INTERNATIONAL STANDARD

ISO 11393-2

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

Part 2:
Test methods and performance requirements for leg protectors

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

Partie 2: Méthodes d'essai et exigences de performance pour protège-jambes

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Contents

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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 3.

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.

International Standard ISO 11393 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 jackets with protection against cuts by hand-held chain-saws*

Annex A of this part of ISO 11393 is for information only.

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.

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 which offers a certain degree of protection.

Different functional principles may be applied in order to give protection.

These include:

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.

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

Part 2:
Test methods and performance requirements for leg protectors

1 Scope

This part of ISO 11393 defines the design and specifies the requirements and test methods for leg protectors which offer protection against cutting from a hand-held chain-saw, including requirements for identification, marking and information for the user.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 11393. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 11393 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3175-1:1998, *Textiles — Dry cleaning and finishing — Part 1: Method for assessing the cleanability of textiles and garments.*

ISO 3175-2:1998, *Textiles — Dry cleaning and finishing — Part 2: Procedures for tetrachlorethene.*

ISO 3759:1994, *Textiles — Preparation, marking and measuring of fabric specimens and garments in tests for determination of dimensional change.*

ISO 5077:1984, *Textiles — Determination of dimensional change in washing and drying.*

ISO 5082:1982, *Textiles — Woven fabrics — Determination of breaking strength — Grab method.*

ISO 6330:1984, *Textiles — Domestic washing and drying procedures for textile testing.*

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 13688:1998, *Protective clothing — General requirements.*

3 Terms and definitions

For the purposes of this part of ISO 11393, the following terms and definitions apply.

3.1
leg protectors
any type of protective garment which protects at least the specified protective area to the level of resistance specified within this part of ISO 11393 for the leg

EXAMPLES Trousers, leggings, etc.

3.2
protective material
material which is designed to protect the wearer against the cutting effect of the hand-held chain-saw

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

3.3
protective coverage
area of the garment which is covered by protective material

3.4
specified protective area
required protective coverage

3.5
front (of a leg protector)
forward 50 % of the leg circumference

3.6
rear (of a leg protector)
backwards 50 % of the leg circumference

NOTE Depending upon the design and construction, and due to many layers of clogging material, it may be difficult to establish the front and the rear of a leg protector. It is nevertheless of great importance to establish the front and the rear before pretreatment and testing.

4 Designs

4.1 Designs of leg protectors

This part of ISO 11393 defines three designs, design A, design B and design C, for leg protectors. Design A, design B and design C have different specified protective areas as stated in 4.2, 4.3 and 4.4.

4.2 Design A

4.2.1 Specified protective area for design A

The specified protective area for design A is described under a), b) and c) and is shown in Figure 1.

a) Front: the specified protective area fully covers the front of the garment from 50 mm above the lower end of the legs to 200 mm above the crotch. It is permitted to leave out protective material at the fly.

b) Rear, left leg: the specified protective area covers, on the outer side of the leg, a 50-mm wide strip extending from 50 mm above the lower end of the leg to 200 mm below the crotch and then tapering to zero at a height of 200 mm above the crotch.

c) Rear, right leg: the specified protective area covers, on the inner side, a 50-mm wide strip from 50 mm from the bottom of the leg to 50 mm below the crotch.

It is permitted to extend the protective coverage provided that the protection level is at least the same as in the specified protective area. There shall be no joints in the protective material within the specified protective area.

4.2.2 Other design requirements for design A

The leg protectors shall have a specified protective area as identified in 4.2.1 and they shall fully enclose both the front and the rear of the user's leg from 50 mm below the crotch to the bottom end of the legs of the garment. The bottom end of the leg of each garment shall be designed to facilitate easy overlap of protective material with safety footwear worn by the user.

4.3 Design B

4.3.1 Specified protective area for design B

The specified protective area for design B is described under a), b) and c) and is shown in Figure 2.

a) Front: the specified protective area fully covers the front of the garment from 50 mm above the lower end of the legs to 200 mm above the crotch. It is permitted to leave out protective material at the fly.

b) Rear, left leg: the specified protective area covers on the inner side of the leg a 50-mm wide strip from 50 mm from the bottom to 50 mm below the crotch. On the outer side of the leg, it covers a 50-mm wide strip extending from 50 mm above the lower end of the leg to 200 mm below the crotch and then tapering to zero at a height of 200 mm above the crotch.

c) Rear, right leg: the specified protective area covers, on the inner side, a 50-mm wide strip from 50 mm from the bottom of the leg to 50 mm below the crotch.

It is permitted to extend the protective coverage provided that the protection level is at least the same as in the specified protective area. There shall be no joints in the protective material within the specified protective area.

4.3.2 Other design requirements for design B

The leg protectors shall have a specified protective area as identified in 4.3.1 and they shall fully enclose both the front and the rear of the users leg from 50 mm below the crotch to the bottom end of the legs of the garment. The bottom end of each leg of the garment shall be designed to facilitate easy overlap of protective material with safety footwear worn by the user.

4.4 Design C

4.4.1 Specified protective area for design C

The specified protective area for design C is described under a) and b) and is shown in Figure 3.

a) Front: the specified protective area fully covers the front of the garment from 50 mm above the lower end of the legs to 200 mm above the crotch. It is permitted to leave out protective material at the fly.

b) Rear: the specified protective area fully covers the rear of the garment from 50 mm above the lower end of the legs to 50 mm below the crotch on the inner side of each leg and to the level of the crotch on the outside of each leg.

No more than two joints are allowed in the protective material.

No gaps shall be more than 4 mm wide, and shall run along the leg.

4.4.2 Other design requirements for design C

The bottom end of each leg of the garment shall be designed to facilitate easy overlap of protective material with chain-saw protective footwear worn by the user.

5 Ergonomic considerations

The protective clothing shall be as lightweight as possible.

Between the crotch and fly, a break of 30 mm is allowed, but it is recommended to keep this break as small as possible.

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

Braces shall have a minimum width of 30 mm.

The construction around the knee shall facilitate bending of the leg.

If the leg protectors are leggings, they shall be capable of being securely connected in the fly area. For zippers, buttons, etc., an opening break of 30 mm is allowed.

6 Requirements

6.1 Dimensional change

The dimensional change as measured in accordance with 9.1 shall be less than 6 %.

6.2 Protective coverage

The protective coverage measured in accordance with 9.2 shall fulfil the requirements given in 4.2 for design A, 4.3 for design B, or 4.4 for design C.

6.3 Resistance to cutting by a chain saw

6.3.1 Classification according to chain speed

Testing according to this part of ISO 11393 can be made with the following three speeds with classes designated as follows:

— class 1: 20 m/s;

— class 2: 24 m/s; and

— class 3: 28 m/s.

6.3.2 Requirements to cut resistance

When tested according to 9.3, no cut through is allowed in any tested specimen.

6.4 Requirements for attachment of protective padding

The protective material shall be permanently attached to the garment. For designs A and B it shall be along the edges of the protective padding along the leg. When tested according to 9.4, the attachment should resist at least a force of 200 N.

7 Test specimens

7.1 Number of test specimens

The total number of test specimens for testing are as follows.

a) Designs A and B:

1) If only cleaned by washing: four pairs of complete leg protectors.

2) If only cleaned by dry-cleaning: four pairs of complete leg protectors.

3) If cleaned both by washing and dry-cleaning: eight pairs of complete leg protectors.

Depending on construction and pretreatment more test specimens may be needed.

b) Design C:

1) If only cleaned by washing: five pairs of complete leg protectors.

2) If only cleaned by dry-cleaning: five pairs of complete leg protectors.

3) If cleaned both by washing and dry-cleaning: ten pairs of complete leg protectors.

Depending on construction and pretreatment more test specimens may be needed.

It is permitted to use the same test specimens for cutting as were used for testing dimensional change.

7.2 Size designation of test specimens

For trousers, the size designation according to Table 1 of ISO 13688:1998 shall be: waist girth 92 to 96.

For other leg protectors a size designation comparable to waist girth 93 shall be chosen.

8 Pretreatment

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

This washing shall be according to procedure 2A of ISO 6330:1984 and the drying shall be by tumble-drying at a temperature not exceeding 70 °C (procedure E).

Exceptions to this treatment are permitted in the following cases.

a) Where the leg 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 8.1 "Process for normal materials" of ISO 3175-2:1998, i.e. using conditioned test specimens, perchlorethylene 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. Tumble-dry with an outlet temperature not exceeding 60 °C. No restorative finishing procedure.

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

In such cases, the test shall be carried out on both washed test specimens and dry-cleaned test specimens, (two sets of test specimens).

c) Where the test specimens are marked as unsuitable for tumble-drying:

In such cases, the test specimens shall be washed by the method described above, then line-dried (procedure A of ISO 6330:1984).

9 Test methods

9.1 Measurement of dimensional change

Number of test specimens is one test specimen for each pretreatment.

Follow the test procedure for determination of dimensional stability in washing and drying as stated in ISO 6330, and follow the manufacturer's care labelling regarding cleaning information.

One test specimen shall be subjected to five washing processes, or the alternative processes mentioned under 8a), 8b) or 8c).

After each washing the leg protectors shall be reshaped by hand, but not reshaped by ironing.

Dimensional change is assessed in accordance with ISO 3759:1994, 7.2.2, for measuring, ISO 5077 for washing, and ISO 3175-1 for dry-cleaning, where it is noted that complete garments are used as test specimens. The measurements shall be made at a place with protective material.

During measurement of distances representing length (L) and width (W), the leg protectors shall be stretched with a force of 20 N. This can be done with a line load for L and a width-stretcher for W. L and W shall be measured with an uncertainty of measurement of ± 5 mm. The line load of 20 N shall be applied between the waist and bottom of the leg protector leg, and it shall be applied through at least three clamps in each end, whereby the load is distributed. At the bottom the clamps shall be fixed to protective padding.

The width-stretcher shall stretch the leg protector leg over a distance of 500 mm with a force of 20 N.

9.2 Checking of protective coverage

Measure the coverage on the pretreated test specimen used for testing of dimensional change.

For trousers the following procedure is recommended.

Establish the front and the rear of the leg protector. It is suggested to "throw" the trousers on a table, getting them stretched out with the fly and crotch centrally on top and bottom, and each time mark the inner and outer lines along the leg. Also mark the front line, which is the line in the middle of the front, and the rear line, which is the line in the middle of the rear.

Take the garment and turn it inside out.

Record the area that is covered with protective material and check that the requirements given in 4.2, 4.3 or 4.4 are fulfilled.

NOTE The process of placing the trousers in a position making measurements possible was discussed carefully when the part of ISO 11393 was developed. The method described will make it possible to check the coverage. If the design of the clothing makes it easier to check the coverage by placing the trousers in a different position, then this can be done, but it should be mentioned in the test report.

For other types of leg protectors, for instance such that cannot be turned inside out, the test house shall check that the requirements are fulfilled using a method suitable for the particular product.

9.3 Testing of resistance to cutting

9.3.1 Purpose of testing

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

9.3.2 Test specimens

The number of test specimens required for each design as defined in 7.1 are as follows.

For design A and design B, three pairs of protective garment, and for design C, four pairs of protective garment.

All pairs of protective garment shall be pretreated according to clause 8.

In the case that both washing and dry-cleaning are performed, the number of test specimens is doubled.

9.3.3 Apparatus

The test rig described in ISO 11393-1 shall be used. For variable properties, use the arrangement and dimensions given in 5.3 of ISO 11393-1:1998.

The calibration pad mount and calibration pad fixture device described in 5.5 of ISO 11393-1:1998 shall be used.

9.3.4 Mounting of test specimens

The test specimen is mounted on the calibration pad mount in such a way that the contact point with the saw chain shall be on the middle line of the front or the middle line of the rear.

It is fixed using the calibration pad fixture device. Ensure that the spikes penetrate the protective material, except approximately 60 mm on each side of the contact point, where the spikes are omitted.

A gravitational line loading of 50 N/m is applied inside the garment under test.

9.3.5 Test procedure

9.3.5.1 Positions

The test cuts are performed either on the front of the leg or on the rear of the leg.

All cuts are made at an angle of 45° to the sample mount, and at a distance of between 250 mm and 500 mm from the crotch. The direction of cut is as shown in Figure 4.

No cutting shall be made at positions where the protective material is folded.

If there are joints in a design C protective leg protectors, the following will apply:

a) if the joint is within the protective area for design B or interferes with the normal testing positions for design B, there is cut testing across such a joint. In such cases more test specimens may be needed.

b) if the joint is outside the protective area for design B and clear of the normal testing point for design C, there is no cut testing over the joints.

Only one cut shall be performed on any one leg of each test specimen.

9.3.5.2 Number of cuts

9.3.5.2.1 Design A and design B

For each pretreatment, six cuts are made, all on the front.

9.3.5.2.2 Design C

For each pretreatment, eight cuts are made, four on the front and four on the rear.

9.3.5.3 Chain speed

The chain speed shall be one of the speeds specified in 6.3.1 as required by the client. If no information is available, 20 m/s is used.

9.4 Testing of attachments

9.4.1 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 trousers or similar leg protectors where outer material is provided with protective material giving the chain-saw protective properties.

The grab test is carried out according to ISO 5082 with trouser legs in full length as test specimens.

9.4.2 Test specimens

Use one pair of trousers for each pretreatment applied.

The leg protectors are cut open in the leg length direction at a distance of at least 100 mm from the seam to be tested. Leg protectors earlier tested according to 9.3 can be used provided the attachment has not been affected.

9.4.3 Apparatus

Use tensile testing machine and grab equipment (see Figure 5) as specified in ISO 5082.

9.4.4 Test procedure

Fix the free end of the protective padding and the opposite free end of the garment to each of the two grabs. The distance from the seam to each grab shall be (25 ± 1) mm and no grab shall be closer to an end or corner of the protective padding than 100 mm. Mount the grabs with the test specimen in a tensile testing machine and pull with a speed of (1,5 ± 1) mm/s. Measure the force needed to break the test specimen. The test can be stopped if the force is above 500 N.

If no tensile testing machine is available, the test may be performed by applying lots of 1 kg mass every 5 s to the lower grab until breaking occurs.

9.5 Test report

The report shall include:

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

b) pretreatment;

c) dimensional change;

d) protective coverage;

e) test results of attachment test;

f) chain speed;

g) test results for resistance to cutting, evaluation of damage and chain stopping mechanism.

10 Changes in construction

The manufacturer may change the construction above the waist level without retesting the type.

11 Marking

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

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

b) designation or style No. (company identification of model);

c) design according to clause 4;

d) serial number/batch number;

e) date of manufacture (year and month);

f) the number ISO 11393-2;

g) size designation;

h) speed classification: this information shall be given outside the frame of the pictogram, preferably on the bottom of the frame;

i) the sentence "If the protective material is damaged, the garment is to be discarded", or similar;

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

Protective clothing fulfilling the requirements of this part of ISO 11393 shall be marked with the pictogram ISO 7000-2416[1)] as shown in Figure 6. The pictogram shall be placed at any visible place on the clothing and have a minimum size of 30 mm × 30 mm

12 Information for the user

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 purchase. The information for the user 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) instructions for allowable alterations for personal fit;

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

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

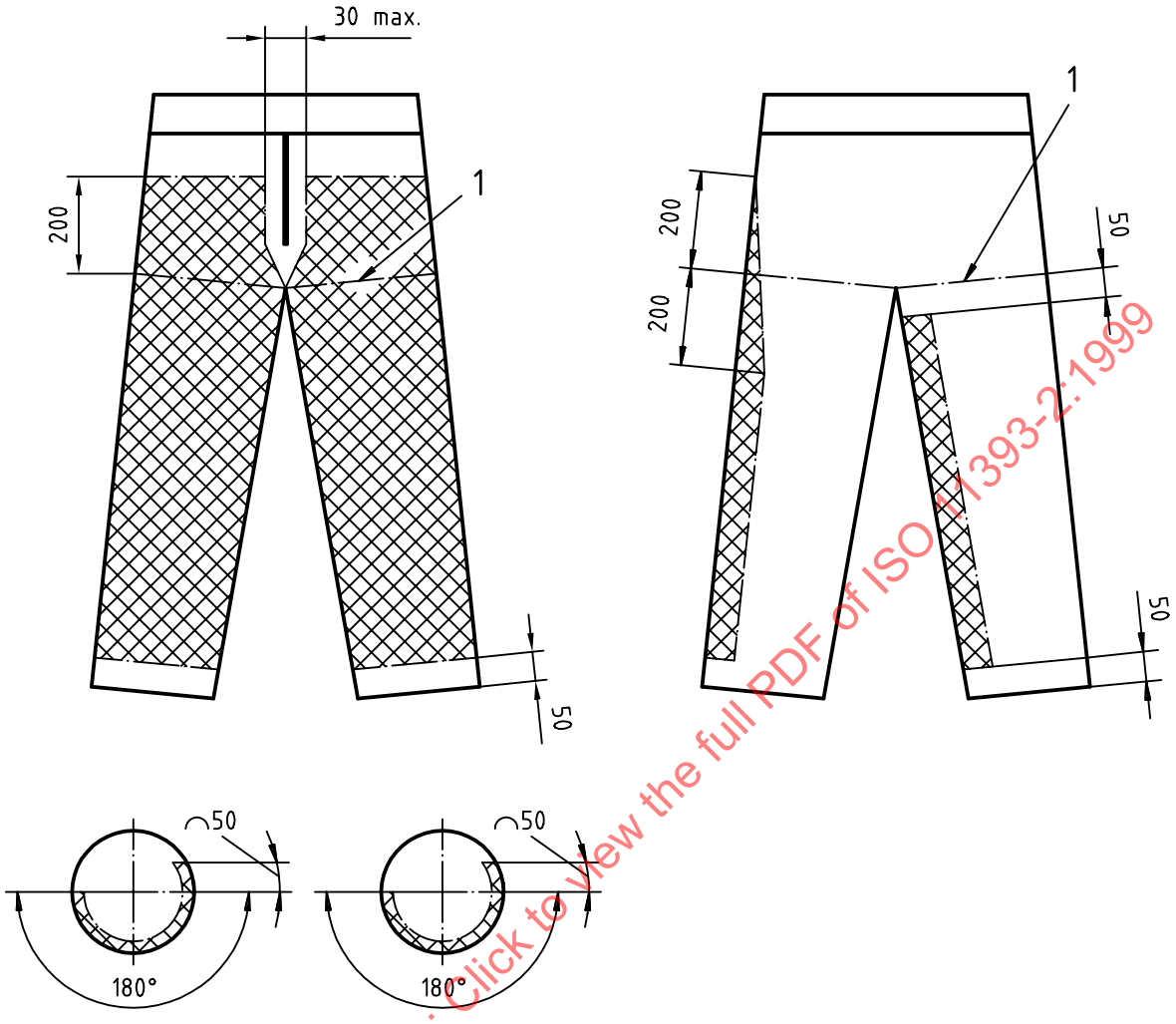
h) criteria for discarding the garment;

i) the text: "Does not offer protection against all risks" or similar;

j) mass of garment to the nearest 100 g, related to size.

1) ISO 7000:1989, *Graphical symbols for use on equipment — Index and synopsis*.

Dimensions in millimetres



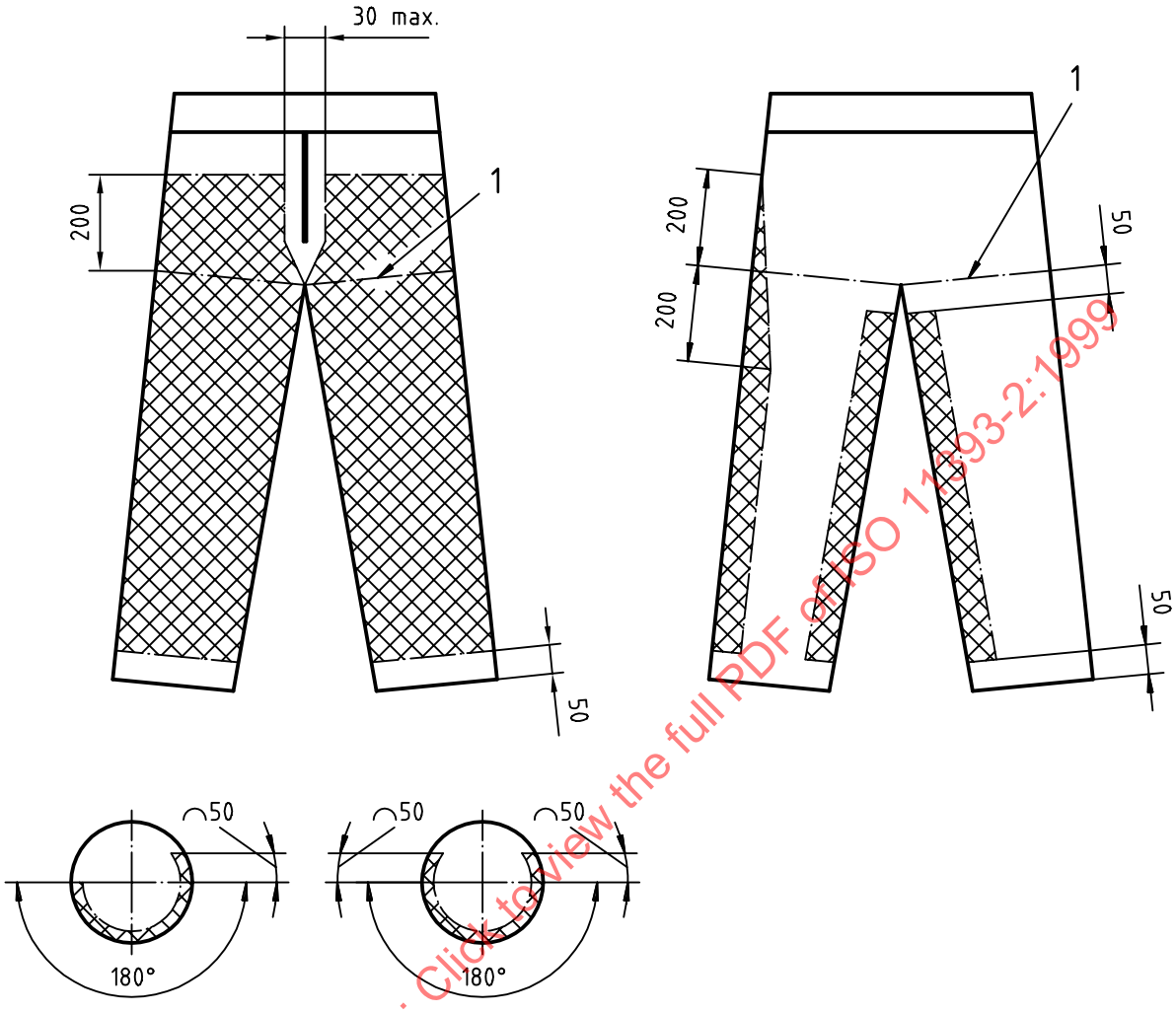
a) Front **b) Rear**

Key

1 Level of crotch

Figure 1 — Specified protective area, design A

Dimensions in millimetres



a) Front **b) Rear**

Key

1 Level of crotch

Figure 2 — Specified protective area, design B