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Revised Body Armor Standard and Testing Program

The date of June 23, 2003, holds a prominent place in the memories of the law enforcement and corrections communities. On that night, in Forest Hills, Pa., Officer Edward Limbacher, wearing body armor constructed primarily of a fiber called Zylon®, threw open the side door of an unmarked Ford van and stepped out to move in on a drug suspect. The suspect fired, striking Limbacher in the arm and abdomen with .40-caliber rounds, then ran.

The shot to the abdomen penetrated Limbacher's body armor. Body armor that, according to its rated level of protection under the National Institute of Justice (NIJ) Compliance Testing Program, should have stopped the bullet.

This incident touched off five years of intensive research, five years of focus group meetings and manufacturer workshops, and five years of intensive scrutiny of the entire testing program and the standard behind it. Then-Attorney General John Ashcroft created the U.S. Department of Justice's Body Armor Safety Initiative in response to concerns from the law enforcement and corrections communities about armor's effectiveness, and directed NIJ to undertake an examination of both new and used Zylon-based armor, to analyze upgrade kits provided by manufacturers that retrofit Zylon-based armors and to review the existing testing program.

The end result, officially launched in December 2008, is not only a revision to the existing standard (*Ballistic Resistance of Personal Body Armor, NIJ Standard-0101.06*), but a complete restructuring of the entire compliance testing program. The new program adds, among other elements, a testing laboratory accreditation process, ongoing manufacturer conformity assessment and a conditioning protocol to impose controlled elements of "wear and tear" on armor before it is tested. These significant changes to the standard offer greater assurance that armor will provide the protection needed by law enforcement and corrections officers. (NIJ Standard

0101.06 supersedes the NIJ 2005 Interim Requirements and all other previous versions of the standard.)

"The overarching theme of this revision is significant expansion of the program, resulting in greater confidence in the performance of armor in field use," says Lance Miller, director of the National Law Enforcement and Corrections Technology Center-National, which administers the Compliance Testing Program for NIJ.

"Key findings out of the National Institute of Standards and Technology [NIST] in the wake of the Forest Hills incident and input from the law enforcement and corrections communities indicated that it is no longer good enough to just test new out-of-the-box armor," Miller says. "The test process itself has been redesigned with the idea that it is no longer 'once and done.'" The NIST Office of Law Enforcement Standards performed extensive testing on used armor made of other fabrics in addition to Zylon and reported its findings to NIJ; those findings have helped inform the revision to the standard.

Miller adds: "In addition to adding the environmental conditioning protocol to ensure that armor will provide its intended level of protection when subjected to high temperature, humidity and mechanical stress, the standard has also been beefed up in terms of the number of shots and test velocities, which gives us a higher degree of confidence in the vests' performance capability. It really was a top-to-bottom overhaul. We're very happy with the way this moves the program forward."

More than 3,000 police officers' lives have been saved by body armor since the mid-1970s, when NIJ began testing body armor and developing performance standards. The NIJ standard and its testing program have gained worldwide recognition as establishing the benchmark for ballistic-resistant armor performance.

Miller explains that when NIJ started the body armor program with field testing in 1975, ballistic-resistant vests were new to the law enforcement market and little was known about them: "Now we're taking the next step

forward. For example, we want to make sure the manufacturer is willing to back up the performance of the armor per the warranty period as stated by the manufacturer.”

“The body armor worn by every officer must provide protection from common street threats and maintain its performance throughout the manufacturers’ warranty period, the manufacturing community must provide armor that instills confidence in its protective ability and this revision to the standard enables the accomplishment of those goals,” says Marc Caplan, chief of the Operational Technologies Division in NIJ’s Office of Science and Technology.

For a look at each of the three major areas of the revised program — the standard itself, the conformity assessment program and the laboratory accreditation program — please see the related sidebars (“Standard 0101.06: More “Muscle” for Better Protection,” “Laboratory Accreditation Promotes Confidence in Testing Results,” and “It’s Not Just ‘Once and Done’ Anymore”). For more detailed information on the Compliance Testing Program and body armor in general, visit <http://www.justnet.org/Pages/Topic.aspx?opentopic=10&topic=10/>.

Standard 0101.06: More “Muscle” for Better Protection

Ballistic Resistance of Personal Body Armor, NIJ Standard-0101.06 incorporates a number of major changes, including the addition of a conditioning protocol, revised test methods, changes to the levels of armor classification and more stringent performance requirements.

“These revisions provide greater assurance that the armor worn by law enforcement officers today will afford the protection they need,” says Lance Miller, director of the National Law Enforcement and Corrections Technology Center (NLECTC)-National, which administers the Compliance Testing Program for the Office of Justice Programs’ National Institute of Justice (NIJ).

NIJ Standard 0101.06 supersedes all other previous versions, including the NIJ 2005 Interim Requirements. However, its implementation does not revoke the compliance listing of body armor models previously tested and listed as compliant under either NIJ Standard 0101.04 (see *TechBeat* Fall 2000, “New Standard ‘4’ Armor”) or the NIJ 2005 Interim Requirements (see *TechBeat* Fall 2006, “30 Years, 3,000 Saves”).

Agencies should not feel they must immediately replace armor previously listed as compliant under those versions; however, they are encouraged to purchase armor that complies with NIJ Standard-0101.06 when they do future procurements. To provide assistance in that area, NIJ and NLECTC-National have also undertaken

a project to coordinate an update of NIJ’s *Selection and Application Guide to Personal Body Armor*, which provides in-depth information regarding appropriate armor classifications for various duty assignments, care and maintenance of equipment, procurement, training/education and other topics.

This revised standard should be the starting point for designing and building armor that not only meets, but also exceeds, the standard, John Morgan, deputy director of NIJ’s Office of Science and Technology, said in a May 2008 workshop for the body armor manufacturing community, adding that armor should provide a level of protection that invokes confidence among law enforcement officers that they will go home to their families at the end of their shifts. Dr. Morgan also said a new laboratory accreditation process should reduce variability in test results between different testing laboratories. However, the law enforcement and corrections communities need to understand that the conditioning protocol does not guarantee that armor will last for any certain period of time in the field; it only provides an initial test of an armor’s ability to withstand a certain amount of degradation.

The addition of this environmental conditioning protocol marks one of the most significant changes in this version of the standard; the new process should eliminate models with inherent weaknesses in design or materials. Samples are placed in a tumbling device and subjected to folding, tossing and crumpling, in addition to being exposed to extremes of heat and humidity.

The revision also includes a change in the “wet conditioning” protocol included in older versions. Previously, armor was “wet conditioned” prior to ballistic testing by means of a water spray. The new version changes this to a complete water submersion of the panels to better test the resistance of panel covers and seams.

Other significant changes include the following:

- The six-shot test pattern has been revised to allow placement of a three-shot grouping anywhere in a “fair-hit area” to simulate the effects of multiple impacts in close proximity to each other and to expose potential vulnerabilities in the armor. The revised shot pattern also places shots within two inches of the edge of armor panels, instead of three inches as in the previous version.
- Five unique size templates have been introduced to ensure that all sizes of a given model comply with the performance requirements of the standard. Manufacturers must submit representative samples of the largest and smallest sizes in which they will manufacture a given armor model. After a model is listed as compliant, the manufacturer cannot introduce sizes outside the tested range. However, if a manufacturer submits

samples representing the largest and smallest template sizes, then they can manufacture vests at any size.

- The testing sample size increases from four vests to 24.
- NIJ has instituted an impartial Special Review Committee to hear disputes or appeals related to compliance decisions. This committee includes technical experts from the disciplines of law enforcement, testing, research and standards development.
- Conformity assessment follow-up is a requirement of the NIJ Compliance Testing Program (CTP) and involves the periodic retesting of armor models previously type tested and found to comply with NIJ Standard-0101.06. Retesting will be performed on samples randomly selected from each manufacturing location by inspectors authorized by the CTP.
- Compliance status is issued for a period of five years, after which a manufacturer can apply for renewal, based on its successful participation in the Conformity Assessment Program over the previous five years and limited retesting of the model.
- The Level I classification has been eliminated as not providing sufficient protection against today's street threats.

Although Level I has been eliminated, the other classification levels remain and have been updated. The standard continues to categorize and rate armor at different threat levels that provide protection against handgun ammunition, with additional protection needed for SWAT team operations, hostage rescues and Special Operations assignments (when officers may be exposed to a weapon threat greater than the protection provided by regular duty armor).

The standard divides body armor into five category types, three for flexible body armor designed to protect against handguns, and two for rigid armor designed to protect officers in tactical operations against rifle threats.

The three flexible armor categories and the threat round calibers associated with their testing are as follows:

- Level IIA: 9mm Luger, .40 Smith & Wesson.
- Level II: 9mm Luger, .357 Magnum.
- Level IIIA: .357 SIG, .44 Magnum.

Rigid armor categories are as follows:

- Level III: 7.62 mm NATO (rifle).
- Level IV: 30.06 M2 AP (armor-piercing rifle).

As before, this particular standard establishes minimum performance requirements and test methods for the ballistic resistance of personal body armor designed to protect the torso against gunfire and does not address resistance to knives and other sharp objects.

For the full text of the standard, visit <http://www.ojp.usdoj.gov/nij/pubs-sum/223054.htm/>. To view information on compliant models, visit [http://www.justnet.org/Pages/ViewPage.aspx?datab=1&location=https%3a%2f%2ftims.justnet.org%2fReports%2fSearch.aspx&ver=%c2%a4q%c3%b0\(p%c3%9d%c3%9a%14k%c2%97%c3%9e7%c2%aa%0eq%14/](http://www.justnet.org/Pages/ViewPage.aspx?datab=1&location=https%3a%2f%2ftims.justnet.org%2fReports%2fSearch.aspx&ver=%c2%a4q%c3%b0(p%c3%9d%c3%9a%14k%c2%97%c3%9e7%c2%aa%0eq%14/).

Laboratory Accreditation Promotes Confidence in Testing Results

The expanded and revised testing protocols of *Ballistic Resistance of Personal Body Armor, NIJ Standard-0101.06*, place even more emphasis than before on the program's need for top-of-the-line testing laboratories that provide consistent results and a reduction or potential elimination of any laboratory-to-laboratory variability. For help in that effort, NIJ turned to the National Voluntary Laboratory Accreditation Program (NVLAP) at the National Institute of Standards and Technology (NIST), establishing a partnership with that agency and adding a requirement that laboratories must first receive NVLAP accreditation as a condition of eligibility to apply to participate in the testing program as an NIJ-approved testing laboratory.

"Historically, laboratory accreditation for the compliance testing program was a joint effort among NIJ, NIST and the National Center," says Lance Miller, director of the National Law Enforcement and Corrections Technology Center (NLECTC)-National, which administers the Compliance Testing Program for NIJ.

"One of the things we realized early on is that there are entities out there like NVLAP that do this all the time," he says. "Working with the NVLAP program in our review of the compliance testing program under the U.S. Department of Justice Body Armor Safety Initiative, we've designed new requirements that are specific to body armor."

"It removes NIJ from the process of accrediting laboratories and places it with an organization that does this all the time," says Alex Sundstrom, testing manager at NLECTC-National.

NVLAP offers unbiased third-party accreditation to testing and calibration laboratories in a variety of areas, and fully conforms with the standards of the International Organization for Standardization and the International Electrotechnical Commission. NVLAP-accredited

laboratories are identified in an online directory that lists contact information, accreditation renewal date and area of accreditation for each laboratory. Manufacturers can select approved laboratories from this list and negotiate testing contracts.

“The new Compliance Testing Program and the laboratory accreditation program complement each other,” Sundstrom says. “With requiring NVLAP accreditation, the labs that conduct the testing and the manufacturers that build the armor both are being assessed by independent third parties. This means that when consumers purchase the armor, they can have confidence in the testing process.”

Each laboratory accreditation program identifies test standards, related methods and protocols that meet the needs for a specific field. NVLAP accredits both public and private laboratories based on evaluation of their technical qualifications and competence to carry out specific calibrations or tests. Accreditation is granted following successful completion of a process that includes the following:

- Application submission.
- Fee payment.
- Onsite assessment.
- Resolution of any nonconformities identified during the assessment.
- Proficiency testing.
- Technical evaluation.

Accredited labs receive a certificate of accreditation in addition to being listed in the online directory. Manufacturers’ in-house, commercial, university, federal, state and local government laboratories all may apply for accreditation.

NVLAP accreditation is solely a finding of laboratory competence. A laboratory may cite its accredited status provided that the usage does not imply product certification. In addition, NVLAP accreditation does not guarantee participation in NIJ’s compliance testing program. This requires a separate application to the National Center through the JUSTNET Web site (www.justnet.org). NVLAP also publishes, in electronic format only, handbooks and bulletins specific to each area in which labs are accredited, including body armor. Bulletins keep laboratories informed about revisions to the program until new handbook editions are published.

For more information on NVLAP, visit <http://ts.nist.gov/standards/accreditation/index.cfm/>.

It’s Not Just “Once and Done” Anymore

The conformity assessment follow-up portion of the National Institute of Justice (NIJ) Body Armor Compliance Testing Program (CTP) ensures that, to the greatest extent possible, the body armor used by the law enforcement and corrections communities continues to remain safe and reliable through periodic selection and testing of NIJ-listed production models to determine whether they continue to meet the standard.

During its initial five-year period of compliance, the CTP will conduct a series of random visits to each manufacturing location of compliant armor, taking samples from the production line without advance notice and subjecting the samples to ballistic testing. (A manufacturer can also renew the compliance status of a model after five years).

This addition to the testing process will ensure that manufacturers continue to build subsequent production units identically to what was originally submitted to the National Law Enforcement and Corrections Technology Center (NLECTC)-National for compliance testing. This process will assist in ensuring that subsequent units display similar ballistic performance capability as the original submissions that were found to be compliant with the standard. Applicants must agree to this follow-up testing as a condition of receiving their initial compliance.

Administered by NLECTC-National, the conformity assessment follow-up process includes an abbreviated form of the initial ballistic testing, construction comparison between production samples and the samples submitted for initial compliance testing, and comparison of current and original manufacturer build sheets.

“Adding a conformity assessment component will increase the confidence of the public safety community that body armor performance will continue to meet the standard on an ongoing basis,” says Rick James, NLECTC-National conformity assessment coordinator. “Law enforcement and corrections officers can feel confident that the vests that they purchase were produced using the same methods as the test samples.”

In this new process, samples will be gathered under two follow-up options. One option requires that the design and production of body armor be conducted under a registered quality management system (QMS) based on ISO 9000:2000, in conjunction with additional body armor-specific QMS requirements. In this case, armor will be retested a total of three times in five years. The second follow-up option does not require the manufacturer to have a registered QMS, but choosing this

option will require the armor to be retested twice as many times in a similar period as does option one.

(The International Organization for Standardization, or ISO, is the world's largest developer and publisher of international standards. A network of the national standards institutes of 157 countries, ISO is a nongovernmental organization that forms a bridge between the public and private sectors. ISO 9000 puts general controls in place, and then for the body armor program, adds specific requirements unique to body armor with which manufacturers must also comply.)

Once the retesting process has begun, voluntary withdrawal of the model from compliance is not an option. Models that fail to pass the retest process may be either suspended or removed from the compliant products list, depending on the severity of the infraction.

"If any problems are encountered during conformity assessment follow-up, we have ensured that they will be addressed, either by taking appropriate corrective actions or if necessary, revoking the product's compliance completely," James says.

Editor's note: It is with great sadness that we note that Rick James, NLECTC-National's conformity assessment coordinator, passed away shortly before this article was published. His contributions to the NLECTC program were invaluable, and he will be deeply missed.

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