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WEAPONS & EQUIPMENT
RESEARCH INSTITUTE

Evaluation of TASER® X2™

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ABSTRACT

The purpose of this study was to conduct testing and evaluation on the TASER® X2™ electronic control device, with the initial goal of determining the overall performance of the weapons system. This report provides both a qualitative and quantitative analysis of the weapon system.

The TASER® X2™ electronic control device is designed for suspect compliance and has the ability to fire two (2) TASER® cartridges in rapid succession. The manufacturer stated range for this weapon is 25 feet. Within the study, testing was conducted to determine its accuracy, reliability and overall functioning. This study produced a linear regression model with the goal to provide an operator the probe spread at various distances and determined that there was 7.03 inches of spread for every five (5) feet of distance.

INTRODUCTION

The TASER® X2™ electronic control device was designed by law enforcement for law enforcement agency use (TASER® International Website, 2012). It was designed with higher performance, more effectiveness, quality and reliability and easier to employ. Dual cartridge bays allow two cartridges to be deployed in rapid succession without the need to reload the weapon. It also utilizes performance power magazines, which offers in excess of 500 firings. The static resistant propulsion system allows the use of a warning arc can help prevent a conflict from escalating and has the potential for gaining compliance without having to deploy the probes. This display can be activated without removing the cartridge and reduces accidental static discharge misfires.

Figure 1. TASER® X2™ Electronic Control Device

According to TASER® International (2011), the feature of Cross Connect™ (X-Connect) provides the potential of six different dart variations in the event that a shot is missed. Consequently, if only one probe strikes the target on the initial deployment, either of the probes from a second deployment will allow an electric current transfer to take place. There are dual lasers, which identify the location the probes will hit when fired and increases the officer accuracy and effectiveness. The Rotational-Pulse™ Drive enables the user to incapacitate two subjects at a time with the same effectiveness as two individual TASER ® devices. This also helps to recover from a missed shot such as if the first shot misses the target, there is the second shot that will help recover the missed shots by utilizing the Cross-Connect™ feature (TASER® International Website, 2012).

TASER® International designed these with Charge Diffusion™ probes which allow much of the charge energy to diffuse into the outermost layers of the skin with less energy penetrating deep into the body in areas such as the vital organs. The TASER® X2™ electronic control device is designed with a pulse calibration system which monitor and calibrates electrical output to deliver for precision optimal shaped pulse. It was designed with an environmentally hardened system which enables them to endure rain, dust, electrostatic discharge, sea spray and short-term water submersion. The blast doors on the cartridge are also weatherproof.

The TASER® X2™ electronic control device utilizes the TASER® Smart™ Cartridges which contain a nitrogen propulsion system with a range of 15 to 35 feet. These cartridges are able to communicate with the TASER® through the Fire Control System™ which indicates what type of cartridge is loaded in each bay and what the deployment status is for each one. These cartridges can be used in both the TASER® X2™ electronic control device and the TASER X3™ electronic control device. The *Trilogy Logs* helps report the event seamlessly, while the *Event Log* records data that includes events such as warning arcs, safety on/off, trigger presses and cartridge deployments. The *Engineering Log* does the monitoring and alerting of any electrical sub-system during events and not during events, and sends alerts if the system is not performing properly and if maintenance is needed.

Figure 2. Smart™ Ca1rtridge

As a means of regulating the use of TASER® electronic control devices, TASER® International has issued each cartridge with tiny confetti-like pieces that include a cartridge specific alpha numeric serial number known as Anti-Felon Identification tags (AFIDs). The Department of Justice has suggested that a sample of AFIDs are to be collected from the scene and treated as forensic evidence each time a cartridge is discharged (Medley,2010). However, there has been no clear justification for this task beyond the simple tracking of the cartridge assigned to the individual law enforcement. Medley's study (2010) plotted the AFID distribution patterns from multiple TASER® test fires and to determine if it was possible to reconstruct a TASER® deployment. The results indicated that even under controlled conditions, AFID distributions are random and provide only a vague image of the crime scene.

METHODOLOGY

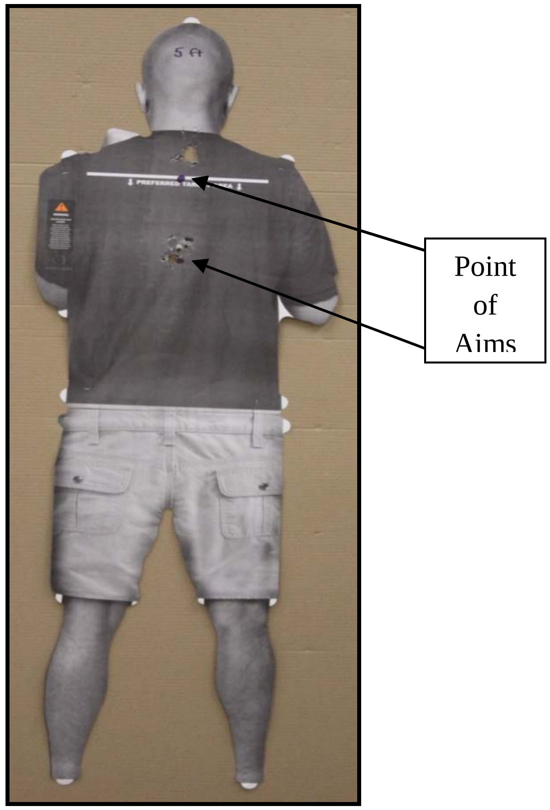
A multifaceted approach was used to conduct this study, which included a field research data collection effort and a qualitative assessment of the weapon. The research design was created to measure the overall performance of the TASER® X2™ electronic control device. The primary goal was to identify its accuracy, reliability, range and any malfunctions presented.

Smart™ Cartridges were used for the testing of the weapon. The testing was also conducted on the TASER® standardized life-sized human style targets (TASER® training targets).

There were five (5) different firing positions beginning with a distance of five (5) feet and moving back in five (5) foot increments for a distance of 25 feet to test the accuracy of the weapon. Forty (40) shots were fired from each distance, (twenty [20] from the left deployment bay and twenty [20] from the right deployment bay) towards the point of aim (POA) on the target, for a total of 200 shots. In order to reduce human error during the testing, the TASER® X2™ electronic control device utilized a gun vice and a single shooter to limit the effect of skill differences. Photographs, videos and measurements of the targets were taken after each distance was tested.

The point of aim was consistent by utilizing a marked area that was consistent with the dual lasers projected from the ECD, which contrasted the rest of the target. These targets are used to help with providing visual views of probe hit and miss ratio. These targets are marked with a preferred target area that was set by TASER® and utilized in this study for the top target zone paired where with the bottom laser which was marked prior to shooting. The TASER® X2™ electronic control device was loaded and two marks were placed on the target where the point of aim was for each distance.

Figure 3. Target



From a quantitative perspective, data was collected by test-firing the TASER® weapon from a fixed platform to reduce human firing error. It was then analyzed by using Statistical Package for the Social Sciences (SPSS) to determine its overall accuracy, hit/miss, and failure rates. Accuracy was measured as the difference between the point of aim and the point of impact (POI) in order to assess the spread of the projectiles and their variations. This method was done by taking measurements after each shot and measuring from the point of aim to its point of impact and this procedure was done for each of the five (5) firing positions.

To further quantify the accuracy of the weapon, maximum spread was measured to determine the distance between the two furthest shots of the shot pattern or grouping. This results in being a less accurate method of measuring of the group size and does not provide a valid measure of central tendency for any statistical analysis. This method relies solely upon the two most extreme data points and does not account for all of the remaining data points. The distance between each probe was measured to determine its spread.

Table 1. Key Variables and Measurement

Variable	Description
Projectile Accuracy	Distance from point of aim to point of impact
Projectile Spread	Distance between projectiles (mean & median)
Reliability	Continues to function without failure
Durability	Humidity, temperature, waterproof, drop test
Malfunctions	Failures in function

FINDINGS

This research study was completed with a statistical analysis and interpretation of the data collected. The results were placed into a statistical software package (SPSS 11) for quantitative analysis which made it possible to evaluate the data using advanced statistical methods beyond that of mere comparison of averages. In terms of individual relationship between the independent variable (distance) and the dependent variables (spread), the overall goal of this project was to create a predictive model that would allow a TASER® X2™ electronic control device user to determine where the probe would strike given a known distance.

Researchers also utilized the same model that Medley (2010) used to determine the random distribution of TASER® AFIDS. The testing of the TASER® X2™ electronic control device determined that the AFIDs were also randomly distributed and did not show a pattern.

Probe Spread

A linear regression was conducted to measure the strength of the relationship between distance and probe spread. The unstandardized coefficients of the regression model indicate that 7.03 inches of spread was expected for every five (5) feet of distance. This was a very strong model and there is almost a perfect relationship between probe spread and distance ($r = .97$).

Illustrated in *Table 2* is the distance to the target in feet, cartridge bay, mean probe spread and the standard deviation. No significant difference in spread was observed between left and right cartridge deployments.

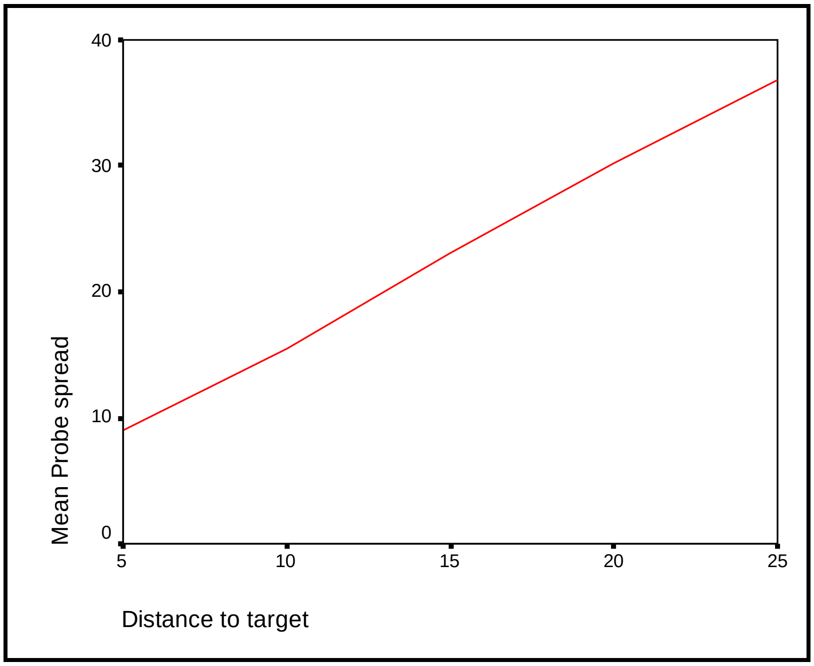
Table 2. Mean Probe Spread

Report

Probe spread

Distance to target	Cartridge	Mean	N	Std. Deviation
5	left	9.2750	20	1.08185
	right	8.6875	20	1.06954
	Total	8.9813	40	1.10272
10	left	15.5500	20	1.45684
	right	15.3875	20	1.43837
	Total	15.4687	40	1.43132
15	left	23.4875	20	2.07662
	right	22.6125	20	2.46218
	Total	23.0500	40	2.29143
20	left	30.0625	20	3.35398
	right	30.1125	20	4.53965
	Total	30.0875	40	3.93967
25	left	37.2125	20	2.29455
	right	36.4250	20	4.47736
	Total	36.8188	40	3.53417
Total	left	23.1175	100	10.23792
	right	22.6450	100	10.45017
	Total	22.8813	200	10.32128

Figure 4. Probe Distribution



Accuracy

In the qualitative part of this study, it was observed that at each distance where the shots hit the target, they were either above or below the point of aim. At five (5) feet and ten (10) feet both the top and bottom probes hit the target above the point of aim, which is above the TASER® said preferred target area. This effect was most serious at five (5) feet where the majority of the probes struck 2 ½ inches above the preferred target area with outliers striking the back of the neck and lower skull region on the target (see figure 3).

At the distance of fifteen (15) feet the top probe landed above the point of aim, while the bottom probe landed below the point of aim. At this distance, the range adjusted dual laser sights (RADLS) have a 7-degree of separation between the top and bottom laser in which the bottom laser is selected automatically for the range of 15 feet or 25 feet depending on the cartridge (TASER® International). At twenty (20) and twenty-five (25) feet, both the top and bottom probes hit the target below the point of aim, which is below the TASER® preferred target area. The following table illustrates an overview of the variation at each distance.

Table 3. Distance Variations

Distance	Top Variation	Bottom Variation
5 Feet	Above	Above
10 Feet	Above	Above
15 Feet	Above	Below
20 Feet	Below	Below
25 Feet	Below	Below

Hit/Miss Ratio

Of the 200 shots that were fired during the course of the testing, 100% of the top probes hit the target, while 25% of the bottom probes completely missed the human-sized target. At five (5) and ten (10) feet, all of the probes hit the target. At the distance of fifteen (15) feet 5% of the bottom probes failed to hit the target. At twenty (20) feet, 37.5% of the bottom probes missed and at twenty-five (25) feet 82.5% of the bottom probes missed the target. For the last two distances, the end users must correct their aim by slightly turning the TASER® sideways which aligns the bottom laser to make contact with the target. The purpose of angling the weapon is to adjust for increasing probe spread as beyond fifteen (15) feet, the bottom probe tends to pass between the legs of the target, rather than make contact. Yet this takes additional time to stop, properly align the weapon, aim and fire. If it is a moving target, this becomes even more difficult and may result in a greater number of misses beyond fifteen feet. However, for the purpose of this study the TASER® was not angled to keep the study variables consistent at all distances.

Durability

The TASER® X2™ was advertised to have been built to withstand just about any kind of treatment and a testing protocol was created to evaluate these claims. The destruction testing portion of the evaluation focused upon the Smart™ cartridges where drop test, freezer test, water test and humidity test were carried out on a separate sample of cartridges.

Drop Test

Ten (10) Smart™ cartridges were dropped from a four (4) foot height on to a concrete surface to test their durability and none sustained any external damage. After each cartridge was dropped, each was successfully test fired. One (1) Smart™ cartridge was then thrown across the room and sustained no external damage and successfully test fired. Based upon these observations, it is unlikely that Smart™ cartridges will be disabled as a result of an accidental drop.

Freezer Test

A total of ten (10) Smart™ cartridges were placed in the freezer for a total of thirty (30) days. On day 30, they were removed directly from the freezer, loaded and fired immediately. Of these Smart™ cartridges, all of them fired without incident.

There was one (1) Smart™ cartridge that was submerged in water and frozen into a block of ice for a total of fifteen (15) days. This cartridge was then set out to dry for fifteen (15) days prior to testing. This cartridge also fired without incident.

Water Test

A total of ten (10) Smart™ cartridges were submerged in a pan of water for a total of ten (10) seconds. They were then set out to dry for thirty (30) days. Of these Smart™ cartridges, all performed without malfunctions.

Humidity Test

A total of ten (10) Smart™ cartridges were placed in a solar still at 100 % humidity for thirty (30) days. Of these cartridge, six (6) had become completely submerged in the water for an unknown amount of time. The four (4) that were not submerged in water performed within standards. Of the six (6) that were submerged, two (2) fired without incident. The remaining four (4) failed to produce a bottom laser and failed to fire. However, after removing the cartridge and rubbing the protruding circuit board against human skin, all cartridges fired without any further problems. It is theorized that corrosion had developed on the conductive strip and that either the corrosion was removed by rubbing or that skin oil aided in conductivity allowing the cartridge to fire.

Malfunctions

There were very few malfunctions to report with the testing of the TASER® X2™ electronic control device. There were three (3) Smart™ cartridges that failed to fire. Three (3) additional Smart™ cartridges were used in their place to maintain sample size for statistical analysis. One (1) of the Smart™ cartridges that was placed in the left deployment bay would not lock in the gun, but once it became locked, it would only arc, not fire. The Smart™ cartridge was then switched to the right deployment bay of the TASER® where it loaded properly and worked accordingly without incident. One (1) of the Smart™ cartridges when loaded did not produce a bottom laser. This Smart™ cartridge was replaced after it also failed to fire. There was one (1) occurrence that the top probe missed the target when the wire snapped. This shot was reshot later to maintain sample size. The table below illustrates the malfunctions that were encountered during the testing.

Table 5. Malfunctions

Shot Number	Distance	Cartridge	Malfunction
37	5 Feet	Left	Cartridge would not lock into weapon
61	10 Feet	Left	Failed to fire
108	15 Feet	Right	Bottom laser didn't activate, failed to fire.
114	15 Feet	Right	Wire broke
154	20 Feet	Right	Failed to fire

CONCLUSION

In conclusion, the purpose of this preliminary study was to evaluate the TASER® X2™ electronic control device with regards to its overall functionality, accuracy, reliability, and possible malfunctions. It was determined that 7.03 inches of probe spread occurred for every five (5) feet of distance and did so with consistency. The weapon performed within the advertised parameters and specifications and was substantially more durable than previous models.

The dual laser aiming system substantially increases the accuracy of this weapon. However, it must be noted that the laser is not infallible and may require the operator to compensate the point of aim for close distances to prevent striking the suspect outside the preferred target area.

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