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NWP 13050

Curvilinear toothed synchronous belt drive systems

<table>
<tr><td align="center">**Warning**</td></tr>
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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.

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The main task of technical committees is to prepare International Standards. 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.

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ISO 13050 was prepared by Technical Committee ISO/TC 41, *Pulleys and belts*, Subcommittee SC 4, *Synchronous belt drives*.

This third edition cancels and replaces the second edition (2004), which has been technically revised.

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; and tolerances;

d) belt length measurement specifications;

e) pulley groove dimensions and tolerances;

f) pulley diameter and width dimensions and tolerances;

g) pulley quality specification.

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

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.*

ISO 1101:1983, *Technical drawings -- Geometrical tolerancing -- Tolerancing of form, orientation, location and run-out -- Generalities, definitions, symbols, indications on drawings.*

2   Belt types

Twelve belt types for synchronous drives are standardized:

- Type H3M (H Type Tooth Profile)

- Type R3M (R Type Tooth Profile)

- Type H5M (H Type Tooth Profile)

- Type R5M (R Type Tooth Profile)

- Type H8M (H Type Tooth Profile)

- Type R8M (R Type Tooth Profile)

- Type S8M (S Type Tooth Profile)

- Type H14M (H Type Tooth Profile)

- Type R14M (R Type Tooth Profile)

- Type S14M (S Type Tooth Profile)

- Type H20M (H Type Tooth Profile)

- Type R20M (R Type Tooth Profile)

3   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 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.

4   Pulley types

Twelve pulley types for synchronous drives are standardized:

- Type H3M (H Type Groove Profile)

- Type R3M (R Type Groove Profile)

- Type H5M (H Type Groove Profile)

- Type R5M (R Type Groove Profile)

- Type H8M (H Type Groove Profile)

- Type R8M (R Type Groove Profile)

- Type S8M (S Type Groove Profile)

- Type H14M (H Type Groove Profile)

- Type R14M (R Type Groove Profile)

- Type S14M (S Type Groove Profile)

- Type H20M (H Type Groove Profile)

- Type R20M (R Type Groove Profile)

5   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.

8 Type H system

8.1 H-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 1 and shown in Figure 1.

Table 1 — Nominal tooth dimensions

Dimensions in millimetres

Belt Section	Pitch	h_s	h_d	h_t	P_1 (X,Y)	P_5 (X,Y)	r_1	P_2 (X,Y)	P_6 (X,Y)	P_3 (X,Y)	P_7 (X,Y)	r_2	P_4 (X,Y)	P_8 (X,Y)	a
H3M	3	2,4	----	1,21	-1,14 0,00	----	0,30	-0,83 -0,30	----	-0,83 -0,35	----	0,86	0,00 -1,21	----	0,381
DH3M	3	----	3,2	----	----	-1,14 0,76	0,30	----	-0,83 1.06	----	-0,83 1,11	0,86	----	0,00 1,97	0,381
H5M	5	3,8	----	2,08	-1,85 0,00	----	0,41	-1,44 -0,42	----	-1,44 -0,53	----	1,50	0,00 -2,08	----	0,572
DH5M	5	----	5,3	----	----	-1,85 1,14	0,41	----	-1,44 1,56	----	-1,44 1,67	1,50	----	0,00 3,22	0,572
H8M	8	6,0	----	3,38	-3,30 0,00	----	0,76	-2,55 -0,65	----	-2,47 -1,17	----	2,59	0,00 -3,38	----	0,686
DH8M	8	----	8,1	----	----	-3,30 1,37	0,76	----	-2,55 2,02	----	-2,47 2,54	2,59	----	0,00 4,75	0,686
H14M	14	10,0	----	6,02	-5,78 0,00	----	1,42	-4,36 -1,29	----	-4,30 -1,97	----	4,46	0,00 -6,02	----	1,397
DH14M	14	----	14,8	----	----	-5,78 2,79	1,42	----	-4,36 4,08	----	-4,30 4,76	4,46	----	0,00 8,81	1,397
H20M	20	13.2	----	8,68	-8,34 0,00	----	2,03	-6,32 -1,84	----	-6,22 -2,90	----	6,40	0,00 -8,68	----	2,159

Single-Sided Belts   **Double-Sided Belts**
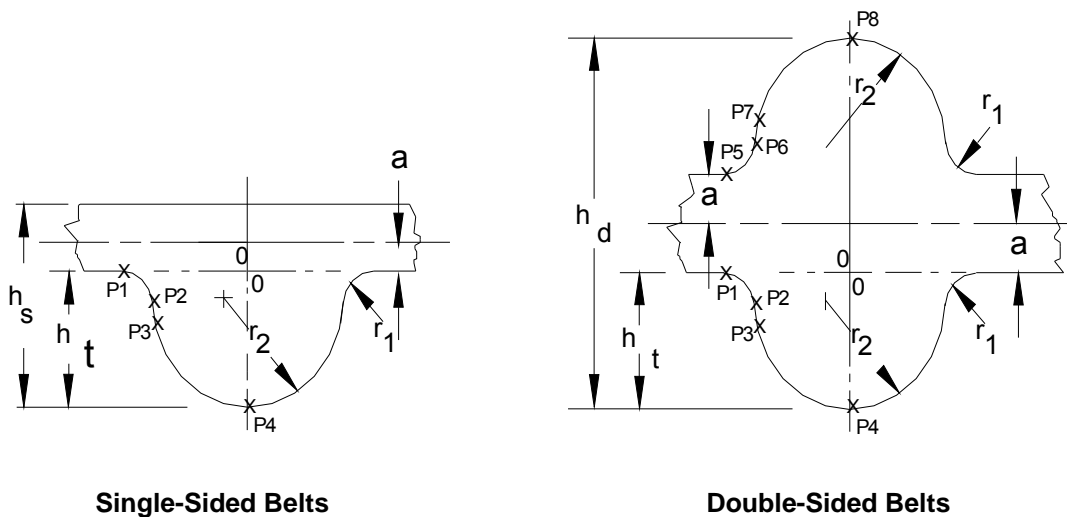
Figure 1 – Tooth Dimensions – "H" Type Profile

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
H3M	6 9	+ 0,4 − 0,8	+ 0,4 − 0,8	----
DH3M	15	+ 0,8 − 0,8	+ 0,8 − 1,2	+ 0,8 − 1,2
H5M	9	+ 0,4 − 0,8	+ 0,4 − 0,8	----
DH5M	15 25	+ 0,8 − 0,8	+ 0,8 − 1.2	+ 0,8 − 1.2
H8M	20 30	+ 0,8 − 0,8	+ 0,8 − 1,2	+ 0,8 − 1,2
DH8M	50	+ 0,8 − 1,2	+ 1,2 − 1,2	+ 1,2 − 1,6
	85	+ 1,6 − 1,6	+ 1,6 − 2,0	+ 2,0 − 2,0
H14M	40	+ 0,8 − 1,2	+ 1,2 − 1,2	+ 1,2 − 1,6
	55	+ 1,2 − 1,2	+ 1,2 − 1,6	+ 1,6 − 1,6
DH14M	85	+ 1,6 − 1,6	+ 1,6 − 2,0	+ 2,0 − 2,0
	115 170	+ 2,4 − 2,4	+ 2,4 − 2,8	+ 2,4 − 3,2
H20M	115 170	+ 2,4 − 2,4	+ 2,4 − 2,8	+ 2,4 − 3,2
	230 290 340	----	----	+ 4,8 − 6,4

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 11)

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.   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. 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.

7.1.3.1.   Means of applying a total measuring force to the moveable 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.

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 spans 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.
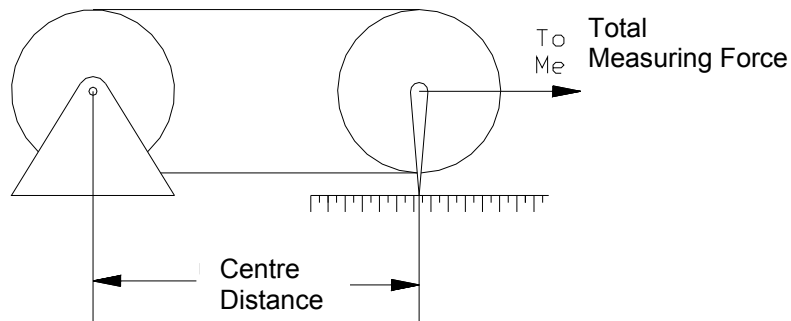
Figure 2 — Diagram of fixture for measuring pitch length

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]
H3M, DH3M	30	90	27,886 ± 0,013	0,013	0,025
H5M, DH5M	20	100	30,687 ± 0,013	0,013	0,025
H8M, DH8M	34	272	85,208 ± 0,013	0,013	0,025
H14M, DH14M	40	560	175,46 ± 0,025	0,013	0,051
H20M	40	800	250,33 ± 0,036	0,013	0,076

[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 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.

Table 4 — Total measuring force

Forces in newtons

Belt Pitch	Belt width (mm)														
	6	9	15	20	25	30	40	50	55	85	115	170	230	290	340
H3M, DH3M	45	76	138												
H5M, DH5M		111	214		376										
H8M, DH8M				470		750		1 320		2 310					
H14M, DH14M							1 350		2 130	3 660	5 180	7 960			
H20M											6 961	10 729	14 839	18 949	22 374

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 H-type pulleys are given in Table 5 and shown in Figure 3.

Table 5 – Pulley generating tool rack dimensions

Dimensions in millimetres

| Belt Section	Number of Grooves	P_b ±0,012	h_r ±0,015	Po (X,Y)	r_1 ±0,012	P_1 (X,Y)	r_2 ±0,012	P_2 (X,Y)	r_3 ±0,012	P_3 (X,Y)	r_4 ±0,012	P_4 (X,Y)	r_5 ±0,012	P_5 (X,Y)	X
H3M	9 thru 13	3,000	1,196	1,4230	0,414	1,061 -0,213	----	----	∞	0,712 -0,840	0,559	0,574 -1,004	0,869	0,029 -1,196	0,029
	14 thru 25	3,000	1,173	1,3240	0,254	1,139 -0,080	0,792	0,992 -0,300	∞	0,747 -0,860	0,254	0,687 -0,944	0,844	0,114 -1,168	0,114
	26 thru 80	3,000	1,227	1,2230	0,262	0,982 -0,159	2,616	0,820 -0,679	-----	----	0,493	0,733 -0,877	0,869	0,036 -1,227	0,036
	81 thru 200	3,000	1,232	1,3330	0,358	0,981 -0,290	----	----	∞	0,923 -0,554	----	----	0,866	0,077 -1,232	0,077
H5M	12 thru 16	5,000	1,986	2,3440	0,659	1,739 -0,316	4,475	1,522 -0,720	∞	1,124 -1,560	0,691	0,773 -1,895	1,133	0,328 -1,986	0,328
	17 thru 31	5,000	2,024	2,2420	0,610	1,871 -0,126	1,431	1,540 -0,593	∞	1,163 -1,566	0,612	1,013 -1,789	1,219	0,295 -2,024	0,295
	32 thru 79	5,000	2,032	2,0730	0,493	1,675 -0,203	1,359	1,501 -0,566	∞	1,370 -1,035	1,402	1,088 -1,617	1,300	0,135 -2,032	0,135
	80 thru 200	5,000	2,065	2,1600	0,610	1,564 -0,483	----	----	∞	1,443 -1,050	----	----	1,471	0,043 -2,065	0,043

Table 5 Continued – Pulley generating tool rack dimensions

Dimensions in millimetres

Belt Section	Number of Grooves	P_b ±0,012	h_r ±0,015	Po (X,Y)	r_1 ±0,012	P_1 (X,Y)	r_2 ±0,012	P_2 (X,Y)	r_3 ±0,012	P_3 (X,Y)	r_4 ±0,012	P_4 (X,Y)	r_5 ±0,012	P_5 (X,Y)	X
H8M	22 thru 27	8,000	3,289	3,805 0	1,143	2,738 -0,648	----	----	∞	2,322 -1,801	----	----	2,553	0 -3,289	----
	28 thru 89	8,000	3,612	3,754 0	1,067	2,748 -0,711	12,903	2,360 -2,024	----	----	0,726	2,283 -2,215	2,744	0 -3,612	----
	90 thru 200	8,000	3,632	3,617 0	0,940	2,697 -0,757	----	----	∞	2,459 -1,948	----	----	2,637	0 -3,632	----
H14M	28 thru 36	14,000	6,320	6,761 0	1,880	5,037 -1,133	20,828	4,064 -3,904	----	----	1,143	3,909 -4,242	4,717	0 -6,320	----
	37 thru 89	14,000	6,223	6,599 0	1,829	4,890 -1,176	15,748	4,204 -3,493	----	----	1,143	4,089 -3,802	4,663	0 -6,223	----
	90 thru 216	14,000	6,350	6,546 0	1,905	4,704 -1,425	20,117	4,288 -3,439	----	----	0,254	4,270 -3,498	4,623	0 -6,350	----
H20M	34 thru 45	20,000	8,644	9,786 0	2,814	7,105 -1,852	----	----	∞	5,972 -4,947	----	----	5,625	0,753 -8,644	0,753
	46 thru 100	20,000	8,591	9,529 0	2,667	7,041 -1,662	20,329	6,015 -5,121	----	----	----	----	5,842	0,711 -8,591	0,711
	101 thru 220	20,000	8,690	9,787 0	2,676	7,305 -1,760	----	----	∞	6,165 -4,855	----	----	5,833	0,739 -8,690	0,739
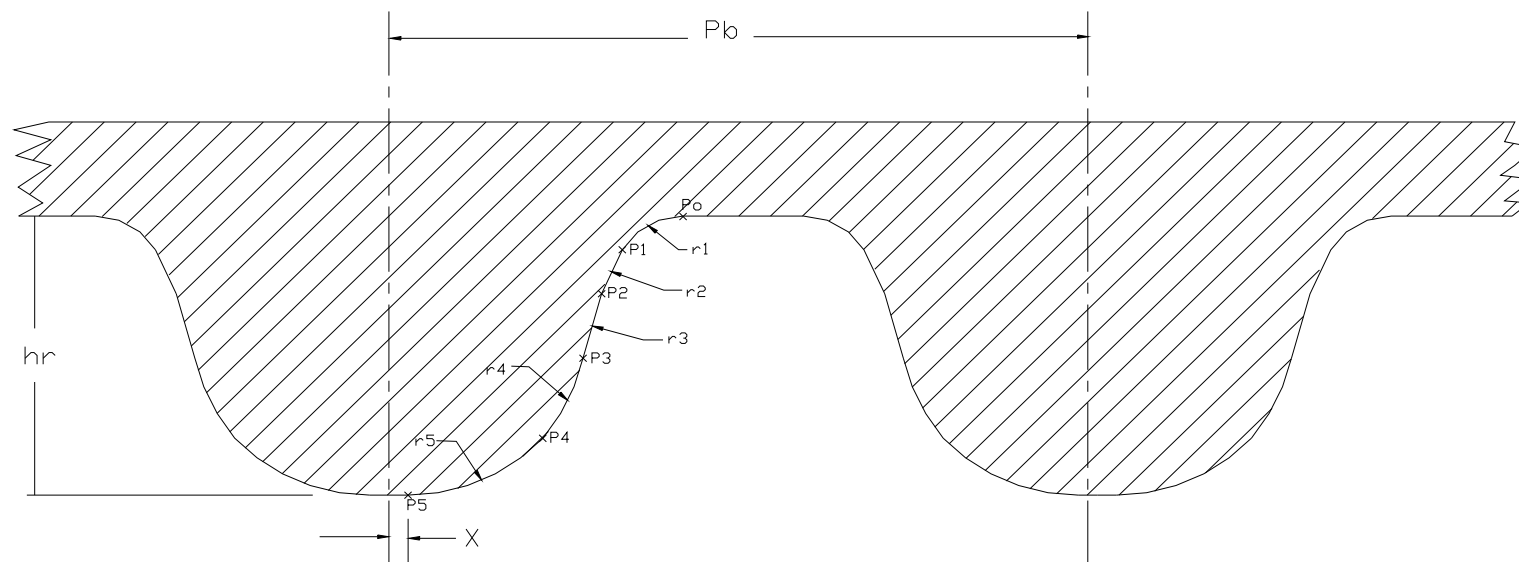
Figure 3 — Pulley generating tool rack form

7.2.3   Pulley groove profile dimensions and tolerances

Dimensions and tolerances for the pulley groove profile for H3M, H5M, H8M, H14M and H20M pulleys are given in Table 6 and shown in Figure 4.

Table 6– Pulley groove profile dimensions

Dimensions in millimetres

Belt Section	Number of Grooves	Hg	X	R_1	θ°	R_2	Profile Band[a]
H3M	10 thru 13	1,190	0,029	0,991	15	0,181	±0,051
	14 thru 25	1,179	0,112	0,889	9	0,229	
	26 thru 80	1,219	0,028	0,927	8	0,191	
	81 thru 200	1,234	0,074	0,925	4	0,301	
H5M	12 thru 16	1,989	0,307	1,265	10	0,432	±0,051
	17 thru 25	2,009	0,320	1,270	6	0,508	
	26 thru 80	2,052	0,081	1,438	2	0,488	
	81 thru 200	2,056	0,028	1,552	5	0,569	
H8M	22 thru 27	3,295	0,000	2,675	11,3	0,874	+0,090 -0,080
	28 thru 89	3,604	0,000	2,629	7	1,024	
	90 thru 200	3,630	0,000	2,639	6,6	1,008	
H14M	28 thru 32	6,327	0,000	4,859	7,1	1,544	+0,090 -0,080
	33 thru 36	6,328	0,000	4,834	5,2	1,613	
	37 thru 57	6,198	0,000	4,737	9,3	1,654	
	58 thru 89	6,198	0,000	4,669	8,9	1,902	
	90 thru 153	6,328	0,000	4,636	6,9	1,704	
	154 thru 216	6,327	0,000	4,597	8,6	1,770	
H20M	32 thru 45	8,649	0,544	6,185	15	2,184	±0,089
	46 thru 100	8,661	0,544	6,185	10	2,540	
	101 thru 220	8,700	0,544	6,185	18	2,540	

[a] the profile band tolerance thru R2 blends into the pulley OD tolerance so that the pulley OD and profile band tolerances do not conflict.

Key
1 Pulley outside diameter
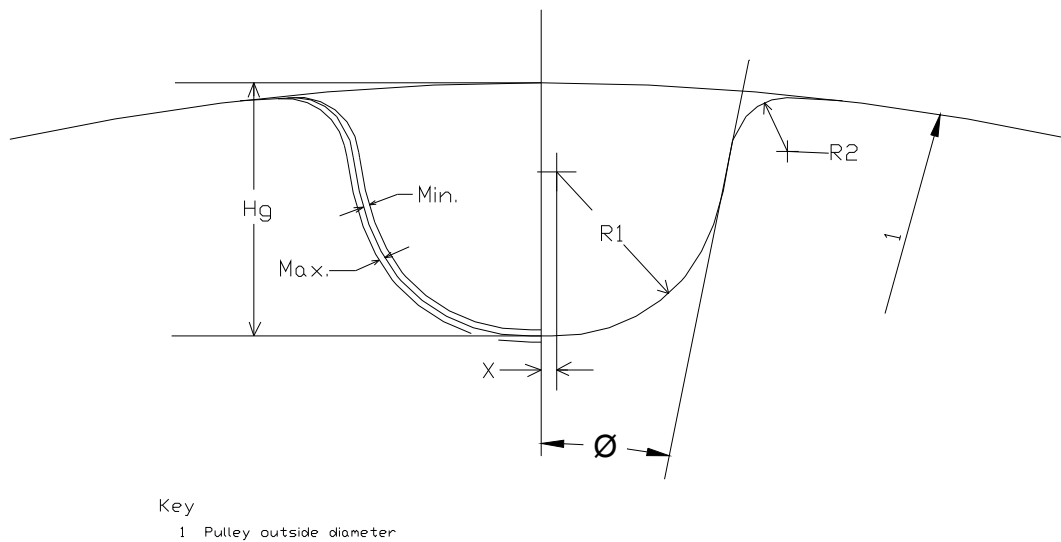
Figure 4 —Pulley groove profile and tolerance bands

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 5 and the following formula. Table 8 provides the N' values to be used in the outside diameter formula.

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

outside diameter = pitch diameter **-** 2a + N'

where a is the value given in Table 1.
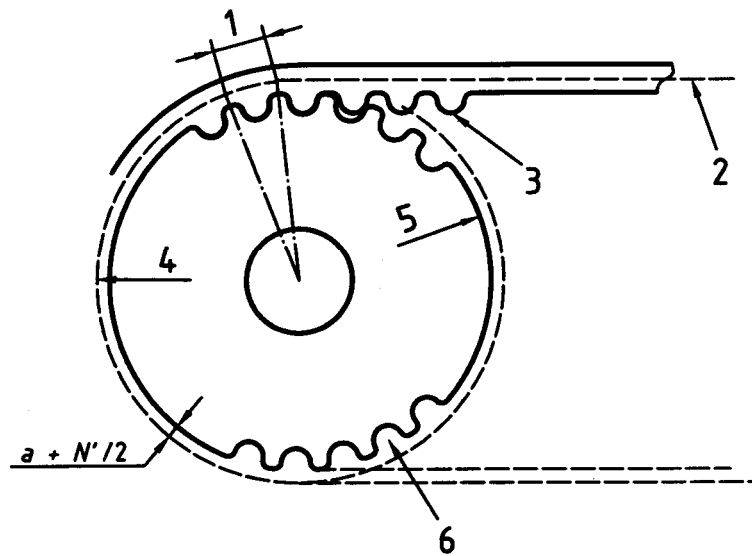
Key

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

Figure 5 — Pulley dimensions

Table 7 — Standard pulley sizes

Dimensions in millimetres

Number of grooves	Pulley type									
	H3M		H5M		H8M		H14M		H20M	
	Pitch Diameter	Outside Diameter	Pitch Diameter	Outside Diameter	Pitch Diameter	Outside Diameter	Pitch Diameter	Outside Diameter	Pitch Diameter	Outside Diameter
14	13,37	12,61	22,28	21,14	----	----	----	----	----	----
15	14,32	13,56	23,87	22,73	----	----	----	----	----	----
16	15,28	14,52	25,46	24,32	----	----	----	----	----	----
17	16,23	15,47	27,06	25,91	----	----	----	----	----	----
18	17,19	16,43	28,65	27,50	----	----	----	----	----	----
19	18,14	17,38	30,24	29,10	----	----	----	----	----	----
20	19,10	18,34	31,83	30,69	----	----	----	----	----	----
21	20,05	19,29	33,42	32,28	----	----	----	----	----	----
22	21,01	20,25	35,01	33,87	56,02 [a]	54,65	----	----	----	----
24	22,92	22,16	38,20	37,05	61,12 [a]	59,74	----	----	----	----
25	----	----	----	----	63.66	62.29	----	----	----	----
26	24,83	24,07	41,38	40,24	66,21 [a]	64,84	----	----	----	----
28	26,74	25,98	44,56	43,42	71,30 [a]	70,08	124,78 [a]	122,12	----	----
29	----	----	----	----	----	----	129,23 [a]	126,57	----	----
30	28,65	27,89	47,75	46,60	76,39 [a]	75,13	133,69 [a]	130,99	----	----
32	30,56	29,80	50,93	49,79	81,49	80,16	142,60 [a]	139,88	----	----
34	32,47	31,71	54,11	52,97	86,58	85,21	151,52 [a]	148,79	216,45	212,13
36	34,38	33,62	57,30	56,15	91,67	90,30	160,43	157,68	229,18	224,87
38	36,29	35,53	60,48	59,34	96,77	95,39	169,34	166,60	241,92	237,60
40	38,20	37,44	63,66	62,52	101,86	100,49	178,25	175,49	254,65	250,33
43	41,06	40,30	68,44	67,29	----	----	----	----	----	----
44	42,02	41,25	70,03	68,89	112,05	110,67	196,08	193,28	280,11	275,79
46	43,93	43,16	73,21	72,07	----	----	----	----	----	----
48	45,48	45,07	76,39	75,25	122,23	120,86	213,90	211,11	305,58	301,26
49	46,79	46,03	77,99	76,84	----	----	----	----	----	----
50	47,75	46,98	79,58	78,43	----	----	----	----	----	----
52	49,66	48,89	82,76	81,62	----	----	231,73	228,94	331,04	326,72
55	52,52	51,76	87,54	86,39	----	----	----	----	----	----
56	----	----	89,13	87,98	142,60	141,23	249,55	246,76	356,51	325,19
60	57,30	56,53	95,49	94,35	----	----	267,38	264,59	381,97	377,65
62	----	----	98,68	97,53	----	----	----	----	----	----
64	----	----	----	----	162,97	161,60	285,21	282,41	407,44	403,12
65	62,07	61,31	103,45	102,31	----	----	----	----	----	----
68	----	----	----	----	----	----	303,03	300,24	432,90	428,58
70	66,85	66,08	111,41	110,27	----	----	----	----	----	----
72	68,75	67,99	----	----	183,35	181,97	320,86	318,06	452,00	447,68
75	71.62	70.86	119.37	118.22	----	----	----	----	----	----
78	74,48	73,72	124,14	123,00	----	----	----	----	----	----
80	76,39	75,63	127,32	126,18	203,72	202,35	356,51	353,71	509,30	504,98
90	85,94	85,18	143,24	142,10	229,18	227,81	401,07	398,28	572,96	568,64
100	95,49	94,73	159,15	158,01	----	----	----	----	----	----
110	105,04	104,28	175,07	173,93	----	----	----	----	----	----
112	----	----	----	----	285,21 [a]	283,83	499,11	496,32	713,01	708,70
120	114,59	113,83	190,99	189,84	----	----	----	----	----	----
130	124,14	123,38	206,90	205,76	----	----	----	----	----	----
140	133,69	132,92	222,82	221,67	----	----	----	----	----	----
144	----	----	----	----	366,69 [a]	365,32	641,71	638,92	916,73	912,41
150	143,24	142,48	238,73	237,59	----	----	----	----	----	----
160	152,79	152,03	254,65	235,50	----	----	----	----	----	----
168	----	----	----	----	427.81	426.44	748,66 [a]	745,87	1 069,52	1 065,20
192	----	----	----	----	488,92 [a]	487,55	855,62 [a]	852,82	1 222,31	1 217,99
216	----	----	----	----	----	----	962,57 [a]	959,78	1375.10	1370.78

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

Table 8 — Values of N'

Dimensions in millimetres

Number of grooves	Pulley type	
	H8M	H14M
	Value of N'	Value of N'
28	0,15	0,15
29	0,15	0,13
30	0,10	0,09
31	0,08	0,09
32	0,05	0,08
33	0,03	0,08
34		0,08
35		0,05
36		0,05
37		0,05
38		0,05
39		0,03
40		0,03

Note: N' values for H3M, H5M, and H20M are zero.

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 are given in Table 9 and shown in Figure 6. 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
H3M	6	8	11
	9	11	14
	15	17	20
H5M	9	11	15
	15	17	21
	25	27	31
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
H20M	115	120	134
	170	175	189
	230	235	251
	290	300	311
	340	350	361

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
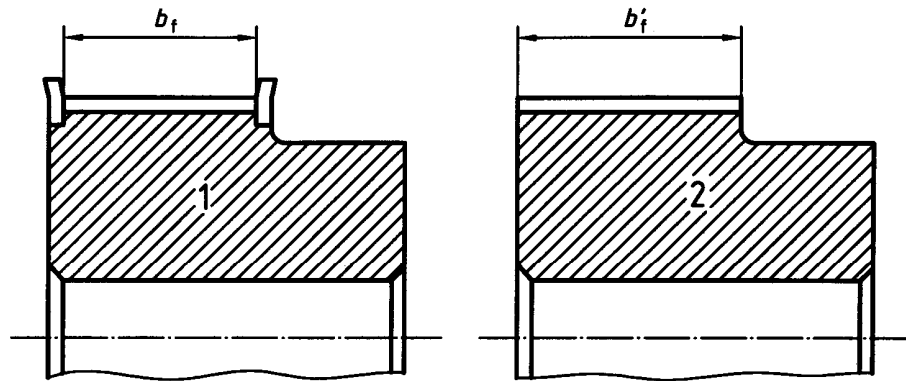
1 Flanged pulley

2 Unflanged pulley

Figure 6 — 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 7.

Table 10 — Nominal tooth dimensions

Dimensions in millimetres

Belt type	Pitch	β	S	h_s	h_d	h_t	r_r	a[a]	C
R3M	3	32°	1,95	2,40	----	1,27	0,380	0,381	3,0567
DR3M	3	32°	1,95	----	3,30	1,27	0,380	0,381	3,0567
R5M	5	32°	3,30	3,80	----	2,15	0,630	0,570	1,7950
DR5M	5	32°	3,30	----	5,44	2,15	0,630	0,570	1,7950
R8M	8	32°	5,49	5,40	----	3,25	1,00	0,686	1,0954
DR8M	8	32°	5,49	----	8,37	3,25	1,00	0,686	1,0954
R14M	14	32°	9,61	9,70	----	6,13	1,75	1,397	0,6250
DR14M	14	32°	9,61	----	15,05	6,13	1,75	1,397	0,6250
R20M	20	32°	13,75	14,50	----	8,75	2,50	2,160	0,0438
a is the belt design pitch differential.									

Figure 7 — Belt tooth dimensions

Key
1. Single-sided belts
2. Double-sided belts
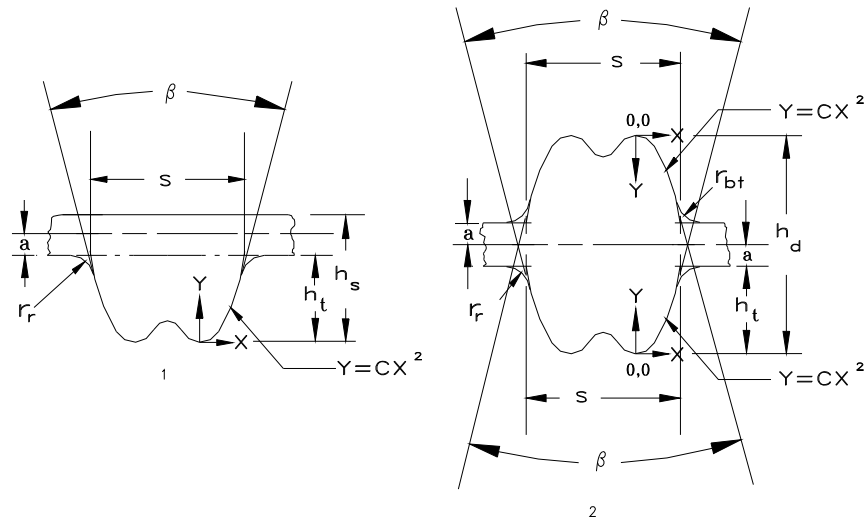
8.1.2 Belt widths and tolerances

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 and up to and including 1 680 mm	Over 1 680 mm
R3M	6 9	+ 0,4 − 0,8	+ 0,4 − 0,8	----
DR3M	15	+ 0,8 − 0,8	+ 0,8 -1,2	+ 0,8 − 1,2
R5M	9	+ 0,4 − 0,8	+ 0,4 − 0,8	----
DR5M	15 25	+ 0,8 − 0,8	+ 0,8 − 1,2	+ 0,8 − 1,2
R8M	20 30	+ 0,8 − 0,8	+ 0,8 − 1,2	+ 0,8 − 1,2
DR8M	50	+ ,8 − 1,2	+ 1,2 − 1,2	+ 1,2 − 1,6
	85	+ 1,6 − 1,6	+ 1,6 − 2,0	+ 2,0 − 2,0
R14M	40	+ 0,8 − 1,2	+ 1,2 − 1,2	+ 1,2 − 1,6
	55	+ 1,2 − 1,2	+ 1,2 − 1,6	+ 1,6 − 1,6
DR14M	85	+ 1,6 − 1,6	+ 1,6 − 2,0	+ 2,0 − 2,0
	115 170	+ 2,4 − 2,4	+ 2,4 − 2,8	+ 2,4 − 3,2
R20M	115 170	+ 2,4 − 2,4	+ 2,4 − 2,8	+ 2,4 − 3,2
	230 290 340	----	----	+ 4,8 − 6,4

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 24)

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. 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.

8.1.3.1.2 Means of applying a total measuring force to the moveable 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.

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.

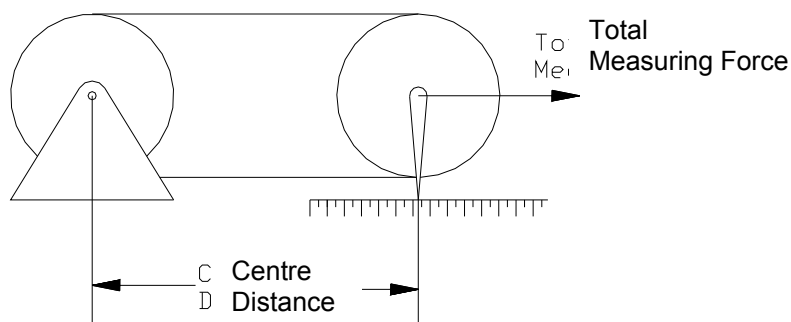Check double-sided belts on both tooth faces.

Figure 8 — 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]
R3M, DR3M	30	90	27,886 ±0,013	0,013	0,025
R5M, DR5M	20	100	30,687 ±0,013	0,013	0,025
R8M, DR8M	34	272	85,208 ±0,013	0,013	0,025
R14M, DR14M	40	560	175,46 ±0,025	0,013	0,051
R20M	40	800	250,33 ±0,036	0,013	0,076

[a]   For pulleys outside of the diameter tolerance range specified consult the belt manufacturer

. [b]   Full Indicator Movement

NOTE: The number of pulley teeth specified in Table 12 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 12.

Table 13 — Total measuring force

Forces in Newtons

Belt pitch	Belt width (mm)														
	6	9	15	20	25	30	40	50	55	85	115	170	230	290	340
R3M, DR3M	45	76	138	----	----	----	----	----	----	----	----	----	----	----	----
R5M, DR5M	----	111	214	----	376	----	----	----	----	----	----	----	----	----	----
R8M, DR8M	----	----	----	470	----	750	----	1 320	----	2 310	----	----	----	----	----
R14M, DR14M	----	----	----	----	----	----	1 350	----	2 130	3 660	5 180	7 960	----	----	----
R20M	----	----	----	----	----	----	----	----	----	----	6 961	10 729	14 839	18 949	22 374

8.2   R-type pulleys

8.2.1   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.

8.2.2   Generating tool rack

Dimensions and tolerances for the generating tool rack for R8M and R14M pulleys are given in Table 14 and Figure 26.

Table 14 — Pulley generating tool rack dimensions

Dimensions in millimetres

| Pulley type	Number of grooves	P_b ±0,012	A ±0,50°	b_t	h_p ref.	h_r	W_p ref.	W_r ref.	W_t	r_2 ±0,025	C
R3M	8 - 15	2,761	16,00	2,06 +0,05 -0,00	0,925	1,15 ±0,025	0,966 0	0,234	0,870 +0,05 -0,00	0,31	3,285 0
R3M	16 - 30	2,867	16,00	2,06 +0,05 -0,00	0,925	1,15 ±0,025	0,966 0	0,340	0,870 +0,05 -0,00	0,31	3,285 0
R3M	31 and over	3,000	16,00	2,00 +0,05 -0,00	0,896	1,20 ±0,025	0,913 0	0,367	0,798 +0,05 -0,00	0,41	3,394 0
R5M	10 - 21	4,761	16,00	3,48 ±0,025	1,604	2,06 +0,05 -0,00	1,609 0	0,332	1,379 ±0,025	0,63	1,896 0
R5M	22 and over	5,000	16,00	3,48 ±0,025	1,604	2,06 +0,05 -0,00	1,609 0	0,571	1,379 ±0,025	0,63	1,896 0
R8M	22 - 27	7,780	18,00	5,900 ±0,025	2,828	3,45 +0 -0,05	2,75	0,577	1,820 ±0,025	0,90	0,837 3
R8M	28 and over	7,890	18,00	5,900 ±0,025	2,794	3,45 +0 -0,05	2,74	0,612	1,840 ±0,025	0,95	0,847 7
R14M	28 and over	13,800	18,00	10,45 +0,05 -0,00	4,930	6,04 +0,05 -0	4,87	1,020	3,320 ±0,025	1,60	0,479 9
R20M	30 and over	19,692	18,00	14,85 +0,05 -0,00	6,703	8,50 +0,05 -0	6,841	1,604	4,970 ±0,025	2,60	0,353 2
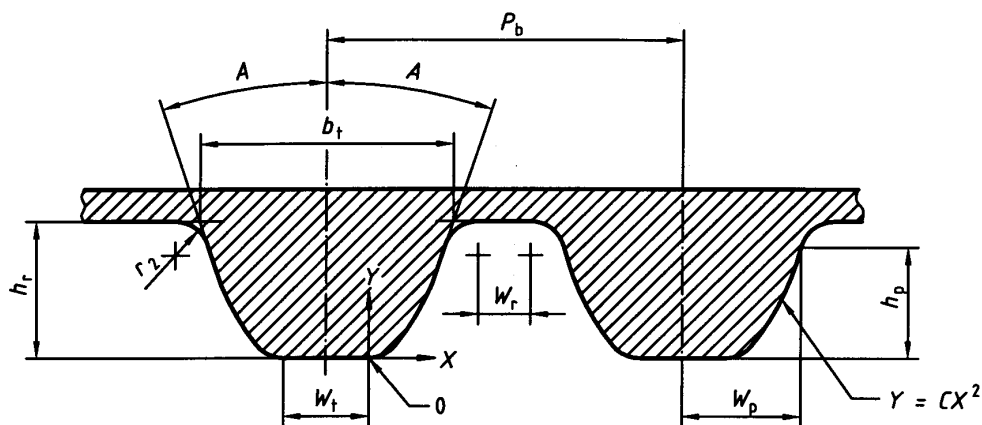
**Figure 9 — Pulley generating tool rack form**

8.2.3 Pulley groove profile dimensions and tolerances

Dimensions and tolerances for the pulley groove profile for R-type pulleys are given in Table 15 and Table 16 and shown in Figures 10 and 11.

Table 15 — Pulley groove profile dimensions

Dimensions in millimetres

Belt section	Number of teeth	GH	X_A	X_B	Y_B	X'_c	Y'_c	K	r_t	R_D
R3M	8 - 15	1,15	0,39	4,00	0,08	0,54	0,94	3,2100	0,28	4,00
	16 - 30	1,15	0,40	4,00	0,00	0,53	0,93	3,2850	0,30	13,00
	31 and over	1,20	0,40	4,00	0,00	0,53	0,93	3,3940	0,40	18,00
R5M	10 - 21	2,06	0,63	4,00	0,06	0,97	1,70	1,7900	0,63	9,00
	22 and over	2,06	0,70	4,00	0,00	0,95	1,66	1,8290	0,50	18,00
R8M	22 - 27	3,47	0,92	4,00	0,11	1,75	2,61	0,8477	0,90	22,00
	28 and over	3,47	0,92	4,00	0,00	1,75	2,61	0,8477	0,95	22,00
R14M	28 and over	6,04	1,64	4,00	0,00	3,21	4,93	0,4799	1,60	32,00
R20M	30 and over	8,50	2,50	4,00	0,00	4,40	6,80	0,3490	2,42	150,00

Key
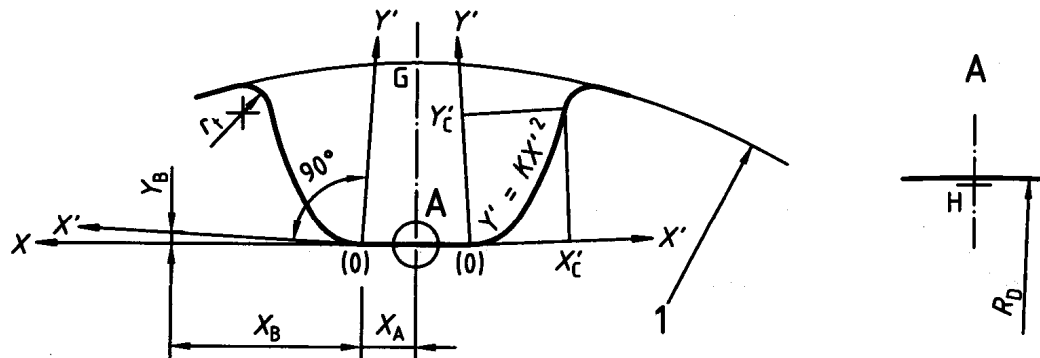
1   Pulley outside diameter

Figure 10 — Pulley groove profile

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 11 illustrates the pulley groove tolerance bands.

Table 16 — Pulley tip radii

Dimensions in millimetres

Pulley type	Number of grooves	r_t [a]
R3M	8 - 15	0,28
	16 - 30	0,30
	31 and over	0,40
R5M	10 - 21	0,63
	22 and over	0,50
R8M	22 - 27	0,90
	28 and over	0,95
R14M	28 and over	1,60
R20M	30 and over	2,42

[a] the profile band tolerance thru R2 blends into the pulley OD tolerance so that the pulley OD and profile band tolerances do not conflict.

Key

1   Pulley outside diameter
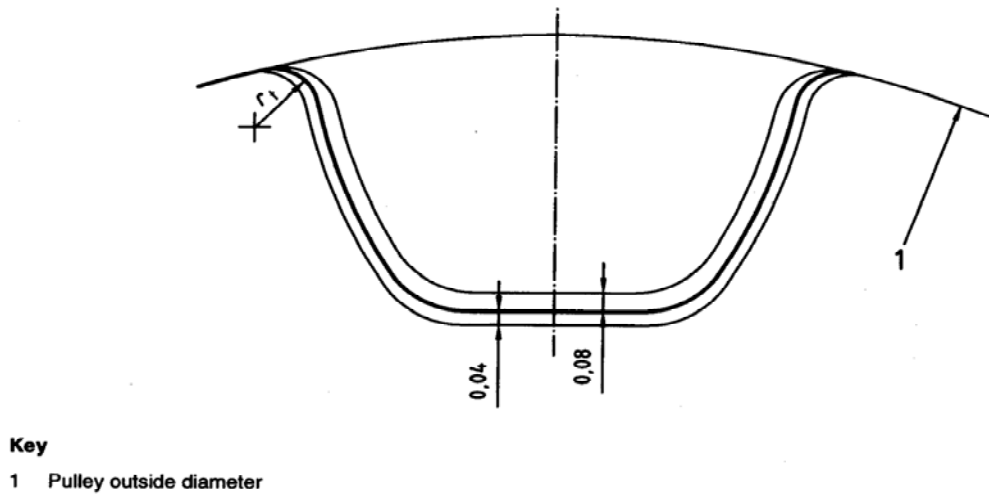
Figure 11 — Pulley groove tolerance band

8.2.4   Pulley outside diameters

Pulleys outside diameters for the standard pulleys are given in Table 17. The relationship of the pulley outside and pitch diameters is illustrated in Figure 12 and the following formula.

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

outside diameter = pitch diameter - 2a

where a is the value given in Table 10.
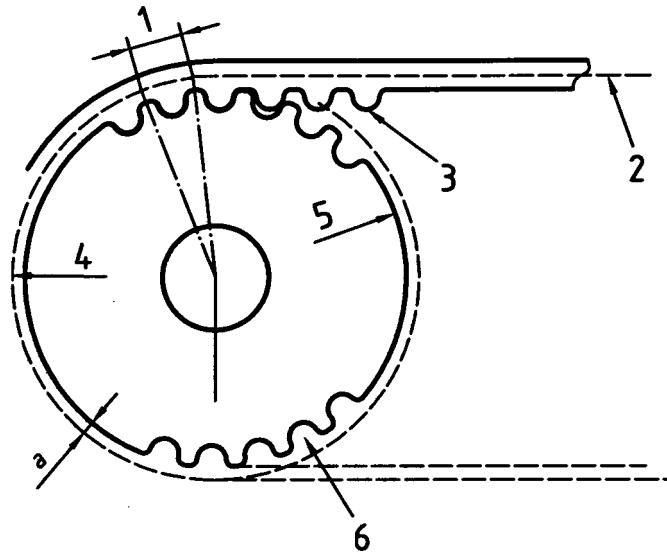
Key

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

Figure 12 — Pulley dimensions

Table 17 — Standard pulley sizes

Dimensions in millimetres

| Number of grooves	Pulley type									
	R3M		R5M		R8M		R14M		R20M	
	Pitch Diameter	Outside Diameter	Pitch Diameter	Outside Diameter	Pitch Diameter	Outside Diameter	Pitch Diameter	Outside Diameter	Pitch Diameter	Outside Diameter
14	13,37	12,61	22,28	21,14	----	----	----	----	----	----
15	14,32	13,56	23,87	22,73	----	----	----	----	----	----
16	15,28	14,52	25,46	24,32	----	----	----	----	----	----
17	16,23	15,47	27,06	25,91	----	----	----	----	----	----
18	17,19	16,43	28,65	27,50	----	----	----	----	----	----
19	18,14	17,38	30,24	29,10	----	----	----	----	----	----
20	19,10	18,34	31,83	30,69	----	----	----	----	----	----
21	20,05	19,29	33,42	32,28	----	----	----	----	----	----
22	21,01	20,25	35,01	33,87	56,02	54,65	----	----	----	----
24	22,92	22,16	38,20	37,05	61,12	59,74	----	----	----	----
25	----	----	----	----	63.66	62.29	----	----	----	----
26	24,83	24,07	41,38	40,24	66,21	64,84	----	----	----	----
28	26,74	25,98	44,56	43,42	71,30	70,08	124,78	122,12	----	----
29	----	----	----	----	----	----	129,23	126,57	----	----
30	28,65	27,89	47,75	46,60	76,39	75,13	133,69	130,99	----	----
32	30,56	29,80	50,93	49,79	81,49	80,16	142,60	139,88	----	----
34	32,47	31,71	54,11	52,97	86,58	85,21	151,52	148,79	216,45	212,13
36	34,38	33,62	57,30	56,15	91,67	90,30	160,43	157,68	229,18	224,87
38	36,29	35,53	60,48	59,34	96,77	95,39	169,34	166,60	241,92	237,60
40	38,20	37,44	63,66	62,52	101,86	100,49	178,25	175,49	254,65	250,33
43	41,06	40,30	68,44	67,29	----	----	----	----	----	----
44	42,02	41,25	70,03	68,89	112,05	110,67	196,08	193,28	280,11	275,79
46	43,93	43,16	73,21	72,07	----	----	----	----	----	----
48	45,48	45,07	76,39	75,25	122,23	120,86	213,90	211,11	305,58	301,26
49	46,79	46,03	77,99	76,84	----	----	----	----	----	----
50	47,75	46,98	79,58	78,43	----	----	----	----	----	----
52	49,66	48,89	82,76	81,62	----	----	231,73	228,94	331,04	326,72
55	52,52	51,76	87,54	86,39	----	----	----	----	----	----
56	----	----	89,13	87,98	142,60	141,23	249,55	246,76	356,51	325,19
60	57,30	56,53	95,49	94,35	----	----	267,38	264,59	381,97	377,65
62	----	----	98,68	97,53	----	----	----	----	----	----
64	----	----	----	----	162,97	161,60	285,21	282,41	407,44	403,12
65	62,07	61,31	103,45	102,31	----	----	----	----	----	----
68	----	----	----	----	----	----	303,03	300,24	432,90	428,58
70	66,85	66,08	111,41	110,27	----	----	----	----	----	----
72	68,75	67,99	----	----	183,35	181,97	320,86	318,06	452,00	447,68
75	71.62	70.86	119.37	118.22	----	----	----	----	----	----
78	74,48	73,72	124,14	123,00	----	----	----	----	----	----
80	76,39	75,63	127,32	126,18	203,72	202,35	356,51	353,71	509,30	504,98
90	85,94	85,18	143,24	142,10	229,18	227,81	401,07	398,28	572,96	568,64
100	95,49	94,73	159,15	158,01	----	----	----	----	----	----
110	105,04	104,28	175,07	173,93	----	----	----	----	----	----
112	----	----	----	----	285,21	283,83	499,11	496,32	713,01	708,70
120	114,59	113,83	190,99	189,84	----	----	----	----	----	----
130	124,14	123,38	206,90	205,76	----	----	----	----	----	----
140	133,69	132,92	222,82	221,67	----	----	----	----	----	----
144	----	----	----	----	366,69	365,32	641,71	638,92	916,73	912,41
150	143,24	142,48	238,73	237,59	----	----	----	----	----	----
160	152,79	152,03	254,65	235,50	----	----	----	----	----	----
168	----	----	----	----	427.81	426.44	748,66	745,87	1 069,52	1 065,20
192	----	----	----	----	488,92	487,55	855,62	852,82	1 222,31	1 217,99
216	----	----	----	----	----	----	962,57	959,78	1375.10	1370.78

8.2.5   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 13), 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
R3M	6	8	11
	9	11	14
	15	17	20
R5M	9	11	15
	15	17	21
	25	27	31
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
R20M	115	120	134
	170	175	189
	230	235	251
	290	300	311
	340	350	361

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
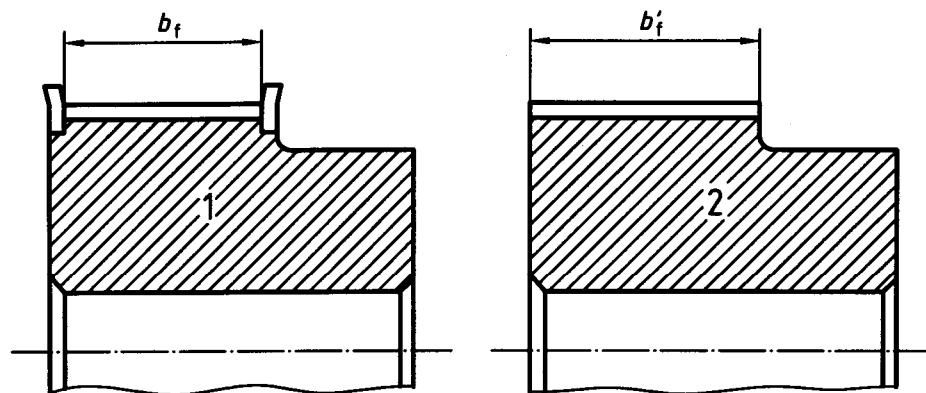
1   Flanged pulley
2   Unflanged pulley

Figure 13 — Minimum pulley width

9 Type S system

9.1- Type belt dimensions and tolerances
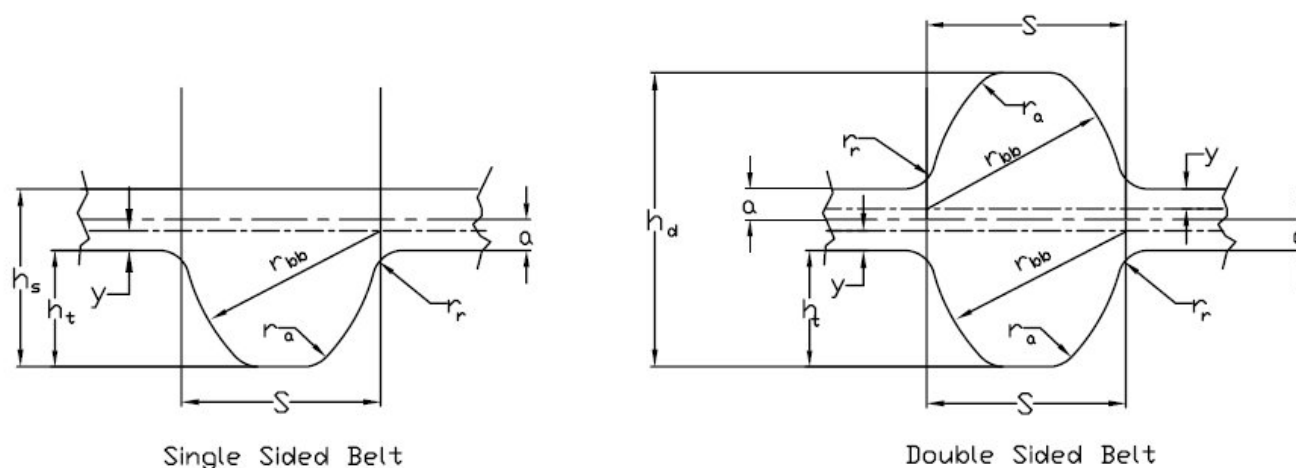
9.1.1 Belt tooth dimensions

The nominal belt tooth dimensions are the same for single-sided and double-sided belts; they are given in Table 19 and shown in Figure 14.

Table 19 — Nominal tooth dimensions

Dimensions in millimetres

Belt type	Pitch	h_s	h_d	h_t	S	r_{bb}	r_a	r_r	Y	α[a]
S8M	8	5,3	----	3,05	5,20	5,20	0,80	0,80	0,686	0,686
DS8M	8	----	7,47	3,05	5,20	5,20	0,80	0,80	0,686	0,686
S14M	14	10,2	----	5,30	9,10	9,10	1,40	1,40	1,397	1,397
DS14M	14	----	13,39	5,30	9,10	9,10	1,40	1,40	1,397	1,397

[a] α is the belt design pitch differential.

Figure 14 — 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 1680 mm	Over 1680 mm
S8M DS8M	15	±0,8	+0,8 -1,2	+0,8 -1,2
	25			
	40	+0,8 -1,2	±1,2	+1,2 -1,6
	60	±1,2	+1,2 -1,6	±1,6
S14M DS14M	40	+0,8 -1,2	±1,2	+1,2 -1,6
	60	±1,2	+1,2 -1,6	±1,6
	80	±1,6	+1,6 -2,0	±2,0
	100	±1,6	+1,6 -2,0	±2,0
	120	±2,4	+2,4 -2,8	+2,4 -3,2

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 15)

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

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. 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.

9.1.3.1.1 Means of applying a total measuring force **to the moveable pulley.**

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

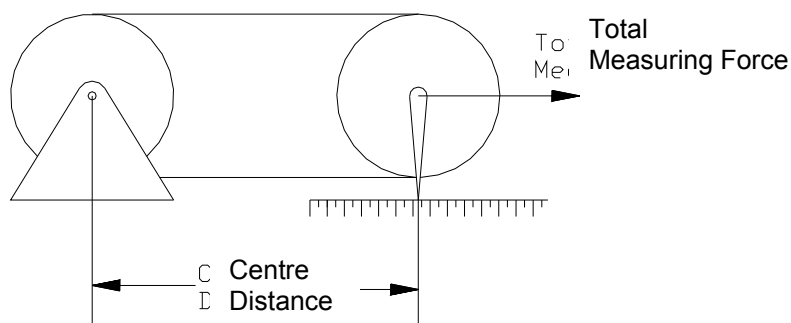Check double-sided belts on both tooth faces.

Figure 15 — 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]
S8M, DS8M	34	272	85,208 ±0,013	0,013	0,025
S14M, DS14M	40	560	175,460 ±0,025	0,013	0,051

[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

9.2.1   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.

9.2.2   Generating tool rack

Dimensions and tolerances for the generating tool rack for pulleys S8M and S14M are given in Table 23 and Figure 16.

Table 23 — Pulley generating tool rack dimensions

Dimensions in millimetres

Pulley Type	Number of grooves	P_b ±0,012	h_r +0,05 -0,00	b_t +0,05 -0,00	r_1 +0,05 -0,00	r_2 ±0,03	r_3 ±0,03	r_4 ±0,03	r_5 ±0,10	X	W	a	Y
S8M	22 and over	8,000	2,830	5,200	5,300	0,750	2,710	0,400	4,040	5,040	1,130	0,686	0,686
Optional S8M	22 - 26	7,611	2,830	4,220	4,740	0,800	----	0,270	5,680	----	----	----	0,256
	27 - 33	7,689	2,830	4,220	4,740	0,800	----	0,290	5,280	----	----	----	0,279
	34 - 46	7,767	2,830	4,220	4,740	0,800	----	0,320	4,920	----	----	----	0,299
	47 - 74	7,844	2,830	4,220	4,740	0,800	----	0,350	4,590	----	----	----	0,321
	75 - 216	7,928	2,830	4,220	4,740	0,800	----	0,380	4,280	----	----	----	0,342
S14M	28 and over	14,000	4,950	9,100	9,28	1,310	4,800	0,700	7,070	8,840	1,980	1,397	1,397
Optional S14M	28 - 34	13,441	4,950	7,500	8,380	1,360	----	0,520	9,170	----	----	----	0,784
	35 - 47	13,577	4,950	7,500	8,380	1,360	----	0,560	8,570	----	----	----	0,819
	48 - 75	13,716	4,950	7,500	8,380	1,360	----	0,610	8,030	----	----	----	0,856
	76 - 216	13,876	4,950	7,500	8,380	1,360	----	0,660	7,460	----	----	----	0,896

NOTE 1: Optional tool rack dimensions represent a refinement of the original patent holder's design. Selection of standard or optional to be agreed between manufacturer and user.
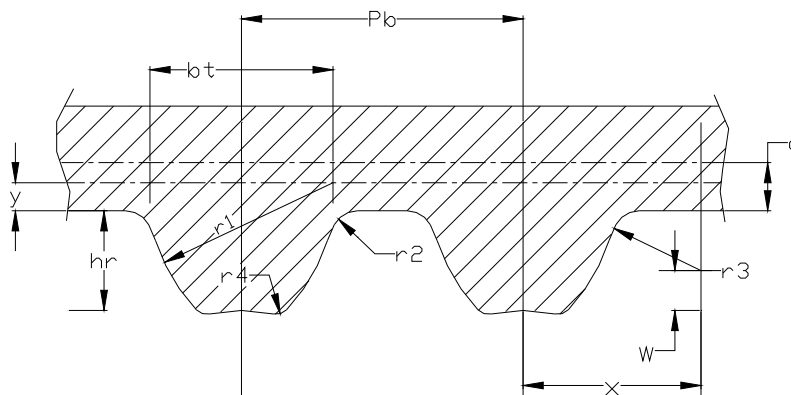

Figure 16 — Pulley generating tool rack form

9.2.3 Pulley groove profile dimensions and tolerances

Dimensions and tolerances for the pulley groove profile for S-type pulleys are given in Table 24 and shown in Figure 17.

Table 24 — Pulley groove profile dimensions

Dimensions in millimetres

Pulley type	Number of grooves	B_g [1] +0,10 -0,00	H_g ±0.03	R_5 ±0.01	R_4 ±0.01	R_2 +0,10 -0,00	R_1 +0,10 -0,00	a	Y
S8M	22 and over	5,20	2,83	4,04	0,40	0,75	5,30	0,686	0,686
S14M	28 and over	9,10	4,95	7,07	0,70	1,31	9,28	1,397	1,397

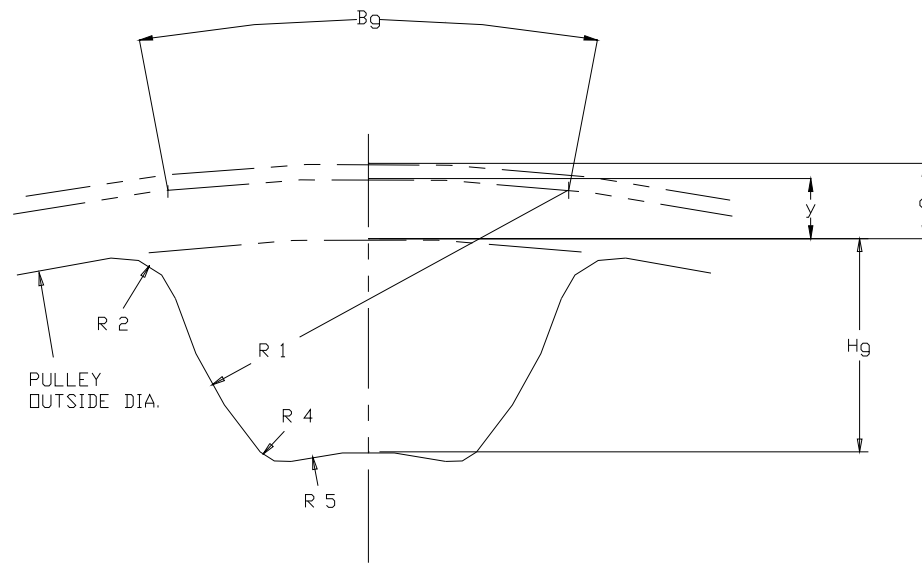NOTE: The B_g dimension is an arc length, not a cord length.

Figure 17 — Pulley groove profile

9.2.4   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 18 and the following formula.

pitch diameter = $\dfrac{No.\,of\ grooves\ x\ pulley\ pitch}{\pi}$

outside diameter = 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[a]
29	----	----	129,23[a]	126,44[a]
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.				
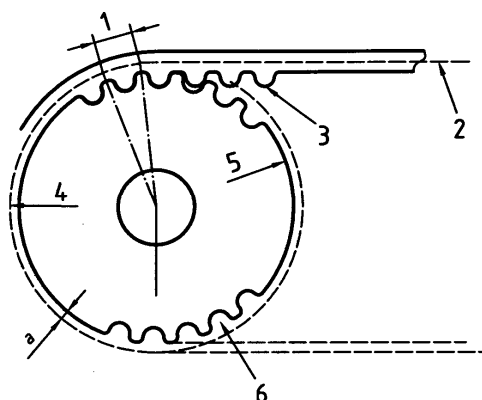
Key

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

Figure 18 — Pulley dimensions

9.2.5 Pulley width

The standard nominal pulley width, and the actual pulley width required, b_f for flanged pulleys, b'_f for unflanged pulleys (see Figure 19), 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	18	25
	25	28	35
	40	43	50
	60	63	70
S14M	40	43	55
	60	63	76
	80	84	96
	100	104	116
	120	125	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
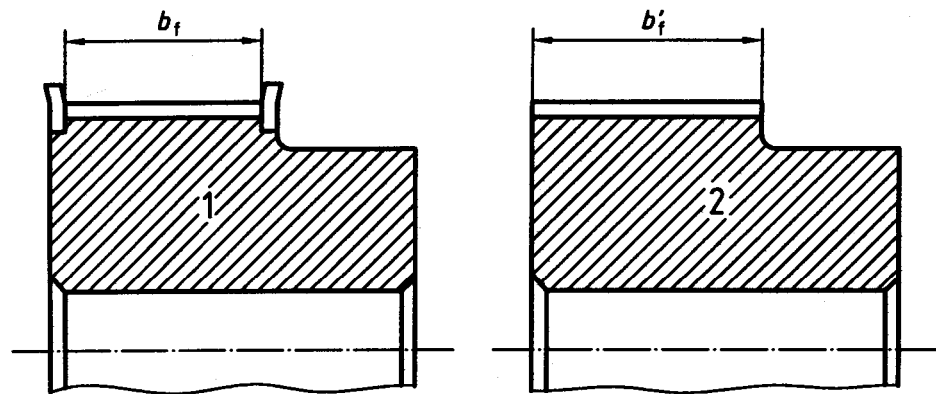
1   Flanged pulley
2   Unflanged pulley

Figure 19 — 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 Pitch Length		Permissible Deviation From Standard Length	
Over	To	Single Sided Belts	Double Sided Belts
127	254	± 0,40	+0,80 -0,60
254	381	± 0,46	+0,92 -0,69
381	508	± 0,50	+1,00 -0,75
508	762	± 0,60	+1,20 -0,90
762	1016	± 0,66	+1,32 - 0,99
1016	1270	± 0,72	+1,44 -1,08
1270	1524	± 0,82	+1,64 -1,23
1524	1778	± 0,86	+1,74 -1,29
1778	2032	± 0,92	+1,84 -1,38
2032	2286	± 0,98	+1,96 -1,47
2286	2540	± 1,04	+2,08 -1,56
2540	2794	± 1,08	+2,16 -1,62
2794	3048	± 1,12	+2,24 -1,68
3048	3302	± 1,16	+2,32 -1,74
3302	3556	± 1,20	+2,40 -1,80
3556	3810	± 1,26	+2,52 -1,89
3810	4064	± 1,32	+2,64 -1,98
4064	4318	± 1,38	+2,76 -2,07
4318	4572	± 1,44	+2,88 -2,16
4572	4826	± 1,50	+3,00 -2,25
4826	5080	± 1,56	+3,12 -2,34
5080	5334	± 1,62	+3,24 -2,43
5334	5588	± 1,68	+3,36 -2,52
5588	5842	± 1,74	+3,48 - 2,61

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Table A.1 (cont.) — Standard pitch lengths and tolerances

Dimensions in millimetres

5842	6096	± 1,80	+3,60 -2,70
6096	6350	± 1,86	+3,72 -2,79
6350	6604	± 1,92	+3,84 -2,88
6604	6860	± 1,98	+3,96 -2,97

NOTE: The permissible deviation from the standard length for double-sided belts is 2 x the plus tolerance and one and 1 1/2 x the minus tolerance of the single-sided belt.

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:

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

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.

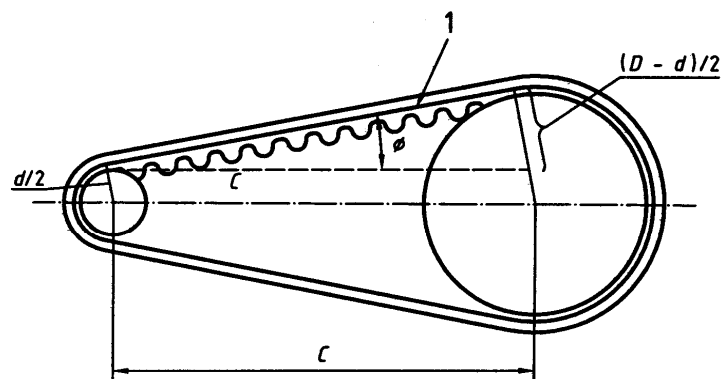$$\theta = \sin^{-1}\left(\frac{D-d}{2C}\right) \text{degrees}$$

The approximate centre distance "C" 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 cumulative deviation 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]**
$d_o \leq 25{,}4$	0,03	0,05
$25{,}4 < d_o \leq 50{,}8$	0,03	0,08
$50{,}8 < d_o \leq 101{,}6$	0,03	0,11
$101{,}6 < d_o \leq 177{,}8$	0,03	0,13
$177{,}8 < d_o \leq 304{,}8$	0,03	0,15
$304{,}8 < d_o \leq 508{,}0$	0,03	0,18
$508{.}0 < d_o \leq 762{.}00$	0,03	0,20
$762{.}00 < d_o \leq 1016{.}00$	0,03	0,23
$d_o > 1016{.}00$	0,03	0,25
[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
$d_o \leq 25{,}4$	+0,05/0
$25{,}4 < d_o \leq 50{,}8$	+0,08/0
$50{,}8 < d_o \leq 101{,}6$	+0,10/0
$101{,}6 < d_o \leq 177{,}8$	+0,13/0
$177{,}8 < d_o \leq 304{,}8$	+0,15/0
$304{,}8 < d_o \leq 508{,}0$	+0,18/0
$508{,}0 < d_o \leq 762{,}0$	+0,20/0
$762{,}0 < d_o \leq 1\,016{,}0$	+0,23/0
$d_o > 1\,016{,}0$	+0,25/0

C.3 Axial circular runout

See Table C.3.

Table C.3 — Axial circular runout

Dimensions in millimetres

Outside diameter range d_o	F.I.M.[a] max.
mm	mm
$d_o \leq 25,4$	0,05
$25,4 < d_o \leq 50,8$	0,08
$50,8 < d_o \leq 101,6$	0,10
$101,6 < d_o \leq 254,0$	0,001 mm per millimetre of outside diameter
$254,0 < d_o$	0,25 mm + 0,000 5 mm per millimetre of outside diameter d_o > 254,0
[a] Full indicator movement	

C.4 Radial circular runout

See Table C.4.

Table C.4 — Radial circular runout

Dimensions in millimetres

Outside diameter range d_o	F.I.M.[a] max.
mm	mm
$d_o \leq 25,4$	0,05
$25,4 < d_o \leq 50,8$	0,07
$50,8 < d_o \leq 101,6$	0,10
$101,6 < d_o \leq 203,2$	0,13
$203,2 < d_o$	0,13 mm + 0,000 5 mm per millimetre of outside diameter d_o > 203,2
[a] Full indicator movement	

C.5 Parallelism

Tolerances on pulley parallelism are given in Table C.5.

Table C.5 — Parallelism

Dimensions in millimetres

Nominal Pulley Width	Tolerances
$b_f \leq 40$	0,03
$40 < b_f \leq 100$	0,04
$100 < b_f \leq 160$	0,05
$160 < b_f \leq 220$	0,06
$220 < b_f \leq 280$	0,07
$280 < b_f \leq 340$	0,08

C.6 Cylindricity

Tolerances on pulley cylindricity are given in Table C.6.

Table C.6 — Cylindricity

Dimensions in millimetres

Nominal Pulley Width	Tolerances
$b_f \leq 20$	0,02
$20 < b_f \leq 40$	0,04
$40 < b_f \leq 80$	0,08
$80 < b_f \leq 120$	0,12
$120 < b_f \leq 160$	0,16
$160 < b_f \leq 340$	0,16mm +0,001mm per millimetre Of nominal pulley width b_f >160

C.7 Taper

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

C.8 Quality specifications

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

Annex D
(normative)

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.
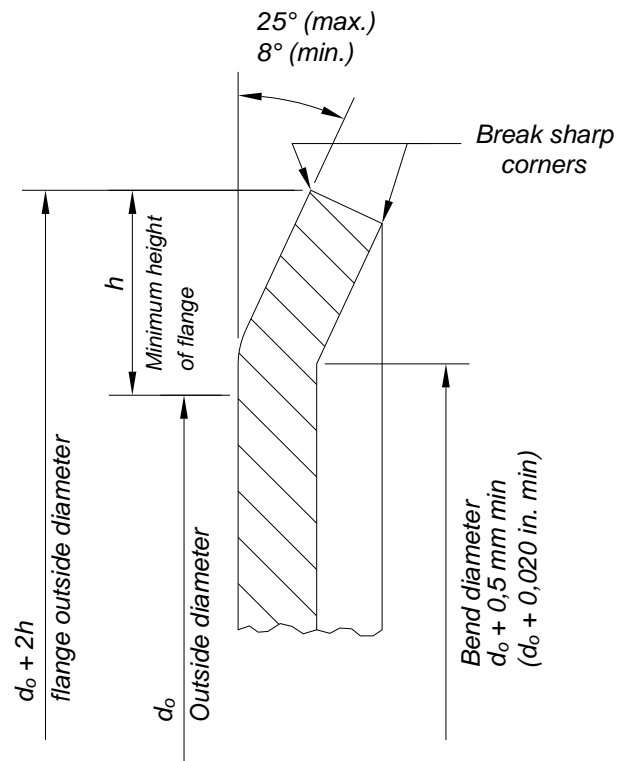

Figure D.1 — Flange dimensions