BRITISH STANDARD

BS 3424 : Part 8 : 1983

Incorporating Amendment No. 1

Testing coated fabrics

Part 8. Methods 10A and 10C. Methods for determination of low temperature performance

IMPORTANT NOTE. It is recommended that this Part be read in conjunction with the information in Part 0 'Foreword and general information'.

ICS 59.080.40

Summary of pages

The following table identifies the current issue of each page. Issue 1 indicates that a page has been introduced for the first time by amendment. Subsequent issue numbers indicate an updated page. Vertical sidelining on replacement pages indicates the most recent changes (amendment, addition, deletion).

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Foreword

In reviewing method 10 the Committee responsible was concerned to remove the anomalies in test results which had manifested themselves during attempts to apply method 10 to all forms of coated fabrics. At the same time a number of international methods of test were to be considered. Consequently, whilst method 10 (now method 10A) of the last edition has been maintained, it has also been extended in that crack propogation is now more clearly defined. The limitations of the test also have been acknowledged.

Text deleted. Method 10B no longer applies.

The provisions of method 10C fulfil the requirements of ISO 4646 but additional information has been included concerning test instrument details as it was felt that the information provided by ISO 4646, whilst accurate and unambiguous, was insufficiently detailed and suffered from the criticism that it did not make it explicit that the striking arm needed to be positively driven if problems associated with the dissipation of momentum of the striking arm were to be avoided. Consequently the details of the test instrument described in ISO 4646 have been supplemented by additional data drawn from BS 903 : Part A25. In so doing, however, the criteria set out in ISO 4646 have been adhered to strictly. Method 10C has been included as a means of assessing low temperature impact performance in those cases where method 10A is found unsuitable due to the specimen configuration during the test.

Fabrics coated with rubber or plastics are used in different applications requiring low temperature flexing, and therefore no general relationship between these tests and service performance can be predicted.

Other low temperature test methods include BS EN 1876-1 : 1998 (bending test), which supersedes method 10B, and BS EN 1876-2 : 1998 (impact test on loop).

This Part of this standard supersedes method 10 of BS 3424 : 1973.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

1. Scope

This Part of this British Standard describes two methods of determining the low temperature performance of coated fabrics.

NOTE. The titles of the publications referred to in this standard are listed on page 9.

2. Method 10A. Determination of cold crack temperature

2.1 General. The cold crack temperature is not a sharply defined temperature, and it is possible that the range of temperatures over which cracking occurs in some proportion of test specimens varies with different materials.

The cold crack temperature varies also with the rate of folding, in that the quicker the folding the higher the temperature at which cracking occurs. The apparatus used in this test is designed to make available sufficient kinetic energy to ensure a flat fold in the test specimen by impact at a velocity of 2 m/s.

In addition, the test result is influenced by the criterion of cracking since, in the broadest sense, cracking is anything from a local crack in the surface of the coating not visible to the naked eye, to one extending across the width of the specimen and down to the fabric; it is essential, therefore, to define the criterion of cracking in such a way as to give the maximum reproducibility of the result.

NOTE. It should be noted however that this method is only considered suitable for those materials which can, at room temperature, be easily bent into the configuration required by the test without damage to the specimen. For those materials which cannot be bent into the required configuration without damage, it is suggested that the alternative methods in 10C or BS EN 1876-1 may be appropriate. Method 10B is no longer appropriate.

The method is applicable to coated fabrics having a thickness not greater than approximately 2 mm.

2.2 Principle. Conditioned specimens are exposed in a coolant to decreasing and increasing temperatures around a datum temperature. At each successive change in temperature the folded specimens are impacted between a plunger and anvil under defined conditions, after which they are examined visually for cracking. The temperature at which cracking occurs is then determined.

2.3 Apparatus. The apparatus (see figure 1) comprises of a vertical spring loaded plunger (A) terminating in a hammer (B) which strikes an anvil (C) on which the looped test specimen (D) is placed. The anvil and the end of the plunger are immersed in methanol cooled to the appropriate temperature.

NOTE 1. It is permissible to cool the methanol by adding solid carbon dioxide.

The lower part (E) of the plunger consists of nylon or other suitable material of low thermal conductivity and the hammer is of brass and 25 mm in diameter. A handle (F) is fitted to the upper end of the plunger. The anvil is of brass and of the same diameter as the hammer. The surfaces of both hammer and anvil are plane and parallel and coincide when in contact. The total mass of the plunger and hammer is 0.45 kg.

The compression spring (G) which actuates the plunger has a rate of 2.7 ± 0.1 N/mm and is so fitted that when the hammer is raised from the anvil there is 10 mm free movement before compression of the spring.

A trigger mechanism (H) is provided to hold the plunger against the spring pressure in the position such that the hammer is 35 mm above the anvil. It is important that the plunger moves freely in its housing (J), and that the trigger mechanism does not impede the movement of the plunger when released. The plunger spring is in a relaxed state when the apparatus is not in use.

The anvil is fixed to the base of the coolant bath (K), which is provided with a mechanical stirrer and a calibrated partial immersion thermometer.

The specimen holder (L) comprises of a spring clip (M), and means are provided for locating it in accordance with 2.7.

NOTE 2. Care should be exercised to ensure that the spring clip of the specimen holder is positioned so that the specimen is in a horizontal plane and level with the anvil surface, as otherwise additional stress areas may be introduced.

2.4 Preparation of test specimens. Twenty specimens 32 mm x 6 ± 0.6 mm shall be cut with the longer dimension in the transverse direction of the roll. The strips shall be evenly spaced from the full usable length and width of the sample and not within 50 mm of the selvedge.

NOTE. Normally, approximately 20 specimens are sufficient for each determination. However, depending upon the type of coated fabric under investigation, the number of specimens required to be tested before the cold crack temperature can be determined, may be less than 20 or, in other cases, greater than 20. (See also 2.8.)

2.5 Conditioning of test specimens. Immediately prior to testing, condition the test specimens in accordance with method 4 (i.e. Part 2 of this standard).

2.6 Time interval between manufacture and testing. For all purposes the minimum time between manufacture and testing shall be at least 16 h.

NOTE. For evaluations intended to be comparable the tests should, as far as possible, be conducted at the same time interval after manufacture.

2.7 Procedure. Bend a test specimen into a pear-shaped loop (see figure 1) approximately 10 mm deep with the face coating outside and insert the ends 2 mm into the clip of the specimen holder.

NOTE 1. For double face coated fabrics either or both coated surfaces may be evaluated.

Use a new specimen for each test. Adjust the coolant bath to the desired temperature. Place the specimen over the anvil so that the looped end is over the centre and the lower side of the loop touching the anvil. After 15 ± 1 s, release the plunger. Raise the plunger immediately, withdraw the specimen and examine it.

For coated fabrics over 70 g/m^2 and for coated fabrics with an expanded layer in the coating, increase the immersion time to 30 ± 1 s.

The specimen is deemed to have failed if the specimen cracks at the fold of the specimen loop with the crack or cracks extending through to the cloth and over more than half of the specimen width.

NOTE 2. Persistent cracking elsewhere suggests that the method is not suitable for the material under test.

Carry out preliminary tests to locate the approximate cold crack temperature by testing specimens at successively reduced temperatures by intervals of 5 °C to 10 °C until a specimen fails. Allow the temperature to rise and test the specimens at 1 °C intervals until a specimen passes. The temperature 1 °C below this point is the approximate cold crack temperature. Record this approximate cold crack temperature but discard these preliminary results in future calculations.

Using fresh test specimens begin the test at the approximate cold crack temperature. If the specimen passes, lower the temperature 1 °C for the next test.

If the specimen fails, raise the temperature 1 °C for the next test. Continue testing until at each of two adjacent temperatures at least five results have been obtained such that at the higher temperature there are more passes than fails whilst at the lower temperature there are more fails than passes. Report this higher temperature as the cold crack temperature.

2.8 Compliance testing. For compliance testing purposes where assessment of the coated fabric at a specific temperature is required, test five test specimens at the temperature specified in the product specification. If no more than two test specimens fail at the specified temperature, the coated fabric shall be deemed to pass, unless the product specification stipulates that no failures shall occur.

2.9 Test report. The test report shall include the following particulars:

(a) identification of the coated fabric;

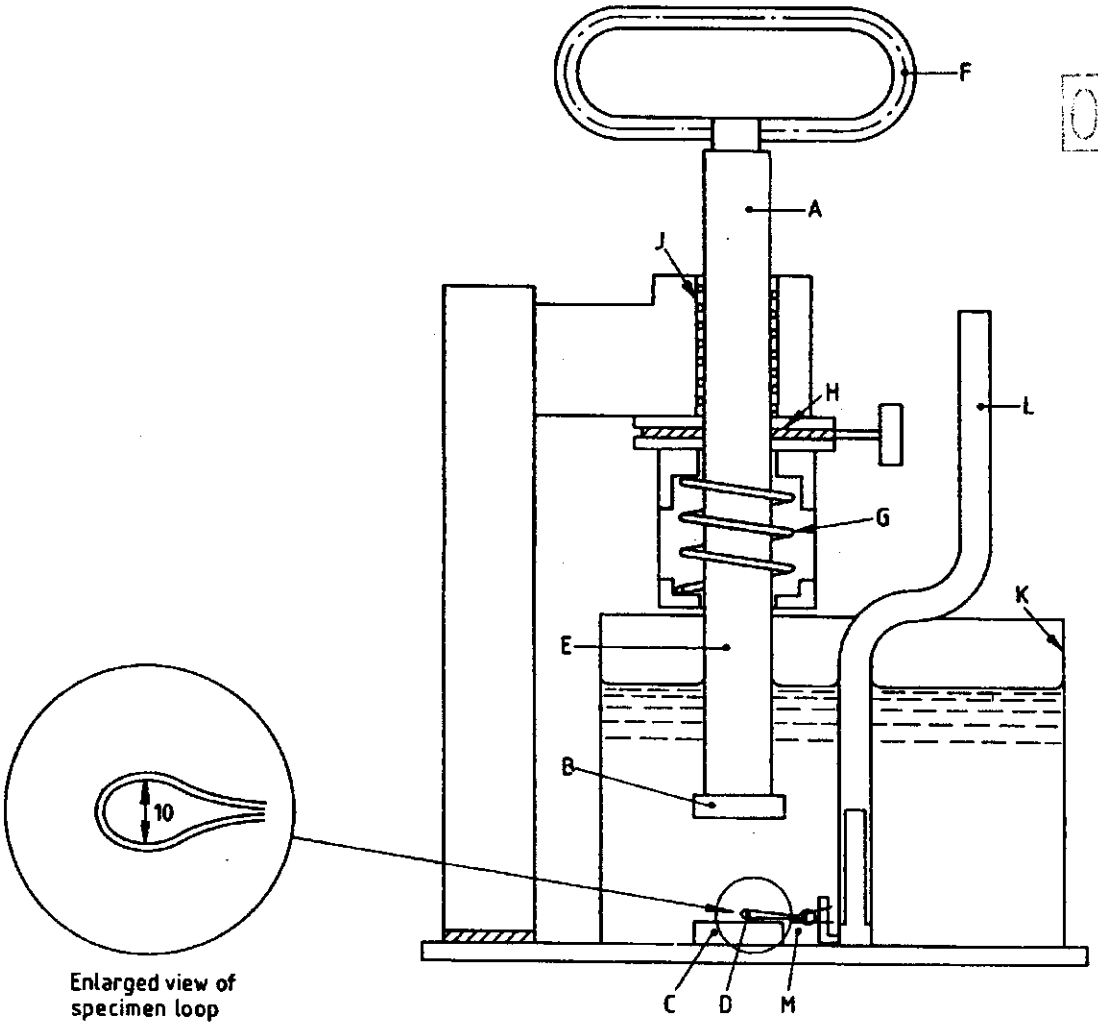
(b) mass per unit area of the coated fabric;

(c) duration of the exposure period;

(d) surface(s) tested;

(e) the cold crack temperature, or, in the case of compliance testing, the temperature at which the test was conducted and the result, i.e. pass or fail;

(f) details of any deviations from the standard test procedure.



Dimension is in millimetres.

Figure 1. Apparatus for determining cold crack temperature

3. Method 10B. Low temperature bend test

3.1 General. This method specifies a means of determining the ability of fabrics coated with rubber or plastics to resist the effect of low temperature when subjected to bending at specified temperatures after definite periods of exposure. It is applicable to material with a thickness within the range 0.10 mm to 2.20 mm. For materials of greater thickness than this, modifications to the standard equipment are necessary (see note 3 of **3.6**).

3.2 Principle. Conditioned specimens are exposed in a cold chamber for a specified time. The specimens are then subjected to a bend test using an appropriate apparatus and examined visually under low magnification.

3.3 Apparatus

3.3.1 *Cold chamber,* in which the specimens are exposed to low temperature and of sufficient size to contain the bending instrument used for testing the specimens and to permit the operation of the instrument without removal from the cold chamber. It is capable of maintaining a uniform atmosphere of cold air or any other suitable gas at specified temperatures to within a tolerance of ± 1 °C.

3.3.2 *Bending jig,* for bending the specimens, as shown in figures 2 and 3.

Mass tolerance and dimensions are as specified in figure 3.

3.3.3 *Two glass plates,* 125 mm x 175 mm x 3 mm.

3.3.4 *Gloves,* for handling specimens within the cold cabinet and which are exposed to the same temperature as the test specimens. A second pair of gloves at room temperature shall be available for wearing within the cold gloves as protection for the operator.

3.4 Preparation of test specimens. Three specimens 25 mm x 100 mm shall be cut with the longer dimension in the longitudinal direction of the roll. The strips shall be evenly spaced from the full usable length and width of the sample and not within 50 mm of the selvedge.

3.5 Conditioning of test specimens. Immediately prior to testing, condition the test specimens in accordance with method 4 (i.e. Part 2 of this standard).

3.6 Procedure. Place the three conditioned test specimens between the glass plates. Place the glass plates with the test specimens held in position, the bending jig and the cold gloves in the cold chamber. Expose the specimens for 4 h to the specified test temperature.

At the termination of the exposure period and while still in the test chamber, remove the test specimens from between the glass plates, one at a time, (see note 2) and place in the bending jig with the flexing plate held in the open position by the trigger pin. In the case of substrates coated on one side only, place the coated side away from the mandrel.

NOTE 1. For double face coated fabrics either or both surfaces may be evaluated.

NOTE 2. CAUTION. It is essential that gloves be worn at all times when handling test specimens prior to making the bend test.

As soon as the test specimen is in position in the bending jig, release the trigger and permit the flexing plate to make a free fall.

NOTE 3. When materials greater than 2.2 mm in thickness are to be tested it may be necessary to increase the mass of the steel top bar *G* (see figure 3) and increase the clearance between the back plate and mandrel to enable the specimen to be inserted. In this case report the deviation in the test report.

Fold each test specimen through 180 ° in the same direction as the bend caused during the test and examine each test specimen for fractures or cracks in their coating under a magnification of x5.

3.7 Assessment of damage

3.7.1 *Depth of crack.* Grade the cracking, if any, according to the following five-part scale.

A — surface or finish crack not exposing any cellular, middle layer or substrate.

B — cracking into but not through the middle layer.

C — cracking through to the substrate or base fabric.

D — cracking completely through the material.

E — if there is no cracking, record 'nil'.

3.7.2 *Number of cracks.* Record the number of cracks of greatest severity, up to 10. If there are more than 10, record 'over 10'.

3.7.3 *Length of crack.* Record the length in mm of the longest crack of greatest severity.

3.8 Test report. The test report shall include the following particulars:

(a) the thickness of the coated fabric measured in accordance with method 26 of BS 3424 : 1973;

(b) the temperature at which the test pieces were tested;

(c) the duration of the exposure period;

(d) the surface(s) tested;

(e) the depth of crack in accordance with the five-part scale given in **3.7.1**, the number of cracks and the length of each crack in each specimen;

(f) details of any deviations from the standard test procedure.

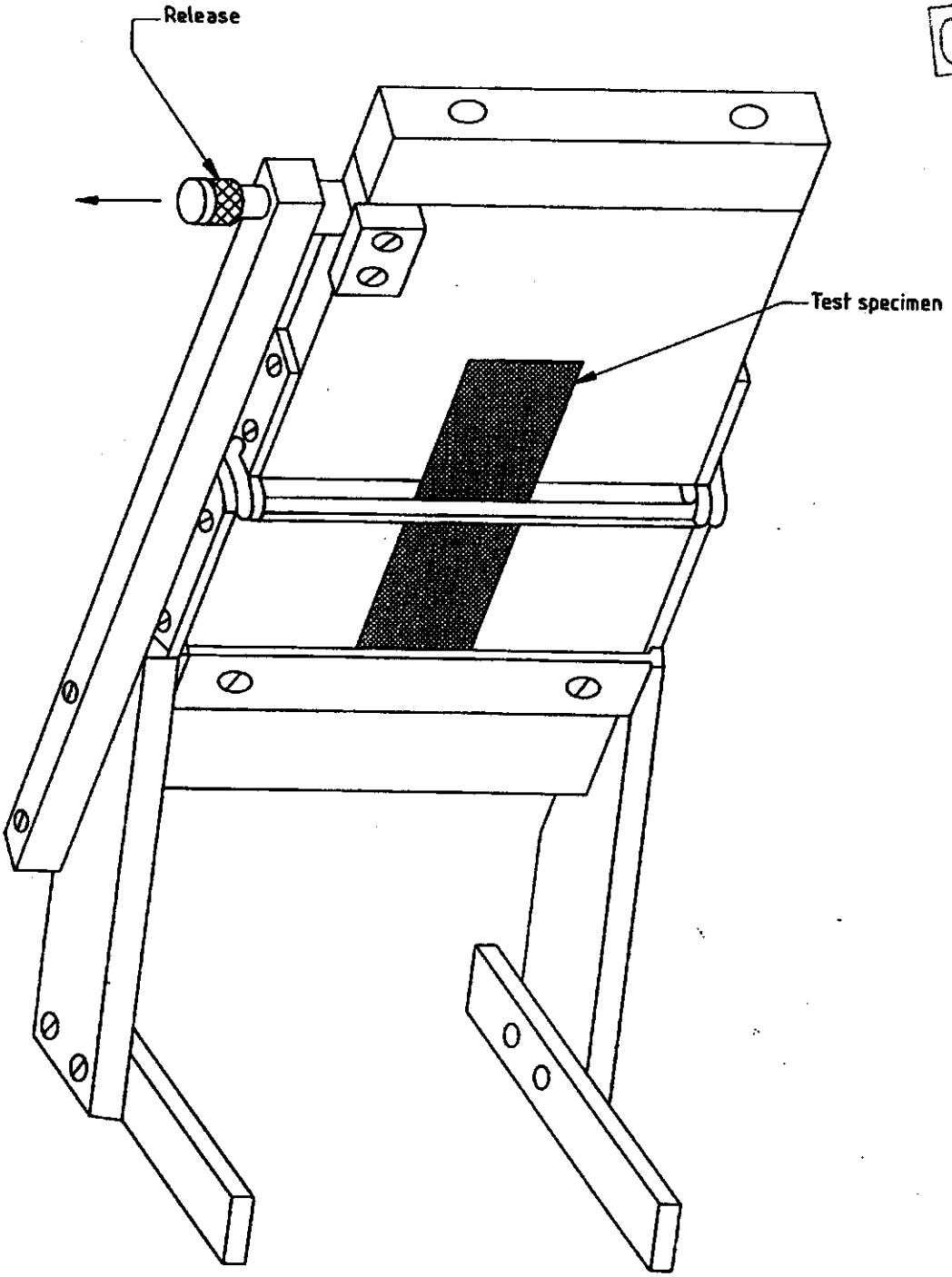


Figure 2. Bending jig for coated fabrics

	mm
A	13
B	25
C	100
D	5
E	48
F	100 × 110 × 13
G	100 × 25 × 13
H	100 × 100 × 13
J	3
K	ϕ 3
L	3 × 3
M	6

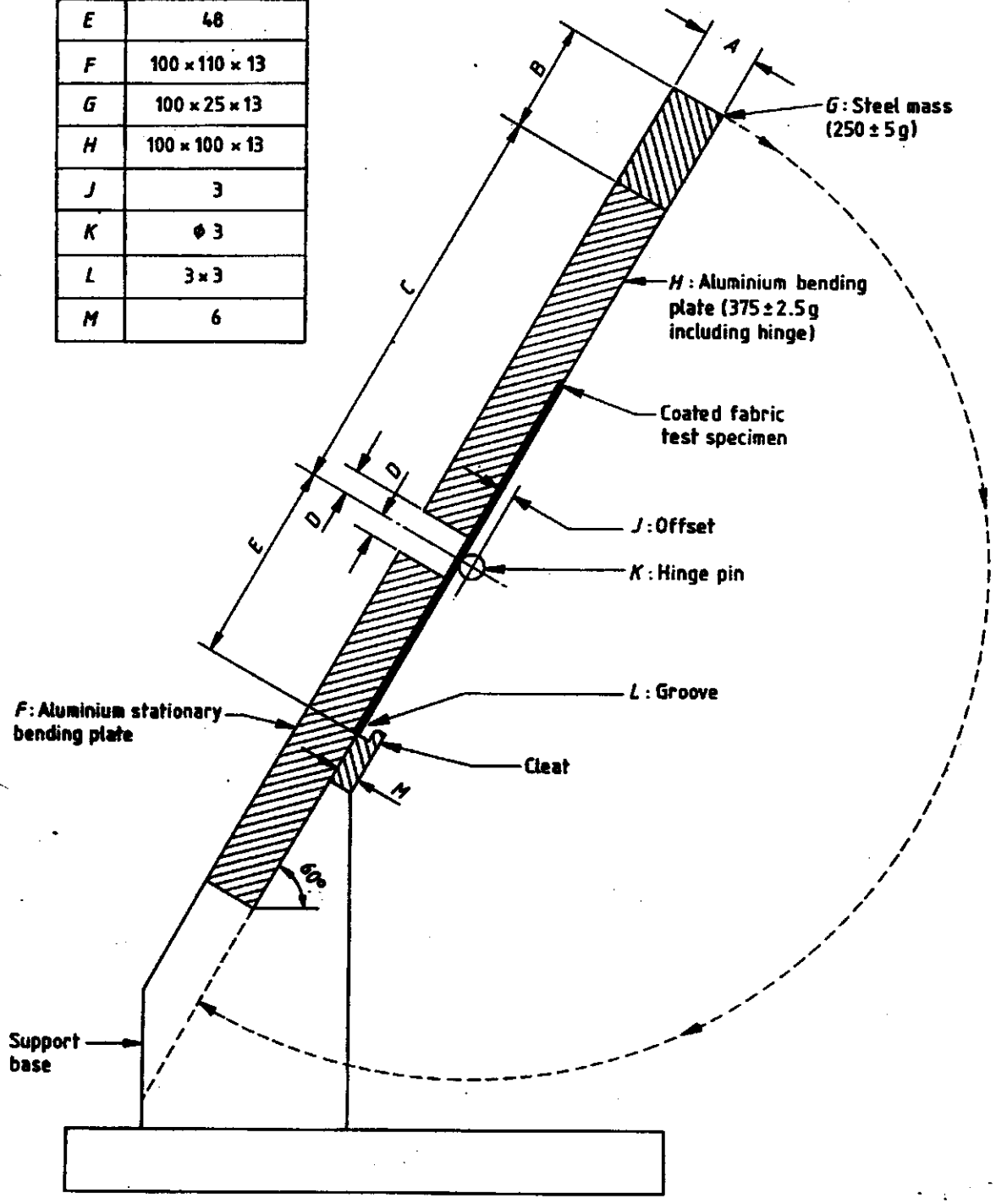


Figure 3. Bending jig, schematic dimensions

4. Method 10C. Low temperature impact test

4.1 General. This method specifies a means of determining the ability of fabrics coated with rubber or plastics to resist the effect of impact at low temperatures. The method is applicable to material with a thickness within the range 0.10 mm to 2.15 mm.

4.2 Principle. Conditioned specimens are immersed in the cold chamber for a specified time. The specimens are then subjected to an impact of controlled force and examined visually under low magnification.

4.3 Apparatus

4.3.1 *An insulated tank,* containing test specimen clamps capable of holding securely the test specimens in the form of a cantilever beam and a striking arm, so designed that its striking edge strikes the specimen at right angles to the surface of the test specimen at a linear velocity of 1.8 m/s to 2.1 m/s. The striking arm maintains the velocity of impact for a distance of at least 6 mm after impact. In order to maintain this velocity consistently within the heat-transfer medium the striking arm is positively driven. The striking edge of the striker arm has a radius of 1.6 ± 0.1 mm and is capable of being adjusted relative to the face of the specimen clamp so that the point of impact can be varied as indicated in table 1.

The specimen clamp and striker arm are immersed in the heat-transfer medium, which can be any liquid medium which remains fluid at the test temperature and which does not appreciably affect the materials being tested.

NOTE 1. For this purpose it is recommended that methanol be used.

A stirrer is provided to ensure thorough circulation of the heat-transfer medium. Means are also provided of controlling the temperature of the heat-transfer medium to within ± 0.5 °C of the desired temperature. Automatic regulation of the temperature of the liquid coolant can be obtained by means of a system employing an externally cooled tank connected to the test area with suitable tubing, thermo-regulator, pump, electric immersion heater and mercury switches.

The regulator, by alternatively actuating the pump and heater through the mercury switches, controls the amount of liquid coolant being pumped to the test area as well as the amount of heat from the heater. Manual temperature control can be accomplished with powdered dry ice (solid carbon dioxide) and an electric immersion heater.
A temperature measuring device in the form of a copper-constantan thermocouple, fusion bonded at the junction and constructed of wire 0.2 mm to 0.5 mm in diameter is located as near the test specimen as possible and operates in conjunction with a potentiometer.

NOTE 2. Provided it can be shown that there is close agreement with the temperature indicated by the specified thermocouple, a thermometer may be used instead of the thermocouple as the temperature measuring device. A schematic illustration of apparatus complying with these requirements is shown in figure 4.

4.3.2 *A die-cutter,* for cutting specimens from the sample.

4.4 Preparation of test specimens. Five specimens 6.4 ± 0.5 mm x 31.5 ± 5 mm with the longer dimension in the longitudinal direction of the roll. The strips shall be evenly spaced from the full usable length and width of the sample and not within 50 mm of the selvedge.

4.5 Conditioning of test specimens. Condition test specimens in accordance with method 4 (i.e. Part 2 of this standard).

4.6 Time interval between manufacturing and testing. For all purposes the minimum time between manufacture and testing shall be at least 16 h.

NOTE. For evaluations intended to be comparable the tests should, as far as possible, be conducted at the same time interval after manufacture.

4.7 Procedure. Prepare the insulated tank and bring the apparatus to the desired temperature. This can be accomplished by placing a suitable quantity of solid carbon dioxide in the tank and slowly adding the heat-transfer medium until the tank is filled to within 50 mm of the top of the tank.

Determine the thickness of each test specimen in accordance with method 26 of BS 3424 : 1973.

When the heat-transfer medium is at the specified temperature, mount each test specimen in the specimen clamps in accordance with figure 5 and table 1 and immerse for 3.0 ± 0.5 min in the heat-transfer medium.

NOTE. For double face coated fabrics either or both coated surfaces may be evaluated.

After immersion for the time specified, record the temperature indicated and deliver a single impact on each test specimen.

Remove the test specimens from the tank and bend the test specimens to an angle of 180 ° in the same direction as the bend caused by impact, around a 6 mm diameter mandrel.

Examine each test specimen under a magnification of x 5 for signs of fracture or cracking.

4.8 Test report. The test report shall include the following particulars:

(a) identification of the coated fabric;

(b) temperature at which the test was conducted;

(c) thickness of the coated fabric measured in accordance with method 26 of BS 3424 : 1973;

(d) behaviour of individual test specimens;

(e) speed of striker at impact;

(f) details of any deviations from the standard test procedure.

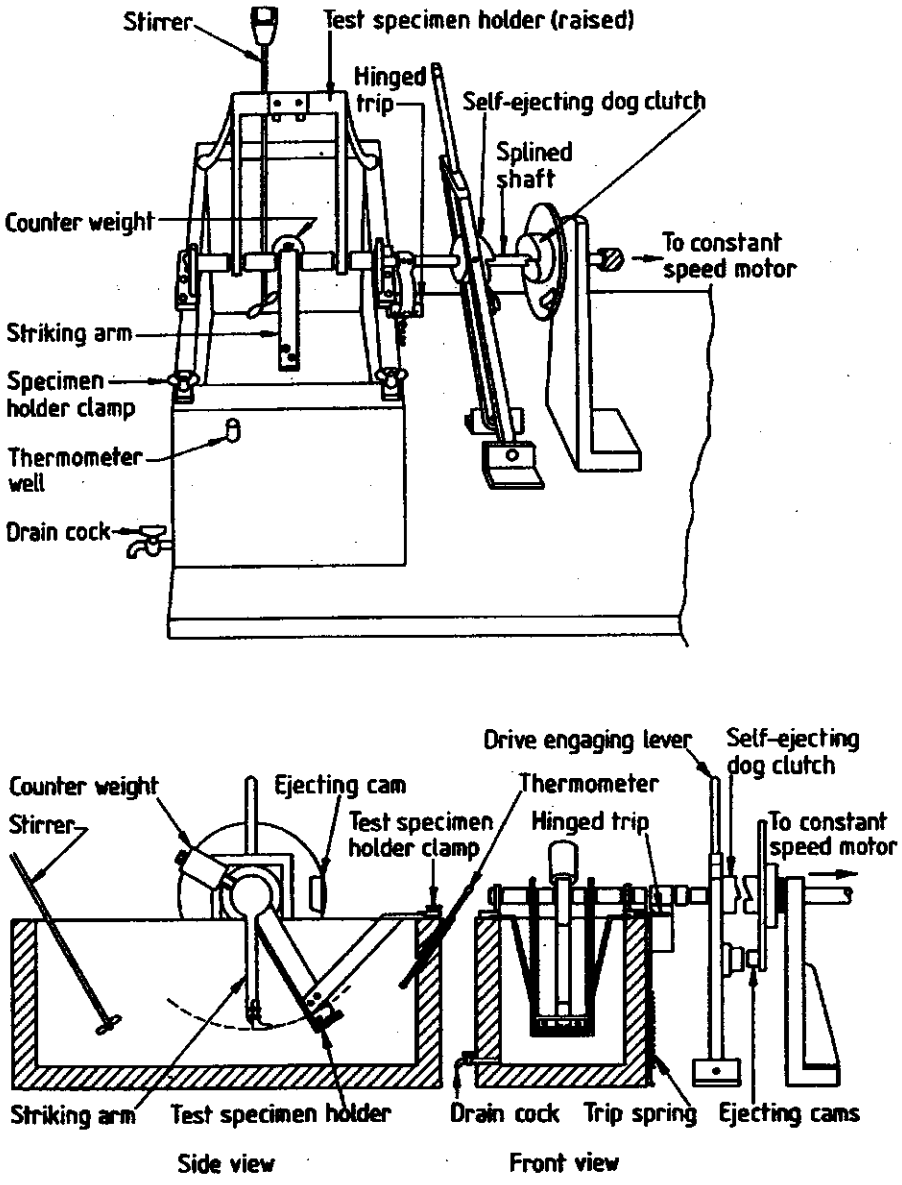
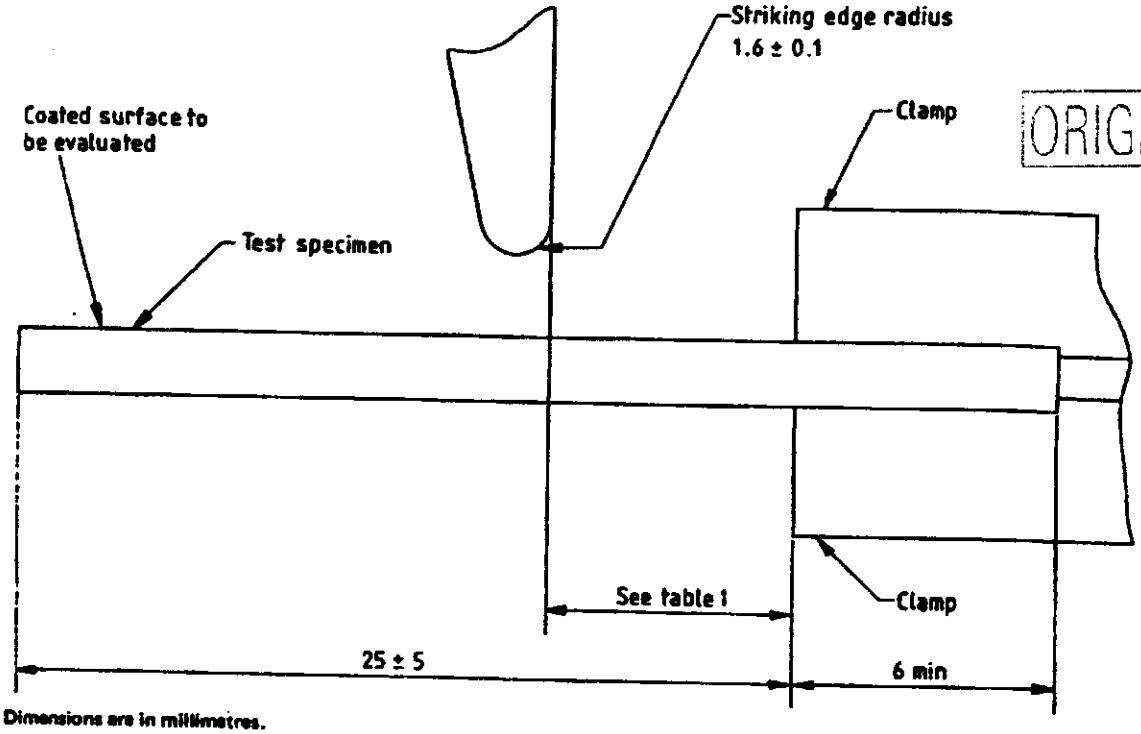


Figure 4. Illustration of test equipment for low temperature impact test



Dimensions are in millimetres.

Figure 5. Illustration of juxtaposition of striker arm and test specimen

Table 1. Clearance of striking arm and test specimen clamps

Thickness of test specimen	Required clearance
mm	mm
1.65 to 2.15	6.4 ± 0.3
1.05 to 1.64	5.7 ± 0.3
0.55 to 1.04	5.2 ± 0.3
0.10 to 0.54	4.8 ± 0.3

Publications referred to

BS 903*	Methods of testing vulcanized rubber Part A25 Determination of impact brittleness temperature
BS 3424†	Methods of test for coated fabrics
BS 3424	Testing coated fabrics Part 2 Method 4. Conditioning and selection of test specimens
BS EN 1876-1	Rubber- or plastics-coated fabrics — Low temperature tests — Bending test
BS EN 1876-2*	Rubber- or plastics-coated fabrics — Low temperature tests — Impact test on loop
ISO 4646*	Rubber or plastics coated fabrics — Low temperature impact test

*Referred to in the foreword only.
†1973 edition.

Issue 2, June 1998

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ORIGI

Amendments issued since publication

Amd. No.	Date of issue	Text affected
9936	June 1998	Indicated by a sideline in the margin BB. 19.6.98

AMD 9936

Amendment No. 1
published and effective from 15 June 1998
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Part 8. Methods 10A, 10B and 10C. Methods for determination of low temperature performance

Instructions for replacement of pages

The following pages contain new or revised text. Please remove any superseded pages and insert the new or revised pages in the position given in the summary of pages (see page a). Where only one of the two pages on each sheet has been updated, the other page has been reprinted.

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Back cover

You may wish to retain the superseded pages, e.g. for reference purposes, if so please mark them 'Superseded by issue X', where 'X' is the appropriate issue number. If you do not wish to retain the superseded pages, please destroy them.