



Home Office

CAST Standard for Police Chemical Irritant Sprays: CS and PAVA

Publication Number: 23/14

Contents

1. Management Summary	3
2. Introduction	4
2.1 Introduction of Chemical Irritants to UK Police	4
2.2 CAST Standards	4
3. Scope	6
4. Manufacturers' Information	7
4.1 General Requirements for Submission of CS or PAVA sprays	7
4.2 Tests and Quantities	8
4.3 Results required to gain certification	10
5. Testing and Requirements	12
5.1 Capacity	12
5.2 Inspection of Labelling	12
5.3 Resistance to Crushing	14
5.4 Assessment of Spray Pattern	16
5.5 Drop Testing	18
5.6 Determination of Discharge Rate	20
5.7 Determination of Impact Pressure of Spray to Solid Surfaces	23
5.8 Performance at Extreme Temperatures	24
5.9 Assessment of Spray Flammability	25
5.10 Compatibility of Spray with Conducted Energy Devices	26
5.11 Trial to Determine Accuracy and Handling Qualities	28
5.12 Chemical Analysis of CS or PAVA Solutions	32
5.13 Inert Devices	34
5.14 Familiarisation Training Sprays	34
6. Manufacturer Quality Testing	35
7. References	36
A. Results Tables	37
B. User Questionnaire	52
C. Pro Forma Results Report (Certification Testing)	56
D. Pro Forma Results Report (MQT)	58
E. Pressure sensing equipment	59

1. Management Summary

In 1997 the Centre for Applied Science and Technology (CAST) produced a technical specification to ensure that CS sprays supplied to the police were manufactured to a consistent standard and were designed to meet Police Operational Requirements. This has been updated a number of times to incorporate the more recently approved irritant PAVA (including two approved solvent formulations) and to reflect experience gained from operational deployment.

This new document replaces pre-existing specifications and standards. The major revisions include:

- Requirement for submission of a technical file detailing construction of device.
- Revised requirements for smaller devices (defined as “concealable devices”) which are suitable for use by specialist officers. These devices will be tested in much the same way as standard canisters, with some exceptions which are outlined in this document.
- Specified methods for chemical analysis, which will be conducted as part of the CAST assessments by a CAST-approved independent test facility.
- Limited assessments for inert devices and general exposure (familiarisation training) devices.
- A batch testing and quality assurance process through manufacturer quality testing.

This document is fully supported by the National Conflict Management Portfolio Lead and the Home Office Public Order Unit.

2. Introduction

2.1 Introduction of Chemical Irritants to UK Police

In 1994 CAST (then PSDB) was tasked by the Home Office Operational Policing Policy Unit (now Public Order Unit) and National Policing Lead on Self Defence Arrest and Restraint Working Group (SDAR) with identifying a suitable chemical irritant spray for use by police officers on routine patrol duties. Following consultation with the Department of Health, the Chemical and Biological Defence Establishment (now Defence Science and Technology Laboratory, dstl) at Porton Down, and international users of the sprays, CS was identified as the most appropriate chemical irritant spray based on the grounds of effectiveness and safety. In 1999 CS was referred to the Department of Health Independent Committees on Toxicity, Mutagenicity and Carcinogenicity in Food, Consumer Products and the Environment, who concluded that "the Committees considered the available data did not, in general, raise concerns regarding the health effects of CS itself".

In April 2000 Sussex Police started a pilot trial with an alternative chemical irritant spray based on pelargonic acid vanillylamide (PAVA). The information available on PAVA was referred to the Committees on Toxicity, Mutagenicity and Carcinogenicity in Food, Consumer Products and the Environment in 2002. In September 2004, after additional data had been submitted, the Committees produced a statement on PAVA. They concluded that "the available information, both from toxicity data in experimental studies, and experience in use, indicates that the low exposures arising from the use of PAVA incapacitant spray would not be expected to be associated with any significant adverse health effects." Following ministerial support for the use of PAVA chief officers now have a choice of chemical irritant spray.

In 2007 the Committees commented on the proposal for the reformulation of PAVA spray (marketed as 'Captor 2' or 'Captor II'), where a new solvent formulation was proposed (the concentration of the active ingredient, PAVA, remains the same). The Committees concluded that "the information submitted on the toxicological risk assessment of Captor II in relation to direct and indirect exposure provided adequate reassurance that the risk was lower than for the previous formulation".

In order to avoid confusion with the term 'incapacitant' which is used to describe tranquillisers and other similar drugs in the Chemical Weapons Convention the term 'Chemical Irritant' will be used to refer to CS and PAVA in this report.

2.2 CAST Standards

CAST produced the first technical specification for CS sprays in 1997. This was developed to outline test methods and requirements to ensure devices were manufactured in a consistent manner and met the Police Operational Requirement. In 2002 this specification was updated to reflect operational experience gained since the introduction of CS sprays. In 2005, following the

approval of PAVA sprays, another update was published as a Standard. This document concerned both CS and PAVA sprays and incorporated requirements for smaller chemical irritant devices. In 2008 a new revision to the Standard was published to account for physical differences between CS and PAVA sprays, introducing tests to verify safety for revised test limits and incorporating assessments for the compatibility of sprays with conducted energy devices.

The major amendments to this Standard include:

- Requirement for submission of a technical file detailing construction of device.
- Revised requirements for smaller devices (defined as “concealable devices”) which are suitable for use by specialist officers. These devices will be tested in much the same way as standard canisters, with some exceptions which are outlined in this document.
- Specified methods for chemical analysis, which will be conducted as part of the CAST assessments by a CAST-approved independent test facility.
- Limited assessments for inert devices and general exposure (familiarisation training) devices.
- A batch testing and quality assurance process through manufacturer quality testing.

3. Scope

This Standard outlines the assessments for Police Chemical Irritant Sprays (containing CS or PAVA) to establish whether devices meet the Police Operational Requirement.

The Standard does not outline regulatory requirements for the manufacture of aerosol devices and their component parts. It is the responsibility of the manufacturers and suppliers of the sprays to ensure that these requirements are met. This will not form part of any CAST evaluation. Guidance on these regulations may be sought from the British Aerosol Manufacturing Association.

This Standard covers CS and PAVA devices, inert training devices and general exposure (familiarisation training) spray devices.

4.Manufacturers' Information

This Standard details the technical requirements for the compliance testing of CS and PAVA devices intended for police use. It also details the test methods that all new devices will be subjected to in order to gain certification.

Certification only applies to a particular design of device, manufactured in accordance with the manufacturer's technical file. If there is a design change to a device it must be resubmitted to CAST with an updated technical file. It will then be retested to ensure sustained compliance with the Standard.

Manufacturers are responsible for ensuring continued performance of their devices throughout production, via their quality assurance process. In addition, CAST have introduced a programme of Manufacturer Quality Testing (detailed in Section 6). This is a formal batch testing method ensuring the continued quality of a device once it has met the requirements of the CAST certification test. It requires manufacturers to submit a number of canisters to be assessed on a five-yearly basis for renewed certification.

CAST reserve the right to spot check canisters should it be found necessary.

Results of compliance testing will be supplied only to the relevant manufacturer, police forces or other UK government departments to aid with their procurement decisions.

To ensure consistent feedback, standardised results tables have been included in the Appendices.

Following assessment of the canisters it is the responsibility of the UK supplier to collect their canisters or arrange for disposal directly from CAST (at their own cost). This is the case regardless of the result of the testing.

4.1 General Requirements for Submission of CS or PAVA sprays

Police chemical irritant sprays shall be delivered to CAST from within the UK. If the devices are manufactured overseas they shall be delivered to a UK supplier before they are submitted to CAST. It is the responsibility of the UK supplier to ensure they have met the requirements of section 5 of the Firearms Act 1968.

Prior to submission of samples for compliance testing, manufacturers/suppliers shall provide CAST with a technical file detailing the following as a minimum:

- the build of the container, including details of suppliers of each component;
- the solution contained within the canister, including details of suppliers of each chemical;
- the density of the solution at 25°C;
- the propellant, including details of the supplier;
- the method used to assemble the canister;
- the shelf life of the device and evidence that the product is stable over the maximum period of the shelf life.

Information on the analytical methods used for manufacturer/supplier internal batch testing of the chemical contents of CS or PAVA sprays, as referred to in Section 4.3.2, shall be supplied. Results of this testing for the batch of devices submitted to CAST shall be provided.

All information submitted as part of the technical file will be classified

OFFICIAL – SENSITIVE.

4.2 Tests and Quantities

The tests are shown in Table 1 below along with the number of devices required for each test. In all cases the devices for testing shall be selected randomly from a production batch where a batch is defined as a set of devices filled from a single volume of solution.

Table 1: Tests and quantities of canisters required

Section	Test	No. Cans Required (upright only)	No. Cans Required (including inverted)
5.2	Inspection of Labelling	n/a	n/a
5.3	Resistance to Crushing	3 live	3 live
5.5	Drop Testing	14 live	17 live
5.6	Determination of Discharge Rate	3 live	6 live
5.7	Determination of Impact Pressure of Spray to Solid Surface	3 live	6 live
5.8	Performance at Extreme Temperatures	15 live	21 live
5.9	Assessment of Spray Flammability	3 live	6 live
5.10	Compatibility of Spray with Conducted Energy Devices	6 live	6 live
5.11	Trial to Determine Accuracy and Handling Qualities	6 live + 6 inert	12 live + 6 inert
5.12	Chemical Analysis	5 live	5 live
5.13	Inert Devices	3 inert	6 inert
5.14	Familiarisation Training Devices ¹	5	5
6	Manufacturer Quality Testing ²	15 live	21 live

Including spares, the total number of canisters required for compliance testing is 65 live and 15 inert. If it is specified that the device will work in an inverted orientation the total number of devices required (including spares) is 90 live and 18 inert.

¹ Optional.

² Not required for initial certification testing.

Assessments will be conducted in the order shown in Table 1. If a device is deemed to have failed any test, subsequent tests will not be completed and the manufacturer/supplier will be notified.

4.3 Results required to gain certification

Devices are expected to pass all of the tests specified within this Standard to receive certification. Requirements particular to each assessment are described in the relevant section.

In addition, the following generic requirements shall be met by all devices:

- shall be discharged when the actuator is activated (e.g. button depressed);
- shall stop discharging when the actuator is de-activated (e.g. button released);
- shall not be discharged as a result of any action other than intended discharge;
- shall not be damaged so that the device cannot physically be discharged without remedial action (e.g. actuator falls off or significant damage to the cap);
- shall not leak.

If a device fails to meet the generic requirements at any stage during assessment, testing will be discontinued and the manufacturer/supplier will be alerted.

Manufacturers/suppliers will be given the opportunity to investigate the issue and resubmit their device for testing. Prior to resubmission of the device the manufacturer/supplier is required to demonstrate why the issue occurred and provide CAST with an update on the remedial action to rectify the problem.

4.3.1 Liability

In all cases manufacturers/suppliers shall supply CS or PAVA devices that are suitable for use by police officers. Compliance of a product to this Standard does not alter the legal obligations of the manufacturers/suppliers with respect to their product.

Manufacturers/suppliers are responsible for ensuring that their CS or PAVA devices, including the canister itself, are produced in accordance with all relevant legislation.

4.3.2 Reliability, Sampling and Quality Assurance Systems

The device shall operate reliably and consistently throughout its warranted lifetime. The manufacturer is responsible for specifying the lifetime for their product. It must be evidenced that the CS or PAVA solution is chemically stable over this period.

A recognised quality control system shall ensure compatibility and stability of the contents and components over this specified time period to ensure continued compliance with Section 5.

The devices shall be designed and manufactured against a recognisable and relevant quality control standard. This shall give accountability at each stage of design and manufacture and help to ensure reliability and consistency.

Manufacturers/suppliers of the CS and PAVA devices are responsible for ensuring that a suitable sampling plan is adopted for product inspection. They shall also ensure the chemical contents of each batch of solution are sufficiently analysed. The actual test methods shall be devised by manufacturers and shall at least cover the points specified below, to suit their own product.

Representative samples from each batch of production devices shall be tested to identify any defect which prevents the device from being drawn, made ready to discharge and discharged in the intended manner. Examples of such defects are:

- on attempting to remove the device from the holster/pouch, the over cap comes off;
- any anti-tamper device cannot be disengaged;
- the discharge valve fails to open fully;
- the nozzle assembly is not properly attached to the discharge valve;
- the device is incorrectly pressurised, resulting in a low, or high, discharge rate.

The system of quality control shall incorporate documentation of any design changes, thus ensuring any design changes that are introduced can be given correct consideration of their effect on performance. If there is any design change to a device it must be resubmitted to CAST to be reassessed to ensure sustained compliance with the Standard.

4.3.3 Hazard Information

The manufacturers/suppliers shall provide hazard information to allow users to comply with the Control of Substances Hazardous to Health (COSHH) regulations.

5. Testing and Requirements

5.1 Capacity

5.1.1 Standard devices

Standard-sized devices shall contain a minimum of 30 ml irritant solution. The maximum capacity for CS canisters is 92 ml; there is no maximum capacity for PAVA canisters.

5.1.2 Concealable devices

Devices containing between 10 ml and 30 ml shall be considered as “Concealable”. These shall be assessed according to the same tests as standard devices; however, some requirements differ. The differing requirements for concealable devices are specifically stated where relevant.

5.2 Inspection of Labelling

Note: It is the responsibility of the manufacturer/supplier to ensure that regulatory labelling information is included on each device³. This will not form part of the CAST assessment.

5.2.1 Facilities required

- One device
- Container with a capacity great enough to accommodate the entire contents of the device e.g. glass beaker
- Glass pipette

5.2.2 Method

The device shall be inspected to ensure that it includes the specific information for police chemical irritant sprays as detailed in Section 5.3.3.

The entire contents of one canister shall be decanted into a suitable container. The label shall be covered in solution that has been decanted from the device using a pipette. This shall include the base of the device.

³Guidance may be sought from the British Aerosol Manufacturing Association.

5.2.3 Requirements and reporting

Standard devices: The following information shall be included on each device:

- Nature of intended use, e.g. "CS Spray, for Police Use Only"
- Supplier's or manufacturer's name, address and telephone number
- Name of main ingredients, e.g. "contains CS in MIBK"
- A number or code uniquely identifying each individual device
- Date of manufacture
- Date at which shelf life expires

Compliance with any part of any standard shall not be indicated on the device.

The required information shall remain on the device and be readable following exposure of the label to the solution contained within the device.

Concealable devices: Refer to the requirements for standard devices; however, concealable devices shall not specify that they are for police use.

A checklist of these points is given in the table in Appendix A.1, where the results of this inspection should be recorded.

5.3 Resistance to Crushing

Note: an assessment of spray pattern (Section 5.4) follows this test.

5.3.1 Facilities required

- Lever device as illustrated in Figure 1 (the distance between the centres of the pivot and attachment holes must be 1500 mm)
- Table clamps
- Weight suitable for suspension from lever (see Figure 1 and calculation below)
- Impermeable bag (e.g. polythene) with capacity at least 20 times of the device
- Balance capable of measuring up to 20 kg ± 0.1 kg
- Three CS / PAVA spray devices
- Conditioning cabinet maintained at 25°C ± 1°C

Calculation of weight (W) for suspension from lever:

$$W = 20 - \left(\frac{wl}{1500} \right)$$

Where:

w is the weight of the arm in kg

l is the distance in mm between the centre of gravity of the arm and the pivot (see Figure 1)

Before testing, the devices shall be conditioned for 30 minutes at 25°C ± 1°C. Each test on each canister should be completed in the shortest time possible after removal of the device from conditioning; ideally within five minutes and up to a maximum of ten minutes.

5.3.2 Method

This test simulates the effect of a person weighing 100 kg stepping on the device. The lever device shall be clamped firmly to a bench using table clamps. The CS/PAVA spray device shall be enclosed in the bag, the air excluded and the bag sealed. The weight shall be suspended from the end of the lever.

The irritant spray device shall be placed under the lever with the foam rubber pad aligned with the bottom of the aerosol container portion of the device (see Figure 1 – Position A). The lever shall be lowered onto the device and the position of the device checked and, if necessary, adjusted. It may be found necessary to secure the device (e.g. with adhesive tape) to stop it slipping out from under the lever. The weight shall then be lowered gently until it is freely suspended from the lever and left for one minute. The device shall be removed from the underneath lever and checked for any leakage or damage.

The test shall be repeated with the foam rubber pad aligned with the cap of the device (Figure 1 – Position B).

After the crush test is completed, each device shall be tested as described in Section 5.4 "Assessment of spray pattern". The test shall be repeated for all three devices.

5.3.3 Requirements and reporting

All three devices shall satisfy the requirements specified in Section 4.3 in addition to the requirements for spray pattern set out in Section 5.4.3.

The results shall be recorded on the table in Appendix A.2.

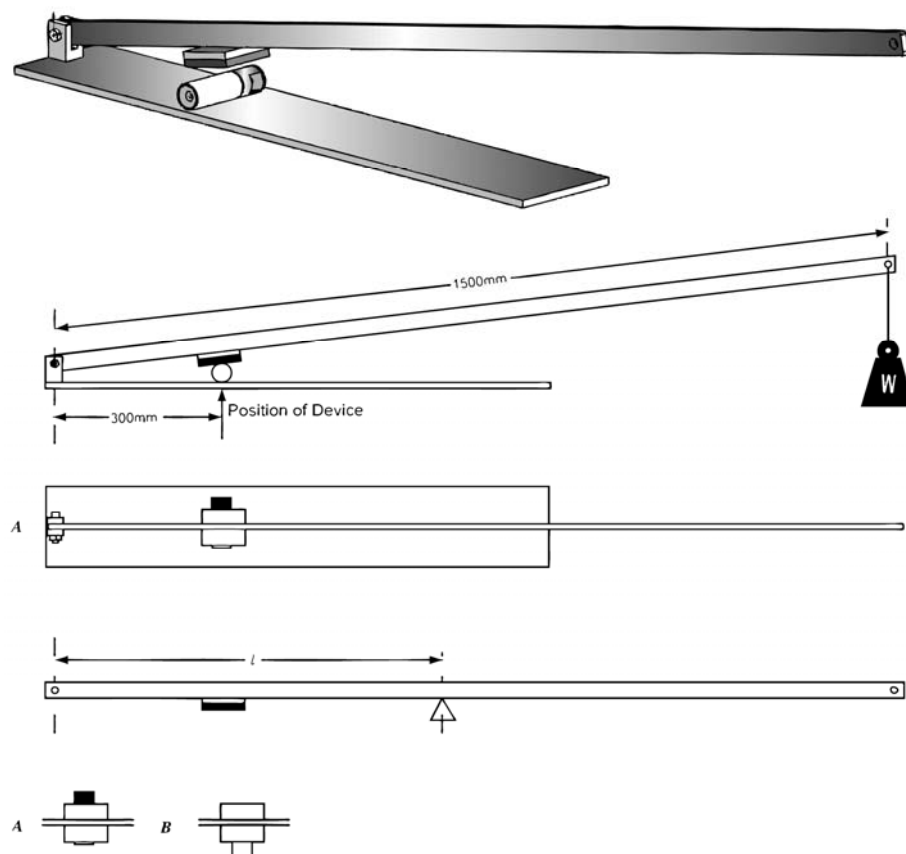


Figure 1 - Crush test rig

Suggested crush pad dimensions: 75 mm x 75 mm, 10 mm thick.

Suggested crush pad material: Nitrile/PVC closed cell foam. Compression deflection 63-91 kPa.

5.4 Assessment of Spray Pattern

Note: this assessment will only be conducted following the tests for Resistance to Crushing (Section 5.3) and Drop Testing (Section 5.5) and Performance at Extreme Temperatures (Section 5.8).

5.4.1 Facilities required

- Tape measure
- Conditioning cabinet maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- 36 sheets of paper, at least A3 sized
- Three CS / PAVA spray devices
- One transparent sheet (e.g. tracing paper or acetate) with a 150 mm diameter circle drawn on it

Before testing, the devices shall be conditioned for 30 minutes at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$. Each test on each canister should be completed in the shortest time possible after removal of the device from conditioning; ideally within five minutes and up to a maximum of ten minutes.

5.4.2 Method

The spray pattern shall be determined by spraying a half-second burst at a sheet of paper at a range of two metres. Most organic solvents will mark the paper. The spray pattern shall be assessed to ascertain if it falls substantially (80%) within a 150 mm diameter circle, by overlaying a transparent sheet with such a circle drawn on it. The test shall be carried out with a full device and repeated to assess a total of 12 sprayings, volume in the canister permitting. The test shall be repeated for all three devices.

Concealable canisters shall be assessed using the same method; however, the range shall be reduced to one metre. The test shall be repeated until the device becomes empty. The test shall be repeated for all three devices.

5.4.3 Requirements and reporting

The following requirements shall be satisfied for all devices, in addition to meeting the requirements specified in Section 4.3.

Standard devices: 80% of each spray from each device shall fall inside a 150 mm target when discharged from a distance of 2 m. The first six half-second sprays for each device tested shall satisfy this requirement; the subsequent six sprays should be assessed to give an indication of continued performance.

Concealable devices: 80% of each spray from each device shall fall inside a 150 mm target when discharged from a distance of 1 m. The first four half-second sprays shall satisfy this requirement; further sprays should be assessed to give an indication of continued performance if the volume contained in the canister allows.

The examples of spray patterns in Figure 2 may be used to help determine whether the spray falls substantially within the circle.

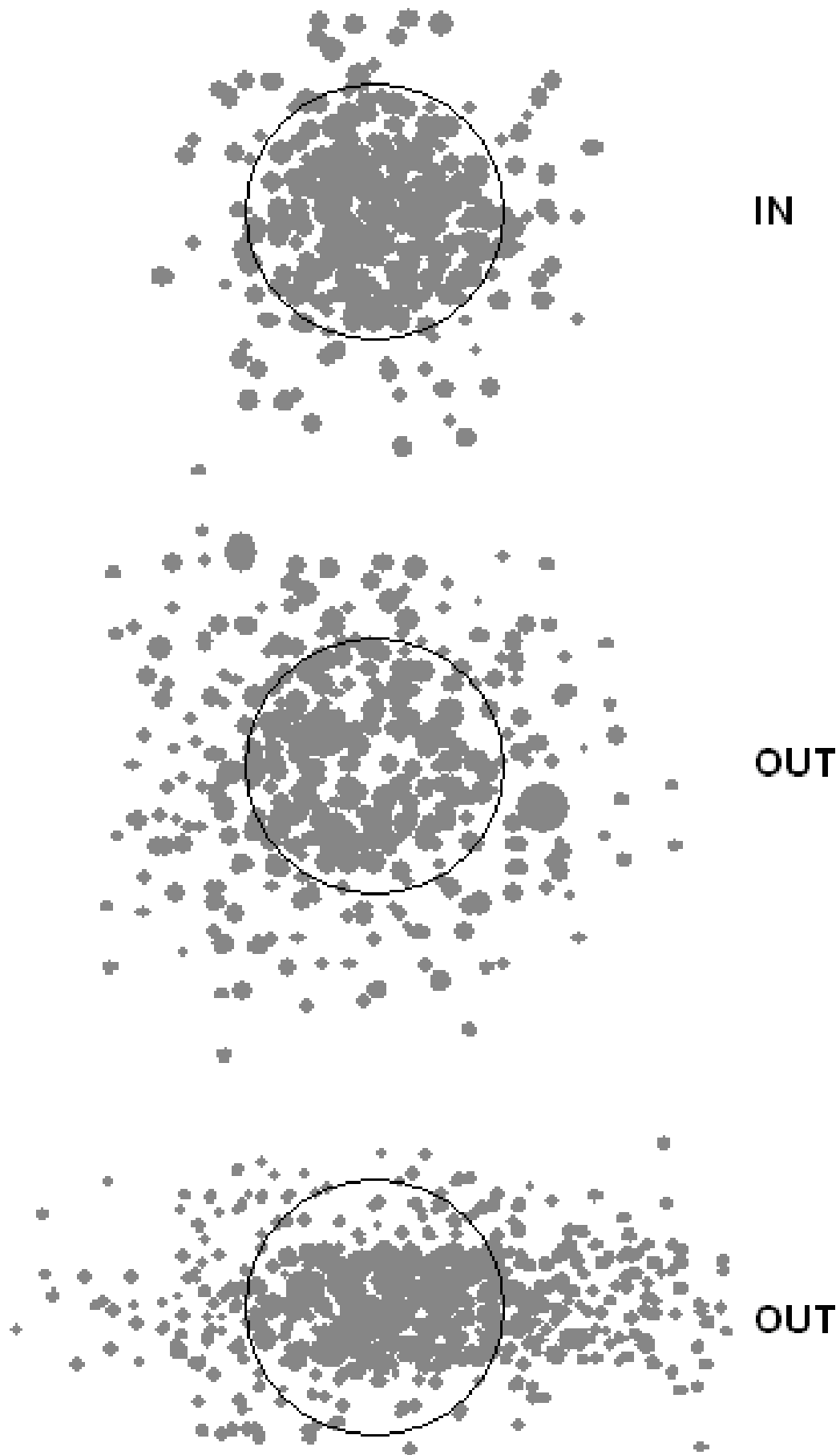


Figure 2 - Spray pattern examples.

5.5 Drop Testing

Note: an assessment of spray pattern (Section 5.4) follows this test.

5.5.1 Facilities required

- Conditioning cabinet maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- Steel plate of at least 6 mm thickness and at least 300 mm x 300 mm
- Tape measure
- Suitable stand and clamp from which device may be suspended
- 14 CS/PAVA spray devices

Before testing, the devices shall be conditioned for 30 minutes at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$. Each test on each canister should be completed in the shortest time possible after removal of the device from conditioning; ideally within five minutes and up to a maximum of ten minutes.

5.5.2 Method

The device shall be suspended at one of the specified angles indicated in Figure 3. The centre of the device shall be $2\text{ m} \pm 5\text{ cm}$ above the approximate centre of the steel plate, which is laid flat. The device shall be dropped by releasing the clamp. The test shall be repeated using a different device at each specified angle until all 14 specified angles have been completed. After the drop test is completed, each device shall be tested as described in Section 5.4 "Assessment of Spray Pattern."

If it is specified by the manufacturer/supplier that the device will work in an inverted orientation a further three canisters shall be tested by dropping from positions 1, 3 and 5 (Figure 3). This shall be followed by the "Assessment of Spray Pattern" (Section 5.4); however, during this assessment the canister shall be mounted in an inverted position.

5.5.3 Requirements and reporting

All devices shall satisfy the requirements specified in Section 4.3 in addition to the requirements for Spray Pattern set out in Section 5.4.3.

The results should be recorded on the table in Appendix A.3

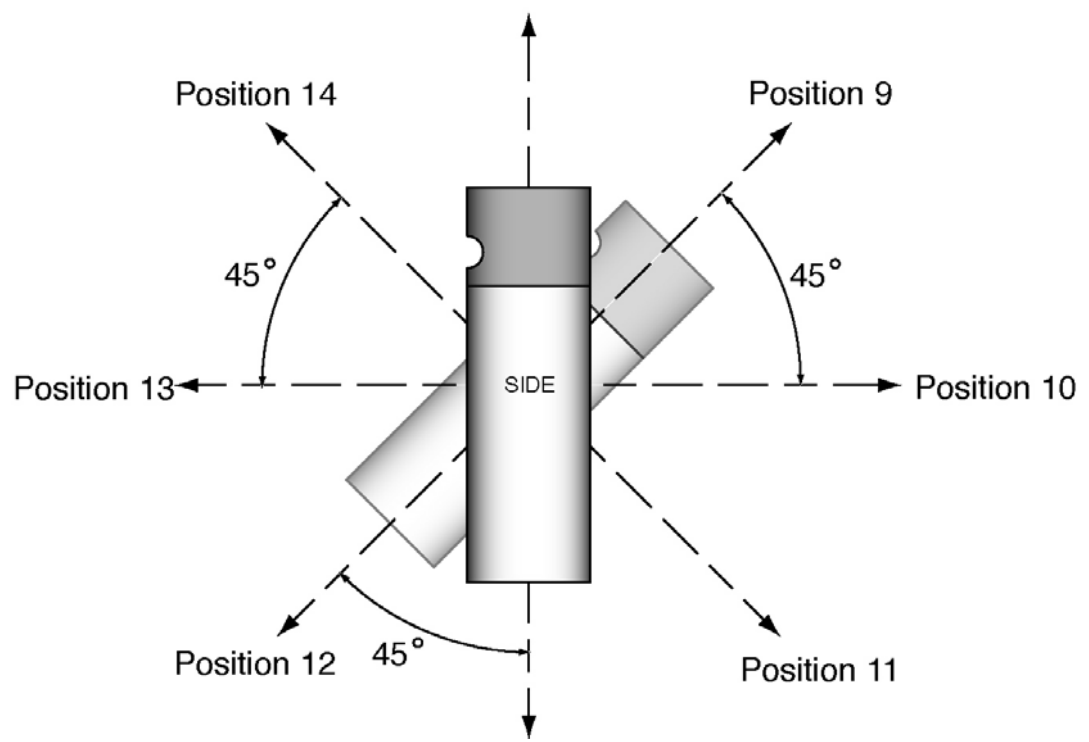
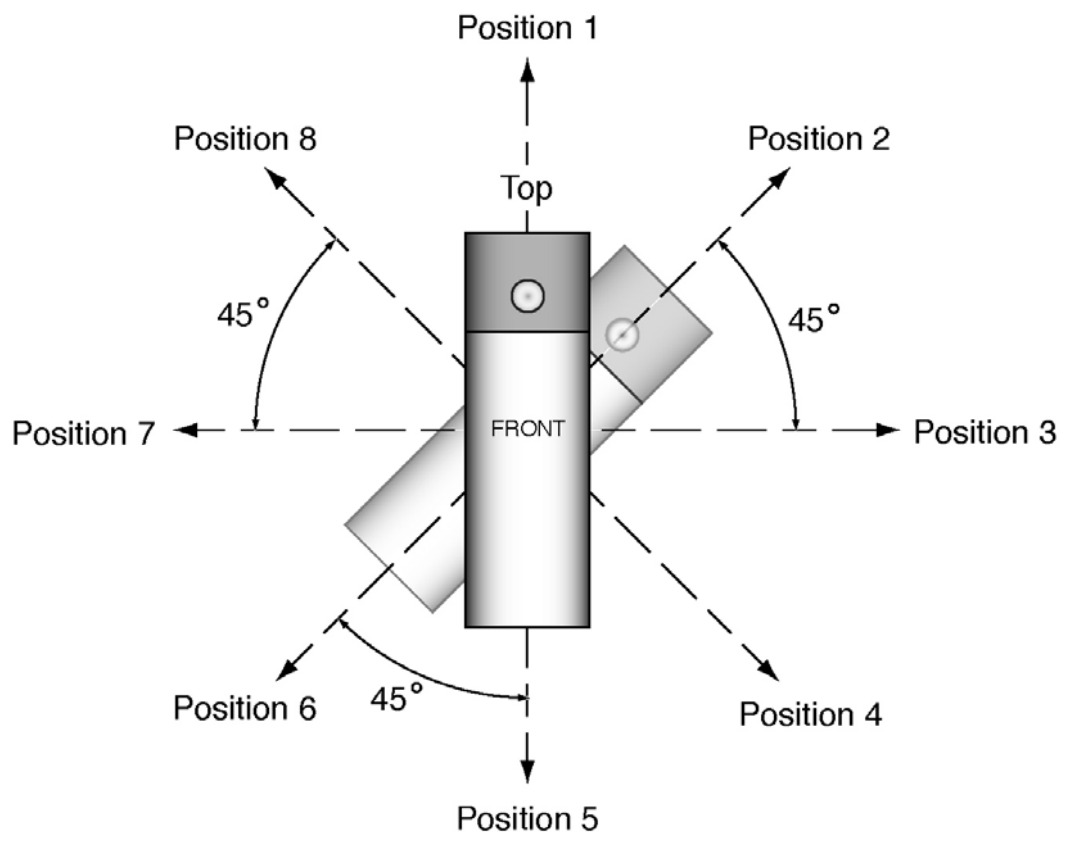


Figure 3 - Specified angles for drop test.

5.6 Determination of Discharge Rate

5.6.1 Facilities required

- A conditioning cabinet maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- A balance accurate to 0.01 g
- Timing apparatus accurate to 0.01 seconds. Suggested timing devices: high-speed camera or speaker cone/microphone and oscilloscope
- Three CS/PAVA spray devices

Before testing, the devices shall be conditioned for 30 minutes at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$. Each test on each canister should be completed in the shortest time possible after removal of the device from conditioning; ideally within five minutes and up to a maximum of ten minutes.

5.6.2 Method

Standard devices: The device shall be weighed three times and individual results shall be recorded. The arithmetic mean shall be calculated and reported. The device shall be discharged for approximately 0.5 seconds (the exact length of time of discharge shall be measured using a suitable timing apparatus). Any liquid which adheres to the device shall be removed before the device is reweighed three times. The individual results shall be recorded and arithmetic mean shall be calculated and reported. This process shall be repeated so that a total of 12 discharges are assessed.

Concealable devices: The method for standard devices shall be followed and repeated until the device becomes empty. It is not necessary to assess 12 discharges.

The test shall be repeated for all three devices.

If it is specified by the manufacturer/supplier that the device will work in an inverted orientation then this test shall be repeated in this orientation.

5.6.3 Calculation of discharge rate

The weight of each discharge (arithmetic mean) and the length of each discharge in seconds shall be recorded for each device. The discharge rate in ml/s shall be calculated at the end of the test.

The discharge rate is calculated using the difference in weight before and after each burst and the density of the liquid contained in the device, according to the following formula:

$$R = \frac{w_1 - w_2}{td}$$

Where:

- R is the discharge rate in ml/s
- w_1 is the weight before the burst in g

- w₂ is the weight after the burst in g
- t is the length of time of discharge in s
- d is the density of the solvent in g/ml

5.6.4 Definitions for requirements

A_{min} – absolute minimum

A_{max} – absolute maximum

P – Permitted range

D – Average (arithmetic mean) discharge rate for the first six half-second discharges from an individual canister

\bar{D} – Average (arithmetic mean) discharge rate for the first six half-second discharges across all canisters

5.6.5 Requirements

The requirements are stated in Table 2.

For any single discharge from any of the three canisters tested the discharge rate shall not be less than the absolute minimum (A_{min}) or greater than the absolute maximum (A_{max}).

The average (arithmetic mean) discharge rate for the first six half-second discharges across all three canisters tested (\bar{D}) shall not exceed the figures stated in Table 2.

The permitted range (P) of results shall be calculated from \bar{D} for the first six half-second discharges across all three devices:

$$\textit{Minimum} = \bar{D} - 2$$

$$\textit{Maximum} = \bar{D} + 2$$

The lower limit of P shall not be less than A_{min} and the upper limit of P shall not be greater than A_{max}. For example for a CS device if $\bar{D} = 5.0$, P would be 3.0 to 6.5.

The average (arithmetic mean) discharge rate for first six half-second discharges for each individual canister (D) must be within 10% of \bar{D} .

Once calculated, the values for \bar{D} , D and P will be set for the device being tested. Any future assessments of the same design of device shall meet these requirements.

Table 2 - Discharge rate requirements

	A_{\min}	A_{\max}	P	\bar{D}	D
CS	2.5ml/sec	6.5ml/sec	$\bar{D} \pm 2\text{ml/sec}$	No greater than 5.0ml/sec	$\bar{D} \pm 10\%$
PAVA	2.5ml/sec	13.0ml/sec	$\bar{D} \pm 2\text{ml/sec}$	No greater than absolute maximum	$\bar{D} \pm 10\%$

* Arithmetic rounding rules will be applied where relevant

5.6.6 Discharge rate worked example

An example demonstrating how to apply the requirements is shown in this section. Table 3 shows the calculated discharge rate per spray of three canisters, as well as figures for D , \bar{D} and P.

Table 3 - Worked example (PAVA spray)

Spray number	Can #1	Can #2	Can #3
1	7.68	8.02	7.05
2	7.54	7.91	6.86
3	7.39	7.68	6.57
4	7.01	7.30	6.42
5	6.84	7.05	6.29
6	6.59	6.92	6.07
7	6.40	6.73	5.87
8	6.28	6.70	5.69
9	6.13	6.52	5.52
10	5.96	6.27	5.39
11	5.87	5.93	5.21
12	5.51	5.23	4.96
D	7.2	7.5	6.5
\bar{D}	7.1		
P	5.1 - 9.1		

This would be a PASS result as:

A_{\min} is less than 6.07

A_{\max} is greater than 8.02

All values for discharges 1 – 6 are within the limits P

D is within 10% of \bar{D} (required to be between 6.36 and 7.78)

5.6.7 Reporting

The results should be recorded on the table in Appendix A.4.

5.7 Determination of Impact Pressure of Spray to Solid Surfaces

5.7.1 Facilities required

- Three CS/PAVA spray devices
- Conditioning cabinet maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- Pressure sensing equipment (described in Appendix E)
- Tape measure

Before testing, the devices shall be conditioned for 30 minutes at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$. Each test on each canister should be completed in the shortest time possible after removal of the device from conditioning; ideally within five minutes and up to a maximum of ten minutes.

5.7.2 Method

The test equipment shall be set up so that the nozzle of the device is 15 cm from the pressure sensing plate and the spray hits the sensor square on. The device shall be discharged for one second and the highest pressure measured over the entire duration of the spray shall be recorded. This shall be repeated until the canister is empty. The test shall be repeated for all three devices.

If it is specified by the manufacturer/supplier that the device will work in an inverted orientation then this test shall be repeated in that position.

5.7.3 Requirements and reporting

A device will be deemed to have failed if the measured pressure, for any one second burst, exceeds the maximum pressure of 40 kPa. All devices shall pass this test.

The results should be recorded in the table in Appendix A.5.

5.8 Performance at Extreme Temperatures

5.8.1 Facilities required

- 15 CS/PAVA spray devices
- Conditioning cabinet maintained at $50^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- Freezer cabinet maintained at $-20^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- Protective gloves suitable for handling items at -20°C and 50°C

Nine spray devices shall be conditioned at $50^{\circ}\text{C} \pm 1^{\circ}\text{C}$ for 24 hours and six at $-20^{\circ}\text{C} \pm 1^{\circ}\text{C}$ for 24 hours. After conditioning at the extremes of temperature the devices shall be removed from the cabinet and left at between 15°C and 25°C for a period of ten minutes. Each test on each canister should then be completed in the shortest time possible; ideally within five minutes and up to a maximum of ten minutes.

5.8.2 Method

Six devices shall be tested as described in Section 5.4 "Assessment of Spray Pattern" (three at -20°C and three at $+50^{\circ}\text{C}$); six shall be tested as described in Section 5.6 "Determination of Discharge Rate" (three at -20°C and three at $+50^{\circ}\text{C}$); and three devices shall be tested as described in Section 5.7 "Determination of Impact Pressure of Spray to Solid Surfaces" (three at $+50^{\circ}\text{C}$).

If it is specified by the manufacturer/supplier that the device will work in an inverted orientation then the test described in Section 5.4 shall be repeated in that position. It is not necessary to repeat tests described in Sections 5.6 or 5.7 in the inverted position.

Note that it is not necessary to condition the devices at 25°C for these tests.

5.8.3 Requirements and reporting

All devices shall satisfy the requirements specified in Sections 4.3, 5.4.3, 5.6.4 and 5.7.3.

The results should be recorded on the table in Appendix A.6.

5.9 Assessment of Spray Flammability

5.9.1 Facilities required

- 150 mm rule
- Three candles
- A conditioning cabinet maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- Three CS/PAVA spray devices
- Draft-free area
- CO₂ fire extinguisher

Before testing, the devices shall be conditioned for 30 minutes at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$. Each test on each canister should be completed in the shortest time possible after removal of the device from conditioning; ideally within five minutes and up to a maximum of ten minutes.

5.9.2 Method

Two candles of the same height shall be mounted in a holder so that the spray will travel through both candle flames. A third candle may be used in order to relight these candles in case of accidental extinguishment by the spray.

The device shall be positioned 150 mm from the candles positioned together. The candles may need support in order to have the flame at the correct vertical height relative to the device. The relative height of the device shall be arranged so that the lower edge of the spray passes through the top third of the candle flames. The device shall be discharged for at least two seconds. It shall be noted if the flame extends back to the device.

This shall be repeated using the same device; however, the spray shall be removed from the candle flames to establish whether it continues to burn. If the spray continues to burn, the flame shall be recorded as self-sustaining.

The test shall be repeated until the device is empty. For a result to be considered valid, the spray shall not extinguish the candle flame during the assessment. The test shall be repeated for all three devices.

If it is specified by the manufacturer/supplier that the device will work in an inverted orientation then this test shall be repeated in that position.

5.9.3 Requirements and reporting

All devices shall satisfy the requirements specified in Section 4.3. In addition there shall be **no** flame extension towards the device and the flame shall **not** be self-sustaining.

The results should be recorded on the table in Appendix A.7.

5.10 Compatibility of Spray with Conducted Energy Devices

The flammability of the sprays shall be assessed when subjected to high-voltage, low-energy sparks. This will be used to monitor the effects of conducted energy devices on chemical irritant sprays. No pass/fail criteria are set for this test; however, the results shall be made available to the manufacturer and police forces.

5.10.1 Facilities required

- Spark generator – 50 kV, maximum 0.0036 Amps, 19 Hz
- Electrically conductive tape
- Mannequin heated to $30^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- Material – 100% cotton ($0.17 \pm 0.05 \text{ kg/m}^2$)
- Conditioning cabinet held at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- Six CS/PAVA spray devices
- Stop watch
- Draft-free area
- CO₂ fire extinguisher

Before testing, the devices shall be conditioned for 30 minutes at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$. Each test on each canister should be completed in the shortest time possible after removal of the device from conditioning; ideally within five minutes and up to a maximum of ten minutes.

5.10.2 Method

The test shall be conducted in a draft-free area which can be ventilated after each test.

The mannequin torso shall be heated to a constant temperature of $30^{\circ}\text{C} \pm 1^{\circ}\text{C}$. A 10 cm piece of conductive tape shall be secured to the mannequin torso. Material shall be attached to the shoulders of the mannequin, allowing it to fall naturally as a t-shirt would over the body. One electrode from the spark generator shall be positioned on the outer side of the material with a 1 cm gap between the electrode and the conductive tape (on the torso – other side of the material). The other electrode shall be attached directly to the conductive tape to complete the circuit. See Figure 4 for recommended equipment set-up.

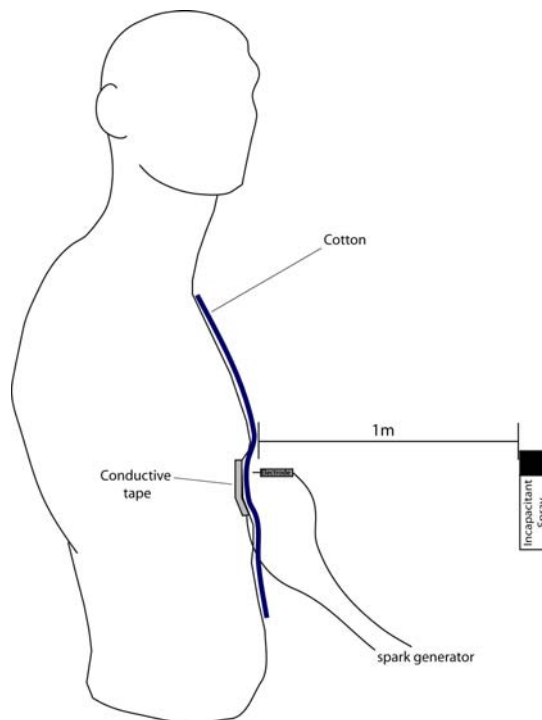


Figure 4 - Equipment set-up.

One device shall be assessed in accordance with each of Parts 1 to 5, unless it is specified that no further assessment is required.

Part 1a

From a distance of one metre two half-second bursts shall be discharged directly onto the material where the electrodes are positioned. After 30 seconds a pulsing spark of five seconds duration shall be generated. If no flames are observed the spark generation shall be repeated, with a five-second duration, 30 seconds after the first test. If no flames are observed during this assessment Part 1b shall be completed. If flames or smouldering of the material are observed during this assessment Part 2 shall be completed.

Part 1b (conduct only if spray is shown to be non-flammable in Part 1a)

Part 1a shall be repeated; however, the entire contents of the device shall be discharged onto the material prior to spark generation.

Part 2 (conduct only if spray is shown to be flammable in Part 1a)

From a distance of one metre the entire contents of the device shall be discharged onto the material where the electrodes are positioned. After 20 minutes a pulsing spark of five seconds duration shall be generated. If no flames are observed the spark generation shall be repeated, with a five-second duration, 30 seconds after the first test. If no flames are observed during this assessment Part 3 shall be completed. If flames or smouldering of the material are observed no further testing shall be conducted.

Part 3 (conduct only if spray is shown to be non-flammable in Part 2)

Part 2 shall be repeated; however, spark generation shall commence after 15 minutes. If no flames are observed during this assessment Part 4 shall be completed. If flames or smouldering of the material are observed no further testing shall be conducted.

Part 4 (conduct only if spray is shown to be non-flammable in Part 3)

Part 2 shall be repeated; however, spark generation shall commence after ten minutes. If no flames are observed during this assessment Part 5 shall be completed. If flames or smouldering of the material are observed no further testing shall be conducted.

Part 5 (conduct only if spray is shown to be non-flammable in Part 4)

Part 2 shall be repeated; however, spark generation shall commence after five minutes. This completes the assessment.

5.10.3 Requirements and reporting

There are no pass/fail criteria for this assessment; the results will be provided for information. However, the device shall satisfy the requirements specified in Section 4.3 and will be deemed to have failed if any of these requirements are not met.

The results shall be recorded on the table in Appendix A.8.

5.11 Trial to Determine Accuracy and Handling Qualities

This part of the assessment is a subjective test carried out to obtain information and feedback on ease of use, accuracy and handling qualities of the canisters. CAST will not make a judgement on a device based on this trial but will make feedback available to the manufacturer and police forces.

This trial is in two parts which can conveniently be carried out together. Part 1 (Section 5.11.1) evaluates the handling and ease of use of the device and Part 2 (Section 5.11.2) tests the accuracy of the device when carefully aimed.

A group of six users is required. These users should be police officers who:

- have been trained in the use of a CS and/or PAVA irritant spray (not necessarily the one being evaluated; it must be noted that the main difference between the use of CS and PAVA sprays is that PAVA has to be sprayed into the eyes, unlike CS; this should be made clear to officers who are only trained to use one or the other;
- represent as wide a range as possible of physical types; and
- are equipped with suitable patrol duty gloves, holsters/ utility vests/ belts.

It would be an advantage if several designs of devices could be tested using the same officers.

Facilities required

- A well-ventilated area
- A vertical wall or board at least 2 m high to which targets may be attached
- Six A₄ sheets of paper
- Rigid tape measure
- Six inert versions of each device being tested
- Six questionnaires (Appendix B) for each type of device being tested
- Suitable holsters/pouches for each device if specified by manufacturer/supplier
- Fabric tape measure
- Callipers suitable for measuring index finger and thumb width

Method

Standard devices: Each user shall wear a holster or pouch suitable for the device being tested. An inert device shall be provided. The target (A₄ sheet of paper) and first user shall be positioned as in Figure 5 so that when their arm is raised in the operating position, the spray device is between 2 and 2.1 m horizontally from the target. The user shall place the device in its holster/pouch and stand with their hands at their sides. On a command, the user shall draw the device, aim at the target and spray two consecutive half-second bursts. This is not timed but the user should aim to complete the action quickly. The target need not be replaced, as the accuracy of the device is not being tested. The test shall be repeated six times for the same device and each user shall repeat the test with a new canister. At least two of these tests shall be carried out when the user is wearing patrol duty gloves.

Concealable canisters: Part 1 shall be repeated; however, a holster or pouch is not necessary. The test shall be completed by the user drawing the device from a pocket; there is no need to wear patrol duty gloves for testing this type of device. It is only necessary to perform this test twice with each canister, although it can be repeated more often if the volume allows.

If more than one design of device is being tested the whole process for each device type shall be repeated.

Reporting results

The users shall complete a questionnaire (Appendix B) after the accuracy trial (Section 5.11.2) which includes comments on their experiences in this test. Any comments users make during the test should also be noted by the trial coordinator (space is provided in Appendix A.9). The hand circumference, hand length, index finger and thumb width of each user's operating hand shall be measured as shown in Figure and recorded on the questionnaire.

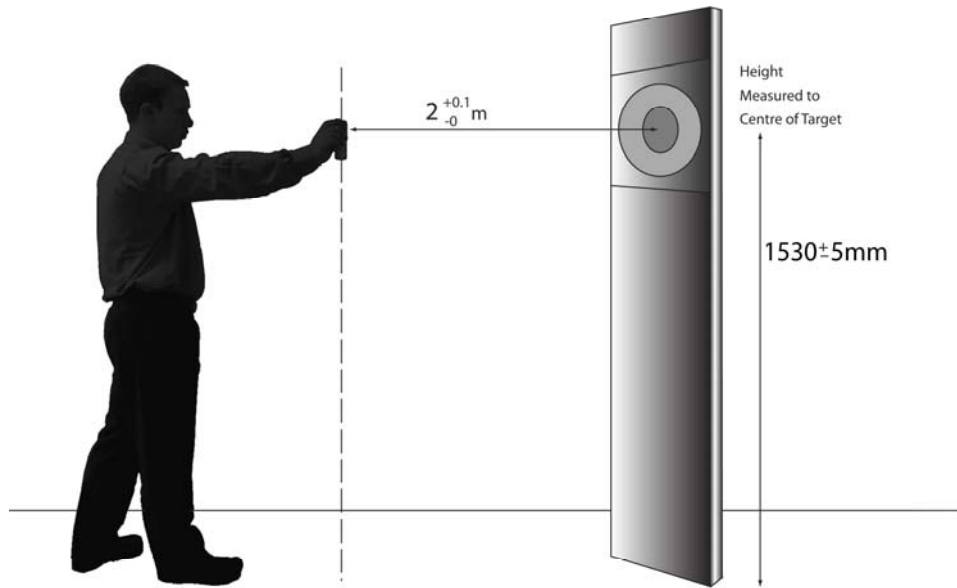


Figure 5- Positions for handling trial.

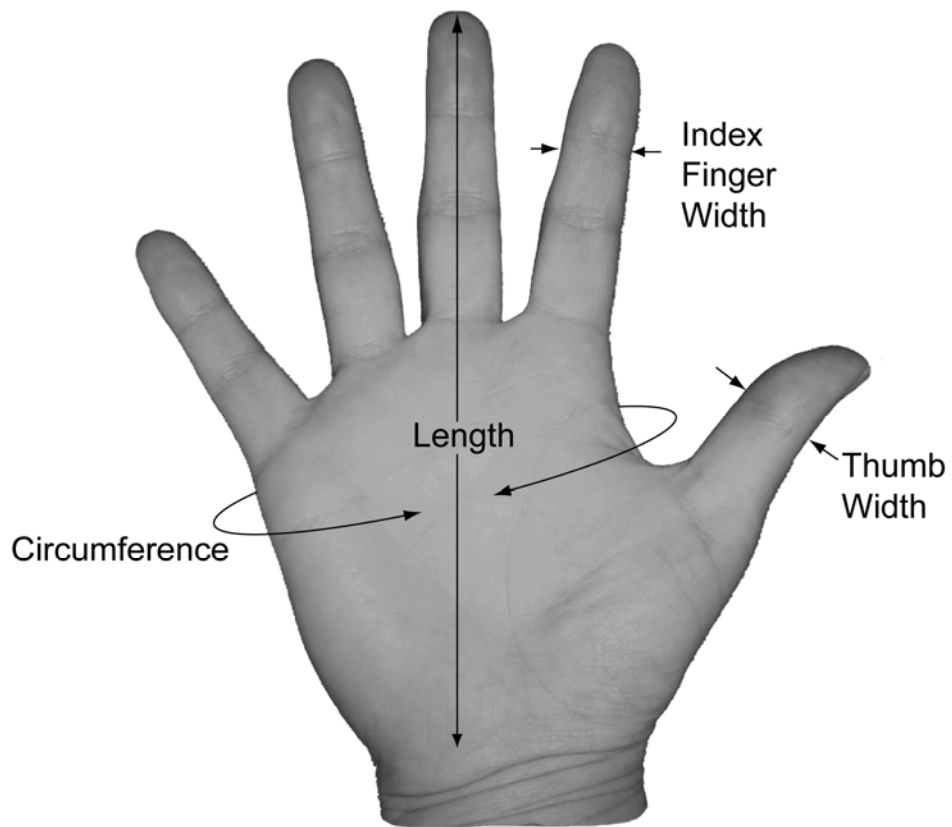


Figure 6 - Measurement of hand dimensions. With the finger or thumb nail facing up the measurements should be taken at the widest parts across the knuckle.

5.11.2 Part 2 – Accuracy

Facilities required

These are the same as for Section 5.11.1, with the addition of:

- Thirty-six targets prepared comprising a 30 cm diameter circle with a 15 cm diameter circle inside it
- Six of each type of device being tested

Method

Standard devices: The target shall be mounted vertically with its centre 1530 ± 5 mm above the ground. The first user shall be positioned as shown in Figure 5 so that when their arm is raised in the operating position, the spray device is between 2 and 2.1 m horizontally from the target.

On a command, the user shall aim at the centre of the target and spray two half-second bursts. The target shall be replaced (alternatively, a number of targets may be set up in advance and the user repositioned). The test shall be repeated six times for the same canister, with a new target each time, and each user shall repeat the test with a new canister.

Concealable devices: It is only necessary to perform this test twice with each canister, although it can be repeated more often if the volume allows.

If it is specified by the manufacturer/supplier that the device will work in an inverted orientation then this test must also be performed in that position.

If more than one design of device is being tested repeat the whole process for each device type.

Reporting results

The results should be recorded on the table in Appendix A.9, noting the number of sprays in each circle. If the spray falls between the two circles the position of the innermost portion of the spray shall be recorded.

At the end of the trial the users shall complete the questionnaire in Appendix B. Inert or empty devices will be available whilst filling in the questionnaire. A discussion will follow during which any significant points should be noted by the trial coordinator (space is provided in Appendix A.9).

5.12 Chemical Analysis of CS or PAVA Solutions

Five devices are required for this assessment. In addition manufacturers/suppliers shall submit a minimum of 1.2 g pure CS or 0.7 g pure PAVA for analysis.

The five devices will be selected from the batch by CAST for analysis at a CAST test facility. CAST will decant 20 ml solution from each of the five devices into separate glass vials and securely seal the containers. These solutions, along with the pure CS or PAVA, will be delivered to a CAST test facility and will be assessed in accordance with the validated test methods described in Table 4.

Table 4 - Methods for analysis of raw materials/solutions.

Solution	Method
CS (raw material) CS solution (in MIBK)	Gas Chromatography with Flame Ionisation Detector
PAVA (raw material) and PAVA 1 solution (in 50% aq. ethanol) PAVA 2 solution (in monopropylene glycol, ethanol and water mix)	High Performance Liquid Chromatography with UV detector at 254nm

The device will be deemed to have failed this requirement if the analytical results fall outside the specifications detailed in Section 5.12.1. Note that this assessment will not be completed until all of the other CAST assessments are finalised.

5.12.1 Requirements

There are a limited number of approved solutions for CS and PAVA sprays for use by UK police. These solutions are described in Table 5. If a manufacturer/supplier has an alternative solution based on CS or PAVA with a different solvent they must contact CAST to discuss the process for approval, as this falls outside of the scope of this Standard.

Table 5 - CS and PAVA requirements

Requirement	CS	PAVA
Irritant Agent	2-chlorobenzylidene malononitrile	Pelagonic Acid Vanillyl Amide
Concentration	5% CS weight/volume	0.3% PAVA weight/volume
Maximum weight of irritant permitted per device	Max 5 g CS in any device	No specified limit
Approved solvents	Methyl Isobutyl Ketone (MIBK)	50% aqueous ethanol Monopropylene glycol, ethanol, water as per relevant COT statement
Propellant	Shall be non-flammable and non-toxic. The propellant currently used is nitrogen	Shall be non-flammable and non-toxic. The propellant currently used is nitrogen

Purity of irritant agent in solid phase

The purity of the CS must be determined in the solid phase and must be at least 99% by weight.

The purity of the PAVA must be determined in the solid phase and must be at least 96.8% by weight.

Overall purity of the liquid contents of the device after filling and pressurising

For a CS device substances other than the solvent and CS must form less than 1% wt/vol of the solvent and CS combined.

For a PAVA device substances other than the solvents and PAVA must form less than 1% wt/vol of the solvents and PAVA combined.

Concentration of the liquid contents of the device after filling and pressurising

For a CS device no measured concentration shall be above 5.45% wt/vol or below 4.55% wt/vol. The mean of the measured concentrations shall be $5.0 \pm 0.4\%$ wt/vol.

For a PAVA device no measured concentration shall be above 0.335% wt/vol or below 0.265% wt/vol. The mean of the measured concentrations shall be $0.3 \pm 0.03\%$ wt/vol.

5.12.2 Comparison of results with manufacturer/supplier data

Manufacturers/suppliers are required to submit details of the methods they use to analyse the chemical contents of their devices as part of the technical file (described in Section 4.2). If manufacturers/suppliers intend to use their batch data for the Manufacturer Quality Testing process (see Section 6) they shall submit full analytical results for the batch of devices that are supplied for compliance testing.

If manufacturers/suppliers choose not to submit batch data, they shall use the CAST approved test facility during all CAST assessments (compliance and Manufacturer Quality Testing (MQT)) at their own cost.

5.13 Inert Devices

Devices for use in training environments that contain only water shall be submitted to be assessed in accordance with Section 5.7– Determination of Impact Pressure of Sprays to a Solid Surface.

5.14 Familiarisation Training Sprays

It is important that officers have an appreciation of the physical and psychological effects of the irritant sprays that they are using. This may assist if they are inadvertently exposed to or they are cross-contaminated by the irritant during a confrontation. If this happens they will need to continue to perform effectively or take appropriate action in spite of being affected.

5.14.1 CS sprays

Some forces provide familiarisation of CS irritant spray to officers through 'general exposure' as a part of their training.

The difference between CS training and operational sprays is the way in which they are delivered. The spray defined in this section is the general exposure type, which produces a diffuse cloud of CS which trainees will walk through. It is not designed to be sprayed directly at any person.

The concentration of CS in MIBK shall be less than 5% weight/volume with a tolerance of 10% of the specified concentration (e.g. a 5% CS solution shall have a tolerance of 0.5%, a 3% CS solution shall have a tolerance of 0.3% etc.).

CAST will not assess the performance of familiarisation devices; however, we will assess the chemical contents in accordance with Section 5.12 according to the manufacturer-stated concentration (and 10% tolerance). Five canisters are required for this evaluation to be completed. If the pure CS that was used to fill these devices was from a different batch to that used for the submitted standard or concealable sprays, a sample of 1.2 g solid will also be required.

5.14.2 PAVA sprays

The training for operational use of PAVA differs from CS in that the irritant must get into the target's eyes for the incapacitating effect to take place. Therefore, there are no specialised training sprays for PAVA.

As there are no specialised training sprays for PAVA, no further CAST assessments will be conducted.

6. Manufacturer Quality Testing

Manufacturer Quality Testing (MQT) shall be conducted on a five-yearly basis from the original certification date. Manufacturers/suppliers are required to submit 20 devices to CAST in order to complete the following assessments:

- Resistance to Crushing (Section 5.3)
- Drop Testing – positions 1, 3 and 5 only (Section 5.5)
- Assessment of Discharge Rate (Section 5.6)
- Extreme Temperature Testing -- spray pattern only (Section 5.8)

Manufacturers/suppliers are required to submit results of chemical analysis for the batch of devices submitted for this assessment. The analytical methods used shall be the same as those presented in the original technical file used for initial certification. The CAST test facility may be used to complete these assessments.

Upon successful completion of these assessment manufacturers/suppliers will be issued with an updated certificate of compliance, which will expire five years after certification date. If the devices are found to fail these tests certification will be suspended until the manufacturer/supplier resolves the issues.

7. References

- 1) Specification for CS Sprays for Operational Police Use, T.G. Sheldon & Dr. J. Tan, 1997, PSDB Publication 2/97
- 2) Specification for CS Sprays for Operational Police Use: 2002 Update, T. Donnelly & M. Macfarlane, PSDB Publication 7/02
- 3) HOSDB Standard for CS and PAVA Sprays for Operational Police Use, J. Crockett, HOSDB Publication 36/05
- 4) HOSDB Standard for CS and PAVA Sprays for Operational Police Use, Revision 1, S. Croft, HOSDB Publication 38/08
- 5) Comparison of CS and PAVA Sprays: Operational and Toxicological Aspects, G. Smith, M. Macfarlane & J. Crockett, PSDB Publication 88/04
- 6) Statement on 2-chlorobenzylidene malononitrile and CS spray, Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment, COT Statement: COT/1999/06, COM Statement: COM/98/S2, COC Statement: COC/98/S4, September 1999
- 7) COT statement on the use of PAVA (Nonivamide) as an incapacitant spray, Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment, April 2002
- 8) Statement on the use of pava (nonivamide) as an incapacitant spray, Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment, COT Statement 2004/06, November 2004
- 9) Statement: Use of PAVA (Nonivamide) as an Incapacitant Spray: Reformulation of Captor, Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment, COT Statement 2007/05, July 2007

A. Results Tables

A.1. Inspection of Labelling

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Can Number	
	Y/N
Nature and intended use, e.g. "CS Spray, For Police Use Only"	
Supplier's / Manufacturer's name, address and telephone number	
Name of main ingredients, e.g. "Contains CS in MIBK"	
Unique number or code	
Date of manufacture	
Date at which shelf life expires	
Label remains legible after contact with irritant solution	

For concealable devices (10 ml–30 ml) use the table below instead:

Can Number	
	Y/N
Unique number or code	
Date of manufacture	
Label remains legible after contact with irritant solution	

A.2. Resistance to Crushing

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Can number						
Result	PASS	FAIL	PASS	FAIL	PASS	FAIL
Crush position A						
Crush position B						
Spray 1						
Spray 2						
Spray 3						
Spray 4						
Spray 5						
Spray 6						
Spray 7						
Spray 8						
Spray 9						
Spray 10						
Spray 11						
Spray 12						

A.3. Drop Testing

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Orientation:.....

Can Number										
Drop Position	1		2		3		4		5	
	PASS	FAIL	PASS	FAIL	PASS	FAIL	PASS	FAIL	PASS	FAIL
Drop										
Spray 1										
Spray 2										
Spray 3										
Spray 4										
Spray 5										
Spray 6										
Spray 7										
Spray 8										
Spray 9										
Spray 10										
Spray 11										
Spray 12										

Drop Testing continued

Can Number										
Drop Position	6		7		8		9		10	
	PASS	FAIL	PASS	FAIL	PASS	FAIL	PASS	FAIL	PASS	FAIL
Drop										
Spray 1										
Spray 2										
Spray 3										
Spray 4										
Spray 5										
Spray 6										
Spray 7										
Spray 8										
Spray 9										
Spray 10										
Spray 11										
Spray 12										

Drop Testing continued

Can Number								
Drop Position	11		12		13		14	
	PASS	FAIL	PASS	FAIL	PASS	FAIL	PASS	FAIL
Drop								
Spray 1								
Spray 2								
Spray 3								
Spray 4								
Spray 5								
Spray 6								
Spray 7								
Spray 8								
Spray 9								
Spray 10								
Spray 11								
Spray 12								

A.4. Determination of Discharge Rate

Note: A different results sheet is required for each device to be tested.

Date of Test: Manufacturer:

Type of Device: Orientation:

Canister Number: Canister capacity:.....

	Spray Duration	Weight 1	Weight 2	Weight 3	Average weight
Start	---				
Spray 1					
Spray 2					
Spray 3					
Spray 4					
Spray 5					
Spray 6					
Spray 7					
Spray 8					
Spray 9					
Spray 10					
Spray 11					
Spray 12					

A.5. Determination of Impact Pressure of Spray to Solid Surface

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Orientation:

Can Number			
	Maximum Pressure (kPa)	Maximum Pressure (kPa)	Maximum Pressure (kPa)
Spray 1			
Spray 2			
Spray 3			
Spray 4			
Spray 5			
Spray 6			
Spray 7			
Spray 8			
Spray 9			
Spray 10			
Spray 11			
Spray 12			

A.6. Performance at Extreme Temperatures

Assessment of Spray Pattern

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Orientation:

Can number						
Temperature	-20°C		-20°C		-20°C	
	PASS	FAIL	PASS	FAIL	PASS	FAIL
Spray 1						
Spray 2						
Spray 3						
Spray 4						
Spray 5						
Spray 6						
Spray 7						
Spray 8						
Spray 9						
Spray 10						
Spray 11						
Spray 12						

Assessment of Spray Pattern

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Orientation:

Can number						
Temperature	+50°C		+50°C		+50°C	
	PASS	FAIL	PASS	FAIL	PASS	FAIL
Spray 1						
Spray 2						
Spray 3						
Spray 4						
Spray 5						
Spray 6						
Spray 7						
Spray 8						
Spray 9						
Spray 10						
Spray 11						
Spray 12						

Determination of Discharge Rate

Note: A different results sheet is required for each device to be tested.

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Canister Number: Temperature: -20°C or +50°C

	Spray Duration	Weight 1	Weight 2	Weight 3	Average weight
Start	---				
Spray 1					
Spray 2					
Spray 3					
Spray 4					
Spray 5					
Spray 6					
Spray 7					
Spray 8					
Spray 9					
Spray 10					
Spray 11					
Spray 12					

Determination of Impact Pressure of Spray to Solid Surface

Note: A different results sheet is required for each device to be tested.

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Temperature: 50°C

Can Number			
	Maximum Pressure (kPa)	Maximum Pressure (kPa)	Maximum Pressure (kPa)
Spray 1			
Spray 2			
Spray 3			
Spray 4			
Spray 5			
Spray 6			
Spray 7			
Spray 8			
Spray 9			
Spray 10			
Spray 11			
Spray 12			

A.7. Assessment of Spray Flammability

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Orientation:

Can Number			
Flame Extension Towards Can (Y/N)			
Flame Self-Sustaining (Y/N)			

A.8. Assessment of Compatibility of Spray with Conducted Energy Devices

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Can number							
Spray duration		2 half-second bursts	2 half-second bursts	2 half-second bursts	Entire can	Entire can	Entire can
Part 1a	Visible Flames (Y/N)						
	Visible Smouldering (Y/N)						
Part 1b	Visible Flames (Y/N)						
	Visible Smouldering (Y/N)						
Part 2	Visible Flames (Y/N)						
	Visible Smouldering (Y/N)						
Part 3	Visible Flames (Y/N)						
	Visible Smouldering (Y/N)						
Part 4	Visible Flames (Y/N)						
	Visible Smouldering (Y/N)						
Part 5	Visible Flames (Y/N)						
	Visible Smouldering (Y/N)						
Additional comments							

A.9. Accuracy and Handling

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Orientation:

Can Number												
User Name/ Number												
	Bursts in		Bursts in		Bursts in		Bursts in		Bursts in		Bursts in	
	Inner circle	Outer circle	Inner circle	Outer circle	Inner circle	Outer circle	Inner circle	Outer circle	Inner circle	Outer circle	Inner circle	Outer circle
Spray 1												
Spray 2												
Spray 3												
Spray 4												
Spray 5												
Spray 6												

Comments made by officers during the trials or post-trial discussion (continue on a separate sheet if necessary).

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

A.10 Inert Devices

Determination of Impact Pressure of Spray to Solid Surface

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

Orientation:

Can Number			
	Maximum Pressure (kPa)	Maximum Pressure (kPa)	Maximum Pressure (kPa)
Spray 1			
Spray 2			
Spray 3			
Spray 4			
Spray 5			
Spray 6			
Spray 7			
Spray 8			
Spray 9			
Spray 10			
Spray 11			
Spray 12			

B. User Questionnaire

Date of Test: Manufacturer:

Type of Device: Canister capacity:.....

User Details:

Name and Collar Number:

Force:

Hand Circumference: Hand Length:

Index Finger Width: Thumb Width:

The following statements are designed to assess the ease of use, accuracy and practicality of the incapacitant spray device you have been using in the trial. For each statement please tick the box that reflects most closely how you felt about the device. You may inspect and handle an inert device whilst completing this questionnaire.

Strongly
Disagree

Disagree

Agree

Strongly
Agree

The device is easy to point and aim

The accuracy of the device would be acceptable in an operational situation

The device would be suitable for use in all lighting conditions

The device fits well in the hand so that it can be concealed if required and can be gripped firmly in the event of a struggle

It is not easy to obstruct the nozzle with the fingers whilst holding the device in the spraying position

The design of the device would make it difficult for the user to be accidentally sprayed in the face

The appearance of the device does not resemble a firearm

The device could not easily be accidentally discharged:

a) by objects other than the user's thumb/finger

--	--	--	--

b) during removal or insertion into a holster or carrying pouch or for a "smaller device" during removal or insertion into a pocket

--	--	--	--

c) during agreed weapon retention techniques

--	--	--	--

d) by other items placed on top of it

--	--	--	--

The device could be used effectively by a person wearing patrol duty gloves (Not applicable for a "smaller device")

--	--	--	--

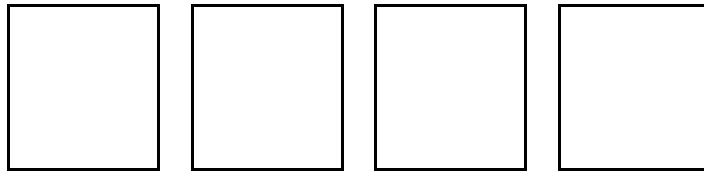
If an anti-tamper device or seal is fitted please also consider the following two statements.

Strongly Disagree Disagree Agree Strongly Agree

The device cannot be used without showing evidence of use

--	--	--	--

The anti-tamper device or seal does not interfere with normal use



If you have any additional comments on any aspect of the device please write them below.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

C. Pro Forma Results Report (Certification Testing)

Date of Tests: Manufacturer:

Type of Device: Canister capacity:.....

Is it specified that this device will work inverted?

Chemical and Physical Tests:

Test	Number tested	Number passed	Inverted if relevant		Test Result	Comments
			Number tested	Number passed		
CS/PAVA Concentration						
CS/PAVA Solid Phase Purity						
CS/PAVA Overall Purity						
Resistance to Crushing	3					
Drop Test	14		3			

Determination of Discharge Rate	3		3			
Determination of Impact Pressure	3		3			
Spray Pattern Performance at -20°C	3					
Spray Pattern Performance at +50°C	3					
Determination of Discharge Rate at -20°C	3					
Determination of Discharge Rate at +50°C	3					
Determination of Impact Pressure +50°C	3					
Assessment of Spray Flammability	3		3			
Compatibility of Spray with CEDs	6					
Determination of Impact Pressure for Inert Devices	3		3			

Handling and Accuracy Trials

A separate sheet should be attached with feedback from users in the handling and accuracy trials. There are no pass/fail criteria for this section but feedback will be available to police forces and may help them make decisions on which products to buy from a handling and ease of use perspective.

D. Pro Forma Results Report (MQT)

Date of Tests:Manufacturer:

Type of Device: Canister capacity:.....

Is it specified that this device will work inverted?

Test	Number tested	Number passed	Inverted if relevant		Test Result	Comments
			Number tested	Number passed		
CS/PAVA Concentration						
CS/PAVA Solid Phase Purity						
CS/PAVA Overall Purity						
Resistance to Crushing	3					
Drop Test	3		3			
Determination of Discharge Rate	3		3			
Spray Pattern Performance at -20°C	3					
Spray Pattern Performance at +50°C	3					

E. Pressure sensing equipment

Pressure Profile Systems T3040 conformable sensing array, mounted on flat aluminium plate.

Specifications:

Number of elements	1024
Individual element dimensions	2 x 2 mm
Entire array dimensions	64 x 64 mm
Sensor frequency	5 Hz
Pressure range	0 – 12 psi (0 – 83 kPa)

Supporting software:

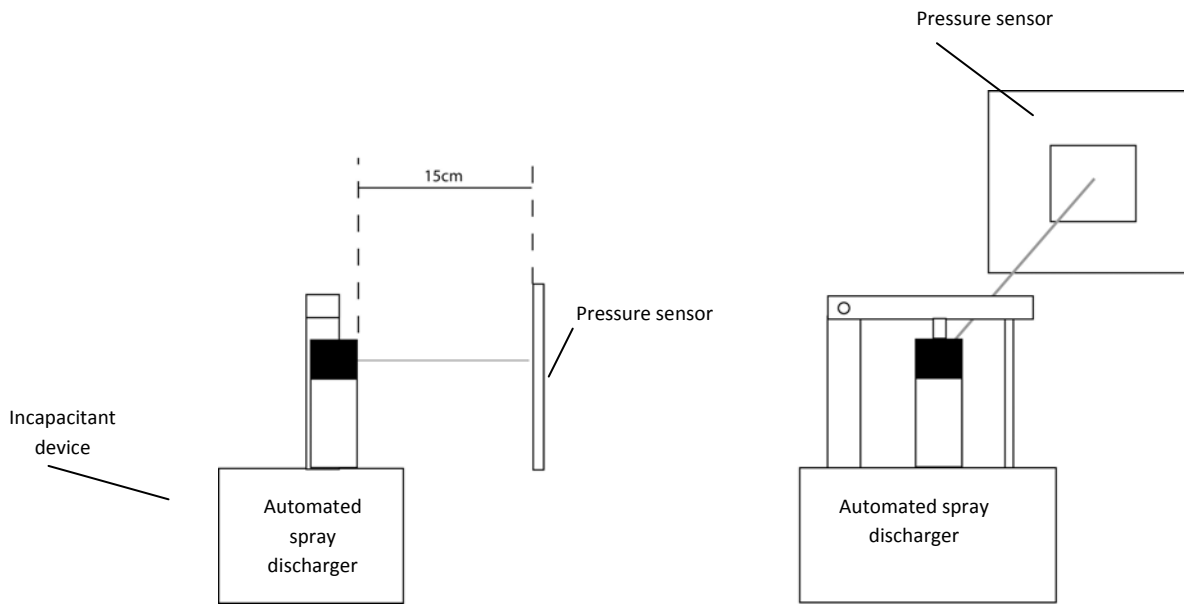
PPS View – PPS Sapphire MFC Application

Use:

Prior to experimentation the accuracy of the sensor will be tested. Pressure readings from the PPS software must be accurate to within 10% of an externally calibrated pressure gauge. If not, the system must be recalibrated prior to use.

Immediately post-experimentation, the accuracy of the sensor must be tested again. Pressure readings from the PPS software must be accurate to within 10% of an externally calibrated pressure gauge. If not, the system must be recalibrated and the test re-run.

Set-up:



Centre for Applied Science and Technology
Sandridge
St Albans
AL4 9HQ
United Kingdom

Telephone: +44 (0)1727 865051
Fax: +44 (0)1727 816233
Email: CAST@homeoffice.gsi.gov.uk

Website: <https://www.gov.uk/government/organisations/home-office/series/centre-for-applied-science-and-technology-information>

ISBN: 978-1-78246-396-2

Published by the Centre for Applied Science and Technology (CAST), Home Office

© Crown Copyright 2014