DECLARATION OF MAGNE "MAX" NERHEIM

REGARDING TASER® X26™ CONDUCTED ELECTRICAL WEAPON ("CEW") OPERATIONAL BASICS, CAPABILITIES AND LIMITATIONS

I, Magne "Max" Nerheim, declare and state as follows:

1. I am a competent adult over the age of 18 and have personal knowledge of the following facts.

2. I am Vice President of Research and Technical Fellow for TASER International, Inc. ("TASER"), stationed at its corporate headquarters in Scottsdale, Arizona. I have held this position since August 2009.

3. I received my Bachelor (1988) and Master (1991) of Science Degrees in Electrical Engineering from Arizona State University in Tempe, Arizona.

4. I began working as a consultant for TASER in 1998 and was hired as the company's first full-time electrical engineer in 2002. I served as TASER's Electrical Engineering Manager from April 2002 to December 2004, and as its Vice President of Research and Development from December 2004 to August 2009, when I was promoted to my present position.

5. I designed the TASER® M26™ CEW (Conducted Electrical Weapon, synonymous with Electronic Control Device or "ECD") released in 1999, the first electrical weapon to incorporate TASER's patented Neuromuscular Disruption technology that affects both the sensory and motor nervous systems to cause incapacitation.

6. I am an inventor on 40 U.S. Patents, including the Shaped Pulse™ waveform technology (Pat. 6.999.295) utilized by the TASER X26™ CEW released in 2003, which

allowed a substantial reduction in CEW size and power consumption. I am therefore intimately familiar with the design, specifications, capabilities and limitations of the TASER X26 CEW.

7. I also directed the development and launched the TASER CAM™ incident audio/video recording system in 2007.

I. X26 CEW APPLICATION MODES.

8. In the field, the TASER X26 CEW may be applied to a person in three ways:

(1) **Probe-Deployment Mode**, where two small metal darts are expelled from a cartridge via compressed nitrogen, with electrical impulses transmitted into the target through very thin insulated trailing wires;

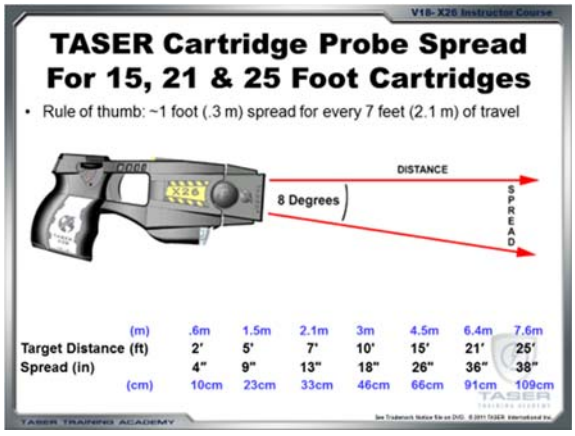
CEW probes deploying through green blast doors

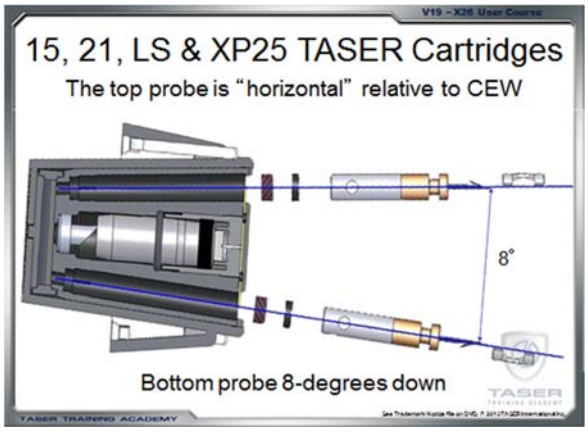
(2) **Drive-Stun Mode** (also referred to as "contact" or "touch" mode), in which the front of the CEW is physically pressed against the target utilizing the fixed electrodes on the front of the X26 CEW without a cartridge or the fixed rounded recessed electrodes on the sides of an expended cartridge; and

(3) **Three- or Four-Point Activation** that combines a probe deployment with a follow up drive stun to potentially combine CEW effects

9. In a successful probe deployment, the CEW is designed to primarily work by motor-nerve mediated stimulation of skeletal muscles. The TASER X26 CEW is designed to transmit stimuli through very short duration (≈125 microseconds ("µs")), low charge (≈100 microcoulombs ("µC")), low energy (≈ 0.1 joules), and low power (≈ 1.9 watts) electrical pulses to interfere with the command and control systems of the body to temporarily induce Neuro-Muscular Incapacitation ("NMI") of the target.

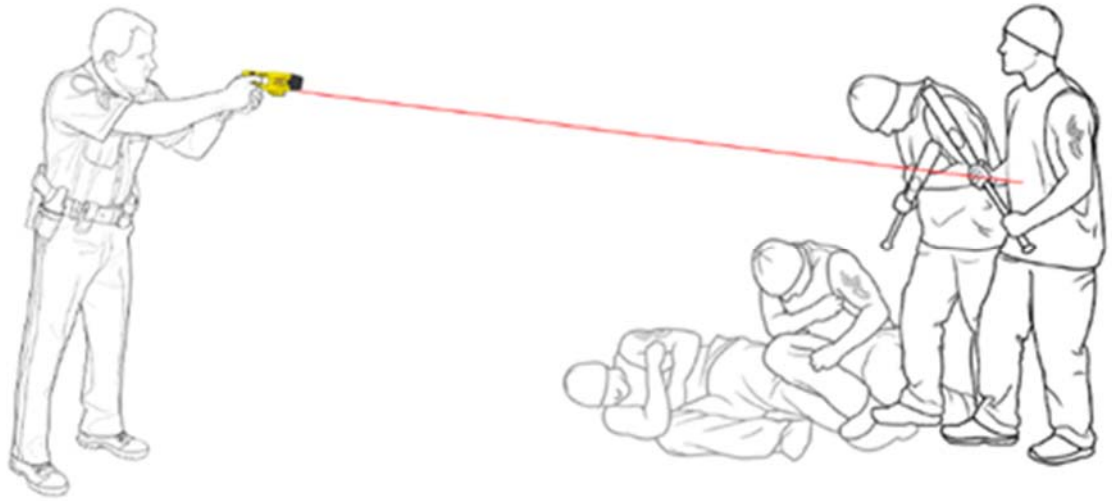
10. To achieve NMI an adequate probe spread is required to ensure major muscle groups between the darts are affected by the delivered electrical charge. As reflected in the following TASER training slide, the bottom probe is deployed at an 8-degree downward angle (for cartridges with a range of ≤ 25 feet) resulting in a probe spread of approximately 1 foot for every 7 feet of distance from the front of the CEW cartridge to the target:





The optimum CEW deployment range is 7 to 15 feet. When deployed at close range, the probe spread may be insufficient to cause NMI.

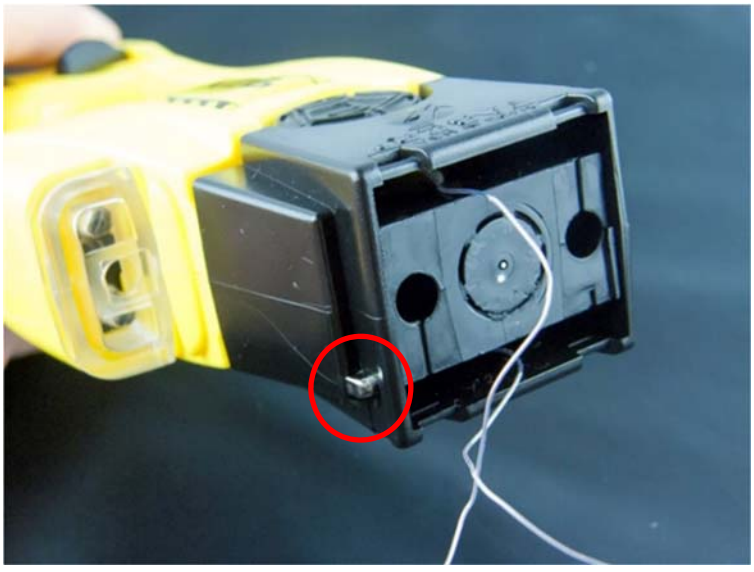
11. To aid officers in deployment accuracy, the X26 CEW is equipped with a LASER sight that emits a red dot on the intended target (when selected and activated). The top probe generally impacts the target near the LASER dot. Impact points may vary based on wind, subject and officer movements, or other variables.



12. In drive-stun (touch/contact) mode without a cartridge attached, electrical impulses are transmitted superficially through two fixed electrodes on the front of the CEW, as pictured below. The electrodes are 1.6 inches (4 centimeters ("cm")) apart.

Electricity arcing between fixed electrodes on CEW without a cartridge attached

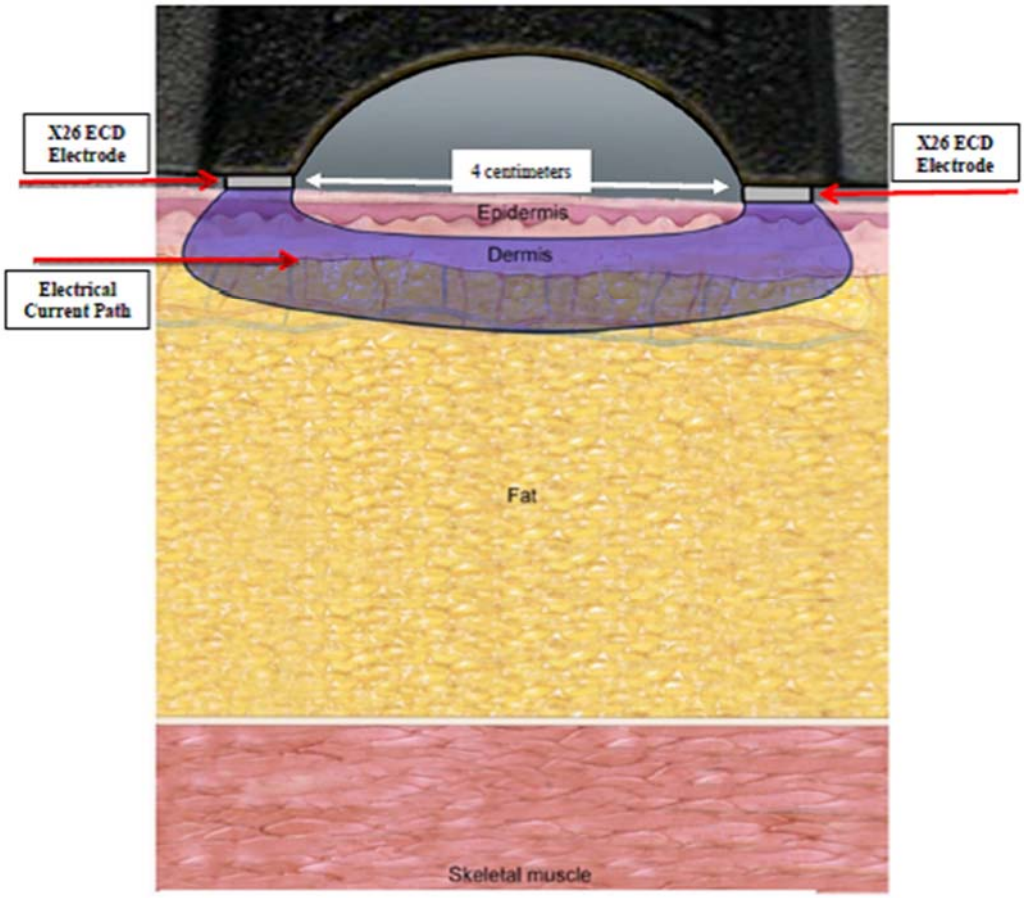
A drive stun may also be applied with an expended (empty) cartridge still attached to the CEW. In this instance, electrical impulses are transmitted through two fixed electrodes on the sides of the cartridge, which are 1.77 inches (4.5 cm) apart.



Fixed electrode (circled in red) on side of expended CEW cartridge

13. Because the electrical current in a drive-stun application is confined to such a small electrical stimulation area between or very close to the two electrodes on the surface of the skin, it does not create any significant muscle mass involvement and does not result in NMI. Thus, a CEW drive stun is strictly a pain compliance tool. The illustration below

depicts the path and depth of delivered electrical charge from a CEW drive-stun based upon finite-element modelling:[1]



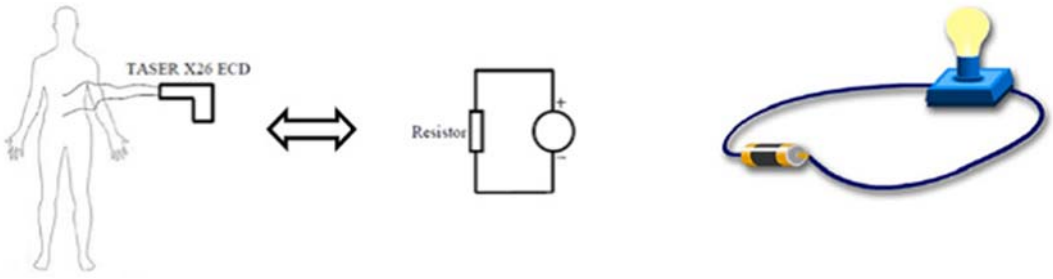
14. It is possible, however, to use a drive stun following and in connection with a probe deployment to achieve NMI in what is known as a "3-point" or "4-point" stun. If only one probe contacts the target, the user may drive stun the subject with the expended probe cartridge still attached to the CEW to an area of the body away from the probe contact

[1] Illustration discussed in *Glowczenski v. TASER Int'l, Inc.*, 2012 WL 976050, *7 (E.D.N.Y. March 22, 2012) (noting electrical charge does not penetrate the dermal fat layer into skeletal muscle of recipient). See also Legal Aspects of Conducted Electrical Weapon Injuries, Wounds, and Effects, Ch. 8 at 149, J.D. Ho et al. (eds.), Atlas of Conducted Electrical Weapon Wounds and Forensic Analysis, Springer (2012).

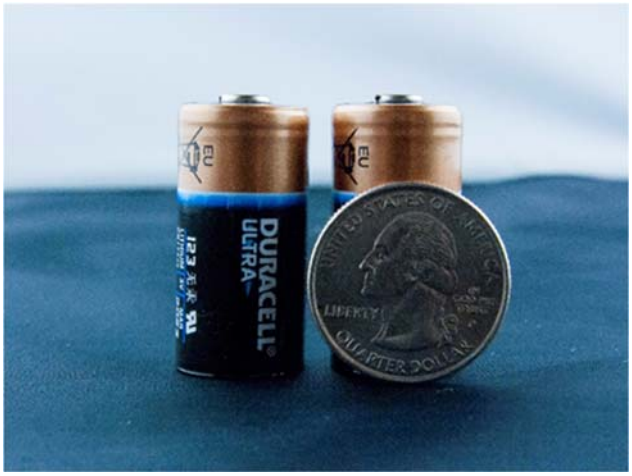
point to complete the circuit and increase the probability of inducing NMI. In this circumstance, the electricity flows between the two fixed electrodes on the sides of the expended cartridge affixed to the CEW and the single probe embedded in the subject or the subject's clothing in a 3-point contact. Similarly, if both probes contact the target but the probe spread is insufficient to cause NMI, as may happen with a close-range deployment, a follow up drive stun away from the probes in a 4-point contact can effectively widen the muscle groups between the probes and the fixed electrodes to cause the intended NMI.

II. X26 CEW ELECTRICAL PRINCIPALS AND LIMITATIONS.

15. In order for a CEW to be effective in delivering an electrical charge to a person, the electricity must flow in a complete circuit. In a CEW, an electric current starts at a small battery power source, flows through an intact circuit, and must return to the power source. If there is no completed circuit, then no electric charge is delivered to the person. There are numerous reasons why a CEW may not have a completed or maintained circuit, including a miss with one or both probes, a dislodged probe, a clothing disconnect, or a broken wire.

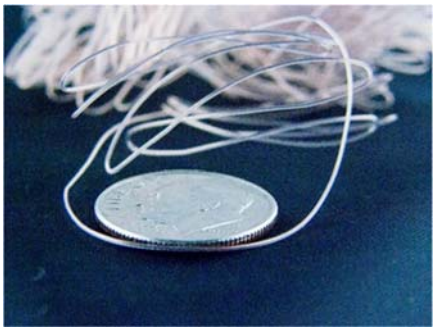


16. In any given electric circuit, the total power is limited by and cannot exceed the output of its power supply. A TASER X26 CEW's power source consists of a battery of two 3-volt cells (Duracell® CR123), such as those commonly used in some digital cameras.



X26 CEW battery of 2 3-volt cells
and U.S. quarter

17. Delivered electrical charge from a TASER CEW also is limited by the wire conductors between the TASER CEW and the target. The TASER CEW cartridge wires are very small (36 gauge, 127 microns (millionths of a meter)) in diameter, and are not capable of delivering large electrical currents that would require much larger wires such as automobile jumper cables or home electrical extension cords.



CEW cartridge wire and U.S. dime

18. CEW cartridges identified by their silver blast doors contain 21 feet of wire per probe and standard probes with 9 millimeter (mm) dart tips.

9 mm Dart and U.S. Dime

21 ft.
Silver Blast Doors
Live Cartridge
Regular Probe

Cartridges containing 15 feet of wire have yellow blast doors, and 25-foot cartridges have green blast doors with XP 13 mm dart tips.

13 mm Dart and U.S. Dime

25 ft.
Green Blast Doors
Live Cartridge
XP Probe

19. While the TASER X26 CEW produces an open-circuit peak voltage of 50,000 volts, the output voltage (what actually enters or is delivered to the body) is approximately 1,400 to 2,520 volts. Claims that a person is shocked with 50,000 volts are simply not true. Moreover, voltage is not a key measure of electrical safety. As examples, Van de Graff generators found in many science museums and grade schools discharge up to 20,000,000 volts without injury.


Examples of Experiencing up to 20 Million Volts from a Van de Graff Generator

20. It is the total number of electrons delivered that matters, and the X26 CEW delivers ≈100 μC of charge at ≈19 pulses per second which yields an actual, or average output of 0.0019 amperes ("A") (or 1.9 milliamperes ("mA")), less than a single Christmas tree light bulb.[2]

21. The TASER X26 CEW produces a complex shaped pulse. It delivers 19 +1/-2.5 pulses per second. Each pulse delivered from a TASER X26 CEW is 105 to 155 microseconds (millionths of a second) in duration. In a single second of time, a TASER X26 CEW is not delivering any electrical charge to the subject for ≈ 99.81% of the second

22. The TASER X26 CEW meets all relevant sections of the International Electrotechnical Commission ("IEC"), Underwriter's Laboratories ("UL"), European

[2] *See Mitchell v. TASER Int'l, Inc.*, 803 F.3d 223, 227 (6th Cir. 2015) (comparing X26 CEW's minimal delivered current to a wall outlet (16 amperes) and a single Christmas-tree light bulb (1 ampere).

Norm ("EN"), British Standard ("BSI"), and Australian/New Zealand ("AUS/NZ") electrical safety standards as they pertain to cardiac safety.[3]

III. X26 CEW Accountability Features.

23. Pulling and releasing the X26 CEW trigger automatically activates a 5-second discharge cycle. The CEW operator may cut the cycle short at any time by placing the safety lever in the down (SAFE) position. As a safety factor, the operator also may extend the CEW discharge beyond 5 seconds by holding the trigger down. Releasing the trigger any time after 5 seconds will immediately stop the CEW discharge.

24. As an objective accountability measure, the X26 CEW has data download capabilities that record the date, time and duration of each CEW discharge. The data download shows discharges (trigger pulls) only, not whether the electrical charge was delivered to the subject. For example, if an officer only pulls and releases the trigger in probe mode, the download report will show a 5-second duration even if one probe misses the target such that there is no completed circuit and no delivered charge to the person. Similarly, in drive-stun mode, if an officer pulls and releases the trigger and presses the CEW against a subject for two seconds before the subject pulls away or the officer disengages and breaks the contact, the download report will still reflect a 5-second duration.

[3] *See also* D. Panescu et al. "Electrical Safety of Conducted Electrical Weapons Relative to Requirements of Relevant Electrical Standards," *Conf Proc IEEE Eng Med Biol Soc*, vol. 35, pp. 5342-47 (2013).

25. An X26 CEW data download reports the time when the firing sequence ends, not the time the trigger pull activates the discharge. Also, time is rounded up to the nearest second. Therefore, if the discharge is 4.01 to 5.00 seconds, the data download time will show a 5-second discharge duration.

26. The X26 CEW's internal clock is run by the central microprocessor. It is initially set to Greenwich Mean Time ("GMT") at the factory. Like most other clocks and watches, the CEW clock is subject to time drift, which ranges up to ± 4 minutes per month. When the X26 CEW is downloaded, the download software automatically adjusts the GMT time in the CEW to the local time zone set on the PC (when in Offline Mode), or to the user's time zone setting in Evidence.com (when in Online Mode).

27. An X26 CEW may be equipped with a TASER-Cam™ recording device—a digital camera with audio mounted in the handle grip (circled in red below), replacing the standard digital power magazine ("DPM"). The camera and audio recording features are automatically activated when the CEW safety lever is moved to the ARMED position, and deactivated when the safety lever is returned to the down (SAFE) position.

The TASER-Cam has a boot-up time of approximately 1.6 seconds after the safety is removed.

28. All photographs and illustrations contained in this declaration are true and accurate representations.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed this 25th day of May, 2016 at Scottsdale, Arizona.

Magne "Max" Nerheim