NIJ Standard 0101.07, *Ballistic Resistance of Body Armor*
Addendum 3

November 25, 2025

This addendum includes revisions to NIJ Standard 0101.07, *Ballistic Resistance of Body Armor*, and Addendum 1 and Addendum 2 of that standard. 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, Addendum 1, or Addendum 2 with new or modified text in red and ~~text to be removed in red strikethrough~~.]

*** REVISIONS ***

Revision: Modified section 3.2.3. as revised in Addendum 2 to clarify the definition of complete penetration.

Version in Addendum 2:

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 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 retained by the ballistic panel.
(7) 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 deflecting toward an edge between layers of ballistic material that meets *all* the following three conditions:
(a) breaks the ballistic panel cover;

(b) is visible when facing the wear face (i.e., line of sight is normal to the wear face); and
(c) extends beyond the edge contour of the armor panel.

NOTE: Any portion of a test threat or a fragment of a test threat that penetrates through the polycotton carrier shall indicate a complete penetration. The edge contour shall be defined as the outer edge of any unpenetrated layer of ballistic material on the wear face side of the armor panel.

(8) 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.
(9) 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.

Revised to state:

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

For all armor:

(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.

For shot 7 on soft armor:

~~(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 retained by the ballistic panel.~~
(5) any portion of a test threat or a fragment of a test threat that is not retained by the ballistic panel after impact.
(6)~~(7) 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 ~~deflecting toward an edge~~

~~between layers of ballistic material~~ at the edge of the ballistic panel that meets *all* the following three conditions:
(a) breaks the ballistic panel cover;
(b) is visible when facing the wear face (i.e., line of sight is normal to the wear face); and
(c) extends beyond the edge ~~contour~~ of the armor panel.

NOTE: Any portion of a test threat or a fragment of a test threat that penetrates through the polycotton carrier shall indicate a complete penetration. ~~The edge contour shall be defined as the outer edge of any unpenetrated layer of ballistic material on the wear face side of the armor panel.~~

For hard armor:

~~(8) 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.~~
(7)~~(9) 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.

Revised version without markup for better readability:

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

For all armor:

(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) 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.

For shot 7 on soft armor:

(5) any portion of a test threat or a fragment of a test threat that is not retained by the ballistic panel after impact.
(6) any portion of a test threat or a fragment of a test threat at the edge of the ballistic panel that meets *all* the following three conditions:
(a) breaks the ballistic panel cover;

(b) is visible when facing the wear face (i.e., line of sight is normal to the wear face); and
(c) extends beyond the edge of the armor panel.

NOTE: Any portion of a test threat or a fragment of a test threat that penetrates through the polycotton carrier shall indicate a complete penetration.

For hard armor:

(7) 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: Corrects error caption of Figures X.2 in Addendum 2.

Figure X.2. Shot locations for shots 1, 2, and 3 on a C-5 panel for B-PBD testing of soft armor. Shots shall be placed within the shaded bands where the light gray band applies to the lesser mass test threat and dark gray band applies to the greater mass test threat. Each band is 0.75 in. wide and the center of the band represented by the dashed white line approximate the minimum shot-to-edge distance for the respective test threats. Note that the overlaid bands in this figure are for illustrative purposes and may not be exactly to scale. Shot 1, shot 3, and shot 3 on odd-numbered test items shall be taken in the green regions. Shot 1, shot 3, and shot 3 on even-numbered test items shall be taken in the green regions.

Revised to state:

Figure X.2. Shot locations for shots 1, 2, and 3 on a C-5 panel for B-PBD testing of soft armor. Shots shall be placed within the shaded bands where the light gray band applies to the lesser mass test threat and dark gray band applies to the greater mass test threat. Each band is 0.75 in. wide and the center of the band represented by the dashed white line approximate the minimum shot-to-edge distance for the respective test threats. Note that the overlaid bands in this figure are for illustrative purposes and may not be exactly to scale. Shot 1, shot ~~3~~ 2, and shot 3 on odd-numbered test items shall be taken in the green regions. Shot 1, shot ~~3~~ 2, and shot 3 on even-numbered test items shall be taken in the ~~green~~ orange regions.

NIJ Standard 0101.07, *Ballistic Resistance of Body Armor*
Addendum 2

July 1, 2025

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 or Addendum 1 with new or modified text in red and ~~text to be removed in red strikethrough~~.]

*** REVISIONS ***

Revision: Revised section 1.1. and its subsections to clarify the scope of the standard.

1.1. This standard specifies minimum performance requirements and test methods for the ballistic resistance of some types of body armor used by U.S. law enforcement intended to protect the torso against handgun and rifle ammunition.

1.1.1. The test methods within this standard were developed and validated for broadly available armor designs. Some armor designs may require additional testing.

Revised to state:

1.1. This standard specifies minimum performance requirements and test methods for the ballistic resistance of some types of body armor used by U.S. law enforcement intended to protect the human torso against handgun and rifle ammunition.

1.1.1. The test methods within this standard were developed and validated for broadly available armor designs. Some armor designs may require additional testing.

1.1.2. The geometries of the test templates, shot patterns, and shot locations, among other considerations, limit the scope of this standard to body armor specifically designed for the human torso. Other form factors of body armor, such as accessory panels, limb and groin protection, and canine or equine equipment, are outside the scope of this standard as they would require different test template geometries, shot patterns, and shot locations, among other considerations.

Revision: Modified section 3.2.3. as revised in Addendum 1 to include a more robust definition of complete penetration when conducting an edge shot on soft armor. The definition of a complete penetration for shot 7 is deleted later in section 9.2.6 since the modified section 3.2.3 addresses the information that was in 9.2.6.

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.

Revised to state:

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 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 deflecting toward an edge between layers of ballistic material that meets *all* the following three conditions:
    (a) breaks the ballistic panel cover;
    (b) is visible when facing the wear face (i.e., line of sight is normal to the wear face); and
    (c) extends beyond the edge contour of the armor panel.

NOTE: Any portion of a test threat or a fragment of a test threat that penetrates through the polycotton carrier shall indicate a complete penetration. The edge contour shall be defined as the outer edge of any unpenetrated layer of ballistic material on the wear face side of the armor panel.

(8) 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.

(9) 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: Added new section 4.4.1.1. to clarify that all testing shall be conducted on a flat clay surface until specified otherwise.

4.4.1.1. All testing shall be conducted on a flat clay surface until specified otherwise.

Revision: Added new section 7.1.4. to clarify that armor models with construction elements shall be tested as a nonplanar armor.

7.1.4. Any armor model with stitches, seams, folds, and other shaping features shall be considered nonplanar armor for the purposes of testing, regardless of whether the model is designated for female wearers, and shall be tested accordingly.

Revision: Added new section 9.2.1.1. that specifies the locations of shots 1, 2, and 3 on a C-1 test item.

9.2.1.1. For NIJ-C-1 test items, shots 1, 2, and 3 shall be placed within the shaded bands indicated in Figure X.1. The light gray band applies to the lesser mass test threat and dark gray band applies to the greater mass test threat. Each band is 0.75 in. wide and the center of the band represented by the dashed white line is the minimum shot-to-edge distance for the respective test threats. Shots shall be placed as follows:

Shot 1: For odd-numbered test items, place the shot on the respective band within the green region in the upper right. For even-numbered test items, place the shot on the respective band within the orange region in the upper left.

Shot 2: Place the shot on the respective band within the green region in the lower left.

Shot 3: Place the shot on the respective band within the green region in the lower right.

Revision: Added new section 9.2.1.2. that specifies shot locations on a C-5 test item.

9.2.1.2. For NIJ-C-5 test items, shots 1, 2, and 3 shall be placed within the shaded bands indicated in Figure X.2. The light gray band applies to the lesser mass test threat and dark gray band applies to the greater mass test threat. Each band is 0.75 in. wide and the center of the band represented by the dashed white line is the minimum shot-to-edge distance for the respective test threats. shall be placed as follows:

Shot 1: For odd-numbered test items, place the shot on the respective band within the green region in the upper right. For even-numbered test items, place the shot on the respective band within the orange region in the upper left.

Shot 2: For odd-numbered test items, place the shot on the respective band within the green region in the middle left. For even-numbered test items, place the shot on the respective band within the orange region in the lower left.

Shot 3: For odd-numbered test items, place the shot on the respective band within the green region in the middle right. For even-numbered test items, place the shot on the respective band within the orange region in the lower right.

Revision: Added new section 9.2.1.3. to further clarify the locations of shots 4, 5, 6, and 7.

9.2.1.3. Shots 4, 5, 6, and 7 shall be placed in accordance with ASTM E3107, Section 11.

Revision: Modified section 9.2.6. to describe the use of a witness panel and clay surface observations during edge shots. The definition of a complete penetration for shot 7 is deleted since section 3.2.3. was modified to include the new definition of complete penetration for all edge shots, including shot 7.

~~9.2.6. For shot 7 on a front panel, if any portion of a test threat or a fragment of a test threat is embedded in or passes into any area of the backing material, that shall be considered a CP.~~

~~NOTE: This is an exception to the definition of a CP on soft armor from Section 3.2.3 of this NIJ standard that applies only to shot 7 at the neck of a front panel.~~

Revised to state:

9.2.6 For any shot at a nonzero angle of obliquity on soft armor, including shot 7, a witness panel and the clay surface between the test item and witness panel shall be used to determine if any portion of a test threat or a fragment of a test threat exited the side of the armor.

9.2.6.1. The witness panel shall be composed of 1/8 in. thick corrugated cardboard and shall be affixed to the metal frame of the clay box such that the cardboard panel extends perpendicular to the clay surface.

9.2.6.2 The cardboard panel shall be affixed to the side of the clay block where the path of the projectile is expected to cross should it exit from the side of the soft armor.

9.2.6.3. The cardboard panel shall be large enough to accommodate a wide range of possible projectile trajectories from the edge of the test item.

9.2.6.4. The witness panel should be placed at a standoff distance of 4 inches or greater.

9.2.6.5. If any portion of a test threat or a fragment of a test threat embeds into or passes into any area of the clay surface between the edge of the test item and the witness panel, or strikes or passes through the witness panel, the shot shall be considered a complete penetration.

Revision: Added new section 9.3.4.3. to specify that a clay block that meets the acceptance criteria may be used for up to 45 minutes after the final drop in the verification procedure.

9.3.4.3. A clay block that meets the acceptance criteria may be used for up to 45 minutes from the final drop in the verification procedure.

Revision: Modified section 9.3.7. to remove clay block verification between test items.

9.3.7. If there are additional test items in the test series, ~~perform the procedure of ASTM E3004, Section 6.6, with the modifications listed in Appendix B, Section B.3: Modifications to ASTM E3004, Section 6.6, Clay Block Verification Procedure: Between Test Items, and~~ repeat the above procedure on another test item.

Revision: Deleted section 9.3.7. to remove clay block verification after the final test item.

~~9.3.8. After the final test item in the test series has been tested, perform the procedure of ASTM E3004, Section 6.7, with the modifications listed in Appendix B, Section B.4: Modifications to ASTM E3004, Section 6.7, Clay Block Verification Procedure: After Final Shot on Clay Block.~~

Revision: Added new section 9.4.6.3. to specify that a clay block that meets the acceptance criteria may be used for up to 45 minutes after the final drop in the verification procedure.

9.4.6.3. A clay block that meets the acceptance criteria may be used for up to 45 minutes from the final drop in the verification procedure.

Revision: Revised section 9.4.10. to remove clay block verification between test items.

9.4.10. If there are additional test items in the test series, ~~perform the procedure of ASTM E3004, Section 6.6, with the modifications listed in Appendix B, Section B.3: Modifications to ASTM E3004, Section 6.6, Clay Block Verification Procedure: Between Test Items, and~~ repeat the above procedure on another test item.

Revision: Deleted section 9.4.11. to remove clay block verification after the final test item.

~~9.4.11. After the final test item in the test series has been tested, perform the procedure of ASTM E3004, Section 6.7, with the modifications listed in Appendix B, Section B.4: Modifications to ASTM E3004, Section 6.7, Clay Block Verification Procedure: After Final Shot on Clay Block.~~

Revision: Modified revised section 9.5.1.1. of Addendum 1 to clarify the velocity range 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 ~~–/+100 ft/s (–/+30 m/s)~~ –30/+100 ft/s (–9/+30 m/s) for the test threat.

Revision: Modified section 9.6.2.1. to specify the shot pattern to use for ballistic limit testing on soft armor test items.

9.6.2.1. Following the required conditioning procedure or sequence, mark the shot locations on each test item using the shot pattern indicated in Figure X.3. Shots for ballistic limit testing shall be taken at these locations in the order enumerated, following the shot spacing requirements of Section 9.5.5 of this NIJ standard.

Revision: Modify section 10.5.2. to clarify the intent of holding the test items at controlled ambient for 24 hours upon receipt.

10.5.2. All test items shall be ~~conditioned~~ acclimated at controlled ambient for at least 24 hours prior to ~~subsequent~~ hard armor conditioning or conditioning by submersion.

Revision: Modify section 12.3.2.3 to bring it into alignment with the modified section 12.2.3.2.

12.3.2.3. When taking six shots per test item, BFD measurements shall be made on ~~shot 6 and three of the shots within the shaded band~~ shots 1 and 2.

Revision: Added new section 12.4.5.3. to specify that a clay block that meets the acceptance criteria may be used for up to 45 minutes after the final drop in the verification procedure.

12.4.5.3. A clay block that meets the acceptance criteria may be used for up to 45 minutes from the final drop in the verification procedure.

Revision: Added new section 12.4.6.1. to amend the requirements in ASTM E3107, Section 12.3.2.

12.4.6.1. The requirements in ASTM E3107, Section 12.3.2. shall be amended as follows: The applique shall be formed such that it completely fills the space between the test item and the clay block surface. The applique shall be the minimum thickness required to completely fill the space. A multi-curve plate shall have at least four points of contact 6 mm (0.25 in.) or less between its edges and the surface of the clay block.

Revision: Added new section 12.4.6.2. to allow the use of clay to fill gaps.

12.4.6.2. Clay may be added to fill in gaps.

Revision: Revised section 12.4.8. to remove clay block verification between test items.

12.4.8. If there are additional test items in the test series, ~~perform the procedure of ASTM E3004, Section 6.6, with the modifications listed in Appendix B, Section B.3: Modifications to ASTM E3004, Section 6.6, Clay Block Verification Procedure: Between Test Items, and~~ repeat the above procedure on another test item.

Revision: Revised section 12.4.8.1 to remove clay block verification between test items.

~~12.4.8.1. When conducting RF1 or RF2 testing using three shots per item, clay block verification shall be required only after six shots have been fired (i.e., after every other test item). The six shots shall be fired in consecutive order using the same clay~~

~~block. Please refer to "Option 2" in Figure 4 and Figure 5. Clay block verification shall be conducted after all other test items are tested.~~

Revision: Revised section 12.4.8.2 to remove clay block verification between test items.

~~12.4.8.2. When conducting RF3 testing using less than six shots per test item, clay block verification shall be required only after six shots have been fired. The six shots shall be fired in consecutive order using the same clay block. Please refer to "Option 2," "Option 3," and "Option 4" in Figure 6. Clay block verification shall be conducted after all other test items are tested.~~

Revision: Revised section 12.4.9. to remove clay block verification after the final test item.

~~12.4.9. After the final test item in the test series has been tested, perform the procedure of ASTM E3004, Section 6.7, with the modifications listed in Appendix B, Section B.4: Modifications to ASTM E3004, Section 6.7, Clay Block Verification Procedure: After Final Shot on Clay Block.~~

Revision: Added new section 12.6.3.1. to clarify the shot patterns used for ballistic limit testing on hard armor test items.

12.6.3.1. The ballistic limit shot pattern for six-shot hard armor test items will be the "dice" pattern as indicated in Figure X.4. Shot 1 is top left, shot 2 is top right, shot 3 is middle left, shot 4 is middle right, shot 5 is lower left, and shot 6 is lower right. Shoot test item 1 in the following order: 1, 2, 3, 4, 5, 6. Shoot test item 2 in the following order: 2, 3, 4, 5, 6, 1. Shoot test item 3 in the following order: 3, 4, 5, 6, 1, 2. And so on, repeating the cycle, until all shots are taken.

Revision: Added new section 12.6.3.2. to clarify the shot patterns used for ballistic limit testing on hard armor test items.

12.6.3.2. The ballistic limit shot pattern for three-shot hard armor test items will be the "dice" pattern for the six-shot plate but fired in an alternating way as follows as indicated in Figure X.5. Shoot test item 1 in the following order: 1, 4, 5. Shoot test item 2 in the

following order: 2, 3, 6. Shoot test item 3 in the following order: 4, 5, 1. Shoot test item 4 in the following order: 3, 6, 2. And so on, repeating the cycle, until all shots are taken.

Revision: Added new section 12.6.3.3. to clarify the shot patterns used for ballistic limit testing on hard armor test items.

12.6.3.3. The ballistic limit shot pattern for one-shot hard armor test items will be shooting each test item in designated locations as indicated in Figure X.6. Top left, top center, top right, middle left, center, middle right, lower left, lower center, lower right. Shoot test items in that order, repeating the cycle, until all shots are taken.

Revision: Added new section 12.6.4.3. to specify that a clay block that meets the acceptance criteria may be used for up to 45 minutes after the final drop in the verification procedure.

12.6.4.3. A clay block that meets the acceptance criteria may be used for up to 45 minutes from the final drop in the verification procedure.

Revision: Revised section 12.6.7. to remove clay block verification between test items.

12.6.7. If there are additional test items in the test series, ~~perform the procedure of ASTM E3004, Section 6.6, with the modifications listed in Appendix B, Section B.3: Modifications to ASTM E3004, Section 6.6, Clay Block Verification Procedure: Between Test Items, and~~ repeat the above procedure on another test item.

Revision: Delete Section B.3. to remove procedure for clay block verification between test items.

~~**B.3 Modifications to ASTM E3004, Section 6.6, Clay Block Verification Procedure: Between Test Items**~~

~~(1) Section 6.6, Clay Block Verification Procedure: Between Test Items, is required.~~
~~(2) Section 6.6.2.2 shall apply, with these additions:~~
~~Five drop target positions shall be marked on the clay surface, attempting to avoid~~

placing drop target locations on the most recently repaired clay. Remove the template.

(3) Section 6.6.2.4 shall be replaced with:
Drop the impactor onto the clay block. The impactor shall be dropped five times, once on each of the marks on the clay surface.

(4) Section 6.6.2.5 shall be modified to require that the five indentation measurements be recorded.

(5) Section 6.6.3, Acceptance Criteria, shall not apply. The acceptance criteria shall be:

- The arithmetic mean of the five indentation depth measurements shall be 19.0 mm ± 2.0 mm (0.748 in ± 0.08 in).
- Each indentation depth measurement shall be 19.0 mm ± 3.0 mm (0.748 ± 0.12) .
- The measurements shall not be rounded off.

Revision: Delete Section B.4. to remove procedure for clay block verification after final shot on clay block.

B.4 Modifications to ASTM E3004, Section 6.7, Clay Block Verification Procedure: After Final Shot on Clay Block

(1) Section 6.7, Clay Block Verification Procedure: After Final Shot on Clay Block is required.

(2) Section 6.7.2.1 shall apply, but the clay block shall be repaired.

(3) Sections 6.7.2.3 and 6.7.2.4, shall be replaced with:
Place the drop template on the clay surface in an arbitrary rotational position, attempting to avoid placing drop target locations on the most recently repaired clay. Mark the surface of the clay block (for example, by nicking the surface, laser marking, applying ink) to indicate five drop target positions. Remove the template.

(4) Section 6.7.2.5, shall be replaced with:
Drop the impactor onto the clay block. The impactor shall be dropped five times, once on each of the marks on the clay surface.

(5) Section 6.7.2.6 shall be modified to require that the five indentation measurements be recorded.

(6) Section 6.7.3, Acceptance Criteria, shall not apply. The acceptance criteria shall be:

- The arithmetic mean of the five indentation depth measurements shall be 19.0 mm ±
- 2.0 mm (0.748 in ± 0.08 in).
- Each indentation depth measurement shall be 19.0 mm ± 3.0 mm (0.748 ± 0.12).
- The measurements shall not be rounded off.

Revision: Revised section F.2.1.2.3. to correct a typo in the label requirement.

F.2.1.2.3. The label itself shall be no less than 0.5 in (13 mm) away from and parallel to the long edges of the substrate.

Revision: Modify F.2.1.3.2. in Appendix F to improve the practicality of the test.

~~F.2.1.3.2. If the label substrate material is not a stand-alone material (e.g., spray liner or fabric wrap), then the manufacturer shall submit test items with representative substrates applied to a nominally planar surface (e.g., plastic, steel or wood). The surface finish of this material shall be representative of the surface finish that will be present in the finished product.~~

Revised to state:

F.2.1.3.2. If the label substrate material derived from the test item cannot be tested in a stand-alone fashion, then the manufacturer shall submit labels applied to a 4mm or less thick purpose-built coupon of the exact substrate material with the characteristics—such as flexibility and physical integrity—to permit completion of label testing.

Revision: Added new Figures X.1. through X.6. and new figure captions.

Figure X.1. Shot locations for shots 1, 2, and 3 on a C-1 panel for B-PBD testing of soft armor. Shots shall be placed within the shaded bands where the light gray band applies to the lesser mass test threat and dark gray band applies to the greater mass test threat. Each band is 0.75 in. wide and the center of the band represented by the dashed white line approximate the minimum shot-to-edge distance for the respective test threats. Note that the overlaid bands in this figure are for illustrative purposes and may not be exactly to scale. Shot 1 on odd-numbered test items shall be taken in the green region. Shot 1 on even-numbered test items shall be taken in the orange region. Shot 2 and shot 3 shall be taken in the purple regions.

Figure X.2. Shot locations for shots 1, 2, and 3 on a C-5 panel for B-PBD testing of soft armor. Shots shall be placed within the shaded bands where the light gray band applies to the lesser mass test threat and dark gray band applies to the greater mass test threat. Each band is 0.75 in. wide and the center of the band represented by the dashed white line approximate the minimum shot-to-edge distance for the respective test threats. Note that

the overlaid bands in this figure are for illustrative purposes and may not be exactly to scale. Shot 1, shot 3, and shot 3 on odd-numbered test items shall be taken in the green regions. Shot 1, shot 3, and shot 3 on even-numbered test items shall be taken in the green regions.

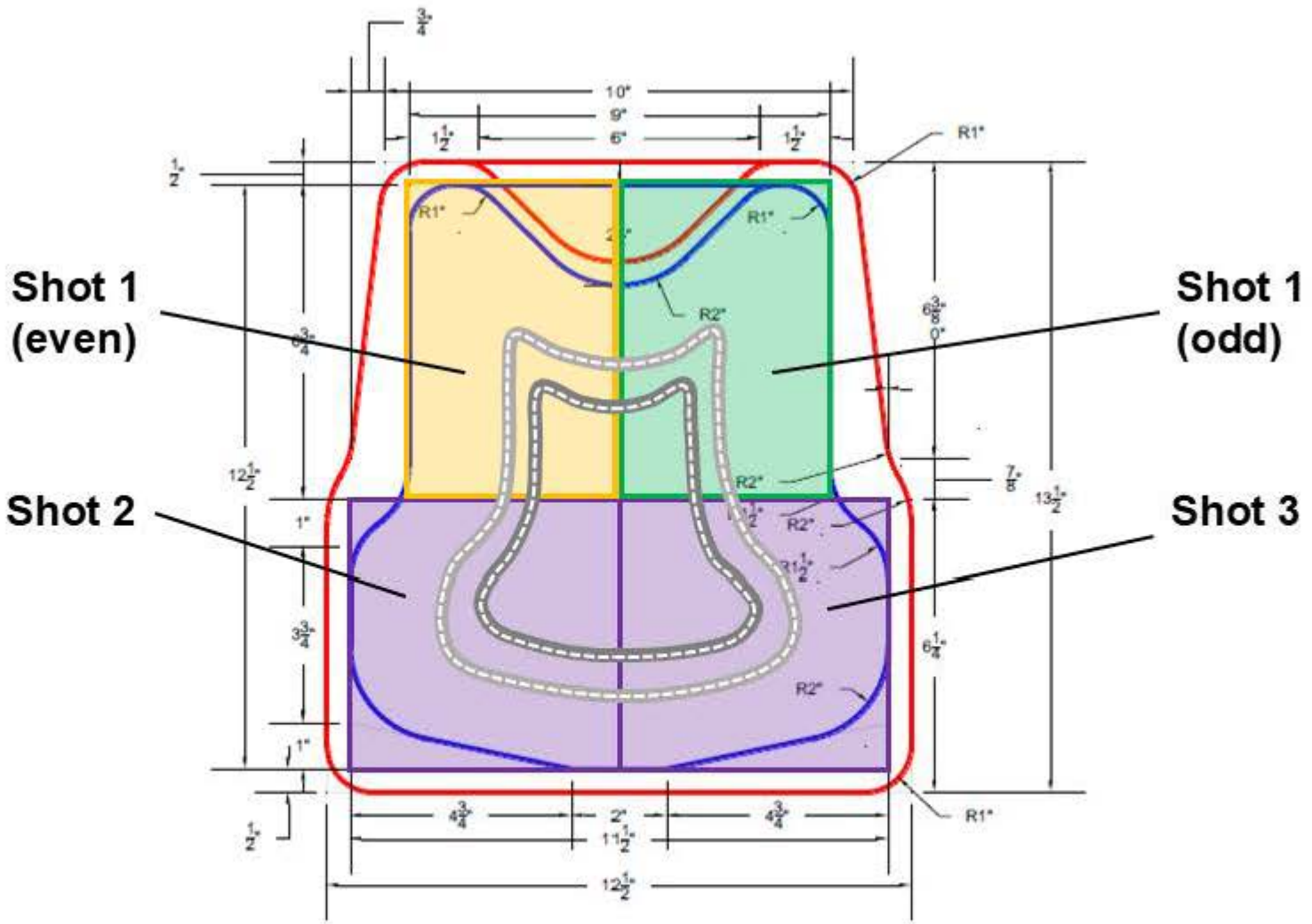
Figure X.3. Shot pattern for ballistic limit testing on soft armor test items with the shot locations and shot order indicated. The shot locations approximate a minimum shot-to-shot distance for the heavier threat in a ballistic protection level. Note that the shot locations in this figure are for illustrative purposes and may not be exactly to scale.

Figure X.4. The shot pattern for ballistic limit testing using six-shot hard armor test items. Note that the shot locations in this figure are for illustrative purposes and shall follow additional shot-to-shot and shot-to-edge distance requirements specified in this standard.

Figure X.5. The shot pattern for ballistic limit testing using three-shot hard armor test items. Note that the shot locations in this figure are for illustrative purposes and shall follow additional shot-to-shot and shot-to-edge distance requirements specified in this standard.

Figure X.6. The shot pattern for ballistic limit testing using one-shot hard armor test items. Note that the shot locations in this figure are for illustrative purposes and shall follow additional shot-to-shot and shot-to-edge distance requirements specified in this standard.

Fig. X.1.



NIJ NATIONAL INSTITUTE OF JUSTICE	Sizing Template For Armor Samples	SIZE Letter (8.5" x 11")	REV 2.0
	Template Size NIJ-C-1 - Smallest	SCALE Approx. 1:4	SHEET 1 of 5

Fig. X.2.

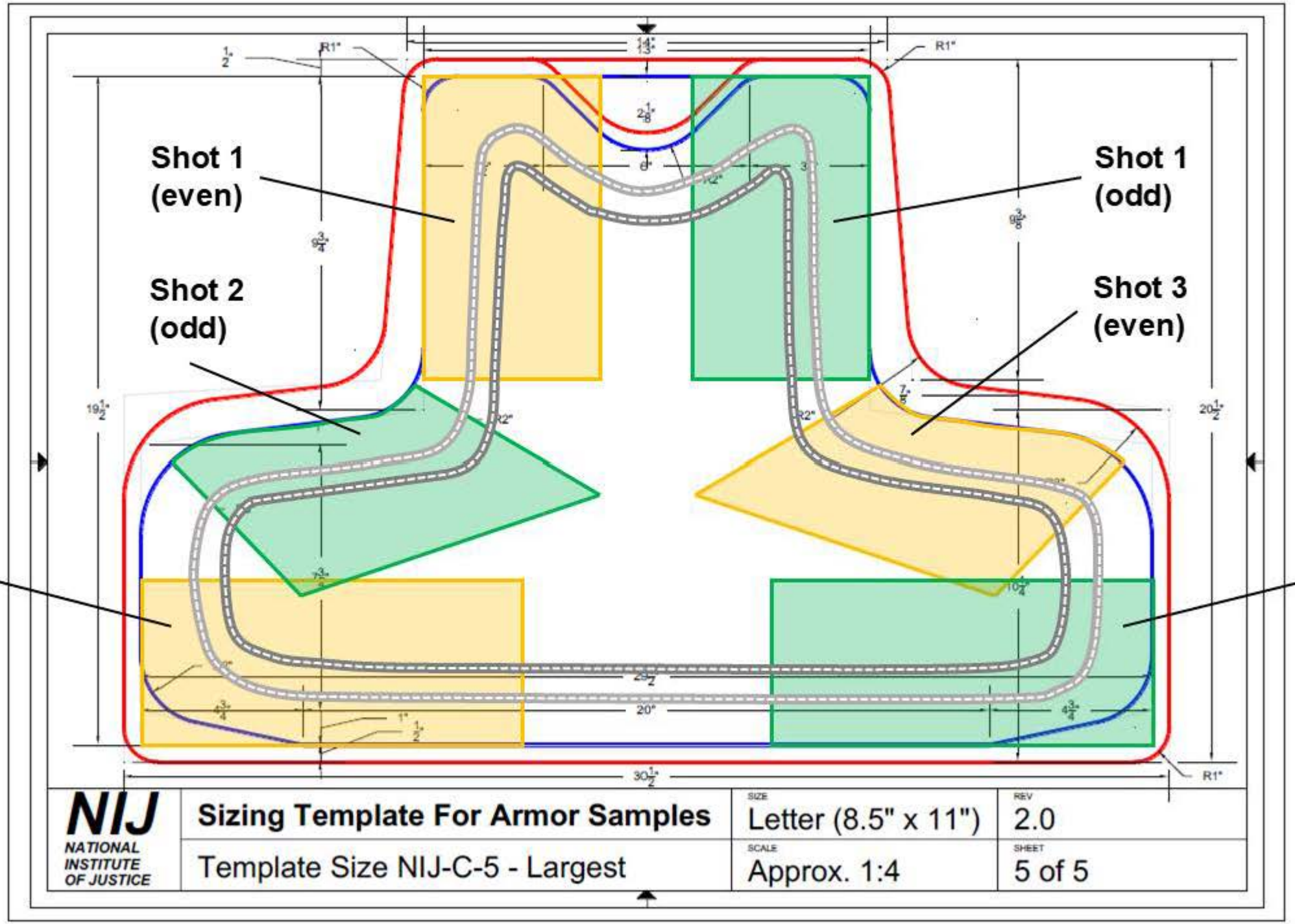

Shot 1
(even)
Shot 1
(odd)
Shot 2
(odd)
Shot 3
(even)
Shot 2
(even)
Shot 3
(odd)
R1"
R2"
20"
30½"
NIJ
NATIONAL INSTITUTE OF JUSTICE
Sizing Template For Armor Samples
Template Size NIJ-C-5 - Largest
SIZE
Letter (8.5" x 11")
REV
2.0
SCALE
Approx. 1:4
SHEET
5 of 5

Fig. X.3.

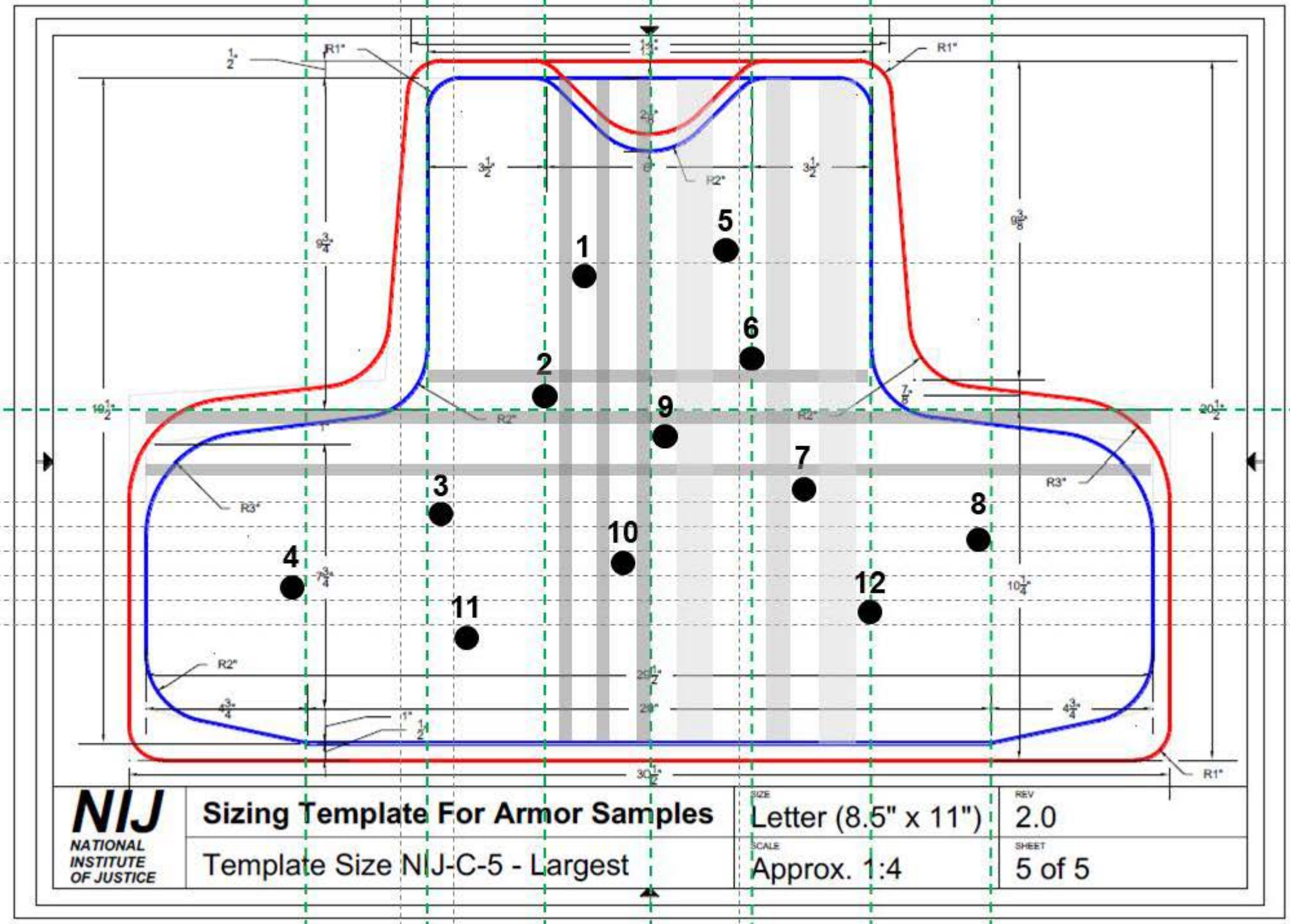

R1"
R2"
R3"
1
2
3
4
5
6
7
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NIJ
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Sizing Template For Armor Samples
Template Size NIJ-C-5 - Largest
SIZE
Letter (8.5" x 11")
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SHEET
5 of 5

Fig. X.4.

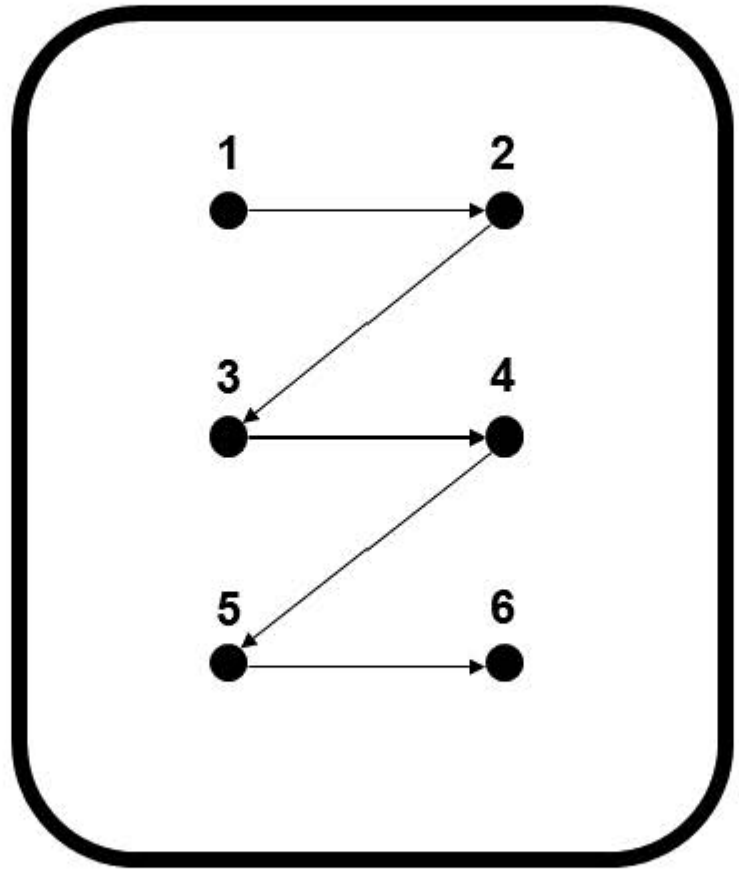


Fig. X.5.

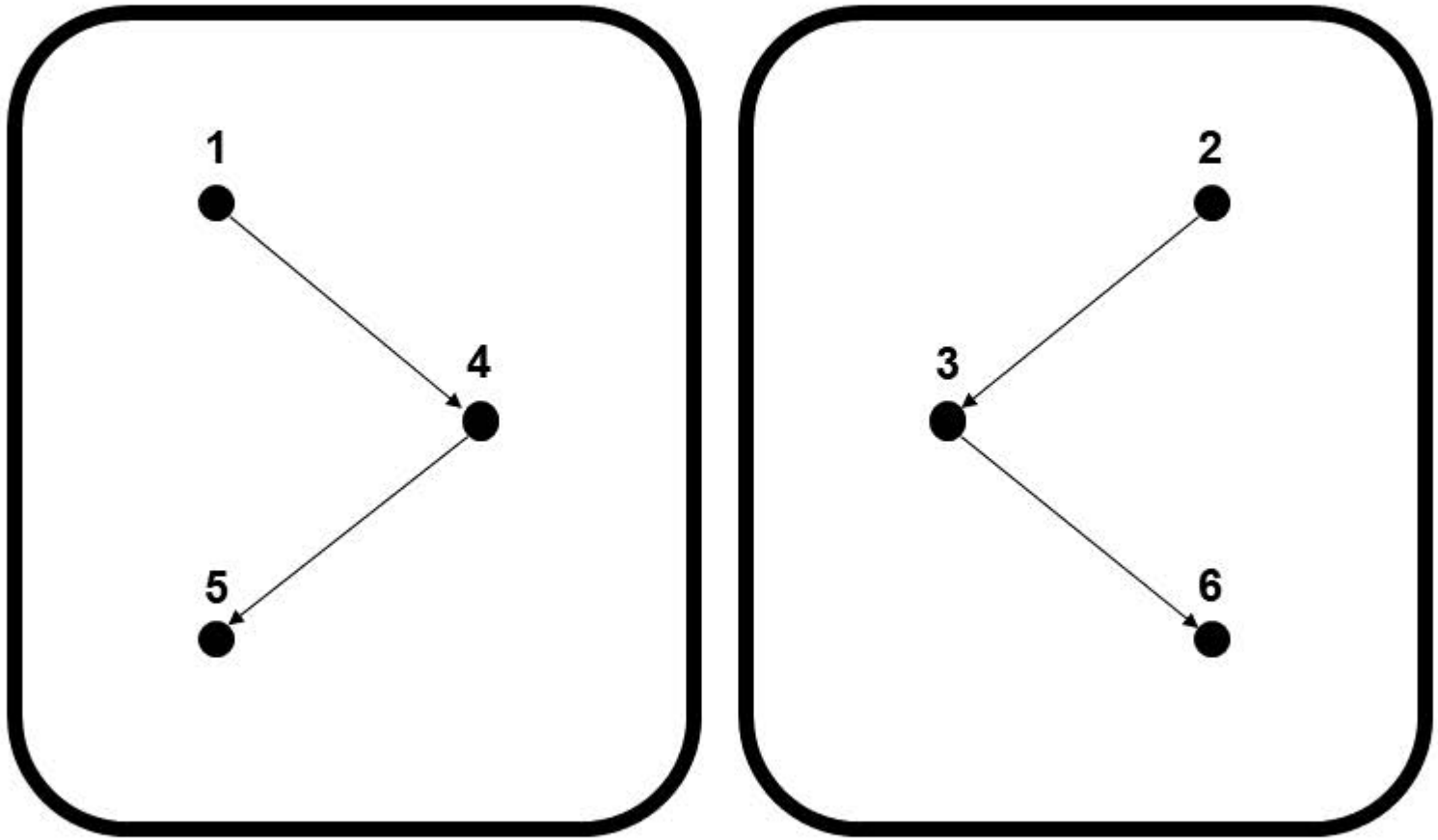
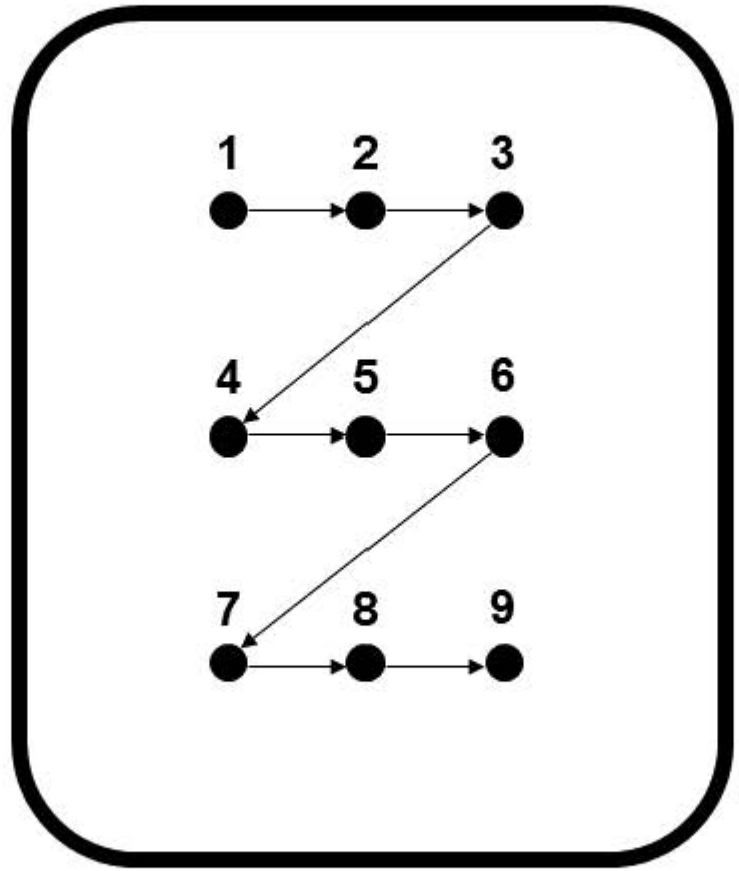


Fig. X.6.



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.

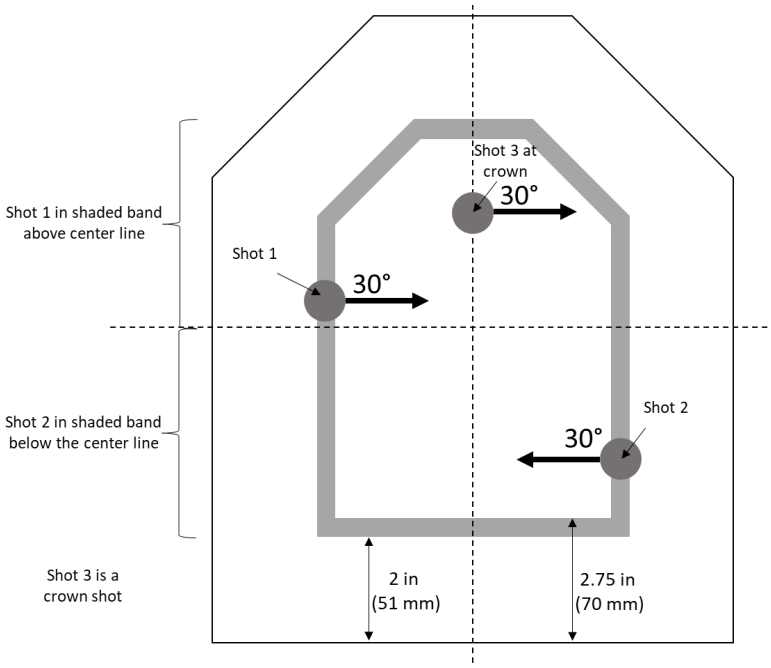
The block at the bottom of the second column should read:

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

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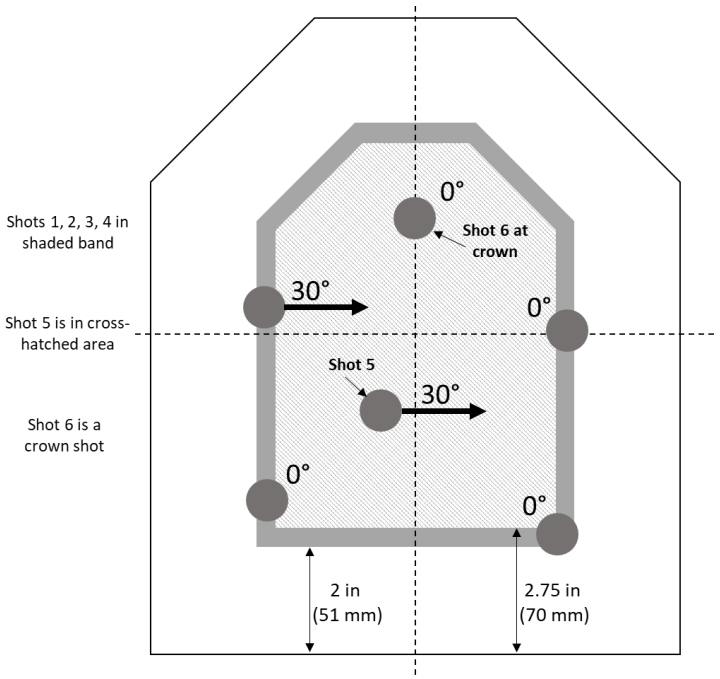
Revision: Figure 8 is modified to show the shot on the left in the band pointing 30 degrees inward toward the center rather than 30 degrees outward toward the edge.

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



U.S. Department of Justice
Office of Justice Programs
National Institute of Justice

OCTOBER 2023

NATIONAL INSTITUTE OF JUSTICE

STANDARD

BODY ARMOR

Ballistic Resistance of Body Armor

NIJ Standard 0101.07

Notice of Addenda
Addendum 1, November 12, 2024.
Addendum 2, July 8, 2025.
Access the addendum.

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Nancy La Vigne, Ph.D.
Director, National Institute of Justice

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Nancy La Vigne
Director

Jennifer Scherer
Principal Deputy Director

Janine Zweig
Executive Science Advisor

Mark Greene
Office Director, Office of Technology and Standards

DIRECTOR'S MESSAGE



Every day in the U.S., law enforcement officers face high-risk, dangerous situations. From traffic stops to serving warrants, domestic violence calls to fugitive apprehension, the threat to their safety from firearms is all too real. Felonious gunfire ended the lives of 61 officers in the United States in 2021, out of the total of 73 killed in the line of duty that year. Firearms caused more than 92% of all felonious deaths of law enforcement officers in the line of duty from 1987 through 2019, according to FBI statistics.

For officers, the last line of defense against potentially lethal attacks is their body armor.

For a half century, the National Institute of Justice, the scientific research and evaluation agency of the U.S. Department of Justice, has led the effort to develop and promote standards for body armor that can stop a bullet from wounding or killing an officer. Although NIJ creates standards to protect officers in the U.S., they have also been adopted in many countries as the benchmark for police body armor internationally as well.

NIJ is issuing this updated standard for the ballistic resistance of body armor, the first revision since 2008. The release of stronger national body armor standards is nothing new for NIJ. The agency has issued six revisions since the initial standard came out in 1972. What is new is the fact that the standards now unify ballistic protection levels across a range of ballistic-resistant products used by U.S. law enforcement. As the growing power of firearms increases the threat to officers, we are also publishing NIJ Standard 0123.00, *Specification for NIJ Ballistic Protection Levels and Associated Test Threats.*

Other new elements of this body armor standards are:

- Improved test methods for armor designed for women.
- More rigorous testing of soft armor panels.
- Revised testing of hard-armor plates, including curved plates.
- References to 10 standardized test methods, laboratory practices, and terminology guides.

NIJ develops ballistic resistant body armor standards tailored to the needs of law enforcement and other criminal justice agencies. The standards are consensus-driven, with input from law enforcement officers, ballistics testing experts, materials scientists, manufacturers, and other stakeholders.

Importantly, NIJ also certifies body armor through its Compliance Testing Program and maintains a public list of compliant, ballistic-resistant armor models for law enforcement use. Independent accredited ballistics laboratories have tested each model on NIJ's Compliant Products List — and it's worth noting that approximately 37% of armor models submitted for certification testing have failed and never make it onto NIJ's list. Every agency that acquires

torso-worn body armor should refer to that list and make sure its armor bears the NIJ mark of compliance.

NIJ's 50 years of leadership in body armor advancement reflects the agency's deep-seated commitment to protecting the public servants who strive each day to keep us safe.



Nancy La Vigne, Ph.D.
Director, National Institute of Justice

Acknowledgments

The National Institute of Justice (NIJ) would like to acknowledge the many individuals and organizations that contributed to the development of this standard.

Members of the Special Technical Committee (STC) for body armor were instrumental in establishing the operational needs and requirements for practitioners in the field, steering the content of the document, addressing public comments, and assisting with resolving various technical matters. Law enforcement practitioners and subject matter experts from the following agencies contributed to the work of the STC during the development of this standard: U.S. Marshals Service, Federal Bureau of Investigation (FBI), Department of Homeland Security, United States Park Police, California Department of Corrections and Rehabilitation, Arizona Department of Public Safety, Orange County Sheriff's Office (FL), Ramsey County Sheriff's Office (MN), Cobb County Police Department (GA), Unified Police Department of Greater Salt Lake, Minneapolis Police Department, Houston Police Department, Denver Police Department, and Columbia College Police Department (SC). In addition, subject matter experts from the Material Measurement Laboratory at the National Institute of Standards and Technology (NIST), U.S. Army Product Manager Soldier Protective Equipment, and the ballistics laboratories NTS Chesapeake, NTS Wichita, H.P. White, and Oregon Ballistic Laboratories provided rich technical insights on the content of the standard.

NIJ thanks staff from the Standards Coordination Office at NIST for assisting with many substantive matters, including constructing and organizing the document, coordinating phone and web meetings with the STC, creating several figures and flow charts, and providing technical advice. NIJ thanks the subject matter expert and administrative staff from the Justice Technology Information Center (JTIC) and the Criminal Justice Testing and Evaluation Consortium (CJTEC) for assisting with the content development of this standard and arranging in-person meetings of the STC. JTIC was operated by Leidos under a cooperative agreement with NIJ, and CJTEC is operated by RTI International under a cooperative agreement with NIJ.

NIJ is grateful for the thorough input from industry during the public comment period. NIJ thanks staff from NTS Chesapeake and Oregon Ballistic Laboratories for validating several test methods and providing insights into the practical implementation of test procedures. NIJ also thanks staff from the FBI Ballistic Research Facility for reviewing a final draft of this standard.

Finally, NIJ would like to acknowledge the significant effort by all those who participated in ASTM Committee E54 on Homeland Security Applications and specifically Subcommittee E54.04 on Public Safety Equipment. This standard references ten ASTM standards developed and published by Committee E54. NIJ would like to extend additional thanks to ASTM and the leadership of Committee E54 for continued support of public safety standards.

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Introduction

This National Institute of Justice (NIJ) publication, *Ballistic Resistance of Body Armor*, NIJ Standard 0101.07, specifies minimum performance requirements and test methods for the ballistic resistance of body armor used by U.S. law enforcement that is intended to protect the torso against handgun and rifle ammunition. It is a revision of National Institute of Justice (NIJ) Standard 0101.06, *Ballistic Resistance of Body Armor*, published in 2008.[1]

The primary purpose of this standard will be for use by the NIJ Compliance Testing Program (CTP) for testing, evaluation, and certification of ballistic-resistant body armor. It will also be used by ballistic testing laboratories and body armor suppliers participating in the NIJ CTP. This standard will be included in the Law Enforcement and Corrections Equipment Laboratory Accreditation Program (LAP) of the National Voluntary Laboratory Accreditation Program (NVLAP) to accredit ballistics laboratories.[2]

NIJ Standard 0101.07 is divided into fourteen sections and eight appendices and differs from NIJ Standard 0101.06 in several important ways. Among these are notable structural changes between the two documents, as well as the introduction of several improvements to test methods and laboratory practices. An overview of these differences is provided in the following paragraphs.

First, unlike previous versions of the NIJ standard, NIJ Standard 0101.07 references a suite of standardized test methods and laboratory practices published by ASTM. NIJ, the U.S. Army, the National Institute of Standards and Technology (NIST), ballistics laboratories, body armor manufacturers, materials suppliers, and other stakeholders have been working collaboratively for several years within ASTM Committee E54 on Homeland Security Applications to harmonize, where possible, laboratory test procedures and practices relevant to ballistic testing. The result of this collaboration has been a suite of test methods and laboratory practices developed within ASTM Subcommittee E54.04 on Public Safety Equipment, many of which are referenced in this document.[3]

Incorporation of relevant ASTM standards into U.S. government standards and technical requirements affords the opportunity to harmonize laboratory test procedures and practices for both law enforcement and military ballistic-resistant armor and other ballistic-resistant equipment where the same general testing methodology otherwise applies. This also provides those end-user communities ultimate control over product specifications, such as the specific threats against which their equipment must protect.

Second, the ballistic test threats are no longer listed in NIJ Standard 0101.07 as in past revisions of the standard. These have been moved into *Specification for NIJ Ballistic Protection Levels*

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[1] NIJ Standard 0101.06*, Ballistic Resistance of Body Armor*, National Institute of Justice, U.S. Department of Justice, Washington, DC, July 2008, https://www.ncjrs.gov/pdffiles1/nij/223054.pdf.
[2] "Law Enforcement and Corrections Equipment LAP," National Institute of Standards and Technology website, https://www.nist.gov/nvlap/law-enforcement-and-corrections-equipment-lap, accessed June 12, 2023.
[3] "Subcommittee E54.04 on Public Safety Equipment: Matching Standards Under the Jurisdiction of E54.04 by Status," ASTM International, West Conshohocken, PA, https://www.astm.org/get-involved/technical-committees/committee-e54/subcommittee-e54/jurisdiction-e5404.

and Associated Test Threats, NIJ Standard 0123.00, which is a new standalone document that defines ballistic threats identified by U.S. law enforcement as representative of current prevalent threats in the United States.

NIJ Standard 0123.00 was designed be used in conjunction with other standards like NIJ Standard 0101.07 to test and evaluate specific ballistic-resistant equipment, such as ballistic-resistant body armor, against contemporary ballistic threats that pose a life-threating safety hazard to U.S. law enforcement officers. The test projectiles and reference velocities in the inaugural version of NIJ Standard 0123.00 have been updated from section 2 of NIJ Standard 0101.06 to reflect the current threats faced by U.S. law enforcement end users, including a wider range of rifle threats.

Third, protection level nomenclature has also been moved into NIJ Standard 0123.00 and has been revised to be more descriptive of threats and to reduce confusion for users of body armor.

- NIJ Level II and NIJ Level IIIA have been replaced with "NIJ HG1" and "NIJ HG2," respectively, to represent handgun (HG) threats.
- NIJ Level III and NIJ Level IV have been revised to three protection levels representing rifle (RF) threats — "NIJ RF1," "NIJ RF2," and "NIJ RF3":
    - NIJ RF1 and NIJ RF3 replace NIJ Level III and NIJ Level IV, respectively.
    - NIJ RF2 is a new intermediate rifle protection level that includes all the threats at the NIJ RF1 protection level plus an additional threat.

NIJ Standard 0101.07 references the new ballistic protection levels in the inaugural version of NIJ Standard 0123.00 rather than defining the levels within NIJ Standard 0101.07 itself, as was done in NIJ Standard 0101.06 and previous versions.

Fourth, this standard contains improvements to the test methods for armor designed for women, including new clay appliques (e.g., build-up of clay) to ensure better contact of nonplanar panels with the clay backing material and new shot requirements to assess shaping features. Shot placement has also been reconfigured to exploit potential vulnerabilities due to unique construction elements in the panel and nonzero angles of incidence in the proximity of edges.

Earlier drafts of NIJ Standard 0101.07 initially referenced ASTM E3086, *Standard Practice for Creating Appliques for Use in Testing of Nonplanar Soft Body Armor Designed for Females*. This ASTM standard specified a procedure for creating appliques for use behind nonplanar soft armor panels and affixing the appliques to the clay block. The purpose was to specify critical parameters for creating appliques in order to improve consistency of the test setup between laboratories. The practice described a single applique shape applicable only to nonplanar, soft body armor designed for women.

Implementation of this laboratory practice proved more challenging than expected, including difficulty creating the specific applique shapes described in ASTM E3086 and ensuring proper contact with the armor panel once mounted on the clay block. These challenges required reconsideration of how to build up clay behind nonplanar soft armor panels. A more simplified

applique was developed to ensure that the panels are fully filled in with clay before mounting on the clay block. This applique is more monolithic in form and better supports armors designed for female wearers during testing. It is created using one of two standardized mold sizes along with a procedure to shape its form once affixed to the clay block. The result is a better substrate to ballistically test nonplanar armor, replacing the procedure in ASTM E3086. The electronic files containing the drawings of the molds to make the clay appliques described in Appendix G are freely available to NIJ-approved testing laboratories and other organizations upon request.

Fifth, NIJ has updated perforation-backface deformation (P-BFD) testing to include an additional shot on soft armor panels. How soft armor responds to handgun projectiles striking very near the top edge of a front armor panel has been explored by an adjacent U.S. Government agency through experimental testing efforts. This involved mounting a ballistic vest with soft armor panels in an external carrier onto a model female torso made of molded ballistic gelatin. In this configuration, the top of the panel is naturally slanted back toward the torso in the carrier, creating an angle of obliquity between the armor panel and the trajectory of the incoming bullet. Shots striking the top-center edge at angles of obliquity in excess of approximately 40° have been demonstrated in some exploratory tests to not fully engage all layers of the armor panel and deflect off a middle layer into the neck region of the gelatin torso.

For soft armor, NIJ has added a shot located at the top center at the minimum shot-to-edge distances (2 in. or 3 in.) for the respective NIJ HG1 and NIJ HG2 threats at a 45° angle of obliquity between the shot and the armor test item. This added shot applies to all soft armor tested, both planar and nonplanar.

- For planar soft armor, the clay block is rotated a 45° angle of incidence to introduce the obliquity for the shot striking the armor.
- For nonplanar soft armor, the built-up clay of the applique introduces an approximately 15° angle of obliquity by slanting the top of the armor panel back toward the clay block. The clay block is rotated an additional 30° angle of incidence to yield the required 45° obliquity for the shot striking the armor.

This new shot will provide minimum performance for soft armor for handgun projectiles striking that location.

Finally, NIJ has also reconfigured P-BFD testing on hard armor plates to include striking the crown on curved plates. The crown is defined as the location of the highest point of the strike face of the plate when the plate is lying horizontally on a flat surface, at the intersection of multiple different curvatures. The placement of a shot on the crown probes the performance of hard armor in a location that may be more vulnerable to penetration due to characteristics of the materials or construction methods used to manufacture plates. This shot location is consistent with testing conducted by the U.S. Army on hard armor to meet its specifications, bringing the NIJ standard into better alignment with U.S. Army testing of hard armor plates.

A previous draft of this standard was published for public comment in the *Federal Register*.[4]

This document uses the following in accordance with international standards:

— "shall" indicates a requirement.

— "should" indicates a recommendation.

— "may" indicates a permission.

— "can" indicates a possibility or a capability.

Please send all written comments and suggestions to the Director, National Institute of Justice, Office of Justice Programs, U.S. Department of Justice, 810 7th Street NW, Washington, DC 20531.

Nothing in this document is intended to create any legal or procedural rights enforceable against the United States. Moreover, nothing in this document creates any obligation for any individual or organization to follow or adopt this voluntary standard nor does it create any obligation for suppliers, law enforcement agencies, or others to follow or adopt voluntary NIJ equipment standards.

[4] "Request for Public Comment on Proposed Revision of NIJ Standard 0101.06, Ballistic Resistance of Body Armor," *Federal Register*, 83 FR 7776, February 22, 2018, https://www.federalregister.gov/d/2018-03674.

Scope

1.1. This standard specifies minimum performance requirements and test methods for the ballistic resistance of some types of body armor used by U.S. law enforcement intended to protect the torso against handgun and rifle ammunition.

1.1.1. The test methods within this standard were developed and validated for broadly available armor designs. Some armor designs may require additional testing.

1.2. Body armor covered by this standard is classified into five protection levels: NIJ HG1 and NIJ HG2 for soft armor and NIJ RF1, NIJ RF2, and NIJ RF3 for hard armor.

1.3. This standard addresses three types of armor:

(1) Soft armor

(2) Stand-alone hard armor

(3) In conjunction with (ICW) hard armor intended to provide the stated level of ballistic protection only when paired with a specific model of soft armor. ICW hard armor is addressed within protection levels NIJ RF1, NIJ RF2, and NIJ RF3.

1.4. This standard is applicable for certification testing or research and development testing.

1.5. This standard incorporates other standards from ANSI/SAAMI, ASTM International, and ISO/IEC.

1.6. Values stated in either the International System of Units (metric) or U.S. Customary Units (inch-pound) are to be regarded separately as standard. The values stated in each system may not be exact equivalents. Both units are referenced to facilitate acquisition of materials internationally and minimize fabrication costs. Tests conducted using either system maintain repeatability and reproducibility of the test method and results are comparable.

1.7. The tests required by this standard have inherent hazards. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to comply with regulatory requirements.

2. References

The following references form a basis and provide support for the requirements and procedures described in this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies, including any amendments.

ANSI/SAAMI. *Glossary of Industry Terms.* Newtown, CT: Sporting Arms and Ammunition Manufacturers' Institute (SAAMI).

ASTM D5264-98(2019), *Practice for Abrasion Resistance of Printed Materials by the Sutherland Rub Test*. West Conshohocken, PA: ASTM International.

ASTM E3004-22. *Standard Specification for Preparation and Verification of Clay Blocks Used in Ballistic-Resistance Testing of Torso Body Armor.* West Conshohocken, PA: ASTM International.

ASTM E3005-20. *Standard Terminology for Body Armor.* West Conshohocken, PA: ASTM International.

ASTM E3062/E3062M-20. *Standard Specification for Ballistic Test Ranges for Small Arms and Fragmentation Testing of Ballistic-Resistant Items.* West Conshohocken, PA: ASTM International.

ASTM E3068-20. *Standard Test Method for Contact Measurement of Backface Deformation in Clay Backing During Body Armor Testing*. West Conshohocken, PA: ASTM International.

ASTM E3078/E3078M-23. *Standard Practice for Conditioning of Hard Armor Test Items.* West Conshohocken, PA: ASTM International.

ASTM E3107-23. *Standard Test Method for Resistance to Penetration and Backface Deformation for Ballistic-Resistant Torso Body Armor and Shoot Packs.* West Conshohocken, PA: ASTM International.

ASTM E3110/E3110M-22. *Standard Test Method for Collection of V_x Ballistic Limit Data for Ballistic-Resistant Torso Body Armor and Shoot Packs.* West Conshohocken, PA: ASTM International.

ASTM E3112/E3112M-20, *Standard Test Method for Ballistic-Resistant Products and Shoot Packs.* West Conshohocken, PA: ASTM International.

ASTM E3192-20, *Standard Practice for Soft Body Armor Conditioning By Tumbling*. West Conshohocken, PA: ASTM International.

ISO/IEC 17025:2017. *General Requirements for the Competence of Testing and Calibration Laboratories*. Geneva, Switzerland: International Organization for Standardization.

NIJ Standard 0123.00, *Specification for NIJ Ballistic Protection Levels and Associated Test Threats*. Washington, DC: National Institute of Justice, U.S. Department of Justice.

3. Terminology

3.1. Terms and definitions from ASTM standards[5]

3.1.1. *accessory*, n. – a body armor component that is detachable or removable from the body armor and is intended to provide extended area of coverage protection against threats that may include ballistic threats, stabbing, fragmentation, blunt impact, or a combination of threats. (ASTM E3005)

NOTE: Accessories are typically attachments to tactical body armor providing protection to areas not covered by the vest, such as the shoulders, upper arms, neck, sides, pelvis, and groin.

3.1.2. *ammunition*, n. – one or more loaded cartridges consisting of case, primer, propellant, and one or more projectiles. (ASTM E3005)

3.1.3. *angle of incidence*, n. – the angle between the test threat line of aim and the line normal to a reference plane based on the front surface of the backing assembly or witness panel. See also *obliquity.* (ASTM E3005)

NOTE: Some standards have used the terms *angle of incidence* and *obliquity* as synonyms, but in this standard, they are defined differently. Figure 1 provides examples to aid in visualizing the difference between angle of incidence and obliquity.

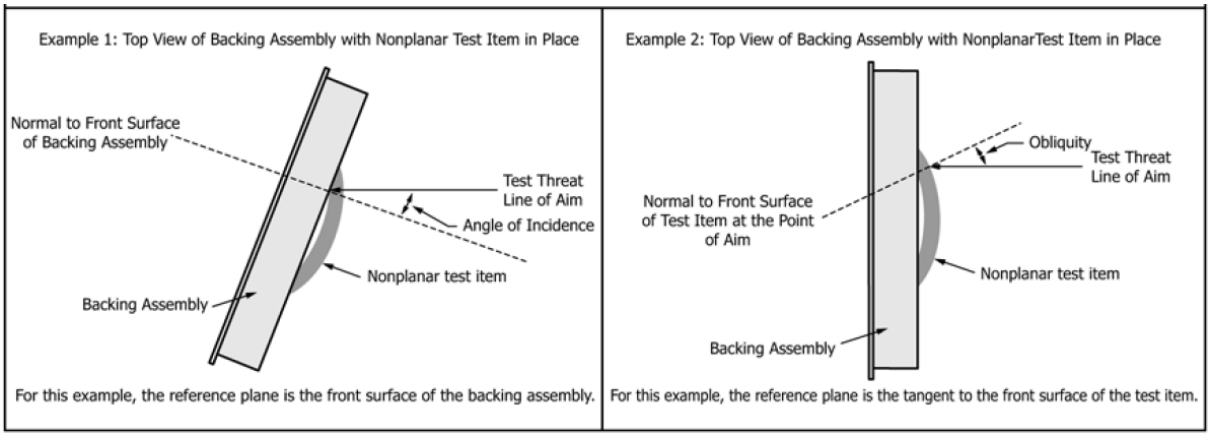


Figure 1. Examples showing angle of incidence and obliquity using a clay block backing assembly

3.1.4. *applique,* n. – a three-dimensional item molded from backing material that is shaped and sized for testing or conditioning a nonplanar test item. (ASTM E3005)

[5] Reprinted, with permission, from D5264, E3004-22, E3005-20, E3078-23, E3107-23, and E3110-22, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Copies of the complete standards may be obtained from ASTM, www.astm.org.

NOTE: Some appliques are designed for the purpose of filling the entire space behind a nonplanar test item; other appliques are designed to assess features of a nonplanar test item.

3.1.5. *armor carrier*, n. – See *carrier.*

3.1.6. *armor panel*, n. – a component of soft body armor consisting of protective materials, typically enclosed in a panel cover. See *ballistic panel*, *blunt impact panel*, *stab* panel. See also *panel cover.* (ASTM E3005)

3.1.7. *backface deformation* (BFD), n. – the indentation in the backing material caused by a projectile impact on the test item during testing. Synonymous with *backface signature.* (ASTM E3005)

3.1.8. *backing assembly*, n. – a backing fixture filled with backing material. For example, a clay block is a type of backing assembly. (ASTM E3005)

3.1.9. *ballistic limit*, n. – a measure of an item's ballistic resistance to complete penetration expressed as a velocity associated with some probability of perforation. (ASTM E3005)

NOTE: The item may be a test item, material, shoot pack, body armor, or other ballistic-resistant product.

3.1.10. *ballistic panel*, n. – a type of armor panel intended to provide ballistic resistance. (ASTM E3005)

3.1.11. *ballistic resistance*, n. – a characteristic of protective equipment or materials describing their ability to provide protection from projectiles. (ASTM E3005)

3.1.12. *body armor*, n. – an item of personal protective equipment intended to protect the wearer from threats that may include ballistic threats, stabbing, fragmentation, or blunt impact. (ASTM E3005)

3.1.13. *bullet*, n. – a projectile fired from a firearm or testing apparatus. (ASTM E3005)

NOTE: The SAAMI definition considers bullets to be projectiles fired from rifled barrels, which differentiates bullets from shot, slugs, fragment simulators, and other projectiles.

3.1.14. *carrier*, n. – a garment whose primary purpose is to retain the armor panel(s) or plate(s) and provide a means of supporting and securing the armor panel(s) or plate(s) to the wearer. (ASTM E3005)

3.1.15. *clay block,* n. – a type of backing assembly in which the backing material is Roma Plastilina #1® modeling clay. (ASTM E3005)

3.1.16. *conditioning*, n. – a process that exposes an item, prior to testing, to a specified controlled environment or physical stresses, or both. (ASTM E3005)

3.1.17. *controlled ambient,* n. – conditions with temperature of 20.0 °C ± 5.6 °C (68 °F ± 10 °F) and 50% ± 20% relative humidity (RH). (ASTM E3005)

3.1.18. *fair hit*, n. – a test threat impact (on a test item) that meets all specified requirements in a particular test method. (ASTM E3005)

3.1.19. *hard armor*, n. – an item of personal protective equipment that is constructed of rigid materials and is intended to protect the wearer from threats that may include ballistic threats, stabbing, fragmentation, or blunt impact, or combinations thereof; synonymous with *hard armor plate* and *plate.* (ASTM E3005)

3.1.20. *in conjunction with armor*, n. – soft or hard armor that is designed to provide a specific level of ballistic protection only when layered with a specified model(s) of body armor. (ASTM E3005)

3.1.21. *insert*, n. – a removable unit of protective material (soft armor or hard armor) intended to be placed into a special pocket on a carrier to enhance protection in a localized area. (ASTM E3005)

3.1.22. *nonplanar*, adj. – having features that would prevent the test item from making full contact with a flat surface; typically used to describe curved plates and armor designed for female wearers. (ASTM E3005)

3.1.23. *obliquity*, n. – the angle between the test threat line of aim and the line normal to a reference plane based on features of the test item at the point of aim. (Adapted from MIL-STD-3027.) See also *angle of incidence.* (ASTM E3005)

NOTE: Some standards have used the terms angle of incidence and obliquity as synonyms, but in this standard, they are defined differently. Figure 1 provides examples to aid in visualizing the difference between angle of incidence and obliquity.

3.1.24. *over velocity*, n. – velocity that is greater than the upper limit of a specified range. (ASTM E3005)

3.1.25. *panel cover*, n. – a covering, typically nonremovable, that encloses the protective materials and protects them from environmental factors, such as moisture, ultraviolet light, debris, and dust. (ASTM E3005)

3.1.26. *partial penetration* (PP), n. – any result of a test threat impact that is not a complete penetration; synonymous with *stop.* (ASTM E3005)

3.1.27. *receptor,* n. – film or paper of a specified abrasiveness onto which coatings (for example, ink or protective coating) removed from the specimen are deposited during the abrasion test. (ASTM D5264)

3.1.28. *shot-to-edge distance*, n. – the distance from the center of the projectile impact to the nearest test item edge. (ASTM E3005) For soft armor, the test item edge shall be the edge of the ballistic material. For hard armor, the test item edge shall be the outermost perimeter of the test item.

3.1.29. *shot-to-shot distance*, n. – the distance from the center of the projectile impact to the center of any other projectile impact on the test item. (ASTM E3005)

3.1.30. *soft armor*, n. – an item of personal protective equipment constructed of pliable/flexible materials intended to protect the wearer from threats that may include ballistic threats, stabbing, fragmentation, or blunt impact. (ASTM E3005)

3.1.31. *strike face*, n. – the surface of an armor panel or plate intended to face the incoming threat. (ASTM E3005)

3.1.32. *test item*, n. – a single article intended for testing. (ASTM E3005)

NOTE: Examples may include one panel, one plate, or one shoot pack.

3.1.33. *test series,* n. – the set of all shots necessary to obtain the required number of fair hits on a single test item or the set of all shots necessary over multiple test items to generate the required data. (ASTM E3005)

3.1.34. *test threat*, n. – the projectile, edged blade, spike, or other object that is used in laboratory testing to impact the test item at a specific velocity or energy to assess performance of body armor. (ASTM E3005)

3.1.35. *under velocity*, n. – velocity that is less than the lower limit of a specified range. (ASTM E3005)

3.1.36. *unfair hit*, n. – a test threat impact that does not meet the specified requirements in a particular test method for impact location and spacing, velocity, obliquity, or yaw. (ASTM E3005)

3.1.37. V_x, n. – the velocity at which x% of the impacts by a specified test threat are expected to completely penetrate nominally identical test items when tested according to a specified test method. (ASTM E3005)

3.1.38. V_0, n. – the maximum velocity at which 0% of the impacts by a specified test threat are expected to completely penetrate nominally identical test items when tested according to a specified test method. (ASTM E3005)

3.1.39. V_{05}, n. – the velocity at which 5% of the impacts by a specified test threat are expected to completely penetrate nominally identical test items when tested according to a specified test method. (ASTM E3005)

3.1.40. V_{50}, n. – the velocity at which 50% of the impacts by a specified test threat are expected to completely penetrate nominally identical test items when tested according to a specified test method. (ASTM E3005)

3.1.41. *wear face*, n. – the surface of an armor panel or plate that is intended to be placed against or proximal to the wearer's body. (ASTM E3005)

3.1.42. *yaw*, n. – the angular deviation between the projectile's axis of symmetry and its line of travel. (ASTM E3005)

3.2. **Terms and definitions specific to this NIJ standard**

3.2.1. *armor model*, n. – synonymous with *model.*

3.2.2. *ballistic layup*, n. – the specific ballistic materials, and their stitching, order, and orientation, of the ballistic-resistant item under consideration. Ballistic layup does not include shaping features for nonplanar armor.

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.

3.2.4. *crown*, n. – location of the highest point of a plate, at the intersection of multiple different curvatures.

NOTE: Novel and innovative designs (such as those for females) may include multiple high points and complex curvatures.

3.2.5. *label,* n. – a material applied to a product and containing information about the product.

3.2.6. *label assembly*, n. – the label itself and any clear plastic laminate that will be used to protect the label.

3.2.7. *label system*, n. – the label assembly and the substrate to which it is applied.

3.2.8. *model,* n. – the manufacturer's design, with unique specifications and characteristics, of a particular item.

3.2.9. *planar*, adj. – two-dimensional in quality such that the test item can make full contact with a flat surface.

3.2.10. *substrate,* n. – the material identical to the external surface of the production body armor to which the label will be affixed. In soft armor, this will typically be the ballistic panel cover material. In some hard armors, the substrate will be the plate material itself. In other hard armors, the substrate will be the plate wrap material or the "sprayed-on liner" covering material.

3.2.11. *supplier,* n. – the party that is responsible for ensuring that products meet and, if applicable, continue to meet, the requirements on which the NIJ certification is based.

4. Test Threats, Equipment, and Materials

4.1. Test threats

4.1.1. The test threats shall be as specified in NIJ Standard 0123.00, *Specification for NIJ Ballistic Protection Levels and Associated Test Threats*.

4.2. Test range

4.2.1. The test range shall meet the requirements of ASTM E3062, including the temperature and humidity requirements.

4.2.2. No firearms shall be used for testing.

4.3. Conditioning equipment

4.3.1. Equipment for soft armor test item conditioning by tumbling shall meet the requirements described in ASTM E3192, Section 6.

4.3.2. Equipment for soft armor test item conditioning by submersion shall meet the requirements described in *Appendix A: Soft Armor Conditioning by Submersion*.

4.3.3. Equipment for hard armor test item conditioning by submersion shall meet the requirements described in ASTM E3112, Section 9.7.1.

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

4.4. Backing assembly and clay verification equipment

4.4.1. The backing assembly shall be a clay block that meets the requirements of ASTM E3004, Section 5, with the exception that plywood backing on the clay block shall be removed for ballistic limit testing.

4.4.2. The clay verification equipment shall be as specified in ASTM E3004, with the modifications listed below.

4.4.2.1. When verifying the backing assembly, the spherical clay-verification impactor specified in ASTM E3004, Section 5.1.6, shall be used, and the test setup shall be as specified in ASTM E3004, Section 5.1.10.

4.4.2.2. The template for marking verification drop locations shall meet the requirements of ASTM E3004, Section 5.1.8, with two additional locations positioned on the 203 mm (8 in.) radius circle, with each respective 60 and 120 degrees from the first location on the 203 mm (8 in.) radius circle. See *Appendix B: Modifications to the Procedures of ASTM E3004 and Additional Requirements, Figure B1.1* for the template.

4.5. **Yaw measurement equipment**

4.5.1. Equipment for measuring yaw shall meet the requirements of ASTM E3110, Section 6.2.1.

4.6. **Backface deformation (BFD) measurement equipment**

4.6.1. Equipment for measuring BFD shall meet the requirements of ASTM E3068, Section 6.

5. NIJ Ballistic Protection Levels

5.1. Soft armor protection levels

5.1.1. For a soft armor model being submitted for testing to this standard, the supplier shall declare to the test laboratory the intended protection level.

5.1.2. The protection levels for soft armor are NIJ HG1 and NIJ HG2 as specified in NIJ Standard 0123.00, *Specification for NIJ Ballistic Protection Levels and Associated Test Threats*.

5.2. Hard armor protection levels

5.2.1. For a hard armor model being submitted for testing to this standard, the supplier shall declare to the test laboratory the intended protection level.

5.2.2. The protection levels for hard armor are NIJ RF1, NIJ RF2, and NIJ RF3 as specified in NIJ Standard 0123.00, *Specification for NIJ Ballistic Protection Levels and Associated Test Threats*.

6. Armor Ballistic Performance Requirements

6.1. Perforation-backface deformation (P-BFD) performance requirements

6.1.1. The P-BFD performance requirements are applicable to soft armor and hard armor, including in conjunction with (ICW) hard armor.

6.1.2. Each test item shall be tested as specified in the appropriate sections of this NIJ standard.

6.1.2.1. Each test item shall withstand the required number of fair hits and shall experience no complete penetrations at or below the reference velocity + 30 ft/s (+ 9.1 m/s).

6.1.2.2. Any complete penetration of a fair hit constitutes a failure.

6.1.3. BFD measurements shall be taken for: (1) soft armor test items conditioned by submersion and (2) hard armor test items conditioned by the hard armor conditioning procedure.

6.1.3.1. Either of the following two conditions shall be met:

1) Each individual BFD measurement (BFD_i) ≤ 44.0 mm

or

2) (44.0 mm ≤ BFD_i ≤ 50.0 mm) and ($BFD_{ave} + k_1 s \leq 44.0$ mm)

BFD_{ave} is obtained by taking the average of all recorded fair hit BFD_i measurements, at full precision, for test items of that particular model, size, conditioning status, and test threat, followed by rounding the result to the nearest 0.1 mm. s is the sample standard deviation. For explanations and calculations for BFD_{ave}, see *Appendix C: BFD Measurements*.

6.1.3.1.1. A BFD_i measurement greater than 50.0 mm shall be considered a failure.

6.1.4. BFD measurements shall be taken for soft armor test items conditioned by tumbling. Those BFD measurements shall be recorded.

NOTE: There is no pass/fail BFD measurement requirement for test items conditioned by tumbling.

6.2. Ballistic limit performance requirements

6.2.1. The ballistic limit performance requirements are applicable to soft armor and hard armor, including in conjunction with (ICW) hard armor.

6.2.2. Each test item shall be tested as specified in the appropriate section of this NIJ standard.

6.2.2.1. Each test item shall withstand the required number of fair hits and shall experience no complete penetrations at or below the reference velocity + 30 ft/s (+ 9.1 m/s).

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., $\hat{V}_{05} \leq V_{ref}$).

7. Soft Armor Requirements and Allocation of Test Items for Conditioning and Testing

7.1. Soft armor test item sizes

The test items shall be sized according to the templates in *Appendix E: Test Item Size Templates.*

7.1.1. The supplier selects the templates to be used based on the range of sizes over which the armor model will be produced.

7.1.1.1. A portion of the test items shall be of the larger size and conform to one of the size templates in *Appendix E: Test Item Size Templates*. The remaining test items shall be a smaller size and conform to a different and smaller size template in *Appendix E: Test Item Size Templates*. (See Table 1 and Table 2.)

NOTE: The NIJ Compliance Testing Program (CTP) requires that the smaller size be NIJ-C-1 and the larger size be NIJ-C-5. Nonplanar test items will be tested using an appropriate applique as described in Appendix G.4.

7.1.2. For planar test items, half of the test items of each size shall be front panels with a neck scoop, as shown on the relevant test item size template.

7.1.3. All nonplanar test items shall be front panels with a neck scoop, as shown on the relevant test item size template.

7.1.3.1. For nonplanar test items, the supplier shall provide a dimensioned diagram for each size of test item indicating the location of stitches, seams, folds, and other shaping features.

7.2. Soft armor test item quantity requirements

7.2.1. For testing soft armor with planar panels, a total of 62 test items is required. See Table 1 for how the test items are to be used. The test item details are described below:

7.2.1.1. 40 larger test items: 20 test items with neck scoop and 20 test items without neck scoop.

7.2.1.2. 22 smaller test items: 14 test items with neck scoop, and 8 test items without neck scoop.

7.2.2. For testing soft armor with nonplanar front panels, a total of 107 test items is required when the planar panel of the same ballistic layup has not previously been tested and certified by NIJ. See Table 1 and Table 2 for how the test items are to be used. The test item details are described below:

7.2.2.1. 59 larger test items: 39 test items with neck scoop and 20 test items without neck scoop.

7.2.2.2. 48 smaller test items: 40 test items with neck scoop, and 8 test items without neck scoop.

7.2.3. For testing soft armor with nonplanar front panels, a total of 45 test items is required when the planar panel of the same ballistic layup has previously been tested and certified by NIJ. See Table 2 for how the test items are to be used.The test item details are described below:

7.2.3.1. 19 larger test items: All test items with neck scoop.

7.2.3.2. 26 smaller test items: All test items with neck scoop.

7.3. Soft armor test item allocation

7.3.1. Table 1 provides a summary of how each planar test item shall be allocated for conditioning and testing.

7.3.2. When testing soft armor with nonplanar front panels, Table 2 provides a summary of how each test item shall be allocated for conditioning and testing.

7.3.3. All test items shall be conditioned at controlled ambient for at least 24 hours prior to submersion.

7.3.4. All test items to be conditioned by tumbling (for both P-BFD and Ballistic Limit testing) shall be conditioned simultaneously in a single tumbler.

7.3.5. Figure 2 provides further details regarding the allocation and utilization of planar test items.

7.3.6. Figure 3 provides further details regarding the allocation and utilization of nonplanar test items.

7.4. Soft armor test item workmanship and construction requirements

7.4.1. Each test item shall be free from evidence of inferior workmanship or material defects, such as wrinkles, blisters, fabric tears, fraying, unintended folds/creases, or discoloration of materials or stitching.

7.4.2. The stitching for each test item shall be consistent and secure.

7.4.3. There shall be no variation in construction details between individual test items.

7.4.4. All test items shall be identical in appearance, materials, and manner of construction, including stitch size and location, as appropriate for the sizes submitted.

7.5. Soft armor test item label requirements

7.5.1. The label shall be permanently attached to the panel cover of the test item and shall meet the requirements below.

7.5.1.1. The label text shall be in a readable typeface and font size, and the content shall be as specified in *Appendix F: Label Requirements, Section F.1: Label Content Requirements.*

7.5.1.2. This label shall match, in materials, manner of construction, printing, and ink(s), the label on a production armor.

7.5.1.3. The labels for every test item conditioned by tumbling shall be evaluated following tumbling.

7.5.1.3.1. Each label shall remain legible and attached to the test item in its original position.

7.5.1.3.2. No more than one inch (25.4 mm) of separation of any label edge from the test item is allowed.

7.5.2. Failure of a label to meet the above requirements is not considered a failure of the armor model. In the event of a label failing to meet these requirements, a case-by-case evaluation will be made by the NIJ CTP.

7.6. Soft armor test item carrier requirements

7.6.1. Test items shall be submitted with carriers that are made from cotton or poly-cotton fabric having an areal density of less than or equal to 250 g/m^2 (7.4 oz/yd^2).

7.6.1.1. If the manufacturer chooses to submit a carrier that does not meet the above requirement, then the carrier becomes part of the unique design and construction of the armor model and cannot be changed in production.

NOTE: It is recommended that the manufacturer contact the NIJ CTP prior to submitting test items to the laboratory.

7.6.2. Carriers for test items that will undergo conditioning by tumbling shall not have strapping, strapping attachment points, or any accessory mounting points.

Table 1. Planar Test Items: Summary

Size and Quantity of Test Items	Conditioning and Quantity of Test Items		Quantity of Test Items for Each Test		
Larger size 40 test items: 20 test items with neck scoop, 20 test items without neck scoop	Conditioning at controlled ambient for at least 24 hours followed by submersion, per Appendix A	8	P-BFD Test	With neck scoop	4
				Without neck scoop	4
	Conditioning at controlled ambient for at least 24 hours followed by tumbling, per ASTM E3192	10	P-BFD Test	With neck scoop	2
				Without neck scoop	2
			Ballistic Limit Test	With neck scoop	2
				Without neck scoop	2
			Spares	With neck scoop	1
				Without neck scoop	1
	Conditioning at controlled ambient for at least 24 hours	22	Ballistic Limit Test	With neck scoop	10
				Without neck scoop	10
			Spares	With neck scoop	1
				Without neck scoop	1
Smaller size 22 test items: 14 test items with neck scoop, 8 test items without neck scoop	Conditioning at controlled ambient for at least 24 hours followed by submersion, per Appendix A	12	P-BFD Test	With neck scoop	8
				Without neck scoop	4
	Conditioning at controlled ambient for at least 24 hours followed by tumbling, per ASTM E3192	8	P-BFD Test	With neck scoop	4
				Without neck scoop	2
			Spares	With neck scoop	1
				Without neck scoop	1
	Conditioning at controlled ambient for at least 24 hours	2	Spares	With neck scoop	1
				Without neck scoop	1

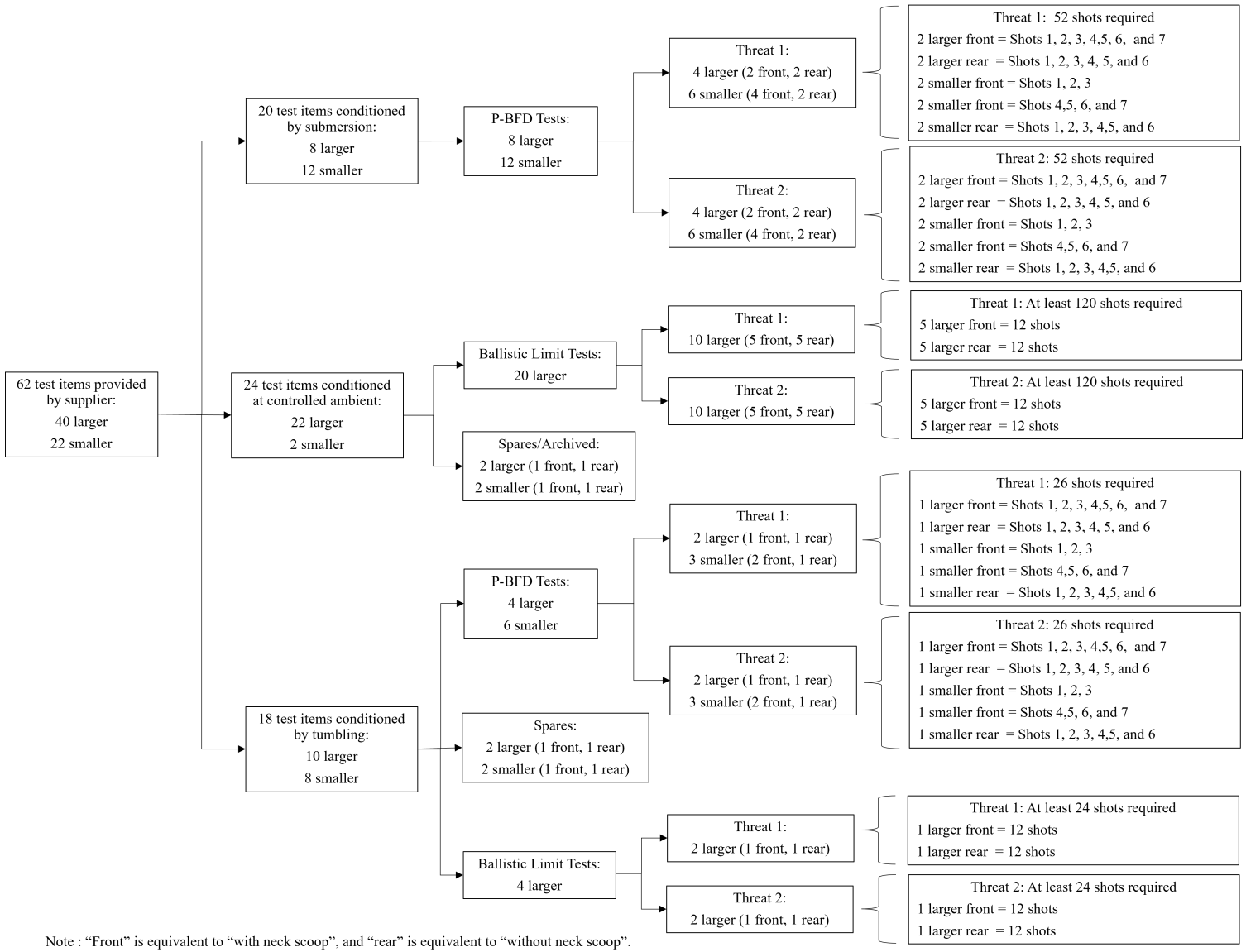
Note: “With neck scoop” is equivalent to “front panel,” and “without neck scoop” is equivalent to “rear panel.”

Table 2. Nonplanar Front Panel Test Items: Summary

Size and Quantity of Test Items	Conditioning and Quantity of Test Items		Quantity of Test Items for Each Test		
Larger size 19 test items: All test items with neck scoop	Conditioning at controlled ambient for at least 24 hours followed by submersion, per Appendix A	8	P-BFD Test	With neck scoop	8
	Conditioning at controlled ambient for at least 24 hours followed by tumbling, per ASTM E3192	10	P-BFD Test	With neck scoop	4
			P-BFD Test	With neck scoop	6
	Conditioning at controlled ambient for at least 24 hours	1	Spare	With neck scoop	1
Smaller size 26 test items: All test items with neck scoop	Conditioning at controlled ambient for at least 24 hours followed by submersion, per Appendix A	16	P-BFD Test	With neck scoop	16
	Conditioning at controlled ambient for at least 24 hours followed by tumbling, per ASTM E3192	9	P-BFD Test	With neck scoop	8
			Spare	With neck scoop	1
	Conditioning at controlled ambient for at least 24 hours	1	Spare	With neck scoop	1

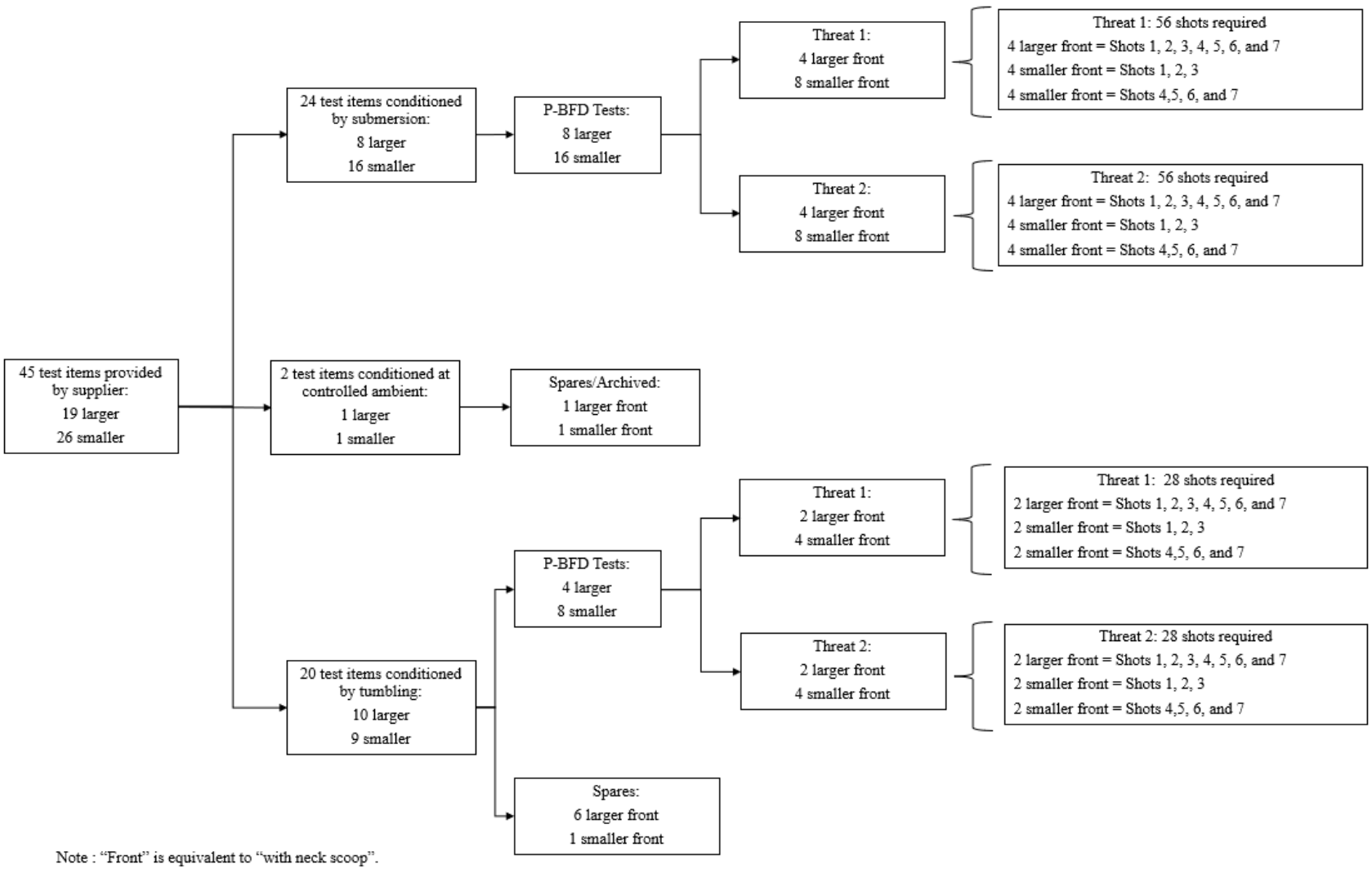
Note: “With neck scoop” is equivalent to “front panel.”

Figure 2. NIJ HG1 and NIJ HG2: Allocation and Utilization of Planar Soft Armor Test Items



Note : “Front” is equivalent to “with neck scoop”, and “rear” is equivalent to “without neck scoop”.

Figure 3. NIJ HG1 and NIJ HG2: Allocation and Utilization of Nonplanar Soft Armor Test Items



8. Soft Armor Test Item Examination

8.1. Verify the group of test items are of the correct model and correct quantity and sizes.

8.2. Examine the group of test items for variations in appearance.

8.3. Weigh each test item.

8.4. Examine the label of a single spare test item to determine whether requirements of *Appendix F: Label Requirements, Section F.1: Label Content Requirements,* are met.

8.5. Prior to submersion or tumbling, photograph at least one test item of each size. For the photograph, the test item shall be lying on a flat surface and shall have a scale (i.e., ruler) visible.

8.6. Following tumbling, evaluate the label of each test item to determine if the label remains legible and adhered to the test item.

8.7. Following ballistic testing, perform the steps below:

8.7.1. Horizontally slit only the test item panel cover with a razor blade near the bottom of the test item and remove the ballistic panel from its cover.

8.7.2. Document any evidence of inferior workmanship or material defects.

8.7.3. Document the construction of the ballistic panel (e.g., layer count, material description, stitching).

8.7.4. Examine the construction of each test item to determine whether the requirements of Sections 7.4.2 through 7.4.4 are met.

8.7.5. After inspecting, reinsert the ballistic panel in its panel cover in the correct orientation.

8.8. Document the relevant details for each test item.

9. Soft Armor Ballistic Test Requirements and Procedures

9.1. Soft armor shots required: planar and nonplanar

9.1.1. A complete P-BFD test series and Ballistic Limit test series consists of the total required number of fair hits accumulated on the required number of test items for each of the specified test threats, as shown in Figure 2 for planar test items or Figure 3 for nonplanar test items.

9.1.1.1. The number of shots shown in Figures 2 and 3 represent the required number of fair hits.

NOTE: Additional shots may be necessary to achieve the required number of fair hits.

9.1.1.2. Each test item shall be subjected to the number of fair hits specified in Figure 2 or Figure 3, as appropriate, using the specified test threat.

9.2. Soft armor P-BFD test requirements

9.2.1. Seven P-BFD shots per test item are required as specified in ASTM E3107.

9.2.2. The fair hit requirements shall be as specified in ASTM E3107, Section 9.3, with the following exceptions:

9.2.2.1. The minimum shot-to-edge distance may be decreased at the request of the supplier.

9.2.2.2. The minimum shot-to-edge distance shall not be greater than 3.0 in (76 mm) for the greater mass test threat and shall not be greater than 2.0 in (51 mm) for the lesser mass test threat.

9.2.2.3. When the measured velocity is not within ± 30 ft/s (± 9.1 m/s) of the reference velocity, but all other requirements are met, the shot shall be considered a fair hit if either:

(1) the velocity is less than the minimum allowed and the shot results in a complete penetration (CP), a BFD measurement is greater than 44.0 mm, or both

or

(2) the velocity is greater than the maximum allowed and results in a partial penetration (PP) and BFD measurement less than or equal to 44.0 mm.

9.2.3. A test item that is impacted with an over-velocity shot and subsequently impacted with a fair hit that completely penetrates or results in a BFD measurement greater than 50.0 mm shall be replaced with a spare test item. This occurrence and the results shall be documented. These shots shall not be included in the data set for calculations. The test series shall be repeated on the spare test item.

9.2.4. A test item that is impacted with an over-velocity shot may be replaced with a spare test item when the following two conditions are met:

1) the over velocity shot results in a PP with a BFD measurement less than 44.0 mm

and

2) another subsequent shot in the test series is a fair hit with a BFD measurement greater than 44.0 mm but less than 50.0 mm

9.2.4.1. If the test item is replaced per the conditions above, this occurrence and the results shall be documented. The shots shall not be included in the data set for calculations. The test series shall be repeated on the spare test item.

NOTE: Despite being a passing result, there is concern that the over-velocity would result in a greater dispersion in the BFD data set. See *Appendix C: BFD Measurements.*

9.2.5. When a shot is determined to be an unfair hit, additional attempts shall be made to obtain a fair hit on the same test item.

9.2.5.1. The number of shots taken on a single test item shall not exceed nine. If this requirement cannot be met, the test series shall be repeated on a spare test item of the same size. This occurrence and the results shall be documented. The shots taken on the spare test item shall be included in the data set for calculations. The shots taken on the original test item shall not be included in the data set for calculations.

9.2.6. For shot 7 on a front panel, if any portion of a test threat or a fragment of a test threat is embedded in or passes into any area of the backing material, that shall be considered a CP.

NOTE: This is an exception to the definition of a CP on soft armor from Section 3.2.3 of this NIJ standard that applies only to shot 7 at the neck of a front panel.

9.2.7. The duration of the ballistic testing of each test item shall be no more than 30 minutes from the time the first shot is fired until the last shot is fired.

9.2.7.1. If the time limit is exceeded, the test series shall be repeated on a spare test item. This occurrence and the results shall be documented. The shots taken on the spare test item shall be included in the data set for calculations. The shots taken on the original test item shall not be included in the data set for calculations.

9.2.8. Ballistic testing of each test item conditioned by submersion shall begin within 15 minutes of removal from the water bath described in *Appendix A: Soft Armor Conditioning by Submersion* (including the 10-minute drying time).

9.2.9. BFD measurements shall be taken on shots 1, 2, and 3 for each test item, and the measurand shall be as defined in ASTM E3068, Section 7.

9.2.9.1. BFD measurements for planar test items shall be performed according to ASTM E3068, Section 8.

9.2.9.2. BFD measurements for nonplanar test items shall be performed according to ASTM E3068, Section 9.

9.2.10. The angle of incidence for each shot shall be as specified in ASTM E3107, Section 11.2.

9.3. **Soft armor P-BFD test procedure for planar test items**

9.3.1. The steps of this procedure are detailed as a flowchart in *Figure H.1 of Appendix H: Flowcharts for Testing*, and summarized below.

9.3.2. For test items to be conditioned by submersion, mark shot locations on the test items per ASTM E3107, Section 11.2, prior to conditioning.

9.3.2.1. For test items having construction features, the locations of shots 4, 5, and 6 shall be adjusted to exploit the perceived weaknesses of the test item.

9.3.2.2. Condition the test items as specified in Section 7.3 and Table 1 or Table 2 of this NIJ standard.

9.3.3. For test items to be conditioned by tumbling, condition the test items as specified in Section 7.3 and Table 1 or Table 2 of this NIJ standard.

9.3.3.1. Following conditioning, mark shot locations on each test item per ASTM E3107, Section 11.2.

9.3.3.1.1. For test items having construction features, the locations of shots 4, 5, and 6 shall be adjusted to exploit perceived weaknesses of the test item.

9.3.4. Prepare and verify the clay block as specified in ASTM E3004, Section 6.3, with the modifications listed in *Appendix B, Section B.2: Modifications to ASTM E3004, Section 6.3, Clay Block Verification Procedure: Prior to Ballistic Testing*.

9.3.4.1. If the clay block meets the acceptance criteria, then repair the clay block according to ASTM E3004, Section 6.4, *Clay Block Repair*.

9.3.4.2. If the clay block does not meet the acceptance criteria, then follow the steps of ASTM E3004, Section 6.5, *Clay Blocks That Fail to Meet the Acceptance Criteria,* or select another clay block and repeat 9.3.4.

9.3.5. Position the clay block for shooting, and place the test item on the clay block per ASTM E3107, Section 10.

9.3.6. Perform the steps of ASTM E3107, Section 11.3, taking shots in this order: 1, 2, 3, 7, 4, 5, 6.

9.3.6.1. Document the result (i.e., CP or PP) and other required data.

9.3.6.2. Determine whether the shot was a fair hit and take appropriate actions.

9.3.6.3. Following each of shots 1, 2, and 3, remove the test item and follow the procedures of ASTM E3068, Section 8 for planar armor.

9.3.7. If there are additional test items in the test series, perform the procedure of ASTM E3004, Section 6.6, with the modifications listed in *Appendix B, Section B.3: Modifications to ASTM E3004, Section 6.6, Clay Block Verification Procedure: Between Test Items*, and repeat the above procedure on another test item.

9.3.8. After the final test item in the test series has been tested, perform the procedure of ASTM E3004, Section 6.7, with the modifications listed in *Appendix B, Section B.4*: *Modifications to ASTM E3004, Section 6.7, Clay Block Verification Procedure: After Final Shot on Clay Block.*

9.4. **Soft armor P-BFD test procedure for nonplanar test items**

9.4.1. The steps of this procedure are detailed as a flowchart in Figure H.1 of *Appendix H: Flowcharts for Testing*, and summarized below.

9.4.1.1. These steps apply only to nonplanar front panels. The construction of the armor model shall have been fully tested as planar armor prior to taking the steps of this section.

9.4.2. For test items to be conditioned by submersion, mark shot locations on the test items per *Appendix G: Guidance for P-BFD Testing of Soft Armor Designed for Female Wearers* of this NIJ standard, prior to conditioning.

9.4.2.1. For smaller test items, shots 1, 2, and 3 shall be marked on one test item, and shots 4, 5, 6, and 7 shall be marked on another.

9.4.2.2. Condition the test items as specified in Section 7.3 and Table 1 or Table 2 of this NIJ standard.

9.4.3. For test items to be conditioned by tumbling, condition the test items as specified in Section 7.3 and Table 1 or Table 2 of this NIJ standard.

9.4.3.1. Following conditioning, mark shot locations on each test item per *Appendix G: Guidance for P-BFD Testing of Soft Armor Designed for Female Wearers*, of this NIJ standard.

9.4.3.1.1. For smaller test items, shots 1, 2, and 3 shall be marked on one test item, and shots 4, 5, 6, and 7 shall be marked on another.

9.4.4. For shots 1, 2, and 3 on nonplanar soft test items, place the test item on the clay block and flatten it as much as possible.

9.4.5. For shots 4, 5, 6, and 7 on nonplanar soft armor test items, construct a suitable applique to fill the void between the test item and the clay block.

9.4.5.1. Follow the procedure in *Appendix G: Guidance for P-BFD Testing of Soft Armor Designed for Female Wearers* of this NIJ standard to create the applique.

9.4.5.2. Each applique shall be formed using clay that has been temperature conditioned as specified in ASTM E3004.

9.4.5.3. Each applique shall be stored, until needed for testing, in a chamber having temperature conditions as specified in ASTM E3004.

9.4.6. Prepare and verify the clay block as specified in ASTM E3004, Section 6.3, with the modifications listed in *Appendix B, Section B.2: Modifications to ASTM E3004, Section 6.3, Clay Block Verification Procedure: Prior to Ballistic Testing*.

9.4.6.1. If the clay block meets the acceptance criteria, then repair the clay block according to ASTM E3004, Section 6.4, *Clay Block Repair*.

9.4.6.2. If the clay block does not meet the acceptance criteria, then follow the steps of ASTM E3004, Section 6.5, *Clay Blocks That Fail to Meet the Acceptance Criteria,* or select another clay block and repeat 9.4.5.

9.4.7. For shots 1, 2, and 3, position the clay block (without applique) for shooting and place the test item on the clay block per ASTM E3107, Section 10.

9.4.8. For shots 4, 5, 6, and 7, affix the applique to the clay block, position the clay block for shooting, and place the test item on the clay block per ASTM E3107, Section 10, aligning the test item with the applique.

9.4.9. Perform the steps of ASTM E3107, Section 11.3, taking shots in this order: 1, 2, 3, 7, 4, 5, 6.

9.4.9.1. Document the result (i.e., CP or PP) and other required data.

9.4.9.2. Determine whether the shot was a fair hit and take appropriate actions.

9.4.9.3. Following each of shots 1, 2, and 3, remove the test item and follow the procedures of ASTM E3068, Section 9 for nonplanar armor.

9.4.10. If there are additional test items in the test series, perform the procedure of ASTM E3004, Section 6.6, with the modifications listed in *Appendix B, Section B.3: Modifications to ASTM E3004, Section 6.6, Clay Block Verification Procedure: Between Test Items*, and repeat the above procedure on another test item.

9.4.10.1. When conducting P-BFD testing on smaller front test items, clay block verification shall not be required after the test items that include only shots 1, 2, and 3. Please refer to Figure 2 for planar test items and Figure 3 for nonplanar test items. Clay block verification shall be conducted after all other test items are tested.

9.4.11. After the final test item in the test series has been tested, perform the procedure of ASTM E3004, Section 6.7, with the modifications listed in *Appendix B, Section B.4*: *Modifications to ASTM E3004, Section 6.7, Clay Block Verification Procedure: After Final Shot on Clay Block.*

9.5. **Soft armor ballistic limit test requirements**

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

9.5.1.1. The actual velocity of the first shot shall be the reference velocity ±100 ft/sec (±30 m/s) for the test threat.

9.5.1.1.1. If this requirement is not met, that shot shall be considered an unfair hit and not included in the data set for ballistic limit calculations. The first shot shall be repeated on the same test item.

9.5.2. After the first shot, the velocity shall be incremented per the steps shown in Table 3. All steps shall be incremented based on the previous intended velocity (i.e., not the measured velocity).

Table 3. Velocity Increments

Nominal Velocity	Incremental Velocity Value
Velocity step until first reversal	-100 ft/sec (-30 m/s) if first shot was a CP
	+100 ft/sec (+30 m/s) if first shot was a PP
Velocity step until second reversal	±75 ft/sec (± 23 m/s) depending on result of previous shot
Velocity step after second reversal	±50 ft/sec (± 15 m/s) depending on result of previous shot

9.5.3. The test requirements of ASTM E3110, Section 9 apply.

9.5.4. The removable plywood backing on the clay block shall be removed for ballistic limit testing.

9.5.5. The fair hit requirements shall be as specified in ASTM E3110, Section 9.1, with the following exceptions:

9.5.5.1. The minimum shot-to-edge distance may be decreased at the request of the supplier.

9.5.5.2. The minimum shot-to-edge distance shall not be greater than 2.0 in (51 mm) for the lesser mass test threat and shall not be greater than 3.0 in (76 mm) for the greater mass test threat.

9.5.6. The number of shots taken on a single test item shall not exceed 15. If this requirement cannot be met, the test series shall be continued on a spare test item. This occurrence shall be documented.

9.5.7. The ballistic limit data set shall contain at least 60 PPs and at least 30 CPs. The additional outcomes may be either PPs or CPs.

9.5.7.1. When the ballistic limit is sufficiently high that achieving the velocity necessary to perforate the test item is difficult or impossible, the test laboratory shall document that this situation has occurred. In such cases, the test series will be considered acceptable when a minimum of 120 shots has been taken even if the minimum number of CPs is not achieved.

9.5.8. All shots for ballistic limit testing shall be reported. The shot information shall be reported in the order of shots fired and, at a minimum, shall include shot number, measured velocity, and shot outcome.

9.6. Soft armor ballistic limit procedure for planar test items

9.6.1. The steps of this procedure are detailed as a flowchart in Figure H.2 of *Appendix H: Flowcharts for Testing*, and summarized below.

9.6.2. Condition test items as specified in Section 7.3 and Table 1 or Table 2 of this NIJ standard.

9.6.2.1. Following the required conditioning procedure or sequence, mark the shot locations on each test item, following the shot spacing requirements of Section 9.5.5 of this NIJ standard.

9.6.2.1.1. If test item size permits, the shot locations should avoid areas where there is an overlap of ballistic material. Impacts on areas of overlap are considered fair hits and shall be documented.

9.6.3. Prepare and verify the clay block as specified in ASTM E3004, Section 6.3, with the modifications listed in *Appendix B, Section B.2: Modifications to ASTM E3004, Section 6.3, Clay Block Verification Procedure: Prior to Ballistic Testing*.

9.6.3.1. If the clay block meets the acceptance criteria, then repair the clay block according to ASTM E3004, Section 6.4, *Clay Block Repair.*

9.6.3.2. If the clay block does not meet the acceptance criteria, then follow the steps of ASTM E3004, Section 6.5, *Clay Blocks That Fail to Meet the Acceptance Criteria,* or select another clay block and repeat 9.6.3.

9.6.4. Position the clay block for shooting (ensuring that the plywood backing is not attached), and place the test item on the clay block.

9.6.5. Perform the steps of ASTM E3110, Section 14.

9.6.5.1. Document each shot outcome (i.e., CP or PP), the corresponding measured velocity for each shot, and other required data.

9.6.5.2. Determine whether the shot was a fair hit and take appropriate actions.

9.6.6. If there are additional test items in the test series, perform the procedure of ASTM E3004, Section 6.6, with the modifications listed in *Appendix B, Section B.3: Modifications to ASTM E3004, Section 6.6, Clay Block Verification Procedure: Between Test Items*, and repeat the above procedure on another test item.

10. Hard Armor Requirements and Allocation of Test Items for Conditioning and Testing

10.1. Stand-alone hard armor and ICW hard armor

10.1.1. This section applies to stand-alone hard armor and ICW hard armor.

10.1.2. For ICW hard armor, an equivalent number of soft armor test items, sized to the NIJ-C-2 template, is required.

10.1.2.1. The associated soft armor model shall be listed on the NIJ Standard 0101.07 Compliant Products List.

10.1.3. For ICW hard armor models, the soft armor carrier shall have the necessary pocket for the hard armor.

10.2. Hard armor test item quantity and size requirements

10.2.1. Either 33 or 63 test items per test threat are required for testing to NIJ RF1. The number required depends on whether the test items are specified by the supplier for three or six shots.

NOTE: There are three test threats for NIJ RF1.

10.2.2. Either 43 or 83 test items per test threat are required for testing to NIJ RF2. The number required depends on whether the test items are specified by the supplier for three or six shots.

NOTE: There are four test threats for NIJ RF2 (including the three threats for NIJ RF1).

10.2.3. 10 to 50 test items are required for testing to NIJ RF3. The number required depends on whether the test items are specified by the supplier for one, two, three, or six shots.

NOTE: There is one test threat for NIJ RF3.

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

10.2.4.1. For all nonplanar test items, the supplier shall provide a dimensioned diagram for the test items indicating the crown location(s).

10.3. Hard armor test item workmanship and construction requirements

10.3.1. Each test item shall be free from evidence of inferior workmanship or material defects, such as uneven coatings or thicknesses of materials, wrinkles, blisters, cracks, fabric tears, fraying, crazing, and chipped or sharp edges.

10.3.2. There shall be no variation in construction details between individual test items.

10.3.3. All test items shall be identical in appearance, materials, and manner of construction, including the outside perimeter and shape of the test item.

10.4. Hard armor test item label requirements

10.4.1. The label shall be permanently attached to the exterior of the test item and shall meet

the requirements below.

10.4.1.1. The label text shall be in a readable typeface and font size, and the content shall be as specified in *Appendix F, Section F.1: Label Content Requirements.*

10.4.1.2. This label shall match — in materials, manner of construction, printing, and ink(s) — the label on a production armor.

10.4.1.3. The labels for every test item shall be evaluated following conditioning, and each label shall remain legible and attached to the test item in its original position. No more than one inch (25.4 mm) of separation of any label edge from the test item is allowed.

10.5. **Hard armor test item allocation for conditioning and testing**

10.5.1. A summary of how hard armor test items shall be allocated for conditioning and testing is shown in Table 4.

10.5.2. All test items shall be conditioned at controlled ambient for at least 24 hours prior to subsequent hard armor conditioning or conditioning by submersion.

10.5.3. All test items, except for one archive test item, shall be subjected to the hard armor conditioning procedures specified in ASTM E3078, Sections 13 and 14. Test items for P-BFD testing shall subsequently be conditioned by submersion per ASTM E3112, Section 9.7.2.

10.5.4. Figure 4 provides further details regarding the allocation and utilization of hard armor and ICW test items at the NIJ RF1 protection level.

10.5.5. Figure 5 provides further details regarding the allocation and utilization of hard armor and ICW test items at the NIJ RF2 protection level.

10.5.6. Figure 6 provides further details regarding the allocation and utilization of hard armor and ICW test items at the NIJ RF3 protection level.

10.5.6.1. The soft armor test items shall be conditioned by submersion, per Appendix A of this NIJ standard, prior to ballistic testing.

10.5.6.2. The combination of that soft armor and the hard armor shall then be tested as a system at a specified NIJ RF protection level.

Table 4. Summary of Hard Armor Test Items, Quantities, Conditioning, and Testing

Protection Level and Quantity of Test Items		Conditioning and Quantity of Test Items		Quantity of Test Items for Each Test	
NIJ RF1	33 or 63	Hard armor conditioning per ASTM 3078 followed by submersion per Appendix A	18 or 36	P-BFD	18 or 36
		Hard armor conditioning per ASTM 3078	14 or 26	Ballistic Limit	12 or 24
				Spare	2
		Conditioning at controlled ambient for at least 24 hours	1	Archive	1
NIJ RF2	43 or 83	Hard armor conditioning per ASTM 3078 followed by submersion per Appendix A	24 or 48	P-BFD	24 or 48
		Hard armor conditioning per ASTM 3078	18 or 34	Ballistic Limit	16 or 32
				Spare	2
		Conditioning at controlled ambient for at least 24 hours	1	Archive	1
NIJ RF3	10 to 50	Hard armor conditioning per ASTM 3078 followed by submersion per Appendix A	6, 12, 18, or 36	P-BFD	6, 12, 18, or 36
		Hard armor conditioning per ASTM 3078	3, 5, 7, or 13	Ballistic Limit	2, 4, 6, or 12
				Spare	1
		Conditioning at controlled ambient for at least 24 hours	1	Archive	1

Figure 4. NIJ RF1: Allocation of Hard Armor (Including ICW) Test Items

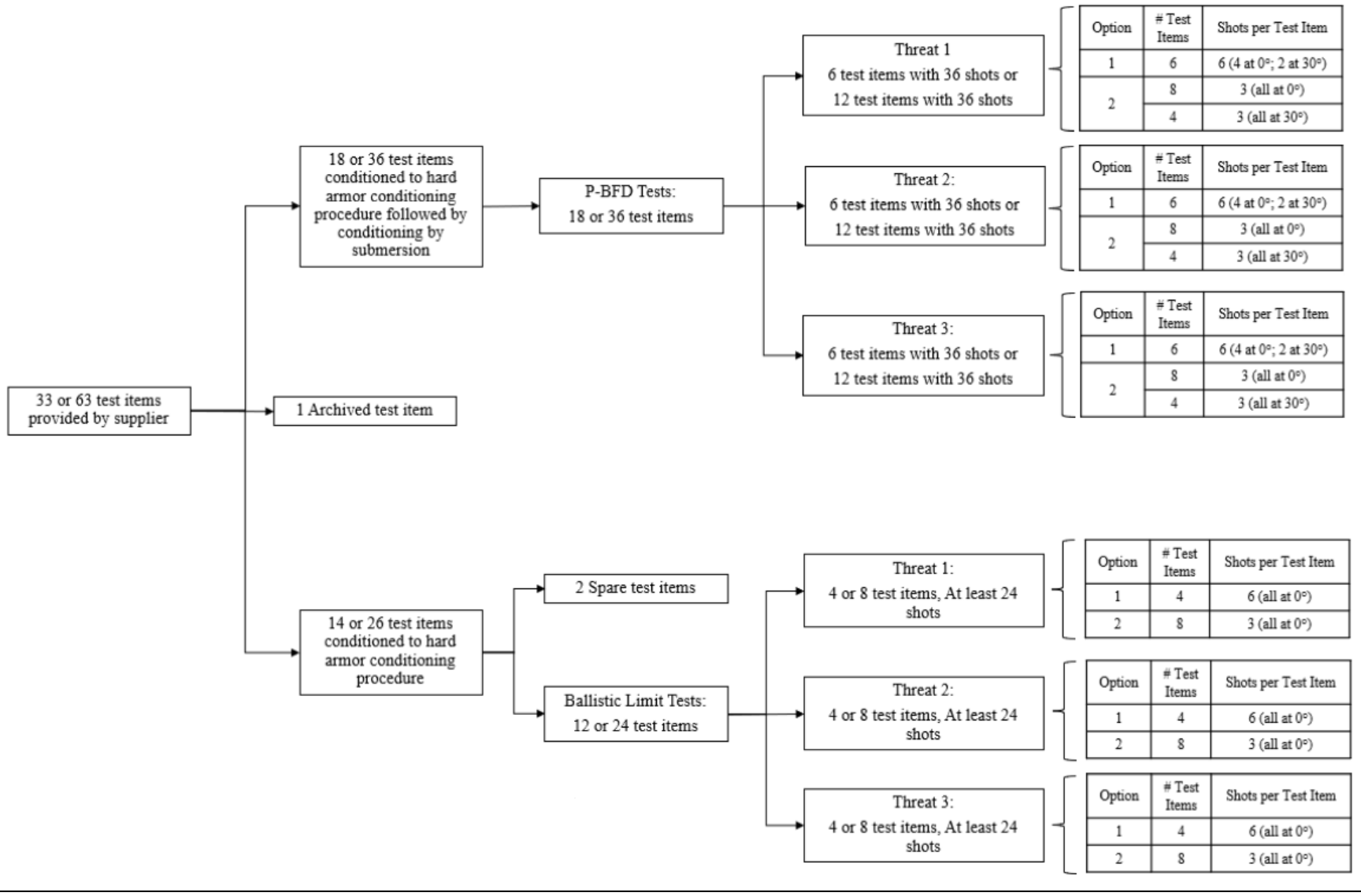
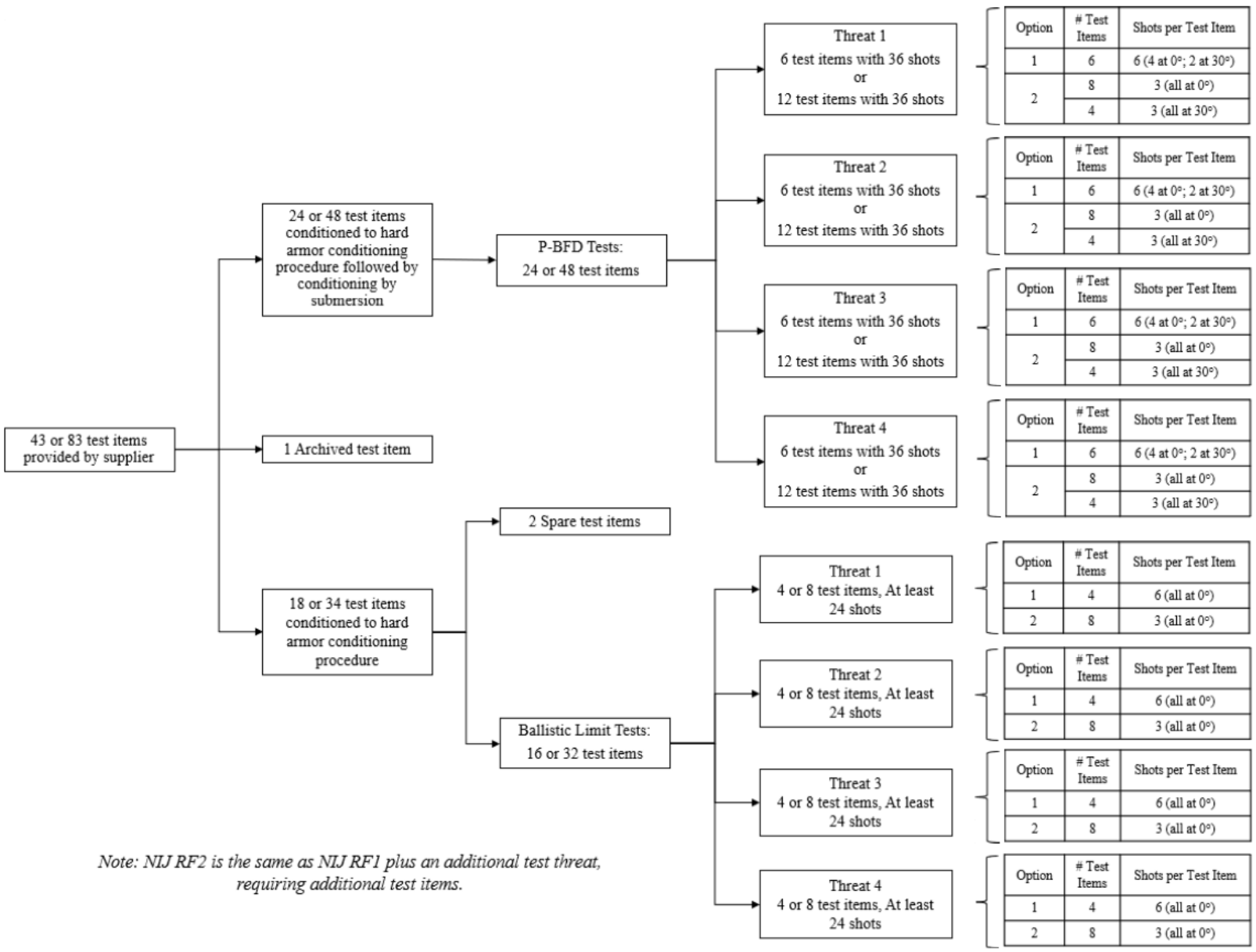
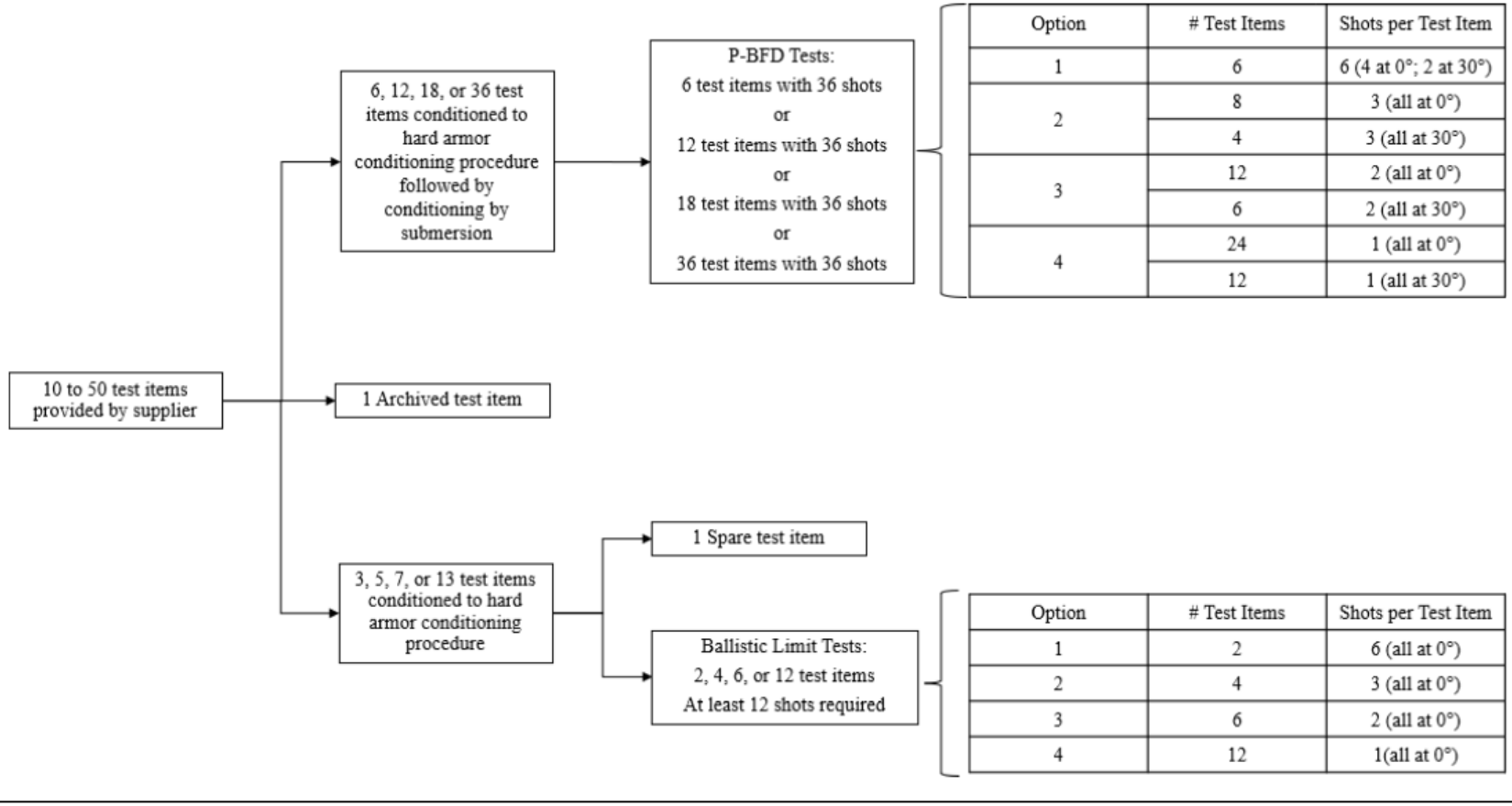


Figure 5. NIJ RF2: Allocation of Hard Armor (Including ICW) Test Items



Note: NIJ RF2 is the same as NIJ RF1 plus an additional test threat, requiring additional test items.

Figure 6. NIJ RF3: Allocation of Hard Armor (Including ICW) Test Items



Option	# Test Items	Shots per Test Item
1	6	6 (4 at 0°; 2 at 30°)
2	8	3 (all at 0°)
	4	3 (all at 30°)
3	12	2 (all at 0°)
	6	2 (all at 30°)
4	24	1 (all at 0°)
	12	1 (all at 30°)

Option	# Test Items	Shots per Test Item
1	2	6 (all at 0°)
2	4	3 (all at 0°)
3	6	2 (all at 0°)
4	12	1(all at 0°)

11. Hard Armor Test Item Examination Procedure

11.1. Verify the group of test items for correct quantity and sizes.

11.2. Examine the group of test items for variations in appearance.

11.3. Weigh each test item.

11.4. Examine the test item label text to determine whether the content requirements are met.

11.5. Prior to conditioning by the hard armor conditioning procedure, photograph at least one test item.

11.6. Following conditioning, examine the test items for visible damage due to conditioning and photograph any test items showing such damage.

11.7. Following ballistic testing, perform the steps below:

11.7.1. If necessary, cut open one side of the test item and peel back the cover or coating material enough to allow viewing of subcomponents.

11.7.2. Document any evidence of inferior workmanship or material defects.

11.7.3. Document the construction of the ballistic plate (e.g., material description, thickness of layered subcomponents, presence of coatings) to assess whether all test items are visually similar.

11.7.4. Examine the construction of each test item to determine whether the requirements of Sections 10.3.2 and 10.3.3 are met.

11.8. Document the relevant details for each test item.

12. Hard Armor Ballistic Test Requirements and Procedures

12.1. Hard armor shots required

12.1.1. A complete P-BFD test series and Ballistic Limit test series consists of the total required number of fair hits accumulated on the required number of test items for each of the specified test threats, as shown in Figure 4 for NIJ RF1, Figure 5 for NIJ RF2, and Figure 6 for RF3.

12.1.1.1. The number of shots shown in Figures 4, 5, and 6 represent the required number of fair hits.

NOTE: Additional shots may be necessary to achieve the required number of fair hits.

12.1.2. Each test item shall be subjected to the number of fair hits specified in Figure 4, 5, or 6, as appropriate, using the specified test threat.

12.1.2.1. The supplier shall declare the number shots to be placed on a single test item in accordance with the listed options.

NOTE: NIJ allows the supplier to choose the number of shots to place on each test item. This enables a supplier to use fewer test items to achieve the required number of shots; however, the supplier assumes the risk associated with a higher number of shots.

12.2. Hard armor P-BFD test requirements

12.2.1. The fair hit requirements shall be as specified in ASTM E3107, Section 9.3, with the following exceptions:

12.2.1.1. Minimum shot-to-edge distances may be decreased at the request of the supplier.

12.2.1.2. All edge shots shall meet the shot-to-edge distance requirements but shall be located not more than the shot-to-edge distance plus 0.75 in (19 mm) from the edge of the test item.

12.2.1.3. When the measured velocity is not within ± 30 ft/s (± 9.1 m/s) of the reference velocity, but all other requirements are met, the shot shall be considered a fair hit if either:

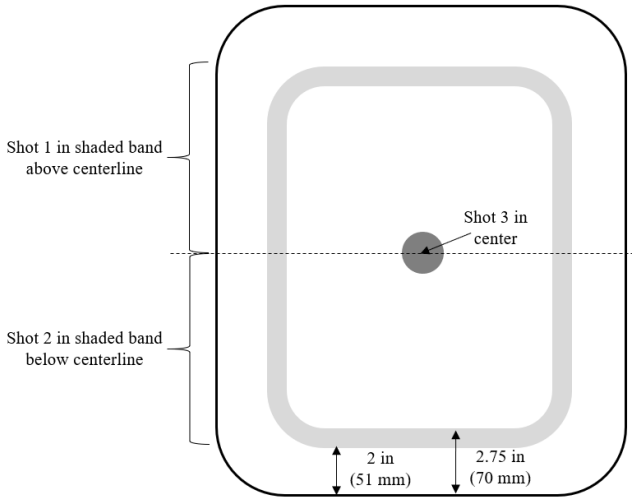
(1) the velocity is less than the minimum allowed and the shot results in a CP, a BFD measurement is greater than 44.0 mm, or both

or

(2) the velocity is greater than the maximum allowed and results in a PP and BFD measurement less than or equal to 44.0 mm.

12.2.2. The shot placement for a 3-shot plate shall be on the test item strike face as shown in Figure 7.

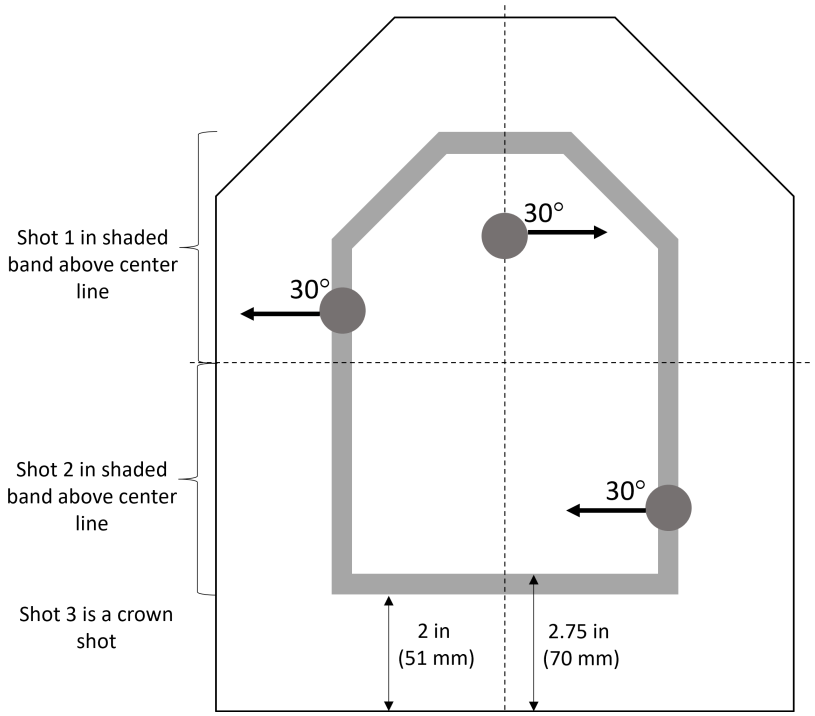
Figure 7. NIJ RF1, NIJ RF2, and NIJ RF3: Shot Placement for 3 Shots per Test Item



12.2.2.1. For each test item, shots 1 and 2 shall be moved to different locations within the shaded band, and shot 3 shall be placed on the center for a planar plate or on the apex of the curve in the center of the plate for a single-curve plate.

NOTE: The crown is not necessarily in the center of the plate for a multi-curve plate. Figure 8 shows an example of a multi-curve swimmer/shooters cut plate where the crown is located in the upper portion of the plate.

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



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.

12.2.3. The shot placement for a 6-shot plate shall be on the test item strike face as shown in Figure 9.

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.

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:

(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, and one shot in the shaded band shall be angled at 30 degrees away from the centerline.

(3) BFD measurements shall be taken for all 0 degree shots, including the crown shot.

Figure 9. NIJ RF1, NIJ RF2, and NIJ RF3: Shot Placement for 6 Shots Per Test Item

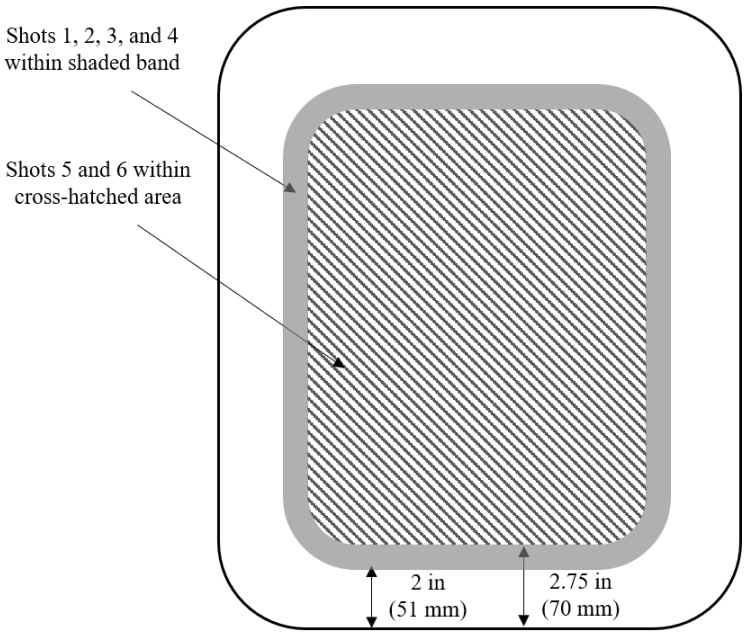
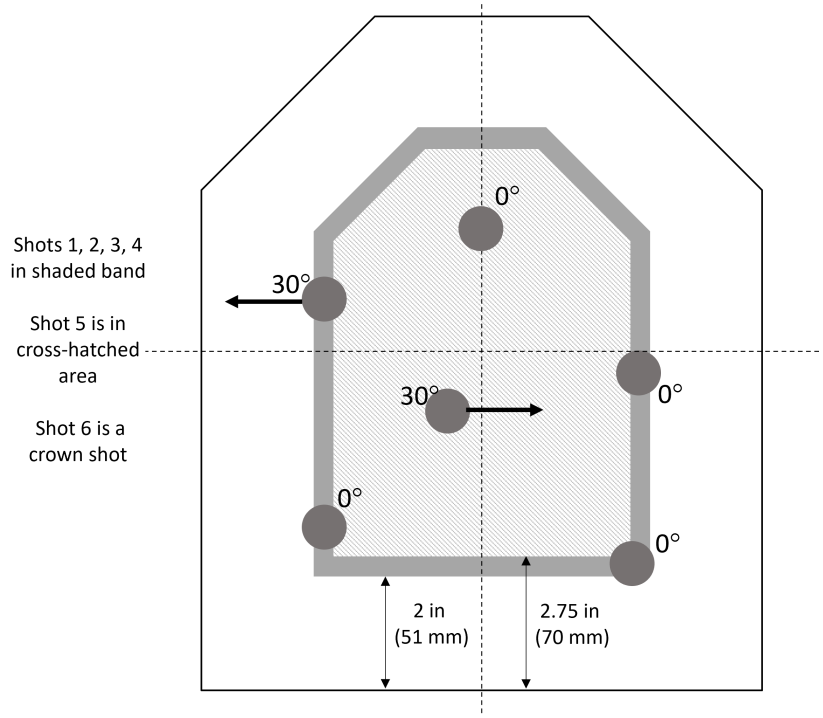
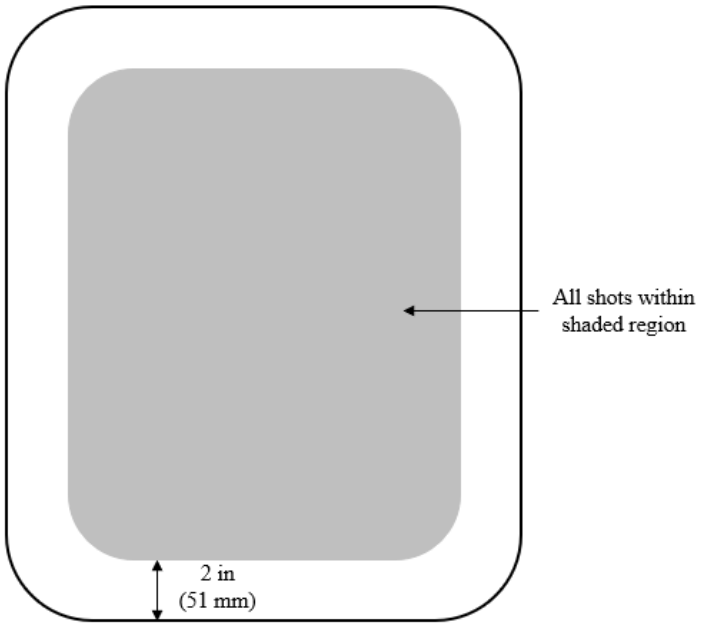


Figure 10. NIJ RF1, NIJ RF2, and NIJ RF3: Example of Shot Placement for 6 Shots Per Test Item on a Multi-Curve Plate



12.2.4. The shot placement for a 1-shot or 2-shot plate shall be on the test item strike face as shown in Figure 11. For a curved plate, at least 25% of the shots in the test series shall be placed on the crown.

Figure 11. NIJ RF3: Shot Placement for 1 or 2 Shots Per Test Item



12.2.5. For test items in which the cross-sectional layup varies across the plate, the placement of shots shown in Figures 7, 9, and 11 shall be adjusted to exploit perceived weaknesses of the test item. Shot angles and number of shots may be adjusted to fully challenge the design.

12.2.6. A test item that is impacted with an over-velocity shot and subsequently impacted with a fair hit that completely penetrates or results in a BFD measurement greater than 50.0 mm shall be replaced with a spare test item. This occurrence and the results shall be documented. The shots taken on the original test item shall not be included in the data set for calculations. The shots taken on the spare test item shall be included in the data set for calculations.

12.2.7. A test item that is impacted with an over-velocity shot may be replaced with a spare test item when the following two conditions are met:

1) the over-velocity shot results in a PP with a BFD measurement less than 44.0 mm and
2) another subsequent shot in the test series is a fair hit with a BFD measurement greater than 44.0 mm but less than 50.0 mm

12.2.7.1. If the test item is replaced per the conditions above, this occurrence and the results shall be documented. The shots taken on the original test item shall not be included in the data set for calculations. The test series shall be repeated on the spare test item. The shots taken on the spare test item shall be included in the data set for calculations.

NOTE: Despite being a passing result, there is concern that the over-velocity would result in a greater dispersion in the BFD data set. See see *Appendix C: BFD Measurements.*

12.2.8. When a shot is determined to be an unfair hit, any preceding shots on that test item shall be included in the data set for the calculations, and this shot shall be repeated on a spare test item. The remainder of the test series shall be continued on the spare test item. This occurrence and the results shall be documented.

12.2.9. The duration of the ballistic testing of each test item shall be no more than 30 minutes from the time the first shot is fired until the last shot is fired.

12.2.9.1. If the time limit is exceeded, the test series shall be repeated on a spare test item. This occurrence and the results shall be documented. The shots taken on the original test item shall not be included in the data set for calculations. The shots taken on the spare test item shall be included in the data set for calculations.

12.2.10. The occurrence of side spalling from angled edge shots shall be documented but is not a failure.

12.3. **Hard armor BFD measurements**

12.3.1. BFD measurements shall be performed as specified in ASTM E3068, and the measurand shall be as defined in ASTM E3068, Section 7.

12.3.1.1. BFD measurements for planar test items shall be performed according to ASTM E3068, Section 8.

12.3.1.2. BFD measurements for nonplanar test items shall be performed according to ASTM E3068, Section 9.

12.3.2. BFD measurements shall be taken on each test item as specified below:

12.3.2.1. When taking one shot per test item, BFD measurement shall be made on shot 1.

12.3.2.2. When taking two or three shots per test item, BFD measurements shall be made on shots 1 and 2.

12.3.2.3. When taking six shots per test item, BFD measurements shall be made on shot 6 and three of the shots within the shaded band.

12.4. **Hard armor P-BFD test procedure for planar and nonplanar test items**

12.4.1. The steps of this procedure are detailed as a flowchart in Figure H.3 of *Appendix H: Flowcharts for Testing*, and summarized below.

12.4.2. Condition the test items as specified in Section 10.5 and Table 4 of this NIJ standard.

12.4.3. Mark shot locations on the test items per this NIJ standard, Section 12.2.2 through 12.2.5 (as appropriate), ensuring that shot locations meet the shot spacing requirements.

12.4.4. For nonplanar hard armor, follow the procedure in ASTM E3107, Section 12.3 to create the applique.

12.4.4.1. Each applique shall be formed using clay that has been temperature conditioned as specified in ASTM E3004.

12.4.4.2. Each applique shall be stored, until needed for testing, in a chamber having temperature conditions as specified in ASTM E3004.

12.4.5. Prepare and verify the clay block as specified in ASTM E3004, Section 6.3, with the modifications listed in *Appendix B, Section B.2: Modifications to ASTM E3004, Section 6.3, Clay Block Verification Procedure: Prior to Ballistic Testing*.

12.4.5.1. If the clay block meets the acceptance criteria, then repair the clay block according to ASTM E3004, Section 6.4, *Clay Block Repair*.

12.4.5.2. If the clay block does not meet the acceptance criteria, then follow the steps of ASTM E3004, Section 6.5 *Clay Blocks That Fail to Meet the Acceptance Criteria,* or select another clay block and repeat 12.4.4.

12.4.6. Position the clay block for shooting, and mount the test item and applique (as needed) on the clay block as specified in ASTM E3107, Section 12.

12.4.7. Perform the steps of ASTM E3107, Section 13.

12.4.7.1. Document the result (i.e., CP or PP) and other required data.

12.4.7.2. Determine whether the shot was a fair hit according to Section 12.2 of this NIJ standard and take appropriate actions.

12.4.7.3. Following each shot for which BFD is to be measured, remove the test item and follow the procedures of ASTM E3068, Section 8 for planar armor or Section 9 for nonplanar armor.

12.4.8. If there are additional test items in the test series, perform the procedure of ASTM E3004, Section 6.6, with the modifications listed in *Appendix B, Section B.3: Modifications to ASTM E3004, Section 6.6, Clay Block Verification Procedure: Between Test Items*, and repeat the above procedure on another test item.

12.4.8.1. When conducting RF1 or RF2 testing using three shots per item, clay block verification shall be required only after six shots have been fired (i.e., after every other test item). The six shots shall be fired in consecutive order using the same clay block. Please refer to "Option 2" in Figure 4 and Figure 5. Clay block verification shall be conducted after all other test items are tested.

12.4.8.2. When conducting RF3 testing using less than six shots per test item, clay block verification shall be required only after six shots have been fired. The six shots shall be fired in consecutive order using the same clay block. Please refer to "Option 2," "Option 3," and "Option 4" in Figure 6. Clay block verification shall be conducted after all other test items are tested.

12.4.9. After the final test item in the test series has been tested, perform the procedure of ASTM E3004, Section 6.7, with the modifications listed in *Appendix B, Section B.4: Modifications to ASTM E3004, Section 6.7, Clay Block Verification Procedure: After Final Shot on Clay Block.*

12.5. **Hard armor ballistic limit test requirements**

12.5.1. The ballistic limit test requirements from Section 9.5 of this NIJ standard apply to hard armor.

12.5.2. The ballistic limit data set for NIJ RF1 and NIJ RF2 shall contain at least six CPs and at least 12 PPs. The additional outcomes may be either PPs or CPs.

12.5.2.1. When the ballistic limit is sufficiently high that achieving the velocity necessary to perforate the test item is difficult or impossible, the test laboratory shall document that this situation has occurred. In such cases, the test series will be

considered acceptable when a minimum of 24 shots has been taken even if the minimum number of CPs is not achieved.

12.5.3. The ballistic limit data set for NIJ RF3 shall contain at least three CPs and at least six PPs. The additional outcomes may be either PPs or CPs.

12.5.3.1. When the ballistic limit is sufficiently high that achieving the velocity necessary to perforate the test item is difficult or impossible, the test laboratory shall document that this situation has occurred. In such cases, the test series will be considered acceptable when a minimum of 12 shots has been taken even if the minimum number of CPs is not achieved.

12.6. **Hard armor ballistic limit test procedure**

12.6.1. The steps of the ballistic limit test procedure for hard armor are detailed as a flowchart in Figure H.4 of *Appendix H: Flowcharts for Testing*, and summarized below.

12.6.2. Condition the test items as specified in Section 10.5 and Table 4 of this NIJ standard.

12.6.3. Mark shot locations on the test items, following the shot spacing requirements of Section 9.5.5 of this NIJ standard.

12.6.4. Prepare and verify the clay block as specified in ASTM E3004, Section 6.3, with the modifications listed in *Appendix B, Section B.2: Modifications to ASTM E3004, Section 6.3, Clay Block Verification Procedure: Prior to Ballistic Testing*.

12.6.4.1. If the clay block meets the acceptance criteria, then repair the clay block according to ASTM E3004, Section 6.4, *Clay Block Repair*.

12.6.4.2. If the clay block does not meet the acceptance criteria, then follow the steps of ASTM E3004, Section 6.5, *Clay Blocks That Fail to Meet the Acceptance Criteria,* or select another clay block and repeat 12.6.4.

12.6.5. Position the clay block for shooting, ensuring that the plywood backing is not attached, and mount the test item on the clay block as specified in ASTM E3110, Section 11, with the exception that Note 7 of ASTM E3110 does not apply.

12.6.6. Perform the steps of ASTM E3110, Section 14.

12.6.6.1. Document each shot outcome (i.e., CP or PP), the corresponding measured velocity for each shot, and other required data.

12.6.6.2. Determine whether the shot was a fair hit according to Section 12.2.1 of this NIJ standard and take appropriate actions.

12.6.7. If there are additional test items in the test series, perform the procedure of ASTM E3004, Section 6.6, with the modifications listed in *Appendix B, Section B.3: Modifications to ASTM E3004, Section 6.6, Clay Block Verification Procedure: Between Test Items*, and repeat the above procedure on another test item.

13. Label System Requirements

13.1. It is strongly recommended that label system testing be successfully completed prior to submitting armor test items for conditioning or ballistic testing.

13.2. Label systems shall be evaluated in accordance with *Appendix F, Section F.2: Label System Tests for Permanency and Durability*.

13.2.1. This label system shall match, in materials, manner of construction, printing, and ink(s), the label system as it would be on a production armor.

13.2.2. The label system text shall be in a readable typeface and font size, and the content shall be as specified in *Appendix F, Section F2.1: Label System Test Items*.

13.2.3. The label systems shall be tested in accordance with the Label System Tests for Permanence and Durability specified in *Appendix F, Section F.2: Label System Tests for Permanency and Durability*.

13.3. In the event of a label system failing to meet the requirements, new label systems are required to be submitted and tested and shall meet the requirements.

14. Test Report

14.1.1. The test laboratory shall develop a test report that meets the requirements of ISO/IEC 17025 and the referenced ASTM standards.

14.1.2. All required data, calculated values, and photographs shall be included in the test report.

Appendix A: Soft Armor Conditioning by Submersion

A.1 Equipment

A.1.1 The armor submersion equipment shall consist of a water bath sufficiently sized to allow at least one test item of the largest template size to hang vertically, without any folds or bends, with the top edge of the test item at least 4 in (~100 mm) below the surface of the water, and with at least 2 in (~50 mm) clearance around the test item.

A.1.2 The water in the bath shall be clean and shall be either potable tap or demineralized water. The water shall be replaced any time there are visible impurities in the water. The water temperature shall be 21 °C + 3 °C/-6 °C (70 °F + 5 °F/-10 °F).

A.2 Procedure

A.2.1 Each test item shall be hung vertically in the water bath for 30 min (+ 5 min/- 0 min) with the top edge of the test item positioned 4 in ± 1 in (100 mm ± 25 mm) below the water surface and maintaining at least a 2 in (~50 mm) clearance around the test item. For test items that are buoyant, weights shall be attached to the bottom edge with clothes pins or similar clips to allow the test item to hang vertically.

A.2.2 After removing the test item from the water, it shall be hung vertically to drip dry for a minimum of 10 minutes before mounting on the clay block for ballistic testing.

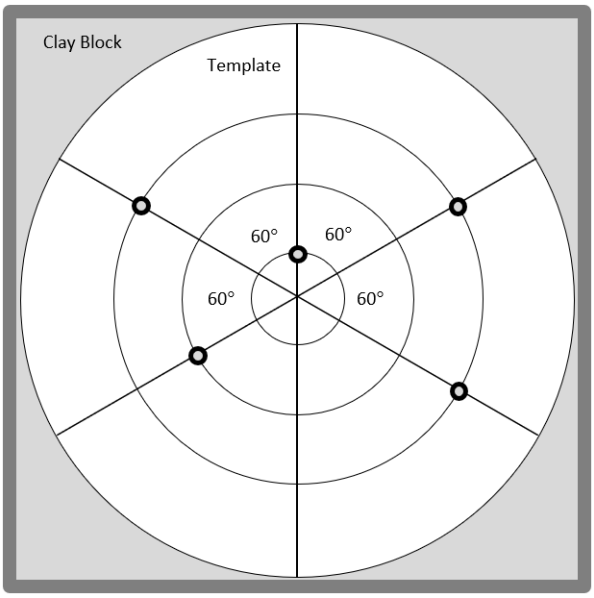
NOTE: Ballistic testing must begin within 15 minutes of removal from the water.

Appendix B: Modifications to the Procedures of ASTM E3004 and Additional Requirements

B.1 Template

B.1.1 Figure B1.1 provides a graphic of the template used to mark clay verification drop locations. The first three locations shall be positioned according to ASTM E3004, Section 5.1.8, and the remaining two locations shall be as shown in Figure B1.1.

Figure B1.1 Template for Marking Clay Verification Drop Locations



B.2 Modifications to ASTM E3004, Section 6.3, *Clay Block Verification Procedure: Prior to Ballistic Testing*

(1) Section 6.3.2.8 shall be replaced with:

Place the drop template on the clay surface in an arbitrary rotational position. Mark the surface of the clay block (for example, by nicking the surface, laser marking, applying ink) to indicate five drop target positions. Remove the template.

(2) Section 6.3.2.12 shall be replaced with:

Drop the impactor onto the clay block, ensuring the movable support does not move during the drop. The impactor shall be dropped five times, once on each of the marks on the clay surface.

(3) Section 6.3.2.13 shall be modified to require that the five indentation measurements be recorded.

(4) Section 6.3.3, *Acceptance Criteria*, shall not apply. The acceptance criteria shall be:

- The arithmetic mean of the five indentation depth measurements shall be 19.0 mm ± 2.0 mm (0.748 in ± 0.08 in).
- Each indentation depth measurement shall be 19.0 mm ± 3.0 mm (0.748 ± 0.12) .
- The measurements shall not be rounded off.

B.3 Modifications to ASTM E3004, Section 6.6, *Clay Block Verification Procedure: Between Test Items*

(1) Section 6.6, *Clay Block Verification Procedure: Between Test Items,* is required.

(2) Section 6.6.2.2 shall apply, with these additions:

Five drop target positions shall be marked on the clay surface, attempting to avoid placing drop target locations on the most recently repaired clay. Remove the template.

(3) Section 6.6.2.4 shall be replaced with:

Drop the impactor onto the clay block. The impactor shall be dropped five times, once on each of the marks on the clay surface.

(4) Section 6.6.2.5 shall be modified to require that the five indentation measurements be recorded.

(5) Section 6.6.3, *Acceptance Criteria*, shall not apply. The acceptance criteria shall be:

- The arithmetic mean of the five indentation depth measurements shall be 19.0 mm ± 2.0 mm (0.748 in ± 0.08 in).
- Each indentation depth measurement shall be 19.0 mm ± 3.0 mm (0.748 ± 0.12) .
- The measurements shall not be rounded off.

B.4 Modifications to ASTM E3004, Section 6.7, *Clay Block Verification Procedure: After Final Shot on Clay Block*

(1) Section 6.7, *Clay Block Verification Procedure: After Final Shot on Clay Block* is required.

(2) Section 6.7.2.1 shall apply, but the clay block shall be repaired.

(3) Sections 6.7.2.3 and 6.7.2.4, shall be replaced with:

Place the drop template on the clay surface in an arbitrary rotational position, attempting to avoid placing drop target locations on the most recently repaired clay. Mark the surface of the clay block (for example, by nicking the surface, laser marking, applying ink) to indicate five drop target positions. Remove the template.

(4) Section 6.7.2.5, shall be replaced with:

Drop the impactor onto the clay block. The impactor shall be dropped five times, once on each of the marks on the clay surface.

(5) Section 6.7.2.6 shall be modified to require that the five indentation measurements be recorded.

(6) Section 6.7.3, *Acceptance Criteria*, shall not apply. The acceptance criteria shall be:

- The arithmetic mean of the five indentation depth measurements shall be 19.0 mm ± 2.0 mm (0.748 in ± 0.08 in).
- Each indentation depth measurement shall be 19.0 mm ± 3.0 mm (0.748 ± 0.12).
- The measurements shall not be rounded off.

Appendix C: BFD Measurements

C.1 When any BFD measurement exceeds 44.0 mm, then there shall be a 95% confidence that 80% of all BFD depths will be 44.0 mm or less. This requirement can be verified using a statistical tolerance limit. It is expected that a stated portion of the entire population of all BFD measurements will lie at or below the statistical upper tolerance limit. To achieve this, the population of BFD measurements is assumed to be normally distributed, and the upper tolerance limit, BFD_U, must be ≤ 44.0 mm. The upper tolerance limit is defined below:

Equation C.1: $BFD_U = BFD_{ave} + k_1 s$

BFD_{ave} is calculated as shown below:

Equation C.2: $BFD_{ave} = \frac{1}{N}\sum_{i=1}^{N} BFD_i$

N represents the number of BFD measurements on a particular model, resulting from fair hits, and where the size, conditioning status, and test threat are the same. BFD_i are the individual BFD measurements. The sample standard deviation, *s*, is calculated as shown below:

Equation C.3: $s = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(BFD_i - BFD_{ave})^2}$

The approximate k factor, k_1, for a one-sided tolerance interval can now be calculated as shown below:

Equation C.4: $k_1 = \frac{z_{1-p} + \sqrt{z^2{}_{1-p} - ab}}{a}$

Here, $z_{1\text{-}p}$ is the normal distribution-critical value that is exceeded with a probability of 1-p. The factors *a* and *b* are defined below:

Equation C.5: $a = 1 - \frac{z^2{}_{1-\gamma}}{2(N-1)}$

Equation C.6: $b = z^2{}_{1-p} - \frac{z^2{}_{1-\gamma}}{N}$

Here, $z_{1\text{-}\gamma}$ is the normal distribution-critical value that is exceeded with a probability of 1-γ.

C.2 For the analysis of BFD measurements according to the requirements of this NIJ standard, the probability that no BFD measurement exceeds 44.0 mm must be at least 80%, so p = 0.80, and the required confidence is 95%, so γ=0.95. The critical values for

the normal distribution can be calculated or obtained from tables in statistical textbooks. For this case, they are:

$z_{1-\gamma} = z_{0.05} = 1.645$; $z_{1-p} = z_{0.20} = 0.842$

Table C.1 below provides some k_1 values based on the number of BFD measurements.

Table C.1. k_1 Values Based on Number of BFD Measurements

Number of BFD Measurements	k_1
12	1.568
13	1.528
14	1.494
15	1.464
16	1.438
17	1.415
18	1.394
19	1.375
20	1.358
21	1.342
22	1.328
23	1.315
24	1.303

Appendix D: Analysis of Ballistic Limit Data

D.1 Once the ballistic limit testing has been completed, the test results shall be analyzed for each test threat by performing a regression to estimate the armor model's performance over a range of velocities. In particular, the analysis shall attempt to estimate the velocity where the probability of CP becomes reasonably small (i.e., $\hat{V}_{05} \leq V_{ref}$). In general, a logistic regression can be used for this purpose; however, other probability distributions and regression methods may be used when one can be shown to better estimate the performance of a particular armor model.

D.2 The logistic regression may be performed on the data using the method of maximum likelihood to estimate the logistic parameters $\hat{\beta}_0$ and $\hat{b}_1$, which are the estimated *logistic constant* and the estimated *velocity coefficient*, respectively. These parameters define the shape of the S-shaped logistic curve, which is defined as:

Equation D.1: $p(v) = \frac{e^{b_0 + v b_1}}{1 + e^{b_0 + v b_1}}$

Here, $\pi(v)$ is the is the probability of a CP occurring at velocity, v. From the estimated logistic parameters, the ballistic limit can be determined as:

Equation D.2: $\hat{V}_{50} = \frac{-\hat{\beta}_0}{\hat{b}_1}$

In addition, the velocity at which the probability of a CP is x%, $\hat{V}_x$, can be determined as:

Equation D.3: $\hat{V}_x = \frac{ln\left(\frac{x}{1-x}\right) - \hat{\beta}_0}{\hat{b}_1}$

To determine the velocity at which the probability of a CP is 5%, $\hat{V}_{05}$, can be determined as:

Equation D.4: $\hat{V}_{05} = \frac{ln(.05) - \hat{\beta}_0}{\hat{b}_1}$

D.2 The estimated logistic parameters for a conditioned armor model and its ballistic limit can be determined in the same method; however, care should be exercised when the analysis is performed on a relatively small data set, as the reliability of the estimated CP probability will be poor for small data sets.

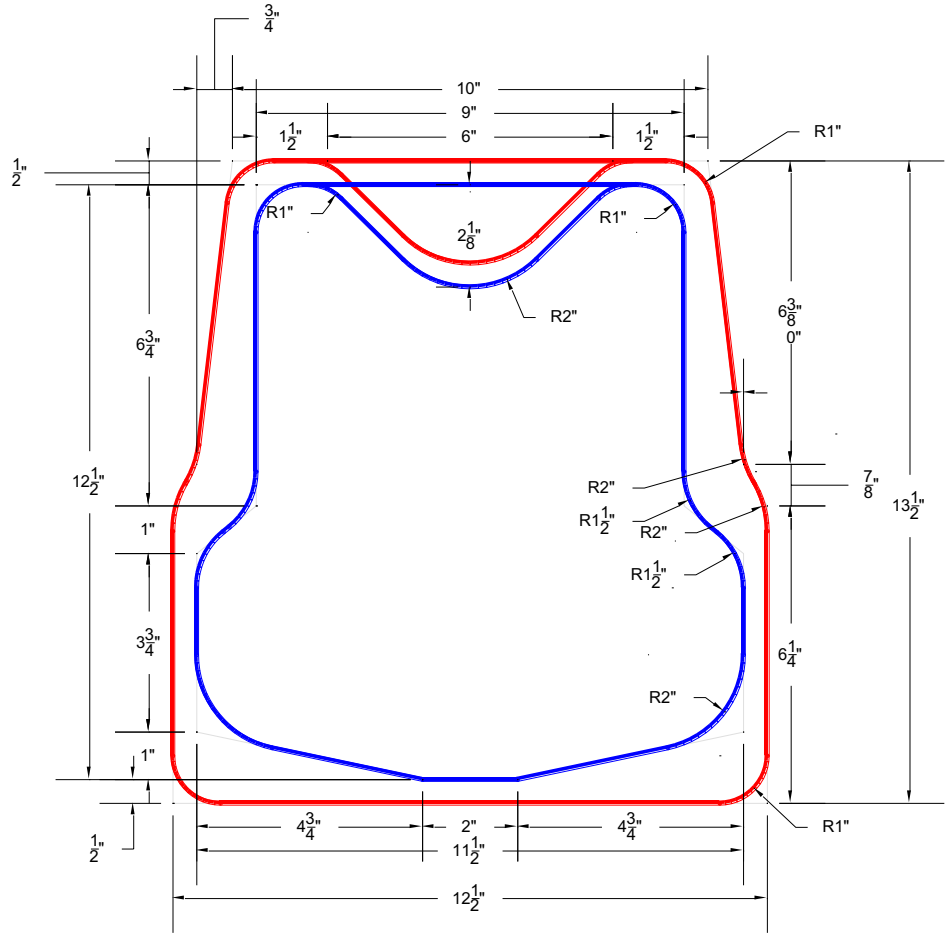
Appendix E: Test Item Size Templates

E.1 This NIJ standard specifies five template sizes for testing soft armor test items:

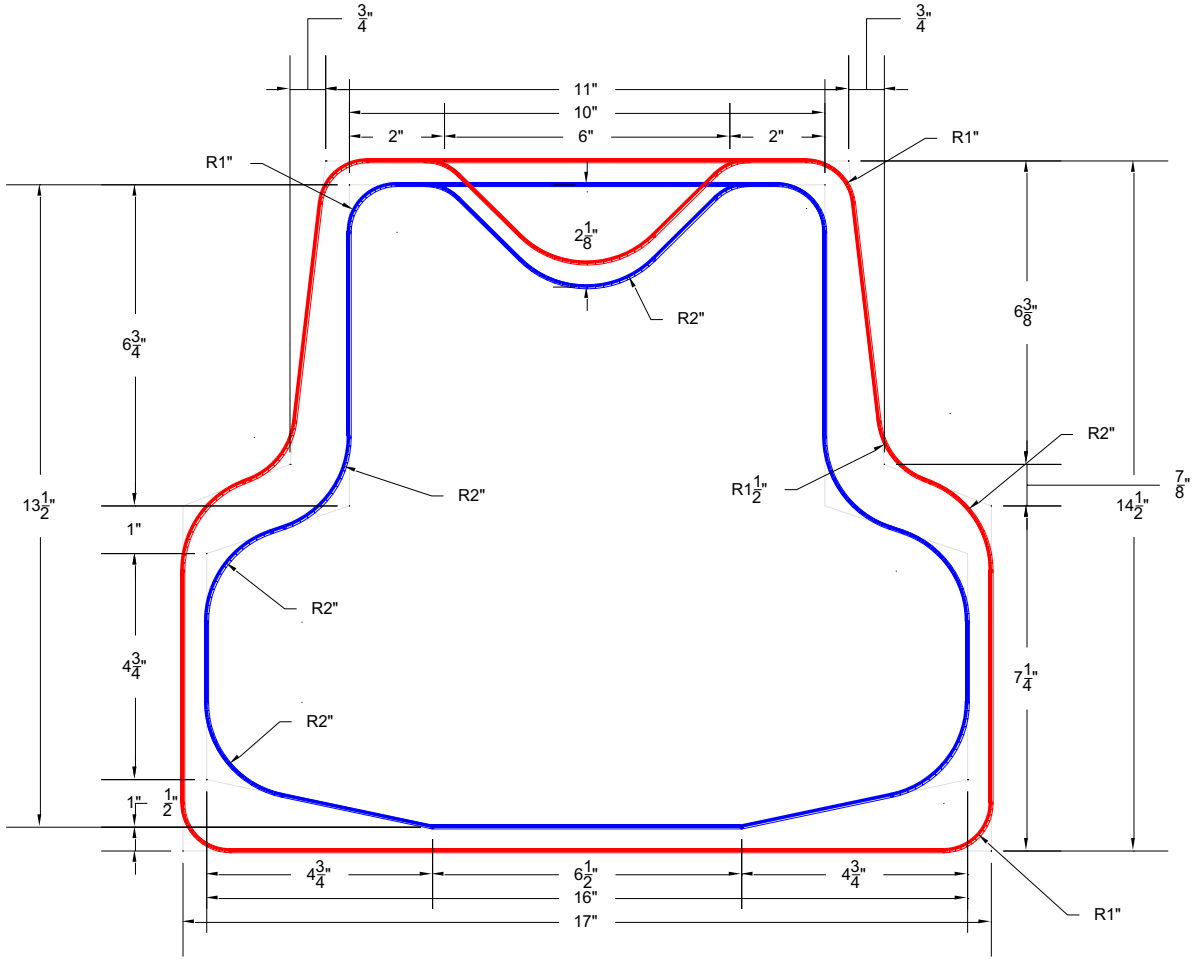
1) NIJ-C-1 (smallest) as shown in Figure E.1.
2) NIJ-C-2 (small) as shown in Figure E.2.
3) NIJ-C-3 (medium) as shown in Figure E.3.
4) NIJ-C-4 (large) as shown in Figure E.4.
5) NIJ-C-5 (largest) as shown in Figure E.5.

E.2 The dimensions and shapes of the templates are shown in the figures on the following pages. The figures show red lines for the maximum test item dimensions and blue lines for the minimum test item dimensions.

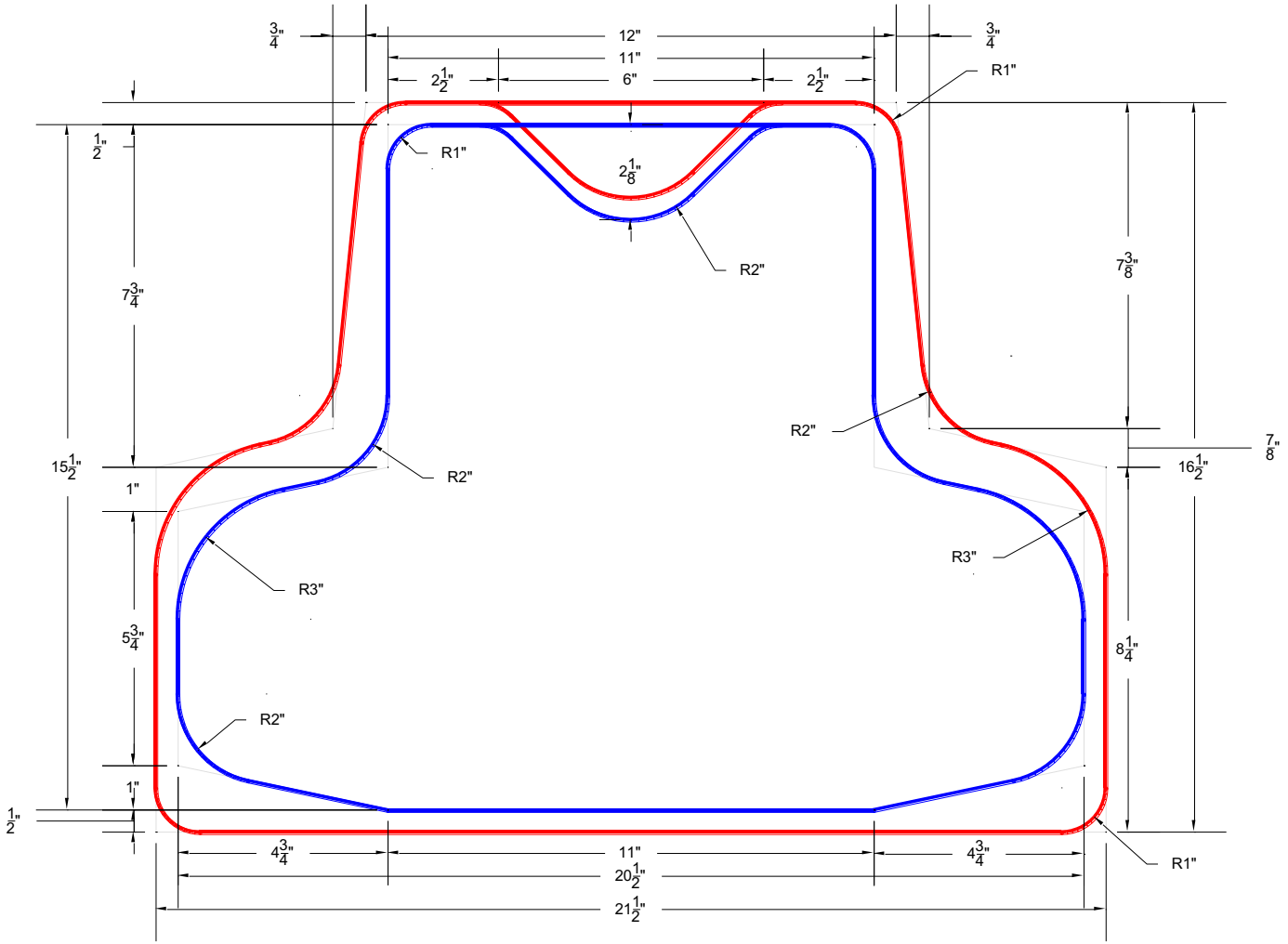
E.3 The figures show the templates with and without a “neck scoop” at the top of each. The neck scoop indicates the front panel.



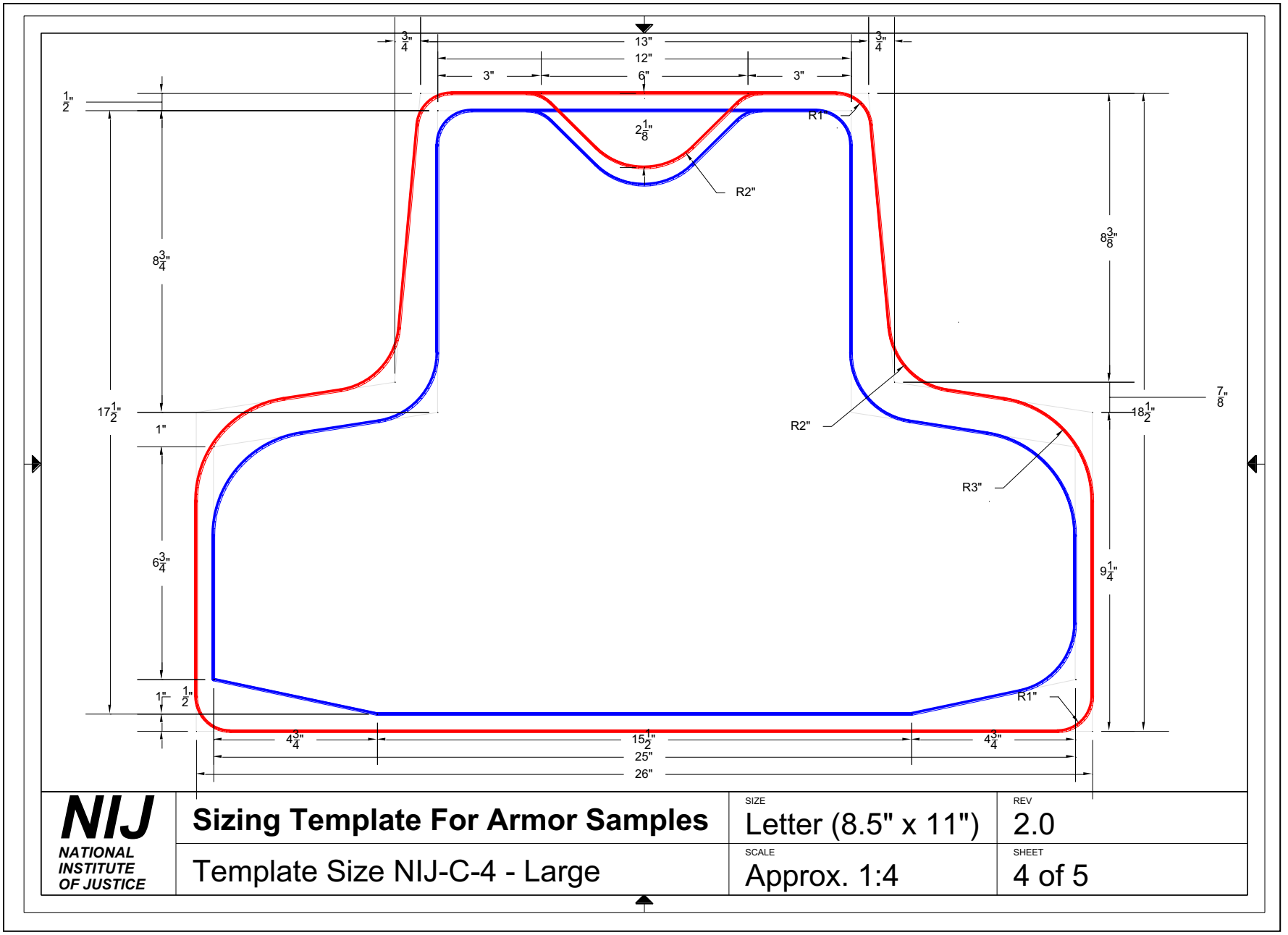
NIJ NATIONAL INSTITUTE OF JUSTICE	Sizing Template For Armor Samples	SIZE Letter (8.5" x 11")	REV 2.0
	Template Size NIJ-C-1 - Smallest	SCALE Approx. 1:4	SHEET 1 of 5



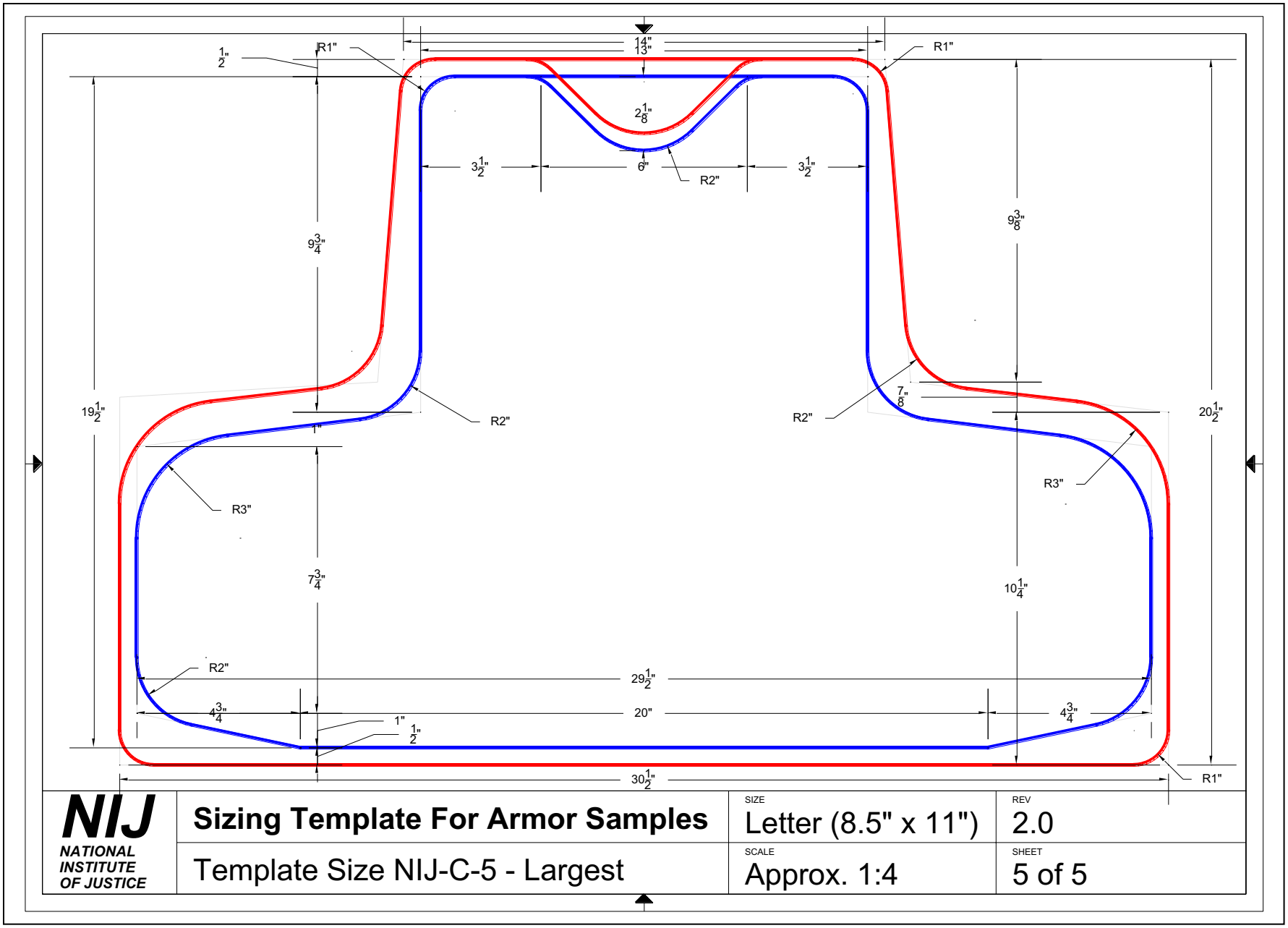
NIJ NATIONAL INSTITUTE OF JUSTICE	Sizing Template For Armor Samples	SIZE Letter (8.5" x 11")	REV 2.0
	Template Size NIJ-C-2 - Small	SCALE Approx. 1:4	SHEET 2 of 5



NIJ NATIONAL INSTITUTE OF JUSTICE	Sizing Template For Armor Samples	SIZE Letter (8.5" x 11")	REV 2.0
	Template Size NIJ-C-3 - Medium	SCALE Approx. 1:4	SHEET 3 of 5



NIJ NATIONAL INSTITUTE OF JUSTICE	Sizing Template For Armor Samples	SIZE Letter (8.5" x 11")	REV 2.0
	Template Size NIJ-C-4 - Large	SCALE Approx. 1:4	SHEET 4 of 5



NIJ NATIONAL INSTITUTE OF JUSTICE	Sizing Template For Armor Samples	SIZE Letter (8.5" x 11")	REV 2.0
	Template Size NIJ-C-5 - Largest	SCALE Approx. 1:4	SHEET 5 of 5

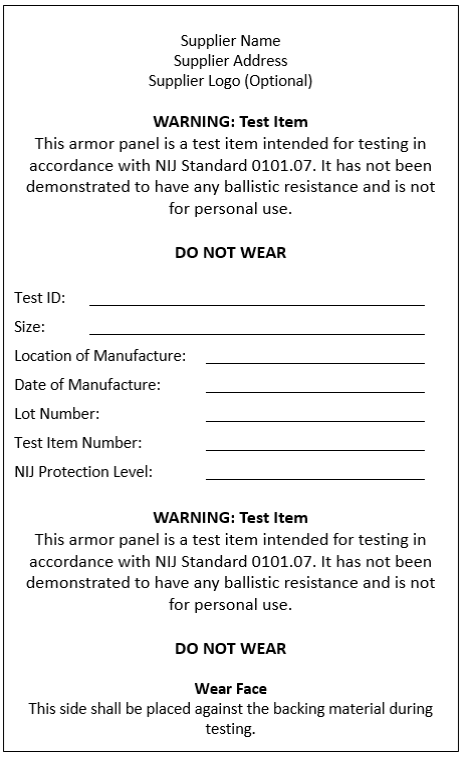
Appendix F: Label Requirements

F.1. Label Content Requirements

F.1.1. The label shall be permanently attached to the face of the test item. The label shall contain the following information (an example is provided in Figure F.1):

- Name, registered trademark or other identification of the supplier.
- The NIJ protection level.
- Reference to NIJ Standard 0101.07.
- A test ID number or model designation that uniquely identifies the armor design for testing purposes.
- The test item template size.
- A number or serial number that uniquely identifies each test item.
- Location of manufacture.
- Date of manufacture.
- Identification of the proper orientation of the armor panel (i.e., strike face or wear face).

Figure F.1. Example Label



- A warning in larger type than the rest of the type on the label that clearly emphasizes that the panel is a test item that has not yet been demonstrated to provide ballistic resistance and that the armor panel or plate is not intended to be worn. Printing color changes are acceptable but may not be substituted for the type size requirement herein.

F.2. **Label System Tests for Permanency and Durability**

F.2.1. Label System Test Items

F.2.1.1. The test item is the label system being evaluated. See Figure F.2 for a graphic of the label system and the required content to be included on the test item.

F.2.1.2. A total of five test items shall be subjected to testing. Two test items shall be tested in accordance with Section F.2.3, *Resistance to Peeling Test*; three test items shall be testing in accordance in Section F.2.4, *Ink Permanency and Edge-of-Label Test.*

F.2.1.2.1. To facilitate testing, the label assembly on the test items shall be affixed such that the long edges of the label assembly are near the edges of the substrate, as shown in Figure F.2.

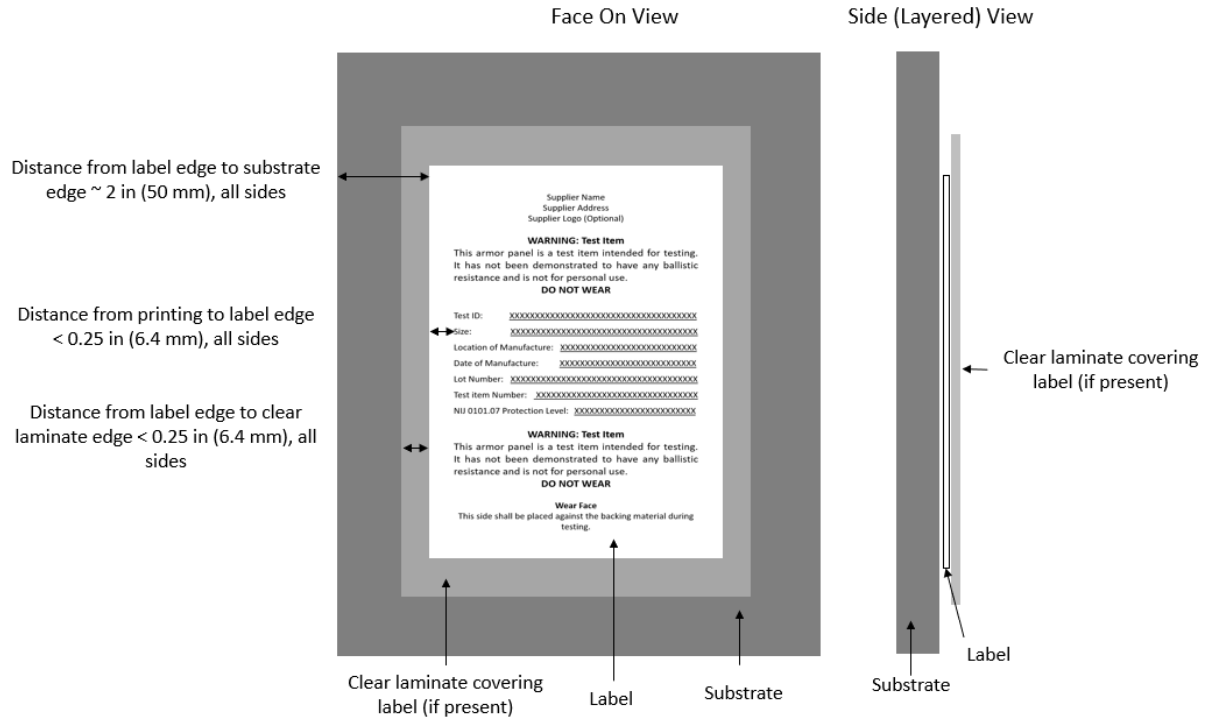
F.2.1.2.2. If a clear laminate is present in the label assembly, its edge shall be less than 0.25 in (6.4 mm) from the long edge of the label.

F.2.1.2.3. The label itself shall be less than 0.5 in (13 mm) away from and parallel to the long edges of the substrate.

F.2.1.3. Special considerations for hard armor systems:

F.2.1.3.1. All substrate systems shall be nominally flat.

Figure F.2. Graphic of Label System



F.2.1.3.2. If the label substrate material is not a stand-alone material (e.g., spray liner or fabric wrap), then the manufacturer shall submit test items with representative substrates applied to a nominally planar surface (e.g., plastic, steel or wood). The surface finish of this material shall be representative of the surface finish that will be present in the finished product.

F.2.2. Visual Examination of Test Items

F.2.2.1. Visually examine each test item for imperfections. Imperfections include areas along the edge of the label or clear plastic laminate that are not in contact with the substrate or areas of the clear plastic laminate that are not in contact with the label.

F.2.2.2. Document any observed imperfections.

F.2.3. Resistance to Peeling Test

F.2.3.1. Quantity of Test Items

F.2.3.1.1. The test item is a label assembly.

F.2.3.1.2. Two test items are required.

F.2.3.2. Equipment and Materials

F.2.3.2.1. Packaging tape: Nominally 2-in wide, clear polypropylene tape with acrylic adhesive, adhesion to steel rating of 27 to 30 oz/in (30 to 34 g/mm).[6]

F.2.3.3. Procedure

F.2.3.3.1. Photograph the test item to document the pre-test condition.

F.2.3.3.2. Place the label assembly on a smooth, flat surface.

F.2.3.3.3. Adhere packaging tape lengthwise to the top surface of the label assembly. The adhered section must begin at the center of the label itself and extend to approximately 0.25 to 0.5 in (6 to 13 mm) beyond a side edge of the label assembly. Firmly press the tape as it is being applied. Allow extra length of tape to form a pull tab.

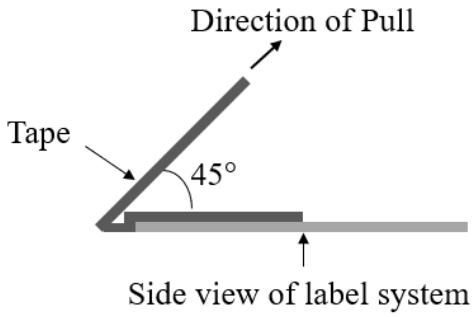
F.2.3.3.4. After waiting 60 seconds, hold the substrate down and use the pull tab, slowly pulling the packing tape by hand toward the label system center at a pull angle of approximately 45°, to remove the packing tape from the label assembly. See Figure F.3.

F.2.3.3.5. Document if any portion of the label assembly was removed from the substrate.

[6] Two examples of available tapes meeting these requirements include: Shurtape AP-401 High Performance Grade Packaging Tape and JVCC OPP-22CC Crystal Clear Packaging Tape.

F.2.3.3.6. Photograph the test item to document the post-test condition.

Figure F.3. Side View of Peel Test



F.2.3.3.7. The label assembly has failed this test if any of the label assembly is removed from the substrate.

F.2.3.3.8. In the event that the first label assembly fails, the test may be stopped.

F.2.3.3.9. Repeat the above steps on the second test item.

F.2.3.4. Test Report

F.2.3.4.1. The results from the peel test and any relevant observations shall be included in the test report.

F.2.4. Ink Permanency and Edge-of-Label Test

F.2.4.1. Test Items

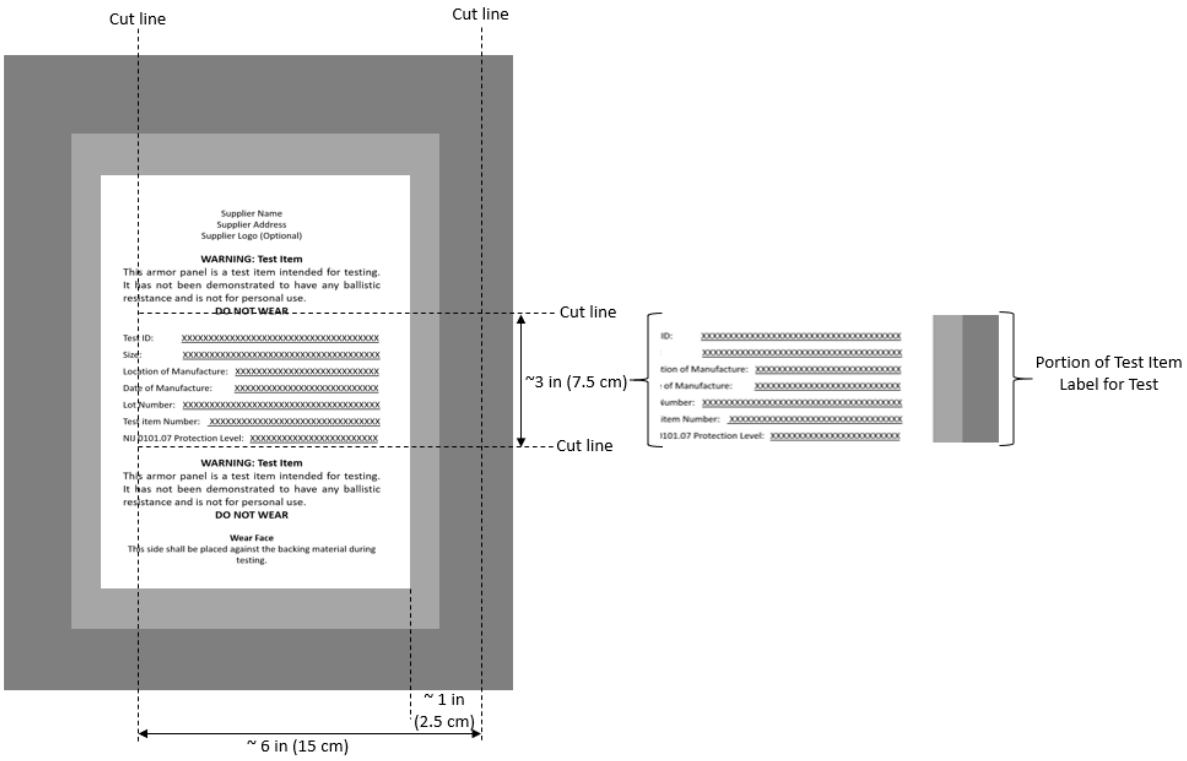
F.2.4.1.1. Three test items are required.

F.2.4.1.2. Test items shall be cut from label assemblies to fit the rubber pad on the ink rub tester base, with the cut portion of the label as shown in Figure F.4.

F.2.4.2. Equipment and Materials

F.2.4.2.1. A Sutherland Ink Rub Tester (SIRT) or equivalent shall be used, with a test weight having mass of 4 lb ± 0.18 oz (1.81 kg ± 5 g), as specified in ASTM D5264. The speed during testing shall be 85 cycles per minute.

Figure F.4. Cutting of Test Item Label to Fit SIRT



F.2.4.2.2. The receptor (in other words, abradant) shall be a swatch of nylon fabric, 200 Denier scoured only, off white color, that is sized to fit the test weight.

F.2.4.2.3. The preparation steps of ASTM D5264, Sections 10.1 through 10.7 shall be followed.

F.2.4.2.4. Two challenge fluids are required.

- Isopropyl alcohol: nominally 70% by volume; commonly available
- Water, oil, and soap mixture with the following formulation:
    - 1 fl oz (30 ml) dish soap
    - 1 fl oz (30 ml) mineral oil
    - 18 fl oz water (532 ml)

F.2.4.2.4.1. Shake the fluid mixture vigorously for a minimum of 30 seconds to mix well before every application.

F.2.4.2.5. This test shall be conducted on a dry test item and then repeated on test items with each challenge fluid.

F.2.4.3. Procedure

F.2.4.3.1. Photograph the test item to document the pre-test condition.

F.2.4.3.2. Place a test item onto the SIRT such that:

1) The test item is positioned on the ink rub testing apparatus such that the rubbing occurs on the face of the label in the long direction of the label.

2) The test item is secured in place and is flat, taut, and unable to move when the test is initiated.

F.2.4.3.3. Place the abradant nylon into the holders on the base of the test weight supplied with the SIRT. Ensure that there are no folds or creases present in the nylon fabric and that it is pulled tight enough to prevent folds and creases from forming during testing.

F.2.4.3.3.1. When challenge fluid is being used, submerse the nylon abradant in the challenge fluid for at least 30 seconds prior to placing it on the test weight.

F.2.4.3.4. Promptly place the test weight and abradant assembly onto the SIRT.

F.2.4.3.5. Run the SIRT for 2,000 cycles, replacing the abradant every 500 ± 100 cycles with a new swatch. When a challenge fluid is being used, the replacement abradant shall have been soaked for at least 30 seconds in the challenge fluid.

F.2.4.3.6. Inspect each test item at the end of the test to check for damage to the test item.

F.2.4.3.6.1. The label system has failed this test if: (1) the edge of the label is worn away or (2) the edge of the label is detached by any amount.

F.2.4.3.6.2. The label system has failed this test if any printed portion of the label becomes illegible through the course of the testing described above.

NOTE: The label system has not failed if the characters on the label remain intact despite significant damage occurring to the label assembly. Damage to any clear plastic laminate coating, if present over the label, does not count as damage to the label.

F.2.4.3.7. Photograph the test item to document the post-test condition.

F.2.4.3.8. In the event a test item fails, the test may be stopped.

F.2.4.3.9. Repeat the above steps for the remaining test items.

F.2.4.4. Test Report

F.2.4.4.1. The results from the ink permanency and edge-of-label test and any relevant observations shall be included in the test report.

Appendix G: Guidance for P-BFD Testing of Soft Armor Designed for Female Wearers

G.1 Location of Shaping Features

G.1.1 Using the supplier-provided dimensioned diagram, locate on each test item the stitches, seams, folds, and other shaping features. If overlaps of material exist in the test item, the direction of overlap of the subcomponents of the test item shall be documented. These features shall be marked on the test item panel cover.

G.2 P-BFD Shot pattern (i.e., shot location, angle, and direction) marking

G.2.1 The guidelines below shall be followed for clearly marking the intended shot pattern directly on the test item panel cover:

1) Markings for each shot shall indicate the shot location, angle of incidence, and direction from which the shot will impact the test item.
2) The shot patterns listed in Table G.1 shall be followed unless modification is necessary to exploit potential areas of weakness.
3) Typically, the shot pattern for the first test item will follow the guidance provided below. The shot patterns for subsequent test items should be modified as necessary based on observed results.

Table G.1. Shot Pattern Summary Table for Test Items with Stitch Patterns (i.e., Darted and Princess Cut) Forming Bust Cups

Shot #	Larger test item 1 Smaller test item 2	Larger test item 2 Smaller test item 4	Larger test item 3 Smaller test item 6	Larger test item 4 Smaller test item 8
Shot 4	• Adjacent to overlap near apex 1 • Angle at 30° into the overlap seam	• Adjacent to overlap near apex 2 • Angle at 45° into the overlap seam	• ½-in offset from overlap near apex 1 • Angle at 30° into the overlap seam	• ½-in offset from overlap near apex 2 • Angle at 45° into the overlap seam
Shot 5	• Angle at 45° in same direction as shot 4	• Angle at 30° in same direction as shot 4	• Angle at 45° in same direction as shot 4	• Angle at 30° in same direction as shot 4
Shot 6	• At 0° angle of incidence	• At 0° angle of incidence	• At 0° angle of incidence	• At 0° angle of incidence

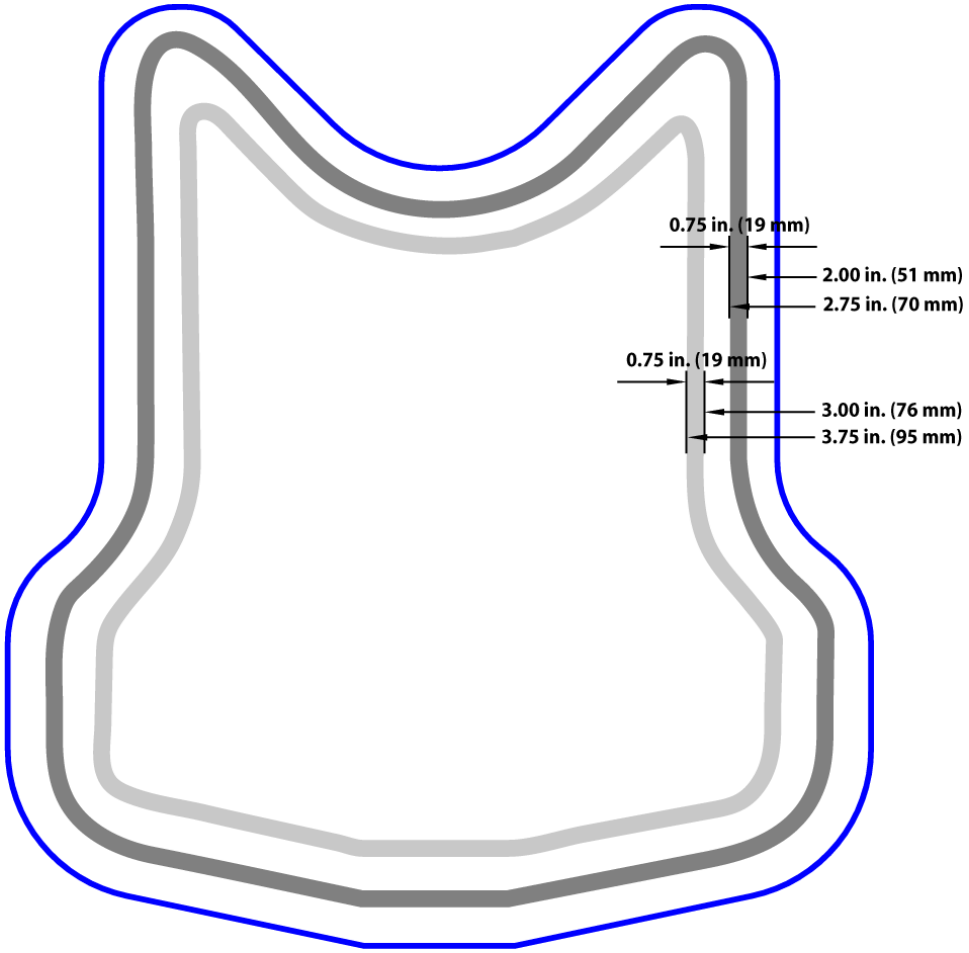
G.3 P-BFD Testing

G.3.1 The P-BFD shots 1 through 6 shall be placed according to ASTM E3107, Section 11.2, with the following modifications:

G.3.1.1 Placement of shots 1, 2, and 3 (i.e., edge shots) should avoid seams or areas of overlap, while meeting the shot spacing requirements of ASTM E3107. For each test item, shots 1, 2, and 3 shall meet the shot-to-edge distance requirements but shall be located not more than the shot-to-edge distance plus 0.75 in (19 mm) from the edge of the test item.

G.3.1.1.1 These shots shall be moved to different locations within the shaded band shown in Figure G.1. The light gray band applies to the greater mass test threat, and the dark gray band applies to the lesser mass test threat.

Figure G.1. Shot Plaement for Shots 1, 2, and 3 on NIJ-C-1 Test Item.



G.3.1.2 Placement of shots 4, 5, and 6 (i.e., cluster shots) shall be considered simultaneously and shall meet the requirements of Table G.1; however, the shot-to-edge and shot-to-shot distances shall be met for all shots, and if necessary, the shot locations shall be moved toward the centerline to meet the shot-to-edge distance requirement

G3.1.2.2 Placement of shot 4

a) First test item of a given size

i) Shot 4 shall be used to challenge the apex of either the left or right bust cup.

ii) For hybrid designs where multiple stitch patterns are used throughout the layup, the strike face stitch pattern shall be used to determine shot placement.

iii) The overlap on the strike face shall be identified, and shot 4 shall be angled into the overlap seam. See Figure G.2 for placement of shot 4 with respect to the overlap. See Figure G.3 for examples of shot placement in regions of horizontal overlap.

b) Second test item of a given size

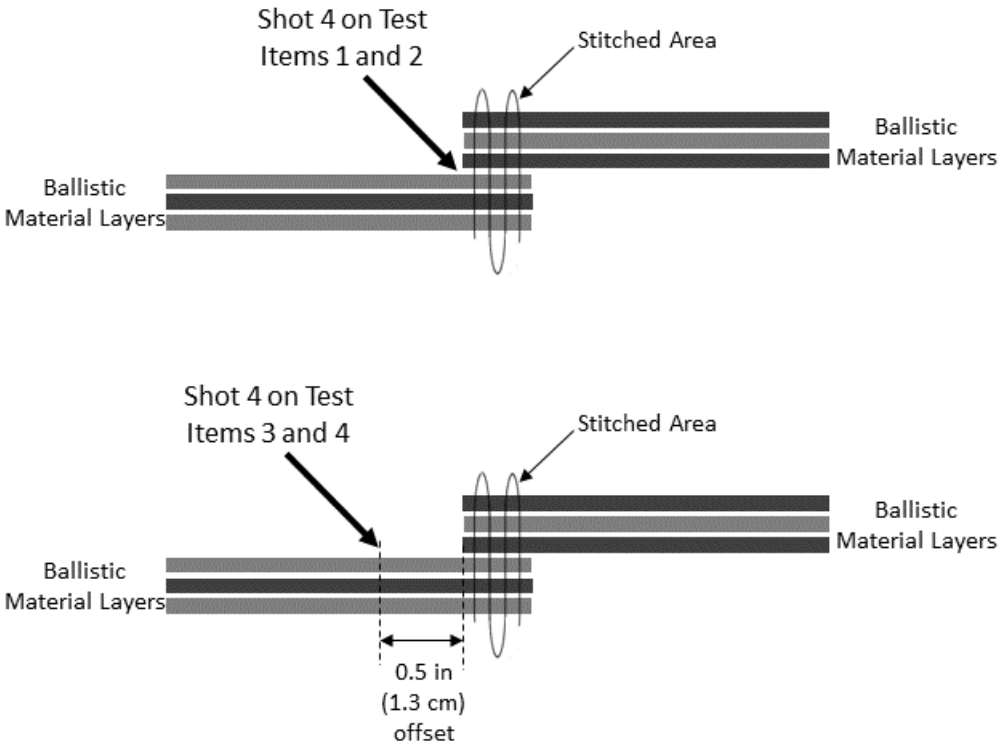
i) Shot 4 on test item 2 shall challenge the other bust cup apex.

ii) The same modifications listed in Section G.3.1.2.2, a) for vertical and horizontal seams shall be followed.

c) Third and fourth test items of a given size

i) For test items where this position represents an overlap in material, the shot shall be offset to the nearest point on the test item where no overlap exists.

Figure G.2. Shot 4 Placement Near Strike Face Overlap.



G.3.1.2.3 Placement of shot 5

a) Shot 5 shall be placed according to ASTM E3107, Section 11.2, following the surface of the test item. Shot 5 shall be shifted slightly to avoid placing shots 4

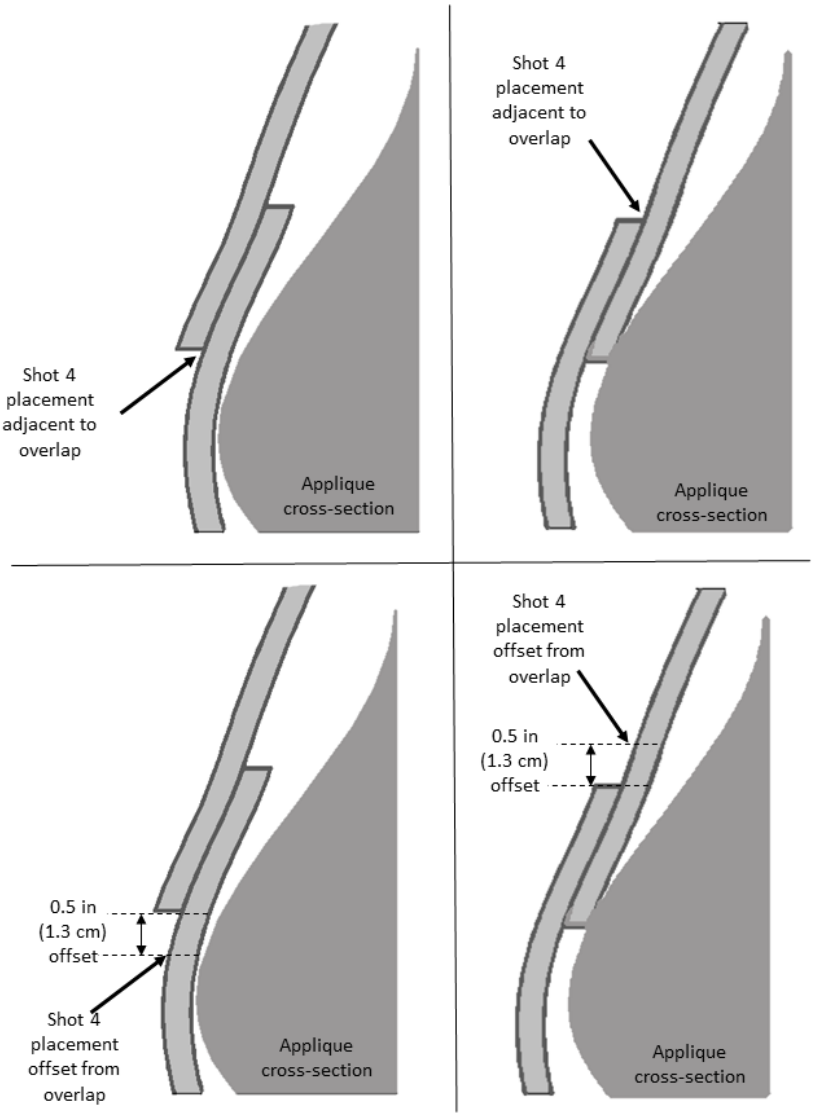
and 5 along the same vertical or horizontal lines while adhering to the 3.94 in (100 mm) diameter circle.

b) The location for shot 5 may be altered by rotating around the shot 4 location.

c) Ensuring that shot spacing requirements are met, the location of shot 5 should not be on an overlap where possible but may be adjacent to or offset from an overlap.

d) Shot 5 shall be taken in the same direction as shot 4.

Figure G.3. Examples of Shot Placement in Regions of Horizontal Overlap.



G.3.1.2.4 Placement of shot 6

a) For the first test item of a given size in the test series, shot 6 shall be placed according to ASTM E3107, Section 11.2, following the surface of the test item.

b) Ensuring that shot spacing requirements are met, the location of shot 6 should avoid an area of overlap where possible.

G.4 Creation of appliques and placement of the test item on the clay block

G.4.1 The NIJ CTP shall provide the electronic design files for the applique molds and shaping molds to the NIJ-approved testing laboratories. Electronic design files will be provided to other organizations upon request.

NOTE: There are 4 molds required:

(1) Smaller applique mold (for making clay appliques)

(2) Smaller shaping mold (for conforming the clay appliques to the shape of the test items)

(3) Larger applique mold

(4) Larger shaping mold

G.4.2 The steps for creating the applique for a female front panel, placing the applique on the clay block, and placing the test item on the clay block are specified below:

(1) Select either the smaller or larger applique mold, as appropriate for the test item size.

(2) Select Roma Plastilina #1 clay that has been temperature conditioned for a minimum of 3 hours in a chamber having conditions as specified in ASTM E3004.

(3) Place a layer of thin plastic wrap, or similar material, into the applique mold to assist with removal of the applique from the mold.

(4) Work the conditioned clay into the applique mold until the mold is completely filled and no voids are present. If necessary, use a draw knife, or similar device, in contact with two parallel edges of the mold to strike the clay to create a planar surface.

(5) Remove the clay applique from the mold, keeping the plastic wrap attached to the applique.

(6) Position the test item, wear face up, on the shaping mold and place the applique on the wear face, matching the appropriate face of the applique to the test item.

(7) Using a uniformly shaped (not tapered) cylinder as a rolling pin, roll the applique into the test item so that the clay conforms to the shape of the test item.

(8) Remove the applique and test item from the shaping mold.

(9) Separate the applique from the test item.

(10) Place the applique on the conditioned clay block with the flat side against the clay block. Remove the plastic wrap from the applique.

(11) Hand form warm clay into a long, thin strip. Place the strip around the perimeter of the applique at the interface with the clay block and press the clay strip into the interface to ensure that the applique remains adhered to the clay block during testing.

NOTE: Care is required to ensure that the shape of the applique is not significantly changed while affixing it to the clay block.

(12) Place the test item on the applique, aligning the test item appropriately with the shape of the applique.

Appendix H. Flowcharts for Testing

Figure H.1. Soft Armor Procedure Flowchart for P-BFD Testing

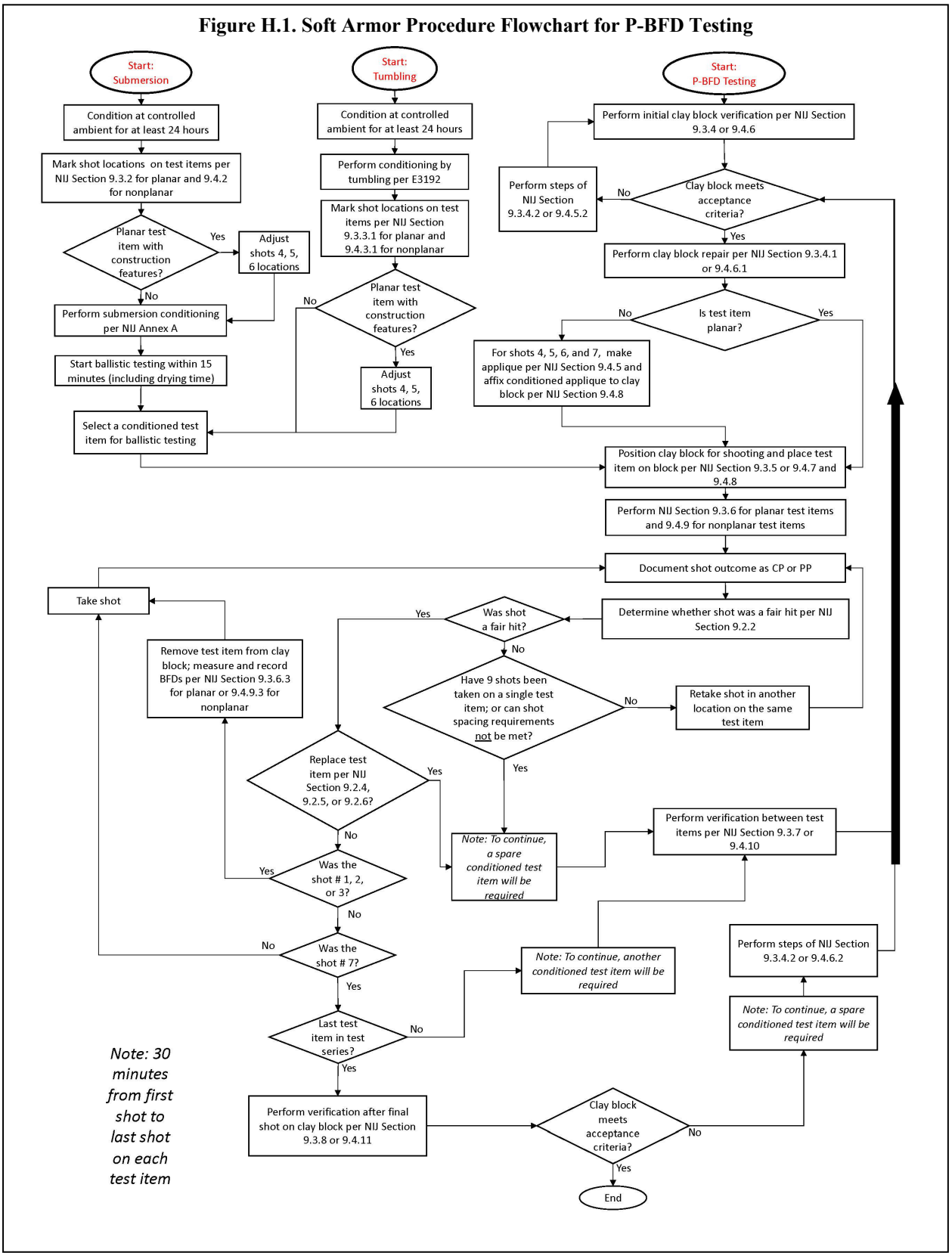


Figure H.2. Soft Armor Procedure Flowchart for Ballistic Limit Testing

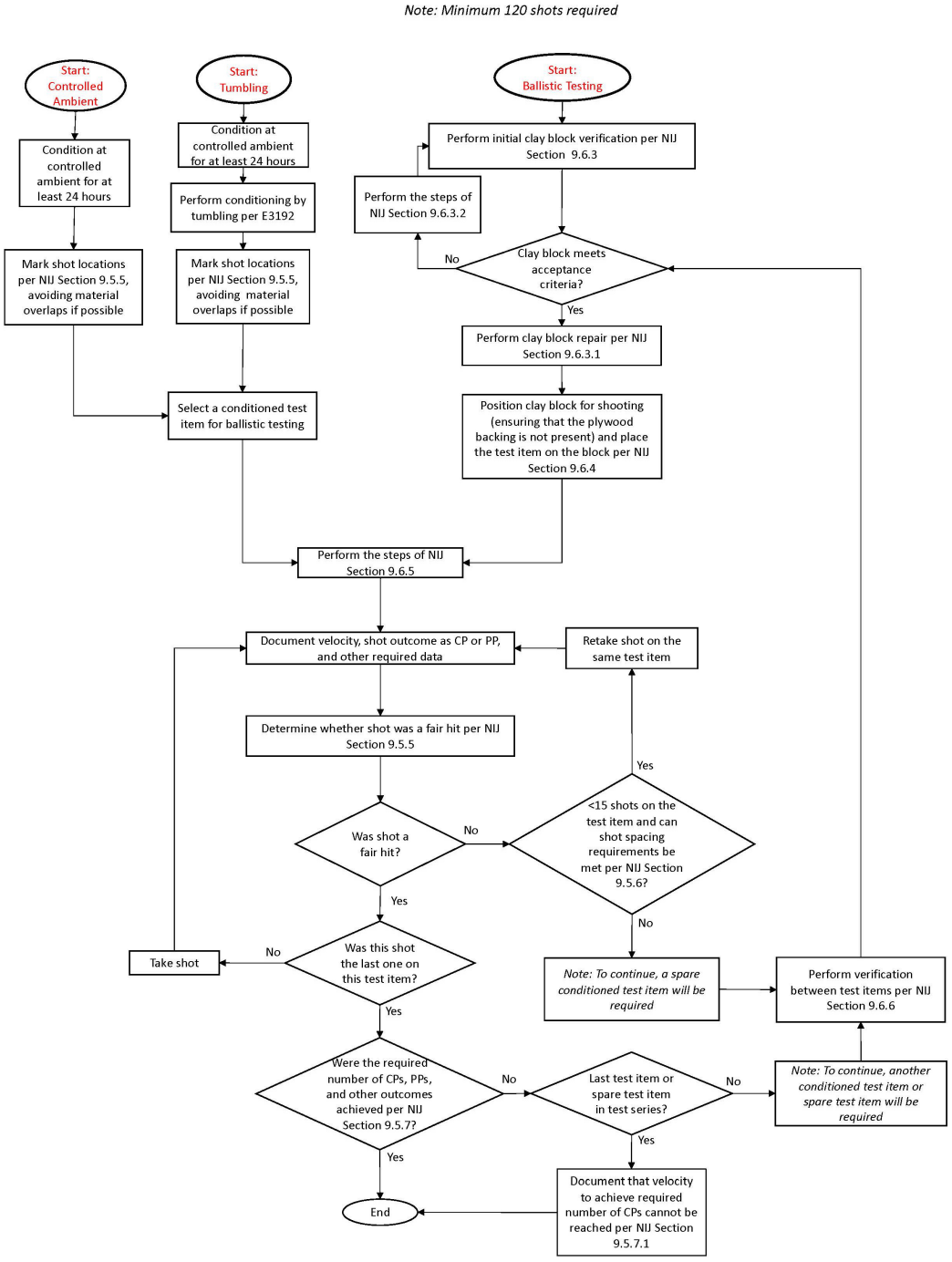


Figure H.3. Hard Armor Procedure Flowchart for P-BFD Testing

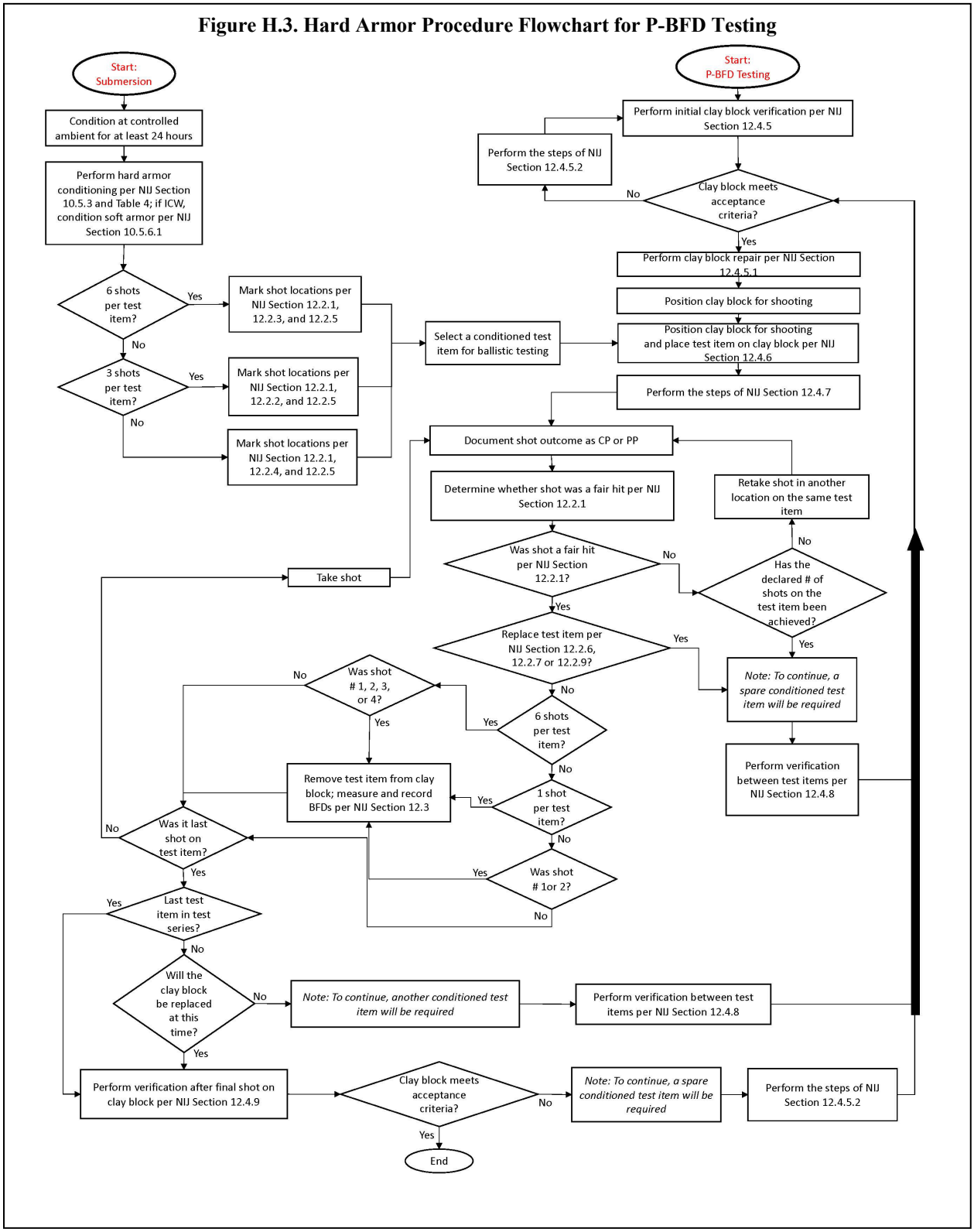
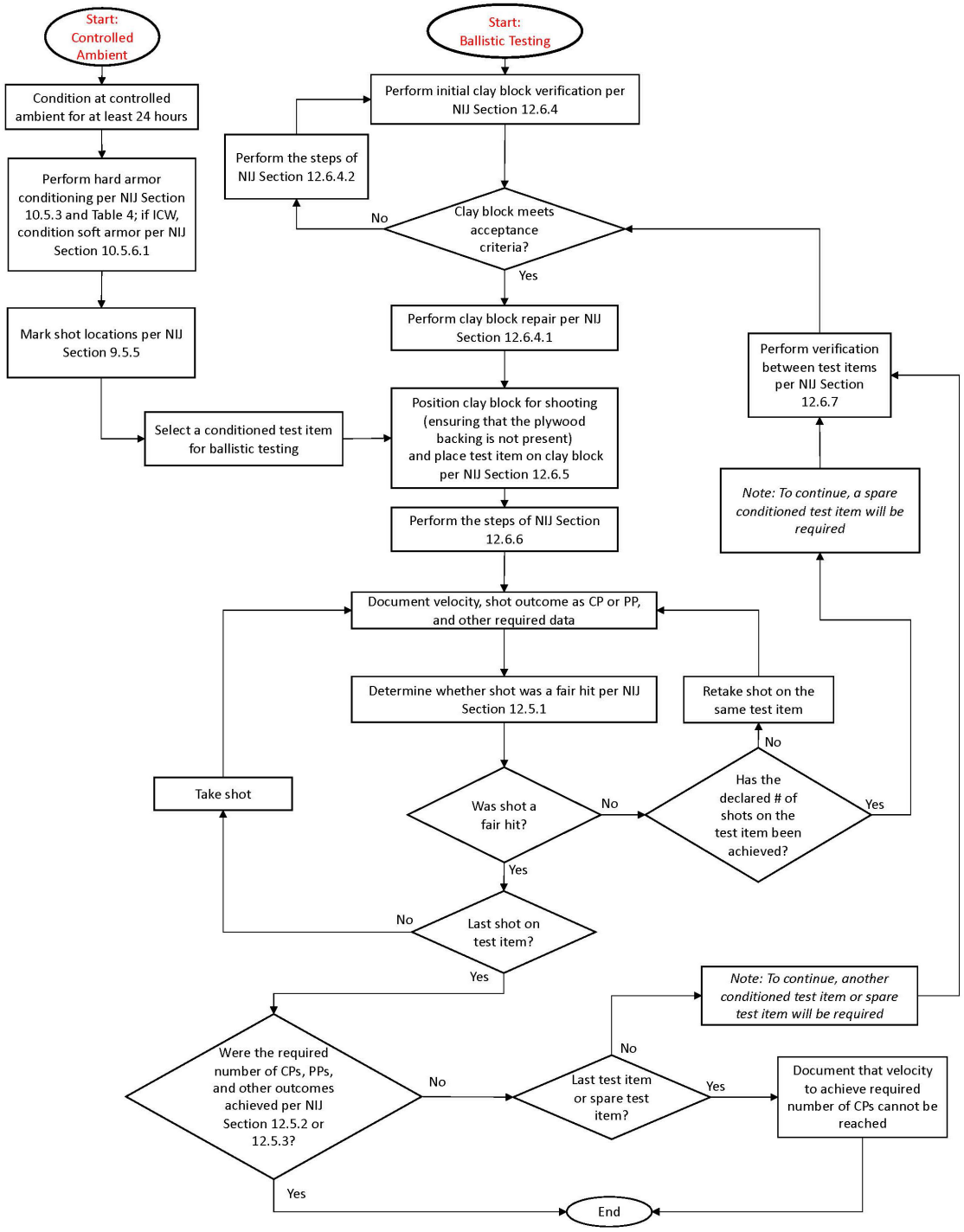


Figure H.4. Hard Armor Procedure Flowchart for Ballistic Limit Testing



About Standards and Conformity Assessment at the National Institute of Justice

NIJ standards and conformity assessment activities are conducted by NIJ's Office of Technology and Standards (OTS). OTS works to identify the needs of state and local criminal justice system practitioners for equipment standards and test protocols, develops voluntary performance standards for specific criminal justice tools and technologies, establishes conformity assessment requirements for demonstrating that commercially available equipment conforms to those standards, and publishes listings of product models that have been tested through one or more specified organizations and found to comply with the standards.

The standards development process begins with gathering the operational needs and requirements of practitioners in the field. Based on those needs and requirements, the standards are developed in coordination with a special technical committee composed of criminal justice practitioners, testing experts, other technical experts, federal partners, and members from practitioner-stakeholder organizations. Manufacturers, vendors, and other interested parties are provided with an opportunity to review and comment on draft standards prior to their publication.

All NIJ standards are voluntary standards. There is no requirement or obligation for manufacturers, law enforcement or corrections agencies, or others to follow or adopt these voluntary law enforcement technology equipment standards. The primary intent of these standards is to provide end users and equipment producers with performance criteria on equipment characteristics and allow comparison of product models based on standardized testing methods and performance requirements. These standards do not specify a particular solution but rather define what a potential solution must accomplish. Conformity assessment based on NIJ standards, such as testing and certification, provides a level of confidence in that particular model's fitness for use in specified circumstances. The ultimate goal is to help ensure, to the degree possible, that law enforcement and corrections equipment is safe, reliable, and effective.

NIJ's standards and conformity assessment activities are responsive to provisions in the Homeland Security Act of 2002 that authorize NIJ to establish and maintain performance standards (in accordance with the National Technology Transfer and Advancement Act of 1995) for law enforcement technologies that may be used by federal, state, and local law enforcement agencies, and to test and evaluate those technologies. The Homeland Security Act of 2002 also authorizes NIJ to establish and maintain a program to certify, validate, and mark or otherwise recognize law enforcement technology products that conform to the standards mentioned above.

NIJ standards, including this standard, are available at no charge online at https://nij.ojp.gov/active-nij-standards-and-comparative-test-methods. Users of NIJ standards are advised to check that page regularly to determine whether a particular law enforcement technology equipment standard has been revised or superseded, or if the compliance status of a particular model has changed as applicable.

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