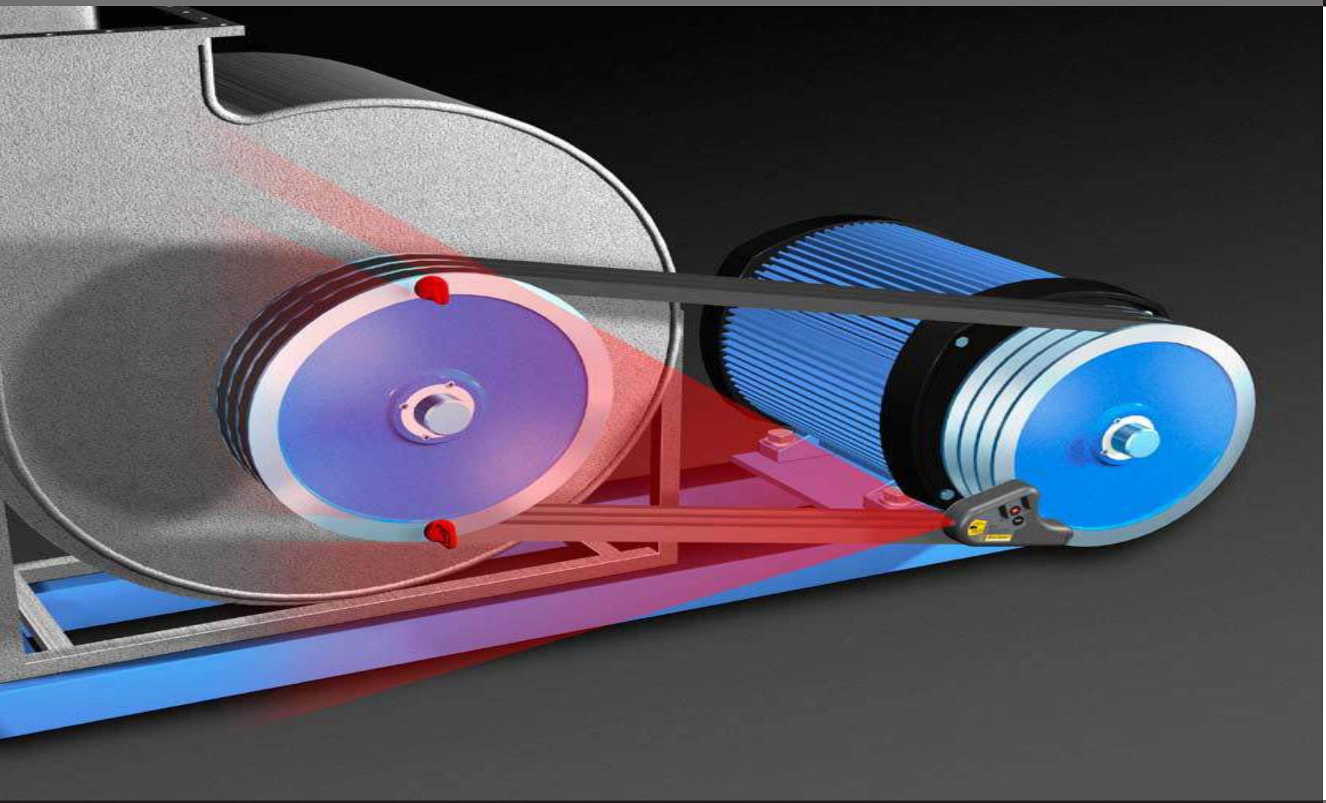
DESIGN MANUAL

τεχνικό εγχειρίδιο σχεδιασμού για ιμάντες

τραπεζοειδείς οδοντωτοί +



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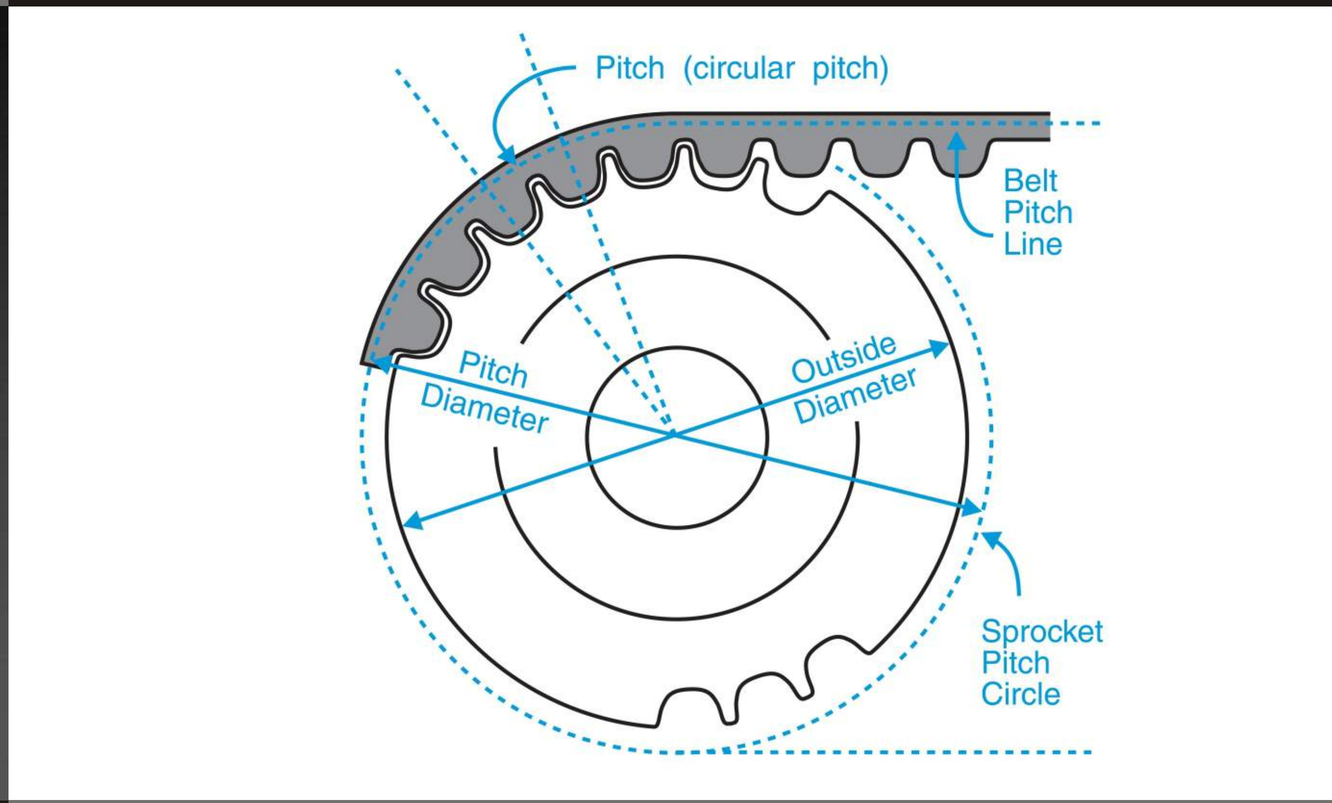

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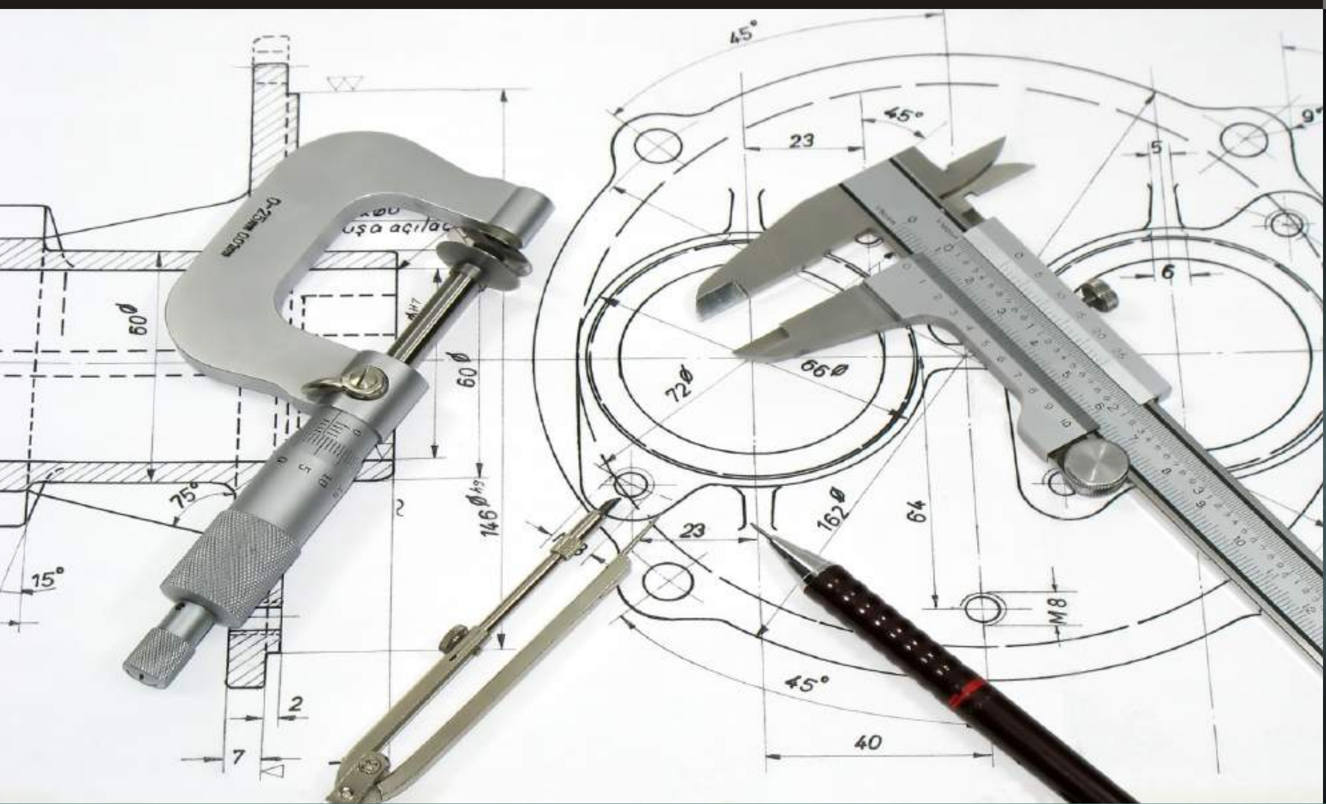

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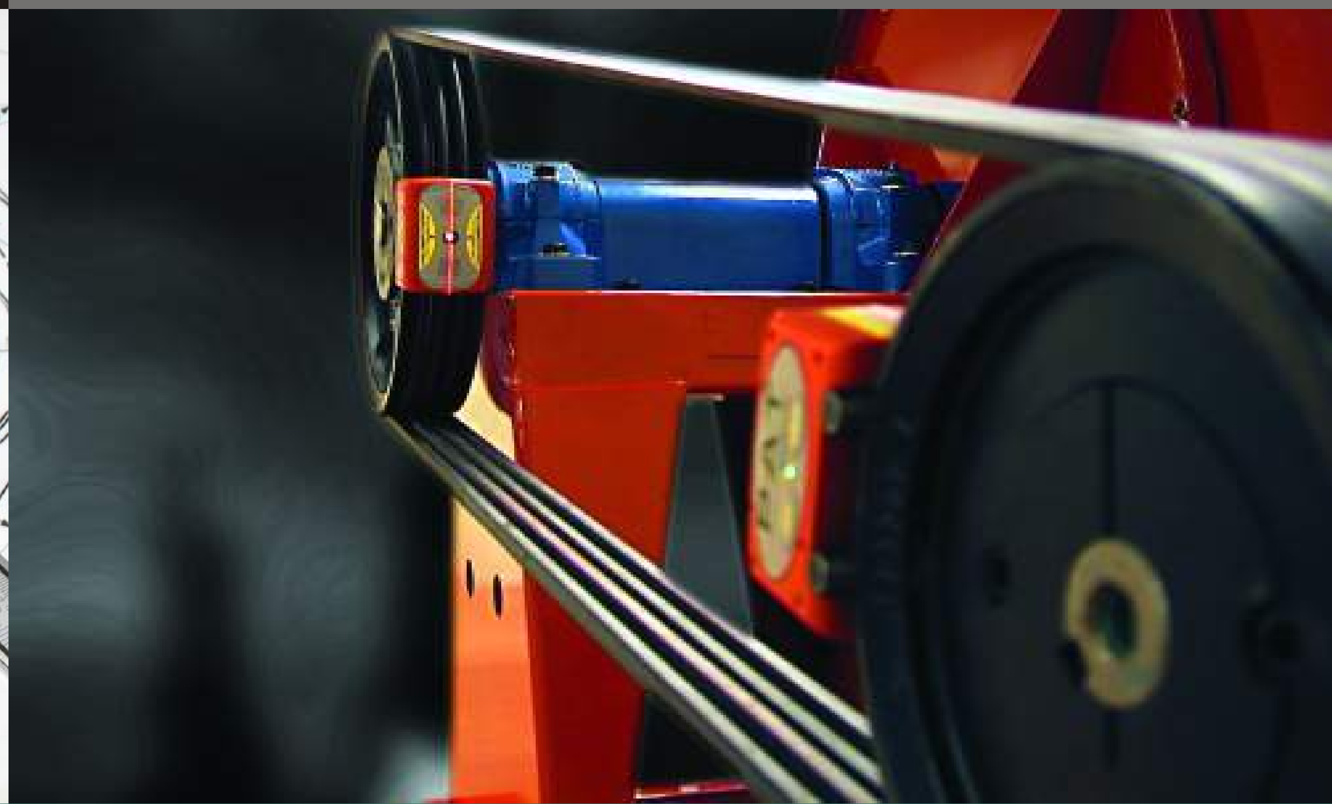


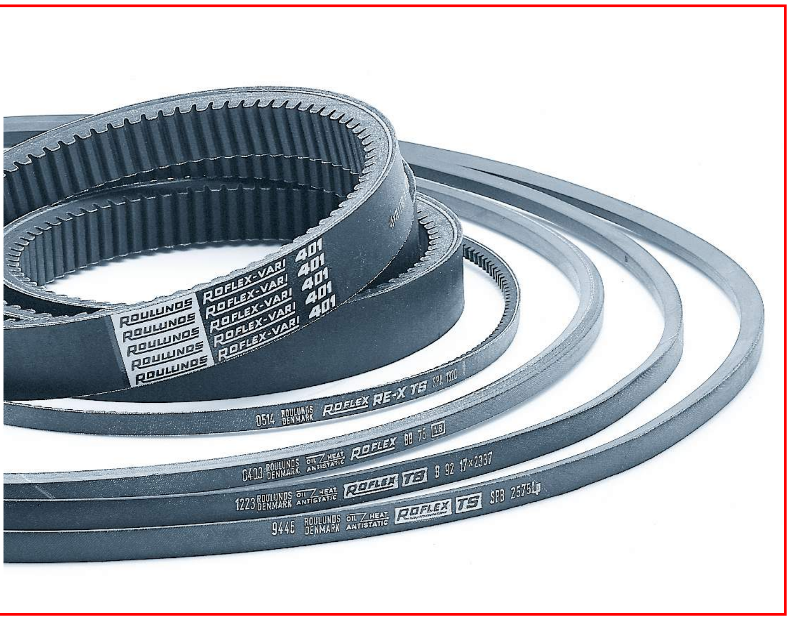
ΒΟΥΚΑΛΗΣ
Για δυναμική απόδοση

Αυτό το εγχειρίδιο παρέχει πληροφορίες σχετικά με τους τύπους ιμάντων καθώς και οδηγίες σχετικά με το σχεδιασμό τους.
Κατά τον υπολογισμό και σχεδιασμό ενός ιμάντα μετάδοσης κίνησης συχνά υπάρχουν αρκετές επιλογές όσον αφορά την επιλογή του τύπου. Αυτή η επιλογή ιμάντα είναι καθοριστική για το σχεδιασμό παρέχει δε τη βέλτιστη λειτουργία και ζωή, εξασφαλίζοντας το χαμηλότερο δυνατό κόστος συντήρησης.

DESIGN OF V-BELT DRIVES

You can calculate industrial drives with ROFLEX belt types by the following procedure.

If the drives are for agricultural machinery or special drives and drives for mass production, we recommend that you contact ROULUNDS technical department which has experts ready to assist you with advice on how to achieve the optimum solution for your belt drive tasks, for example by running ROFLEX calculation programs but also on the basis of many years' practical experience.



DESIGNATIONS AND UNITS APPLIED

a	Number of pulleys in the drive	
B	Width of pulley	[mm]
B_F	Width of flat pulley	[mm]
b_d	Correction supplement to datum-diameter for V-belt pulley	[mm]
b_e	Correction reduction of effective-diameter for V-belt pulley	[mm]
C	Centre distance	[mm]
c_1	Service factor	
c_2	Belt length correction factor	
c_3	Arc of contact correction factor on smaller V-belt pulley	
c_4	Correction factor for tension idler	
c_5	Arc of contact correction factor in a V-flat drive	
D_F	Diameter of flat pulley	[mm]
D_{FD}	Calculated datum-diameter of flat pulley	[mm]
D_{FP}	Calculated pitch-diameter of flat pulley	[mm]
D_{FE}	Calculated effective-diameter of flat pulley	[mm]
D_t	Supplement for belt height	[mm]
D_e	Effective-diameter of larger V-belt pulley	[mm]
D_d	Datum-diameter of larger V-belt pulley	[mm]
D_p	Pitch-diameter of larger V-belt pulley	[mm]
d_e	Effective-diameter of smaller V-belt pulley	[mm]
d_d	Datum-diameter of smaller V-belt pulley	[mm]
d_p	Pitch-diameter of smaller V-belt pulley	[mm]

f	Deflection frequency	[Hz]
h	Height difference between shafts in turned drives	[mm]
i	Speed ratio	
K	Deflection force per belt	[N]
k_1	Tensioning factor for belt tension	
k_2	Factor for centrifugal force	[kg/m]
l	Span length of belt	[mm]
L_a	Outside V-belt length	[mm]
L_d	Datum V-belt length	[mm]
L_e	Effective V-belt length	[mm or 1/10 inch]
L_i	Inside V-belt length	[mm]
L_m	Mean V-belt length	[mm]
P_M	Power consumption of driven unit or motor output	[kW]
P_N	Power rating per V-belt	[kW]
P_D	Design power	[kW]
n_1	Revolutions of smaller V-belt pulley	[rev/min]
n_2	Revolutions of larger V-belt pulley	[rev/min]
S_{dyn}	Shaft load, dynamic	[N]
S_{stat}	Shaft load, static	[N]
T_{stat}	Belt tension per belt, static	[N]
T	Section height of V-belt	[mm]
v	Belt speed	[m/s]
z	Number of V-belts	[pieces]
x	Adjustment of centre distance for take-up	[mm]
y	Adjustment of centre distance for installation	[mm]
β	Arc of contact on smaller V-belt pulley	[°]
σ	Deflection of span length	[mm]
φ	Angle between pulleys in drives with nonparallel shafts	[°]
π	3.1416	
hp	0.736 kW	
kp	9.815 N	
inch	25.4 mm	

CALCULATION PROCEDURE

1. Service factor c_1

Table 1, page 15.
Choose from the table the operating conditions which best correspond to the actual operating conditions for the drive.

2. Belt section

is selected on the basis of diagrams 1 - 5, page 16 - 18.
As a principal rule, narrow V-belts should be used for new drives. This gives the most economical and least space demanding design.
For high-speed drives, or where small pulley diameters are required, ROFLEX RE-X programmes 10 and 17 and ROFLEX-X programmes 12 and 16 will usually provide the optimum solution.

When selecting belt type and section, the recommended maximum belt speed v [m/s] must be taken into consideration. This speed is listed on the data sheet for the belt type in question, in the PROGRAMME KEY and in the DIMENSION TABLES, page 41 - 43.

3. **Speed ratio i**

is the ratio of the rev/min of the smaller to that of the larger V-belt pulley

$$i = \frac{n_1}{n_2}$$

or the ratio of the pitch-diameter of the larger to that of the smaller pulley.

$$i = \frac{D_p}{d_p}$$

For calculation of pitch-diameter, see point 4.

Having selected the V-belt pulley diameters, check that the speed ratio is as desired.

4. **V-belt pulley diameters d_d/d_p and D_d/D_p [mm]**

Tables 2 and 3 on page 19 - 20 indicate the standard datum- and effective-diameters.

We recommend selecting as large diameters as practically possible in order to obtain better power transmission at higher belt speeds.

The diameter of the smaller V-belt pulley is selected from the table. The diameter of the larger V-belt pulley is calculated as follows:

$$D_d = d_d \times i \text{ [mm]}$$

Standard diameters should always be selected if at all possible.

The PITCH-diameter is used for an exact calculation of the speed ratio i, point 3, and the belt speed v, point 8.

These are calculated from the datum-diameter or the effective-diameter:

$d_p = d_d + 2b_d$ [mm] $d_p = d_e - 2b_e$ [mm]

$D_p = D_d + 2b_d$ [mm] $D_p = D_e - 2b_e$ [mm]

Correction supplement/reduction $2b_d$ and $2b_e$, see tables 2a and 3a on page 20.

For most drives it is sufficiently accurate to use datum-diameters when calculating the speed ratio and belt speed.

V-belt pulley groove dimensions are shown in tables 21 - 25 on page 43 - 46.

5. **Centre distance C [mm]**

The centre distance should be selected within this range:

$C > 0{,}7\ (d_d + D_d)$ [mm]

$C < \ \ 2\ (d_d + D_d)$ [mm]

Deviations from this may occur due to the practical conditions of space or other technical requirements.

Actual centre distance, see point 7.

6. **Belt length, datum L_d [mm]**

$$L_d = 2C + 1{,}57\ (D_d + d_d) + \frac{(D_d - d_d)^2}{4C} \text{ [mm]}$$

C = Centre distance, point 5
D_d = Datum-diameter of larger V-belt pulley [mm].
d_d = Datum-diameter of smaller V-belt pulley [mm].

Find the closest standard belt length in the selected belt programme.

7. **Centre distance C [mm]**

The actual centre distance is calculated by adjusting the selected C with half of the difference between the belt length calculated in point 6 and the selected standard belt length.

For necessary installation and take-up allowance, see tables 4 - 5, page 21 - 22, which indicate the recommended minimum.

8. **Belt speed v [m/s]**

$$v = \frac{d_p \times n_1}{19100} \text{ [m/s]}$$

d_p = V-belt pulley pitch-diameter [mm]
For calculation of pitch diameter, see point 4.

In practice it will usually be sufficiently accurate to use the datum-diameter d_d [mm].

n_1 = Number of revolutions [rev/min] of same V-belt pulley.

Check that the belt speed is not higher than the recommended maximum speed v, which is listed in the PROGRAMME KEY and in the DIMENSION TABELS, page 41 - 43.

9. Deflection frequency f [Hz]

$$f = \frac{a \times v \times 1000}{L_d} \quad [Hz]$$

a = Number of pulleys in the drive
v = Belt speed [m/s]
L_d = Datum belt length [mm]

"f" is to be checked in proportion to the maximum deflection frequency, which is listed in the selected belt programme.

10. Power rating per belt P_N [kW]
can be found in the power ratings table for the selected belt programme and section.

11. Belt length correction factor c_2
See table 6, page 23.

12. Arc of contact correction factor c_3

The ratio $\frac{D_d - d_d}{C}$

is calculated and factor c_3 is found in table 7, page 24, for wrapped or raw-edge belt types.

Table 7 also contains the arc of contact β [°] on the smaller V-belt pulley. This is used for calculating the shaft load, point 15, for example.

13. Number of V-belts z
The required number of V-belts z is calculated according to the following formula and the result then rounded up to the nearest whole number above it.

$$z = \frac{P_M \times c_1}{P_N \times c_2 \times c_3}$$

P_M = Power consumption of driven unit or the motor's rated output [kW].
P_N = Power rating per V-belt, point 10.
c_1 = Service factor, point 1.
c_2 = Belt length correction factor, point 11.
c_3 = Arc of contact correction factor, point 12.

Calculation of drive with tension idler, see point 16.

14. Belt tension T_{stat} [N]
Correct belt tension is one of the preconditions for achieving satisfactory operation of the V-belt drive. For calculation, see page 25.

Belt tension checking, page 26.

Instructions on procedure for installation and maintenance of drive, see page 34

15. Shaft load S_{stat} and S_{dyn} [N]
Based on the prescribed belt tension, the shaft load is calculated according to the formulas on page 27.

The dynamic shaft load S_{dyn} is used for dimensioning bearings and shafts.

16. Drives with tensioning idler
Installation of an extra idler in the drive may be required for technical reasons.
Instructions on
- placing and design
- dimensioning

see page 28.

17. Drives with nonparallel shafts
For conditions, see page 29.

18. Fully turned drives
For conditions, see page 30.

19. V-Flat drives
Page 31.

CALCULATION EXAMPLE

According to the information given in the questionnaire, select in the PROGRAMME KEY. — Programme 11, Narrow V-belts, wrapped

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1. Service factor c_1

Table 1, page 15.

Look for centrifugal pump or the closest similar unit under driven unit. — Rotary pump

Look for motor type and operating time over 16 hours under driving machine/motor and read the value c_1. — $c_1 = 1.4$

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2. Belt section for programme 11

Diagram 2, page 17

$P_D = P_M \times c_1$ [kW] — $P_D = 35 \times 1.4 = 49$ kW

The point of intersection of P_D and the 1470 rev/min of the smaller V-belt pulley is in the borderland between sections SPA and SPB. In such cases we recommend selecting the smaller section. — Belt section SPA

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3. Speed ratio i

$$i = \frac{n_1}{n_2}$$

$$i = \frac{1470}{1000} = 1.47$$

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4. Pulley diameter

The diameter of the smaller pulley is selected from table 2, page 19, under section SPA. — $d_d = 150$ mm

The datum-diameter of the larger pulley is calculated as follows:

$D_d = d_d \times i$ [mm] — $D_d = 150 \times 1.47 = 220.5$ mm

Closest standard according to table 2: — $D_d = 224$ mm

The pitch-diameter of the pulleys is calculated and the speed ratio checked:

$$i = \frac{D_d + 2\,b_d}{d_d + 2b_d} = \frac{D_p}{d_p}$$

$$i = \frac{224 + 0}{150 + 0} = 1.49$$

2 b_d according to table 2a, page 20, under belt section SPA and programme 11.

The deviation from the desired speed ratio i = 1.47 is acceptable for this drive.

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5. Centre distance C [mm]

Should be selected within this area:

$C > 0.7\,(d_d + D_d)$ [mm] — $C > 0{,}7(150 + 224)$ $C > 262$ mm

$C < 2\,(d_d + D_d)$ [mm] — $C < 2(150 + 224)$ $C < 748$ mm

C min. according to questionnaire 450 mm.

C max. according to questionnaire 1000 mm.

C is initially selected as = 550 mm

6. Belt length L_d [mm]

$$L_d = 2 \times C + 1.57 \times (D_d + d_d) + \frac{(D_d - d_d)^2}{4 \times C} \text{ [mm]}$$

$$L_d = 2 \times 550 + 1.57 \times (224 + 150) + \frac{(224 - 150)^2}{4 \times 550} \text{ [mm]}$$

L_d = 1690 mm

Closest standard L_d according to programme 11, section SPA, STANDRAD PROGRAMME

L_d = 1682 mm

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7. Centre distance C [mm]

With proper correction for belt length, the actual centre distance will be C [mm].

$$C = 550 - \frac{1690 - 1682}{2} = 546 \text{ mm}$$

Adjustment of C, table 4, page 21.

C min. = C – y [mm]
C max. = C + x [mm]

C min. = 546 - 27 = 519 mm
C max. = 546 + 22 = 568 mm

which is within the limits specified in the questionnaire.

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8. Belt speed v [m/s]

Calculation of pitch-diameter
$d_p = d_d + 2b_d$

d_p = 150 + 0 = 150 mm

$2b_d$ according to table 2a, page 20.

$$v = \frac{d_p \times n_1}{19100} \text{ [m/s]}$$

$$v = \frac{150 \times 1470}{19100} = 11.5 \text{ m/s}$$

Recommended maximum belt speed v for programme 11.

42 m/s

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9. Deflection frequency f [Hz]

$$f = \frac{a \times v \times 1000}{L_d} \text{ [Hz]}$$

$$f = \frac{2 \times 11.5 \times 1000}{1682} = 13.7 \text{ Hz}$$

Recommended maximum f for programme 11

100 Hz

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10. Power rating per belt P_N [kW]

According to programme 11, section SPA, POWER RATING TABLES.
n_1 = 1470 rev/min and i = 1.5
Smaller V-belt pulley d_d is 150 mm. With interpolation for d_d = 140 mm and d_d = 160 mm.

P_N = 6.7 kW

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11. Belt length correction factor c_2

For L_d 1682 mm under section SPA narrow V-belts in table 6, page 23.

c_2 = 0.95

12. Arc of contact correction factor c_3

For wrapped V-belts
Table 7, page 24.

$$\frac{D_d - d_d}{C} \qquad \frac{224 - 150}{546} \approx 0.14 \qquad \beta = 172°$$

Arc of contact ß and factor c_3 is calculated by interpolation between β = 174° and β = 169°.

Correction factor — $c_3 = 0.99$

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13. Number of V-belts z

$$z = \frac{P_M \times c_1}{P_N \times c_2 \times c_3} \qquad z = \frac{35 \times 1.4}{6.7 \times 0.95 \times 0.99} = 7.8 \text{ pcs.}$$

Number of V-belts — z = 8 pcs.

Checking of pulley width B [mm].

According to table 21, page 43, Section SPA.

B = (z-1) × e + 2 × f [mm] — B = (8-1) × 15 + 2 × 10 = 125 mm

Maximum permissible B according to questionnaire — 125 mm.

<u>Proposal for drive design</u>

Belt type	ROFLEX narrow V-belts, programme 11
Datum-diameter of smaller pulley	d_d = 150 mm
Datum-diameter of larger pulley	D_d = 224 mm
Pulley width	B = 125 mm
Speed ratio	i = 1.49
Centre distance	C = 546 mm
Installation and take-up allowance	- 27/+ 22 mm
Belt set	8 pcs. ROFLEX SPA 1682 L_d

The above is one of several possible solutions. We therefore recommend making more calculations in order to optimize the solution both technically and economically.

If a different programme is selected, e.g. programme 10, together with larger pulley diameters, the drive design could have the technical data shown in example 2. This proposal gives a solution that is technically and economically superior.

<u>Example 2</u>

Belt type	ROFLEX RE-X narrow V-belt, programme 10
Datum-diameter of smaller pulley	d_d = 224 mm
Datum-diameter of larger pulley	D_d = 315 mm
Pulley width	B = 65 mm
Speed ratio	i = 1.4
Centre distance	C = 541 mm
Installation and take-up allowance	- 27/+ 22 mm
Belt set	4 pcs. ROFLEX RE-X XPA 1932 L_d

14. Belt tension T_{stat} [N] per belt

Static tension T_{stat} [N], see page 25.

In table 8, look for k_1 under programme 11, mean load and arc of contact $\beta = 172°$. — $k_1 = 1.75$

In table 9, look for k_2 under programme 11, section SPA. — $k_2 = 0.115$

$$T_{stat} = 500 \times k_1 \times \frac{P_M}{z \times v} + k_2 \times v^2 \text{ [N]}$$

$$T_{stat} = 500 \times 1.75 \times \frac{35}{8 \times 11.5} + 0.115 \times 11.5^2 \text{ [N]}$$

$T_{stat} \approx 348$ N per belt

For example 2, the belt tension will be

$$T_{stat} = 500 \times 1.74 \times \frac{35}{4 \times 17.2} + 0.105 \times 17.2^2 \text{ [N]}$$

$T_{stat} \approx 474$ N per belt

Checking the belt tension.
Calculation of deflection force K [N], page 26.

$K = 0.06 \times T_{stat}$ [N] — $K = 0.06 \times 348 \approx 20.9$ N

Span length of belt $l = c \times \sin\frac{\beta}{2}$ [mm] — $l = 546 \times \sin\frac{172}{2} = 545$ mm

Deflection $\sigma = \frac{l \times 15}{1000}$ [mm] — $\sigma = \frac{545 \times 15}{1000} = 8.2 \text{ mm} \approx 8 \text{ mm}$

For example 2, K will be — $K = 0.06 \times 474 = 28.4$ N

Span length — $l = 541 \times \sin\frac{171}{2} = 539$ mm

Deflection — $\sigma = \frac{539 \times 15}{1000} = 8.1 \text{ mm} \approx 8 \text{ mm}$

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15. Shaft load, page 27

Static shaft load S_{stat} [N].

$$S_{stat} = 2 \times z \times T_{stat} \times \sin\frac{\beta}{2} \text{ [N]}$$

$$S_{stat} = 2 \times 8 \times 348 \times \sin\frac{172}{2} \text{ [N]}$$

$S_{stat} = 5554$ N

Example 2

$$S_{stat} = 2 \times 4 \times 474 \times \sin\frac{171}{2} \text{ [N]}$$

$S_{stat} = 3780$ N

Dynamic shaft load

$$S_{dyn} = 707 \times \frac{P_M}{v} \sqrt{k_1^2 + 1 - (k_1^2 - 1)\cos\beta} \text{ [N]}$$

$$S_{dyn} = 707 \times \frac{35}{11.5} \sqrt{1{,}75^2 + 1 - (1{,}75^2 - 1)\cos 172} \text{ [N]}$$

$S_{dyn} = 5317$ N

Example 2

$$S_{dyn} = 707 \times \frac{35}{17.2} \sqrt{1{,}74^2 + 1 - (1{,}74^2 - 1)\cos 171} \text{ [N]}$$

$S_{dyn} = 3533$ N

SERVICE FACTOR c_1, POINT 1

With the c_1 factor, allowance is made for the load conditions which are characteristic of the listed driving unit types and driven units as well as of the number of operating hours.

If the driving unit or driven unit in question is not listed, we recommend selecting a listed unit which is as close to the applicable load con-ditions as possible.

Under extreme operating conditions with e.g. sharp dust, high temperatures, high starting tor-que and heavy shock loads, the c_1 factor should be increased.

Our technical department is ready to help you with advice within this area, too.

Table 1, Service factor c_1

Driven unit	Driving unit / Motor					
	AC motors, single- and three-phase with star-delta start. DC shunt-wound motors. Multiple cylin-der internal combustion engines.			AC motors, single- and three-phase, series wound, slip-ring motors with direct start. DC motors, series and compound wound. Single cylinder internal com-bustion engines.		
	Number of operating hours per 24 hours			Number of operating hours per 24 hours		
	Up to 10	Over 10 to 16	Over 16	Up to 10	Over 10 to 16	Over 16
Agitators for liquids. Small centrifugal blowers. Fans up to 7.5 kW. Light-duty conveyors.	1.0	1.1	1.2	1.1	1.2	1.3
Belt conveyors for sand, grain, etc. Dough mixers. Fans over 7.5 kW. Generators. Washing machines. Machine tools. Punching, pressing and shearing machines. Printing machines. Positive displacement rotary pumps. Vibrating and rotary screens.	1.1	1.2	1.3	1.2	1.3	1.4
Brick-making machinery. Bucket elevator. Piston compressors. Screw conveyors. Hammer mills. Hollanders. Piston pumps. Positive displacement blowers. Crushers. Woodworking machinery. Textile machinery.	1.2	1.3	1.4	1.4	1.5	1.6
Gyratory and jaw-roll crushers. Mills (ball/rod). Hoists (heavy loads). Rolling mills, calenders etc. for the rubber and plastics industries.	1.3	1.4	1.5	1.5	1.6	1.8

SELECTION OF BELT SECTION, POINT 2

Diagrams 1-5 provide guidelines for selection of belt section within the selected programme. Consequently, it is often appropriate to make calculations with a different section and programme.

In marginal cases we recommend selecting the closest smaller section, since it is our experience that this gives the best solution, economically as well as technically.

From an overall point of view, we further recommend selecting the largest possible pulley diameter within the limits of the recommended maxi-mum belt speed and the space available.

The diagrams are a function of the design power P_D [kW] and the number of revolutions n_1 [rev/min] of the smaller pulley.

Design power $P_D = P_M \times c_1$ [kW]

P_M = Power consumption of the driven unit in kW or the rated kW of the driving unit.

c_1 = Service factor, table 1, page 15.

The belt section is found in the intersection of lines drawn from the design power P_D in the left-hand side of the diagrams and the number of re-volutions n_1 on the bottom line. The pulley dia-meter d_d [mm] corresponding to the recom-mended maxi-mum belt speed is shown here, too.

Diagram 1, Programme 10, ROFLEX RE-X narrow V-belts
Programme 12, ROFLEX-X narrow V-belts

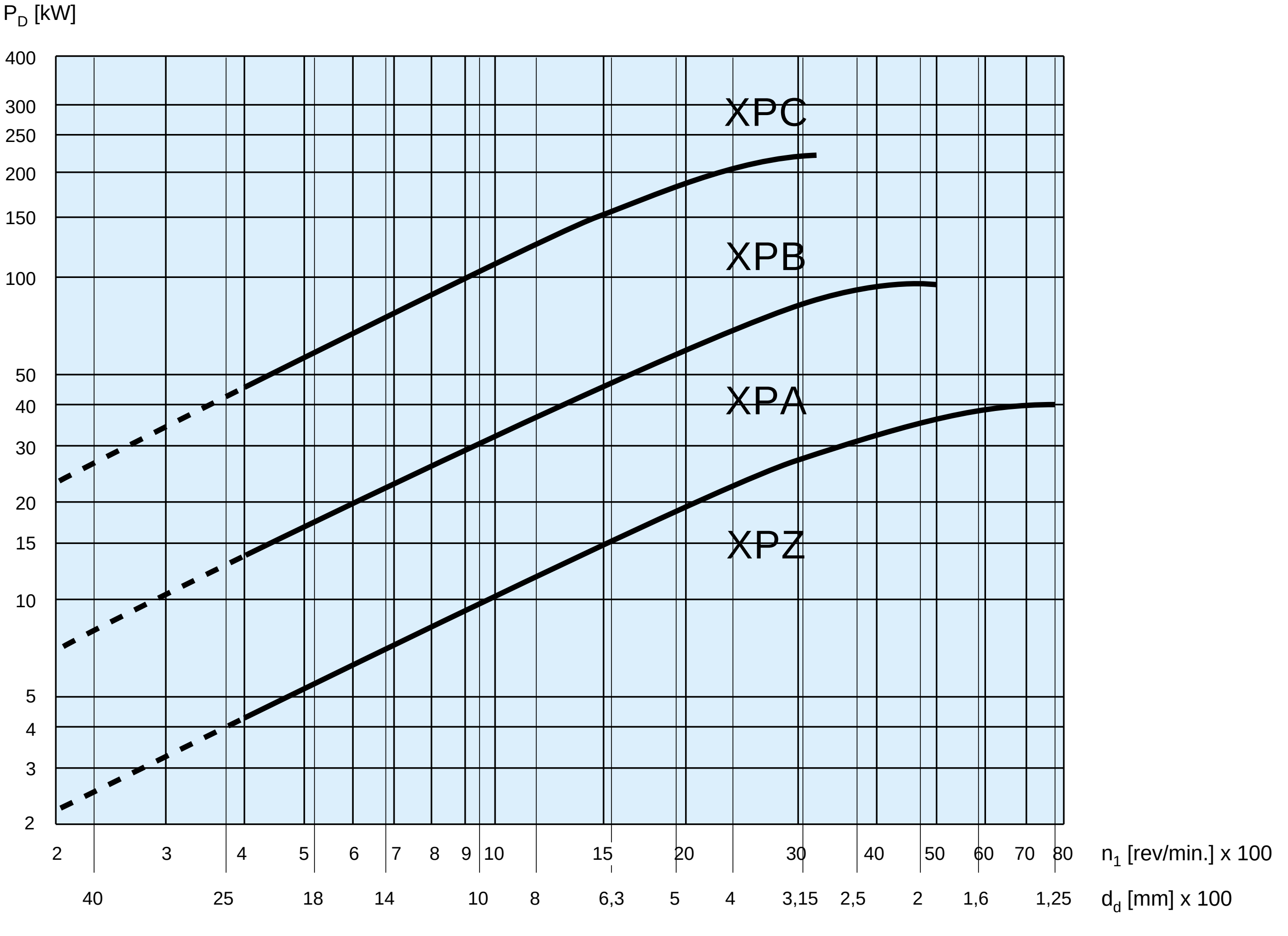


Diagramme 2, Program 11, ROFLEX narrow V-belts

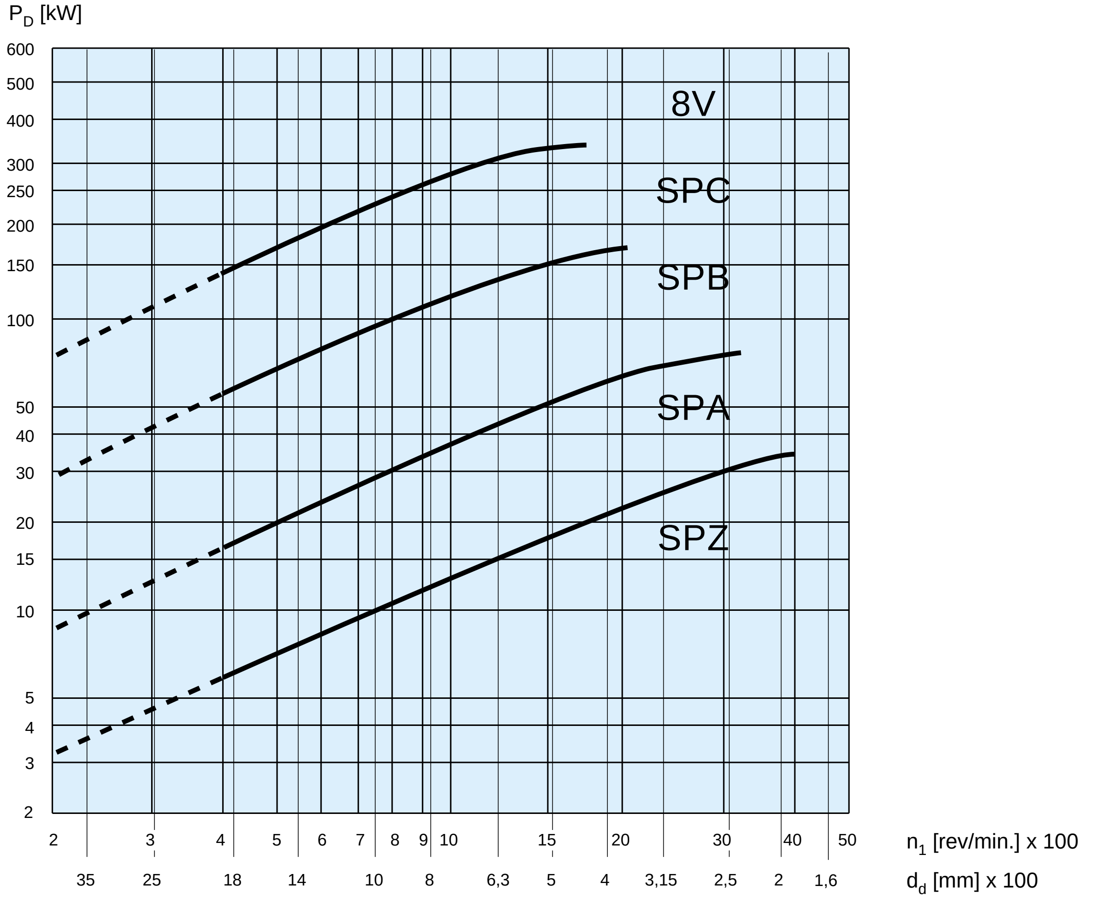


Diagram 3, Programme 15, ROFLEX classical V-belts

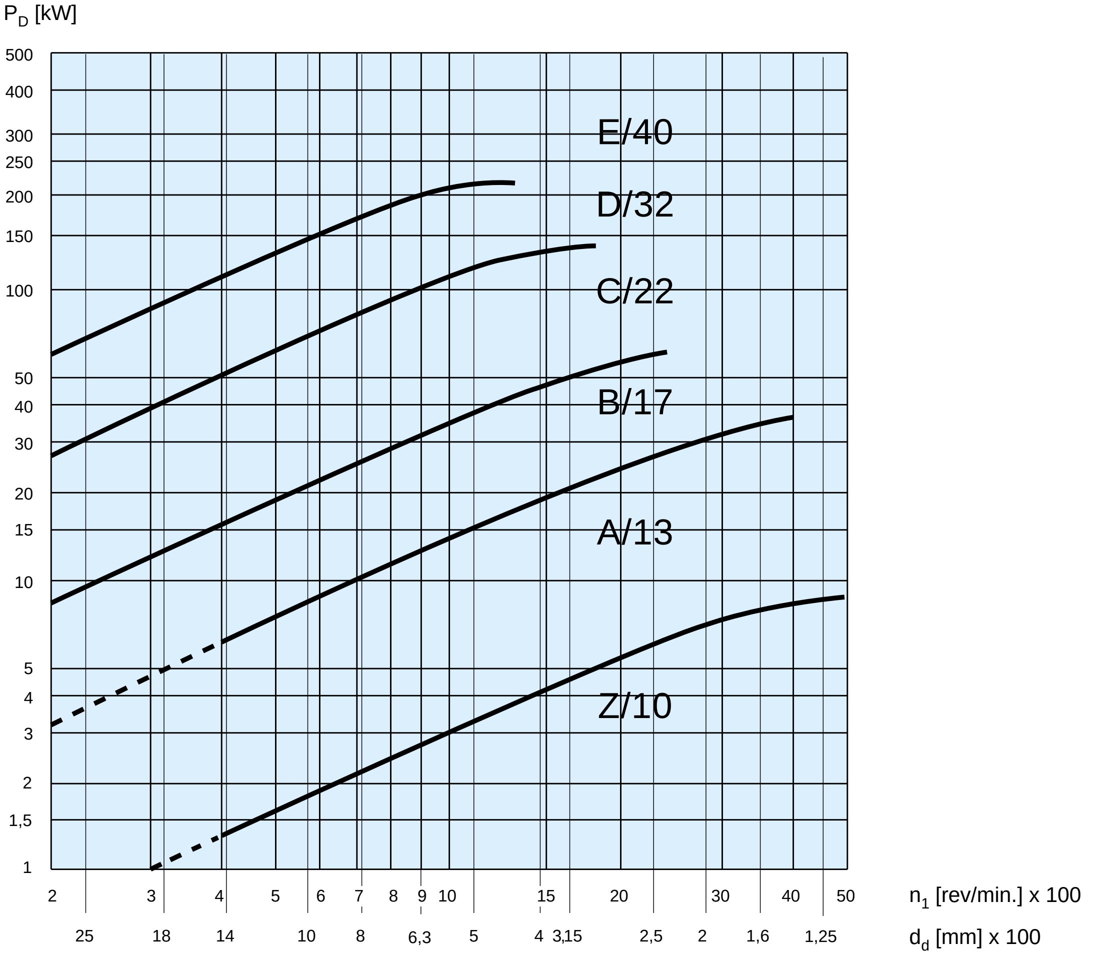


Diagram 4, Programme 16, ROFLEX-X classical V-belts

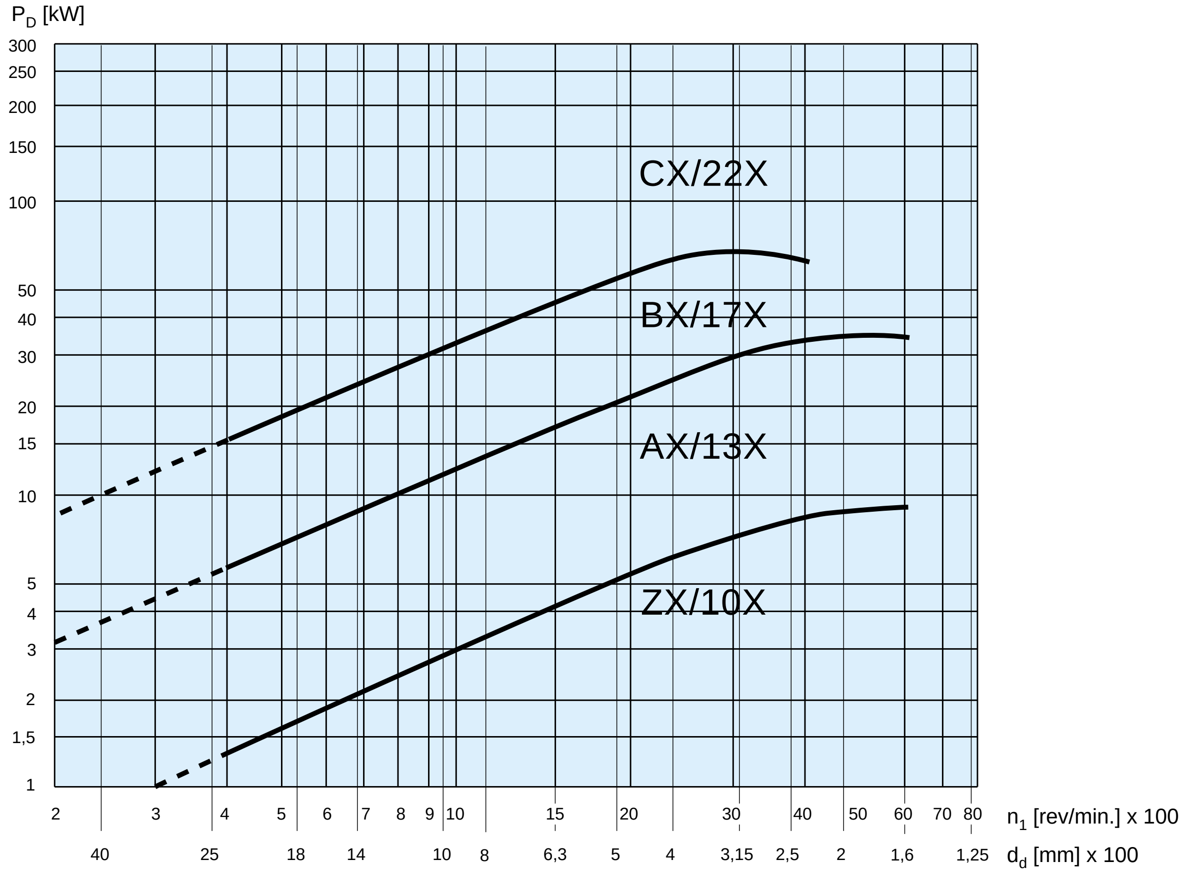
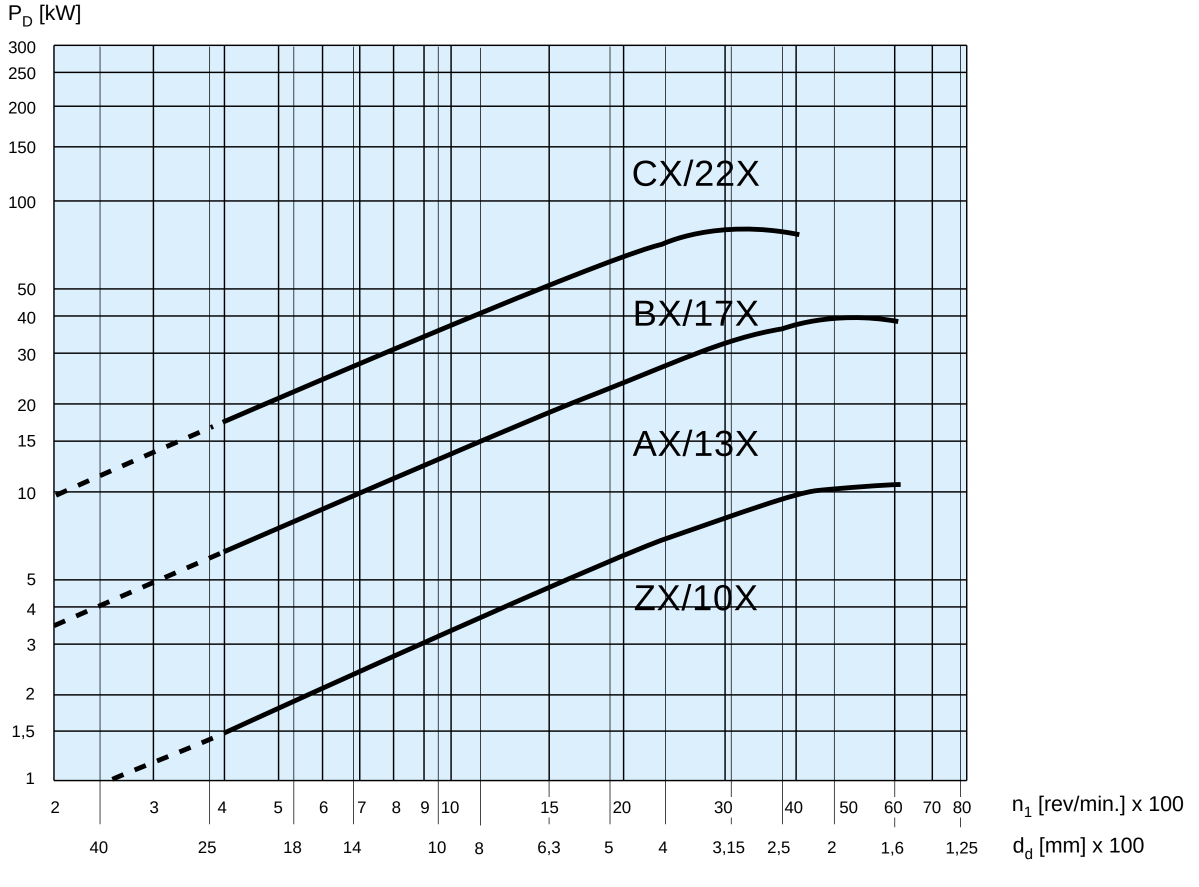


Diagram 5, Programme 17, ROFLEX RE-X classical V-belts



For further information, please refer to the standards ISO 4183, BS 3790, DIN 2211/1, DIN 2217/1.
The datum designation has not been introduced in some standards.
For further reference, please see the summary on page 57.

The recommended minimum pulley diameter is listed in power rating tables for belt programmes 10, 11, 12, 15, 16 and 17.
As regards the other programmes, this information is listed on the applicable programme in the PRODUCT SPECIFICATIONS

Table 2, Standard diameters [mm]

Classical V-belt sections	**Z ZX 10 10X**	**A AX 13 13X**	**B BX 17 17X**		**20**	**C CX 22 22X**	**25**	**D 32**	**E 40**
Narrow V-belt sections	**SPZ XPZ**	**SPA XPA**	**SPB XPB**	**S19**		**SPC XPC**			
Datum-diameter [mm]	40 50 56	50							
	63 71 80	63 71 80	80						
	90 100 112	90 100 112	100 112						
	125 132	118 125 132	125						
	140 150 160	140 150 160	140 150 160		140 160	140 160			
	180 200	180 190 200	180 190 200	180 190 200	180 200	180 190 200			
	224	224 236	224 236	212 224	224	212 224 236	224		
	250 280 300	250 280 300	250 280 300	250 280	250 280	250 280 300	250 280	280	
	315 355 400	315 355 400	315 355 400	315 355 400	315 355 400	315 355 400	315 355 400	315 355 400	
	450 500 560	450 500 560	450 500 560	450 500 560	450 500 560	450 500 560	450 500 560	450 500 560	450 500 560
	630	630	600 630	630	630	600 630	630	600 630	600 630 670
	800	710 800	710 750 800	710 800	710 800	710 750 800	710 800	710 750 800	710 800
		1000	900 1000 1120	900 1000 1120	900 1000 1120	900 1000 1120	900 1000 1120	900 1000 1120	900 1000 1120
			1250	1250 1400	1250 1400	1250 1400	1250 1400	1250 1400 1500	1250 1400 1500
				1600 1800 2000	1600 1800 2000	1600 1800 2000	1600 1800 2000	1600 1800 2000	1600 1800 2000

For calculation of PITCH-DIAMETER, see table 2a, page 20.

Table 2a Correction supplement $2b_d$ [mm]

Pitch-diameter calculation:
Pitch-diameter d_p = datum-diameter d_d + $2b_d$ [mm]

Programme	V-belt section								
	Z ZX 10 10X SPZ XPZ	A AX 13 13X SPA XPA	B BX 17 17X SPB XPB	S19	20	C CX 22 22X SPC XPC	25	D 32	E 40
10, 12, 16, 17	0	1.7	3.2			5.5			
11	–1.4	0	0	1.8		2.5			
15	1.2	2.8	1.2		2.4	4.8	3.4	4.8	3.2

Pulley groove dimensions, see tables 21-22, page 46 - 47.

PULLEY DIAMETERS, standard
The recommended minimum pulley diameter is listed in the power rating table for belt programmes 10, 11 and 12.
When converting the belt section according to the RMA/MPTA standard into SP and XP, then:

3V/9N ≈ SPZ 5V/15N ≈ SPB
3VX ≈ XPZ 5VX ≈ XPB
For further information, please refer to the US standard RMA/MPTA IP-22.

Table 3 Standard diameters [mm]

V-belt section	Effective-diameter d_e [mm]												
3V/9N 3VX	67 140 630	71 150 800	75 160 850	80 165	85 175	90 200	92,5 250	100 265	103 315	112 355	118 400	125 475	132 500
5V/15N 5VX	180 315 1000	190 335 1120	200 355 1250	212 375 1600	224 400 1800	236 475	243 500	250 530	258 600	265 630	272 710	280 800	300 950
8V/25N	315 250	335 800	355 900	375 1000	400 1120	425 1250	450 1320	475 1600	500 1800	530 2000	560 2500	600	630

Table 3a, Correction reduction $2b_e$ [mm]

Pitch-diameter calculation:
Pitch-diameter d_p = effective diameter d_e - $2b_e$ [mm]

Programme	V-belt section						
	3V	5V	8V	HA/A	HB/B	HC/C	HD/D
10, 11, 12	3,0	4,3	9,2				
23*)	–0,8	1,5	4,1	–2,4	1,4	2,3	5,9

*) See programme 23, PRODUCT SPECIFICATION, regarding standards for pulleys.
As regards pulley groove dimensions, see tables 23-25, page 48 - 49.

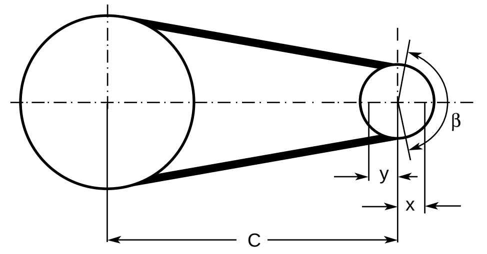
To install the belts without damaging them and to maintain the proper belt tension, it must be possible to adjust the centre distance as specified in table 4.

As regards joined V-belts, see table 5, page 22.

The adjustments are guidelines, and they can be used for most drives.

If a specific calculation of x and y is required, these formulas have to be used:

If the centre distance is fixed, an adjustment facility can be established by means of a tension idler, see page 28.



$$x = \frac{0.01 \times L_d}{\sin \frac{\beta}{2}} \text{ [mm]}$$

$$y = \frac{0.005 \times L_d + \pi \times T \times \frac{\beta}{360}}{\sin \frac{\beta}{2}} \text{ [mm]}$$

L_d = Datum belt length [mm]
T = Section height [mm]
β = Arc of contact [°]
π = 3.1416

Table 4 ROFLEX V-belts programmes 10, 11, 12, 15, 16, 17.

Datum belt length L_d [mm]	Minimum adjustment y [mm]											Minimum take-up x [mm]
	SPZ XPZ 3V A/13 AX 13X	SPA XPA	SPB XPB 5V 20	SPC XPC	Z/10 ZX 10X	B/17 BX 17X	C/22 CX 22X	25 S19	D/32	E/40	8V	All sections
≤ 670	16	19			13	20						**10**
> 670 - 1000	18	21			14	21	27					**10**
> 1000 - 1320	19	22	27		16	23	29				43	**13**
> 1320 - 1662	21	24	29		18	25	30				44	**17**
> 1662 - 2240	24	27	32	39	21	28	33	36	41		47	**22**
> 2240 - 3000	28	31	35	43	24	31	37	40	45		51	**30**
> 3000 - 3550	30	33	38	46	27	34	40	43	48		54	**36**
> 3550 - 4500	35	38	43	51	32	39	44	48	52	62	59	**45**
> 4500 - 5600	41	44	48	56	37	44	50	53	58	67	64	**56**
> 5600 - 6700	46		54	62		50	55	59	63	73	70	**67**
> 6700 - 8500	55		63	71		59	64	68	72	82	79	**85**
> 8500 - 10000			70	78		66	72	75	80	89	86	**100**
> 10000 - 11800			79	87		75	81	84	89	98	95	**118**
> 11800 - 13500			88	96		84	89	93	97	107		**135**
> 13500 - 15000			95	103		91	97	103	105	114		**150**
> 15000 - 16100			101	109		97	102	106	110	120		**160**

Table 5 ROFLEX joined V-belts, programme 23.

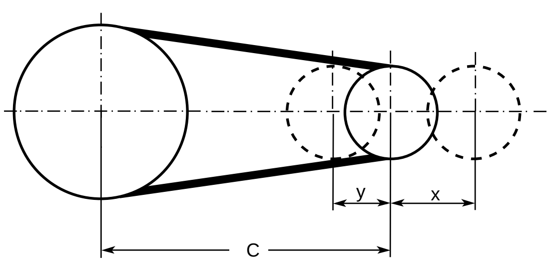
Effective belt length L_e [mm]	Minimum adjustment y [mm]							Minimum take-up x [mm]
	HA/A	HB/B	HC/C	HD/D	3V/9J	5V/15J	8V/25J	All sections
1100 ≤ 2240	36	46	55		36			**22**
> 2240 - 3550	43	53	62		43	59		**36**
> 3550 - 4500		58	67		48	64		**45**
> 4500 - 5600		63	72	88	53	69	100	**56**
> 5600 - 6700		69	78	94		75	106	**67**
> 6700 - 8500		78	87	103		84	115	**85**
> 8500 - 10000				110			122	**100**
> 10000 - 11800				119			131	**118**
> 11800 - 13500				128			140	**135**
> 13500 - 15000				135			147	**150**
> 15000 - 16000				140			152	**160**

The adjustments in table 5 are guidelines. If a specific calculation of x and y is required, use these formulas:

$$x = \frac{0{,}01 \times L_e}{\sin \frac{\beta}{2}} \quad [\text{mm}]$$

$$y = \frac{0{,}005 \times L_e + \pi \times T}{\sin \frac{\beta}{2}} \quad [\text{mm}]$$

L_e = Effective belt length [mm]
T = Section height [mm]
β = Arc of contact [°]
π = 3,1416



BELT LENGTH CORRECTION FACTOR c_2, POINT 11

The length factor c_2 expresses the deflection frequency which the V-belt is subjected to when passing over the pulleys.
The table values for power rating P_N [kW] per belt are based on a reference or basic belt length.
Where belt lengths differ from that length, the deflection frequency and thus also the factor c_2 are changed.
The reference length is listed against c_2 = 1.00.

Table 6 Belt length correction factor c_2

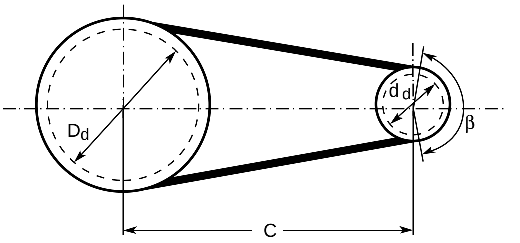
c_2	Narrow V-belts						Classical V-belts							
	SPZ XPZ 3V 3VX	SPA XPA	SPB XPB 5V 5VX	SPC XPC	S19	8V	Z/10 ZX 10X	A/13 AX 13X	B/17 BX 17X	20	C/22 CX 22X	25	D/32	E/40
0.80	465	551	915	1.453	1.622	1.653	297	666	875	1.216	1.448	1.735	2.320	2.578
0.81	496	695	977	1.551	1.241	1.765	312	700	920	1.279	1.523	1.824	2.440	2.712
0.82	529	741	1.042	1.655	1.324	1.883	328	736	967	1.345	1.601	1.918	2.565	2.851
0.83	565	791	1.112	1.765	1.412	2.008	345	774	1.017	1.414	1.683	2.016	2.697	2.997
0.84	602	843	1.185	1.881	1.505	2.141	362	813	1.069	1.486	1.769	2.119	2.834	3.150
0.85	642	898	1.263	2.005	1.604	2.282	381	854	1.123	1.561	1.859	2.227	2.978	3.310
0.86	684	957	1.346	2.136	1.709	2.431	400	897	1.179	1.640	1.953	2.339	3.128	3.477
0.87	728	1.019	1.433	2.275	1.820	2.589	420	943	1.239	1.722	2.051	2.457	3.286	3.652
0.88	775	1.085	1.526	2.422	1.938	2.756	441	990	1.301	1.809	2.154	2.580	3.450	3.835
0.89	825	1.155	1.624	2.577	2.062	2.933	463	1.039	1.366	1.899	2.261	2.708	3.622	4.026
0.90	877	1.228	1.727	2.742	2.194	3.120	486	1.091	1.433	1.993	2.373	2.842	3.802	4.225
0.91	933	1.306	1.837	2.916	2.333	3.319	510	1.144	1.504	2.091	2.490	2.983	3.989	4.434
0.92	992	1.389	1.953	3.100	2.480	3.528	535	1.201	1.578	2.194	2.613	3.129	4.185	4.652
0.93	1.054	1.476	2.075	3.295	2.636	3.749	561	1.260	1.655	2.302	2.741	3.283	4.390	4.880
0.94	1.120	1.568	2.205	3.500	2.800	3.984	589	1.321	1.735	2.414	2.874	3.443	4.604	5.118
0.95	1.190	1.666	2.342	3.718	2.974	4.231	617	1.385	1.820	2.581	3.014	3.610	4.828	5.366
0.96	1.263	1.768	2.487	3.947	3.158	4.492	647	1.452	1.908	2.653	3.159	3.784	5.061	5.625
0.97	1.341	1.877	2.639	4.190	3.352	4.768	678	1.522	2.000	2.781	3.311	3.966	5.304	5.895
0.98	1.423	1.992	2.801	4.445	3.555	5.069	711	1.595	2.095	2.914	3.470	4.156	5.558	6.178
0.99	1.509	2.112	2.971	4.715	3.772	5.366	745	1.671	2.195	3.053	3.635	4.354	5.823	6.473
1.00	1.600	2.240	3.150	5.000	4.000	5.690	780	1.750	2.300	3.198	3.808	4.561	6.100	6.780
1.01	1.695	2.375	3.339	5.300	4.240	6.032	817	1.833	2.409	3.349	3.956	4.777	6.368	7.101
1.02	1.797	2.516	3.539	5.617	4.494	6.392	855	1.919	2.522	3.507	4.176	5.002	6.689	7.435
1.03	1.904	2.666	3.749	5.951	4.761	6.772	895	2.009	2.640	3.671	4.372	5.236	7.003	7.783
1.04	2.017	2.823	3.971	6.302	5.042	7.172	937	2.103	2.764	3.843	4.576	5.481	7.330	8.147
1.05	2.135	2.989	4.204	6.673	5.338	7.594	981	2.201	2.892	4.021	4.788	5.735	7.671	8.526
1.06	2.260	3.164	4.450	7.063	5.651	8.038	1.026	2.302	3.026	4.208	5.010	6.001	8.026	8.920
1.07	2.392	3.348	4.709	7.474	5.979	8.505	1.074	2.409	3.166	4.402	5.241	6.278	8.396	9.332
1.08	2.530	3.542	4.981	7.907	6.325	8.998	1.123	2.519	3.311	4.604	5.482	6.566	8.781	9.760
1.09	2.676	3.746	5.268	8.362	6.689	9.516	1.174	2.634	3.452	4.814	5.732	6.866	9.183	10.206
1.10	2.829	3.961	5.570	8.841	7.073	10.061	1.228	2.754	3.620	5.033	5.994	7.179	9.601	10.671
1.11	2.990	4.186	5.887	9.344		10.634	1.283	2.879	3.784	5.262	6.265	7.504	10.036	11.155
1.12	3.160	4.424	6.221	9.874		11.237	1.341	3.009	3.955	5.499	6.548	7.843	10.490	11.659
1.13	3.338	4.673	6.572	10.431		11.871	1.402	3.145	4.133	5.747	6.843	8.196	10.962	12.184
1.14	3.525	4.935	6.940	11.016		12.537	1.464	3.286	4.318	6.004	7.150	8.563	11.483	12.730
1.15	3.722	5.211	7.328	11.632		13.237	1.530	3.432	4.511	6.272	7.469	8.945	11.964	13.298
1.16	3.929	5.500	7.735	12.278		13.972	1.598	3.585	4.711	6.551	7.801	9.343	12.496	13.889
1.17	4.146		8.163	12.957		14.745	1.669	3.744	4.920	6.841	8.146	9.757	13.049	14.504
1.18	4.374		8.612	13.669		15.556	1.742	3.909	5.137	7.143	8.505	10.187	13.624	15.143
1.19	4.614		9.083	14.417		16.407	1.819	4.080	5.363	7.456	8.879	10.634	14.223	15.808
1.20	4.865		9.578	15.203			1.898	4.259	5.597	7.783	9.267	11.100	14.845	16.500
1.21	5.129		10.097	16.027			1.981	4.444	5.841	8.122	9.671	11.583	15.492	
1.22	5.405		10.641	15.551			2.067	4.667	6.095	6.474	10.091	12.035	15.164	
1.23	5.695		11.213				2.155	4.838	6.358	8.841	10.527	12.609	15.863	
1.24	6.000		11.812				2.249	5.046	6.632	9.221	10.980	13.152		

ARC OF CONTACT CORRECTION FACTOR c_3, POINT 12

The V-belt power rating P_N [kW/belt] is based on a 180° arc of contact. If the arc of contact is smaller, the power transmission capability is reduced and P_N is adjusted by multiplying the read table value by factor c_3.

Correction factor c_3 is listed in table 7

- for wrapped V-belts, programmes 11, 15.
- for raw-edge V-belts, programmes 10, 12, 16, 17.



D_d = Datum-diameter of larger V-belt pulley [mm]

d_d = Datum-diameter of smaller V-belt pulley [mm]

β = Arc of contact on smaller V-belt pulley [°]

For those drives in which effective-diameters D_e/d_e [mm] are used, these values must be used in the calculations.

Table 7, Arc of contact correction factor c_3.

$\frac{D_d - d_d}{C}$	**0.00**	**0.10**	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**	**0.80**	**0.90**	**1.00**	**1.10**	**1.20**	**1.30**	**1.40**	**1.50**
Angle β [°]	**180**	**174**	**169**	**163**	**157**	**151**	**145**	**139**	**133**	**127**	**120**	**113**	**106**	**99**	**91**	**83**
c_3, wrapped	1.00	0.99	0.99	0.98	0.98	0.97	0.96	0.95	0.94	0.92	0.91	0.89	0.87	0.85	0.82	0.78
c_3, raw-edge	1.00	1.00	0.99	0.99	0.99	0.98	0.98	0.97	0.97	0.96	0.95	0.94	0.92	0.90	0.88	0.85

BELT TENSION, POINT 14

It is essential to the operation and life of V-belts that they are installed with the necessary tension and that this tension is maintained.

Excessive belt tension results in poorer efficiency and an increased, unnecessary load on the belt. This means shorter belt life and extra load on shaft bearings etc.

Insufficient belt tension reduces the power transmission capability. Any slip between belt profile and pulley groove causes extra wear of the belt edges and increased heat build-up in the belts. This means faster destruction of the belts and thus too short life.

We therefore recommend calculating the necessary static belt tension T_{stat} according to the following formula:

$$T_{stat} = 500 \times k_1 \times \frac{P_M}{z \times v} + k_2 \times v^2 \quad \text{[N/belt]}$$

k_1 = Tension factor, table 8.
k_2 = Factor for centrifugal force [kg/m], table 9, page 23.
P_M = Power consumption or rated output of the motor [kW]
z = Number of V-belts
v = Belt speed [m/s]

When installing new belts, we recommend a belt tension of $1.3 \times T_{stat}$ in order to compensate for the initial belt tension drop which occurs during the first hours of operation.

The belt tension should then be checked periodically, see the section on installation and maintenance, page 34 - 38.

Table 8 Tension factor k_1

Arc of contact β [°]	Programmes 10, 12, 16, 17			Programmes 11, 15, 20, 23		
	Operating conditions			Operating conditions		
	Light drives Constant load k_1	Mean load k_1	Heavy drives Shock load k_1	Light drives Constant load k_1	Mean load k_1	Heavy drives Shock load k_1
180	1.50	1.73	2.03	1.50	1.73	2.03
175	1.51	1.73	2.03	1.51	1.74	2.04
170	1.51	1.74	2.04	1.52	1.75	2.06
165	1.52	1.75	2.05	1.54	1.77	2.08
160	1.53	1.75	2.06	1.55	1.79	2.10
155	1.53	1.76	2.07	1.57	1.80	2.12
150	1.54	1.77	2.08	1.59	1.83	2.14
145	1.55	1.79	2.10	1.61	1.85	2.17
140	1.57	1.80	2.12	1.63	1.88	2.20
135	1.58	1.82	2.13	1.66	1.90	2.24
130	1.60	1.84	2.16	1.68	1.94	2.27
125	1.62	1.86	2.18	1.72	1.97	2.32
120	1.64	1.88	2.21	1.75	2.01	2.36
115	1.66	1.91	2.24	1.79	2.06	2.42
110	1.69	1.94	2.28	1.83	2.11	2.48
105	1.72	1.98	2.32	1.88	2.17	2.54
100	1.75	2.02	2.37	1.94	2.23	2.62
95	1.80	2.07	2.43	2.00	2.30	2.70
90	1.85	2.12	2.49	2.08	2.39	2.80

Table 9 Factor for centrifugal force k_2 [kg/m]

Programme	Belt section									
	XPZ	**XPA**	**XPB**	**XPC**	**SPZ**	**SPA**	**SPB**	**S19**	**SPC**	**8V**
10	0.065	0.105	0.190	0.325						
11					0.065	0.115	0.200	0.275	0.350	0.520
12	0.060	0.100	0.180	0.320						
	ZX/10X	**AX/13X**	**BX/17X**	**CX/22X**						
16	0.055	0.080	0.165	0.250						
17	0.060	0.090	0.180	0.255						
	Z/10	**A/13**	**B/17**	**20**	**C/22**	**25**	**32**	**D/32**	**E/40**	
15	0.058	0.104	0.172	0.239	0.282	0.366		0.591	0.958	
20		0.104	0.172	0.239	0.282	0.366	0.519	0.591		
	HA/A	**HB/B**	**HC/C**	**HD/D**	**3V/9J**	**5V/15J**	**8V/25J**			
23	0.154	0.237	0.406	0.750	0.095	0.250	0.637			

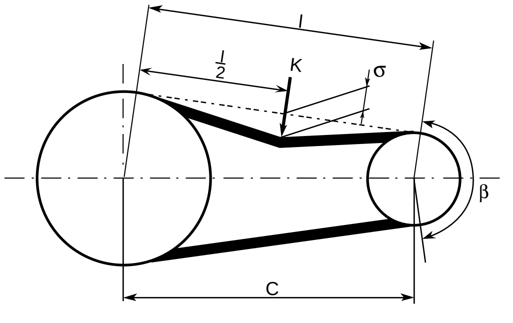
CHECKING THE BELT TENSION

When the V-belt set has been installed, the belt tension can be checked in the following, simple way, which provides adequate security that the belt tension is correct.

Apply a calculated force K at the centre of the span l. This force shall be sufficient for deflecting the belt 15 mm per 1000 mm of span. K must be applied perpendicularly to the belt.

K = 0,06 x T_{stat} [N]

K = Deflection force per belt [N]
T_{stat} = Static tension per belt [N], see page 25.



Span length of belt l [mm]

$$l = C \times \sin\frac{\beta}{2} \text{ [mm]}$$

C = Centre distance [mm]

β = Arc of contact [°], see table 7, page 24

Deflection σ [mm]

$$\sigma = \frac{l \times 15}{1000} \text{ [mm]}$$

A practical procedure for checking the belt tension is shown in the section “Installation”, page 34.

JOINED V-BELTS

The method with the deflection force and deflection of a belt cannot be used for checking the belt tension of joined V-belts.

We recommend using the following procedure which is based on an elastic belt extension corresponding to the static belt tension T_{stat}.

1. The joined V-belt is installed on the pulleys and stretched so slightly that in reality it has no tension.

2. The belt length L is measured with a tape measure placed on the outside of the belt. Then the necessary belt extension is calculated - length correction L_k - to achieve the proper belt tension.

The length correction L_k is calculated according to the following principle:

$$L_k = \frac{T_{stat} \times L}{c_k} \text{ [mm]}$$

T_{stat} = Static tension per belt [N], see page 25

L = Measured outside belt length [mm]

c_k = Extension factor, see table 10

Tabel 10 Extension factor c_k

Belt section	c_k
HA/A	53.000
HB/B	75.000
HC/C	104.000
HD/D	161.000
3V/9J	37.000
5V/15	75.000
8V/25J	127.000

3. The outside belt length L_a in tensioned condition is calculated as follows:

$L_a = L + L_k$ [mm]

4. Then tension the belt until it has reached the calculated outside length L_a [mm]

Subsequent periodic checking of the belt tension is carried out by slackening the belt until it is without tension, point 1. Then follow the procedure as described in points 2 - 4.

SHAFT LOAD, POINT 15

Based on the necessary belt tension, the static and dynamic shaft loads can be calculated according to the following formulas:

Static shaft load S_{stat} [N]

$$S_{stat} = 2 \times z \times T_{stat} \times \sin\frac{\beta}{2} \text{ [N]}$$

z = Number of V-belts

T_{stat} = Static belt tension [N], see page 86

β = Arc of contact [°] on smaller pulley Table 7, page 24.

Dynamic shaft load S_{dyn} [N]

$$S_{dyn} = 707 \times \frac{P_M}{v} \sqrt{k_1^2 + 1 - (k_1^2 - 1)\cos\beta} \text{ [N]}$$

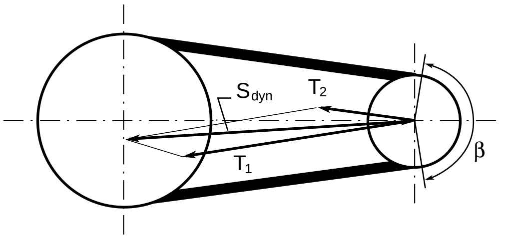
P_M = Power consumption or rated output of the motor [kW]

v = Belt speed [m/s]

k_1 = Tension factor, table 8, page 25.

β = Arc of contact [°] on smaller pulley Table 7, page 24.

The dynamic shaft load is used for dimensioning shafts and bearings.



T_1 = Effective belt force in tight belt part [N]

T_2 = Effective belt force in slack belt part [N]

S_{dyn} = Dynamic shaft load [N]

DRIVES WITH TENSIONING IDLER, POINT 16

It may be necessary to install an additional idler or tensioning idler on V-belt drives for several reasons, for example where you have:

FIXED CENTRE DISTANCE
An adjustable tensioning idler has to provide the retensioning facility necessary for installing V-belts and securing the tension.

DESIGN DETAILS
The V-belts can be guided around fixed structural parts of the machine by means of an idler.

LARGE CENTRE DISTANCE
By applying a slight pressure an idler is able to damp any vibrations in the slack belt part which ensures that the V-belts do not keel over when entering the groove of the driven pulley.

SMALL ARC OF CONTACT
The arc of contact can be increased by means of an outside idler, thereby reducing the risk of slippage.

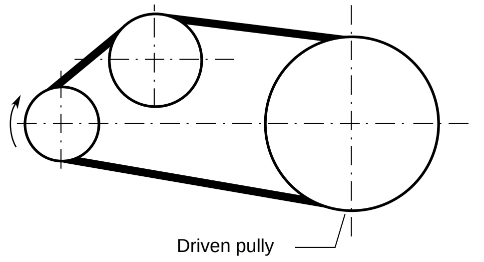
NONPARALLEL SHAFTS
Proper entry into the pulley groove can be ensured by means of a tensioning idler or guide idler.

COUPLING FEATURE
The drive can be engaged or disengaged by means of an idler system which establishes the belt tension with springs or hydraulics.
With extremely varying loads, such a system is also able to safeguard against overloading of the drive and machine parts.

An idler will apply additional load to the belts and should be omitted if technically possible.

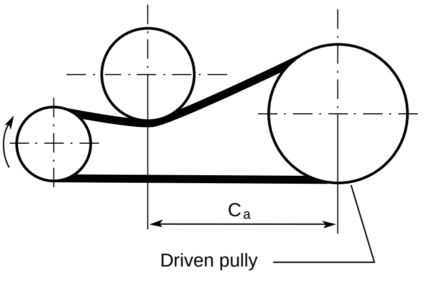
The following principal rules are recommended for the placing of an idler system:

The idler should act on the “slack” part of the belt drive, if possible. This will reduce the load on the idler system and the belts to a minimum.
This means that tensioning idlers should not be used in reversible drives.



An inside idler for belt types within programmes 10, 11, 12, 16 and 17 should be constructed as a V-belt pulley. For programmes 15, 20, 21 and 23 it may be constructed as a flat pulley.
However, a V-belt pulley should always be used for drives with a large centre distance in order to achieve lateral control of the V-belts.

An inside idler reduces the arc of contact on the pulleys. We recommend that it be placed such that it produces the same arc of contact on both pulleys regardless of how it is set within its adjustment range.



An outside idler may be constructed as a flat pulley with a cylindrical face. It increases the arc of contact on the pulleys but the possibility of retensioning is often limited, and the take-up allowance should therefore be checked in relation to tables 4-5, page 21 - 22.

The idler should be placed with the greatest possible distance Ca from the pulley where the belts are running in. The reason for this is that a flat pulley does not control the V-belts laterally, which may result in sidewards tracking.

DIAMETER OF IDLERS

The diameter of an inside idler must as a minimum be equal to the diameter of the smaller pulley in the drive.

The diameter of an outside idler must as a minimum be 1.4 × the diameter of the smaller pulley.

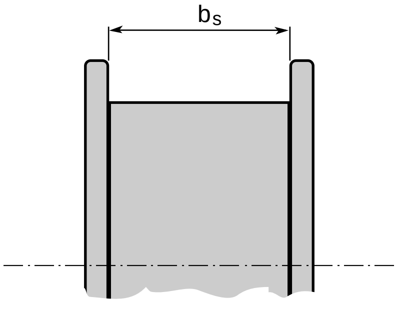
We recommend using a diameter larger than the stated minimum if that is technically possible. This will reduce the extra load always applied by the idlers to the V-belts.

IDLER CONSTRUCTION

Inside idlers with grooves should be made in accordance with the applicable standard for V-belt pulleys, see tables 21 - 25, page 46 - 49.

An outside or inside idler constructed as a flat pulley must have a cylindrical face, i.e. not convex.

From a technical point of view, the drive will often operate better if idlers with flanges are used. Any rounding between flanges and face must be avoided, since that may cause the belts to pull up the sides of the flanges and capsize.



Distance between flanges bs [mm]

b_s = 1.5 × top width of V-belt profile + width of pulley B [mm].

as regards the V-belt sections D/32 and E/40:

b_s = 1.3 x top width of V-belt profile + width of pulley B [mm].

CALCULATION OF DRIVE

Belt length

It will usually be necessary to calculate the belt length according to a drawing of the drive.
Check that the idler movement provides the adjustment facility necessary for installation and take-up allowance, see tables 4 and 5 on page 21 - 22.

Correction factor for idler c_4

An idler will have a negative influence on V-belt life. To compensate for that, the correction factor c_4 is inserted into the formula for calculating the required number of belts.

Table 11 Correction factor for idler c_4

Number of idlers	c_4
1	0.91
2	0.86
3	0.81

The number of V-belts is then calculated as follows:

$$z = \frac{P_M \times c_1}{P_N \times c_2 \times c_3 \times c_4}$$

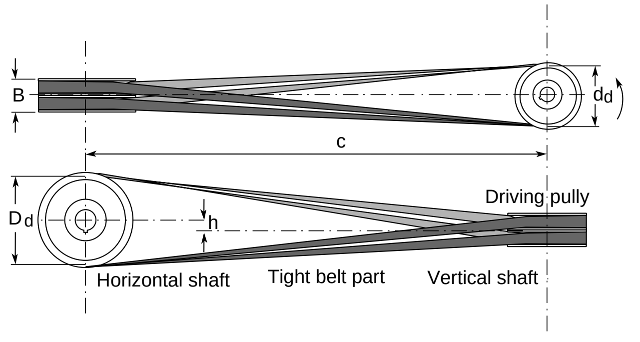
For further information, see point 13, page 8.

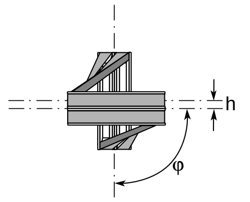
DRIVES WITH NONPARALLEL SHAFTS, POINT 17

are also termed turned drives.

When the following guidelines are observed, this type of drive operates well but shorter belt life relative to a traditional drive must be expected.

Our technical department gives advice on design, dimensioning and, if necessary, selection of special belts which have been designed to absorb the extra loads.





Drives with 30 - 90° angle between the shafts.

1. **Minimum centre distance C [mm]**
At φ = 90°
C min. = 5,5 (D_d + B) [mm]

At φ = 45°
C min. = 4 (D_d + B) [mm]

At φ = 30°
C min. = 3 (D_d + B) [mm]

D_d = Datum-diameter of larger pulley [mm]

B = Width of pulley [mm]

2. **The speed ratio i**
should not exceed i = 2.5.
If a greater speed ratio is required, the power has to be transmitted in two stages, e.g. first a traditional drive and then a turned.

3. **Height difference h [mm]**
The centre line of the horizontal shaft must be h [mm] higher than the centre line of the pulley on the vertical shaft.

The size of h is changed in relation to the centre distance C, see table 12.

Table 12

Centre distance C [mm]	Classical V-belts h [mm]	Narrow V-belts h [mm]
- 1500	5	3
1501 - 2000	10	8
2001 - 2500	15	10
3001 - 3500	30	20
3501 - 4000	35	25
4001 - 4500	45	35
4501 - 5000	60	40
5001 - 5500	70	50
5501 - 6000	85	55

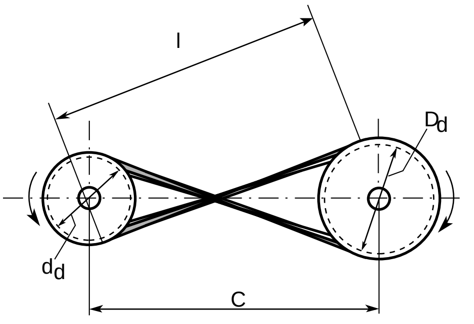
4. **Direction of rotation**
The direction of rotation is selected such that the tight belt part is at the bottom of the drive.

5. **Pulleys**
Both pulleys must be with grooves according to standard, see tables 21 - 25 on page 46 - 49.
For drives with a single V-belt, we recommend using deep groove pulleys, see table 22, page 47.

6. **Calculation**
The calculation of the drive follows the procedure described in points 1-15, page 5 - 8.

FULLY TURNED DRIVE, POINT 18

The shafts are parallel and the V-belt turned 180°, thereby producing a reversal of the direction of rotation of one of the shafts.



The following guidelines should be followed when establishing a fully turned V-belt drive.

1. **Minimum length of belt part l [mm]**

l min. = 6 × (D_d + B) [mm]

D_d = Datum-diameter of larger pulley [mm]

B = Width of pulley [mm], tables 21 - 25, page 46 - 49.

2. **Guide idler**
To avoid mutual wear where the two belt parts are crossing each other, a guide idler can be installed on the slack belt part near the point of intersection.

Raw-edge belt types with inside cogging must be turned such that the belt top of the two belt parts are facing each other.

3. **Calculation of drive**
follows the procedure described on page 5 - 8, with the exception of point 6, belt length, which is calculated as follows:

$$L_d = 2 \times C + 1{,}57\,(D_d + d_d) + \frac{(D_d + d_d)^2}{4 \times C} \quad [mm]$$

V-FLAT DRIVES, POINT 19

This type of drive is used when it is desirable to change a flat belt drive into a V-belt drive, because it is often most economical to retain the flat pulley which is also serving as flywheel in many cases. Moreover, it could be advantageous to use this type of drive in new constructions, because of the cost of manufacturing large V-belt pulleys.

The following ROFLEX programmes can be used for V-FLAT drives:

15 Classical V-belts
20 - -
21 Double V-belts
23 Joined V-belts.

As regards programmes 20 and 21, please contact our technical department.

Narrow V-belts should not be used because of the relatively small bottom width of the belt sections, which may result in the V-belts capsizing. However, this does not apply to joined V-belts in programme 23.

A V-FLAT drive does not exploit the power transmission capability of the belts as a drive with two V-belt pulleys. Special conditions and factors therefore need to be included in the calculations.

The following guidelines must be observed to ensure an efficient, functional drive.

1. The smaller pulley must be a V-belt pulley with grooves according to standard, see tables 21, 24 and 25, page 46 and 49, or a deep-groove pulley, see table 22 on page 47.

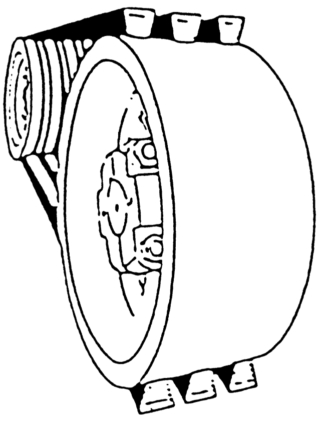
2. The flat pulley must have a straight/cylindrical belt face.

3. The speed ratio must be at least i = 3.

$$i = \frac{n_1}{n_2} = \frac{D_{FP}}{d_p} \geq 3$$

n_1 = Number of revolutions of smaller pulley [rev/min].

n_2 = Number of revolutions of larger pulley [rev/min].



D_{FP} = Calculated pitch-diameter of the flat pulley [mm], see page 32.

d_p = Pitch-diameter of V-belt pulley [mm].

4. Centre distance C to be selected within the following limits, as determined by the speed ratio.

at $i \leq 5$, $C = 1{,}2\ (D_F - d_d)$ [mm]

at $i > 5$, $C = D_F$ [mm]

D_F = Diameter of flat pulley [mm]

d_d = Datum-diameter of V-belt pulley [mm]

5. At the same time ratio $\frac{D_{Fp} - d_p}{C}$ should be within 0,5 - 1,17.

As regards D_{Fp} and d_p, see point 3.

The optimal ratio is 0.85.

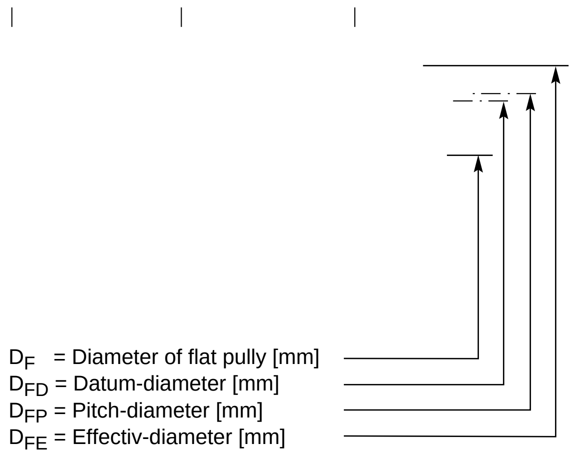
6. The width of the flat pulley's belt face, B_F, should as a minimum be as specified in table 15, page 32.

When the preconditions 1 - 6 have been satisfied, the V-FLAT drive is calculated as described on page 6 - 8, with the exception of:

Point 4, As regards the flat pulley, D_F, the calculation diameter is determined as shown on page 32.

Point 6, Belt length; see page 33.

Point 12, As regards the arc of contact correction factor, use factor c_5, table 16, page 33.



Calculated diameters are determined with a supplement to D_F according to tables 13 - 14.

Datum-diameter	$D_{FD} = D_F + D_{td}$ [mm]
Pitch-diameter	$D_{FP} = D_F + D_{tp}$ [mm]
Effective-diameter	$D_{FE} = D_F + D_{te}$ [mm]

Table 13, Programme 15

Belt section	Z/10	A/13	B/17	20
D_{td}	7	10	14	16
D_{tp}	8	12	15	18

Belt section	C/22	25	D/32	E/40
D_{td}	21	20	22	27
D_{tp}	26	23	27	30

Table 14, Programme 23

Belt section	HA/A	HB/B	HC/C	HD/D
D_{tp}	12	14	18	24
D_{te}	10	16	22	30

Belt section	3V/9J	5V/15J	8V/25J	
D_{tp}	13	21	36	
D_{te}	12	23	40	

Example, Programme 15

D_F = 1200 mm, belt section C/22
D_{FP} = 1200 + 26 = 1226 mm.

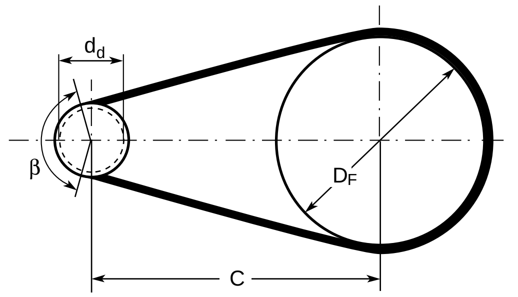
V-BELT PULLEY
Calculation of pitch-diameter, see table 2a and 3a, page 20.

Table 15 Flat pulley, minimum width of belt face B_F [mm]

Programme No.	Belt section	Number of V-belts in belt set										Supplement per extra belt [mm]
		1	2	3	4	5	6	7	8	9	10	
15	**Z/10**	36	48	60	72	84	96	108	120	132	144	**12**
15	**A/13**	45	60	75	90	105	120	135	160	165	180	**15**
15	**B/17**	55	74	93	112	131	150	169	189	207	226	**19**
15	**20**	65	88	111	134	157	180	203	226	249	272	**23**
15	**C/22**	74	99	126	151	177	202	228	253	279	304	**25.5**
15	**25**	83	112	141	170	199	228	257	286	315	344	**29**
15	**D/32**	98	135	172	209	246	283	320	357	394	431	**37**
15	**E/40**	118	162	207	251	296	340	385	429	474	508	**44.5**
23	**HA/A**		60	76	92	108	124	139	155	171	187	**15.88**
23	**HB/B**		72	91	110	129	148	167	186	205	224	**19.05**
23	**HC/C**		97	123	148	174	199	224	250	275	301	**25.4**
23	**HD/D**		133	169	206	242	279	315	352	388	425	**36.53**
23	**3V/9J**		53	64	74	84	95	105	115	125	136	**10.3**
23	**5V/15J**		79	96	114	131	149	166	184	201	218	**17.5**
23	**8V/25J**		117	145	174	202	231	260	288	317	345	**28.6**

ARC OF CONTACT CORRECTION FACTOR c_5

The correction factor for the arc of contact on the smaller pulley differs from that used for drives with two V-belt pulleys.



The correction factor c_5 for a V-FLAT drive is listed in table 16 and has to be inserted into the formula in point 13 page 8 instead of factor c_3.

The calculation diameter of the flat pulley is
$D_{FD} = D_F + D_{td}$, see table 13.

The following formula is used for joined V-belts:

$$\frac{D_{FE} - d_e}{C}$$

$D_{FE} = D_F + D_{te}$ [mm], see table 14.
d_e = Effective-diameter of V-belt pulley [mm]

Table 16, Arc of contact correction factor c_5.

$\frac{D_{FD} - d_d}{C}$	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40
Arc of contact β [°]	**180**	**174**	**169**	**163**	**157**	**151**	**145**	**139**	**133**	**127**	**120**	**113**	**105**	**99**	**91**
c_5	0.75	0.76	0.78	0.79	0.80	0.81	0.83	0.84	0.85	0.85	0.82	0.80	0.77	0.73	0.70

CALCULATION OF BELT LENGTH

Datum belt length L_d [mm]

$$L_d = 2 \times C + 1{,}57\,(d_d + D_F + D_{td}) + \frac{(D_F + D_{td} - d_d)^2}{4 \times C} \text{ [mm]}$$

C = Centre distance [mm]
d_d = Datum-diameter of V-belt pulley [mm]
D_F = Diameter of flat pulley [mm]
D_{td} = Supplement to D_F, table 13, page 32

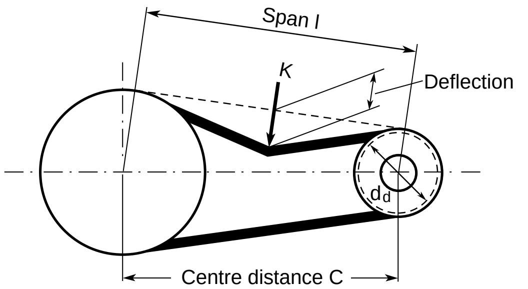
Effective belt length L_e [mm]

$$L_e = 2 \times C + 1{,}57\,(d_e + D_F + D_{te}) + \frac{(D_F + D_{te} - d_e)^2}{4 \times C} \text{ [mm]}$$

C = Centre distance [mm]
d_e = Effective-diameter of V-belt pulley [mm]
D_F = Diameter of flat pulley [mm]
D_{te} = Supplement to D_F, table 14 page 32

BELT TENSION

Proper belt tension is vital to the operation of the drive and the life of the V-belts.
To ensure optimum V-belt drive operation, we recommend calculating the belt tension and deflection force K [N] for the drive in question.
See the sections on belt tension, page 25, and checking of belt tension, page 26.



The belt tension in most drives can be checked with adequate reliability by means of ROULUNDS belt tension gauge; alternatively a spring balance can be used.

When checking the belt tension, follow this procedure:

1. When the V-belts have been installed into the grooves of the pulleys, increase the centre distance until the belts are taut.

2. Measure or calculate the span length of the belts l [mm] as shown on page 26.

3. The deflection is calculated as 15 mm per 1000 mm of span.

   For example, the span l = 900 mm

   $$\text{Deflection} = \frac{900 \times 15}{1000} = 13{,}5 \text{ mm}$$

4. Place the large O-ring on the scale of the belt tension gauge at the calculated deflection.

5. Place the small O-ring at 0 [mm].

6. Place a straightedge on the pulleys.

7. Place the belt tension gauge at the centre of the span and perpendicularly to the straightedge.

8. Push down the belt tension gauge until the large O-ring is flush with the bottom edge of the straightedge.

9. Read the deflection force K [N] on the belt tension gauge scale by the small O-ring.

10. Compare the K-value reading with the calculated value or the table value for the belt section of the belt type in question and with the datum-diameter of the smaller pulley, tables 17 - 20 page 36 - 37.

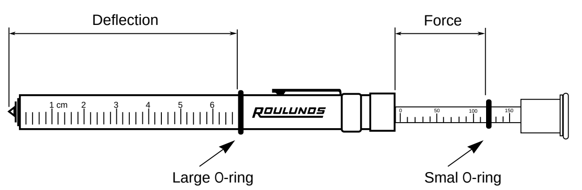
    K must be within K_{min} and K_{max} in the table. For drives with a heavy, pulsating load, we recommend $K = K_{max}$.

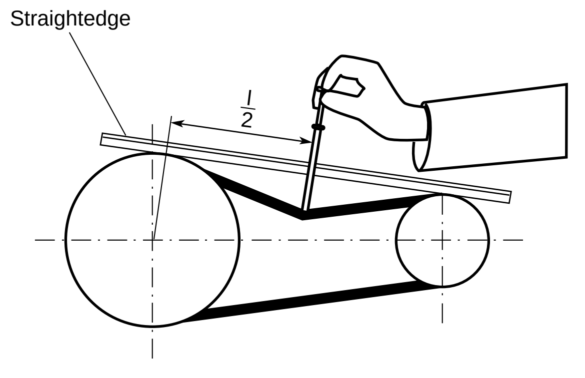
    When the belts are installed for the first time, we recommend multiplying the table values for K_{min} and K_{max} by 1.3.

11. If the K-value reading is too low or too high compared with the table or calculated value, adjust the centre distance until the correct K is achieved.

12. Start the drive. Let it run for 5 minutes. Check the belt tension, and adjust it if necessary.

13. After approx. 24 hours of operation, check the belt tension. Check it regularly after that, and keep it at the recommended value.





Joined V-belts
The procedure for ordinary V-belts cannot be applied to checking the belt tension of joined V-belts.

We recommend following the procedure described on page 26.

Table 17 Deflection force K [N]

Datum-diameter of smaller pulley	Programme 10								Programme 17							
d_d [mm]	XPZ K_{min} [N]	XPZ K_{max} [N]	XPA K_{min} [N]	XPA K_{max} [N]	XPB K_{min} [N]	XPB K_{max} [N]	XPC K_{min} [N]	XPC K_{max} [N]	ZX/10X K_{min} [N]	ZX/10X K_{max} [N]	AX/13X K_{min} [N]	AX/13X K_{max} [N]	BX/17X K_{min} [N]	BX/17X K_{max} [N]	CX/22X K_{min} [N]	CX/22X K_{max} [N]
40									5	7						
45									6	8						
50	12	16							7	9	5	9				
56	13	18							7	10	8	12				
63	15	20	14	20					8	11	10	15				
71	16	21	17	23					8	11	13	17				
80	17	23	20	27					9	12	15	20	15	22		
90	18	24	23	31					9	12	16	22	19	25		
100	19	25	25	33	29	39			9	12	18	24	22	29		
112	19	26	27	36	34	45			9	13	19	25	24	32		
125	20	27	28	38	38	51			10	13	20	27	26	35		
140	20	27	30	40	42	56			10	13	21	28	28	38	34	46
160	21	28	31	42	46	62	56	75			22	29	30	41	39	52
180	21	29	33	44	49	66	63	84			23	30	32	43	42	56
200			33	45	52	69	69	92					33	44	45	60
224			34	46	54	72	75	100					35	46	48	63
250					57	75	80	106					36	47	50	66
280					59	78	85	112					37	48	52	69
315					61	80	90	118							55	71
355					63	82	94	123							57	73
400							99	127							59	75
450							103	132							61	77
500							107	135							63	78
560							112	139								

Table 18 Deflection force K [N]

Datum-diameter of smaller pulley	Programme 11											
d_d [mm]	SPZ K_{min} [N]	SPZ K_{max} [N]	SPA K_{min} [N]	SPA K_{max} [N]	SPB K_{min} [N]	SPB K_{max} [N]	S19 K_{min} [N]	S19 K_{max} [N]	SPC K_{min} [N]	SPC K_{max} [N]	8V/25N K_{min} [N]	8V/25N K_{max} [N]
63	9	13										
71	11	15										
80	12	17										
90	14	19	14	20								
100	15	21	17	23								
112	16	22	20	26								
125	17	23	22	30								
140	18	24	24	32	27	37						
160	19	26	26	35	32	43						
180	20	26	28	38	37	49	34	47				
200	20	27	30	40	40	53	40	53				
224	21	28	31	41	43	57	45	59	53	71		
250			32	43	46	60	50	65	61	80		
280			33	44	48	63	54	71	68	89		
315			34	45	51	66	58	76	75	97	88	117
355					53	68	62	80	81	104	100	132
400					55	71	66	84	87	110	110	145
450					57	72	69	87	92	115	120	156
500					59	74	72	89	96	119	127	165
560							74	95	99	129	134	173
630							76	97	103	132	142	181
710									106	135	148	187
860									110	137	155	192

Table 19 Deflection force K [N]

Datum-diameter of smaller pulley	Programme 12								Programme 16							
	XPZ		XPA		XPB		XPC		ZX/10X		AX/13X		BX/17X		CX/22X	
d_d [mm]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]
40									4	6						
45									5	7						
50	8	11							6	8	3	7				
56	10	13							6	8	6	10				
63	11	16	8	14					7	9	7	11				
71	13	18	12	18					7	10	10	14				
80	14	19	15	21					8	10	12	16	9	15		
90	16	21	18	25					8	11	14	19	13	19		
100	17	22	21	28	19	28			8	11	15	20	16	22		
112	17	23	23	31	25	34			9	11	17	22	19	25		
125	18	24	25	33	29	39			9	12	18	24	21	29		
140	19	25	27	36	34	45			9	12	19	25	24	32	24	34
160	20	26	28	38	38	51	43	58			20	27	26	35	30	40
180	20	27	30	40	42	56	51	68			21	28	28	37	34	45
200			31	41	45	60	57	76					30	39	38	50
224			32	43	48	63	64	84					31	41	41	54
250					50	66	69	91					32	43	44	58
280					52	69	75	98					34	44	47	61
315					54	71	80	104							49	64
355					57	74	84	109							52	66
400							89	114							54	69
450							94	119							57	71
500							98	122							59	73
560							102	126								

Table 20 Deflection force K [N]

Datum-diameter of smaller pulley	Programme 15, 20															
	Z/10		A/13		B/17		20		C/22		25		32-D/32		E/40	
d_d [mm]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]	K_{min} [N]	K_{max} [N]
50	4	6														
56	5	6														
63	5	7	4	8												
71	6	8	7	11												
80	7	9	9	13												
90	7	9	11	16												
100	7	10	13	18	10	16										
112	8	10	15	20	13	19										
125	8	11	16	22	16	23										
140	8	11	17	23	19	26	18	26								
160	8	11	19	25	22	29	22	30	21	31						
180	9	11	20	26	24	32	26	34	27	37						
200			21	27	26	35	28	37	31	41						
224			21	28	28	37	31	40	36	46	35	48				
250					29	39	33	43	39	51	40	54				
280					31	40	35	45	43	55	46	60	53	72		
315					32	42	37	47	46	59	50	66	62	81		
355					34	43	39	49	49	62	55	72	70	91		
400							41	51	52	65	59	77	78	100		
450							42	54	54	70	62	81	85	108	86	113
500							43	55	56	72	66	84	90	114	97	125
560									58	74	69	87	96	121	108	138
630											71	92	101	129	119	150
710											74	95	105	134	129	161
800											76	97	110	139	139	171

Maintenance
In addition to checking the belt tension, regular checks should be made to ensure that the drive is not soiled with oil or dirt and that the V-belts and pulleys are not damaged.

The V-belts can be cleaned with a mixture of glycerol and alcohol at the ratio of 1:10.
Never use strong degreasing agents such as petrol, turpentine, diluents etc.

Belt dressing, regardless of its nature, must not be used.

Replacement
If a V-belt in a belt set is damaged, the entire belt set must be replaced.

A belt set must not consist of different belt makes.

Influence of heat
High temperatures are damaging and will reduce belt life. Sealed shields and other objects which prevent free circulation of air should therefore be avoided.

If the driven unit radiates strong heat, the belts should be protected with shielding.

Storage of V-belts
If stored as per the instructions, V-belts can be stored for several years without any noticeable influence on their features.

Storage on shelves is the best and least space demanding method.

If suspended, the peg diameter must be at least 12 × the belt height. Consequently, never use ordinary steel hooks, nails or similar objects.

Storage conditions
The temperature in the storage room should be 10 - 25°C, and the relative humidity must not exceed 65%.

Direct sunlight on V-belts and sources of heat near the belts must be avoided.

V-belts should not be stored near chemicals, oil and grease, acids and other substances which degrade rubber and textiles.

TERMINOLOGY

Standardised terms are used for describing a drive with V-belts; the most common ones will be described in this section.

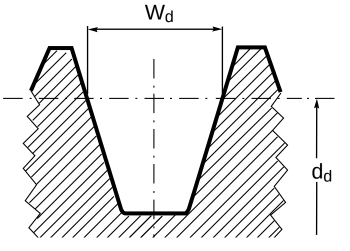
DATUM SYSTEM
The ISO 1081-1980 standard describes two systems for defining pulleys and V-belts: datum and effective.

This means that three concepts are now being used for describing drives with V-belts: datum and effective as well as the traditional term, pitch, but pitch is used only for calculating the speed ratio and the belt speed of the drive.

The DATUM/EFFECTIVE systems can be defined as systems that provide an unequivocal, unvarying identification, whereas PITCH is variable, depending on the design of the V-belt. For this very reason, the more recent belt designs have generated a need for an identification system other than pitch.

The grooves and diameters of pulleys as well as V-belt lengths have been determined unequivocally with the introduction of the datum/effective systems.

DATUM SYSTEM
The groove of a pulley is identified by its datum width W_d, which is independent of the groove angle.



The pulley diameter is termed the datum-diameter d_d and is measured by the groove width W_d.

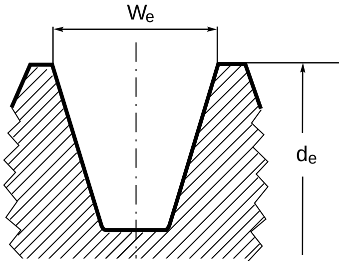
The V-belt length is defined as the datum length L_d and is measured as shown in the following point concerning V-belt length.

ISO has determined that the datum groove width W_d of pulleys shall be identical with the formerly standardised pitch groove widths.

In practice, this means that the pitch-diameter d_p of the pulleys is now termed datum-diameter d_d and that the pitch length L_p of the V-belts is changed into a datum belt length L_d.

EFFECTIVE SYSTEM

Under this system, a pulley groove width W_e is defined by the measurement shown in the illustration below.

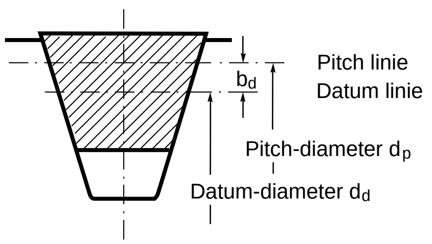


The pulley diameter is termed effective outside diameter d_e, or just effective-diameter.

The V-belt length is defined as effective belt length L_e and is measured as shown in the following points concerning V-belt length.

PITCH SYSTEM

This definition is used for calculating the exact speed ratio and belt speed of a drive, since these values are determined by the placement of the V-belt section pitch line in the pulley groove. See the following points concerning V-belt section.



The distance b_d is therefore variable and is included as a correction supplement when determining the pitch-diameter d_p of the pulley.

The calculation of the speed ratio i and the belt speed v is therefore as follows:

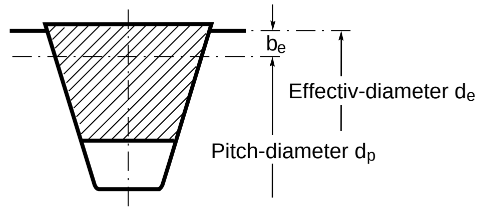
$$i = \frac{D_d + 2b_d}{d_d + 2b_d} = \frac{D_p}{d_p}$$

see point 3, page 7

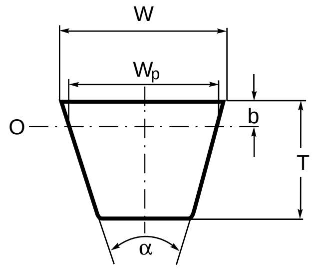
$$v = \frac{(d_d + 2b_d) \times n_1}{19100} = \frac{d_p \times n_1}{19100} \quad [m/s]$$

see point 8, page 7

Under the effective system, the pitch-diameter is calculated as follows: $d_p = d_e - 2b_e$ [mm]

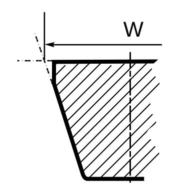


BELT SECTION



0 Pitch zone
Tensile and compressive stresses occur in the cross section of the profile during the bending of the belt in the pulley groove.
These stresses will decrease to “0” (zero) in the line that is termed NEUTRAL AXIS, PITCH ZONE or PITCH.

W Top width
As regards sections with bevelled corners, the top width is determined on the basis of the point of intersection of the extended lines.



W_p Pitch width

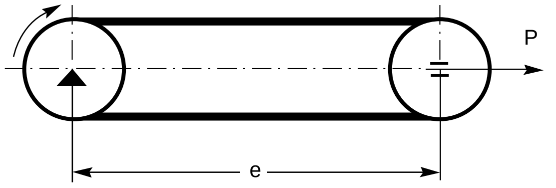
T Section height

b Pitch placement
is the distance from the top line of the profile to the pitch zone.

α Profile angle
For standard V-belts α = 38 - 40°

V-BELT LENGTH

The V-belt length is defined in different ways in the standards but it is measured according to specified methods in all cases.
The measuring machine consists of two pulleys with the same datum-diameter, effective-diameter or two plane pulleys. The measurement load on the moving pulley depends on the belt section.



P = Measurement load
e = Centre distance

Datum belt length L_d [mm]
is measured over pulleys with datum-diameter d_d [mm].

$L_d = 2 \times e + d_d \times \pi$ [mm]

The ISO term datum length L_d [mm] is identical with the previously used pitch belt length L_p [mm].

Effective belt length L_e [mm]
The effective-diameter of the pulleys, d_e [mm], is used for calculating the belt length.

$L_e = 2 \times e + d_e \times \pi$ [mm].

Outside belt length L_a [mm]
The physical outside length of the V-belt is measured with a measuring tape on the outside of the belt while the belt is installed in the measuring machine.

Inside belt length L_i [mm]
is measured over two plane pulleys with the diameter d [mm], centre distance e [mm], is calculated as follows:

$L_i = 2 \times e + d \times \pi$ [mm]

Mean belt length L_m [mm]
occurs in connection with double V-belts, and for all practical purposes it may be said to be ≈ effective belt length.
$L_m \approx L_e$ [mm].

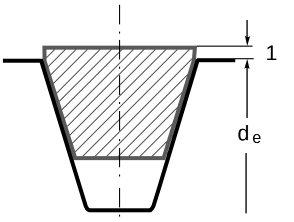
The programmes on ROFLEX V-belts and the dimension tables page 41 - 43 include informations regards the supplements and reductions to be applied when making an approximate calculation of a belt length specification other than the one listed, e.g. conversion from datum length L_d [mm] to inside length L_i [mm].

V-BELT IN PULLEY GROOVE

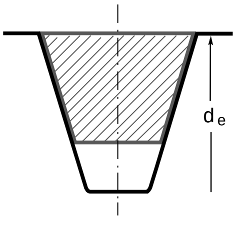
The placement of a V-belt section in the groove of the standard pulley designed for it is described with the term “Ride”. This is the distance from the top of the section to the outside diameter d_e of the pulley.

The permissible maximum/minimum distance/ride is specified in standards.

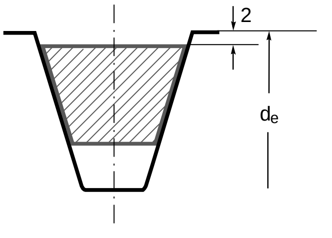
RIDE OUT
Distance (1) from the top of the V-belt section to the outside diameter d_e of the pulley.



RIDE 0/RIDE FLUSH
The top of the V-belt section is flush with the outside diameter d_e of the pulley.



RIDE IN
Distance (2) from the top of the V-belt section to the outside diameter d_e of the pulley.



DIMENSION TABLES

In those programmes where several standards are listed, there may be minor differences in the dimension specification.

The designation “X” for V-belts of the raw-edge design has not been introduced in all standards. Summary of standards, see page 57.

ROFLEX RE-X NARROW V-BELTS ISO 4184, BS 3790, DIN 7753/1 — PROGRAMME 10

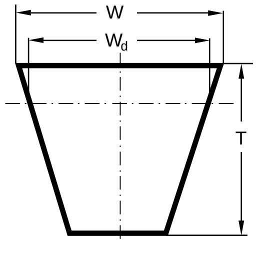
Section designation	Section dimension W × T [mm] ~	Datum width W_d [mm]	Datum belt length $L_d \approx L_e -$ [mm]	Datum belt length $L_d \approx L_i +$ [mm]	Outside belt length $L_a \approx L_d +$ [mm]	Effective belt length $L_e \approx L_d +$ [mm]	Inside belt length $L_i \approx L_d -$ [mm]	Inside belt length $L_i \approx L_e -$ [mm]	Min. pulley datum-diameter d_d [mm]	Min. pulley effective-diameter d_e [mm]	Recom. max. belt speed v [m/s]	Max. deflection freq. f [Hz]	Weight [kg/m] ~
XPZ	9,7 × 8	8,5			13				50		50	120	0,065
XPA	12,7 × 9	11			18				63				0,105
XPB	16,3 × 13	14			22				100				0,190
XPC	22 × 18	19			30				160				0,325

ROFLEX NARROW V-BELTS ISO 4184, BS 3790, DIN 7753/1, RMA-MPTA IP-22 — PROGRAMME

Section designation	Section dimension W × T [mm] ~	Datum width W_d [mm]	Datum belt length $L_d \approx L_e -$ [mm]	Datum belt length $L_d \approx L_i +$ [mm]	Outside belt length $L_a \approx L_d +$ [mm]	Effective belt length $L_e \approx L_d +$ [mm]	Inside belt length $L_i \approx L_d -$ [mm]	Inside belt length $L_i \approx L_e -$ [mm]	Min. pulley datum-diameter d_d [mm]	Min. pulley effective-diameter d_e [mm]	Recom. max. belt speed v [m/s]	Max. deflection freq. f [Hz]	Weight [kg/m] ~
SPZ	9,7 × 8	8,5		37	13		37		63		42	100	0,065
SPA	12,7 × 10	11		45	18		45		90				0,115
SPB	16,3 × 13	14		60	22		60		140				0,200
SPC	22 × 18	19		83	30		83		224				0,350
S19	18,6 × 15	16		69	25		69		180				0,275
3V/9N	9 × 8		4			4				67			
5V/15N	15 × 13		11			11				180			
8V/25N	25 × 23		16			16				315			0,520

ROFLEX-X NARROW V-BELTS ISO 4184, BS 3790, DIN 7753/1 — PROGRAMME 12

Section designation	Section dimension W × T [mm] ~	Datum width W_d [mm]	Datum belt length $L_d \approx L_e -$ [mm]	Datum belt length $L_d \approx L_i +$ [mm]	Outside belt length $L_a \approx L_d +$ [mm]	Effective belt length $L_e \approx L_d +$ [mm]	Inside belt length $L_i \approx L_d -$ [mm]	Inside belt length $L_i \approx L_e -$ [mm]	Min. pulley datum-diameter d_d [mm]	Min. pulley effective-diameter d_e [mm]	Recom. max. belt speed v [m/s]	Max. deflection freq. f [Hz]	Weight [kg/m] ~
XPZ	9,7 × 8	8,5			13				50		50	120	0,060
XPA	12,7 × 9	11			18				63				0,100
XPB	16,3 × 13	14			22				100				0,180
XPC	22 × 18	19			30				160				0,320



Section designation	Section dimension W × T [mm] ~	Datum width W_d [mm]	Datum belt length $L_d \approx L_e$ – [mm]	Datum belt length $L_d \approx L_i$ + [mm]	Outside belt length $L_a \approx L_i$ + [mm]	Effective belt length $L_e \approx L_d$ + [mm]	Inside belt length $L_i \approx L_d$ – [mm]	Inside belt length $L_i \approx L_e$ – [mm]	Minimum pulley datum-diameter d_d	Min. pulley effective-diameter d_e [mm]	Recom. max. belt speed v [m/s]	Max. deflection freq. f [Hz]	Weight [kg/m] ~

ROFLEX CLASSICAL V-BELTS ISO 4184, BS 3790, DIN 2215, ANSI/RMA IP-20 PROGRAMME 15

Section designation	W × T	W_d	$L_d \approx L_e$ –	$L_d \approx L_i$ +	$L_a \approx L_i$ +	$L_e \approx L_d$ +	$L_i \approx L_d$ –	$L_i \approx L_e$ –	d_d	d_e	v	f	Weight
8	8 × 5	6,7		19	31		19		40				0,040
Z/ 10	10 × 6	8,5		22	38		22		50				0,058
A/13	13 × 8	11		30	50		30		63				0,104
B/17	17 × 11	14		43	66		43		100				0,172
20	20 × 12,5	17		48	79		48		140		30	70	0,239
C/22	22 × 14	19		65	85		65		160				0,282
25	25 × 16	21		61	101		61		224				0,366
D/32	32 × 20	27		69	126		69		280				0,591
E/40	40 × 25	32		84	157		84		450				0,958

ROFLEX-X CLASSICAL V-BELTS ISO 4184, BS 3790, DIN 2215 PROGRAMME 16

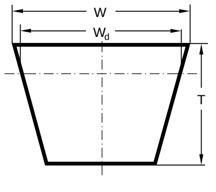
Section designation	W × T	W_d	$L_d \approx L_e$ –	$L_d \approx L_i$ +	$L_a \approx L_i$ +	$L_e \approx L_d$ +	$L_i \approx L_d$ –	$L_i \approx L_e$ –	d_d	d_e	v	f	Weight
ZX/10X	10 × 6	8,5		22	38		22		40				0,055
AX/13X	13 × 8	11		30	50		30		50		50	120	0,080
BX/17X	17 × 11	14		43	66		43		80				0,165
CX/22X	22 × 14	19		65	85		65		140				0,250

ROFLEX RE-X CLASSICAL V-BELTS ISO 4184, BS 3790, DIN 2215 PROGRAMME 17

Section designation	W × T	W_d	$L_d \approx L_e$ –	$L_d \approx L_i$ +	$L_a \approx L_i$ +	$L_e \approx L_d$ +	$L_i \approx L_d$ –	$L_i \approx L_e$ –	d_d	d_e	v	f	Weight
ZX/10X	10 × 6	8,5		22	38		22		40				0,060
AX/13X	13 × 8	11		30	50		30		50		50	120	0,090
BX/17X	17 × 11	14		43	66		43		80				0,180
CX/22X	22 × 14	19		65	85		65		140				0,255

ROFLEX CLASSICAL V-BELTS ISO 4184, BS 3790, DIN 2215, ASAE S 211.4 PROGRAMME 20

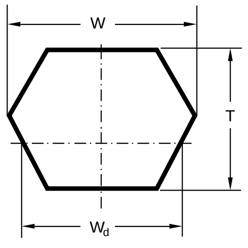
Section designation	W × T	W_d	$L_d \approx L_e$ –	$L_d \approx L_i$ +	$L_a \approx L_i$ +	$L_e \approx L_d$ +	$L_i \approx L_d$ –	$L_i \approx L_e$ –	d_d	d_e	v	f	Weight
A/13	13 × 8	11		30	50		30	46	63				0,104
B/17	17 × 11	14		43	66		43	65	100				0,172
20	20 × 12,5	17		48	79		48		140				0,239
C/22	22 × 14	19		65	85		65	99	160		30	60	0,282
25	25 × 16	21		61	101		61		224				0,366
32	32 × 16	27		50	101		50	101	250				0,519
D/32	32 × 20	27		69	126		69	120	280				0,591



ROFLEX DOUBLE V-BELTS DIN 7772, ASAE S 211.4

PROGRAMME 21

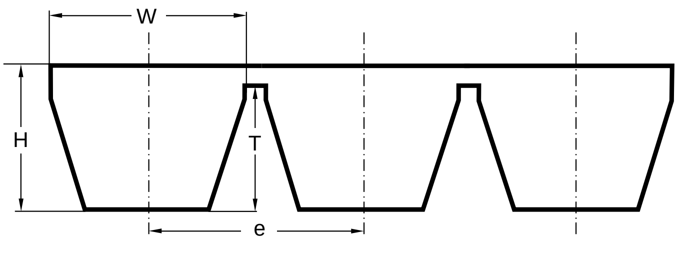
Section designation	Section dimension W × T [mm] ~	Datum width W_d [mm]	Datum belt length $L_d \approx L_e -$ [mm]	Datum belt length $L_d \approx L_i +$ [mm]	Outside belt length $L_a \approx L_i +$ [mm]	Effective belt length $L_e \approx L_d +$ [mm]	Inside belt length $L_i \approx L_d -$ [mm]	Inside belt length $L_i \approx L_e -$ [mm]	Min. pulley datum-diameter d_d [mm]	Min. pulley effective-diameter d_e [mm]	Recom. max. belt speed v [m/s]	Max. deflection freq. f [Hz]	Weight [kg/m] ~
HAA/AA	13 × 10	11	21		63	21		31		80	30	60	0,140
HBB/BB	17 × 13	14	26		82	26		41		112			0,244
HCC/CC	22 × 17	19	36		107	36		53		200			0,409
25	25 × 22	21	40		138	40		69		280			0,590
HDD/DD	32 × 25	27	51		157	51		79		355			0,878



ROFLEX JOINED V-BELTS ANSI/RMA IP-20, RMA/MPTA IP-22, ASAE S 211.4

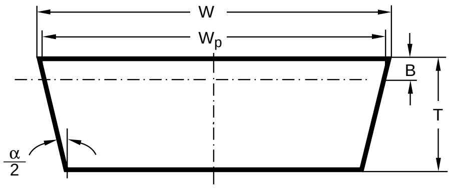
PROGRAMM 23

Section designation	Section dimension W × T [mm] ~	Total height H [mm] ~	Section spacing e [mm]	Datum belt length $L_d \approx L_e -$ [mm]	Outside belt length $L_a \approx L_i +$ [mm]	Effective belt length $L_e \approx L_a -$ [mm]	Inside belt length $L_i \approx L_d -$ [mm]	Inside belt length $L_i \approx L_e -$ [mm]	Min. pulley datum-diameter d_d [mm]	Min. pulley effective-diameter d_e [mm]	Recom. max. belt speed v [m/s]	Max. deflection freq. f [Hz]	Weight per section [kg/m] ~
HA/A	13 × 8	10	15,88	9	64	32		32		80	30	60	0,154
HB/B	17 × 11	13	19,05	13	80	29		51		130			0,237
HC/C	22 × 14	17	25,4	18	100	32		68		210			0,406
HD/D	32 × 19	22	36,53	28	130	36		94		370			0,750
3V/9J	9 × 8	10	10,3		66	28		38		67			0,095
5V/15J	15 × 13	16	17,5		100	29		71		180			0,250
8V/25J	25 × 23	26	28,6		157	32		125		315			0,637



ROFLEX-VARI VARIABLE SPEED V-BELTS, ISO 1604, DIN 7719 — PROGRAMME 40

Section designation		W16	W20	W25	W31,5	W40	W50	W63	W71	W80	W100
Top width	**W [mm] ~**	17	21	26	33	42	52	65	74	83	104
Pitch width	**W_p [mm]**	16	20	25	31.5	40	50	63	71	80	100
Section height	**T [mm] ~**	6	7	8	10	13	16	20	23	26	32
Pitch zone	**B [mm] ~**	1.5	1.75	2	2.5	3.25	4	5	5.75	6.5	8
Section angle	**α [°] ~**	26	28	28	28	28	30	30	30	32	32

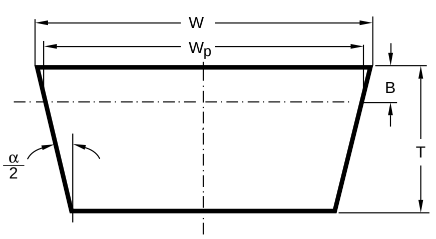


ROFLEX-VARI VARIABLE SPEED V-BELTS, RMA/MPTA IP-25 — PROGRAMME 40

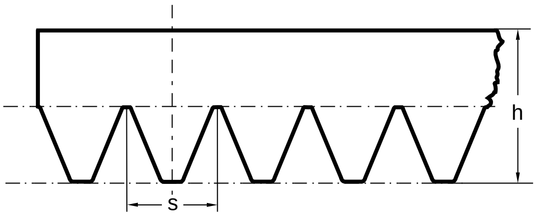
Section designation		1422V	1922V	2322V	1926V	2926V	3226V	2530V	3230V	4430V	4036V	4436V	4836V
		22V A22	30V A22	37V A22	30V A26	46V A26	51V A26	40V A30	51V A30	70V A30	64V A36	70V A36	76V A36
Top width	**W [mm] ~**	22	30	37	30	46	51	40	51	70	64	70	76
Section height	**T [mm] ~**	8	10	11	11	13	13	15	16	18	18	18	19
Section angle	**α [°] ~**	24	24	24	28	28	28	32	32	32	38	38	38

ROFLEX-VARI VARIABLE SPEED V-BELTS ISO 3410, ASAE S 211.4 — PROGRAMME 41

Section designation		HG	HH	HI	HJ	HK	HL	HM	HN	HO
Top width	**W [mm] ~**	16.5	20.4	25.4	31.8	38.1	44.5	50.8	57.2	63.5
Pitch width	**W_p [mm]**	15.4	19	23.6	29.6	35.5	41.4	47.3	53.2	59.1
Section height	**T [mm] ~**	8	10	12.7	15.1	17.5	19.8	22.2	23.9	25.4
Pitch zone	**B [mm] ~**	2.5	3	3.8	4.7	5.7	6.6	7.6	8.5	9.5
Section angle	**α [°] ~**	28	28	28	28	28	28	28	28	28

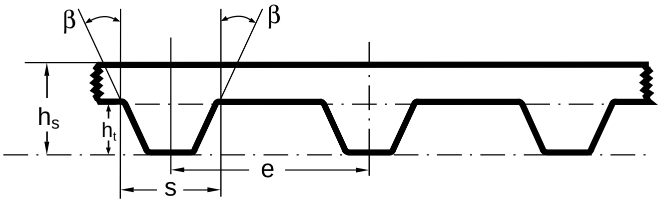


Section designation		PH	PJ	PK	PL	PM				
		H	J	K	L	M				
Rib spacing	**s [mm]**	1.60	2.34	3.56	4.70	9.40				
Belt height	**h [mm] ~**	3	4	6	10	17				
Minimum pulley diameter	**d_e [mm]**	13	20	45	75	180				



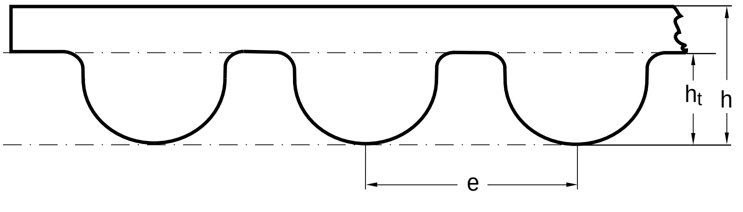
ROFLEX SYNCHRONOUS BELTS, ISO 5296 PROGRAMME 34

Section designation		MXL	XXL	XL	L	H	XH	XXH
Circular pitch	**e [mm]**	2.032	3.175	5.080	9.525	12.700	22.225	31.750
Tooth width	**s [mm]**	1.14	1.73	2.57	4.65	6.12	12.57	19.05
Tooth height	**h_t [mm]**	0.51	0.76	1.27	1.91	2.29	6.35	9.53
Tooth angle	**2β [°]**	40	50	50	40	40	40	40
Belt height	**h_s [mm] ~**	1.14	1.52	2.3	3.6	4.3	11.2	15.7



ROFLEX SYNCHRONOUS BELTS PROGRAMME 34

Section designation		3M	5M	8M	14M	20M		
Circular pitch	**e [mm]**	3.0	5.0	8.0	14.0	20.0		
Tooth height	**h_t [mm]**	1.2	2.1	3.4	6.1	8.4		
Belt height	**h [mm] ~**	2.4	3.8	5.6	10.0	13.2		



PULLEYS - GROOVE DIMENSIONS

For further information, please refer to the standards ISO 4183, BS 3790, DIN 2211/1, DIN 2217/1.
Summary of standards, see page 57.

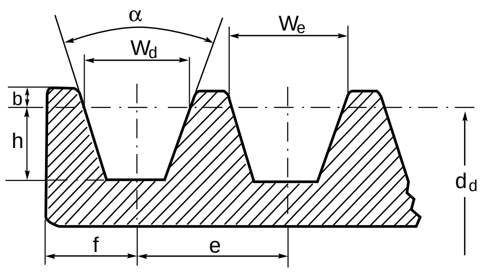
Narrow V-belts:
Programmes 10, 11 and 12

Classical V-belts:
Programmes 15, 16, 17, 20, 21 and 30

Table 21

Classical V-belts sections		Y 6	8	Z ZX 10	A AX 13	B BX 17		20	C CX 22	25	D 32	E 40
Narrow V-belt sections				**SPZ** **XPZ**	**SPA** **XPA**	**SPB** **XPB**	**S19**		**SPC** **XPC**			
W_d		5,3	6,7	8,5	11	14	16	17	19	21	27	32
W_e		6,3	8	9,7	12,7	16,3	18,6	20	22	25	32	40
b min.		1,6	2	2	2,75	3,5	4	5,1	4,8	6,3	8,1	9,6
h min.		4,7	7	9	11	14	16	13	19	16	19,9	23,4
e		8 ± 0,3	10 ± 0,3	12 ± 0,3	15 ± 0,3	19 ± 0,4	22 ± 0,4	23 ± 0,4	25,5 ± 0,5	29 ± 0,5	37 ± 0,6	44,5 ± 0,7
f		7 ± 1	7 ± 1	8 ± 1	10^{+2}_{-1}	$12{,}5^{+2}_{-1}$	$14{,}5^{+2}_{-1}$	15^{+2}_{-1}	17^{+2}_{-1}	19^{+2}_{-1}	24^{+3}_{-1}	29^{+4}_{-1}
α **32°**	**At datum-diameter d_d [mm]**	≤ 63	≤ 71									
α **34°**				≤ 80	≤ 118	≤ 190	≤ 250	≤ 250	≤ 315	≤ 355		
α **36°**		> 63	> 71								≤ 500	≤ 600
α **38°**				> 80	> 118	> 190	> 250	> 250	> 315	> 355	> 500	> 600

Total width B [mm] of pulley with × number of grooves: B = (x-1)e + 2f [mm]



DEEP - GROOVE PULLEYS - GROOVE DIMENSIONS

Table 22 lists the groove dimensions which are commonly used.
For further information, please refer to ANSI/RMA IP-20 and ASAE S 211.4

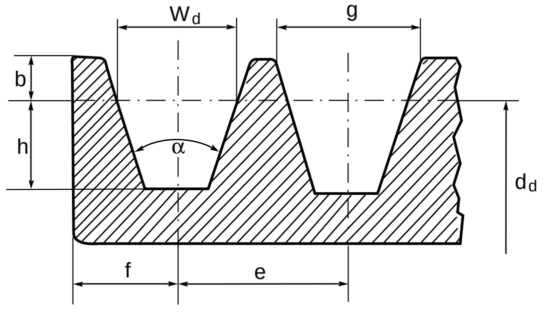
Narrow V-belts:
Programmes 10, 11 and 12

Classical V-belts:
Programmes 15, 16, 17, 20, 21 and 30

Table 22

Classical V-belt sections			Z ZX	A AX	B BX		C CX
			10	13	17		22
Narrow V-belt sections			SPZ XPZ	SPA XPA	SPB XPB	S19	SPC XPC
W_d			8.5	11	14	16	19
g ~	$\alpha = 34°$		11	15	18.9	22.1	26.3
	$\alpha = 38°$		11.3	15.4	19.5	22.9	27.3
b min.			4	6.5	8	10	12
h min.			9	11.5	14.5	16	19.5
e			14 ± 0.3	18 ± 0.3	23 ± 0.4	27 ± 0.5	31 ± 0.5
f			9 ± 0.6	11.5 ± 0.6	14.5 ± 0.8	17 ± 1	20 ± 1
α	34°	At datum-diameter d_d [mm]	80	118	190	250	315
	38°		> 80	> 118	> 190	> 250	> 315

Total width B [mm] of pulley with × number of grooves: B = (x-1)e + 2f [mm]



PULLEYS - GROOVE DIMENSIONS

For further information, please refer to the standards RMA/MPTA IP-22 and ASAE S 211.4

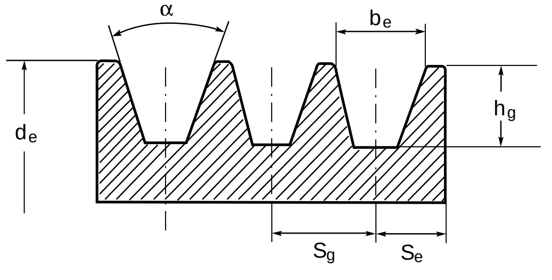
Narrow V-belts:
Programmes 10, 11 and 12

3V ≈ SPZ 3VX ≈ XPZ
5V ≈ SPB 5VX ≈ XPB

Table 23

Groove profile	d_e [mm]	α°	b_e	h_g min.	S_g	S_e min.	Groove profile ISO
3V	**≤ 90** **> 90 – ≤ 150** **> 150 – ≤ 305** **> 305**	36 38 40 42	8,89	8,6	10,3	9,0	9N
5V	**≤ 255** **> 255 – ≤ 405** **> 405**	38 40 42	15,24	15,0	17,5	13,0	15N
8V	**≤ 405** **> 405 – ≤ 570** **> 570**	38 40 42	25,4	25,1	28,6	19,0	25N

Total width B [mm] of pulley with × number of grooves: $B = (x\text{-}1)\ S_g + 2\ S_e$ [mm]



JOINED V-BELT PULLEYS - GROOVE DIMENSIONS

For further information, see the standards ISO 5290, ISO 5291, ASAE S 211.4, ANSI/RMA IP-20 and RMA/MPTA IP-22

Joined V-belts:
Programme 23

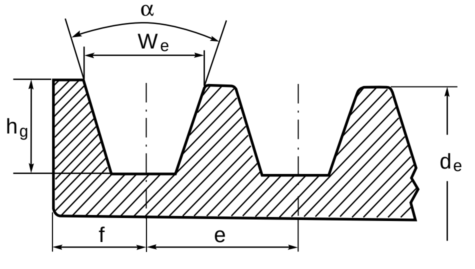
Table 24 Standard ISO 5291

Groove profile	d_e [mm]	α°	w_e	h_g min.	e	f min.	Groove profile ISO
HA/A	**≤ 125** **> 125**	34 38	13	12	15,88	9	AJ
HB/B	**≤ 195** **> 195**	34 38	16,5	14	19,05	11,5	BJ
HC/C	**≤ 325** **> 325**	34 38	22,4	19	25,40	16	CJ
HD/D	**≤ 490** **> 490**	36 38	32,8	26	36,53	23	DJ

Table 25 Standard ISO 5290

Groove profile	d_e [mm]	α°	w_e	h_g min.	e	f min.	Groove profile ISO
3V	**≤ 90** **> 90 – ≤ 150** **> 150 – ≤ 300** **> 300**	36 38 40 42	8,9	8,9	10,3	9,0	9J
5V	**≤ 250** **> 250 – ≤ 400** **> 400**	38 40 42	15,2	15,2	17,5	13,0	15J
8V	**≤ 400** **> 400 – ≤ 560** **> 560**	38 40 42	25,4	25,4	28,6	19,0	25J

Total width of pulley with × number of grooves: B = (x-1)e + 2 × f [mm]



DRIVES WITH FLAT BELTS

ROULUNDS standard flat belt types are described in programme 50, PRODUCT SPECIFICATIONS, and in the following calculation procedure their power rating is listed in tables 3 and 4, page 52. The belt type to be used for the drive in question is selected on the basis of this.

CALCULATION

Terms and units used.

B	Width of pulley	[mm]
b	Belt width	[mm]
C	Centre distance	[mm]
c_1	Service factor	
c_2	Arc of contact correction factor	
D	Diameter of larger pulley	[mm]
d	Diameter of smaller pulley	[mm]
h	Crown of camber on pulley face	[mm]
i	Speed ratio	
L_i	Inside belt length	[mm]
n_1	Number of revolutions of smaller pulley	[rev/min]
n_2	Number of revolutions of larger pulley	[rev/min]
P_M	Power consumption	[kW]
P_N	Power rating per 10 mm belt width	[kW]
v	Belt speed	[m/s]
x	Adjustment of centre distance for take-up allowance	[mm]
y	Adjustment of centre distance for installation	[mm]
β	Arc of contact on smaller pulley	[°]

1. Service factor c_1

Table 1, page 51.

The power rating tables are based on the maximum permissible tension in the applicable belt types at the stated pulley diameter and rev/min. It is therefore important that calculation is carried out with a service factor that makes allowance for the operating conditions of the driven unit, e.g. overloading when started, shock loads etc.

2. Belt type

To be selected according to application, see programme 50.

3. Speed ratio i

is the ratio of the rev/min of the smaller to that of the larger pulley

$$i = \frac{n_1}{n_2}$$

or the ratio of the diameter of the larger to that of the smaller pulley.

$$i = \frac{D}{d}$$

4. Pulley diameter

The diameter of the smaller pulley d [mm] is selected from the power rating table for the selected belt type, tables 3-4 page 52.

The diameter of the larger pulley D [mm] is calculated as follows:

$D = d \times i$ [mm]

Tension idlers, see point 13, page 53.

5. Centre distance C [mm]

C may be determined on the basis of the applicable conditions or it may be chosen to be 2 × the diameter of the larger pulley D [mm].

For installation and take-up allowance, see point 11, page 53.

6. Belt length L_i [mm]

The inside belt length is calculated as follows:

$$L_i = 2 \times C + 1{,}57\,(D + d) + \frac{(D - d)^2}{4 \times C} \quad \text{[mm]}$$

C = Centre distance [mm]
D = Diameter of larger pulley [mm]
d = Diameter of smaller pulley [mm]

For further detail, see point 14, page 53

7. Belt speed v [m/s]

$$v = \frac{d \times n_1}{19100} \text{ [m/s]}$$

d = Diameter of smaller pulley [mm]
n_1 = Rev/min of smaller pulley

The recommended maximum belt speed is listed in the power rating table for the selected belt type.

8. Arc of contact correction factor c_2
Table 2, page 52

In drives with more than two pulleys, the arc of contact is calculated according to drawing.

9. Power rating P_N [kW]
The power rating per 10 mm belt width is determined from the table for the selected belt type, tables 3-4, page 52.

For further detail, see point 14 for fully- and semi-turned drives.

10. Necessary belt width b [mm]

$$b = \frac{P_M \times c_1 \times 10}{P_N \times c_2} \text{ [mm]}$$

P_M = Power consumption of driven unit in kW or rated kW of motor.

P_N = Power rating [kW] per 10 mm belt width, tables 3-4.

c_1 = Service factor, table 1

c_2 = Arc of contact correction factor, table 2.

The belt width b [mm] is rounded up to the closest standard width, see table 5, page 53.

Table 1 Service factor c_1

Driven unit	Driving unit/motor					
	AC motors, single- and three-phase with star-delta start. DC shunt-wound motors. Multiple cylinder internal combustion engines.			AC motors, single- and three-phase, series wound, slip-ring motors with direct start. DC motors, series and compound wound. Single cylinder internal combustion engines.		
	Number of operating hours per 24 hours			Number of operating hours per 24 hours		
	Up to 10	Over 10 to16	Over 16	Up to 10	Over 10 to16	Over 16
Agitators for liquids. Small centrifugal blowers. Fans up to 7.5 kW. Light-duty conveyors.	1.0	1.1	1.2	1.1	1.2	1.3
Belt conveyors for sand, grain, etc. Dough mixers. Fans over 7.5 kW. Generators. Washing machines. Machine tools. Punching, pressing and shearing machines. Printing machines. Positive displacement rotary pumps. Vibrating and rotary screens.	1.1	1.2	1.3	1.2	1.3	1.4
Brick-making machinery. Bucket elevator. Piston compressors. Screw conveyors. Hammer mills. Hollanders. Piston pumps. Positive displacement blowers. Crushers. Woodworking machinery. Textile machinery.	1.2	1.3	1.4	1.4	1.5	1.6

Table 2 Arc of contact correction factor c_2

$\frac{D-d}{C}$	**0.00**	**0.10**	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**
Arc of contact β [°]	**180**	**174**	**169**	**163**	**157**	**151**	**145**	**139**
C_2	1.00	0.98	0.96	0.93	0.91	0.88	0.86	0.82
$\frac{D-d}{C}$	**0.80**	**0.90**	**1.00**	**1.10**	**1.20**	**1.30**	**1.40**	**1.50**
Arc of contact β [°]	**133**	**127**	**120**	**113**	**106**	**99**	**91**	**83**
C_2	0.80	0.78	0.74	0.71	0.66	0.64	0.59	0.54

Table 3 Power rating P_N [kW] per 10 mm belt width

DANCORD

	d [mm]	**Number of revolutions of smaller pulley [rev/min]**																	
		200	**400**	**720**	**800**	**920**	**1200**	**1450**	**1600**	**2000**	**2400**	**2800**	**3200**	**3600**	**4000**	**4500**	**5000**	**5500**	**6000**
DANCORD M	**80**	0.07	0.18	0.26	0.29	0.35	0.49	0.56	0.60	0.74	0.88	0.95	1.01	1.10	1.18	1.19	1.23	1.23	1.12
	100	0.11	0.26	0.49	0.57	0.73	0.82	0.96	1.01	1.23	1.38	1.51	1.60	1.72	1.80	1.80	1.78	1.76	1.71
	125	0.18	0.44	0.78	0.89	0.98	1.18	1.34	1.43	1.67	1.89	2.03	2.16	2.60	2.29	2.29	2.21	2.03	1.93
	160	0.29	0.60	1.07	1.21	1.38	1.60	1.82	1.94	2.23	2.46	2.63	2.69	2.71	2.57	2.27	1.96		
	200	0.44	0.82	1.43	1.58	1.87	2.14	2.45	2.60	2.94	3.18	3.35	3.23	3.03	2.71	2.02			
	250	0.53	1.01	1.95	2.13	2.40	2.76	3.10	3.23	3.56	3.74	3.57	3.21	2.57					
	315	0.71	1.37	2.36	2.54	2.90	3.36	3.68	3.83	3.96	3.71	2.99							
	400	0.89	1.71	2.94	3.17	3.51	2.92	4.16	4.16	3.71									
DANCORD G	**160**	0.37	0.66	1.18	1.26	1.43	1.71	1.95	2.06	2.36	2.61	2.71	2.78	2.80	2.61	2.21	1.64		
	200	0.55	1.03	1.66	1.81	2.08	2.43	2.76	2.93	3.31	3.53	3.68	3.59	3.21	2.82	2.02			
	250	0.74	1.40	2.28	2.46	2.76	3.24	3.69	3.85	4.23	4.40	4.19	3.71	2.93					
	315	0.92	1.76	2.93	3.20	3.55	4.10	4.49	4.66	4.90	4.67	4.45							
	400	1.18	2.27	3.75	4.04	4.50	5.07	5.38	5.38	4.96									
	630	1.79	3.49	5.16	5.38	5.67	5.49	4.49											
DANCORD H	**250**	0.26	1.20	1.88	2.03	2.28	2.43	2.29	2.04	1.89									
	400	1.01	1.91	3.01	3.24	3.65	3.88	3.68											
	500	1.45	2.78	4.32	4.54	4.94	4.90												
	630	2.09	3.74	5.46	5.68	5.77	4.95												
	700	2.40	4.32	6.13	6.30	6.25	4.61												
	800	2.74	4.96	6.62	6.82	6.32													
	900	3.07	5.59	6.79	6.53	5.30													
						v > approx. 40 m/s													

Recommended maximum belt speed 40 m/s

Table 4 Power rating P_N [kW] per 10 mm belt width

STARKODDER

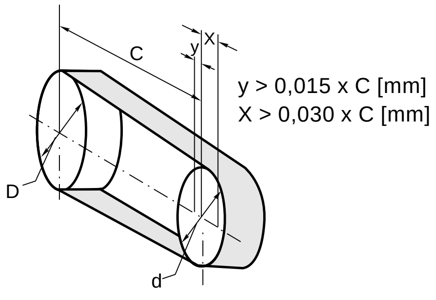
	d [mm]	**Number of revolutions of smaller pulley [rev/min]**														
		200	**400**	**720**	**800**	**920**	**1200**	**1450**	**1600**	**2000**	**2400**	**2800**	**3200**	**3600**	**4000**	**4500**
3 plies	**80**	0.04	0.09	0.21	0.23	0.26	0.32	0.38	0.41	0.52	0.63	0.71	0.78	0.85	0.91	1.02
	100	0.06	0.15	0.28	0.31	0.37	0.44	0.56	0.60	0.76	0.90	1.00	1.13	1.21	1.31	
	125	0.12	0.22	0.37	0.43	0.51	0.65	0.78	0.87	1.04	1.22	1.41	1.50	1.59	1.69	
	160	0.16	0.31	0.54	0.62	0.74	0.88	1.07	1.18	1.47	1.62	1.74	1.87	1.99		
	200	0.19	0.41	0.74	0.87	0.97	1.17	1.43	1.52	1.79	1.95	2.13				
	250	0.29	0.55	0.94	1.06	1.17	1.29	1.51	1.76	1.90	2.13	2.26				
4 plies	**125**	0.13	0.18	0.40	0.53	0.57	0.65	0.87	0.99	1.25	1.31	1.38	1.45	1.57		
	160	0.18	0.33	0.59	0.68	0.81	0.96	1.20	1.31	1.54	1.71	1.91				
	200	0.26	0.48	0.81	0.92	1.10	1.36	1.58	1.69	1.97	2.24					
	250	0.35	0.53	1.19	1.26	1.47	1.64	2.06	2.19	2.49						
	315	0.46	0.85	1.51	1.67	1.97	2.32	2.57	2.72							
	400	0.61	1.14	1.97	2.15	2.43	2.82	3.01								
5 plies	**160**	0.18	0.37	0.62	0.74	0.84	0.96	1.07	1.18	1.46	1.63	1.87				
	200	0.26	0.53	0.93	1.02	1.25	1.50	1.76	1.91	2.18	2.40					
	250	0.39	0.71	1.31	1.45	1.67	2.02	2.36	2.49	2.80						
	315	0.51	0.98	1.74	1.93	2.23	2.69	2.97	3.17							
	400	0.74	1.38	2.32	2.51	2.90	3.29	3.54								
	500	0.96	1.76	2.90	3.14	3.51	3.83									
6 plies	**200**	0.29	0.56	0.96	1.06	1.24	1.50	1.74	1.89	2.16						
	250	0.41	0.74	1.38	1.49	1.74	2.14	2.47	2.65	2.88						
	315	0.56	1.12	1.88	2.09	2.44	2.90	3.31	3.41							
	400	0.79	1.54	2.59	2.84	3.24	3.71	3.97								
	500	1.06	1.96	3.28	3.53	3.82										
	630	1.38	2.62	4.07	4.38											
					v > approx. 20 m/s											

Recommended maximum belt speed 20 m/s for belts with endless joint.

Table 5 Recommended belt and pulley widths

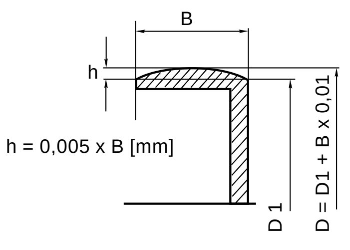
Belt width b [mm]	**25**	**32**	**40**	**50**	**63**	**71**	**80**	**90**	**100**	**112**	**125**	
Corresponding pulley width B [mm]	32	40	50	63	71	80	90	100	112	125	140	
Belt width b [mm]	**140**	**160**	**180**	**200**	**224**	**250**	**280**	**315**	**355**	**400**	**450**	**500**
Corresponding pulley width B [mm]	160	180	200	224	250	280	315	355	400	450	500	560

11. Installation and take-up allowance.



12. Pulley crown, camber h [mm]

To achieve optimum exploitation of the drive, the belt must be assured an even run on the pulleys. This can be achieved by giving the pulleys a smooth, crowned face with a camber h [mm] according to the sketch below.

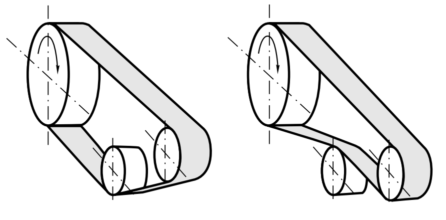


The pulleys must never be equipped with side edges/flanges.

13. Tension idlers

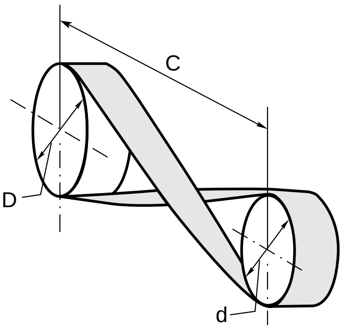
If a tension idler is used, it should have at least the same diameter as that of the smaller pulley, and it must provide the same possibilities with regard to installation and take-up allowance as those mentioned in point 11.

The tension idler should be installed against the slack part of the belt, as illustrated in the sketches below.



14. Fully- and semiturned transmissions

Fully turned transmission - 180°

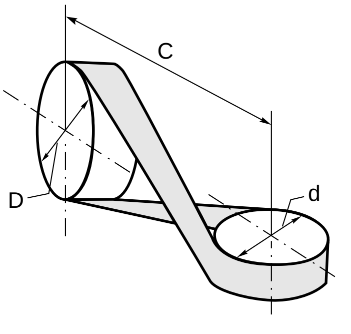


Belt length L_i [mm]

$$L_i = 2 \times C + 1,57\,(D + d) + \frac{(D + d)^2}{4 \times C} \text{ [mm]}$$

Power transmission
P_N = Table value $\times$ 0,75 [kW]

Semiturned transmission - 90°



Belt lenght L_i [mm]

$$L_i = 2 \times C + 1,57\,(D + d) + \frac{\left(D + \frac{d}{2}\right)^2}{4 \times C} \text{ [mm]}$$

Power transmission
P_N = Table value $\times$ 0,75 [kW]

P_N = kW per 10 mm belt width.

BELT CONSTRUCTIONS

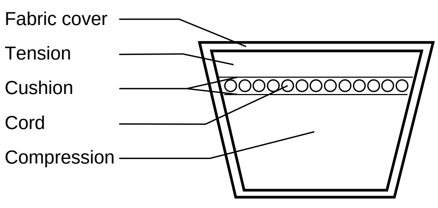
The following is a description of the basic designs used for the belt types listed in the PROGRAMME KEY.

The technical features, fields of application and data of the individual belt types, which are intended for use in the design of the drive, are listed in the DIMENSION TABLES, pages 41 - 43.

WRAPPED V-BELTS

The term “wrapped” indicates that the V-belt core is protected by one or more plies of fabric called fabric cover.

The fabric cover is of cotton or polyester, it is wear resistant and coated with rubber.



The power transmitting element in the cord zone is ordinarily polyester cord or several plies of special cord fabric. Kevlar cord is used in certain special belts.

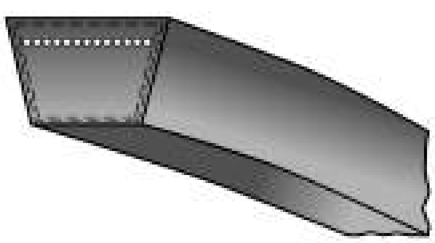
Tension, cushion and compression are rubber compounds with specific properties.

The cushion bonds the cord to the other rubber elements and absorbs shock loads.

The compression gives the belt cross section form stability and supports the cord zone against deflection while under load.

This design is used for both classical and narrow V-belts.

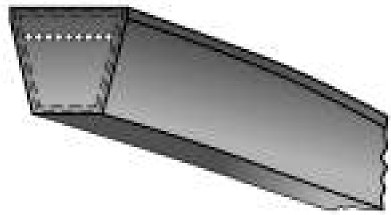
Classical V-belts
are defined in terms of dimensions in standards such as ISO 4184, DIN 2215, BS 3790, ANSI/RMA IP-20 etc., see standards summary on page 57.



The ratio of the top width to the height of the sections is approx. 1.6.

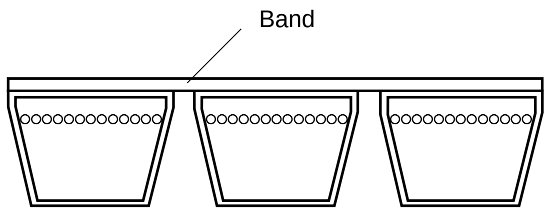
Narrow V-belts
Dimensions according to the standards ISO 4184, DIN 7753/1, BS 3790, RMA/MPTA IP-22 etc., see summary on page 57.

The top width of the section is often bevelled to facilitate adaptation to minor deviations from the standard for pulley groove dimension.



The ratio of the top width to the height of the sections is approx. 1.2. Hence the term narrow V-belts, as seen in relation to classical V-belts.

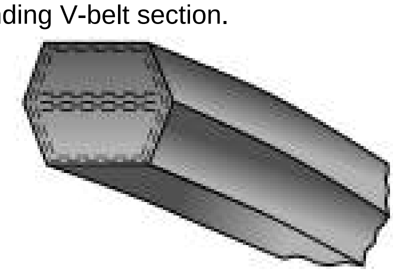
Joined V-belts
are often termed JV-belts. These consist of 2-5 standard V-belts which are joined into one unit by means of an overlaying band.



This design reduces vibrations in drives subjected to shock loads. This belt type is also used as a coupling belt, for example on combine harvesters.

Dimensions are defined in the standards ANSI/RMA IP-20, RMA/MPTA IP-22 and ASAE S 211.4, see summary on page 57.

Double V-belts
are also termed HEXAGONAL belts. The section width corresponds to the top width of the corresponding V-belt section.

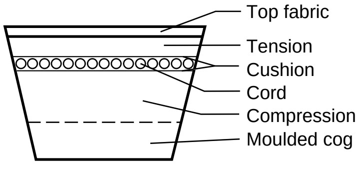


This belt type has been designed for the so-called serpentine drives with more than two pulleys and in which the direction of rotation of at least one shaft is reversed.

Standards: ISO 5289, DIN 7722, ASAE S 211.4, see summary on page 57.

RAW-EDGE V-BELTS

have no fabric cover on the sides of the belt profile. A special rubber compound ensures this belt type a greater resistance to wear than wrapped V-belts. Also, it is characteristic of raw-edge belts that they keep a constant friction level for the remainder of their life after running in.



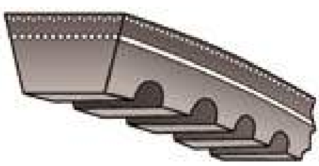
The compression in ROFLEX raw-edge V-belts is a special rubber compound - STIFLEX - with textile fibres oriented across the belt length. This safeguards the form stability of the cross section and provides effective support for the power transmitting polyester cord.

The inside moulded cog gives the belts high flexibility and a good fit in the pulley grooves as well as a low operating temperature.

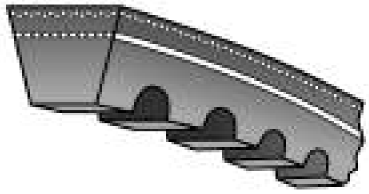
This design is used for both classical and narrow V-belts.

Classical V-belts
in the raw-edge design are designated with an "X" after the ordinary section designation, for example BX.

This designation has not yet been introduced by all standards but as far as dimensions are concerned reference can be made to ISO 4184, DIN 2215, BS 3790, ANSI/RMA IP-20 etc., see summary on page 57.



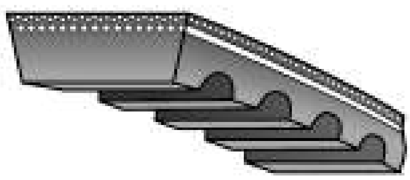
Narrow V-belts
of the raw-edge type are designated by changing the SP before the section designation to XP, for example XPA.



As far as dimensions are concerned reference can be made to ISO 4184, DIN 7753/1, BS 3790, RMA/MPTA IP-22, see summary on page 57.
Some standards have not yet been updated with the new section designations.

Variable speed V-belts
for infinitely variable gears have been specially designed to achieve minimum transverse deflection of the cross section while under load and at the same time a large degree of flexibility. The belts have an inside moulded cog or double cog, i.e. both inside and outside cog.

This belt type is also termed a V/S (Variable Speed) belt. It is built up of components as those described in the section on raw-edge.

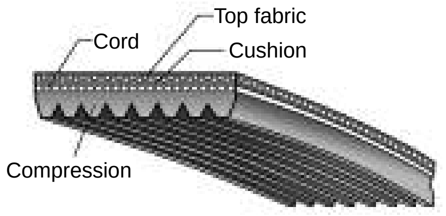


As regards V/S-belts, the ratio of the top width to the height of the sections is as follows:
- Minimum 3 for industrial V/S-belts
- 2-2.5 for V/S-belts for agricultural machinery, increasing in relation to larger top widths.

The dimensions for industrial V/S-belts are defined in standards ISO 1604, DIN 7714/1, RMA/MPTA IP-25.
Belts for agricultural machinery are defined in standards ISO 3410, ASAE S 211.4.
See summary on page 57.

Multi-rib belts
are generally designed like a raw-edge V-belt in which the compression zone has V-profiles running along the length of the belt.

The relatively low belt height permits the use of small pulley diameters and high belt speed. The characteristic V-profiles with the large contact surface engaging the pulleys give a high power rating and permit high speed ratios.



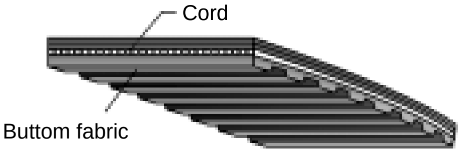
See the section on raw-edge, page 116, in which the individual components are described.

A number of profile dimensions etc. are defined in standards RMA/MPTA IP-26, DIN 7867, ASAE S211.4, see summary on page 57.

SYNCHRONOUS BELTS
This belt type is primarily used for drives demanding a fixed speed ratio and is therefore also termed “Timing Belts”.

A number of tooth profiles have been designed for a varying and diverse range of applications.

The protective fabric is ordinarily of nylon, and the tensile cords which give the belt its carrying power are often of glass or Aramid fibre, Kevlar.



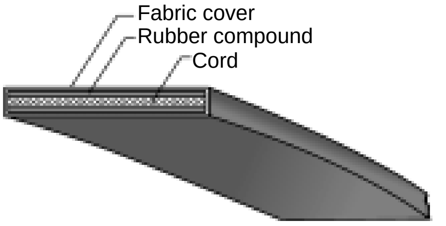
Synchronous belts with both inside and outside teeth are used for drives with more than two shafts and where the direction of rotation has to be reversed.

Synchronous belts are defined in standards ISO 5296, ANSI/RMA IP-24, see summary on page 57.

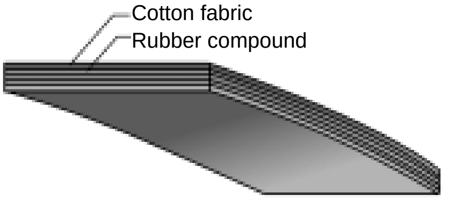
FLAT BELTS
include two basic types:

- cord belts
- multi-ply textile/rubber belts.

Cord belts
are endless belts with power transmitting rayon or polyester cord in a core of a special rubber compound. The core is protected by a wear resistant fabric cover with one or two plies against the pulleys.



Textile/rubber belts
are built up of 2-6 plies of gummed cotton fabric. The special rubber compound between the individual plies ensures the adhesion ply/ply and high flexibility.



The belts are available as endless belts in specific lengths, or they can be connected at the installation site with mechanical belt connectors.

STANDARDS

No.	Subject
ASAE S 211.4	V-Belt and V-Ribbed Belt Drive for agricultural machines
BS 3733	Endless V-Belt drives for agricultural purposes
BS 3790	Endless wedge belt drives and endless V-belt drives
DIN 109/2	Antriebselemente. Achsabstand für Riementriebe mit Keilriemen
DIN 111	Antriebselemente. Flachriemenscheiben. Masse Nenndrehmomente
DIN 2211/1	Schmalkeilriemenscheiben
DIN 2211/2	Schmalkeilriemenscheiben. Prüfung der Rillen
DIN 2215	Endlose Keilriemen
DIN 2216	Endliche Keilriemen
DIN 2217	Keilriemenscheiben
DIN 2217/2	Keilriemenscheiben. Prüfung der Rillen
DIN 2218	Endlose Keilriemen für den Maschinenbau. Berechnung der Antriebe. Leistungswerte
DIN 7719	Endlose Breitkeilriemen für industrielle Drehzahlwandler. Riemen und Rillenprofile der zugehörigen Scheiben
DIN 7721/1	Synchronriemenantriebe, metrische Teilung. Synchronriemen
DIN 7722	Endlose Hexagonalriemen für Landmaschinen und Rillenprofile der zugehörigen Scheiben
DIN 7753/1	Endlose Schmalkeilriemen für den Maschinenbau
DIN 7753/2	Endlose Schmalkeilriemen für den Maschinenbau. Berechnung der Antriebe. Leistungswerte
DIN 7867	Keilrippenriemen und -scheiben
DIN/ISO 5290	Rillenscheiben für Verbund-Schmalkeilriemen, Rillenprofile 9J, 15J, 20J, 25J
DIN/ISO 5294	Synchronriementriebe. Scheiben
DIN/ISO 5296/1	Synchronriementriebe. Riemen
DIN/ISO 5296/2	Synchronriementriebe. Riemen
DIN/ISO 7721/2	Synchronriementriebe, metrische Teilung. Zahnlückenprofil für Synchronscheiben
DS 974	Fladremstræk. Dimensioner på remme og remskiver. Justering af centerafstand
DS 2104	Geometrisk kontrol af sporene i kileremsskiver
DS 2107	Kileremsskiver til remprofilerne Y, Z, A, B, C, D, og E
DS 2108	Kileremstræk - Monteringsanvisninger
DS/ISO 254	Remtræk. Kileremsskiver. Kvalitet, bearbejdning og afbalancering
DS/ISO 3410	Landbrugsmaskiner. Kileremme til variabel hastighed og sammenhørende remskivespor
DS/ISO 4183	Remtræk. Kileremsskiver til remprofilerne Y, Z, A, B, C, D, E, SPZ, SPA,SPB og SPC. Middeldiametre og spordimensioner
DS/ISO 4184	Remtræk. Kileremme. Længder
DS/ISO 5289	Remtræk. Endeløse sekskant-kileremme til landbrugsmaskiner og kilespor i de tilsvarende skiver
DS/ISO 5294	Remtræk. Remskiver til synkrone remtræk
DS/ISO 5296	Remtræk. Synkrone remtræk
ISO 22	Belt drives - Flat transmission belt and corresponding pulleys - Dimensions and tolerances
ISO 155	Belt drives - Pulleys - Limiting values for adjustment of centres
ISO 254	Belt drives - Pulleys - Quality, finish and balance
ISO 255	Belt drives - Pulleys for V-belts (system based on datum with) - Geometrical inspection of grooves
ISO 1081	Drives using V-Belts and grooved pulleys - Terminology
ISO 1604	Belt drives - Endless wide V-belts for industrial speed-changers and groove profiles for corresponding pulleys.

ISO 1813	Anti-static endless V-Belts - Electric conductivity
ISO 3410	Agricultural machinery - Endless variable-speed V-belts and groove sections of corresponding pulleys.
ISO 4183	Grooved pulleys for classical and narrow V-belts.
ISO 4184	Classical and narrow V-belts - Lengths
ISO 5289	Agricultural machinery - Endless hexagonal belts and groove sections of corresponding pulleys.
ISO 5290	Grooved pulleys for joined narrow V-belts. Groove sections 9J, 15J, 20J, and 25J
ISO 5291	Grooved pulleys for joined classical V-belts. Groove sections AJ, BJ, CJ and DJ (effective system).
ISO 5292	Industrial V-Belt transmissions - Calculation of power ratings.
ISO 5294	Synchronous belt drives - Pulleys
ISO 5295	Synchronous belt - Calculation of power rating and drive centre distance
ISO 5296-1	Synchronous belt drives - Belts
ISO 5296-2	Synchronous belt drives - Belts
ISO 8370	V- and ribbed V-belts - Dynamic test to determine pitch zone location
ISO 8419	Narrow joined V-belts - Lengths in effective system
ISO 9653	Belt drives - Electrical conductivity of antistatic endless synchronous belts - Characteristics and test method
ISO 9980	Belt drives - Grooved pulleys for V-belts (system based in effective with) - Geometrical inspection of grooves
ISO 9982	Belt drives - Pulleys and V-ribbed belts for industrial applications

ANSI/RMA IP-20	Classical V-Belt and Sheaves
ANSI/RMA IP-21	Double-V (Hexagonal) Belts
RMA/MPTA IP-22	Narrow Multiple V-Belts
RMA/MPTA IP-23	Light-Duty Single V-belts
RMA/MPTA IP-24	Synchronous Belts
RMA/MPTA IP-25	Variable Speed V-Belts
RMA/MPTA IP-26	V-Ribbed Belts

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