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ISO 11393-6

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Protective clothing for users of hand-held chain-saws —

Part 6: Test methods and performance requirements for upper body protectors

Vêtements de protection pour utilisateurs de scies à chaîne tenues à la main —

Partie 6: Méthodes d'essai et exigences pour vestes de protection

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 11393-6 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing*.

ISO 11393 consists of the following parts, under the general title *Protective clothing for users of hand-held chain-saws*:

— *Part 1: Test rig driven by a flywheel for testing resistance to cutting by a chain-saw*

— *Part 2: Test methods and performance requirements for leg protectors*

— *Part 3: Test methods for footwear*

— *Part 4: Test methods and performance requirements for protective gloves*

— *Part 5: Test methods and performance requirements for protective gaiters*

— *Part 6: Test methods and performance requirements for upper body protectors*

Introduction

This part of ISO 11393 forms part of a series concerned with personal protective equipment designed to protect against the risks arising from the use of hand-held chain-saws.

Accidents occur due to a number of complex reasons, but a common factor is incorrect use of the chain-saw. The importance of correct training and proper use of a chain-saw in preventing accidents cannot be underestimated.

All parts of the upper body have been shown to be at risk when using a chain-saw.

In this part of ISO 11393, specifications for the protective coverage and performance of the upper body protectors are given. No personal protective equipment can ensure a 100 % protection against cutting from a hand-held chain-saw.

Nevertheless, experience has shown that it is possible to design personal protective equipment that offers a certain degree of protection.

Different functional principles may be applied in order to give protection, such as:

a) chain slipping: on contact, the chain does not cut the material;

b) clogging: fibres are drawn by the chain into the drive sprocket and block chain movement;

c) chain braking: fibres have a high resistance to cutting and absorb rotational energy, thereby reducing the chain speed.

Often more than one principle is applied in chain-saw protective clothing. Upper body protectors meeting this part of ISO 11393 are meant to be used whilst working off the ground, and where risk assessment shows that there is a significant risk to be cut by the moving chain on the upper part of the body such as when working from a sky lift and carrying out tree surgery.

Protective clothing for users of hand-held chain-saws —

Part 6:
Test methods and performance requirements for upper body protectors

1 Scope

This part of ISO 11393 specifies requirements for the protection offered by upper body protectors against cutting by a hand-held chain-saw.

It also specifies the procedures for sampling and pre-treatment of upper body protectors, the measurement of the protective coverage, the apparatus and test methods for assessing resistance to cutting, and the practical performance test for evaluating ergonomic properties.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3175-2:1998, *Textiles — Professional care, drycleaning and wetcleaning of fabrics and garments — Part 2: Procedure for testing performance when cleaning and finishing using tetrachloroethene*

ISO 6330:2000, *Textiles — Domestic washing and drying procedures for textile testing*

ISO 13934-2:1999, *Textiles — Tensile properties of fabrics — Part 2: Determination of maximum force using the grab method*

ISO 11092, *Textiles — Physiological effects — Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded-hotplate test)*

ISO 11393-1:1998, *Protective clothing for users of hand-held chain-saws — Part 1: Test rig driven by a flywheel for testing resistance to cutting by a chain-saw*

ISO 11393-3:1999, *Protective clothing for users of hand-held chain-saws — Part 3: Test methods for footwear*

ISO 13688, *Protective clothing — General requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
upper body protector
any type of protective garment, which protects at least the specified area to the level of resistance to cutting by a chain-saw specified within this part of ISO 11393 for the upper part of the body, e.g. jacket

3.2
front
〈of an upper body protector〉 part of a garment covering the forward 50 % of the upper body circumference

3.3
rear
〈of an upper body protector〉 part of a garment covering the rear 50 % of the upper body circumference

NOTE Depending upon design and construction, and due to many layers of protective material, it can be difficult to establish the division between the front and the rear of an upper body protector. It is nevertheless of great importance to establish this before pre-treatment and testing.

3.4
top of shoulder
top of shoulder as shown in Figure 1

3.5
protective material
material which is designed to protect the wearer against the cutting effect of a hand-held chain-saw

NOTE This protective material may include the cloth of the garment.

3.6
unit of protective material
cut out piece or panel of protective material consisting of all the fabric or other layers that constitute the protective material that go into the construction of a garment

NOTE A unit has no seams or joins within it. Units can be joined together to provide the complete protective coverage required, before insertion and attachment to garments, but such units retain their individuality for testing purposes.

3.7
protective coverage
area of the garment which consists of protective material

3.8
specified protective area
required protective coverage defined in this part of ISO 11393

4 Requirements

4.1 General

Upper body protectors for chain-saw users shall meet an overall requirement that they are safe and fit for the purpose. They shall meet requirements listed in 4.2 to 4.7.

4.2 Innocuousness

Upper body protectors for chain-saw users shall be designed and manufactured to provide protection when used in accordance with the manufacturer's instructions, without endangering the user or others. Construction materials and incorporated substances shall meet the innocuousness requirements in ISO 13688. They shall not endanger those coming into contact with them. The names and concentrations of all substances contained in the product, which are generally known to cause allergies or sensitization, shall be listed in the information supplied by the manufacturer. Upper body protectors for chain-saw users shall be free of hard or sharp components and rough surfaces, that could cause abrasion, bruising, irritation, punctures or cuts to a user coming into contact with them. The manufacturer shall give guidance on the safe destruction and disposal of the products and of any hazards that can arise during mechanically disrupting or incinerating the product.

4.3 Ergonomic requirements

The protective clothing should be as lightweight as possible.

The design shall be without appendages, which can become entangled in machinery or the undergrowth.

The construction around the sleeve shall facilitate bending and lifting the arm.

The water vapour resistance of the garment outside the specific protected area shall be no more than 5 (m^2·Pa/W) when tested in accordance with 12.1.

The protective garments shall be designed to minimize discomfort and restriction while wearing them. When tested in accordance with 12.2 and 12.3, the mean score of all subjects shall be less than 1,5 for each of comfort and restriction.

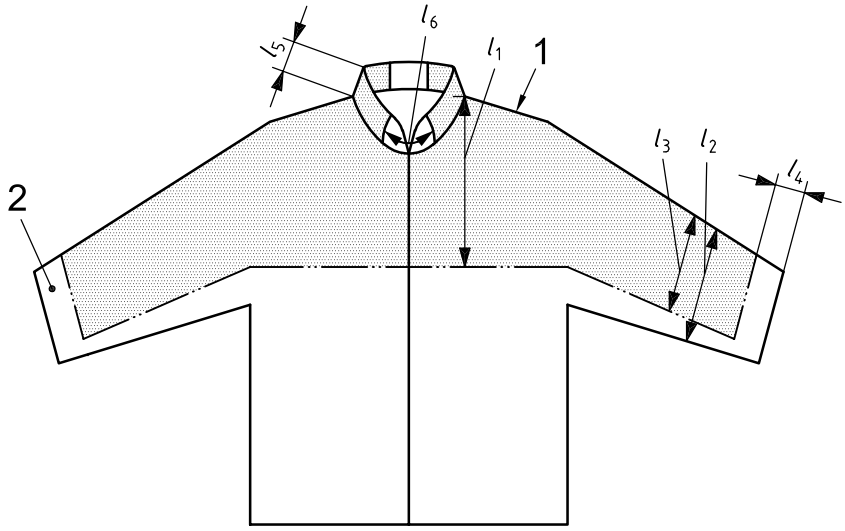
4.4 Specified minimum protective area for upper body protectors

4.4.1 General

The protective coverage shall be measured in accordance with Clause 9.

4.4.2 Front

The specified protective area shall cover the front of the garment from the top of the shoulder downwards for a distance equivalent to at least 25 % of the chest girth of the largest intended user as given in the marking. The protective area shall include the upper 80 % of the surface of the front of the sleeve down to within 70 mm of the lower edge of the cuff of the sleeve. See Figure 1.



Key

1 top of shoulder
2 cuff

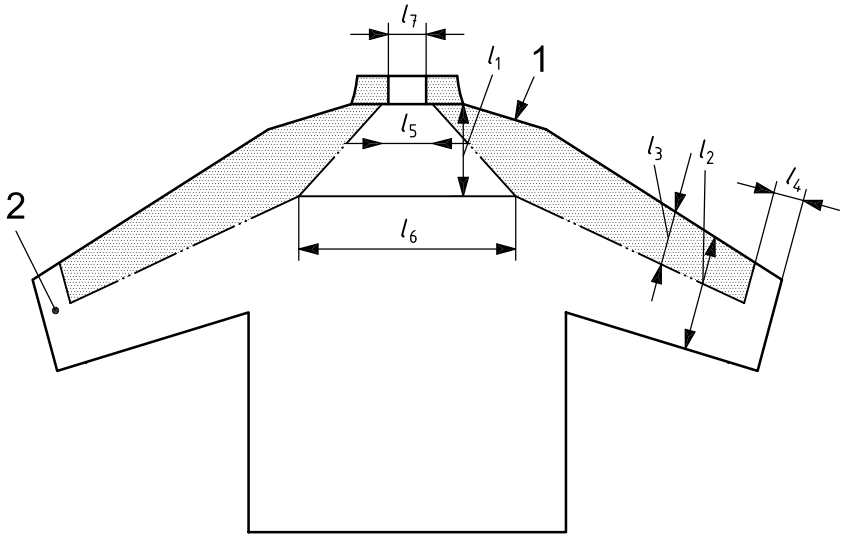
l_1 minimum height of protective coverage at the front of the garment
l_2 width of sleeve
l_3 width of protective coverage on the front of the sleeve (minimum 80 % of l_2)
l_4 unprotected cuff, width less than 70 mm
l_5 height of protective coverage in collar, minimum of 30 mm
l_6 gap in the protective coverage in the collar, maximum of 80 mm

Figure 1 — Specified protective area: front of garment

4.4.3 Back

The protective area shall cover the top of the shoulders plus the superior 40 % of the surface of the back of the sleeve down to within 70 mm of the lower edge of the cuff of the sleeve. See Figure 2.

A gap is permitted in the protective material in the centre of the back. The dimensions of the gap, l_5 and l_6, are shown in Figure 2. l_5 shall be less than 9 % of the chest girth of the smallest intended user of the garment, as given in the marking, and l_6 shall be less than 35 % of the chest girth of the smallest intended user of the garment.



Key

1 top of shoulder
2 cuff

l_1 minimum height of protective coverage at the back of the garment
l_2 width of sleeve
l_3 width of protective coverage on the back of the sleeve (minimum 40 % of l_2)
l_4 unprotected cuff, width less than 70 mm
l_5 gap in protective coverage at the level of the top of the shoulders
l_6 gap in protective coverage at a distance of l_1 below the top of the shoulders
l_7 gap in the protective coverage in the collar, maximum of 80 mm

Figure 2 — Specified protective area: back of garment

4.4.4 **Collar** (optional)

If a protective collar is fitted, the protective area shall cover a minimum length of 100 mm on each side of the neck. A gap in the protective material at the centre front of a maximum of 80 mm is permitted and a gap in the protective material at the centre back of a maximum of 80 mm is also permitted. The height of the protective material shall be a minimum of 30 mm. See Figures 1 and 2.

4.4.5 Fastenings/joins

The garment may have a closure down the centre front to facilitate donning and removal. When the garment is fastened, the gap between the edges of the protective material shall be no more than 30 mm. The gap in the protective material at the join between the main body of the garment and the collar shall be less than 8 mm.

4.5 Dimensional change

The dimensional change after washing as measured in accordance with Clause 8 shall be less than 6 %.

4.6 Resistance to chain-saw cutting

When tested in accordance with Clause 10, no cut through is allowed in any test specimen.

4.7 Requirements for attachment of protective padding and strength of closures

The protective material shall be permanently attached to the garment. Attachment shall be continuous along all the edges of the protective material, except around the cuff. When tested in accordance with Clause 11, the mean breaking force of each type of attachment present in the garment shall be at least 200 N.

5 Classification according to chain speed

Testing in accordance with this part of ISO 11393 shall be carried out at one of the following four speeds with classes assigned as follows:

a) Class 0: (16,0 $\pm$ 0,2) m/s;

b) Class 1: (20,0 $\pm$ 0,2) m/s;

c) Class 2: (24,0 $\pm$ 0,2) m/s;

d) Class 3: (28,0 $\pm$ 0,2) m/s.

6 Test methods

6.1 General

Measuring instruments unless otherwise specified shall be accurate to $\pm$ 2 % of the pass/fail level of the characteristic being measured.

For each of the required sequences of measurements performed in accordance with this part of ISO 11393 a corresponding estimate of the uncertainty of the final result shall be determined. This uncertainty (U_m) shall be given in the test report in the form $U_m = \pm X$. It shall be used in determining whether a “Pass” performance has been achieved. If the final result minus U_m is below the pass level when the requirement that a certain value shall be exceeded, the sample shall be deemed to have failed.

6.2 Number of test specimens

A set of test specimens shall be supplied that is sufficient to complete all the tests. Note that if two types of pre-treatments are specified, the testing and the numbers of test specimens is effectively doubled and two sets are required. Test specimens which have been used to assess dimensional stability and protective coverage may be used for cut-testing if it has not been necessary to cut them up for these measurements.

The number of garments required for cut testing depends on the number of units of protective material present within them and whether there are any joins or seams between different protective material units such as between the body and the sleeve. Only one test cut shall be carried out on each unit of protective material. Therefore at least three garments are required for cut testing if the design includes a fastening down the centre front of the garment, but no seams between the protective material on the body and in the sleeve. For a design incorporating only one unit of protective material, six garments are required for cut testing.

6.3 Sizes of test specimens

Whenever possible, test specimens shall be of a size to fit users with chest girths of 108 cm to 112 cm.

7 Pre-treatment

Except in the specific cases detailed below, all the test specimens shall be washed and dried five times before testing.

Test specimens shall be washed in accordance with ISO 6330:2000, procedure 2 A. After each wash cycle the test specimen shall be dried in accordance with ISO 6330:2000, procedure E (temperature not to exceed 70 °C). If the upper body protectors are marked as unsuitable for tumble-drying, the test specimens shall be line-dried after each wash cycle in accordance with ISO 6330:2000, procedure A.

Exceptions and additions to this treatment shall be made in the following cases:

a) Where the upper body protectors are marked as unsuitable for washing, but suitable for dry-cleaning.

   In such cases, the test specimens shall be dry-cleaned five times before testing. In principle the dry-cleaning shall be performed in accordance with the conditions described in of ISO 3175-2:1998, 8.1, i.e. using conditioned test specimens, tetrachloroethene with surfactant, addition of emulsified water, cleaning for 15 min at (30 ± 3) °C, draining and extracting, rinsing for 5 min with pure solvent, and draining and final extraction, followed by tumble drying with an outlet temperature not exceeding 60 °C. No restorative finishing procedure shall be applied.

b) Where the test specimens are marked as suitable for both washing and dry-cleaning.

   One set of test specimens shall be washed and dried five times and one set of test specimens shall be dry cleaned five times.

c) Where the manufacturer specifies different washing or cleaning procedures these shall be used in preference to those above.

8 Testing for dimensional change

One upper body protector shall be tested by each pre-treatment applicable.

It shall be subjected to five pre-treatment cycles in accordance with Clause 7.

After the completion of each cycle, the upper body protectors shall be reshaped by hand, but not by ironing.

The dimensions of the protective material coverage shall be measured before the first pre-treatment cycle and on completion of last cycle of the pre-treatment procedure. The dimensional change shall be determined from the percentage difference between the measurements made before the pre-treatment and the measurements made after the pre-treatment.

Measurements shall be carried out in two directions, at right angles to the other. It is suggested that one measurement should be the length of the protective material from cuff to cuff, or cuff to the centre of the garment. The other measurement is then appropriately the length of the protective material from the bottom edge near the centre front, up to the top edge at the collar and similarly on the back.

While measuring the dimensions the garment shall be stretched with a force of (20 ± 2) N in the direction of the dimension being measured. Clamps may be attached to the part of the garment to which the protective material is attached, except at the cuff where the clamps shall be attached to the protective material.

9 Checking of protective coverage

The coverage shall be measured on the pre-treated test specimen used for the testing of dimensional change.

The following procedure is one way to carry this out. Cut out any non-protective lining. Lay the garment out flat, front side uppermost on a flat surface such as a table top. Smooth out any wrinkles and creases and ensure that any fastening present lies down the centre of the garment. On the outer material, mark a line along the top of the shoulder and top and bottom of the sleeve. If there is no front fastening, mark a line down the centre front of the garment. Carefully and with minimal disturbance of the garment, mark lines on the inside surface of the protective material of the garment, corresponding to the top of shoulder and the top and bottom of the sleeves.

Take the garment and turn it inside out.

Measure the area that is covered with protective material and check that the requirements given in Clause 4 are fulfilled.

For some types of upper body protective jackets such as those that cannot be turned inside out, the test house will have to check that the requirements are fulfilled using a method suitable for that particular product. It will probably be necessary to expose the protective material by cutting away most of the outer of the garment while not disturbing the arrangement of protective material units.

10 Testing of resistance to cutting

10.1 Purpose of testing

The purpose of this test is to assess the resistance of the upper body protector to cutting by a chain-saw under such conditions that the garment is restrained from twisting when contacted by the moving chain.

10.2 Test specimens

The number of test specimens required for cut testing depends on the design of the protective material units constituting the required protective coverage, and the positions of seams between units of protective material (see 6.2).

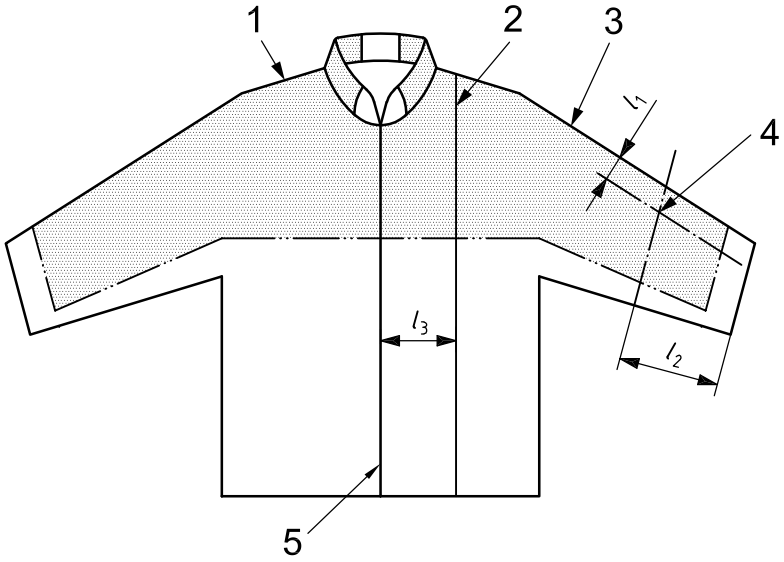
All cut test specimens shall have been pre-treated in accordance with Clause 7.

Where the garments are marked as suitable for both washing and dry cleaning two sets of garments shall be tested.

10.3 Marking of positions for cutting

10.3.1 Test position on shoulder

Mark a line parallel to, and (150 ± 10) mm from the centre front line, from the shoulder vertically down the front of the garment (see Figure 3).



Key

1 top line of shoulder

2 shoulder test line

3 top line of sleeve

4 test site on sleeve

5 centre front line

l_1 (50 ± 10) mm

l_2 (200 ± 10) mm

l_3 (150 ± 10) mm

Figure 3 — Test positions on shoulder and sleeve units of protective material

10.3.2 Test position on the sleeve

Mark a line (50 ± 10) mm in front of and parallel to the upper line of the sleeve. Mark the test line (200 ± 10) mm from the free edge of the cuff at an angle of (90 ± 10)° across the first line (see Figure 3).

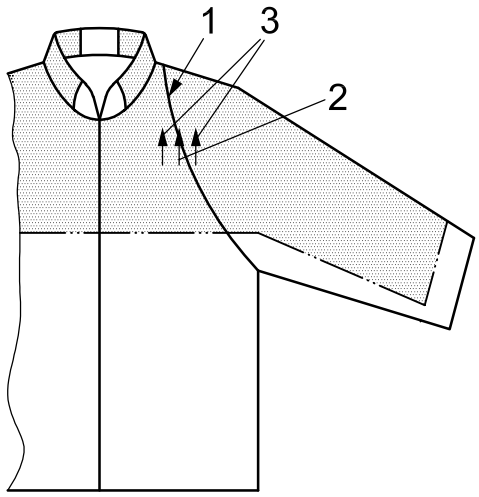
10.3.3 Test positions if there are seams in the protective material

If there are seams between units of protective material they shall be tested as follows:

— once across the seam at (0 ± 10)° to the vertical axis of the garment in the shoulder region and at (90 ± 10)° to the long axis of the arm on the sleeve (the first point of contact of the chain being on the seam);

— once each side of the seam with the first contact of the chain being (20 ± 5) mm from the seam (the cut directions being determined by the seam position as shown in Figures 4 and 5).

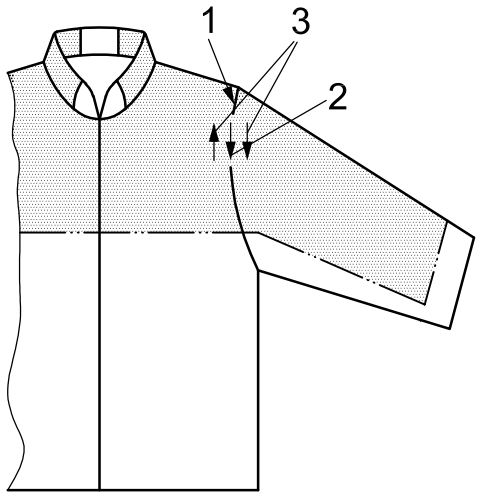
For these cut tests, the jacket shall be positioned on the appropriate mount as specified in either 10.6.1 with the top line of the shoulder of the jacket in line with the top of the mount, or 10.6.2 with the first marked line as specified in 10.3.2 along the top of the sleeve mount. The jacket shall then be moved along the mount until the seam, or the test points 20 mm either side of the seam, are at the point of first contact of the chain.



Key

1 seam
2 direction of the cut directly on the seam
3 direction of the cuts on either side of the seam

Figure 4 — Test positions and cut directions on seam in shoulder area



Key

1 seam
2 direction of the cut directly on the seam
3 direction of the cuts on either side of the seam

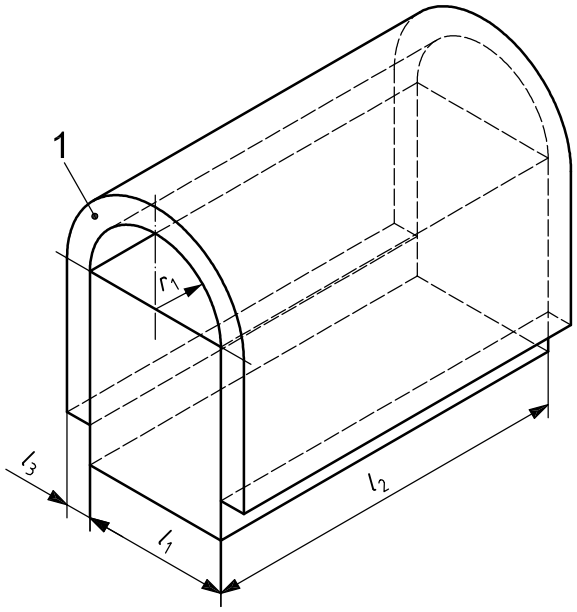
Figure 5 — Test positions and cut directions on seams between protective material on the shoulder and arm

10.4 Test mounts

10.4.1 Shoulder test mount

The shoulder test mount (see Figure 6) shall be made of rigid material such as wood. The top section shall be a half cylinder at least 200 mm long with a radius of (40 ± 1) mm. The bottom section shall be (80 ± 2) mm wide and at least 200 mm long. It shall be high enough so that the test samples can be mounted satisfactorily in accordance with 10.6.1. A height of at least 220 mm should be satisfactory.

It shall be covered with (14 ± 2) mm thick flexible cellular material in accordance with ISO 11393-1:1998, 5.4.



Key

1 flexible cellular covering

r radius of half cylinder (40 ± 1) mm

l_1 width of block (80 ± 2) mm

l_2 length of block 200 mm minimum

l_3 thickness of flexible cellular foam (14 ± 2) mm

Figure 6 — Shoulder test mount

10.4.2 Sleeve test mount

Use the artificial shinbone as described in ISO 11393-3:1999, 6.1.2.2.

10.5 Apparatus

The test rig described in ISO 11393-1:1998, 5.1, shall be used. It shall be set up so that the horizontal distance from the centre of the drive sprocket to the contact point between the guide bar and the test mount is (300 ± 5) mm. The contact force between the test mount and the guide bar with a chain fitted shall be (15 ± 0,5) N.

Before beginning a series of cut tests on a set of upper body protectors, the test rig and chain shall be calibrated in accordance with the method in ISO 11393-1:1998, Clause 7. For calibration, the test rig shall be set up in accordance with 5.3.4 in ISO 11393-1:1998 using the calibration mount specified in ISO 11393-1:1998, 5.4, and standard calibration pads specified in ISO 11393-1:1998, Clause 6.

Measured chain speeds at the point of release shall be as specified with an accuracy of ± 0,2 m/s. Between test cuts, the test rig shall be checked in accordance with ISO 11393-1:1998, 7.3, the free-running stopping time shall be (4 ± 0,2) s at a chain speed of (20 ± 0,2) m/s.

10.6 Mounting of test specimens

10.6.1 Shoulder test

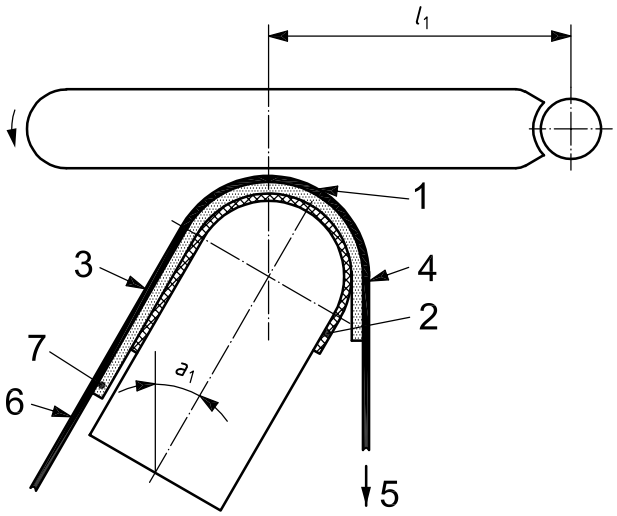
The upper body protector shall be mounted on the shoulder test mount in such a way that the top line of the shoulder follows the centre top line of the shoulder mount. The front part of the upper body protector is then stapled every (50 ± 3) mm to the mount in such a way that the staples do not penetrate the protective material (Figure 7).

Three (1 000 ± 10) g weights shall be attached to the back of the jacket. The middle weight shall be in line with the chain-saw guide bar ± 10 mm. The other weights shall be (100 ± 10) mm on either side.

The shoulder test mount with the jacket shall be mounted at a (90 ± 10)° angle to the direction of the saw chain in such a way that the back of the jacket is nearest the drive sprocket.

The mount shall then be tilted (30 ± 5)° from the vertical plane (see Figure 7).

The contact point between the saw chain and the test specimen shall be (300 ± 5) mm from the drive sprocket and on the shoulder test line at the point marked in accordance with 10.3.1.



Key

1 top line of shoulders
2 flexible foam covering mount
3 outer material of the front of garment
4 outer material of the back of garment
5 stretching force on back of garment
6 position of the line of staples through the front of the garment
7 protective material

α_1 (30 ± 5)°

l_1 (300 ± 5) mm

Figure 7 — Mounting of test specimens on the shoulder test mount

10.6.2 Sleeve test

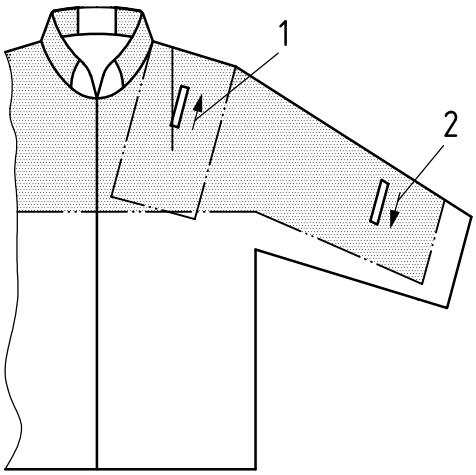
The sleeve shall be put on the test mount described in 10.4.2 in such a way that the marked line 50 mm forward of and parallel to the upper line of the sleeve is along the top of the mount. The backside of the sleeve shall be stapled every 50 mm along the mount. The staples will usually pass through protective material. A (500 ± 10) g weight on a cord with a clamp shall be attached to the outer material only of the front of the sleeve near its lower edge as it is mounted on the apparatus, in line with the intended cut, and so that the fabric in the region of the cut is under tension.

10.7 Test procedure

10.7.1 Positions of cuts

10.7.1.1 On protective material units

Test cuts shall be performed on protective material units on the front of the shoulder and on the front upper part of the sleeve. All cuts shall be made at an angle of (90 ± 5)° to the mount used and on lines, which were marked out in accordance with 10.3 and are shown in Figure 3. The directions of cut (i.e. the movement of the cutting chain relative to the test site) at the shoulder and sleeve test points shall be as shown in Figure 8. Cuts on the shoulder shall be carried out with the test specimen mounted so that the cutting direction is up the garment. The cut on the sleeve shall be carried out with the test specimen mounted so that the cutting direction is across the front of the sleeve towards the body. One test cut shall be made on each unit of protective material.



Key

1 direction of cut on the shoulder
2 direction of cut on the sleeve

Figure 8 — Direction of cut on units of protective material

10.7.1.2 On seams between protective material units

One test cut shall be carried out on each seam type and one test cut shall be carried out on either side of each seam type. For seams in the shoulder region as shown in Figure 4, all test cuts shall be carried out using the shoulder mount and the cuts shall be directed upwards. For seams between the shoulder and sleeve, as shown in Figure 5, the test cut on the shoulder side shall be carried out on the shoulder mount in an upwards direction, and the test cuts on the seam itself and on the sleeve shall be carried out on the sleeve mount in a downwards direction.

Any other seams found between units of protective material shall be tested in accordance with the same principles. All tests on the trunk part of the garment shall be carried out on the shoulder mount with the direction

of the cuts upwards, and all tests on sleeves shall be carried out on the sleeve mount with the direction of the cuts downwards. For seams, which are parallel to the shoulder or sleeve top lines, it will only normally be possible to do a cut across the seam. However, if there is any doubt about the safety of the design, samples shall be cut to test the cut resistance parallel to the seam and along the seam.

10.7.2 Number of cuts

One test cut only shall be performed on any one unit of protective material or on any seam between two units. The units either side of a seam shall be considered tested and shall not be used for further test cuts. A total of three test cuts shall be carried out at the shoulder test site, and three test cuts shall be carried out at the sleeve test site described in 10.7.1.1. A total of three test cuts shall be made on each seam type as described in 10.7.1.2.

10.7.3 Chain speed

The chain speed shall be one of the speeds specified in Clause 5 in accordance with the level of protection that the garment is stated as providing. If no information is available the speed shall be (20 ± 0,2) m/s.

11 Testing of attachment of protective material

11.1 General

The purpose of this test is to ensure that the protective material is adequately fixed to the garment.

This test is only applied to upper body protectors where the outer material covers the protective material providing the chain-saw protective properties.

Testing shall be carried out in accordance with ISO 13934-2. Any deviations to this test procedure are given below.

11.2 Test specimens

One upper body protector from each pre-treatment applied shall be tested. To assist in preparation of the test specimens, the sleeves may be cut open along the arm at a distance of at least 100 mm from the seam to be tested. Upper body protectors tested earlier in accordance with Clause 10 can be used provided the attachment has not been affected.

Examine the upper body protector and identify how many different types of attachment between the outer material and the protective material have been used in its construction. Three test specimens of each type of attachment shall be tested.

11.3 Apparatus

Apparatus in accordance with ISO 13934-2:1999, Clause 6, shall be used. For testing the strength of attachment of protective material, a cross head speed of 100 mm/min shall be used.

If no tensile testing machine is available, the test can be performed by applying units of 1 kg every 5 s to the lower grab jaw until the attachment breaks.

11.4 Test procedure

Cut out three test specimens from the upper body protector. The test specimens shall be (100 ± 2) mm wide (along the length of the seam or attachment) and (150 ± 2) mm in length (across the seam or attachment) so that there is (75 ± 2) mm of material either side of the seam or attachment.

Prepare the test specimens as specified in 8.3 in ISO 13934-2:1999, except that the lines shall be drawn on both the outer material, and the facing surface of the protective material.

Mount the test specimens in accordance with 9.3 in ISO 13934-2:1999. Each test specimen shall be mounted so that the outer material is clamped in one jaw of the tensile tester and the full thickness of protective material is clamped in the other jaw of the tensile tester, with the attachment positioned equidistant between the jaws.

Using a cross-head speed of 100 mm/min, begin the test and record the breaking force of the attachment.

If carrying out the test by applying units of 1 kg to the lower grab jaw in accordance with 9.3 in ISO 13934-2:1999, the test may be stopped if breakage has not occurred, when the mass hanging from the lower jaw reached 50 kg.

For each type of attachment, calculate the mean breaking force of the three individual tests.

12 Ergonomic testing

12.1 Water vapour resistance

The water vapour resistance of three test specimens shall be measured in accordance with ISO 11092.

12.2 Ergonomic assessment

The upper body protectors shall be examined to determine whether they are ergonomically satisfactory. The sizes, the fit and the ergonomic characteristics of garments shall be determined by an assessor with the help of a test panel of persons who wear the garments and perform a number of prescribed actions and answer questions. The members of the test panel do not have to be habitual wearers of the protective garments. They shall be selected to have physiques that would be expected of users of the garments. They shall be medically fit. Their body dimensions shall be measured and provided to the manufacturer or supplier of the garments to be tested. At least three persons should be available as test panel members. Garments shall be supplied, which fit the test persons.

12.3 Procedures

Three persons shall put on the upper body protectors and adjust them according to the information supplied with the manufacturer's instructions. They shall perform the movements below to assess the restriction and discomfort imposed by the upper body protectors. The movements shall be typical of those made by users of the garments, and shall include:

— raising the arms forwards to above the head;

— raising the arms sideways to above the head;

— bending the torso forwards with the arms outstretched as if to pick up an object placed about 300 mm above the floor;

— bending forward with the legs flexed to pick up an object from the ground;

— standing with the feet slightly apart and holding a chain-saw without its motor running in front of the body, turning 90° to the left and then 90° to the right;

— holding a chain-saw without its motor running, and moving it as in cutting and de-branching;

— standing in front of a working surface about 800 mm high and bringing the hands together to manipulate small objects.

After performing each movement several times, the test panel members shall separately report their responses, which shall be scored in accordance with Table 1.

Table 1 — Score of ergonometric response

Score	Response
0	No restriction and no discomfort
1	Slight restriction of movement, or slight discomfort
2	Significant restriction of movement and significant discomfort
3	More severe restriction of movement, and more severe discomfort
4	Movement very restricted and extreme discomfort

The scores recorded by each member shall be added up and divided by the number of movements performed. For each member of the initial panel giving an average score of 3 or above, one further member shall carry out the procedure. The mean value of the scores of all members shall be calculated.

The individual scores of all panel members and the mean value obtained shall be included in the test report.

13 Test report

The report shall include:

a) identification of the test specimens, e.g. manufacturer, style, design, date of manufacture, size;

b) pre-treatments carried out, dimensional change measurements, protective coverage assessment results, positions of seams identified between protective material units;

c) protective material attachment strength;

d) chain speed used in the tests;

e) test results for resistance to cutting, evaluation of damage and chain-stopping mechanism;

f) results from ergonomic testing;

g) water vapour resistance of the garment outside the protective coverage.

14 Marking

Protective clothing for users of hand-held chain-saws shall be durably marked with at least the following information:

a) name or trade mark or other means of identification of the manufacturer or legally responsible company;

b) designation or style number (company identification of model);

c) serial number/batch number;

d) date of manufacture (year and month);

e) number and year of this part of ISO 11393 (ISO 11393-6:2006);

f) size designation;

g) speed classification, which shall be given outside the frame of the pictogram showing a chain-saw, preferably below the shield;

h) statement “if the protective material is damaged, the garment is to be discarded” or similar statement;

i) washing/cleaning instructions including warnings against incorrect treatment.

15 Information supplied by the manufacturer

Protective clothing for users of hand-held chain-saws shall be supplied with an unambiguous information for the user, in the language(s) of the country of destination. The information supplied by the manufacturer shall contain at least the following:

a) information given in the marking;

b) name, address and telephone number of manufacturer or legally responsible company;

c) instructions to reshape when wet after each washing;

d) instructions for correct use;

e) instruction for allowable alterations for personal fit;

f) instructions about repair of the garment especially pointing out that the protective material cannot be repaired;

g) instruction that the protective area and material shall not be altered in any way and that once cut into, the garment should be discarded;

h) criteria for discarding the garment;

i) statement “does not offer protection against all risks” or similar statement;

j) weight of garment to the nearest 100 g related to size;

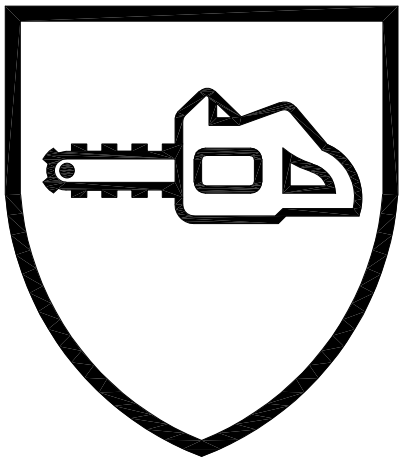
k) statement “maximum protection will only be available when the garment is fully closed”;

l) explanation of speed classification;

m) warning about any materials used in the product that can cause allergic responses or sensitization.

16 Pictogram

Protective clothing fulfilling this part of ISO 11393 shall be marked with the pictogram shown in Figure 9. The pictogram shall be placed at any visible place on the clothing and have minimum size 30 mm × 30 mm. The class of protection shall be given outside the frame of the pictogram showing the chain-saw, preferably below the shield, see Figure 9.



CLASS X

NOTE “X” corresponds to the appropriate digit representing the class of the product.

Figure 9 — Pictogram: Protection against chain-saw (ISO 7000-2416)

Annex A
(informative)

Chain-saw use and the selection of appropriate upper body protectors

A.1 General

Chain-saws are designed to cut timber. Because they can cut the human body very rapidly causing massive tissue loss, even the best protective equipment only provides partial protection.

A.2 Risk analysis

A.2.1 General

The risk of injury while using a chain-saw is dependent on many factors.

Thus a risk analysis of the type of job should be carried out and consists of a risk evaluation and risk reduction as described in A.2.2.

A.2.2 Method

A.2.2.1 Step 1: Risk evaluation

A risk evaluation should consider the following:

— level of training, skill and experience of the operator;

— frequency with which a chain-saw is used;

— duration of work;

— nature of the working environment;

— slope of the ground;

— mud, slipping soil or stones;

— suitability of the footwear;

— temperature, wind, rain or snow;

— lighting level;

— nature of the work;

— whether ground based or arboreal;

— degree of interference by cut material and branches;

— type of cutting operations involved;

— urgency or stress to complete the work;

— type of chain-saw machine (single-hand operated machines are particularly hazardous and should not be used on the ground);

— technique used to clear away cut material;

— frequency the left hand is not gripping the saw handle while the chain is moving.

A.2.2.2 Step 2: Risk reductions

Risk reduction should be considered. Each of the risk factors should be examined and ways sought to reduce them. If there is a residual risk of chain contact with the human body, the job is too hazardous. If the residual risk is for infrequent light contact of the human body with the chain, the use of upper body protectors is appropriate.

A.3 Visibility of the user

When working with chain-saws for tree service, in situations where the user needs to be visible, a suitable colour (in accordance with Clause 5 in EN 471:2003 or equivalent) for the garment is required.

Bibliography

[1] ISO 7000, *Graphical symbols for use on equipment — Index and synopsis*

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[6] ANSI/ISEA 107, *High Visibility Safety Apparel*

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