C16 Time for Change? The Science & Technology Behind Firearm Trigger Mechanism Evaluation

John R. Nixon, MBA,* Athena Research & Consulting*, PO Box 66, Bippus, IN 46713*

After attending this presentation, attendees will gain an appreciation of the basic science and technology behind firearms trigger mechanism evaluation, current trigger mechanism evaluation techniques, the influence that test techniques and their results have on final conclusions drawn, and the ultimate impact of those conclusions within the criminal and civil justice systems. Attendees will learn that the most commonly applied laboratory trigger examination techniques generate inaccurate and incomplete data, and that they frequently result in misleading conclusions being drawn with regard to firearm safety. Attendees will be introduced to a scientifically valid trigger mechanism evaluation technique that has been adopted by crime laboratories and firearms manufacturers worldwide.

This presentation will impact the forensic community by raising awareness of a scientifically valid trigger testing technique and associated data analysis. The implications for civil and criminal litigation, where accidental or negligent discharge of a firearm is an issue, will be discussed.

Summary, Hypothesis, and Proposition: The majority of crime laboratories offer a firearms evaluation service to their clients. This paper outlines the science and technology behind firearms trigger mechanism operation, evaluation, and data analysis; and presents an overview of the most commonly employed evaluation techniques. A scientifically valid trigger mechanism evaluation technique will be explained by way of example, and the results will be compared and contrasted to those of commonly applied evaluation techniques. Case studies will be used to illustrate the key points made. It is recommended that current laboratory trigger test protocols be modified to take account of the new technology.

Many jurisdictions prohibit legal possession of firearms by their citizens, however, the criminal elements in those jurisdictions appear intent on ignoring the regulations, and firearms related crime continues to be a problem in many countries. Forensic firearms examination is a routine daily activity in U.S. crime laboratories.

Firearms have been in Western civilizations for over six hundred years, and have evolved significantly over the past two hundred years. Until the last one hundred and fifty years or so, firearms were generally incapable of good accuracy, and were used primarily as short range and/or area weapons (volley musket fire). The advent of rifled barrels, and improved ammunition, resulted in significantly improved accuracy potential. In order to utilize this new accuracy potential it was necessary to develop trigger mechanisms that required less effort to actuate, thereby enabling the shooter to maintain a steady aim.

The effort required to discharge a firearm is a function of both the force applied to, and the distance travelled by, the trigger. Engineers have long been able to design trigger mechanisms and calculate the travel, peak force, and total effort required to discharge a firearm. Engineers have had the capability to scientifically test trigger mechanisms to determine the force-travel profile, and calculate the effort required to actuate the mechanism. However, until relatively recently the techniques involved were labor intensive and required a laboratory. Analysis and interpretation of the test data required appropriate engineering and mathematical education and training.

In the absence of an engineer and a laboratory, firearms users and armorers wanted a simple way to evaluate 'trigger pull' and, historically, the arsenal weight and spring gauge techniques have been used to determine the peak force required to actuate a trigger and thereby discharge a firearm. These peak force techniques, by their nature, generate minimal and inconsistent data. The peak force techniques of trigger evaluation provide an apparently quick and easy method of trigger mechanism evaluation in the field, but the data generated are of very limited value and, in general, are misleading when used to quantify the relative ease of firearm discharge. The peak force test techniques are of value only when assessing whether or not the peak force required to discharge a given model of firearm falls within the normal limits for that firearm. Even this limited application of peak force test data is questionable, because the peak force can fall within specified

 ** Presenting Author*

limits, while other trigger characteristics simultaneously fall outside design specifications.

A purpose built electro-mechanical trigger testing device linked to a computer, and utilizing proprietary software, makes relatively easy work of scientifically valid trigger mechanism testing and evaluation. The technique, equipment, and data analyses are described and explained with the aid of practical examples and case studies. Specifically, the firearm is secured in a test rig, and an electrically driven mechanical arm moves the trigger rearward at constant velocity. The force range is from zero to 20 pounds, with a resolution of 0.007 pounds, and the travel range is from zero to 1.4 inches. Every 0.005 inches the electro- mechanical test apparatus records the force exerted on the trigger face, and these data are downloaded to a computer where proprietary software plots a chart and utilizes integral calculus to determine the total effort required to actuate the trigger mechanism. The software displays key trigger characteristics, such as energy to actuate and trigger travel to actuation. A suitably qualified person can use the chart to visually identify potential defects, modifications, and/or design deficiencies in the trigger mechanism, and the captured data may be exported and analyzed in greater detail. The widespread application of this test and evaluation technique will have implications for both the criminal and civil justice systems, and these will be discussed.

It is concluded that currently employed peak force methods of firearms trigger evaluation should be phased out and replaced by electro- mechanical trigger evaluation, with the measure of ease of discharge expressed in terms of the effort required to actuate the trigger mechanism, thereby providing a scientifically valid method of comparison between firearms.

Trigger Pull, Trigger Actuation Energy, Accidental Discharge

 ** Presenting Author*