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## 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](http://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](http://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 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 \(standards.iteh.ai\)](http://Foreword - Supplementary information (standards.iteh.ai))

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

This second edition ~~replaces the first edition (ISO 13050:1999)~~, which has been technically revised.

This corrected version of ISO 13050:2014 incorporates the following corrections: in Formulas (1) and (2), “Ao” has been added before the first square bracket in each equation.

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

## 1 Scope

This International Standard 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 might 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 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 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 8mm)  
Profile G14M  
(Tooth/groove pitch 14mm)

#### Profile system R

Profile R3M  
(Tooth/groove pitch 3mm)  
Profile R5M  
(Tooth/groove pitch 5mm)  
Profile R8M  
(Tooth/groove pitch 8mm)  
Profile R14M  
(Tooth/groove pitch 14mm)  
Profile R20M  
(Tooth/groove pitch 20mm)

#### Profile system H

Profile H3M  
(Tooth/groove pitch 3mm)  
Profile H5M  
(Tooth/groove pitch 5mm)  
Profile H8M  
(Tooth/groove pitch 8mm)  
Profile H14M  
(Tooth/groove pitch 14mm)  
Profile H20M  
(Tooth/groove pitch 20mm)

#### Profile system S

Profile S8M  
(Tooth/groove pitch 8mm)  
Profile S14M  
(Tooth/groove pitch 14mm)

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## 4 Belt nomenclature

A belt is identified as follows:

- the belt length or pitch length in millimetres, e.g. 1 400 mm;
- the profile system, e.g. “G”, “H”, “R”, or “S”;
- the pitch or tooth pitch in millimetres, e.g. 14 mm;
- the width or belt width in millimetres, e.g. 40 mm (for profile system S, the width in millimetres  $\times$  10);
- 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

## 5 Pulley nomenclature

A pulley is identified as follows: (standards.iteh.ai)

- the letter “P” indicates a pulley; [ISO 13050:2014](https://standards.iteh.ai/catalog/standards/sist/8f72d0fc-1d4d-4488-b707-d494bce580fe/iso-13050-2014)
- the number of grooves, e.g. 30; <https://standards.iteh.ai/catalog/standards/sist/8f72d0fc-1d4d-4488-b707-d494bce580fe/iso-13050-2014>
- the profile system, e.g. “G”, “H”, “R”, or “S”;
- the pitch or groove pitch in millimetres, e.g. 14 mm;
- 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-G14M-40

**Profile system R**  
P30-R14M-40

**Profile system H**  
P30-H14M-40

**Profile system S**  
P30-S14M-400

6 Profile system G

6.1 Belt dimensions and tolerances

6.1.1 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	$b_g$	$h_g$	R1	$A_o$	$a^a$	$x_o$	L1
G8M	8	5,200	3,43	0,74	2,29	0,80	0,379	1,378
G14M	14	9,100	6,00	1,30	4,00	1,40	0,661	2,422

<sup>a</sup>  $a$  is the belt design pitch differential.

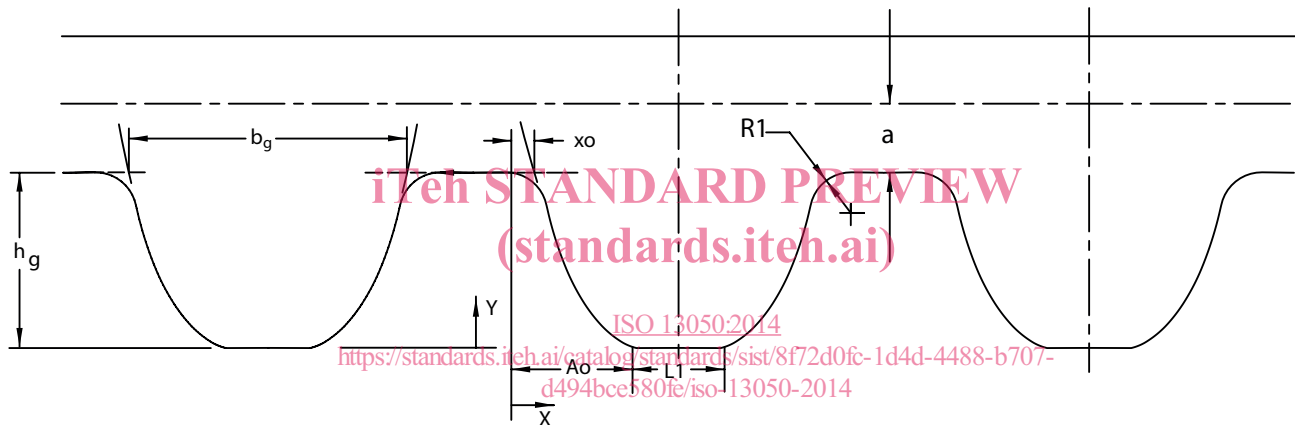


Figure 1 — Tooth dimensions — Profile system G

### Detail of tooth face

For  $Ao \geq x \geq xo$ :

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

where

$xo$  corresponds to  $y = hg$ ;

$L1$  is equal to  $bg - 2(Ao - xo)$ .

NOTE 1 Indicated base tooth profile remains constant in all parts.

NOTE 2 "O" reference points remain in contact with the part outer surface generated by part radius of curvature.

NOTE 3 Groove profile bottom surface in circular part form is an arc whose chordal distance is  $L1$  and whose radius originates at the part centre.

### 6.1.2 Belt widths and tolerances

Belt widths and tolerances are given in [Table 2](#).

**Table 2 — Widths and width tolerances**  
(standards.iteh.ai)

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

### 6.1.3 Pitch length measurement

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

#### 6.1.3.1 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.

**6.1.3.1.1 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.

### 6.1.3.1.2 Means of applying a total measuring force to the moveable pulley.

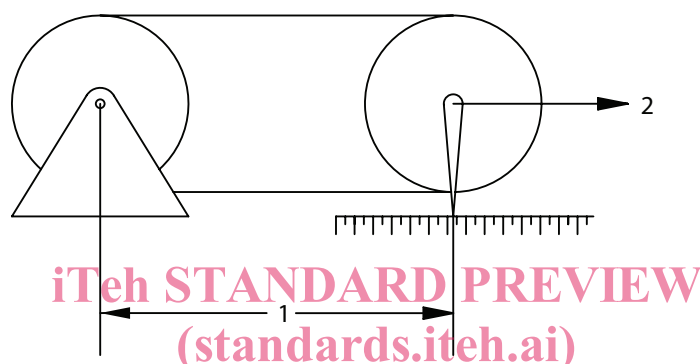
6.1.3.1.3 Means of measuring the centre distance between the two pulleys with the necessary degree of accuracy for centre distance measurement.

### 6.1.3.2 Total measuring force

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

### 6.1.3.3 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.



#### Key

- 1 centre distance
- 2 total measuring force

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**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 <sup>a</sup>	Radial runout F.I.M. <sup>b</sup>	Axial runout F.I.M. <sup>b</sup>
G8M	34	272	84,980 ±0,013	0,013	0,025
G14M	40	560	175,454 ±0,025	0,013	0,051
<sup>a</sup> Pulleys outside of the diameter tolerance range specified can be used if the resulting belt length measurements are corrected for the actual pulley diameters. <sup>b</sup> 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 they have the same number of teeth, and meet the dimensional requirements of [Table 3](#).

Table 4 — Total measuring force

Forces in newtons

Profile	Belt width mm								
	12	20	21	36	37	62	68	90	125
<b>G8M</b>	267	—	467	756	—	1223	—	—	—
<b>G14M</b>	—	1179	—	—	2046	—	3447	4315	5627

## 6.2 Pulleys, profile system G

### 6.2.1 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.

### 6.2.2 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.

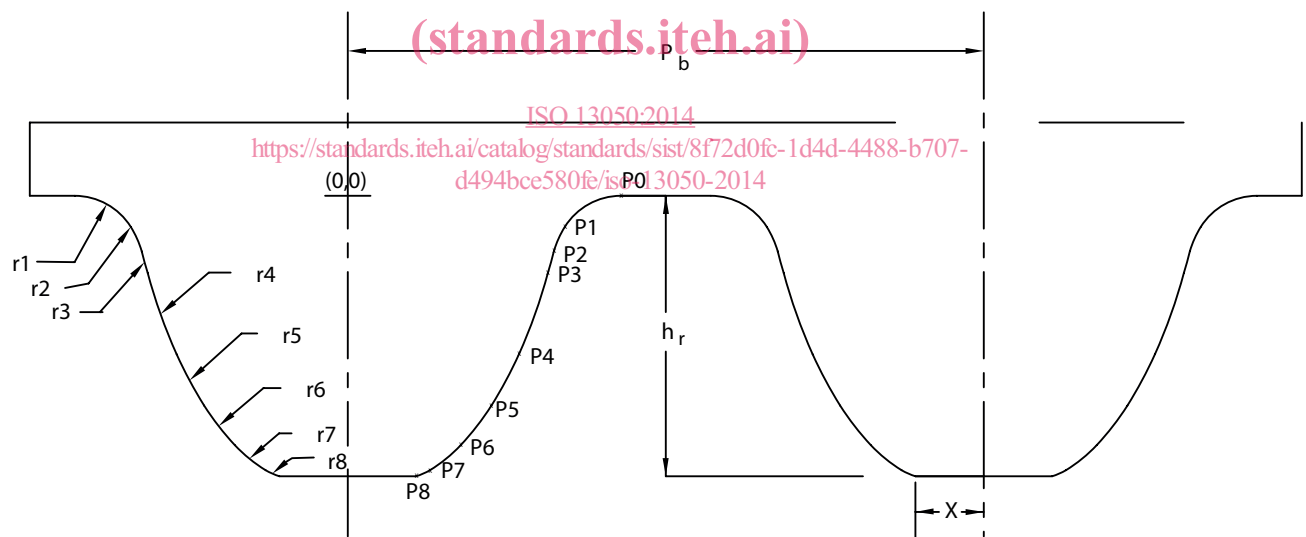


Figure 3 — Pulley generating tool rack dimensions

Table 5 — Pulley generating tool rack dimensions

Dimensions in millimetres

Profile	Number of grooves	P <sub>b</sub>	h <sub>r</sub>	P <sub>0</sub> (x,y)	r <sub>1</sub>	P <sub>1</sub> (x,y)	r <sub>2</sub>	P <sub>2</sub> (x,y)	r <sub>3</sub>	P <sub>3</sub> (x,y)	r <sub>4</sub>	P <sub>4</sub> (x,y)	r <sub>5</sub>	P <sub>5</sub> (x,y)	r <sub>6</sub>	P <sub>6</sub> (x,y)	r <sub>7</sub>	P <sub>7</sub> (x,y)	r <sub>8</sub>	P <sub>8</sub> (x,y)	X
G8M	22 to 27	7,784	3,541	3,480	0,842	2,710	1,459	2,567	—	—	8,833	2,427	5,882	1,841	3,123	1,324	1,450	0,979	0,552	0,856	0,856
	28 to 37	7,843	3,513	3,448	0,828	2,746	1,086	2,578	—	—	9,487	2,447	5,901	1,894	3,152	1,367	1,505	1,009	0,640	0,843	0,843
	38 to 58	7,891	3,487	3,426	0,819	2,829	0,918	2,583	—	—	9,964	2,462	5,921	1,940	3,181	1,410	1,562	1,024	0,669	0,831	0,831
	59 to 89	7,930	3,467	3,412	0,818	2,943	0,846	2,586	—	—	10,385	2,470	5,932	1,978	3,205	1,443	1,614	1,039	0,725	0,820	0,820
	90 to 250	8,040	3,452	3,558	0,846	3,040	0,957	2,751	1,984	2,617	8,275	2,345	5,111	1,978	3,042	1,559	1,725	1,181	0,805	0,951	0,951
G14M	27 to 29	13,674	6,174	6,009	1,461	4,777	2,188	4,536	9,728	4,405	11,867	3,768	9,625	3,161	6,114	2,486	3,338	1,808	1,511	1,505	1,505
	30 to 35	13,725	6,147	5,986	1,453	4,738	2,206	4,519	9,448	4,418	11,919	3,800	9,584	3,213	6,129	2,522	3,433	1,850	1,588	1,496	1,496
	36 to 45	13,780	6,117	5,961	1,446	4,685	2,241	4,490	—	—	13,051	3,951	10,115	3,297	6,163	2,582	3,489	1,883	1,672	1,485	1,485
	46 to 60	13,831	6,090	5,940	1,437	4,652	2,180	4,484	—	—	13,091	3,971	10,092	3,417	6,222	2,649	3,541	1,913	1,745	1,476	1,476
	61 to 90	13,879	6,065	5,919	1,429	4,608	2,151	4,484	—	—	13,183	3,988	10,067	3,463	6,236	2,702	3,586	1,940	1,812	1,467	1,467
	91 to 149	13,927	6,040	5,900	1,420	4,568	2,586	4,476	—	—	13,304	4,014	10,051	3,505	6,245	2,746	3,629	1,969	1,872	1,458	1,458
	150 to 250	13,956	6,024	5,887	1,414	4,537	5,757	4,458	—	—	13,150	4,030	10,051	3,533	6,249	2,701	3,652	1,983	1,908	1,453	1,453
				0		-1,031		-1,352				-2,799		-3,938		-5,171		-5,792		-6,024	

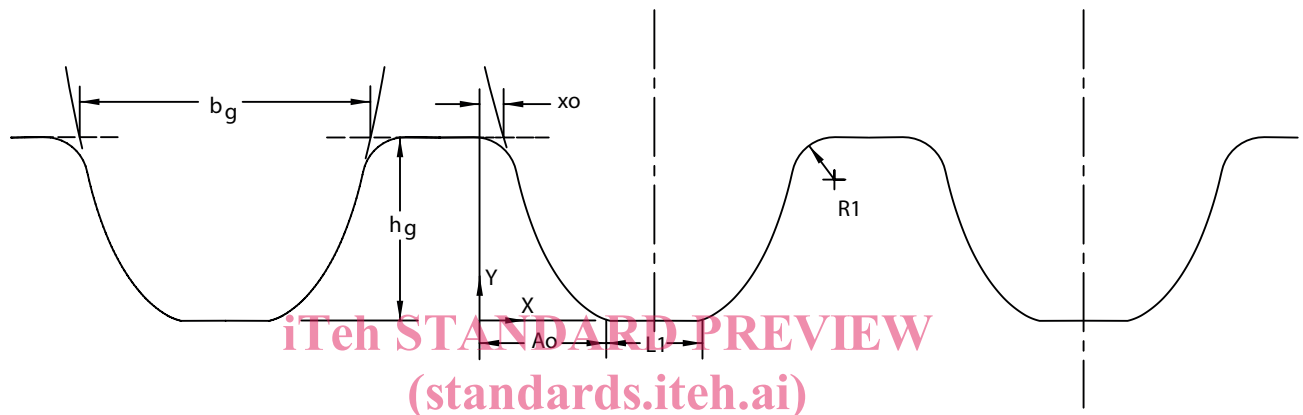
### 6.2.3 Pulley groove profile dimensions and tolerances

Dimensions and tolerances for the pulley groove profile for G8M and G14M pulleys are given in [Table 6](#) and shown in [Figures 4](#) and [5](#).

**Table 6 — Pulley groove profile dimensions**

Dimensions in millimetres

Profile	Number of grooves	$b_g$	$h_g$	$R_1$	$A_o$	$x_o$	$L_1$	$a$
<b>G8M</b>	22 to 89	5,400	3,43	0,80	2,29	0,379	1,60	0,80
	90 to 250	5,660	3,43	0,80	2,29	0,379	1,60	0,80
<b>G14M</b>	28 to over	9,450	6,00	1,40	4,00	0,661	2,80	1,40



**Figure 4 — Pulley groove profile**

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For  $A_o \geq x \geq x_o$ :

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

where

$x_o$  corresponds to  $y = h_g$ ;

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

NOTE 1 Indicated base tooth profile remains constant in all parts.

NOTE 2 “O” Reference points remain in contact with the part outer surface generated by part radius of curvature.

NOTE 3 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.