



## Engineering Sciences Section - 2013

### C29 Safety Evaluation of Post-Manufacture Firearm Modifications

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After attending this presentation, attendees will gain knowledge in the mechanics of firearms, how they may be modified after leaving the manufacturer, and how practical, instrumented, and calculative techniques may be employed to assess those modifications from the perspective of both performance and safety. It is anticipated that the presentation will be of particular interest to engineers, and that it will be of benefit to both civil and criminal attorneys and their investigators.

This presentation will impact the forensic science community by discussing how firearms accidents, and claimed accidents, are investigated by proposing that the firearms be assessed using a holistic approach that combines traditional practical methods coupled with modern sophisticated instrumentation, and mathematical/engineering calculations.

The presentation focuses on a real world practical example of a rifle that was modified after leaving the manufacturer. The owner of the rifle felt that the trigger "feel" was not conducive to accurate shooting and had a local gunsmith do a "trigger job" on the rifle. Following modification, the rifle discharged inside a residence, causing serious injury to a third party. The shooter stated that the rifle discharged while he was attempting to unload it by first removing the magazine, and further stated that the rifle may have been bumped against a piece of furniture immediately prior to discharge. There was some question as to whether the rifle discharged accidentally due to mechanical defect or whether it may have been due to negligent or deliberate action on the part of the operator. Due to the severity of the injuries, criminal and civil investigations, and lawsuits, ensued.

No documentation or testimony was available from the gunsmith who performed the work on the rifle, and this meant the investigation needed to ascertain exactly how the trigger mechanism had been modified. This was achieved by comparison with an exemplar rifle—new and unmodified. The operation of the rifle is described, including its trigger mechanism and its safety mechanisms. The general trigger mechanism modification options available to gunsmiths are described, and their pros and cons discussed.

The evaluation procedure commenced with basic testing of the mechanical aspects of the trigger and safety systems in both the subject rifle and the exemplar rifle. This comprised a basic operation test, followed by shock and vibration testing. Next, the trigger mechanisms were tested using an electro-mechanical trigger test apparatus linked to a computer. Finally, the rifles were disassembled and the trigger mechanism components were visually and dimensionally examined and compared. This procedure included a full evaluation of the trigger-sear springs.

The test and evaluation data were used to perform some calculations with regard to operating forces within the trigger mechanism, and the implications of these results are discussed. It was concluded that the only modification to the trigger mechanism of the subject rifle was a replacement trigger-sear spring of unknown origin. A commercially available aftermarket trigger-sear spring was procured and installed in the exemplar rifle. The test procedures were repeated for that configuration and the results compared to the "as manufactured" exemplar and to the subject rifle. Finally, the safety implications for all three systems evaluated are discussed in the context of the incident under investigation, and for firearm safety in general.

**Firearm Accident, Firearm Modifications, Trigger & Safety Analysis**