Bodycote MATERIALS TESTING

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Testing of a Conducted Energy Weapon for Electric Current Output

A Report to:	RCMP 10010 100TH Ave., P. O. Box 30 High Level, Alberta T0H 1ZO
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1.0 INTRODUCTION AND SAMPLE IDENTIFICATION

Bodycote Ortech was contracted by the RCMP to conduct comparative electrical characterization of current output of five Conducted Energy Weapons. Testing was conducted according to written instructions provided by the RCMP. Five conducted energy weapons were tested with two types of batteries for electrical current output with variance of device, variance of barrier and variance of temperature. The sample weapons were submitted for testing on April 9, 2001.

The samples were received, logged in and assigned the following Sample Numbers:

Client Identification	**Our Sample Number**
Sample 1 Serial No. P007984 Date of manufacturing: 5/00	01-06-M0095-1
Sample 2 Serial No. P001823 Date of manufacturing: 12/99	01-06-M0095-2
Sample 3 Serial No. P001432 Date of manufacturing: 12/99	01-06-M0095-3
Sample 4 Serial No. P001420 Date of manufacturing: 12/99	01-06-M0095-4
Sample 5 Serial No. P001639 Date of manufacturing: 12/99	01-06-M0095-5

Manufacturer: Taser International
Model No.: M-26

Manufacturer's Specifications:

Power supply [E]: Eight (8) "AA" batteries – 12 VDC.

Amperage [I RMS]: 162 mA,

Power: 26 Watts

Output Voltage: 50 kV peak

Output Amperage: 18 A peak

Output Power: 324,000 Watts peak

Pulse Energy: 1.76 Joules

Number of pulses [1/second]: 15

Firing range: Up to 6.4 m (21 feet)

Operating temperature range: -7 °C (20 °F) to 46 °C (114 °F)

Weight: 510 grams (18 ounces) – including batteries.

Sample No. 01-06-M0095-2 photographed on Figure 1.

Figure 1

Cartridges

The M26 energy weapon is equipped with a single use cartridge that utilizes compressed nitrogen to shoot two small electrodes (also called "probes") to a distance of up to 6.4 m (21 feet). The probes are connected to the M26 weapon by high voltage wiring. The cartridge is shown on Figures 2, 3 and 4.

Figure 2: Cartridge before use

Figure 3: Cartridge after use

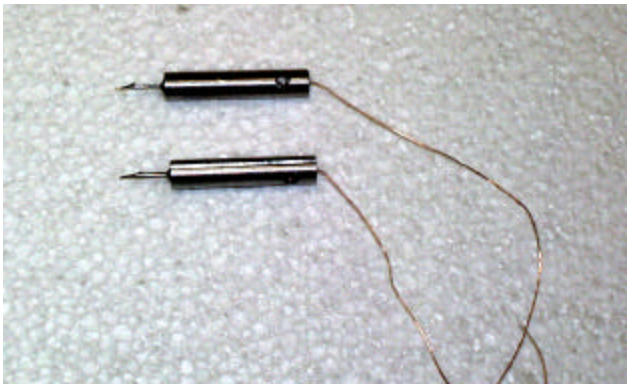


Figure 4: HV Probes after use

Test Batteries:

1. Duracell Ultra AA Alkaline (1.5 VDC) shown in battery pack of M26 on Figure 5.

Figure 5.

2. Energizer NiMH Accu – rechargeable (1.26 VDC) shown in battery pack of M26 on Fig. 6.

Figure 6.

2.0 TEST PROGRAM AND RESULTS

2.1 Overview

The high voltage test station was assembled in the "Tenney" environmental chamber, where the RCMP completed the final assembly of the weapons.

The following is a list of instruments that were used for the tests:

- Tenney Environmental Chamber , WI-T-40+80°C, Serial #7675, (MII A04852),
- Oscilloscope, Tektronix, 2430, (MII A07846),
- Digital Voltmeter, HP 3456A (MII A08338),
- Current Shunt 150A/300mV (MII B04910),
- High Voltage Probe, Ross Engineering, VD60-6.2Y-A-KB-ALT (MII A13987),
- Multimeter, Fluke 87, (MII B01580),
- Caliper, Mitutoyo, Digimatic 0-12 inches (MII B02703),
- Digital Thermometer, Omega HH82 (MII B01293),
- Precision Resistor, 1000.0 Ohms ±0.1%, 7 Watts (as load).
- Digital Camcorder, Sony DCRTRV720 (as sound recorder)

All raw data is referenced in Lab Book No. 8181.

- Test setup:

The high-voltage probes of each weapon were electrically connected (physically secured) to the test station. A ceramic high voltage probe was used to measure the voltage level and a current shunt was used to measure the current levels. They were connected to a 100 MHz oscilloscope. A 1000-Ohm precision resistor was used as load, simulating the electrical properties of human body.

Each weapon was fired five (5) times for about two (2) seconds. The oscilloscope recorded peak voltage and amperage levels of weapon output. Battery voltages were recorded before and after each test.

2.2 Comparative Level of Electric Current – Variance of Device

The purpose of this test was to determine the difference in electrical output of each weapon with two types of batteries. The RCMP made the selection of the weapons and provided all of the batteries.

- RCMP's Test Procedure:

RCMP operated each of the five weapons five times with a half-a-minute intervals for the duration of two seconds.

- Test Results:

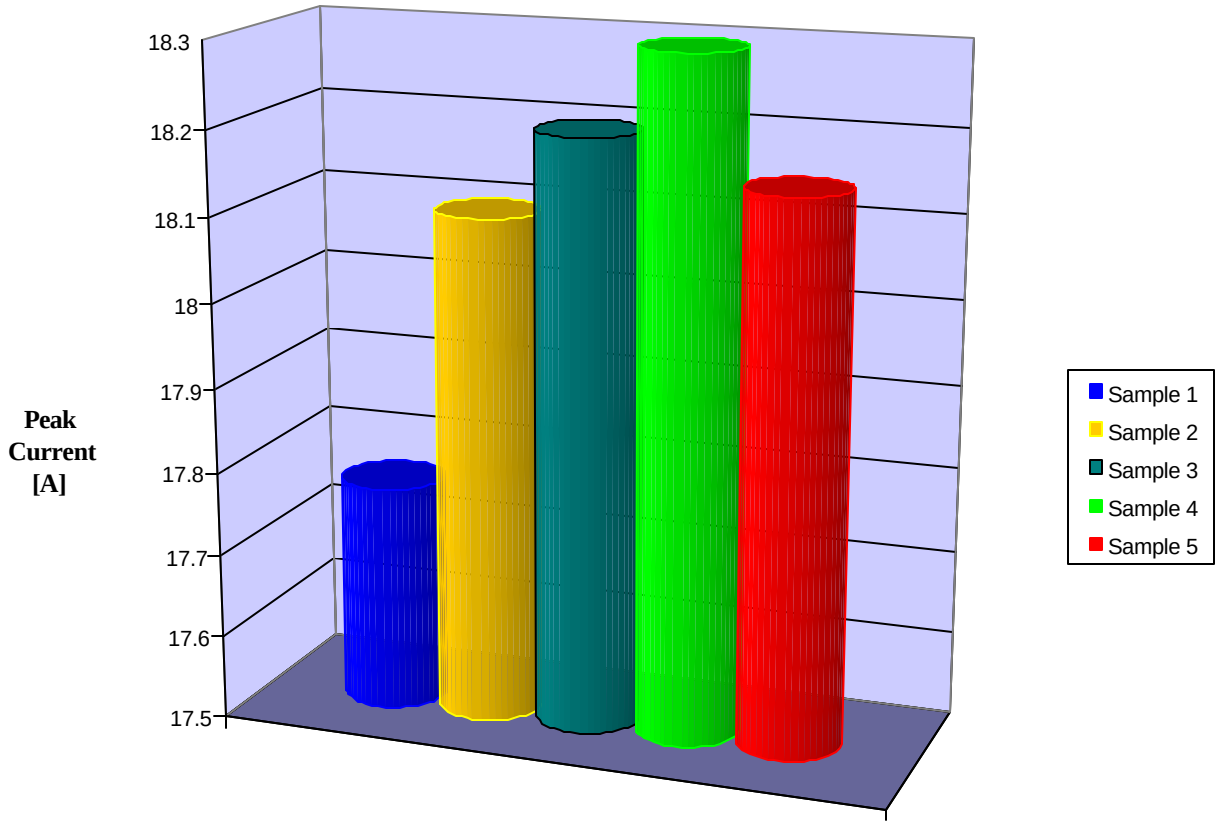
Battery pack voltages were recorded prior to testing at 12.9 VDC (Duracell) and 10.6 VDC (Energizer). Battery voltages were measured again immediately after the five operations. The voltage level of the battery pack with Duracell batteries had decreased to 11.6 VDC and the Energizer battery pack decreased to 10.2 VDC. Both battery packs recovered nearly 50 % of the loss within a 5-minute period of time.

The waveforms of the emitted pulses were half-sinusoidal with the duration of 10 microseconds (μs). The averaged test results are shown in Table 1 and Figure 7:

Table 1: Variance of Device

Sample No.	Battery Type	Temperature [°C]	Duration [seconds]	I peak [A]	P peak [W]
1	Duracell	23	2	17.77	326080
2	Duracell	23	2	18.1	314578
3	Duracell	23	2	18.2	333060
4	Energizer	23	2	18.3	326838
5	Energizer	23	2	18.15	329967

Figure 7: Variance of Device



Note: An additional "Double Hit" test was performed immediately after the "Variance of Device" tests. Two weapons were activated connected parallel to the HV test station and fired simultaneously. Detailed test result can be found in Appendix A.

2.3 Comparative Level of Electric Current – Variance of Barrier

The purpose of this test was to determine each weapon's firing capability through various clothing as subject of barrier.

- RCMP's Test Procedure:

  The RCMP operated each of the five weapons five times with a half-a-minute intervals for the duration of two seconds. All barrier materials were placed between the test sample weapon and the HV station. The RCMP made the selection of clothing. They are shown in Figures 8 and 9.

Figure 8: Barrier of clothing photographed prior to testing

Figure 9: Barrier of clothing photographed during testing

- Test Results:

The averaged test results are shown in Table 2 and Figure 10:

Table 2: Variance of Barrier

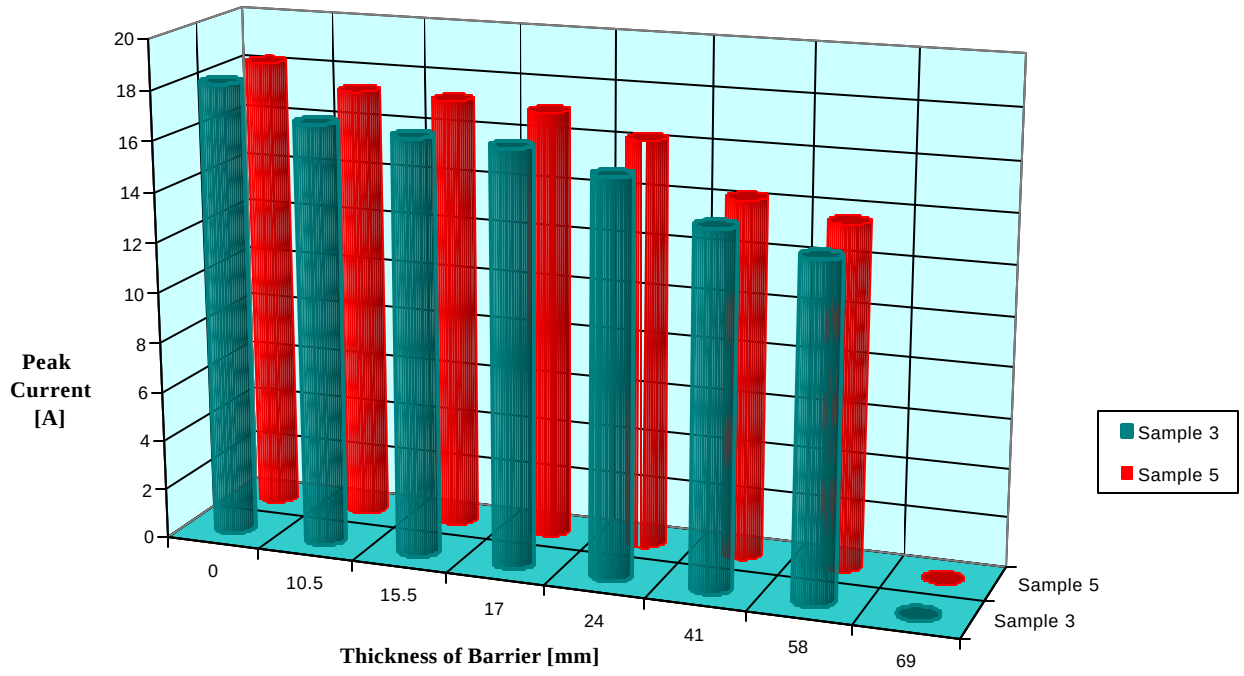
Sample No.	Battery Type	Temp. [°C]	Duration [seconds]	I peak [A]	P peak [W]	Barrier
3	Duracell	23	2	16.85	291168	Holofilled synthetic insulated jacket (short sleeves) - Two layers, Thickness: 38.5 mm, 10.5 mm (compressed)
5	Energizer	23	2	17.4	293016	Holofilled synthetic insulated jacket (short sleeves) - Two layers, Thickness: 38.5 mm, 10.5 mm (compressed)
3	Duracell	23	2	16.6	284690	Holofilled synthetic insulated jacket (two layers) + melton (75 % wool / 20 % nylon /5 % other, 100 % polyester liner),Thickness: 41.6 mm, 15.5 mm (compressed)
5	Energizer	23	2	17.3	288910	Holofilled synthetic insulated jacket (two layers) + melton (75 % wool / 20 % nylon /5 % other, 100 % polyester liner),Thickness: 41.6 mm, 15.5 mm (compressed)
3	Duracell	23	2	16.5	282150	Holofilled synthetic insulated jacket (two layers) + melton + sweatshirt (50 % cotton / 50 % polyester), Thickness: 66 mm, 17 mm (compressed)
5	Energizer	23	2	17.1	282150	Holofilled synthetic insulated jacket (two layers) + melton + sweatshirt (50 % cotton / 50 % polyester), Thickness: 66 mm, 17 mm (compressed)
3	Duracell	23	2	15.7	263760	Holofilled synthetic insulated jacket (two layers) + melton + sweatshirt + shirt (100 % cotton, light denon), Thickness: 73 mm, 24 mm (compressed)
5	Energizer	23	2	16.3	269765	Holofilled synthetic insulated jacket (two layers) + melton + sweatshirt + shirt (100 % cotton, light denon), Thickness: 73 mm, 24 mm (compressed)
3	Duracell	23	2	14.1	195285	Holofilled synthetic insulated jacket (two layers) + melton + sweatshirt + shirt + RCMP storm coat (current issue), Thickness: 107.2 mm, 41 mm (compressed)
5	Energizer	23	2	14.3	194337	Holofilled synthetic insulated jacket (two layers) + melton + sweatshirt + shirt + RCMP storm coat (current issue), Thickness: 107.2 mm, 41 mm (compressed)

Table 2: Variance of Barrier (cont.)

Sample No.	Battery Type	Temp. [°C]	Duration [seconds]	I peak [A]	P peak [W]	Barrier
3	Duracell	23	2	13.3	173698	Holofilled synthetic insulated jacket (two layers) + melton + sweatshirt + shirt + RCMP storm coat (pre 1990 issue), Thickness: 140 mm, 58 mm (compressed)
5	Energizer	23	2	13.7	174675	Holofilled synthetic insulated jacket (two layers) + melton + sweatshirt + shirt + RCMP storm coat (pre 1990 issue), Thickness: 140 mm, 58 mm (compressed)
3	Duracell	23	2	0	0	Holofilled synthetic insulated jacket (two layers) + melton + sweatshirt + shirt + RCMP storm coat (pre 1990 issue) + additional jacket, Thickness: 123 mm, 69 mm (compressed)
5	Energizer	23	2	0	0	Holofilled synthetic insulated jacket (two layers) + melton + sweatshirt + shirt + RCMP storm coat (pre 1990 issue) + additional jacket, Thickness: 123 mm, 69 mm (compressed)
3	Duracell	23	2	16.85	296560	RCMP body armour (current issue), Thickness: 6.5 mm
5	Energizer	23	2	16.4	283392	RCMP body armour (current issue), Thickness: 6.5 mm
3	Duracell	23	2	16.05	271085	RCMP body armour (current issue) + RCMP storm coat (current issue), Thickness: 36 mm, 16 mm (compressed)
5	Energizer	23	2	16.9	281047	RCMP body armour (current issue) + RCMP storm coat (current issue), Thickness: 36 mm, 16 mm (compressed)

Note: Some of the pulses were not going through the test materials in the first two tests on this page (140 / 58mm thick combination barrier). The values represent the averaged measurements of the first 10 pulses.

Figure 10: Variance of Barrier
Peak Current vs. Thickness of Barrier



2.4 Comparative Level of Electric Current – Variance of Temperature

The purpose of this test was to determine each weapon's firing capability at various temperature environments.

- RCMP's Test Procedure:

The test weapons were placed in the walk-in environmental chamber and conditioned to each temperature level for approximately 30 minutes prior to testing. Then they were removed and the RCMP officer operated each weapon once for the duration of five seconds. The sounds of pulses were recorded by a digital camcorder. The pulse rate of each firing was determined graphically from the camcorder's digital sound track.

- Test Results:

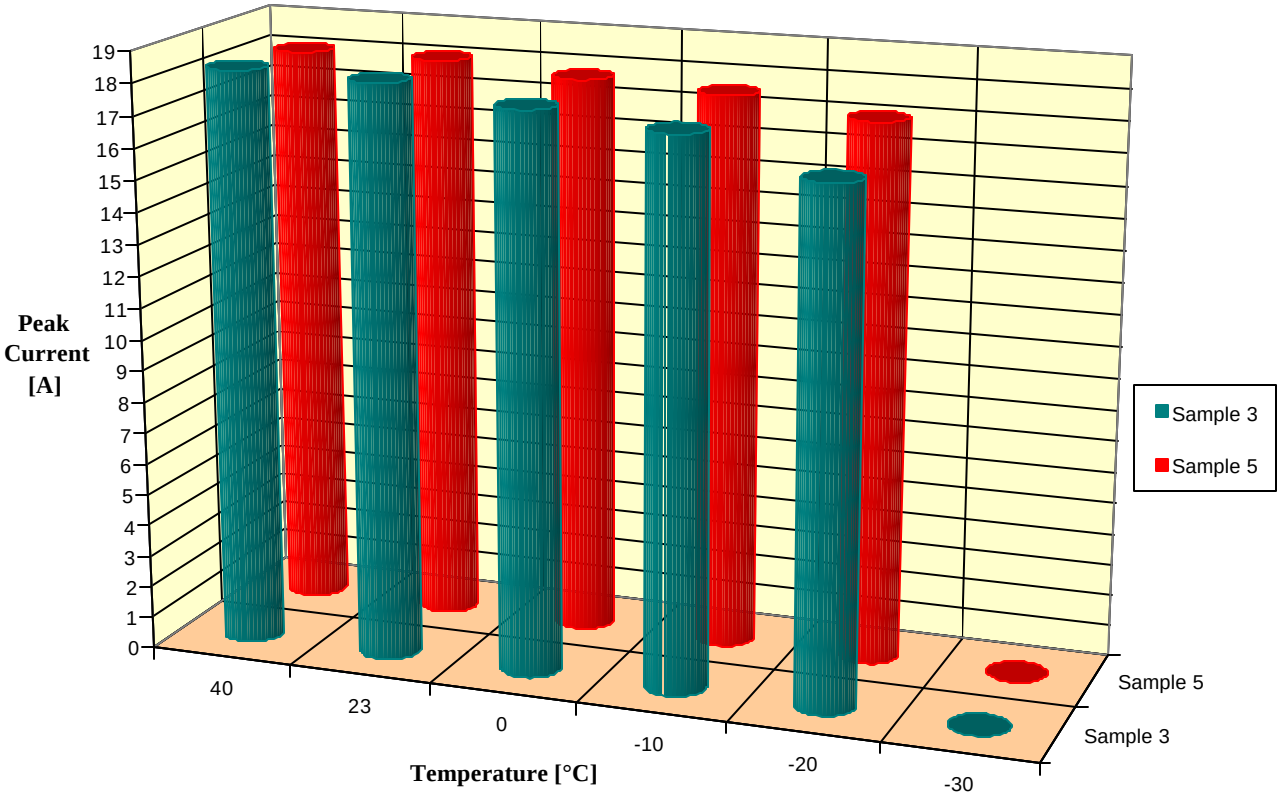
The test results are shown in Table 3 and Figure 11:

Table 3: Variance of Temperature

Sample No.	Battery Type	Temperature [°C]	No. of pulses (1st second)	Duration [seconds]	I peak [A]	P peak [W]	Energy max. [Joules/second]	Notes
3	Dura.	40	22	5	18.3	337086	38.7	
5	Ener.	40	22	5	18.1	330325	38.7	
3	Dura.	23	23	5	18.2	333606	40.5	
5	Ener.	23	22	5	18.1	329601	38.7	
3	Dura.	0	10	5	17.7	315945	17.6	
5	Ener.	0	23	5	17.8	319510	40.5	
3	Dura.	-10	6.5	5	17.3	301885	11.4	
5	Ener.	-10	21	5	17.6	310640	37.0	
3	Dura.	-20	4.75	5	16.2	273618	8.4	There was no output at the end of the 5th second
5	Ener.	-20	15	5	17.1	289845	26.4	The operation was unusually slow.
3	Dura.	-30	0	0	0	0	0.0	There was no output
5	Ener.	-30	0	0	0	0	0.0	There was no output

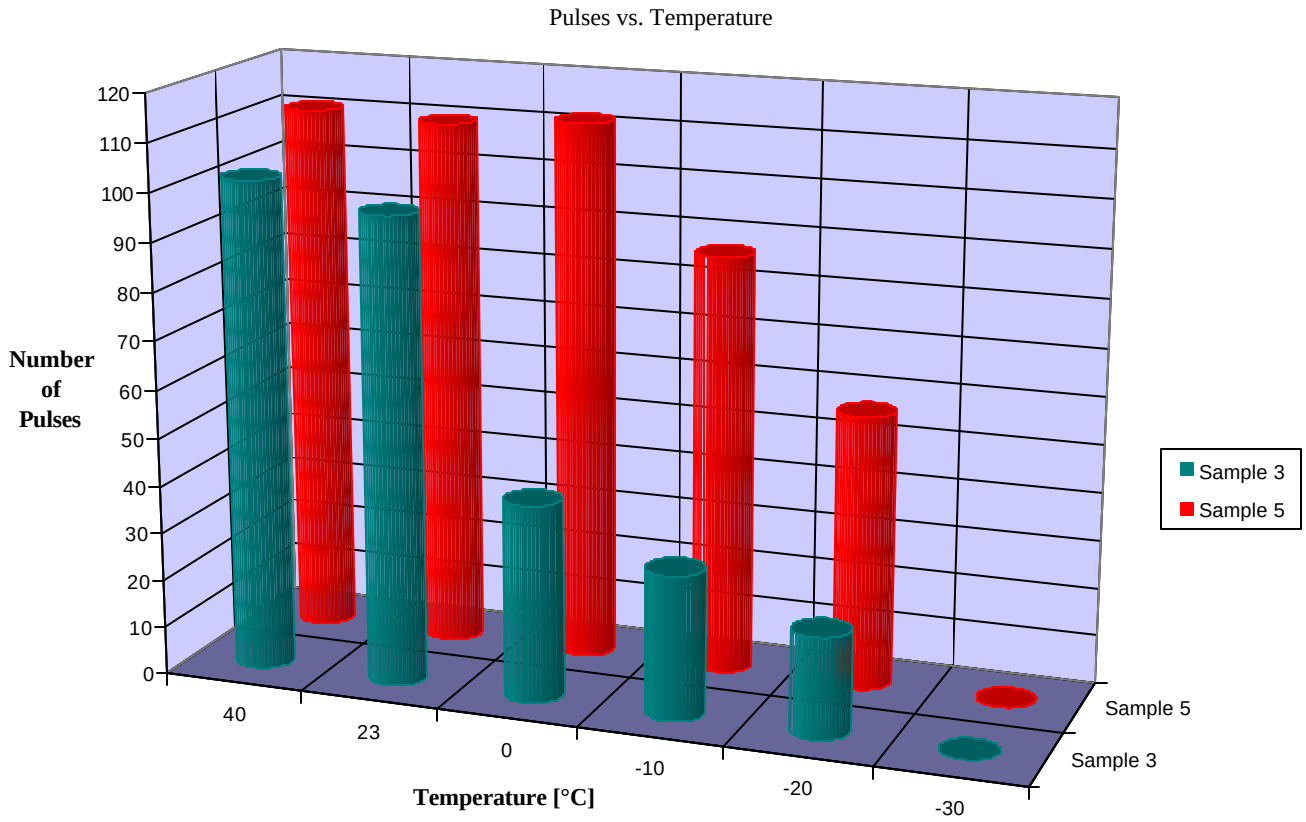
Note: The calculations for the maximum transmitted energy per second (Energy max.) were based on the manufacturer's published capacitor value of 0.88 µFarad and 2,000-Volt spark gap.

Figure 11: Variance of Temperature
Peak Current vs. Temperature



Note: The number of emitted pulses varied at various temperatures. The effect of the temperature change is reflected on Figure 12.

Figure 12: Number of Pulses Emitted by M26



Note: The test weapons slowed down significantly by the 5th second of the five-second operations at lower temperatures. The number of pulses emitted by the test weapons is shown in Table 4.

Table 4: The number of pulses emitted in the 5th second

Temperature	Sample No. 3	Sample No. 5
[°C]	Number of pulses	Number of pulses
40	20	22
23	19	23
0	7	22
-10	5	15
-20	3.5	10
-30	0	0

3.0 CONCLUSION

Testing of the five Conducted Energy Weapons provided by the RCMP indicates that the test samples **met** the electrical current specifications published by the manufacturer, Taser International.

Reported by:

by:_____
Thomas Orban
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This report refers only to the particular samples, units, material, instrument, or other subject used and referred to in it, and is limited by the tests and/or analyses performed. Similar articles may not be of like quality, and other testing and/or analysis programs might be desirable and might give different results.

ACCREDITATION

Canadian General Standards Board #76002, Standards Council of Canada #1.

REGISTRATION

ISO 9002-1994 registered by QMI, Registration #001109

APPENDIX A

Additional Testing: Double Hits

(1 Page)

APPENDIX A

Double Hits

This additional test was performed immediately after the "Variance of Device" tests. Two weapons were connected parallel to the HV test station and fired simultaneously.

The test proved that the amperage of the emitted pulses did not changed significantly from a single weapon's output pulse during the test.

The electrical current output results are shown in the following table:

Sample No.	Battery Type	Temperature [°C]	Duration [seconds]	I peak [A]	P peak [W]
2 and 3	Duracell	23	2	17.9	327570
4 and 5	Energizer	23	2	18.2	318864