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Curvilinear toothed synchronous belt drive systems

Transmissions par courroies synchrones à denture curviligne

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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 3.

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.

International Standard ISO 13050 was prepared by Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts)*, Subcommittee SC 4, *Synchronous belt drives*.

Annexes A , B and C form a normative part of this International Standard. Annex D is for information only.

Introduction

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this International Standard may involve the use of a patent concerning belt tooth and pulley groove profiles given in 8.1.1 and 8.2.2.

ISO takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured ISO that he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. Information may be obtained from:

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Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights other than those identified above. ISO shall not be held responsible for identifying any or all such patent rights.

Curvilinear toothed synchronous belt drive systems

1 Scope

This International Standard specifies the principal characteristics of synchronous endless belts and pulleys for use in synchronous belt drives[1)] for mechanical power transmission and where positive indexing or synchronization may be required.

The principal belt and pulley characteristics include:

a) nominal belt tooth dimensions;

b) belt tooth pitch spacing;

c) belt length and width dimensions;

d) belt length-measurement specifications;

e) pulley groove dimensions and tolerances;

f) pulley diameter and width dimensions and tolerances;

g) pulley quality specification.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 254:1998, *Belt drives — Pulleys — Quality, finish and balance*.

3 Belt types

Six belt types for synchronous drives are standardized:

— type H8M (H-type tooth profile);

— type S8M (S-type tooth profile);

— type R8M (R-type tooth profile);

1) Synchronous belt drives have been known by various titles in the past: for example, timing belt drives, positive belt drives, gear belt drives.

— type H14M (H-type tooth profile);

— type S14M (S-type tooth profile);

— type R14M (R-type tooth profile).

4 Belt nomenclature

A belt is identified by a combination of numbers and letters as follows:

a) the belt pitch length in millimetres;

b) the type of tooth profile;

c) the tooth pitch in millimetres;

d) the width in millimetres or 10 times the width in millimetres for the S-type belt;

e) double-sided belts are designated by adding the letter "D" before the tooth profile letter.

EXAMPLE A curvilinear tooth synchronous belt of 14 mm pitch, 40 mm wide, 1 400 mm in pitch length is identified as follows:

1400-H14M-40 for H-type single-sided belt, 1400-DH14M-40 for H-type double-sided belt;

400-S14M-1400 for S-type single-sided belt, 400-DS14M-1400 for S-type double-sided belt;

1400-R14M-40 for R-type single-sided belt, 1400-DR14M-40 for R-type double-sided belt.

5 Pulley types

Six pulley types for synchronous drives are standardized:

— type H8M (H-type groove profile);

— type S8M (S-type groove profile);

— type R8M (R-type groove profile);

— type H14M (H-type groove profile);

— type S14M (S-type groove profile);

— type R14M (R-type groove profile).

6 Pulley nomenclature

A pulley for a synchronous drive is identified by the number of grooves, the groove pitch and profile, and the width. It is identified as is the belt by a combination of numbers and letters as follows:

a) the letter "P" indicates a pulley;

b) the number of grooves;

c) the type of groove profile;

d) the groove pitch in millimetres;

e) the width in millimetres or ten times the width in millimetres for S-type pulleys.

EXAMPLE A pulley for a curvilinear toothed belt which has 14 mm pitch and 30 grooves with a nominal width of 40 mm is identified as follows:

P30-H14M-40 for H-type pulleys;

P30-S14M-0400 for S-type pulleys;

P30-R14M-40 for R-type pulleys.

7 Type H system

7.1 H-type belt dimensions and tolerances

7.1.1 Belt tooth dimensions

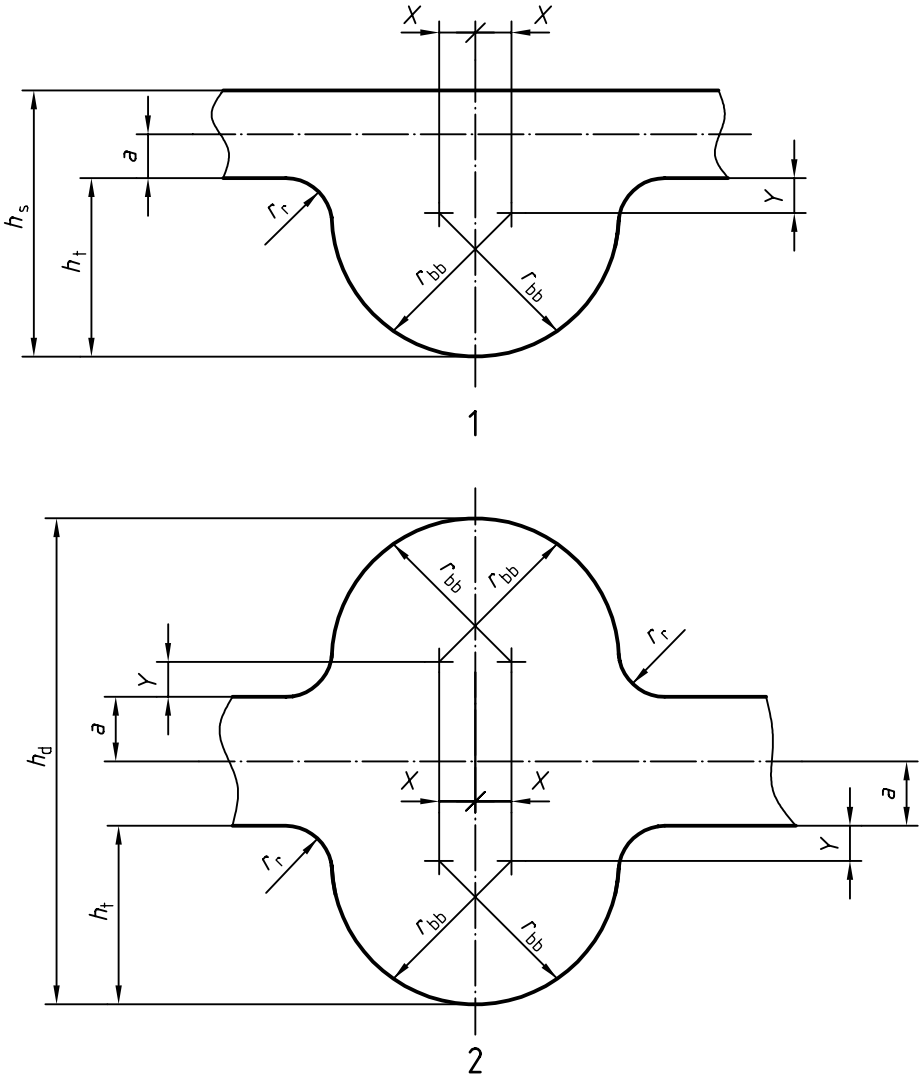
The nominal belt tooth dimensions are the same for single-sided and double-sided belts; they are given in Table 1 and shown in Figure 1.

Table 1 — Nominal tooth dimensions

Dimensions in millimetres

Belt type	Pitch	h_s	h_d	h_t	X ref.	Y ref.	r_{bb}	r_r	a[a]
H8M	8	6		3,38	0,089	0,787	2,59	0,76	0,686
DH8M	8		8,1	3,38	0,089	0,787	2,59	0,76	0,686
H14M	14	10		6,02	0,152	1,470	4,55	1,35	1,397
DH14M	14		14,8	6,02	0,152	1,470	4,55	1,35	1,397

[a] a is the belt design pitch differential.



Key

1 Single-sided belts

2 Double-sided belts

Figure 1 — Belt tooth dimensions

7.1.2 Belt widths and tolerances

Belt widths and tolerances are given in Table 2.

Table 2 — Widths and width tolerances

Dimensions in millimetres

Belt type	Nominal belt width	Tolerance on width for belt pitch lengths		
		Up to and including 840 mm	Over 840 mm and up to and including 1 680 mm	Over 1 680 mm
H8M DH8M	20 30	+ 0,8 − 0,8	+ 0,8 − 1,3	+ 0,8 − 1,3
	50	+ 1,3 − 1,3	+ 1,3 − 1,3	+ 1,3 − 1,5
	85	+ 1,5 − 1,5	+ 1,5 − 2,0	+ 2 − 2
H14M DH14M	40	+ 0,8 − 1,3	+ 0,8 − 1,3	+ 1,3 − 1,5
	55	+ 1,3 − 1,3	+ 1,5 − 1,5	+ 1,5 − 1,5
	85	+ 1,5 − 1,5	+ 1,5 − 2,0	+ 2 − 2
	115 170	+ 2,3 − 2,3	+ 2,3 − 2,8	+ 2,3 − 3,3

7.1.3 Pitch length measurement

See annex A for tolerances and annex B for the relationship between the centre distance and the belt pitch length.

7.1.3.1 **Measuring fixture** (see Figure 3)

The pitch length of a synchronous belt shall be determined by placing the belt on a measuring fixture composed of the following elements.

7.1.3.1.1 Two pulleys of equal diameter, as specified in Table 3, of the proper belt type and having standard tooth space dimensions. These pulleys should be made to the tolerances shown in Table 3 and have the proper clearance C_m, between pulley and theoretical belt as specified in Table 3 (see Figure 2). One pulley shall be free to rotate on a fixed-position shaft, while the other shall be free to rotate on a movable shaft to permit the centre distance to change.

7.1.3.1.2 Means of applying a total measuring force to the movable pulley.

7.1.3.1.3 Means of measuring the centre distance between the two pulleys with the necessary degree of accuracy for centre distance measurement.

NOTE The number of pulley teeth specified in Table 3 determine the recommended sizes for measuring the belt pitch length. Practically, other sizes of pulleys could be used provided they have the same number of teeth, and meet the dimensional requirements of Table 3.

7.1.3.2 Total measuring force

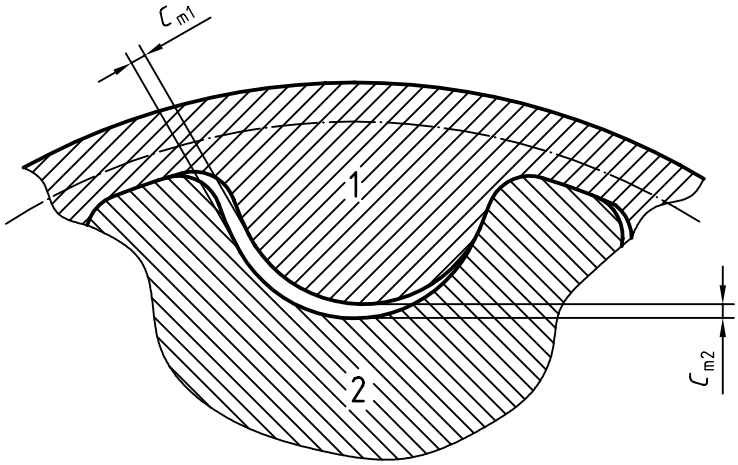
The total measuring force to be applied for measuring belts is given in Table 4.

7.1.3.3 Procedure

In measuring the pitch length of a synchronous belt, the belt should be rotated at least two revolutions to seat it properly and to divide the total force equally between the two lengths of the belt.

The pitch length shall be calculated by adding the pitch circumference of one of the pulleys to twice the measured centre distance.

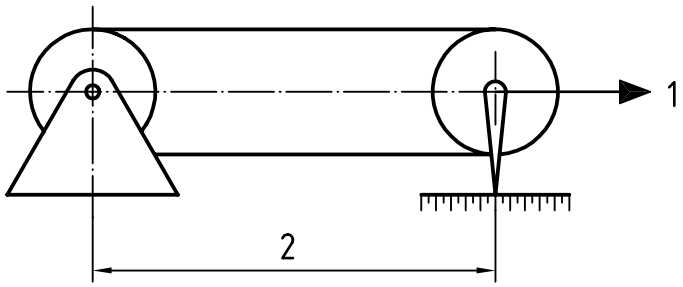
Check double-sided belts on both tooth faces.



Key

1 Belt
2 Pulley

Figure 2 — Clearance between measuring pulley and belt (H-type profile)



Key

1 Total measuring force
2 Centre distance

Figure 3 — Diagram of fixture for measuring pitch length

Table 3 — Belt length measuring pulleys

Dimensions in millimetres

Belt type	Number of grooves	Pitch circumference	Outside diameter [a]	Radial runout F.I.M. [b]	Axial runout F.I.M. [b]	Minimum clearance (see Figure 2)	
						C_{m1}	C_{m2}
H8M, DH8M	34	272	85,209 ± 0,013	0,013	0,025	0,34	0,11
H14M, DH14M	40	560	175,46 ± 0,025	0,013	0,051	0,64	0,20

[a] Pulleys outside of the diameter tolerance range specified may be used if the resulting belt length measurements are corrected for the actual pulley diameters.

[b] Full indicator movement.

Table 4 — Total measuring force

Forces in newtons

Belt type	Total measuring force							
	Belt width, mm							
	20	30	40	50	55	85	115	170
H8M, DH8M	470	750		1 320		2 310		
H14M, DH14M			1 350		2 130	3 660	5 180	7 960

7.2 H-type pulleys

7.2.1 General

See annex C for tolerances.

The pulley is characterized by a curvilinear groove profile. This groove profile is defined as the profile formed by the generating tool rack form required to machine-finish the curvilinear profile. The profile is different for each pulley diameter, but can be closely approximated by a nominal groove profile over specified ranges of number of grooves.

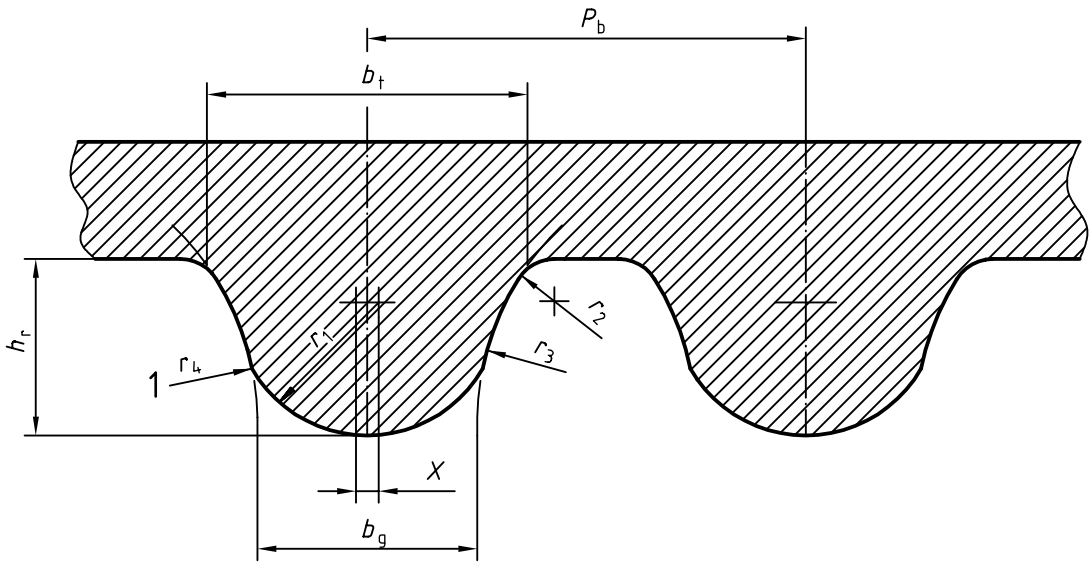
7.2.2 Generating tool rack

Dimensions and tolerances for the generating tool rack for H8M and H14M pulleys are given in Table 5 and shown in Figure 4.

Table 5 — Pulley generating tool rack dimensions

Dimensions in millimetres

Belt section	Number of grooves	P_b ± 0,012	h_r ± 0,015	b_g	b_t	r_1 ± 0,012	r_2 ± 0,012	r_3 ± 0,012	r_4 ± 0,012	X
H8M	22 through 27	8	3,29	3,48	6,04	2,55	1,14	0	0	0
	28 through 89	8	3,61	4,16	6,05	2,77	1,07	12,90	0,73	0,25
	90 through 200	8	3,63	4,24	5,69	2,64	0,94	0	0	0
H14M	28 through 36	14	6,32	7,11	11,14	4,72	1,88	20,83	1,14	0
	37 through 89	14	6,20	7,73	10,79	4,66	1,83	15,75	1,14	0
	90 through 216	14	6,35	8,11	10,26	4,62	1,91	20,12	0,25	0



Key

1 Blend radius

Figure 4 — Pulley generating tool rack form

7.2.3 Pulley groove profile dimensions and tolerances

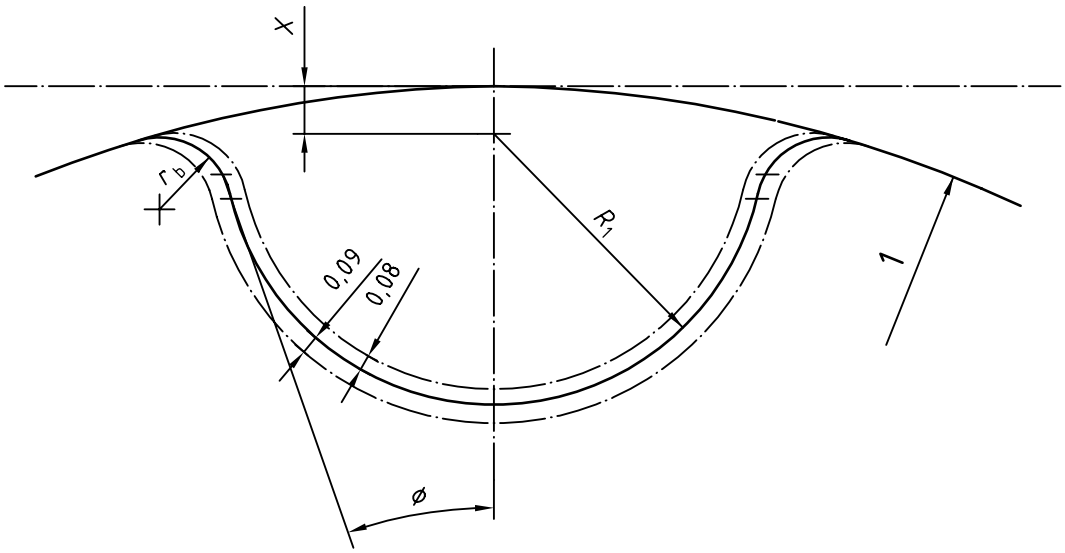
Dimensions and tolerances for the pulley groove profile for H8M and H14M pulleys are given in Table 6 and shown in Figure 5.

Table 6 — Pulley groove profile dimensions

Dimensions in millimetres

Pulley type	Number of grooves		R_1	r_t	X	$\phi°$
H8M	22 through 27	Profile	2,675	0,874	0,620	11,3
		Max.	2,764	1,052	0,620	11,3
		Min.	2,598	0,798	0,620	11,3
	28 through 89	Profile	2,629	1,024	0,975	7
		Max.	2,718	1,201	0,975	7
		Min.	2,553	0,947	0,975	7
	90 through 200	Profile	2,639	1,008	0,991	6,6
		Max.	2,728	1,186	0,991	6,6
		Min.	2,563	0,932	0,991	6,6
H14M	28 through 32	Profile	4,859	1,544	1,468	7,1
		Max.	4,948	1,722	1,468	7,1
		Min.	4,783	1,468	1,468	7,1
	33 through 36	Profile	4,834	1,613	1,494	5,2
		Max.	4,923	1,791	1,494	5,2
		Min.	4,757	1,537	1,494	5,2
	37 through 57	Profile	4,737	1,654	1,461	9,3
		Max.	4,826	1,831	1,461	9,3
		Min.	4,661	1,577	1,461	9,3
	58 through 89	Profile	4,669	1,902	1,529	8,9
		Max.	4,757	2,080	1,529	8,9
		Min.	4,592	1,826	1,529	8,9
	90 through 153	Profile	4,636	1,704	1,692	6,9
		Max.	4,724	1,882	1,692	6,9
		Min.	4,559	1,628	1,692	6,9
	154 through 216	Profile	4,597	1,770	1,730	8,6
		Max.	4,686	1,948	1,730	8,6
		Min.	4,521	1,694	1,730	8,6

Dimensions in millimetres



Key

1 Pulley outside diameter

Figure 5 — Pulley groove profile and tolerance bands

7.2.4 Pulley outside diameters

Pulley outside diameters for the standard pulleys are given in Table 7. The relationship of the pulley outside and pitch diameters is illustrated in Figure 6 and the following formulas. Table 8 provides the N' values to be used in the outside diameter formula.

$$\text{pitch diameter} = \frac{\text{No. of grooves} \times \text{pulley pitch}}{\pi}$$

$$\text{outside diameter} = \text{pitch diameter} - 2a + N'$$

where a is the value given in Table 1.

Table 7 — Standard pulley sizes

Dimensions in millimetres

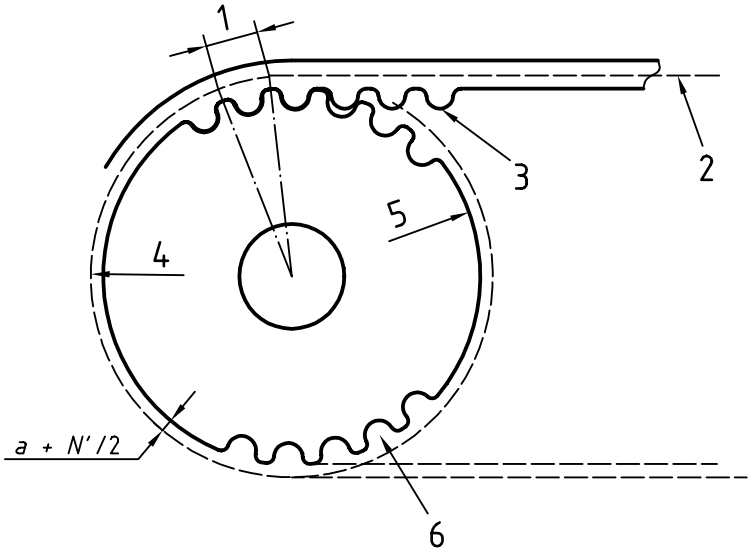
Number of grooves	Pulley type			
	H8M		H14M	
	Pitch diameter	**Outside diameter**	**Pitch diameter**	**Outside diameter**
22	56,02 [a]	54,65		
24	61,12 [a]	59,74		
26	66,21 [a]	64,84		
28	71,30 [a]	70,08	124,78 [a]	122,12
29			129,23 [a]	126,57
30	76,39 [a]	75,13	133,69 [a]	130,99
32	81,49	80,16	142,60 [a]	139,88
34	86,58	85,21	151,52 [a]	148,79
36	91,67	90,30	160,43	157,68
38	96,77	95,39	169,34	166,60
40	101,86	100,49	178,25	175,49
44	112,05	110,67	196,08	193,28
48	122,23	120,86	213,90	211,11
52			231,73	228,94
56	142,60	141,23	249,55	246,76
60			267,38	264,59
64	162,97	161,60	285,21	282,41
68			303,03	300,24
72	183,35	181,97	320,86	318,06
80	203,72	202,35	356,51	353,71
90	229,18	227,81	401,07	398,28
112	285,21 [a]	283,83	499,11	496,32
144	366,69 [a]	365,32	641,71	638,92
168			748,66 [a]	745,87
192	488,92 [a]	487,55	855,62 [a]	852,82
216			962,57 [a]	959,78

[a] Usually not available in all widths — consult supplier.

Table 8 — Values of N'

Values in millimetres

Number of grooves	Pulley type	
	H8M	H14M
	Value of N'	**Value of N'**
28	0,15	0,13
29	0,14	0,13
30	0,11	0,09
31	0,08	0,09
32	0,04	0,07
33	0,02	0,08
34		0,06
35		0,05
36		0,04
37		0,04
38		0,05
39		0,04
40		0,03



Key

1 Pitch (circular pitch)
2 Belt pitch line
3 Belt tooth
4 Pitch diameter
5 Outside diameter
6 Pulley groove

Figure 6 — Pulley dimensions

7.2.5 Pulley width

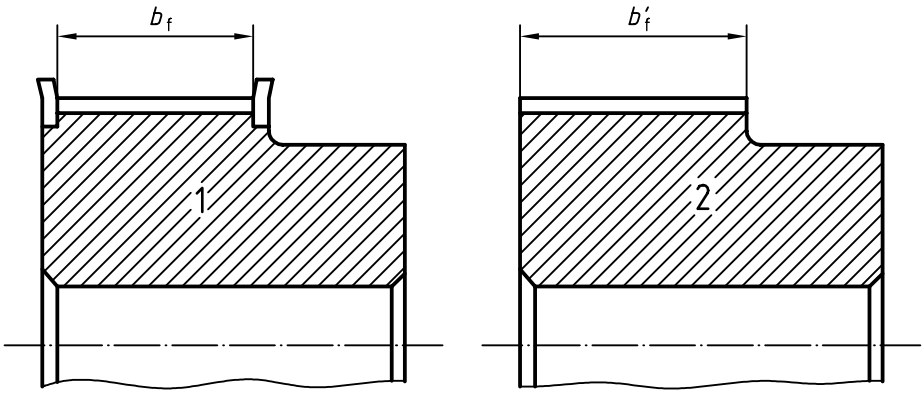
The standard nominal pulley width, and the minimum actual pulley width required, b_f for flanged pulleys, b'_f for unflanged pulleys (see Figure 7), are given in Table 9. Users are advised that the values given for b'_f apply also to pulleys with only one flange (see annex D).

Table 9 — Standard pulley widths

Dimensions in millimetres

Pulley type	Standard nominal pulley width	Minimum pulley width	
		Flanged b_f	Unflanged b'_f
H8M	20	22	30
	30	32	40
	50	53	60
	85	89	96
H14M	40	42	55
	55	58	70
	85	89	101
	115	120	131
	170	175	186

The minimum unflanged pulley width may be reduced when the alignment of the drive can be controlled but shall not be less than the minimum flanged pulley width.



Key

1 Flanged pulley
2 Unflanged pulley

Figure 7 — Minimum pulley width

8 Type R system

8.1 R-type belt dimensions and tolerances

8.1.1 Belt tooth dimensions

The nominal belt tooth dimensions are the same for single-sided and double-sided belts; they are given in Table 10 and shown in Figure 8.

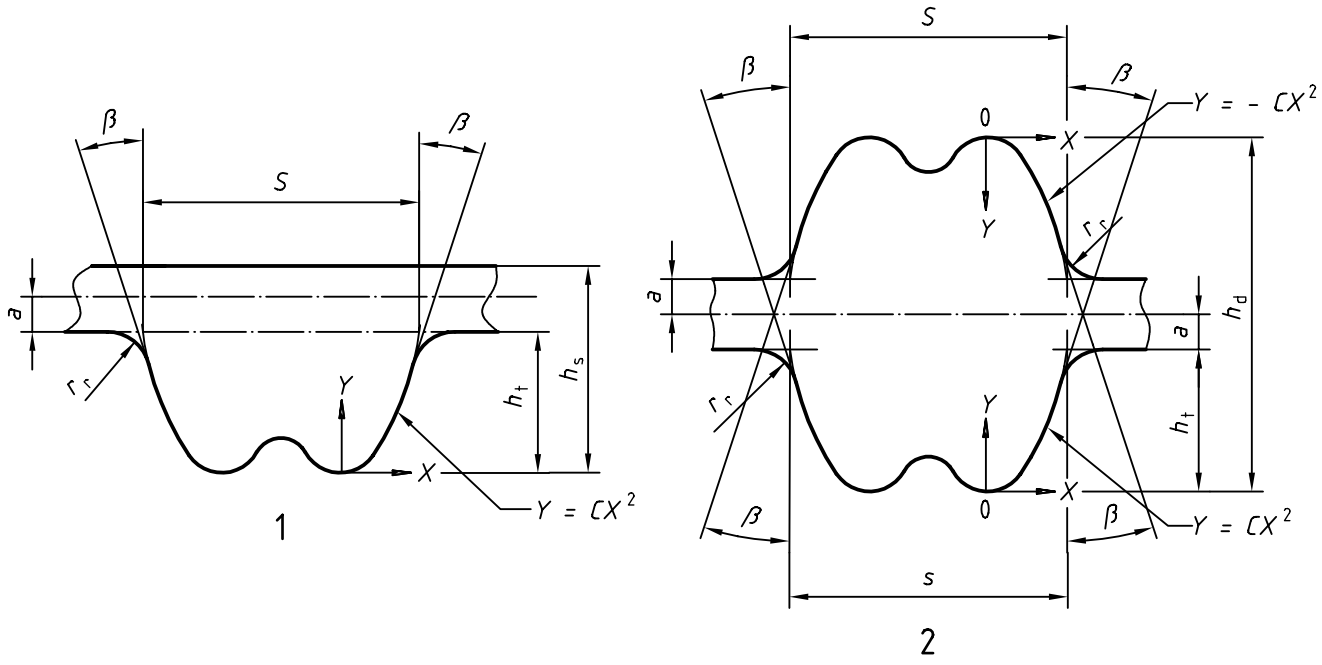
Table 10 — Nominal tooth dimensions[2)]

Dimensions in millimetres

Belt type	Pitch	β	S	h_s	h_d	h_t	r_r	a [a]	C
R8M	8	16°	5,5	5,4		3,2	1	0,686	1,228
DR8M	8	16°	5,5		7,8	3,2	1	0,686	1,228
R14M	14	16°	9,5	9,7		6	1,75	1,397	0,643
DR14M	14	16°	9,5		14,5	6	1,75	1,397	0,643

[a] a is the belt design pitch differential.

2) The belt tooth profiles expressed in Table 10 are covered by Italian Patent No. 1166847, US Patent No. 4,371,363 and corresponding patents in various other countries and assigned to Dayco PTI S.p.A. an Italian company associated with Dayco Products, Inc. which individually and collectively will be referred to herein as “DAYCO”. Permission to use this table and accompanying figure to compare or check profiles should not be considered as an express or implied license to manufacture belts, pulleys, or tooling for said belts or pulleys under any patents or patent applications owned by DAYCO.



Key

1 Single-sided belts

2 Double-sided belts

Figure 8 — Belt tooth dimensions

8.1.2 Belt widths and tolerances

Belt widths and tolerances are given in Table 11.

Table 11 — Widths and width tolerances

Dimensions in millimetres

Belt type	Nominal belt width	Tolerance on width for belt pitch lengths		
		Up to and including 840 mm	Over 840 mm up to and including 1 680 mm	Over 1 680 mm
R8M DR8M	20 30	+ 0,8 − 0,8	+ 0,8 − 1,3	+ 0,8 − 1,3
	50	+ 1,3 − 1,3	+ 1,3 − 1,3	+ 1,3 − 1,5
	85	+ 1,5 − 1,5	+ 1,5 − 2,0	+ 2 − 2
R14M DR14M	40	+ 0,8 − 1,3	+ 0,8 − 1,3	+ 1,3 − 1,5
	55	+ 1,3 − 1,3	+ 1,5 − 1,5	+ 1,5 − 1,5
	85	+ 1,5 − 1,5	+ 1,5 − 2,0	+ 2 − 2
	115 170	+ 2,3 − 2,3	+ 2,3 − 2,8	+ 2,3 − 3,3

8.1.3 Pitch length measurement

See annex A for tolerances and annex B for the relationship between the centre distance and the belt pitch length.

8.1.3.1 **Measuring fixture** (see Figure 10)

The pitch length of a synchronous belt shall be determined by placing the belt on a measuring fixture composed of the following elements.

8.1.3.1.1 Two pulleys of equal diameter, as specified in Table 12, of the proper belt type and having standard tooth space dimensions. These pulleys should be made to the tolerances shown in Table 12 and have the proper clearance C_m, between pulley and theoretical belt as specified in Table 12 (see Figure 9). One pulley shall be free to rotate on a fixed-position shaft, while the other shall be free to rotate on a movable shaft to permit the centre distance to change.

8.1.3.1.2 Means of applying a total measuring force to the movable pulley.

8.1.3.1.3 Means of measuring the centre distance between the two pulleys with the necessary degree of accuracy for centre distance measurement.

NOTE The number of pulley teeth specified in the Table 12 are the recommended sizes to measure the belt pitch length. Practically, other sizes of pulleys could be used provided they have the same number of teeth, and meet the dimensional requirements of Table 12.

8.1.3.2 Total measuring force

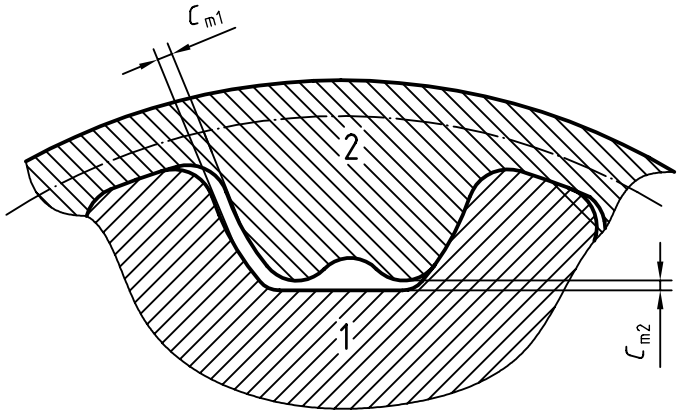
The total measuring force to be applied for measuring belts is given in Table 13.

8.1.3.3 Procedure

In measuring the pitch length of a synchronous belt, the belt should be rotated at least two revolutions to seat it properly and to divide the total force equally between the two lengths of the belt.

The pitch length shall be calculated by adding the pitch circumference of one of the pulleys to twice the measured centre distance.

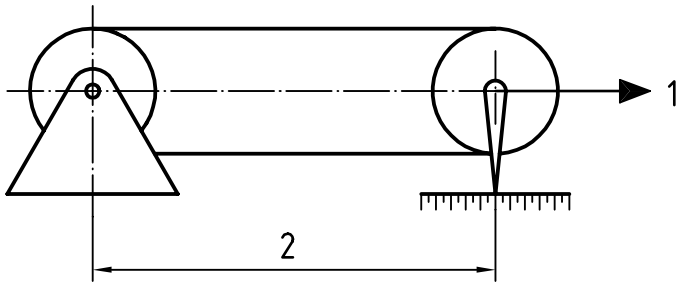
Check double-sided belts on both tooth faces.



Key

1 Pulley
2 Belt

Figure 9 — Clearance between measuring pulley and belt — R-type profile



Key

1 Total measuring force
2 Centre distance

Figure 10 — Diagram of fixture for measuring pitch length

Table 12 — Belt length measuring pulleys

Dimensions in millimetres

Belt type	Number of grooves	Pitch circumference	Outside diameter [a]	Radial runout F.I.M. [b]	Axial runout F.I.M. [b]	Minimum clearance (see Figure 9)	
						C_{m1}	C_{m2}
R8M, DR8M	34	272	85,209 ± 0,013	0,013	0,025	0,30	0,15
R14M, DR14M	40	560	175,46 ± 0,025	0,013	0,051	0,60	0,20

[a] Pulleys outside of the diameter tolerance range specified may be used if the resulting belt length measurements are corrected for the actual pulley diameters.

[b] Full indicator movement.

Table 13 — Total measuring force

Forces in newtons

Belt type	Total measuring force							
	Belt width, mm							
	20	30	40	50	55	85	115	170
R8M, DR8M	470	750		1 320		2 310		
R14M, DR14M			1 350		2 130	3 660	5 180	7 960

8.2 R-type pulleys

See annex C for tolerances.

8.2.1 Generating tool rack

Dimensions and tolerances for the generating tool rack for R8M and R14M pulleys are given in Table 14 and Figure 11.

Table 14 — Pulley generating tool rack dimensions

Dimensions in millimetres

Pulley type	Number of grooves	P_b ± 0,012	A ± 0,5°	b_t	h_p ref.	h_r	W_p ref.	W_r ref.	W_t ± 0,025	r_2 ± 0,025	C
R8M	22 through 27	7,78	18°	5,900 ± 0,025	2,83	3,45 0 − 0,05	2,75	0,58	1,82	0,9	0,837 3
	28 and over	7,89	18°	5,900 ± 0,025	2,79	3,45 0 − 0,05	2,74	0,61	1,84	0,95	0,847 7
R14M	28 and over	13,8	18°	10,45 + 0,05 0	4,93	6,04 + 0,05 0	4,87	1,02	3,32	1,6	0,479 9

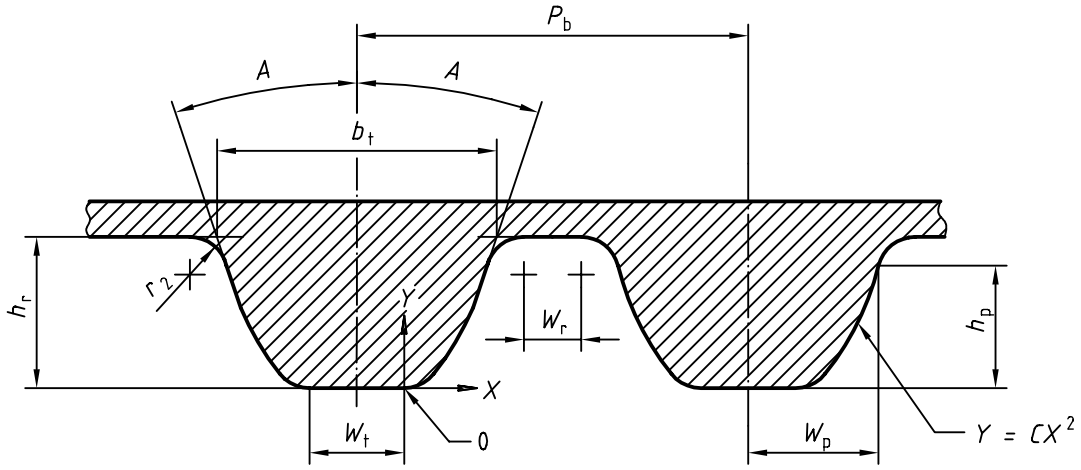


Figure 11 — Pulley generating tool rack form

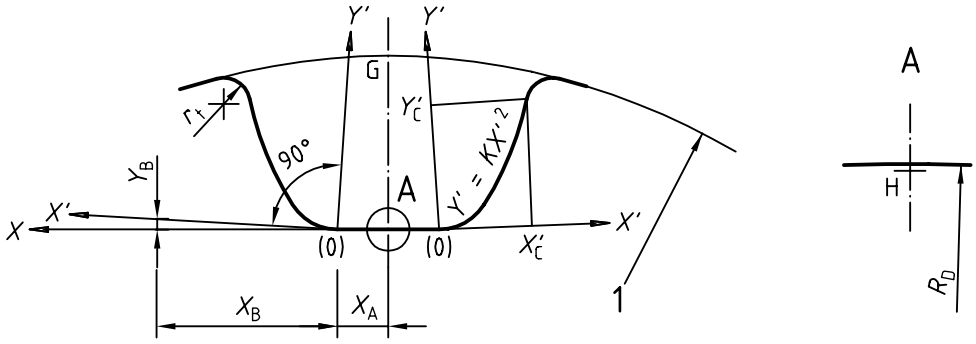
8.2.2 Pulley groove profile dimensions and tolerances

Dimensions and tolerances for the pulley groove profile for R8M and R14M pulleys are given in Table 15 and Table 16 and shown in Figures 12 and 13.

Table 15 — Pulley groove profile dimensions — "R" type profile[3)]

Dimensions in millimetres

Pulley section	Number of teeth	GH	X_A	X_B	Y_B	X'_c	Y'_c	K	r_t	R_D
R8M	22 through 37	3,47	1	4	0,11	1,75	2,61	0,847 67	0,83 ± 0,15	22
	38 and over	3,47	0,92	4	0	1,75	2,61	0,847 67	0,95 ± 0,15	22
R14M	28 and over	6,04	1,64	4	0	3,21	4,93	0,479 9	1,6 ± 0,15	32



Key

1 Pulley outside diameter

Figure 12 — Pulley groove profile

3) The pulley groove profiles expressed in Table 15 are covered by Italian patent 1174166, US patent 4,696,665 and corresponding patents in various other countries assigned to Dayco PTI S.p.A. an Italian company associated with Dayco Products, Inc. which individually and collectively will be referred to herein as "DAYCO". Permission to use this table and accompanying figure to compare or check profiles should not be considered as an express or implied license to manufacture belts, pulleys, or tooling for said belts or pulleys under any patents or patent applications owned by DAYCO.

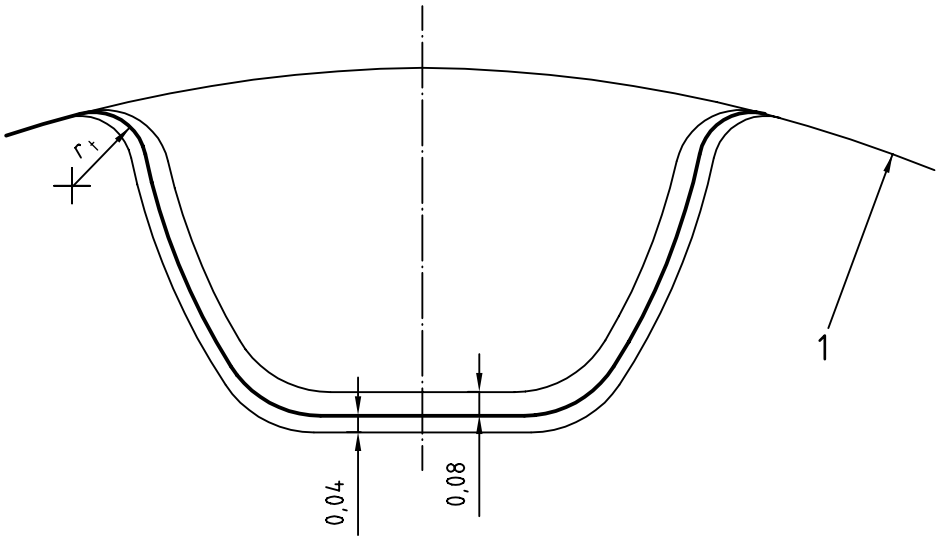
The true profile of the R-type pulley groove can only be produced by plotting the parabolic function associated with the cross section and the number of grooves. Table 16 provides the tip radii dimensions to be used with these generations. Figure 13 illustrates the pulley groove tolerance bands.

Table 16 — Pulley tip radii

Dimensions in millimetres

Pulley type	Number of grooves	r_t
R8M	22 through 27	0,90
R8M	28 and over	0,95
R14M	28 and over	1,60

Dimensions in millimetres



Key

1 Pulley outside diameter

Figure 13 — Pulley groove tolerance band

8.2.3 Pulley outside diameters

Pulley outside diameters for the standard pulleys are given in Table 17. The relationship of the pulley outside and pitch diameters is illustrated in Figure 14 and the following formulas.

$$\text{pitch diameter} = \frac{\text{No. of grooves} \times \text{pulley pitch}}{\pi}$$

$$\text{outside diameter} = \text{pitch diameter} - 2a$$

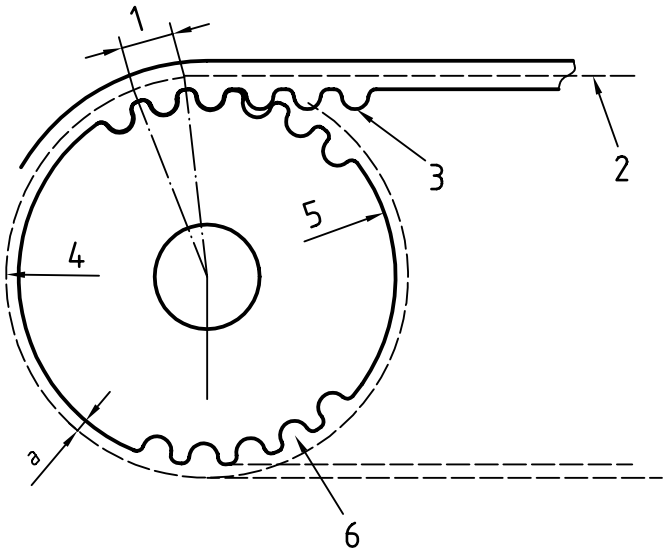
where a is the value given in Table 10.

Table 17 — Standard pulley sizes

Dimensions in millimetres

Number of grooves	Pulley type			
	R8M		R14M	
	Pitch diameter	Outside diameter	Pitch diameter	Outside diameter
22	56,02 [a]	54,65		
24	61,12 [a]	59,74		
26	66,21 [a]	64,84		
28	71,30 [a]	69,93	124,78 [a]	121,98
29			129,23 [a]	126,44
30	76,39 [a]	75,02	133,69 [a]	130,90
32	81,49	80,12	142,60 [a]	139,81
34	86,58	85,21	151,52 [a]	148,72
36	91,67	90,30	160,43	157,63
38	96,77	95,39	169,34	166,55
40	101,86	100,49	178,25	175,46
44	112,05	110,67	196,08	193,28
48	122,23	120,86	213,90	211,11
52			231,73	228,94
56	142,60	141,23	249,55	246,76
60			267,38	264,59
64	162,97	161,60	285,21	282,41
68			303,03	300,24
72	183,35	181,97	320,86	318,06
80	203,72	202,35	356,51	353,71
90	229,18	227,81	401,07	398,28
112	285,21 [a]	283,83	499,11	496,32
144	366,69 [a]	365,32	641,71	638,92
168			748,66 [a]	745,87
192	488,92 [a]	487,55	855,62 [a]	852,82
216			962,57 [a]	959,78

[a] Usually not available in all widths — consult supplier.



Key

1 Pitch (circular pitch)
2 Belt pitch line
3 Belt tooth
4 Pitch diameter
5 Outside diameter
6 Pulley groove

Figure 14 — Pulley dimensions

8.2.4 Pulley width

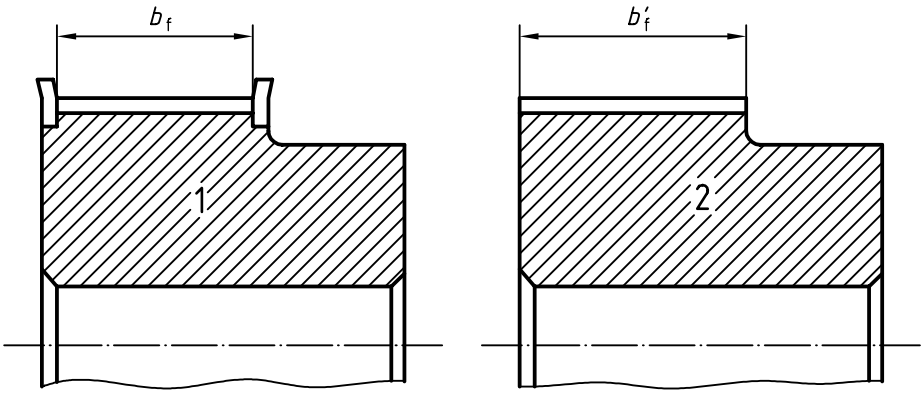
The standard nominal pulley width, and the minimum actual pulley width required, b_f for flanged pulleys, b'_f for unflanged pulleys (see Figure 15), are given in Table 18. Users are advised that the values given for b'_f apply also to pulleys with only one flange (see annex D).

Table 18 — Standard pulley widths

Dimensions in millimetres

Pulley type	Standard nominal pulley width	Minimum pulley width	
		Flanged b_f	Unflanged b'_f
R8M	20	22	30
	30	32	40
	50	53	60
	85	89	96
R14M	40	42	55
	55	58	70
	85	89	101
	115	120	131
	170	175	186

The minimum unflanged pulley width may be reduced when the alignment of the drive can be controlled, but shall not be less than the minimum flanged pulley width.



Key

1 Flanged pulley
2 Unflanged pulley

Figure 15 — Minimum pulley width

9 Type S system

9.1 S-type belt dimensions and tolerances

9.1.1 Belt tooth dimensions

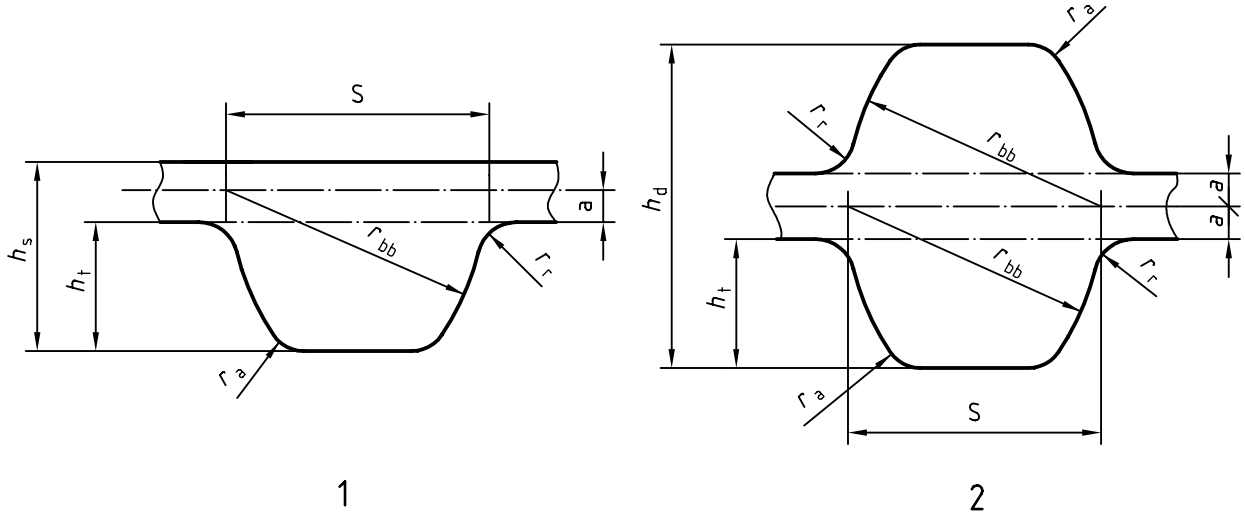
The nominal belt tooth dimensions are the same for one-sided and double-sided belts; they are given in Table 19 and shown in Figure 16.

Table 19 — Nominal tooth dimensions

Dimensions in millimetres

Belt type	Pitch	h_s	h_d	h_t	S	r_{bb}	r_a	r_r	a [a]
S8M	8	5,3		3,05	5,2	5,2	0,8	0,8	0,686
DS8M	8		7,5	3,05	5,2	5,2	0,8	0,8	0,686
S14M	14	10,2		5,3	9,1	9,1	1,4	1,4	1,397
DS14M	14		13,4	5,3	9,1	9,1	1,4	1,4	1,397

[a] a is the belt design pitch differential.



Key

1 Single-sided belts
2 Double-sided belts

Figure 16 — Tooth dimensions

9.1.2 Belt widths and tolerances

Belt widths and tolerances are given in Table 20.

Table 20 — Widths and width tolerances

Dimensions in millimetres

Belt type	Nominal belt width	Tolerance on width for belt pitch lengths		
		Up to and including 840 mm	Over 840 mm up to and including 1 680 mm	Over 1 680 mm
S8M DS8M	15 25 40	+ 0,8 − 0,8	+ 0,8 − 1,3	+ 0,8 − 1,3
	60	+ 1,3 − 1,5	+ 1,5 − 1,5	+ 1,5 − 2,0
S14M	40	+ 0,8 − 1,3	+ 0,8 − 1,3	+ 1,3 − 1,5
	60	+ 1,3 − 1,5	+ 1,5 − 1,5	+ 1,5 − 2,0
DS14M	80 100	+ 1,5 − 1,5	+ 1,5 − 2,0	+ 2 − 2
	120	+ 2,3 − 2,3	+ 2,3 − 2,8	+ 2,3 − 3,3

9.1.3 Pitch length measurement

See annex A for tolerances and annex B for the relationship between the centre distance and the belt pitch length.

9.1.3.1 **Measuring fixture** (see Figure 18)

The pitch length of a synchronous belt shall be determined by placing the belt on a measuring fixture composed of the following elements.

9.1.3.1.1 Two pulleys of equal diameter, as specified in Table 21 of the proper belt type and having standard tooth space dimensions. These pulleys should be made to the tolerances shown in Table 21 and have the proper clearance C_m, between pulley and theoretical belt as specified in Table 21 (see Figure 17). One pulley shall be free to rotate on a fixed-position shaft, while the other shall be free to rotate on a moveable shaft to permit the centre distance to change.

9.1.3.1.2 Means of applying a total measuring force to the movable pulley.

9.1.3.1.3 Means of measuring the centre distance between the two pulleys with the necessary degree of accuracy for center distance measurement.

9.1.3.2 Total measuring force

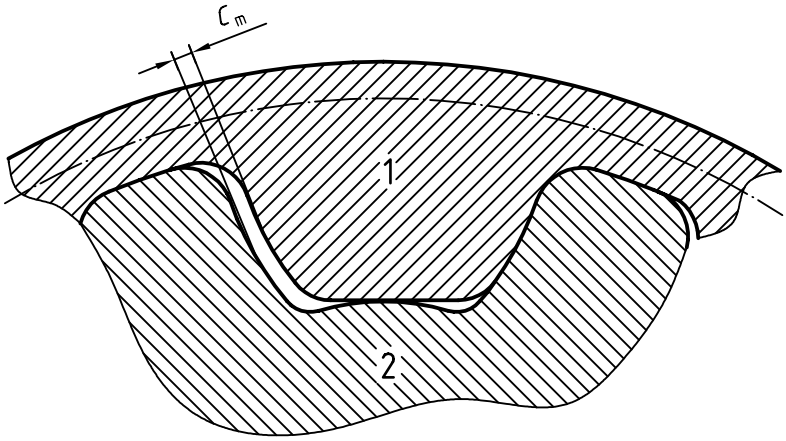
The total measuring force to be applied for measuring belts is given in Table 22.

9.1.3.3 Procedure

In measuring the pitch length of a synchronous belt, the belt should be rotated at least two revolutions to seat it properly and to divide the total force equally between the two lengths of the belt.

The pitch length shall be calculated by adding the pitch circumference of one of the pulleys to twice the measured centre distance.

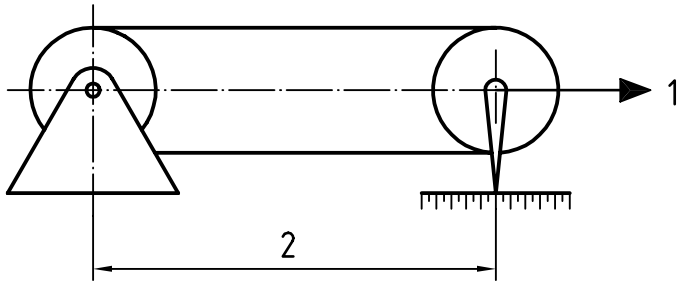
Check double-sided belts on both tooth faces.



Key

1 Belt
2 Pulley

Figure 17 — Clearance between measuring pulley and belt — S-type profile



Key

1 Total measuring force

2 Centre distance

Figure 18 — Diagram of fixture for measuring pitch length

Table 21 — Belt length measuring pulleys

Dimensions in millimetres

Belt type	Number of grooves	Pitch circumference	Outside diameter [a]	Radial runout F.I.M. [b]	Axial runout F.I.M. [b]	Minimum clearance C_m (see Figure 17)
S8M, DS8M	34	272	85,209 ± 0,013	0,013	0,025	0,2
14SM, DS14M	40	560	175,46 ± 0,025	0,013	0,051	0,36

[a] Pulleys outside of the diameter tolerance range specified may be used if the resulting belt length measurements are corrected for the actual pulley diameters.

[b] Full indicator movement.

NOTE The number of pulley teeth specified in Table 21 determine the recommended sizes for measuring the belt pitch length. Practically, other sizes of pulleys could be used provided they each have the same number of teeth, and meet the dimensional requirements of Table 21.

Table 22 — Total measuring force

Forces in newtons

Belt type	Total measuring force						
	Belt width, mm						
	15	25	40	60	80	100	120
S8M, DS8M	570	1 020	1 740	2 770			
S14M, DS14M			2 420	3 840	5 340	6 880	8 470

9.2 S-type pulleys

See annex C for tolerances.

9.2.1 Generating tool rack

Dimensions and tolerances for the generating tool rack for pulleys S8M and S14M are given in Table 23 and Figure 19.

Table 23 — Pulley generating tool rack dimensions

Dimensions in millimetres

Pulley type	Number of grooves	P_b ± 0,012	h_r + 0,05 0	b_t + 0,05 0	r_1 + 0,05 0	r_2 ± 0,03	r_3 ± 0,03	r_4 ± 0,03	r_5 ± 0,10	X	W	a
S8M	22 and over	8	2,83	5,2	5,3	0,75	2,71	0,4	4,04	5,05	1,13	0,686
S14M	28 and over	14	4,95	9,1	9,28	1,31	4,8	0,7	7,07	8,84	1,98	1,397
S8M Optional	22 through 26	7,611	2,83	4,22	4,74	0,8		0,27	5,68			0,256
	27 through 33	7,689	2,83	4,22	4,74	0,8		0,29	5,28			0,279
	34 through 46	7,767	2,83	4,22	4,74	0,8		0,32	4,92			0,299
	47 through 74	7,844	2,83	4,22	4,74	0,8		0,35	4,59			0,321
	75 through 216	7,928	2,83	4,22	4,74	0,8		0,38	4,28			0,342
S14M Optional	28 through 34	13,441	4,95	7,50	8,38	1,36		0,52	9,17			0,784
	35 through 47	13,577	4,95	7,50	8,38	1,36		0,56	8,57			0,819
	48 through 75	13,716	4,95	7,50	8,38	1,36		0,61	8,03			0,856
	76 through 216	13,876	4,95	7,50	8,38	1,36		0,66	7,46			0,896

NOTE Both the standard generating tool rack and the optional one will produce pulleys within acceptable tolerance. However, on pulleys with lower numbers of teeth the optional generating tool rack will be closer to ideal.

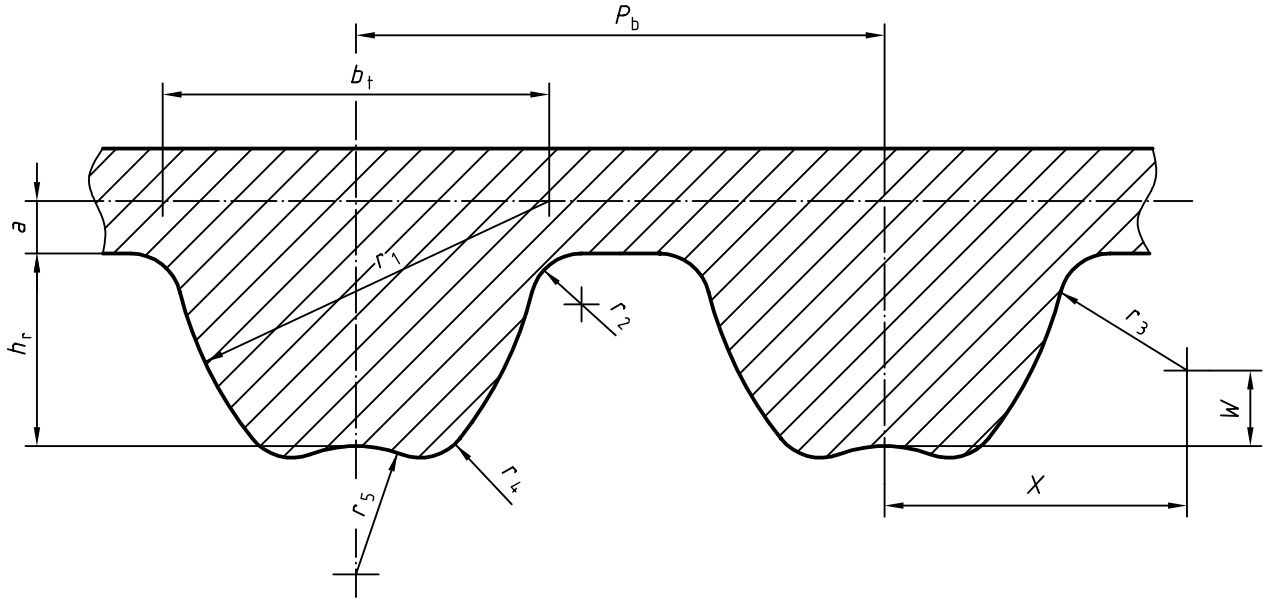


Figure 19 — Pulley generating tool rack form

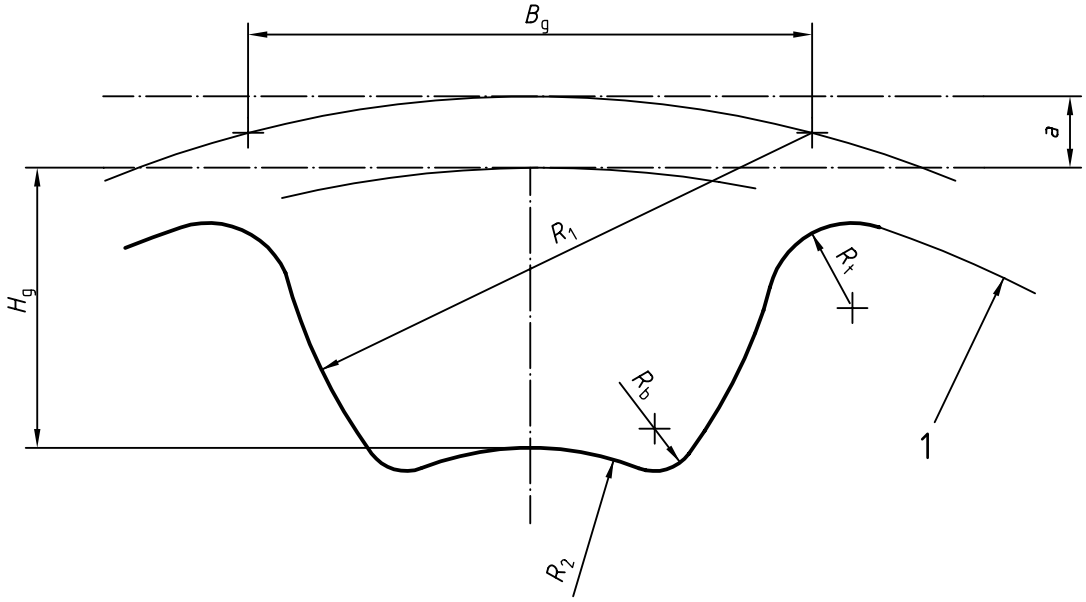
9.2.2 Pulley groove profile dimensions and tolerances

Dimensions and tolerances for the pulley groove profile for pulleys S8M and S14M are given in Table 24 and shown in Figure 20.

Table 24 — Pulley groove profile dimensions

Dimensions in millimetres

Pulley type	Number of grooves	B_g + 0,1 0	H_g ± 0,03	R_2 ± 0,1	R_b ± 0,1	R_t + 0,1 0	a	R_1 + 0,1 0
S8M	22 and over	5,2	2,83	4,04	0,4	0,75	0,686	5,3
S14M	28 and over	9,1	4,95	7,07	0,7	1,31	1,397	9,28



Key

1 Pulley outside diameter

Figure 20 — Pulley groove profile

9.2.3 Pulley outside diameters

Pulley outside diameters for the standard pulleys are given in Table 25. The relationship of the pulley outside and pitch diameters is illustrated in Figure 21 and the following formulas.

$$\text{pitch diameter} = \frac{\text{No. of grooves} \times \text{pulley pitch}}{\pi}$$

$$\text{outside diameter} = \text{pitch diameter} - 2a$$

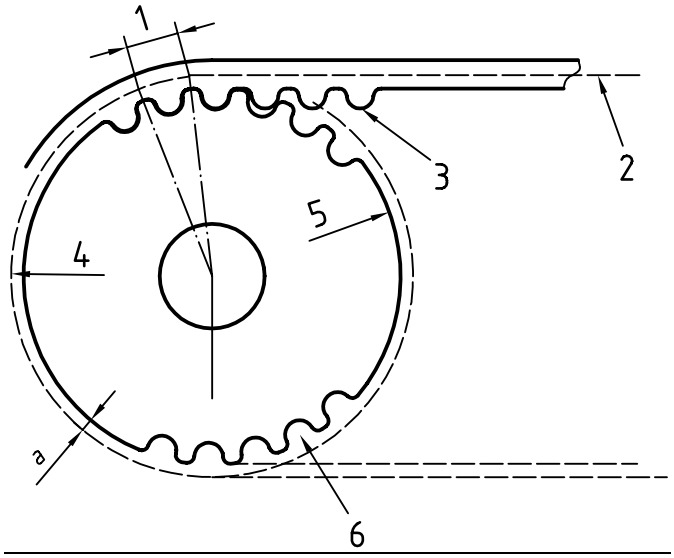
where a is the value given in Table 19.

Table 25 — Standard pulley sizes

Dimensions in millimetres

Number of grooves	Belt type			
	S8M		S14M	
	Pitch diameter	Outside diameter	Pitch diameter	Outside diameter
22	56,02 [a]	54,65		
24	61,12 [a]	59,74		
26	66,21 [a]	64,84		
28	71,30 [a]	69,93	124,78 [a]	121,98
29			129,23 [a]	126,44
30	76,39 [a]	75,02	133,69 [a]	130,90
32	81,49	80,12	142,60 [a]	139,81
34	86,58	85,21	151,52 [a]	148,72
36	91,67	90,30	160,43	157,63
38	96,77	95,39	169,34	166,55
40	101,86	100,49	178,25	175,46
44	112,05	110,67	196,08	193,28
48	122,23	120,86	213,90	211,11
52			231,73	228,94
56	142,60	141,23	249,55	246,76
60			267,38	264,59
64	162,97	161,60	285,21	282,41
68			303,03	300,24
72	183,35	181,97	320,86	318,06
80	203,72	202,35	356,51	353,71
90	229,18	227,81	401,07	398,28
112	285,21 [a]	283,83	499,11	496,32
144	366,69 [a]	365,32	641,71	638,92
168			748,66 [a]	745,87
192	488,92 [a]	487,55	855,62 [a]	852,82
216			962,57 [a]	959,78

[a] Usually not available in all widths — consult supplier.



Key

1 Pitch (circular pitch)
2 Belt pitch line
3 Belt tooth
4 Pitch diameter
5 Outside diameter
6 Pulley groove

Figure 21 — Pulley dimensions

9.2.4 Pulley width

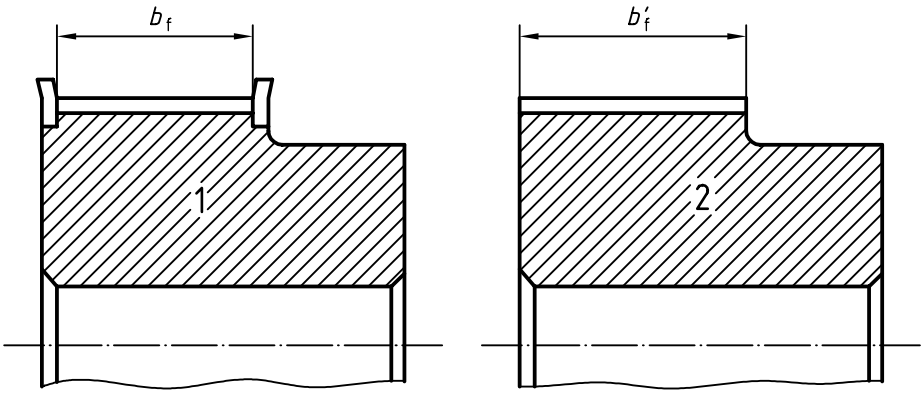
The standard nominal pulley width, and the minimum actual pulley width required, b_f for flanged pulleys, b'_f for unflanged pulleys (see Figure 22), are given in Table 26. Users are advised that the values given for b'_f apply also to pulleys with only one flange (see annex D).

Table 26 — Standard pulley widths

Dimensions in millimetres

Pulley type	Standard nominal pulley width	Minimum pulley width	
		Flanged b_f	Unflanged b'_f
S8M	15	16,3	25
	25	26,6	35
	40	42,1	50
	60	62,7	70
S14M	40	41,8	55
	60	62,9	76
	80	83,4	96
	100	103,8	116
	120	124,3	136

The minimum unflanged pulley width may be reduced when the alignment of the drive can be controlled, but shall not be less than the minimum flanged pulley width.



Key

1 Flanged pulley
2 Unflanged pulley

Figure 22 — Minimum pulley width

Annex A
(normative)

Belt pitch lengths and tolerances

The belt pitch lengths and tolerances are given in Table A.1.

Table A.1 — Standard pitch lengths and tolerances

Dimensions in millimetres

Belt length designation	Pitch length	Permissible deviation from standard length				Number of teeth for standard lengths	
		8M	14M	D8M	D14M	8M	14M
480	480	± 0,51		+ 1,02/ – 0,76		60	
560	560	± 0,61		+ 1,22/– 0,91		70	
640	640	± 0,61		+ 1,22/ – 0,91		80	
720	720	± 0,61		+ 1,22/– 0,91		90	
800	800	± 0,66		+1,32/– 0,99		100	
880	880	± 0,66		+1,32/– 0,99		110	
960	960	± 0,66		+1,32/– 0,99		120	
966	966		± 0,66		+1,32/– 0,99		69
1 040	1 040	± 0,76		+1,52/– 1,14		130	
1 120	1 120	± 0,76		+1,52/– 1,14		140	
1 190	1 190		± 0,76		+1,52/– 1,14		85
1 200	1 200	± 0,76		+1,52/– 1,14		150	
1 280	1 280	± 0,81		+1,62/– 1,21		160	
1 400	1 400		± 0,81		+1,62/– 1,21		100
1 440	1 440	± 0,81		+1,62/– 1,21		180	
1 600	1 600	± 0,86		+1,73/– 1,29		200	
1 610	1 610		± 0,86		+1,73/– 1,29		115
1 760	1 760	± 0,86		+1,73/– 1,29		220	
1 778	1 778		± 0,91		+1,82/– 1,36		127
1 800	1 800	± 0,91		+1,82/– 1,36		225	
1 890	1 890		± 0,91		+1,82/– 1,36		135
2 000	2 000	± 0,91		+1,82/– 1,36		250	
2 100	2 100		± 0,97		+1,94/– 1,45		150
2 310	2 310		± 1,02		+2,04/– 1,53		165
2 400	2 400	± 1,02		+2,04/– 1,53		300	
2 450	2 450		± 1,02		+2,04/– 1,53		175
2 590	2 590		± 1,07		+2,14/– 1,60		185
2 600	2 600	± 1,07		+2,14/– 1,60		325	
2 800	2 800	± 1,12	± 1,12	+2,24/– 1,68	+2,24/– 1,68	350	200
3 150	3 150		± 1,17		+2,34/– 1,75		225
3 360	3 360		± 1,22		+2,44/– 1,83		240
3 500	3 500		± 1,22		+2,44/– 1,83		250
3 600	3 600	± 1,28		+2,56/– 1,92		450	
3 850	3 850		± 1,32		+2,64/– 1,98		275
4 326	4 326		± 1,42		+2,84/– 2,13		309
4 400	4 400	± 1,42		+2,84/– 2,13		550	
4 578	4 578		± 1,46		+2,92/– 2,19		327
4 956	4 956		± 1,52		+3,04/– 2,28		354
5 320	5 320		± 1,58		+3,16/– 2,37		380
5 740	5 740		± 1,70		+3,40/– 2,55		410
6 160	6 160		± 1,82		+3,64/– 2,73		440
6 860	6 860		± 2,00		+4,00/– 3,00		490

Annex B
(normative)

Relationship between centre distance and belt pitch length

The relationship between centre distance and belt pitch length is given by the following formula:

$$L_p = 2\,C\cos\phi + \frac{\pi(D+d)}{2} + \frac{\pi\phi(D-d)}{180}$$

where

L_p is the pitch length of belt, in millimetres;

C is the centre distance, in millimetres;

D is the pitch diameter of large pulley, in millimetres;

d is the pitch diameter of small pulley, in millimetres.

$$\phi = \sin^{-1}\left(\frac{D-d}{2C}\right) \text{ degrees}$$

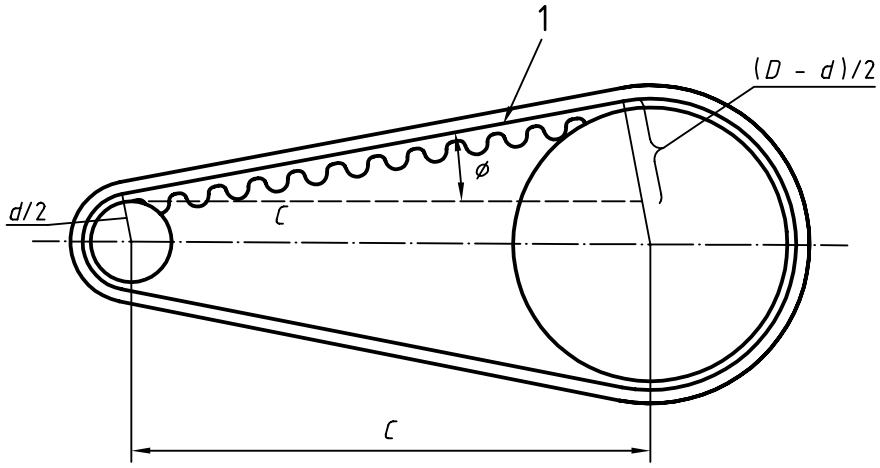
The approximate centre distance can be found by the following formula:

$$C = \frac{K + \sqrt{K^2 - 32\,(D-d)^2}}{16}$$

where

$K = 4\,L_p - 6{,}28\,(D + d)$

The exact centre distance can then be determined by trial, using the belt pitch length formula, or by using the centre distance tables available from the belt manufacturers.



Key

1 Pitch line

Figure B.1

Annex C
(normative)

Pulley tolerances

C.1 Pitch-to-pitch tolerances

Tolerances on the amount of deviation of pulley pitch between adjacent teeth, and on the summation of deviations within 90° arc of a pulley, are given in Table C.1. This tolerance applies to the distance between the same point on either the right or left corresponding flanks of adjacent teeth.

Table C.1 — Pitch-to-pitch tolerance

Dimensions in millimetres

Outside diameter d_o	**Allowable deviation of pitch**	
	Between any two adjacent teeth	**Summation within a** 90°arc [a]
$50{,}8 < d_o \leqslant 101{,}6$	0,03	0,1
$101{,}6 < d_o \leqslant 177{,}8$	0,03	0,13
$177{,}8 < d_o \leqslant 304{,}8$	0,03	0,15
$304{,}8 < d_o \leqslant 508$	0,03	0,18
$d_o > 508$	0,03	0,2

[a] The allowable deviation of pitch is to include the next full tooth past a 90° arc.

C.2 Diameter tolerances

Table C.2 — Tolerances on outside diameter

Dimensions in millimetres

Outside diameter d_o	Tolerance
50,8 < $d_o \leqslant$ 101,6	$^{+0,1}_{0}$
101,6 < $d_o \leqslant$ 177,8	$^{+0,13}_{0}$
177,8 < $d_o \leqslant$ 304,8	$^{+0,15}_{0}$
304,8 < $d_o \leqslant$ 508	$^{+0,18}_{0}$
508,0 < $d_o \leqslant$ 762	$^{+0,2}_{0}$
762,0 < $d_o \leqslant$ 1 016	$^{+0,23}_{0}$
d_o > 1 016	$^{+0,25}_{0}$

C.3 Axial circular runout

See Table C.3.

C.4 Radial circular runout

See Table C.4.

C.5 Parallelism

Teeth shall be parallel to the axis of the bore within 0,001 mm per millimetre of face width.

C.6 Taper

The maximum taper will be 0,001 mm per millimetre of face width provided that the outside diameter is within the tolerance given in Table C.2.

C.7 Quality specifications

The quality, finish and balance of pulleys shall comply with the requirements specified in ISO 254.

Table C.3 — Axial circular runout

Dimensions in millimetres

Outside diameter range d_0	**F.I.M.** [a] max.
$d_0 \leqslant 101{,}6$	0,1
$101{,}6 < d_0 \leqslant 254$	0,001 per millimetre of outside diameter
$d_0 > 254$	0,25 + 0,000 5 per millimetre of outside diameter $d_0 > 254$
[a] Full indicator movement.	

Table C.4 — Radial circular runout

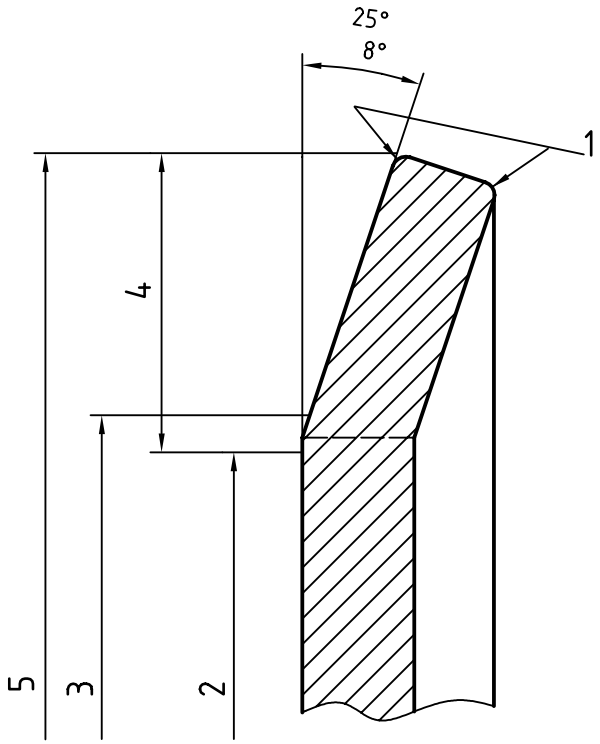
Dimensions in millimetres

Outside diameter range d_0	**F.I.M.** [a] max.
$d_0 \leqslant 203{,}2$	0,13
$d_0 > 203{,}2$	0,13 + 0,000 5 per millimetre of outside diameter $d_0 > 203{,}2$
[a] Full indicator movement	

Annex D
(informative)

Flange dimensions

The minimum flange height (h) equals the belt tooth height (h_t) plus the pitch line differential (a) for the respective H, R, or S system. The flange dimensions are illustrated in Figure D.1.



Key

1 Break sharp corners
2 Outside diameter, d_0
3 Bend diameter, d_0 + 0,38 mm ± 0,25 mm
4 Minimum height of flange, h
5 Flange outside diameter, d_0 + 2h

Figure D.1 — Flange dimensions

ICS 21.220.10

Price based on 37 pages