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Synchronous belt drives — Metric pitch, trapezoidal profile systems T and AT, belts and pulleys

Transmissions synchrones par courroies — Pas métrique, poulies et courroies dentées à dents trapézoïdales de profil T ou AT

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 41, *Pulleys and belts (including veebelts)*, Subcommittee SC 4, *Synchronous belt drives*.

Synchronous belt drives — Metric pitch, trapezoidal profile systems T and AT, belts and pulleys

1 Scope

This International Standard specifies the principal characteristics of synchronous endless and open belts and pulleys of the profile systems T and AT for use in synchronous belt drives[1)] for mechanical power transmission and where positive indexing or synchronization can 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, and

g) pulley quality specification.

The belts of the profile systems T and AT are made of polyurethane with high-tension fine steel cord tension members in most cases. As far as certain forces are given in this International Standard, these values are only valid for this kinds of belt. For polyurethane belts with different tensile cords, i.e. aramid or rubber belts reinforced with glass fibre, the values can be different. It is intended that the user and the manufacturer agree about suitable values. Open belts made of thermoplastic polyurethane can be spliced to work as endless belts in conveyor applications. In this case, the tolerances are not valid for the splicing area of the endless spliced belt.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

3 Belt profile systems

Eight belt profiles for synchronous drives are standardized.

Profile system T:

— profile T2,5

— profile T5

— profile T10

Profile system AT:

— profile AT3

— profile AT5

— profile AT10

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

— profile T20 — profile AT20

4 Belt nomenclature

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

a) the width, in millimetres;

b) the profile system;

c) the pitch, in millimetres;

d) the belt pitch length, in millimetres (and add the number of teeth in brackets, if required);

e) double-sided belts are designated by adding D_G or D_T before the profile system letter: D_G if the tooth position is opposite **G**ap; D_T if the tooth position is opposite **T**ooth;

f) open belts are designated by adding the letter "M" behind the length; for spliced belts, use the letter "V."

EXAMPLE 1 A metric synchronous belt of 10 mm pitch, profile system T, 50 mm wide, and 1 400 mm in pitch length is designated as:

— for a single-sided belt: **50 - T10 - 1 400**

— for a double-sided belt : **50 - D_G - T10 - 1 400 or 50 - D_T - T10 - 1 400**

EXAMPLE 2 A metric synchronous belt of 5 mm pitch, profile system AT, 25 mm wide, and 500 mm in pitch length (number of teeth = 100) is designated as:

— for a single-sided belt: **25 - AT5 - 500 (100 t)**

— for double-sided belt: **25 - D_G - AT5 - 500 (100 t) or 25 - D_T - AT5 - 500 (100 t)**

EXAMPLE 3 An open metric synchronous belt of 5 mm pitch, profile system AT, 25 mm wide, and 50000 mm in pitch length is designated as:

25 - AT5 - 50000 - M

5 Pulley profile systems

Eight pulley profiles for synchronous drives are standardized:

Profile system T:

— profile T2,5

— profile T5

— profile T10

— profile T20

Profile system AT:

— profile AT3

— profile AT5

— profile AT10

— profile AT20

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 designated, as is the belt, by a combination of numbers and letters as follows:

a) the letter "P," which indicates a pulley;

b) the number of grooves;

c) the profile system;

d) the groove pitch, in millimetres;

e) the width, in millimetres.

EXAMPLE A pulley for a metric toothed belt which has 20 mm pitch and 30 grooves with a nominal width of 50 mm is identified as follows.

— for T-profile system pulley: **P30 - T20 - 50**

— for AT-profile system pulley: **P30 - AT20 - 50**

7 Belt profile systems T and AT

7.1 Belt profile systems T and AT — General

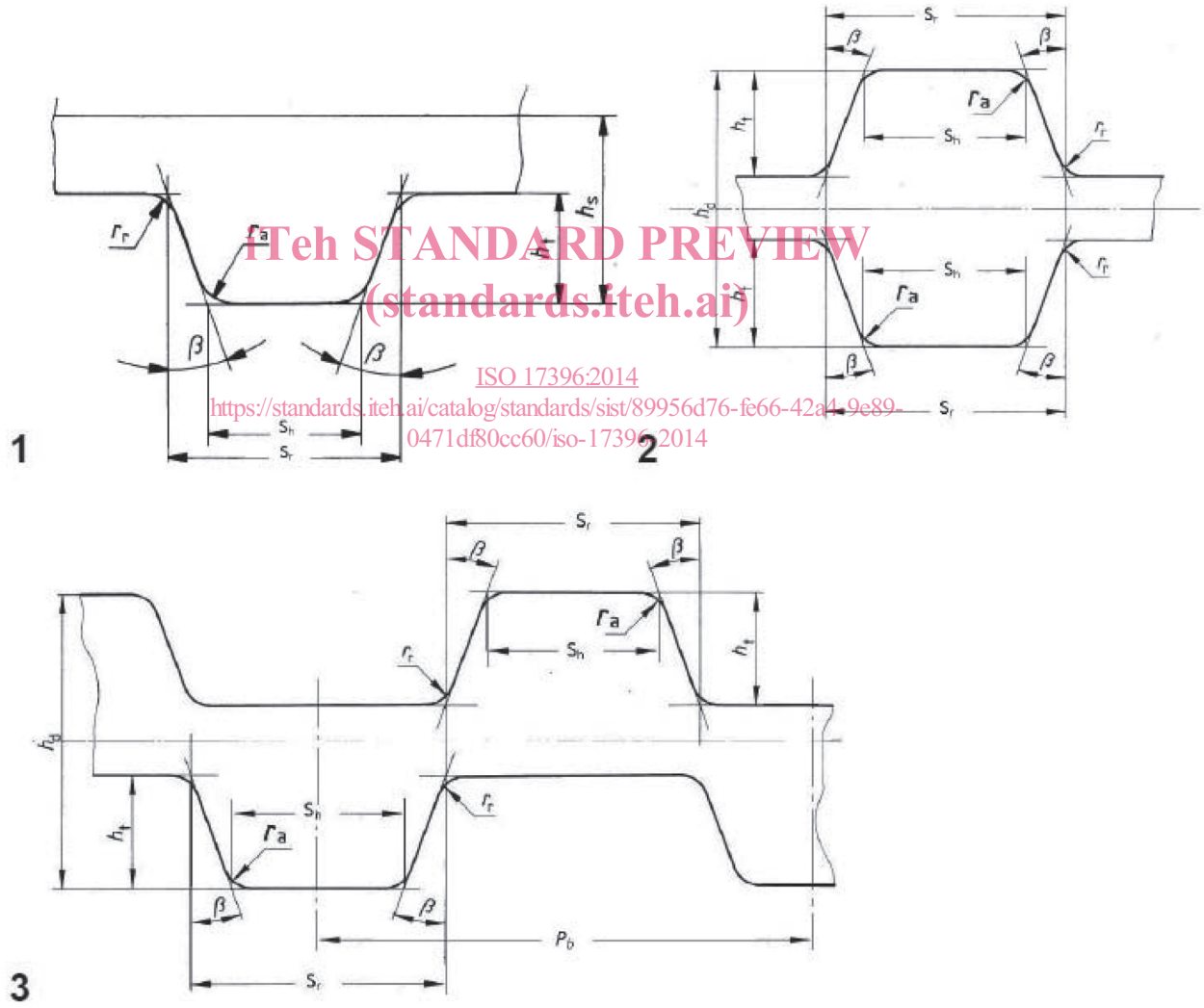


Figure 1 — Belt dimensions for profile systems T and AT

7.2 Profile system T — Belt tooth dimensions and tolerances

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 — Profile system T — Nominal tooth dimensions

Belt profile	Pitch P_b mm	Tooth angle 2β °	Root width S_r mm	h_s mm	h_d mm	h_t mm	r_a min mm	r_r ±0,1 mm
T2,5	2,5	40 ± 2	1,50 ± 0,05	1,30 ± 0,15	1,90	0,70 ± 0,05	0,2	0,2
T5	5,0	40 ± 2	2,65 ± 0,05	2,20 ± 0,15	3,25	1,20 ± 0,05	0,4	0,4
T10	10,0	40 ± 2	5,30 ± 0,10	4,50 ± 0,30	6,80	2,50 ± 0,10	0,6	0,6
T20	20,0	40 ± 2	10,15 ± 0,15	8,00 ± 0,45	12,85	5,00 ± 0,15	0,8	0,8
NOTE The value of h_d can vary due to process-related adjustments of the manufacturer.								

7.3 Profile system AT — Belt tooth dimensions and tolerances

The nominal belt tooth dimensions are the same for single-sided and double-sided belts; they are given in Table 2 and shown in Figure 1.

Table 2 — Profile system AT — Nominal tooth dimensions

Belt profile	Pitch P_b mm	Tooth angle 2β °	Head width S_h mm	h_s mm	h_d mm	h_t mm	r_a min mm	r_r ±0,1 mm
AT3	3,0	50 ± 2	1,50 ± 0,05	1,90 ± 0,15	n.a.	1,10 ± 0,05	0,3	0,1
AT5	5,0	50 ± 2	2,50 ± 0,05	2,70 ± 0,15	3,05	1,20 ± 0,05	0,4	0,6
AT10	10,0	50 ± 2	5,00 ± 0,10	4,50 ± 0,30[a] (5,0)	6,50	2,50 ± 0,10	0,6	1,2
AT20	20,0	50 ± 2	10,00 ± 0,15	8,00 ± 0,45[a] (9,0)	12,15	5,00 ± 0,15	1,6	2,5
NOTE The value of h_d can vary due to process-related adjustments of the manufacturer.								
[a] The thickness of the backside depends on the method of manufacturing.								

8 Belt widths and tolerances

Belt widths and tolerances are given in Table 3.

Table 3 — Belt widths and width tolerances

Dimensions in millimetres

Belt profile	Nominal belt width				Tolerance
T2,5	-	4	6	10	±0,3
T5	6	10	16	25	±0,5
T10	16	25	32	50	±0,5
T20	32	50	75	100	±1,0
AT3	6	10	16	25	±0,3
AT5	6	10	16	25	±0,5
AT10	16	25	32	50	±0,5
AT20	32	50	75	100	±1,0
NOTE Tolerances for larger belt widths and closer tolerances to be confirmed between the user and the manufacturer.					

9 Pitch length measurement

9.1 Endless belts manufactured in circular moulds

9.1.1 Measuring fixture (see Figure 2)

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

9.1.1.1 Two pulleys of equal diameter, as specified in Table 4, of the proper profile shown in Table 7. 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.

9.1.1.2 Means of applying a total measuring force, to the moveable pulley, as given in Table 5.

9.1.1.3 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 4 determines the recommended sizes for measuring the belt pitch length. Practicably, the other sizes of pulleys can be used provided they have the same number of teeth and meet the dimensional requirements of Table 4.

Key

1 total measuring force

2 centre distance

Figure 2 — Fixture for measuring the pitch length for endless belts manufactured in circular moulds

Table 4 — Belt length measuring pulleys

Dimensions in millimetres

Belt profile	Number of grooves	Pitch circumference	Outside diameter[a]	Radial runout	Axial runout
				FIM[a]	FIM[a]
T2,5	20	50	15,42 $_{-0,05}$	0,013	0,025
T5	20	100	30,99 $_{-0,05}$	0,013	0,025
T10	20	200	61,80 $_{-0,08}$	0,013	0,025
T20	20	400	124,47 $_{-0,08}$	0,013	0,050
AT3	20	60	18,69 $_{-0,05}$	0,013	0,025
AT5	20	100	30,61 $_{-0,05}$	0,013	0,025
AT10	24	240	74,57 $_{-0,08}$	0,013	0,025
AT20	25	500	156,33 $_{-0,08}$	0,013	0,050

[a] Full indicator movement.

9.2 For very long endless belts and open belts

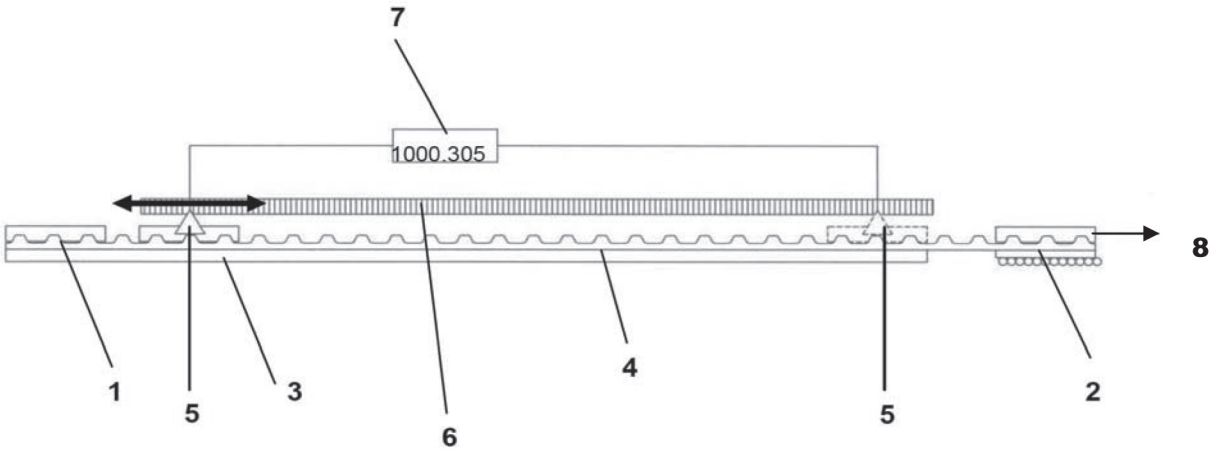
9.2.1 Measuring fixture (see Figure 3)

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

9.2.1.1 Two identical toothed clamps, of the proper profile, covering three complete belt teeth in mesh, and having zero spacing tooth shape.

9.2.1.2 Means of applying a total measuring force to the moveable clamp, given in Table 5.

9.2.1.3 Means of measuring the distance between the two clamps with the necessary degree of accuracy for distance measurement.



Key

1 fixed clamp
2 moveable clamp
3 table
4 belt specimen
5 measuring plate
6 scale
7 display
8 total measuring force

Figure 3 — Fixture for measuring pitch length of very long endless belts and open belts

9.3 Total measuring forces

The total measuring force to be applied for measuring belts is given in Table 5.

Table 5 — Total measuring force

Forces in newton

Belt profile	Total measuring force N								
	Belt width mm								
	4	6	10	16	25	32	50	75	100
T2,5	6	10	20						
T5		20	40	60	90	*(120)*			
T10				90	140	170	270	*(410)*	*(540)*
T20					*(270)*	340	540	800	1100
AT3		20	40	60	90				
AT5		25	50	80	120	*(160)*	*(250)*		
AT10			*(110)*	170	270	340	540	*(800)*	*(1100)*
AT20					*(650)*	860	1300	1950	2600

The given measuring forces are valid for the measurement according to 9.4.1; for 9.4.2, the measuring forces have to be bisected (50 % of given values). Forces for bigger belt width shall be confirmed between the user and the manufacturer.

9.4 Procedures

9.4.1 For endless belts manufactured in circular moulds

In measuring the pitch length of a synchronous belt as illustrated in Figure 2, 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 separately.

9.4.2 For very long endless belts and open belts

A single-sided belt specimen is fixed with the belt's flat side on a device as illustrated in Figure 3, and loaded with 50 % of the measuring force (see Table 5). The measuring plate of the device shall be brought into contact with the belts teeth and the measuring system shall be set to zero then. After that, the measuring plate shall be traversed as shown in Figure 3 to the right side and brought into contact with the belt again at a distance of 1 000 mm (or 1 002 mm in case of AT3) corresponding to the exact number of teeth (see NOTE below). The real distance is read from the display of the measuring system. This distance corresponds with the belt length. Double sided belts shall be checked on both sides separately.

NOTE 1 000 mm equals

— 400 teeth for a pitch of 2,5 mm,

— 200 teeth for a pitch of 5 mm,

— 100 teeth for a pitch of 10 mm, and

— 50 teeth for a pitch of 20 mm.

1 002 mm equals 334 teeth for a pitch of 3 mm.