Abstract: The present invention relates to a garment for providing protection against trauma injury to a body, such as impact trauma injury which can be caused by blunt, sharp or ballistic objects, which provides effective protection and is comfortable to wear. The garment has a plurality of discrete sections over areas of the body intended to be protected in which a protective material representative of the level of protection required may be situated. The invention is able to be worn covertly under ordinary everyday clothing and provide protection for most of the body, particularly for the major organs.
before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))
TRAUMA PROTECTION GARMENT

The present invention relates to a garment for providing protection against trauma injury to a body, such as impact trauma injury which can be caused by blunt, sharp or ballistic objects, which provides effective protection and is comfortable to wear. The invention is able to be worn covertly under ordinary everyday clothing and provides protection for a majority of the upper body, i.e. the torso and abdomen, thus protecting the major organs of a body.

Personal Protective Equipment (PPE) is designed to reduce the risk of permanent and serious injury to people who endanger their safety in the course of their professional duties, and has played a vital role for many years. However, the level of protection and comfort afforded to such users by PPE currently available could be significantly improved.

There has been stagnation in the development of PPE over the last few years. Police officers constitute those who are among the most likely to be in need of wearing PPE during the course of their everyday business or duties, or in situations of public disorder, such as in riot situations or in dealing with potentially armed or dangerous criminals. Current PPE worn by e.g. police officers comes in several overt pieces, usually made from hard materials, which are each individually held on to the body with straps of Velcro®. This PPE is bulky and cumbersome, and takes a long time to put on due to the number of separate pieces. In addition, it can only be worn for short periods before it becomes too uncomfortable either due to its bulkiness and weight or it becoming uncomfortably hot for the wearer. Most importantly, it offers only a limited level of protection as no special protection is built into the PPE for key
organs of the body, such as the heart, liver or kidneys. Trauma to any one of the key bodily organs can result in more serious injury or even death.

Due to the size and bulk of existing PPE, it can only be worn over a person's clothes or uniform. It is not possible for a person to wear it covertly under their clothes. The ability to be able to wear PPE covertly would be desirable in police situations where, for example, officers are covertly pursuing criminals or are engaged in counter-terrorist activity and do not wish to be visually identified, or those engaged on driving duties, or any situation where police officers do not wish to appear overtly aggressive while being protected. Current PPE looks overtly aggressive, and the mere presence of the bulky and conspicuous external PPE would easily identify them to those being pursued. Community considerations have meant that public relations has been given a higher priority than protection and if the choice is public consideration over adequate personal protection, police commanders may be forced to, or may be likely to tend to err on the side of public consideration at the cost of officer safety.

Persons wearing existing PPE experience restricted manoeuvrability and are slowed down due to the greater bulk and weight of the PPE. This is a clear disadvantage in situations where it is important that an officer's manoeuvrability is not hindered and where quick reactions may be required.

Upwards of 125,000 police officers have been injured while on duty over the last few years, including some fatalities. Many of these officers were injured during their normal duties because they were in situations where police officers cannot wear PPE, due to public relations issues of officers being seen in aggressive PPE. These injuries result in a huge loss in man-hours for the police due to the time off work injured officers require to recuperate, and also in potentially fewer officers available
to protect the public. In addition, there is the considerable cost of having to meet overtime payments at an enhanced rate for other officers who have to cover for the absences. These costs only add strain to what is a finite budget. Many of these injuries could have been rendered significantly less serious or prevented altogether had the officers concerned been wearing more effective protective garments, and it is likely that some deaths or serious injuries may have been able to be avoided had the current PPE been provided with special protection for the key organs of the body.

Existing PPE only provides a limited level of protection to certain parts of the body as it is designed to protect a person against particular situations which carry threats to specific areas of the body.

For example, US 6,961,958 to Seitzinger describes PPE which is specifically designed to just protect the femoral artery and iliac vessels, and was designed for the ballistic protection of e.g. helicopter pilots in the armed forces who are susceptible to attack from bullets fired from the ground. The protective portion of the Seitzinger PPE is primarily around the groin, tailbone and upper thigh region of the body, together with a small area of protection running down the centre of the breastbone.

This PPE does not conform to the UK Home Office requirements for limb and torso PPE (HOSDB Blunt Trauma Protector Standard for UK Police 20/07) which can be used by e.g. police officers as it does not provide any level of protection for areas of the body which do not contain the femoral artery and iliac vessels. To provide any sort of adequate protection for a wearer, there must be protection provided for the areas of the body containing the major organs, as, of course, trauma to any of these can result in serious injury or even death. The Seitzinger PPE does not do this as the rib area and abdomen area are entirely unprotected, so the major organs which are
located in the front of the body, such as the heart, lungs, liver and stomach, are completely exposed. Additionally, there is no protection for the arms and minimal protection for the legs. This is not adequate PPE for e.g. a police officer faced with criminals or serious public order situations.

The PPE described in GB 2418832 to Eagle Technical Fabrics also is deficient in the amount of protection which is provided to the torso and abdomen areas. GB 2418832 only provides protection for the arms and legs, and provides no protection for any major organs. It too would not even come close to conform to the UK Home Office requirements for limb and torso PPE.

Further examples of existing PPE can be found in WO 2006/072179 and WO 2006/096981 to Med-Eng Systems Inc. Neither of these examples of PPE can be worn covertly under everyday clothing as they are much too bulky. This is an undesirable characteristic for the reasons outlined above. As a result of this, they are also heavy pieces of equipment, which in turn restricts a person's speed and flexibility of movement. This is also undesirable in situations where a person needs to have quick reactions to react to developing events. They also contain several different pieces of protective pads, and hence take a significant length of time to put on.

It is therefore desirable to provide a garment which provides a high level of protection against trauma injury to a body, which is lightweight and comfortable to wear, discreet, covert, and which can be worn under a person's normal clothes. The present invention overcomes one or more of these problems.

Therefore, in accordance with the invention, there is provided a garment for protecting against trauma injury of a body, the garment comprising a top portion and a lower portion, which portions may or may not be interconnected, the garment having
a plurality of discrete sections thereon over areas of the body intended to be protected in which a quantity of protective material representative of the level of protection required may be situated, wherein the garment can be worn covertly under everyday clothing, and wherein the areas of the body the garment provides protection for include at least a majority of a torso and abdomen of the body.

By the phrase "at least a majority of a torso and abdomen" is protected by the garment of the invention, in accordance with the present invention it is meant that protection is provided such that more than half of the front part of a person's torso and abdomen is covered by a section of the garment containing one or more protective pads, and such that protection is provided for the major organs which are located in the front of the body, including at least one of, and typically two, three or all four of the heart, lungs, liver and stomach.

There is a clear distinction to be drawn between PPE which is able to be worn covertly and PPE which can be worn under clothes. In the latter instance, the PPE can be accommodated under a person's clothes, but due to the bulk of the PPE it is obvious to any observers that they are wearing some protective equipment under the outer layers of clothing. By the PPE of the invention being able to be worn 'covertly', it is intended to mean that the PPE can be worn such that an observer is unable to notice whether or not a person is wearing it. This allows a person to be protected by PPE while not alerting the public that anything is happening, or visually identifying a police officer to criminal elements they may be e.g. conducting surveillance on or pursuing.

The garment is typically a one-piece suit, or alternatively may be separated into a two-piece suit for the top half and the bottom half of the body, respectively. If
desired, a person need only wear the top (or bottom) half of the two-piece suit and the person has the ability to insert or remove protective trauma pads. The garment can also be worn without pads at all. The trauma pads are smaller and lighter than currently available PPE.

The garment protects areas of the body that are not currently protected, including the lower leg (including the calf), knee, thigh, hip, torso, abdomen, lower arm, elbow, upper arm, shoulder, clavicle, groin, posterior, spine, lower back and upper back, coccyx, calf and female specific regions, for example protecting the ovarian area of the body, while also ensuring that all of the key organs are well-protected. It is a unique protective garment which can be donned within 60 seconds and can protect all vital organs and key areas of the body.

Police forces typically have to have garments or products specifically designed or altered to meet their own specific personal needs or requirements. This garment has the flexibility and adaptability to meet personal requirements as the garment can be made in a number of different shapes and sizes and pads can be added or removed in any one of a multitude of positions as desired.

The garment acts as a carrier for pads which provide the protection. Sections or pockets are provided on the suit over the areas of the body which are to be protected. The protective pads are inserted into these pockets, which are then sealed or sewn shut. Pads of different tensile strengths can be inserted into the pockets depending upon the level of protection which is required. This allows the garment to be customised to a person's specific needs, in contrast to existing PPE which has one standard of equipment and hence one level of protection.
The material used to make the garment of the invention is specifically designed to possess the characteristics required. The material has elasticity and tensile strength levels strong enough to hold the pads in position close to the body which enable the garment to protect against trauma injury and also to have sufficient flexibility to ensure comfort. The pad material is typically made by injection moulding; however, it can also be cast and cut in a variety of shapes. EVA (ethyl vinyl acetate) is another exemplary material which may be used, but the pad must not be manufactured from any flammable material.

A typical fabric composition comprises about 75% polyester and about 25% spandex. Spandex is a copolymer of polyurethane and polyethylene glycol. The spandex element greatly increases the flexibility of the fabric and makes for greater comfort for a wearer. The polyester yarn contains silver ions impregnated into the fibre, and moisture wicking fibre, giving the fabric antibacterial and cooling characteristics and also typically has a low heat transfer coefficient which can protect the body in the event of e.g. fire bombing attacks.

The fabric is lightweight, and the presence of the spandex in the fabric enables the garment to be worn tight to the body. The garment can therefore be covertly worn under normal clothes.

The fabric is also breathable and not uncomfortably hot to wear, typically comprising a moisture wicking which makes the garment cooler to wear, using, for example, fabric technology produced under the names Coolmax® Extreme or Gore-tex®. As it is comfortable to wear, for all of the reasons given above, it can be worn throughout a shift without any adverse effects to the wearer.
In addition to the material being breathable, it is the case in the present invention that the areas having the pads which provide protection from trauma are also breathable. This is not the case in existing PPE. For example, in US 6,961,958 to Seitzinger, the protective pads are inserted into pockets having water-resistant coverings. Any PPE having protective pads inserted into a waterproof covering cannot be breathable in those areas.

In neither of the PPE examples in WO 2006/072179 and WO 2006/096981 is the material breathable or provide comfort for a wearer for heat dissipation. In WO 2006/072179, the only aid provided for this is holes in the armpits and elbows; however, these localised holes will have a significantly limited ability to reduce a person's heat load or to facilitate cooling.

The garment of the invention can be furnished either with the protective pads already in position in the pockets, or it can be furnished without the protective pads in place. In the latter embodiment, the garment can be provided in the form of a kit, with pads of varying tensile strengths provided with it enabling a user to select the level of protection desired and insert the pads into the pockets accordingly.

The garment of the invention is also envisaged to be of use for persons other than police officers who may be subject to assault of varying levels of seriousness during the course of their work, such as military personnel, door security, security staff, prison officers, hospital workers, or even taxi drivers, traffic wardens or street wardens.

The protective garment of the invention can offer three levels of protection depending upon the requirements of a particular person and the situation faced. These are:
1) Trauma only - this protects a person against low level trauma such as punching and kicking to the body, as well as low velocity non-sharpened hand-thrown missiles such as rocks or bricks or hand-wielded weapons such as baseball bats.

2) Full stab/spike protection - this protects a person against trauma caused by sharp objects such as knives or broken glass.

3) Full ballistic protection.

Level (1) protection is envisaged to be suitable for people such as taxi drivers or hospital workers, who may encounter people, especially late at night, who may turn violent. Level (2) protection is envisaged to be suitable for people such as door security operatives who are more likely to encounter assailants armed with sharp objects such as broken glass, or any profession which entails a heightened risk of violence, while Level (3) protection is intended for law enforcement professionals and armed forces who deal with more serious incidents, such as a riot scenario, or where a criminal is thought to be armed with a gun. Depending upon the level of protection required the garment of the invention can be equipped with the corresponding strength of pads, either already in place or separately for insertion by the user, as mentioned above.

The pockets on the garment are strategically positioned and the pads used for protection are specially shaped and located to cover key organs of the body.

The material used in the protective pads is dependent upon the level of protection required. For Level (1) protection, suitable materials include those which exhibit shock-deadening properties, such as products sold under the trademarks Zorbolite and Zorbathane. Zorbolite is an oil-absorbent urethane foam, while
Zorbathane is a synthetic rubber material having shock-deadening properties. For Level (3) ballistic protection, Kevlar® (a poly paraphenylene terephthalamide-comprising composition) is a preferred material for the pads due to its very high tensile strength.

Other components, such as fillers, additives, crosslinking agents and blowing agents may also comprise part of the garment as required. Exemplary fillers include calcium carbonate and talc; exemplary additives include plasticiser and a heat stabiliser; exemplary crosslinking agents include peroxides such as dicumyl peroxide (DCP) and exemplary blowing agents include azodicarbonamide.

The pads are made of three layers referenced as 6395, 270 and 1158. The constituents of these three layers are given in the table below.

<table>
<thead>
<tr>
<th>Composition</th>
<th>Article Name</th>
<th>Layer 3</th>
<th>Layer 4</th>
<th>Layer 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC (polyvinyl chloride)</td>
<td>ZS-6395</td>
<td>None</td>
<td>20-30%</td>
<td>20-30%</td>
</tr>
<tr>
<td>NBR (acrylonitrile butadiene rubber)</td>
<td></td>
<td>None</td>
<td>20-30%</td>
<td>20-30%</td>
</tr>
<tr>
<td>POE (polyolefin elastomer)</td>
<td></td>
<td>25-35%</td>
<td>15-20%</td>
<td>15-20%</td>
</tr>
<tr>
<td>EVA (ethylene vinyl acetate copolymer)</td>
<td></td>
<td>35-45%</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Filler</td>
<td></td>
<td>15-25%</td>
<td>15-25%</td>
<td>10-20%</td>
</tr>
<tr>
<td>Additive, crosslinking agent and blowing agent</td>
<td></td>
<td>5-8%</td>
<td>6-10%</td>
<td>6-10%</td>
</tr>
<tr>
<td>Pigment</td>
<td></td>
<td>3-6%</td>
<td>3-6%</td>
<td>3-6%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
If desired, the garment may also be worn over the top of normal clothing if an overt police presence is required as the sight of a police officer in body armour can have an intimidatory effect upon people and help to maintain the peace.

Due to the design of the garment making it tight to the body, it enables a person wearing it to enter premises through smaller or narrower spaces, in contrast to the current bulkier PPE which may not allow this. This especially relates to police "Method of Entry" tactics which require special training for smooth and fast entry into premises. It also allows for maximum mobility and flexibility for a wearer. Indeed, it has been shown that a police officer is able to pass a firearms reclassification test wearing a garment according to the invention. This would not be possible using existing bulkier PPE as the products are inflexible and restrict movement significantly.

The garment of the invention offers a very high level of protection. The Home Office Scientific Development Branch (HOSDB) of the UK Government has prescribed new standards for PPE which all new protective garments have to reach before they can be introduced into use.

The official Home Office Scientific Development Branch tests state that to reach the required standard, blunt trauma protectors must meet the following criteria:

- Demonstrate a transmitted force of less than 10,000 Newtons (the maximum predicted value) from an energy impact of 20 Joules within the area of full protection as defined by the manufacturer;
- A retention system holding strength of greater than 150 Newtons; and
A back face signature (the maximum displacement of the back surface of a soft tissue protector) of less than 15 mm (groin guards) or 25 mm (female chest protectors).

The garment of the invention has been tested in accordance with Home Office Scientific Development Branch standards. It comes well within the 10,000 N maximum limit. Further details are given in the results section.

The principal areas of protection afforded by the garment of the invention include the lower leg including the calf, knee, thigh, hip, torso, abdomen, lower arm, elbow, upper arm, shoulder, clavicle, groin, posterior, upper back, lower back including the coccyx, and female specific areas, for example protecting the ovarian area of the body, while also ensuring that all of the key organs are well-protected. A protective curved back panel is typically provided for the lower back and coccyx, and the suit (or the top half thereof) has a fastening zip which is set off to the side of the body in order that it does not interfere with the protection of the chest/torso.

The garment of the invention will be economically advantageous as it will be able to effectively pay for itself for those institutions that use it. Taking the police force as an example, it will reduce the number of injuries obtained in the course of duties significantly so that fewer days leave are taken by officers due to their injuries. This will subsequently also reduce the overtime payments required to cover for the absence of injured officers. If the garment of the invention was standard issue kit for every frontline officer or warden, they will be protected against injury from both spontaneous and pre-meditated incidents of violence. As with the current policy relating to the wearing of ballistic garments, officers who suffer injury whilst not wearing their ballistic jackets are liable to receive a reduced compensatory payment.
The garment of the invention will also help from a physiotherapy perspective, as many police officers suffer back and muscle injuries simply from wearing the existing PPE for prolonged periods. Additionally, it will also reduce problems associated with insurance issues, as if an officer is injured on duty when not wearing PPE and wearing it could have prevented the injury, he or she may not be insured. This can happen even if the reason for not wearing it is that there is simply insufficient time to put the PPE on due a rapid escalation of a public disorder situation. With the garment of the invention, this would be made much simpler as protection can be worn all the time under everyday clothing.

A further benefit of the invention is that due to the tight nature of the suit to the body, muscle compression occurs. This minimises the build up of lactic acid in the muscles during vigorous activity and has been shown to increase a person's performance by up to 6%, allowing wearers to be more productive for longer, as well as reducing back and muscle injuries.

The garment of the invention has a memory membrane designed to follow and support the muscles of the body. When a person is wearing the compression body suit, the garment fit, seaming detail and tensile strength assist with muscle flexion and extension. The garment and soft trauma pads help absorb the fatigue inducing shock and vibration that muscles normally absorb during repetitive use and impact. The garment therefore allows an increased flow of oxygen, reduces delayed muscle soreness, muscle vibration, and muscle and ligament strain by keeping muscles in line and at optimum position for action, and aids recovery after intensive exercise.

Existing PPE also does not account for variations in peoples’ sizes or even their gender. Originally, it was designed by men predominantly for use by men.
Women in the same professions would often require protective equipment which is smaller than those of their male counterparts, and which is also shaped differently. This would often not be available. The present invention can provide a gender-specific protective garment which can accommodate specific personal needs such as female needs. Indeed, it is possible to manufacture the garment in any size or specification necessary.

It is also envisaged to be of use with Chemical, Biological, Radiological and Nuclear (CBRN) suits. Existing CBRN suits are heavy, hot, consist of three layers, and take 30-45 minutes to put on. There is a new government requirement to wear PPE under CBRN suits which makes conditions even more uncomfortable for the wearers. The PPE garment of the invention is the only product which:

a) will satisfy the current requirements of the Home Office need for PPE to be able to be worn underneath the CBRN suits; and

b) will be cooling and anti-bacterial which will reduce the body temperature of the wearer to within more comfortable limits.

Existing PPE cannot do the above. It is too bulky to be worn under the CBRN suit and does not cool the body. The garment of the invention, on the other hand, can achieve the above and would be ideal for such use.

The present invention will now be further described with reference to the following Figures, which are intended to be entirely illustrative and in no way limiting upon the scope of the invention.

Figure 1 shows a typical top half of a protective garment for men.  
Figure 2 shows a typical bottom half of a protective garment for men.  
Figure 3 shows a typical top half of a protective garment for women.
Figure 4 shows a typical bottom half of a protective garment for women.

Figure 5 shows some of the latest protective equipment which is currently being used by the police.

Figure 6 shows a front view of the protective garment being worn.

Figure 7 shows a rear view of the protective garment being worn.

Figure 8 shows a view of the side-oriented zip fastener.

Figure 9 shows a side view of the protective garment for women.

Figure 10 shows a view of the torso and abdomen portion of the protective garment.

Figure 11 shows a view of the leg portion of the protective garment.

Figure 1 illustrates the top half 2 of the garment of the invention which has been designed for male use. It can be seen that the front 4 of the top half 2 of the garment has sections designed to comprise padded protection for the upper arms/shoulders 6, the lower arms/elbows 8, the chest/torso 10, the abdomen 12 and also the sides 14 of the body. The back 16 of the garment 2 has further sections designed to comprise padded protection for the upper back 18 and the lower back 20 (including the kidney area). It is to be noted that the majority of the torso and abdomen is protected, so protection is afforded to the major organs such as the heart, lungs, liver and stomach.

The top half 2 of the garment which has been designed for female use can be seen in Figure 3. It will be seen that the protection afforded is very similar, but differs in that the chest protection section 10 covers a greater proportion of the width of the chest than the equivalent male garment in Figure 1.

Figures 2 and 4 illustrate the lower half 22 of the garment which has been designed for male and female use, respectively. Both lower halves have sections
designed to comprise padded protection for the hips 24, the coccyx 26, the groin 28, the posterior 30, the thighs 32 and the shins 34. In these representations, the shapes of the respective hip protection sections are slightly different due to the different average relative sizes of men and women.

In Figures 6 and 7, a garment is shown when it is being worn. It is immediately apparent from the Figures that the garment is considerably less bulky than the PPE currently being used by the police, shown in Figure 5 as a means of comparison. The current PPE comes in many discrete pieces, each piece to protect a separate part of the body and is extremely bulky. It cannot be worn underneath a normal police uniform, and also cannot be put on quickly when needed due to the multitude of parts. Figures 6 and 7 demonstrate that the garment of the invention is unobtrusive and can be worn under an officer's clothes so that he or she is ready for action and protected when called upon.

Figure 8 shows a view of the zip fastener 36 for the garment which is oriented to one side of the suit in order that is does not interfere with the chest/torso protection 10. The zip runs down one side of the suit.

In Figure 9, the pads for the upper 6 and lower arms 8 can be clearly seen, together with the protective pad for the abdomen 12. Figure 10 shows a frontal view of the chest/torso portion 10 and abdomen portion 12. The hip 24, thigh 32 and shin 34 protected portions are shown in Figure 11.

**Results**

The garment of the invention has been tested in accordance with Home Office standards for low velocity blunt trauma impacts, such as those caused by hand-thrown missiles and hand-wielded weapons. Full information on the tests carried out may be
found at http://scienceandresearch.homeoffice.gov.uk/hosdb/publications/protective-equipment/20-07 - HOSDB Blunt Trauma 1.pdf?view=Bmary, a summary of which information is given below.

The testing regime includes:

- Anatomically 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; and
- Testing of the retention system.

The testing is carried out under ambient conditions (15-24°C at 40-70% humidity).

In order to pass compliance testing, a blunt trauma protector garment has to meet the criteria detailed hereinafore.

When testing for the effectiveness of a blunt trauma protector garment, an impact is performed thereon and the transmitted force is measured. One such impact is carried out using a "Drop Test". This involves an assembly mounted above a sample of the material to be tested, the sample being rested on a test anvil which is in turn situated on a force table.

The test anvils are constructed from stainless steel and are shaped to represent different parts of the human body. There are three different styles of anvil, cylindrical, semi-circular and convex. Each anvil is constructed in three sizes to represent different sizes of adults.

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

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. 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 1000 kg to ensure that no movement takes place during the test.

Two test impactors are used to represent common threats faced by e.g. police officers, which are a bar impactor to represent a hand-wielded weapon, and a wedge impactor to represent an edge of a brick (worst case impact) or another hand-propelled missile.

A tester selects one of the test samples supplied and retains it as new for performance testing. The remaining test samples are pre-conditioned according to Table 1 below.

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 are performed on the blunt trauma protector as it is allowed to cool on the anvil.
Table 1: Conditioning of the Test Samples

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

A suitable anvil is selected and mounted on the force table securing the fixing bolts to a torque of 25 to 30 Nm. If required, the test sample may be cut to ensure it fits onto the anvil and to allow it to be rotated. The appropriate impactor is placed in the guided drop test assembly and positioned ready for the first impact.

The test sample is mounted on the test anvil using its own retention system, though if required additional strapping may be used.

The first test sample is impacted a minimum of six times at an energy of 20 ± 0.5 J within the area of full protection (as designated by the manufacturer) using the bar shaped anvil aligned to impact the protector across the long axis. The transmitted force and velocity of each impact are recorded.

Additional impacts are performed, space permitting, up to a maximum of twelve impacts on any one guard. Impacts are performed at any location within the area of full protection as appropriate. However, the impacts must be spaced with a minimum distance of 15 mm from the centre line of any other impact and a minimum of 5 mm from the edge of the area of full protection to the closest edge of the anvil.

This process is repeated for the second test sample using the wedge shaped anvil to impact the protective garment.
Table 2: Drop Test - Transmitted Force

<table>
<thead>
<tr>
<th>Black Layers</th>
<th>White Layers</th>
<th>Anvil</th>
<th>Force Reading (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3</td>
<td>Brick</td>
<td>3756</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Bar</td>
<td>4225</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Brick</td>
<td>4360</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Bar</td>
<td>4935</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Brick</td>
<td>7040</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Bar</td>
<td>6928</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Black Layers</th>
<th>White Layers</th>
<th>Anvil</th>
<th>Force Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 4</td>
<td>3</td>
<td>Brick</td>
<td>4569</td>
</tr>
<tr>
<td>Layer 4</td>
<td>3</td>
<td>Bar</td>
<td>5298</td>
</tr>
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The results in Table 2 show that in almost every single test the garment of the invention scores significantly better than the target levels set by the Government, with a
transmitted force value of just 3,756 N, against a target of 10,000 N. The garment is therefore over 2\(\frac{1}{2}\) times better than the required standard.

It will be appreciated that minor modifications to this invention may be made without departing from the scope of the invention as defined in the appended claims.
Claims

1. A garment for protecting against trauma injury of a body, the garment comprising a top portion and a lower portion, which portions may or may not be interconnected, the garment having a plurality of discrete sections thereon over areas of the body intended to be protected in which a quantity of protective material representative of the level of protection required may be situated, wherein the garment can be worn covertly under everyday clothing, and wherein the areas of the body the garment provides protection for include at least a majority of a torso and abdomen of the body.

2. The garment according to claim 1, which is a one- or two-piece garment.

3. The garment according to claim 1 or claim 2, wherein the garment is manufactured using a fabric comprising polyester and a copolymer of polyurethane and polyethylene glycol.

4. The garment according to any preceding claim, wherein the protective material comprises a urethane foam, a synthetic rubber material, or poly paraphenylene terephthalamide.

5. The garment according to any preceding claim, wherein at least some of the discrete sections are positioned to protect key bodily organs.

6. The garment according to any preceding claim, wherein the garment is manufactured from a fabric which has moisture wicking and/or an antibacterial yarn.
7. The garment according to any preceding claim, further comprising a quantity of protective material in a plurality of discrete sections.

8. The garment according to any preceding claim, wherein different levels of protection can be provided by use of different protective material.

9. A kit comprising a garment according to any of claims 1-8 and a plurality of pieces of protective material.

10. A garment substantially as described herein in the description and drawings.
A. CLASSIFICATION OF SUBJECT MATTER

INV. A41D13/015 A41D13/05 F41H1/02

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A 41 D  F 41 H

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search

19 June 2009

Date of mailing of the international search report

06/07/2009

Name and mailing address of the ISA

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Authorized officer

Fonseca Fernandez, H
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