



## Engineering Sciences Section - 2015

---

### D21 Forensic Investigation of a Premature Mortar Explosion That Resulted in the Death and Maiming of Several United States Marines

*John Nixon, MBA\*, ARC, PO Box 66, Bippus, IN 46713*

---

After attending this presentation, attendees will understand how a mortar system is designed and works and what can go wrong. Additionally, attendees will learn how defects can be identified post-accident using deductive reasoning, the importance of correct designation, and the use of fact vs. expert witnesses.

This presentation will impact the forensic science community by establishing that deductive-reasoning analytical techniques may be gainfully employed outside their typical use in medical diagnoses. This presentation will also highlight the importance of correctly designating expert and fact witnesses.

This presentation will educate attendees as to potential failure modes in medium caliber mortar systems, civil litigation fact/expert witness procedure pitfalls, and illustrate the legitimate use of deductive reasoning to form scientifically valid conclusions in instances where much of the physical evidence is lost or destroyed.

This presentation focuses on an actual forensic case study relating to a training accident involving United States marines who were conducting a training exercise using a battery of medium caliber mortars. The case is interesting for a number of reasons. First, mortar system failures are very rare. Second, the use of deductive reasoning, while widely accepted in the medical profession when making diagnoses, may be frowned upon outside of the medical profession; however, in this instance, the court ruled that the technique was appropriate to utilize in a situation where the majority of the evidence was destroyed and/or lost. Third, the case demonstrated, from a legal perspective, the importance of correct identification and use of fact versus expert witnesses and the perils of flouting relevant correct procedures.

Medium caliber mortar systems are the heaviest portable artillery that may realistically be carried by infantry troops. A mortar is the most basic form of artillery, but is nonetheless a very valuable weapon system that provides a tactical edge to infantry during forward operations. The mortar system is comprised of a muzzle-loading smooth bore gun (tube) and fin-stabilized high-explosive projectiles with an integral propelling charge system. The gun itself is comprised of a barrel, a base plate, and an aiming system. The firing pin is fixed, at the bottom of the tube, and the ammunition propelling charge is ignited by a percussion primer that impacts the firing pin when the ammunition is dropped down the tube by the loader. It is a low-pressure, low-stress system, and this enables the tube weight to be kept to a minimum, thereby ensuring that the system is man portable.

If all goes according to plan, the crew sets up the mortar and sets the tube to the correct angle of elevation to achieve the range they need using the propelling charge they have selected. The loader drops a round of ammunition, fitted with the appropriate number of propelling charge segments, into the muzzle end of the tube. Gravity takes the round of ammunition to the bottom of the tube at which point the percussion-actuated primer makes contact with the fixed firing pin and the propelling charge is initiated. The round of ammunition is accelerated up the barrel (tube) and makes its way to the target. The ammunition incorporates a safety and arming device in the nose-mounted fusing system. This safety and arming device ensures that the high-explosive charge in the warhead cannot be detonated by the fuse/booster while the round is still in the tube or while it is within an unsafe distance of the gun emplacement.

These mortar systems are comparatively simple, safe, and reliable. The gun tube is inspected regularly and the degree of wear noted. At some point, the tube will fall below the minimum safe-wall thickness, exhibit signs of cracking, and be replaced. There are several things that can potentially go wrong and result in crew injuries or fatalities. In broad terms, these fall into three main categories: (1) the tube may rupture due to excessive wear and/or metallurgical defects (tube failure); (2) the ammunition warhead may detonate prematurely due to body failure, fuse failure, or high-explosive warhead defects; or, (3) the crew may insert a live round into the tube before the previous one has left (double charge=operator error). Any of these events are bad news for the crew who are, by necessity, in very close proximity to the tube. A tube failure is less catastrophic than a premature detonation of the high-explosive warhead. A double charge may result in the two rounds of ammunition being propelled harmlessly downrange, or a very violent in-bore explosion. The case under review was further complicated due to issues relating to evidence examination (resolved pre-trial) and designation and use of expert vs. fact witnesses (resolved on appeal).

---

#### **Mortar Accident, Deductive Reasoning, Expert vs. Fact Witnesses**