International Standard ISO 5293

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Conveyor belts — Formula for transition distance on three equal length idler rollers

Courroies transporteuses — Formule de calcul de la distance de transition d'auge à trois rouleaux égaux

First edition — 1981-12-01

UDC 621.867.2 **Ref. No. ISO 5293-1981 (E)**

Descriptors : conveyor belts, pulleys, formulas (mathematics), computation, distance.

Price based on 3 pages

ISO 5293-1981 (E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 5293 was developed by Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts)*, and was circulated to the member bodies in August 1980.

It has been approved by the member bodies of the following countries :

Australia
Austria
Canada
Egypt, Arab Rep. of
Finland
France
India
Italy
Japan
Korea, Rep. of
Netherlands
Norway
Romania
South Africa, Rep. of
Spain
Sweden
United Kingdom
USA
USSR

The member body of the following country expressed disapproval of the document on technical grounds :

Germany, F. R.

Conveyor belts — Formula for transition distance on three equal length idler rollers

0 Introduction

The distance between the terminal pulley and the adjacent fully troughed idler set at either the head or tail end of the conveyor is known as the transition distance. Within this distance, the belt changes from a fully troughed to a flat profile, or vice versa. It is important that these distances should be sufficient to prevent the tension in the belt edges, and the resultant pressure forcing the belt towards the idler roller intersections, becoming excessive. In addition, the occurrence of zero or negative tensions in the centre of the belts must be avoided when the belt tension is low, such as that which occurs at the tail end of some conveyors. It is recommended, therefore, that the transition distances are calculated from the following formula, taking the appropriate values of the functions from the tables provided and using the manufacturer's value of belt modulus. The level of the top of the terminal pulleys is significant and is normally set in line with the horizontal rollers of the three pulley sets or alternatively in line with an imaginary line located at one third of the depth of the troughed section of the conveyor. Methods of calculation for each of these configurations are given.

1 Scope and field of application

This International Standard specifies the formula to calculate conveyor belt transition distances.

2 Formula to calculate transition distance

The formula to calculate transition distance, the demonstration of which is given in the annex, is the following :

$$L_1 = 0{,}707\, V \left(\frac{M}{\Delta T} \right)^{\frac{1}{2}}$$

where

L_1 is the transition distance, in metres;

V is the vertical distance the belt edge raises or lowers in the transition (see figure 1) in metres;

M is the elastic modulus measured at the maximum rated belt tension (RMBT), in newtons per millimetres;

T_R is the maximum rated belt tension (RMBT), in newtons per millimetre;

ΔT is the induced belt edge stress in the transition in newtons per millimetre.

Transition distances calculated by the formula will :

— limit edge tension to a maximum of 130 % maximum rated belt tension;

— prevent buckling of the centre portion of the belt.

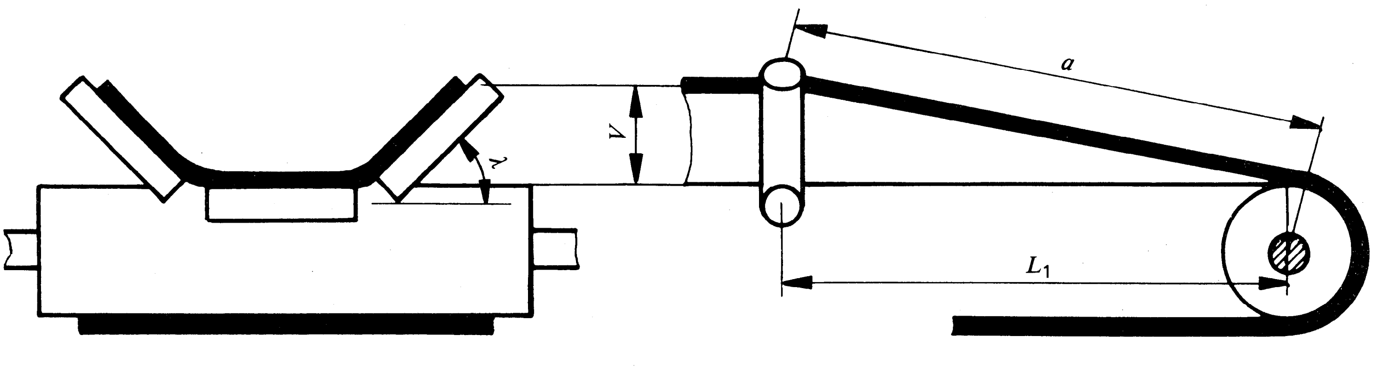

Figure 1

3 Application of the formula for transition distance

Calculate the transition distance by using appropriate values of M_1, V and ΔT as follows :

3.1 Values of elastic modulus, M, of belt

These are provided by the belt manufacturer.

3.2 Value of vertical distance, V, which the belt edge raises or lowers

This is calculated from the idler trough angle λ (see figure 1) and the position of the terminal pulley with respect to the centre idler roller. Two common situations are as follows.

3.2.1 The pulley is on a line with the top centre idler roller (see figure 2).

$$V = \frac{b \sin \lambda}{3}$$

where

V is defined in clause 2;

b is the width of the belt, in metres;

λ is the idler trough angle.

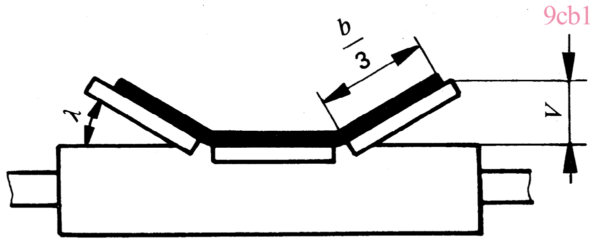

Figure 2

3.2.2 The pulley is elevated by 1/3 of the trough depth above the line of centre idler roller.

V is then equal to 2/3 full trough depth, then :

$$V = \frac{2}{3} \times \frac{b \sin \lambda}{3} = \frac{b \sin \lambda}{4,5}$$

where V, b and λ are defined in 3.2.1.

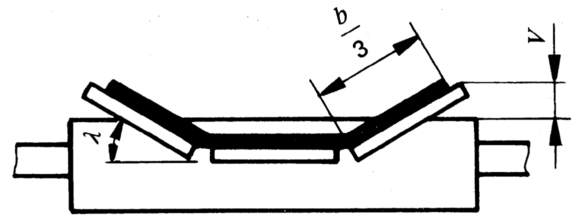

Figure 3

3.3 Values of ΔT

Calculate belt tension at the transition and express it as a proportion of T_R (maximum rated belt tension).

Then select the value ΔT from the table below (interpolate if necessary).

Ratio of belt tension at transition to T_R	ΔT
1,0	0,30 T_R
0,9	0,35 T_R
0,8	0,45 T_R
0,7	0,55 T_R
0,6 to 0,3	0,60 T_R
0,2	0,40 T_R
0,1	0,20 T_R
0,05	0,10 T_R

The values of ΔT selected here will :

— prevent edge tension from exceeding 130 % of the maximum rated belt tension[1];

— prevent the centre of the belt from buckling.[2]

1) Or higher value to be fixed by agreement with the manufacturers.

2) To prevent buckling, the tension in the centre of the belt must be adequate and always positive.

Annex

Derivation of the formula for transition distance

A.1 Assumptions

The following two assumptions are made to simplify the mathematics and because they only have a minor effect on the calculated transition distance. Also, the effect of the first is partially compensated by the effect of the second.

The portion of belt on the inclined troughing roll is assumed to be $\frac{b}{3}$ where slightly less than this is normally the case.

The belt edge is assumed to make a straight vertical drop through the transition whereas there is actually a slight lateral displacement as well.

A.1.1 From the stress-strain-modulus relationship

$$\frac{a - L_1}{L_1} M = \Delta T \qquad \ldots (1)$$

Or :

$$a = L_1 \left(\frac{\Delta T}{M} + 1 \right) \qquad \ldots (2)$$

where

a is the length of belt edge in transition distance;

L_1, M, V and ΔT are defined in clause 2.

A.1.2 Also, by the pythagorean theorem :

$$a = \left(L_1^2 + V^2 \right)^{\frac{1}{2}} \qquad \ldots (3)$$

A.1.3 Let equation (2) equal equation (3). Square both sides and simplify to the following :

$$L_1 = \frac{\left(\frac{M}{\Delta T} \right) V}{\left(1 + \frac{2M}{\Delta T} \right)^{\frac{1}{2}}} \qquad \ldots (4)$$

A.1.4 Drop the 1 in the equation (4) denominator since it will be very small compared to $\frac{2M}{\Delta T}$

Then simplify to the following formula for transition distance :

$$L_1 = 0{,}707\, V \left(\frac{M}{\Delta T} \right)^{\frac{1}{2}} \qquad \ldots (5)$$

This page intentionally left blank

This page intentionally left blank

This page intentionally left blank