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Update on Technology Research

The National Institute of Justice (NIJ) is committed to making law enforcement equipment as effective and reliable as possible. Through its Technology Assessment Program (TAP), NIJ develops performance standards for equipment, tests equipment against these standards, and issues reports and guidelines to help law enforcement agencies select equipment that meets their needs and is also most cost effective.

To accomplish the goals of the Technology Assessment Program, NIJ relies on research conducted by the National Institute of Standards and Technology's Law Enforcement Standards Laboratory (LESL). This article discusses several projects LESL is working on; some will be completed in the near term, and work will continue on others for several years.

Weapons and Protective Equipment Program

Ammunition primers

Ammunition primers, while simple in design, are complex mechanisms and are critical to the effectiveness of handguns.

Unfortunately, research on the interaction between the firing pin and the ammunition primer is so limited that when a handgun misfires, it is difficult, if not impossible, to determine whether the weapon or the ammunition is at fault. It is also not possible to measure the impact characteristics of the firing pin to verify that a handgun will repeatedly and reliably detonate the ammunition primer.

NIJ Standard-0109.00, which describes the minimum performance standards for .38- and .357-caliber revolvers, requires that a revolver loaded with primed cases be dropped from six different positions and that none of the primers shows visible indent as a result of being dropped. There is no question that firearms should not discharge if dropped. NIJ's requirement for .38- and .357-caliber revolvers reflects the varying sensitivity of primers used in ammunition for these types of revolvers. Because of the lack of quantifiable data to determine a worst-case primer, those who developed the standard chose to be conservative and offer a margin of safety; hence, they considered any indent a potential source of primer detonation.

Some of the revolvers NIJ tested in 1987 had indented primers as a result of the drop test. Manufacturers have suggested that an indented primer should not result in a failure to comply with the revolver standards, because NIJ standards for other firearms permit primer indent in the absence of detonation.

NIJ has long recognized the need for laboratories to measure the adequacy of weapon firing mechanisms and has authorized a research program to accomplish this objective. The results of this investigation, scheduled for completion during the summer of 1989, will enable LESL and NIJ to modify, if necessary, the requirements of NIJ's standard for .38- and .357-caliber revolvers.

Holsters

All sworn officers use handgun holsters to keep their weapons accessible and to protect them from the elements and from criminals. Yet, as common as they are, we have no standard to judge whether a holster is satisfactory for police use. Manufacturers do not even have a common vocabulary for the terms that describe

various holster features. Law enforcement personnel have frequently expressed a need for a standard for holsters but have been unable to effectively describe the features of such a standard. NIJ was pleased when holster manufacturers expressed their concern about the lack of a standard and their willingness to cooperate in defining holster attributes for a performance standard.

LESL is now classifying the applications and characteristics that are essential for each type of holster. NIJ expects to publish a standard by late fall 1989.

Handgun accuracy

It is not uncommon for a handgun to need minor sight adjustments; shooters accommodate such misalignment by adjusting their aim. LESL is now preparing a report that presents a method to determine handgun accuracy. Any ballistic laboratory can employ the test method.

The test uses a collimated light source to establish a reference line between the sights and the aim point on a target. Accuracy is measured as the average X and Y coordinate displacement of the center of a 10-shot group from the aim point. These accuracy coordinates permit the shooter to calculate how much the sights of a weapon should be adjusted to move the center of the shot group to the true aim point. Not only can the test be used to determine handgun accuracy, it can also be used to measure the size of the shot group. NIJ Report 100-88, "Test Procedures for Handgun Accuracy," which describes this test method, will be published in spring 1989.

Ammunition

Anyone who uses a handgun knows that ammunition has a major effect on accuracy and marksmanship. Improper ammunition can contribute to malfunction, particularly in the case of autoloading pistols that are ammunition specific. Law enforcement agencies base their selection of service rounds on an ammunition's effectiveness. Simply stated, the effectiveness (or incapacitating capability) of a bullet depends not only on where the bullet enters the body, but also on the specific tissue, organs, and bone in the path of the wound track and the velocity and physical characteristics of the bullet, including weight, shape, and composition (i.e., lead round nose, full metal jacket, hollow point, etc.). While it is generally agreed that the physical characteristics and velocity of the bullet govern interaction between the bullet and the body, opinions differ widely concerning which specific ammunition is ideal for service weapons.

NIJ research in the 1970's developed a new concept for rating the effectiveness of handgun ammunition. The concept, known as the Relative Incapacitation Index (RII), is derived from a calculation in which the maximum volume of the temporary cavity produced by a bullet passing through ordnance gelatin is multiplied by a weighting factor (vulnerability index) for each 1-cm segment of the penetration depth and the weighted values summed to a depth of 22 cm. The resulting value, the RII, permits agencies to compare the effectiveness of different bullets.

Because law enforcement officers often engage in armed confrontation in urban settings where overpenetration can endanger innocent bystanders, the RII is limited to a depth of 22 cm, which is the average thickness of the human torso from front to back. Military confrontation typically occurs on open battlefields and overpenetration is not a concern.

Those who support the military concept of ammunition selection often criticize the RII concept. They believe that energy transfer into the body (fundamental to the RII concept) is inconsequential and that incapacitation is only achieved through wounds to vital organs or the primary nervous system. Because angle and side shots must sometimes travel more than 22 cm to reach vital organs, the military method of selecting ammunition places strong emphasis on heavy, large-caliber bullets capable of deep penetration.

The two-volume NIJ report on RII, "Police Handgun Ammunitions, Incapacitation Effects," was published in 1983 and includes specific data for rounds used in the 1970's. Since the report was published, NIJ has tested many new types of ammunition and will add the data when the second edition of the report is published in the summer of 1989. Many departments now use the 1983 report to help them select handgun ammunition. The second edition is also expected to be quite popular.

Body armor's resistance to sharp instrument penetration

Although soft body armor is resistant to penetration from bullets, sharp instruments can often penetrate it easily. Armor manufacturers, particularly those who market their products

to the staffs of corrections facilities, have asked NIJ to establish a performance standard for sharp instrument penetration resistance.

This project, only recently initiated, seeks to quantify the threat from sharp instruments and establish performance requirements and a suitable test method for various types of armor that can resist penetration by sharp instruments ranging from ice picks to broad blades. NIJ expects the standard to be available in 1990.

Communications Systems

Mobile and base station communications

Reliable communications between the base station and mobile units is critical. Those who have participated in the planning and installation of law enforcement communication systems know how complex the design can be. Once installed, systems often must be modified to adjust for the effects of urban construction or expanded partrol responsibilities. All law enforcement agencies are suffering from the limited availability of communication channels, and some departments find it necessary to move their network to an entirely different frequency band to increase channel capacity.

A soon-to-be-published report should help departments compare the performance of mobile communication systems in the four authorized police frequency bands in their localities, or project the adequacy of existing systems to cover an expanded area. NIJ Report 201-88, "Communications Range Predictions for Mobile Radio Systems," combines previously published quantitative gain measurements of mobile antennas, with and without light bars installed, with range prediction calculations.

Greatly oversimplified, the distance over which a base station and mobile unit can communicate depends on the terrain, the transceiver frequency, transmitter power, receiver gain, antenna height and gain, and the location of the mobile antenna on the vehicle.

The new report presents a series of nomograms that permit the prediction of the overall system communication coverage based upon transmission reliability.

The report explains how to adjust the coverage range obtained directly from the nomogram to accommodate mobile/base station systems with different characteristics (such as transmitter power or receiver sensitivity) than those used to calculate the point-to-point transmission range data that are presented.

Miniature surveillance recorders

Miniature surveillance recorders are increasingly used in covert investigations, especially drug operations. NIJ has recently developed a performance standard for commercially available miniature surveillance recorders.

The standard classifies the units on the basis of recording frequency response and establishes performance requirements and test methods for a dozen critical parameters, including electronic characteristics, tape transport, and battery service life.

Now in press, the standard should be available in mid-1989. The TAP Information Center will then have independent laboratories test surveillance recorders and publish the results in late 1989.

Body-worn FM transmitters

Body-worn transmitters, like surveillance recorders, are used in covert investigations. The TAP Information Center plans to test body-worn transmitters in accordance with the existing NIJ standard next spring. The results of the test should be available in the summer of 1989.

The standard classified the units on the basis of operating frequencies and establishes performance requirements and test methods for transmitter performance, frequency carrier and modulation characteristics, electromagnetic capability and battery service life.

Hands-free communications

Hands-free communications systems are highly desirable in tactical situations and for motorcycle patrol. A draft of the performance standard for this equipment is now being reviewed, and NIJ expects to publish a final version during the summer of 1989.

The draft performance standard is based on commercially available equipment that uses ear or throat microphones, bone conduction, and boom microphones. It also provides requirements for other critical parts of the system such as voice activation or push-to-talk features, characteristics of the preamplifier, and interconnection to the separate transceivers.

Microwave fields

All communications systems radiate microwaves during transmission, and

officers who use the systems sometimes express concern about potential hazards from these microwave fields. NIJ Report 200-83, "Field Strength Levels in Vehicles Resulting from Communications Transmitters," provides data for fields measured in and around typical police vehicles at each of the four frequency bands. Research was recently completed to enable publication of an updated report that will contain measurements of the field strengths from hand-held, high-power (5- or 6-watt) units, which the earlier report did not measure. As in the earlier report, the updated version does not attempt to interpret the data with respect to biomedical concerns. However, the report does discuss the standards for exposure to nonionizing radiation in sufficient detail to permit law enforcement administrators to assess whether the field strength levels are cause for concern. The report will be published in the summer of 1989.

Trunking communications

Trunking communication systems, now available in the 806 to 866 MHz frequency band, are gaining popularity as one means to improve the efficiency of limited communication channels. Trunking systems reduce the queue during peak transmission times by automatically switching transmission to those channels in the network that are not in use.

The initial study of this technology began in the spring of 1988. Researchers are now designing laboratory experiments to evaluate the performance of trunking systems. A selection and application guide will be prepared in the summer of 1989 and published early in 1990.

Pen registers

Pen registers are frequently used in major investigations to monitor telephone activity. These unmanned systems log the date and time of telephone calls, the duration of the call, and the specific numbers of the telephones involved.

A project to develop performance standards for these devices was recently initiated. The research is scheduled to be completed in the fall of 1990 with publication of a standard scheduled for early 1991.

To Obtain Documents

All documents mentioned in this article can be obtained from the Technology Assessment Program Information Center. Contact the Information Center at 1–800–248–2742 or 301–251–5060 in the Washington, D.C., area or write TAPIC, Box 6000, Rockville, MD 20850.

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