WAYNE STATE UNIVERSITY

Development of Standard for Less-lethal Kinetic Energy Rounds 2002-MU-CX-K006

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BALLISTIC IMPACT RESEARCH LABORATORY

BIOMEDICAL ENGINEERING

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1. Introduction

1.1 Background

Many times in tactical situations there exists a need to deploy a restrained amount of force. In these instances, less-than-lethal weapons are a popular choice, with extended-range kinetic energy rounds being the most common choice among law enforcement agencies. The term extended-range kinetic energy round describes an entire class of less-than-lethal munitions. These munitions, by definition, use kinetic energy as the means of transferring an incapacitating force in the form of a ballistic impact.

Extended-range kinetic energy rounds are utilized in law enforcement activities as well as in military "peace-keeping" missions. Regardless of the scope of their deployment, the rounds always serve the same purpose; they persuade an unwilling party to comply without the use of lethal force. The compliance is often a result of the pain caused by these munitions. The goal is to inflict enough discomfort to solicit compliance without severe injury or fatality. Unfortunately, fatalities, as well as severe non-fatal injuries, have occurred.

1.2 Goals and Objectives

The goal of this research is to initiate a process by which kinetic energy munitions can be evaluated. The National Institute of Standards and Technology (NIST) has developed a procedure for developing standards. This process was initiated as part of this effort. The overall objective of the current effort is to establish the framework for the development of a standard.

2. Methodology

2.1 Initial meeting at NIST (December 2005)

An initial meeting was held at NIST to discuss the process to move the standard development forward. Attendees included: Joe Cecconi (NIJ), Kirk Rice (NIST), Cynthia Bir (WSU) and John Kenney (PSU). Draft standards for both blunt and penetrating impacts were presented. The process previously followed by NIST was identified as the appropriate path to follow and is presented in Figure 1.

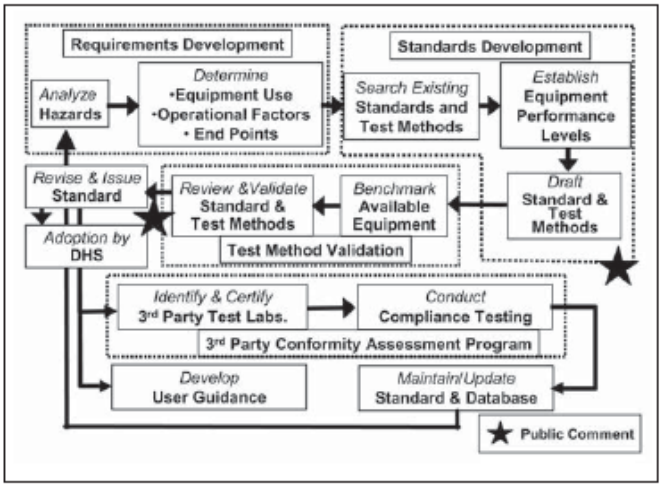

Figure 1: Procedure for development of standards as established by NIST. (NIST, 2005)

Based on this guideline, it was determined the requirements development was the first priority. Both end-users and manufacturers were identified as essential groups from which to garner suggested requirements.

2.2 End user meeting – Technical Working Group (April 2006)

A meeting was held in conjunction with the Technical Working Group – Less Lethal in Orlando, FL in April 2006. End users of less-lethal kinetic energy devices were queried as to their experiences with the devices. The following individuals were invited to attend: Sid Heal, Steve Ijames, Chris Myers, Rick Wyant, Al Cannon, Don Kester, Wayne Fryer, and Jim Mahan. All were in attendance with the exception of Steve Ijames, who could not attend for personal reasons. Matt Begert, Joe Cecconi and Brian Montgomery were in attendance and represented the National Institute of Justice. In addition, Ed Hughes from Penn State participated in the discussions.

The current Wayne State University testing procedures for both penetration and blunt trauma assessment were distributed, as well as the Less-Lethal Kinetic Energy Accuracy Program developed by WSU and funded by the NIJ in 2002. Discussions were held in terms of the pros and cons of a standard versus a user's guide. Since the time and logistics for the development of a standard are lengthy, a user's guide might serve to be more readily accessible with the ability to be updated.

A list of key factors that need to be considered was generated and included the following:

Muzzle velocity average and standard deviation
    Feet and metric units (fps, m/s)
Target velocity average and standard deviation
Maximum effective range –maximum distance that the round performs as designed
Minimum safe range – definitions from ILEF report
Human size target – target A, B, C size
Ranges - 21ft (distance to needed to not be stab), 25 yds (compromise range pistol qualification), 60 yds (how far you can throw), 100 yards

essential versus desired (ILEF)
Close versus long distance range –more tests at close range
0, 4ft, 8 ft, 12 ft, 16 ft, 20 ft
Spot checks of rounds that are tested (if the manufacturer submits round)
Definitions of short range, low range
Manufacturer, model number, price, availability, configuration, cartridge size, material, launcher, methods of engagement, field identification, number of projectiles, special features, accuracy, momentum, weight
Test out of both rifled and smooth bore
Percent risk of injury
Accuracy and precision
Circle error probable (take group and draw circle)
Multiple rounds – how wide is spread, at distance how much energy, percent saturation at distances (80% landed within 10 inch, 90% within 12 inch, etc)
Terminal performance – wound profile, how it hits, fragments, terminal effects, focalized energy, energy/density,
Aerodynamics
Reliability – are there misfires, consistency, functioning, chamber jams, outliers, launcher or round
Launchers – must provide specialized launchers,
12 ga - standard Remington 870, smooth and rifled, choke (71-72)
37 mm – Federal Labs, smooth and rifled (adapter)
40 mm – Defense Tech, (M-203), rifled
Pneumatics
Special storage, shelf life, temperature (cycle), testing at temperatures (hot and cold)
Durometer testing
Weight, speed, surface (Blunt criterion) number to relate munitions
Physical characteristics (picture)
Wadding and casing description
Payloads – OC, taggants
Toxicity of components that may enter body – submunitions
High speed video

2.3 Manufacturer meeting (November 2006)

A meeting with the manufacturers was held in conjunction with the International Association of Chiefs of Police. Attendees included Kirk Rice (NIST), Cynthia Bir (WSU), Paul Ford (Defense Technology), Joe Cecconi (NIJ), Dave DuBay (Non-lethal Defense, Inc), Jay Kehoe (TASER International), Lee Tolleson (ALS Technologies), and Jim Simonds (AFRL). It was suggested that defining a simple standardized test protocol was the best first step, as testing progresses additional testing protocols may be added. Once this initial data has been acquired, threshold standards can be set for acceptable passing scores.

3. Summary

As part of the suggestion for an initial standard development, key areas have been identified including the accuracy of round and risk of trauma (blunt and penetrating). The evaluation of potential testing surrogates is the next critical step for an ongoing study. Key considerations will include applicability and feasibility of the testing techniques. Testing will be conducted to determine if a proposed methodology will provide the expected results. Various surrogates have been identified for use in a possible standard. A new system for monitoring deflection in the surrogate, called Rib Eye, has also been identified. This system using a non-contact technique for monitoring displacement and would replace the current mechanical devices.

Any additional experimental work that needs to be conducted will be evaluated under a separate contract that will include: risk of eye penetration, evaluation of causation of known fatalities and potential review of new technologies that may be deployed by civilians.

4. References

National Institute of Standards and Technology (2005) *Critical Incident Tehcnologies*. Office of Law Enforcement Standards: Programs, activities and accomplishments. NISTIR 7182