

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 0 729 714 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.09.1996 Bulletin 1996/36

(51) Int Cl.⁶: **A41D 13/00, A41D 31/00**

(21) Application number: **96300949.3**

(22) Date of filing: **12.02.1996**

(84) Designated Contracting States:
BE DE GB NL

(72) Inventor: **Ellingham, Paul John**
Dunstable, Bedfordshire LU6 1UR (GB)

(30) Priority: **02.03.1995 GB 9504150**

(74) Representative: **Crump, Julian Richard John et al**
F.J. Cleveland & Company
40-43 Chancery Lane
London WC2A 1JQ (GB)

(71) Applicant: **FOAM ENGINEERS LTD**
High Wycombe, Bucks (GB)

(54) **Body protection device**

(57) The present invention provides a body protection device comprising a first layer of a polyolefin foam and a second layer of polyvinylchloride/nitrile foam rubber, wherein the foam rubber has a density of at least 100kg/m³. Also provided are a body protection article comprising such a body protection device and fastening

means for fastening the protection device to an article of clothing, and an article of body protection clothing comprising such a protection device. The PVC/nitrile foam rubber may have a density in the range 100 to 250kg/m³. The polyolefin foam may be HDPE having a cross-linked cell structure, and a volumetric cell count in the range 500 to 1500 cells/cm³.

EP 0 729 714 A2

Description

The present invention relates to a body protection device for providing personal protection against injury as a result of a mechanical impact or abrasion. The invention relates particularly to a body protection device for incorporation in motorcycle rider's clothing, and also embraces an article of personal protective clothing including a body protection device in accordance with the present invention.

A requirement of motorcycle rider's protective clothing is to provide protection against physical injury. It will be appreciated that a motorcycle rider is vulnerable to a wide range of injuries arising as a result of e.g. abrasion or mechanical impact in the event of an accident, particularly where the rider comes off the motorcycle, or from debris such as stones thrown up from the road against the rider. Motorcycle rider's clothing therefore typically includes one or more body protection devices to protect against injury in these and other circumstances.

A conventional body protection device for incorporation e.g. in motorcycle rider's clothing consists of a first layer of a high density polyethylene material bonded to a second layer of a polyurethane material. This composite device has over the years gained market acceptance on the basis of its technical performance and its overall cost. Council Directive 89/686/EEC (OJ No. L399, 30.12.89, p.18) which relates to personal protective equipment applies in all member states of the EU from 30 June 1995, however, and in accordance with this Directive, all motorcycle rider's protective clothing for sale in the EU will have to be certified by an approved body as being in conformity with the requirements of the Directive. For this purpose, new tests have been devised for assessing the performance of motorcycle rider's protective clothing and categories of high performance, normal performance and low performance clothing have been established.

High performance clothing is required to provide a high level of protection in high speed road surface impacts; the clothing is expected to be reusable after an accident. Normal performance clothing is required to provide adequate protection in typical 30 mph accidents; the clothing would not be expected to be reusable after a high speed accident. Low performance clothing is designed to give some protection in low speed accidents, whilst having the lowest possible weight and ergonomic penalties associated with its use. Low performance clothing is considered suitable for use only by riders of mopeds and similar machines.

It has been found that conventional HDPE/PU composite protective devices, while meeting the requirements for classification as low performance clothing, will fail the test for classification as high performance clothing.

It is an object of the present invention therefore to provide an improved body protection device which will meet the requirements for high performance of clothing.

In accordance with one aspect of the present invention therefore there is provided a body protection device comprising a first layer of a polyolefin foam and a second layer of a polyvinylchloride/nitrile foam rubber, wherein the foam rubber has a density of at least 100 kg/m³.

The applicants have carried out tests on a wide range of materials and combinations of materials, including variations of the HDPE/PU devices known in the art, and have found surprisingly that the polyolefin-PVC/nitrile devices in accordance with the present invention perform significantly better than would be expected by a person skilled in the art.

In another aspect of the present invention there is provided a body protection article comprising a body protection device in accordance with the present invention and fastening means for fastening the body protection device to an article of clothing.

In yet another aspect of the present invention there is provided an article of body protection clothing, particularly motorcycle rider's clothing, comprising a body protection device in accordance with the present invention.

In some embodiments, the first polyolefin foam layer and second PVC/nitrile rubber foam layer may be bonded one to the other. For this purpose, any suitable adhesive or bonding agent known to a person skilled in the art may be employed. Alternatively, in some embodiments, the first and second layers may be unconnected to each other and simply incorporated e.g. in an article of personal protective clothing in juxtaposition one with the other.

It is envisaged that generally the body protection device will be used with the foam rubber layer nearest to the body and the polyolefin foam layer disposed outside the second foam rubber layer with respect to the wearer. It is thought that the second foam rubber layer acts principally as an energy/shock absorber to absorb the force of mechanical impact. The polyolefin foam layer may also act as an energy absorber, but more importantly acts to spread the load on impact to the foam rubber layer.

The polyolefin foam may comprise a high density polyethylene foam or polypropylene foam. The device can be used as a flat sheet. Alternatively, in some embodiments, the body protection device of the present invention may have a moulded configuration such that it is adapted for protecting e.g. the shoulder, elbow or knee of the wearer. In such modes of use, the polyethylene or polypropylene foam will act to retain the moulded shape of the device.

The PVC/nitrile foam rubber may have a density in the range 100 to 250 kg/m³. Preferably, the rubber foam may have a density of 150 to 200 kg/m³, typically 180 kg/m³. A suitable PVC/nitrile foam rubber for use in the device of the present invention is that which is available commercially under the trade name Vitacel 8/43 from Vita Industrial Polymers Ltd.

Advantageously the PVC/nitrile foam rubber used in the device of the present invention may be fire-self-extinguishing.

Said second layer of PVC/nitrile foam rubber may have a thickness of 3 to 15 mm, preferably 6 to 12 mm. In some embodiments, the second layer will typically have a thickness of about 8 mm.

The high density polyethylene foam constituting the first layer may have a cross-linked cell structure. Said HDPE foam may have a volumetric cell count in the range 500 to 1500 cells/cm³, typically 1000 cells/cm³. The first layer may have a density in the range 100 to 300 kg/m³, preferably 170 to 250 kg/m³. In one embodiment, said HDPE foam may have a density of 200 kg/m³. The thickness of the first layer may be between 1 to 10 mm, preferably 3 to 6 mm. Typically, a thickness of HDPE foam of about 4 mm will be used.

A particularly suitable high density polyethylene foam for use in the first layer of the device of the present invention is that which is available commercially from Messrs. Wardle Storey Ltd.

As mentioned above, the body protection device may, for some applications, be moulded to form e.g. a shoulder, elbow or knee pad. To this end, the first and second layers may be laminated together using a conventional laminating agent and cut to shape, typically using a die cutter. The composite material may be placed in an oven at a prescribed temperature for such a time that the material becomes mouldable. The composite material may then be removed from the oven and placed on a metal forming tool or mandrel and allowed to cool. On removal of the device from the mandrel, the device may substantially retain its shape.

The body protection device may be equipped with fastening means for fastening the device to an article of protective clothing. Said fastening means may comprise e.g. press-stud fastening means or hook and loop type fastening means e.g. Velcro (registered trade mark).

The present invention embraces an article of personal protective clothing incorporating a body protection device in accordance with the present invention. Said article of clothing may be a jacket or pair of trousers, particularly a motorcycle rider's jacket or trousers. Said article of clothing may comprise an outer layer of leather or synthetic leather material and an inner lining. The body protection device of the present invention may be interposed in the outer layer and said lining.

It will be appreciated that the present invention also embraces other types of personal protective clothing for use e.g. by sportsmen and women or in equestrian riding, as well as body protective sports accessories such as knee, shin, elbow or shoulder pads for use e.g. in hockey or the like.

Following is a description by way of example only of methods of carrying the present invention into effect.

Example 1

A body protection device in accordance with the present invention was manufactured by bonding a 4 mm thick first layer of a high density polyethylene foam having a density of 200 kg/m³ (measured according to British Standard BS 4443) which is available commercially from Messrs. Wardle Storey Ltd to a 8 mm thick second layer of a nitrile/PVC rubber foam having a density of 180 +/-20 kg/m³ which is available commercially from Vita Industrial Polymers Ltd under the trade name Vitacel 8/43. Any suitable bonding agent known to a person skilled in the art can be used for this purpose.

For comparative purposes, the following examples were also made up, namely:-

Comparison 1

8 mm HDPE + 6 mm polyurethane.

Comparison 2

4 mm HDPE + 9 mm low density polyethylene.

Comparison 3

4 mm HDPE + 8 mm PVC/nitrile foam rubber having a density of 80 +/- 5 kg/m³ which is commercially available from Vita Industrial Polymers Ltd under the trade name Vitacel 7/80.

The samples were tested on a test apparatus comprising a 50 mm radius hemispherical anvil and a 40 mm x 80 mm impactor. The anvil was mounted on a block of concrete of more than 1000 kg, and the impactor was arranged to be dropped onto the anvil from any height upto about three metres above the anvil with a 5 kg guided falling mass. The samples were placed, in turn, on the anvil and the force transmitted by the sample to the anvil was measured with a piezo electric load cell mounted between the anvil and block of concrete. The peak force occurring during the impact was recorded.

Each sample was placed on a 0.8 - 1.1 mm thick sheepskin chammy leather layer with the HDPE layer uppermost. Two layers of cowhide were placed over the sample. The chammy leather "artificial skin" layer was examined after the impact and any tears noted.

Low Performance Test

A low performance test was carried out by arranging the impactor to impact on the sample with an impact energy of about 50J. A sample was deemed to have passed the low performance test if the maximum force recorded below the anvil was below 35 kN.

High Performance Test

A high performance test was conducted by arranging the impactor to impact on the sample with an impact energy of 75J. A sample was deemed to have passed the high performance test if the maximum force recorded below the anvil was below 35 kN.

Results

The results of the high and low performance tests carried out on the device of the invention and the three comparative examples was as follows:-

	HIGH PERFORMANCE	LOW PERFORMANCE
	TEST	TEST
Invention	Pass	Pass
Comparison 1	Fail	Pass
Comparison 2	Fail	Pass
Comparison 3	Fail	Pass

It will be seen that the material of the invention was the only sample to pass the high performance test as well as the low performance test.

The present invention therefore comprehends a personal protective device, particularly for motorcycle rider's protective clothing, which comprises a layer of high density polyethylene and a layer of PVC/nitrile foam rubber having a density of at least 100 kg/m³. This composite material has been found by the applicants to exhibit significantly improved protection against mechanical impact as compared with conventional HDPE/polyurethane composite materials of the prior art as well as a number of other samples prepared for the purpose of comparison. This superiority of the device of the present invention could not be predicted by a person skilled in the art and would not have been expected, particularly as a composite material of the same kind as the invention except that the density of the PVC/nitrile is below 100 kg/m³ does not perform sufficiently well to pass the high performance test as described above.

Claims

1. A body protection device comprising a first layer of a polyolefin foam and a second layer of polyvinylchloride/nitrile foam rubber, wherein the foam rubber has a density of at least 100kg/m³.
2. A body protection device as claimed in claim 1 wherein said polyolefin foam comprises high density polyethylene foam or polypropylene foam.
3. A body protection device as claimed in claim 1 or claim 2 wherein said polyolefin foam is high density polyethylene foam having a cross-linked cell structure, having a volumetric cell count in the range 500 to 1500 cells/cm³.
4. A body protection device as claimed in claim 1, claim 2 or claim 3 wherein said first layer has a density in range 100 to 300 mg/m³, preferably 170 to 250 kg/m³.
5. A body protection device as claimed in any preceding claim wherein the thickness of the first layer is between 1

and 10mm, preferably 3 to 6mm.

6. A body protection device as claimed in any preceding claim wherein said PVC/nitrile foam rubber has a density in the range 100 to 220 kg/m³, preferably 150 to 200 kg/m³.
7. A body protection device as claimed in any preceding claim wherein the thickness of the second layer is 3 to 15mm, preferably 6 to 12mm.
8. A body protection article comprising a body protection device as claimed in any preceding claim and fastening means for fastening the body protection device to an article of clothing.
9. An article of body protection clothing, particularly motor cycle riders' clothing, comprising a body protection device as claimed in any of claims 1 to 7.