METRIC

MIL-STD-3038

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DEPARTMENT OF DEFENSE
TEST METHOD STANDARD

TEST METHODS FOR BALLISTIC DEFEAT MATERIALS

AMSC N/A FSC 2040

FOREWORD

1. This standard is approved for use by all Departments and Agencies of the Department of Defense.

2. Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy.mil, with the subject line “Document Comment”. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil.

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1. SCOPE

1.1 Scope. This standard covers test methods for ballistic defeat materials and solutions intended to provide protection against direct fire projectiles.

1.2 Classification. The ballistic resistant material should be classified into these types, classes, and grades according to its ballistic protection limit (ballistic resistance).

1.2.1 Type and class. The type classifications of ballistic resistant material are based on the lethality of projectile and cartridge used for testing. The class of ballistic resistant material is based on the material and design of the projectile used for testing (see 6.2).

a. Type I - 9 by 19 millimeters.

(1) Class A - Should be tested with 9-millimeter Full Metal Jacketed Round Nose (FMJ RN) M882 bullets with a specified mass of 8.0 grams (124 grains) ±5 percent and a velocity of 385±9.1 meters per second (1263±30 feet per second).

b. Type II - 11 by 41 millimeters.

(1) Class A - Should be tested with .44 magnum SWC Gas Checked bullets with a specified mass of 15.55 grams (240 grains) ±5 percent and a velocity of 426±9.1 meters per second (1400±30 feet per second).

c. Type III - 7.62 by 39 millimeters.

(1) Class A - Should be tested with Type PS M67 bullets with a specified mass of 8.0 grams (124 grains) ±5 percent and a velocity of 700±9.1 meters per second (2300±30 feet per second).

(2) Class B - Should be tested with API BZ M43 bullets with a specified mass of 7.8 grams (120 grains) ±5 percent and a velocity of 715±9.1 meters per second (2340±30 feet per second).

d. Type IV - 5.45 by 39 millimeters.

(1) Class A - Should be tested with 5N7 bullets with a specified mass of 3.2 grams (50 grains) ±5 percent and a velocity of 915±9.1 meters per second (3000±30 feet per second).

(2) Class B - Should be tested with 7N22 AP bullets with a specified mass of 3.7 grams (57 grains) ±5 percent and a velocity of 887±9.1 meters per second (2910±30 feet per second).

e. Type V - 5.56 by 45 millimeters.

(1) Class A - Should be tested with M855 FMJ bullets with a specified mass of 4.0 grams (62 grains) ±5 percent and a velocity of 950±9.1 meters per second (3117±30 feet per second).

(2) Class B - Should be tested with M995 WC AP bullets with a specified mass of 3.4 grams (52 grains) ±5 percent and a velocity of 1030±9.1 meters per second (3380±30 feet per second).

f. Type VI - 7.62 by 63 millimeters.

(1) Class A - Should be tested with 7.62-millimeter M2 Ball bullets with a specified mass of 9.8 grams (152 grains) ±5 percent and a velocity of 880±9.1 meters per second (2900±30 feet per second).

(2) Class B - Should be tested with 7.62-millimeter M2 AP bullets with a specified mass of 10.8 grams (166 grains) ±5 percent and a velocity of 878±9.1 meters per second (2880±30 feet per second).

g. Type VII - 7.62 by 51 millimeters.

(1) Class A - Should be tested with 7.62-millimeter FMJ M80 bullets with a specified mass of 9.6 grams (147 grains) ±5 percent and a velocity of 838±9.1 meters per second (2750±30 feet per second).

(2) Class B - Should be tested with 7.62-millimeter AP M993 bullets with a specified mass of 8.3 grams (128 grains) ±5 percent and a velocity of 910±9.1 meters per second (2986±30 feet per second).

h. Type VIII - 7.62 by 54 millimeters.

(1) Class A - Should be tested with 7.62-millimeter LPS bullets with a specified mass of 9.7 grams (151 grains) ±5 percent and a velocity of 865±9.1 meters per second (2840±30 feet per second).

(2) Class B - Should be tested with 7.62-millimeter B32 bullets with a specified mass of 10.0 grams (155 grains) ±5 percent and a velocity of 854±9.1 meters per second (2801±30 feet per second).

i. Type IX - 12.7 by 108 millimeters.

(1) Class B - Should be tested with 12.7-millimeter API, B32 bullets with a specified mass of 48.0 grams (740 grains) ±5 percent and a velocity of 853±9.1 meters per second (2800±30 feet per second).

j. Type X - 12.7 by 99 millimeters.

(1) Class A - Should be tested with Caliber .50 M33 Ball bullets with a specified mass of 42.9 grams (662 grains) ±5 percent and a velocity of 887±9.1 meters per second (2910±30 feet per second).

(2) Class B - Should be tested with Caliber .50 MK 263 AP bullets with a specified mass of 48.6 grams (750 grains) ±5 percent and a velocity of 887±9.1 meters per second (2910±30 feet per second).

k. Type XI - 14.5 by 114 millimeters.

(1) Class B - Should be tested with 14.5-millimeter API-B32 bullets with a specified mass of 64 grams (990 grains) ±5 percent and a velocity of 914±9.1 meters per second (3000±30 feet per second).

l. Type XII - 20 by 102 millimeters.

(1) Class B - Should be tested with 20-millimeter M53 bullets with a specified mass of 102 grams (1574 grains) ±5 percent and a velocity of 1030±9.1 meters per second (3380±30 feet per second).

m. Type XIII - 23 by 152 millimeters.

(1) Class B - Should be tested with 23-millimeter API-T BZT bullets with a specified mass of 187 grams (2885 grains) ±5 percent and a velocity of 1000±9.1 meters per second (3300±30 feet per second).

n. Type XIV - 25 by 137 millimeters.

(1) Class B - Should be tested with 25-millimeter APDS-T M791 bullets with a specified mass of 149 grams (2300 grains) ±5 percent and a velocity of 1344±9.1 meters per second (4412±30 feet per second).

o. Type XV - 30 by 113 millimeters.

(1) Class B - Should be tested with 30-millimeter M789 HEDP bullets with a specified mass of 229 grams (3534 grains) ±5 percent and a velocity of 805±9.1 meters per second (2641±30 feet per second).

p. Type XVI - 30 by 165 millimeters.

(1) Class B - Should be tested with 30-millimeter BT bullets with a specified mass of 400 grams (6175 grains) ±5 percent and a velocity of 880±9.1 meters per second (2900±30 feet per second).

q. Type XVII - 30 by 173 millimeters.

(1) Class B - Should be tested with 30-millimeter APFSDS-T with a specified mass of 235 grams (3627 grains) ±5 percent and a velocity of 1385±9.1 meters per second (4544±30 feet per second).

1.2.2 Grade. The grade classification of ballistic resistant material denotes single or multiple shot capabilities (see 6.2).

a. Grade S - The ballistic material test sample should stop a single shot in accordance with qualification procedures in 5.5.3.1.

b. Grade M - The ballistic material test sample should stop a multiple shots in accordance with qualification procedures in 5.5.3.2.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this standard, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests

(Copies of this document are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

INTERNATIONAL TEST OPERATIONS PROCEDURES (ITOP)

ITOP 2-2-713 - Ballistic Testing of Armor

ITOP 4-2-805 - Projectile Velocity and Time-of-Flight Measurements

(Copies of these documents are available from the U.S. Army Developmental Test Command, 314 Longs Corner Road, Aberdeen Proving Ground, MD 21005-5055.)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Areal density. A measure of the weight of armor material per unit area, usually expressed in kilograms per square meter (kg/m^2) or pounds per square foot ($1b/ft^2$) of surface area.

3.2 Armor. A shielding material provided for ballistic defeat of projectiles or fragments when inherent shielding is inadequate.

3.3 Armor-piercing (AP) bullet. Armor-piercing ammunition is used to penetrate armored targets. Armor-piercing ammunition consists of a penetrator constructed of hardened steel, tungsten carbide, or depleted uranium, enclosed within a softer jacket, such as copper or aluminum.

3.4 Armor-piercing discarding sabot (APDS) bullet. Armor-piercing round that also has a case to permit firing through a bore of larger diameter; the case is discarded upon firing.

3.5 Armor-piercing, fin stabilized, discarding sabot – tracer (APFSDS-T). Armor-piercing tracer round with discarding sabot and fins to provide aerodynamic stability.

3.6 Armor-piercing incendiary (API) bullet. Armor-piercing bullet with an added incendiary compound that deflagrates upon impact and causes fires.

3.7 B32. Soviet military armor-piercing incendiary projectile of various calibers.

3.8 Ball. General term for a full metal jacketed solid bullet with no special projectile capability or configuration (e.g., armor piercing, hollow point, etc.).

3.9 Ballistic acceptance test. A test performed on representative samples to determine whether or not the armor design is ballistically acceptable for use in production armor items.

3.10 Ballistic defeat materials. Materials designed to completely stop the impact velocity and mass of a given projectile.

3.11 Ballistic deformation. The maximum momentary displacement of the back surface of the armor test specimen caused by a fair hit that does not penetrate the armor when the armor is in initial contact with the backing material.

3.12 Ballistic impact. Those impacts due to hits on the target by projectiles, fragments, or other aerodynamically-affected threat mechanisms.

3.13 Ballistic resistance. A measure of the capability of a material or component to stop or reduce the impact velocity and mass of an impacting projectile or fragment.

3.14 BZ. Soviet 7.62- by 39-millimeter armor-piercing incendiary projectile fired from the AK-47 rifle.

3.15 Complete penetration. A complete penetration occurs when the impacting projectile, or any fragment thereof, or any fragment of the test specimen perforates the witness plate, resulting in a crack or hole which permits light passage.

3.16 Coupon. An armor plate or fabricated armor section or component which is specifically sized for testing and is to be tested for evaluation of ballistic protection properties (also known as “test sample”).

3.17 Delamination. A condition in which ceramic composite armor or armor composed of other layered materials loses adhesion, or experiences deterioration of, the outer thin layer or protective coating.

3.18 Full metal jacketed (FMJ) bullet. A bullet made of lead completely covered, except for the base, typically with copper alloy (approximately 90 percent copper-10 percent zinc). Some other full metal jacketed ammunition may utilize alternative metals.

3.19 High explosive, dual purpose (HEDP) projectile. Anti-materiel and anti-personnel round. The round is comprised of a spin-charged fuse that initiates the projectile’s explosive filler upon impact. This explosive is formed as a shape-charge that forms an armor-piercing jet upon initiation. Fragmentation also occurs upon initiation that can produce anti-personnel effects.

3.20 Impact velocity. The velocity of a projectile or missile at the instant of impact (also known as “striking velocity”).

3.21 Jacketed soft point (JSP) bullet. A bullet made of lead completely covered, except for the point, with copper alloy (approximately 90 percent copper-10 percent zinc).

3.22 LPS. Soviet 7.62- by 54-millimeter mild-steel core ball round typically fired through medium machine gun.

3.23 Multi-point. The multi-point is the intersection of seams on a tiled coupon where the greatest numbers of seams converge.

3.24 Muzzle velocity. The velocity of the projectile with respect to the muzzle at the instant the projectile leaves the weapon. This velocity is a function of the projectile weight, firing charge of the projectile, barrel characteristics, etc.

3.25 Obliquity. A measure, normally in degrees, of the extent to which the impact of a projectile on an armor material deviates from a line normal to the target. Thus, a projectile fired perpendicular to the armor surface has 0 degrees obliquity.

3.26 Partial penetration. Any impact which is not a complete penetration should be considered a partial penetration.

3.27 Protection level. A classification of ballistic defeat capability defined by a specific caliber and type of ammunition to which a shield or piece of armor is tested.

3.28 PS. Soviet 7.62- by 39-millimeter mild-steel core ball round fired by the AK-47 rifle.

3.29 Spall. The detachment or delaminating of a layer of material in the area surrounding the location of impact, which may occur on either the front or rear surfaces of the armor. Spalling may be a threat mechanism even when penetration of the armor itself is not complete.

3.30 Strike face. The surface of a ballistic resistant protective material designated by the manufacturer as the surface that should be exposed to (face) the weapon threat.

3.31 Tuned armor. Armor material that has been highly engineered to defeat a particular threat often at the expense of smaller threats (e.g., perforated plates, ceramic spheres).

3.32 Witness plate. A thin sheet located behind and parallel to the ballistic test sample which is used to detect penetrating projectiles or spall.

3.33 Yaw. Projectile yaw is the angular deviation of the longitudinal axis of the projectile from the line of flight at a point as close to the impact point on the target as is practical to measure.

4. GENERAL REQUIREMENTS

4.1 Conduct of test. General guidance for establishing and monitoring test conditions, instrumentation, and procedural protocol is provided in MIL-STD-810. Specific parameters are provided herein. Procedural guidance is provided in Appendix A.

4.2 Production representative sample. Test sample shall be representative of the materials and manufacturing techniques of the production version. A minimum of 3 coupons shall be tested.

4.2.1 Workmanship. Test sample shall be free from dents, blisters, cracks, chipped or sharp corners, and other evidence of inferior workmanship.

4.3 Marking. The sample item and each full size panel of ballistic defeat material shall be permanently and legibly labeled and shall include the following information:

a. Name, designation, or logo of the manufacturer.

b. Month and year of manufacture.

c. Lot number.

d. Strike face.

All targets and any separate subcomponents including the witness plate shall carry a unique identifying number that should relate to:

e. Trial series number.

f. Threat weapon ammunition used in the assessment. Type and class of material should be included per 1.2.1.

In addition, during testing all ballistic impacts shall be individually marked on all components of the target and witness plate. Numbers shall be sequential and account for all serials fired including any preliminary test rounds or UNFAIR impacts, etc. These unique target and ballistic impact numbers shall be recorded within the test facility report.

4.4 Coupon conditioning. Unless otherwise specified in the test plan (i.e., specific temperature or humidity testing), prior to ballistic testing, each target should be pre-conditioned to a temperature of 20±5 °C and a relative humidity (RH) of 50±5 percent for at least 12 hours.

4.5 Test round conditioning. Unless otherwise specified in the test plan (i.e., specific temperature testing), prior to ballistic testing, each round should be pre-conditioned to a temperature of 20±5 °C for at least 12 hours.

4.6 Test conditions. Unless otherwise specified in the test plan, all ballistic tests shall be performed in a standard atmosphere of 20±5 °C and 50±5 percent relative humidity. Temperature and humidity measurements shall be recorded for each firing.

4.7 Coupon mounting. The armor test sample shall be secured on the test target mount with impact side perpendicular to the line-of-flight of the projectile. The frame supports and clamps or mounting fixtures must be capable of retaining the sample and withstanding shock resulting from ballistic impact by the test projectiles. The test sample mount shall be capable of adjustment for moving the sample in the vertical or horizontal directions so that the point of impact can be located anywhere on the sample, and so that zero degree obliquity impacts can be achieved anywhere on the sample. The sample shall be mounted in a suitable frame which fully supports the sample with or without the gasket, and which supports the sample on a shoulder 30±3 millimeter wide behind the perimeter of the sample. NOTE: Clamping pressure is not always precisely defined, as the effect of clamping on the final result is relatively small. Shielding shall be incorporated into the fixture to ensure adequate blow-by prevention on the sides and rear so that debris from the front surface impact does not ricochet off surfaces in the impact chamber and cause false failure holes.

4.8 Strike angle. The target samples shall be positioned at 0 degrees obliquity ±2 degrees. The projectiles shall have no more than 5 degrees of yaw angle. Yaw and obliquity may be measured in accordance with ITOP 2-2-713. The ballistic defeat material shall defeat the projectile anywhere between 0 degrees and 88 degrees obliquity. Testing with obliquities other than 0 degrees shall occur when there is reason to believe that the protection system may be vulnerable to such threats.

4.9 Launcher to target distance. The launcher to target distance shall be selected such that there is a high probability of the impact conditions being FAIR in terms of velocity, yaw, and impact position.

4.10 Triggering devices set-up. The triggering devices shall be placed such that the velocity of the round is measured at a location 2.5 meters (8.2 feet) in front of the test sample, and arranged so that they define planes perpendicular to the line of flight of the bullet. The distance between them shall be measured with an accuracy of 1.0 millimeters (0.04 inches).

4.11 Projectile velocity measurement. The velocity of the bullet shall be measured with an electronic measuring system not more than 2.5 meters in front of the test coupon. The mechanism for measuring the bullet velocity shall be accurate to 1.0 meters per second. The projectile velocity may be measured in accordance with ITOP 4-2-805.

4.12 Launching system. Actual weapon or test barrel is allowed. Any launching device may be used provided it is capable of consistently and reproducibly propelling the test projectiles (bullets or fragment simulators) at the required aiming point with an acceptable accuracy, impact velocity, and angle of impact yaw.

5. DETAILED REQUIREMENTS

5.1 Coupon size. For Protection Level VIII and below, the test specimen shall be a current production sample of the ballistic resistant material at least 30.5 by 30.5 centimeters (12 by 12 inches). For Protection Level IX to Level XI, the size of the test pieces shall be at least 50.8 centimeters by 50.8 centimeters (20 by 20 inches) square. For Protection Level XII and above, the size of the test pieces shall be at least 122 centimeters by 122 centimeters (48 by 48 inches) square. The edges of the test pieces shall be smooth for ease of handling.

5.2 Witness plate. For testing opaque armor material targets, the witness system shall consist of a nominal 0.5-millimeter (±0.05millimeters) thick aluminum alloy sheet (e.g., 2024 T3 or T4, AlCuMg ISO/R209 with minimum tensile strength of 440 Newtons per square millimeter). For testing transparent armor material targets, the witness system shall consist of a nominal 0.0254-millimeter (±0.005 millimeter) thick aluminum alloy sheet (e.g., kitchen foil. Alloy may be 8111 or 1100, “0” temper). It shall be placed at a standoff distance of 150 millimeters (±10 millimeters) behind and parallel to the back face surface of the target at the aim point as illustrated on figure A-1. The witness system should extend over a sufficient area (equal to or larger than the target size) such that all significant projectile debris or target spall can be detected.

5.3 Projectile. The test projectile shall be of the type and caliber specified (see 6.2). Unless otherwise specified (see 6.2), millimeters shall be used to identify the caliber of projectiles. Table I provides the weights and composition of test projectiles.

5.4 Projectile velocity. The test projectile velocity shall be as specified (see 6.2) and in accordance with table I.

TABLE I. Projectile information by type and class.

Type	Class		Caliber (mm)	Round Weight	Velocity
I	A		9	8.0g (124 gr) (M882) ±5%	385±9.1 m/s (1263±30 ft/s)
II	A		11	15.55g (240 gr) (.44 Magnum SWC gas checked) ±5%	426±9.1 m/s (1400±30 ft/s)
III	A		7.62	8.0g (124 gr) (Type PS M67) ±5%	700±9.1 m/s (2300±30 ft/s)
		B		7.8g (120gr) (API BZ M43) ±5%	715±9.1 m/s (2340±30 ft/s)
IV	A		5.45	3.2g (50 gr) (5N7) ±5%	915±9.1 m/s (3000±30 ft/s)
		B		3.7g (57 gr) (7N22 AP) ±5%	887±9.1 m/s (2910±30 ft/s)
V	A		5.56	4.0g (62 gr) (M855) ±5%	950±9.1 m/s (3117±30 ft/s)
		B		3.4 g (52 gr) (M995 WC AP) ±5%	1030±9.1 m/s (3380±30 ft/s)
VI	A		7.62	9.8g (152 gr) (M2) ±5%	880±9.1 m/s (2900±30 ft/s)
		B		10.8g (166 gr) (AP M2) ±5%	878±9.1 m/s (2880±30 ft/s)
VII	A		7.62	9.6g (147 gr) (M80) ±5%	838±9.1 m/s (2750±30 ft/s)
		B		8.3g (128 gr) (AP M993) ±5%	910±9.1 m/s (2986±30 ft/s)
VIII	A		7.62	9.7g (151 gr) (Type LPS) ±5%	865±9.1 m/s (2840±30 ft/s)
		B		10.0g (155 gr) (Type B32) ±5%	854±9.1 m/s (2801±30 ft/s)
IX		B	12.7	48.0g (740 gr) (API, B32) ±5%	853±9.1 m/s (2800±30 ft/s)
X	A		12.7	42.9g (662 gr) (M33) ±5%	887±9.1 m/s (2910±30 ft/s)
		B		48.6g (750 gr) (MK 263 AP) ±5%	887±9.1 m/s (2910±30 ft/s)
XI		B	14.5	64.0g (990 gr) (API-B32) ±5%	914±9.1 m/s (3000±30 ft/s)
XII		B	20	102g (1574 gr) (M53) ±5%	1030±9.1 m/s (3380±30 ft/s)
XIII		B	23	187.0g (2885 gr) (API-T BZT) ±5%	1000±9.1 m/s (3300±30 ft/s)
XIV		B	25	149g (2300 gr) (APDS-T M791) ±5%	1344±9.1 m/s (4412±30 ft/s)
XV		B	30	229g (3534 gr) (M789 HEDP) ±5%	805±9.1 m/s (2641±30 ft/s)
XVI		B	30	400g (6175 gr) (30 x 165mm BT) ±5%	880±9.1 m/s (2900±30 ft/s)
XVII		B	30	235g (3627 gr) (APFSDS-T) ±5%	1385±9.1 m/s (4544±30 ft/s)

5.5 Shot locations

5.5.1 General shot locations. Each unique solution shall, at minimum, be tested at three general locations: an edge shot, a center shot, and corner shot (see figure 1). The general locations shall be tested on a separate coupon for each location.

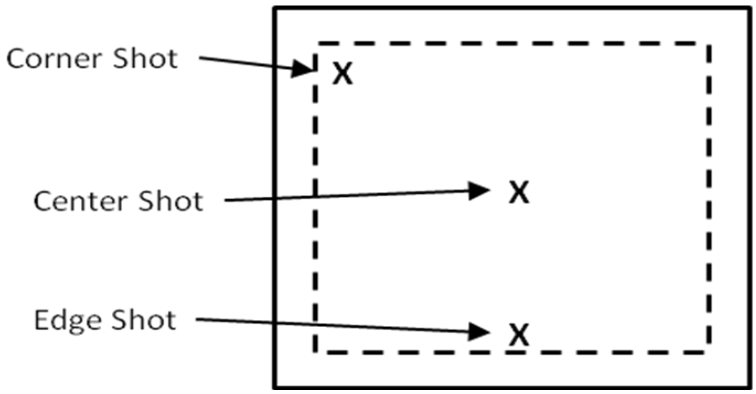

FIGURE 1. General shot locations.

5.5.1.1 Edge shot. One impact shall be no farther from the edge of the coupon than 7.6 centimeters (3 inches) for Protection Type VIII and below, 12.7 centimeters (5 inches) for Protection Type IX to Type XI, and 30.5 centimeters (12 inches) for Protection Type XII and above. This shot shall be within 5.0 centimeters (2 inches) of the center of the coupon edge.

5.5.1.1.1 Edge standoff. An exclusion zone shall consist of a standoff distance of 2.5 centimeters (1 inch) from the edge of the coupon. If a round impacts in the exclusion zone and results in a penetration for that impact or a subsequent impact in the case of multi-shot testing, the test shall be considered UNFAIR. If a round impacts the exclusion zone and no penetration results for that impact or a subsequent impact in the case of multi-shot testing, the test shall be considered FAIR.

5.5.1.2 Center shot. One impact shall be within a circle of radius 5.0 centimeters (2 inches) from the center of the coupon.

5.5.1.3 Corner shot. One impact shall be near the corner of the coupon. The impact shall be within the maximum edge shot distance for the protection type as measured from two adjoining edges.

5.5.2 Incongruent coupon shot locations. Due to the possible weaknesses associated with incongruencies (e.g., seams, joints, etc.) as viewed perpendicular to the strike face, coupons shall undergo additional special impact locations. These special locations shall consist of a seam between two sections, the multi-point between adjoining sections, the near edge of one section, and two adjoining sections. Where possible, the special shots shall compose the additional two impacts in a multi-shot test, or additional three shot tests shall be required. The outline of the sections shall be marked for ease of aligning the special location shots (see figure 2).

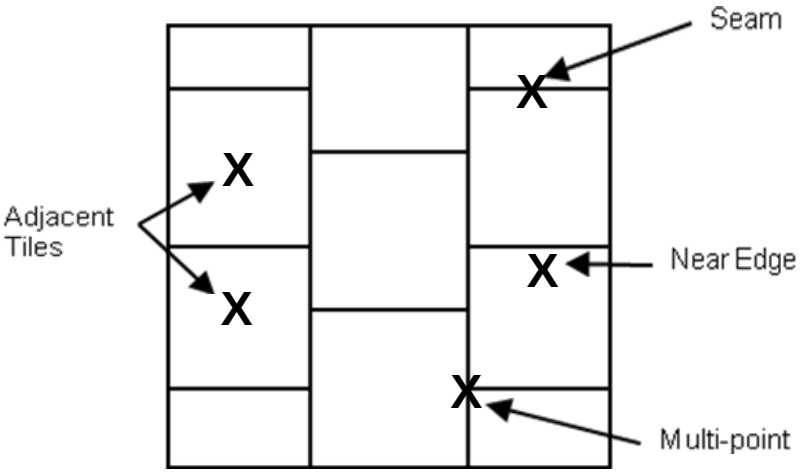

FIGURE 2. Incongruent coupon shot locations.

5.5.2.1 Near edge. Near edge shall be within 1.25 centimeters (0.5 inches) of the edge of the tile.

5.5.2.2 Multi-point and seam. The center of the round strike for multi-point and seam shots shall be within ½ diameter of the round.

5.5.2.3 Adjacent tiles. Adjacent tile shots shall be within a radius of 1.25 centimeters (0.5 inches) from the centers of the two adjacent tiles. Adjacent tiles shall share one complete adjoining edge.

5.5.3 Shot grading.

5.5.3.1 Single-shot grading. A single-shot grading requires each general shot location to be shot on a separate coupon. All three impacts shall be FAIR with no penetration to receive this grade. Due to the adjacent section requirement, an incongruent solution shall not be tested to a single-shot grading.

5.5.3.2 Multi-shot grading. A multi-shot grading requires each general shot location to be shot on a separate coupon. Additionally, each coupon shall be shot with an additional two rounds within the acceptable shot spacing limits for the given protection type. All impacts shall be FAIR with no penetration to receive this grade.

5.5.3.2.1 Shot spacing. The placement of the three shots shall form a triangle with side lengths based on protection type. The side lengths shall be measured from impact center to impact center. For Protection Type VIII and below, the distance shall be 10.16±5 percent centimeters (4±5 percent inches). For Protection Type IX to Type XI, the distance shall be 16.51±5 percent centimeters (6.7±5 percent inches). For Protection Type XII and above, the distance shall be 40.64±5 percent centimeters (16±5 percent inches).

5.6 Post-shot analysis.

5.6.1 Test impact validity assessment. A ballistic impact is considered FAIR if the conditions defined within this standard creating the expectation of a valid test are met, but is considered as UNFAIR if the criteria are not met. All ballistic impacts whether FAIR or UNFAIR shall be recorded. An UNFAIR impact is accepted as FAIR if the target succeeded under more severe conditions than specified.

5.6.2 Examination of witness plate. The witness plate shall be examined for penetration by holding it up to a light to observe light passage. A FAILURE is recorded when any light passes through the witness plate. If no light is visible through the witness plate, a PASS is recorded.

5.6.3 Acceptance and rejection. The selected armor samples shall meet the requirements per the protection level for the represented lot to be acceptable. Failure of any test samples to meet the requirements in table I shall constitute rejection of the entire lot which they represent. Unless otherwise specified (see 6.2), the ballistic tests shall be conducted and the test results accepted prior to shipment of the lot of armor represented by the test samples.

5.6.4 Lesser threat compliance testing. To meet the requirements of this document for a defined type, the ballistic defeat material shall defeat the projectile specified for that type and those specified for any lower types of the same class. Testing with projectiles specified for the lower types shall occur whenever there is reason to believe that the protection system may be vulnerable to such threats.

NOTE: Since increasing types are usually more penetrative, most ballistic defeat material automatically meets this requirement. Exception may occur with tuned armor designs, for example perforated armor designed for 7.62-millimeter caliber bullets may demonstrate a weakness to smaller caliber or lower energy projectiles such as 5.56-millimeter caliber bullets. Therefore, this circumstance may represent more severe test conditions, and additional testing shall occur.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This test standard is pass/fail determination of ballistic defeat material against specific threat rounds. It is not a material properties test such as MIL-STD-662. Appendix B identifies types and classes of ballistic resistant materials with the common threats they are intended to defeat. This standard tests all materials and solutions against threats at muzzle velocity and 0 degrees obliquity for the purpose of simulating worst case scenario. This test standard is not for the purpose of body armor qualification.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this standard.

b. Type (see 1.2.1).

c. Class (see 1.2.1).

d. Grade (see 1.2.2).

e. Projectile and projectile velocity (see 5.3 and 5.4).

f. Acceptance and rejection (see 5.6.3).

g. Report requirements (see 6.3 through 6.5).

h. Confidence interval (see 6.6).

6.3 Ballistic test report. Ballistic test reports should contain the following minimum information as applicable:

a. Items a, b, c, d, and e of 6.2.

b. Contractor identification.

c. Test facility.

d. Contract number.

e. Lot numbers and quantities.

f. Item specification number.

g. Armor material description (i.e., areal density, descriptive composition).

h. Material identification number for each test sample.

i. Temperature and humidity at the test facility.

j. Date.

k. Personnel conducting test and any witnesses.

l. Projectile launcher used.

m. Projectile used.

n. Projectile weight.

o. Witness plate characteristics, partial or complete.

p. Remarks pertinent to the conduct of the test, or behavior of the material (including ballistic deformation, disposition of projectile).

Additional data may be required by a contracting activity. When testing is done at a place other than a Government facility, results should be reported on forms either furnished or approved by the Government. One copy of each complete report should be forwarded to the agency designated by the Government.

6.4 Test samples ownership.

a. First Article Test (FAT) plates. Upon request of the applicant, FAT plates should be returned “as is” to the applicant within 15 days after ballistic testing, at his expense, unless the plates were destroyed in testing.

b. Acceptance test plates. Acceptance test plates that comply with the requirements of this standard are considered as part of the lot they represent and ownership of them passes to the Government with the acceptance of that lot. Acceptance test plates that fail to comply with the requirements of this standard are considered as part of the lot they represent and remain the property of the producer just as the rejected lot does. The failed plates should be returned, upon request, “as is” to the applicant, at his expense.

6.5 Retests. If a test plate representing a lot fails to meet the ballistic requirement, the manufacturer, upon notification of the failure, may submit at his own expense additional test plates from the same lot for ballistic retest. If any of these plates fail the ballistic test, the lot should be rejected. The manufacturer may elect to resubmit the lot after certified retreatment of the entire lot by submitting retreated test plates. If any of these plates fail, the lot should be permanently rejected.

6.6 Test round availability. While this standard represents the most common threats in usage around the world, it does not guarantee the availability of rounds for testing. Some foreign rounds may require an unacceptable lead-time for procurement. Inquiries about the availability of foreign rounds should be addressed to:
Product Director for Non-Standard Ammunition
(973) 724-1685
DSN 880-1685
robert.dionisio1@us.army.mil

6.7 Confidence interval. With a minimum sample size of 3 coupons and a confidence level of 95 percent, an accepted lot has a confidence interval of 11.26 percent. If a smaller confidence interval is desired, a larger sample size may be specified (see 6.2).

6.8 Subject term (key word) listing.

Armor

Ballistic Testing

Force Protection

Survivability

SEQUENCE OF TEST EVENTS FOR BALLISTIC DEFEAT MATERIALS

A.1 SCOPE

A.1.1 Scope. This Appendix details the order of events associated with the conduct of ballistic defeat material testing. This Appendix is not a mandatory part of the standard. The information contained herein is intended for guidance only.

A.2 PROCEDURE

A.2.1 Coupon. Inspect the coupon(s) to ensure they meet the test requirements (production representative sample, workmanship, marking, and size).

A.2.2 Conditioning. Validate that the coupon, test rounds, and facility meet the conditioning requirements.

A.2.3 Test set-up.

A.2.3.1 Equipment set-up. Ensure that the launch device, velocity measurement device, coupon mount, and witness plate mount are properly installed and aligned. Further, ensure all distances required are within tolerances (see figure A-1).

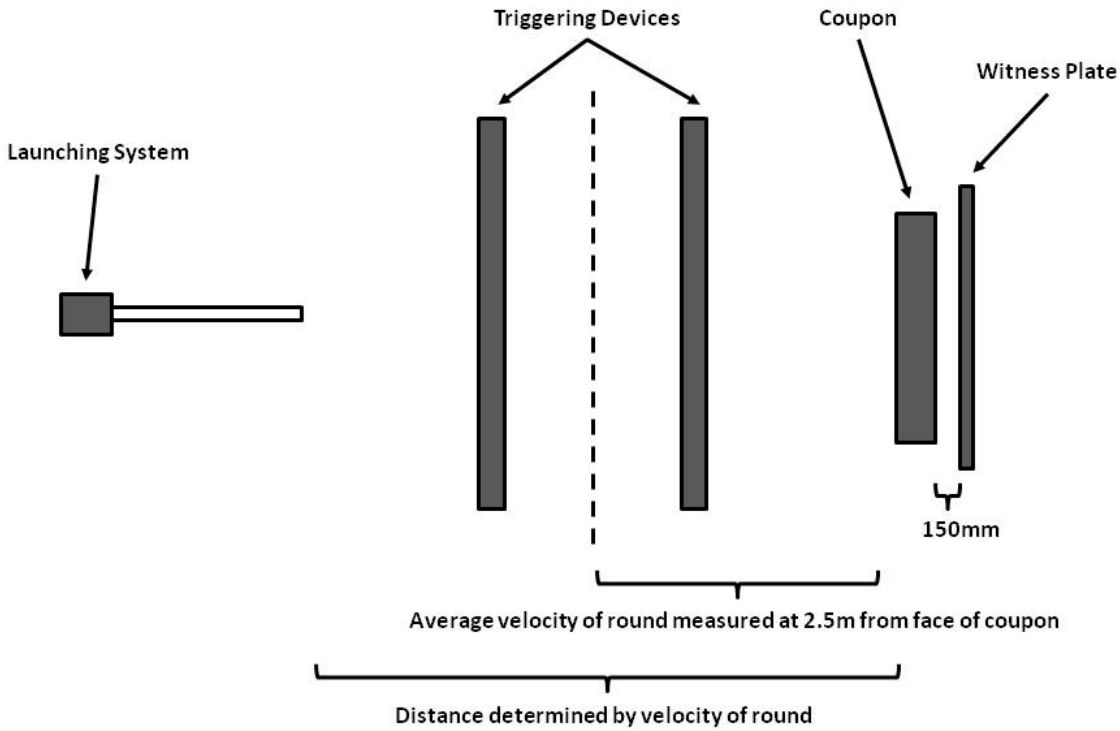

FIGURE A-1. Equipment set-up.

A.2.3.2 Calibration of set-up. Fire test shot to validate velocity, yaw, and aim are within tolerances.

A.2.3.3 Coupon set-up. Ensure the coupon and witness plate are properly attached to their respective mounts.

A.2.4 Conduct test.

A.2.4.1 First shot. Shoot first shot at coupon in accordance with required location.

A.2.4.2 Inspection. Inspect coupon and witness plate and determine PASS or FAIL.

A.2.4.3 Recording. Document results required for reporting. Make markings on coupon and witness plate as required.

A.2.4.4 Reset. Adjust aim-point for subsequent shots and continue test cycle until test is complete or as failure dictates for the installed coupon. Replace coupon and repeat until all required samples and shot locations have been tested and satisfied or failure has concluded the test.

A.2.5 Reporting. Compile applicable test data and results into a test report as required.

COMPARISON OF TYPE AND CLASS TO COMMON WEAPONS

B.1 SCOPE

B1.1 Scope. This Appendix details the most common weapon that utilizes the representative round corresponding to the type and class. This Appendix is not a mandatory part of the standard. The information contained herein is intended for guidance only.

B.2 TABLE

B.2.1 Usage. This table is designed to be utilized for purposes of determining a type and class for requirements generation or acquisition purposes. Table B-I facilitates the selection of a type and class based on a known threat weapon.

TABLE B-I. Type and class to common weapons.

MIL-STD-3038			**Threat Information**		
Type	**Class**		**Caliber**	**Round**	**Weapon**
I	A		9 x 19	9 mm FMJ RN M882	M9
II	A		11 x 41	.44 Magnum SWC gas checked	S & W Model 29
III	A		7.62 x 39	Type PS M67	AK-47
		B		API BZ M43	
IV	A		5.45 x 39	5N7	AK-74
		B		7N22 AP	
V	A		5.56 x 45	M855	M16
		B		AP M995	
VI	A		7.62 x 63	M2	M1 Garand
		B		AP M2	
VII	A		7.62 x 51	M80	FN FAL
		B		AP M993	
VIII	A		7.62 x 54R	SOVIET, Type LPS	PKM, Dragonuv
		B		Type B32	
IX		B	12.7 x 108	12.7mm API, B32	DShK
X	A		12.7 x 99	M33	M2 BMG
		B		MK 263 AP	
XI		B	14.5 x 114	14.5mm API-B32	KPV
XII		B	20 x 102	M53	M61 Vulcan
XIII		B	23 x 152	23mm API-T BZT	2A14
XIV		B	25 x 137	APDsS-T M791	M242
XV		B	30mm	M789 HEDP	M230
XVI		B	30mm	30 x 165mm BT	GSh-30-1
XVII		B	30mm	APFSDS-T	GAU-8

Custodians:
Navy – SH
Air Force – 99

Review Activity:
DLA – CC

Civil Agency:
GSA – FAS

Preparing Activity:
Navy – SH
(Project 2040-2010-001)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.daps.dla.mil.