Home Office

Portable Ballistic Protection for UK Police (2011)

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In association with

C Tichler

Portable Ballistic Protection for UK Police (2011)

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1 Management summary

In 2004 the Centre for Applied Science and Technology (CAST) produced a standard for Portable Ballistic Protection for UK police. It was introduced to ensure ballistic shields and blankets supplied to the police were manufactured to a consistent standard and would meet the police Operational Requirement. This document supersedes the 2004 standard (any prior testing to the 2004 standard will still be valid) and key updates include:

- the standardisation of test levels across blankets and shields to incorporate any new designs of portable ballistic protection (PBP);
- introduction of new test levels;
- Manufacturers' Quality Testing (MQT) to ensure continued quality throughout production;
- edge testing; and
- multi-shot testing.

This standard is supported by:

The Association of Chief Police Officers (ACPO) Conflict Management Portfolio and Home Office Science – CAST.

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2 Introduction

Ballistic protection has been available to UK police for many years and in 1993 CAST (then the Police Scientific Development Branch – PSDB) introduced its first standard for ballistic protection. This document described a test methodology for assessing the protection offered by commercial body armour systems against typical ballistic threats in the UK. Over the years the standard has been developed and in 2004 it was identified that a separate standard for portable ballistic protection (PBP) was required. This enabled testing to be developed to reflect the differences in the usage between body armour and PBP.

This standard supersedes the Portable Ballistic Protection Standard for UK Police 2004; any prior testing to the 2004 standard will remain valid but new testing will be conducted in accordance with this document.

This standard provides information on the ballistic test requirements and methods for manufacturers to achieve successful compliance testing of PBP within the CAST voluntary testing programme. It should be noted that this standard does not cover the ergonomics and handling of PBP. It is recommended that end users conduct operational usage trials to establish the suitability of PBP before purchase.

This standard relates to the following Home Office objectives:

- free up the police to fight crime more effectively and efficiently;
- protect our citizens from terrorism.

This standard is fully supported by the Association of Chief Police Officers (ACPO) Conflict Management Portfolio, ACPO Armed Policing Working Group, ACPO Body Armour Sub Group and the Home Office Public Order Unit.

3 Definitions

3.1 Model number

A manufacturer designation (name, number or other description) that serves to uniquely identify a specific configuration of PBP 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 refer to all or part of the threat level. ***Each sample type submitted for testing shall carry this model number on every panel. Also, if testing is successful, the model number shall be attached to all production models supplied to UK police in accordance with the labelling instructions (section 4.1).***

3.2 Fair hit or strike

A fair hit is that which adheres to all of the rules set out below.

- Shots must be a minimum of 50 mm from the edges of the panel for all ammunition except the Winchester 1 oz. Rifled Lead Slug which must be 200 mm from the edges.
- All shots must be a minimum of 50 mm from any other shots.
- The velocity must be within the tolerances set out in Table 1.
- All shots must be no more than ± 5˚ from the intended angle of incidence.

If a shot does not meet these criteria, it will be classed as an unfair hit or strike. Unfair hits or strikes may be accepted according to the criteria for "accepted hit or strike"; otherwise they will be repeated.

3.3 Accepted hit or strike

An accepted hit or strike will conform to the criteria for a "fair hit or strike". Unfair hits or strikes will also be accepted if:

- The shot is closer than 50 mm to the edges (200 mm for the Winchester 1 oz. Rifled Lead Slug) and the bullet is held by the PBP.
- The impact velocity is above the specified test limits and the bullet is held by the PBP.
- The impact velocity is below the specified test limits, resulting in a perforation.

Any shots that do not meet these criteria will be classed as rejected and must be repeated.

3.4 Fragmentation

Fragmentation (also known as spall) is the break-up of the armour material into small pieces, due to the impact of the bullet. Figure 1 illustrates three different types of fragmentation seen on the back of an armour material. Any

fragmentation from the back of an armour material that occurs during testing, as evidenced by the presence of that fragment in the witness material, shall be recorded as a perforation.

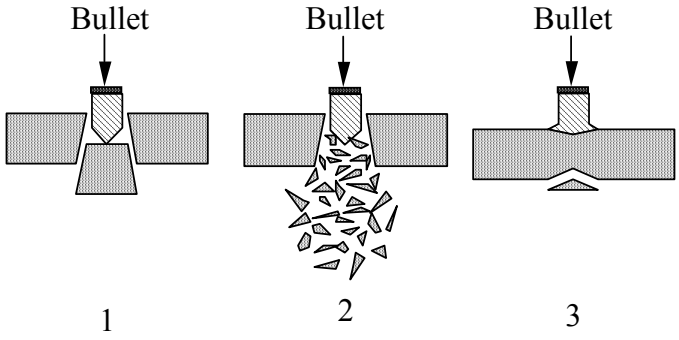

Figure 1: Diagram illustrating different types of fragmentation.

3.5 Perforation

This is when the bullet, a piece of the bullet, or any fragmentation of the PBP itself (as described in Section 3.4) creates a hole that passes through the test sample. This is also known as complete penetration.

3.6 Penetration

This is when a bullet enters the test sample. A penetration can result as eitherheld (if the bullet is stopped within the test sample and no fragmentation from the back of the test sample is seen) or perforated (as described in Section 3.5).

3.7 Strike face

This is the surface of the PBP designated by the manufacturer as the surface facing the threat.

3.8 Back face

This is the surface of the PBP that is intended to be held against/towards the body and will be positioned facing the witness material during testing.

3.9 Angle of incidence

The angle between the line of flight of the bullet and a line perpendicular to the surface face at the point of impact (see Figure 2).

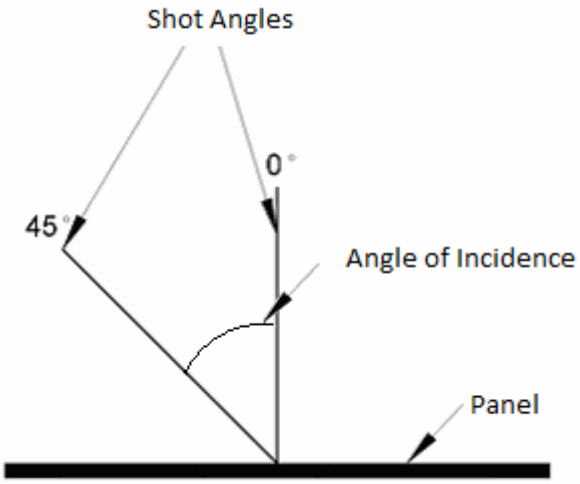

Figure 2: Shows the angles at which the panels will be tested.

3.10 Ballistic resistance

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

3.11 In-service testing

Testing of PBP that is currently in service. Sometimes referred to as "dip" or "age" testing, it involves the selection of in-use samples at intervals (usually annually). In-service testing can be applied to PBP under warranty and even beyond the warranty period.

3.12 Modular insert

Additional protective pieces that may be added to PBP to increase the level of ballistic resistance provided.

3.13 Manufacturers' Quality Testing (MQT)

MQT is a suggested method of ensuring the continued quality of a PBP model once it has met the requirements of the CAST compliance test.

3.14 Test reference

This reference (unique to each model) is present on all documentation issued by the test house and on the certification document issued by CAST. ***The test reference must be displayed adjacent to the model number on every production unit produced as a result of successful compliance testing to CAST standards.***

3.15 Edge performance level

The edge performance level is designed to give the users further information on the performance of the PBP when shot close to the edges.

The edge performance level of PBP will be set at the distance where all shots at that distance and distances further from the edge meet the criteria set out in Section 5.4. Further information on the edge performance testing can be found in Section 5.5.

4 General requirements

This section details the general requirements of PBP submitted for compliance testing to this standard at a CAST-approved testing facility.

The PBP shall afford protection against injury from perforation of the bullet and the behind-armour effects of the impact, such as fragmentation of the rear face of the sample. The protection level required by the user should be determined from the specific threats and risk assessments.

4.1 Labelling

A clearly marked label in an easily readable type size, providing the following information, shall be permanently attached to the PBP:

- the manufacturer's name;
- the date of manufacture and batch number;
- the model number (see definitions in Section 3);
- the test house reference[1];
- the protection level/s of the panel;
- a set of instructions for maintenance, cleaning and use;
- a statement clearly defining either the strike face or back face of the panel;
- serial number.

The area/s of protection of the shield should be clearly identifiable on the back face of the PBP.

If the PBP is constructed from more than one component, e.g. a modular insert, each separate component shall also clearly display information to ensure that it is correctly inserted and which components it should be used in conjunction with to meet the stated protection level/s. The main information label shall include details of all components.

The following statement shall be included on all portable ballistic protection that has been successfully tested for compliance to this standard at a CAST-approved testing facility.

"The manufacturer certifies that the model number (insert) has been tested at a CAST-approved testing facility and has been found to comply with CAST Portable Ballistic Protection Standard for UK Police (2011) (insert protection level e.g. PB1)."

No claim shall be made by manufacturers regarding compliance to CAST standards for portable ballistic protection that has failed CAST compliance testing, or on products that have not been fully tested at a

[1] This 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 PBP.

CAST-approved test facility for compliance to one or more of the protection levels in this standard.

4.2 Quality of manufacture and traceability

PBP 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 and manner of construction.

Manufacturers providing PBP for compliance testing should be able to demonstrate consistency of manufacture through membership of a recognised Quality Assurance Standard.

Additionally, before a model is accepted for compliance testing, manufacturers are encouraged to submit with the declaration any details of testing (including methods) previously carried out or data relating to the performance of the model submitted.

4.3 Submitting PBP for testing

Prior to compliance testing by a CAST-approved test facility manufacturers and suppliers are required to inform CAST in writing of their intention to submit PBP for testing.

4.4 Declaration of construction

A declaration of construction must be submitted and approved by CAST prior to any compliance testing taking place. Declarations should be submitted via email to: declarations@homeoffice.gsi.gov.uk . The subject of the email should use the following convention:

Manufacturer: Model: Threat Level: Chosen Test Facility

The signed declaration submitted to CAST states:

(*Insert Company Name here*) hereby declare that all PBP produced as model number ….. as a result of successful Compliance Testing to CAST Standards will be of the same construction, using the same materials (from the same manufacturers/suppliers) and stitch patterns as the test sample/s listed above in accordance with CAST Portable Ballistic Protection Standard for UK Police (2011) Publication No 47/11.

The declaration must be on company-headed paper. In addition a full technical file for the PBP must be submitted detailing the carrier (if required), any handles and fixings, the order of construction of materials from strike face down and details and evidence of registration to a recognised Quality Assurance system. As a minimum it should include the following details (where relevant):

- Manufacturer's references
- Trade names
- Number of layers
- Thickness

- Stitching detail (stitch length, thread used, distance to edges etc.)
- Orientation

For common soft materials used in the construction of the PBP (e.g. para-aramids and Ultra High Molecular Weight Polyethylene [UHMWPE]):

Yarn

- Name (trade name and reference)
- Producer (manufacturer and specific location)
- Construction/filament count
- Decitex (grams per 10 Km of yarn)

Weave type

- Material
- Material producer (manufacturer and specific location)
- Material coating: International Union of Pure and Applied Chemistry International Identifier (InChI)
- Quilting orientation and spacing
- Quilting thread

For metallic elements:

- Metal used (including alloy ratios)
- Metal supplier (including specific location)
- Manufacturer (manufacturer and specific location)
- Manufacturer's reference
- Metal hardness
- Link size (wire diameter and link internal diameter)
- Welding methods

For ceramic/hard armour elements:

- Ceramic type
- Physical dimensions (plate thickness)
- Porosity/density (specify scale)
- Particle size/shape
- Hardness
- Adhesive used for bonding layers
- Layer count (for pressed UHMWPE/pressed aramids etc.)

If the PBP is constructed from more than one component, the intended positions of each component and its securing mechanism should be supplied.

Any novel construction not detailed above should include a similar level of information.

CAST will classify this information "PROTECT COMMERCIAL".

Manufacturers/suppliers are asked to provide information on the intended handling and usage instructions for the PBP. This will enable test houses to ensure the unit is tested as it is intended to be used.

4.5 Continuity of construction

For each successful PBP model, the manufacturer/supplier will be issued compliance documentation on the understanding that it is the responsibility of the manufacturer/supplier to ensure that the performance level of the compliant model is maintained (preferably by using an appropriate quality control system) throughout manufacture.

4.6 Test houses

Once CAST is satisfied with the declaration, the test house will be informed of the manufacturer's/supplier's intention to submit the model number/s agreed with CAST for testing. The manufacturer/supplier will then be invited to contact the test house to arrange a test date and subsequently submit the PBP for compliance testing.

Test houses are not authorised to carry out compliance testing to CAST standards until a satisfactory declaration has been received and approved by CAST.

When the test house receives the PBP, it shall be examined to ensure that labels are present and state the correct information in accordance with this standard.

Test houses are not authorised to carry out compliance testing to CAST standards until the labelling requirements have been complied with. Please use test reference "compliance sample" on the PBP supplied for testing.

Following the ballistic testing of the PBP, a test report shall be produced; the information below shall appear on the test report. At this stage, the test report shall not indicate if the PBP has met the requirements for compliance.

- The protection level/s 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.
- For each test shot, the velocity of the bullet, as measured, shall be stated.
- Where relevant, distance measurement from the edge.
- A held or perforated criterion for the sample as a result of each shot shall be recorded.
- Information regarding the way in which the shield was held during testing and details of any failures of the fixing mechanisms (handles and stitching) during and immediately post testing.

4.7 Results communication

After successful testing, the PBP, along with its test results, will be returned to CAST for analysis of construction and comparison with the declaration before the compliance document is issued. If the PBP is not successful, the test house will inform CAST and the test sample will be returned to the manufacturer at their request.

All test samples and documents for successful testing will be kept by CAST for a minimum of five years following the completion of conformance testing. After this period the sample may be disposed of securely.

5 Test details

5.1 Test sample

All PBP submitted for testing to this standard must be supplied to the test facility as complete units and as they are intended to be supplied to users or stored e.g. utilising folds. This is so any fixings and areas of perceived weakness can be subject to additional shots.

A minimum of two samples for PB1 and PB2 and three samples for PB3 (or enough samples to accommodate the required number of fair shots) will be required to undertake this testing. Please contact CAST for guidance.

5.2 Set up

The test shall be set up as detailed in Figure 3 below. Full technical drawings of an example rig are available on request.

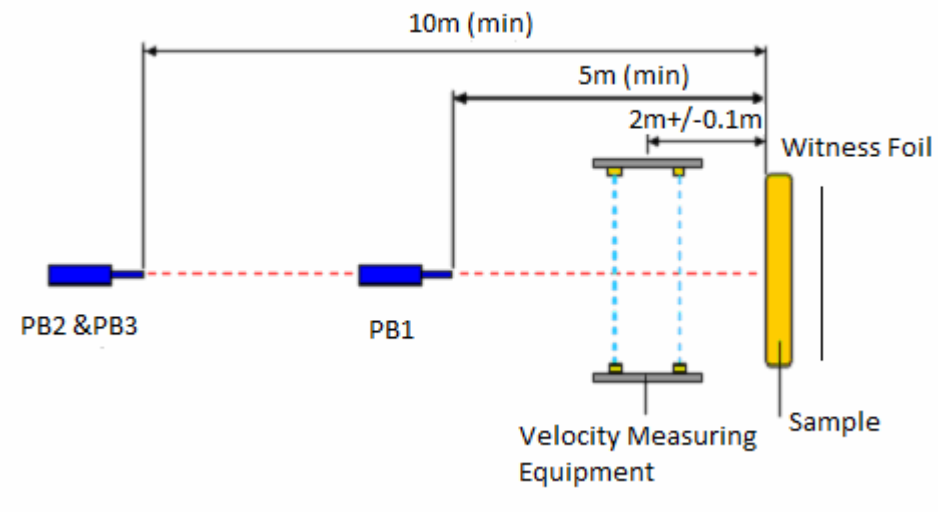

Figure 3: Test configuration.

PBP will be mounted on the test rig using any handles provided, in conjunction with the manufacturer's guidance, to ensure it is tested in the same way it is intended to be used.

Ammunition used for testing shall be subject to a visual inspection to ensure there are no defects.

Shots will be accepted in accordance with Section 3.3; additionally, a minimum of ten shots shall be taken within an area of 500 mm x 500 mm for all shields, regardless of size.

Unless otherwise stated (in the optional tests), the sample under test shall be placed in a room held at a temperature of 20±3˚C, and 40 per cent to 70 per cent humidity for a minimum of 12 hours immediately prior to testing. The

PBP shall be conditioned as it has been sent to the test facility, i.e. if it has been sent folded it will be conditioned folded.

5.3 Measurements

Velocity measurements shall be taken at a distance of 2 m±0.1 m from the surface of the test sample. The velocity measuring equipment shall be capable of taking measurements to an accuracy of ± 1 m/s and must be calibrated and maintained in accordance with the requirements of a recognised Quality Assurance Standard.

Fragmentation and perforation evidence shall be observed by placing a sheet of witness material consisting of aluminium foil, 0.02 mm thick and mass 54 g per m^2 behind the test sample. The witness foil shall be mounted in a suitable frame at a distance of 500 mm ±10 mm directly behind the test shot and must be a minimum of 300 mm x 300 mm in size. Witness foil shall be replaced after recording any fragmentation or perforation.

5.4 Test levels

Threat Level	Ammunition Description	Bullet Mass	Minimum No. Shots	Minimum Range (m)	Velocity (m/s)
PB1	9 mm DM11A1B2	124 gr	12 @ 0˚ 12 @ 45˚	5	430 ±10
	Winchester 1 oz. Rifled Lead Slug 12RS15 or 12RSE	437 gr	4 @ 0˚ (≥200 mm from edges)	5	435 ±10
PB2	5.56x45 mm LE223T3 Federal Tactical Bonded	62 gr	12 @ 0˚ 12 @ 45˚	10	750 ±15
	7.62x51 mm L2A2 NATO Ball	144 gr	12 @ 0˚ 12 @ 45˚	10	830 ±15
PB3	5.56x45 mm SS109 L17A1	62 gr	12 @ 0˚ 12 @ 45˚	10	920 ±15
	7.62x39 mm PS1943	122 gr	12 @ 0˚ 12 @ 45˚	10	705 ±15
	7.62x51 mm FED AE308D	150 gr	12 @ 0˚ 12 @ 45˚	10	840 ±15

Table 1: Shows the test levels and test details for compliance testing to this standard.

Any areas of perceived weakness on the PBP (e.g. joins, glazing, fixings, folds, stitching, handles etc.) will be subjected to extra shots; these shots must also adhere to the rules set out in Section 3.3. Any unaccepted strikes will be repeated on the same unit where possible.

For PBP to successfully pass compliance testing to this standard, the following criteria must be met.

- The shots must be classed as an accepted hit or strike (as described in Section 3.3).
- 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.
- The witness foil shall show no signs of perforation resulting from pieces of the test sample or the bullet passing through it.

5.5 Edge performance tests

The edge performance tests are designed to give the users further information on the performance of the PBP when shot close to the edges.

For this testing all of the rules in Section 3.3 must still be adhered to, except the distance to edge, which will be varied in these tests.

For shotgun edge performance, testing will be at 200 mm, 150 mm, 100 mm and 50 mm from the edge (±5mm). For all other calibres in all of the test levels, testing will be at 50 mm, 40 mm, 30 mm and 20 mm from the edge (±5mm). Two shots will be taken at each distance; all tests will be conducted at 0˚ angle of incidence.

The edge performance level of PBP will be set at the distance where all shots at that distance and distances further from the edge meet the criteria set out in Section 5.4. An example of this for PB1 level of protection is in Table 2 and would have the following result PB1-20/SG150.

Ammunition	Distance from edge (mm)	Shot 1	Shot 2
9 mm DM11A1B2	50	Held	Held
9 mm DM11A1B2	40	Held	Held
9 mm DM11A1B2	30	Held	Held
9 mm DM11A1B2	20	Held	Held
Winchester 1 oz. Rifled Lead Slug 12RS15 or 12RSE	200	Held	Held
Winchester 1 oz. Rifled Lead Slug 12RS15 or 12RSE	150	Held	Held
Winchester 1 oz. Rifled Lead Slug 12RS15 or 12RSE	100	Held	Perforated
Winchester 1 oz. Rifled Lead Slug 12RS15 or 12RSE	50	Perforated	Perforated

Table 2: Illustration of PB1 edge performance.

Table 3 below shows an example of PB2 results giving an edge performance level of PB2-30.

Ammunition	Distance from edge (mm)	Shot 1	Shot 2
5.56x45 mm LE223T3 Federal Tactical Bonded	50	Held	Held
5.56x45 mm LE223T3 Federal Tactical Bonded	40	Held	Held
5.56x45 mm LE223T3 Federal Tactical Bonded	30	Held	Held
5.56x45 mm LE223T3 Federal Tactical Bonded	20	Held	Perforated
7.62x51 mm L2A2 NATO Ball	50	Held	Held
7.62x51 mm L2A2 NATO Ball	40	Held	Held
7.62x51 mm L2A2 NATO Ball	30	Held	Held
7.62x51 mm L2A2 NATO Ball	20	Perforated	Perforated

Table 3: Illustration of PB2 edge performance.

Edge performance tests can be conducted using the same shields that were used for compliance testing as long as the rules regarding distance between shots are adhered to; otherwise extra samples will be required. Please contact CAST for further guidance.

5.6 Optional testing

In addition to the tests outlined in Table 1, and the edge performance tests above, PBP can be submitted to testing tailored for specific situations including: wet testing; testing after being exposed to high temperatures; testing after being exposed to low temperatures; and testing the ability of the PBP to withstand multiple shots in one location.

These tests are optional. However, if additional compliance tests are performed and meet the test criteria, these additional compliance tests and their results shall be clearly marked on the label and compliance certificate.

5.6.1 Wet test (optional)

Before the sample is tested it shall be fully submerged in water (at 15˚C to 20˚C) for a period of one hour. It shall then be removed and allowed to dry for three minutes in a room held at a temperature of approximately 20±3˚C, and 40 per cent to 70per cent humidity. The first shot shall impact within five minutes of the completion of the drying period, and the final shot fired within one hour.

A minimum of two extra samples for PB1 and PB2 and three extra samples for PB3 (or enough samples to accommodate the required number of fair shots) will be required to undertake this testing.

5.6.2 Extreme temperature test (optional)

Before the first sample is tested it shall be heated to 50˚C ±3˚C for a period of 1 hour +23-0. The first shot should impact within five minutes and six shots fired within one hour of removal of the PBP from the heating chamber.

Before the second sample is tested it shall be cooled to -20˚C ±3˚C for a period of 1 hour +23-0. The first shot should impact within five minutes and six shots fired within one hour of removal of the PBP from the cooling chamber.

A minimum of four extra samples for PB1 and PB2 and six extra samples for PB3 (or enough samples to accommodate the required number of fair shots) will be required to undertake this testing.

5.6.3 Multi-shot test (optional)

The multi-shot test is designed to test the PBP's ability to protect against multiple shots in the same location and will be conducted at 0˚ only.

Testing will be carried out using all of the ammunition types defined in the test level. For example, PB2 will be tested with 5.56x45 mm LE223T3 Federal Tactical Bonded and 7.62x51 mm L2A2 NATO Ball.

Shot one will be fired in accordance with the rules set out in Section 3.3; a held or perforated criterion will be given to this shot. If a held criterion is given, a second shot in the same location will be taken, i.e. not moving the PBP or barrel position. The PBP will then be reassessed for a held or perforated criterion for the second shot. This two-shot process shall be repeated a minimum of six times in separate locations in accordance with the rules set out in Section 3.3.

To pass the multi-shot test all shots will be required to be held.

A minimum of two extra samples for PB1 and PB2 and three extra samples for PB3 (or enough samples to accommodate the required number of fair shots) will be required to undertake this testing.

5.7 Certification

After successful compliance testing to this standard, any changes in size or design of the carrier (that do not change the construction of the protective pack) to PBP should be reported to CAST in order to determine if a new model number and/or certification is required.

Any changes to the construction of the protective pack must be given a new model number and are subject to full certification testing.

Modular inserts must be tested in conjunction with any other panels they are designed to be used with.

6 Manufacturers' Quality Testing (MQT)

MQT testing is a suggested[2] method of ensuring the continued quality of a PBP model once it has met the requirements of the CAST compliance test.

If a manufacturer already utilises an alternative sampling system, which meets or exceeds the sampling requirements of MQT1, it may be offered in preference, providing agreement has been reached with the customer.

Manufacturers/suppliers will be asked to agree to MQT (or an alternative as above) at the declaration stage of the compliance testing process. Results of MQT shall be made available to CAST upon request.

6.1 MQT1

Once 100 units of any model have been produced, manufacturers/suppliers shall carry out this testing (or arrange for it to be done at a suitable test facility; CAST will advise if required). Provision should be made for customer involvement with regard to selection of samples for testing.

MQT1 testing will follow the same format and pass/fail criteria as compliance testing, with a reduced number of shots as shown in Table 4 below.

Threat Level	Ammunition Description	Bullet Mass	Minimum No. Shots	Minimum Range (m)	Velocity (m/s)
PB1	9 mm DM11A1B2	124 gr	5 @ 0˚ 5 @ 45˚	5	430 ±10
	*Winchester 1 oz. Rifled Lead Slug 12RS15 or 12RSE	437 gr	1 @ 0˚	5	435 ±10
PB2	5.56x45 mm LE223T3 Federal Tactical Bonded	62 gr	5 @ 0˚ 5 @ 45˚	10	750 ±15
	7.62x51 mm L2A2 NATO Ball	144 gr	5 @ 0˚ 5 @ 45˚	10	830 ±15
PB3	5.56x45 mm SS109	62 gr	5 @ 0˚ 5 @ 45˚	10	920 ±15
	7.62x39 mm PS1943	122 gr	5 @ 0˚ 5 @ 45˚	10	705 ±15
	7.62x51 mm FED AE308D	150 gr	5 @ 0˚ 5 @ 45˚	10	840 ±15

Table 4: Test levels for MQT1 testing.

[2] The MQT test protocol has been supported by ACPO and the Police Federation of England and Wales in an attempt to encourage forces who do not already request some form of quality assurance from manufacturers to start including it in future supply contracts.

6.1.1 Edge testing for MQT1

A minimum of one shot at each calibre must be taken at the edge performance level achieved during certification.

Manufacturers are required to supply enough units to enable the full amount of testing to be completed, with a suggested minimum of one complete unit for each ammunition type. Please contact CAST directly for guidance.

6.2 MQT2

Once 400 units of any model have been produced or two years have elapsed (whichever is soonest) since compliance testing, manufacturers/suppliers shall arrange for MQT2 testing to be conducted at a CAST-approved facility. MQT2 testing shall follow the same format and pass/fail criteria as compliance testing. Edge performance testing and any optional testing shall be repeated.

If the test is successful, the test house shall inform CAST and a new compliance certificate will be issued and will remain valid for a further two years or 200 units.

6.3 Manufacture of new PBP to MQT2

If the model fails to meet the requirements of MQT2 testing, the manufacturer/supplier shall investigate the reason/s for failure. If the reason/s for failure is identified and rectified for all affected PBP, production may resume.

If the reason/s for failure cannot be established, production of the model shall cease and CAST shall be informed. The model may then be up-rated and re-submitted for full compliance testing at a CAST-approved test facility with a suffix added to the existing model designation. Once the model meets the requirements of compliance testing, all affected models shall be withdrawn, up-rated to their original protection level/s and returned to service.

6.4 In-service testing (dip or age)

In-service testing should be conducted at regular intervals during the warranty period of the PBP to determine if the PBP is prone to degradation over time. In some cases (usually with prior agreement with the supplier) this can extend beyond the warranty period. If any “in-service” model fails to meet the requirements of this testing, the manufacturer/supplier shall investigate the reason/s for the failure. If the reason/s for failure is identified, the test should be repeated on further “in-service” samples.

If these further samples fail to meet the requirements and the reason/s for failure cannot be established, CAST shall be informed as it is possible that a progressive degradation in protection level has occurred and remedial action will need to be considered to return the PBP to its original protection level. This testing shall be conducted in accordance with the MQT2 protocol, i.e. it should be conducted at an approved CAST test facility unless separate manufacturer’s in-house testing regimes have been contractually agreed with the customer with regard to frequency and numbers of samples submitted.

Where contracts make provision (for the purpose of in-service testing) for in-house testing by the manufacturer/supplier, the agreed number of samples should be withdrawn from service (at pre-determined intervals), examined and subjected to testing in accordance with the test criteria for MQT2. These conditions are usually requested at the tender stage or at the onset of a contract whereby the manufacturer will agree (at a cost) to maintain the PBP for the warranty period and in some cases extend the warranty period. Any post-warranty agreement is usually carried out on an annual basis and conditions of service may vary between manufacturers.

7 Inspection of PBP

This section gives guidance on the inspection of PBP for both soft and hard elements. PBP should be examined on a large flat clean surface with adequate lighting. PBP should be checked to ensure it has all labels attached and that they are clearly legible.

7.1 Soft armour elements

- Check across the faces to verify the material is not torn or snagged.
- If the unit is sealed (does not come out of the carrier), check the seam for tears, in particular in areas where there are fixings or handles etc.
- If the protective pack does come out of the carrier, carefully remove and check for tears in the outer layer.[3]
- Ensure all handles and fixing mechanisms are still securely attached, not damaged and fully functioning.
- Ensure that the protective material is positioned as designed, i.e. covers the entire specified area of protection.
- By carefully running your hands over the surface of the PBP, check that there are no creases or areas of unusual thickness (excluding areas that are designed to be folded).

7.2 Hard armour elements

- Check for cracks, breaks and irregularities of the surface.
- Ensure all handles and fixing mechanisms are still securely attached, not damaged and fully functioning.
- Check the shield does not rattle when shaken (if possible); here you are listening for indications of damage within the main component of the protection, where the material may have broken up.
- Check for fraying of material along any edges.
- Check for damage or crumbling at corners.

If there are any concerns with the PBP, contact the manufacturer or CAST for guidance.

[3] If any tears are found, the PBP should be returned to the manufacturer for inspection and recovering as water ingress can degrade the properties of the protective material.

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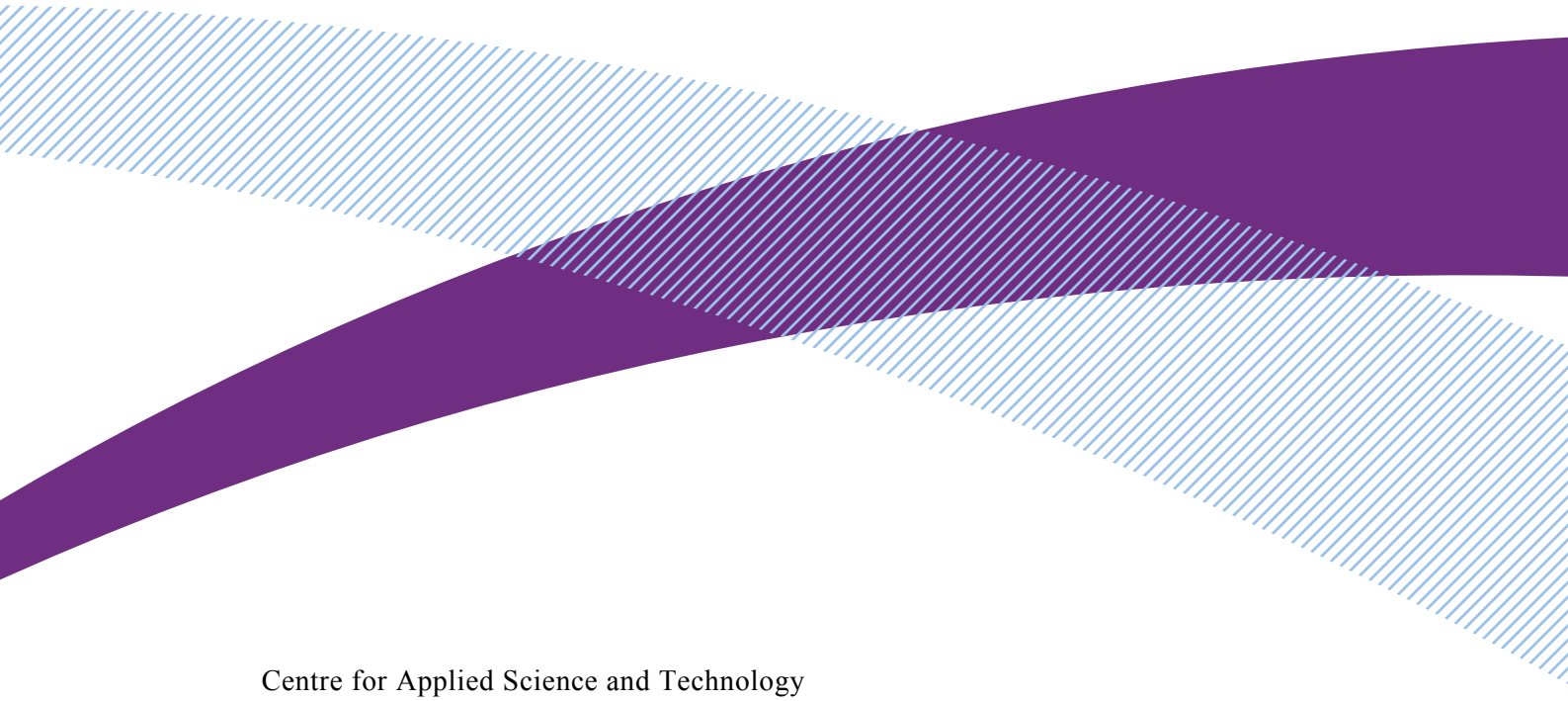

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