FINAL DRAFT

INTERNATIONAL STANDARD

ISO/FDIS 5295

ISO/TC **41**/SC **4**

Secretariat: **ANSI**

Voting begins on: **2023-04-06**

Voting terminates on: **2023-06-01**

Synchronous belts — Calculation of power rating and drive centre distance

Courroies synchrones — Calcul de la puissance transmissible et de l'entraxe

Reference number
ISO/FDIS 5295:2023(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 document 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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This document was prepared by Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts)*, Subcommittee SC 41, *Synchronous belt drives*.

This fourth edition cancels and replaces the third edition (ISO 5295:2017), of which it constitutes a minor revision.

The changes are as follows:

— the scope been revised to clarify the applicability of the document.

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 belts — Calculation of power rating and drive centre distance

1 Scope

This document establishes formulae for the calculation of power rating and centre distance of standard synchronous belts on two pulley drives.

It is applicable to trapezoidal belts only. It does not apply to curvilinear synchronous belts.

The numerical values of certain parameters used in the calculations depend upon the pitch and the construction of the belt and are specified by the belt manufacturer.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/

3.1
power rating
power that a specified synchronous belt can transmit under specified geometrical and ambient conditions for a satisfactory period of time, provided that the drive has been installed and is maintained in a proper manner

Note 1 to entry: The power rating depends on the following:

— the pitch of the belt and pulley teeth;

— the belt width;

— the mass of a linear metre of belt;

— the allowable working tension in the belt;

— the angular velocity of the smaller pulley;

— the number of teeth of the smaller pulley;

— the number of teeth in mesh on the smaller pulley.

4 Symbols

Symbol	Description	Units
b_s	Width of the belt to be rated	mm
b_{so}	Base width of the widest standard belt of pitch P_b (see Table 1)	mm

Symbol	Description	Units
C	Centre distance of the pulleys	mm
k_w	Width factor	
k_z	Teeth in mesh factor	
m	Linear mass of a belt having a width b_{so}	kg/m
P	Power rating of a belt of base width b_s	kW
P_b	Pitch of the teeth of the belt and pulleys	mm
P_o	Power rating of a belt of base width b_{so}	kW
T_a	Allowable working tension of a belt having a width b_{so}	N
ω	Angular velocity of the smaller pulley	rad/s
v	Belt velocity	m/s
z_1	Number of teeth of the smaller pulley	
z_2	Number of teeth of the larger pulley	
z_b	Number of teeth of the belt	
z_m	Number of teeth in mesh on the smaller pulley	
int [ ]	Integer part only of the expression following	

5 Basic power rating

The basic power rating of a belt of base width, b_{so}, is given by the Formula (1):

$$P_o = \frac{\left(T_a - mv^2\right)v}{1\,000} \quad (1)$$

where the belt velocity, v, has the value given by Formula (2):

$$v = \frac{\omega P_b z_1 \times 10^{-3}}{2\pi} \quad (2)$$

Formula (1) is valid only if the number of teeth in mesh $z_m \geq 6$ (see Clause 6 for $z_m < 6$).

The values of T_a and m depend upon the construction and the type of belt; these shall be supplied by the belt manufacturer.

6 Power rating

6.1 Exact formula

The power rating of a belt of width, b_s, having z_m teeth in mesh on the smaller pulley, is given by Formula (3):

$$P = \left(k_z k_w T_a - \frac{b_s m v^2}{b_{so}}\right) v \times 10^{-3} \quad (3)$$

See Clauses 9 and 10 for k_z and k_w, respectively.

6.2 Approximate formula

The power rating may be calculated approximately by simplification of Formula (3) as given by Formula (4):

$$P \approx k_z k_w P_o \tag{4}$$

7 Centre distance

7.1 Exact formula

First, calculate the auxiliary angle, θ, using Formula (5):

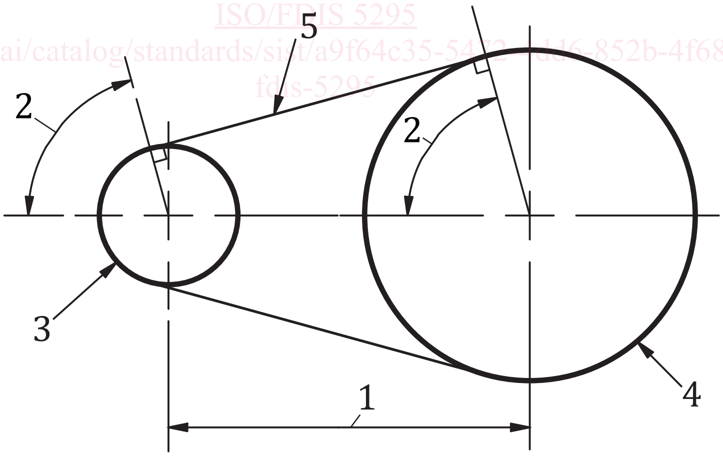
$$\text{inv}\ \theta = \pi \frac{z_b - z_2}{z_2 - z_1} \tag{5}$$

where inv $\theta = \tan \theta - \theta$; the value of θ (see Figure 1) can be determined by iteration or from involute tables.

The centre distance, C, is then given by Formula (6):

$$C = \frac{P_b \left(z_2 - z_1 \right)}{2\pi \cos \theta} \tag{6}$$

The method according to Formulae (5) and (6) is valid in any case. However, it should not be used if the ratio z_2/z_1 is close to unity, because the expression for C becomes the ratio of two small quantities. In this case, the method according to 7.2 is recommended.



Key

1 C

2 θ

3 z_1 teeth

4 z_2 teeth

5 z_b teeth

Figure 1 — Centre distance

7.2 Approximate formula

Firstly, calculate M by using Formula (7):

$$M = \frac{P_b}{8}(2z_b - z_1 - z_2) \tag{7}$$

then the centre distance, C, by using Formula (8):

$$C = M + \sqrt{M^2 - \frac{1}{8}\left[\frac{P_b(z_2 - z_1)}{\pi}\right]^2} \tag{8}$$

This method is to be avoided when the ratio z_2/z_1 is large. In this case, the method according to 7.1 shall be used.

8 Number of teeth in mesh

This number is given by Formula (9):

$$z_m = \text{int}\left[\frac{z_1}{2} - \frac{P_b\, z_1}{2\pi^2 C}(z_2 - z_1)\right] \tag{9}$$

in which $\frac{1}{2\pi^2}$ may be replaced by $\frac{1}{20}$ for ease of calculation.

9 Factor k_z

The factor k_z is given by Formulae (10) and (11):

If $z_m \geq 6$, $k_z = 1$ (10)

If $z_m < 6$, $k_z = 1 - 0{,}2(6 - z_m)$ (11)

10 Factor k_w

The factor k_w is given by Formula (12):

$$k_w = \left(\frac{b_s}{b_{so}}\right)^{1{,}14} \tag{12}$$

where b_{so} depends upon the pitch code as given in Table 1.

The resulting calculation of k_w is rounded off to two decimal places according to the usual convention.

Table 1 — Base widths of trapezoidal synchronous belts

Dimensions in millimetres

<table>
<tr><th>Pitch code</th><th>b_{so}</th></tr>
<tr><td>MXL</td><td rowspan="2">6,4</td></tr>
<tr><td>XXL</td></tr>
<tr><td>XL</td><td>9,5</td></tr>
<tr><td>L</td><td>25,4</td></tr>
<tr><td>H</td><td>76,2</td></tr>
</table>

Table 1 *(continued)*

Pitch code	b_{so}
XH	101,6
XXH	127

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