



# Standard Specification for Body Protectors Used in Equine Racing<sup>1</sup>

This standard is issued under the fixed designation F2681; 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 reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

Equine racing is a sport with intrinsic hazards. It is recognized that serious injury or death can result from both low-energy and high-energy impacts, even when body protectors are worn. It is also recognized that body protection must be acceptable for the sport, the user, and to the regulating associations or agencies requiring their use. This specification has been developed with an emphasis on providing comfortable, nonrestrictive impact protection in a lower weight garment. Injuries will not be prevented by protective padding in accidents involving severe torsion, flexion or crushing of the body. Acknowledging these limitations, this specification was developed using resources in the medical, scientific, engineering, human factors, and biomedical fields, as well as resources from equine competitors and professional Standardbred drivers and Thoroughbred jockeys. This specification draws from work done by others where appropriate for this specification, and these standards may be referenced. It should be noted that this specification specifies a laboratory test of a completed body protector's ability to reduce impacts.

## 1. Scope

1.1 This specification covers minimum performance criteria and describes test methods for body protectors for use in equine racing in a controlled environment.

NOTE 1—It is recognized that it is not possible to write a body protector performance standard that will result in products that can protect against all types of injury or death in an accident.

1.2 It is not the intention of this specification to bar from consideration materials of improved quality or performance not known at time of development of this specification.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the*

*Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

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

**F1446 Test Methods for Equipment and Procedures Used in Evaluating the Performance Characteristics of Protective Headgear**

2.2 *BSI Standards:*<sup>3</sup>

**EN 13158:2000 Protective clothing – protective jackets, body and shoulder protectors for horse riders – Requirements and test methods**

2.3 *SAE Standards:*<sup>4</sup>

**SAE J211 Recommended Practice for Instrumentation for Impact Tests – Requirements for Channel Class 1000**

## 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 In addition to terms defined in Test Methods **F1446**, the following terms are specific to this specification.

<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.

<sup>3</sup> Available from British Standards Institute (BSI), 389 Chiswick High Rd., London W4 4AL, U.K., <http://www.bsi-global.com>.

<sup>4</sup> Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee **F08** on Sports Equipment, Playing Surfaces, and Facilities and is the direct responsibility of Subcommittee **F08.55** on Body Padding.

Current edition approved Aug. 1, 2023. Published August 2023. Originally approved in 2008. Last previous edition approved in 2018 as F2681 – 18. DOI: 10.1520/F2681-18R23.

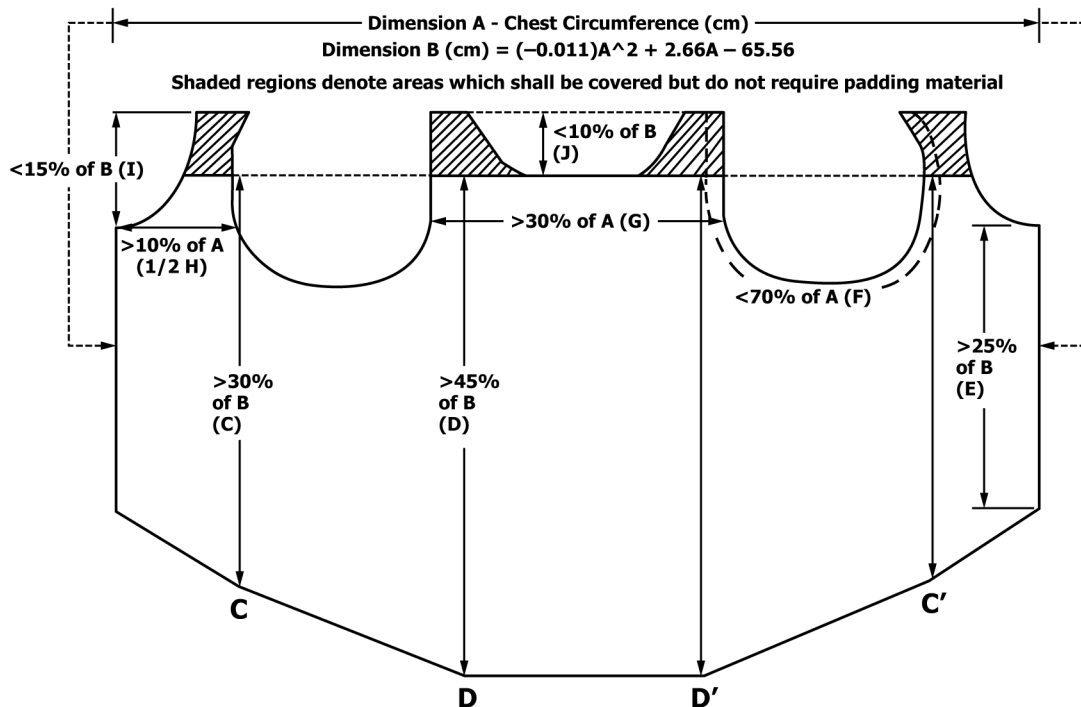


FIG. 1 Dimensional Coverage Requirements

3.1.2 *body protector, n*—sleeveless garment covering defined areas of the torso and lower back and consisting of one or more layers of material and designed to reduce trauma from impacts and falls.

3.1.3 *calibration impact surface, n*—flat modular elastomer programmer (MEP), as specified in Test Methods F1446.

3.1.4 *equine racing, n*—any event or activity on a flat dirt, grass, or synthetic surface track that emphasizes the horse’s and rider’s or driver’s ability to complete a designated distance or course in as short a time as possible (for example, Standardbred, Thoroughbred, and Quarter Horse racing).

3.1.5 *impact surface, n*—flat anvil, as specified in the Apparatus section of Test Methods F1446, used as the impact surface for the shock attenuation test (see 7.2).

3.1.6 *padding, n*—any material or structure designed to absorb or distribute, or both, impact energy.

3.1.7 *spherical impactor, n*—spherical impactor, as specified in Test Methods F1446, used for the impact attenuation system check (see 10.1) and impact test procedures (see 11.2).

#### 4. Materials and Manufacture

##### 4.1 Materials:

4.1.1 All materials used in the fabrication of the body protector shall be known as suitable for the intended application. All padding materials used in the body protector shall not permanently distort during an exposure of at least 4 h to any temperature in the range from  $-15 \pm 2$  to  $40 \pm 2^\circ\text{C}$ , nor shall the material be significantly affected by exposure to ultraviolet radiation, water, dirt, or vibration.

4.1.2 Materials coming into contact with the wearer’s skin shall not be a type known to cause skin irritation or diseases.

These materials shall not undergo significant loss of strength, flexibility, or other physical change as a result of contact with perspiration or body oil. Any material used in the construction of body protectors shall not be adversely affected by ordinary household soap and water, mild household detergent, or cleaners recommended by the manufacturer.

4.1.3 Adhesive materials used to attach padding or straps to the body protector shall be of a formulation that will not alter the chemical or physical properties of the materials to an extent as to reduce their protective qualities.

4.1.4 The manufacturer of the body protector shall provide written documentation to the testing laboratory indicating that the materials used in the body protector fulfill the requirements of 4.1.1 – 4.1.3.

##### 4.2 Body Protector Assembly:

4.2.1 Any optional devices provided by the manufacturer of the body protector and fitted to the body protector shall be so designed that they are unlikely to cause any injury to the wearer or other participants during contact. If the manufacturer provides optional devices then the body protector shall be tested with the optional devices fitted to the body protector.

4.2.2 Any unfaired projection extending more than 7 mm from the body protector outer surface shall break away or collapse when impacted with forces equivalent to those produced by the impact tests described in 11.2 of this specification. There shall be no fixture on the inner surface of the body protector projecting more than 2 mm from the inner surface of the body protector toward the wearer’s body.

4.3 *Extent and Form of Padding*—The coverage of the body protector listed in Section 6 shall be capable of being evaluated according to 11.2 and shall meet the impact requirements of

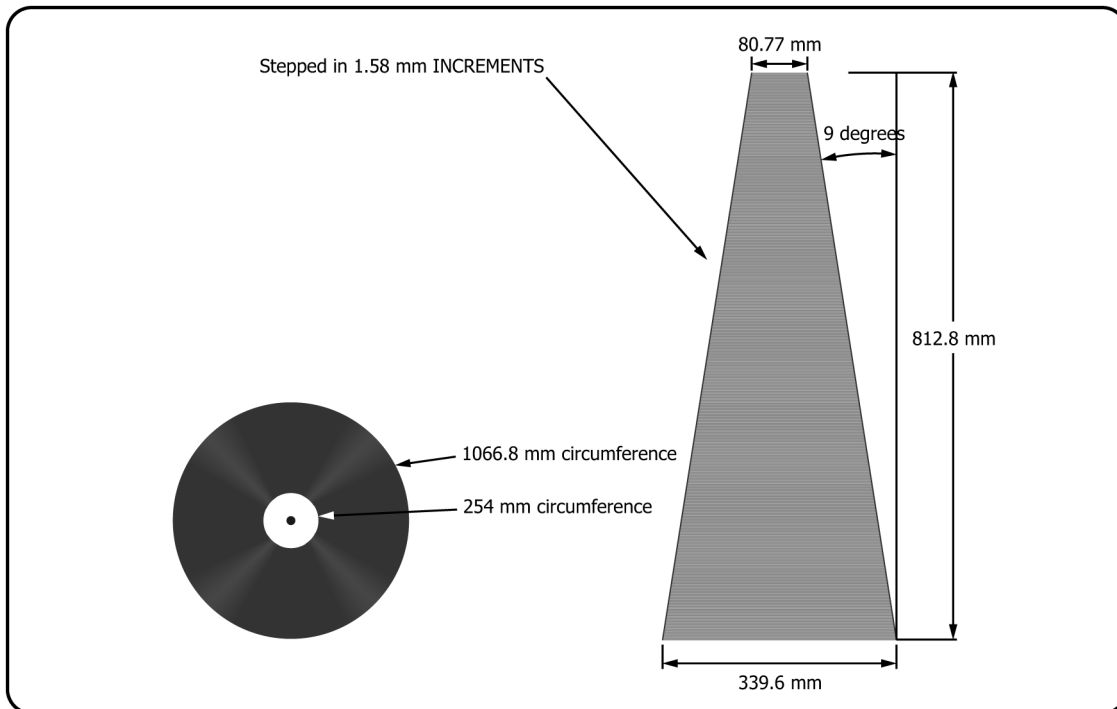


FIG. 2 Armhole Circumference Measurement Device

Section 5. The extent of coverage shall include at least all of the designated areas shown in Fig. 1.

NOTE 2—The body protector may have reduced padding thickness over the shoulder, and it does not require padding in areas outside the test area defined in Fig. 1.

4.4 Attachments—The components of the fasteners for securing attachments to the body protector shall not reduce the impact attenuation properties of the body protector.

## 5. Performance Requirements

5.1 General—Body protectors shall be capable of meeting the requirements in this specification throughout their full range of adjustment.

5.2 When tested in accordance with 11.1, the force to separate any closures shall not be less than 50 N. This requirement shall be met at ambient temperature  $21 \pm 3^\circ\text{C}$  and at a relative humidity of  $50 \pm 15\%$ .

5.3 The velocity of any test impact shall be  $3.15 \text{ m/s} \pm 2\%$ . The peak acceleration of any test impact shall not exceed 300 g, when conditioned as described in 9.1 and when tested in accordance with 11.2.

## 6. Dimensioning, Sizing and Body Coverage

6.1 The whole circumference of the torso shall be covered by the body protector.

6.2 All measurements shall be taken from the edge of the padding material to the edge of the padding material as designated in 6.3. The outer material that holds the padding material shall not be considered to be padding material.

6.3 Dimensioning—Body protectors shall have dimensions as shown in Fig. 1. Dimension A shall be the mid-value of the range of the chest circumference, in centimetres, that the manufacturer states the body protector will fit. Dimension B shall be reported in centimetres and defined by the following equation:

$$B = (-0.011)A^2 + 2.66A - 65.56 \quad (1)$$

which represents the mathematically calculated anthropometric mean for the waist to waist over the shoulder length for chest sizes of 53 to 122 cm.

6.3.1 Four vertical reference lines, as defined in EN 13158:2000, are to be used: C and C' separated by 25 % of Dimension A on the chest, and D and D' separated by 25 % of Dimension A on the back.

6.3.2 The padding shall extend for more than 30 % of Dimension B along the lines C and C' (C in Fig. 1).

6.3.3 The padding shall extend for more than 45 % of Dimension B along the lines D and D' (D in Fig. 1).

6.3.4 The padding shall extend for a length greater than 25 % of Dimension B in the center front (E in Fig. 1).

6.3.5 The armhole circumference shall be measured by placing the armhole opening over the test device shown in Fig. 2. The point at which the armhole opening circumference contacts the cone measurement device at all points around the circumference of the armhole shall be considered to be the armhole circumference. The circumference of the armhole shall be less than 70 % of Dimension A (F in Fig. 1).

6.3.6 The minimum width of padding across the back between the armholes shall be more than 30 % of Dimension A (G in Fig. 1).

6.3.7 The minimum width of padding across the chest between the armholes shall be more than 20 % of Dimension A (H in Fig. 1).

6.3.8 The maximum vertical dimension (depth) of the front neck opening shall be less than 15 % of Dimension B (I in Fig. 1).

6.3.9 The maximum vertical dimension (depth) of the back neck opening shall be less than 10 % of Dimension B (J in Fig. 1).

6.3.10 The test area shall consist of the area bounded by dimensions A, C, C', D and D' as shown in Fig. 1.

## 7. Apparatus

7.1 *Dimensioning, Sizing and Coverage*—The apparatus for the dimensioning, sizing and coverage evaluation shall include:

7.1.1 *Cloth Tape Measure*, metric, capable of reporting measurements to the nearest 0.1 cm.

7.1.2 *Armhole Circumference Measurement Device*, shown in Fig. 2. The armhole circumference measurement device shall be fabricated from any material that will not significantly degrade over time. Suitable materials include plastic, metal or wood.

7.2 *Shock Attenuation Test*—The apparatus for the shock attenuation test shall consist of the following:

7.2.1 *Guide Assembly*—The spherical impactor shall be attached to the free fall drop assembly carriage by an adjustable mounting that will allow impacts to be delivered to any point of the body protector within the area designated by 6.3, provided that the center of any impact is not less than 50 mm from any padding edge, and at least 100 mm from any prior impact center. The carriage shall be free to slide on vertical guides. If wires are used, they shall be placed under at least 845 N tension. The guide assembly shall not weigh more than 1.100 kg. The total weight of the guide assembly and spherical impactor shall be  $5.0 \pm 0.1$  kg.

7.2.2 *Recording Equipment*—The recording equipment shall meet the following criteria:

7.2.2.1 *Acceleration Transducer*—A linear accelerometer shall be mounted at the center of gravity of the spherical impactor and carriage assembly with the sensitive axis aligned to within  $5^\circ$  of the vertical when the spherical impactor is in the impact position. The transducer shall be capable of withstanding a shock of 1000 g without damage and shall have a frequency response (variation  $\pm 1.5$  %) from 5 to 900 Hz.

7.2.2.2 *Impact Recording*—The impact shall be recorded using digital data processing equipment that complies with the requirements of SAE J211. The minimum sampling rate shall not be less than 10 kHz, and the resolution shall be not less than 12 bits (including sign).

7.2.2.3 *Signal Filtering*—Analog or digital filtering of the acceleration data channel shall comply with the requirements of SAE J211.

7.2.3 *Closure Test Equipment*—The closure test equipment shall consist of a force gauge capable of measuring up to 100 N without damage to the device. The force gauge shall have an accuracy of  $\pm 5$  % and be capable of reporting force to the nearest 1 N.

**TABLE 1 Sampling and Test Schedule**

	Dimensioning, Sizing and Body Coverage (Section 6)	Closures (11.1)	Impact Attenuation (11.2)
Sample 1, Ambient	X	X	X
Sample 2, High Temperature			X
Sample 3, Low Temperature			X
Sample 4, Water Immersion			X

## 8. Sampling and Test Schedule

8.1 A total of four specimens of each size of the protector model shall be submitted for testing. The ambient sample shall be tested for dimensioning, sizing, and body coverage prior to closure testing. Upon completion of closure testing, the ambient sample shall be subjected to impact attenuation testing. A summary of the sampling and test schedule appears in Table 1.

## 9. Conditioning

9.1 Prior to testing, condition one body protector piece in each of the following four ways:

9.1.1 *Ambient Temperature*—Condition one body protector for a period of not less than 4 h at laboratory conditions at a temperature of  $21 \pm 3^\circ\text{C}$  and a relative humidity of  $50 \pm 15$  %. Record the temperature to the nearest degree and the relative humidity to the nearest percent at the time of testing on the report form for each test series.

9.1.2 *Low Temperature*—Condition the second body protector by exposing it to a temperature of  $-15 \pm 3^\circ\text{C}$  for not less than 4 h nor more than 24 h in a mechanically cooled apparatus.

9.1.3 *High Temperature*—Condition the third body protector by exposing it to a temperature of  $40 \pm 2^\circ\text{C}$  for not less than 4 h nor more than 24 h.

9.1.4 *Water Immersion*—Condition the fourth body protector by fully immersing in potable water at a temperature of  $19 \pm 3^\circ\text{C}$  for not less than 4 h nor more than 24 h.

9.1.5 *Testing for Conditioned Specimens*—Complete all testing on body protectors within 5 min after removal from the conditioning environment. If testing cannot be completed within 5 min, the body protector shall be returned to the conditioning environment for a minimum of 15 min for each 5 min period that they are out of the conditioning environment, prior to the resumption of testing.

## 10. System Check

10.1 *Impact Attenuation Instrumentation System Check*—The system instrumentation shall be checked before and after each series of tests by dropping the spherical impactor onto the MEP pad at an impact velocity of  $5.44 \text{ m/s} \pm 2$  %. Impact velocity shall be measured during the last 25 mm of free fall for each test. The weight of the drop assembly (which is the combined weight of the instrumented spherical impactor and supporting assembly) for the drop test shall be  $5.0 \pm 0.1$  kg. Three such impacts, at intervals of  $75 \pm 15$  s, shall be performed before and after each series of tests. The peak acceleration obtained during impact shall be  $389 \pm 8$  g. If the average peak acceleration obtained in the post test impacts differs by more than 5 % from the average peak acceleration