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INTERNATIONAL STANDARD 3684

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

Conveyor belts — Determination of minimum pulley diameters for belt-conveyors

Courroies transporteuses — Détermination des diamètres minimaux des tambours

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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 3684 was drawn up by Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts)* and was circulated to the Member Bodies in September 1974.

It has been approved by the Member Bodies of the following countries :

Belgium	Germany	Spain
Bulgaria	India	Sweden
Canada	Ireland	Turkey
Czechoslovakia	Italy	U.S.A.
Finland	Poland	Yugoslavia
France	Romania	

The Member Body of the following country expressed disapproval of the document on technical grounds :

United Kingdom

Conveyor belts — Determination of minimum pulley diameters for belt-conveyors

1 SCOPE AND FIELD OF APPLICATION

This International Standard establishes a method of calculation of minimum pulley diameters for belt-conveyors.

It applies to belts made of rubber or plastics with textile carcasses, of different carcass thicknesses and different carcass materials, operating at any anticipated belt tension up to, but not exceeding, the recommended maximum belt tension (RMBT).

It does not apply either to belts which have a carcass thickness of more than 20 mm or to those which have intermediate layers of rubber or plastics of more than 0,8 mm thickness between the plies.

The use on belt-conveyors of pulleys with diameters too small for the construction of the carcass may lead to premature belt failure, occurring either as ply-separation or as fracture of the fabric.

NOTES

1 The values indicated in this International Standard are minimum values to be used in the absence of information provided by the conveyor belt manufacturer.

2 The calculation of the minimum pulley diameter according to this International Standard is valid for all general applications. For special purposes the conveyor belt manufacturer may allow smaller pulley diameters. For belts which are not listed in the following tables, consult the manufacturer.

3 In the case of use of pulleys with larger diameters than those which correspond to the minimum diameter calculated for the recommended maximum belt tension, an increase of this maximum tension is not permissible.

2 DEFINITIONS

2.1 Belt structure (see figure 1)

thickness of carcass, e : The distance between the highest points of the upper layer of fabric and the lowest points of the lower layer.

2.2 Types of pulleys

Figures 2 to 5 show the different types of pulleys for belt-conveyors.

A: Driving pulleys and pulleys exposed to high belt tension, for example:

- main driving pulley on the head or on the tail;
- delivery pulleys under full tension;

- loop pulleys in the tripper;
- terminal head pulleys in the case of tail driving, etc.

B: Snub pulleys in the return run under lower belt tension, for example:

- terminal tail pulleys in the case of head driving;
- terminal head pulleys for down-hill conveying if the terminal tail pulley is braked;
- snub and bend pulleys in take-up devices.

C: Bend pulleys, for a change of direction of the belt of less than 30°.

2.3 Pulley diameter

pulley diameter: The overall diameter of the pulley, disregarding protecting layers made of rubber, ceramic or similar material if they are exposed to wear.

For crowned pulleys, the smallest diameter shall be at least the specified minimum.

3 STANDARD PULLEY DIAMETERS

The pulley diameters follow the steps of the R 10 (or R 20 for 1 400 mm and 1 800 mm) series of preferred numbers (see table 1).

TABLE 1 — Standard pulley diameters

Values in millimetres

100	630
125	800
160	1 000
200	1 250
250	(1 400)
315	1 600
400	(1 800)
500	2 000

This table includes, particularly, all the values fixed by ISO 1536, *Continuous mechanical handling equipment for loose bulk materials — Troughed belt conveyors (other than portable conveyors) — Belt pulleys*.

4 DETERMINATION OF THE RECOMMENDED MINIMUM DIAMETER

4.1 Formula

The pulley diameter, *D*, in millimetres, is determined by the formula

$$D = e \times C$$

where

e is the thickness of the carcass, in millimetres;

C is a factor for the material of the warp of the carcass, from table 2.

TABLE 2 – Factor *C*

Carcass material	<i>C</i>
Cotton	100
Polyamide	90
Cotton/polyamide	90
Cotton/polyester	98
Polyester	108
Rayon	118

The pulley diameters calculated using this formula shall be rounded up to the next larger standard pulley diameter (R 10 or R 20 series of preferred numbers according to table 1).

4.2 Influence of the type of pulley

In order to take the type of pulley into account, it is possible to choose smaller standard pulley diameters from the series of preferred numbers according to table 3.

TABLE 3 – Diameters according to pulley type

Type of pulley (see 2.2)	Pulley diameter
A	Standard pulley diameter according to 4.1
B	One step lower in the R 10 series of standard pulley diameters than the diameter for type of pulley A (but see 4.4.1)
C	Two steps lower in the R 10 series of standard pulley diameters than the diameter for type of pulley A (but see 4.4.2)

4.3 Influence of belt tension

In order to take the effect of belt tension (as a percentage of the recommended maximum belt tension, RMBT) into account it is possible to choose smaller standard pulley diameters from the series of preferred numbers according to table 4.

TABLE 4 – Diameters according to belt tension

Percentage of the recommended maximum belt tension used	Pulley diameter
over 60 % up to 100 % of RMBT	Standard pulley diameter according to 4.1
over 30 % up to 60 % of RMBT	One step lower in the R 10 series of standard pulley diameters than the pulley diameter for "60 % up to 100 %"
up to 30 % of RMBT	Two steps lower in the R 10 series of standard pulley diameters than the pulley diameter for "60 % up to 100 %" (but see 4.4.1 and 4.4.2)

4.4 Combination of influences, and limitations

The possibilities for reducing the pulley diameters because of the influence of the type of pulley, according to 4.2, and of the belt tension, according to 4.3, may be considered at the same time. However, pulley diameters which are too small must be avoided. For this reason, the following limitations shall be observed :

4.4.1 No pulley of type B for a belt-conveyor shall have a diameter smaller than two steps in the R 10 series of standard diameters below that which results from 4.1 (pulley type A at 60 to 100 % of RMBT).

4.4.2 No pulley of type C for a belt-conveyor shall have a diameter smaller than three steps in the R 10 series of standard diameters below that which results from 4.1 (pulley type A at 60 to 100 % of RMBT).

For example :

TABLE 5 – Pulley diameter

Values in millimetres

Percentage of the recommended maximum belt tension used	Pulley type		
	A	B	C
over 60 up to 100 % of RMBT	1 000	800	630
over 30 up to 60 % of RMBT	800	630	500
up to 30 % of RMBT	630	630	500

5 SUMMARY

In table 6, the minimum pulley diameters have been calculated according to clause 4, for different carcass thicknesses and materials, for different types of pulleys and for different belt tensions. The table does not constitute a limitation on larger pulley diameters, which may result in longer service from the belting used.

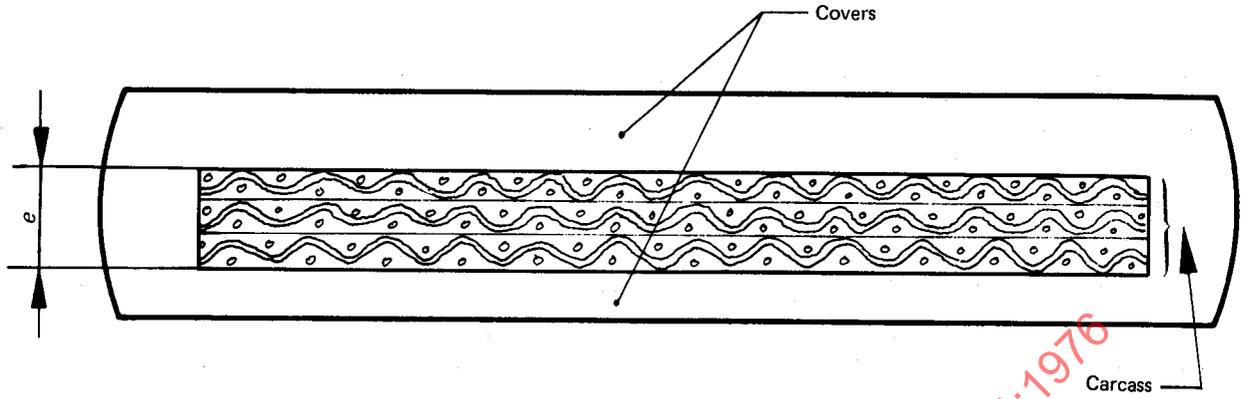


FIGURE 1

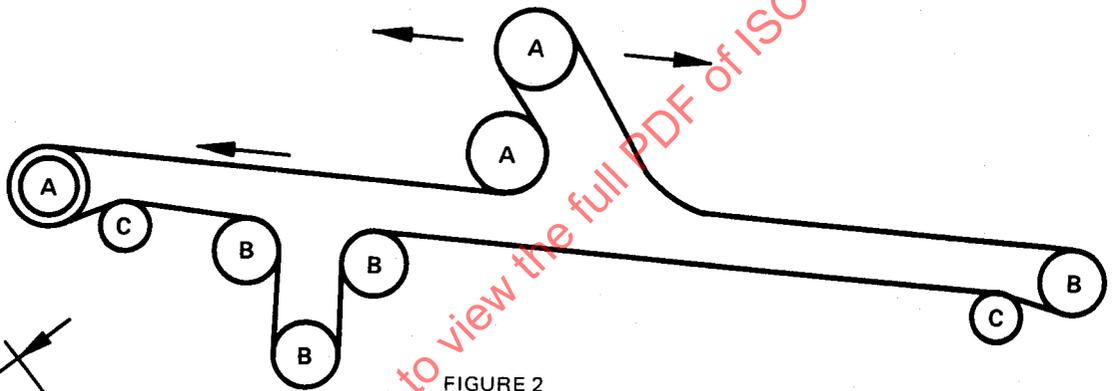


FIGURE 2

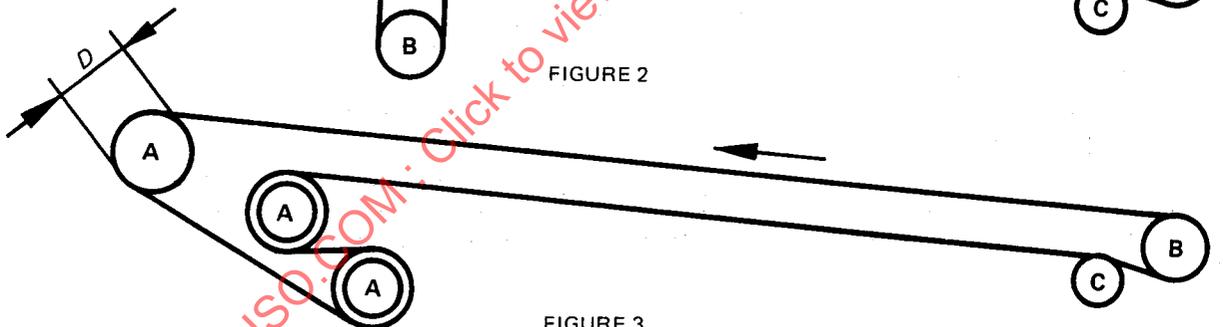


FIGURE 3

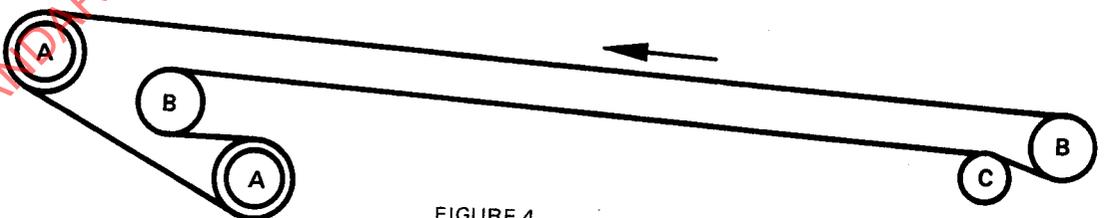


FIGURE 4

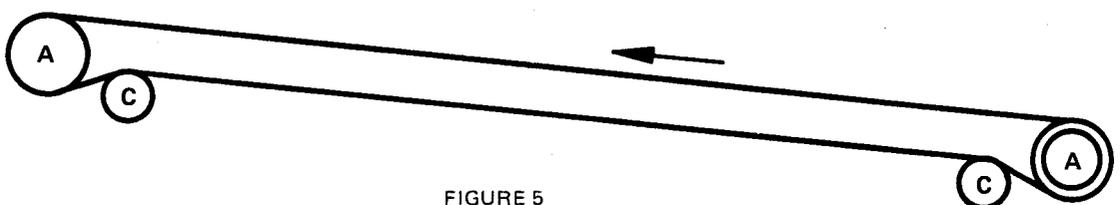


FIGURE 5

⊙ = Driving pulley

○ = Non-driving pulley

TABLE 6 – Summary

Values in millimetres

Carcass thickness										Recommended minimum diameter								
Material of the warp										Percentage of the RMBT used								
Cotton C = 86		Polyamide and cotton/ polyamide C = 90		Cotton/ polyester C = 98		Polyester C = 108		Rayon C = 118		over 60 up to 100 %			over 30 up to 60 %			up to 30 %		
from	to	from	to	from	to	from	to	from	to	Type of pulley			Type of pulley			Type of pulley		
										A	B	C	A	B	C	A	B	C
	1,2		1,1		1,0		0,9		0,8	100								
1,3	1,5	1,2	1,3	1,1	1,2	1,0	1,1	0,9	1,0	125	100		100					
1,6	2,0	1,4	1,7	1,3	1,6	1,2	1,4	1,1	1,3	160	125	100	125	100		100	100	
2,1	2,5	1,8	2,2	1,7	2,0	1,5	1,8	1,4	1,6	200	160	125	160	125	100	125	125	100
2,6	3,1	2,3	2,7	2,1	2,5	1,9	2,3	1,7	2,1	250	200	160	200	160	125	160	160	125
3,2	3,9	2,8	3,5	2,6	3,2	2,4	2,9	2,2	2,6	315	250	200	250	200	160	200	200	160
4,0	5,0	3,6	4,4	3,3	4,0	3,0	3,7	2,7	3,3	400	315	250	315	250	200	250	250	200
5,1	6,2	4,5	5,5	4,1	5,1	3,8	4,6	3,4	4,2	500	400	315	400	315	250	315	315	250
6,3	7,8	5,6	7,0	5,2	6,4	4,7	5,8	4,3	5,3	630	500	400	500	400	315	400	400	315
7,9	10,0	7,1	8,8	6,5	8,1	5,9	7,4	5,4	6,7	800	630	500	630	500	400	500	500	400
10,1	12,5	8,9	11,1	8,2	10,2	7,5	9,2	6,8	8,4	1 000	800	630	800	630	500	630	630	500
12,6	15,6	11,2	13,8	10,3	12,7	9,3	11,5	8,5	10,5	1 250	1 000	800	1 000	800	630	800	800	630
15,7	17,5	13,9	15,5	12,8	14,2	11,6	12,9	10,6	11,8	1 400	1 250	1 000	1 250	1 000	800	1 000	1 000	800
17,6	20,0	15,6	17,7	14,3	16,3	13,0	14,8	11,9	13,5	1 600	1 250	1 000	1 250	1 000	800	1 000	1 000	800
		17,8	20,0	16,4	18,3	14,9	16,6	13,6	15,2	1 800	1 400	1 250	1 400	1 250	1 000	1 250	1 250	1 000
				18,4	20,0	16,7	18,5	15,3	16,9	2 000	1 600	1 250	1 600	1 250	1 000	1 250	1 250	1 000

Example of reading : Carcass belt with polyester warp of 4 mm thickness, working on a driving pulley (type A) at 75 % of RMBT : recommended minimum diameter = 500 mm.

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