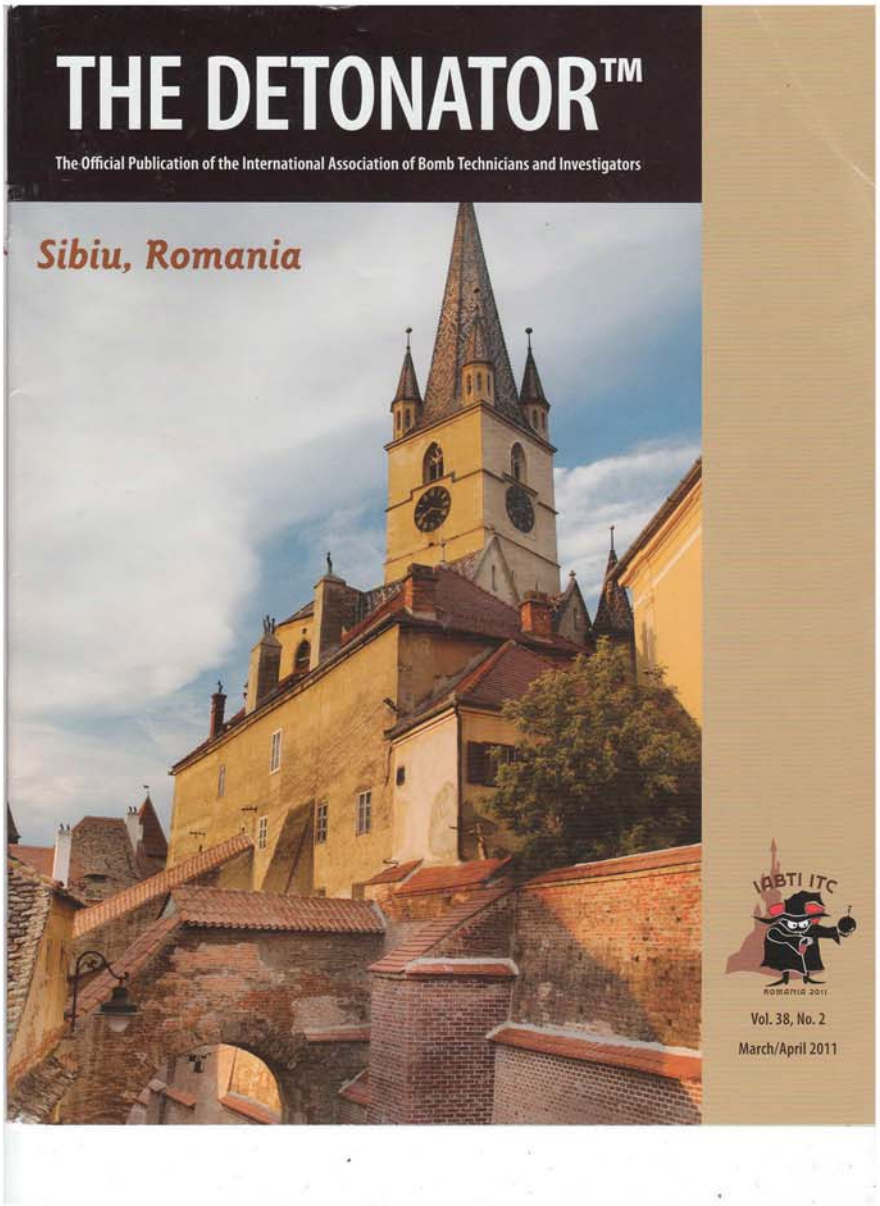
The following is a re-print of an article written by Detective Dale Green, a Hazardous Devices & Materials Specialist with the Baltimore County Police Department Hazardous Devices Team.

Detective Green examines and tests the Z-BOLT C-TRIP laser line generator for the purpose of Tripwire Illumination, and provides his insight on the effectiveness of these tools.



Using Hand-held Lasers To Detect Tripwires

By Dale Green, IABTI Region IV, Chesapeake Chapter

Even with all the modern technology available to terrorists and criminals, like infra-red, radio control, cell phones, etc., tripwires remain one of the easiest and most reliable ways to initiate a booby trap device. To counter this threat, over the years Bomb Technicians have devised various means of detecting tripwires, which are in use all around the world today. Perhaps the most common among these are Silly String®, weighted spools of ribbon or string, and hand-held lasers (usually simple laser pointers, not intended for this application).

Of these techniques, probably the most effective and efficient in my opinion is the laser. This is because the others have a relatively short effective range, are limited in their application (i.e. deployment around and under obstructions like furniture), require physical penetration of a danger area where PIR/motion detectors may potentially be in use, and require physical contact with a tripwire in order to indicate its presence.

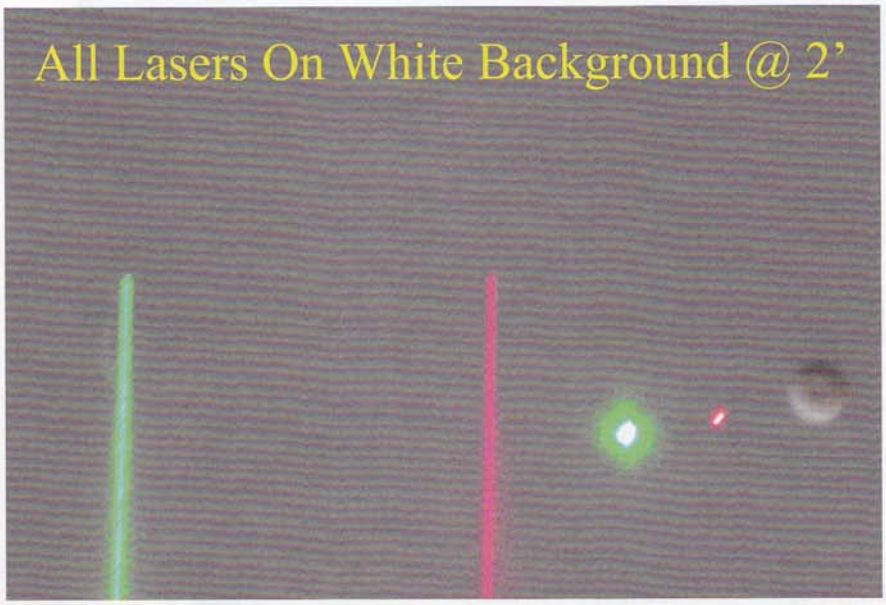
Traditionally. the common red laser has been used, which as stated above was often in the form of a presentation pointer or other novelty device (like the cat toy I have) having never been intended by its manufacturer for that purpose. Also in use, albeit to a much lesser degree, is the laser line generator, which by means of a small prism spreads the laser into a vertical or horizontal line of various lengths as

opposed to a focused point of light.

Tripwire detection is not exactly a quick task, especially under conditions of limited visibility, nor is the need to do it something most of us encounter with a great deal of frequency, unless you do a lot of looking for covert marijuana fields. For these reasons, it is not normally used unless there is specific reason to suspect the presence of tripwires at a scene—although I believe the means to do so is something that should be kept ready in your kit at all times.

When using a point laser, a slow, methodical, systematic top-to-bottom/side-to-side method should be employed, and your full time and attention must be focused on the task at hand. When a laser crosses a tripwire, a point of fluorescence appears momentarily, offset to the projected beam, and then disappears in an instant. As you can see from the photos, the point laser creates substantial fluorescence upon contact with a tripwire due to the increased concentration of laser energy at a single focused point. However, their use is time consuming because of the extremely small area covered.

On the other hand, the line generator allows for the "sweeping" of a much greater area in less time, and the point of fluorescence does not instantly disappear as the laser moves. The trade-off is that it does not fluoresce as brightly on contact with a tripwire, due to the greater diffusion of energy over distance.



Another benefit of line generators is that when they contact a tripwire parallel to the beam, they illuminate a much larger portion of the wire vs. a small point of fluorescence as when perpendicular to it.

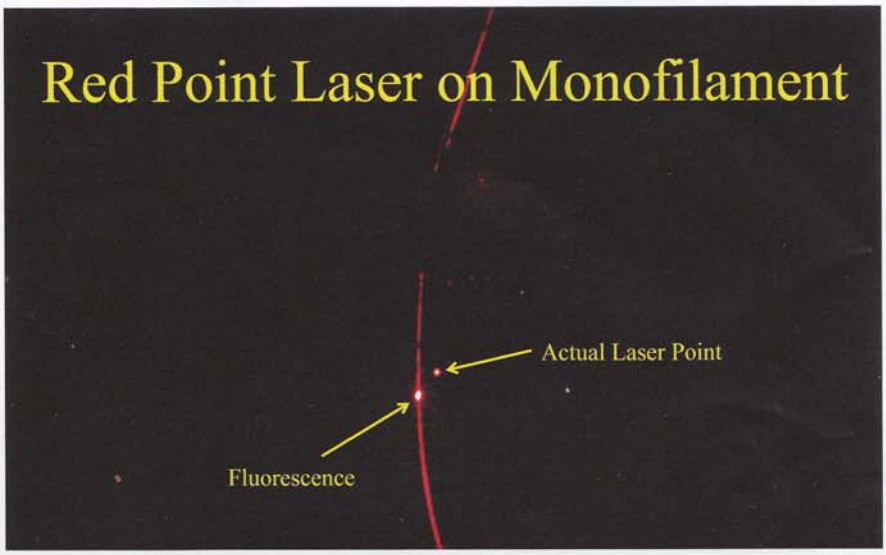
A drawback of red lasers in general is their tendency toward poor visibility in sunlight, especially at a distance. Anyone who has ever tried to aim a disruptor shot with a robot-mounted laser in daylight knows what I mean.

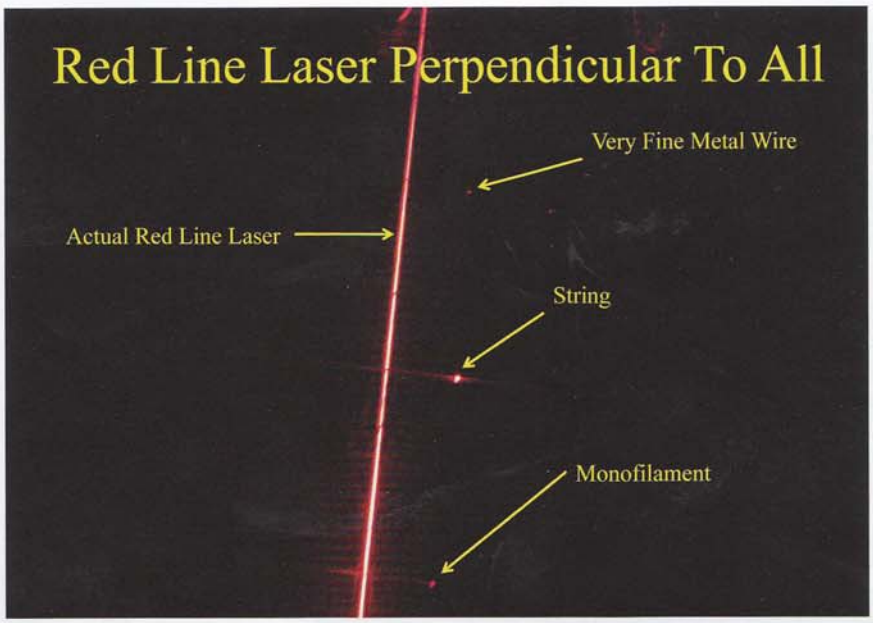
As time and technology progressed, new tools have been developed, and while they may not have been designed for our purposes, that hasn't stopped Bomb Technicians from finding creative uses for them. More to the point, the green laser has gained popularity due to its increased intensity over red lasers, providing a higher level of visibility in daylight, artificial light, and darkness.

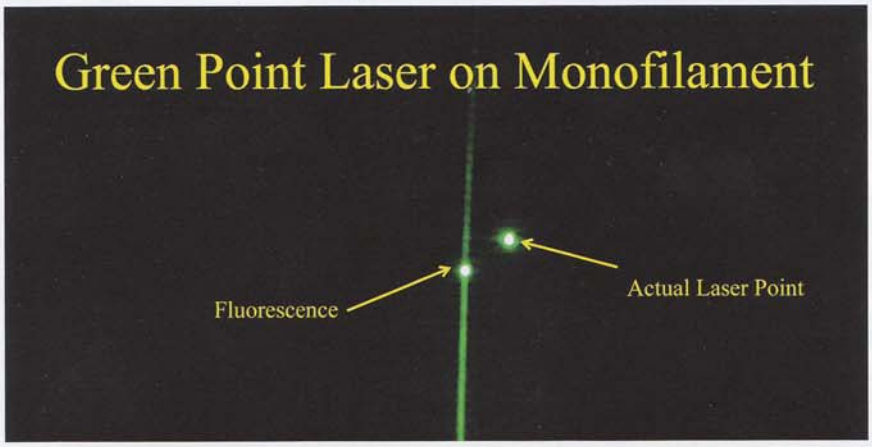
This is because the primary factor determining the visibility of light to the human eye is its wavelength measured in nanometers (nm). The human eye is sensitive to a fractional portion of the electromagnetic spectrum known as visible light, which ranges from 380 nm to 750 nm approximately. The colors of the visible spectrum from lowest wavelength to highest include violet, blue, green, yellow, orange, and red. Those colors with lower wavelength values have longer ranges, appear brighter, and present a generally larger point or spot, as compared to those with higher wavelength values. The human eye is most sensitive at about 555 nm, which is within the green region, making it much more sensitive to greens than reds. The green laser has a wavelength of approximately 532 nm, as compared to the red laser's approximately 645 nm (as used in this experiment), making the green laser appear approximately 40 times brighter than the red.

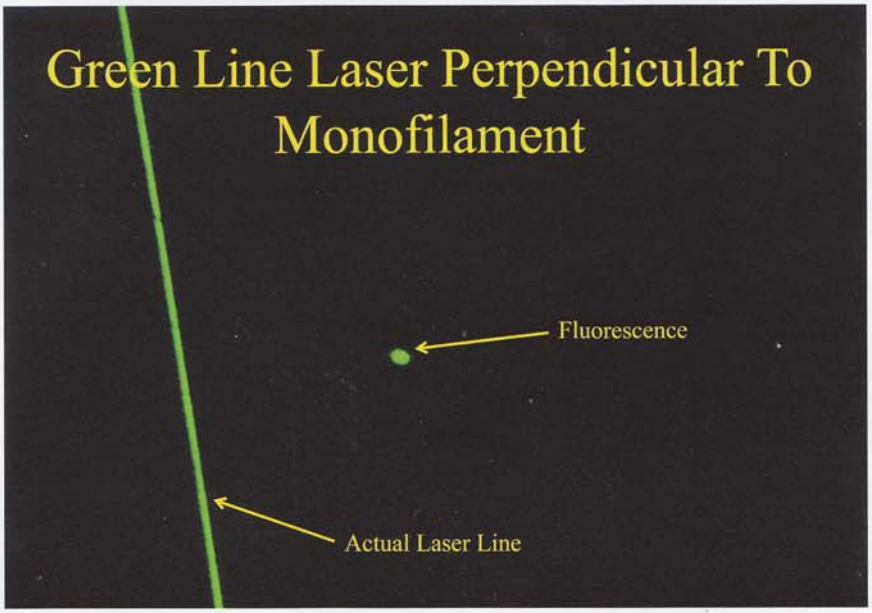
Some time ago, my friend Mike Eldredge showed me a small handheld green laser point generator that he used for designating and identifying items of concern and other targets down range. This got me to thinking about employing a green laser for tripwire detection, so I began researching the topic and looking for manufacturers. A simple Internet search revealed numerous manufacturers with green point lasers on the market right now, though most are not specifically designed for our purposes. Repeated searches over time ultimately led me to a company called Z-Bolt, out of Clackamas, Oregon.

Z-Bolt makes green laser generators specifically for military and









law enforcement purposes and a little background research revealed that to date they have shipped more than 40,000 lasers to the middle-east theater of conflict, Kosovo Force–NATO, and the Sinai Multi-National Force & Observers. While most of these were intended for use as weapon mounted devices, they are also marketed as hand-held target designators and escalation of force (EOF) warning devices. What really made them stand out from other manufacturers was their Tripwire Illuminator®.

I contacted Z-Bolt and spoke with John Mueller, Managing Director, and had an extended conversation with him. He told me that in the course of providing new lasers for the military, he had the opportunity to speak with some EOD operators who told him the same things I mentioned above. He said following that conversation he thought wouldn't a green laser line generator be a more effective tool, so he made one and the Tripwire Illuminator® was born. (Before I go any further, let me state for the record that prior to testing this product, I had no relationship with Z-Bolt or any of its personnel, and I have no financial interest in the company.)

For testing and evaluation (T&E) purposes I obtained one of their green laser point generators (item: BTG-10G) and one Tripwire Illuminator® green laser line generator (item: C-TRIP). The first thing I noticed was that each came complete with a MOLLE compatible carrying pouch, lanyard, and batteries (in the devices and spares), so nothing else was needed and they were ready to use right out of the box. The batteries they use are also over the counter CR123A lithium type, so nothing

proprietary needs to be purchased for sustainment in the field.

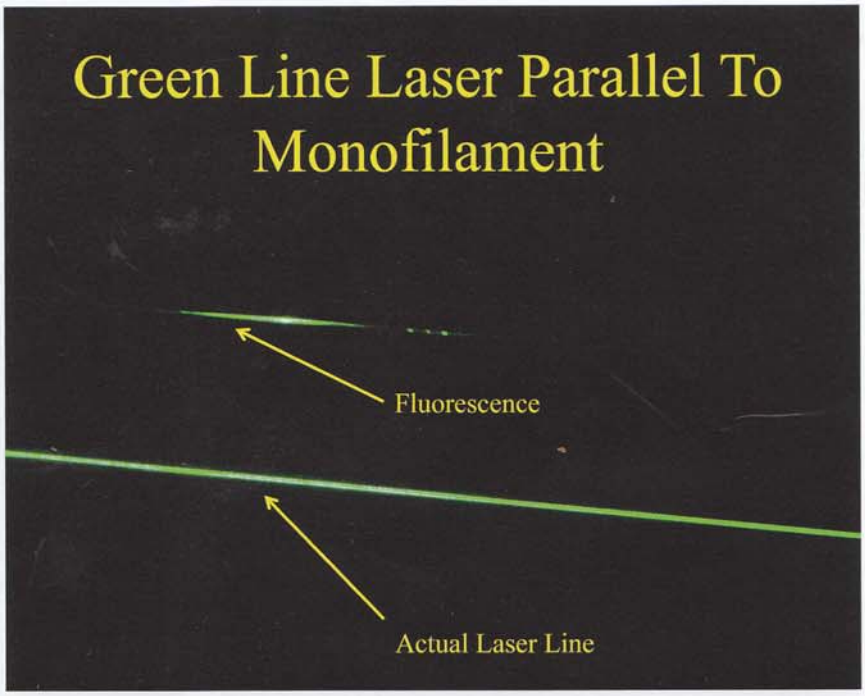
Two other major items of note: the Z-Bolt lasers are all "eye safe," which seems to me rather unusual among laser devices currently on the market; and they are waterproof as well, important for any electronic item carried with our gear and used outside.

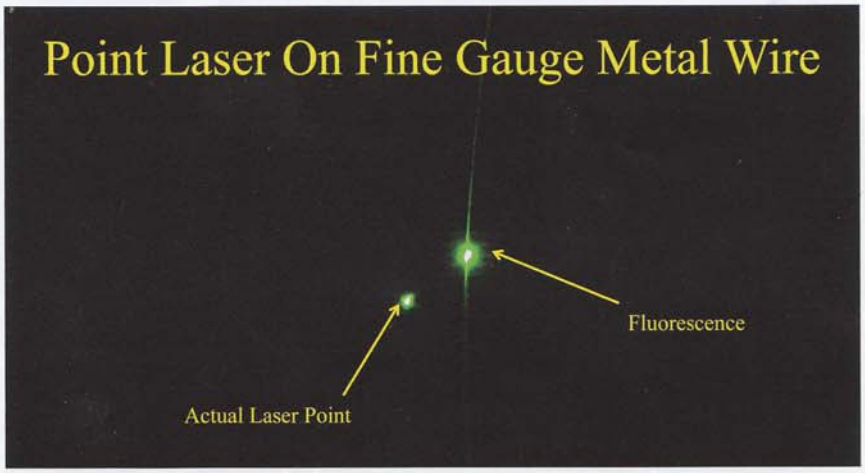
Testing began with deploying both lasers under natural, artificial, and low/no light conditions. Right away the higher intensity and visibility of the green laser devices was apparent in all lighting conditions, with the point generator having a visible range of 25,000 feet under low/no light conditions.

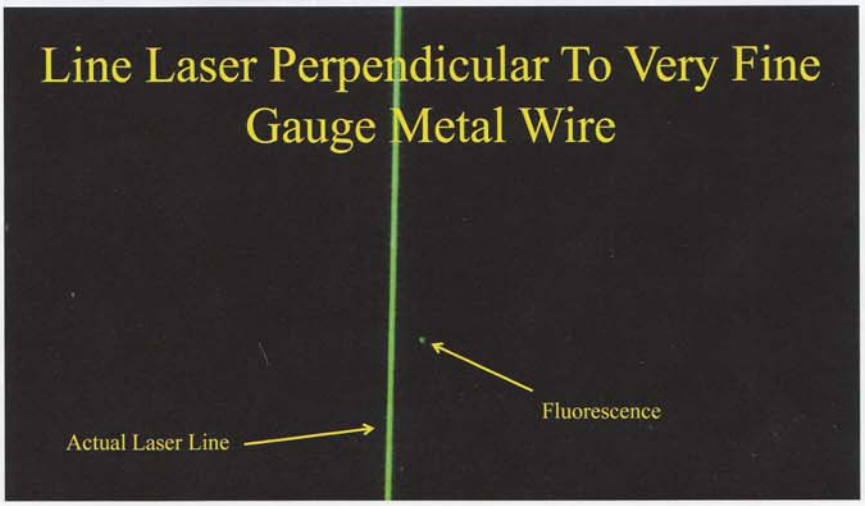
Next I tested the laser generators in a simulated "bomb maker's lab" to see how great an area could be searched, and in what amount of time. The line generators were tremendously efficient in this environment, with the Tripwire Illuminator® producing a line over a 60° fan, which equates to a 15 ft. line at 15 ft. from the source, and lengthening over distance, essentially to whatever point you feel confident with your ability to search.

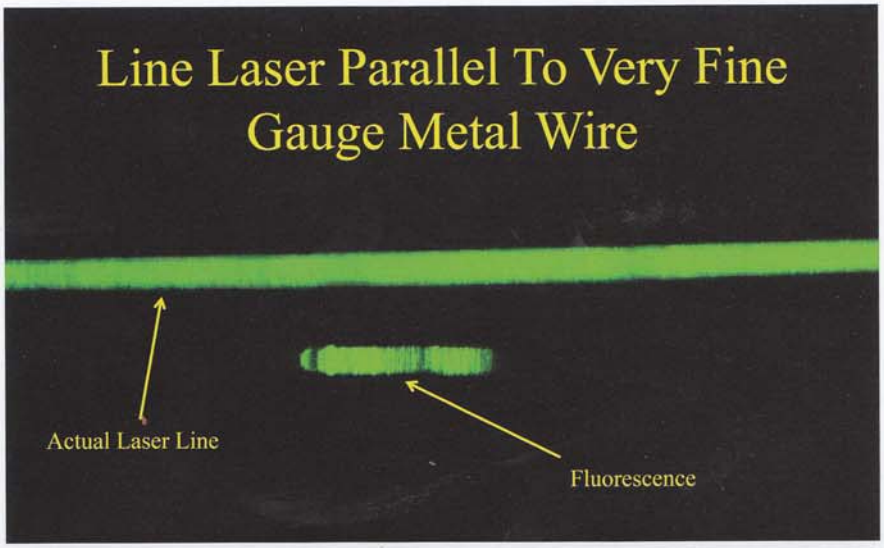
The red laser line generator tested (a consumer device intended for in-home use in leveling wall-mounted pictures and shelves), which was provided by my Bomb Squad Commander, Rob Conroy, is only good for a maximum distance of 30 ft., and only indoors according to the manufacturer. The line generators were able to sweep the entire room with one pass horizontally and one vertically. Of course for good measure, you would sweep each way a couple of times, which is still much quicker than using a point laser.

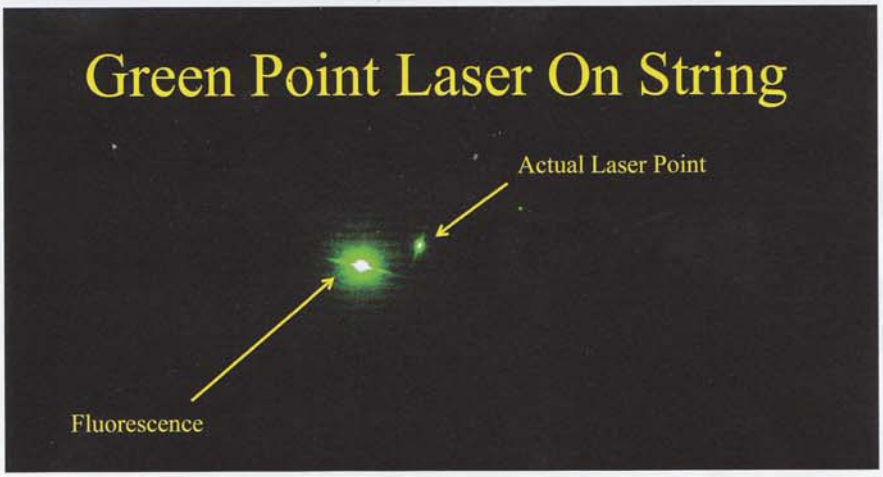
The next phase of testing was on

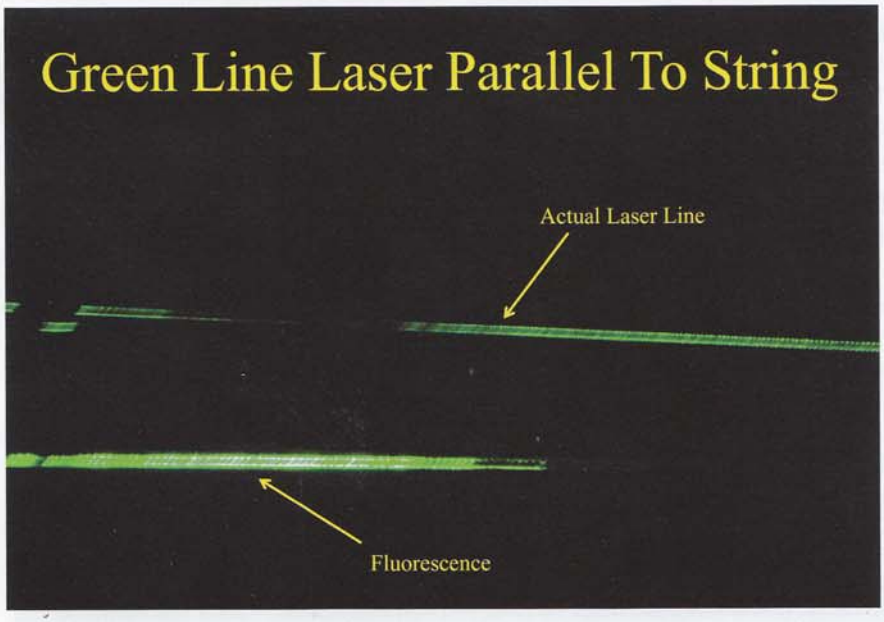












actual tripwires in total darkness. For this I used three different types of tripwire to simulate real-world conditions: monofilament line, thin string, and very fine gauge metal wire. This test was sub-divided into two separate parts. The first was each tripwire by itself, with a point generator and a line generator used to detect each. The second was all three types side by side for comparison and contrast purposes.

The point generators produced an intense point of fluorescence on each, but as mentioned above, it disappeared almost instantly as the beam moved. If you move the beam back slowly to the wire and are actually able to hold it steady on target, it produces what can be described as a "light explosion" throwing off glare into the room. The green laser was more effective than the red laser and due to its greater intensity, even introduced a measure of illumination into the room. Once again the line generators took the prize allowing the room to be scanned in a remarkably short span of time. Upon contacting a tripwire the point of fluorescence did not disappear and when parallel to it, illuminated a large section of the wire leaving no doubt as to its presence and the direction in which it was strung. In fact, the Tripwire Illuminator® worked so well that it even lit up cobwebs in the corner of the room.

During all testing, regardless of the type of laser used, the greatest fluorescence and reflection, somewhat to my surprise, came from the string. I was rather expecting the monofilament to show up best, due to its translucent nature, but it actually came in second with the metal wire third.

Overall I am very pleased with the results of these tests, as they were better than I had anticipated. In particular the line generator's performance certainly proved it to be a valuable tool. The hand-held lasers' portability, affordability, and ease of use, make them an excellent option for the Bomb Technician or other operator in the field likely to encounter a tripwire. As they say, a picture is worth a thousand words, and as these photos clearly demonstrate, a hand-held laser is a highly effective tool for tripwire detection.

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