INTERNATIONAL STANDARD

ISO 7854

Second edition
1995-08-15

Rubber- or plastics-coated fabrics — Determination of resistance to damage by flexing

Supports textiles revêtus de caoutchouc ou de plastique — Détermination de la résistance à la flexion

Reference number
ISO 7854:1995(E)

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Foreword

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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 7854 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*.

This second edition cancels and replaces the first edition (ISO 7854: 1984), which has been technically revised.

Annex A of this International Standard is for information only.

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Introduction

Investigation of dynamic-flex fatigue properties of coated fabrics has for a number of years suffered from poor repeatability (due in part to the unknown but inevitable variability of the material tested) and worse reproducibility. Nevertheless, dynamic-flex performance of coated fabrics has been long and widely used as a measure of the product quality.

The methods traditionally used suffered from the common deficiency of testing only a small test piece. The De Mattia test is unsuitable for materials that exhibit "set", such as thermoplastics, and the Schildknecht method has disadvantages when testing the heavier industrial fabrics and also tends to require very high geometric ratios and consequently time-consuming tests to verify results. In addition, the mounting of Schildknecht test pieces can seriously affect test results and repeatability.

Both the De Mattia and Schildknecht methods are also uni-directional, which in some cases is advantageous, but in many cases is not appropriate, e.g. where bi-directional stresses are exerted during use.

This revised edition of ISO 7854 attempts to standardize the mounting difficulties associated with the Schildknecht apparatus (method B) and introduces a bi-directional flex fatigue test that provides a large test piece, enabling post-flexing investigations, such as hydrostatic-head tests, to be conducted. The apparatus is described in ISO 8096-3:1988, *Rubber- or plastics-coated fabrics for water-resistant clothing — Specification — Part 3: Natural rubber- and synthetic rubber-coated fabrics*. The apparatus outlined there in illustrative form (see the note to F.1 in annex F of ISO 8096-3:1988) has been developed in more detail and is now widely available commercially from a number of sources.

Flex testing can provide a useful indication of the durability of coated fabrics. However, for most applications, flexing conditions induced by these test methods are dissimilar to the conditions met in practice. In particular, the micro-climate induced around the test piece and the thermal stresses induced in the molecular structure of the coating during flexing are unlikely to be representative of practical situations. It is important therefore that these effects be kept to a minimum and their effect be given due consideration when test results are being considered. Consequently, it is important to ensure that the air temperature around the test pieces is kept constant during the test. This can be achieved either by maintaining adequate non-forced, open ventilation around the test pieces or by controlling the air temperature within any closed container in which the test apparatus may be mounted.

Three methods are described. Method A (De Mattia) may be found suitable for flex testing coated fabrics which cannot be constrained into the configuration required by method B or where the amount of material available for testing is too small to permit the other methods to be employed. Method B (Schildknecht) will be found useful for flex testing coated fabrics of relatively lightweight construction or whose practical

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usage would be in the light to medium range in terms of severity of flexing.

Method C (crumple/flex test) has been found useful in testing coated fabrics which will be subject to severe usage in terms of their flexing capability under arduous conditions. The method requires a large test piece but this provides certain advantages for selecting test pieces for related testing after flexing, e.g. hydrostatic-head testing.

Some coated fabrics are more susceptible to delamination when flexed in the wet state and attention is drawn to the information given in annex A.

Because of the differences in the nature of the flexing in the three methods, no true correlation of results between the different methods is possible.

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Rubber- or plastics-coated fabrics — Determination of resistance to damage by flexing

1 Scope

This International Standard describes three methods of assessing the resistance of coated fabrics to damage by repeated flexing.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 132:1983, *Rubber, vulcanized — Determination of flex cracking (De Mattia).*

ISO 1420:1987, *Rubber- or plastics-coated fabrics — Determination of resistance to penetration by water.*

ISO 2231:1989, *Rubber- or plastics-coated fabrics — Standard atmospheres for conditioning and testing.*

ISO 2286:1986, *Rubber- or plastics-coated fabrics — Determination of roll characteristics.*

3 Method A — De Mattia method

3.1 Principle

A rectangular strip of coated fabric is folded twice so that its long edges meet forming a strip measuring 125 mm × 12,5 mm. This folded strip is mounted between a pair of flat grips, one of which reciprocates, causing the folded test piece to be bent outwards five times per second. This high-speed folding of the test piece is continued for either a pre-set number of cycles or until damage to the test piece is apparent.

3.2 Apparatus

3.2.1 Flex-testing machine, as specified in ISO 132, with pairs of flat grips. One of the grips of each pair is capable of a reciprocating motion in a vertical plane with a stroke length of $(57\ ^{+0,5}_{0})$ mm and a frequency of 5,0 Hz ± 0,2 Hz.

Each pair of grips is positioned so that they are 70 mm ± 1 mm apart when in the open position and 13 mm ± 0,5 mm apart when in the closed position.

3.3 Preparation of test pieces

Select six test pieces each 37,5 mm ± 1 mm wide × 125 mm long from the usable width of the roll as defined in ISO 2286. Three test pieces shall be selected with their longer dimension in the longitudinal direction of the roll of coated fabric and three test pieces with the longer dimension in the transverse direction of the roll of coated fabric. Test pieces shall be selected from positions evenly spaced across the full width and length of the sample.

NOTES

1 In the case of woven-fabric substrates, as far as possible no two test pieces should contain the same threads of the fabric in the direction to be tested.

2 Together with suitable increases in the width of grips, the test piece size may be increased so as to permit subsequent hydrostatic-head tests to be conducted.

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3.4 Conditioning and testing atmosphere

Condition the test pieces in atmosphere A, B or C of ISO 2231:1989, and conduct the test in that atmosphere.

3.5 Procedure

Fold each test piece twice as illustrated in figure 1, with the coating to be tested outermost, along lines 12,5 mm from each of the longer edges and to a width of 12,5 mm. Mount each folded test piece between a pair of grips whilst they are in the open position so that the test piece is slightly taut and so that the coating on the centre section of the test piece will be subjected to an outward fold. Move the grips together by hand and guide each test piece into a fold at approximately the midpoint (see figure 1).

Set the apparatus in motion and stop it after the specified number of cycles or, if the point of failure or breakdown of the coated fabric is to be determined, stop the apparatus at predetermined intervals to allow examination of the test piece.

3.6 Examination of test pieces

Examine the test pieces initially whilst retained in the grips of the flexing apparatus or, if required, remove the test pieces from the grips for a more detailed inspection in accordance with clause 6. Test pieces removed from the grips shall not be remounted.

Terminate flexing either at the specified number of cycles or at the first inspection at which test pieces show signs of deterioration or cracking of the type under investigation. Where relevant, record at each examination the total number of flexes to which the test pieces have been subjected and assess the flexing damage in accordance with clause 6.

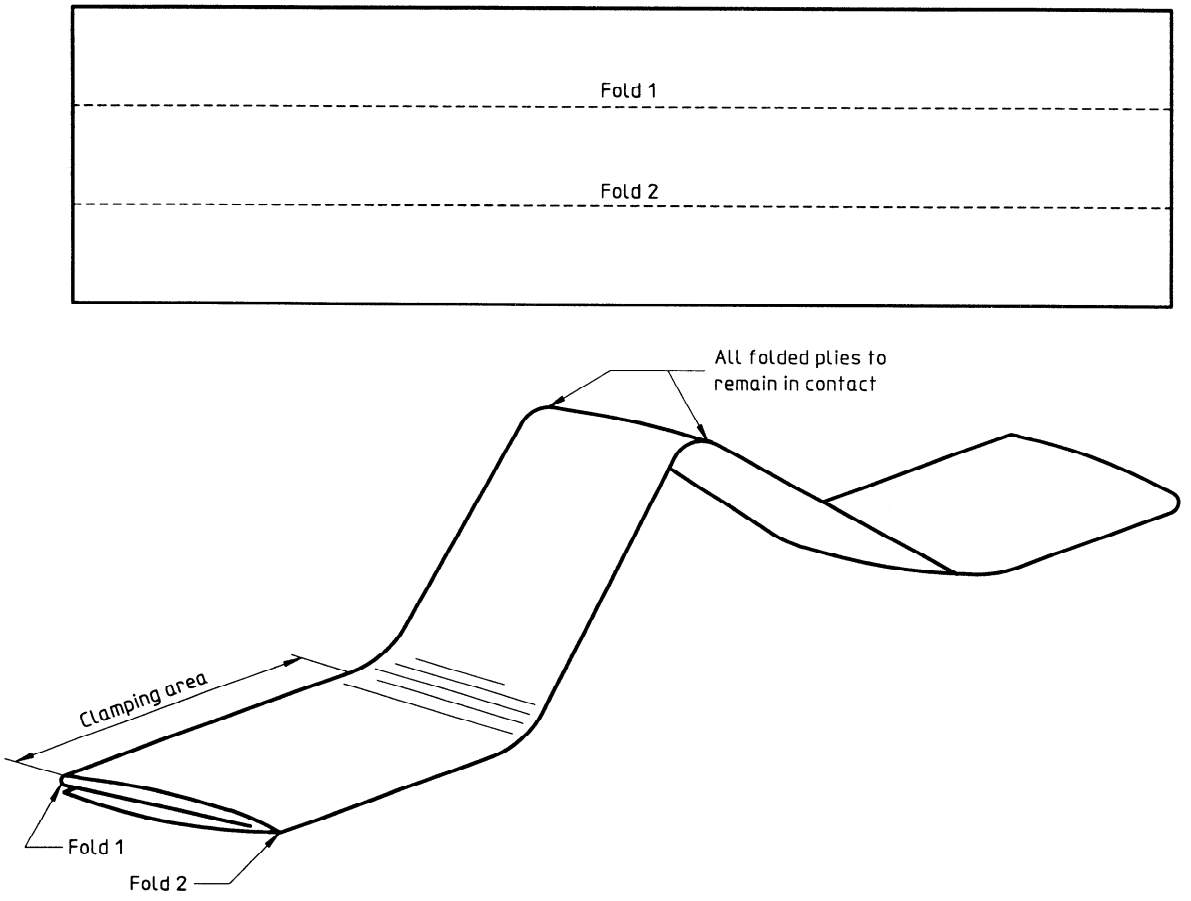

Figure 1 — Illustration of folding and configuration of test piece for De Mattia method

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3.7 Test report

The test report shall include the following particulars:

a) a reference to this method of test, i.e. Method A of ISO 7854:1995;

b) all details necessary for the identification of the coated fabric, including any relevant reference number;

c) the specified number of flexes for which the test was run and at which the examination was made and/or the number of flexes at final inspection;

d) the severity of damage at each inspection, reported in accordance with clause 6;

e) details of any deviation from the standard test procedure.

4 Method B — Schildknecht method

4.1 Principle

A rectangular strip of coated fabric is mounted around two opposing cylinders so that the test piece takes a cylindrical form. One of the cylinders reciprocates along its axis, causing the coated-fabric cylinder to be alternately compressed and relaxed, thus inducing folds in the test piece. This folding of the coated-fabric cylinder is continued for either a pre-set number of cycles or until damage to the test piece is apparent.

4.2 Apparatus

4.2.1 Test machine, consisting of a pair or pairs of metal cylinders suitably mounted so that the axes of each pair lie along an arc having a radius of not less than 450 mm. The cylinders are 25,4 mm ± 0,1 mm in external diameter and one cylinder of each pair is capable of a reciprocating motion along its axis at a frequency of 8,3 Hz ± 0,4 Hz. The stroke length of the reciprocating cylinder is 11,7 mm ± 0,35 mm.

4.2.2 Hose clips or **tool clips,** 10 mm ± 1 mm wide, to attach the test pieces to the cylinders.

4.3 Preparation of test pieces

4.3.1 General

Select six test pieces each 105 mm long × 50 mm wide from the usable width of the roll as defined in ISO 2286. Three test pieces shall be selected with their longer dimension in the longitudinal direction of the roll of coated fabric and three test pieces with their longer dimension in the transverse direction of the roll of coated fabric. Test pieces shall be selected from positions evenly spaced across the full width and length of the sample.

NOTE 3 In the case of woven-fabric substrates, as far as possible no two test pieces should contain the same threads of the fabric in the direction to be tested.

4.3.2 Test pieces for subsequent hydrostatic-head testing

When hydrostatic-head tests are to be subsequently conducted in accordance with method B of ISO 1420:1987, the test piece size used for flexing shall be 105 mm × 65 mm and the test piece for hydrostatic-head testing shall be taken from the central portion of the flexed test piece.

4.4 Conditioning and testing atmosphere

Condition the test pieces in atmosphere A, B or C of ISO 2231:1989, and conduct the test in that atmosphere.

4.5 Procedure

Mount each test piece, with the coating to be evaluated outermost, around two opposing cylinders that are in the fully open position with the length of the test piece around the circumference of the cylinders. Secure the test pieces into position on each cylinder by means of a clip (4.2.2). Ensure that the distance between the inside faces of the attachment clips (4.2.2) is 36 mm ± 1 mm. When using enlarged test pieces 65 mm wide (see 4.3.2), the free length of unclamped test piece shall be 44 mm ± 1 mm (see figure 2).

Set the apparatus in motion and stop it after the specified number of cycles or, if the point of failure or breakdown of the coated fabric is to be determined, stop the apparatus at predetermined intervals to allow examination of the test piece.

4.6 Examination of test pieces

Examine the test pieces initially whilst retained in the clips around the mounting cylinders or, if required, remove the test pieces from the clips for a more detailed inspection in accordance with clause 6. Test pieces removed from the clips shall not be remounted.

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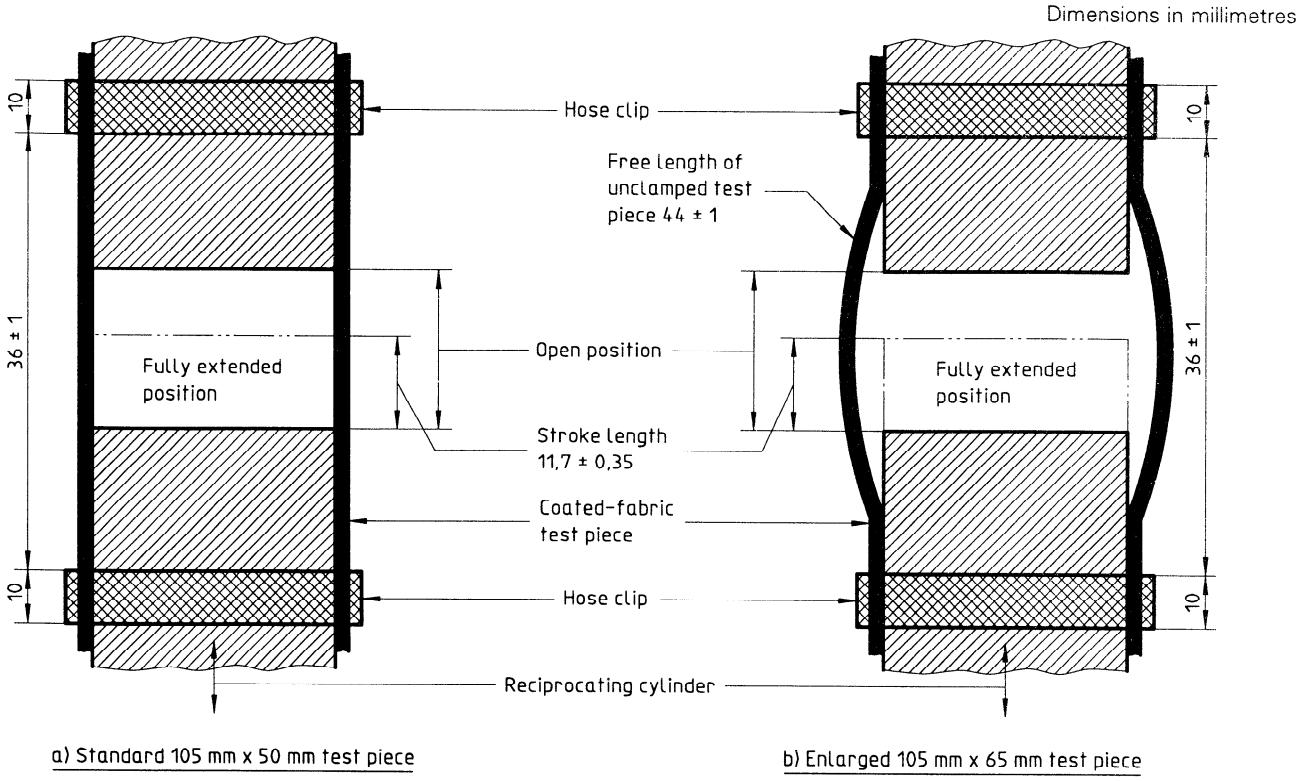

Figure 2 — Mounting the test pieces

Terminate flexing either at the specified number of cycles or at the first inspection at which test pieces show signs of deterioration or cracking of the type under investigation. Where relevant, record at each examination the total number of flexes to which the test pieces have been subjected and assess the flexing damage in accordance with clause 6.

NOTE 4 It is possible to remove the test pieces for examination from the apparatus whilst still retained by the clips. This permits the test pieces to be re-inserted in the apparatus and flexing continued if so required, without interfering with the folded configuration of the test pieces caused by flexing.

4.7 Test report

The test report shall include the following particulars:

a) a reference to this method of test, i.e. Method B of ISO 7854:1995;

b) all details necessary for the identification of the coated fabric, including any relevant reference number;

c) the specified number of flexes for which the test was run and at which the examination was made and/or the number of flexes at final inspection;

d) the severity of damage at each inspection, reported in accordance with clause 6;

e) details of any deviations from the standard test procedure.

5 Method C — Crumple/flex method

5.1 Principle

A rectangular test piece of coated fabric is sewn into a cylindrical shape. The cylinder of coated fabric is mounted between two discs and secured into position. One of the discs oscillates on its axis through approximately 90°. This induces twisting in the coated-fabric test piece cylinder. At the same time, the other disc reciprocates along its axis, thus causing the cylindrical test piece to compress along its length. This twisting and simultaneous compressing of the cylindrical test piece is continued for either a pre-set number of cycles or until damage to the test piece is apparent.

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5.2 Apparatus

The apparatus consists essentially of two opposing flanged or shouldered discs, with $(180\ ^{+3}_{0})$ mm between the inside faces of the flanges at maximum disc separation. The unflanged part of each disc is 63,5 mm in diameter × 15,0 mm face width. The discs are mounted along the same axis with their edges 152,4 mm apart at their maximum separation (see figure 3). One disc shall be capable of moving towards the other along their common axis for a distance of 70,0 mm, thus inducing compression into the cylindrical test piece at the rate of 2,53 Hz ± 0,07 Hz, i.e. (152 ± 4) compression strokes per minute. The second disc shall be capable of turning through an angle of 90° ± 2°, thus inserting twist into the cylindrical test piece at a frequency of 3,33 Hz ± 0,17 Hz, i.e. (200 ± 10) twist insertions per minute.

Counters record the total number of compression strokes inserted during a test and the frequency at which the machine is operating.

5.3 Preparation of test pieces

5.3.1 General

Select two test pieces each 220 mm long × 190 mm wide from the usable width of the roll as defined in ISO 2286. One test piece shall be selected with its longer dimension in the longitudinal direction of the roll of coated fabric and one test piece with the longer dimension in the transverse direction of the roll of coated fabric. Each test piece shall be sewn into a cylindrical shape 190 mm long × 64 mm inside diameter with the coating face to be evaluated outermost, as illustrated in figure 4.

5.3.2 Test pieces for subsequent hydrostatic-head testing

When subsequent hydrostatic-head tests are to be conducted in accordance with ISO 1420, test pieces for hydrostatic-head testing shall be taken from the crumple/flex test piece in accordance with figure 5.

5.4 Conditioning and testing atmosphere

Condition the test pieces in atmosphere A, B or C of ISO 2231:1989, and conduct the test in that atmosphere.

5.5 Procedure

Check that the apparatus is functioning at the required speed before proceeding with the test.

Mount the cylindrical test piece between the discs so that each end of the test piece butts up to the inside face of the shoulder on the disc.

NOTE 5 This ensures that there is approximately 10 mm of slack in the test piece when mounted.

Ensure when mounting the test piece that the oscillating disc is set at the mid-point of its oscillatory cycle, i.e. at zero torque, and that the sewn seam (see 5.3) is in line with the mid-point of the oscillating disc (i.e. uppermost on a horizontal machine).

NOTES

6 The alignment of the sewn seam with the mid-point of the oscillating disc on a horizontally oriented machine is to reduce the effect of test piece sag when mounted, which can influence the effectiveness of the test.

7 The speed of the machine may require adjusting during the test to offset the reduced damping effect of the test piece as the test proceeds. Heavier or thicker-coated fabrics will tend to have a greater damping effect at the start of the test and may therefore require greater adjustment as the damping effect is reduced during the test due to folding and heating up of the test piece.

Set the apparatus in motion and stop it after the specified number of cycles or, if the point of failure or breakdown of the coated fabric is to be determined, stop the apparatus at predetermined intervals to allow examination of the test piece.

5.6 Examination of test pieces

Examine the test pieces initially whilst retained in the apparatus. Move the discs to the closed position and examine the test pieces for signs of cracking or deterioration.

Terminate flexing either at the specified number of cycles or at the first inspection at which test pieces show signs of deterioration or cracking of the type under investigation. Where relevant, record at each examination the total number of flexes to which the test pieces have been subjected and assess the flexing damage in accordance with clause 6.

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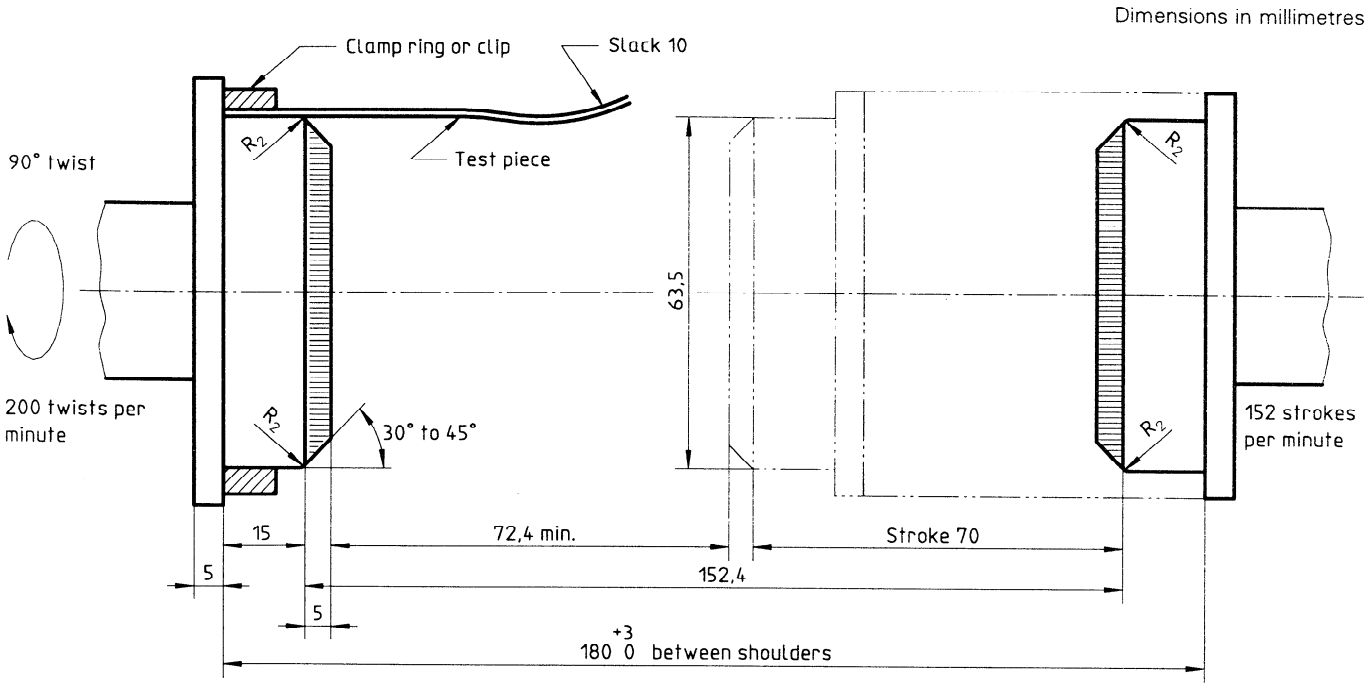

Figure 3 — Illustrative diagram of crumple/flex apparatus

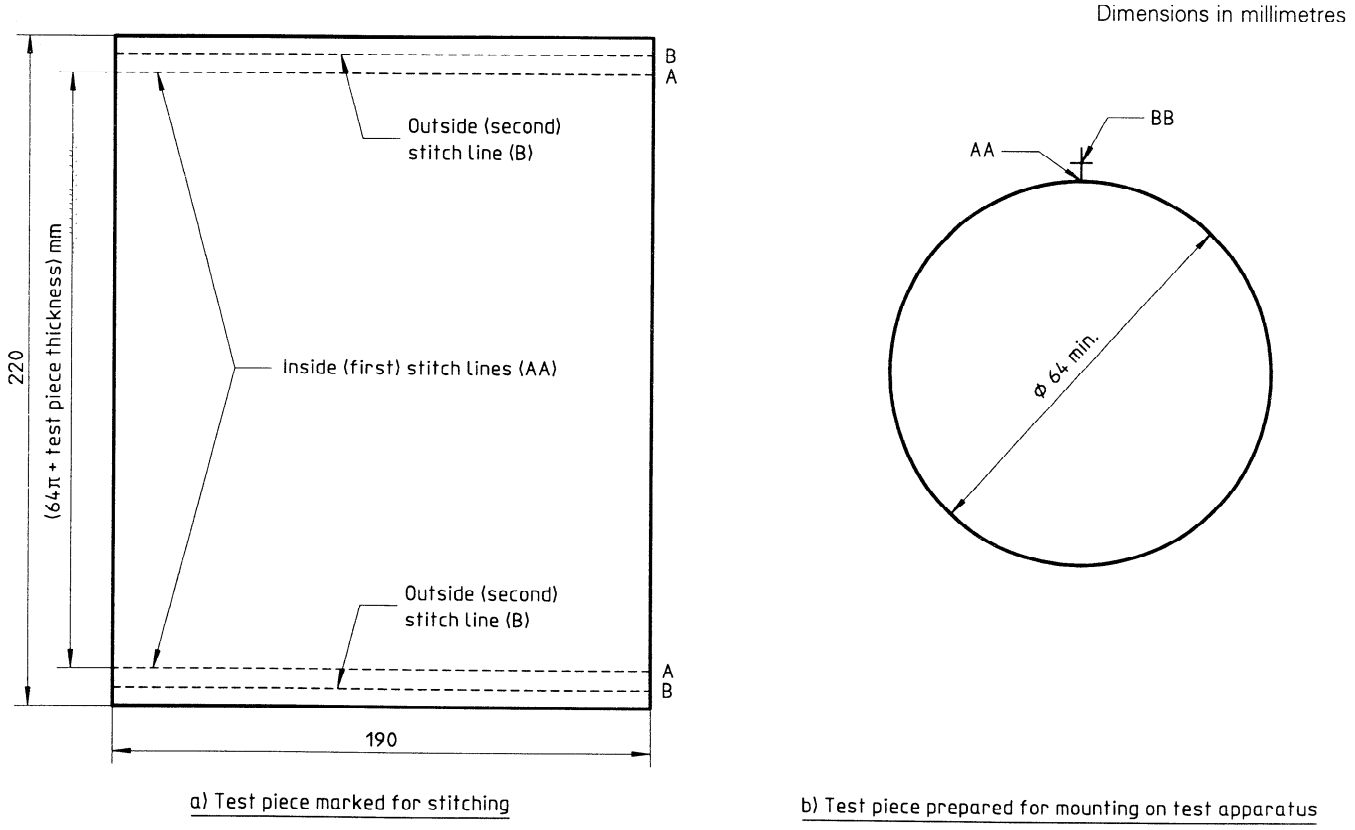

Figure 4 — Configuration of test piece for crumple/flex method

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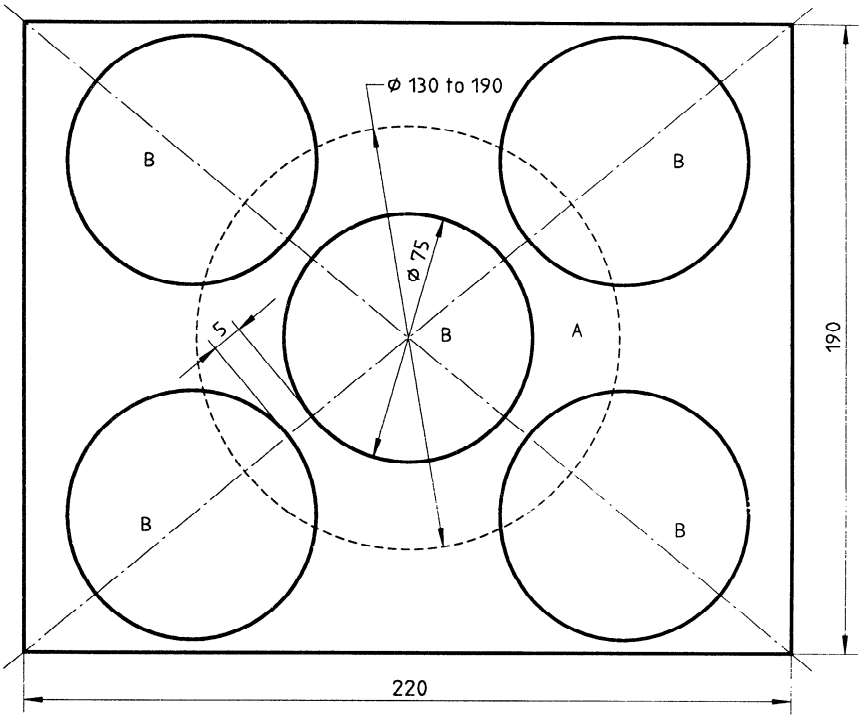
Dimensions in millimetres



A = for use in method A of ISO 1420; B = for use in method B of ISO 1420.

Figure 5 — Selection of test pieces for hydrostatic-head testing from crumple/flex test pieces

5.7 Test report

The test report shall include the following particulars:

a) a reference to this method of test, i.e. Method C of ISO 7854:1995;

b) all details necessary for the identification of the coated fabric, including any relevant reference number;

c) the specified number of flexes for which the test was run and at which the examination was made and/or the number of flexes at final inspection;

d) the severity of damage at each inspection, reported in accordance with clause 6;

e) details of any deviation from the standard test procedure.

6 Analysis of flexing damage

6.1 Assessment and description

6.1.1 Assessment of flex crack resistance

Assess the overall appearance, taking into account all visible factors such as wrinkling, cracking, flaking and discolouration. Compare the flexed test pieces with the unflexed material and grade the flexed material according to the following four-part scale relative to the unflexed material, without magnification, as deterioration in appearance:

0 None

1 Slight

2 Moderate

3 Severe

NOTE 8 Intermediate assessments are acceptable

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6.1.2 Description of damage

Describe the type of damage, if any, which is present.

6.2 Cracking

6.2.1 General

Using a ×10 lens or, preferably, a ×10 stereo microscope, examine the test piece closely and report the depth, number and length of the cracks, if any, in accordance with 6.2.2, 6.2.3 and 6.2.4.

6.2.2 Depth of cracking

Grade the depth of cracking according to the following:

"Nil"	no cracking;
"A"	surface or finish crack, not exposing the cellular or middle layer;
"B"	cracking into but not right through the middle layer, or, in the case of single-layer coatings, not exposing the base fabric;
"C"	cracking through to the base fabric;
"D"	cracking right through the material.

6.2.3 Number of cracks

Record the number of cracks of lowest grade, representing the worst degree of cracking. If there are more than 10, simply report "over 10".

6.2.4 Length of cracks

Record the length, in millimetres, of the longest crack of the lowest grade, representing the worst degree of cracking.

6.3 Delamination

In order to assess whether delamination has occurred to any appreciable degree, either test specifically for significant changes in coating adhesion or test for changes in performance in terms of abrasion or snag resistance, wicking or hydrostatic-head resistance. Alternatively, cut through the whole thickness of the material at a point where its occurrence is suspected to reveal delamination.

NOTES

9 Delamination may not be apparent or visible but may nevertheless still render the coated fabric more susceptible to abrasion damage, snagging and wicking and may also reduce the hydrostatic-head resistance.

10 These are optional additional tests and do not relate to the flexing test, save as a means of assessing the effect of flexing on the coated fabric.

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Annex A
(informative)

Recommendations for conducting flex testing on wet test pieces

A.1 Wetting-out

Soak the test pieces to be tested for 30 min, at one of the standard temperatures defined in ISO 2231, in a 2 % solution of sodium oleate, using a liquor ratio of 20:1.

A.2 Mounting

Without shaking the test pieces or otherwise drying off the excess moisture, mount the wetted test pieces in the flexing apparatus with the coating to be evaluated outermost and carry out the test as required.

NOTE 11 When the test pieces in methods B and C are mounted in an apparatus with its axis oriented vertically, it is inadvisable to conduct flex testing on wet test pieces.

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