Home Office

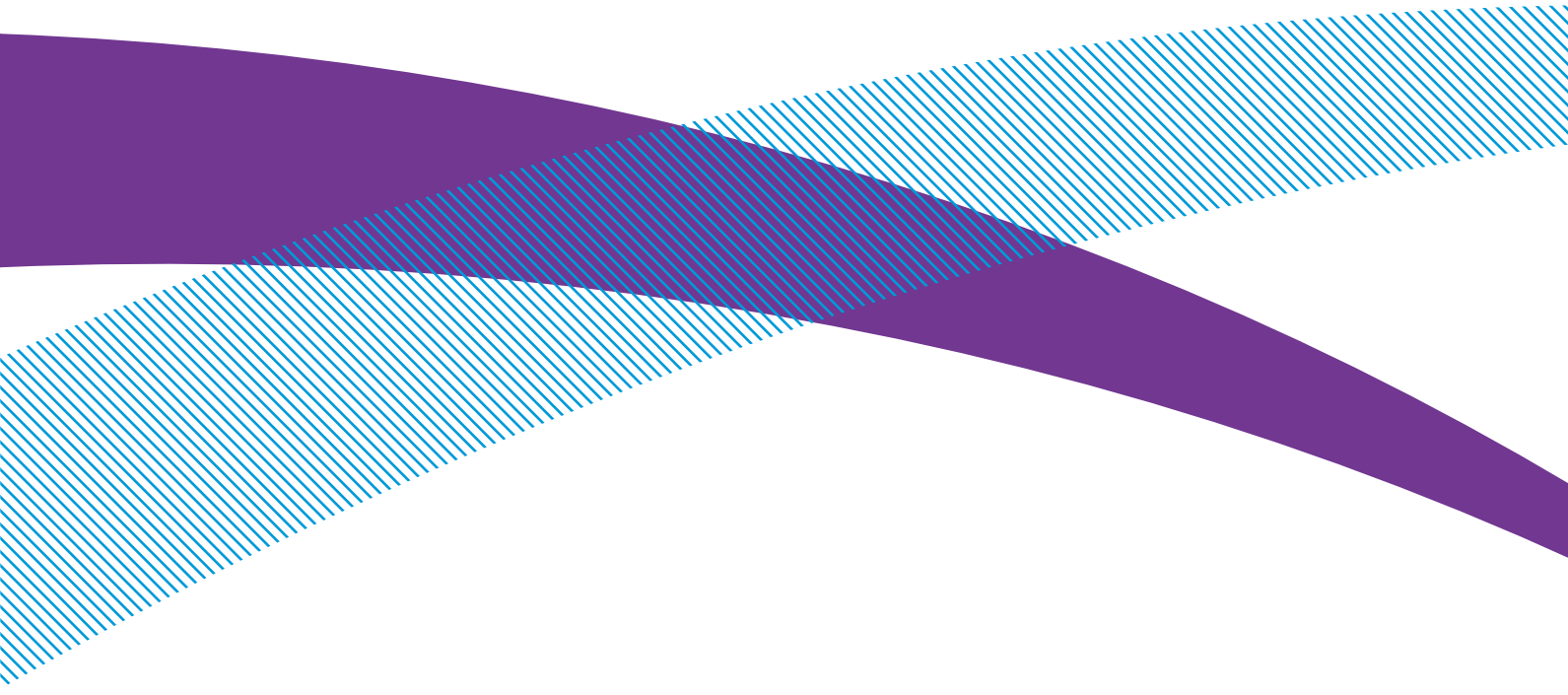
Scientific Development Branch

HOSDB Body Armour Standards for UK Police (2007)

Part 1: General Requirements

Publication No. 39/07/A

John Croft
Daniel Longhurst



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Foreword

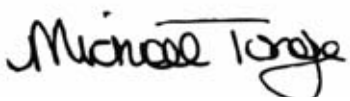
In 1993, HOSDB (then PSDB) published the first Stab Resistant Body Armour Test Procedure. This document provided a reproducible test method for assessing the protection offered by commercial body armour. The test procedure dealt primarily with the typical threat that may have been encountered from readily available knives. In the same year PSDB published a revision of an earlier version of a ballistic test procedure as a Standard. This revision was the first body armour standard produced by the Home Office and it was this standard that prepared the ground work for further standards. In 1995 a further revision to the ballistic standard incorporating a rifle threat was published.

In October 1999 PSDB completed a major review to the 1993 stab specification and published the PSDB Stab Resistance Standard for Body Armour (1999). The standard contained a number of significant new features including the use of two engineered test blades to replace the previous commercially produced blades and three different levels of knife and spike protection for use in different operational scenarios. For instance, the optional spike protection level was introduced into the standard as attacks using a none-edged weapon were identified as a particular threat to UK Prison Officers.

The year 2003 saw the Ballistic and Stab Standard reviewed again and combined into a three part document: Part 1 General Requirements, Part 2 Ballistic Resistance and Part 3 Knife and Spike Resistance. Other changes included the addition of a new HG1/A ballistic threat level with an increased blunt trauma limit to accommodate officers who required a more flexible garment. This protection level has proved particularly popular as a covert vest.

In 2005, HOSDB and ACPO staged a series of body armour road shows to almost every UK Police Force. One important issue highlighted in the road show discussions was a need to address the increased ballistic threat to Authorised Firearms Officers (AFOs) posed by the introduction of more powerful weaponry.

This document is the product of further reviews and has been introduced to offer protection against the threat from the G36C and other short barrelled 5.56 calibre carbines increasingly used by AFOs. A further rifle protection level – RF2- is also included in this standard together with increased compliance testing to increase the statistical confidence and robustness of body armour at all threat levels.



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1 Management Summary

In 1993 and 1995, HOSDB (then PSDB) published a Stab Resistant Body Armour Test Specification and the PSDB Ballistic Body Armour Standard (1995) respectively. These documents described a test methodology for assessing the protection afforded by commercial body armour systems against typical ballistic and edged weapons judged to be a threat in the UK.

In October 1999 HOSDB completed a major revision to the 1993 stab specification and published the PSDB Stab Resistance Standard for Body Armour (1999). The standard contained a number of significant new features including:

- The use of engineered test knives to replace the previous commercially produced knives;
- The introduction of a guided rail drop tube to replace the air cannon fired system;
- A new composite backing material;
- Three different levels of protection for use in different operational scenarios.

In 2003, HOSDB revised the 1999 stab standard and produced a three part standard:

- Part 1 General Requirements;
- Part 2 Ballistic Resistance;
- Part 3 Knife and Spike Resistance.

This 2007 revision provides further enhancements identified during a comprehensive series of body armour presentations to forces (road shows) with a new HG3 threat level to address the threat of the ever increasing use of the G36 Carbine by Authorised Firearms Officers (AFOs). A further rifle protection level is also included in this standard along with increased compliance testing to increase the statistical confidence and robustness of body armour. The enhancements include:

- HG3 (including HG3 special): Carbine protection against specific 5.56mm ammunition;
- RF2: Rifle protection against high power 7.62mm ammunition;
- MQT: A method of ensuring continued quality of an armour model.

2 Introduction

Ballistic body armour has been available to UK police for many years. Initially, the main users were Authorised Firearms Officers (AFOs) and those tasked with duties where they were exposed to known risks from armed attack. In recent years there has also been a requirement for stab protection for officers involved in specialist duties. The requirement for protective body armour embracing both ballistic and stab protection is now extended to patrol officers who, in some forces, are wearing overt protective body armours whilst on foot and vehicle patrol.

Before selecting body armour, each force should perform a risk assessment to determine the appropriate level of protection required for its officers. For instance, it is generally accepted that UK officers face a greater threat from edged weapons (knives) than they do from bullets. Likewise, attack with non-edged weapons (spikes) is more likely to be faced by prison officers than police.

A major feature of this revision is the inclusion of a suggested method to assess the continued quality of newly manufactured and in-service body armour.

Manufacturers Quality Testing (MQT) is an attempt to encourage forces who do not already request some form of quality assurance from body armour manufacturers to start requesting it in future supply contracts.

These and other revisions such as the introduction of HG3 and RF2 protection levels have been supported by ACPO and the Police Federation of England and Wales

3 Scope

This part of the standard contains the general requirements for body armour intended to provide torso protection to officers exposed to assaults by firearms and/or edged weapons (knives) and non-edged weapons (spikes). The standard does not directly address slash threats. However, as stabbing attack by both edged and non-edged weapons are more difficult to defeat, body armour capable of defeating stab (and ballistic) threats will perform satisfactorily against slash attacks.

4 Associated Documents

HOSDB Body Armour Standards for UK Police (2007) - Part 2 Ballistic Resistance;

HOSDB Body Armour Standards for UK Police (2007) - Part 3 Knife and Spike Resistance.

PSDB Portable Ballistic Standard for UK Police (2004)

HOSDB Slash Resistance Standard for UK Police (2006)

5 Testing and Publication of Results

The primary purpose of this document is to detail the general requirements for the compliance testing of body armour. It also provides body armour manufacturers with sufficient information to enable them to carry out development testing prior to submission for compliance testing by a HOSDB accredited test facility.

The results of body armour certification testing to HOSDB standards are published on the Home Office website

The website contains information regarding manufacturer's contact details, details of body armour models that meet particular levels of protection and downloadable copies of the standards and can be accessed at: http://science.homeoffice.gov.uk/hosdb

6 General Requirements and Documentation

Part 2, Ballistic Resistance and Part 3, Knife and Spike Resistance define methods of assessing the protection offered to the police by commercial body armour systems against firearm and/or knife and spike threats.

Body armour certified to HOSDB standards shall, in the case of a stab threat, afford protection against injury from penetration by knives (edged weapons) or by knives and spikes (edged weapons plus non-edged weapons). In the case of a firearm threat, protection shall be afforded against penetration by the bullet and the blunt trauma effects of the impact. In all cases, the construction of the body armour must ensure that the movement of the wearer is not unduly restricted.

The protected area of all body armour supplied as a result of successful compliance testing to this standard must include the torso to ensure coverage of the major organs, in particular the heart, liver, lungs, kidneys and spleen[1]. Each model of body armour shall meet one of the protection classes described in the standard. The protection must be determined by conducting a full risk assessment of the specific threats that the wearer is likely to encounter.

6.1 Declaration of Construction

Prior to compliance testing by an HOSDB approved test facility; a declaration of construction (appendix A) must be submitted for approval by HOSDB.

Declarations should be submitted via e-mail, as a Microsoft word document attachment to: declarations@homeoffice.gsi.gov.uk . The subject of the e-mail should use the following convention:

Manufacturer: Model: Threat Level: Chosen Test Facility e.g.: Your Company: model: HG1/A KR2+SP2: Mellrichstadt, Shrivenham or Wichita.

For common soft materials used in the construction of the Body armour (e.g. aramids & Ultra High Molecular Weight Polyethylene [UHMWPE]) the declaration shall contain the following level of detail:

Yarn

- Name (trade name and reference);
- Producer (manufacturer and specific location);
- Construction/ Filament Count;

[1] Certification to any HOSDB protection level does not imply that a particular design of body armour will automatically provide protection of the 5 named major organs. Purchasers should satisfy themselves that any armour supplied to them complies with these requirements.

- Decitex (grams per 1000m of yarn);

Weave type

- Material;
- Material Producer (Manufacturer Name and Specific Location);
- Material Coating: International Union of Pure and Applied Chemistry, International Identifier (InChI);
- Quilting Orientation and Spacing;
- Quilting Thread.

For metallic elements, the following information is required:

- Metal used, including alloy ratios;
- Metal Supplier;
- Manufacturer;
- 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).

Carriers and Protective Pack Covers:

It is generally expected that customers will specify their preference of the type/style of carrier and/or cover on armour models supplied to them. However, for the purpose of compliance testing, both carrier and protective pack cover shall not contain any ballistic and/or stab resistant qualities.

Test samples shall be supplied for compliance testing in plain single layer carriers and protective pack covers of density not exceeding 220g/m^2. The armour construction (including any films, sealing materials or any supporting fabric) within the protective pack cover must be identical to that described on

the declaration and must remain consistent throughout manufacture of the model.

6.2 General Labelling

Each protective pack shall have a label permanently attached to its exterior surface. The label shall be clearly marked in an easily readable type size with the following information:

- The manufacturer's name;
- The date of manufacture and batch number;
- The model number (see definitions sect 7)
- The test house reference e.g. DCMT/ESD/JC/1234/OCT/07. This reference along with the model number 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 type that the armour affords (e.g. 'Stab Resistant Only');
- The protection level of the armour (i.e. HG1+KR1+SP1 etc.);
- A set of instructions for cleaning and use;
- A statement clearly defining the side of the panel to be worn against the body.

If the protective pack is constructed from more than one component, each separate component shall also clearly display information to ensure that it is inserted correctly. The main information label on the protective pack cover/s shall include information describing how many components are required to meet the stated protection level.

6.3 Colour Coded Labels

Additionally, a user identification label (figures 1, 2 and 3) shall be attached to the exterior surface of the protective pack and to the inside of the carrier such that it is clearly displayed to the user. This label shall be coloured according to the type of protection offered by the body armour and shall be at least 100mm x 60mm in size.

If the armour carrier has been designed to allow for the fitting of a further protective pack effectively converting it to dual-purpose armour, an appropriate colour coded label shall be fitted to each panel. In this case, a statement must also be carried on the inside of the carrier warning the user that the armour has removable panels, each offering different threat levels. It should also state that its contents must be checked to ensure the correct protective packs have been fitted and that the armour is capable of providing the intended protection level.

Note:

Windows may be incorporated into the inside of the carrier so that each colour coded label fitted to the exterior of the protective packs can be seen without the need to open the armour pack pockets of the carrier. If this method is preferred, a colour-coded label will not be required on the inside of the carrier. Also, the requirement for a colour coded label on the carrier may be omitted but only with the written agreement of the customer.

FIGURE 1 *A Stab Only Label*

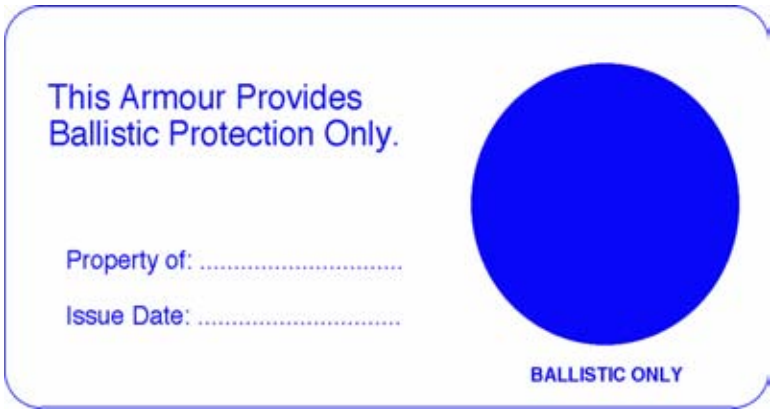

FIGURE 2 *A Ballistic Only Label*

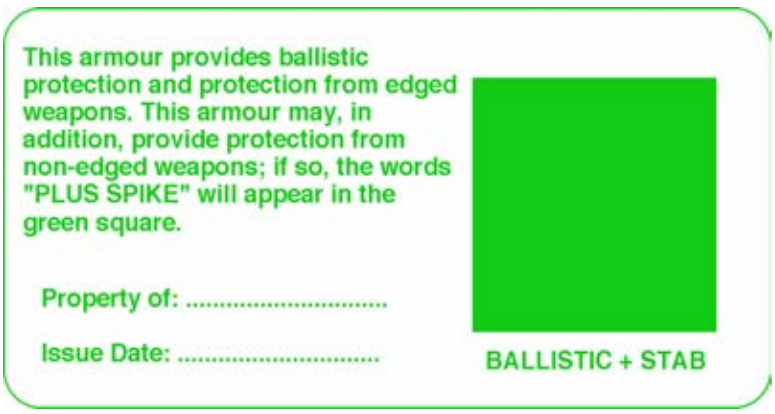

FIGURE 3 *A Dual-Purpose Label*

For body armour that has been successfully tested for compliance to this standard at a HOSDB approved testing facility, the following statement shall be included on the label:

"The manufacturer certifies that model number (insert) has been tested at a HOSDB approved testing facility and has been found to comply with HOSDB standard 39/07 for (insert protection level e.g. HG1/KR1+SP1)."

The above statement and labelling shall not appear on body armour that has failed HOSDB compliance testing, or on armour that has not been fully tested for compliance to one or more of the protection levels in this standard.

6.4 Sizing and Comfort

The armour system shall be made available in a variety of sizes to allow for a variation in height and build of the wearer. Any tapering of the protective pack (feathering) to allow for a comfortable fit shall be restricted to 15mm. Any such tapering must be taken into account so as not to affect the area of full protection to the 5 major organs. It must also be adjustable to afford the wearer maximum comfort. The protective insert must be removable to enable the outer jacket (carrier) to be laundered when necessary.

Consideration may be given to the jacket/carrier design so that the protection rating can be upgraded by the insertion of additional panels. The level of any protection must be clearly stated using labels described in section 6.2 and 6.3 of this standard. Additional/upgrade panels (Modular Inserts) must offer the same area of protection as the original armour and afford full protection to the five major organs to the upgraded level.

6.5 Additional Panels for Extended Coverage

Any additional panels supplied for protection of the neck, groin, shoulders etc. shall be of identical construction as the main front and rear torso stab and/or ballistic resistant panels unless clearly marked that they offer another form of protection e.g. Slash Resistance.

6.6 Quality of Manufacture and Traceability

Each armour test sample shall be free from wrinkles, blisters, cracks or fabric tears, crazing, chipped or sharp corners or other evidence of inferior workmanship. All samples shall be identical in appearance and manner of construction.

Note:

Body armour produced as a result of successful compliance testing shall also fulfil these requirements

Manufacturers providing armour for compliance testing should be able to demonstrate consistency of manufacture through membership of an appropriate quality standard e.g. ISO 9001:2000, UKAS, ISO 17025 etc.

Additionally, before a model is accepted for compliance testing, manufacturers are encouraged to submit (with the declaration) a statement detailing test data such as ballistic limit test results, V50 or similar relating to the performance of the model submitted.

6.7 Continuity of Construction

The signed declaration submitted to HOSDB states:

(*Insert Company Name here)* hereby declare that all body armour produced as model Number ..... as a result of successful Compliance Testing to HOSDB Standards will be of the same construction, using the same materials (from the same suppliers) and stitch patterns as the test sample/s listed above in accordance with Part 1 General Requirements, Section 6.1 of HOSDB Body Armour for UK Police (2007) Publication No 39/07 whether the armour is Ballistic, Stab or both.

For each successful armour 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.

7 Definitions

7.1 Accepted Hit or Strike

An accepted hit or strike is defined as all those conforming to the criteria for a "Fair hit or strike". An accepted hit or strike can be an "Unfair hit or strike", when the impact energy, or velocity, is above the specified test limits and results in no excessive penetration, or back face deformation, of the armour sample. Additionally, any hit below the minimum velocity, which results in penetration or excessive back face deformation shall be an accepted hit or strike.

7.2 Angle of Incidence

The angle formed by the line of flight of the knife missile or bullet and the perpendicular to the plane tangent with the point of impact (see figure 4). The values for the angle of incidence depends on the nature of the test being carried out; for further details refer to the appropriate test procedure.

7.3 Armour Panel

This is constructed of layers of material designed to provide protection against a ballistic and/or knife/spike threat. Also known as the protection panel or pack.

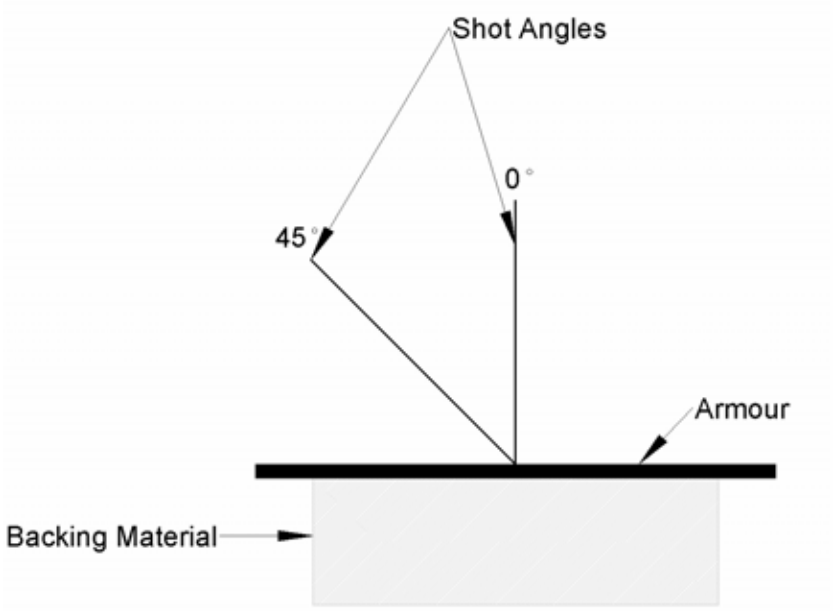

FIGURE 4 *Ballistic Shot Angle*

7.4 Armour Plate

A rigid structure intended to provide protection against high energy, high velocity or armour piercing bullets and projectiles. These plates can be placed in large pockets on the carriers of ballistic vests and must have been tested for compliance to SG1, RF1 or RF2 in conjunction with the armour with which it is intended to be paired[2]

7.5 Back Face

This is the inner surface of the body armour that is worn against the body, and placed against the surface of the backing material during testing.

7.6 Back Face Signature (BFS)

The maximum displacement of the back surface of the protective pack, caused by a fair hit that does not penetrate the armour, and is determined by measuring the depression in the backing material. This measurement is taken from the top edges of the steel tray (see relevant section of Part 2).

Note: For tests carried out on built up or curved backing material (i.e. bust shots) the back face signature is not measured.

7.7 Backing Material (Ballistic and Stab [bust shots on shaped armour only])

A homogenous material of non-hardening, oil based modelling clay giving plastic qualities. For the purpose of HOSDB compliance testing, Roma Plastilina® No1 shall be used.

7.8 Blunt Trauma

This is the injury resulting from energy transfer from the projectile or weapon to the body.

7.9 Bullet Resistance

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

7.10 Bullet Resistant

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

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[2] SG1, RF1 and RF2 plates are intended for use by Authorised Firearms Officers (AFOs) in conjunction with HG2 or HG3 armour. However, if a plate is tested and achieves certification using a certified HG1 armour, it may then be used in conjunction with any HOSDB certified HG2 or HG3 armour from the **same manufacturer**. HOSDB reserves the right to carry out testing on any HG1 armour submitted for use with SG1 and RF1/RF2 plates to ensure that it is a genuine HG1 level armour and that it does not meet the HG2 or HG3 level.

7.11 Carrier

This is the outer garment sometimes referred to as the armour jacket usually supplied in tabard or pseudo waistcoat (two-piece) or waistcoat style (three-piece). For armour submitted for HOSDB Compliance Testing, the test sample shall be supplied in a plain single layer carrier of density not exceeding 220g/m^2. Armour packs shall be removed from carriers for the purpose of knife and spike testing.

7.12 Composite Backing Material (stab only)

A composite of materials consisting of (from the strike face, see section 7.28) four layers of 6mm RA110 neoprene, followed by a single 30mm layer of 33kgm^{-3} Plastazote® foam, backed by 2 layers of 6mm 2494D rubber.

7.13 Engineered Test Knife

An edged test blade designed to replicate a class of actual knives used in assaults on police at typical test energies described in Part 3. Detailed engineering drawings of the knife are also given in Part 3.

7.14 Engineered Test Spike

A test spike designed to represent a typical non-edged weapon at typical test energies described in Part 3. Detailed engineering drawings of the spike are also given in Part 3.

7.15 Feathering

A tapering or gradual step down of the layers in the protective pack. This is usually done to allow a more comfortable fit for the wearer. However, this feathering has to be limited as the feathered area does not offer full protection against the threat. See section 8.2

7.16 Fair Hit or Strike

A hit or strike that impacts the armour at an angle of incidence no greater than ± 5° from the intended angle of incidence. The hit or strike shall be no closer to the edge of the protective insert than 50mm, no closer than 50mm from the edge of the tray holding the backing material and no closer to a previous strike than 50mm. The energy will be within the specifications required for the intended level of protection.

7.17 Fragmentation

The break up of the armour material into small pieces, due to the impact of a bullet, knife or spike. Also known as ‘Spall’ Figure 5 illustrates this process.

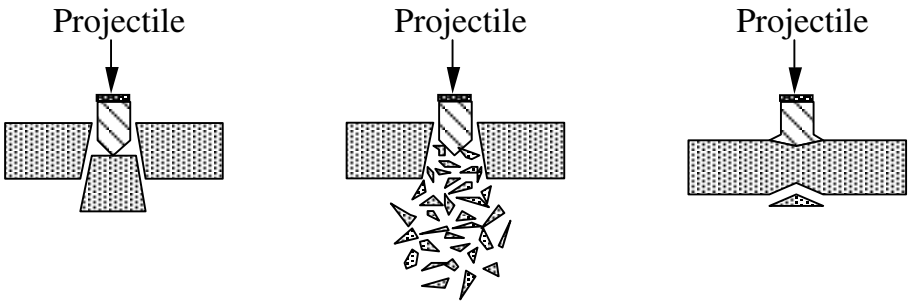

***FIGURE 5**: Diagram illustrating different examples of fragmentation.*

7.18 In-Service Testing

Testing of armour that is in use and being worn. 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 armour under warranty and even beyond the warranty period.

7.19 Knife/Spike Missile

The apparatus that drops freely under its own weight to strike the test armour at a specified energy. The knife/spike missile incorporates a damping system, which is designed to accurately replicate the energy delivery of a human hand stabbing action.

7.20 Model

A manufacturer designation[3] (name, number or other description) that serves to uniquely identify a specific configuration of body armour based upon the details of the protective pack construction (i.e. number of layers of one or more types of stab and/or ballistic resistant material assembled in a specific manner) The model number shall not consist of all or part of the threat levels i.e. model numbers such as: HG1/KR1 shall not be permitted. ***Each sample type submitted for testing shall carry this unique identification on every armour panel.***

7.21 Modular Insert

Additional items that may be added to body armour to increase the level of protection provided. These must offer the same area of protection as the original armour and afford full protection to the five major organs to the upgraded level.

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[3] HOSDB verifies the stab and/or ballistic resistance of a **model** on the basis of compliance testing of samples of the model in accordance with this standard. As an example, differences in stitching (e.g. box stitch versus quilt stitch) would make the panels different **models**. If a **model** of armour fails compliance testing, the manufacturer may never resubmit any armour construction under that model designation or the same construction under a different model number.

7.22 Manufacturers Quality Testing (MQT)

MQT testing is a suggested method of ensuring the continued quality of an armour model once it has met the requirements of the HOSDB compliance test. It is intended that this method will be used by the police customer at the tender stage of body armour procurement

7.23 Pencilling

This is the general term for a narrow diameter indentation in the Roma Plastilina® backing material caused by the bullet. The armour sample has not been penetrated but the material has failed to stop the round from causing a deep narrow indentation, which has the potential to cause a serious or fatal injury. See Part 2 section 8.3.

7.24 Penetrating Trauma

This is the injury resulting from a bullet or projectile passing through the skin, or a knife, spike or a similar weapon perforating the skin. The extent of this type of trauma can vary. Penetrating trauma may be the result of 'Pencilling'

7.25 Penetration

Complete perforation of an armour sample by a fragment, or whole, of a test knife, spike or bullet, or by the armour material or fragments, as evidenced by the presence of that fragment in the backing material, or of a hole in the backing material.

7.26 Penetration Depth (knife test only)

The length portion of the P1B test knife protruding through the rear surface of the armour sample.

7.27 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".

7.28 Stab Resistance

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

7.29 Stab Resistant

A description of a material or product showing resistance to knife and/or spike penetration.

7.30 Strike Face

The surface of the body armour designated by the manufacturer as the surface facing the threat.

7.31 Style

A manufacturer designation (name, number or description) that uniquely identifies the design of the carrier or the size of the armour. For example a manufacturer may make two armours, each of the same model, but in different styles (i.e. covert and overt). For the purposes of testing, only the model requires testing; if the model meets the requirements of this standard, then each style can be considered to meet the requirements of the standard without requiring a test of each style.

7.32 Test Reference

This reference (unique to each body armour model) is present on all documentation issued by the test house and on the certification document issued by HOSDB. ***The test reference must be displayed on each armour panel label adjacent to the model number[4].***

7.33 Test Sample

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

7.34 Trauma Pack

This is constructed from materials that are designed to fit in a carrier and be worn in conjunction with a ballistic panel to reduce blunt trauma injury. If the protective pack has been tested with the trauma pack in place, the trauma pack becomes an integral part of the protective pack and must always be correctly fitted to ensure full protection.

7.35 Unfair Hit or Strike

A shot or strike that:

- Impacts the body armour at an angle of incidence greater than ± 5° from the intended angle of incidence;
- Is closer then 50mm from any other shot, 50mm from the edge of the sample and 50mm from the edge of the tray holding the backing material;
- Produces velocities above the specified test limits and results in excessive penetration;
- Produces energies outside the specifications required for the intended level of protection.

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[4] This applies only to production body armour produced as a result of successful compliance testing to HOSDB Standards.

7.36 Upper Prediction Limit (UPL)

The upper prediction limit is a prediction of the likely maximum Back Face Signature (BFS) that would be seen over many hits, based upon the measurements obtained from the limited numbers of test samples.

To be meaningful, the UPL must be associated with a particular probability. For example 95% UPL means that we expect 95% of hits to have BFS within the UPL.

7.37 Velocity of Bullet

The velocity of the bullet, measured at a distance of 2m ± 0.1m from the front face of the armour sample to the centre of the velocity measuring sensors. See relevant section of Part 2.

7.38 Velocity of Knife/Spike

The velocity of the knife or spike measured at a distance of 25mm ± 2mm from the knife/spike tip to the front face of the armour sample. See relevant section of Part 3.

7.39 V50

V50 is a method of determining the velocity of a particular round that will cause 50% penetration of a particular armour model. V100 being the velocity of a round that will cause 100% penetration and V0 is the velocity in which no penetration would result.

7.40 Wear Face

The surface of the body armour designated by the manufacturer as the surface that must be worn towards the body.

8 The Body Armour Test Sample

8.1 Submission Requirements of the Test Sample

Before submitting any armour samples to a HOSDB approved test house for compliance testing, manufacturers and suppliers are required to inform HOSDB, in writing, of their intention to submit the samples for testing. Documentation describing the construction of the body armour shall be included. This documentation shall be in the form of a declaration stating that any body armour produced as model number **** as a result of successful compliance testing to HOSDB standards, will be of the same construction, using the same materials as the armour sample (a copy of the declaration form can be found in appendix A). The order of construction of materials (see section 6.1) from the strike face down 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 protective pack. The manufacturers/suppliers choice of test house should also be included.

HOSDB will classify this information "RESTRICTED COMMERCIAL".

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

Once HOSDB is satisfied with the declaration, the test house will be informed of the manufacturer/supplier intention to submit the model number/s agreed with HOSDB 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.

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

When the test house receives the sample/s, it shall be examined to ensure that labels are present on the sample/s stating the correct model number and that all information complies with the requirements of Part 1 section 6[5].

Test houses are not authorised to carry out compliance testing to HOSDB standards until the labelling requirements have been complied with.

After successful testing, the body armour sample/s along with test results will be returned to HOSDB for analysis of construction and comparison with the declaration and issuing of the certification document. If the armour is not successful, the test house will inform HOSDB and the test samples will returned at the request of the manufacturer.

Each armour sample shall fulfil the workmanship criteria detailed in Part 1 section 6.6. The sample should be a complete body armour, including front and

[5] Colour Coded Labels are not required at certification testing if the following statement is present on the declaration: "If this body armour model is supplied to UK Police, we certify that the correct colour coded labels will be fitted in accordance with Part 1 section 6.3 of this standard". See also note at section 6.3

rear panels in a protective carrier, and should represent a model that is either in production, or intended for production.

If shaped bust female body armour is supplied, it should be representative of the construction method employed on both the smallest and the largest bust-sized garments of the model range. If either of the extreme sizes (large or small) have different methods for producing the shaped bust cups (i.e. with differing inherent weaknesses), then samples of *each* type of construction shall be supplied for testing.

8.2 Feathering of the Protective Pack Material

Armour samples submitted for HOSDB compliance testing will be allowed a maximum of 15mm of tapering (feathering) or step down of its edges (see section 6.4). HOSDB advise that: If a model is successful in achieving certification, the certification documentation will be issued on the understanding that this limit is not exceeded on any armour produced (as a result of successful compliance testing). **Any breach of this limit may result in certification being removed from the model.**

8.3 Pre-conditioning the Test Sample for the Dry Test

The armour under test should be placed in a room/area held at a temperature of $20^{o}C \pm 3^{o}C$ and 40% to 70% humidity for at least 12 hours prior to testing.

8.4 Pre-conditioning the Test Sample for the Wet Test (optional)

Wet testing of the body armour is optional, providing that compliance with the wet test is clearly marked on the armour. If a wet test is performed, a dry test will still be required for the body armour to comply with the standard.

The body armour sample inner cover shall be cut from the centre neck line (body side) to the base to allow water ingress. The sample shall then be submerged vertically in de-ionised distilled water (Baxter H_2O or similar) at 15°C to 20°C for a period of 15mins ± 3mins. The sample shall then removed and allowed to hang vertically for 5 minutes in a room/area complying with the pre-treatment conditions given at section 8.3. The appropriate test procedure shall then be carried out. The first strike shall impact within 5 minutes of the completion of the drying period and the final strike not more than 45 minutes later.

9 Additional Testing at Specific Points of Weakness

Seams, or other joins between materials used in the armour construction shall be subjected to additional testing at each seam or join type, in an orientation most likely to show weaknesses in the join or seam.

9.1 Additional Test Strikes on Waistcoat Fastenings

Where body armour is cut into a waistcoat design (or similar) containing zips or hook-and-pile fastenings running down the front of the chest area, additional tests are required to ensure that the join provides adequate protection when sealed.

9.2 Additional Test Strikes on Female Armour

Where body armour is cut and stitched to form bust cups for female body armour, additional tests shall be performed to ensure that the armour provides acceptable protection at these potential areas of weakness.[6] If the bust cup contains one or more seams, the manufacturer shall supply a detailed diagram to identify the location of each seam, and the shot or strike shall impact a seam.

These tests shall be performed with the backing material fitted to the bust shape to remove any air gaps between the face of the backing material and the body armour.

9.3 Additional 45° Angle Test Strikes (Knife only)

Angled test strikes shall be performed at the discretion of the test house if overlapping plates have been used in the armour construction or where a construction may be compromised by an angled attack. Full test details are given in Part 3 of this standard.

[6] At least two front female panels will normally be required to perform this test in addition to the flat panels required for the tests described in the remainder of this document.

10 Performance Assessment

10.1 Ballistic Performance

For ballistic resistant body armour to be successful, in accordance with Part 2 of this standard, it must meet the following criteria:

- Each shot must satisfy the criteria of an accepted shot as defined in Part 1 section 7.1 with respect to velocity and position detailed in the relevant section of Part 2;
- No penetration of the bullet or fragment through the armour sample is permissible, nor may any part of the bullet be visible from the side of the wear face;
- If a rigid panel is incorporated into the design of the body armour, then no part of the panel, i.e. pieces of metal or ceramic plate, may be found in the Roma Plastilina® backing material;
- The BFS resulting from each shot in the backing material must not exceed the limits given in Part 2 sections 5.3 and 8.1 measured from the top edges of the steel tray, as shown in the relevant section of Part 2.[7]
- Pencilling of the armour sample shall be subject to a maximum of 20mm BFS regardless of protection level. See Part 2 section 8.3.

10.2 Knife/Spike Performance

For knife or knife + spike resistant body armour to be successful, in accordance with Part 3 of this standard, it must meet the following criteria:

- The sample must have been tested with either the P1B test knife (for knife resistance), or both the P1B test knife and the SP/B test spike (for knife + spike resistance) to one or more of the protection levels of Part 3, following the strike protocol described in the relevant section of Part 3.
- The penetration from any strike must not exceed the maximum allowable depth, as defined in Part 3, figure 6 for the relevant protection level to which the armour sample is being tested.
- If a rigid panel is incorporated into the armour sample, no part of the panel i.e. pieces of metal or other fragments may be found in the backing material.

[7] Where it is necessary for the Roma Plastilina® No 1 to be built up to allow the testing of curved SG1, RF1 or SG1 plates, the back face deformation may be measured from the original surface of the Roma Plastilina® No 1

11 Presentation of Results

Following testing of body armour sample/s, the following results shall be given. At this stage, the test report shall not indicate that the armour has met the requirements of the standard. The protection level to which the armour has been tested shall be clearly marked, along with the manufacturer's name and the body armour model number. A unique test reference number shall also be given. Finally, the body armour will be examined by HOSDB to ensure conformance to the manufacturer/supplier declaration and awarded an overall Pass/Fail rating for the test, according to the specification performance assessment quoted in the appropriate test procedure.

11.1 Ballistic Resistance Tests:

For each test shot the calibre and velocity of the round, the BFS (if any) and whether the round has "held" or "penetrated" the sample shall be recorded.

11.2 Knife Resistance Tests:

For each test strike the impact energy, the angle of incidence of the blade on impact and the depth of penetration (if any) of the knife through the sample shall be recorded.

11.3 Spike Resistance Tests:

For each test strike the impact energy, the angle of incidence of the spike on impact and whether the spike has "held" or "penetrated" the sample shall be recorded.

11.4 Data and Test Sample/s Reporting and Storage

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

- The body armour sample(s) complete with correct labelling as described in Part 1: General Requirements, section 6.2 and 6.3;
- A copy of the test report;
- A colour digital image of the armour taken before testing (email or disc) of:
  - minimum resolution of 640 x 480 pixels;
  - JPEG format.

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

12 Manufacturers Quality Testing (MQT)

MQT testing is a suggested[8] method of ensuring the continued quality of an armour model once it has met the requirements of the HOSDB compliance test. It is intended that this method will be used by the police customer at the tender stage of body armour procurement.

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.

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

12.1 MQT 1 (HG1/A, HG1, HG2 and HG3)

Once 500 units of any model have been produced, manufacturers shall carry out this testing (or arrange for it to be done at a suitable facility, HOSDB will advise if required) Provision should be made for customer involvement with regard to selection of samples for testing.

For the purpose of MQT1 ballistic testing, the armour samples shall be fitted in plain single layer carriers of maximum density 220g/m^2

12.2 MQT 1 (RF1, RF2 and SG1)

Once 100 units of any model have been produced, manufacturers shall carry out this testing in conjunction with the soft armour model it was certified with (or arrange for it to be done at a suitable facility, HOSDB will advise if required) Provision should be made for customer involvement with regard to selection of samples for testing.

12.3 MQT 2 (HG1/A, HG1, HG2 and HG3)

Once 5,000 units of any model have been produced or 2 years have elapsed (whichever is soonest) since compliance testing, manufacturers/suppliers shall arrange for this testing (same test criteria as MQT1) to be conducted at an HOSDB approved facility. If the test is successful, the test house shall inform HOSDB and a new document of conformance will be issued and will remain valid for a further 2 years or 5,000 units.

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[8] 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 body armour manufacturers to start including it in future supply contracts.

12.4 MQT 2 (RF1, RF2 and SG1)

Once 500 units of any model have been produced or 2 years have elapsed (whichever is soonest) since compliance testing, manufacturers/suppliers shall arrange for this testing (same test criteria as MQT1) to be conducted at a HOSDB approved facility. If the test is successful, the test house shall inform HOSDB and a new document of conformance will be issued and will remain valid for a further 2 years or 500 units.

12.5 Manufacture of New Armour (to MQT2)

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

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

12.6 In-Service Testing (Dip or Age) to MQT2

In-service testing should be conducted at regular intervals during the warranty period of the armour to determine if the armour 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 MQT2 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, HOSDB shall be informed as it is a possibility that a progressive degradation in protection level has occurred and remedial action will need to be considered to return the armour 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 HOSDB 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. In service testing may (at the discretion of the customer) be conducted with the armour panels fitted in the lightest carriers supplied for use with the model.

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 armour for the warranty period and in some cases they may be prepared to offer a service to extend the warranty period. Any post warranty agreement is usually carried out on an annual basis and conditions of service may vary between manufacturers.

13 Acknowledgements

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

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Prof Ian Horsfall, Mrs Celia Watson, Mrs Caroline McKenna and Mr James Harber from the Cranfield University Defence Academy of UK Shrivenham;

The National Institute of Justice (NIJ) and the National Institute of Standards and Technology (NIST) in the USA.

Ms Christine O'Brien, (technical drawings and pictures) Sandwich Student – Brunel University.

Appendix A: Declaration Of Construction Form

Home Office

Declaration of Content and Construction of Body Armour to:

HOSDB Body Armour Standards for UK Police 2007

When completed this document will be classified "RESTRICTED COMMERCIAL"

Manufacturer:……..Model……Protection Level……. **(This must also be displayed on all armour panels)**	
	Description of all materials used, as per Part 1 section 6 of the HOSDB Body Armour Standards for UK Police 2007.
Strike Face ↓ **Body Side**	USE CONTINUATION SHEET IF NECESSARY. Total Number of pages used:
Details of Cover **Details of Carrier (jacket) [single layer max 220 gm^2]**	

(Insert Company Name here)**……. hereby declare that all body armour produced as model Number ……as a result of successful Compliance Testing to HOSDB Standards will be of the same construction, using the same materials (from the same suppliers)and stitch patterns as the test sample/s listed above in accordance with Part 1 General Requirements, Section 6 of HOSDB Body Armour for UK Police (2007) Publication No 39/07 whether the armour is Ballistic, Stab or both. Also, if the body armour is supplied to UK police, the correct colour coded labels will be fitted in accordance with Part 1, section 6**

Further, we agree to uphold the requirements of Manufacturers Quality Testing (MQT) [If a manufacturer already utilises an alternative sampling system, which meets or exceeds the requirements of MQT1, it may be offered in preference] if requested by the UK Police customer.

Signed……Date……

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Continuation Sheet: Duplicate as necessary.

Manufacturer:……..Model……Protection Level……

Strike Face

Body Side

HOSDB Use Only

Model Number……..Test House Ref……..

Approved Threat Level……Signed on behalf of HOSDB……Date……..

Appendix B: Test Sample Size Templates (dimensions in mm)

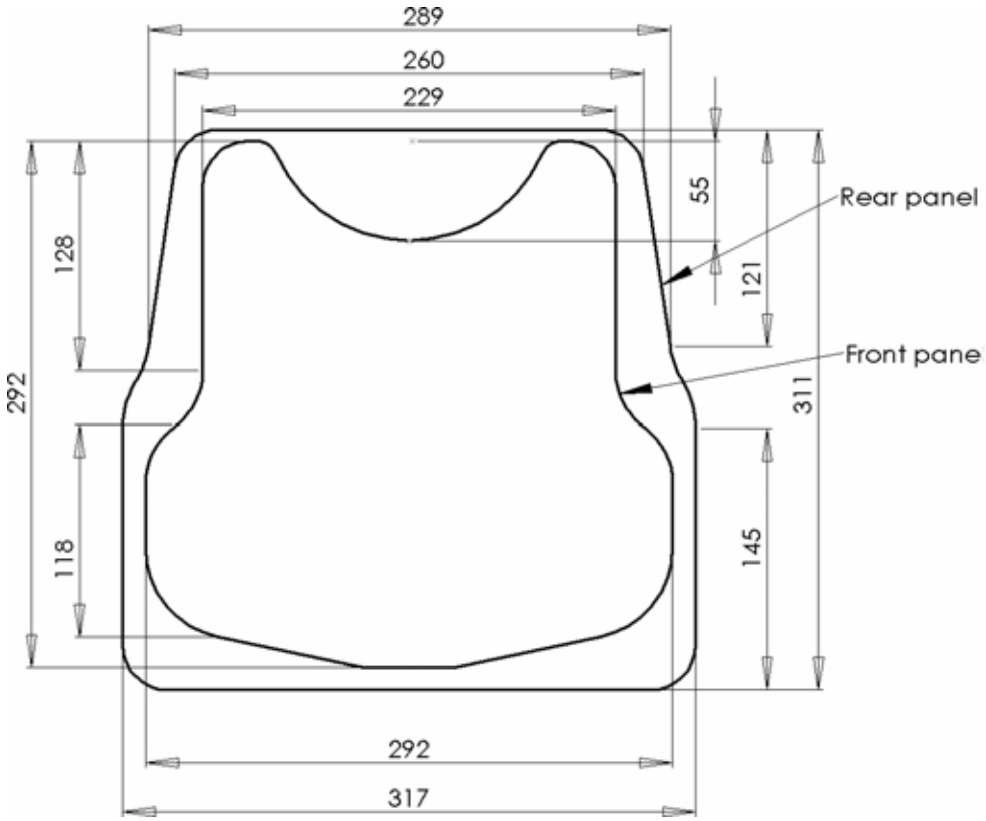

FIGURE 10: Small size

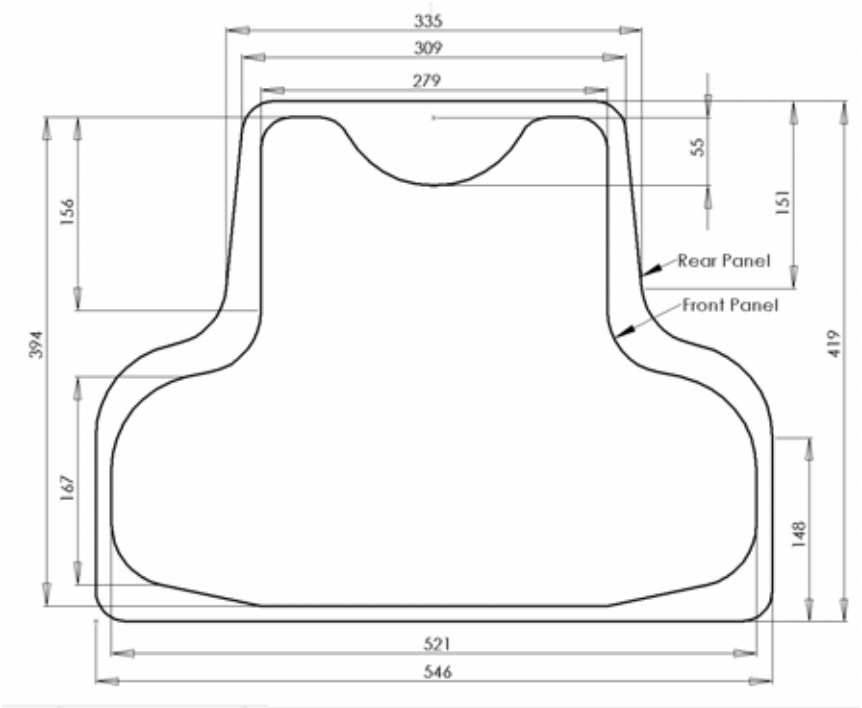

FIGURE 11: Medium Size

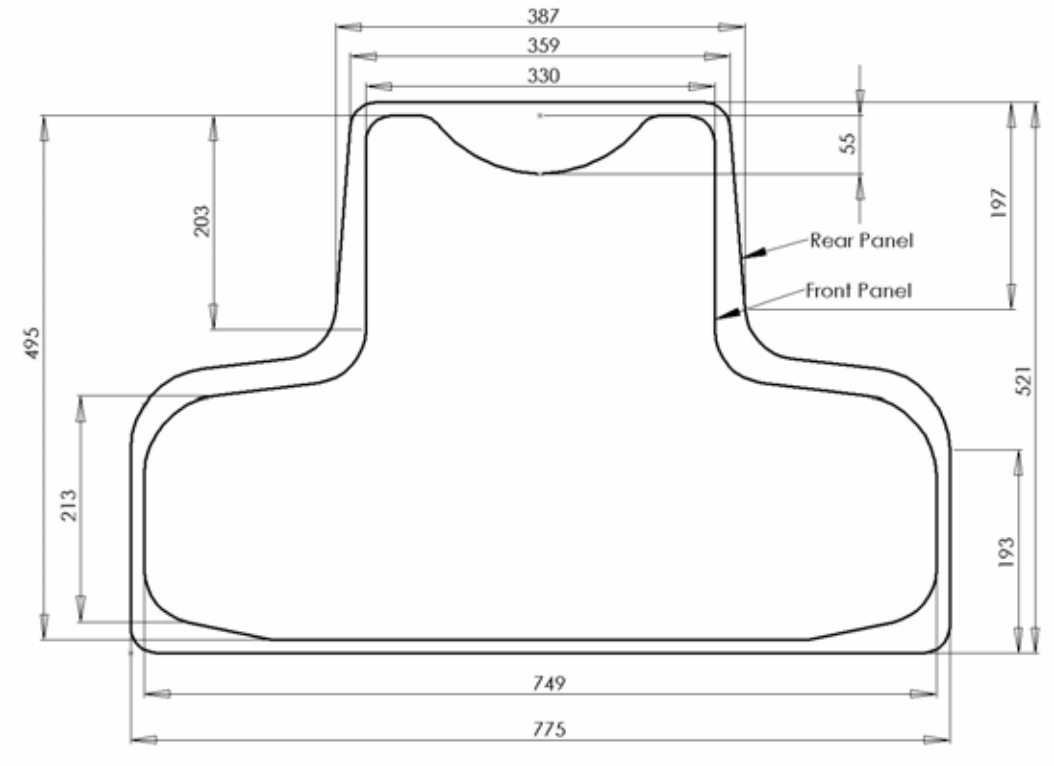

FIGURE 12: Large Size

Tolerances:

- **Small Size fig 10**: Drawing dimensions are maximum sizes;
- **Medium size fig 11**: Drawing dimensions are maximum sizes;
- **Large size fig 12:** Drawing dimensions are minimum sizes.

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