D4 A Comparison of Scientifically Valid and Traditional Firearm Trigger Mechanism Evaluation Techniques

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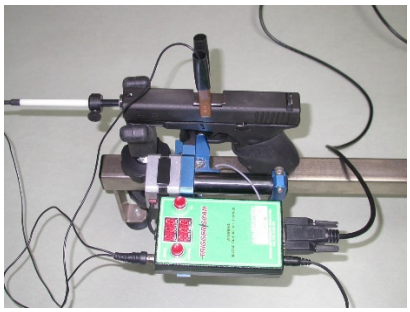
Learning Overview: After attending this presentation, attendees will have gained an appreciation of the basic science and technology behind firearms trigger mechanism evaluation, current trigger mechanism evaluation techniques, the influence that test techniques and their results have on final conclusions drawn, and the ultimate impact of those conclusions within the criminal and civil justice systems. Attendees will learn that widely applied crime 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 many crime laboratories and firearms manufacturers worldwide.

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



The effort required to discharge a firearm is a function of both the force applied to and the distance traveled 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. These peak force techniques generate minimal and inconsistent data that are misleading when used to quantify the relative ease of firearm discharge.

A purpose-built electro-mechanical trigger testing device linked to a computer, and utilizing analytical 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 0 to 20 pounds, with a resolution of 0.007 pounds, and the travel range is from 0 to 1.4 inches. Every 0.005 inches, the electro-mechanical test apparatus software records the force exerted on the trigger face, and these data are downloaded to a computer where the 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 equipment can be further modified with the addition of an electrical circuit that enables the determination of lock time (illustrated). Another advantage of this system is that, for practical purposes, the effort required to actuate the trigger mechanism is independent of the position of the test arm on the trigger face.

It is concluded that widely employed “traditional” 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

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