BRITISH STANDARD

BS 8407:2002

Specification for mechanical and spliced joints in conveyor belting for use underground

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PRI/67, Conveyor belts, upon which the following bodies were represented:

British Rubber Manufacturers Association Ltd

Health and Safety Executive

Institute of Materials

Tun Abdul Razak Research Centre

UK Steel Association

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Contents

Foreword

This British Standard has been prepared by PRI/67, Conveyor belting.

For some years the industry has adopted informal specifications which have provided a satisfactory level of operational safety, but with the increased use and value of risk assessments a more formalized approach is necessary.

This document is intended to be used in conjunction with BS 3289 and British Coal Specification 730 until such time as these specifications are replaced by harmonized European Standards.

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

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, an inside back cover and a back cover.

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1 Scope

This British Standard specifies requirements for joints made in conveyor belting for use underground.

It specifies performance requirements for the following properties:

— joints made with mechanical fasteners (static strength);

— joints made with mechanical fasteners (dynamic strength);

— joints made by chemical splicing/vulcanization (static strength);

— joints made by chemical splicing/vulcanization (dynamic strength).

The methods of test to be used to validate the requirements are specified in the annexes. This standard is not applicable or valid for light conveyor belts as specified in BS EN 873.

NOTE Although this standard is intended to specify the requirements for conveyor belting, the test methods specified in **4.1.1** and **4.2.1** can also be used to assess the performance of mechanical fasteners when used with specific types of conveyor belting. For this reason, an alternative test configuration is specified in Annex A.

2 Normative references

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

BS EN ISO 1120*, Conveyor belts — Determination of strength of mechanical fastenings — Static test method*.

BS 3289*, Specification for textile carcass conveyor belting for use in underground mines (including fire performance).*

BS 1610*, Methods for the load verification of testing machines.*

3 Terms and definitions

For the purpose of this standard, the following terms and definitions apply:

3.1
fastener pitch
the nominal distance between a point on a fastener unit and the corresponding point on the next fastener unit (see Figure A.1 and Figure A.2)

3.2
fastened width
the number of fastener units inserted in one end of a test piece multiplied by the pitch (see Figure A.1 and Figure A.2)

3.3
nominal tensile strength
the specified minimum value of the tensile strength of the conveyor belt, expressed in N/mm

3.4
joints
the joining of individual lengths of conveyor belting to produce a longer length

NOTE This should not be confused with transverse (or longitudinal) fabric joints made during the production process for multi-ply belting.

4 Mechanical fastener holding (applicable only to textile belting)

4.1 Static tensile strength

4.1.1 *Test method*

Belts up to and including Type 15 (2 650 N/mm) shall be tested in accordance with BS EN ISO 1120.

4.1.2 *Requirement*

For new belting, the mean value obtained shall be not less than 60 % of the nominal tensile strength for belts of tensile strength up to and including 1 400 N/mm (Type 8), and not less than 50 % of nominal tensile strength for belts above 1 400 N/mm.

4.2 Dynamic life-test

4.2.1 *Test method*

Belts up to and including Type 15 (2 650 N/mm), as defined in BS 3289:1990, shall be tested in accordance with Annex A.

4.2.2 *Requirements*

When tested in accordance with **4.2.1**, belts of nominal tensile strength up to and including 2 650 N/mm (Type 15 as defined in BS 3289:1990) shall conform to Table 1.

NOTE 1 The type of fastener specified in Table 1 is for test purposes only, and to allow a comparison of belt performance. The table is not a list of approved or recommended fasteners.

NOTE 2 Solid mild steel pins should be used, of appropriate diameter, as recommended by the fastener supplier.

In line with good practice, belts of Type 12 and above would normally be vulcanized. Mechanical fasteners, if used, shall conform to the static tensile strength requirement specified in **4.1.2**.

Table 1 — Belt test requirements (mechanical fasteners)

Belt	Pulley diameter mm	Total loop length m	Type of fastener	No. of pieces in loop	No. of test loops	Minimum no. of cycles (mean of each piece in test loop)
4	250	5.2	BC Spec 557 Type A Mato U35	4	2	75 000
5	455	10.5	BC Spec 557 Type A Mato U35	4	2	75 000
6	610	12.0	Titan 1 MME Type C	6	1	100 000
8	610	12.0	Titan 1 MME Type C	6	1	100 000
10	800	13.5	Titan 1 MME Type C Mato U37A	6	1	100 000
12	800	13.5	Titan 1 MME Type C Mato U38A	6	1	100 000
15	1 000	13.5	Mato U38	6	1	100 000
NOTE The pulleys in column 2 are the “break-back” pulleys. Refer to Table A.1 and Table A.2 for full configuration.						

5 Spliced/vulcanized joints (applicable to textile and steel cord conveyor belts)

5.1 Static tensile strength

5.1.1 *Test method*

Belts up to and including those of tensile strength 3 150 N/mm shall be tested in accordance with Annex B.

5.1.2 *Requirements*

When tested in accordance with **4.1.1**, the loop shall not break at less than 60 % of the belt's nominal tensile strength for textile belting, and 70 % for steel cord belting. This shall apply to all belts up to and including 3 150 N/mm.

5.2 Dynamic life-test

5.2.1 *Test method*

Belts up to and including those of tensile strength 3 150 N/mm shall be tested in accordance with Annex C.

5.2.2 *Requirements*

When tested in accordance with **5.2.1**, textile belts up to and including Type 18 shall conform to Table 2. In addition to completing the required minimum number of cycles, the tested loop shall have a remaining tensile strength of not less than 50 % of nominal tensile strength.

Steel cord belts shall complete 1 000 000 cycles and have a residual tensile strength of not less than 60 % of the nominal tensile strength of the belt.

Table 2 — Belt test requirements [vulcanized (spliced) joints]

Belt type	Tensile strength N/mm	Pulley diameter mm	Total loop length m	Initial static tensile %	Residual static tensile %	Minimum no. of cycles (at 12.5 % tension)
4	700	250	4.5	60	50	100 000
5	875	455	4.5	60	50	100 000
6	1 140	610	9.5	60	50	100 000
8	1 400	610	9.5	60	50	250 000
10	1 750	800	14.0	60	50	250 000
12	2 100	800	14.0	60	50	250 000
15	2 650	1 000	15.0	60	50	250 000
18	3 150	1 000	15.0	60	50	250 000
NOTE The pulleys in column 3 are the "break-back" pulleys. Refer to Table A.1 and Table A.2 for full configuration.						

Annex A (normative)
Dynamic life-test for joints made with mechanical fasteners

A.1 General

The method is applicable to joints made with mechanical fasteners in textile belting having a nominal tensile strength of up to 2 650 N/mm (Type 15).

A.2 Testing machine

A.2.1 The dimensions and layout of the testing machine shall be in accordance with Figure A.3 and Table A.1. One pulley shall be connected to a driving motor, through a gearbox, if necessary. The remaining pulleys shall be free to rotate.

A.2.2 Means shall be provided for measuring the tension in the belt through the force exerted by the belt on one of the pulleys.

A.2.3 Means shall be provided for obtaining and maintaining the required tension in the belt, and for accommodating the changes in loop length that occur during the test.

NOTE It is recommended that these functions are performed by traversing only one pulley, as shown in Figure A.3.

A.2.4 Means shall be provided for stopping the testing machine when the test loop breaks.

A.2.5 Means shall be provided for measuring the running time of the testing machine.

A.3 Test tension

The test tension in the conveyor belt throughout the test shall be 10 % ± 0.5 % of the nominal tensile strength of the conveyor belt in N/mm multiplied by the fastened width in metres.

NOTE This corresponds to a normal service tension.

A.4 Preparation of test pieces

A.4.1 The number of cycles to be conducted, and the number of test pieces required for each test, is specified in Table 1. For each test, a further test piece may be required if the available take-up is exceeded during the course of the test. This additional test piece shall have the same width and shall be prepared from the same sample of belting but shall have a length of approximately 1 000 mm.

A.4.2 Test pieces shall be prepared not less than five days after the date of manufacture of the belt.

A.4.3 The width of each test piece shall be the fastened width +50 mm, ±1.5 mm. The fastened width will vary depending upon the pitch of the fastener used, but shall be as near as possible to 250 mm.

NOTE 1 The length of each test piece is obtained from the overall test loop length, and the number of test pieces in the loop.

Each individual belt piece in the loop shall be clearly marked for identification purposes during the test.

NOTE 2 During the preparation of test pieces, good craft practice in belt jointing should be observed and careful attention should be paid to the instructions of the fastener manufacturers. In particular, attention is drawn to the need for the open ends of the belting to be cleanly cut and perpendicular to the edge of the belting, before the insertion of fasteners.

A.5 Preparation of test loop

A.5.1 The test pieces shall be joined by means of a fastener specified in Table 1 to form a test loop.

A.5.2 Insert the number of fasteners (n) required to give the fastened width into one end of the test piece. At the opposite end of the test piece insert $n + 1$ fasteners as shown in Figure A.1. This produces a symmetrical joint which aids tensioning and tracking, and also gives a degree of control over the position where failure is likely to occur.

NOTE When this test method is being used to test fasteners other than those specified in Table 1, the configuration shown in Figure A.1 may not be practicable, in which case the configuration shown in Figure A.2 should be used. When this asymmetric configuration is used, the joint fastener arrangement shall be reversed at each successive joint to aid tracking and uniformity of tensioning.

A.6 Test method

A.6.1 Assemble the test loop into the testing machine using connecting pins as specified in the configuration as shown in Figure A.3.

A.6.2 Apply a tension approximately equal to half the test tension to the belt and start the testing machine. Gradually increase test tension in the belt until the full test tension is attained. Measure the time for 20 cycles of the testing machine and calculate the time for one cycle.

A.6.3 Continue the test without unnecessary interruption until one joint breaks.

Record the time elapsed from the time the test machine was started at **A.6.2**. Calculate the number of circuits of the testing machine completed by the broken joint and record this value as the joint life of the broken joint (see **A.7**). Record also details of the manner of failure of the joint.

A.6.4 Remove the two halves of the broken joint by cutting a length of 60 mm from the ends of the test pieces adjacent to the broken joints. Insert a replacement joint in the manner specified in **A.5.2**.

A.6.5 Re-start the testing machine and measure the new cycle time as above. Continue the test until the next joint breakage occurs. Record the additional elapsed time and the additional number of circuits of the testing machine. Calculate the total number of circuits of the testing machine endured by the joint at break and record the value as the life of that joint, also record details of the manner of failure of that joint.

A.6.6 Continue the test until each original joint has broken. If a second breakage occurs at any joint, re-join the test pieces and maintain the joint but keep no record of its life. Record details of the total number of circuits for each joint, also the manner of failure.

A.6.7 If necessary (i.e. to maintain the test loop at the correct length), insert the additional test piece at the junction between the two test pieces for which the joint life has already been recorded. No joint life shall be recorded for any joint connected to the additional test piece.

A.7 Calculation and expression of results

Calculate the mean joint life as the arithmetic mean of the observed values, using the following equation to calculate the individual joint life values.

$$JL = \frac{T \times 3\,600}{S}$$

where

JL = individual joint life in cycles;
T = elapsed time in hours for joint to fail (see **A.6.3**);
S = cycle time in seconds (see **A.6.2**).

A.8 Test report

The test report shall include the following:

a) belt type;

b) mean joint life;

c) type of joint pin (if known);

d) fastened width.

e) number and type of fastener units inserted in each end of the test pieces;

f) details of failure of the joints.

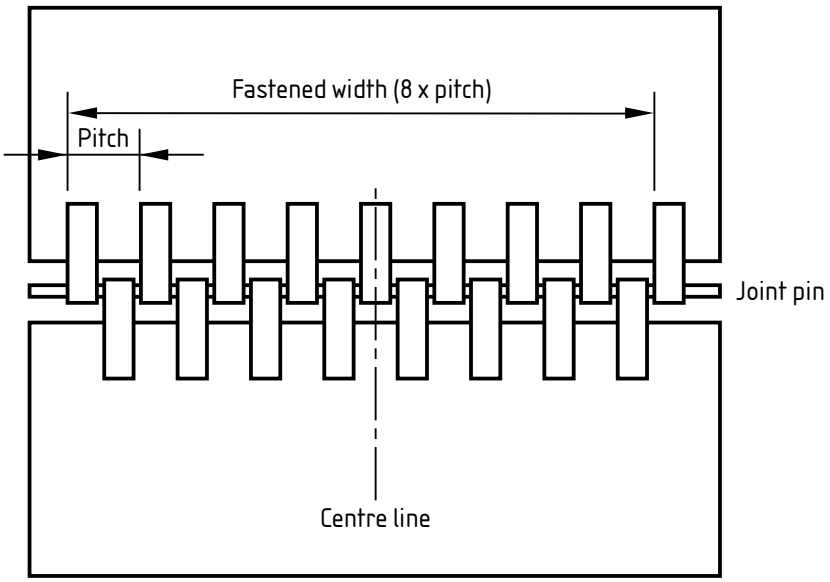


Figure A.1 — Symmetric geometry

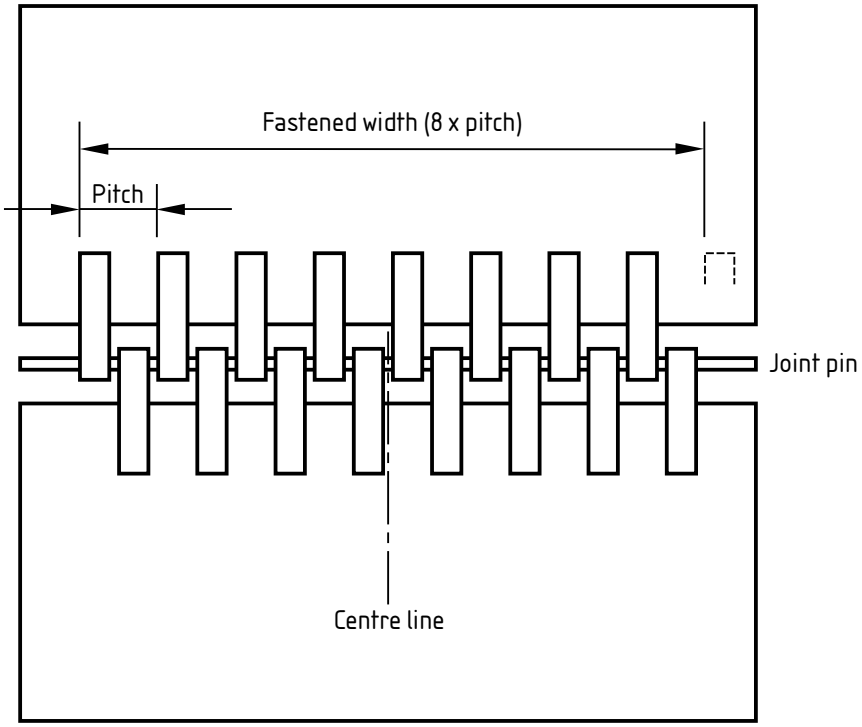
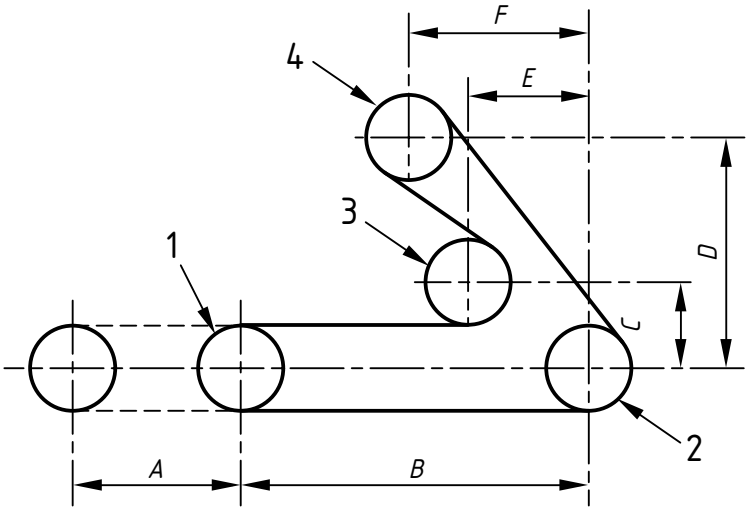


Figure A.2 — Asymmetric geometry



Key
1 Roller 1 = tensioning pulley.
2 Roller 2 = driven pulley.
3 Only the "break-back" rollers are changed when smaller pulleys are specified.
4 Roller 4 = "break-back" roller.

NOTE See Table A.1 and Table A.2 for dimensions.

Figure A.3 — Configuration of dynamic testing machine

Table A.1 — Dimensions of pulley diameters and pulley centres for testing machine (see Figure A.3) relative to nominal belt strengths

Belt type	Belt N/mm	Pulley diameters mm ±10				A	B	C	D	E	F
		1	2	3	4						
4	700	250	250	250	250	300	990	260	670	450	740
5	875	610	610	455	455	810	1 940	545	1 020	550	840
6	1 140	610	610	610	610	810	1 940	620	1 250	550	840
8	1 400					max.	min.				
10	1 750	1 000	1 000	800	800	810	3 050	910	1 750	990	1 480
12	2 100					max.	min.				
15	2 625	1 000	1 000	1 000	1 000	810	3 050	1 010	2 050	990	1 480
18	3 150					max.	min.				

Table A.2 — Nominal loop lengths and speeds for pulley configurations

Belt type	Belt N/mm	Pulley diameters mm ±10				Nominal loop length m	Belt speed m/sec
		1	2	3	4		
4	700	250	250	250	250	5.20	1.27
5	875	610	610	455	455	10.50	1.80
6 8	1 140 1 400	610	610	610	610	12.00	1.80
10 12	1 750 2 100	1 000	1 000	800	800	13.50	3.00
15 18	2 625 3 150	1 000	1 000	1 000	1 000	14.50	3.00

Annex B (normative)
Static tensile test for spliced (vulcanized) joints

B.1 General

This method is applicable to spliced joints made in either textile or steel cord belting having a nominal tensile strength of up to 3 150 N/mm.

B.2 Testing machine

The machine shall have a capacity of not less than 2 MN and be capable of jaw separation at 30 mm/min. It shall be fitted with cylindrical drum attachments, free to rotate about their vertical axis.

The machine shall be accurate to not less than Grade 2.0 of BS 1610.

B.3 Preparation of test pieces

One loop shall be prepared, containing two spliced joints. The loop shall be 300 mm wide and have a length of 5 m + the length of each joint.

Alternatively, with the agreement of the customer, static strength may be demonstrated on an alternative machine using two strips of belting each containing one joint and each being not less than 150 mm wide (i.e. the length depending on the jaws/grips of the testing machine).

B.4 Method

The loop shall be positioned over the two cylindrical drums such that the joints are positioned centrally between the drums.

Sufficient tension shall be given to the loop to enable it to remain positioned on the centre line of the drum.

After starting the test machine, load shall be applied until the belt breaks, and the breaking load recorded. Static breaking strength of the joint = 0.5 × loop breaking strength, expressed in N/mm.

B.5 Test report

The test report shall include the following particulars:

a) belt type;

b) breaking load of joint;

c) breaking load of joint expressed as a percentage of nominal tensile strength of belt;

d) method of failure.

Annex C (normative)
Dynamic life-test for spliced (vulcanized) joints

C.1 General

The method is applicable to spliced joints made of either textile or steel cord belting having a nominal tensile strength of up to 3 150 N/mm.

C.2 Test tension

The test tension in the conveyor belt throughout the test shall be 12.5 % ± 0.5 % of the nominal tensile strength of the conveyor belt in N/mm.

C.3 Testing machine

The dimensions and layout of the testing machine shall be in accordance with Figure A.3 and Table 2 or otherwise in accordance with **4.2**. The arrangement shall be such that an endless loop can be fitted in the configuration shown.

C.4 Number of tests

Conduct one test at the tension specified in **C.2**.

C.5 Preparation of test pieces

Prepare the test loop, to the length specified in Table A.2, not less than five days after the date of manufacture of the belt. This loop shall be 300 mm wide and contain two equally spaced vulcanized joints from the sample of belting under test.

C.6 Method

C.6.1 *Dynamic assessment*

Fit the test loop on the testing machine in the configuration shown in Figure A.3. Apply tension to the belt equal to half the test tension and start the testing machine. Gradually increase the tension in the belt until the full test tension is obtained.

Measure the time for 20 cycles of the testing machine and calculate the time for one cycle.

Continue the test without unnecessary interruption until one joint breaks or until the specified number of cycles has been attained.

C.6.2 *Residual tensile strength*

Loops which successfully complete the specified number of cycles shall be tested for residual tensile strength in accordance with Annex B.

C.7 Test report

The test report shall include the following:

a) belt type;

b) the joint life to failure, expressed in cycles, together with a description of the type of failure; or

c) verification of the attainment of the required number of cycles as applicable, together with the residual tensile strength of the test loop (expressed as a percentage of the nominal tensile strength of the belt).

Bibliography

Standards publications

BS 3289, *Specification for textile carcass conveyor belting for use in underground mines (including fire performance).*

BS EN 873, *Light conveyor belts. Principal characteristics and applications.*

Other publications

BC 730 British Coal Specification

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