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Additional testing of the TASER 10™

Executive Summary

This letter report is intended to update SACMILL on the outcome of the additional work that the committee had requested to clarify certain aspects of the TASER 10™ system. The additional work comprised the following:

- Comparison of the zeroing of hand-held *vs.* clamped devices at a firing distance of 10 m;
- Testing the perforating ability of the dart using clothing more challenging than that used in earlier testing;
- More extensive electrical testing to confirm that the TASER 10™ output conformed with Axon's claims when more than two probes have been fired.

The more detailed electrical testing was the final piece of work undertaken by an independent commercial test house. Dstl received the first draft report on this testing from PA Consulting on 30/05/2025 [1] and the second draft on 11/06/2025 [2]. The third draft was received on 18/06/2025 [3] and the fourth on 26/06/2025 [4]. A fifth draft was received on 30/06/2025 [5]. At each draft iteration, Dstl undertook a technical review and provided feedback to PA Consulting.

The outcomes of the first two items of testing have been previously conveyed to SACMILL (reviewed here in sections 2.1 and 2.2), hence, the present report mainly focuses on the electrical testing findings (section 2.3). The primary question to be addressed concerned the maximum number of probes energised on each pulse during a discharge cycle, with the concern being that subjects could be exposed to excessive discharge from multiple probes contributing to a single pulse. This question is now resolved, it having been confirmed that only two probes contribute to each pulse delivered. This is no different from other Axon devices. The testing also provided an opportunity to explore other aspects of the electrical output and these are also discussed.

Ministry
of Defence

1 Background

At the request of the Home Office Police Powers Unit, SACMILL undertook a review of the medical implications of the TASER 10™ system which duly culminated in the delivery of a medical statement to the Home Office earlier this year [6].

Notably, paragraph 109 of the statement made the following observation:

> *109. SACMILL has requested some additional work to go forward into independent technical testing. SACMILL wishes to be notified of the results of this work and also wishes to see final versions of the NPCC Implementation Programme and College of Policing training material. SACMILL will report to the Home Office if any of these have medical implications that may affect the applicability of this statement.*

The independent additional testing to which SACMILL referred comprised three elements:

- Exploration of a discrepancy between the mean point of impact of probes at a 10 m firing distance when comparing hand-fired devices versus clamped devices. This raised a concern over the zeroing of the weapon, which is said by Axon to be zeroed at 33 feet or about 10 m.

- Examination of the ability of the darts of the TASER 10™ probes to perforate through clothing that was more demanding than that used in the initial round of technical testing. For SACMILL, a reduced ability of the dart to overmatch more challenging clothing and embed in the skin could be reflected in officers resorting to other, potentially more injurious, forms of force. This aspect of the extra testing clearly also has value for the wider TASER 10™ stakeholder community.

- Confirmation of the electrical output of the TASER 10™ when up to ten probes are introduced into a physical model designed to simulate a situation where the probes have embedded in the skin of a subject. Among other things, this was requested amid concern that more than one probe-pair could be energised during each output pulse.

Following SACMILL's suggestion for additional testing, Home Office ministers wanted to consider the full evidence, including the additional testing, before taking a decision on approval. For this reason, the SACMILL Chair's intention is to provide the Home Office with an amended medical statement that brings in a consideration of the additional information.

SACMILL has already been informed and expressed an opinion on the zeroing and dart perforation aspects of the additional testing. SACMILL was of the view that the outcomes from this testing did not cause the committee to revisit the opinion already expressed in its initial statement. Therefore, these aspects are considered here relatively briefly before moving on to cover the electrical testing in greater depth.

2 The additional testing

2.1 Addressing the zeroing concerns at 10 m

2.1.1 Why the work was undertaken

It was noted in original technical testing using a single clamped TASER 10™ device that the mean point of impact at ~10 m was lower than the mean point of impact observed in the user handling trials [7][8]. The zeroing range claimed by the manufacture is ~10 m. The reason for this could be simply that the weapon is zeroed taking into account the effect of recoil as the weapon is hand-fired or it could be more sinister, such as the handle used for the technical testing was poorly zeroed, either because the laser sight had been knocked out of position or because the weapon had not been correctly zeroed prior to release by the manufacturer, thereby raising wider quality control issues. This aspect of the additional testing was designed to explore this matter further.

2.1.2 The mean point of impact

The testing compared the variation in the mean point of impact from the device when hand-fired and fired from a weapon mount (clamped). Unfortunately, it was not possible to use the device employed in the original technical testing as it no longer functioned (following heavy usage). As a result, three other TASER 10™ devices were used instead. There was no significant difference in the mean points of impact between the firing conditions (hand-fired vs clamped) but it should be noted that the devices were not truly zeroed at the zeroing range of 10.1 m (Figure 1).

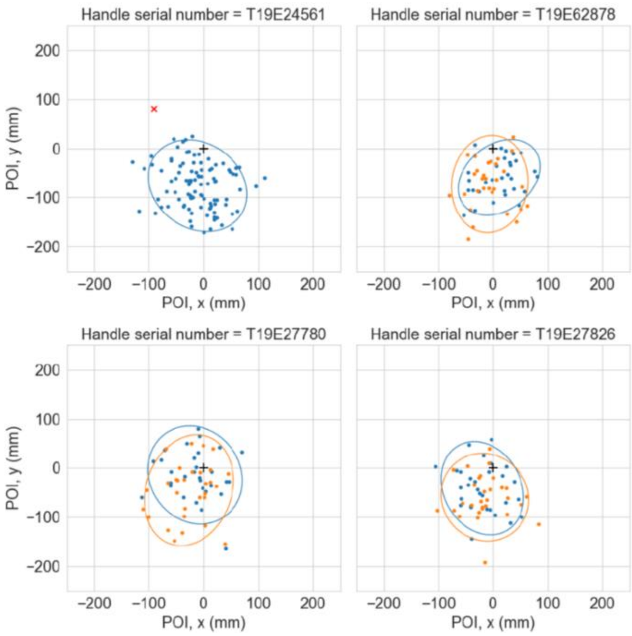

Figure 1. Probe impact locations from three TASER 10™ handles (with the impact points from the clamped handle originally used shown at top left), comparing clamped firing (blue) and hand-firing (orange).

The above findings were reported to the Home Office and Dstl on 12/03/2025 [7].

It would, therefore, appear that there is some (minor) variation in the zeroing of the device and it is not necessarily truly zeroed at 10.1 m. There was no difference in accuracy when hand-fired compared to when it was fired from a clamp.

Dstl had some concern that an officer who passed qualification with one device, may operate with another device that had a different 'zero', and that this would affect their accuracy when operationally deployed with a different device, or that the differences in the zero range may affect the accuracy of the device. Therefore, the College of Policing were asked to reconsider their conclusions from the User Handling Trial [9] given this new information. Specifically, they were asked to consider whether the device was still appropriate to use at operational ranges, knowing there is some variation in the zero location of the device. The College of Policing concluded that, even with some variation in the zero of the weapon, they would still regard the device as having sufficient practical accuracy (i.e. accuracy in the hands of the user) at ranges up to 10 m (i.e. they had no reason to change their original conclusion on the suitability of the device) [10].

Therefore, the original conclusion on practical accuracy from the College of Policing and considered by SACMILL remains unchanged.

2.2 Dart perforation using more challenging clothing

2.2.1 Why the work was undertaken

The original testing of clothing perforation by the TASER 10™ darts, reported in [8], was considered by various stakeholders to be insufficiently challenging (a view retrospectively adopted after the first round of testing had been undertaken).

2.2.2 Dart perforation tests

The test house conducted additional testing that included a padded jacket over a hoodie and a t-shirt. This clothing combination was sufficient to provide circumstances in which the darts of the TASER 10™ probes did not penetrate the underlying conductive 'skin'. Not unexpectedly, this work demonstrated that there would be occasions where a TASER 10™ probe impact on a person would mean that electrical contact was not a certainty, but this scenario is already encountered with existing authorised devices. Further review of the training and discussion with the College of Policing noted that this eventuality is covered in training and covered in the original discussions leading to the formulation of the initial SACMILL medical statement for SACMILL. The outcome of the additional dart perforation testing was reported to SACMILL on 02/04/2025 [11].

2.3 The additional electrical testing

2.3.1 Why the work was undertaken

The original electrical testing considered by SACMILL reproduced the methodology laid down by Axon, which is designed to confirm the electrical output of the TASER 10™ when the device discharges through a single pair of probes. As SACMILL noted in paragraph 23 of its initial medical statement [6]:

> *The electrical output of four TASER 10™ devices was measured in independent testing using the method prescribed by Axon. This method is designed to confirm the pulse rate, pulse charge and peak voltage of the waveform when measured across a 600 Ω load. The independent testing confirmed that the electrical output parameters conformed to the manufacturer's specifications.*

There were concerns expressed, however, that the independent testing was not sufficiently comprehensive to reassure SACMILL how the discharge would be delivered in the case of more than two TASER 10™ probes being in electrical contact with the subject.

The purpose of the additional testing, then, was to obtain independent assurance that the claims made by the manufacture on how the discharge was delivered could be sustained.

Given the fundamental importance of the electrical discharge behaviour of CEDs in general, and the TASER 10™ in particular (with up to ten probes available), this aspect of the additional testing is covered in greater detail.

2.3.2 Confusing claims made by the manufacturer

Axon provided mixed messaging regarding the behaviour of the electrical output of the TASER 10™ when multiple probes had been deployed and had embedded in the skin of a single subject. Once source of information stated:

> **/ ANY-PROBE CONNECT**
> Intelligent, any-probe connect with spread optimizer energizes up to 4 probes at once to maximize the effectiveness of the probe deployment.

Figure 2. Screen capture from a document entitled 'taser-10-product-card-1.pdf'. This document is no longer available on the Axon US website.

Meanwhile, the TASER 10™ user manual states [12]:

> *Two probes must hit the target for electricity to flow and the possibility of NMI to occur. After the second probe has been deployed, an electrical output begins. If there are multiple (more than two) probe connections, the weapon will adjust output energy to make the most optimal connections. If the quality of a connection changes, the weapon will adjust accordingly. The TASER 10 energy weapon can create a connection between any two probes. It can even reverse polarity (change the electrical charge in a probe) if necessary. This is part of the design to optimize effectiveness. Although as many as 10 probes could be connected to the subject at once, the weapon will only energize up to four connections at one time.*

The confusion in how the device delivers its discharge carried through to the College of Policing's report on the user handling trials [9]:

> *Whilst it can deploy up to ten probes, a maximum of only four of these will be energised, which is the same as extant twin-cartridge CEDs when both cartridge bays have been fired.*

> *The T10 introduces a system called 'any probe connect'. It no longer has pre-designated polarity and is able to create a circuit from any combination of skin-penetrating probes, with a maximum of four probes energised at any one time.*

The concept that a maximum of four probes may be energised was subsequently taken-up by SACMILL in its initial medical statement on the TASER 10™ system [6].

The confusion was acknowledged by Axon in response to questions raised by Dstl [13]:

> **s41** [redacted]

A further attempt at clarification was received in May 2025 (emphasis added) [14]:

> **s41** [redacted]
>
> [redacted]
>
> [redacted]

2.3.3 The claimed electrical behaviour explained

The present authors are of the view that use of the phrases ***'at any one time'*** and ***'at once'*** in the various communications cited above only serve to continue to cloud clarity.

Our current understanding of how the TASER 10™ delivers its discharge is best explained graphically Figure 3:

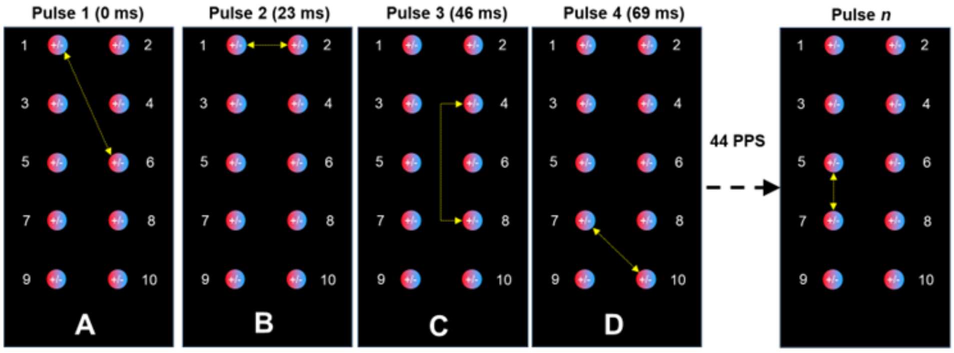

Figure 3. Hypothetical scenario in which ten probes are in electrical contact with a subject.

The figure depicts an event in which all ten probes have been fired and their darts are embedded in the skin of a single subject. The firmware will seek out the best four probe-pair connections based on the impedance sensed between the various probe permutations (of which there are 45 permutations with ten skin-embedded probes deployed).

The pulse rate when three or more probes have been deployed (and in electrical contact with the subject) is said to be 43-45 PPS, meaning that the interval between consecutive pulses is about 23 ms. On the first pulse delivered in this hypothetical ten-probe deployment, a connection between probes 1 and 6 is shown, but this changes in the following consecutive pulses to connections between probes 1 and 2, probes 4 and 8, and so on. Notably, a total of seven probes have contributed at some point during the first four pulses, **but only a single pair of these probes contributed to each pulse**. This was not clear from the early communications from Axon, nor was it clear in the company's documentation at the time of the original SACMILL assessment.

In reality, the device can actually change the probe-pairing on a pulse-by-pulse basis if it determines a more suitable conduction pathway exists. This could occur, for example, if a probe that was previously embedded in skin becomes dislodged. The device does not, therefore, limit itself to energising the same four probes during a discharge cycle. Rather, the TASER 10™ continually assesses the most suitable probe-pair combination with which to deliver each pulse.

2.3.4 The electrical testing

The electrical testing was conducted by an independent test house subcontracted by PA Consulting who, in turn, had been contracted by the Home Office. The electrical testing employed the following circuit (Figure 4):

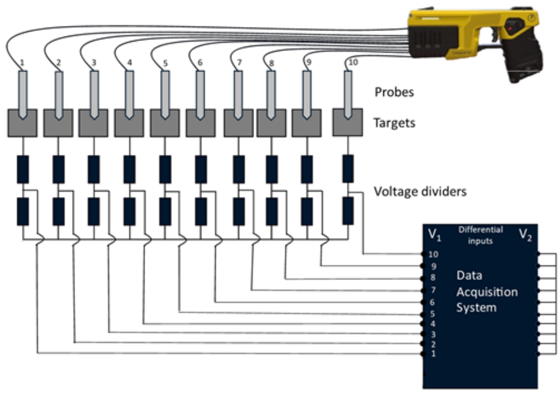

Figure 4. Test circuit schematic [4].

Further details on the methodology used may be obtained from the PA Consulting report [5].[1]

Probes were sequentially fired at the conductive targets (Figure 4), with the first set of data sampling beginning after the firing of the second probe, after which pulses were recorded throughout the 5 s discharge cycle. The third probe was then fired and the process repeated. This process continued up to and including the firing of the tenth probe.

It was originally intended that the sum of the resistances for each divider would approximate 300 Ω, meaning that a pair of connecting probes would see a resistance of around 600 Ω (i.e. the value specified by Axon for the basic electrical testing using just a two-probe output[2]). For that reason, the probe side of each divider consisted of 120 Ω and 150 Ω resistances in series, while the other side consisted of two 16 Ω resistances in series (32 Ω total).

However, an unanticipated problem was encountered with the 150 Ω resistances which, when coupled with resistor availability, meant that the final divider values on the probe side for the bulk of the testing were 740 Ω (for probes 1 to 5) and 1570 Ω (for probes 6 to 10). The resistance on the recorder side remained at 32 Ω for all probes. The inter-probe resistances, therefore, will have varied according to which probe-pairs became energised:

- For inter-probe energisations between probes 1 to 5, the resistance seen by the energised probe pair totalled 1544 Ω.
- For inter-probe energisations between probes 6 to 10, the resistance seen by the energised probe pair totalled 3204 Ω.
- Where the energisation was between one of the ‘1 to 5’ probes and one of the ‘6 to 10’ probes, the resistance seen by the energised probe pair totalled 2374 Ω.

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[1] The function of the potential dividers was to drop the voltage to a level compatible with the data acquisition system.
[2] Axon’s method of testing of the TASER 10™ and other TASER devices is designed to provide its various customers with a consistent way of testing their products.

The electrical tests were conducted in three series, which the test house termed Salvo 1, Salvo 2 and Salvo 3. Salvo 1 involved the problematic 150 Ω resistances, while Salvos 2 and 3 used the higher value resistances.

Although not included in the original technical test plan [15], the test house undertook further testing at the end of each salvo after the tenth probe had been fired. This included re-energising the probes (Salvos 1, 2 and 3) and cutting wires to probes that had been deployed (Salvo 3 only).

The data sampling side of the work was conducted under the supervision of a member of Dstl staff competent in instrumentation techniques who captured the data on Dstl-owned equipment. The data were subsequently transferred to PA Consulting for analysis.

2.3.5 The output parameters assessed in the additional testing

The electrical testing was designed to confirm the following:

- The number of energised probes contributing to each pulse when more than two probes had been deployed into their targets. This was the primary outcome measure of interest.
- That probes can alter their polarities and connect to different probes during the course of a discharge cycle (the *Any-Probe Connect* functionality).
- That the pulse rate is 21-23 PPS with two probes deployed and 43-45 PPS with three or more probes deployed [17].
- That the electrical charge delivered on each pulse is within Axon's specification of 52 to 95 µC [17].

2.3.6 The findings from the independent testing

At the time of writing, the Home Office and Dstl are yet to receive the final report from PA Consulting. The first draft report was received on 30/05/2025 [1] while the second draft was received on 11/06/2025 [2]. A third draft was received on 18/06/2025 [3] and a fourth draft was received on 26/06/2025 [4] with a fifth being received on 30/06/2025 [5].

Dstl has technically reviewed the various draft iterations and provided feedback to PA Consulting for their consideration. The draft report from PA Consulting, received on 30/06/2025, is anticipated to be the final draft (subject to technical review). It is the present authors' contention that the level of maturity of the fifth draft means that a high level of confidence may be placed the conclusions drawn. The following is, therefore, based on the findings set out in this fifth draft [5], however, Dstl will inform SACMILL should the final version change any of the observations made in the present report.

PA's conclusions, based on their analysis of the data provided by the test house and reported in the latest substantive draft, are as follows:

- **The number of probes energised during each discharge pulse**
  PA Consulting: *After removing artefacts***…only 2 probes were observed to be simultaneously energised during each individual discharge pulse.*

  * The artefacts to which PA allude refer to signals accompanying the primary signals from the energised probes. These are covered in more detail in section 2.4.2, where the basis for their identification and rejection are discussed.

- **The total number of probes energised during a 5 s discharge cycle**
  PA report that up to seven probes were energised over the course of a discharge cycle. This electrical behaviour, which results from changes to the identity of the probe-pair contributing to a pulse, is consistent with the *Any-Probe Connect* function, whereby any one probe may assume either polarity and is able to form a probe-pairing with any other probe in the electrical circuit.

- **Pulse frequency**
  In line with Axon's specifications, the pulse frequency was 22.2-22.4 PPS when two probes were deployed into their targets.

  When more than two probes were deployed, the pulse rate recorded on 15 of the 24 discharge cycles ranged from 42.6-45.7 PPS, broadly in line with Axon's 43-45 PPS specification. Although the 45.7 PPS upper end slightly breaches the specification, it is probably of doubtful significance from a medical perspective should it be replicated outside of a technical test environment.

  Five discharge cycles registered pulse rates of 39.2, 37.8, 36.8, 34.5 and 34.1 PSS and one discharge cycle registered a pulse rate of 22.6 PPS. Three of the six low pulse rate outliers were recorded in Salvo 1 but there are some technical concerns about the integrity of the test circuit in this salvo (see section 2.4.1). The remaining three low pulse rate outliers were associated with Salvo 2. Two of these outliers may or may not reflect the intrinsic behaviour of the TASER 10™ handle, but the 22.6 PPS outlier seems more likely to reflect a physical change in the circuit. The discharge cycle for this 22.6 PPS event was seen after the third probe was fired in Salvo 2 (Figure 5):

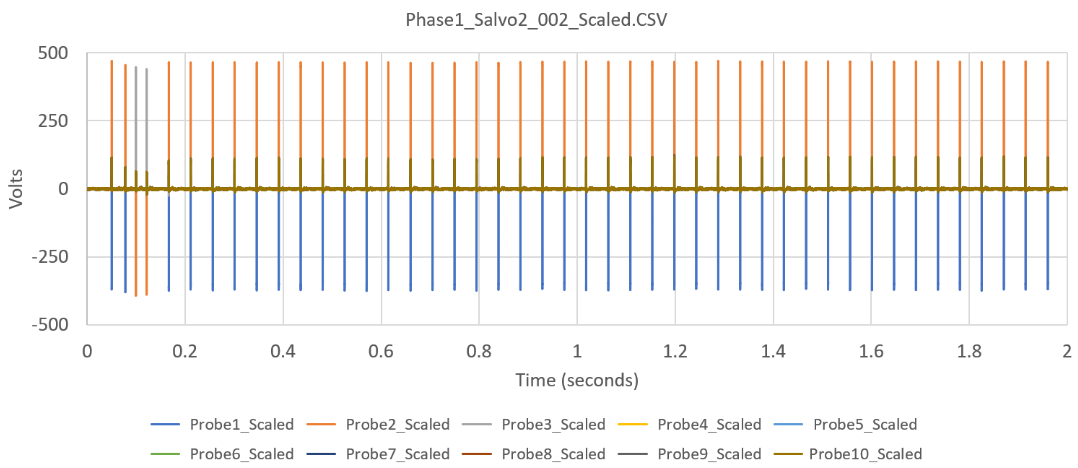

Figure 5. First 2 s of the discharge cycle with the largest pulse rate outlier.

It may be seen in Figure 5 that after the third probe has been introduced into the circuit, the cycle briefly adopts the expected rate of 43-45 PPS, with all three probes contributing to the first four pulses. On subsequent pulses in the 5 s cycle only probes 1 and 2 contributed to the pulses and the pulse rate is that expected when only two probes are in circuit. The most plausible explanation for this is an electrical discontinuity between probe 3 and its target following the fourth pulse.

Another low pulse rate example is shown in Figure 6:

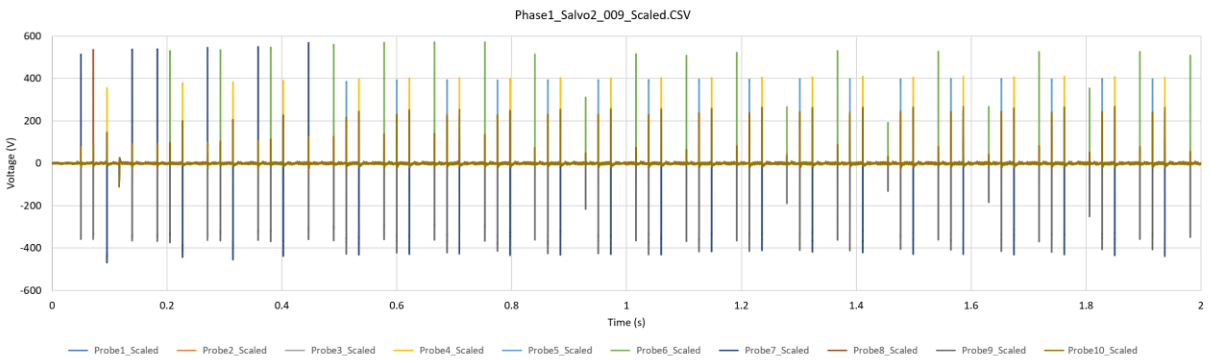

Figure 6. A second example of a low pulse rate discharge cycle in Salvo 2. The cycle initiated after the tenth probe had been fired at its target. The probe had bounced out of its target and the cycle continued with only nine probes present.

Figure 6 shows the first 2 s of a discharge cycle where the pulse rate averaged over the entire 5 s cycle was 34.1 PPS. The discharge pattern largely consisted of ≈44 PPS triplets interspersed with dropped pulses. The cause of this pattern is not known, but it is presumably due either to the TASER 10™ itself or to physical or electrical instability in one or more parts on the measurement side of the system.

On the measurement side of the system, instability could have arisen from the physical interface of the probe with its target, resulting in a less than ideal electrical continuity condition between probe and target. Also on the measurement side are the potential divider resistors, one value of which was found to have been particularly problematic during the Salvo 1 tests (see section 2.3.4). Concerns with these divider resistors are further explored in section 2.4.1.

Also evident in Figure 5 and Figure 6 are smaller positive deflections accompanying the main positive deflections. The smaller deflections were determined to be artefacts and are discussed in section 2.4.2.

Three discharge cycles are awaiting pulse rate analysis pending confirmation of the integrity of the data files.

- **Pulse charge**
  The average pulse charge measured for each discharge cycle was 65.5-79.2 µC (for Salvo 1), 28-87 µC (Salvo 2) and 76-92 µC (for Salvo 3).

  While the averaged pulse charges for Salvo 3 were within Axon's 52-95 µC specification and did not include any outliers, this was not the case for Salvo 1 and Salvo 2.

  While 93.9% of the measured pulse charges in Salvo 1 were said by PA to be within specification, they report that outliers of sub-10 µC and up to 229 µC were detected [4]. In debating the significance of these outlier events, PA interpret the findings as possibly being related to the problems with the 150 Ω resistors used as part of the potential divider chains used in Salvo 1. Based on information supplied by Axon, PA speculate that the presence of the outliers may be a function of how the TASER 10™ handle senses inter-probe resistance in anticipation of delivering the next pulse through that resistance.

  The authors of the present report are of the opinion that the known issues with the 150 Ω resistors preclude over-reliance on Salvo 1 when it comes to interpreting pulse charge. The issues with the 150 Ω resistors are discussed further in section 2.4.1.

  The charge outliers in Salvo 2 comprised a high proportion of pulses carrying a charge of less than 12 µC. PA report that these low charge events invariably occurred when the energised probe pairing was between probes 6-10. The dividers for these probes were constructed from the highest resistance values (see section 2.3.4), meaning that when pairings were formed by two probes in this group, the inter-probe resistance would have been 3204 Ω. An inter-probe resistance of greater than 3000 Ω is understood to lie beyond the limit of the ability of the TASER 10™ to form a within-specification pulse and, according to Axon, the device would not normally attempt to discharge into such a high resistance [4]. PA speculate on why this appeared not to have been the case for parts of Salvo 2.

  Irrespective of whether the low charge events in Salvo 2 would be reproduced in the field, PA note that the events only appeared in the test set-up with at least nine probes deployed into their targets. a situation which they understand, with reason, to be an unrealistic use-case.

2.4 Dstl comment

PA's analysis largely confirms the discharge behaviour and parameters listed in section 2.3.5 in respect of the number of probes contributing to each pulse, *Any-Probe Connect* functionality, pulse rates and pulse charge.

2.4.1 The potential dividers

As noted in section 2.3.4, a problem was encountered in Salvo 1 with the 150 Ω resistors on the probe side of the dividers. Dstl understands that this became apparent at the start of Salvo 2 (which followed Salvo 1). From the PA draft report [5]:

> *During the first attempt at Salvo 2, it was identified that some resistors had become damaged and no longer exhibited the correct resistance – instead they appeared to be an open circuit. In particular, it was noted that the 150Ω resistors appeared to be 'burning out' after a small number of energisations and only a limited number of spares were available. In order to continue testing, it was decided to attempt to reduce this effect by adding more resistance to each probe's load.*

The authors asked PA to source from the test house the data sheet for the resistors used for the dividers, and this was duly provided [16].

Assuming all the resistors were the ARCOL AP101 high power (100 W) type specified in the data sheet sent to Dstl, then their 100 W rating would *initially* appear to be appropriate for the intended tests. However, the 100 W rating applies only when the resistors are correctly mounted to a heatsink using properly applied thermal grease.

Dstl determined that this was not the case and, indeed, the resistors had been operated in so-called 'free-air' conditions, in which case the resistors are rated at 3.5 W (at 25°C) [16].

However, the free-air condition assumes that there is optimal air circulation around the resistor to allow for heat dissipation. On further enquiry, Dstl determined that the resistors in the potential dividers were labelled on one side with the other side near or touching a textile surface [4]. Under these non-ideal (and arguably thermally insulated) conditions, it is assumed that the power rating of the resistors would have been decreased from their 3.5 W rating, but by an unknown extent.

Assuming a conservative pulse amplitude of 500 V across the dividers in Salvo 1, then the 150 Ω resistors in the 302 Ω divider would have taken about 50% of the potential difference, or 250 V. The average power dissipation may be estimated from the following:

$$P_{avg} = \frac{V^2}{150}\ x\ D$$

where P_{avg} is the average power, V is the voltage across the 150 Ω resistor and D is the duty cycle, which is a function of pulse duration and pulse rate (conservatively estimated at 0.1 ms and 25 PPS, respectively):[3]

$$D = \frac{0.1\ ms}{\frac{1}{25}s} = \frac{0.0001}{0.04} = 0.0025$$

The average power dissipated by the 150 Ω resistor in Salvo 1 is therefore:

$$P_{avg} = \frac{250^2}{150} * 0.0025 = 1.04\ \mathrm{W}$$

While 1.04 W appears to lie comfortably within the 3.5 W free-air rating of the AP101, the added derating effect of the labelling sticker and proximity to a textile surface may mean that the 150 Ω resistors were operating close to their actual power rating limit. That the 150 Ω resistors were seen to be the resistance value susceptible to burn-out is consistent with the power derating argument given that it was this resistance that took the largest proportion of the potential difference across the various resistors making up the divider in Salvo 1.

2.4.2 Artefact detection and rejection

Given that the number of probes energised *during each pulse* was the primary outcome of interest in the present testing, there was some concern that PA initially reported three of the discharge cycles where pulses were seen to have been formed by more than two energised probes [1][2]:

- Salvo 1, Shot 5: Three probes contributing to single pulses;
- Salvo 2, Shot 10: Six probes contributing to single pulses;
- Salvo 3, Shot 9: Three probes contributing to single pulses.

PA subsequently detected anomalies in the data files for the above Salvo 1 and 3 events and excluded them from their current analysis, pending further exploration [5]. However, that still left the concerning finding in relation to Salvo 2 which, despite being confined to only one discharge cycle, had the potential to undermine confidence in how the TASER 10™ controls its discharge as it carried the implication that an excessive pulse charge could at times be delivered to a single subject.

Dstl, therefore, undertook a separate analysis of the aberrant finding and concluded that the most likely reason for their occurrence in Salvo 2 was due to confounding from the presence of signal artefacts. An example of artefactual pulse components is shown in APPENDIX A, where a pulse event from Salvo 2 Shot 3 is shown after the third probe had been fired. It can be seen that the pulse manifests as four components: a large positive and negative deflection and two smaller positive deflections. When viewed on an expanded voltage scale,

[3] A pulse rate of 25 PPS assumes that when more than two probes have been deployed, that any single probe will not be energised at the higher rate of 43-45 PPS.

the smaller deflections are seen to be made up of contributions from multiple probes, whereas the large deflections consist of contributions from only single probes.

A second characteristic of the artefactual signals is they could be seen to come from probes that had not yet been fired, although this would have become less and less clear as more probes were fired into their targets. This may be seen in the example in APPENDIX A, where signal contributions from unfired probes 4-10 are seen in the artefactual signals.

The automated method used by PA to detect pulse events and to determine the number of probes contributing to each pulse relied on setting a voltage threshold for detection. In the example shown in APPENDIX A, the voltage threshold was set to +/- 250 V, and it is apparent in this example that these thresholds would not have detected the presence of the artefact pulses.

Figure 7 shows an example of a multi-component pulse event from Salvo 2 shot 10, in which six probes were initially seen to be contributing single pulse events:

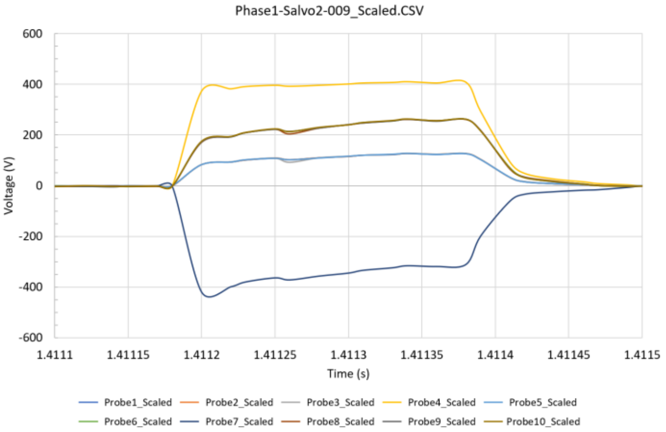

Figure 7. Example pulse from Salvo 2 after the tenth probe was fired at its target. This probe bounced out of its target on impact but the 5 s discharge cycle was still recorded.

The figure shows high amplitude positive and negative deflections which arise from probes 4 and 7, respectively. However, there are also artefactual components which, while smaller than the signals from probes 4 and 7, are of a substantially higher magnitude than those observed earlier in Salvo 2 (see APPENDIX A).

The larger artefactual event in Figure 7 is actually a composite of signals from probes 6, 8, 9 and 10 (even though probe 10 had bounced out from its target on impact). The smaller amplitude artefactual event is a composite of signals from probes 1, 2, 3 and 5.

Had the detection threshold been set at +/- 250 V, as was the case for the example pulse event shown in APPENDIX A, then the detection algorithm would have identified the primary signals from probes 4 and 7, as well as the signals from probes 6, 8, 9 and 10 that contributed to the larger of the two artefactual pulse events. Therefore, a total of six probes would have been identified as contributing to the pulses in Salvo 2 during the discharge cycle that followed the tenth probe firing.

Having confirmed that their original finding of six probes contributing to pulse events for Salvo 2 Shot 9 was erroneous for the reasons given above, PA subsequently revised-down the number of pulse-contributory probes to the expected two.

As for the source of the artefactual signals, PA conclude (and Dstl concur) that it is an unanticipated by-product of the way the circuit was constructed [5].[4]

2.5 Summary and conclusions

This letter report is designed to advise SACMILL on the outcome of the three items of additional testing of the TASER 10™ requested by the committee.

The first two items consisted of confirmation of the zeroing of the device at 10 m and exploring the ability of the dart of the TASER 10™ to perforate clothing more challenging than that used in earlier testing. SACMILL has already been briefed on both of these outcomes and concluded that the findings do not alter the committee's opinion already expressed in its initial medical statement on the TASER 10™ system.

The present report, therefore, focuses on the third item of additional testing, namely, confirmation of the way in which the TASER 10™ delivers its electrical discharge when more than two probes are in electrical contact with the subject.

The primary purpose of the testing was to ascertain the number of probes active during each of the pulses delivered during a 5 s discharge cycle. It was determined that each pulse was formed via the energisation of a single pair of probes, despite there being up to ten probes in introduced into the electrical circuit. In this regard, the TASER 10™ is no different from the earlier twin cartridge Conducted Energy Devices designed and manufactured by Axon.

The ability of probes to adopt either a positive or negative polarity during the course of a pulse train was also demonstrated, as was the switching between active probes contributing to each pulse. These are features of Axon's proprietary *Any-Probe Connect* functionality of the TASER 10™ device which is designed to optimise the effectiveness of the device.

The measured pulse charges and pulse rates were, in the main, consistent with Axon's specifications for the TASER 10™, which are 21-23 PPS (when two probes are energised), 43-45 PPS (when three or more probes are energised) and a pulse charge range of 52-95 µC. Although there were some pulse rate and pulse charge outliers, the most parsimonious explanation for their occurrence relates to technical issues with the set-up.

The pulse charge specification of the TASER 10™ spans the charge specifications seen with other Axon devices: TASER X26™ (110-135 µC when measured in human volunteers [18]), TASER X2™ (54-72 µC [19]) and TASER 7™ (59-67 µC [20]).

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[4] At a Teams meeting (01/05/2025) involving Home Office, Dstl, PA Consulting and Axon, Axon were asked whether they thought the circuit that would be used for testing would work as expected. The Axon representative believed that the circuit would work but added the caveat that they could not be firmer than that as they had not themselves tested it.

The pulse rate specification of the TASER 10™ is similar to other devices: TASER X26™ (16.5-20 PPS [18]), TASER X2™ (19 PPS with two probes in contact and 38 PPS with four probes in contact [23]) and TASER 7™ (22 PPS with two probes in contact and 44 PPS with four probes in contact [22])

In conclusion, it is the opinion of the present authors that the outcome of the additional electrical testing does not adversely or materially impact on SACMILL's overall opinion on the medical implications of the TASER 10™ system, as expressed in its initial statement. However, the clarifications from Axon (following its mixed messaging around how the discharge is delivered), together with the results from the additional testing, mean that any amended medical statement would benefit from the correction of some points of detail that appeared in the initial statement.

s40(2)

Senior Principal Scientist

Lead Technical Reviewer
Dstl Fellow

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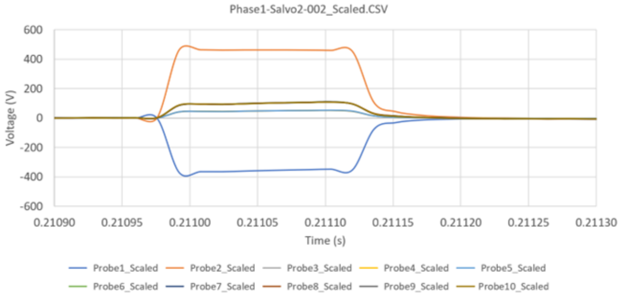
APPENDIX A   Artefact identification

A



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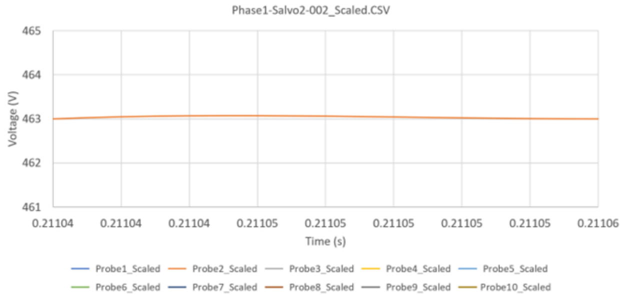

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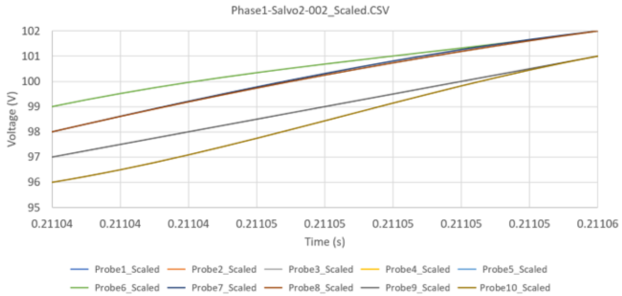

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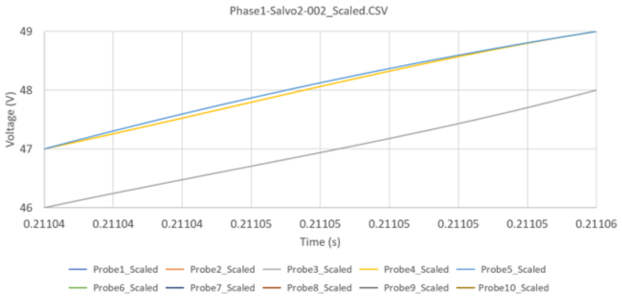

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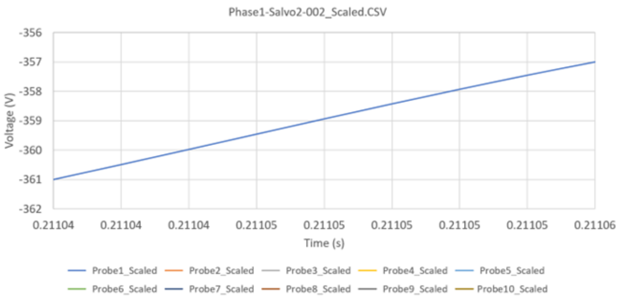

Key

A. Full pulse after three probes fired into targets.

B-E. Expanded views of the full pulse components going from top to bottom of the signal:

B. Contribution to the signal from probe 1.

C. Contributions from probes 6, 7, 8, 9 and 10.

D. Contributions from probes 3, 4 and 5.

E. Contribution from probe 1.

The artefactual components were identified by their make-up from multiple probes and lower amplitudes compared with the primary signals.

Artefactual signals appeared to come from some probes (probes 4-10 in this example) that had not yet been fired into their targets.

Report documentation page **v5.0**

* Denotes a mandatory field

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5b.	**Title UK protective marking: ***	UK OFFICIAL
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6.	**Authors: ***	[redacted] **s40(2)**

7a. Abstract: *

This letter report advises SACMILL on the outcome of three items of additional testing of the TASER 10™. SACMILL has already been briefed on the first two items, namely, confirmation of the zeroing of the device and exploration of the ability of the dart of the TASER 10™ to perforate clothing more challenging than that used in earlier testing. The present report therefore focuses on the final item of additional testing, namely, confirmation of how the TASER 10™ delivers its discharge when more than two probes are in contact with the subject. Testing confirmed that each pulse delivered is formed via the energisation of only a single pair of probes. In this regard, the TASER 10™ is no different from extant Axon twin cartridge devices. The ability of probes to adopt either polarity during a pulse train was also observed, as was the switching between active probes contributing to each pulse. The measured pulse rates and pulse charges were, in the main, consistent with Axon's specifications for the TASER 10™. Although a number of outliers were seen, these were most likely attributable to technical issues with the electrical test set-up.

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17a.	**Patents:**	No		
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