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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

Reference number
ISO 15236-4:2004(E)

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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of an identical text or by endorsement, at the latest by December 2004, and conflicting national standards shall be withdrawn at the latest by December 2004.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

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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.

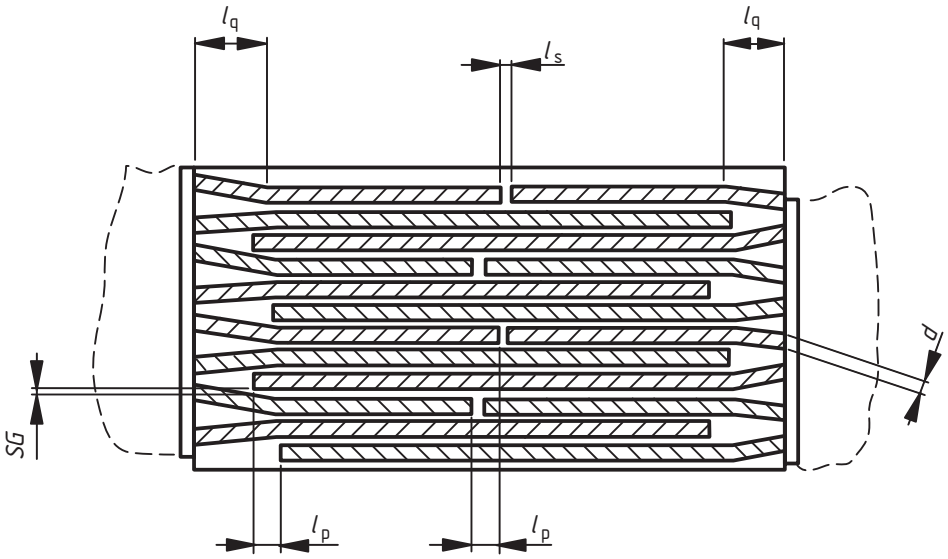
On both sides of the joint, a length, l_{q}, shall be allowed for transition of the cords, l_{q} being a function of the cord diameter. Preferred transition lengths of the cords are given in Table 2. Transition lengths shall be not less than 16 x the cord diameter.

Table 2 — Transition length of cords

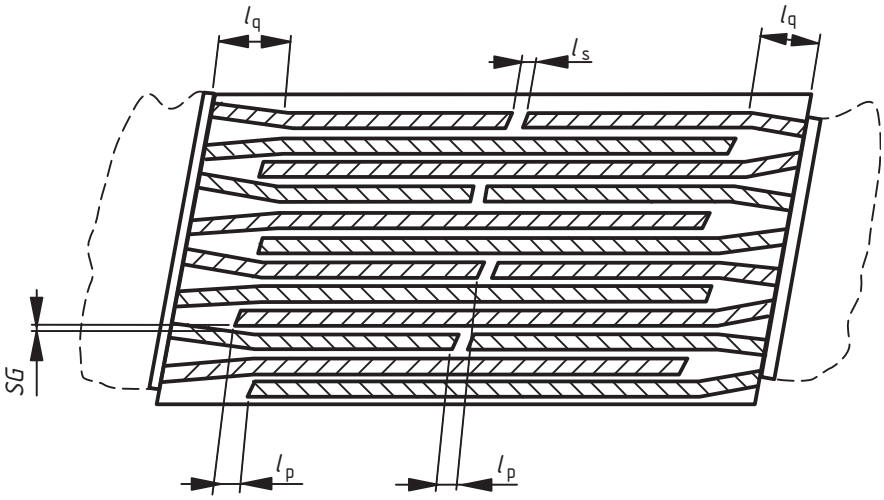
D (mm)	l_q (mm)
≥ 6,0	100
>6,0 - ≤ 8,5	150
>8,5 - ≤ 10,0	200
>10,0 - ≤ 11,5	250

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.

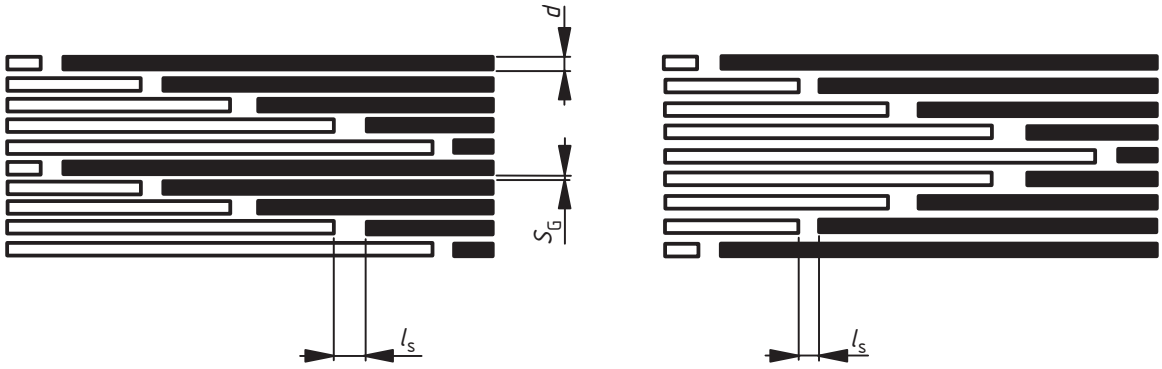
4.2.6.2 Breaking strength of the joint

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.

4.3 Finger joints

To make finger joints cords shall be such that they can be cut accurately by scissors or a scissors-like tools. Therefore this type of joint is normally limited to belting having a maximum cord diameter of 3,3 mm.

To make a finger joint, the covers and transverse reinforcements shall be removed in the joint area of both belt ends. Triangular pieces shall be cut in such a way, that “tongues” of the belt are left. These “tongues” or “fingers” from both ends shall be merged into each other, covered with rubberized transverse reinforcements and cover sheets and vulcanised (see Figure 3).

NOTE 1 Transverse reinforcements within the joint area are essential for the quality of the joint.

The length and the width of the fingers shall either be specified by the belt manufacturers or be given in company standards or national standards.

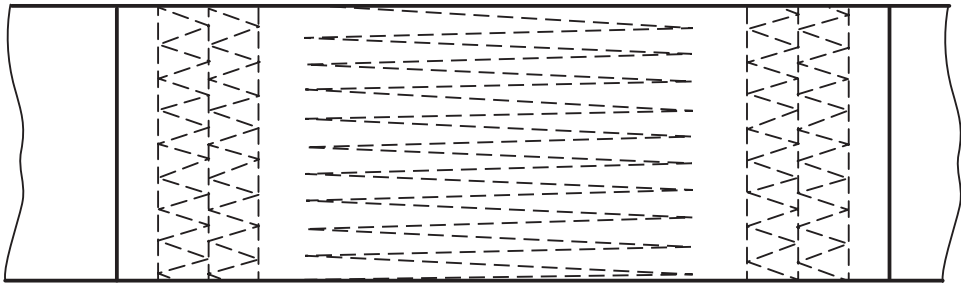


Figure 3 — Part of a finger joint

NOTE 2 A loss of static strength in the splice is unavoidable, the extent of the loss being dependent on the construction of the splice.

5 Joint material

The joint material shall be chosen for the belt types to be joined, ensuring that the material will not be spoiled by ageing.

6 Making the joint

The heating platens shall be at least 150 mm larger than the joint on both sides in the longitudinal direction and shall at least cover the side irons in the transverse direction.

The heating platens shall be loaded evenly with a pressure of at least 1 MPa. Mechanical pressure equipment shall use a device to even out the applied pressure.

Unless otherwise agreed between the manufacturer and purchaser, when making the joint there shall be an equal thickness of the rubber between the cords.

When making joints the following general guidance shall be observed:

— ensure a large adhesion area by bevelling the cover transition zones;

— leave a coat of adhesion rubber on the cord;

— carefully fill the space between the cords with a sufficient quality of adhesion rubber;

— use a material with a high adhesion.

In addition for interlaced stepped joints:

— avoid cords lying butt at the belt edges;

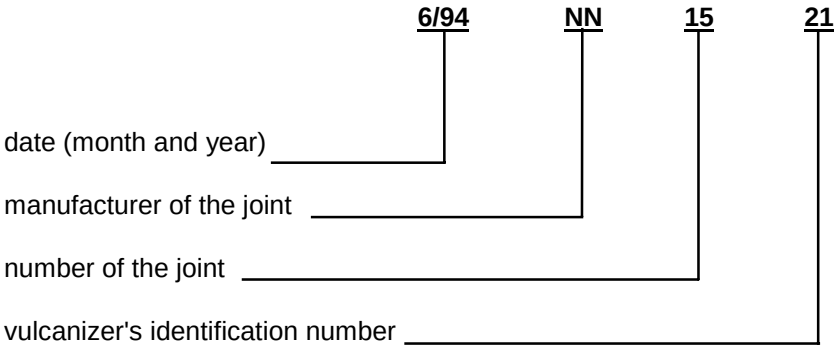
— transfer necessary deviations from the pattern of the joint to the centre of the belt.

NOTE Detailed information about belt joint manufacturing and requirements for curing are provided by the manufacturer or by companies specialized in belt service.

7 Marking the joint

The joint shall be provided with an easy to read lasting marking. Letters and numerals shall have a height of at least 20 mm and a line width of at least 3 mm.

The markings shall be in the order shown in the following example:



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