



Designation: E3004 – 22

Standard Specification for Preparation and Verification of Clay Blocks Used in Ballistic-Resistance Testing of Torso Body Armor¹

This standard is issued under the fixed designation E3004; 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.

INTRODUCTION

At the time when work on this specification was undertaken, different ballistic-resistant body armor test protocols required different impactors for verification of the clay blocks placed behind the test items, and the lack of detailed guidance about the clay blocks resulted in different practices for preparation and verification. To improve laboratory-to-laboratory consistency, major stakeholders sought to harmonize practices related to the preparation and verification of the clay blocks used for testing of ballistic-resistant body armor.

1. Scope

1.1 The purpose of this specification is to provide standardized methods for preparation and verification of backing assemblies used in ballistic-resistant torso body armor testing and to reduce variability within and between laboratories.

1.2 The backing assembly is a clay block that contains ROMA Plastilina No. 1®² clay as the backing material. The clay serves as a witness material and provides a measurable indication of test item performance.

1.3 This specification identifies two clay-verification impactors that may be used: (1) cylindrical and (2) spherical. Purchasers and other users will specify the clay-verification impactor to be used.

1.4 This specification is primarily directed toward test laboratories but may be applicable to body armor manufacturers, researchers, and end users performing ballistic-resistance testing of body armor.

1.5 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to non-SI units that are provided for information only.

1.6 *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.*

1.7 *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*:³

E3005 Terminology for Body Armor

2.2 *NIST Standard*:⁴

NIST Special Publication 330 The International System of Units (SI), 2008 Edition, Barry N. Taylor and Ambler Thompson, Editors

3. Terminology

3.1 The terms and definitions of Terminology **E3005** apply for the following terms: *backing assembly*, *backing fixture*,

¹ This specification 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 U.S. Government standards require ROMA Plastilina No. 1®, from Sculpture House, Inc., as the backing material for ballistic-resistance testing.

³ 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.

⁴ Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, <http://www.nist.gov>.

backing material, bridge gauge, clay block, clay package, clay-verification impactor, depth gauge, striking device, and test item.

4. Significance and Use

4.1 U.S. Department of Defense and U.S. Department of Justice standards for assessing the performance of ballistic-resistant torso body armor require the use of backing assemblies made with Roma Plastilina No. 1®. It can be demonstrated that the way the clay block is handled prior to and during ballistic testing can have a significant influence on deformation of the clay when a test item is struck by a projectile during testing.

4.2 At the time when work on this specification was undertaken, different ballistic-resistant body armor test protocols required different impactors for verification of the clay blocks placed behind the test items, and the lack of detailed guidance about the clay blocks resulted in different practices for preparation and verification. To improve laboratory-to-laboratory consistency, major stakeholders sought to harmonize practices related to the preparation and verification of the clay blocks used for testing of ballistic-resistant body armor.

5. Equipment

5.1 The equipment used for preparation and verification of clay blocks shall be as described below:

5.1.1 *Backing Fixture*—The backing fixture shall be a rigid, metal frame with a plywood bottom. The inside dimensions of the metal frame shall be $610 \text{ mm} \pm 2 \text{ mm}$ ($24.0 \text{ in.} \pm 0.08 \text{ in.}$) by $610 \text{ mm} \pm 2 \text{ mm}$ ($24.0 \text{ in.} \pm 0.08 \text{ in.}$) with a depth of $140 \text{ mm} \pm 2 \text{ mm}$ ($5.5 \text{ in.} \pm 0.08 \text{ in.}$). The top and bottom edges of the metal frame shall be planar. Plywood, of any grade, that is nominally “ $\frac{3}{4}$ in.” or “18 mm,” shall be attached to the outside of the metal frame to form the bottom of the fixture and shall be removable. See Fig. 1.

5.1.2 *Backing Fixture Liner*—A liner, such as 0.08 mm to 0.13 mm (3 mil to 5 mil) polyethylene sheeting, shall be inserted into the backing fixture to prevent the clay oils from

coming into contact with the plywood. The liner shall be placed against the plywood bottom of the backing fixture and shall not extend up the inside surfaces of the metal frame.

NOTE 1—The backing fixture liner is intended to be a barrier between the clay and the plywood and may be sheeting, a coating (for example, spray, paint, shellac), or any other barrier that prevents leaching of oil into the plywood.

5.1.3 *Bridge Gauge*—The bridge gauge shall be a rigid assembly that rests on two parallel strike face edges of the backing fixture and supports a depth gauge that can slide back and forth on the assembly to measure depths across the surface of the backing material. The depth gauge tip that touches the clay shall be hemispherical or spherical with a diameter of $6.35 \text{ mm} \pm 0.0254 \text{ mm}$ ($0.25 \text{ in.} \pm 0.001 \text{ in.}$) and attached to a cylindrical stem having a minimum length of 38.1 mm (1.5 in.) and maximum diameter of 6.35 mm (0.25 in.) such that only the tip touches the deepest location of the indentation. The bridge gauge (independent of the backing fixture) shall have a resolution of 0.01 mm or better with an accuracy of $\pm 0.1 \text{ mm}$ or better.

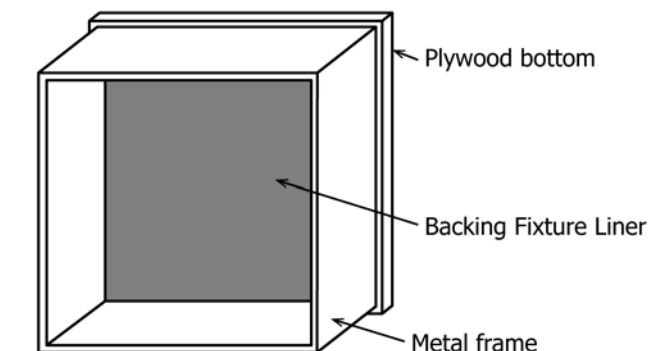
5.1.4 *Conditioning Chamber*—The chamber shall be temperature controlled, be sufficiently large, and have continuous circulation of air with the intention of uniformly heating all clay blocks in the chamber.

5.1.5 *Cylindrical Clay-verification Impactor*:

5.1.5.1 The impactor shall be a steel, constant diameter cylinder having a hemispherical end of diameter equal to the cylinder diameter and a smooth transition from the hemispherical end to the cylinder body. A drawing specifying the dimensions of the impactor is provided in Fig. 2.

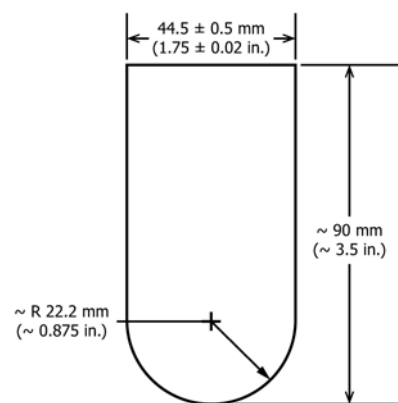
5.1.5.2 The impactor mass shall be $1.0 \text{ kg} \pm 0.005 \text{ kg}$ ($2.20 \text{ lb}_m \pm 0.01 \text{ lb}_m$).

NOTE 2—To achieve the required mass, the length of the entire impactor will be approximately 90 mm (3.5 in.).



NOTE 1—The plywood bottom is shown larger than the metal frame for illustrative purposes only.

FIG. 1 Backing Fixture



Notes:

1. The material shall be steel with a smooth finish.
2. There shall be a smooth transition from the hemispherical end to the cylindrical body.

FIG. 2 Impactor