



The Next Revision of the NIJ Performance Standard for Ballistic Resistance of Body Armor, NIJ Standard 0101.07: Changes to Test Methods and Test Threats

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U.S. Law Enforcement: A Dangerous Profession

Law enforcement is a dangerous profession. The U.S. Bureau of Labor Statistics reports that in 2007 police and sheriffs' patrol officers in the United States experienced a fatality rate on the job of approximately 20 in 100,000 officers – five times higher than the overall fatality rate on the job of 4 in 100,000 workers across all industries in the U.S. that year [1]. A majority of the accidental fatalities each year are traffic-related, while a majority of the felonious fatalities are due to assaults with firearms. The Federal Bureau of Investigation's (FBI) Law Enforcement Officers Killed and Assaulted (LEOKA) statistics show that from 1987 through 2015, over 70,000 officers were assaulted with firearms. Furthermore, of the 1,708 officers feloniously killed in the line of duty by all means over that time span, 1,574 were feloniously killed by firearms. That equates to over 92% of all felonious deaths in the line of duty were due to firearms. Handguns alone accounted for at least 1,179 of those firearms fatalities [2].

Body Armor Saves Lives

NIJ funded the National Opinion Research Center (NORC) in 2012 to provide independent, evidence-based knowledge regarding the impact that body armor has had on officer safety [3], building on previous research efforts on this topic [4]. Detailed information from the FBI's LEOKA dataset on 1,789 officers assaulted by firearms, knives/other cutting instruments, and were killed or severely injured as a result between 2002 and 2011 was analyzed for cases where officers were shot in the torso. Among the 637 officers who were shot by a firearm in the torso, those who wore body armor were 76% less likely to be killed than those who did not wear armor, controlling for an array of individual and incident characteristics [5]. This research comports with previous reports on the benefits of body armor in saving lives [6].

Body Armor Standards and Conformity Assessment

NIJ develops body armor performance standards and operates a body armor certification program called the Compliance Testing Program (CTP) to provide U.S. law enforcement confidence that the body armor they purchase and use performs according to minimum performance requirements to protect against common handgun and rifle fire threats. NIJ published the first performance standard for ballistic-resistant police body armor in 1972 and established body armor compliance testing several years later. The current ballistic standard, NIJ Standard 0101.06, *Ballistic Resistance of Body Armor*, published in 2008 [7], has evolved from the first 0101.00 standard published in 1972 by NIJ's predecessor organization, the National Institute of Law Enforcement and Criminal Justice (NILECJ), and developed by the then Law Enforcement Standards Laboratory (LESL) at the National Bureau of Standards (NBS), now the National Institute of Standards and Technology (NIST) [8].

Numerous projects funded by NILECJ to the MITRE Corporation, the Aerospace Corporation, and the U.S. Army in the 1970s through the Equipment Systems Improvement Program were pivotal in the development of modern police body armor, including the first field test and evaluation of approximately 5,000 lightweight body armor garments in 15 geographically diverse cities [9], and in establishing the primacy of standards and testing for U.S. law enforcement body armor. Since these early days, the ballistic body armor standard has evolved through a number of iterations to its current version, and it has been a priority of NIJ to provide law enforcement with the tools to make informed decisions regarding body armor to improve officer safety [10,11,12,13].

Today, the CTP is the recognized authority on body armor for law enforcement use – not only in the U.S., but across the world. Use of NIJ-certified body armor is ubiquitous among U.S. law enforcement agencies, and many law enforcement agencies outside the U.S. make use of NIJ standards and NIJ-certified armor as well. While participation in the program by manufacturers is voluntary, it is recognized by industry as the standard in body armor quality assurance, with manufacturers representing over 100 manufacturing locations and 16 countries participating. Since the CTP began accepting armor submissions to meet the requirements of NIJ Standard 0101.06 in 2009, over 1,100 unique models of ballistic-resistant body armor have been submitted to the CTP for compliance testing through the end 2017.

NIJ Standard 0101.07

NIJ is currently working on the seventh revision to its body armor performance standard anticipated to be published in late 2018 or early 2019 as NIJ Standard 0101.07, which will include improved test methods for female body armor and updated body armor protection levels that incorporate additional rifle threats faced by U.S. law enforcement [14]. Its primary purpose will be for use by the NIJ CTP for testing and evaluation of ballistic-resistant body armor for certification by NIJ. It will be used by both ballistics laboratories that test body armor and body armor manufacturers participating in the NIJ CTP. It is anticipated that this standard will be added to the Personal Body Armor scope of accreditation used by the National Voluntary Laboratory Accreditation Program (NVLAP) to accredit ballistics laboratories.

Unlike the current and previous versions of the NIJ body armor standard which have been comprehensive, standalone documents, NIJ Standard 0101.07 will incorporate by reference a suite of ASTM standard test methods and practices. In 2013, the U.S. Army, NIJ, and NIST began a partnership to harmonize the standards and their implementation for ballistic-resistant vests. The federal agencies chose to work through ASTM's E54 Committee on Homeland Security Applications to develop standard test methods and practices for the purpose of improving and validating methods, increasing consistency between test laboratories, and ultimately increasing confidence in ballistic-resistant equipment. ASTM provides a forum and infrastructure that enables all interested stakeholders to collaborate, discuss differences and commonalities, and come to consensus on standards, test methods, and practices [15]. Incorporation of relevant ASTM standards by reference into NIJ standards and U.S. Army requirements and testing documents affords the opportunity to harmonize laboratory test procedures and practices for both law enforcement and military

ballistic-resistant armor and other ballistic-resistant equipment while allowing those end user communities ultimate control over product specifications, such as the specific threats against which their equipment must protect. Table 1 below lists the standardized test methods, practices, and specifications published by ASTM that will be incorporated by reference into NIJ Standard 0101.017.

Table 1. ASTM standards that are incorporated by reference into the proposed NIJ

Standard 0101.07.	
ASTM Standard	Description
ASTM E3004-15e1, <i>Standard Specification for Preparation and Verification of Clay Blocks Used in Ballistic-resistance Testing of Torso Body Armor</i>	This standardizes a method for preparation and verification of backing assemblies used in ballistic-resistant torso body armor testing and to reduce variability within and between laboratories. The backing assembly is a clay block that contains ROMA Plastilina No. 1® clay as the backing material, which serves as a witness material and provides a measurable indication of test item performance.
ASTM E3005-15, <i>Standard Terminology for Body Armor and Related Items</i>	This standardizes terminology for body armor providing protection against ballistic threats, stabbing, fragmentation, blunt impact, or a combination of threats. The intent of this terminology is to have terms, abbreviations, and formulas that are applicable across federal agencies, law enforcement and corrections agencies, testing and certification bodies, and manufacturers.
ASTM E3062-15e1, <i>Standard Specification for Ballistic Test Range Configuration for Small Arms and Fragmentation Testing of Ballistic-resistant Items</i>	This specifies indoor ballistic test range requirements for small arms and fragmentation testing of the following ballistic-resistant items: soft body armor, hard armor plates, body armor accessories, shields, and helmets. The specification includes requirements for range geometry, range conditions, test equipment, instrumentation, and measurement procedures. The purpose is to specify critical test range parameters in order to achieve consistency and repeatability among test ranges.
ASTM E3068-17, <i>Standard Test Method for Contact Measurement of Backface Deformation in Clay Backing During Body Armor Testing</i>	This describes test methods for the contact measurement of backface deformation (BFD) in clay backing caused by a test threat that produces a partial penetration in a body armor test item. The purpose is to achieve consistent measurements between laboratories and reduce differences that could result from using different measurement techniques. This test method is applicable to testing of planar and nonplanar soft armor and hard armor.
ASTM E3078-17, <i>Standard Practice for Conditioning of Hard Armor Test Items</i>	This applies to the conditioning of hard armor test items constructed of rigid materials prior to ballistic resistance testing. This practice describes requirements for subjecting test items to conditions intended to assess the capability of the test item to withstand environmental conditions that induce responses similar to those that might result from conditions encountered during use.
ASTM E3086-17, <i>Standard Practice for Creating Appliques for Use in Testing of Nonplanar Soft Body Armor Designed for Females</i>	This specifies a procedure for creating appliques (e.g., build-up of clay) for use behind nonplanar, soft body armor test items and affixing the appliques to the clay block. The purpose is to specify critical parameters for creating appliques in order to improve consistency of the test setup between laboratories. This practice describes a single applique shape applicable only to nonplanar soft body armor designed for females.
ASTM E3107-17a, <i>Standard Test Method for Resistance to Penetration and Backface Deformation for Ballistic-resistant Torso Body Armor and Shoot Packs</i>	This standardizes testing the resistance to ballistic penetration and to BFD for ballistic-resistant torso body armor and shoot packs. This test method is intended for testing of soft body armor, hard armor plates, in conjunction with armor, and shoot packs mounted on a clay block as the backing assembly.
ASTM WK52176, <i>Standard Test</i>	

Method for Collection of Vx Ballistic Limit Data for Ballistic-resistant Torso Body Armor and Shoot Packs	This describes procedures for collecting ballistic limit data for ballistic-resistant torso body armor and shoot packs. This test method does not specify computation or performance criteria for the ballistic limit.
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Ballistic Threats to Law Enforcement

NIJ has also developed a standalone specification of ballistic threat levels and associated test ammunition. This specification is intended for use with voluntary NIJ standards that specify 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 [16]. It defines ballistic threats identified by U.S. law enforcement as representative of prevalent threats in the United States. Its primary purpose will be to test ballistic-resistant equipment for U.S. law enforcement applications and will be incorporated into NIJ Standard 0101.07 for body armor, as well as anticipated NIJ standards for ballistic-resistant helmets and ballistic-resistant shields. This document is anticipated to be published in late 2018 or early 2019 as a companion to NIJ Standard 0101.07. A standalone threats specification may also enable testing of a variety of ballistic-resistant equipment, not just ballistic-resistant body armor, against contemporary U.S. law enforcement threats, although the specification itself does not define any test methods.

Threat level nomenclature has been revised from previous NIJ standards to be more descriptive of threats and to reduce confusion among law enforcement end users of body armor. Level II and level IIIA have been replaced with "NIJ HG1" and "NIJ HG2," respectively, to represent handgun (HG) threats, as listed in Table 2 below. Level III and level IV have been revised to three levels representing rifle (RF) threats – "NIJ RF1," "NIJ RF2," and "NIJ RF3." These rifle threats are listed in Table 3 below.

Table 2. Proposed NIJ handgun (HG) threat levels and associated test ammunition.

NIJ HG Threat Level	Test Threat Ammunition	Manufacturer and Model	Reference Velocity
NIJ HG1 (Formerly NIJ 0101.06 Level II)	9mm Luger full metal jacketed (FMJ) round nose (RN) 124 grain	Remington #23558	1305 ft/s (398 m/s)
	.357 Mag jacketed soft point (JSP) 158 grain	Remington #22847	1430 ft/s (436 m/s)
NIJ HG2 (Formerly NIJ 0101.06 Level IIIA)	9mm Luger FMJ RN 124 grain	Remington #23558	1470 ft/s (448 m/s)
	.44 MAG jacketed hollow point (JHP) 240 grain	Speer #4453 or #4736	1430 ft/s (436 m/s)

Table 3. Proposed NIJ rifle (RF) threat levels and associated test ammunition.

NIJ RF Threat Level	Test Threat Ammunition	Manufacturer & Model ID	Reference Velocity
NIJ RF1 (Enhanced version of NIJ 0101.06 Level III)	7.62x51mm M80 Ball NATO FMJ steel jacketed spire point boat tail (BT) 149 +0/-3 grain	U.S. military supply or rounds meeting NATO specifications	2780 ft/s (847 m/s)
NIJ RF1 (Enhanced version of NIJ 0101.06 Level III)	7.62x39mm surrogate test round 120.5 grain (7.81 g)	Specifications provided by NIJ (See Ref. 16)	2380 ft/s (725 m/s)
NIJ RF1 (Enhanced version of NIJ 0101.06 Level III)	5.56mm M193 BT 56 +0/-2 grain	U.S. military supply or rounds meeting NATO specifications	3250 ft/s (990 m/s)
NIJ RF2 (Same as NIJ RF1 plus 5.56 mm M855)	7.62x51mm M80 Ball NATO FMJ steel jacketed spire point BT 149 +0/-3 grain	US military supply or rounds meeting NATO specifications	2780 ft/s (847 m/s)
NIJ RF2 (Same as NIJ RF1 plus 5.56 mm M855)	7.62x39mm surrogate test round 120.5 grain (7.81 g)	Specifications provided by NIJ (See Ref. 16)	2380 ft/s (725 m/s)

5.56 mm M855)	100.1 ± 20.5 g/mm (.037 g)	Ref. 16)	(920 m/s)
NIJ RF2 (Same as NIJ RF1 plus 5.56 mm M855)	5.56mm M193 BT 56 +0/-2 grain	U.S. military supply or rounds meeting NATO specifications	3250 ft/s (990 m/s)
NIJ RF2 (Same as NIJ RF1 plus 5.56 mm M855)	5.56mm M855 BT 61.8 ± 1.5 grain	U.S. military supply or rounds meeting NATO specifications	3115 ft/s (950 m/s)
NIJ RF3 (Formerly NIJ 0101.06 Level IV)	30.06 M2 Armor Piercing (AP) FMJ spire point AP 165.7 +0/-7 grain	U.S. military supply or rounds meeting NATO specifications	2880 ft/s (878 m/s)

Conclusion

FBI statistics show that from 1987 through 2015 over 92% of all felonious deaths of law enforcement officers in the line of duty in the U.S. were due to firearms. However, analysis of 637 cases from FBI data where officers who were shot by a firearm in the torso found that those who wore body armor were 76% less likely to be killed than those who did not wear armor. NIJ develops body armor performance standards and operates a body armor certification program called the Compliance Testing Program to provide U.S. law enforcement confidence that the body armor they purchase and use performs according to minimum performance requirements to protect against common handgun and rifle fire threats. NIJ is currently working on the seventh revision to its body armor performance standard as NIJ Standard 0101.07, which will include improved test methods for female body armor and updated body armor protection levels that incorporate additional rifle threats faced by U.S. law enforcement. NIJ has also developed a standalone specification of ballistic threat levels and associated ammunition intended for use with voluntary NIJ standards that specify 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. Both documents are anticipated to be published in late 2018 or early 2019.

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Notes

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