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**Steel cord conveyor belts —**

Part 1:

**Design, dimensions and mechanical  
requirements for conveyor belts for  
general use**

*Courroies transporteuses à câbles d'acier —*

*Partie 1: Exigences de conception, de dimensions et mécaniques des  
courroies transporteuses à usage général*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15236-1 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 188 *Conveyor belts*, in collaboration with Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts)*, Subcommittee SC 3, *Conveyor belts*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 15236 consists of the following parts, under the general title *Steel cord conveyor belts*:

- *Part 1: Design, dimensions and mechanical requirements for conveyor belts for general use*
- *Part 2: Preferred belt types*
- *Part 3: Special safety requirements for belts for use in underground installations*
- *Part 4: Vulcanized belt joints*

# Steel cord conveyor belts —

## Part 1: Design, dimensions and mechanical requirements for conveyor belts for general use

### 1 Scope

This part of ISO 15236 specifies the performance and constructional requirements applicable to conveyor belts having steel cords in the longitudinal direction as reinforcement. The requirements for construction given in Clause 6 apply to the design of single belts as well as the design of complete type series such as those covered in ISO 15236-2.

### 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.

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 284, *Conveyor belts — Electrical conductivity — Specification and test method*

ISO 340, *Conveyor belts — Laboratory scale flammability characteristics — Requirements and test method*

ISO 703, *Conveyor belts — Transverse flexibility (troughability) — Test method<sup>1)</sup>*

ISO 4649:2002, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*

ISO 7590:2001, *Steel cord conveyor belts — Methods for the determination of total thickness and cover thickness*

ISO 7622-2, *Steel cord conveyor belts — Longitudinal traction test — Part 2: Measurement of tensile strength*

ISO 7623, *Steel cord conveyor belts — Cord-to-coating bond test — Initial test and after thermal treatment*

ISO 8094, *Steel cord conveyor belts — Adhesion strength test of the cover to the core layer*

ISO 10247, *Conveyor belts — Characteristics of covers — Classification*

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1) To be published. (Revision of ISO 703:1988 and ISO 703-1:1999)

ISO 15236-2:2004, *Steel cord conveyor belts — Part 2: Preferred belt types*

EN 12882, *Conveyor belts for general purpose use — Electrical and flammability safety requirements*

EN 13827, *Steel cord conveyor belts — Determination of the lateral and vertical displacement of steel cords*

### 3 Terms and definitions

For the purposes of this part of ISO 15236, the following terms and definitions apply.

#### 3.1

##### **edge width**

$b_k$

thickness of rubber between the outer cord and the belt edge

See Figure 1.

#### 3.2

##### **breaker**

transverse reinforcement in the conveyor belt, normally of a textile material, attached both above and below or either above or below the layer of longitudinal cords at a distance of at least 1 mm and considered to be part of the cover

See Figure 2.

NOTE Adapted from ISO 7590:2001, 2.1.

#### 3.3

##### **weft**

transverse reinforcement in the conveyor belt, normally of steel wires, attached both above and below, or either above or below, the layer of longitudinal cords at a distance of less than 1 mm and considered to be part of the belt core

See Figure 3.

NOTE Adapted from ISO 7590:2001, 2.2.

## 4 Symbols and units

For the purposes of this part of ISO 15236, the symbols and units given in Table 1 apply.

Table 1 — Symbols and units

Symbol	Explanation	Unit
$B$	Belt width	mm
$F_a$	Pull-out force of cord per cord length	N/mm
$F_{bs}$	Breaking strength of cord taken from cured belt	kN
$F_v$	Pull-out force of cord per cord length — after thermal treatment	N/mm
$K_N$	Minimum (nominal) breaking strength per width of belt	N/mm
$b_k$	Calculated edge width	mm
$b_t$	Supporting belt width	mm
$d$	Cord diameter	mm
$F$	Deflection (troughability)	mm
$h_m$	Median cord height according to EN 13827	mm
$n$	Number of cords	—
$s_1$	Belt thickness	mm
$s_2$	Cover thickness carrying side	mm
$s_3$	Cover thickness pulley side	mm
$s_4$	Thickness of layer between breaker and layer of longitudinal cords	mm
$s_5$	Thickness of layer between weft and layer of longitudinal cords	mm
$s_6$	Thickness of belt core	mm
$t$	Cord pitch	mm
$\Delta h_1$	Number of cords positioned within a range of $h_m \leq 1$ mm as a percentage of the total number of cords	%
$\Delta h_2$	Number of cords positioned within a range of $h_m$ of from $> 1,0$ mm to $1,5$ mm and expressed as a percentage of the total number of cords	%
$\Delta h_3$	Percentage of cords with $h_m > 1,5$ mm	%

## 5 Belt design

### 5.1 Standard type

Conveyor belts conforming to this part of ISO 15236 contain steel cords surrounded by a layer of core rubber. This belt core is protected on top and bottom by cover layers (see Figure 1).

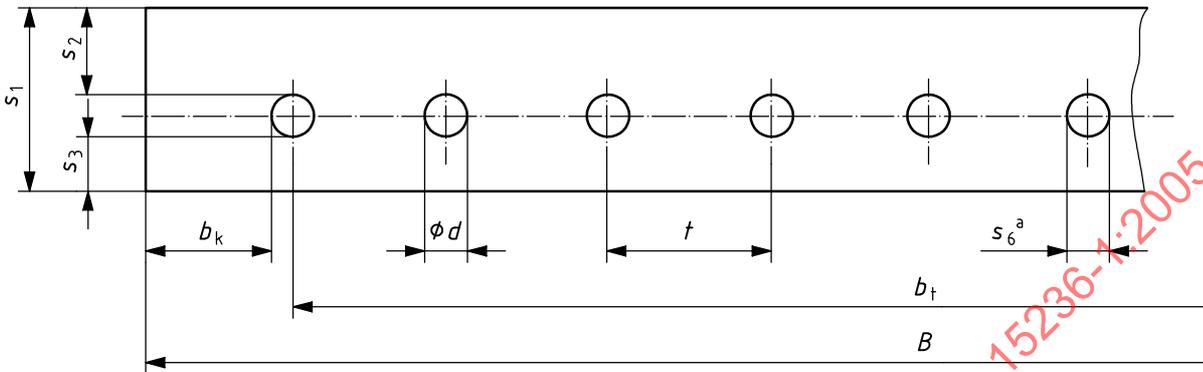
### 5.2 Conveyor belting having transverse reinforcements

Requirements for steel cord conveyor belts having breakers are illustrated in Figure 2 and requirements relating to weft are illustrated in Figure 3.

5.3 Belt core

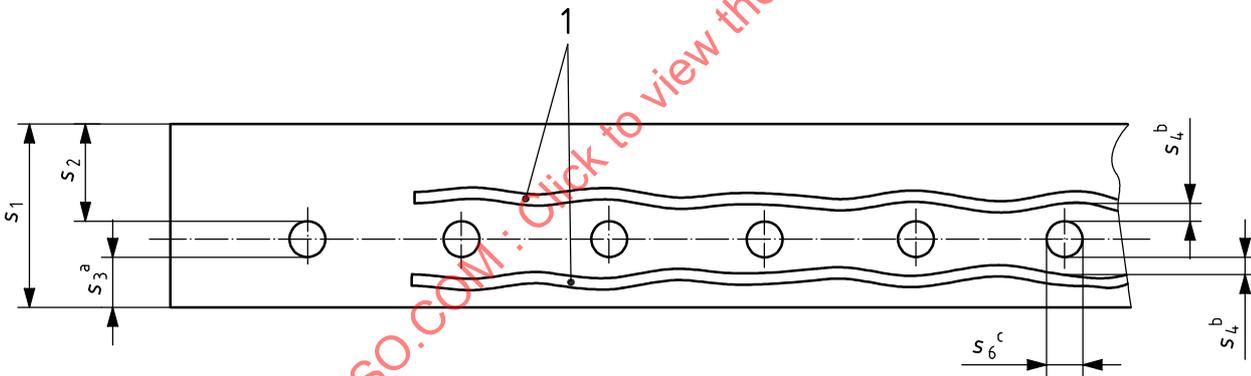
The thickness of the belt core (carcass),  $s_6$ , for all belt types is defined as follows:

$$s_6 = s_1 - s_2 - s_3$$



a  $s_6 = d$

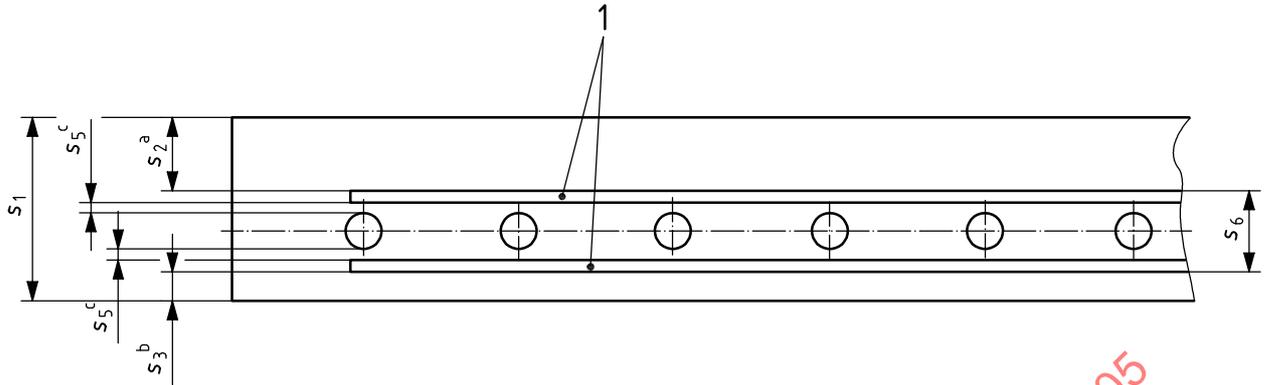
Figure 1 — Cross section of standard belt



Key

- 1 breaker
- a Including the breaker.
- b  $\geq 1$  mm.
- c  $s_6 = d$  (see Table 1).

Figure 2 — Belt cross section with breaker



**Key**

- 1 weft
- a Above the weft.
- b Below the weft.
- c < 1 mm.

**Figure 3 — Belt cross section with weft**

**6 Design and construction**

**6.1 Belt strengths**

Steel cord belts shall be manufactured in strengths of between 500 N/mm and 8 000 N/mm belt width.

The selection of preferred belt types shown in Table 2 should be used. Three groups are indicated, for low-, medium- and high-strength belts.

**Table 2 — Belt types**

<b>Low</b>	ST 500	ST 630	ST 800	ST 1000	ST 1250	ST 1600
<b>Medium</b>	ST 2000	ST 2250	ST 2500	ST 2800	ST 3150	
<b>High</b>	ST 3500	ST 4000	ST 4500	ST 5000	ST 5400	

**6.2 Belt widths**

The belt widths and tolerances according to Table 3 shall apply only to belts when manufactured and not to belts when tensioned on-site.

**Table 3 — Belt widths, *B***

Dimensions in millimetres

<i>B</i>														
500	650	800	1 000	1 200	1 400	1 600	1 800	2 000	2 200	2 400	2 600	2 800	3 000	3 200
+10 -5	+10 -7	+10 -8	± 10	± 10	± 12	± 12	± 14	± 14	± 15	± 15	± 15	± 15	± 15	± 15

### 6.3 Belt edge and supporting belt width

#### 6.3.1 Edge width

The edge width shall not be less than 15 mm and not more than 40 mm. Within these limits the calculated edge width,  $b_k$ , is approximated from the following formula:

$$b_k \approx 5 \times s_6$$

#### 6.3.2 Supporting belt width

The supporting belt width,  $b_t$ , is derived as follows:

$$b_t = B - 2b_k - d$$

(see also 7.2.2).

### 6.4 Number of cords

Based on the minimum breaking strength of the cord,  $F_{bs}$  (see 7.1), in kilonewtons (kN), the minimum breaking strength of the belt,  $K_N$ , in newtons per millimetre (N/mm) of belt width, and on the width of the belt,  $B$ , in millimetres (mm), the minimum number of cords,  $n_{min}$ , is given by the following equation:

$$n_{min} = \frac{K_N \times B}{F_{bs} \times 1\,000}$$

The actual number of cords,  $n$ , shall be greater than or equal to  $n_{min}$ .

### 6.5 Cord pitch

The cord pitch,  $t$ , is calculated using the following equation:

$$t = \frac{b_t}{n-1}$$

The cord pitch shall be selected to the nearest 0,1 mm.

The calculated edge width,  $b_k$ , is given by the following equation:

$$b_k = 0,5 \times [B - d - t \times (n - 1)]$$

### 6.6 Thickness of covers

For standard type belts (see 5.1) the minimum thickness of either of the covers ( $s_2$  or  $s_3$ ) shall be not less than  $0,7d$  or not less than 4 mm, whichever is the higher value.

For belts with transverse reinforcements (see 5.2), the minimum cover thickness for belts with breaker, depending on breaker design, may be higher. The minimum cover thickness for belts with a weft may be lower.

The cover thicknesses employed shall be determined taking into account cover grade and conveying conditions.

### 6.7 Belt thickness

The thickness,  $s_1$ , is the result of the addition of the core thickness,  $s_6$ , and the cover thicknesses  $s_2$  and  $s_3$ .

When measured according to ISO 7590, the maximum belt thickness,  $s_{1\max}$ , shall be equal to  $1,1s_1$ , and the minimum belt thickness,  $s_{1\min}$ , shall be in accordance with the following:

$$s_1 \leq 20 \text{ mm: } s_{1\min} = (s_1 - 1) \text{ mm}$$

$$s_1 > 20 \text{ mm: } s_{1\min} = (s_1 - 1,5) \text{ mm}$$

The belt surfaces shall be plain and parallel and any difference in belt thickness (e.g. across the width of the belt) shall not exceed  $0,05s_1$ .

## 6.8 Belt length

Belting shall be supplied subject to the tolerances on length detailed in Table 4.

Table 4 — Tolerances on belt lengths

Belt delivery condition	Maximum permissible difference between delivered and ordered lengths
For a belt delivered in one complete length	+ 2,5% 0
For belt delivered in several length	± 5 % for each single length, subject to an overall tolerance for the sum of all lengths of + 2,5% 0

When placing orders for belting, purchasers should specify a length of belting that includes such lengths as are required for jointing and external testing.

## 7 Mechanical requirements

### 7.1 Breaking strength of the steel cord

The breaking strength of the cord shall be proved by the test certificate of the cord manufacturer. Alternatively, if a test of the cord taken from the belt is requested, the test shall be carried out in accordance with ISO 7622-2.

The breaking strength of the cord,  $F_{bs}$ , shall at least be equal to the product of the minimum breaking strength of the belt,  $K_N$ , and the belt width,  $B$ , divided by the number of cords,  $n$ , i.e.

$$F_{bs} \geq \frac{K_N \times B}{n \times 1\,000}$$

### 7.2 Position of the steel cord in the conveyor belt

#### 7.2.1 General

The position of the cords shall be determined according to EN 13827.

#### 7.2.2 Horizontal position

The cords in the belt shall be rectilinear. Not more than 5 % of the steel cords shall deviate from the nominal cord pitch by more than  $\pm 1,5$  mm when measured in accordance with EN 13827.

The deviation of the supporting belt width,  $b_t$ , from the arithmetic value  $[(n - 1) \times t]$ , shall not exceed 1 %.

**7.2.3 Vertical position**

The steel cords of the belt shall be in one plane. When measured in accordance with EN 13827, the value of  $\Delta h_1$  shall be at least 95 %, the value of  $\Delta h_2$  shall not exceed 5 % and the value of  $\Delta h_3$  shall be zero.

**7.3 Number and spacing of cord joints**

In any individual length of conveyor belt (see 6.8), not more than 2 % of the total number of cords,  $n$ , may be joined and no individual cord shall have more than one joint.

The distance between joints in the longitudinal direction shall be greater than 10 m.

**7.4 Cord pull-out force**

The adhesion force between rubber and steel cord is represented in the as-delivered state by  $F_a$  and after thermal treatment by  $F_v$ .

When tested in accordance with ISO 7623, the cord pull-out forces  $F_a$  and  $F_v$  shall meet the requirements given in Table 5.

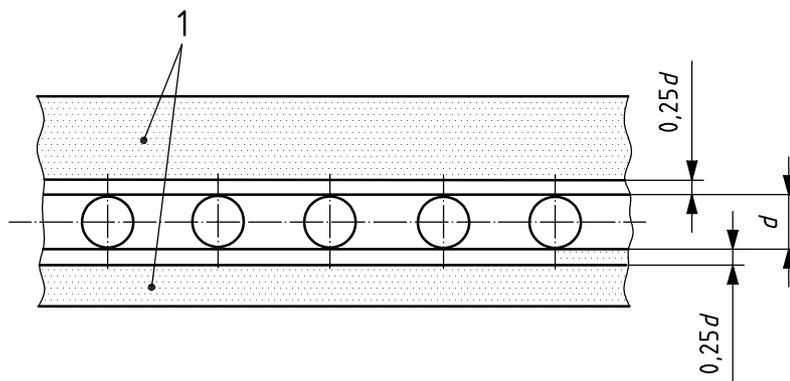
**Table 5 — Performance requirements for cord-to-coating bond strength per cord length**

Test conditions	Cord pull-out forces	
	$F_a$	$F_v$
	N/mm	
As-delivered state	$15d + 15$	—
After thermal treatment ( $145 \pm 5$ ) °C for ( $150 \pm 1$ ) min	—	$15d + 5$

**7.5 Covers — Quality classification**

When tested in accordance with ISO 37 and ISO 4649:2002, method A, the conveyor belt covers shall comply with the requirements of Table 6 with respect to a cover surface

- down to a distance from the cord surface equal to  $0,25 d$  of the cord diameter, as shown in Figure 4 (if there is no transverse reinforcement),
- down to a distance of 0,5 mm from the transverse reinforcement, as shown in Figure 5 (if transverse reinforcement is present).

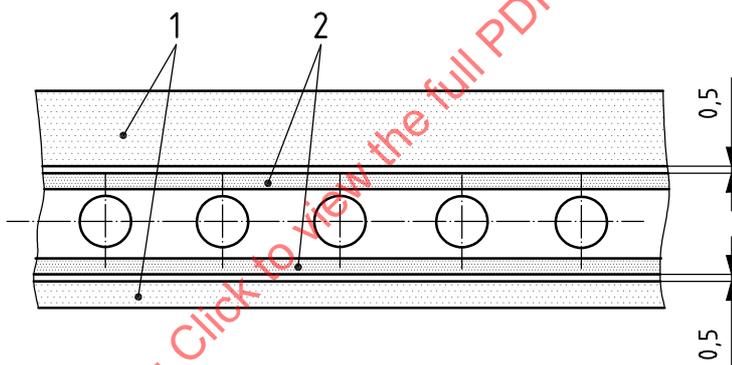


**Key**

- 1 cover grade

**Figure 4 — Applicable cover grade depth of standard belt**

Dimensions in millimetres



**Key**

- 1 cover grade
- 2 transverse reinforcement

**Figure 5 — Applicable cover grade depth of belt with transverse reinforcement**

Table 6 — Cover grades

Grade	Tensile strength min. (ISO 37) MPa	Elongation at break min. (ISO 37) %	Abrasion resistance max. (ISO 4649) mm <sup>3</sup>
H	24	450	120
D	18	400	100
L	15	350	200
K <sup>a</sup>	15	350	200

NOTE The cover grades H, D, and L are in accordance with ISO 10247. The values will help to determine the appropriate cover compound for the application or for the materials carried. Other values such as tear resistance can be considered if required. Reliable assessment of the behaviour of the covers in service for wear and cut resistance cannot be determined from tensile strength, elongation, and abrasion values alone.

<sup>a</sup> For flame-resistant and antistatic belts in accordance with ISO 340 and ISO 284.

## 7.6 Ageing of covers

The median values for tensile strength and elongation at break after accelerated ageing in an air oven at 70 °C for seven days in accordance with ISO 188 shall not be lower than 75 % of the values obtained before ageing.

## 7.7 Adhesion

When tested according to ISO 8094, the adhesion between covers and rubber core shall be at least 12 N/mm sample width. The adhesion between transverse reinforcements and core and between transverse reinforcements and covers shall be at least 10 N/mm.

If the weft is interwoven with the cords, the test should not be carried out.

## 7.8 Transverse reinforcements

### 7.8.1 Breaker

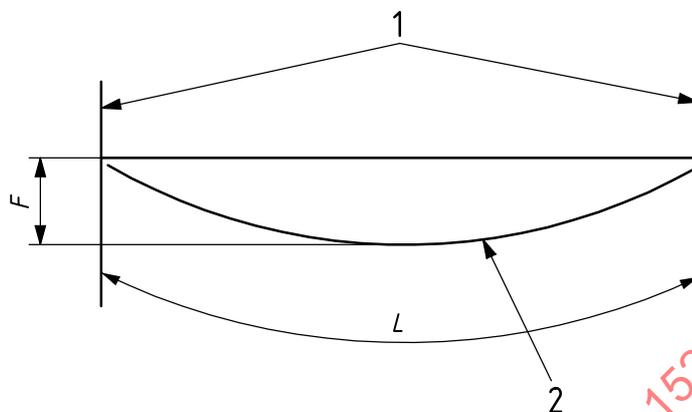
Transverse reinforcements in the cover (breaker) are applied at a distance,  $s_4$ , from the longitudinal cords ranging between 1 mm and 3 mm. The width of the breaker ply shall not be less than the belt width minus 100 mm. The distance between the edge of the breaker and the belt edge shall be at least 10 mm.

### 7.8.2 Weft

Transverse reinforcements as a part of the carcass (weft) are applied at a distance,  $s_5$ , of less than 1 mm from the layer of longitudinal cords. The width of the weft shall not be less than the belt width minus 50 mm. The distance between the edge of the weft and the edge of the belt shall be at least 5 mm.

## 7.9 Troughability

Testing shall be carried out in accordance with ISO 703. The troughability is characterized by the ratio of the deflection  $F$  to the belt width  $L^2$  (see Figure 6), as given in Table 7.



### key

- 1 suspension filament
- 2 belt sample

Figure 6 — Suspension of sample

Table 7 — Minimum values of  $F/L$  for belt conveyors of three idlers of equal length, according to ISO 703

Troughing angle of side idlers	$F/L$
20°	0,08
25°	0,10
30°	0,12
35°	0,14
40°	0,16
45°	0,18
50°	0,20
55°	0,23
60°	0,26

## 7.10 Tracking

Steel cord conveyor belting, when running on a perfectly aligned conveyor and loaded centrally, shall not deviate from the central track by more than  $\pm 40$  mm for a belt width up to 800 mm; for belt width over 800 mm, it shall not deviate by more than  $\pm 5\%$  or by more than  $\pm 75$  mm, whichever is the lesser value.

2) In this subclause, exceptionally, the symbol  $L$  has been used so as to conform with its use in ISO 703. Elsewhere, the symbol  $B$  was chosen in order to be in conformance with ISO 15236-2:2004.

**7.11 Safety requirements**

Each conveyor belt shall comply with one of the safety categories specified in EN 12882.

For applications where hazards from fire and/or explosions are likely, additional steps can be taken to increase safety such as

- automatic fire extinguishers, and
- automatic control of temperature, belt slip, belt tension, mechanical overload, etc.

**8 Sampling**

If a certificate pertaining to the tests required by Clause 7 is to be provided, take a sample between two successive lengths to represent both lengths.

If additional tests are required, take samples of not less than 450 mm length in the full width distributed approximately equally over the belt length up to the number of samples given in Table 8.

**Table 8 — Number of samples**

Belt length	Number of samples
≤ 200 m	1 (if requested)
≥ 200 m ≤ 500 m	1
> 500 m ≤ 1 000 m	2
> 1 000 m ≤ 2 000 m	3
> 2 000 m ≤ 3 500 m	4
> 3 500 m ≤ 5 000 m	5
> 5 000 m ≤ 7 000 m	6
> 7 000 m ≤ 10 000 m	7
for each addition 5 000 m	1

**9 Designation**

The symbol ST shall signify the material (steel cords) used for the tension member in the longitudinal direction. This symbol shall be followed by the nominal breaking strength of the belt in newtons per millimetre (N/mm) belt width (see Table 2).

Breaker transverse reinforcements shall be designated by the cover thickness followed by T (for textile) or S (for steel).

Weft transverse reinforcements shall be designated by the letter S (for steel) or T (for textile), after the ST sign, to indicate the material of the weft and the place where it is applied.

The belt type, in accordance with ISO 15236-2, shall be designated by A1, A2 or B1, as appropriate.

EXAMPLE 1 A 1 400 m steel cord conveyor belt (ST) of 2 200 mm width, a minimum breaking strength of 3 500 N/mm belt width, covers of 10 mm on the carrying side and 7 mm on the pulley side, of grade H and type A1:

**1 400 m steel cord conveyor belt, ISO 15236-1 - 2 200 ST 3 500/10 + 7 H + A1**

**EXAMPLE 2** A 900 m steel cord conveyor belt (ST) of 1 400 mm width, a minimum breaking strength of 2 500 N/mm belt width, covers of 10 mm on the carrying side and 6 mm on the pulley side, of grade D, with transverse reinforcements (breaker) in the covers of carrying and pulley sides, consisting of textile material and type A2.

**900 m steel cord conveyor belt, ISO 15236-1 – 1 400 ST 2 500/10T + 6T D + A2**

**EXAMPLE** A 1 000 m steel cord conveyor belt (ST) of 1 000 mm width, a minimum breaking strength of 800 N/mm belt width, covers of 6 mm on the carrying side and 3 mm on the pulley side of grade L, with transverse reinforcements (weft) on the carrying and pulley sides, consisting of steel and type B1.

**1 000 m steel cord conveyor belt, ISO 15236-1 – 1 000 ST S/S 800/6 + 3 L + B1**

## 10 Ordering data

The minimum requirements of the customers are length, width, breaking strength, cover gauges, cover quality.

For purchasers placing orders with more than one manufacturer or for replacement belting, more detailed information is required for compatibility such as pitch, number of cords, and possibly cord diameter, as well as whether the belt is to be of the standard type or equipped with breaker plies or weft. Attention should be drawn to ISO 15236-2 regarding preferred types.

## 11 Marking

**11.1** Steel cord conveyor belts are generally long-lasting products. Therefore, the marking should be durable and the use of imprints is recommended. As this might have the negative effect of increasing the noise generated when the belt passes the idlers, the method of marking should be agreed between the manufacturer and purchaser.

**11.2** Steel cord conveyor belts shall be marked with at least the following information:

- a) number of this part of ISO 15236 and last two digits of its year of publication;
- b) name of belt manufacturer;
- c) symbol ST followed by the breaking strength, expressed in newtons per millimetre (N/mm), e.g. ST 2500 (see 6.1 and Clause 9);
- d) type of belt in accordance with ISO 15236-2, e.g. A1 or B2;
- e) thickness of covers, expressed in millimetres, including type of breaker or weft;
- f) last two digits of year of manufacture;
- g) belt identification number, with no more than five digits.

**11.3** The height of the marking shall be between 20 mm and 80 mm. If imprints are used, they shall be at least 1 mm deep for covers having a thickness of up to 6 mm and at least 3 mm deep for covers having a thickness of more than 6 mm.

**11.4** Belts shall be marked on the top cover, approximately 50 mm from the edges for belts up to 800 mm wide and approximately 100 mm from the edges for belts more than 800 mm wide. The distance between adjacent marks shall not exceed 15 mm. For belts up to 1 400 mm wide, marking on one belt edge is sufficient.

**11.5** The information given in 11.2 shall also be marked on the outside of the reel on which the conveyor belt is supplied, in addition to any information required by the purchaser.