NIJ Standard 0101.07, *Ballistic Resistance of Body Armor*
Addendum 1

October 31, 2024

This addendum includes revisions to NIJ Standard 0101.07, *Ballistic Resistance of Body Armor*. Users of the NIJ Standard should incorporate the revisions in this addendum as a part of the NIJ Standard.

The revisions are presented in the following format:

Revision: [description of the revision]

[relevant section of NIJ Standard 0101.07 with new or modified text in red and ~~text to be removed in red strikethrough~~.]

*** REVISIONS ***

Revision: Modified and added to the definition of *complete penetration* in 3.2.3.

3.2.3. *complete penetration* (CP), n. – the result of a test threat impact if one or more of the following conditions are met:

(1) any portion of a test threat or a fragment of a test threat passes through the wear face of the test item.
(2) the test threat is visible from the wear face of the test item.
(3) a hole is created through the test item by the test threat.
(4) for soft armor, any portion of a test threat or a fragment of a test threat is embedded in or passes into the backing material directly behind the test item.
~~(5) for hard armor, any portion of a test threat, a fragment of a test threat, or a fragment of the test item is embedded in or passes into the backing material directly behind the test item.~~
(5) for any shot at a nonzero angle of obliquity on soft armor, including shot 7, any portion of a test threat or a fragment of a test threat that is visible through the panel cover.
(6) for any shot at a nonzero angle of obliquity on soft armor, including shot 7, if the shot exits the panel cover from the edge and is not fully retained by the ballistic panel.

NOTE for (5) and (6): For any shot at a nonzero angle of obliquity on soft armor, including shot 7, test threats protruding from the edge shall be considered fully retained if the test threat is encapsulated in the panel cover and not visible. If the test

threat penetrates the panel cover but is retained in the polycotton carrier, the test result shall be considered a complete penetration.

(7) for hard armor, any portion of a test threat or a fragment of a test threat embedded in or passes into the backing material directly behind the test item.

(8) for hard armor, a fragment of any hard component of the test item that penetrates the cover material on the back of the test item.

NOTE: For the purposes of this definition, ceramics and metals shall be considered hard components.

NOTE: Spall embedded in the clay surface beyond the perimeter of the test item shall not be considered a complete penetration.

Revision: Modified the definition of *crown* in 3.2.4. and added a clarifying note.

3.2.4. *crown*, n. – location of ~~the highest point of a plate, at~~ the intersection of multiple ~~different~~ curvatures on the strike face in a multi-curve hard plate.

NOTE: Most contemporary multi-curve hard plate designs are derived from the small arms protective insert (SAPI), with the crown located on the vertical centerline and above the horizontal centerline. Novel and innovative designs, such as those for women, may include ~~multiple high points and~~ complex curvatures and multiple points that meet the definition of crown. Shooting at these multiple locations will need to be incorporated into the overall test plan. Additional test items may be required depending on the specific armor design.

Revision: Added new section 4.3.4.1. to section 4.3.4. to clarify the requirements for the apparatus used for hard armor test item conditioning.

4.3.4. Specialized equipment for hard armor test item conditioning shall meet the requirements described in ASTM E3078 for the following two procedures:

1) Impact Durability Pre-conditioning in ASTM E3078, Section 13.1

2) Impact Durability Conditioning Procedure for Torso Front and Back Plates in ASTM E3078, Section 14.2

4.3.4.1. Laboratories are encouraged to reproduce the specialized equipment described in ASTM E3078, Section 14.2. However, if the actual apparatus employed to accomplish the testing described in ASTM E3078, Section 14 is (1) similar in design, construction, and function to the specialize equipment described in Section 14.2, and (2) it produces the required test results, then the actual apparatus employed shall be considered equivalent to what is described in 14.2. Laboratories shall document how the actual apparatus employed is equivalent to the specialized equipment described in ASTM E3078, Section 14.2.

Revision: Corrected the sign of the inequality in the parentheses in 6.2.3.

6.2.3. The ballistic limit data shall be analyzed as described in *Appendix D: Analysis of Ballistic Limit Data*. The estimated probability of complete penetration at the reference velocity (V_{ref}) shall be less than 5% (i.e., $\hat{V}_{05} \geq V_{ref}$).

Revision: Added new section 9.2.11. regarding the number of test items that may be used on a clay block.

9.2.11. One clay block may be used for multiple test items, so long as the clay meets the acceptance criteria in *Appendix B, Modifications to the Procedures of ASTM E3004 and Additional Requirements*.

NOTE: ASTM E3004 does not require that a clay block only be used for up to an hour. E3004 Section 6.2.3.1(c) states that any clay block that has been out of the conditioning chamber for more than one hour shall be reheated for at least three times the time out of the chamber but not more than 24 hours.

Revision: Added new sections 9.3.3.1.2. and 9.3.3.1.3. regarding shot locations on conditioned soft armor.

9.3.3.1.2. Shot locations that overlap with features introduced by conditioning by tumbling, such as creases, shall not be avoided during testing.

9.3.3.1.3. Shot locations should be preferentially selected within the fair impact areas to strike features introduced by conditioning by tumbling, such as creases, to exploit potential weaknesses or vulnerabilities in the armor.

NOTE: Shooting a crease within the fair impact areas shall constitute a fair hit, and if the projectile completely penetrates the test item, then it constitutes a failure.

Revision: Added new section 9.3.5.1. to permit rotating the test items on clay.

9.3.5.1. Test items may be rotated on the clay block to fulfill shot requirements.

Revision: Added new section 9.3.5.2. to require that ballistic panels shall not be folded to accommodate shot 7.

9.3.5.2. The ballistic panel shall not be folded to fulfill shot requirements for shot 7.

NOTE: ASTM E3107 section 10.2 indicates that the test item shall be positioned on a clay block such that the entire test item is supported. When the test item exceeds the size of the clay block, backing fixture extensions coplanar with the backing material surface should be used to allow the test item to be fully supported. Test laboratories will need to determine whether the combination of strapping and backing fixture extenders allows the test item to come into intimate contact with the backing material. Laboratories may opt to rely solely on strapping to allow the test item to maintain intimate contact with the clay, or may modify backing fixture extensions to accommodate the test item.

Revision: Added new section 9.3.5.3. to permit adjusting strapping to accommodate shot 7.

9.3.5.3. Strapping may be adjusted on shot 7 to fulfill shot requirements without obstructing the path of the projectile.

Revision: Added new section 9.3.6.4. to include tolerances on the location of shot 7.

9.3.6.4 In accordance with ASTM E3107 11.2.4.1, shot 7 shall be placed at the center of the neck scoop, but shall not be located more than the 19 mm (0.75 in.) away from the centerline in either direction.

Revision: Added new section 9.3.7.1. to permit multiple test items on a clay block.

9.3.7.1. Multiple test items may be used on a single clay block.

Revision: Added new section 9.3.7.2. to permit up to 28 shots on a clay block.

9.3.7.2. Up to 28 shots of one type of threat may be used on a clay block before reconditioning.

NOTE: The maximum number of shots on a clay block can accommodate all 7 shots on 4 large C-5 panels.

Revision: Added new sections 9.4.3.1.2. and 9.4.3.1.3. regarding shot locations on conditioned soft armor.

9.4.3.1.2. Shot locations that overlap with features introduced by conditioning by tumbling, such as creases, shall not be avoided during testing.

9.4.3.1.3. Shot locations should be preferentially selected within the fair impact areas to strike features introduced by conditioning by tumbling, such as creases, to exploit potential weaknesses or vulnerabilities in the armor.

NOTE: Shooting a crease within the fair impact areas shall constitute a fair hit, and if the projectile completely penetrates the test item, then it constitutes a failure.

Revision: Added new section 9.4.9.4. to permit rotating the test items on clay.

9.4.9.4. Test items may be rotated on the clay block to fulfill shot requirements.

Revision: Added new section 9.4.9.5. to require that ballistic panels shall not be folded to accommodate shot 7.

9.4.9.5. The ballistic panel shall not be folded to fulfill shot requirements for shot 7.

NOTE: ASTM E3107 section 10.2 indicates that the test item shall be positioned on a clay block such that the entire test item is supported. When the test item exceeds the size of the clay block, backing fixture extensions coplanar with the backing material surface should be used to allow the test item to be fully supported. Test laboratories will need to determine whether the combination of strapping and backing fixture extenders allows the test item to come into intimate contact with the backing material. Laboratories may opt to rely solely on strapping to allow the test item to maintain intimate contact with the clay, or may modify backing fixture extensions to accommodate the test item.

Revision: Added new section 9.4.9.6. to permit adjusting strapping to accommodate shot 7.

9.4.9.6. Strapping may be adjusted on shot 7 to fulfill shot requirements without obstructing the path of the projectile.

Revision: Added new section 9.4.9.7 to require refilling of the clay after shots 4 and 5.

9.4.9.7. Clay shall be refilled after shot 4 for shot 5 and after shot 5 for shot 6.

Revision: Added new section 9.4.9.8. to include tolerances on the location of shot 7.

9.4.9.8 In accordance with ASTM E3107 11.2.4.1, shot 7 shall be placed at the center of the neck scoop, but shall not be located more than the 19 mm (0.75 in.) away from the centerline in either direction.

Revision: Added new section 9.4.10.1. to permit multiple test items on a clay block.

9.4.10.1. Multiple test items may be used on a single clay block.

Revision: Added new section 9.4.10.2. to permit up to 28 shots on a clay block.

9.4.10.2. Up to 28 shots of one type of threat may be used on a clay block before reconditioning.

NOTE: The maximum number of shots on a clay block can accommodate all 7 shots on 4 large C-5 panels.

Revision: Modified section 9.5.1.1. to adjust the velocity tolerances on the first shot of the ballistic limit test series.

9.5.1.1. The actual velocity of the first shot shall be the reference velocity for the test threat, including its tolerances, –0/+100 ft/sec (–0/+30 m/s).

Revision: Modified section 10.2.4. to specify minimum hard armor test item dimensions.

10.2.4. Test items shall be no larger than 10 in. x 12 in. (254 mm x 305 mm) and no smaller than 8 in. x 10 in. (203 mm x 254 mm). All test items shall be identically sized.

NOTE: Test items should avoid excessive reduction in material on the corners which could lead to reduced testable area on the strike face.

Revision: Added new section 12.1.2.2. to permit the supplier to declare the number of shots per test item based on the threat round for RF1 and RF2 P-BFD testing.

12.1.2.2. For RF1 and RF2, the supplier may declare the number shots to be placed on a single test item *based on threat round*, rather than protection level alone, in accordance with the listed options.

NOTE: For example, for RF1, NIJ would allow a supplier to choose 6 shots per test item for Threat 1 and 3 shots per test item for Threat 2 and Threat 3.

Revision: Modified section 12.2.2.2. to add new sections 12.2.2.3. and 12.2.2.4. to clarify the shot requirements for P-BPD testing on hard armor test items.

12.2.2.2. All shots shall be taken at either 0° or 30° angle of incidence. See Figures 4, 5, and 6 for specific shot angles. ~~For a 3-shot plate with 30-degree shots, the following requirements apply:~~

~~(1) The crown shot and the next closest shot shall be angled away from each other.~~
~~(2) The remaining shot shall be angled toward the centerline.~~

Revised to state:

12.2.2.2. All shots shall be taken at either 0° or 30° angle of incidence. See Figures 4, 5, and 6 for specific shot angles.

12.2.2.3. For a 3-shot plate with 0-degree shots, BFD measurements shall be taken for shot 1 and shot 2.

12.2.2.4. For a 3-shot plate with 30-degree shots, refer to Figure 8. The following requirements apply:

(1) The crown shot and the next closest shot shall be angled parallel to each other.
(2) The shots in the shaded band shall be angled toward the centerline.

Revision: Modified section 12.2.3.1. to require shot 6 be placed on the crown and added a more clarification in the note about where the crown is typically located.

12.2.3.1. For each test item, shots 1, 2, 3, and 4 shall be moved to different locations within the shaded band, and shots 5 and 6 shall be placed in the cross-hatched area; for a curved plate, ~~either shot 5 or~~ shot 6 shall be placed on the crown.

NOTE: The crown is not necessarily in the center of the plate for a multi-curve plate. Figure 10 shows an example of a multi-curve swimmer/shooters cut plate where the

crown is located in the upper portion of the plate. Please refer to 3.2.4 of this document.

Revision: Modified section 12.2.3.2. to clarify shot locations and angles of incidence, and on which shots to conduct P-BFD measurements.

12.2.3.2. All shots shall be taken at either 0° or 30° angle of incidence. See Figures 4, 5, and 6 for specific shot angles. The following requirements apply; refer to Figure 10:

(1) Shot 6 (crown shot) and three shots in the shaded band shall be taken at 0 degrees.
(2) Shot 5 ~~shall be angled at 30 degrees toward the centerline,~~ in the cross-hatched area and one shot in the shaded band shall be angled at 30 degrees ~~away from~~ toward the centerline.
(3) BFD measurements shall be taken for ~~all 0 degree shots, including the crown shot~~ shot 1 and shot 2 taken at 0 degrees.

Revision: Added new section 12.5.2.2. to require the number of test items to be used depending on the number of shots per test item selected for each threat and an explanatory note.

12.5.2.2. Testing shall be conducted using either 4 or 8 test items per threat round dictated by how many shots per test item the supplier has selected in accordance with 12.1.2.1. of this standard.

NOTE: For example, 4 test items would be needed to complete at least 24 shots for Threat 1 in accordance with 12.5.2.1. of this standard if the supplier to chooses 6 shots per test item for Threat 1. Similarly, 8 test items would be needed to complete at least 24 shots for Threat 2 if the supplier chooses 3 shots per test item for Threat 2.

Revision: Added new section 12.6.6.3. to clarify the shot sequence.

12.6.6.3. For each test item, shooting shall continue until either 12 shots or the maximum number of shots allowed on the panel has been reached. For armors that are limited to less than 12 shots, the firing sequence shall be continued on additional panels until 12 shots are reached. After each 12-shot sequence, a new sequence shall be performed until the total required number of shots as listed in table 4 has been reached.

Revision: Figure 3 is modified to correct the number of test items in one of the blocks in the diagram.

The block at the bottom of the second column should read:

~~20~~ 19 test items conditioned by tumbling: 10 larger 9 smaller

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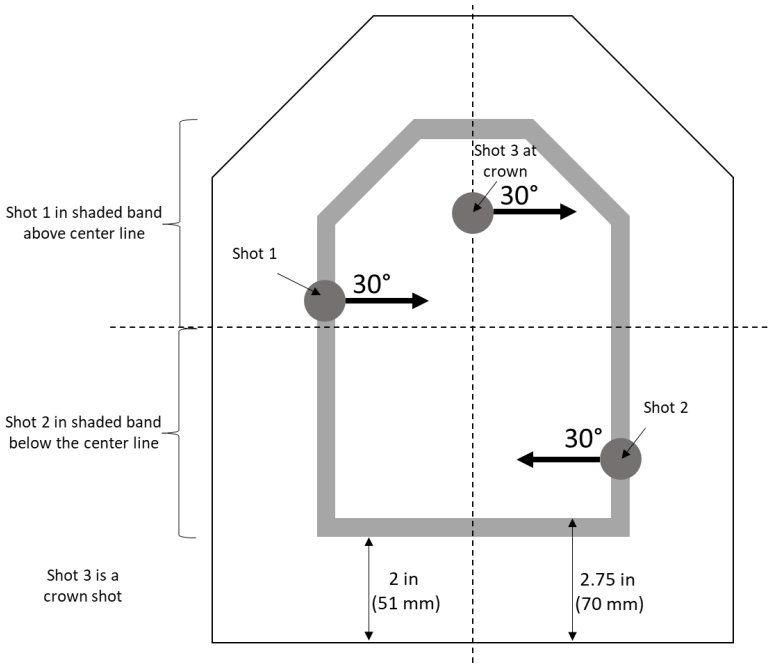
Revision: Figure 8 is modified to show the shot on the left in the band pointing 30 degrees inward toward the center rather than 30 degrees outward toward the edge.

Figure 8. NIJ RF1, NIJ RF2, and NIJ RF3: Example of Shot Placement for 3 Shots per Test Item on a Multi-Curve Plate



Revision: Figure 10 is modified to show the shot on the left in the band pointing 30 degrees inward toward the center rather than 30 degrees outward toward the edge.

Figure 10. NIJ RF1, NIJ RF2, and NIJ RF3: Example of Shot Placement for 6 Shots Per Test Item on a Multi-Curve Plate