INTERNATIONAL STANDARD

ISO 9982

Third edition
2021-09

Belt drives — Pulleys and V-ribbed belts for industrial applications — PH, PJ, PK, PL and PM profiles: dimensions

Transmissions par courroies — Poulies et courroies striées pour des applications industrielles — Profils PH, PJ, PK, PL et PM: dimensions

Reference number
ISO 9982:2021(E)

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Published in Switzerland

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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 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 1, *Friction*.

This third edition cancels and replaces the second edition (ISO 9982:1998), which has been technically revised. The main changes compared to the previous edition are as follows:

— updating of the normative reference listing;

— clarification made where the document is not for elastic belts;

— revision of 5.3.6 to reference ISO 254 for pulley roughness;

— removal of the current roughness values;

— specification of the maximum pulley groove radius (Table 2);

— specification of the minimum pulley groove radius of PH and PJ profiles (Table 2);

— specification of the maximum belt groove bottom radius of PH and PJ profiles (Table 8);

— specification of the measuring pulleys and measuring forces of PK, PL and PM profiles (Table 9).

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.

Introduction

A V-ribbed belt drive is composed of an endless belt with a longitudinally ribbed traction surface which engages and grips, by friction, pulley grooves of similar shape. The belt ribbed surface fits the pulley grooves to make nearly total contact.

Belt drives — Pulleys and V-ribbed belts for industrial applications — PH, PJ, PK, PL and PM profiles: dimensions

1 Scope

This document specifies the principal dimensional characteristics of V-ribbed pulley groove profiles, together with the corresponding endless V-ribbed belts, of PH, PJ, PK, PL and PM profiles which are used for general industrial applications except elastic belts.

The PK belt was originally established for automotive accessory drive applications and ISO 9981 deals specifically with that particular field.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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 Table 1 apply.

Table 1 — Symbols

Symbol	Designation	Unit
b	nominal width of the belt	mm
b_e	effective line differential	mm
d_B	checking ball or rod diameter	mm
d_e	effective diameter	mm
d_o	outer diameter	mm
d_p	pitch diameter	mm
E	centre distance between the pulleys	mm
E_{max}	maximum centre distance between the pulleys	mm
E_{min}	minimum centre distance between the pulleys	mm
ΔE	centre distance variation	mm
e	groove pitch	mm
F	measuring force per rib	N
f	distance between the outside of the rim and the axis of the first groove	mm
h	belt height	mm
K	diameter over balls or rods	mm

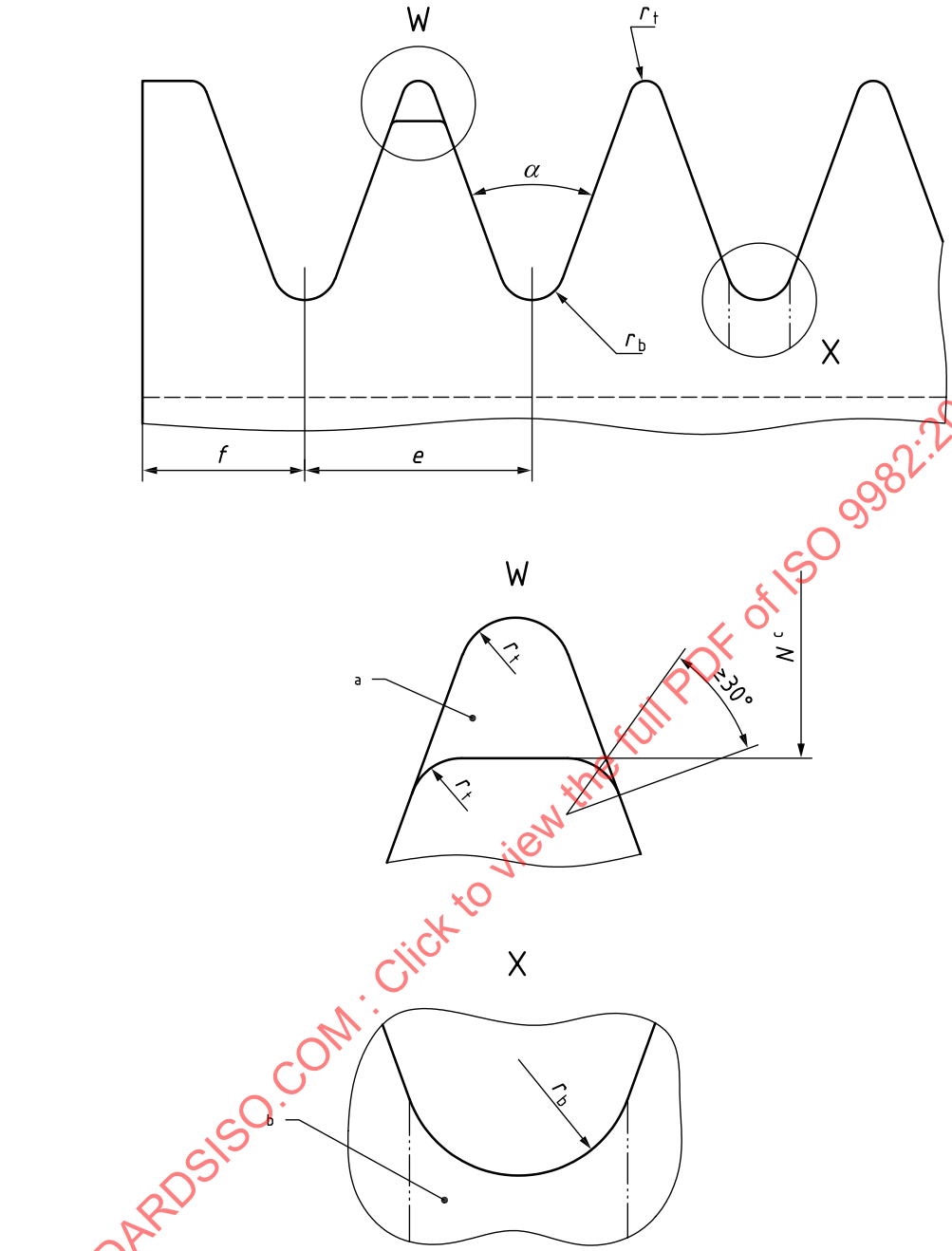
Table 1 *(continued)*

Symbol	Designation	Unit
L_e	effective length	mm
N	half the difference between the outer diameter and the diameter over balls or rods	mm
n	number of ribs	—
p_b	rib pitch	mm
r_b	groove bottom radius of pulleys or rib tip radius of belts	mm
r_t	groove transitional radius of pulleys or rib bottom radius of belts	mm
Ra	surface roughness	µm
U_e	pulley effective circumference	mm
x	half the difference between the effective diameter and the diameter over balls or rods	mm
α	groove or rib angle	°

5 Pulleys

5.1 Groove dimensions and tolerances

The groove dimensions of PH, PJ, PK, PL and PM belts are shown in Figure 1 and 2, and given in Table 2.



Key

e	groove pitch
f	distance between the outside of the rim and the axis of the first groove
N	half the difference between the outer diameter and the diameter over balls or rods
r_b	groove bottom radius of pulleys or rib tip radius of belts
r_t	groove transitional radius of pulleys or rib bottom radius of belts
α	groove or rib angle

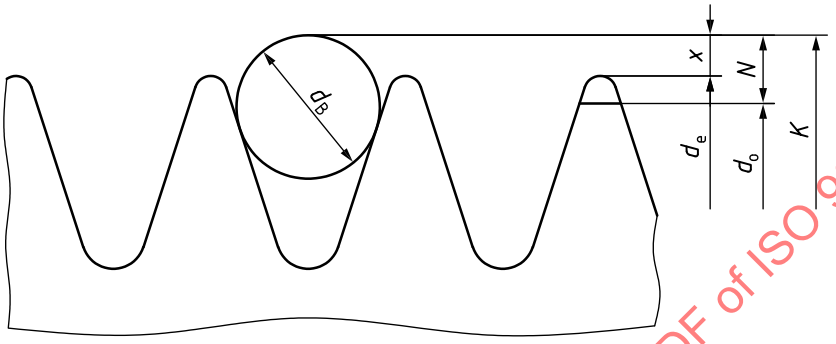
a The actual configuration of the tip profile can lie anywhere between the maximum and minimum indicated. Any configuration shall have a transitional radius r_t corresponding to a 30° minimum arc tangent to the groove sidewall.

b The configuration of the groove bottom below r_b is optional.

c See Figure 2.

NOTE View W represents the pulley tip profile and view X represents the pulley groove bottom.

Figure 1 — Cross-section of pulley grooves



Key

d_B checking ball or rod diameter
d_e effective diameter
d_o outer diameter
K diameter over balls or rods
x half the difference between the effective diameter and the diameter over balls or rods

Figure 2 — Pulley diameters

Table 2 — Dimensions of pulley grooves

Parameter		Dimensions of pulley grooves Profile				
		PH	PJ	PK	PL	PM
Groove pitch, e [a] [b]		1,6 ± 0,03	2,34 ± 0,03	3,56 ± 0,05	4,7 ± 0,05	9,4 ± 0,08
Groove angle, α [c]	±0,5°	40°	40°	40°	40°	40°
r_t [d]		0,25 ± 0,05	0,30 ± 0,05	0,35 ± 0,10	0,55 ± 0,15	0,90 ± 0,15
r_b	maximum	0,3	0,4	0,5	0,4	0,75
Checking ball or rod diameter, d_B	±0,01	1	1,5	2,5	3,5	7
$2x$	nominal	0,11	0,23	0,99	2,36	4,53
$2N$ [e]	maximum	0,69	0,81	1,68	3,5	5,92
f	minimum	1,3	1,8	2,5	3,3	6,4

a The tolerance on e applies to the distance between the axes of two consecutive grooves.

b The sum of all deviations from the nominal value e for all grooves in any pulley shall not exceed ±0,3.

c The centreline of the groove shall make an angle of 90° ± 0,5° with the axis of the pulley.

d The transitional radius of PH and PJ made from plastic shall be agreed between the parties concerned.

e N is not related to the nominal diameter of the pulley but is measured from the actual ride position of the ball or rod in the pulley.

5.2 Minimum effective diameter

The minimum recommended effective diameter, d_e, for V-ribbed pulleys is given in Table 3.

Table 3 — Minimum effective diameter

Dimensions in millimetres

Profile		PH	PJ	PK	PL	PM
Effective diameter, d_e	min.	13	20	45	75	180

5.3 Tolerances on finished pulley

5.3.1 Checking conditions

Profile, diameter and run-out tolerances shall be checked on the finished pulley without surface coating.

5.3.2 Groove-to-groove diameter tolerances

The variation in diameters between the grooves in any one pulley shall be within the limits given in Table 4. This variation is obtained by comparing the diameter over balls or rods.

Table 4 — Groove-to-groove diameter variation

Dimensions in millimetres

Effective diameter d_e	Number of grooves n	Maximum diameter variation
$d_e \leq 74$	≤6	0,1
	>6	Add 0,003 for each additional groove
$74 < d_e \leq 500$	≤10	0,15
	>10	Add 0,005 for each additional groove
$d_e > 500$	≤10	0,25
	>10	Add 0,01 for each additional groove

5.3.3 Radial circular run-out

Radial circular run-out shall be within the limits given in Table 5. Radial run-out is measured with a ball mounted under spring pressure to ensure contact with the groove as the pulley is rotated.

Table 5 — Radial circular run-out

Dimensions in millimetres

Effective diameter d_e	Radial circular run-out FIM[a] maximum
$d_e \leq 74$	0,13
$74 < d_e \leq 250$	0,25
$d_e > 250$	0,25 + 0,000 4 per millimetre of effective diameter over 250

[a] Full indicator movement.

5.3.4 Axial circular run-out

Axial circular run-out (full indicator movement) shall be within 0,002 mm per millimetre of effective diameter. Run-out shall be measured with a ball mounted under spring pressure to ensure contact with the groove as the pulley is rotated.

5.3.5 Diameter over balls

The tolerances on the diameter over balls (K) shall be within the limits given in Table 6.

Table 6 — Tolerance on the diameter over balls

Dimensions in millimetres

Diameter over balls K	Tolerance
$K \leq 75$	±0,3
$75 < K \leq 200$	±0,6
For each additional 25 mm, add	±0,1

5.3.6 Groove finish

The pulley grooves shall have a surface roughness $Ra \leq 3{,}2$ µm. See ISO 254 and ISO 4287 for definitions and the method of measurement.

5.4 Pitch diameter, d_p

The fit of a V-ribbed belt in the corresponding pulley is shown in Figure 3. The true pitch diameter of a V-ribbed pulley is slightly larger than the effective diameter and its exact value is determined with the particular belt being used.

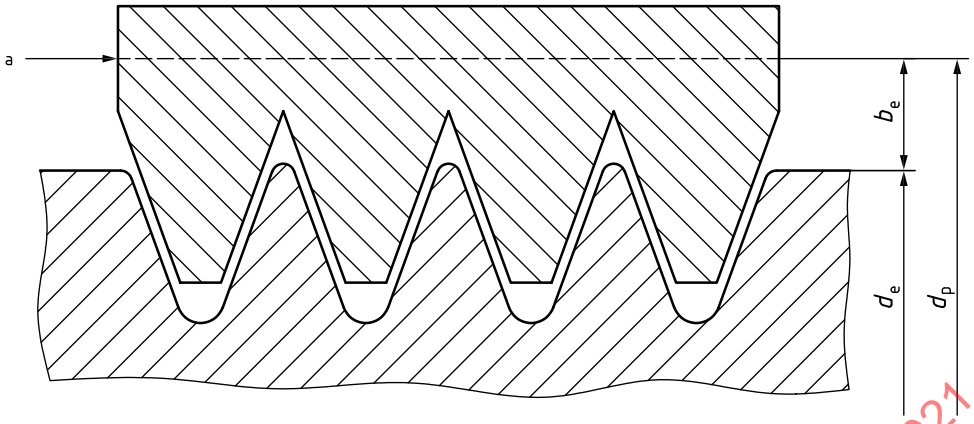
The appropriate nominal value of the effective line differential, b_e, which is given in Table 7 may be used to calculate the speed ratio. If more precision is required, the belt manufacturer should be consulted.

Further information is given in ISO 8370 series.

Table 7 — Nominal value of the effective line differential, b_e

Dimensions in millimetres

Profile	PH	PJ	PK	PL	PM
Effective line differential, b_e	0,8	1,2	2	3	4



Key

b_e effective line differential
d_p pitch diameter
[a] Position of the pitch zone.

Figure 3 — Determination of pitch diameter

5.5 Designation of pulleys

A V-ribbed pulley is characterized by the number of grooves, the profile and the effective diameter. It is designated by a series of numbers and letters as follows:

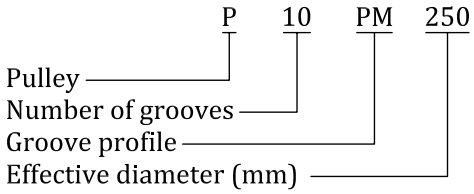
a) the first letter "P" means "Pulley";

b) the first set of numbers indicates the number of grooves;

c) the second set of letters indicates the groove profile;

d) the second set of numbers indicates the effective diameter, in millimetres.

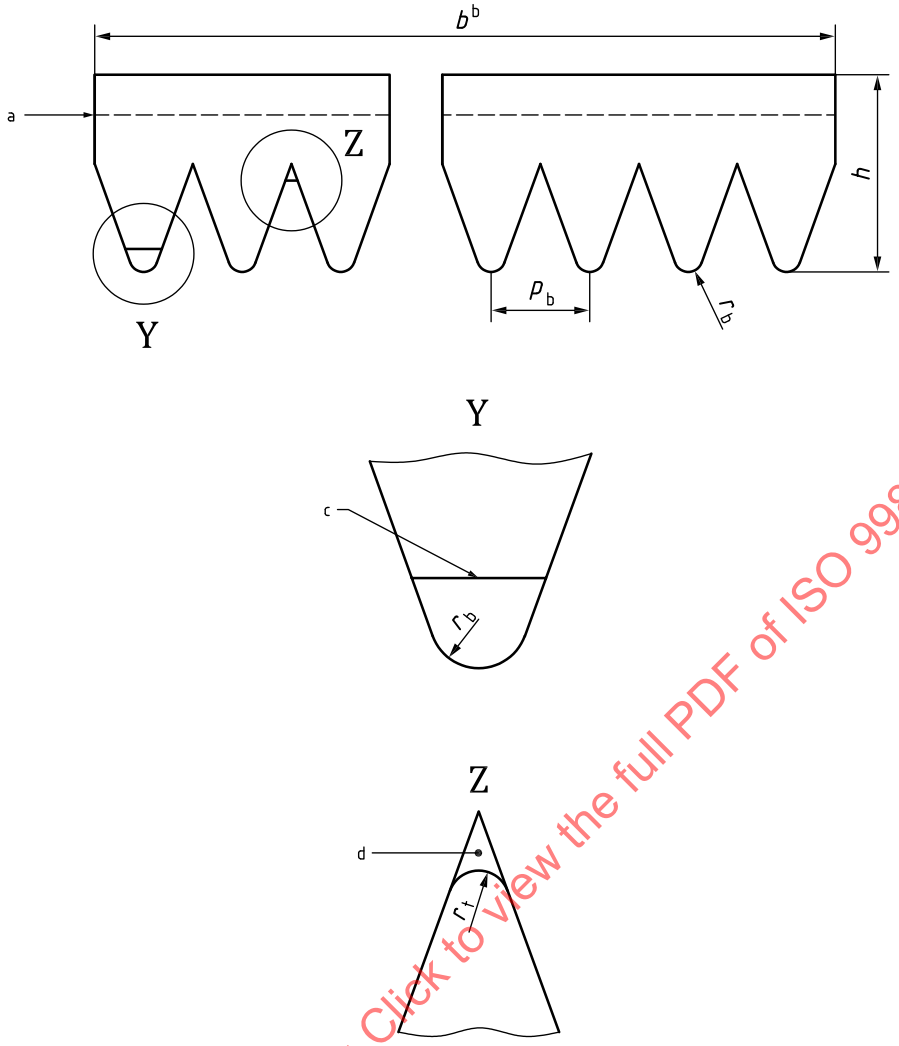
EXAMPLE



6 Belts

6.1 Belt dimensions

The belt dimensions are shown on Figure 4 and given in Table 8.



Key

b	nominal width of the belt
h	belt height
p_b	rib pitch
a	Position of the pitch zone.
b	Nominal width of the belt $b = n \times P_b$, where n is the number of ribs.
c	The flat belt tip is optional.
d	The configuration of the belt groove bottom may lie anywhere between the maximum and the minimum indicated.

NOTE View Y represents the belt rib tip and view Z represents the belt groove bottom.

Figure 4 — Cross-section of belt

Table 8 — Belt dimensions

Dimensions in millimetres

Profile		PH	PJ	PK	PL	PM
Rib pitch, p_b		1,6	2,34	3,56	4,7	9,4
Rib tip radius, r_b	minimum	0,3	0,4	0,5	0,4	0,75
Rib bottom radius, r_t	maximum	0,20	0,25	0,25	0,4	0,75
Belt height, h	≈	3	4	6	10	17
NOTE Belt rib pitch and belt height are shown as reference dimensions only. Cumulative rib pitch tolerance is an important value, however, it is frequently affected by the tension at which the belt operates and the modulus of the tension member.						

6.2 Measurement of effective belt length

6.2.1 Measuring fixture — Apparatus

The effective belt length shall be determined by placing the belt on a measuring fixture shown in Figure 5 which is composed of the following elements.

— Two pulleys of equal diameter, one of which is fixed and the other movable.

Their profile shall comply with Figure 1 and Table 2, and their recommended effective diameter shall be determined from the values given in Table 9.

— Device for applying a total measuring force to the movable pulley.

— Device for measuring the centre distance between the two pulleys.

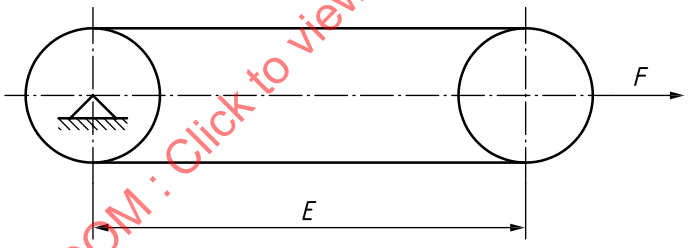


Figure 5 — Measuring fixture to determine effective length

6.2.2 Measuring force

The measuring force to be applied for measuring the effective length of belts is given in Table 9.

Table 9 — Measuring pulleys and measuring forces

Dimensions in millimetres and measuring forces in newtons

Profile	PH		PJ		PK		PL		PM
Pulley effective circumference (at the level of effective diameter), U_e	100	300	100	300	200	300	300	500	800
Diameter over balls or rods, $K \pm 0{,}13$	31,94	95,6	32,06	95,72	65,65	96,48	97,85	161,51	259,17
Measuring force per rib, F	30		50		100		200		450

6.2.3 Procedure

To measure the effective length of a belt, rotate the belt at least two revolutions to seat it properly and to divide the total force equally between the two strands of the belt.

Then measure the centre distance between the pulleys, E, and calculate the effective length, L_e, of the belt using Formula (1):

$$L_e = E_{max} + E_{min} + U_e \quad (1)$$

where

U_e is the effective circumference of the measuring pulley;

E_{max} is the maximum centre distance between the pulleys;

E_{min} is the minimum centre distance between the pulleys.

6.2.4 Manufacturing tolerances

The permissible manufacturing tolerances for effective lengths of V-ribbed belts are given in Table 10.

The tolerances for Table 10 are approximately calculated using Formulae (2) and (3). The values for L_e in Formulae (2) and (3) are the maximum for the range and the results are rounded to reasonable values.

$$+0{,}3 \cdot \sqrt[3]{L_e} + 0{,}003 \cdot L_e \quad (2)$$

$$-2 \times \left(0{,}3 \cdot \sqrt[3]{L_e} + 0{,}003 \cdot L_e\right) \quad (3)$$