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Textile fire resistant conveyor belting for coalmine

煤矿用织物芯阻燃输送带

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Textile fire resistant conveyor belting for coalmine

1 Scope

This standard specifies the terms and definitions, product classification, models and specifications, technical requirements, test methods and inspection rules, marking, packaging, storage, transportation of textile fire resistant conveyor belting for coalmine (hereinafter referred to as fire retardant belts).

This standard applies to textile fire resistant conveyor belting for coalmine.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB/T 338 Industrial methanol

GB/T 394.1 Ethanol for industrial use

GB/T 528-2009 Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties

GB/T 3512 Rubber, vulcanized or thermoplastic - Accelerated ageing and heat resistance tests - Air-oven method

GB/T 3690 Textile conveyor belts - Full thickness tensile strength, elongation at break and elongation at the reference load - Test method

GB/T 5752 Conveyor belts - Marking

GB/T 6759-2013 Conveyor belts - Adhesion between constitutive elements - Test methods

GB/T 7983 Conveyor belts - Transverse flexibility (troughability) - Test method

GB/T 7984 Conveyor belts of textile construction for general use

GB/T 9867 Rubber, vulcanized or thermoplastic - Determination of abrasion resistance using a rotating cylindrical drum device

- a) The undamaged length of each specimen shall not be less than 600 mm;
- b) The undamaged length shall not be less than 50 mm; the maximum average temperature rise shall not be greater than 140 °C and the loss length shall not be greater than 1250 mm.

When the test is terminated prematurely due to danger to people and equipment during the combustion process, the laneway combustion test of the solid belt is deemed to be unqualified.

5.14 Joint strength

5.14.1 Classification

The joint strength of fire retardant belts is divided into mechanical joint strength and adhesive joint strength, according to the joint method. The solid belt and laminated belt can be selected for assessment. Aramid belts are assessed by adhesive joints.

5.14.2 Mechanical joint strength

5.14.2.1 Mechanical joint strength of solid belt

- a) For solid belts of models below 1000S (inclusive), the strength of the mechanical joint shall not be less than 70% of the rated tensile strength of the belt;
- b) For solid belts of models from 1250S (inclusive) to 1600S (inclusive), the strength of the mechanical joint shall not be less than 65% of the rated tensile strength of the belt;
- c) For solid belts of models from 1800S (inclusive) to 2000S (inclusive), the strength of the mechanical joint shall not be less than 60% of the rated tensile strength of the belt;
- d) For solid belts of models above 2000S, the strength of the mechanical joint shall not be less than 55% of the rated tensile strength of the belt.

5.14.2.2 Mechanical joint strength of laminated belt

The strength of the mechanical joint of laminated belt shall not be less than 60% of the rated strength of the belt.

5.14.3 Strength of adhesive joints

The strength of adhesive joints of solid belts shall not be less than 90% of the rated tensile strength of the belt. The strength of adhesive joints of laminated belts shall not be less than 85% of the rated tensile strength of the belt. The strength of adhesive joints of aramid belts shall not be less than 80% of the rated tensile strength of the belt.

5.15 Dynamic durability of joints

5.15.1 The dynamic durability of joints of solid belts and laminated belts is divided into: conventional test and enhanced test of joint dynamic durability strength, either one of the two can be selected for testing.

5.15.2 For the conventional test of joint dynamic durability strength, it shall select one type of joint for assessment and it shall comply with the following provisions:

- a) The average service life of mechanical joints shall not be less than 100000 turnovers;
- b) The average service life of adhesive joints shall not be less than 250000 turnovers.

5.15.3 The service life of joint dynamic durability strength enhanced test shall not be less than 10000 tension pulsation cycles.

5.16 Fabric joints

5.16.1 Fabric joints of solid belt and aramid belt

The core of solid belt and aramid belt shall not have transverse and longitudinal joints. Solid belt supplied in rolls shall not have spliced joints.

5.16.2 Fabric joints of laminated belt

Fabric joints of laminated belt shall comply with the provisions of GB/T 7984.

6 Test methods

6.1 Sample collection method

Take samples 24 hours after the fire retardant belt is made.

6.2 Appearance quality inspection

Visual inspection.

6.3 Width test

Use a steel ruler or belt measure with a minimum division value of 1 mm for measurement; measure the dimensions of 3 positions at both ends and the middle of the belt, take the median value as the measurement result.

6.4 Cover thickness test

It is performed in accordance with the provisions of GB/T 32331.

6.5 Straightness test

It is performed in accordance with the provisions of GB/T 7984.

6.6 Tensile strength and tensile elongation test

It is performed according to the provisions of Appendix A.

6.7 Rated force elongation test

It is performed according to the provisions of GB/T 3690.

6.8 Troughability test

It is performed according to the provisions of GB/T 7983.

6.9 Tear force test

The tear force determination method of the solid belt shall be carried out in accordance with the provisions of Appendix B.

6.10 Adhesion strength test

The adhesion strength determination of the solid belt shall be carried out in accordance with the provisions of Appendix C. The adhesion strength test of the laminated belt and aramid belt shall be carried out in accordance with the provisions of Method A of GB/T 6759-2013.

6.11 Physical and mechanical properties test of the covering layer**6.11.1 Tensile strength and tensile elongation test of the covering layer**

It is performed according to the provisions of GB/T 528-2009. The specimen size of the rubber covering layer of the solid belt is cut by a dumbbell-shaped cutter of type 4 [the width of the narrow parallel part is (2.0 ± 0.1) mm]. The laminated belt and aramid belt cover layer specimens are cut by dumbbell-shaped cutter type 2 [narrow parallel part width is (4.0 ± 0.1) mm].

6.11.2 Cover layer aging performance test

It is performed according to GB/T 3512.

6.11.3 Wear resistance test

It is performed according to GB/T 9867.

6.12 Surface resistance test

It is performed according to Appendix D.

6.13 Roller friction test

It is performed according to Appendix E.

6.14 Blowtorch combustion test

It is performed according to Appendix F.

6.15 Laneway propane combustion test

It is performed according to Appendix G.

6.16 Joint strength test

The mechanical joint strength of fire retardant belt shall be carried out in accordance with the provisions of GB/T 12736. The mechanical joint test shall use mechanical buckles that meet the MT/T 319 standard or buckles with higher performance. The buckles shall be bound neatly and there shall be no obvious deformation during the test. Otherwise, a more suitable mechanical buckle shall be selected; the strength of fire retardant belt's adhesive joints shall be carried out in accordance with the provisions of MT/T 318.

6.17 Joint dynamic durability test

6.17.1 Conventional dynamic durability test

The conventional dynamic durability of mechanical joints shall be carried out in accordance with the provisions of 5.3.1.3 of MT/T 318.1-1997. The conventional dynamic durability test of adhesive joints shall be carried out in accordance with the provisions of MT/T 318.

6.17.2 Strengthened dynamic durability test

It shall be carried out in accordance with the provisions of 5.3.2 of MT/T 318.1-1997.

7 Inspection rules

7.1 Inspection report

The inspection report shall include the following contents:

- a) Name of the manufacturer of the fire retardant belt;
- b) Model, specification, production date of the fire retardant belt;
- c) Inspection date;
- d) Laboratory temperature and relative humidity;

A.1.2 The punched specimen cover shall be intact; the punched surface shall be neat and smooth. When the cover is very thick, the cover at the clamping position may be peeled off to prevent the specimen from sliding in the fixture during the test.

A.1.3 When punching the specimen, punch at least 50 mm away from the edge of the belt.

A.1.4 When punching the specimen, the axis of the longitudinal specimen shall be parallel to the longitudinal axis of the fire retardant belt; the axis of the transverse specimen shall be perpendicular to the longitudinal axis of the fire retardant belt.

A.1.5 On both sides of the center of the specimen, draw two symmetrical markings perpendicular to the longitudinal axis, with an initial marking length L_0 of 100 mm, as shown in Figure A.1.

A.1.6 After the specimen is punched off the sample, it shall be placed in an environment at a temperature of $(23 \pm 2) ^\circ\text{C}$ and a relative humidity of 45%RH ~ 75%RH for 16 hours before starting the test.

A.1.7 Number of specimens: 3 longitudinal specimens, 3 transverse specimens, a total of 6 specimens.

A.2 Instruments and equipment

A.2.1 Tensile testing machine: The accuracy of the tensile testing machine shall be no less than 1%; its measurement range shall meet the requirements of the limit value of the tested specimen.

A.2.2 The clamp of the tensile testing machine: The working speed is (100 ± 10) mm/min. During the stretching process, the specimen is well clamped, without slipping or breaking.

A.3 Measurement steps

A.3.1 The room temperature during the test shall be $(23 \pm 2) ^\circ\text{C}$; the relative humidity shall be 45%RH ~ 75%RH.

A.3.2 Clamp the two ends of the specimen on the two clamps of the test tensile machine; the longitudinal center line of the specimen shall be consistent with the direction of the force line.

A.3.3 The clamp continuously stretches the specimen at a constant speed of (100 ± 10) mm/min until the specimen breaks. During this process, the tensile value shall be automatically recorded.

A.3.4 The maximum tensile value of the specimen before breaking is the measured breaking force F_1 .

Appendix C

(Normative)

Method for determining the bonding strength of solid belt

C.1 Preparation of specimens

C.1.1 The specimen is a rectangular strip with a width of (25 ± 1) mm and a length of 300 mm; its edges shall be cut neatly.

C.1.2 There are 8 specimens in total, 4 of which are cut longitudinally (2 between the cover layer and the belt core, 2 inside the belt core), 4 of which are cut transversely (2 between the cover layer and the belt core, 2 inside the belt core).

C.2 Instruments and equipment

C.2.1 Tensile testing machine: It has an accuracy of 1% and automatic recording function.

C.2.2 Clamp: It shall be able to ensure that the specimen is well fixed and does not slip during the test.

C.3 Determination steps of the bonding strength between the cover layer and the core

C.3.1 The cut specimen shall be placed in an environment, at a temperature of (23 ± 2) °C and a relative humidity of 45%RH ~ 75%RH for at least 24 hours; the test shall also be carried out in this environment.

C.3.2 During the test, first peel off a cover layer and the core of the belt about 75 mm from one end of the specimen; clamp the two separated parts in the two clamps of the tensile testing machine respectively; move the clamps at a speed of (100 ± 10) mm/min to peel off the two separated parts of the specimen for another 100 mm. The recorder automatically draws the peeling force recording curve. During the test, the unpeeled part of the specimen shall not be fixed.

C.3.3 Test the other cover layer at the other end of the same specimen according to the above procedure.

C.4 Determination steps of internal bonding strength of the belt core

C.4.1 The cut specimen shall be placed in an environment, at a temperature of (23 ± 2) °C and a relative humidity of 45%RH ~ 75%RH for at least 24 hours; the test shall also be carried out in this environment.

C.4.2 During the test, firstly, cut about 75 mm from the middle of the belt from one end

of the specimen; clamp the two separated parts in the two clamps of the tensile testing machine respectively. Move the clamps at a speed of (100 ± 10) mm/min to peel off the two separated parts of the specimen for another 100 mm. The recorder automatically draws the peeling force recording curve. During the test, the unpeeled part of the specimen is not fixed.

C.5 Curve processing

C.5.1 Use the peeling curve to determine its average peeling force, as follows (Figure C.1)

- a) Mark 9 straight lines perpendicular to the time axis on the recording paper, which divide the projection of the complete curve on the axis (the AB line segment in the Figure) into 10 equal parts. Mark the 9 peaks closest to these 9 straight lines. According to the height of the peak point, find the median of the 9 peaks, as the average peeling force;
- b) When the curve near one of the above 9 straight lines is relatively flat, so that the distance from the straight line to the nearest peak point is also greater than $1/2$ of the distance between adjacent straight lines, take the adhesion force corresponding to the intersection of the straight line and the curve, as the force value used to find the median.

C.5.2 Find the highest peak and the lowest peak of the complete curve.

C.6 Data processing

The adhesion strength is the ratio -- of the peeling force to the width of the specimen, in Newtons per millimeter.

C.7 Result expression

The following test results shall be recorded and calculated separately:

- a) Average peeling force and minimum peeling force between the upper and lower cover layers and the belt core of each specimen;
- b) Average bonding strength and minimum bonding strength between the upper and lower cover layers and the belt core of each specimen;
- c) The minimum of the arithmetic mean of the average bonding strength and the minimum bonding strength between the upper and lower cover layers and the belt core of the above two groups of specimens;
- d) Average peeling force and minimum peeling force inside the belt core of each specimen;
- e) Average bonding strength and minimum bonding strength inside the belt core of

Appendix D

(Normative)

Surface resistance determination method

D.1 Preparation of specimens

D.1.1 The specimen shall be cut from a complete fire retardant belt, which has a length and width of not less than 300 mm and a thickness equal to the full thickness of the fire retardant belt. The number of specimens is 3.

D.1.2 The specimens shall be free of defects such as cracks, bubbles, and mechanical impurities.

D.1.3 After wiping the specimen with a clean silk cloth or gauze dipped in distilled water, wipe the specimen with a clean dry cloth and place it in a dry place for more than 24 hours.

D.1.4 Before the test, place the specimen in an environment at a temperature of $(23 \pm 2) ^\circ\text{C}$ and a relative humidity of $(65 \pm 5\%) \text{RH}$ for at least 2 hours.

D.1.5 Electrode placement

For fire retardant belts with smooth surfaces, apply conductive glue (liquid) to the test base of the electrode. The conductive liquid should not be too thick or have obvious flow.

For patterned surface belt or fire retardant belt with uneven surface, the following steps can be followed:

- a) Use flexible metal foil electrode (tin foil or aluminum foil); it is recommended to use a thickness of about $56 \mu\text{m}$, a surface area of about 25 m^2 per kilogram or a thickness of about $76 \mu\text{m}$, a surface area of about 18 m^2 per kilogram;
- b) Apply conductive liquid to the test area of the specimen (the top view of the glue-coated area is shown in Figure D.1); then place the flexible electrode on it. The plane of the annular area formed by the prepared electrode after use shall be the same size as the electrode base surface. When applying the conductive liquid, the size of the coated area shall be consistent with the size of the lower surface of the flexible electrode;
- c) Press the flexible electrode placed on the contact liquid area on the specimen with your fingers or a soft cloth. If the surface of the specimen is uneven, the flexible electrode will be pressed tightly against the concave area. The conductive liquid applied to the area outside the area where the foil electrode is to be placed can be wiped off with a soft cloth;

only the non-patterned surface is tested twice in static and flowing air respectively.

E.3.4 Test in still air (with the micro-blower turned off): The specimen shall be placed around a steel drum in a 180° arc, with one end rigidly fixed and the other end connected to a tensioning device (Figure E.2). The initial tension is 343 N; the drum rotates at a speed of (200 ± 5) r/min in the direction away from the fixed end of the specimen.

E.3.5 Test tension and time:

- a) When the solid belt is subjected to the roller friction test, the tension during the test is always 343 N. If the specimen breaks within 60 minutes during the test, the test is stopped. If it does not break, the test is continued until 60 minutes.
- b) When the laminated belt is subjected to the roller friction test, the test tension is 343 N. If the specimen does not break within 60 minutes, the counterweight shall be increased from 343 N to 686 N. Thereafter, the counterweight shall be increased by 343 N every 30 minutes, until the counterweight is increased to 1715 N. The test is continued until the laminated belt breaks.
- c) When the aramid belt is subjected to the roller friction test, the tension during the test is always 343 N. The test is stopped after 60 minutes.

E.3.6 Test in flowing air (with micro-blower turned on): Repeat the test according to the test procedure of E.3.4 in the air flow described in E.2.3.

E.3.7 Observe whether there is burning phenomenon: During the test, the specimen shall be observed at any time to see whether there is flaming or flameless burning. When the test reaches the specified termination condition, the drum shall be stopped immediately; the specimen shall be removed in time, to continue to observe whether there is flaming or flameless burning.

E.4 Result expression

The test results shall be recorded and calculated:

- a) Whether there is burning phenomenon in each test;
- b) The highest temperature of the drum surface in each test;
- c) The time from the start of the test to the specimen exceeding 325 °C or the breaking time when it does not reach 325 °C.

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