

Part 3

Conducted Energy Weapons

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PART 3: CONDUCTED ENERGY WEAPONS

A. HISTORY OF CONDUCTED ENERGY WEAPONS

1. Origins

Conducted energy weapons or devices, which are designed to use a conducted electrical current in order to incapacitate a person or to ensure compliance through pain, have been available for more than three decades.

It is my understanding, based on the presentation of Thomas Smith (Chairman of the Board of TASER International, Inc.) at our public forums and the TASER International, Inc., website, that the first device was developed in the late 1960s by Mr. Jack Cover, an American physicist and NASA researcher. His inspiration was drawn from the 1966 Blue Ribbon Crime Commission that called for the development of non-lethal devices for use in controlling riots, which were occurring across the United States at that time. His first model, known as the Tasertron Taser,¹² was a pain compliance device, which he patented in 1974. By 1976, several police agencies were utilizing his products.

2. Manufacturers

There are several manufacturers of conducted energy weapons, including:

- TASER International, Inc., headquartered in Scottsdale, Arizona. It manufactures devices for civilian, policing, and military purposes.
- Stinger Systems, Inc., of Tampa, Florida. It manufactures a projectile stun weapon, as well as an electronic stun restraint device used for prisoner transport and an electrified riot shield.
- Aegis Industries, Inc., of Delaware. It develops intermediate-force devices, including its MK63 Trident, a close-quarters engagement device that also acts as a stun device.

¹² The name TASER is apparently an acronym for "Thomas A. Swift's Electric Rifle," named for a science fiction teenage inventor and adventure character: see <http://www.taser.com/legal/Pages/trademarks.aspx>.

B. TASER INTERNATIONAL, INC.

1. Origins and growth of the company

Since the only conducted energy weapons authorized for use in Canada are those manufactured by TASER International, Inc., I will limit my discussion to that firm's products. Mr. Smith told me that he and his brother Patrick bought the company, and rights to the TASER name, from Mr. Cover in 1993. Their initial goal was to use modern technology to develop a self-defence device for the civilian market, after two friends were shot and killed in a road rage incident in Scottsdale. In 1993, after switching from gunpowder to a compressed nitrogen propellant (which meant that the device was no longer classified as a firearm), the company introduced the Air Taser™ to the civilian market. It has subsequently developed a compact C2™ model that it markets primarily to women.

In 1999, the company expanded into the law enforcement market, with its development of a handgun-shaped model (the Advanced TASER M26), which could be used for incapacitation as well as pain compliance. In 2003, it introduced a smaller, lighter and more advanced X26 model that police officers could wear on their belts. Both models are also marketed to the military.

The company is currently field testing a new model. The XREP projectile is self-contained, wireless, and fires from a 12-gauge shotgun. It delivers the same neuromuscular incapacitation as the handheld TASER X26 (but for 20 seconds instead of five seconds), but can be delivered to a distance of 20 metres.

According to Mr. Smith, 350,000 officers in over 12,750 agencies in 45 countries use his company's technology today. He estimates that approximately 680,000 human volunteers have been exposed to the company's conducted energy weapons, most of them being law enforcement officers who have been exposed as part of their training. In addition, there have been approximately 547,000 field uses. He told me that in Canada, 160 agencies are using almost 2,300 M26s and almost 4,200 X26s.

2. Models used by policing bodies in British Columbia

TASER M26 and TASER X26¹³



a. *The Advanced TASER M26*

Introduced to the law enforcement community in 1999, the Advanced TASER M26 is a pistol-shaped weapon. It can be used in two modes:

- *Push-stun mode*—the end of the weapon is pressed against the target's body (with an expended cartridge attached or without a cartridge attached), and a pulsed electrical current is transferred to the adjacent muscles; or
- *Probe mode*—when a cartridge is attached to the end of the weapon, it fires two metal darts or probes (using compressed nitrogen as a propellant), which imbed in the target's skin or clothing. The probes, which have hooked tips, can penetrate up to 9 mm into the subject's skin. If the probes do not reach the skin due to bulky clothing, the high voltage creates an arc enabling the current to enter the body. The probes are connected to the weapon by wires that conduct a pulsed electrical current from the weapon into the target's body.

The trigger activates a five-second electrical current cycle, which can be stopped by placing the safety lever in the safe position, or can be repeated by re-pressing the trigger after the completion of the first cycle. Holding the trigger down continuously can extend a cycle.

¹³ Photos and approval for use provided by TASER International, Inc.

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Eight AA nickel metal hydride or alkaline cell batteries power the M26. Depending on the battery brand used, the electrical current has a pulse rate of 15 or 20 pulses per second, with a pulse duration of 40 microseconds (40 millionths of a second) full waveform.

When the M26 is held level, the upper probe is propelled in a horizontal direction and the lower probe is propelled at an eight-degree downward angle, which means that, for every seven feet of travel, there is a one-foot spread between the probes (or, for every 2.1 metres of travel, there is a 0.3 metre spread). Four different colour-coded single-use cartridges can be installed, with different wire lengths—yellow (15 feet), silver (21 feet), green (25 feet), and orange (35 feet).

For the M26 to be effective when used in its probe mode, both probes should hit the subject.¹⁴ To assist the officer in aiming, the M26 emits a red laser beam, which marks where the upper probe will hit the target.

Every cartridge has a unique serial number. When it fires out the two probes and wires, it also disperses about 30 small discs, called Anti-Felon Identification tags, with the same serial number on it. This enables investigators to link up the user of the weapon with the person to whom the cartridge was issued.

The M26 has an LED indicator showing that the laser is on and the weapon is capable of firing, but it does not indicate whether there is sufficient battery power to fire or discharge. The weapon stores data about firings, date, and time for approximately 585 firings, which can be downloaded using an M26 dataport download kit.

The manufacturer's specifications respecting the M26's electrical output, which I will discuss in more detail later, include the following:

- Voltage:
 - Peak open circuit arcing voltage—50,000 V
 - Peak loaded voltage—5,000 V

¹⁴ However, Mr. Reilly testified that an electrical shock can be delivered across several inches of air and if one probe hits the subject and the other probe falls on wet ground, the subject may still receive a shock.

- Average voltage over duration of main phase—3,400 V
- Average voltage over full phase—320 V
- Average voltage over one second—1.3 V
- Current: 3.6 mA average (milliamps)
- Energy per pulse:
 - Nominal at main capacitor—1.76 joules
 - Delivered into load—0.50 joules
- Power rating:
 - Nominal at main capacitor—26 watts at 15 pulses per second
 - Nominal delivered into load—7.39 watts at 15 pulses per second

b. The TASER X26

The manufacturer introduced its X26 model, for law enforcement and military use, in 2003. It was more compact, 60 percent lighter, and designed to be carried in a holster on an officer's service belt.

The X26's specifications are similar to the M26, except for the following:

- Batteries—digital power magazine (two 3-volt lithium batteries, as used in digital cameras)
- Pulse rate—19 pulses per second
- Pulse duration—100 microseconds (100 millionths of a second)
- Peak loaded voltage—1,200 V
- Average voltage over duration of main phase—400 V
- Average voltage over full phase—350 V
- Average voltage over one second—0.76 V
- Current—2.1 mA average
- Energy per pulse:
 - Nominal at main capacitors—0.36 joules
 - Delivered into load—0.07 joules
- Power rating:
 - Nominal at main capacitors—6.84 watts
 - Delivered into load—1.33 watts

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- LED display—a two-digit display of remaining digital power magazine energy percentage, burst time, warranty expiration, unit temperature, illumination status, and current time and date.
- Data storage—stores time, date, burst duration, unit temperature, and remaining digital power magazine energy percentage for approximately 1,500 firings. The data can be downloaded using a USB data interface module.
- Video and audio—available with an optional video and audio recorder that is activated when the safety switch is armed. It is capable of recording for up to 90 minutes.

3. How a TASER conducted energy weapon works

In order to understand how a conducted energy weapon works, a basic understanding of electricity is required. I am indebted to Mr. J. Patrick Reilly, from the Applied Physics Laboratory of Johns Hopkins University, for his very informative presentation during our public forums. Much of the explanation that follows is based on what he said and his PowerPoint presentation.

To begin with a question, if putting my finger into a 120-volt light socket could kill me, why could I walk away from a 50,000-volt shock from a conducted energy weapon? There are two reasons. First, the “peak open circuit arcing voltage” is rated at 50,000 volts when nothing is connected to the probes, such as when the officer is testing the weapon by creating an electrical arc between the two electrodes. When the weapon is under load (such as when imbedded in a person’s skin or clothing), the voltage is much less—7,000 volts for the M26 and 1,300 volts for the X26, according to Mr. Reilly. Second, the duration of the conducted energy weapon pulse is short. In the case of the wiring in our homes, the electrical current is continuous. However, in a conducted energy weapon, a new electrical pulse begins 19 times every second. The actual duration of each of these pulses is much briefer—30 microseconds (30 millionths of a second) with the M26 and 80 microseconds (80 millionths of a second) with the X26.¹⁵

¹⁵ The pulse durations of 30 and 80 microseconds are taken from Mr. Reilly’s presentation. According to the manufacturer’s specifications, the pulse durations are 40 and 100 microseconds for the M26 and X26 respectively.

There is an important reason why a conducted energy weapon needs 50,000 volts. This voltage (analogous to pressure in a water hose) is required in order to create an electric arc that bridges an air gap. For example, if one of the probes is imbedded in clothing and does not touch the skin, the high voltage creates an arc between the probe and the skin, enabling the electrical current to enter the body. Similarly, although the outer layer of a person's skin (the corneum) is dry and normally a poor conductor, the high voltage breaks down the dryness and makes the skin a good conductor.

Turning now to current (analogous to the water flow rate in a hose, such as litres per minute), the manufacturer's specifications state that the M26 has a current of 3.6 milliamps (3.6 thousandths of an ampere) average, and the X26 has a current of 2.1 milliamps (2.1 thousandths of an ampere) average. Mr. Reilly, on the other hand, cites the M26 as having a peak output current of 17 amperes, and the X26 as having a peak output current of 3 amperes. He explained the difference between his numbers and the manufacturer's numbers as follows. His numbers measure the actual amperage during a pulse, whereas the manufacturer's numbers are an average over the total time period, during and between pulses. In his view, average current is irrelevant to electrostimulation.

According to Mr. Reilly, "delivered charge" is the best indicator of the potential electrostimulation. It is measured in coulombs, which is analogous to the volume of water delivered by a hose during a set period of time. The significant point is that both the M26 and the X26 have an almost identical "delivered charge" for each pulse—approximately 100 micro-coulombs (or 100 millionths of a coulomb). This is so because of the differing currents and pulse durations of the two models, as shown in Table 1.

Table 1: Delivered charge of M26 and X26 models

	M26	X26
Current	17 amperes per pulse	3 amperes per pulse
Pulse duration	30 microseconds	80 microseconds

To give a sense of what effect 100 micro-coulombs of delivered charge would have on a person, Mr. Reilly conducted laboratory experiments with human subjects, who were subjected to brief high-voltage pulses on their forearms. Subjects reported pain on average at 0.5 micro-coulombs, and intolerable pain at 1.0 micro-coulombs. This is to be contrasted to the delivered charge of 100 micro-coulombs from each pulse of a conducted energy weapon, which delivers 95 pulses over a five-second period.

The purpose of the electrical current is different, depending on the mode used:

- **Push-stun mode**—if the trigger is pulled when the end of the conducted energy weapon is pressed against the person’s skin (*e.g.*, arm). The electrodes are close together, which means that the electrical current is localized to the muscles in that area. In that case it serves a pain compliance purpose, to persuade the person to let go of something, or to otherwise comply in order to avoid further shocks.
- **Probe mode**—when the probes are deployed they are normally imbedded in the person farther apart than the electrodes are in the push-stun mode. In that case, the electrical current spreads out more and goes deeper into the body, engaging more and more excited tissue. In addition to the same pain experienced in the push-stun mode, the electrical current now interferes with the person’s neuromuscular system. The person typically becomes incapacitated, and falls to the ground with no ability to put his or her hands out to break the fall.

When the five-second cycle is over, the pain and/or incapacitation is over, and the person’s normal strength returns immediately.