PSDB PORTABLE BALLISTIC PROTECTION STANDARD FOR UK POLICE (2004)

(Incorporating Test Methods for Ballistic Blankets and Shields)

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Publication No 34/04

HOME OFFICE
POLICE SCIENTIFIC DEVELOPMENT BRANCH

PSDB PORTABLE BALLISTIC PROTECTION STANDARD FOR UK POLICE

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FIRST PUBLISHED 2004

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Published by: Home Office Police Scientific Development Branch Sandridge, St Albans Hertfordshire AL4 9HQ United Kingdom

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Cover photograph courtesy of Chris Georgiou PSDB Sandwich Student Brunel University.





FOREWORD

This standard is the culmination of a major piece of work within the PSDB Crime Investigation and Officer Safety Sector and is supported by:

- The Association of Chief Police Officers (ACPO) Conflict Management Portfolio;
- ACPO Police Use of Firearms Working Group;
- The Home Office Public Order and Crime Issues Unit (POCIU). (This work supports Home Office AIM 1, which is "To reduce crime and the fear of crime").

In May 2003 PSDB published The PSDB Body Armour Standard for UK Police (2003). The standard was produced in three parts: Part 1 describes the general requirements common to both ballistic and stab testing for the submission of body armour for conformance testing. Part 2 describes the test methodology specific to ballistic testing and Part 3 describes the test methodology specific to knife and spike testing.

This document standardises further ballistic protection by providing the general requirements and test methodology for portable ballistic blankets and shields that are designed to offer high level ballistic protection to suitably trained officers in firearms situations where portable ballistic protection is required.

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Management Summary

This standard describes test methods to assess the protection offered by commercial ballistic protection panels against the current firearm threat to the police forces of the United Kingdom. The standard seeks to provide police and manufacturers with a common specification that covers the current ammunition and weapons typically used in firearms offences in the UK. It aims to ensure that items such as ballistic shields and ballistic blankets, which have been certified to this standard, offer a level of protection that is compatible with body armours constructed to meet the PSDB Ballistic Body Armour Standard.

Three protection levels are provided in this standard:

BB1 Ballistic Blanket

This protection level provides for soft fabric blankets, which can be rolled up and stored when not in use. The blanket should be suitable for covering people or draping over objects such as fences and vehicles in the event of a ballistic attack.

Note: The positioning of a flexible ballistic blanket directly in front of glazing, including vehicle windscreens and door windows may not prevent the window from fragmenting and causing injury to the occupants of the vehicle.

BS1 & BS2 Ballistic Shield

These protection levels provide for both opaque and transparent panels and includes measurement of both the resistance of the material to penetration and behind-armour effects such as fragmentation of the test sample, which in extreme cases can result in injuries to the face and eyes.

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PSDB PORTABLE BALLISTIC PROTECTION STANDARD FOR UK POLICE (2004)

1 INTRODUCTION

Ballistic body armour has been available to UK police for many years. Firstly to offer high level protection to Firearms Officers and more recently to offer adequate protection to officers carrying out routine patrol duties on foot or by vehicle patrol.

This standard addresses three further protection levels by describing a test protocol for Ballistic Blankets (BB1) and Ballistic Shields (BS1 & BS2).

2 SCOPE

This standard contains the general requirements and test protocol for the testing of ballistic blankets and shields to PSDB ballistic threat levels. Equipment offering ballistic protection certified as a result of successful testing to this standard is intended for use only by trained officers when carrying out specialist duties.

3 ASSOCIATED DOCUMENTS

PSDB Body Armour Standards for UK Police - Part 1 General Requirements;

PSDB Body Armour Standards for UK Police - Part 2 Ballistic Resistance;

PSDB Manual of Ballistic and Stab Resistant Body Armour.

4 TESTING AND PUBLICATION OF RESULTS

Although the primary purpose of this document is to detail the PSDB Portable Ballistic Protection Test Procedures, it also provides manufacturers with sufficient information to enable them to carry out development testing prior to submission for formal compliance testing by a PSDB accredited test facility.

The results of portable ballistic protection tested to this standard will be published in the Manual of Ballistic and Stab Resistant Body Armours which is a joint ACPO/PSDB publication. The manual is classified "RESTRICTED COMMERCIAL" and as such, the information contained within it should not be made available to competing manufacturers and suppliers. The manual will be regularly updated to keep police forces up to date with the latest available portable ballistic protection. PSDB Certified Police Protective Equipment, for which there is PSDB Standards are also listed on the Home Office web-site at: www.homeoffice.gov.uk/crimpol/police/scidev/bodyarm/

5 GENERAL REQUIREMENTS

This PSDB Portable Ballistic Protection (2004) Test Standard defines a method of assessing the protection provided by commercial personal armour systems against the current firearms threat to the police forces of the United Kingdom.

A ballistic panel system should afford protection against injury from penetration by the bullet and the behind-armour effects of the impact such as fragmentation of the rear face of the sample. Each model of ballistic panel should either meet the test requirements of BB1 – Ballistic Blanket or BS1/BS2 – Ballistic Shield. The protection class required by the user should be determined from the specific firearms threats they are likely to encounter.

5.1 Labelling

An information panel, providing the following information, shall be permanently attached to the blanket cover or the body side of the shield:

- The manufacturer's name;
- The date of manufacture and batch number;
- The model number (see definitions Section 6);
- The test house reference e.g. PSDB/FPE/JC/1234/FEB/04 This reference is present on all documentation supplied as a result of compliance testing. It uniquely identifies the product as having a specified construction and level/s of protection common to all examples of the armour. The test house reference shall be clearly marked on each protective pack produced as a result of successful testing to this standard;
- The protection level of the panel, (i.e. BB1, BS1 or BS2);
- A set of instructions for maintenance, cleaning and use.

Panels which are constructed such that two or more separate materials face the threat in normal use should afford protection to the class stated not only for each of the materials separately, but also along any join between the materials.

For Portable Ballistic Protection that has been successfully tested for compliance to this standard at a PSDB approved testing facility, the following statement shall be included on the label:

"The manufacturer certifies that model number (insert) has been tested at a PSDB approved testing facility and has been found to comply with PSDB Portable Ballistic Standard for UK Police (2004) (insert protection level e.g. BB1)."

The above statement and labelling shall not appear on any portable ballistic protection that has failed PSDB compliance testing, or on products that have not been fully tested at a PSDB approved test facility for compliance to one or more of the protection levels in this standard.

5.2 Additional Panels and Extended Coverage

Any additional viewing area built into an opaque system shall provide the same protection as the main panel.

5.3 Quality of Manufacture and Traceability

Each armour sample shall be free from wrinkles, blisters, cracks or fabric tears, crazing, chipping or sharp corners or other evidence of inferior workmanship. All samples carrying the same model number shall be identical in appearance, size and manner of construction.

Manufacturers providing armour for compliance testing must be able to demonstrate consistency of manufacture through membership of a recognised Quality Assurance Standard (e.g. ISO 9000:2000, UKAS, ISO 17025 etc.)

6 DEFINITIONS

6.1 Accepted Hit or Strike

An accepted hit or strike are all those that conform to the criterion for a "Fair hit or strike". An accepted hit or strike can be an "Unfair hit or strike when the impact velocity is above the specified test limits and results in no excessive penetration. Additionally, a hit/strike below the minimum velocity, which results in a penetration shall be accepted as a fair hit.

6.2 Bullet Resistance

The property of the material, or combination of materials, describing its/their ability to prevent perforation by a bullet.

6.3 Bullet Resistant

A description of a material or product showing bullet resistance sufficient to prevent penetration by the bullet.

6.4 Fair Hit or Strike

A fair hit is that which impacts the armour at an angle of incidence no greater than ± 5 degrees from the intended value. The impact must not be closer than 50mm to the edge of the test sample (or to a previous strike), and with a velocity that is within the specifications required for the intended level of protection.

6.5 Fragmentation

This is the break up of the armour material into small pieces, due to the impact of the bullet. Figure 1 illustrates this process.

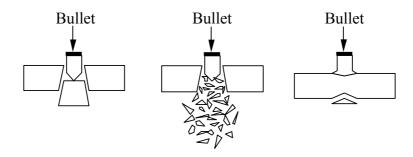


FIGURE 1 Diagram Illustrating Different Types of Fragmentation.

6.6 Model

A manufacturer designation¹ (name, number or other description) that serves to uniquely identify a specific configuration of blanket or shield based upon the details of its construction (i.e. number of layers of ballistic resistant material assembled in a specific manner). The model number shall not consist of all or part of the threat levels. Each sample type submitted for testing shall carry this unique identification on every armour panel. Also, if the testing is successful, the model number shall be attached to all production models supplied to UK Police in accordance with section 5.1

6.7 Penetration

Complete perforation of a test sample by the bullet, a fragment of the bullet, or by the pieces of the armour itself, as evidenced by the presence of that fragment in the witness material.

6.8 Rejected Hit or Strike

All hits or strikes that conform to the criterion for an "unfair hit or strike", but do not meet the special cases detailed in "accepted hit or strike".

6.9 Rigid Panel

This term refers to an armour panel such as a ballistic shield.

6.10 Soft Panel

This term refers to a flexible panel such as a ballistic blanket.

¹ PSDB verifies the ballistic resistance of a **model** on the basis of compliance testing of samples of the model in accordance with this standard. For example, differences in stitching (e.g. box stitch versus quilt stitch) would make the panels different **models**. If a **model** fails compliance testing, the manufacturer may never resubmit any construction under that model designation or the same construction under a different model number.

6.11 Strike Face

The surface of the armour designed by the manufacturer as the surface that should face the ballistic threat. In the case of a flexible ballistic blanket, this shall be either face.

6.12 Test Reference

This reference (unique to each model number) is present on all documentation issued by the test house and on the certification document issued by PSDB. *The test reference must be displayed on each armour panel label adjacent to the model number*².

6.13 Test Sample

The armour panel supplied by the manufacturer or purchasing authority for testing. Sometimes referred to as the armour or test sample.

6.14 Unfair Hit or Strike

A hit or strike:

- That impacts the armour at an angle of incidence greater than $\pm 5^{\circ}$ from the intended angle of incidence;
- That is closer to the edge of the armour than 50mm and closer to a prior strike than 50mm;
- Delivering and energy outside the specifications for the intended level of protection.

7 THE TEST SAMPLE

7.1 Submission Requirements of the Test Sample

Before submitting any test samples to a PSDB accredited test house for compliance testing, manufacturers and suppliers are required to inform PSDB, in writing, of their intention to submit the samples for testing. Documentation describing the construction of the test sample shall be included. This documentation shall be in the form of a declaration stating that "Any product produced as model number **** as a result of successful compliance testing to PSDB standards, will be of the same construction, using the <u>same</u> materials, from the <u>same</u> manufacturer as the test sample". The order of construction of materials shall also be listed, giving manufacturers references, trade names, number of layers, thickness, weave, stitch pattern etc. and where applicable orientation of each layer within the test sample. The manufacturers/suppliers choice of test house should also be included.

PSDB will classify this information "RESTRICTED COMMERCIAL".

A sample declaration form showing the information required, which may be photocopied is shown in Appendix B. This form is also available in electronic format on request from PSDB and when completed may be submitted to PSDB by email.

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² This applies only to production armour produced as a result of successful compliance testing to PSDB Standards.

Once PSDB has accepted the declaration, the test house will be informed of the manufacturer/supplier intention to submit the model number/s agreed with PSDB for testing. The manufacturer/supplier will then be invited to contact the test house to arrange a test date and subsequently submit the samples for compliance testing. The test house is not authorised to carry out compliance testing to PSDB Standards until a satisfactory declaration has been received by PSDB.

When the test house receives the test sample, it shall be examined to ensure that the correct labels are present on the sample/s stating the model number and that all other information complies with the submission requirements of this standard.

- Where a test sample has been submitted for testing to BB1 level that is intended to be supplied as a flexible ballistic blanket, it is a requirement of this standard that the blanket shall offer protection to the stated level whichever side of the blanket is presented to the threat.
- In the case of test samples being submitted for testing to BS1 or BS2 that are intended to be supplied as hand held ballistic shields, it is a requirement of this standard that complete shields shall be supplied for compliance testing as all fixings shall be subject to additional shots.

After successful testing, the test sample/s will be returned to PSDB for comparison with the declaration and issuing of the certification document. If the armour is not successful, the test house will inform PSDB and the supplier will be offered back the test sample/s.

Each test sample shall fulfil the workmanship criteria detailed in Section 5.3. The sample should represent a model that is either in production, or intended for production.

7.2 Pre-Conditioning of the Test Sample for the Dry Test

The sample under test should be placed in a room held at a temperature of approximately 20±3°C, and 40% to 70% humidity for at least 12 hours immediately prior to the ballistic trial.

7.3 Pre-Conditioning of the Test Sample for the Wet Test (optional)

Wet testing of the armour sample is optional. However, if a wet test is successfully carried out, its compliance shall be clearly marked on the armour label. In addition, a dry ballistic test is still required for the armour to comply with the standard.

Before the sample is tested it shall be submerged vertically in water (at 15°C to 20°C) for a period of one hour. It shall then be removed and allowed to dry vertically for 3 minutes in an area complying with the pre-treatment conditions. The appropriate ballistic test is then carried out. The first shot shall impact within 5 minutes of the completion of the drying period, and the final shot fired no more than 30 minutes later.

8 TEST METHODOLOGY

8.1 The Test Equipment

All velocities should be measured such that the distance from the front face of the target to the centre of the velocity measuring sensors is 2 ± 0.1 m. The velocity of each test shot should lie within the limits specified in Table 1.

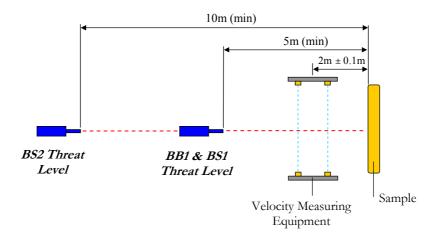


FIGURE 2 Positioning of the Test Apparatus for Ballistic Testing.

Performance Level	Weapon & Calibre	Ammunition Description	Bullet Mass	Minimum Range (m)	Velocity (m/s)
BB1	Carbine 9mm Calibre	9mm FMJ Dynamit Nobel DM11A1B2	8.0g (124 grain)	5	510± 10
BS1	Carbine 9mm Calibre	9mm FMJ Dynamit Nobel DM11A1B2	8.0g (124 grain)	5	425 ± 10
	Handgun 0.357" Magnum	Remington Soft Point Flat Nose R357M3	10.2g (158 grain)	5	450 ± 10
BS2	Rifle 7.62mm Calibre	Royal Ordnance NATO Ball L2 A2	9.3g (144 grain)	10	830 ± 15

TABLE 1: PSDB Portable Ballistic Performance Levels

8.2 Velocity Measurement

A suitable method of accurately measuring the velocity of the bullet at a distance of 2m from the surface of the test sample shall be used. If light screens are used, the base length of the timing sensors should be no less than 1 metre. The measuring equipment shall be capable of measuring the velocity to an accuracy of ± 0.2 m/s.

8.3 Velocity Measuring Equipment Calibration

The instrument used for measuring the velocity of the bullet shall be calibrated according to the manufacturer's instructions. Test calibration records shall be maintained and be traceable to the requirements of a recognised Quality Assurance organisation (e.g. ISO 9000:2000, UKAS, ISO 17025 etc.

8.4 Selecting the Ammunition

A simple visual check is sufficient to ensure there are no defects in the ammunition.

8.5 Mounting the Armour (BB1)

The product to be tested shall consist of a 1m x 1m \pm 100mm square and shall be mounted in a test rig similar to that described in Appendix A. In the case of flexible ballistic blankets, the strike face shall be chosen at random. The test sample shall be suspended vertically and allowed to hang free within the test frame. The shot pattern shall

be marked by using a suitable template (figure 3). The position of the highest shot shall be between 200mm and 400mm from the top of the test sample.

8.6 Mounting the Armour (BS1 & BS2)

The product to be tested shall be mounted using a suitable clamping method, which allows the utilisation of any handles provided. The armour shall be suspended vertically and be firmly fixed to minimise movement during testing.

8.7 Mounting the Witness Foil

Fragmentation evidence shall be observed by placing a sheet of witness foil consisting of aluminium foil, 0.02mm thick and density $54g/m^2$ behind the test sample. The witness foil shall be mounted in a suitable frame and mounted vertically at a distance of $500mm \pm 10mm$ behind the test sample. The frame shall be sufficiently large to cover the entire test pattern area.

9 TESTING

9.1 Threat Levels

- **BB1:** Protection against standard ammunition fired from long barrelled handguns, 9mm carbines and sub-machine guns. This test reflects the use of soft armours designed to be used as ballistic blankets. See Table 1 for test round specifications.
- **BS1:** Protection against standard ammunition fired from long barrelled handguns, 9mm carbines and sub-machine guns. This test reflects the use of hard armours designed to be used as ballistic shields and incorporates a behind-armour fragmentation measurement to ensure that the user is not injured whilst using products that conform to this standard. See Table 1 for test round specifications.
- **BS2:** Protection against soft-core ammunition fired from rifles. This test reflects the use of hard armours designed to be used as ballistic shields and incorporates a behind-armour fragmentation measurement to ensure that the user is not injured whilst using products that conform to this standard. See Table 1 for test round specifications.

9.2 Shot positions (BB1)

The pattern of the test shots for protection level BB1 is shown in figure 3. The firing order of the six shots shall be as follows:

Shot 1: Top centre. A 0° angle of incidence shot;

Shot 2: Bottom right. A 0° angle of incidence shot;

Shot 3: Bottom left. A 0° angle of incidence shot;

Shot 4: Upper left side. A 0° angle of incidence shot;

Shot 5: Lower right side. A 0° angle of incidence shot; Shot 6: Bottom centre. A 0° angle of incidence shot;

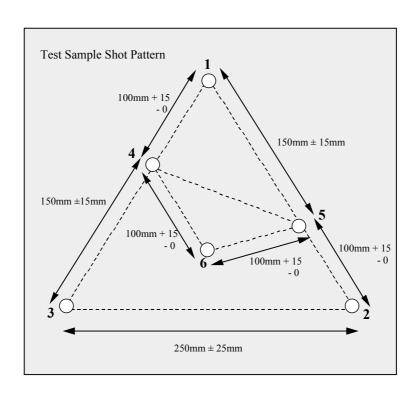


FIGURE 3 *PSDB Shot pattern for BB1 Protection Level.*

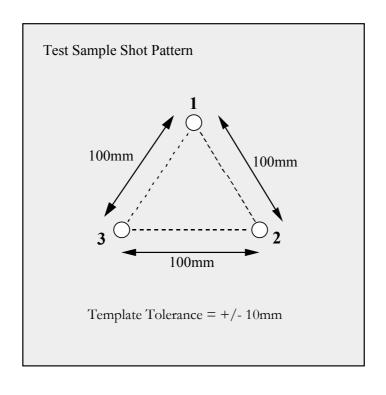


FIGURE 4 *PSDB Shot pattern for BS1 & BS2 Protection Levels.*

9.3 Soft Armour Test (BB1)

The following test shots shall be performed:

Test Shot No. 1

Adjust the holding fixture so that the shot impacts at location 1 (figure 3) at 0° angle of incidence. Fire the first test round against the test sample. Ensure that the shot impacts at least 200mm from any edge of the test sample. Ensure that the test sample remains firmly attached on the test fixture and adjust as necessary. No smoothing or shaking of the sample is permitted between shots. *Do not remove any trapped bullets.*

Test Shot No. 2

Repeat procedure of test shot No 1. Fire the test round against the test sample at location 2 (figure 3). Ensure that the shot impacts at least 200mm from any edge of the test sample. Ensure that the test sample remains firmly attached on the test fixture and adjust as necessary. No smoothing or shaking of the test sample is permitted between shots. **Do not remove any trapped bullets.**

Test Shot No. 3

Repeat procedure of test shot No 1. Fire the test round against the test sample at location 3 (figure 3). Ensure that the shot impacts at least 200mm from any edge of the test sample. Ensure that the test sample remains firmly attached on the test fixture and adjust as necessary. No smoothing or shaking of the test sample is permitted between shots. **Do not remove any trapped bullets.**

Test Shot No. 4

Repeat procedure of test shot No 1. Fire the test round against the test sample at location 4 (figure 3). Ensure that the shot impacts at least 200mm from any edge of the test sample. Ensure that the test sample remains firmly attached on the test fixture and adjust as necessary. No smoothing or shaking of the test sample is permitted between shots. **Do not remove any trapped bullets.**

Test Shot No. 5

Repeat procedure of test shot No 1. Fire the test round against the test sample at location 5 (figure 3). Ensure that the shot impacts at least 200mm from any edge of the test sample. Ensure that the test sample remains firmly attached on the test fixture and adjust as necessary. No smoothing or shaking of the test sample is permitted between shots. *Do not remove any trapped bullets.*

Test Shot No. 6

Repeat procedure of test shot No 1. Fire the test round against the test sample at location 6 (figure 3). Ensure that the shot impacts at least 200mm from any edge of the sample. **Do not remove any trapped bullets.**

On completion of the test, remove the test sample from the test fixture and examine it for signs of perforation in accordance with section 10.

9.4 Hard Armour Test. (BS1 & BS2)

For the BS1 and BS2 protection levels, the shots shall be positioned as shown in Figure 4, with all shots fired at 0° angle of incidence to the face of the armour. For curved surfaces this will involve adjusting the fixture so that the required strike angle can be achieved.

The test sample should be of sufficient size such that no shot strikes the target at a distance of less than 100mm from each other and at least 50mm from any edge of the test sample.

On completion of the test, remove the test sample from the test fixture and examine it for signs of perforation in accordance with section 10.

9.5 Additional Test Strikes at Specific Points of Weakness

Seams, fixing points for handles etc, or other joins between materials used in the armour shall be subjected to an additional strike at each seam/fixing or join type in an orientation most likely to show weaknesses in the joint or seam. Ensure that the impact position is at least 50mm from any other impact and at least 50mm from the edge of the test sample for BS1 and BS2 and at least 200mm in the case of BB1.

10 PERFORMANCE ASSESSMENT

For the test sample to have successfully passed ballistic compliance testing, the following criteria must be met:

- i. The velocity of each shot must be within the limits specified in Table 1;
- ii. No bullet shall have passed completely through the test sample, nor may any part of the bullet be visible from the rear side of the sample;
- iii. The witness foil shall show no signs of perforation resulting from pieces of the test sample or bullet passing through.

11 PRESENTATION OF RESULTS

Following the ballistic testing on a test sample, the following information shall appear on the test report. At this stage, the test report shall not indicate that the armour has been certified.

- The protection level to which the sample has been tested shall be clearly stated, along with the manufacturer's name and the test sample model number;
- A unique test reference number shall also be included;
- For each test shot, the velocity of the round, as measured shall be stated. A <u>pass/fail</u> (not held or penetrated) criterion for penetration of the sample as a result of each shot shall be recorded on the test report.

11.1 Data and Test Sample/s Reporting and Storage

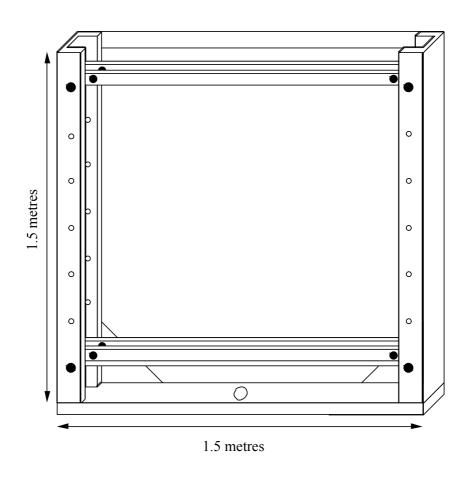
Upon completion of successful testing, results of each test shall be submitted to PSDB and shall consist of the following:

- (a) The test sample(s) complete with correct labelling as described in Section 5.1
- (b) A copy of the test report.

In the event of an unsuccessful test, failure documentation shall be submitted to PSDB and in normal circumstances the test house will return the test sample/s to the manufacturer or supplier.

All test samples and documentation will be kept by PSDB for a minimum of 5 years following the completion of conformance testing and will be classified as "RESTRICTED COMMERCIAL".

Appendix A Design for the Ballistic Blanket Mounting Frame



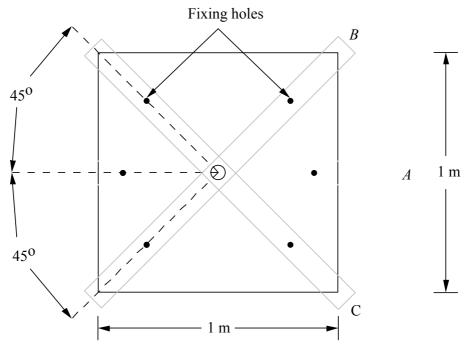


FIGURE A1 Current design for Mounting Frame.

Appendix B: Declaration of Construction Form

Declaration of Content and Construction of Portable Ballistic Protection to: PSDB Portable Ballistic Protection Standard for UK Police (2004)

When completed this document will be classified "RESTRICTED COMMERCIAL"

nsert threa	t level here
Model N	lumber
(This nun	ber must be displayed on all products)
No of Layers	Description of Materials Include manufacturers' references, trade names, number of layer, thickness, weave, stitch pattern etc, and where applicable orientation of each layer within the test sample. If a ballistic blanket is submitted for compliance testing, it must be of a symmetrical construction i.e., it must afford the
	intended protection whichever side is presented to the threat.
Details	of Cover (Blanket)
Insert Cor	npany Name here) hereby declare that ballistic protection produced
	nberas a result of successful Compliance Testing to PSDB Standards
ill be of tl	ne same construction, using the same materials (from the same manufacturer) and stitch patterns as the te
-	sted above in accordance with the General Requirements, Section 5 of PSDB Portable ballistic Protection (2004) Publication No 34/04
signed	Date
SDB Use	Only
Model Nun	nberTest House Ref
	Chroat Lavel Signed on behalf of DSDD Date