



Designation: E3110/E3110M – 22

Standard Test Method for Collection of Ballistic Limit Data for Ballistic-resistant Torso Body Armor and Shoot Packs¹

This standard is issued under the fixed designation E3110/E3110M; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method addresses the collection of ballistic limit data for ballistic-resistant torso body armor and shoot packs.

1.2 This test method is intended for testing of soft body armor, hard armor plates, and shoot packs. This test method does not apply to ballistic helmets.

1.3 This test method describes procedures for collecting data and does not specify computation or performance criteria for the ballistic limit. Instructions for computation and performance criteria are specified in other standards and specifications.

1.4 Several commonly used test item mounting procedures and ballistic limit procedures are included in this test method; certifiers, purchasers, and other users will specify the procedures to be used.

1.5 This test method does not address conditioning of test items.

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

1.6.1 Certifier, purchasers, and other users will specify and describe the ballistic test threats to be used. Within this test method, the reference will be called the “test threats document.”

1.6.2 Certifiers, purchasers, and other users will provide specific instructions for the determination of complete penetrations or partial penetrations.

1.6.3 In this test method, “other standards and specifications” and “unless specified elsewhere” refer to documents (for example, military standards, purchase specifications) that require the use of this test method. Certifiers, purchasers, and other users are responsible for the “other standards and

specifications” and for specifying any requirements that supersede those of this test method.

1.7 *Units*—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.

1.7.1 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.

1.8 *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.*

1.9 *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:*²

B209/B209M Specification for Aluminum and Aluminum-Alloy Sheet and Plate

E3004 Specification for Preparation and Verification of Clay Blocks Used in Ballistic-Resistance Testing of Torso Body Armor

E3005 Terminology for Body Armor

E3062/E3062M Specification for Indoor Ballistic Test Ranges for Small Arms and Fragmentation Testing of Ballistic-resistant Items

E3086 Practice for Creating Appliques for Use in Testing of Nonplanar Soft Body Armor Designed for Females

¹ This test method is under the jurisdiction of ASTM Committee E54 on Homeland Security Applications and is the direct responsibility of Subcommittee E54.04 on Public Safety Equipment.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.



2.2 U.S. Army Research Laboratory:³

ARL-TN-437 LangMod Users Manual

2.3 Department of Defense Standards:⁴

MIL-STD-662F V₅₀ Ballistic Test for Armor

2.4 Department of Justice Standards:⁵

NIJ Standard–0101.06 Ballistic Resistance of Personal Body Armor

2.5 ISO Standards:⁶

ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories

3. Terminology

3.1 For terms not defined in this test method, the following definitions of Terminology E3005 apply: *angle of incidence, applique, backing assembly, backing material, backing fixture, ballistic limit, body armor, complete penetration, fair hit, gate, hard armor, obliquity, partial penetration, plates, shoot pack, shot-to-edge distance, shot-to-shot distance, soft body armor, stop, strike face, test item, test series, unfair hit, V_x, V₅₀, warmer round, yaw, and zone of mixed results (ZMR).*

4. Summary of Test Method

4.1 This test method specifies multiple methods for ballistic limit testing, which are designed to estimate the penetration resistance of soft body armor, hard armor, or shoot packs.

4.2 The test method also specifies multiple methods for mounting test items. A test item is either mounted on a backing assembly with clay backing material or mounted in a frame with a separate witness panel.

4.3 Projectiles are fired at the test item starting at a specified velocity, with subsequent projectiles incrementally increasing or decreasing in velocity based on each shot outcome (complete penetration or partial penetration). This information is subsequently used to calculate the ballistic limit.

5. Significance and Use

5.1 U.S. Department of Defense and U.S. Department of Justice standards require ballistic limit determination for assessing the performance of ballistic-resistant body armor.

5.2 This test method may be used by private-sector and government laboratories, manufacturers, research and development organizations, and others assessing the ballistic resistance of body armor or performing research and development of new materials.

5.3 It is intended that this test method be referenced by other standards, specifications, and test methods.

6. Test Equipment and Apparatus

6.1 Test threats shall be specified in a separate test threats document.

6.2 The ballistic test range shall meet the requirements of Specification E3062/E3062M.

6.2.1 The method of measuring yaw may be with a yaw card, flash radiography, high speed video, or photography and shall be capable of determining, at the point of measurement, whether the angle of yaw was greater or less than 5°.

6.3 When clay blocks are required to be used as backing assemblies behind test items, they shall meet the requirements of Specification E3004.

6.4 For test procedures requiring the test item to be mounted in a frame, the frame shall consist of two layers of metal between which the test item is secured.

6.4.1 The frame shall be of sufficient size to allow restraint of the test item during ballistic impact. The frame, supports, clamps, and mounting fixtures shall be capable of securely retaining the test item and withstanding shock resulting from ballistic impact by the test projectiles.

6.4.2 Additional frame details, such as frame size and clamping force, are provided in other standards and specifications.

6.5 When required by some test procedures, a witness panel shall be used to determine whether a complete penetration has occurred.

6.5.1 The witness panel shall be at least 305 mm by 305 mm [12 in. by 12 in.].

NOTE 1—The witness panel may be larger to allow for impact by all fragments resulting from projectile penetration.

6.5.2 For opaque test items, the witness panel shall be a 0.50 mm ± 0.08 mm [0.020 in. ± 0.003 in.] thick sheet of 2024-T3, 2024-T4, or 5052 aluminum alloy.⁷

7. Hazards

7.1 The ballistic tests described in this test method have inherent hazards. Adequate safeguards for personnel and property shall be employed when conducting these tests.

8. Sampling and Test Items

8.1 The test items shall be individual soft armor panels, hard armor plates, or shoot packs.

8.2 Test item details, including quantity, size, and conditioning, shall be specified in other standards and specifications.

NOTE 2—It is recommended that spare test items be provided.

9. Test Requirements

9.1 Unless otherwise specified, each ballistic impact shall meet the requirements listed below to be considered a fair hit.

9.1.1 The test threat shall impact the test item at an angle ≤5° from the intended angle.

⁷ Specifications for these alloys may be found in Specification B209/B209M or equivalent international specifications.

³ Available from U.S. Army Research Laboratory, 2800 Powder Mill Rd., Adelphi, MD 20783-1138, <https://www.arl.army.mil>.

⁴ Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.access.gpo.gov>.

⁵ Available from National Institute of Justice (NIJ), 810 7th St., NW, Washington, DC 20531, <http://nij.gov>.

⁶ 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>.