BRITISH STANDARD

BS 3289:2005

Textile carcass conveyor belting for use in underground mines (including fire performance) — Specification

ICS 53.040.20; 73.100.40

BSI
British Standards

Committees responsible for this British Standard

This British Standard was prepared by Technical Committee, PRI/67, Conveyor belts, upon which the following bodies were represented:

British Rubber Manufacturers' Association Limited
HSE — Health and Safety Executive
Institute of Materials, Minerals and Mining
Tun Abdul Razak Research Centre
University of Nottingham
UK Steel Association

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 3 March 2005

First published November 1960
Second edition, December 1982
Third edition, August 1990
Fourth edition, March 2005

Amendments issued since publication

Amd. No.	Date	Comments

The following BSI references relate to the work on this British Standard:
Committee reference PRI/67
Draft for comment 04/30111059 DC

ISBN 0 580 45426 6

Contents

Foreword

This British Standard has been prepared by Technical Committee PRI/67. It is a revision of BS 3289:1990, which is withdrawn. A number of changes have been made by this edition. In particular, the following should be noted.

The high-energy fire propagation test has been replaced with a more practicable mid-scale test [Prepared by Cerberus (Mining Acceptance Services) Ltd for the Health and Safety Executive].

The purpose of this standard is to enable belting to be obtained and installed in underground mines in the confidence that it will perform satisfactorily the job it is required to do, and that it is not a flammability hazard.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 47 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

blank

1 Scope

This British Standard specifies requirements for textile carcass conveyor belting for use in underground mines (including fire performance).

NOTE 1 For guidance on storage and handling of finished belting, reference should be made to BS ISO 5285.

WARNING In the overall assessment of the suitability of conveyor belting for a given use, and in particular for single entry headings, account should be taken of the flame propagation and smoke and toxic fume emission characteristics of the belting material, as well as of the fire precautionary measures, such as smoke detection, over-temperature protection, below ground ventilation, etc. embraced within the total system.

NOTE 2 DD 180 describes threshold toxic atmospheres and provides methods for their assessment; reference to this publication is recommended.

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 the amendments) applies.

BS 871:1981, *Specification for abrasive papers and cloths.*

BS 907, *Specification for dial gauges for linear measurement.*

BS 970-1:1996, *Specification for wrought steels for mechanical and allied engineering purposes — Part 1: General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels.*

BS 3591, *Specification for industrial methylated spirits.*

BS 4250, *Specification for commercial butane and propane.*

BS EN ISO 7500-1:1999, *Metallic materials. Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system.*

BS EN 10216-2, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties.*

BS EN 10217-2, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties.*

BS EN ISO 340:2004, *Conveyor belts — Laboratory scale flammability characteristics — Requirements and test method.*

BS EN 60584-1, *Thermocouples — Part 1: reference tables.*

BS ISO 5893:2002, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Specification.*

3 Terms and definitions

For the purposes of this British Standard the following terms and definitions apply.

3.1
fire retardant
substance added, or treatment applied to a material in order to suppress, significantly reduce or delay the combustion of the material

3.2
fire performance
ability to pass the tests described in Annex G

3.3
full thickness tensile strength
maximum force that a test piece cut from the full thickness of the belting withstands during test divided by the original width of the narrowest part of the gauge length portion of the test piece

4 Construction

The belting shall be of solid woven construction or it shall consist of plies of woven fabric. The carcass shall be impregnated with a fire retardant compound and have a fire retardant cover, the whole being fused or vulcanized together.

Belting having a plied construction shall contain not less than four plies.

The edge of the belting shall be completely sealed by a fire retardant compound.

Where the edge cover material is manufactured and applied separately in the form of a strip, it shall be fused or vulcanized to the edges of the surface covers and the fabric, and shall demonstrate good adhesion (see **14.2**).

5 Fabric

The fabric used shall be evenly and firmly woven and free from foreign matter and defects such as knots, lumps and irregularities of twist.

6 Physical properties

Belting for use in underground coal mines shall be designated according to its physical properties as given in Table 1. Belting for use in underground mining (other than coal mines) shall be designated according to its physical properties as given in Table 2.

Table 1 — Designation and physical properties of finished belting for use in underground coal mines

Belting type	Minimum full thickness tensile strength		Minimum elongation at break		Minimum tear strength	Minimum belt thickness
	Longitudinal N/mm width	Transverse N/mm width	Longitudinal %	Transverse %	kN	mm
3	580	245	17	18	1.0	7.5
4	700	265	17	18	1.1	8.0
5	875	280	15	18	1.2	8.5
6	1 140	350	OPEN	18	1.6	9.0
8	1 400	350	OPEN	18	1.6	9.0
10	1 750	OPEN	OPEN	18	OPEN	9.0
12	2 100	OPEN	OPEN	18	OPEN	9.0
15	2 625	OPEN	OPEN	18	OPEN	9.0
Clause	**13**	**13**	**13**	**13**	**15**	**9**
Method of test	Annex C				Annex E	Annex A
NOTE The values left "open" are not standardized.						

Table 2 — Designation and physical properties of finished belting for use in underground mines (other than coal mines)

Belting type	Minimum full thickness tensile strength		Minimum longitudinal elongation at break
	Longitudinal N/mm width	Transverse N/mm width	%
160	160	63	10
200	200	80	10
250	250	100	10
315	315	125	10
400	400	160	10
500	500	200	10
630	630	250	10
800	800	270	10
1 000	1 000	315	10
1 250	1 250	—	10
1 600	1 600	—	10
2 000	2 000	—	10
2 500	2 500	—	10
Clause	**13**	**13**	**13**
Method of test	Annex C	Annex C	Annex C

7 Length

The tolerance on length on individual rolls shall be $^{+2}_{-0.5}$ % and the total length supplied for a specific installation shall be not less than the specified length.

8 Width

The width of the belting shall be selected from the widths specified in Table 3. This table also specifies the permitted tolerances on these widths.

Table 3 — Widths of belting

Width mm	Tolerance on width	Total variation in any one length
300, 400, 500, 600	+10 mm –5 mm	10 mm
650, 750, 800, 900, 1 000, 1 050, 1 200, 1 350, 1 400, 1 500, 1 600, 1 800, 2 000	+2 % –1 %	2 %

9 Belting and carcass thickness

9.1 Belting thickness

The belting thickness shall be determined in accordance with Annex A and Annex B. The difference between any two of the measurements taken in the same method shall not exceed:

a) 1 mm for belting of which the mean thickness does not exceed 10 mm;

b) 10 % of the mean belt thickness for belting of which the mean thickness exceeds 10 mm.

9.2 Carcass thickness

The carcass thickness, for all belting, shall be derived by subtracting the mean thickness of top and bottom covers, as calculated in accordance with **B.5.1**, from the mean belting thickness as calculated in accordance with Annex A.

9.3 Coal mining belts

The mean belting thickness (see **9.1**) and the derived carcass thickness of belting (see **9.2**) for use in underground coal mines shall be not less than that shown in Table 4.

Table 4 — Mean belting thickness and carcass thickness for use in underground coal mines

Belting type	Minimum mean belting thickness mm	Minimum carcass thickness mm
3	7.5	5.9
4	8.0	6.4
5	8.5	6.9
6 and above	9.0	7.4

10 Cover thickness

10.1 Mean cover thickness

When measured in accordance with **B.4.1** and calculated and expressed in accordance with **B.5.1**, the mean cover thickness shall be not less than the specified cover thickness.

NOTE Cover thicknesses should be decided when the specific site application is fully detailed.

10.2 Localized thin cover thickness

When measured in accordance with **B.4.2** and calculated and/or expressed in accordance with **B.5.2**, any localized thin cover thickness shall be not less than 70 % of the specified cover thickness (see Note to **10.1**).

10.3 Minimum cover thickness within 25 mm and 12 mm of belting edges

When measured in accordance with **B.4.3** and expressed in accordance with **B.5.3**, the minimum cover thickness within 25 mm and 12 mm of belting edges shall be not less than the appropriate values given in Table 5.

10.4 Edge cover thickness

When measured in accordance with **B.4.4** and expressed in accordance with **B.5.4**, edge cover thickness shall be not more than 9 mm. In cases where edge covers are trimmed, the belt carcass shall not be exposed.

Table 5 — Minimum cover thicknesses within 25 mm and 12 mm of belting edges

Belting width mm	Specified cover thickness mm	Minimum cover thickness	
		Within 25 mm of belt edge %	Within 12 mm of belt edge %
≤1 350	<1	50	Not applicable
>1 350	<1	50	20
≤1 350	≥1	70	Not applicable
>1 350	≥1	70	20

11 Joints in fabric

11.1 Transverse joints

11.1.1 *Solid woven belting*. In solid woven belting there shall be no transverse joints in the fabric.

11.1.2 *Plied belting*. In the fabric plies of multi-ply belting any transverse joints shall be at an angle of not greater than 70° and not less than 45° to the longitudinal axis. The minimum distance between joints shall be as follows.

a) Joints in outer plies shall be not less than 100 m apart in the same ply. The adjoining edges shall butt closely together and shall not overlap.

b) Joints in inner plies shall be not less than 15 m apart in the same ply and there shall be not more than two joints in any one ply in each 200 m belting.

c) Joints in adjacent plies shall be not less than 3 m apart.

d) Joints in non-adjacent plies shall be separated by a distance not less than twice the width of the belting.

11.2 Longitudinal joints

11.2.1 *Solid woven belting*. There shall be no longitudinal joints in the fabric of solid woven belting.

11.2.2 *Plied belting*. For plied belting, the maximum number of longitudinal joints in the plies shall be as given in Table 6.

11.3 Spliced joints in finished belting

11.3.1 *Solid woven belting*. Solid woven belting shall not contain spliced joints.

11.3.2 *Plied belting*. Plied belting in lengths of 50 m or less shall not contain spliced joints. For lengths over 50 m, one spliced joint shall be permitted, which shall be not less than 10 m from the end of the belting.

NOTE The manufacturer should provide information on the position in the belting length of any spliced joint made during manufacture.

Table 6 — Number of longitudinal joints in the plies of plied belting

Width of belting mm	Maximum number of longitudinal joints	
	External ply	Internal ply
Up to and including 1 200	0	0
Above 1 200 up to and including 1 600	1	2
Above 1 600 up to and including 2 000	2	2

12 Freedom from defects

The belting shall be straight when rolled out flat. The surfaces and edges of finished belting shall be free from blisters and other surface defects and shall be completely sealed against ingress of moisture.

13 Tensile strength and elongation at break

The average values for tensile strength (both longitudinal and transverse) and the elongation at break, when determined and calculated in accordance with Annex C, shall be taken as the value of tensile strength and elongation at break of the finished belting. These values shall be not less than the values given in Table 1 or Table 2, as appropriate.

14 Adhesion

14.1 Cover to carcass or internal adhesion

The adhesion between cover and carcass and internal adhesion shall be tested longitudinally and transversely in accordance with Annex D and the values recorded shall be not less than the values given in Table 7.

14.2 Edge strip adhesion

Where appropriate (see Clause **4**) the force required to strip the edging from the belt at a grip separation rate not exceeding 50 mm/min shall be not less than 2.6 N/mm of belt thickness when measured in a direction parallel to the edges of the belting, in accordance with Annex D.

14.3 Separation of additional cover from standard cover

The adhesion between additional cover and standard cover shall be tested in accordance with Annex D, and the values recorded.

NOTE The values for adhesion between additional cover and standard cover are not standardized.

Table 7 — Adhesion properties

Annex D test results to be used	Adhesion between cover and carcass N/mm	Internal adhesion of solid woven belting N/mm	Ply to ply adhesion N/mm
Average of the two mean values of force from the two tests	4.0	4.0	4.0 for fabrics containing natural fibres or 4.5 for 100 % synthetic fabrics
Lower of the two minimum values of force from the two tests	3.25	3.25	3.25

15 Tear strength

The tear strength of the finished belting shall be measured in accordance with Annex E. For underground coal mines, the average value in sense A and the average value in sense B shall be not less than the value given in Table 1. For other underground mines, the average values should be agreed between the supplier and the customer.

16 Electrical resistance

Electrical resistance shall be measured in accordance with Annex F and the average value on both the upper and lower surfaces of the belting shall be not greater than $3 \times 10^8\ \Omega$. This figure shall also represent a maximum during the working life of the belting.

17 Fire performance

17.1 Drum friction test

When tested in accordance with **G.1**, there shall be no flame or glow on any part of any one of the test pieces either during each test or after each test piece breaks.

Temperature measurements of the surface of the drum taken during each test shall not exceed 325 °C.

17.2 Spirit burner flame test

17.2.1 *General.* When tested in accordance with **G.2**, the belting shall comply with **17.2.2**, **17.2.3** and **17.2.4**, as appropriate.

17.2.2 *For the six test pieces with the outer covers intact.* The average time for all flame or glow to disappear after withdrawal of the burner shall not exceed 3 s. No individual test piece shall flame or glow for more than 10 s.

In the event that an individual test piece continues to flame or glow for more than 10 s and the average flame or glow time does not exceed 3 s, a further six test pieces shall be tested.

If none of the further six test pieces flame or glow for more than 10 s, and the average flame or glow time does not exceed 3 s, the sample shall be deemed to have met the requirements. Otherwise, the sample shall be deemed to have failed.

17.2.3 *For the nine test pieces (cut longitudinally and parallel to the length of the belting) with covers removed*. The average time for all flame or glow to disappear after the withdrawal of the burner shall not exceed 5 s. No individual test piece shall flame or glow for more than 15 s.

In the event that an individual test piece continues to flame or glow for more than 15 s and the average flame or glow time does not exceed 5 s, a further nine test pieces shall be tested.

If none of the further nine test pieces flame or glow for more than 15 s, and the average flame or glow time does not exceed 5 s, the sample shall be deemed to have met the requirements. Otherwise, the sample shall be deemed to have failed.

17.2.4 *For the nine test pieces (cut transversely and at right angles to the length of the belting) with covers removed*. The average time for all flame or glow to disappear after the withdrawal of the burner shall not exceed 5 s. No individual test piece shall flame or glow for more than 15 s.

In the event that an individual test piece continues to flame or glow for more than 15 s and the average flame or glow time does not exceed 5 s, a further nine test pieces shall be tested.

If none of the further nine test pieces flame or glow for more than 15 s, and the average flame or glow time does not exceed 5 s, the sample shall be deemed to have met the requirements. Otherwise, the sample shall be deemed to have failed.

17.3 Mid-scale fire propagation test

When tested in accordance with **G.3**, the belting shall comply with one of the following in each test run.

NOTE See **G.3.8** for criteria for assessment of damage and length of belting consumed.

The belt shall have met the requirements of this test if, for each of the test pieces, either:

a) the minimum length undamaged for each test piece is not less than 600 mm; or

b) the minimum length undamaged is not less than 50 mm, the maximum average temperature rise is not greater than 140 °C, and the maximum length consumed by mass is not greater than 1 250 mm.

Where any of the tests is terminated prematurely for reasons of safety to persons or equipment the belt shall be deemed to have failed to meet the requirements of this test.

18 Sampling

18.1 Representational samples

Samples shall be taken that are representative of the manufacturing batch from which they are drawn and from which specimens for testing shall be selected. Sampling shall be carried out at the discretion of the testing authority. Samples shall not be tested within 48 h of completion of manufacture.

18.2 Sample dimensions

The sample size shall be sufficient to conduct all the tests specified in this standard. Individual test piece requirements are detailed in the appropriate annexes.

19 Marking

The following information shall be marked on one face of the belting, using characters not less than 20 mm high:

a) month and year of manufacture, e.g. 6.04;

b) any approval number allocated by the purchaser;

c) belting type number, where applicable, or tensile value, together with the number and date of this British Standard, e.g. Type 3 BS 3289:2004 or 1200/BS 3289/04;

d) specified cover thickness;

e) letters or trade mark identifying the manufacturer;

f) manufacturer's batch number.

Markings shall be repeated at a maximum longitudinal spacing of 10 m, at approximately 100 mm from the left and right edges alternately.

In the case of belts of unequal cover thickness, the markings shall be on the thicker cover.

The manufacturer's production batch number or P-number shall be applied to the outer face of the rolled belting at a distance of approximately one metre from the end of the belting. The characters shall be not less than 40 mm high. The marking shall be sufficiently durable to withstand abrasion during transport, handling and during installation.

Annex A (normative)
Method for determination of mean belting thickness

A.1 Principle

The belting thickness is measured at seven positions, and the average of the seven results is reported as the mean belting thickness.

Belting thickness and cover thickness measurements shall be taken from the same test piece.

A.2 Apparatus

A.2.1 *Micrometer dial gauge*, firmly located in a rigid stand over a flat baseplate, the top surface of which should be at least 100 mm square. The gauge shall be graduated in divisions of 0.01 mm and shall comply with BS 907.

The dial gauge shall be fitted with a flat contact of diameter (19 ± 2.0) mm which shall be square to the plunger and parallel to the baseplate.

The working force at the contact surface, measured with the dial gauge in the vertical position, shall be (0.50 ± 0.20) N.

A.3 Preparation of test piece

Cut a rectangular test piece, 80 mm long × full belting width. Cut the belting cleanly across its full width at right angles to the edges of the belt. Ensure that the surface of the test piece is devoid of any embossed markings. Mark the test piece as shown in Figure A.1.

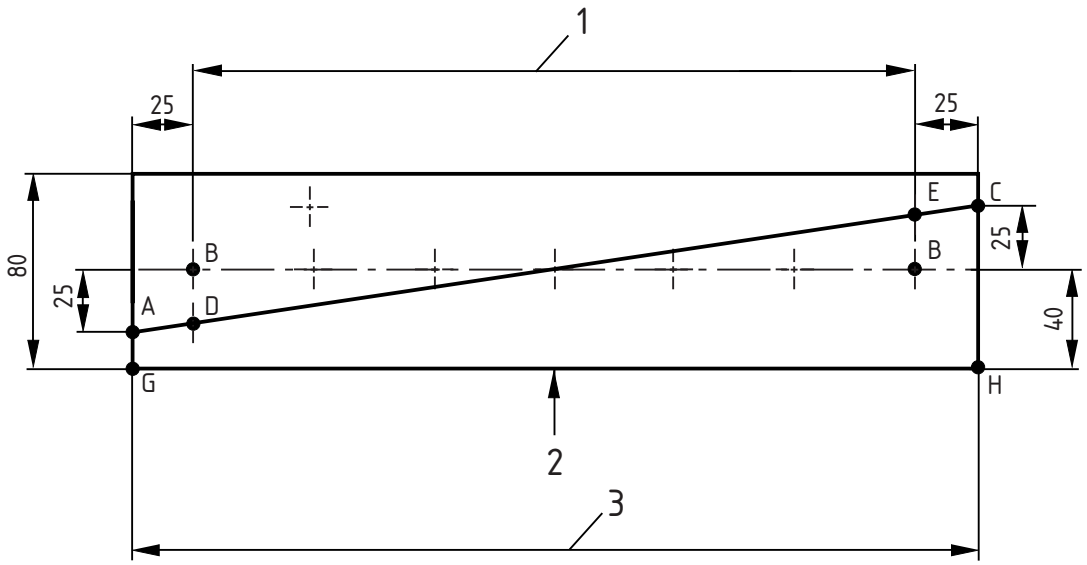
A.4 Procedure

Hold the test piece flat on the baseplate using finger pressure where necessary. Overhanging belting should be supported at the same height. Measure the thickness of the belting at seven positions along line B-B as indicated in Figure A.1.

A.5 Calculation and expression of results

Record the measured thickness of the belting at each of the seven points (see **A.4**) rounded to two decimal places, and calculate the average of the seven results. Report the resulting figure as the mean belting thickness (in millimetres).

All dimensions are in millimetres



Key

1 Seven measurement points, equally spaced
2 Belt cut at right angles to edge
3 Full belt width

Figure A.1 — Test piece for measuring belting thickness and cover thickness

Annex B (normative)
Method of measuring cover thickness

B.1 Principle

The top and bottom cover thicknesses are measured on a cut edge of unstripped belting.

NOTE Belting thickness and cover thickness measurements are taken from the same test piece. Complete belting thickness measurements (see Annex A) before proceeding with cover thickness measurements.

B.2 Apparatus

B.2.1 *Optical magnifier*, incorporating a scale graduated in divisions of 0.1 mm.

B.3 Preparation of test piece

Cut the test piece, prepared in accordance with **A.3**, cleanly along line A–C as indicated in Figure A.1, at right angles to the surface of the test piece.

NOTE With certain colours of cover material and impregnation compound, difficulty can be experienced in determining the outline of the fabric knuckles. In these cases, it is permissible to colour the textile fabric with a suitable colour stain.

B.4 Procedure

B.4.1 *Mean cover thickness*

NOTE The procedures are the same for measuring mean cover thickness of the top and bottom covers.

B.4.1.1 For belting where the cover material is applied directly to the belting carcass, make seven measurements (in millimetres) of the distance between the surface (top cover) and the top of the exposed fabric knuckles, as follows (see also Figure B.1):

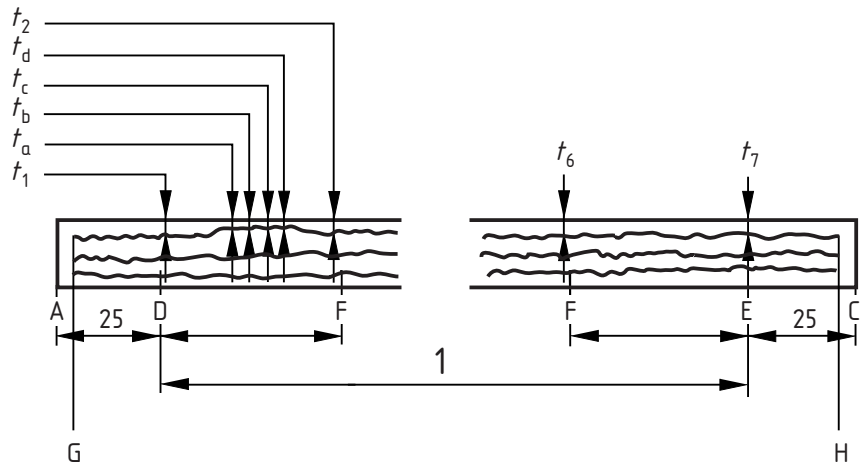
a) t_1 and t_7 are the distances between the surface (top cover) of the belting and the exposed fabric at the nearest knuckle to each of the two lines D and E;

NOTE 1 The lines D and E are situated at points 25 mm from each edge of the belting.

b) t_2 and t_6 are the distances between the surface (top cover) of the belting and the exposed fabric at the nearest knuckle to each of the five lines F.

NOTE 2 The five lines F are situated, at equally-spaced intervals, between D and E across the width of the belting.

All dimensions are in millimetres



Key

1 Seven measurement points, equally spaced

Figure B.1 — Measurement of cover thickness (for covers applied directly on to carcass) and measurement of edge cover thickness

B.4.1.2 For belting where a material that is different from, but compatible with, standard top cover material is fused or vulcanized onto existing standard cover material as additional cover thickness, make seven measurements (in millimetres) of the distance between the surface (top cover) of the belting and the interface between additional and standard cover material as follows (see also Figure B.2):

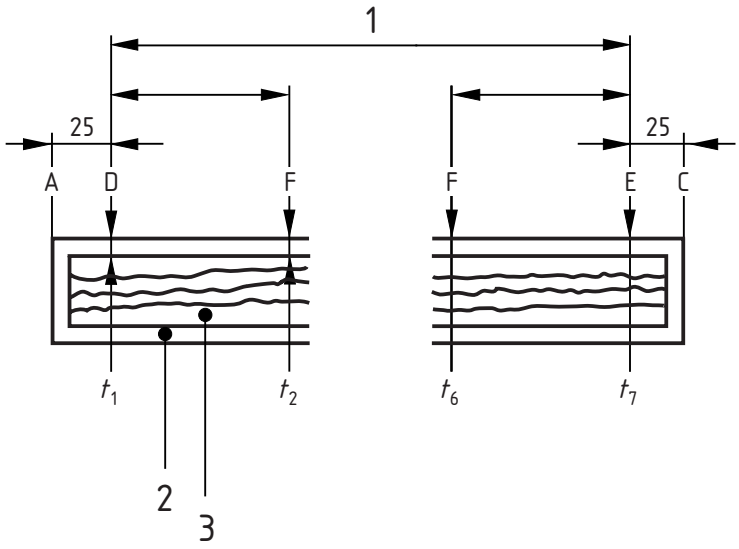
a) t_1 and t_7 are the distances between the surface (top cover) of the belting and the interface between additional and standard cover material at each of the two lines D and E;

NOTE 1 The lines D and E are situated at points 25 mm from each edge of the belting.

b) t_2 and t_6 are the distances between the surface (top cover) of the belting and the interface between additional and standard cover material at each of the five lines F.

NOTE 2 The five lines F are situated, at equally-spaced intervals, between D and E across the width of the belting.

All dimensions are in millimetres



Key

1 Seven measurement points, equally spaced

2 Additional cover of different material from normal

3 Normal cover material

Figure B.2 — Measurement of cover thickness (for additional covers applied on to standard cover)

B.4.1.3 For belting where a material that is different from, but not compatible with, standard top cover material is fused onto the carcass using an adhesive layer, make seven measurements (in millimetres) of the distance between the surface (top cover) of the belting and the interface between the surface material and the adhesive layer as follows (see also Figure B.2):

a) t_1 and t_7 are the distances between the surface (top cover) of the belting and the interface between the surface material and the adhesive layer at each of the two lines D and E;

NOTE 1 The lines D and E are situated at points 25 mm from each edge of the belting.

b) t_2 and t_6 are the distances between the surface (top cover) of the belting and the interface between the surface material and the adhesive layer at each of the five lines F.

NOTE 2 The five lines F are situated, at equally-spaced intervals, between D and E across the width of the belting.

B.4.2 *Localized thin cover thickness*

NOTE The procedures are the same for measuring localized thin cover thickness of the top and bottom covers.

B.4.2.1 Where visual inspection, without the optical magnifier (**B.2.1**) reveals a portion of localized thin cover thickness, excluding any within 25 mm of the belting edges, the procedures detailed in **B.4.2.2**, **B.4.2.3** and **B.4.2.4** apply, as appropriate.

B.4.2.2 For belting where the cover material is applied directly to the belting carcass, make four measurements (in millimetres) of the distance between the surface (top cover) and the exposed fabric at four adjacent knuckles within the affected area, i.e. at positions t_a, t_b, t_c and t_d as indicated on Figure B.1.

B.4.2.3 For belting where a material that is different from, but compatible with, standard top cover material is fused or vulcanized onto existing standard cover material as additional cover thickness, record the smaller of the following dimensions:

a) the minimum distance between the surface of the belting and the interface between additional and standard cover material;

b) the mean of four measurements of the distance between the surface and the exposed fabric at four adjacent knuckles within the affected area, i.e. at positions t_a, t_b, t_c and t_d as indicated on Figure B.1.

B.4.2.4 For belting where a material that is different from, but not compatible with, standard top cover material is fused onto the carcass using an adhesive layer, record the smaller of the following dimensions:

a) the minimum distance between the surface of the belting and the interface between the surface material and the adhesive layer;

b) the mean of four measurements of the distance between the surface and the exposed fabric at four adjacent knuckles within the affected area, i.e. at positions t_a, t_b, t_c and t_d as indicated on Figure B.1.

B.4.3 *Minimum cover thickness within 25 mm and 12 mm of the belting edges*

NOTE The procedures are the same for measuring minimum cover thickness of the top and bottom covers.

B.4.3.1 For belting where the cover material is applied directly to the belting carcass measure, to the nearest 0.05 mm, the minimum distance between the surface of the belting and the fabric knuckle within that part of the belting that lies between points A–D and E–C (see Figure B.1).

B.4.3.2 For belting where a material that is different from, but compatible with, standard top cover material is fused or vulcanized onto existing standard cover material as additional cover thickness, record the smaller of the following dimensions:

a) the minimum distance, to the nearest 0.05 mm, between the surface of the belting and the fabric knuckle within that part of the belting that lies between points A–D and E–C (see Figure B.1);

b) the minimum distance, to the nearest 0.05 mm, between the surface of the belting and the interface between additional and standard cover materials within that part of the belting that lies between points A–D and E–C (see Figure B.1).

B.4.3.3 For belting where a material that is different from, but not compatible with, standard top cover material is fused onto the carcass using an adhesive layer, record the smaller of the following dimensions:

a) the minimum distance, to the nearest 0.05 mm, between the surface of the belting and the fabric knuckle within that part of the belting that lies between points A–D and E–C (see Figure B.1);

b) the minimum distance, to the nearest 0.05 mm, between the surface of the belting and the interface between the surface material and the adhesive layer within that part of the belting that lies between A–D and E–C (see Figure B.1).

B.4.4 *Edge cover thickness*

NOTE The procedures are the same for measuring edge cover thickness of the top and bottom covers.

On a cross-section of belting (see Figure B.1) measure, to the nearest 0.05 mm, the distances H–C and G–A, using the optical magnifier (**B.2.1**).

B.5 Calculation and expression of results

B.5.1 *Mean cover thickness*

Calculate the mean cover thickness c (in millimetres) using the following equation:

$$c = \frac{t_1 + t_2 + t_3 + t_4 + t_5 + t_6 + t_7}{7}$$

where

t_1 to t_7 are as defined in **B.4.1**, **B.4.2** or **B.4.3**, as appropriate.

B.5.2 *Localized thin cover thickness*

B.5.2.1 Record as the localized thin cover thickness l_c (in millimetres) the results of measurements and calculations made in accordance with **B.5.2.2**, **B.5.2.3** or **B.5.2.4**, as appropriate, according to cover type.

B.5.2.2 For belting where the cover material is applied directly to the belting carcass, l_c (in millimetres) is calculated from the following equation:

$$I_c = \frac{t_a + t_b + t_c + t_d}{4}$$

where

t_a to t_d are as defined in **B.4.2**.

B.5.2.3 For belting where a material that is different from, but compatible with, standard top cover material is fused or vulcanized onto existing standard cover material as additional cover thickness, l_c (in millimetres) is the smaller of the following:

a) the result following calculations in accordance with **B.5.2.2**;

b) the minimum thickness between the surface of the belting and the interface between additional and standard cover material [see **B.4.2.3**a)].

B.5.2.4 For belting where a material that is different from, but not compatible with, standard top cover material is fused onto the carcass using an adhesive layer, l_c (in millimetres) is the smaller of the following:

a) the result following calculations in accordance with **B.5.2.2**;

b) the minimum thickness between the surface of the belting and the interface between the surface material and the adhesive layer [see **B.4.2.4**a)].

B.5.3 *Minimum cover thickness within 25 mm and 12 mm of the belting edges*

Record as the minimum cover thickness within 25 mm and 12 mm of the belting edges (in millimetres) the results of measuring in accordance with **B.4.3.1**, **B.4.3.2** or **B.4.3.3**, as appropriate, according to cover type.

B.5.4 *Edge cover thickness*

Record as the edge cover thickness (in millimetres) the two measurements made in accordance with **B.4.4**.

B.5.5 *Test report*

The following shall be reported:

a) the mean cover thickness, recorded in accordance with **B.5.1**;

b) the thickness of any localized thin cover, recorded in accordance with **B.5.2**;

c) cover thickness within 25 mm and 12 mm of the belting edges, recorded in accordance with **B.5.3**;

d) edge cover thickness at both edges of belting, recorded in accordance with **B.5.4**.

Annex C (normative)
Method of test for tensile strength and elongation at break

C.1 Principle

A sample of belting is selected, with covers intact, from which are cut dumb-bell shaped test pieces of full belting thickness. The tensile strength at break and the maximum elongation at break of each test piece is determined.

C.2 Apparatus

C.2.1 *Tensile testing machine*, complying with Annex H.

NOTE Hydraulically-operated unserrated grips or other such devices may be used for this test, provided that they do not cause the test piece to break near the jaws rather than at its centre.

C.3 Preparation of test pieces

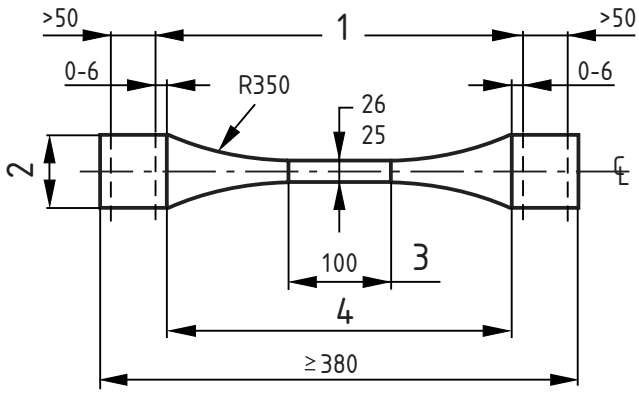
C.3.1 Cut six test pieces, three in the longitudinal direction parallel to the length of the belting and three in the transverse direction at right angles to the length of the belting. Cut the test pieces from places widely spaced from each other, so as to be representative of the condition and thickness of the sample of belting.

Ensure that the test pieces do not contain any joints, and that no test piece is cut from the sample with its longitudinal edge less than 12 mm from an edge of the sample.

C.3.2 Dies with a wall profile as shown in Figure C.2 have proved suitable for cutting test pieces. After cutting, ensure that each test piece conforms to the shape and dimensions shown in Figure C.1.

C.3.3 Test immediately after preparing the test pieces or, if this is impracticable, store the test pieces in a manner which prevents the ingress of moisture at the cut edges until tested.

All dimensions are in millimetres

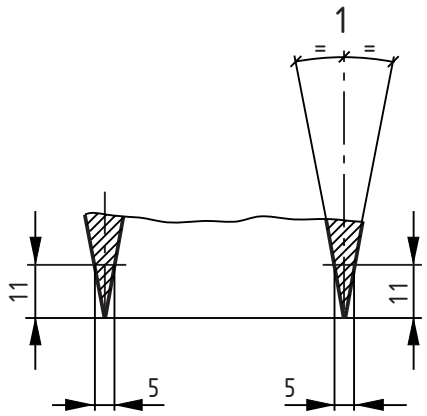


Key

1 Clamping zones
2 Nominally 63 mm
3 Reference lines
4 Nominally 227 mm

Figure C.1 — Test piece for tensile strength and elongation at break tests

All dimensions are in millimetres



Key

1 All round die

Figure C.2 — Example of a die used to cut test pieces for tensile strength and elongation at break tests

C.4 Procedure

Maintain the test pieces at room temperature. Record the room temperature and relative humidity (r.h.).

Prior to testing, measure the width of the narrow portion of each test piece to the nearest 0.1 mm. From the dimensions of the six test pieces (see **C.3.1**), calculate the average width of the narrow portion and record the value to the nearest 0.1 mm. (See Figure C.1.)

Place the ends of each test piece symmetrically in the grips of the tensile testing machine (**C.2.1**) as shown in Figure C.1. Separate the grips at a constant rate of traverse speed of (100 ± 10) mm/min until the test piece breaks. Record the maximum breaking force.

Determine the elongation at break by measuring (on the centreline of the test piece) the distance between the reference lines of the defined 100 mm gauge length (see Figure C.1) at the moment of break of the test piece.

NOTE This may conveniently be done by following the extension with dividers or by means of a suitable extensometer operating in direct contact with the test piece.

Record the extension at the moment of break.

C.5 Calculation and expression of results

C.5.1 *Tensile strength at break*

Record separately the breaking force of each of the six test pieces (three in the longitudinal direction, three in the transverse direction).

Calculate and record the average breaking force in newtons per millimetre for each group of three test pieces.

C.5.2 *Elongation at break*

Record separately the elongation at break of each of the six test pieces (three in the longitudinal direction, three in the transverse direction).

Express these as a percentage of the initial 100 mm gauge length.

Calculate and record the average elongation at break (as a percentage) for each group of three test pieces.

Annex D (normative)
Method of test for adhesion

D.1 Principle

A sample of belting is selected, with covers intact, from which test pieces are cut of full belting thickness. The following properties are determined, as appropriate (see Table 7).

a) Solid woven belting:

1) the force required to strip the cover from the carcass;

2) the force required to strip any additional cover from the standard cover (see **14.3**);

3) the force required to produce separation of the carcass.

b) Plied belting:

1) the force required to strip the cover from the adjacent ply;

2) the force required to strip one ply from the next;

3) the force required to strip any additional cover from the standard cover (see **14.3**).

NOTE For the purposes of the tests listed in items a) and b), the unqualified term "cover" includes any adhesive layer present.

D.2 Apparatus

D.2.1 *Tensile testing machine*, complying with Annex H.

D.3 Preparation of test pieces

Cut 12 test pieces (two pairs of test pieces are required for each of the tests listed in **D.1**), each as a rectangular strip (25 ± 1.0) mm wide and 300 mm long. Ensure that they have clean-cut edges.

NOTE The test pieces may be cut by machine or by hand.

Cut six test pieces in the longitudinal direction, parallel to the length of the belting, and the remainder in the transverse direction, at right angles to the length of the belting. Cut the test pieces from places widely spaced from each other, so as to be representative of the condition and thickness of the sample of belting.

D.4 Conditioning

Condition each test piece at a temperature of (20 ± 2) °C for at least two hours immediately before testing.

D.5 Procedure

D.5.1 *General*

If any test piece breaks during the test, prepare and test a further test piece.

If the replacement test piece breaks during the test, determine the highest maximum value of force recorded for the two test pieces from the value of the highest peak, including the initial peak (see **D.5.4**) on the autographic record.

D.5.2 *Solid woven belting*

D.5.2.1 Determine the force required to strip the cover from the carcass as follows.

a) Separate one of the covers from the carcass for a distance of approximately 75 mm at one end of a test piece. Secure the separated ends in the grips of the tensile testing machine (**D.2.1**), and make an autographic record of the force required to strip a further 100 mm with a constant rate of traverse speed of the driven jaw of (50 ± 2.5) mm/min. Leave the unstripped part of the test piece free from support during the test.

b) Determine the mean and minimum values of stripping force (see **D.5.4**).

c) Using the same test piece, repeat the test for the other cover at the other end of the test piece.

d) Repeat the procedure described in a) to c) on the second test piece of the pair.

e) Repeat the procedure described in a) to d) on the other pair of test pieces.

D.5.2.2 Determine the force required to strip any additional cover from the standard cover as follows.

a) Separate one of the additional covers from the standard cover for a distance of approximately 75 mm at one end of a test piece. Secure the separated ends in the grips of the tensile testing machine (**D.2.1**) and make an autographic record of the force required to strip a further 100 mm with a constant rate of traverse speed of the driven jaw of (50 ± 2.5) mm/min. Leave the unstripped part of the test piece free from support during the test.

b) Determine the mean and minimum values of stripping force (see **D.5.4**).

c) Using the same test piece, repeat the test for the other additional cover at the other end of the test piece.

d) Repeat the procedure described in a) to c) on the second test piece of the pair.

e) Repeat the procedure described in a) to d) on the other pair of test pieces.

D.5.2.3 Determine the internal adhesion by measuring the force required to produce separation of the carcass as follows.

a) Cut through the middle of the carcass, over the full width and parallel to the covers, for a distance of approximately 75 mm (see Figure D.1) at one end of the test piece. Secure the separated ends in the grips of the tensile testing machine (**D.2.1**) and make an autographic record of the force required to separate a further 100 mm with a constant rate of traverse speed of the driven jaw of (50 ± 2.5) mm/min. Leave the unstripped part of the test piece free from support during the test.

b) Determine the mean and minimum values of stripping force (see **D.5.4**).

c) Repeat the procedure described in a) and b) on the three remaining test pieces.

D.5.3 *Plied belting*

D.5.3.1 Determine the force required to strip the cover from the adjacent ply as follows.

a) Separate one of the covers from the adjacent ply for a distance of approximately 75 mm at one end of a test piece. Secure the separated ends in the grips of the tensile testing machine (**D.2.1**) and make an autographic record of the force required to strip a further 100 mm with a constant rate of traverse speed of the driven jaw of (50 ± 2.5) mm/min. Leave the unstripped part of the test piece free from support during the test.

b) Determine the mean and minimum values of stripping force (see **D.5.4**).

D.5.3.2 Determine the force required to strip one ply from the next as follows.

a) Repeat the procedure described in a) and b) of **D.5.3.1**, using the same test piece for each consecutive ply to the middle of the test piece. Conduct a similar test on the second test piece of the pair commencing with the opposite cover and again working to the middle of the test piece.

b) Repeat the procedure described in a) on the other three pairs of test pieces.

D.5.3.3 Determine the force required to strip any additional cover from the standard cover following the procedure described in **D.5.2.2**.

D.5.4 *Determination of the mean and minimum values of stripping force*

Make a visual determination of the mean and minimum values of stripping force, from the autographic record, over a length of trace corresponding to not less than 75 mm of stripping, ignoring the initial rise of the trace. In cases of dispute, or where substantial fluctuations of force occur, determine the mean and minimum values of stripping force as follows (see Figure D.2).

a) Draw a mean curve through the centres of oscillation of the trace; this represents the stripping force curve.

b) Determine the mean height of the stripping force curve, either visually or by suitable graphical means and represent it by a straight line drawn parallel to the base line of the autographic record. Position the mean line such that the sum of the areas above the line is equal to the sum of the areas below the line. The height of the line (to scale) defines the mean stripping force.

c) The minimum height of the stripping force curve determines the minimum stripping force.

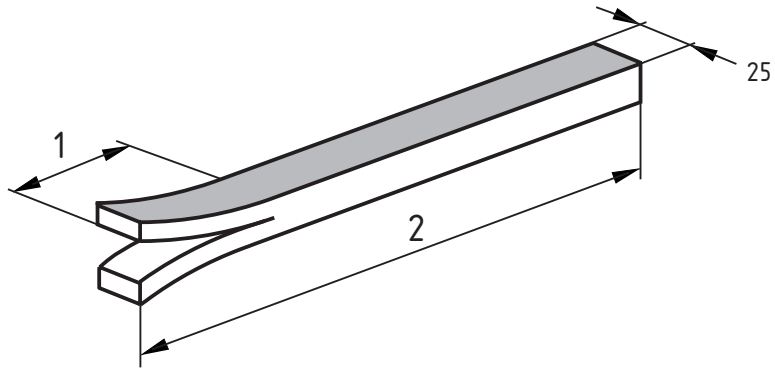
D.6 Calculation and expression of results

D.6.1 *General*

Express results, in newtons per millimetre width of belting, for each of the required values of force.

For each pair of test pieces subjected to the tests listed in **D.1** (one pair cut longitudinally, parallel to the length of the belting, and one pair cut transversely, at right angles to the length of the belting) determine and record the adhesion properties of the belting in accordance with **D.6.2**, **D.6.3** and **D.6.4**.

All dimensions are in millimetres

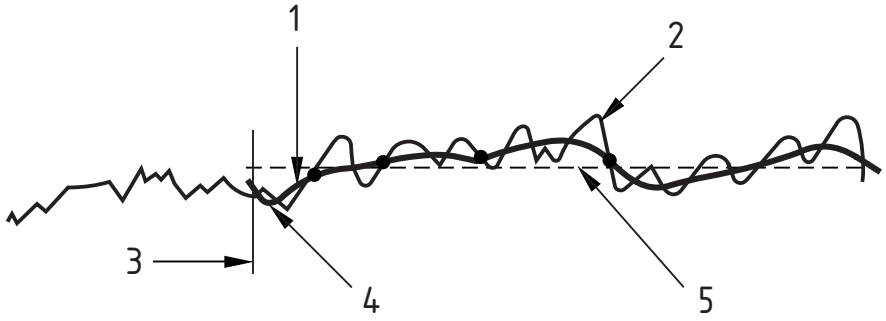


Key

1 Cut 75 mm

2 Overall 300 mm

Figure D.1 — Test piece for determination of internal adhesion



Key

1 Mean curve

2 Autographic record

3 Ignore first 50 mm

4 Minimum value

5 Mean line

Figure D.2 — Determination of mean and minimum values of stripping force from the autographic record

D.6.2 *Solid woven belt*

D.6.2.1 *Between each cover and carcass*. Record the average of the two mean values of stripping force and the lower of the two minimum values of stripping force, i.e. four recorded force values for each pair.

D.6.2.2 *Between any additional cover and standard cover*. Record the average of the two mean values of stripping force and the lower of the two minimum values of stripping force, i.e. four recorded force values for each pair.

D.6.2.3 *For separation of carcass*. Record the mean values of stripping force and the minimum values of stripping force, i.e. four recorded force values for each pair.

D.6.3 ***Plied belting***

D.6.3.1 *Between each cover and adjacent ply*. Record the average of the two mean values of stripping force and the lower of the two minimum values of stripping force, i.e. two recorded force values for each pair.

D.6.3.2 *Between adjacent plies*. Record the average of the two mean values of stripping force and the lower of the two minimum values of stripping force, i.e. two recorded force values for each pair.

D.6.3.3 *Between any additional cover and standard cover*. Record the average of the two mean values of stripping force and the lower of the two minimum values of stripping force, i.e. four recorded force values for each pair.

D.6.4 ***Test pieces that break in tension***

Where both the test piece and its replacement break in tension, record the maximum value of force for the two test pieces and the fact that a break occurred.

Annex E (normative)
Method of test for tear strength

E.1 Principle

A sample of belting is selected, with covers intact, from which are cut test pieces of full belting thickness. The force required to extend a cut made in a test piece is measured.

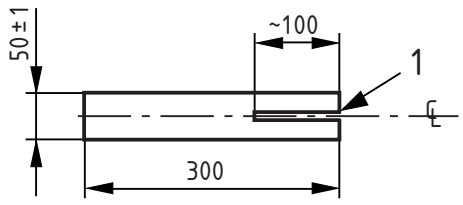
E.2 Apparatus

E.2.1 *Tensile testing machine*, complying with Annex H.

E.3 Preparation of test pieces

E.3.1 Cut six rectangular test pieces of the full thickness of the belting, (50 ± 1) mm wide and 300 mm long, in the longitudinal direction parallel to the length of the belting. Cut each test piece down the centre, parallel with the sides, for a length of approximately 100 mm from one end so as to form two legs as shown in Figure E.1.

All dimensions are in millimetres



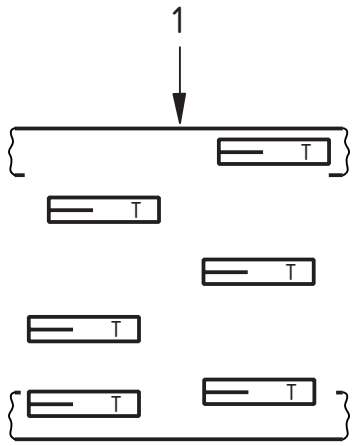
Key
1 Cut

Figure E.1 — Test piece for tear strength test

E.3.2 Cut the test pieces from places widely spaced from each other so as to be representative of the condition and thickness of the sample of belting, but ensure that one test piece is cut with its edge not less than 12 mm and not more than 18 mm from the finished edge of the belting.

E.3.3 Mark each test piece with a letter T on the top cover of the belting. Make this mark at the same end of each test piece in relation to the run of the belt (see Figure E.2).

E.3.4 Test immediately after preparing the test pieces or, if this is impracticable, store the test pieces in a manner which prevents the ingress of moisture at the cut edges until tested.



Key

1 Edge of belt

Figure E.2 — Arrangement of test pieces and their marking for tear strength test

E.4 Procedure

Maintain the test pieces at room temperature. Record the room temperature and relative humidity (r.h.).

Secure the two legs of a test piece in the grips of the tensile testing machine (**E.2.1**), one leg in each grip. Clamp the legs, with the inner cut edges located at the centres of the grips and the legs set parallel to the direction of the traverse. Make an autographic record of the force required to tear the test piece a further 100 mm with a constant rate of traverse speed of the driven jaw of (50 ± 2.5) mm/min.

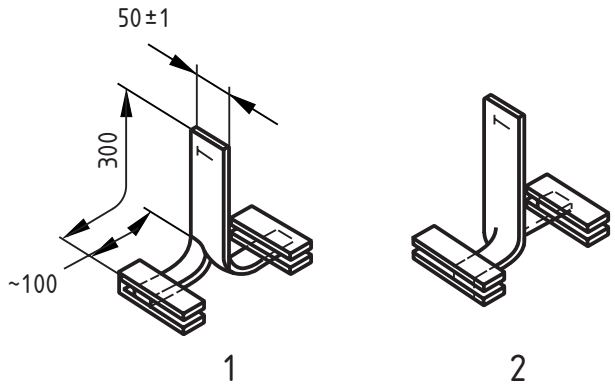
Test three test pieces in sense A and three in sense B as shown in Figure E.3.

Make a visual determination of the mean tearing force, from the autographic record, over a length of trace corresponding to not less than 75 mm of tearing, ignoring the initial rise of the trace. In cases of dispute or where substantial fluctuations of force occur, determine the mean tearing force as follows (see Figure D.2).

a) Draw a mean curve through the centres of oscillation of the trace; this represents the tearing force curve.

b) Determine the mean height of the tearing force curve, either visually or by suitable graphical means and represent it by a straight line drawn parallel to the base line of the autographic record. Position the mean line such that the sum of the areas above the line is equal to the sum of the areas below the line. The height of the line (to scale) defines the mean tearing force.

All dimensions are in millimetres



Key

1 Sense A

2 Sense B

Figure E.3 — Illustration of the two senses of testing for tear strength

E.5 Calculation and expression of results

Record separately the mean tearing force (in kN) for each of the six test pieces.

Record the average of the three values of the mean tearing force determined in sense A and the average of the three values determined in sense B.

In cases where the threads of the fabric pull out before direct tearing takes place, make a statement to this effect and report the mean tearing force recorded.

Annex F (normative)
Method of test for electrical resistance

F.1 Principle

The electrical resistance between electrodes placed on the surface of a sample of belting is measured.

F.2 Apparatus

F.2.1 *Resistance measuring instrument*, capable of measuring the range $10^5\ \Omega$ to $10^{10}\ \Omega$ and to be accurate to within 5 % of the true value over this range. The potential difference applied between the electrodes during the test shall be between 40 V d.c. and 1 000 V d.c. and shall be chosen so that not more than 1 W is dissipated in the test piece.

F.2.2 *Brass contact pieces*, comprising a cylinder and a ring as dimensioned in Figure F.1. Ensure that the lower surface of each contact piece is machined flat and that it is polished and clean. Ensure that each contact piece is provided with a flexible insulated lead.

F.2.3 *Base sheet*, which shall be a clean sheet of polyethylene, or alternative material with resistivity not less than that of polyethylene. Ensure that the base sheet is not less than 2 mm thick and 300 mm square.

F.2.4 *Electrode system*, comprising two electrodes of soft thin metal foil (but see Note) one being a disc 25 mm in diameter and the other being an annulus having internal and external diameters of 125 mm and 150 mm respectively (see Figure F.2). Take great care to ensure accuracy of the dimensions of the electrodes, but the symmetry of the annulus about the centre disc is not critical.

Suitable foil electrodes are as follows:

a) for general use: tin on lead, 1.5 % tin, 98.5 % lead, 0.025 mm thick, 3.5 m^2/kg;

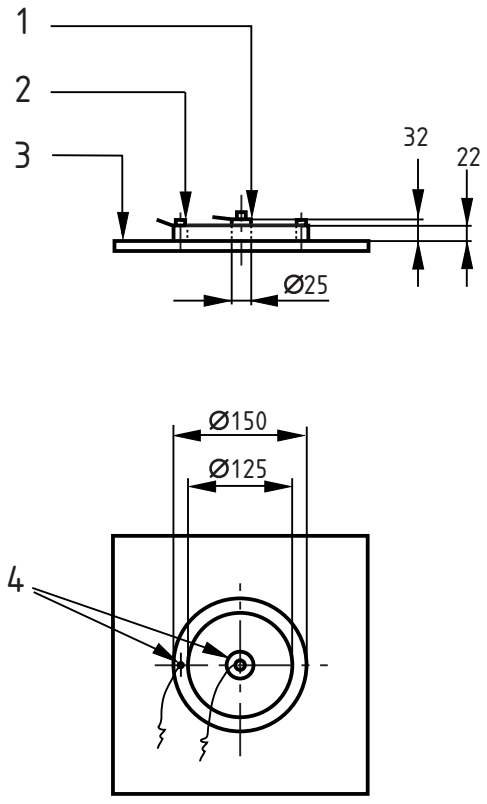
b) for indented surface: soft tin foil, 98.25 % tin, 1.25 % antimony, 0.5 % copper, and either:

0.0056 mm thick, 25 m^2/kg; or

0.0076 mm thick, 18 m^2/kg.

NOTE The foil electrodes may be omitted if the belting surface is sufficiently smooth and flat to enable the liquid contact agent to maintain continuous contact between the belting and the brass contact pieces. With irregular surfaces their omission may result in the indicated resistance being higher than the true resistance.

All dimensions are in millimetres



Key

1 Brass cylinder
2 Brass ring
3 Belt sample
4 5 mm cheese head screws

Figure F.1 — Layout and dimensions of brass contact pieces for electrical resistance test

F.3 Preparation of test piece

F.3.1 *General*

Prepare two test areas on the upper surface and two on the lower surface of the sample of belting. Ensure that each test area is not less than 300 mm × 300 mm.

F.3.2 *Surface cleaning*

Clean the surfaces of the test areas by dusting and rubbing with Fuller's earth (BP Grade) using a clean pad of cloth or cotton wool. When all traces of powder have been removed, clean the test areas with a pad moistened with either distilled water or de-ionized water and then rub dry with a clean cloth.

All dimensions are in millimetres

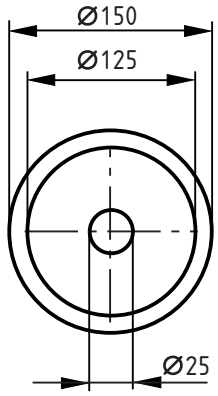


Figure F.2 — Electrode system for electrical resistance test

F.3.3 *Application of electrodes*

Where required, attach the electrodes to the test areas by a conducting liquid contact agent consisting of the following:

a) anhydrous polyethylene glycol of molecular weight 600:	4 parts by mass;
b) soft soap (BP quality):	0.005 parts by mass;
c) water:	1 part by mass.

Ensure that coatings of the liquid contact agent having the same dimensions as the foil electrodes form on the surface.

NOTE This may be accomplished with two felt pads of the same dimensions as the electrodes, moistened with the contact agent.

Rub the electrodes on to the test surface with a finger or small soft pad. If the surface is indented, ensure that the foil electrodes, after rubbing, clearly follow the indentations. Ensure that the contact agent is not smeared on the surface between the centre disc and the annulus. Wipe off any excess with a clean cotton wool pad.

F.4 Procedure

F.4.1 After cleaning in accordance with **F.3.2** immediately place the test piece in an atmosphere of (20 ± 2) °C and (65 ± 5) % r.h. for a period of two hours. Apply the electrodes centrally on the test area as described in **F.3.3**. Test the sample of belting without delay in the same conditions, i.e. (20 ± 2) °C and (65 ± 5) % r.h.

NOTE Non-compliance with the limit of resistivity specified in this British Standard can be proved only within these conditions, but compliance can be indicated under any conditions in which the temperature is lower than 22 °C and the relative humidity is less than 70 %.

F.4.2 Place the base sheet underneath the belting immediately below the test areas and mount the brass contact pieces in position on the electrodes.

Run the leads from these contact pieces direct to the measuring instrument so that the outer brass ring electrode is always connected to the earthed or low potential terminal and the inner brass cylinder to the higher potential terminal. Ensure that these leads cannot touch each other, the belting, or any part of the apparatus except the terminals to which each is connected. Connect all earth terminals to the same point.

Apply the test potential from the measuring instrument to the test area and measure the resistance when a steady indication is obtained. Apply the test potential for not more than five minutes.

Take particular care to avoid breathing on the test areas as condensation of moisture on these surfaces might lead to inaccuracies in the resistance measured.

Repeat the test on the remaining three test areas in turn.

NOTE Where a high degree of accuracy and reproducibility is required, the following refinements are recommended.

a) Care should be taken after conditioning not to stress the test area during handling.

b) The temperature and humidity at which the tests are made should be controlled as closely as possible.

c) When working with an instrument for measuring a very high resistance range, an earthed metal base sheet covered with insulating material should be placed under the instrument and base sheet.

F.5 Expression of results

Record the following results:

a) the electrical resistance (in Ω) measured on each electrode system;

b) the average value of the two resistance measurements on the upper surface (in Ω);

c) the average value of the two resistance measurements on the lower surface (in Ω).

Annex G (normative)
Methods of tests for fire performance

G.1 Drum friction test

G.1.1 *Apparatus*

NOTE A general arrangement of the standard drum friction testing apparatus is shown in Figure G.1.

G.1.1.1 *Steel drum*, of (210 ± 1) mm external diameter, mounted on a horizontal axle and capable of being rotated under all load conditions at (200 ± 5) r/min. To achieve this, a power supply of at least 7.5 kW is required. The outer shell of the drum is manufactured from tube complying with BS EN 10216-2 and BS EN 10217-2.

Basic dimensions of the drum (shown in Figure G.2) are given in order to standardize its thermal characteristics. The variation in diameter along the length of any one drum shall not exceed one millimetre.

Notwithstanding the dimensions and tolerances on drum diameter and shell thickness shown in Figure G.2, the effect of wear, down to a minimum shell thickness of six millimetres is permissible.

G.1.1.2 *Drum temperature measuring device*, comprising a mineral-insulated, stainless steel sheathed nickel-chromium/nickel-aluminium thermocouple having a nominal outside diameter of two millimetres and complying with BS EN 60584-1. The thermocouple is secured in a stainless steel housing by a copper ferrule. The tip of the thermocouple is set not more than 0.5 mm below the surface of the drum, midway along its length. The thermocouple housing and shaft material is of grade 070 M20 of BS 970-1:1996.

NOTE 1 It is advisable to fit three thermocouples to provide back-up in the event of failure.

NOTE 2 The thermocouple housing is shown in Figure G.2.

Take care to see that the effective "cold junction" temperature is compensated for or alternatively is measured and the appropriate correction made.

NOTE 3 The functioning of the slip ring contacts should be checked periodically by observing that there is no change in the recorded temperature when the apparatus is run without a test sample.

G.1.1.3 *Tensioning system*, as shown in Figure G.3, for applying tension to the test piece.

G.1.1.4 *Air current*, having a velocity of (2.0 ± 0.1) m/s. The air supplied to the apparatus shall be at normal ambient temperature with a minimum of 5 °C, otherwise tests shall not be made.

The air current shall be produced from a pipe perforated with a single row of holes supplied with compressed air. The pipe shall be fixed horizontally at the back of the drum, i.e. between the top and bottom portions of the belt, 600 mm from the drum centre and in the same horizontal plane. The row of holes shall face the drum. The actual air velocity shall be measured by an anemometer and should be checked at regular intervals.

The anemometer shall be positioned 200 mm from the surface of the drum on the same horizontal plane as the perforated pipe.

G.1.1.5 *Anemometer*, capable of measuring the velocity of the air current to an accuracy of ±5 %. Where an extractor system is provided for the removal of fumes from the vicinity of the apparatus, ensure that the maximum velocity of the air current through the system does not exceed 0.5 m/s.

G.1.2 *Test pieces*

Cut six or eight test pieces (depending upon whether the belt has identical or different cover types/thicknesses), each as a rectangular strip 150 mm wide and not less than 750 mm long, in the longitudinal direction, parallel to the length of the belting.

G.1.3 *Number of tests*

G.1.3.1 On belting with top and bottom covers which are identical, carry out six tests, three tests in still air and three tests in moving air.

G.1.3.2 On belting with top and bottom covers which are not identical, carry out eight tests as follows:

a) carry out one test in still air and one test in moving air with each of the two covers in contact with the drum;

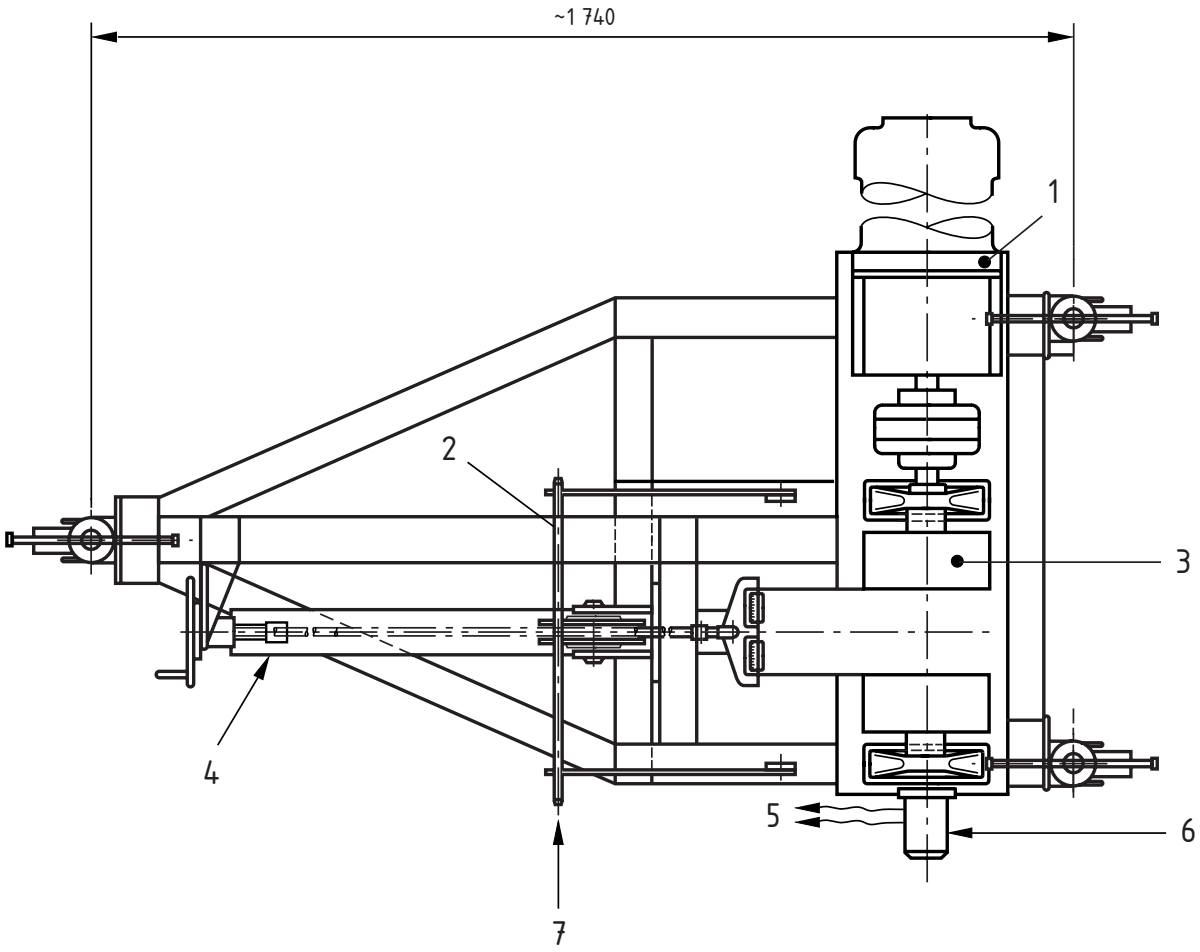
b) carry out two further tests in still air and two further tests in moving air with the cover next to the drum which gave the worst result in the tests described in item a).

G.1.4 *Procedure*

G.1.4.1 *General*

Thoroughly clean the surface of the steel drum to remove all traces of rust or residual debris, using abrasive paper or cloth grade P100 complying with BS 871:1981. Ensure that the temperature of the drum does not exceed 30 °C at the start of any test.

All dimensions are in millimetres



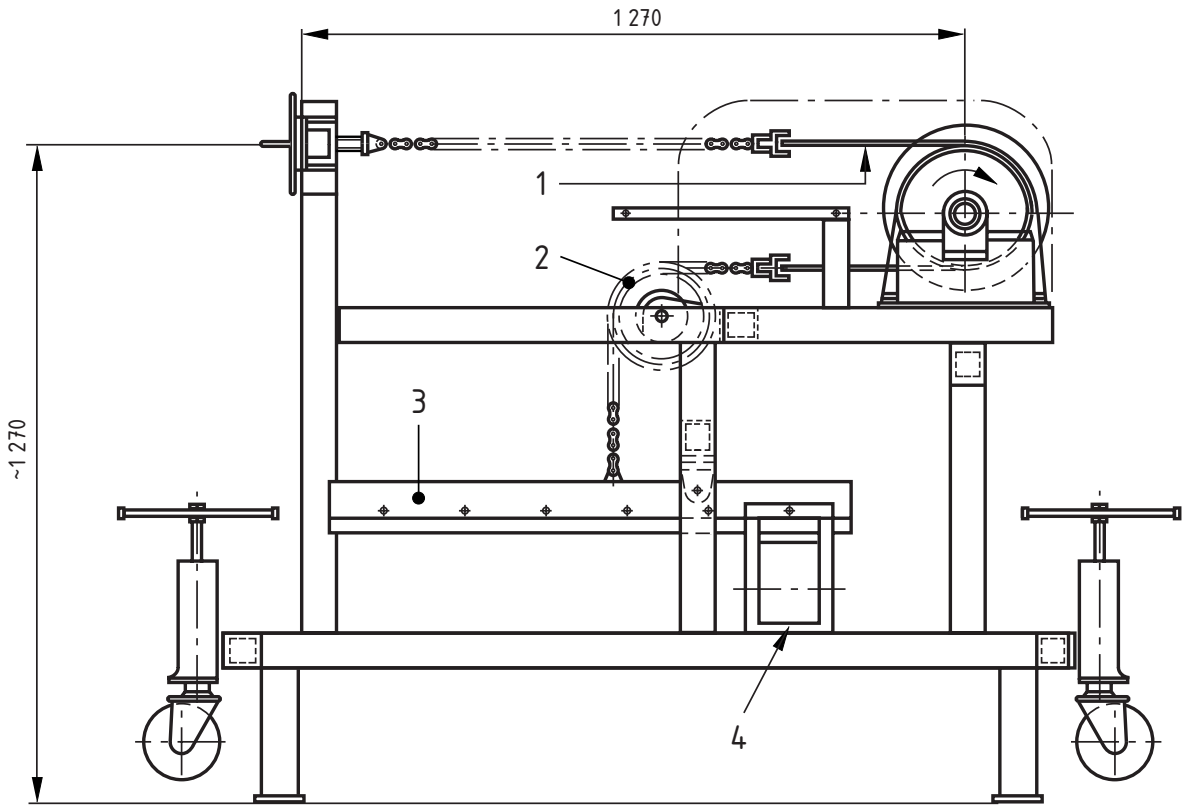
Key

1 Drive unit
2 Perforated pipe holes on side facing drum
3 Friction drum
4 Arrangement for tensioning belt sample
5 To temperature recorder
6 Slip ring contacts
7 Air supply

a) Plan view

Figure G.1 — Drum friction test apparatus

All dimensions are in millimetres



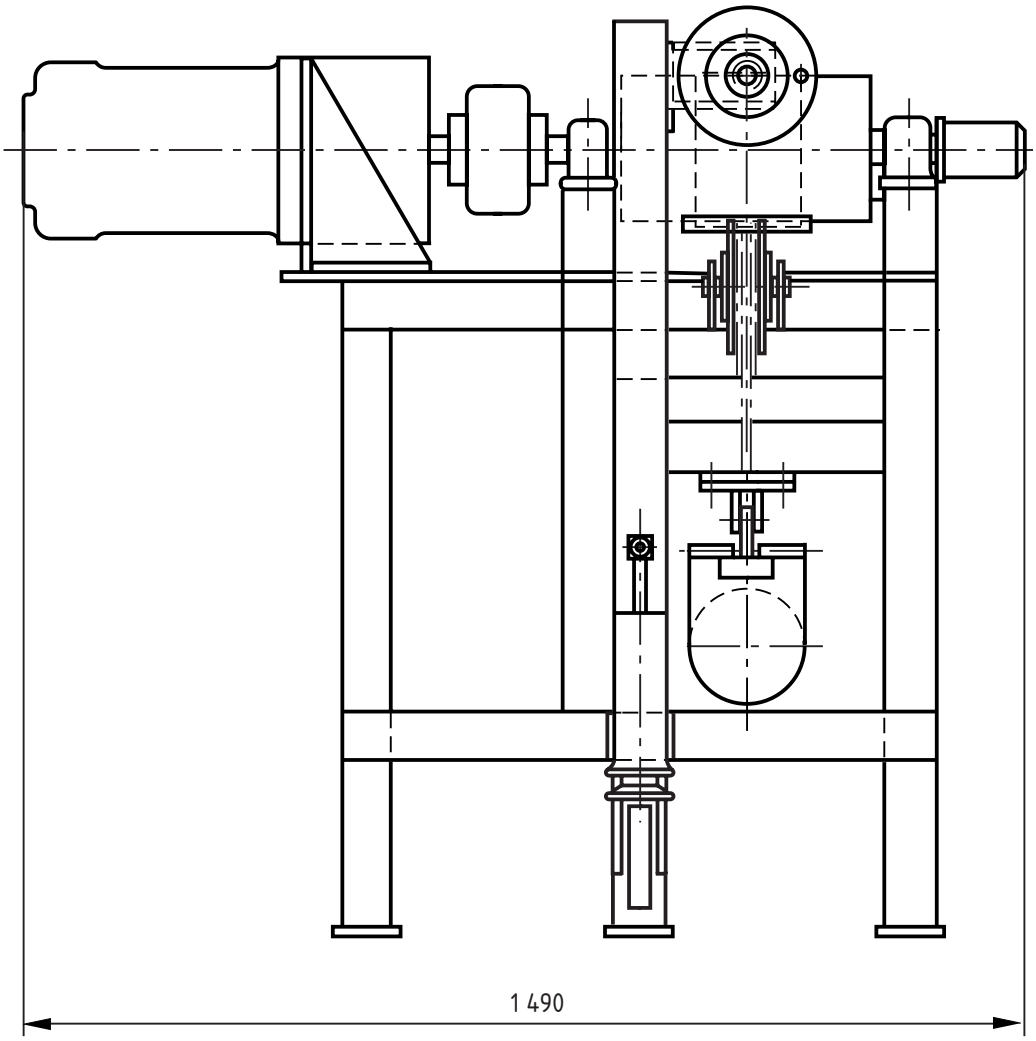
Key

1 Test piece
2 Guide pulley
3 Balance weight lever
4 Balance weight, shown in counter balance position

b) Side elevation

Figure G.1 — Drum friction test apparatus (*continued*)

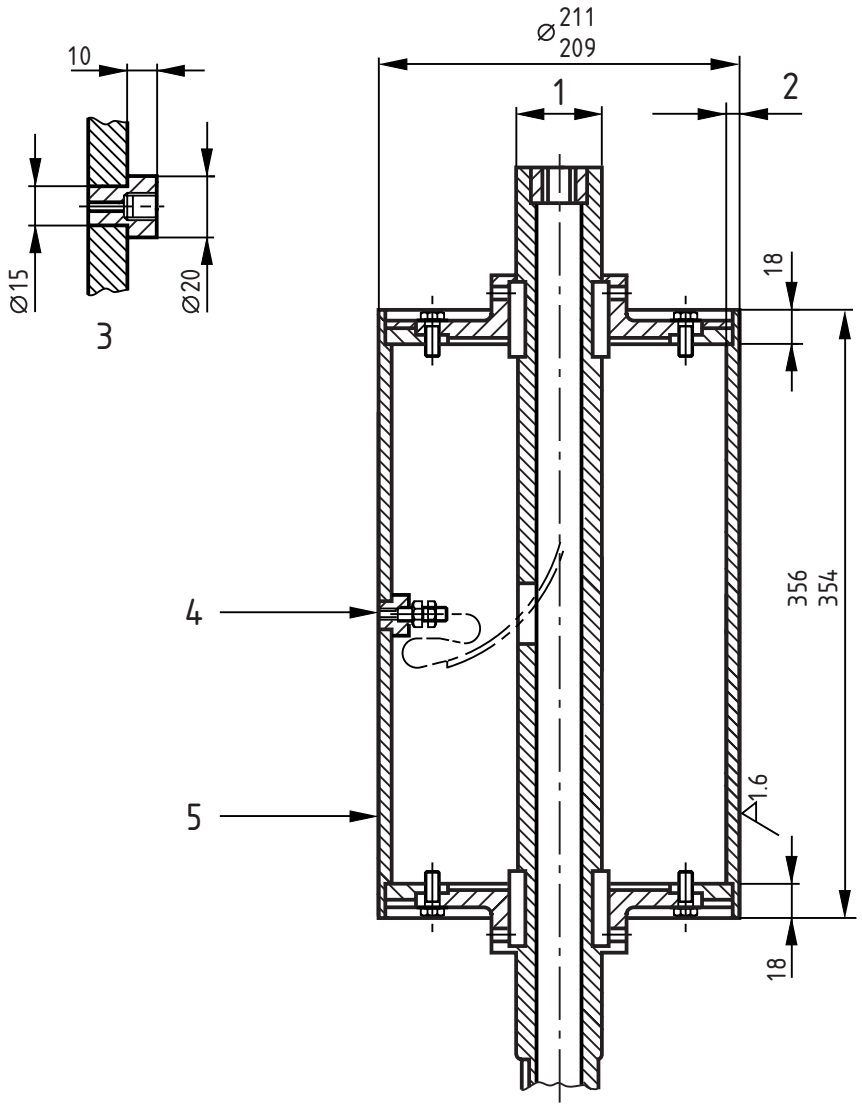
All dimensions are in millimetres



c) End elevation

Figure G.1 — Drum friction test apparatus (*continued*)

All dimensions are in millimetres



Key

1 Nominally 50 mm
2 Shell thickness 6.50 mm/6.75 mm
3 Enlarged view of thermocouple housing
4 Temperature probe
5 Outer shell manufactured from tube to BS EN 10216-2 and BS EN 10217-2

Thermocouple housing and shaft material BS 970 grade 070 M20.

Figure G.2 — Cross-section of stainless steel drum and thermocouple housing for drum friction test

All dimensions are in millimetres

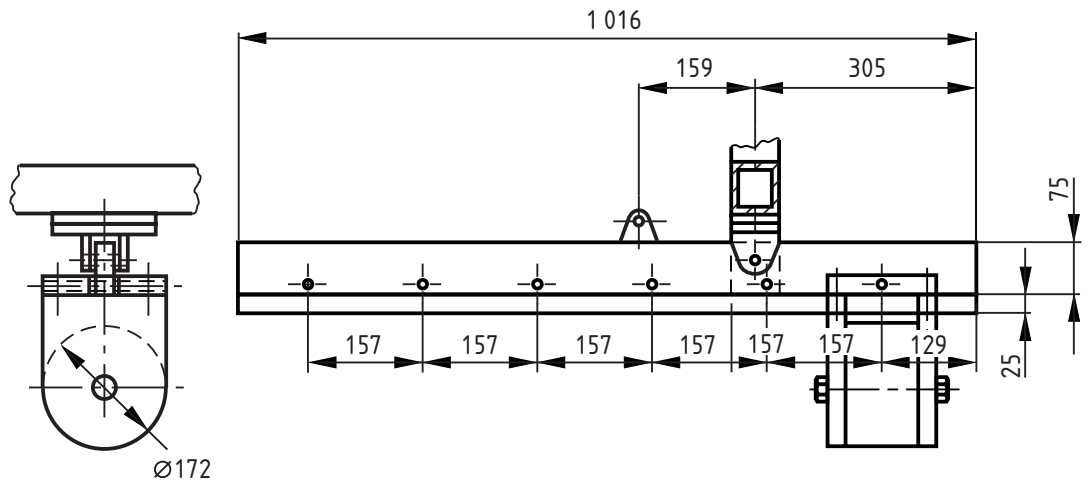


Figure G.3 — Basic dimensions of tensioning system for drum friction test apparatus

G.1.4.2 *Test in still air*. Pass the test piece through an arc of 180° around the steel drum. Ensure that one end is rigidly secured and the other end attached to the tensioning system as shown in Figure G.1b). Apply tension of 343 N.

Rotate the drum at (200 ± 5) r/min in a direction away from the rigidly secured end of the test piece, i.e. similar to the forward direction of a conveyor drive. Maintain the tension of 343 N until the test piece breaks. If the test piece has not broken after 60 min on test, increase the tension as follows whilst the drum is still rotating.

a) Increase the tension by 343 N to 686 N for a further 30 min.

b) If the test piece has still not broken, increase the tension by a further 343 N to 1 029 N for a further 30 min.

c) If the test piece has still not broken, increase the tension by a further 343 N to 1 372 N for a further 10 min.

d) If the test piece has still not broken, increase the tension by a further 343 N to 1 715 N, the test being continued at 1 715 N until the test piece breaks.

Examine the test piece for any flame or glow during the test. After the test piece has broken, leave the two pieces within the influence of the air current (**G.1.1.4**) until either flame or glow occurs, or until it is clear that neither is possible.

NOTE 1 The test is deemed to be terminated at this point.

Record the surface temperature of the drum during the test.

NOTE 2 It might be necessary, in the initial stages of a test, to reduce the tension in the sample by reducing the force applied to the free end in order to prevent the drum drive motor from stalling. Such reductions in tension should be kept to a minimum and the full tension of 343 N should be applied as evenly and as quickly as possible.

G.1.4.3 *Test in an air current*. Repeat the test described in **G.1.4.2** in an air current as described in **G.1.1.4**.

G.1.5 *Expression of results*

Record the following results:

a) the presence or absence of flame or glow in each test;

b) the maximum temperature of the surface of the drum in each test;

c) the time taken, in minutes, for the test piece to break.

G.2 Spirit burner flame test

G.2.1 *Apparatus*

G.2.1.1 *Spirit burner*, complying with BS EN ISO 340:2004, fitted to a suitable device to enable it to be moved away from the test piece without opening the door of the cabinet (**G.2.1.3**). The supply of fuel (**G.2.1.2**) to the burner is from a reservoir having a graduated side arm (as shown in Figure 2 of BS EN ISO 340:2004).

G.2.1.2 *Industrial methylated spirit*, conforming to BS 3591, strength 95 % (V/V) at 20 °C.

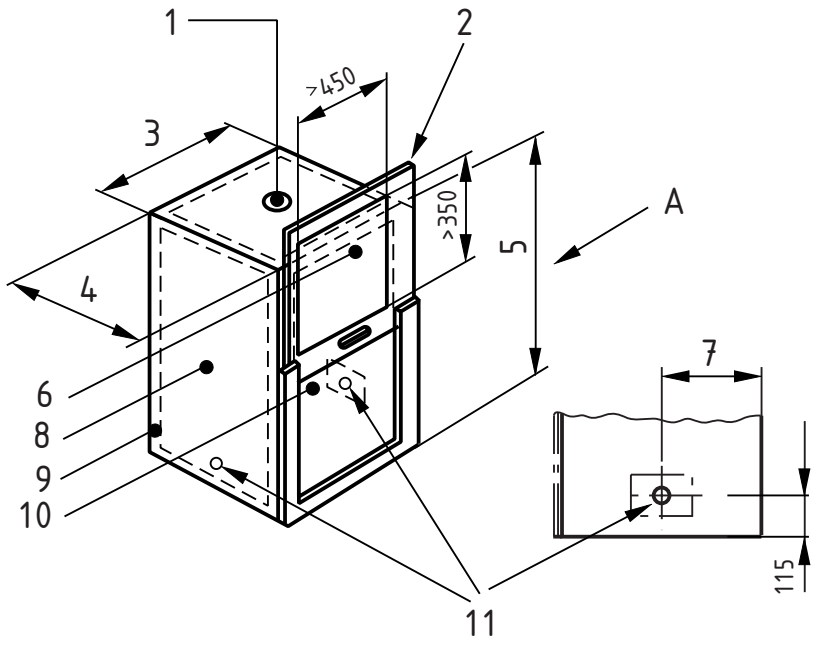
Ensure the fuel is free from suspended matter, and that it has been filtered before use.

NOTE A Whatman No. 1 paper is a suitable filter material.

G.2.1.3 *Cabinet*, in accordance with Figure G.4, the inside of which is coloured black. The cabinet is provided with an adjustable device to hold the test piece in position. The door of the cabinet is flush fitting, completely covering the cabinet aperture and may slide vertically or horizontally.

NOTE Additional close fitting holes may be made in the cabinet for the entry of the remote-handling device of the burner (**G.2.1.1**) and the fuel pipe.

All dimensions are in millimetres



Key

1	Ventilation hole, 150 mm diameter	7	305 mm internal
2	Door	8	Top, sides and base (6 ± 1) mm thick asbestos-free insulating board
3	660 mm internal		
4	610 mm internal	9	(30 ± 5) mm × (30 ± 5) mm angle frame work, if required
5	(1070 ± 15) mm internal	10	Aperture, 600 mm × 600 mm
6	Window aperture covered by an airtight transparent panel, e.g. 4½-5 toughened soda glass	11	40 mm diameter hole on each side of cabinet

Detail is of the view on A.

NOTE A fume hood, with an extraction fan, may be positioned above the cabinet; the fan may be run during the test provided that it does not induce air movement through the cabinet additional to that required for the operation of the burner. Where this condition is not satisfied, ensure that the fan is switched off during the test.

Figure G.4 — Cabinet for spirit burner flame test

G.2.1.4 *Stop-watch*, with maximum graduations of 0.2 s.

G.2.1.5 *Band facer*, with an abrasive band, not less than 100 mm wide, conforming to grade P60 of BS 871:1981.

G.2.2 *Selection of test pieces*

Cut 24 test pieces, each as a rectangular strip 25 mm wide and 150 mm long. Cut 12 test pieces in the longitudinal direction, parallel to the length of the belting, and the remainder in the transverse direction, at right angles to the length of the belting. Cut test pieces from places widely spaced from each other, so as to be representative of the condition and thickness of the sample of belting.

G.2.3 *Preparation of test pieces*

Six of the test pieces, comprising three cut in each direction (see **G.2.2**) are for tests with covers intact, i.e. no further preparation is required. Take the remaining 18 test pieces and remove the cover from the end to be tested by buffing on the band facer (**G.2.1.5**) in the direction of the length of the test piece. Remove not less than a 50 mm length of the covers. Stop buffing when all the knuckles of the fabric become exposed. Apply the test piece to the band facer intermittently to minimize frictional heating. Take care to avoid spreading a layer of cover material over the knuckles of the fabric.

G.2.4 *Operation and maintenance of the spirit burner*

G.2.4.1 *Operation*

Operate the burner as follows.

a) With the control valve closed, check that the fuel consumption is zero and then heat the burner by burning fuel in the primary heating cup.

b) Adjust the reservoir so that the fuel level is (760 ± 20) mm above the base of the burner. Fully open the control valve at least one turn and ignite the burner. Allow the flame to stabilize for 10 min.

c) Measure the fuel consumption for at least one minute while feeding the burner from the graduated side arm with the main reservoir tap closed. During the measurement, ensure that the mean fuel level in the side arm is 760 mm above the burner base. Ensure that the fuel consumption so measured is (2.55 ± 0.15) ml/min.

d) During the testing, maintain the fuel level in the reservoir within the range (760 ± 20) mm above the base of the burner.

NOTE 1 Violent oscillation of the fuel level (in excess of 1.5 ml in amplitude) should be taken as an indication of a fault in the burner. However, if violent oscillation occurs only after prolonged use, it is indicative of the onset of "hot hunting" and might be cured by turning off the burner for a short period.

NOTE 2 High fuel consumption is indicative of a fuel leakage which could be occurring at any of the joints in the burner or its fuel supply. If leakage is indicated, the fuel supply should be shut off immediately and the leakage rectified.

NOTE 3 Solid particles reaching the jet may stop or reduce the flow of fuel. Low fuel consumption is a clear indication of a blockage. This will rarely occur provided the system is thoroughly cleaned before use and filtered fuel is used (see **G.2.1.2**).

NOTE 4 When clearing a blocked jet, care should be exercised to avoid enlarging the hole. A "pricker" should not be used as this could produce a non-circular oversize jet.

Recommended methods for clearing jets are as follows:

1) blow cleaning fluid, from an aerosol pack fitted with a capillary outlet tube, through the orifice; or, if unsuccessful,

2) use a drill blank held in the fingers and inserted from the bottom of the jet to avoid damage to the outlet end.

After clearing a blockage, the whole of the burner should be thoroughly cleaned before reassembly.

G.2.4.2 *Maintenance*

Before using a burner, or on investigating a suspected fault, adopt the following procedure:

a) dismantle the burner;

b) clean the jet;

c) remove all packing rods, clean the interior of the burner and clean and replace the rods;

d) reassemble the burner, connect it to the fuel reservoir (with the control valve closed) and check it very carefully for fuel leaks.

NOTE Polytetrafluoroethylene (PTFE) tape may be used to seal the following joints:

1) the threads on the on/off control gland;

2) the threads on the fuel pipe/handle into the base of the burner.

To seal the jet, PTFE tape is rolled into a string and applied as a collar around the neck of the jet, i.e. not the threads.

The use of PTFE tape is not necessary to seal the screw thread on the base of the flame tube, as the effective sealing of this joint relies solely on the compression of the copper washer.

G.2.5 ***Procedure***

G.2.5.1 Carry out the tests in the test cabinet (**G.2.1.3**) in subdued light. Light the burner and check for correct operation as described in **G.2.4.1**.

G.2.5.2 Insert the test piece into the holder, ensuring that the test piece projects a minimum of 50 mm beyond the edge of the holder. Adjust the holder so that with the burner in the test position, i.e. placed centrally on the base plate of the cabinet, the following conditions are satisfied:

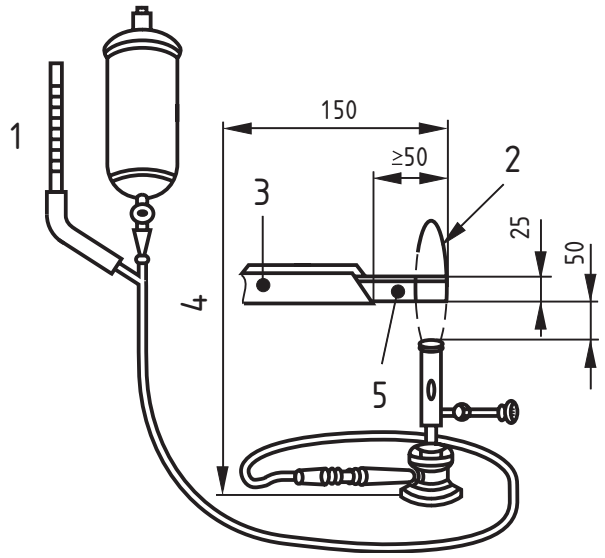
a) the faces of the test piece are vertical, the long edges horizontal, and the lower edge 50 mm above the top of the burner flame tube;

b) the test piece is located centrally in the flame, with its front edge coincident with the outer edge of the flame as shown in Figure G.5;

c) the test piece is at right angles to the door of the test cabinet so that both faces can be observed.

G.2.5.3 Bring the burner to the test position and simultaneously start the stop-watch (**G.2.1.4**) and close the cabinet door. After 30 s move the burner quickly but smoothly away from the sample to the side of the cabinet using the remote handling device. Record the time taken for all visible flame or glow to disappear from any part of the test piece after the withdrawal of the burner.

All dimensions are in millimetres



Key

1 Open graduated side arm, 10 ml capacity
2 Position of flame
3 Test piece holder
4 Fuel level approximately 760 mm above burner base
5 Specimen

Figure G.5 — Layout for spirit burner flame test

G.2.6 *Calculation and expression of results*

Record the following results:

a) the time for all flame or glow to disappear on each of the six test pieces with covers intact;

b) the average time for all flame or glow to disappear on the six test pieces with covers intact;

c) the time for all flame or glow to disappear on each of the nine test pieces (cut longitudinally, parallel to the length of the belting) with covers removed;

d) the average time for all flame or glow to disappear for the nine test pieces (cut longitudinally, parallel to the length of the belting) with covers removed;

e) the time for all flame or glow to disappear on each of the nine test pieces (cut transversely, at right angles to the length of the belting) with covers removed;

f) the average time for all flame or glow to disappear for the nine test pieces (cut transversely, at right angles to the length of the belting) with covers removed.

In the event that further samples are required to be tested (see **17.2**) report the results of such tests in addition to those reported in accordance with items a) to f) above.

G.3 Mid–scale fire propagation test

G.3.1 *Apparatus*

G.3.1.1 *Test gallery*, comprising a chamber made from 25 mm thick refractory material, with an opening measuring 460 mm × 460 mm and a length of 1676 mm. The chamber shall be connected to a 300 mm diameter exhaust duct by a conical transition section (plenum) made of stainless steel, 1.5 mm thick. A fan shall be situated in the exhaust duct to enable air to be drawn through the gallery, the speed of which is controlled by dampers. (See Figure G.6 and Figure G.7.)

G.3.1.2 *Exhaust hood*, made of stainless steel, 1.5 mm thick, placed over the test chamber to extract smoke and fumes that might escape from the front of the chamber during a test [See Figure G.7b)].

G.3.1.3 *Trestle*, to carry the belt sample. This shall be 1 500 mm long, 220 mm wide and 160 mm high, made from 10 mm diameter mild steel rod. It shall have lugs by which the belt sample can be wired down to the trestle (See Figure G.8.)

G.3.1.4 *Gas burner*, comprising six jets with dimensions as shown in Figure G.10, mounted in two rows of three inclined at 45º inwards and positioned on a frame to place them beneath the test sample. (See Figure G.9.)

G.3.1.5 *Propane gas*, conforming to BS 4250, supplied at a constant rate to the burner via a flowmeter, such that the mass of gas consumed during the test is (565 ± 10) g (see **G.3.6.4** for details of the flow rate needed to achieve this gas consumption).

G.3.1.6 *Weighing instrument*, capable of weighing the belt sample and the gas bottle before and after the test to an accuracy of five grams or better.

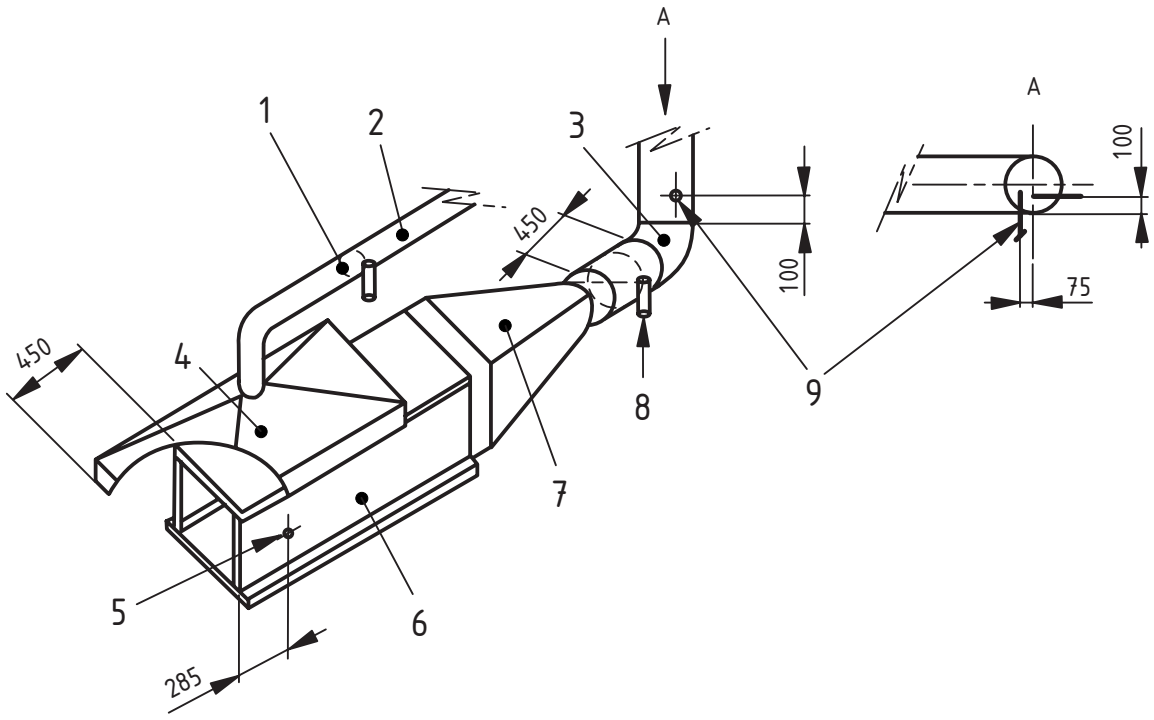
G.3.1.7 *Anemometer*, positioned on the centreline of the test chamber at a height of 310 mm above the floor and 285 mm from the front.

G.3.1.8 *K-type thermocouple*, positioned in the exhaust duct as shown in Figure G.6, and connected to a recording device.

G.3.1.9 *Recording device*, capable of recording the temperature at least six times per minute.

G.3.1.10 *Timer*, capable of measuring to within one second.

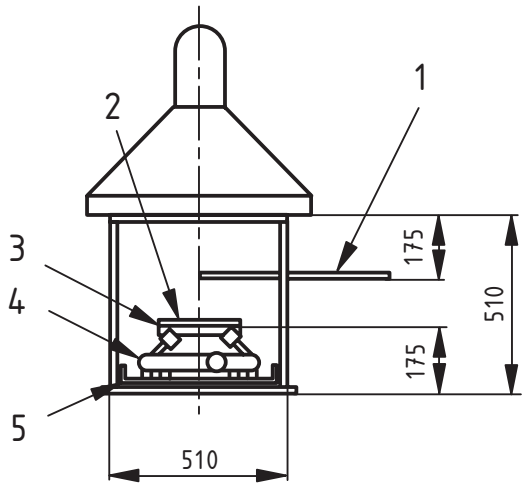
All dimensions are in millimetres



a) Third angle projection

Key

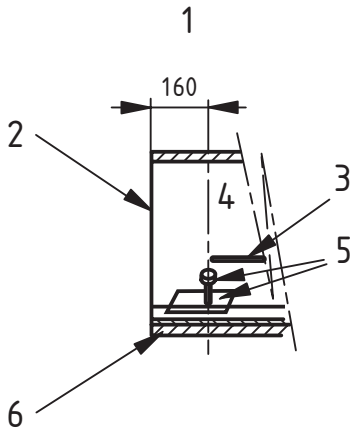
1 Exhaust control gate
2 150 mm diameter exhaust duct
3 300 mm diameter exhaust duct
4 Exhaust hood
5 Anemometer position
6 Test chamber, 25 mm thick refractory material
7 Plenum
8 Exhaust control gate
9 Thermocouple



b) Front view

Key

1 Anemometer position
2 Belt sample
3 Trestle
4 Burner
5 Debris tray, 1.5 mm thickness stainless steel



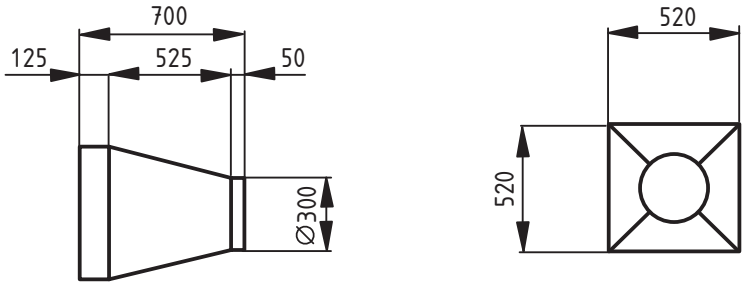
c) Cross-section of front face

Key

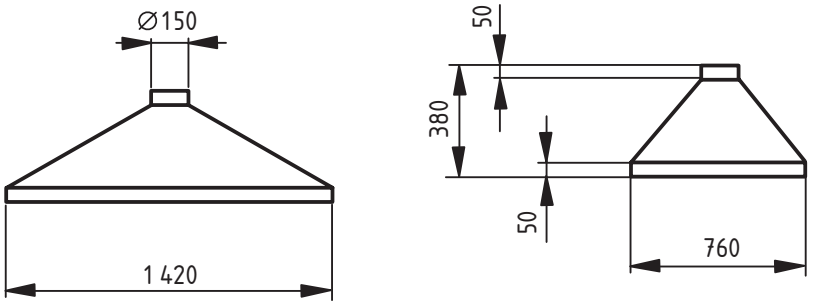
1 Exhaust hood not shown
2 Front face
3 Trestle
4 Test chamber
5 Burner
6 Debris tray, 1.5 mm thickness stainless steel

Figure G.6 — Laboratory-scale fire tunnel

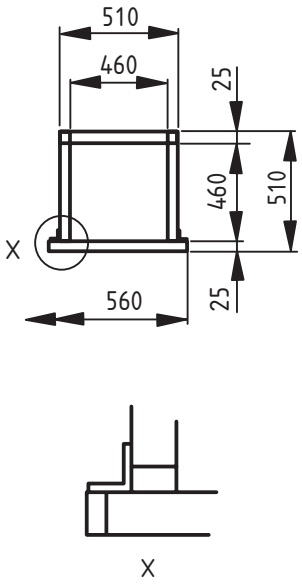
All dimensions are in millimetres

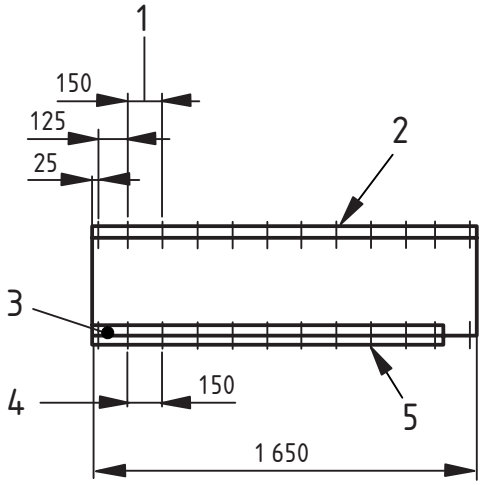


a) Plenum, stainless steel, 1.5 mm thick



b) Exhaust hood, stainless steel, 1.5 mm thick

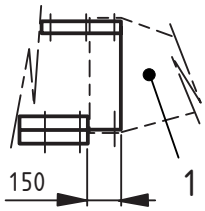




c) Test chamber

Key

1 Nine times 150 mm
2 Self-tapping screws
3 Metal support, 25 mm × 25 mm × 25 mm RSA
4 Six times 150 mm
5 Self-tapping screws

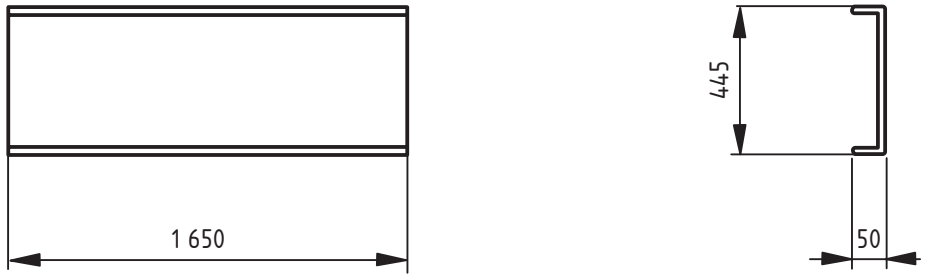


d) Test chamber/plenum join

Key

1 Cut floor and RSA as shown to fit plenum

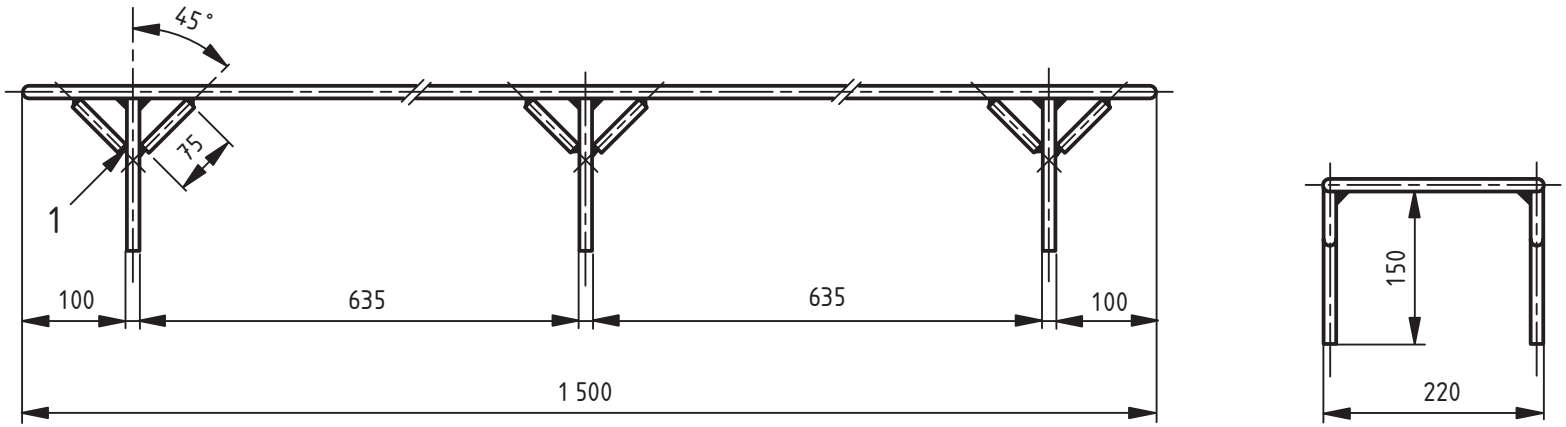
Figure G.7 — Laboratory-scale fire tunnel details



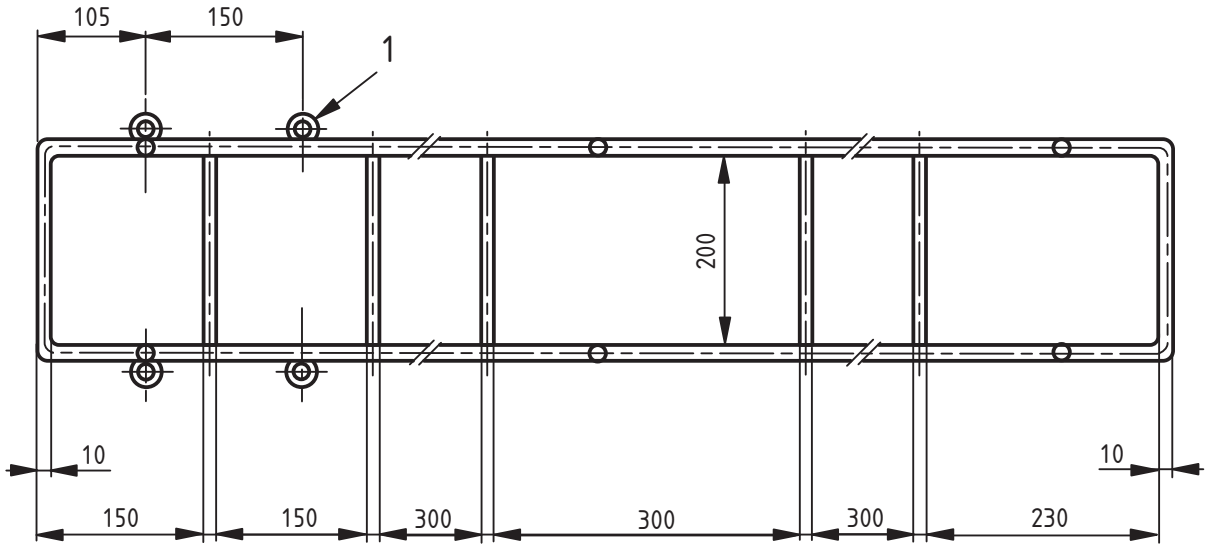
e) Debris tray

Figure G.7 — Laboratory-scale fire tunnel details (*continued*)

All dimensions are in millimetres



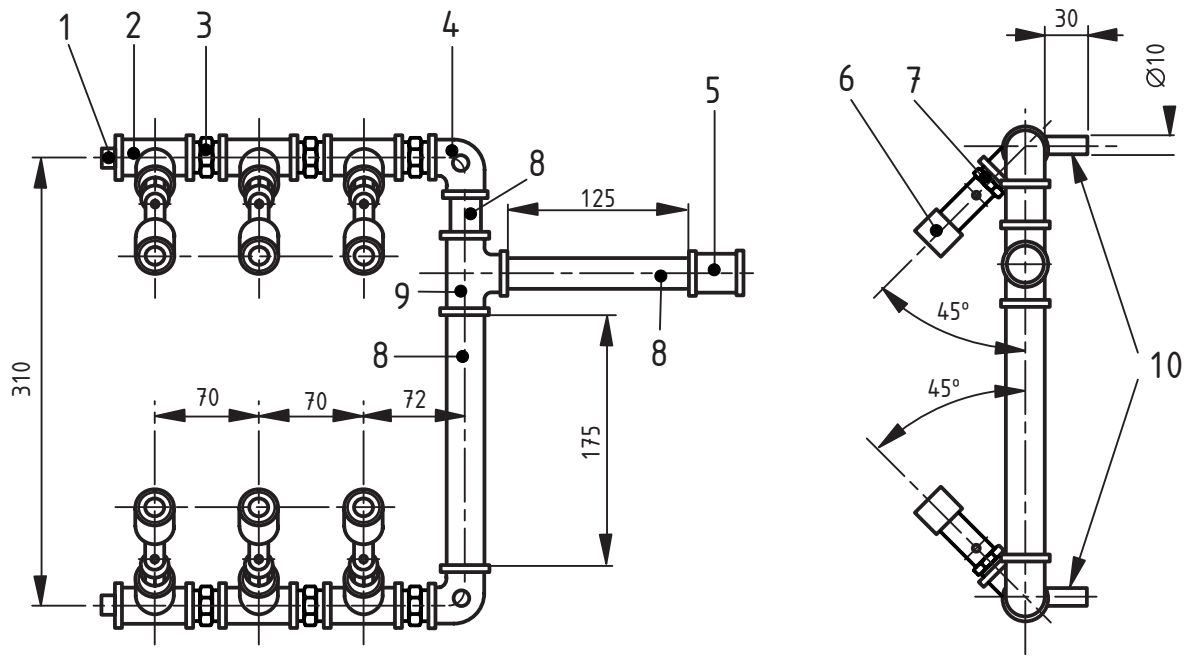
Key
1 Weld as shown (12 times)



Key
1 Washer, diameter 12 mm, cut to hole edge weld as shown (four times)

Figure G.8 — Trestle (belt support frame)

All dimensions are in millimetres



Key

1	Solid plug	6	Gas burner
2	Reducing tee	7	Reducing bush
3	Hexagonal nipple	8	1/2 nominal tube
4	90° elbow	9	Equal tee
5	Socket	10	Four mild steel feet welded to the underside of items 2 and 4

Figure G.9 — Gas burner assembly

All dimensions are in millimetres

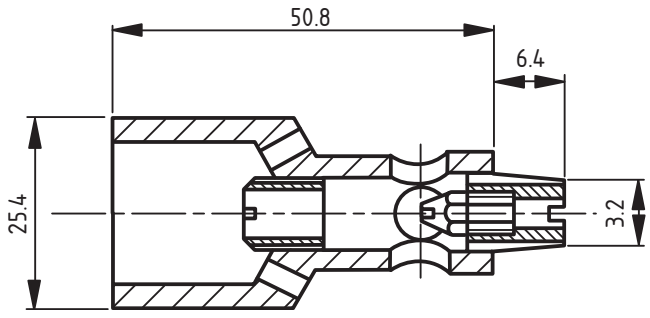


Figure G.10 — Jets for burners

G.3.2 *Preparation of test pieces*

G.3.2.1 For belts with top and bottom covers of equal thickness, cut two test pieces measuring 1 500 mm long by 230 mm wide in a longitudinal direction from the conveyor belt to be tested. For belts with covers of unequal thickness cut three samples. Ensure that the test pieces have clean-cut edges and are not taken from within 50 mm of the edges of the belt. Weigh each test piece after cutting. Allow the test pieces to lie flat for 24 h prior to testing.

G.3.2.2 To enable the test pieces to be secured to the trestle, drill six holes, using an 8 mm diameter drill bit, in the test piece as follows:

a) four holes through the belt 50 mm in from each side of the belt and 50 mm from the front and rear of the test piece; and

b) two holes through the test piece 20 mm in from the sides and 330 mm from the front edge.

G.3.2.3 Lay the test piece on the trestle and secure it to the frame using 25 gauge wire through the six drilled holes. In addition, pass two pieces of the wire over the test piece at positions 100 mm and 250 mm from the front and secure the test piece tightly down to the lugs on the frame.

G.3.3 ***Installation of the test pieces and burner***

G.3.3.1 Place the trestle in the test chamber centrally with the front edge of the test piece 160 mm from the front of the test chamber.

G.3.3.2 Install the burner centrally beneath the trestle such that the front jets are in line with the front edge of the test piece.

G.3.4 ***Temperature at commencement of test***

The ambient temperature at the commencement of the test shall be between 5 °C and 30 °C.

NOTE A substantial amount of heat is absorbed by the gallery during each test and this can affect subsequent tests. It is important, therefore, that the gallery be allowed to cool to ambient temperature between each test. In practice, a period of three hours has proved satisfactory.

G.3.5 ***Number of tests***

G.3.5.1 For belting with top and bottom covers that are of equal thickness, conduct two tests.

G.3.5.2 For belting with top and bottom covers that are of unequal thickness, conduct three tests as follows:

a) test one test piece with the top cover uppermost;

b) test one test piece with the top cover face downwards;

c) test the third test piece in configuration a) or b) that gave the worse result.

G.3.6 ***Procedure***

G.3.6.1 Weigh the propane gas bottle prior to the test.

G.3.6.2 Set the air velocity at (1.0 ± 0.05) m/s using the anemometer positioned as described in **G.3.1.7**.

G.3.6.3 Record the temperature of the exhaust air for between two and five minutes to give a measure of the ambient air temperature.

G.3.6.4 Set the gas flow to approximately 350 l/h and light the burner. Start the timer. Adjust the gas flow to (345 ± 5) l/h.

G.3.6.5 After 50 min turn off the gas to the burner and allow the test piece and trestle to cool (see also **G.3.7**). Terminate the test immediately if the extent of the fire appears to be a danger to persons or equipment.

G.3.6.6 Re-weigh the gas bottle at the end of the test and confirm that the mass of gas consumed during the test is (565 ± 10) g. If it is not, adjust the flow rate accordingly and repeat the test.

G.3.6.7 Remove all belting remaining on the trestle and allow it to cool to ambient temperature. Detach any friable material and weigh the belting.

G.3.7 ***Termination of tests***

G.3.7.1 *Normal termination*

A test shall be terminated and deemed to be terminated normally, when a period of at least 10 min has elapsed after all flaming on the test piece and debris has ceased.

G.3.7.2 *Premature termination*

Any test terminated for safety reasons shall be deemed to be terminated prematurely and shall be recorded on the test report (see **G.3.10**).

G.3.8 *Expression of results*

G.3.8.1 *Assessment of damage*

On each face of the test piece, measure from the rear end of the test piece the length left undamaged. Consider any cracks, blemishes or blisters not originally present as damage. Record the lower of the two measurements as the minimum length undamaged.

G.3.8.2 *Temperature rise*

From the temperature measurements taken during the test calculate the maximum average temperature rise over ambient in any one minute period during the test. Record this value as the maximum average temperature rise.

G.3.8.3 *Determination of length of belting consumed*

Determine the length of belting consumed during the test from measurements of mass before and after testing.

Express the length consumed by mass as follows:

$$L_{\text{mass}} = \frac{m_{\text{before}} - m_{\text{after}}}{m_{\text{before}}} \times 1\ 500$$

where

L_{mass} is the length consumed by mass;

m_{before} is the mass of the sample before the test;

m_{after} is the mass of the sample after the test.

G.3.9 *Exhaust temperature calibration.*

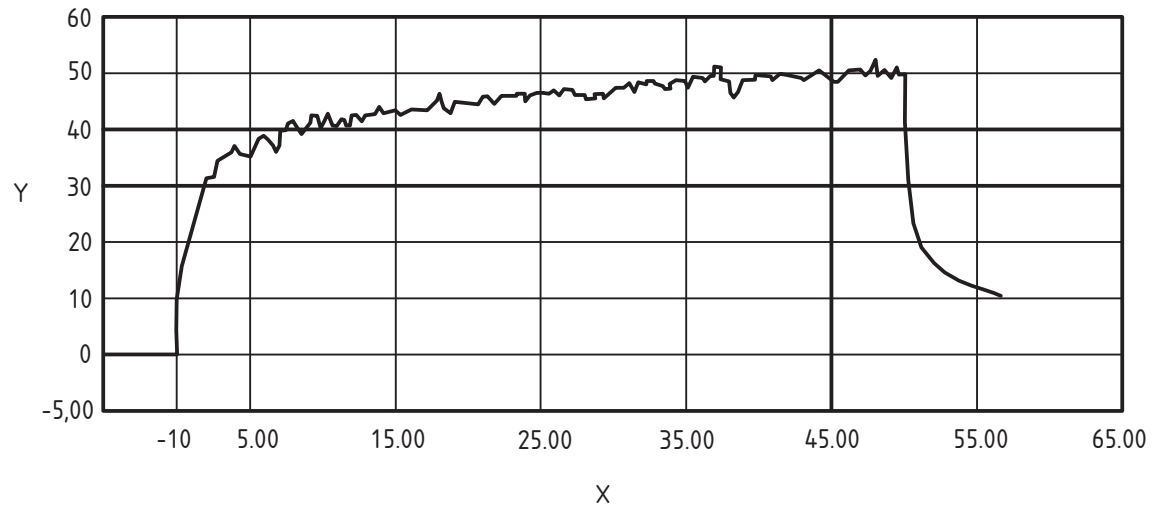
G.3.9.1 Carry out the calibration described in **G.3.9.2** in the following circumstances:

a) before a new gallery is used for the first time;

b) following maintenance work to the gallery; and

c) periodically, to ensure that accidental changes to conditions have not occurred.

G.3.9.2 Operate the test gallery, without the test piece present, at a gas flow rate equivalent to (565 ± 5) g/50 min. The exhaust gas temperature measured in the duct over the final minute of the test shall rise over ambient by (50 ± 5) °C. Plot the exhaust gas temperature against time, for the period of the test, and ensure that the temperature rise above ambient follows the form shown in Figure G.11.



Key

X Time (in minutes)

Y Temperature (in degrees Celsius)

Figure G.11 — Typical exhaust temperature calibration curve

G.3.10 ***Test report***

The test report shall include the following:

a) reference to this standard and method. i.e. BS 3289:2004, mid-scale fire propagation test;

b) date of test;

c) identification of the belt under test;

d) for each test piece, the minimum length measured as being undamaged;

e) length of belting consumed;

f) maximum average temperature rise;

g) mass of gas consumed;

h) any deviations from the procedure, including whether the test was terminated prematurely;

i) the following statement: "The test results relate only to the behaviour of the test pieces of a product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use".

Annex H (normative)
Tensile testing machine

H.1 The tensile testing machine shall comply with the following:

a) The accuracy of the machine shall be in accordance with class B of BS ISO 5893:2002, or grade 2.0 of BS EN ISO 7500-1:1999.

b) The range of the machine shall be chosen so that the forces to be measured are above the lower limit of verification of the scale.

c) For the tensile strength test, the machine shall have either an autographic force recorder or a maximum force indicator.

For the adhesion tests and tear test, the machine shall have an autographic force recorder. The natural frequency, inertia and damping characteristics of the recorder shall be such that it is capable of recording fluctuations of the separating force. The ratio of the movement of the recorder paper to the movement of the machine jaw shall be 1:1.

d) The machine shall be capable of applying force with an even jaw separation rate of (100 ± 10) mm/min or (50 ± 2.5) mm/min, as appropriate. Sufficient force shall be available to induce test piece failure, when required.

e) The jaws of the machine shall hold the test piece without slip and without damage.

f) The jaws of the machine shall move without undue friction and in correct alignment.

blank

Bibliography

BS ISO 5285, *Conveyor belts — Guidelines for storage and handling.*
DD 180, *Guide for the assessment of toxic hazards in fire in buildings and transport.*

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001. Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsi-global.com/bsonline.

Further information about BSI is available on the BSI website at http://www.bsi-global.com.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL