



HOSDB Blunt Trauma Protector Standard for UK Police (2007)

Publication No. 20/07

Limb and Torso Protectors

C Malbon

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FIRST PUBLISHED SEPTEMBER 2007

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Foreword

The Home Office Scientific Development Branch (HOSDB), at the request of the Association of Chief Police Officers (ACPO) Public Order Working Group, has developed this police specific standard for blunt trauma protectors.

The standard is the culmination of a major piece of work by HOSDB investigating the threats faced by police officers in situations of public disorder.

This standard covers protective equipment that is worn by police officers to reduce the risk of injury to the limbs and torso from low velocity blunt trauma impacts, such as those caused by hand thrown missiles and hand wielded weapons. It does not consider threats posed by ballistics, bladed weapons, fire or protection for the head which are covered in other HOSDB publications.

The standard includes tests and information, which can be used to assist police forces in the selection of suitable protective equipment for low velocity blunt trauma. It provides information on area of protection, protection above the minimum requirements specified in the standard and guidance on quality assurance testing by manufacturers. Issues of ergonomics or suitability for role should be considered during the selection process.

This standard is supported by ACPO Public Order Working Group, part of the ACPO Conflict Management Portfolio, whose membership includes representatives from the Police Federation of England and Wales.

This standard has also been peer reviewed by the Health and Safety Laboratories (HSL).

The standard will enable police services to issue guidance on the selection of protective equipment for blunt trauma that will assist Chief Officers when carrying out risk assessments that are required to comply with the Police (Health and Safety) Act.

Mike Tonge
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ACPO Conflict Management
Portfolio Holder

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Contents

	Page
1	Management Summary..... 3
2	Introduction 4
	2.1 Scope 4
	2.2 Background 5
	2.3 Testing..... 5
	2.4 Publication of Results..... 5
3	Definitions 6
	3.1 Area of Coverage 6
	3.2 Area of Full Protection..... 6
	3.3 Back Face Signature (BFS) 6
	3.4 Batch 6
	3.5 Batch Identifier 6
	3.6 Batch Testing/Quality Assurance 6
	3.7 Blunt Trauma Protector 6
	3.8 Compliance Test 6
	3.9 Model Identifier..... 7
	3.10 Protective Padding 7
	3.11 Retention System 7
	3.12 Sabot 7
	3.13 Test Sample 7
	3.14 Upper Prediction Limit (UPL) 7
4	General Requirements 8
	4.1 Labelling 8
	4.2 Sizing..... 9
	4.3 Comfort..... 9
	4.4 Quality of Manufacture and Traceability..... 9
	4.5 Construction 9
	4.6 Environment 9
	4.7 Flammability 9
5	Test Procedure..... 10
	5.1 Test Equipment 10
	5.2 Test Sample Submission 13
	5.3 Compliance Testing Process 14
	5.4 Transmitted Force Testing 14
	5.5 Blunt Trauma Protectors for Soft Tissues 16
	5.6 Retention System Testing 17

	5.7 Performance Testing.....	18
	5.8 Performance Assessment.....	19
6	Presentation of Results.....	21
	6.1 HOSDB Certificate (Details).....	21
7	Batch Testing.....	24
	7.1 Batch Sample Size.....	24
	7.2 Batch Test Procedure	24
8	Acknowledgements.....	26
9	Appendix A – Example Declaration	27
10	Appendix B - Calculation of Upper Prediction Limit.....	28

1 Management Summary

This standard describes the test methodology for blunt trauma protectors for UK police to minimise the risk of injury to the limbs and torso from low velocity blunt trauma impacts, such as those caused by hand thrown missiles and hand wielded weapons. It does not consider protection for the head or the threats posed by ballistics, bladed weapons or fire which are covered in other HOSDB publications. Issues of ergonomics or suitability for role should be considered during the selection process.

The standard introduces a new test methodology to meet the requirements of the Police Operational Requirement prepared by HOSDB on behalf of the Association of Chief Police Officers (ACPO) Public Order Working Group for blunt trauma protectors. Also included is information on performance testing to assist in the selection of blunt trauma protectors.

The testing regime includes:

- Anatomical shaped anvils which represent the major areas protected by blunt trauma protectors;
- Two impact anvils representing a bar and a non sharpened edge;
- The measurement of the back face signature for soft tissue protectors;
- Testing of the retention system.

A blunt trauma protector which has passed compliance testing to this standard will meet the following criteria:

- Transmitted force of less than 10000 newton's (maximum predicted value) from an energy impact of 20 joules within the area of full protection as defined by the manufacturer;
- Retention system holding strength of greater than 150 newton's;
- A back face signature of less than 15mm (groin guards) or 25mm (female chest protectors).

Once a blunt trauma protector has passed compliance testing to this standard, manufacturers are required to ensure that a quality assurance program is maintained and that samples are submitted for batch testing in accordance with this standard.

2 Introduction

This standard provides information on the test methodology, batch testing and protection level for blunt trauma protectors for use by police officers in public disorder situations. The protection levels in this standard are based on the assessed threats determined in consultation with police officers and detailed in the Police Operational Requirement on which this standard is based.

The protection provided by a blunt trauma protector is designed to reduce the risk of permanent and serious injury to a police officer; however, it cannot eliminate the possibility of an injury still occurring.

This standard has been developed with consideration to the unique requirements of the police and other law enforcement services and the balance that has to be made between protection and mobility. This standard does not address ergonomics and suitability for roles, which should be considered as part of the procurement process. Additionally, consideration should be given to the interaction between blunt trauma protectors with other items of Personal Protective Equipment (PPE).

2.1 Scope

This standard applies to blunt trauma protectors that are designed to offer protection to areas of the body to reduce the risk of serious injury to a police officer. The areas of protection include:

- lower leg
- knee
- thigh
- hip
- torso
- lower arm
- elbow
- upper arm
- shoulder
- clavicle
- groin.

Other areas of protection may be available and can be submitted for compliance testing in accordance to this standard. This standard does not address the issue of protection from flames (such as from petrol bombs), chemicals, stab, slash, ballistic threats or protection to the head which are covered by other HOSDB standards.

This standard does not contain specifications for design or ergonomics of blunt trauma protectors. Consideration should be given to these factors when assessing any blunt trauma protector for suitability, for example by user trials.

2.2 Background

Police officers are faced with various threats during public disorder situations. The typical threats are from hand thrown missiles e.g. small bricks, and hand wielded weapons e.g. baseball bats. In addition to providing a level of protection, an officer's ability to be able to move must not be significantly hindered as they can be required to perform a range of dynamic activities during public disorder activities.

2.3 Testing

Compliance and quality assurance testing of blunt trauma protectors to this standard must only be performed at HOSDB approved test facilities. Development testing of blunt trauma protectors by manufacturers to this standard may be performed using a test facility of the manufacturers/suppliers choice. HOSDB will provide details of the test equipment used by HOSDB approved test facilities on request.

2.4 Publication of Results

The results of compliance testing to this standard will be held by HOSDB and treated as **RESTRICTED – COMMERCIAL**, and as such, the information will not be made available to competing manufacturers or suppliers.

A non-Restricted listing of blunt trauma protectors that have passed compliance testing to this standard will be published on the HOSDB web site. Full details are available on request from HOSDB (see page ii for contact details).

3 Definitions

3.1 Area of Coverage

The total area of the body surface covered by the blunt trauma protector which may not necessarily offer protection to the levels defined in this standard.

3.2 Area of Full Protection

The area of the blunt trauma protector that actually provides protection to the level specified in this standard defined by the manufacturer.

3.3 Back Face Signature (BFS)

The maximum displacement of the back surface of a soft tissue protector.

3.4 Batch

A quantity of a model of blunt trauma protectors manufactured using materials produced in any one production run.

3.5 Batch Identifier

A unique identifier allocated to a single batch of protectors which enables the manufacturer to identify the batch. The use of any material from a new batch shall be classed as a new batch of protectors and shall require a new batch identifier and test.

3.6 Batch Testing/Quality Assurance

Testing of a model of blunt trauma protector in production which has already passed compliance testing to this standard to ensure continued performance of product throughout manufacturing life.

3.7 Blunt Trauma Protector

A protector/guard that provides a level of protection to an area of the body from low velocity blunt trauma.

3.8 Compliance Test

Testing of a new model of blunt trauma protector to the levels defined in this standard for initial certification.

3.9 Model Identifier

A manufacturer's designation (name, number or other description) that serves to uniquely identify a specific blunt trauma protector design.

3.10 Protective Padding

The lining material within the guard which is designed to absorb the energy of an impact.

3.11 Retention System

The assembly, which when closed or fastened, resists the forcible or accidental removal of the blunt trauma protector whilst it is being worn.

3.12 Sabot

The holding mechanism for the steel impactor which is used to ensure the impactor hits the limb guard in the correct orientation.

3.13 Test Sample

The blunt trauma protector supplied by the manufacturer or supplier for testing.

3.14 Upper Prediction Limit (UPL)

The upper prediction limit is a statistical prediction, calculated from the test data collected, of the maximum expected transmitted force that may occur if additional impacts were performed at the defined test level.

4 General Requirements

4.1 Labelling

A panel, providing the following information, must be permanently attached to the blunt trauma protector:

- a) The manufacturer's name;
- b) The date of manufacture and batch identifier;
- c) The model identifier;
- d) The test report reference;
- e) The size range, area of protection and left or right identifier (if required);
- f) An area for the user to enable them to write/attach their own identifier (e.g. name).

In addition, each blunt trauma protector should be supplied with an information document including the following details:

- g) The expected lifespan of the blunt trauma protector, in accordance with guidance from the manufacturer;
- h) Recommended storage conditions for the blunt trauma protector;
- i) Care and cleaning instructions;
- j) Advice on how to ensure the blunt trauma protector fits correctly, including instructions on any adjustments that can be made if applicable;
- k) Instructions on the correct usage of the retention systems;
- l) The materials used in the construction of the blunt trauma protector;
- m) Guidance on disposal of the blunt trauma protector and recycling options;
- n) Guidance on the correct sizing of the blunt trauma protector;
- o) The following statement:

“This PPE absorbs the energy of an impact by partial destruction of, or damage to, the PPE. Any PPE subjected to a severe impact, even though such damage may not be readily apparent, should be replaced;”
- p) A statement that the PPE complies with the performance requirements of this standard when it is worn and adjusted in accordance with manufacturer's instructions.

4.2 Sizing

Blunt trauma protectors shall be available in a range of sizes to fit the user population and should be clearly defined by the manufacturer.

4.3 Comfort

Blunt trauma protectors must be designed to ensure that there are no protrusions which may harm the wearer. The blunt trauma protector shall be made from materials which are known not to undergo any appreciable alteration through the effects of perspiration, toiletries or cleaning products used in accordance with manufacturers guidance or cause any adverse reaction to the user (e.g. skin allergy). The manufacturer must provide the test facility with documentary evidence that the materials used are suitable for the requirement.

4.4 Quality of Manufacture and Traceability

Each blunt trauma protector shall be free from manufacturing flaws and evidence of inferior workmanship. Manufacturers submitting blunt trauma protectors for compliance testing must be able to demonstrate consistency of manufacturing through membership of a nationally recognised quality assurance scheme e.g. ISO9001:2000, etc.

4.5 Construction

Blunt trauma protectors shall be designed and fabricated with due regard to the properties and limitations of the materials used. All methods of shaping, moulding and attachment must not produce any localised areas of stress concentrations that may reduce the level of protection provided. Any internal rigid projections or fastenings must be covered with protective padding so that any force transmitted to the body is not concentrated.

4.6 Environment

Blunt trauma protectors shall be constructed from materials which when exposed to environmental conditions such as UV light, temperature variations, etc at levels that would be expected over the lifespan of the protector, do not undergo any alterations that may make it unfit for its intended application.

4.7 Flammability

The blunt trauma protector must be constructed from materials which are not flammable or liable to pose a significant risk when subjected to heat transfer levels that may be expected during public order duties. The manufacturer must provide the test facility with documentary evidence that the materials used are suitable for the requirement.

5 Test Procedure

5.1 Test Equipment

Compliance testing shall be performed using the HOSDB designed test equipment, as shown in figure 1. Drawings of the test equipment are available on request from HOSDB.

This assembly enables an impact to be performed on a blunt trauma protector and the transmitted force to be measured.

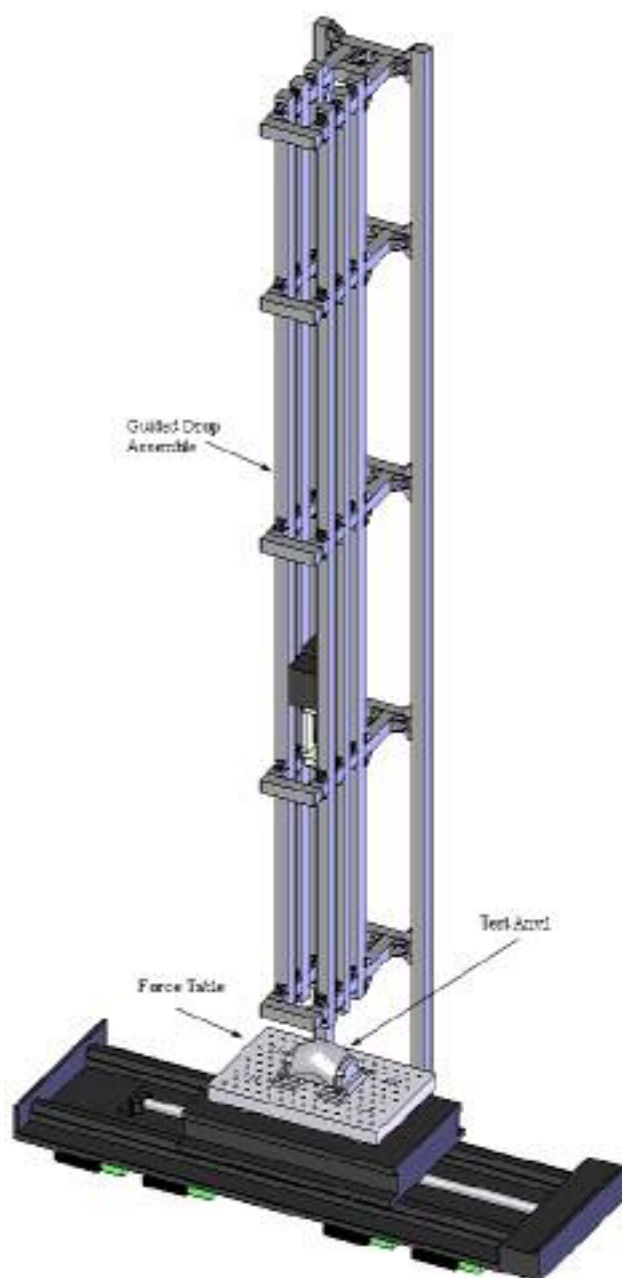


Figure 1 Impact test rig

5.1.1 Guided Drop Assembly

This system prevents the sabot from rotating about its axis during its descent and must be rigidly mounted to a supporting wall or frame ensuring the assembly is mounted vertically. The drop assembly includes a velocity measurement system for the sabot mounted at the bottom of the drop rails prior to impact.

5.1.2 Force Table

The force table consists of a rigid stainless steel plate mounted on four evenly spaced load cells preloaded to 50% of their maximum value. In addition the top of the force table has fixing holes evenly spaced to enable the test anvils to be securely fixed to the table, as shown in figure 2. The force table is mounted onto a linear rail system to enable it to be moved under the guided drop assembly to allow for various impact sites. The whole system must be secured rigidly to a solid floor with a minimum mass of 1000kg to ensure that no movement takes place during the test.

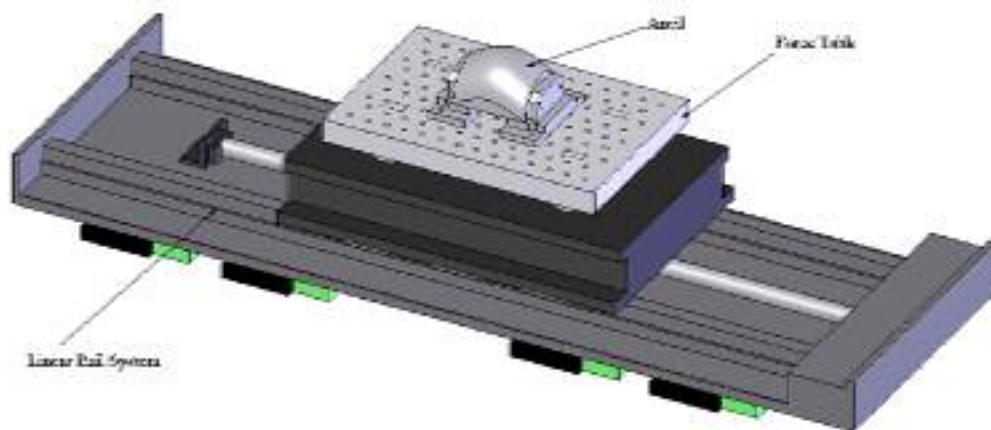


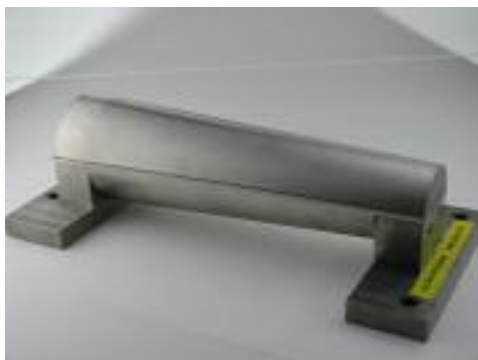
Figure 2 Force table and linear rail system

5.1.3 Test Anvils

The test anvils are constructed from stainless steel and are shaped to represent parts of the human body, as shown in figure 3a to c. There are 3 different styles of anvil:

- Cylindrical
- Semi-Circular
- Convex

Each anvil is constructed in 3 sizes to represent the 5th, 50th and 95th percentile of adults (male and female combined) aged 18 to 65.



(a) Cylindrical



(b) Semi-Circular



(c) Convex

Figure 3 Test Anvils

In addition to these anvils an anvil is used for the testing of a blunt trauma protector for soft tissue such as male groin guards. This anvil incorporates a laser displacement sensor to measure the back face signature (BFS) of the protector in addition to the transmitted force, as shown in figure 4.



Figure 4 Soft Tissue Protector Test Anvil

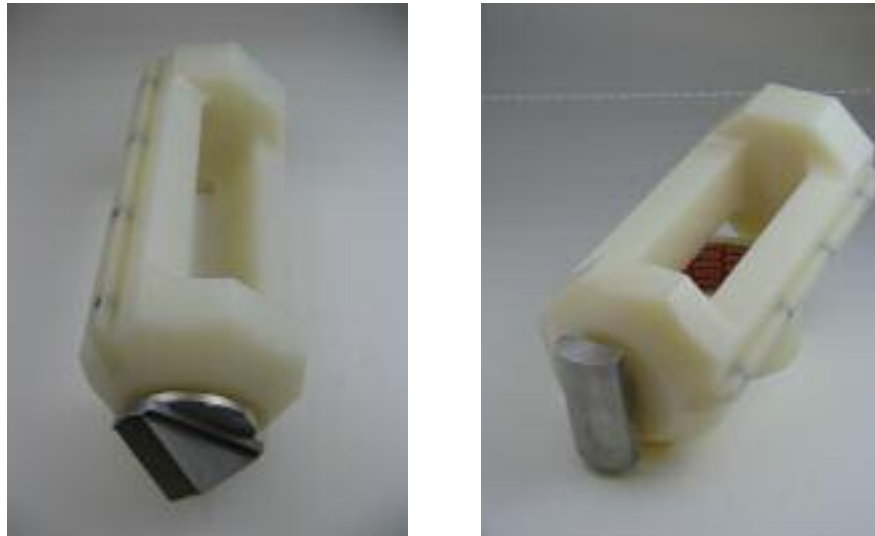
5.1.4 Test Impactors

Two test impactors, figure 5a and b, are used to represent the common threat faced by UK police officers, these are:

- Bar Impactor – to represent a hand wielded weapon.

- Wedge Impactor – to represent an edge of a brick (worst case impact) or other thrown missile.

These impactors are mounted into sabots constructed in nylon to give a total mass of $1.6 \pm 0.05\text{kg}$.



(a) Wedge Impactor

(b) Bar Impactor

Figure 5 Impactors

5.2 Test Sample Submission

For compliance testing, one blunt trauma protector for each size of a model designation must be submitted (a minimum of three blunt trauma protectors are required). Each of the submitted blunt trauma protectors must be clearly marked by the manufacturer/supplier showing clearly the area of full protection. Additional samples may be required by the test house to ensure that full compliance testing can be performed.

Before submitting any test samples for compliance testing, the manufacturer or supplier is required to inform HOSDB, in writing, of their intention to submit for compliance testing. Documentation describing the construction of the test sample must be included. This documentation shall be in the form of a declaration stating that “Any product produced as model designation **** as a result of successful compliance testing to HOSDB standards, will be of the same construction, using the same materials, from the same manufacturer as the test sample”. **NOTE: Any deviation from the original declared construction may lead to certification being withdrawn.**

The materials used in the construction of the blunt trauma protector must also be listed starting from the outer face, giving manufacturer’s references, trade names, thickness, etc.

The information supplied on this declaration will be treated as “**RESTRICTED COMMERCIAL**” by HOSDB.

A sample declaration form showing the information required, which may be photocopied, is shown in Appendix A. An electronic version of this form may be obtained from HOSDB. Declarations can be either posted or faxed to

HOSDB, alternatively the declaration can be submitted by email from a verifiable email address to declarations@homeoffice.gsi.gov.uk¹

Once the declaration has been approved by HOSDB, the test house will be informed of the manufacturer or supplier's intention to submit the model for testing.

The manufacturer or supplier will then be invited to contact the test house directly to arrange a test date and submit the required number of samples to the test house for compliance testing. **The test house is not authorised to carry out compliance testing to HOSDB standards until a satisfactory declaration has been received and approved by HOSDB.**

5.3 Compliance Testing Process

Testing of blunt trauma protectors except soft tissue protectors shall include the following stages:

- Transmitted force (section 5.4);
- Retention system (section 5.6);
- Transmitted force performance above minimum requirements (section 5.7).

Blunt trauma protectors designed to protect soft tissue shall be tested in the following stages:

- BFS and Transmitted force (section 5.5);
- Retention system (section 5.6).

5.4 Transmitted Force Testing

The blunt trauma protector shall be visually checked for any manufacturing flaws and defects prior to testing. Where a blunt trauma protector is constructed of several parts that would require the use of different anvils for testing, they shall be separated into their parts and each section treated as a separate blunt trauma protector for the purpose of testing.

5.4.1 Pre Test Checks

Before testing commences, the test system operation must be confirmed following the test laboratories standard operating procedure.

This procedure may be omitted if the pre test checks have been previously performed on the day.

5.4.2 Preconditioning of Test Sample

The tester shall select one of the test samples supplied and retain it as new for performance testing (section 5.7).

¹ This email address is for the submission of declarations only, for all other enquiries please use the contact details specified on page ii

The remaining test samples shall be pre conditioned according to table 1.

After completion of the pre conditioning process the first impact must be completed within five minutes of removal from the conditioning chamber. All additional impacts shall be performed on the blunt trauma protector as it is allowed to cool on the anvil.

Condition	Description	Time
UV	Expose the outer surface of the blunt trauma protector to ultra violet radiation from a 150W Xenon filled Quartz lamp at a range of 150mm	90 hrs +8/-0 hrs
Ambient	15 to 24°C at 40 to 70% humidity	24 hrs +12/-0 hrs
Hot	Place the blunt trauma protector in a conditioning chamber +50 ± 2°C	2 hrs +22/-0 hrs

Table 1. Conditioning of the Test Samples

5.4.3 Preparation

A suitable anvil shall be selected and mounted on the force table securing the fixing bolts to a torque of 25 to 30Nm. If required the test sample may be cut to ensure it fits onto the anvil and to allow it to be rotated. Care should be taken to avoid altering the performance of the test sample and any alterations made must be noted on the test report.

The appropriate impactor shall be placed in the guided drop rig and positioned ready for the first impact.

5.4.4 Test procedure

1. The test sample shall be mounted on the test anvil using its own retention system, if required additional strapping may be used at the discretion of the test house. The test sample shall be mounted as instructed in any user guidelines supplied with the test sample. Care must be taken not to over tighten the test sample to an anvil.
2. The first test sample shall be impacted a minimum of six times at an energy of 20 ±0.5J within the area of full protection[♦] (defined by the manufacturer) using the bar shaped anvil aligned to impact the protector across the long axis.
3. Record the transmitted force and velocity of each impact.
4. Additional impacts shall be performed, space permitting, up to a maximum of twelve impacts on any one guard. Impacts shall be performed at any location within the area of full protection as the test facility feels appropriate.

[♦] The impacts must be spaced with a minimum distance of 15mm from the centre line of any other impact and a minimum of 5mm from the edge of the area of full protection to the closest edge of the anvil.

5. The second test sample shall be impacted a minimum of six times at an energy of $20 \pm 0.5\text{J}$ within the area of full protection[♦] (defined by the manufacturer) using the wedge shaped anvil aligned to impact the protector across the long axis.
6. Record the transmitted force and velocity of each impact.
7. Additional impacts shall be performed, space permitting, up to a maximum of twelve impacts. Impacts can be performed at any location within the area of full protection as the discretion of the test facility.
8. For each additional test sample supplied, the tester shall determine which impactor shall be used to perform additional testing as detailed above.

5.4.5 Calculation of Upper Predicted Transmitted Force

On completion of impact testing the Upper Predicted Transmitted Force shall be calculated using the UPL calculation (Equation 1 and Appendix B) for each type of impactor and using a confidence level of 95%.

$$UPL = \bar{x} + t_{crit} s \sqrt{\frac{n+1}{n}}$$

Where

UPL	the upper prediction limit
\bar{x}	the mean transmitted force
t_{crit}	value from tables for a single tail of the specified confidence limit
S	standard deviation of the transmitted force
n	number of impacts

Equation 1

5.5 Blunt Trauma Protectors for Soft Tissues

The soft tissue protector shall be visually checked for any manufacturing flaws and defects prior to testing. If the soft tissue protector is supplied in a holding or retention system it shall be removed prior to testing.

5.5.1 Pre Test Checks

Before testing commences, the test system operation must be confirmed following the test laboratories standard operating procedure.

[♦] The impacts must be spaced with a minimum distance of 15mm from the centre line of any other impact and a minimum of 5mm from the edge of the area of full protection to the closest edge of the anvil.

This procedure may be omitted if the pre test checks have been previously performed on the day.

5.5.2 Preconditioning of Test Sample

The test sample shall be pre conditioned according to table 1.

After completion of the pre conditioning process the test must be carried out within five minutes of removal from the conditioning chamber.

5.5.3 Preparation

The soft tissue blunt trauma protector anvil and measurement device shall be mounted on the force table securing the fixing bolts to a torque of 25 to 30Nm. The bar impactor shall be placed in the guided drop rig and positioned ready for the first impact.

5.5.4 Test procedure

1. The test sample shall be mounted on the test anvil with its highest point directly under the impactor with the measurement device mounted directly below the highest point. The test sample shall be restrained using suitable strapping so that it is securely mounted on the anvil.
2. The test sample shall be impacted at an energy of 20 ± 0.5 J at its highest point using the bar shaped anvil.
3. Repeat the test with all remaining test samples.

The transmitted force, back face signature and velocity of impact shall be recorded for each impact.

5.6 Retention System Testing

One of each type of retention system shall be tested. Both the securing mechanism and the fastening of the mechanism to the protector shall be tested.

5.6.1 Test Sample preparation

Using a test sample previously impacted, remove the following:

- One of each type of securing mechanism, including a reasonable length of strap as shown in figure 6(a).
- One of each type of fastening of the securing mechanism to the guard shall be carefully removed ensuring that this does not weaken the fixing as shown in figure 6(b).



(a) Securing connector



(b) connection to guard

Figure 6 Retention System

5.6.2 Test Procedure

1. Mount the first test sample in a tensile test machine such that the sample is perpendicular to the restraining mechanism.
2. Extend the sample at a rate of 20mmMin^{-1} to a maximum force of 200N. Record the peak force at which the test sample fails, or $>200\text{N}$ if the sample does not fail. A failure is defined as:
 - i. failure of any part of the securing connector;
 - ii. separating of the retention system into two or more parts;
 - iii. lengthening of the retention system by more than 25% of its original length (excluding any elastic parts).

Repeat the above procedure for all samples taken from the blunt trauma protector.

The same procedure shall be followed for testing soft tissue protectors.

5.7 Performance Testing

Where a blunt trauma protector is constructed of several parts that would require the use of different anvils for testing, they shall be separated into their parts and each section treated as a separate blunt trauma protector for the purpose of testing.

5.7.1 Pre Test Checks

Before testing commences, the system operation must be confirmed following the test laboratories standard operating procedure.

This procedure may be omitted if the pre test checks have been previously performed on the day.

5.7.2 Preparation

A suitable anvil shall be selected and mounted on the force table securing the fixing bolts to a torque of 25-30Nm. If required the test sample may be cut to ensure it fits onto the anvil and allow it to be rotated. Care should be taken to avoid altering the performance of the test sample and any alterations made must be noted on the test report.

The bar impactor shall be placed in the guided drop rig and positioned ready for the first impact.

5.7.3 Test procedure

1. The test sample shall be mounted on the test anvil using its own retention system, if required additional strapping may be used at the discretion of the test house. The test sample shall be mounted 'as worn' and as instructed in any user guidelines supplied with the test sample. Care must be taken not to over tighten the test sample to an anvil.
2. The test sample shall be impacted at energy of $22\pm 0.5\text{J}$ within the area of full protection[♦] defined by the manufacturer. The impact shall be performed at any location within the area of full protection at the tester's discretion.
3. Record the transmitted force and velocity of impact.
4. Impact the test sample at energy of $24\pm 0.5\text{J}$ within the area of full protection[♦] defined by the manufacturer. Impacts can be performed at any location within the area of full protection at the tester's discretion.
5. Record the transmitted force and velocity of impact.
6. Repeat steps 4 and 5 increasing the energy by $2\pm 0.5\text{J}$ until $40\pm 0.5\text{J}$.

These results are NOT used to assess the performance of the guard for compliance testing but they will be used to provide an indication of performance above the minimum requirements of this standard.

5.8 Performance Assessment

For a blunt trauma protector to have successfully passed compliance testing to this standard the following criteria must be met.

- The UPL must not be $>10000\text{N}$
- The strap must not fail at a force $<150\text{N}$

For a blunt trauma protector for soft tissue **except** female chest protectors to have successfully passed compliance testing to this standard the following criteria must be met.

- The average BFS must not be $> 15\text{mm}$

[♦] The impact must be spaced with a minimum distance of 15mm from the centre line of any other impact and a minimum of 5mm from the edge of the area of full protection to the closest edge of the anvil.

Home Office Scientific Development Branch

- The average transmitted force must not be $>10000\text{N}$
- The strap must not fail at a force $<150\text{N}$

For a blunt trauma protector for female chest protectors to have successfully passed compliance testing to this standard the following criteria must be met.

- The average BFS must not be $> 25\text{mm}$
- The average transmitted force must not be $>10000\text{N}$
- The strap must not fail at a force $<150\text{N}$

6 Presentation of Results

Upon successful completion of testing, the test samples and test data must be supplied to HOSDB for verification.

In addition, the area of full protection defined by the manufacturer will be calculated in proportion to the area of full coverage of the blunt trauma protector and a star rating will be awarded of between 1 to 5 stars as defined in table 2.

Area of full protection/area of coverage	Star rating
1 – 50%	★
50 – 70%	★★
70 – 80%	★★★
80 – 90%	★★★★
90 – 100%	★★★★★

Table 2 Star rating guide

Once the test samples have been evaluated and are confirmed to be satisfactory, HOSDB will issue a compliance certificate to the manufacturer, along with a copy of the test report. Additionally, the model and manufacturers and/or suppliers details will be added to the HOSDB Protective Equipment Database on the Home Office web site.

Any submission which has failed compliance testing will be returned to the manufacturer, directly from the test house with a copy of the test report. No listing will be made on the HOSDB Protective Equipment Database.

Once a certificate has been issued, no changes in construction may be made to the model without the written consent of HOSDB. Under normal circumstances, any change in construction would require the submission of a new declaration with a new model designation and, subsequently, a new compliance test.

6.1 HOSDB Certificate (Details)

The certificate for blunt trauma protectors provides information regarding the tests that have been performed on the model submitted.

6.1.1 Force Transmission

This is either the Upper Prediction Limit (UPL) for the protector or the average transmitted force for blunt trauma protectors for soft tissue. This test

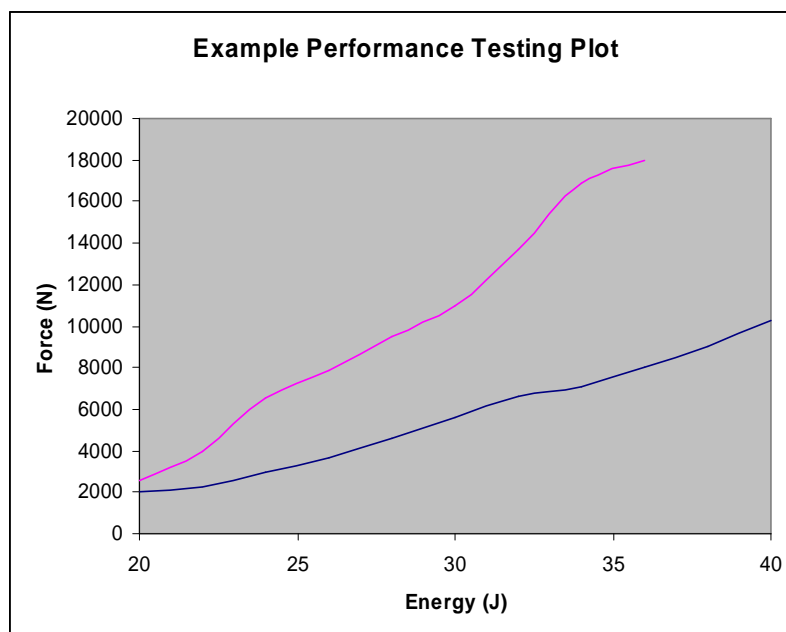
is a pass/fail test based on the minimum performance criteria specified in this standard.

6.1.2 Retention system

This is the performance of the retention system against the minimum requirements specified in this standard and is a pass or fail test. It indicates how resistant the blunt trauma protector is to either accidental or forcible removal.

6.1.3 Performance above minimum requirements (not applicable to soft tissue protectors)

This test indicates the performance of the blunt trauma protector against impacts greater than the minimum requirements of this standard and is presented graphically, as illustrated in graph 1. The plot shows impact energy against transmitted force. A small gradient indicates better performance (lower transmitted force levels, blue line) than a steep gradient (high transmitted force levels, pink line). It is only representative of the performance of the blunt trauma protector and is designed to enable a comparison of the overall performance of different blunt trauma protectors to be assessed. This should be considered in conjunction with user trials of the blunt trauma protectors. This test does **not** apply to blunt trauma protectors for soft tissue.



Graph 1

6.1.4 Star rating

This shows the percentage of the blunt trauma protector which is defined by the manufacturer or supplier as being the area of full protection (i.e. the area that meets the minimum requirements of this standard) and is scored between 1 to 5 stars. The area in m² is also given to enable a quantifiable assessment of coverage to be made when comparing blunt trauma protectors. An example

of a blunt trauma protector with its defined area of full protection, star rating and area in m² is in figure 7.



Area of full Protection = 0.35m²

Area of coverage = 0.48m²

Star Rating ★★☆☆☆

Figure 7 Illustration of blunt trauma protector, area of full protection and star rating

A guard with a low star rating may still offer protection beyond its defined area of full protection which does not meet the minimum requirements of this standard. Additional force transmission testing of the protector may be performed but this is not a requirement for this standard.

6.1.5 Back Face Signature (BFS) (only applicable for soft tissue protectors)

This is the performance of the protector against the minimum requirements specified in this standard and is a pass/fail test. BFS indicates how far the protector may push against soft tissue, which may result in bruising or other internal injuries.

7 Batch Testing

It is the responsibility of the manufacturer or supplier to ensure that batch testing is performed on all new batches of blunt trauma protectors supplied.

Batch testing must be performed at a HOSDB approved test facility and shall be arranged directly with the test facility. HOSDB need not be informed unless a batch test fails, in which case a copy of the test report must be sent to HOSDB by the test facility for review.

HOSDB reserve the right to inspect batch test records at any time. Failure to perform batch testing may lead to certification being withdrawn.

7.1 Batch Sample Size

Batch testing shall be performed on numbers specified in table 2.

Batch Size	Number of Samples
<300	1% of batch
300 to 700	3 protectors
700 to 1000	5 protectors

Table 3: Batch test quantities

For batch sizes greater than 1000, multiples of the above values specified in table 2 should be submitted.

7.2 Batch Test Procedure

The blunt trauma protectors shall be tested for the following

- Force transmission
- Retention system strength
- Back Face Signature (soft tissue protectors only)

The blunt trauma protectors shall be tested at ambient temperature (15 to 24°C at 40 to 70% humidity) following the procedure specified in Section 5 for the tests. The Upper prediction limit (UPL) shall be calculated with a confidence level of 95%.

For the blunt trauma protector to have successfully passed batch testing to this standard the following criteria must be met.

- The UPL must not be >10000N
- The strap must not fail at a force <150N

For a blunt trauma protector for soft tissue **except** female chest protectors to have successfully passed batch testing to this standard the following criteria must be met.

- The average BFS must not be $> 15\text{mm}$
- The average transmitted force must not be $>10000\text{N}$
- The strap must not fail at a force $<150\text{N}$

For a blunt trauma protector for female chest protectors to have successfully passed batch testing to this standard the following criteria must be met.

- The average BFS must not be $> 25\text{mm}$
- The average transmitted force must not be $>10000\text{N}$
- The strap must not fail at a force $<150\text{N}$

A failed batch test may be repeated with twice the sample size specified in table 2 after consultation between the manufacture or supplier and HOSDB. The test facility should not repeat batch testing for a failed batch without approval from HOSDB. A manufacturer may perform development testing on a failed batch to determine the cause of the failure without approval from HOSDB.

8 Acknowledgements

Grateful thanks are given to the following people and organisations in helping produce this standard:

ACPO Working Group on Public Order;

ACPO Tactics, Training and Equipment Sub Group;

Miss Christine O'Brien, Mr James Adide and Mr Sam Davies (sandwich students from Brunel University)

Mr Andrew Diamond, INSPEC International Ltd Manchester


Mr Duncan Webb, Health and Safety Laboratories, Buxton.

9 Appendix A – Example Declaration

Declaration of Content and Construction of Blunt Trauma Protectors to:

HOSDB Blunt Trauma Protectors for UK Police (2007)

When completed this document will be classified “**RESTRICTED COMMERCIAL**”

Model Number (This number must also be displayed on all blunt trauma protectors)	
Area of Protection..... Size Range.....	
	Description of Materials (from strike face to body face) Include manufacturers' references, trade names, number of layers, thicknesses, stitch pattern etc.
Strike Face  Body Face	

(Insert Company Name here) hereby declare that all Blunt Trauma Protectors produced as model designation as a result of successful Compliance Testing to HOSDB Standards will be of the same construction, using the same materials (from the same manufacturer) as the test sample/s listed above in accordance with Section 5.2 of HOSDB Blunt Trauma Protectors for UK Police (2007) Publication No 20/07. Also, if the Blunt Trauma Protector is supplied to UK police, the correct labels will be fitted in accordance with section 4.1

Signed.....

Date.....

10 Appendix B - Calculation of Upper Prediction Limit

The upper prediction limit is a prediction of the upper tail of a normal distribution which provides a value that the next test is unlikely to exceed. It is used to provide the value which another observation will not exceed, with a specified probability (for example 95%).

The upper prediction limit is given by:

$$UPL = \bar{x} + t_{crit} s \sqrt{\frac{n+1}{n}}$$


Where

- UPL the upper prediction limit for a single new observation
- \bar{x} the sample mean
- t_{crit} t value from tables for a single tail of the specified confidence limit (shown below)
- S sample standard deviation
- n number of data points in the sample from which \bar{x} and S are calculated

From - Hahn, G.J. and Meeker, W.Q. (1991).
 Statistical Intervals: A Guide for Practitioners.
 Wiley, New York. page 61, equation 4.2.

t_{crit} values

Number of data points (n)	t_{crit} for specified probability		Number of data points (n)	t_{crit} for specified probability	
	90%	95%		90%	95%
2	3.0777	6.3138	14	1.3502	1.7709
3	1.8856	2.92	15	1.345	1.7613
4	1.6377	2.3534	16	1.3406	1.7531
5	1.5332	2.1318	17	1.3368	1.7459
6	1.4759	2.015	18	1.3334	1.7396
7	1.4398	1.9432	19	1.3304	1.7341
8	1.4149	1.8946	20	1.3277	1.7291
9	1.3968	1.8595	25	1.3178	1.7109
10	1.383	1.8331	30	1.3114	1.6991
11	1.3722	1.8125	40	1.3036	1.6849
12	1.3634	1.7959	50	1.2991	1.6766
13	1.3562	1.7823			



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ISBN: 978-1-84726-329-2