INTERNATIONAL STANDARD

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Steel cord conveyor belts —

Part 4:
Vulcanized belt joints

Courroies transporteuses à câbles d'acier —

Partie 4: Jonctions vulcanisées des courroies

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Foreword

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ISO 15236-4 was prepared by the European Committee for Standardization (CEN) 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).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

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 4: Vulcanized belt joints*

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Foreword

This document (EN ISO 15236-4:2004) has been prepared by Technical Committee CEN/TC 188 “Conveyor belts”, the secretariat of which is held by BSI, in collaboration with Technical Committee ISO/TC 41 “Pulleys and belts (including veebelts)”.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2004, and conflicting national standards shall be withdrawn at the latest by December 2004.

EN ISO 15236 will consist 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 applications*

– *Part 4: Vulcanized belt joints*

– *Part 5: Marking*

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1 Scope

This part of EN ISO 15236 specifies design, dimensions, requirements and marking of vulcanized joints for steel cord conveyor belts.

2 Terms and definitions

For the purposes of this European Standard, the following term and definition applies.

vulcanized joint
area within which the cords from two belt lengths are joined and vulcanized through the surrounding rubber

3 Symbols and units

For the purposes of this European Standard, the symbols and units given in Table 1 apply.

Table 1 — Symbols and units

Symbol	Explanation	Unit
d	Cord diameter	mm
K_N	Nominal breaking strength of the belt	N/mm
K_{Nred}	Reduced breaking strength of the joint	N/mm
l_p	Length of cord end staggering area	mm
l_q	Length of the cord transition area	mm
l_s	Butt end clearance of the cord ends	mm
n_{st}	Number of steps	-
SG	Thickness of rubber between the cords in the joint	mm
SG_{min}	Minimum thickness of rubber between the cords in the joint	mm
t	Pitch	mm
t_{min}	Minimum spacing of the cord in the belt	mm

4 Types of joints

4.1 General

There are two types of joints differing in the way that forces are transferred from one belt length to the other:

a) stepped joints;

— where the forces are transferred by the rubber surrounding the cords.

b) finger joints;

— where the forces are transferred by the rubber surrounding the cords and by the transverse reinforcements. For this type of joint, transverse reinforcement is required.

NOTE 1 Stepped joints offer the highest possible dynamic performance but require a high amount of time, knowledge, and care in their fabrication.

NOTE 2 For both types of joint, the physical properties of the rubber, especially the adhesion to the cords, are of utmost importance for the quality of the joint.

4.2 Stepped joints

4.2.1 Design principles

The cords of the belt ends to be joined are cut free from the cover rubber in the joint area. According to an agreed joint pattern, the cords are cut or separated in steps and cut free from the core rubber where necessary. The cords of both ends are merged into each other, embedded in bonding rubber and covered with cover rubber. After vulcanizing the joint will be able to transmit forces from one belt length to the other.

Unlike joints in conveyor belts with textile reinforcements for which the belt ends are generally cut in a bias, the ends of steel cord belts are cut either in a bias or perpendicular to the belt edge or in a bias for joining.

The number of steps, the length of the joint, the length of the steps and the joint pattern, i.e. the sequence of cuts of the cords, is either specified by the belt manufacturers or is given in company standards or national standards.

In addition to practical experience, the quality of a stepped joint can be evaluated by the calculation of the stresses of the rubber and the cords within the joint or by static and dynamic testing methods.

4.2.2 Rubber gap in the joint

The rubber filling the gap between two adjacent cords from different lengths is strained most and receives the highest stresses. A minimum distance SG_{min} of the cords within the joint therefore has to be kept, as follows.

$$SG_{\min} \geq 1{,}2 + (0{,}1 \times d)$$

4.2.3 Butt end clearance

For cords meeting in the joint, the distance of the butt ends, l_s , shall be approximately 4 x d but not less than 3 x d.

4.2.4 Steps

Joints shall be carried out as 1-step, 2-step, 3-step, or 4-step joints, although higher numbers of steps are permitted.

According to the number of steps determined, the cords shall be cut in a sequence repeated throughout the belt width.

4.2.5 Interlaced stepped joint

It is characteristic of this type of joint that it contains a larger number of cords than the belt itself.

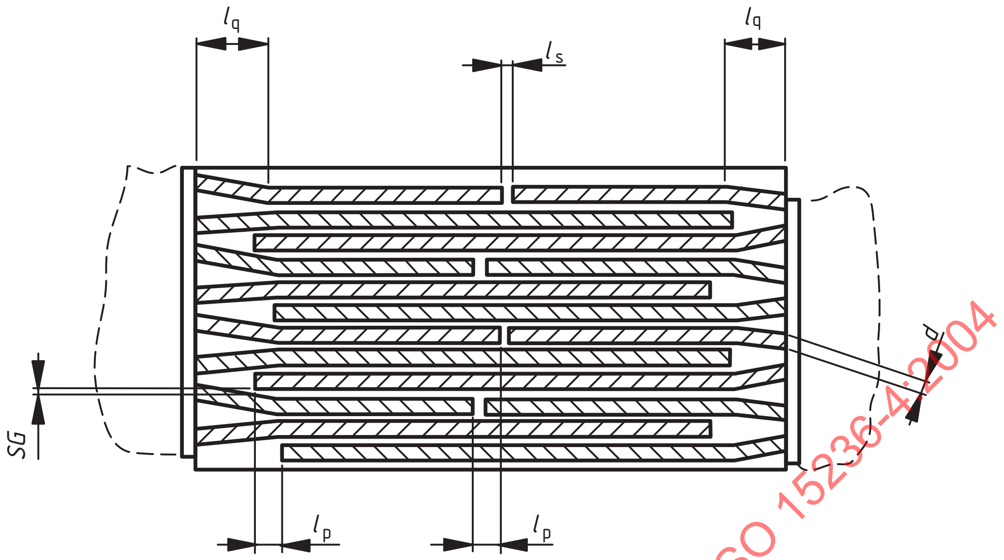
On both sides of the joint, a length, l_q , shall be allowed for transition of the cords, l_q being a function of the cord diameter. Preferred transition lengths of the cords are given in Table 2. Transition lengths shall be not less than 16 x the cord diameter.

Table 2 — Transition length of cords

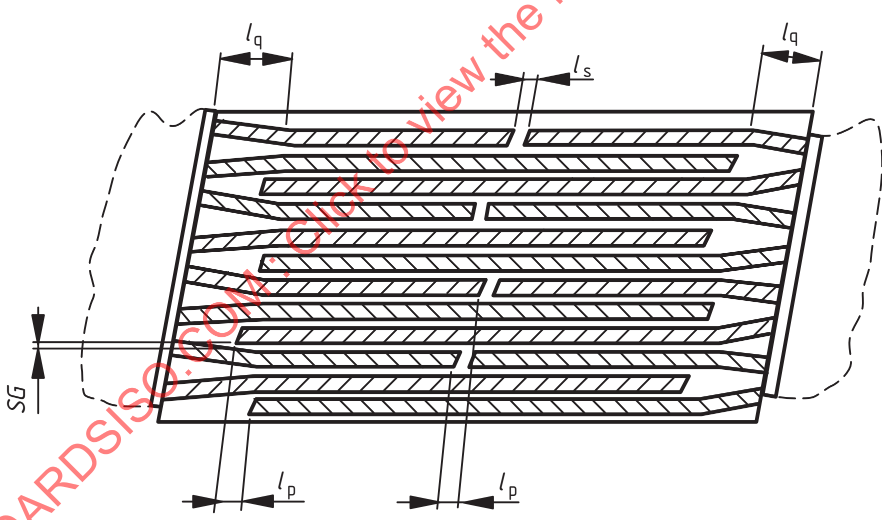
D (mm)	l_q (mm)
≥ 6,0	100
>6,0 - ≤ 8,5	150
>8,5 - ≤ 10,0	200
>10,0 - ≤ 11,5	250

NOTE Cord end staggering where l_p is 50 mm is beneficial.

Part of a 2-step interlaced joint rectangular cut and cut on bias is shown in Figure 1.



a) Rectangular cut



b) Cut on a bias

Key

See Table 1 for explanation of symbols

Figure 1 — Part of 2-step interlaced joint rectangular cut and cut on a bias

4.2.6 Plain stepped joint

4.2.6.1 Minimum cord spacing in the belt

Plain stepped joints shall contain the same number of cords in the joint as in the belt itself. The minimum cord spacing of the belt t_{min} shall, therefore, be as follows.

$$t_{\min} = d + SG_{\min}$$

NOTE Smaller spacings will reduce the quality of the joint and should be avoided.

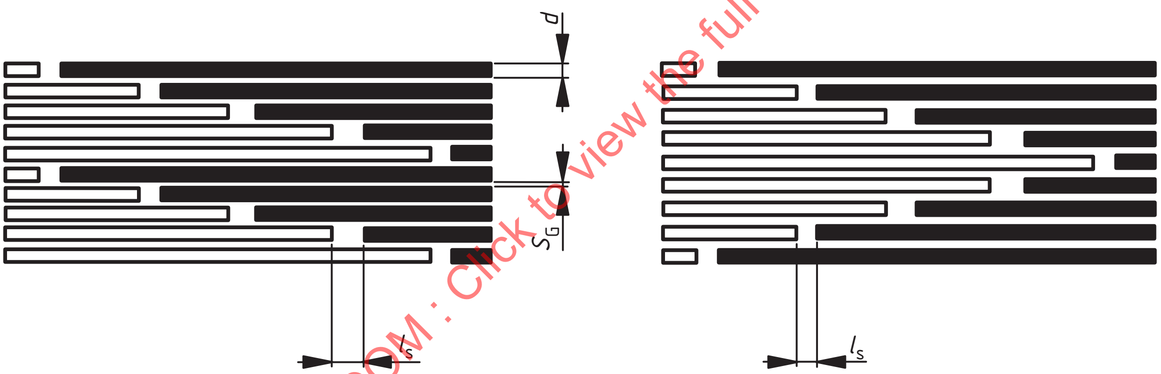
4.2.6.2 Breaking strength of the joint

The actual breaking strength of a joint may be calculated from the number of adhesion areas between the ends of opposite belts.

$$K_{Nred} \geq \frac{n_{st}}{n_{st}+1} \times K_N$$

4.2.6.3 Cord pattern

Plain stepped joints shall be either “organ pipe joints” or “fir tree joints” as illustrated in Figure 2.



a) Organ pipe joint

b) Fir tree joint

Figure 2 — Parts of typical 4-step plain stepped joints

4.2.7 Transverse reinforcements[1)]

The peak stresses on the material in the joint can be reduced by transverse reinforcements in the splice, i.e. the stresses are equalized. Transverse reinforcements shall end at least 50 mm from the cover transition area.

1) A calculation shows lower stresses for the “organ pipe” type than for the “fir tree” joint.