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## Standard Specification for Ballistic-resistant Barriers Used in Homeland Security or Public Safety Applications<sup>1</sup>

This standard is issued under the fixed designation E3236/E3236M; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope

1.1 This specification specifies requirements for ballistic-resistant barriers to be used in homeland security or public safety applications for protection against complete penetration of projectiles from small arms<sup>2</sup>. The purpose of this specification is to define baseline performance for ballistic-resistant barriers.

1.2 Items covered by this specification may be rigid or flexible barriers of uniform ballistic layout that are either temporarily or permanently installed. Examples of products include cubicle partitions; non-structural barriers; security checkpoint barriers; and barriers installed in judges' benches, school safe rooms, and service counters.

1.2.1 This specification addresses two configurations of barriers: (1) stand-alone and (2) in conjunction.

1.2.2 This specification does not address items having viewports. For barriers that include a viewport(s), each viewport shall be tested in accordance with Test Method [E3141/E3141M](#).

1.2.3 This specification is not intended to address architectural products covered by ASTM Committee ~~Committees~~ F12 and F33, such as building materials and security glazing.

1.3 This specification defines ballistic performance categories, and the supplier shall declare the ballistic performance category(ies) for testing to this specification.

1.4 This specification requires both Resistance to Penetration (RTP) Testing and Ballistic Limit ( $V_{50}$ ) Testing.

1.4.1 In addition to the required tests, an optional test with specific temperature conditions is provided that allows testing beyond the minimum requirements of this specification. See [Appendix X1](#). Statements of conformance with this specification shall not include any optional tests unless the optional test is conducted, and the results are included in the test report.

1.5 This specification requires testing of ballistic-resistant barriers in one of the following two ways:

1.5.1 *Stand-alone Products*—Test items shall be shoot packs, armor coupons, or actual products mounted in a test fixture with air backing.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee [E54](#) on Homeland Security Applications and is the direct responsibility of Subcommittee [E54.04](#) on Personal Protective Equipment (PPE).

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<sup>2</sup> Small arms are defined as portable firearms, typically including handguns, shotguns, rifles, and light machine guns (Terminology [E3005](#)).

1.5.2 *In Conjunction Products*—Test items shall be actual products mounted in the intended use configuration, including mounting hardware and any materials expected to be in front of and behind the product.

1.6 It is anticipated that this specification will be referenced by certifiers, purchasers, or other users to meet their specific needs.

1.7 Selection and procurement guidance is provided in [Appendix X2](#) to assist purchasers in using this specification.

1.8 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.8.1 The user of this standard will identify the system of units to be used, and it is critical to ensure that any cross-referenced standards maintain consistency of units between standards.

1.9 *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.*

1.10 *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>3</sup>

[E3005 Terminology for Body Armor](#)

[E3062/E3062M Specification for Indoor Ballistic Test Ranges for Small Arms and Fragmentation Testing of Ballistic-resistant Items](#)

[E3110/E3110M Test Method for Collection of Ballistic Limit Data for Ballistic-resistant Torso Body Armor and Shoot Packs](#)

[E3112/E3112M Test Method for Ballistic-resistant Products and Shoot Packs](#)

[E3141/E3141M Test Method for Ballistic Resistant Shields for Law Enforcement](#)

### 2.2 ISO/IEC Standards:<sup>4</sup>

[ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories](#)

[ISO/IEC 17050-1 Conformity assessment – Supplier’s declaration of conformity – Part 1: General requirements](#)

[ISO/IEC 17050-2 Conformity assessment – Supplier’s declaration of conformity – Part 2: Supporting documentation](#)

[ISO/IEC 17065 Conformity assessment – Requirements for bodies certifying products, processes and services](#)

### 2.3 Other Standards:

[MIL-STD-662F Military Standard: V<sub>50</sub> Ballistic Test for Armor](#)<sup>5</sup>

[NIJ Standard-0101.06 Ballistic Resistance of Body Armor](#)<sup>6</sup>

## 3. Terminology

3.1 From Terminology [E3005](#): *ballistic limit, ballistic material, complete penetration, controlled ambient, hard armor, obliquity, plate, small arms, shoot pack, soft armor, test item, test threat, and V<sub>50</sub>.*

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *armor coupon, n*—a test item prepared with materials, or with materials and construction features, utilized in body armor or other ballistic-resistant products, but not intended to be used as a ballistic-resistant product.

#### 3.2.1.1 Discussion—

The armor coupon may be either rigid or soft.

<sup>3</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>4</sup> Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

<sup>5</sup> Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.access.gpo.gov>.

<sup>6</sup> Available from National Institute of Justice (NIJ), 810 7th St., NW, Washington, DC 20531, <http://nij.gov>.

3.2.2 *ballistic layup, n*—the layering and arrangement of ballistic materials through the thickness of a protective product.

3.2.3 *in conjunction, adj*—intended to be used with another material or item in close proximity to either surface of the protective product.

3.2.4 *stand-alone, adj*—intended to be used with no other material or item within 5 cm [2 in.] of either surface of the protective product.

3.2.5 *supplier, n*—the party that is responsible for ensuring that products meet and, if applicable, continue to meet, the requirements (adapted from ISO/IEC 17065); requirements. **(Adapted from ISO/IEC 17065)**

3.2.6 *supplier's declaration of conformity (SDOC), n*—the procedure by which a first party or supplier conveys assurance that the object of conformity fulfills specified requirements.<sup>7</sup>

#### 4. Design and Configuration Requirements

4.1 The ballistic-resistant barrier shall be free of any unintended holes, voids, bulges, protrusions, or dents.

4.2 The surfaces of the barrier shall be free from blisters, cracks, crazing, chipped corners or edges, sharp edges, or delamination.

#### 5. Test Item Requirements

##### 5.1 Test Item Quantity

5.1.1 The number of test items required depends on the supplier-declared ballistic performance category, the materials being tested, and the test item configuration. See Fig. A1.1 through Fig. A1.5 in Annex A1 for the expected number of test items for each performance category.

##### 5.2 Stand-alone Product Testing

###### 5.2.1 Single-piece Test Items:

5.2.1.1 Each test item shall be either:

- (a) The actual product, or
- (b) An armor coupon, at least 380 mm by 380 mm [15.0 in. by 15.0 in.] and having identical ballistic layup and build as the actual product.

###### 5.2.2 Multi-Piece Test Items:

5.2.2.1 The test item shall be the actual product or a miniature mockup of a complete system build (for example, three identical panels connected together by vertical or horizontal joints).

##### 5.3 In Conjunction Product Testing

###### 5.3.1 Single-piece Test Items:

5.3.1.1 Each test item shall be an actual product of representative size mounted in its intended use configuration.

###### 5.3.2 Multi-Piece Test Items:

5.3.2.1 The test item shall be the actual product or a miniature mockup of a complete system build (for example, three identical panels connected together by vertical or horizontal joints) mounted in its intended use configuration.

<sup>7</sup> Definition source: [https://www.standardsportal.org/usa\\_en/conformity\\_assessment/suppliers\\_declaration.aspx](https://www.standardsportal.org/usa_en/conformity_assessment/suppliers_declaration.aspx).

#### 5.4 Test Items for Optional Testing

5.4.1 One or more additional test items may be needed to fit the necessary shots for optional testing at extreme temperatures.

### 6. Performance Requirements

#### 6.1 Resistance to Penetration (RTP) Testing

6.1.1 Each test item shall be tested as specified in the appropriate section of this standard, and there shall be no complete penetrations at or below a velocity that is the reference velocity plus 9.1 m/s [30 ft/s].

#### 6.2 $V_{50}$ Testing

6.2.1 Each test item shall be tested as specified in the appropriate section of this standard and shall withstand the required number of fair hits and shall experience no complete penetrations at or below a velocity that is the reference velocity plus 9.1 m/s [30 ft/s].

6.2.2 The test method results in a calculated  $V_{50}$  value that is documented.

### 7. Test Item Conditioning

7.1 Test items shall be stored at controlled ambient conditions ( $20.0 \pm 5.6^\circ\text{C}$  [ $68 \pm 10^\circ\text{F}$ ] and  $50 \pm 20\%$  RH) for at least 24 h prior to the start of ballistic testing or other required conditioning.

7.2 Evaluation of armor coupons via customized temperature, humidity, or ultraviolet (UV) conditioning is recommended to properly vet ballistic-resistant barriers that are to be stored or used in uncontrolled environmental conditions.

7.2.1 Conditioning options are provided in Test Method E3112/E3112M, Section 9, and in Appendix X1 of this standard.

NOTE 1—Ballistic products are often made of many different materials that may react negatively to temperature extremes, high humidity, or UV exposure. This can result in delamination of the armor or lower than expected ballistic performance, or both. It is thus critically important to consider where and how a ballistic-resistant barrier is to be used and stored and to ensure that the barrier has been evaluated under these conditions or is environmentally protected in other ways.

7.2.2 When a ballistic barrier is expected to provide ballistic protection at an extreme temperature, the test items shall be conditioned at the appropriate extreme temperature, and ballistic testing shall be completed within 30 min of removal from conditioning.

7.2.2.1 If ballistic testing cannot be completed within 30 min, the test item shall be returned to conditioning at the extreme temperature for at least 2 h.

7.2.2.2 The test item shall not be out of conditioning for more than 30 min at a time until ballistic testing is complete.

NOTE 2—Multiple test items may be needed to complete testing in a timely manner.

7.2.3 Any visible separation or delamination of the test item upon the completion of extreme temperature, humidity, or UV conditioning shall be documented in the test report.

### 8. Test Requirements

#### 8.1 Test Item Mounting

8.1.1 Stand-alone products shall be tested with test items mounted in a test fixture with air backing.

8.1.2 In conjunction products shall be tested with test items mounted in a test fixture matching the end use configuration, using the barrier's mounting holes, mounting points, or attachments.

8.1.3 The supplier shall be responsible for providing the test fixture to the test laboratory, unless the test laboratory has a test fixture that is acceptable to the supplier.

8.1.4 The test fixture shall be capable of maintaining the position of the test item and witness panel and withstanding the forces from the test.

## 8.2 *Witness Panel*

8.2.1 The witness panel shall meet the requirements of Test Method [E3112/E3112M](#).

8.2.2 Test items shall be shot at 0° obliquity unless the probability of penetration will be greater if shot at a different angle based upon the barrier's configuration.

8.2.2.1 The decision to shoot at an angle other than 0° shall be made by the user of this standard in coordination with the testing laboratory. Angled shots and the rationale shall be documented in the test report.

8.3 The test range setup and relative distances shall be as defined in Specification [E3062/E3062M](#).

8.4 Between test threat impacts, if the test item has pulled out of the test fixture frame, the test item shall be manipulated (for example, flattened) and reinstalled in the test fixture prior to the next shot. No effort shall be made to recover any projectiles trapped in the test item until the test series is complete unless the projectile or fragment interferes with the clamping mechanism in such a way that would result in unequal pressure applied to all sides of the test item. If the projectile or fragment is in the path of the next shot, either move the projectile or fragment, move the location of the next shot, or take the required shots on a spare test item.

## 9. Ballistic Performance Categories, Test Threats, and Shot Requirements

9.1 The ballistic performance categories, test threats, and shot requirements are specified in [Annex A2](#).

9.1.1 [Table A2.1](#) specifies the ballistic performance categories and test threat details, including velocities.

9.1.2 [Table A2.2](#) specifies shot requirements, including velocities and minimum number of shots for each performance category. Additional shots shall be allowed and are recommended. [E3236/E3236M-21](#)

<https://standards.iteh.ai/catalog/standards/sist/81388761-bcab-4990-a950-1ac56233c0f9/astm-e3236-e3236m-21>

9.1.3 Each ballistic performance category is independent of the others.

9.1.4 For each ballistic performance category, ballistic testing shall be performed using all listed threats for that ballistic performance category.

## 10. Resistance to Penetration (RTP) Testing

10.1 The requirements of [Table A2.2](#) for RTP testing shall apply.

10.2 The supplier shall declare the shot grouping to be used during RTP testing as 216 mm [8.5 in.] or 102 mm [4.0 in.].

10.3 [Fig. A2.1](#) specifies the shot locations and spacing for the 5-shot dice pattern. [Fig. A2.2](#) specifies the shot locations and spacing for the 3-shot triangle pattern. The patterns may be rotated on the face of the test item as needed.

NOTE 3—These shot patterns are intended to assess the main portions of the test items, not potential weak points (discussed below).

10.3.1 If the 102-mm [4.0-in.] shot group testing is requested after the product has met the same performance category using 216-mm [8.5-in.] shot grouping, then only the RTP testing needs to be performed;  $V_{50}$  testing does not need to be repeated.

10.4 A flowchart for RTP testing is provided in [Appendix X3](#).

10.5 Perform the ballistic testing and reporting of test results following the requirements of Test Method [E3112/E3112M](#).

10.6 Potential weak points can be present in panels, and a sampling of each type of potential weak point shall be shot.

10.6.1 The supplier shall provide to the testing laboratory a drawing that shows the location of all potential weak points in the barrier. The testing laboratory shall determine which of the weak points of each type identified will be shot based on visual examination of the test items and the drawing provided by the supplier.

NOTE 4—Every weak point of each type identified is not required to be shot because it is assumed that all similar weak points will perform the same during testing.

10.6.2 Common types of potential weak points and relative shot impact location for each are described in **Table 1**. If any of these weak points is not present on a barrier, the respective shot(s) shall be taken at other weak points.

10.6.2.1 For multi-piece test items, three additional shots shall be placed on each joint within 0 + 6 mm [0 + 0.25 in.] of the joint centerline.

10.6.2.2 For seams and joints, angled shots at 45° may be taken.

10.6.3 Other (uncommon) potential weak points not listed in **Table 1** may be present in a barrier. At least one of each type of uncommon potential weak point shall be shot, and the shot impact shall be 0 + 12.7 mm [0 + 0.5 in.] from the weak point.

10.7 The purchaser may specify additional weak points to be tested.

**11. V<sub>50</sub> Testing**

11.1 The requirements of **Table A2.2** for V<sub>50</sub> testing shall apply.

11.2 The intended velocity of the first shot shall be the reference velocity for the test threat.

11.3 After the first shot, the velocity shall be incremented per the steps shown in **Table 2**. All steps shall be incremented based on the previous intended velocity (that is, not the measured velocity).

11.4 Shot locations shall not be within 45 mm [1.75 in.] of potential weak points.

11.5 The requirements of Test Method **E3110/E3110M**, Section 9 (*Test Requirements*) and Section 14 (*Ballistic Limit Procedure: NIJ Method Based on NIJ Standard-0101.06*) apply, with the exception that two exceptions: (1) Table 2 of Test Method **E3110/E3110M** does not apply and (2) test items shall be mounted in a frame, not on a clay block.

NOTE 5—The incremental velocity values in **Table 2** are intended velocities, and the actual velocity achieved for a shot is not expected to be identical to the listed value.

11.6 The required number of highest partial penetrations (PP) and lowest complete penetrations (CP) and the maximum allowable velocity range shall be as shown in **Table 3**.

**TABLE 1 Common Types of Potential Weak Points and Shot Impact Locations**

| Types of Potential Weak Points  | Location of Shot Impact Relative to Weak Point |
|---|--|
| Edges or holes; if corners are present, at least one edge shot shall be taken at the corner midpoint; perimeter corners shall take precedence over cutout corners | 45 ± 6 mm [1.75 ± 0.25 in.]                    |
| Cutout  | 45 ± 6 mm [1.75 ± 0.25 in.]                    |
| Seams, folds, or bends forming a corner   | 0 + 6 mm [0 + 0.25 in.] of seam midpoint       |



TABLE 2 Velocity Increments After First Shot

| Nominal Velocity                    | Incremental Velocity Value  |
|-------------------------------------|---|
| Velocity step until first reversal  | -31 m/s [-100 ft/s] if first shot was a complete penetration<br>+31 m/s [+100 ft/s] if first shot was a partial penetration |
| Velocity step until second reversal | ±23 m/s [±75 ft/s] depending on result of previous shot   |
| Velocity step after second reversal | ±15 m/s [±50 ft/s] depending on result of previous shot   |

TABLE 3 Required Numbers and Maximum Allowable Velocity Range

| Label | Number of Highest Partial Penetrations | Number of Lowest Complete Penetrations | Maximum Allowable Velocity Range |
|-------|--|--|----------------------------------|
| 2 × 2 | 2                                      | 2                                      | 18 m/s [60 ft/s]                 |
| 3 × 3 | 3                                      | 3                                      | 38 m/s [125 ft/s]                |
| 5 × 5 | 5                                      | 5                                      | 46 m/s [150 ft/s]                |

11.6.1 If the four shot conditions of Table 3 cannot be satisfied, and (1) there are at least two partial penetrations at velocities in excess of the required velocity, (2) there are no complete penetrations at or below the required velocity, and (3) at least four fair shot impact velocities have been made in the test item(s), it shall be determined to have satisfied the threat condition requirement.

11.6.2 If the six shot conditions of Table 3 cannot be satisfied, and (1) there are at least three partial penetrations at velocities in excess of the required velocity, (2) there are no complete penetrations at or below the required velocity, (3) at least six fair shot impact velocities have been made in the test item(s), it shall be determined to have satisfied the threat condition requirement.

11.6.3 If the ten shot conditions of Table 3 cannot be satisfied, and (1) there are at least five partial penetrations at velocities in excess of the required velocity, (2) there are no complete penetrations at or below the required velocity, and (3) at least ten fair shot impact velocities have been made in the test item(s), it shall be determined to have satisfied the threat condition requirement.

12. Documentation Requirements

12.1 The supplier shall make available at least the following documentation as part of the written user information:

- (a) Performance category of the product.
- (b) Threats that the product has been tested to protect against.
- (c) Shot grouping used for RTP testing.
- (d) Certification or testing to standards.
- (e) Drawing showing dimensions of the barrier with respect to the installation for which it was designed.
- (f) Intended environmental conditions for use (such as temperature range) and for storage.
- (g) End-of-life recommendations for proper disposal.
- (h) Warranty information, including time period and what the warranty covers (for example, performance, workmanship and materials).

13. Test Laboratory

13.1 The test laboratory shall develop a test report that meets the requirements of Test Method E3112/E3112M and includes the following:

13.1.1 Details of any subcontracted testing;

13.1.2 Statement of how the test items were conditioned (that is, ambient conditioned, extreme temperature conditioned) prior to ballistic testing;

13.1.3 Statement that test report applies only to models represented by the items tested; and