NIJ STANDARD–0101.04
BALLISTIC RESISTANCE OF PERSONAL BODY ARMOR

ADDENDUM B

1. PURPOSE

This addendum provides clarification and changes to the text, methodology, and procedures of the National Institute of Justice (NIJ) Standard–0101.04, "Ballistic Resistance of Personal Body Armor," document NCJ 183651, originally published in September 2000. The preceding addendum, "A," was published in 2001. This second addendum is published in continuing recognition of the dynamic, evolving basis of the NIJ body armor standard, and reflects NIJ's commitment to actively monitor and improve upon the standard. Before citing this, or any other NIJ standard in a contract document, users should verify that the most recent edition of the standard is used. Users of NIJ Standard-0101.04 are strongly encouraged to obtain the latest version of the standard document, available online from the NIJ Compliance Testing Office, www.justnet.org. Users may also write to the Director, Office of Law Enforcement Standards, National Institute of Standards and Technology, 100 Bureau Drive, Stop 8102, Gaithersburg, MD 20899–8102 to obtain a printed copy.

Technical comments and recommended revisions are welcome. Please send all written comments and suggestions to the Assistant Director, National Institute of Justice, Office of Science and Technology, 810 7th St., NW, Washington, DC 20531. Questions or requests for additional information about this document should be submitted in writing to the NIJ Body Armor Compliance Test Program, NLECTC-National, 2277 Research Boulevard M/S 8J, Rockville, MD 20850, Attn: Compliance Test Program Manager, or to: asknlectc@nlectc.org.

2. SCOPE

Clarification is provided for the methods and procedures in the following existing sections of the standard:

3.1	Accessory Ballistic Panels (new definition)
3.5	Backface Signature (BFS)
4.1	Acceptance Criteria
4.6	Ballistic Penetration and Backface Signature Criteria
4.7	Sampling
4.8	Armor Backing Material
5.5	Velocity Measuring Equipment
5.6	Wet Conditioning
5.7	Backing Material Fixture Preparation
5.8	Workmanship Examination
5.12	Firing Sequence for Type I, IIA, II, and IIIA Armor
5.16	P-BFS Test for Groin and Coccyx Protectors
5.22	Ballistic Limit Retesting of Compliant Armor
6.1	Test Documentation
	Appendix A

3. ADDENDUM ITEMS

Changes to the text in the standard are formatted in *italics* for clarity. All item numbering reflects the new section number for the revised standard.

3.1 Accessory Ballistic Panels

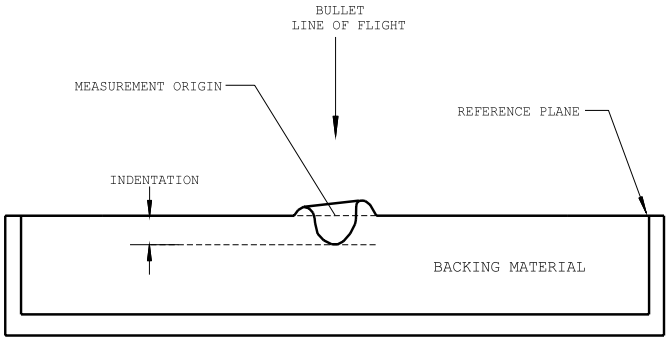
Accessory ballistic panels are armor components which are detachable or removable from the primary body armor sample, and are intended to provide comparable ballistic protection. Examples include groin, coccyx, and side protection panels which are attachable or inserted into the external armor carrier, but are not integral to the protective ballistic elements of the primary armor sample.

3.4 Armor Sample

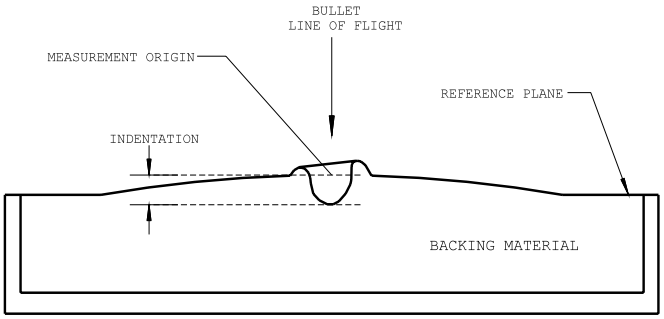
One complete armor garment comprised of a single wraparound style jacket, *or any combination of front, back, and accessory armor ballistic panels.*

3.6 Backface Signature (BFS)

The *deepest* depth of the depression made in the backing material, created by a nonpenetrating projectile impact, measured from the *reference* plane, *which is* defined by the front edge of the backing material fixture. For armor tested on built up or curved backing material, the BFS is measured *to the deepest point of indentation from the measurement origin.*



0-DEGREE ANGLE OF INCIDENCE



4.1 Acceptance Criteria

Each submitted armor sample that has successfully met the P-BFS requirements of sections 4.6, 5.4, and table 1, will also be tested to determine a baseline Ballistic Limit velocity (sec. 5.17), to be used for any future NIJ retest examination of that armor model (sec. 5.22). After P-BFS *compliance* testing, if the sample's construction is found inconsistent, then the baseline Ballistic Limit test will *either not be performed or declared non-applicable to that model designation* and the *compliance* test results shall be declared inconclusive.

4.6 Ballistic Penetration and Backface Signature Criteria

Each part of one complete body armor sample shall be tested for resistance to ballistic penetration and backface signature (depth of depression in backing material) after wet conditioning in accordance with the procedures in section 5.0. *A complete penetration or BFS measurement* in the backing material greater than 44 mm (1.73 in) by any fair hit (as defined in sec. 3.14) shall constitute a failure.

4.7.4 Accessory Panels

Groin and Coccyx Protectors – A minimum of eight groin or coccyx protectors, complete with their external carriers or covers will constitute a compliance test group. If, at the discretion of the NIJ CTP or test laboratory, the sizing of the protectors is such that fewer than three impacts can be fairly and evenly spaced on the item, the manufacturer shall be required to supply additional test samples in order to complete the full compliance test series (sec. 5.16.1).

Removable Side Protection Panels – The manufacturer shall submit, based upon size, an adequate number of removable side panels and external carriers or covers in order to complete the full compliance test series described in section 5.16.2. The number of impacts per test sample shall be determined by the fair hit impact spacing criteria of section 3.14. If, at the discretion of the NIJ CTP or test laboratory, the size or shape of the side panel is such that no more than one impact can be fairly taken on the item, the manufacturer shall be required to supply additional test samples to complete the test series (sec. 5.16.2). Figure 5 provides general examples of removable side panel sizes and impact locations. Test samples which are not appropriately sized for testing will result in rejection of the armor model for compliance testing.

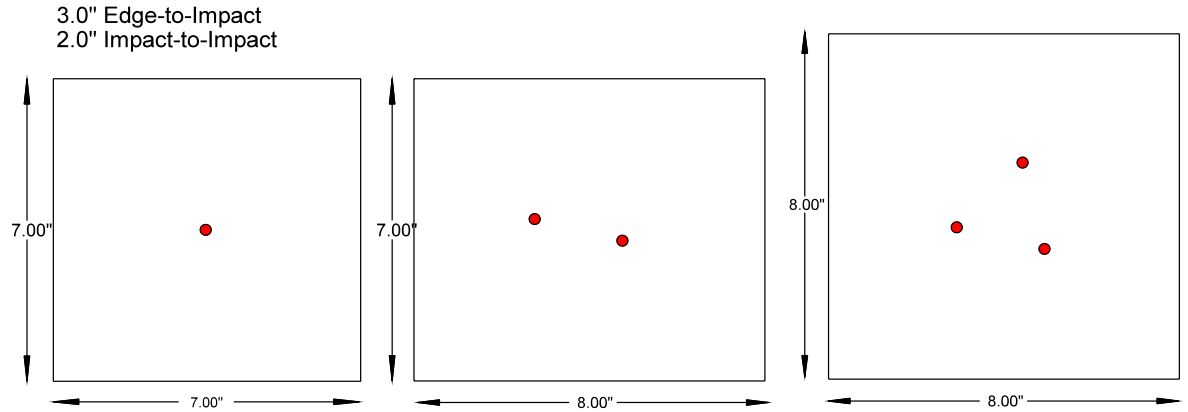


Figure 5. General Examples of Removable Side Panel Sizes and Impact Locations

4.8.3 Backing Material

It has been determined that Roma Plastilina No.1 oil-based modeling clay is acceptable for the backing material application. In the interest of *interlaboratory testing* conformity only, it is being specified as the designated backing material for all NIJ Standard-0101.04 Body Armor Compliance Testing. This material is available from art supply stores.

5.5.4 Calibration

Velocity measuring instrumentation shall be calibrated for *time base accuracy* according to the manufacturer's instructions. Calibration shall be accomplished at the following intervals:

(a) Prior to any NIJ laboratory certification for compliance testing.
(b) Prior to any NIJ recertification of the testing laboratory.
(c) As recommended by the equipment manufacturer.
(d) Annually.

5.6.2 Spray Conditioning Equipment

The minimum conditioning surface area of the spray enclosure *shall* be 762 mm x 762 mm (30.0 in x 30.0 in). This surface should be constructed of a material *that permits* the unobstructed flow of water through it, without allowing build-up on the *armor panel's* spray facing surface. The enclosure shall be constructed in such a manner that the flow of water cannot accumulate, to prevent complete immersion of the armor panel. *Suitable single or multiple spray delivery devices that deliver the correct flow rate and provide uniform coverage of the conditioning surface area shall* be mounted in the top of the enclosure.

5.6.3 Conditioning Requirements

The average *spray* flow rate shall be 100 mm/h ± 20 mm/h (4.0 in/h ± 0.8 in/h), determined by calculating the arithmetic mean of five rain gauges symmetrically arranged within the prescribed conditioning surface area (sec. 5.6.4, b). The source water temperature shall be 10 ºC to 21 ºC (50 ºF to 70 ºF).

5.7.5 Backing Material Calibration

Drop test calibration of the Roma Plastilina No. 1 clay backing material shall be accomplished before every six shot armor panel test sequence (sec. 5.4, table 1). *Failure to meet drop test depth requirements will result in the invalidation of the previous six shot series and require a new conditioned and drop test calibrated backing material fixture be used. A post test drop series shall also be performed after each test caliber's 24 shot series (sec. 5.12.4.17). All drop test calibration results shall be recorded in the CTR.* Calibration shall be accomplished using the equipment and techniques specified below:

5.7.7 Backing Material Fixture Rotation

A newly conditioned and drop test calibrated backing material fixture shall be used *for each threat specific 24 shot series of firings (sec. 5.4, table 1) and* whenever *drop test* results dictate. It is recommended that a minimum of two fixtures be rotated *between* test and conditioning cycles to ensure meeting these requirements.

5.8.2 Ballistic Panels

Post Test - Each armor sample's ballistic components (e.g., front and back panels) shall be physically inspected immediately after *P-BFS* testing, *before ballistic limit testing,* and their respective configuration reported in the CTR (layers, weave, stitching, material, etc.). *Any inconsistency in the components will result in the compliance test being declared inconclusive in accordance with sec. 4.1.*

5.12.4.15 (re-numbered from 5.12.4.16)

Test Second Armor Panel: Mount the rear panel of the armor sample to *the repaired and drop test calibrated backing material fixture, or if necessary, a newly conditioned and drop test calibrated fixture,* and repeat the test sequence above using the same test round from section 5.4, table 1 as required for the armor type being tested. Record all results *in* the CTR.

5.12.4.16 (re-numbered from 5.12.4.17)

Test Second Armor Sample: Repeat the sequence above (sec. 5.12.4.1 – 5.12.4.15) for armor sample 2, using the same test round as used for armor sample 1. The same backing material fixture may be used if it remains in compliance with *drop test criteria* (sec. 5.7.5). Record all results *in* the CTR.

5.12.4.17 (re-numbered from 5.12.4.15)

Post Test Drop Calibration: Without repairing the *measured* BFS depressions from the *second armor sample's* firing sequence, perform five drop tests on the backing material in the general areas of figure 5. Post test drop locations shall be at least 51 mm (2.0 in) away from any BFS depression or other drop impact. Record all measurements *in* the CTR and determine compliance with drop *test* calibration criteria *(sec 5.7.1).* Failure to meet clay backing material *drop test* calibration specifications invalidates the previous six shots.

5.12.4.18

Test Third Armor Sample: *Replace the backing material fixture with a newly conditioned and pretest drop calibrated backing material fixture. Repeat the test sequence above using test round number two from section 5.4, table 1.* Record all results *in* the CTR.

5.16 P-BFS Test for Accessory Ballistic Panels

For the purposes of compliance testing to this standard, accessory ballistic panels are defined according to section 3.1.

5.16.1 Groin and Coccyx Protectors

A minimum of eight individual groin or coccyx protectors and their external carriers shall be supplied to permit P-BFS testing in accordance with sec. 5.4, table 1. Each protector shall be tested in its external carrier. Each protector shall be impacted with three evenly spaced fair hits at 0° obliquity (24 shots total). A single BFS depth measurement shall be taken on the first fair hit impact for each test caliber, for a total of two BFS measurements. P-BFS failure (sec. 4.6) of any groin or coccyx protector will constitute a compliance test failure of the model designation. Baseline ballistic limit testing will not be performed for groin and coccyx protectors.

5.16.2 Removable Side Protection

All removable side protection panels which contain ballistic-resistant material shall be tested for the same protective type rating as the primary armor sample (sec 5.4, table 1). All removable side panel test samples will meet the labeling requirements of section 4.5.

The manufacturer shall supply an adequate number of test samples and external carriers to complete a 24 shot P-BFS test sequence, 12 impacts per test caliber, according to fair hit and shot spacing criteria (sec. 3.14). Removable side protection panels shall be tested in the primary armor's external carriers as appropriate for each armor model designation. Test samples which are not appropriately sized for shot location (sec. 4.7.4) or for use in the primary armor model's external carrier will result in rejection of the armor model for compliance testing.

The samples shall be tested in accordance with the requirements of sec. 5.9 and sec. 5.12.4, placing as many fair hit impacts as possible on each test sample, to achieve a total of 12 fair hits per test caliber at both 0° and 30° obliquity, per section 5.4, table 1. A single BFS depth measurement shall be taken on the first fair hit impact for each test caliber, for a total of two BFS measurements. P-BFS failure (sec. 4.6) of any removable side protection panel will constitute a compliance test failure of the entire armor sample and model designation.

Each side protection panel or insert shall be physically inspected after P-BFS testing and its respective configuration compared to the other side protection samples for layers, weave, stitching, material, etc. Any inconsistency in the side protection components will result in the compliance test being declared inconclusive in accordance with sec. 4.1. Baseline ballistic limit testing will not be performed for removable side protection panels.

5.22 Ballistic Limit Retesting of Compliant Armor

In instances of questionable post compliance testing performance, the NIJ CTP, at its sole discretion, will initiate a compliance investigation designed to incrementally assess the armor model's ballistic performance in increasingly comprehensive steps. This compliance retesting process will, at a minimum, utilize ballistic limit testing and, if deemed necessary, review of manufacturer provided performance testing data and quality assurance documentation as well as new P-BFS compliance testing.

Armor models which do not satisfactorily complete the NIJ CTP retest investigation shall be removed from the NIJ Consumer Products List (CPL) and that model designation shall be permanently banned from the NIJ compliance testing program. Appendix A lists the general retest investigation procedure to be used by the NIJ CTP.

When compliant body armor models are submitted to NIJ for *initial ballistic limit* retest *per Appendix A*, two complete sets or samples shall be required according to section 4.7 *and section 5.17.3, table 2*. The samples shall be the same size *and configuration* as originally submitted. The *ballistic limit* and standard deviation (σ) of each *panel from one of the retest armor samples* shall be *re-determined* in accordance with sections 5.17 through 5.21. The remaining retest armor sample will be retained for use as needed, should the *first* armor sample fail to meet the *ballistic limit* retest criteria.

Compliance retested armor will continue to be compliant if the *ballistic limit of each retested panel* is ± 3 σ from each of the *respective panel's* baseline *ballistic limit* determined during its original compliance testing. Armor found noncompliant with *its initial compliance* baseline ballistic limits will undergo additional discretionary investigation by the NIJ CTP *(app. A)*. Compliance *retesting* determinations using *NIJ Standard–0101.04 criteria* apply to new, unworn, manufacturer supplied body armor samples only.

6.1.1 Data Recording

The results of each *NIJ Compliance* test shall be recorded in *NIJ CTP supplied reporting and submission software.* All test data and activities shall be *documented* in sufficient detail such that a reconstruction of the test based on the information contained in the *final report submission* can be performed.

The Compliance Test Report (CTR) shall be used in conjunction with NIJ Standard-0101.04, Ballistic Resistance of Personal Body Armor, and shall become a part of the official records of the compliance testing of each armor model submitted for testing. All sections of the report shall be completed as applicable.

Current versions of the CTR software are available only to NIJ/NLECTC-certified test laboratories from the NIJ Compliance Test Program Office, National Law Enforcement and Corrections Technology Center – National (NLECTC-National). Requests for this file can be sent to, NLECTC-National, NIJ Body Armor Compliance Test Program, 2277 Research Blvd, M/S 8J, Rockville, MD 20850, Attn: Compliance Test Program Manager, or to asknlectc@nlectc.org.

APPENDIX A

NIJ STANDARD–0101.04 COMPLIANCE RETEST PROTOCOL

STEP	ACTION	REQUIREMENT
Initial Assessment	*NIJ Ballistic Limit Retesting:*	*Section 5.22*
	1st Test Result = "Pass"	*No further action required. Compliance/re-compliance letter.*
	1st Test Result = "Fail"	*Repeat test with 2nd sample.*
	2nd Test Result = "Pass"	*NIJ CTP discretion.*
	2nd Test Result = "Fail"	*Conduct secondary assessment.*
Secondary Assessment	*NIJ CTP Investigation*	*Review of manufacturer-supplied:* *1. Armor model test data.* *2. Quality assurance documentation for model production.*
	CTP Review Acceptable:	*Conduct abbreviated P-BFS retesting—48 shots; one laboratory.*
	CTP Review Unacceptable:	*Conduct full P-BFSS retesting—96 shots; two laboratories.*
	Abbreviated P-BFS Retest:	*8 new production armor test samples.*
	Test Result = "Pass"	*NIJ CTP discretion.*
	Test Result = "Fail"	*Conduct full P-BFS retesting—96 shots; two laboratories.*
Final Assessment	*Full P-BFS Retesting:*	*16 new production armor test samples.*
	Test Result = "Pass"	*No further action required; compliance/re-compliance letter.*
	Test Result = "Fail"	*Model designation failure; permanent removal of model.*

Abbreviated P-BFS compliance retesting will follow all NIJ Standard–0101.04 requirements, procedures, and performance criteria, with testing conducted at an NIJ-certified laboratory that did not perform the armor the model's original NIJ compliance testing.

Full P-BFS compliance retesting will follow all NIJ Standard–0101.04 requirements, procedures, and performance criteria, with testing conducted at two NIJ-certified laboratories, including the original compliance laboratory if applicable.