

Tuesday 8 August 2017

Sergeant Rachael Kilshaw
San Francisco Police Department
Police Commission Office
1245 – 3rd Street, 6th Floor
San Francisco, CA 94158

Re: Response to your email of 26 July 2017 with 2 additional questions.

Dear Sergeant Kilshaw:

In your email of 26 July 2017 you presented two additional follow-up questions to my very brief comments to the San Francisco Police Commission (SFPC) on 21 June 2017:

1. If the SFPD decides to purchase CEWs [Conducted Electrical Weapons] from your company, what model number is available? Is it the X26P or a different model?
2. As to the models that are available for purchase, what is the electrical output? I understand that in your previous model, the M26 model output was 85-120 microcoulombs [μC]. It has been said that the model that is available for purchase today has a lower output. If so, why was the electrical output lowered for the newer model?

BRAVE Question 1 Response: The 2 CEWs that are available are the Smart CEWs: the X2 CEW and the X26(P) CEW.

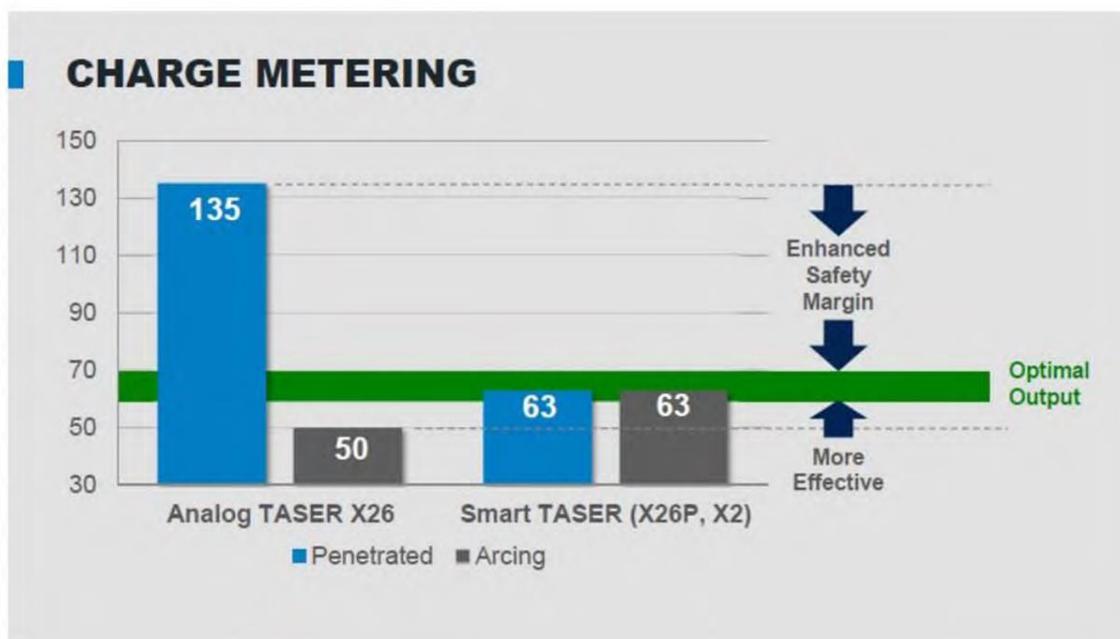
BRAVE Question 2 Response: The outputs of the X2 and X26(P) CEWs are the same:

X2 CEW Output Specifications (April 5, 2017)	X26P CEW Output Specifications (April 5, 2017)
1. Output Specifications (per cartridge bay) ^{4,5} Waveform: Precision Shaped Pulse technology. Into 600-ohm (Ω) load: <ul style="list-style-type: none">• Pulse duration: 50–125 microseconds (μs).• Peak loaded voltage: 840–1440 volts.• Pulse rate: 19 ± 1 pulses per second (PPS).• Full pulse charge: 63 ± 9 microcoulombs (μC).• Current: 1.2 milliamperes (mA) typical.	1. Output specifications: ^{4,5} Waveform: Precision Shaped Pulse technology. Into 600-ohm (Ω) load: <ul style="list-style-type: none">• Pulse duration: 50–125 microseconds (μs).• Peak loaded voltage: 840–1,440 volts (V).• Pulse rate: 19 ± 1 pulses per second (PPS).• Full pulse charge: 63 ± 9 microcoulombs (μC).• Current: 1.2 milliamperes (mA) typical.

We cannot make a direct comparison between the obsolete M26 CEW and the modern Smart CEWs. The M26 CEW delivered a short alternating pulse with basically 2 positive pulses and 2 negative pulses. Modern CEWs are all rated by the “net” charge meaning that the negative charge portion is subtracted from the positive portions. The M26 CEW net charge was 32 μC but the main phase charge was 85 μC . A direct comparison — between the 1999 M26 AC CEW and the modern DC weapons — is meaningless.

Even with the modern weapons, there is another subtlety. The X26E CEW delivered 20–95 μC for arcing distances of 1.0–1.5 inches.¹ This is typical when the probes are in the clothing and the charge must spark through the clothing and outer skin. The X26E CEW will deliver $\approx 108 \mu\text{C}$ [Adler²] when the probes are embedded in the skin. Smart CEWs are designed to deliver $\approx 63 \mu\text{C}$ *whether arcing or not*. This discharge level is above the 3 cm (1.2 in) sparking discharge of the X26E CEW at 50 μC , and has similar effectiveness while maintaining significantly increased precision. See the graphic below. Because the delivered charge of the Smart CEWs is well below the maximum delivered charge of the X26E CEW, they further increase cardiac safety margins. The X2 CEW pulse duration is also shorter so it uses the charge more efficiently.

The X26E CEW output is dependent on the connection to the subject. When a low resistance connection is established to a subject (both probes into low resistance tissue), the X26E CEW delivers $\approx 108 \mu\text{C}$ (max specification 135). When a poor connection is made to the subject (arcing probes, and/or connecting through highly resistive tissue) the X26E CEW delivers as low as 20 μC . The next generation Smart CEWs (X2, and X26P CEWs) have charge metering and pulse calibration to regulate the delivered charge to $63 \pm 9 \mu\text{C}$. This allows enhanced cardiac safety margins while performing comparably to the 2003 X26E CEW technology.



- It has been said that the model that is available for purchase today has a lower output.

BRAVE Response: That which has “been said,” is only from those who do not understand charge metering and pulse calibration and have not followed TASER Training Programs and presentations since at least August 2009. Please see response above.

¹ Reilly J, Diamant A, Comeaux J. Dosimetry considerations for electrical stun devices. *Phys Med Biol*. 2009;54:1319-35. doi:10.1088/0031-9155/54/5/015.

² Adler A. Toward a Test Protocol for Conducted Energy Weapons. *Modern Instrumentation*. 2013;02(01):7-15.

- If so, why was the electrical output lowered for the newer model?

BRAVE Response: Please see responses above. The output is more precisely controlled with charge metering and pulse calibration that was not available in the M26 (1999) and X26(E) (2003) CEWs. Think of this as a governor on a truck. To make sure that the truck had enough horsepower to get up long hills, they had enough horsepower so that they could go 100 mph down hills. Now, we have modern trucks with governors that go 63 mph up and down hills.

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Axon Enterprise, Inc.