
**Synchronous belt drives — Metric
pitch, curvilinear profile systems G, H,
R and S, belts and pulleys**

*Transmissions synchrones — Pas métrique, systèmes à denture
curviligne G, H, R et S, courroies et poulies*

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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.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 13050:2014), which has been technically revised.

The main changes are as follows:

- in [Formulae \(1\)](#) and [\(2\)](#), “A_o” has been added before the first square bracket;
- the formulae in the document have been renumbered and symbols are now used;
- the nomenclature has been changed in [Tables 1](#) and [14](#), and [Figures 1](#) and [11](#);
- belt width measurement methods were improved in [8.1.2](#), [9.1.2](#), [10.1.2](#), [11.1.2](#);
- total measuring forces are now for reference only in [8.1.3.2](#), [9.1.3.2](#), [10.1.3.2](#), [11.1.3.2](#);
- belt length measurement procedures were enhanced in [8.1.3.3](#), [9.1.3.3](#), [10.1.3.3](#), [11.1.3.3](#);
- the taper specification in [Annex C](#) was removed.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Synchronous belt drives — Metric pitch, curvilinear profile systems G, H, R and S, belts and pulleys

1 Scope

This document specifies the principal characteristics of metric pitch curvilinear synchronous endless belts and pulleys in G, H, R, and S profile systems for use in synchronous belt drives (also known in the past as timing belt drives, positive belt drives, gear belt drives) for mechanical power transmission and where positive indexing or synchronization can be required.

The principal belt and pulley characteristics include the following:

- 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.

2 Normative reference

[ISO 13050:2022](https://standards.iteh.ai/catalog/standards/sist/1ab35798-3583-4e07-b16b-3b18be61a4fe/iso-13050-2022)

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The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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*

ISO 5288, *Synchronous belt drives — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5288 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Symbols

For the purpose of this document, the symbols given in ISO 5288 and the following apply,

Symbol	Definition	Symbol	Definition
a	Pitch line differential	h_r	Reference rack tooth height

$2A$	Reference rack tooth angle	h_t	Tooth height
b_f	Minimum flanged pulley width	L_p	Belt pitch length
b'_f	Minimum unflanged pulley width	n_g	Number of grooves
b_g	Reference rack width at tooth tip	P_b	Tooth pitch
b_r	Width at groove crest	r_a	Radius at tooth tip
b_t	Reference rack width at tooth root	r_r	Radius at tooth root
C	Centre distance	r_t	Radius at the groove crest
d	Pitch diameter	S	Width at tooth root
d_o	Outside diameter	2β	Tooth angle
h_d	Total height of a double-sided belt	2ϕ	Groove angle
h_s	Total height of a single-sided belt		

5 Synchronous belt drive system types

Four profile systems and 14 profiles for curvilinear synchronous drives are standardized.

Profile system G

Profile G8M
(Tooth/groove pitch 8 mm)

Profile G14M
(Tooth/groove pitch 14 mm)

Profile system H

Profile H3M
(Tooth/groove pitch 3 mm)

Profile H5M
(Tooth/groove pitch 5 mm)

Profile H8M
(Tooth/groove pitch 8 mm)

Profile H14M
(Tooth/groove pitch 14 mm)

Profile system R

Profile R3M
(Tooth/groove pitch 3 mm)

Profile R5M
(Tooth/groove pitch 5 mm)

Profile R8M
(Tooth/groove pitch 8 mm)

Profile R14M
(Tooth/groove pitch 14 mm)

Profile R20M
(Tooth/groove pitch 20 mm)

Profile system S

Profile S8M
(Tooth/groove pitch 8 mm)

Profile S14M
(Tooth/groove pitch 14 mm)

Profile H20M
(Tooth/groove pitch 20 mm)

6 Belt nomenclature

A belt is identified as follows:

- a) the belt length or pitch length in millimetres, e.g. 1 400 mm;
- b) the profile system, e.g. “G”, “H”, “R”, or “S”;
- c) the pitch or tooth pitch in millimetres, e.g. 14 mm;
- d) the width or belt width in millimetres, e.g. 40 mm (for Profile system S, the width in millimetres \times 10);
- e) double-sided belts are designated by adding the letter “D” before the designation of the profile system.

EXAMPLE A synchronous belt in the above profile systems of 1 400 mm length, 14 mm pitch, and 40 mm wide is identified as follows:

Profile system G

1400-G14M-40

1400-DG14M-40

Profile system R

1400-R14M-40

1400-DR14M-40

Profile system H

1400-H14M-40

1400-DH14M-40

Profile system S

1400-S14M-400

1400-DS14M-400

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7 Pulley nomenclature

A pulley is identified as follows:

- a) the letter “P” indicates a pulley;
- b) the number of grooves, e.g. 30;
- c) the profile system, e.g. “G”, “H”, “R”, or “S”;
- d) the pitch or groove pitch in millimetres, e.g. 14 mm;
- e) the width or belt width in millimetres, e.g. 40 mm (for profile system S, the width in millimetres \times 10).

EXAMPLE A pulley in the above profile systems of 30 grooves, 14 mm pitch, and 40 mm wide is identified as follows:

Profile system G

P30-R14M-40

Profile system R

P30-G14M-40

Profile system H

P30-H14M-40

Profile system S

P30-S14M-400

8 Profile system G

8.1 Belt dimensions and tolerances

8.1.1 Belt tooth dimensions

The nominal belt tooth dimensions are given in [Table 1](#) and shown in [Figure 1](#).

Table 1 — Nominal tooth dimensions

Dimensions in millimetres

Profile	Belt pitch	S	h_s	h_t	r_r	A_o	a	x_o	L_1
G8M	8	5,200	5,87	3,43	0,74	2,29	0,80	0,379	1,378
G14M	14	9,100	10,11	6,00	1,30	4,00	1,40	0,661	2,422

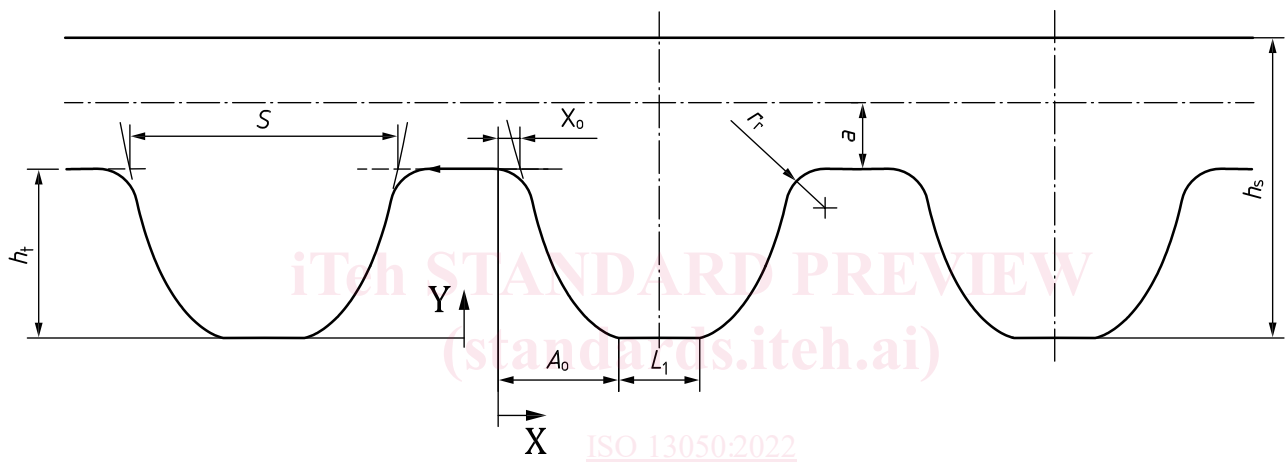


Figure 1 — Tooth dimensions — Profile system G

Detail of tooth face

For $A_o \geq x \geq x_o$:

$$y = A_o \left[\ln \left(A_o / x + \sqrt{(A_o / x)^2 - 1} \right) - \sqrt{1 - (x / A_o)^2} \right] \quad (1)$$

NOTE 1 x_o corresponds to $y = h_t$.

NOTE 2 L_1 is equal to $S - 2(A_o - x_o)$.

NOTE 3 Indicated base tooth profile remains constant in all parts.

NOTE 4 “o” reference points remain in contact with the part outer surface generated by part radius of curvature.

NOTE 5 Groove profile bottom surface in circular part form is an arc whose chordal distance is L_1 and whose radius originates at the part centre.

8.1.2 Belt widths and tolerances

Belt widths and tolerances are given in [Table 2](#). Evenly measure at least three points throughout circumference and average them.

Table 2 — Widths and width tolerances

Dimensions in millimetres

Profile	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
G8M	12	+0,8 -0,8	+0,8 -1,2	+0,8 -1,2
	21	+0,8 -0,8	+0,8 -1,2	+0,8 -1,2
	36	+0,8 -0,8	+0,8 -1,2	+0,8 -1,2
	62	+1,2 -1,2	+1,2 -1,6	+1,6 -1,6
G14M	20	+0,8 -0,8	+0,8 -1,2	+0,8 -1,2
	37	+0,8 -0,8	+0,8 -1,2	+0,8 -1,2
	68	+1,2 -1,6	+1,6 -1,6	+1,6 -2,0
	90	+1,6 -1,6	+1,6 -2,0	+2,0 -2,0
	125	+2,4 -2,4	+2,4 -2,8	+2,4 -3,2

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 2](#))

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 3](#), of the proper belt profile 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.

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.

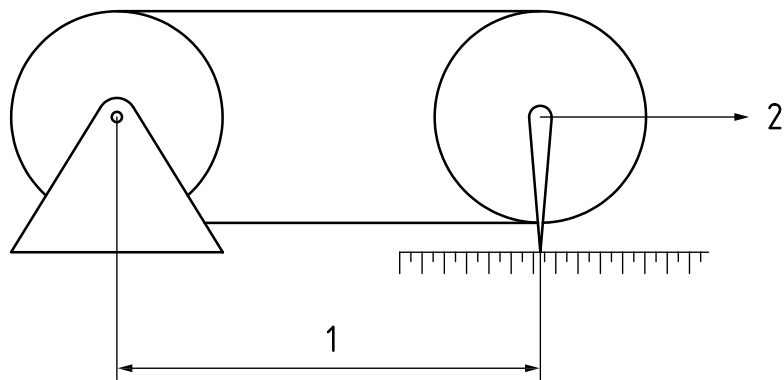
8.1.3.2 Total measuring force

The total measuring force to be applied for measuring belts is given in [Table 4](#). The forces shown in [Table 4](#) are for reference only.

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 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.

Centre-to-centre distance measurement methodology should include multiple sensor readings from a minimum of 3 belt revolutions averaged together.



Key

- 1 centre distance
- 2 total measuring force

Figure 2 — Diagram of fixture for measuring pitch length

Table 3 — Belt length measuring pulleys

Dimensions in millimetres

Profile	Number of grooves	Pitch circumference	Outside diameter ^a	Radial runout F.I.M. ^b	Axial runout F.I.M. ^b
G8M	34	272	84,980 ±0,013	0,013	0,025
G14M	40	560	175,454 ±0,025	0,013	0,051

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

^b F.I.M means the full indicator movement.

NOTE The number of pulley teeth specified in [Table 3](#) determines the recommended sizes for measuring the belt pitch length. Practically, other sizes of pulleys could be used provided both pulleys are of equal size, and meet the outside diameter tolerance, radial runout, and axial runout specifications of [Table 3](#).

Table 4 — Total measuring force

Forces in Newtons

Profile	Belt width mm								
	12	20	21	36	37	62	68	90	125
G8M	267	—	467	756	—	1 223	—	—	—
G14M	—	1 179	—	—	2 046	—	3 447	4 315	5 627

NOTE Total measuring forces are for reference only.

8.2 Pulleys, profile system G

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 pulleys with profile system G are given in [Table 5](#) and shown in [Figure 3](#).

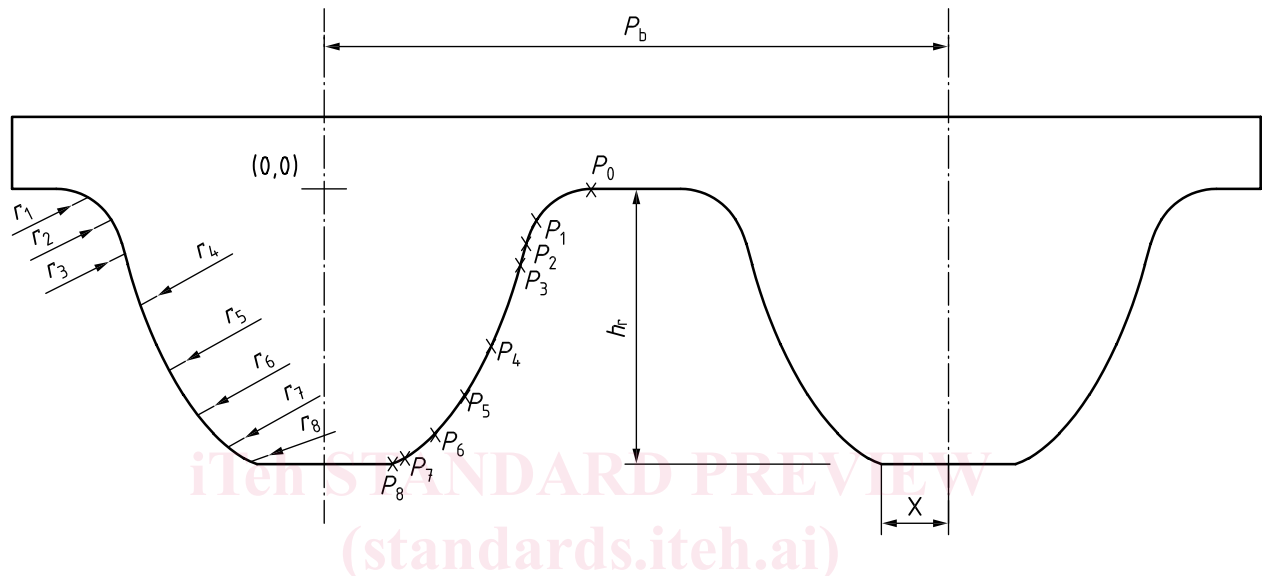


Figure 3 — Pulley generating tool rack dimensions

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Table 5 — Pulley generating tool rack dimensions

Dimensions in millimetres

Profile	Number of grooves	P_b	h_r	P_0 (X,Y)	r_1	P_1 (X,Y)	r_2	P_2 (X,Y)	r_3	P_3 (X,Y)	r_4	P_4 (X,Y)	r_5	P_5 (X,Y)	r_6	P_6 (X,Y)	r_7	P_7 (X,Y)	r_8	P_8 (X,Y)	X		
G8M	22 to 27	7,784	3,541	3,480 0	0,842 -0,433	2,710 -0,433	1,459 1,086	2,567 -0,788	—	—	8,833 9,487	2,427 2,447	5,882 5,901	1,841 -2,580	3,123 3,152	1,324 -3,235	1,450 1,505	0,979 -3,491	0,552	0,856 -3,541	0,856 0,843	0,856 0,843	
	28 to 37	7,843	3,513	3,448 0	0,828 -0,348	2,746 -0,348	1,086 0,918	2,578 -0,715	—	—	9,487 9,964	2,447 2,462	5,901 5,921	1,894 -2,486	3,152 3,181	1,367 -3,177	1,505 1,562	1,009 -3,447	0,640	0,843 -3,513	0,843 0,831	0,843 0,831	
	38 to 58	7,891	3,487	3,426 0	0,819 -0,232	2,829 -0,232	0,918 0,846	2,583 -0,668	—	—	9,964 10,385	2,462 2,470	5,921 5,932	1,940 -2,402	3,181 3,205	1,410 -3,119	1,410 1,443	1,562 1,614	1,024 -3,414	0,669	0,831 -3,487	0,831 0,820	0,831 0,820
	59 to 89	7,930	3,467	3,412 0	0,818 -0,130	2,943 -0,130	0,846 0,957	2,586 -0,632	—	—	10,385 8,275	2,470 2,345	5,932 5,111	1,978 -2,328	3,205 3,042	1,443 -3,072	1,443 1,559	1,614 1,725	1,039 -3,384	0,725	0,820 -3,467	0,820 0,951	0,820 0,951
	90 to 250	8,040	3,452	3,558 0	0,846 -0,164	3,040 -0,164	0,957 0,512	2,751 -0,512	1,984 -0,873	2,617 -0,873	8,275 -0,873	2,345 -1,724	5,111 9,625	1,978 -2,495	3,042 3,161	1,559 -3,056	1,559 2,486	1,725 3,338	1,181 -3,359	0,805	0,951 -3,452	0,951 -3,452	0,951 1,505
	G14M	27 to 29	13,674	6,174	6,009 0	1,461 -0,684	4,777 -0,684	2,188 2,206	4,536 -1,222	9,728 -1,696	4,405 -1,696	11,867 11,919	3,768 -3,487	9,625 9,584	3,161 -4,619	6,114 6,129	2,486 -5,489	3,338 3,433	1,808 -6,041	1,511	1,505 -6,174	1,505 -6,174	1,505 1,496
30 to 35		13,725	6,147	5,986 0	1,453 -0,717	4,738 -0,717	2,206 2,241	4,519 -1,244	9,448 -1,626	4,418 -1,626	11,919 13,051	3,800 -3,408	9,584 10,115	3,213 -4,531	6,129 6,163	2,522 -5,436	3,433 3,489	1,850 -5,990	1,588	1,496 -6,147	1,496 -6,147	1,496 1,485	1,496 1,485
36 to 45		13,780	6,117	5,961 0	1,446 -0,780	4,685 -0,780	2,241 2,180	4,490 -1,312	—	—	13,051 13,091	3,951 -3,041	10,115 10,092	3,297 -4,387	6,163 6,222	2,582 -5,356	3,489 3,541	1,883 -5,942	1,672	1,485 -6,117	1,485 -6,117	1,485 1,476	1,485 1,476
46 to 60		13,831	6,090	5,940 0	1,437 -0,815	4,652 -0,815	2,180 2,151	4,484 -1,313	—	—	13,091 13,183	3,971 -2,983	10,092 10,067	3,417 -4,172	6,222 6,236	2,649 -5,267	3,541 3,586	1,913 -5,899	1,745	1,476 -6,090	1,476 -6,090	1,476 1,467	1,476 1,467
61 to 90		13,879	6,065	5,919 0	1,429 -0,883	4,608 -0,883	2,151 2,586	4,484 -1,285	—	—	13,183 13,304	3,988 -2,928	10,067 10,051	3,463 -4,081	6,236 6,245	2,702 -5,193	3,586 3,629	1,940 -5,857	1,812	1,467 -6,065	1,467 -6,065	1,467 1,458	1,467 1,458
91 to 149		13,927	6,040	5,900 0	1,420 -0,955	4,568 -0,955	2,586 5,757	4,476 -1,292	—	—	13,304 13,150	4,014 -2,848	10,051 10,051	3,505 -3,997	6,245 6,249	2,746 -5,128	3,629 3,652	1,969 -5,815	1,872	1,458 -6,040	1,458 -6,040	1,458 1,453	1,458 1,453
150 to 250	13,956	6,024	5,887 0	1,414 -1,031	4,537 -1,031	5,757 -1,352	4,458 -1,352	—	—	13,150 -1,352	4,030 -2,799	10,051 -2,799	3,533 -3,938	6,249 -3,938	2,701 -5,171	3,652 -5,171	1,983 -5,792	1,908	1,453 -6,024	1,453 -6,024	1,453 -6,024	1,453 -6,024	

