

# TASER®<sup>1</sup> X26 - ELECTRICAL DEMONSTRATIONS

By Michael Brave - October 24, 2006

## Introduction:

There are numerous, mostly media created, misconceptions regarding the strength of the electrical energy discharged from a TASER X26, e.g. “50,000 volts!!!!” Couple this with a lack of basic understanding and a deeply ingrained phobia of electricity – **electricaphobia** – and there exists a very negative underlying misunderstanding of basic TASER electronic control device (ECD or device) electrical principles.

Thus, the challenge is to visually, tactilly, and verbally demonstrate basic TASER device electrical principles in a short time frame and very easy to understand manner. That is the purpose of this memo, to present suggestions on how to accomplish this in a positive way.

## The demonstrations or illustrations include:

1. Pair of 3 volt (V) lithium cells
  2. TASER cartridge wire
  3. TASER probes
  4. Stack of copy paper (illustrate duration of “on” ECD discharge in one second)
  5. Why 19 pulses per second from TASER X26
  6. Peak discharge comparison to “strong static shock”
  7. TASER X26 discharge will not activate a Ground Fault Interrupter
  8. Ball analogy - all electricity is not the same
  9. Comparison with NSC Odds of Dying Charts
1. **Lithium Cells demo** - a TASER X26 is powered by a pair of 3 V lithium cells. The cells together comprise a “battery” of cells. Show the following:
    - a. **Size of cells (very small, finite energy):**
      - i. Show the 2 lithium cells.
      - ii. Explain that these are digital camera type cells.
      - iii. These cells do not have unlimited power, nor are they nuclear devices.
    - b. **Limited energy per discharge:**
      - i. Explain that these two (2) cells can produce up to (quantity of) 195 five-second (5 s) duration TASER X26 discharges (from a single battery of cells).

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- ii. Thus, the energy discharged by the TASER X26 in a given discharge is very small.
- c. **Number of Pulses per battery of (2) three-volt cells:**
- i. How many pulses per second (s)? Answer - "19"
  - ii. How many seconds per trigger pull? Answer - "5"
  - iii. How many pulses per five second trigger pull?  $19 \times 5 = 95$  pulses/5 s
  - iv. How many (conservative) 5 second discharges per battery set? A - 195
  - v.  $195 \times 95 =$  (conservatively) 18,525 pulses per battery of cells
  - vi. This can be rounded to 20,000 pulses per battery of cells
  - vii. Since these are "photo" batteries – this 20,000 pulses number can be compared to:
    - (1) Number of flashes from a digital camera with same battery of cells
    - (2) Number of digital photos that can be taken with same battery of cells
2. **TASER Cartridge Wire** - some people have the misconception that a TASER ECD is a lighting bolt in the hand, or a horsepower in the hand (745 watts (W)). Also, many people understand the visual concept that it would take a large cable to transmit the electrical energy from a lighting bolt.
- a. Show the TASER cartridge wire.
  - b. Explain and show that the wire is easily broken.
  - c. State that the cartridge wires are not car "jumper cables."
3. **TASER Probes** - the purpose is to show that the point of contact for the TASER probes is very small, especially when compared to a medical external defibrillator.
- a. The TASER probes have a very small point of contact. And, TASER probes do not need to penetrate the skin to be effective, this is the reason for the 50,000 volts (V) open circuit peak voltage. Due to the sharp points a two inch (2") air gap of thick clothing can be traversed with this 50,000 V.
  - b. **Comparison to medical external defibrillator:**
    - i. Medical external defibrillators, that everyone has seen (probably on television), have pads or paddles approximately the size of pancakes.
    - ii. The defibrillator pads are large to drive electrical energy deep into a person's body.
    - iii. Compared with a TASER probe – the probe is very small.
  - c. **Joule (J) output comparison - TASER X26 and external defibrillator:**
    - i. An external defibrillator is commonly set to discharge 360 joules (J) of energy.
    - ii. While a TASER X26 only discharges 0.07 J per pulse into a person.
      - (1) Note, the TASER X26 does have 0.36 J per pulse at the main capacitor, however, this is not delivered into the load (the person).

4. **Paper Stack** - the stack of copy paper is to visually show the duration that a TASER X26 is “on” (and discharging) during one second and this is compared to a normal wall electrical outlet.
  - a. The stack of paper (for a 100  $\mu$ s (microseconds or millionths of a second) needed for this demonstration is 10,000 sheets (about a five foot high stack).
    - i. It has worked well to take the paper out of the boxes, keep them in their packaged reams, and open only one ream (500 pages).
    - ii. For an 80  $\mu$ s pulse demonstration - the stack of paper would be 12,500 sheets
  - b. Stack the paper.
  - c. Explain that the stack of paper equals one second of time.
  - d. For the normal wall electrical outlet, the electricity is being transferred, “on” 100% of the time, or the full one second, or the full 10,000 sheets of paper.
  - e. A TASER X26 discharges at a rate of 19 pulses per second (pps) and each pulse is only 100  $\mu$ s in duration.
  - f. Thus, “one” piece of paper from the stack of 10,000 sheets is the duration of “on” for one TASER X26 pulse.
  - g. Thus, “nineteen” (19) pieces of paper from the stack of 10,000 sheets of the TOTAL duration of “on” for a TASER X26 for all 19 pulses within that second.
  - h. The rest of the stack of paper – 9,981 sheets – is the total time that the TASER X26 is NOT on, or discharging.
  - i. The equation (stack) is different for the Advanced TASER M26 because the TASER M26 has a shorter pulse duration (40  $\mu$ s for full pulse width, with a primary pulse duration of 10  $\mu$ s).
  
5. **Why 19 pps** – it may be helpful to explain an example of why TASER chose 19 pps for the TASER X26 – use the Colorado Springs, CO incident as an example:
  - a. TASER chose 19 pps in order to maximize control of a person without over stimulation (or unnecessary pulses to accomplish the objective).
  - b. When the TASER X26 was first introduced in 2003, a five-second (5 s) discharge was – the first two (2) seconds were at 19 pps, and then the next three (3) seconds were at 15 pps. This was done to minimize the energy output and to attempt to save battery life.
  - c. Now, the TASER X26 is set to always deliver 19 pps. One example of why is the Colorado Springs, CO handgun suicide that occurred.
    - i. In Colorado Springs, a man was threatening to kill himself with a handgun. When an officer hit the man with a TASER X26, for the first two (2) seconds (19 pps) the man was literally frozen in place and could not move. As soon as the discharge rate (for the next three (3) seconds) dropped to 15 pps, the officers present watched the man force – as though in slow motion – the gun towards his chest and pull the trigger.
  - d. Thus, the pulse rate for a TASER X26 is now set to 19 pps.

6. **Strong Static Shock** – TASER X26 pulses have a lower peak electrical current than a “strong static shock” [IEC 61000-4-2] [International Electrotechnical Commission, [www.iec.ch](http://www.iec.ch)]
  - a. Because electrical devices need to be virtually immune to strong static shocks, there are international standards that define what a “strong static shock” is.
  - b. Peak electrical current:
    - i. IEC 61000-4-2 defines a strong (level 4) static shock as having a potential peak electrical current of 30 amperes (A).
    - ii. A TASER X26 has a peak electrical current of 3 A, with an average current of 1.9 mA (0.0019 A) to 2.1 mA (or 0.0021 A), depending upon how it is measured.
  - c. Voltage:
    - i. A strong (level 4) static shock can have a peak voltage of 8,000 volts (V).
    - ii. A TASER X26 delivers 1,200 volts into the load (the person), but only has an average voltage of 0.76 V (one second baseline)
  
7. **Ground Fault Interrupter (GFI)** - TASER X26 discharge will not set off a GFI - the average current is too low to activate a GFI.
  
8. **Ball Analogy** - some people state that all electricity is the same. A simple analogy is that stating that all electricity is not the same, just like all balls are not the same. There are significant differences between a nerf ball, a ping pong ball, a wiffle ball, a tennis ball, a base ball, a football, a basketball, a bowling ball, a medicine ball, a wrecking ball. The wrecking ball would represent lightning, the bowling ball would represent 110 V AC house current, and the tennis ball would represent the TASER device.
  
9. **NSC (National Safety Council) Odds of Dying Comparison Chart** - compare the “odds of dying” between a TASER device and the NSC Odds of Dying Comparison (Odds of Death Due to Injury, United States, 2003):
  - a. NSC Odds of Dying - [http://www.nsc.org/lrs/statinfo/odds\\_back.htm](http://www.nsc.org/lrs/statinfo/odds_back.htm)
  - b. NSC Odds of Dying Graphic - [http://www.nsc.org/lrs/statinfo/odds\\_dying.jpg](http://www.nsc.org/lrs/statinfo/odds_dying.jpg)
  - c. Examples of Odds of Dying:
    - i. Total odds of dying any cause 1 in 1
    - ii. Heart attack - 1 in 5
    - iii. Cancer - 1 in 7
    - iv. Stroke - 1 in 24
    - v. Motor vehicle accident - 1 in 84
    - vi. Suicide - 1 in 119
    - vii. Falling - 1 in 218
    - viii. Firearm assault - 1 in 314
    - ix. Drowning - 1 in 1008
    - x. Air/Space accident 1 in 5,051
    - xi. Hot weather 1 in 13,729

xii. Hornet, wasp, or bee sting -	1 in 56,789
xiii. Legal execution -	1 in 62,468
xiv. Lightning -	1 in 79,746
xv. Earthquake -	1 in 117,127
xvi. Flood -	1 in 144,156
xvii. Fireworks discharge -	1 in 340,733