Autodesk Inventor Engineer s Handbook

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Transmission Mechanism

Belt Transmission Calculator

Calculation basics

The first pulley is considered a driver pulley. The rest of the pulleys are driven pulleys or idlers. Input power can be split among several driven pulleys by using a power ratio factor for each pulley. The forces and torques are calculated accordingly.

Arc of contact correction factor c_1

The arc of contact correction factor corrects the power rating of the V-belt for pulleys where the arc of the contact differs from 180 degrees. The size of the correction factor is determined from the following equation.

$$c_1 = \frac{5}{4} \cdot \left[1 - 5^{\left(- \frac{\beta}{180} \right)} \right]$$

Service factor c_2

The service factor takes into account the daily service period and the type of drive units and driven machine. The service factor corrects the power to transmit. Also, consider increasing the service factor for drives with a high starting torque or a high starting frequency, high dynamic loading, or acceleration.

Belt length correction factor c_3

Belt length correction factor takes into account modification of belt power rating for belt which length differs from base belt length. The value is defined by belt manufacturer and it is stated within belt data file. For belt base length the value of length correction factor is 1.0 what does not affect the results.

Number of belts correction factor c_4

The number of belts correction factor takes into account difference of load distribution among multiple belts for transmission where more than one V-belt is used. Difference in load per belt is caused by belt's length difference as well as shaft deformation. The factor corrects the power rating of the V-belt by built-in table of approximate values as follows. The values that are not cited within the table are computed using linear interpolation.

z 13 6 999

$c_4$10.950.90.85

Number of pulleys correction factor c_5

This factor corrects the belt power rating. It takes into account the imposition of additional bending stresses caused by additional pulleys or idlers. Use of an idler (or several idlers) has its effect on belt performance so the belt power rating should be reduced.

In general, idlers are used to provide take-up for drives with fixed center distance, turn corners, break up long spans where belt vibration may be a problem, maintain tension, act as a clutching device and so on. We recommend that you avoid idlers, if possible. If needed at all in the drive, design idler dimensions and locations for a minimum reduction of belt life. Inside idlers should be at least as large as the smallest power transmitting pulley.

Outside idlers should be at least 50% larger than the smallest power transmitting pulley.

The number of pulleys correction factor is by default determined by following built-in table of approximate values. The values that are not cited within the table are computed using linear interpolation.

k 23 4 5 6 7 8 100

$c_5$10.910.860.810.780.760.750.7

Tension factor k_1

The tension factor allows control of initial installation tension of the belt. There are recommended practices provided by belt manufacturers. If a belt is not tensioned according to these recommendations, the belt horse power rating might not be determined properly. The installation tension has a significant impact on the efficiency and belt slip and service live. There is commonly used magnitude of belt tensioning factor from 1.0 up to 1.5 however it is a decisive criterion.

Insufficient belt tension results in inadequate power transmission, reduced efficiency, and premature belt damage due to belt slip.

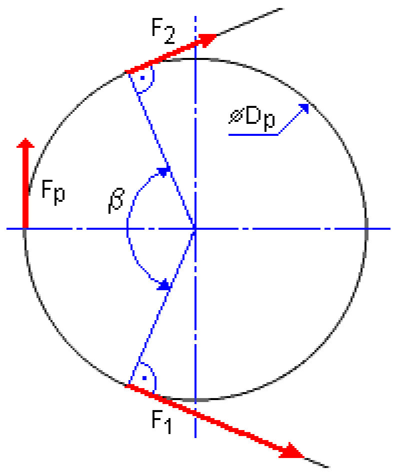
Excessive belt tension leads to high specific surface pressure, a risk of cross flexing, increased flexing stress and increased strain on the tension members with consequent premature fractures and elongation.

The correct belt tension is just enough tension to keep the belt from slipping under normal load conditions.

Efficiency torque factor η_t

The efficiency torque factor describes level of quality of belt transmission. The loss of energy that leads to decreased output torque is considered. Factors like deformation energy of the belt, wind turbulences in grooves, and so on take place. The power loss caused by belt slip is not included here and it is determined by generator separately. Combination of these two factors results in final belt drive efficiency.

Belt slip and total belt drive efficiency η



Belt drive factor is determined at most suspicious pulley as

$$\varphi = \frac{F_p}{F_1 + F_2}$$

Belt slip is defined by built-in slip table.

Driven pulley speed

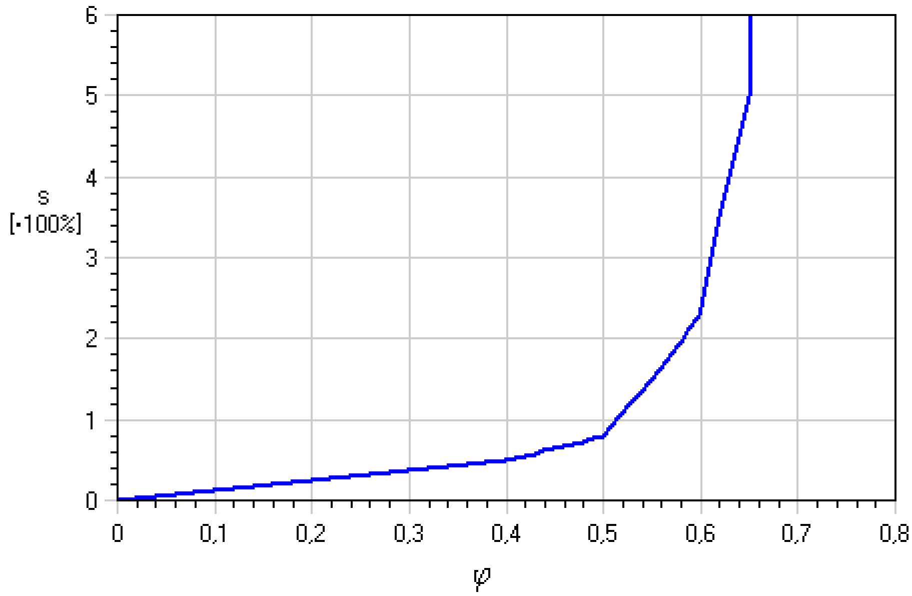
$$n_i = \frac{n_1}{i_i} \cdot (1 - s)$$

Driven pulley output power

$P_i = P_{xi} F_p v \eta_t (1 - s)$

$$\eta = \frac{P_i}{P} = \eta_t \cdot (1 - s)$$

Built-in slip table



It is assumed that:

- The belt slip occurs on the driver pulley so the speed of all driven pulleys and idlers is influenced by the same slip.
- The belt speed change due to slip is neglected. Usual belt slip magnitude is 1% ~ 2% what results in s = 0,01 ~ 0,02

Transmission ratio

Transmission ratio for V-belt generator is determined for each driven pulley and idler. There are three types of ratios that have specific meaning.

i_D	[-]	Desired transmission ratio (speed ratio) of given pulley. This ratio serves as a design guide for pulley size. User set this ratio to let v-belts generator find closest pulley diameter that accomplish desired transmission ratio.
i_T	[-]	Ideal transmission ratio (speed ratio) of given pulley. This ratio is calculated directly from pulley diameters as precise value. No belt slip is considered.
i	[-]	Transmission ratio (speed ratio) of given pulley. This ratio is calculated with consideration of belt slip. Use this value as closest transmission ratio for your pulley under full load. Power and shaft speed of given pulley is determined using this ratio..

Modify friction with belt speed f_{mod}

The modify friction with belt speed factor describes how much the friction factor changes with the belt speed. If the modify friction factor is zero it does not influence the friction factor.

Resultant service factor c_{PR}

The resultant service factor is determined from equation below. The belt power rating for given transmission layout is compared with power to transmit. The resultant service factor gives fast answer of how much the belt drive is over designed.

$$c_{PR} = \frac{z \cdot P_R}{P}$$

$c_{PR} < c_2$ Strength check fails
$c_{PR} \geq c_2$ Strength check succeeds
$c_{PR} > c_2$ Consider to change transmission layout, use different belt or decrease belt width

Meaning of used variables:

Arc of contact [deg]
β
F_p Effective pull (or effective tension) [N]
n_1 Speed of the driver pulley [rpm]
n_i Speed of given driven pulley [rpm]
i Transmission ratio (speed ratio) of given pulley [-]
s Belt slip [-]
P_x Power ratio of given pulley [-]
P_R Belt power rating, power that can be transmitted by one belt [W]
v Belt speed [m/s]
η_t Efficiency torque factor [-]
P power to transmit [W]
z Number of belts [-]

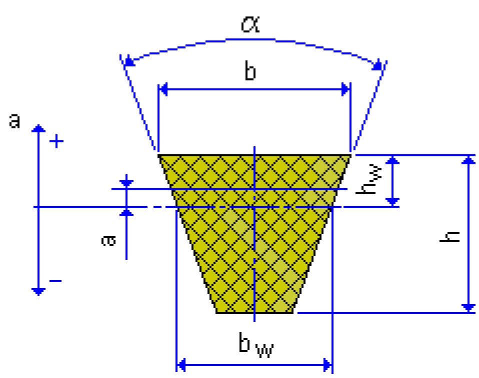
Datum belt length [m]

Geometry design properties

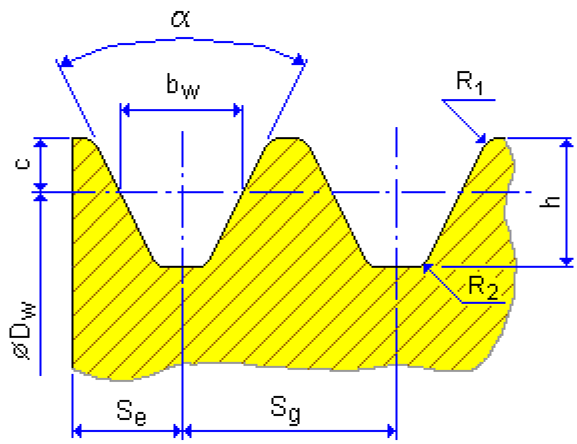
To successfully determine the datum, effective or pitch diameter for each pulley by the V-Belts Generator, the nominal dimensions D_w, b_w, a, h_w are used. The nominal belt width b_w always corresponds with nominal pulley diameter D_w. The pitch diameter D_p is determined using the pitch line offset 'a'. The outside (effective) diameter is determined using nominal height h_w. For belts that are measured on effective (outside) pulley diameters, the pitch line offset is of a negative value ($a < 0$) and the nominal height value is zero ($h_w = 0$). See Belt length calculation to get more information about how the pulley diameters are determined.

NoteThe belt length measuring system (datum or effective) as well as nominal dimensions b_w, a, h_w are given by specific belt type and they are defined in an XML data file in Design Data\Design Accelerator\Tables\Vbelts folder. It is not required from user to modify these properties unless there is a need to add additional belts based on specific manufacturer data.

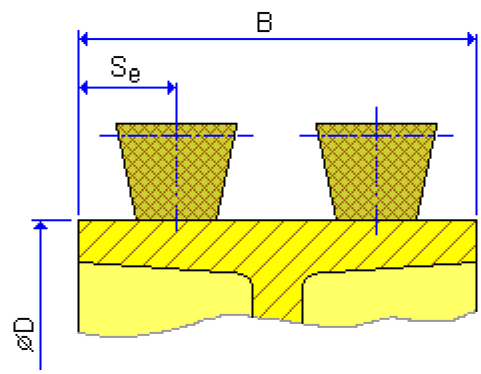
V-Belt



Grooved Pulley

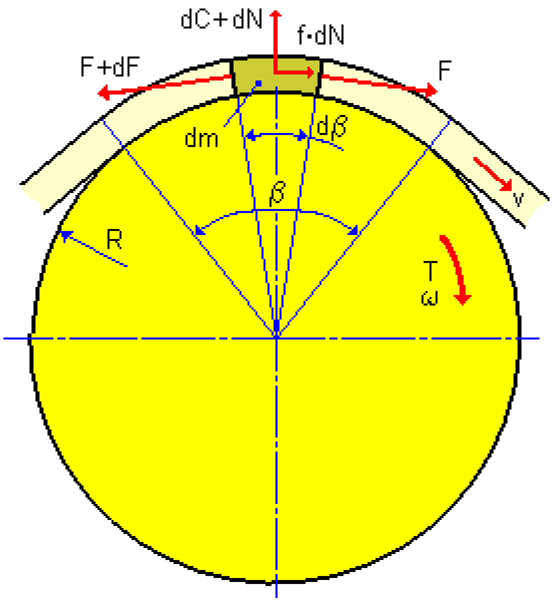


Flat Pulley



Calculation of strength proportions

General equations used



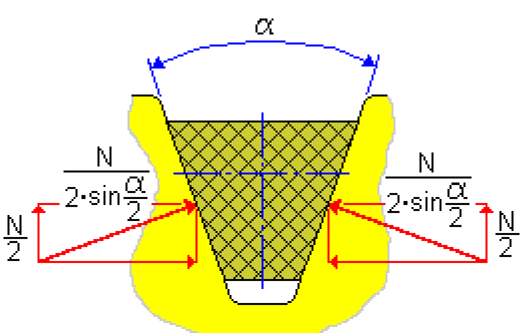
$$-(F+dF)\cdot\cos\frac{d\beta}{2}+f\cdot dN+F\cdot\cos\frac{d\beta}{2}=0$$

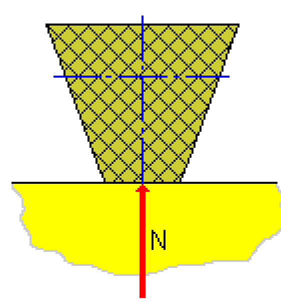
$$dC+dN-(2\cdot F+dF)\cdot\sin\frac{d\beta}{2}=0$$

$$dC=dm\cdot\frac{v^2}{R}=\frac{\rho\cdot S\cdot R\cdot d\beta\cdot v^2}{R}=m\cdot v^2\cdot d\beta$$

Where m is a specific mass of belt defined as m = S ρ

Modified friction factor of given pulley





$$f = f_g + v\, f_{mod}$$

$$f = \frac{f_g + v \cdot f_{mod}}{\sin \frac{\alpha}{2}}$$

Driver pulley and belt fundamental equations

power to transmit

$$P = \frac{T \cdot \pi \cdot n}{30}$$

Belt speed

$$v = \frac{D_p \cdot \pi \cdot n}{60}$$

Belt flexing frequency

$$f_b = \frac{v \cdot k}{L_w}$$

Effective pull (or effective tension)

$$F_p = \frac{P}{v}$$

Centrifugal force

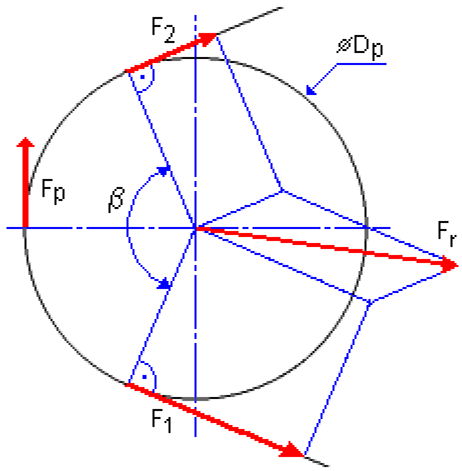
$F_c = z\ m\ v^2$

Tension in belt spans

In the following equations, the application first determines the most suspicious pulley what requires the maximum belt installation tension to transmit a load. Then the belt tension in each span is adjusted for all pulleys accordingly with respect to initial belt installation tension.

$$\frac{F_{1i} - F_c}{F_{2i} - F_c} = e^{f_i \cdot \beta_i}$$

$$F_{1i} - F_p P_{xi} - F_{2i} = 0$$



$$F_{1i} = F_{pi}\frac{e^{f_i \cdot \beta_i}}{e^{f_i \cdot \beta_i} - 1} + F_c$$

$$F_{2i} = F_{pi}\frac{1}{e^{f_i \cdot \beta_i} - 1} + F_c$$

The most suspicious pulley criteria is maximum tight side tension

$F_{1max} = max (F_{1i})$

The total maximum tension in belt span (per belt) when the belt drive is under full load is determined as

$$F_{tmax} = \frac{k_1 \cdot F_{1max}}{z}$$

Where expression "$k_1 F_{1max}$" is the actual maximum tension in belt span considered for all belts in the belt drive. In this manner, all corresponding tensions in individual spans are re-computed to fulfill following condition:

$F_{1i} - F_P P_{xi} - F_{2i} = 0$

Resultant axle load for each pulley when the belt drive is under full load

$$\vec{F}_{ri} = \vec{F}_{1i} - \vec{F}_{2i}$$

$$F_{ri} = \sqrt{F_{1i}^2 + F_{2i}^2 - 2 \cdot F_{1i} \cdot F_{2i} \cdot \cos \beta_i}$$

NoteFor driven pulleys and idlers the F_1 and F_2 are reversed within the generator so the F_1 is belt span tension on input and F_2 is belt span tension on output in sense of belt motion.

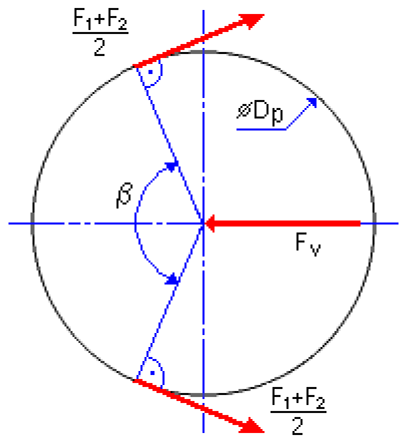
Belt initial installation tension and static tensioning force

The required belt initial installation tension (per belt) can be adjusted by tensioning factor and then determined as follows:

$$F_t = \frac{F_1 + F_2}{2 \cdot z}$$

Static tensioning force F_v is determined for each pulley. The application computes the tensioning force that performs along the centerline of belt spans as follows:

$$F_V = 2 \cdot z \cdot F_t \cdot \sin\frac{\beta}{2} = (F_1 + F_2) \cdot \sin\frac{\beta}{2}$$



Meaning of used variables:

F Tangential force [N]

β Arc of contact [deg]

α Wedge angle [deg]

C Centrifugal force [N]

N Normal force [N]

m Specific belt mass [kg/m]

v Belt speed [m/s]

R Pulley radius [m]

S Belt cross section area [m^2]

T Torque acting on given pulley [Nm]

D_p Pulley pitch diameter [m]

k Number of pulleys [-]

P power to transmit [N]

v Belt speed [m/s]

F_c Centrifugal force [N]

F^1 Tension in belt span on input for given pulley [-]

F_2 Tension in belt span on output for given pulley [-]

f Modified friction factor of given pulley [-]

P_x Power ratio of given pulley [-]

f_g Friction factor of the given pulley material and belt [-]

f_{mod} Speed factor of friction modification [s/m]

Z Number of belts [-]

ρ Belt density [kg/m3]

F_t Belt initial installation tension [N

F_v Static tensioning force for given pulley [N]

k_1 Belt tension factor [-]

Strength check

To determine the number of belts required or do a strength check of the belt drive, the application compares the belt power rating with the power to transmit. To get the belt power rating, the base belt power rating is used and corrected by specific factors determined from the given belt drive layout.

Base belt power rating P_{BR}

The base belt power rating is determined by formulas defined within an XML data table and stored within Design Data folders. Each belt provided within a V-belt generator is described by a specific XML file that contains all belt available sizes as well as required mechanical properties. The base power formulas and factors used within the formulas are taken from standard recommendations that may differ from real manufacturer data. You can customize the base belt power rating and provide real data from belt manufacturer catalogs. Usually the standard recommended power rating is more conservative and provides potential level of belt manufacturer interchangeability, however the belt drive might be over-designed.

In general, the base belt power rating is a function of speed, pitch diameter, and speed ratio of the smallest pulley (driver or driven pulley).

$P_{RB} = F(n_j, D_{Pj}, i_j)$

Note j index represents index of smallest driver or driven pulley within the belt drive.

Belt power rating P_R

$P_R = P_{RB}\, c_1\, c_3\, c_4\, c_5$

Resultant service factor

$$c_{PR} = \frac{z \cdot P_R}{P}$$

Strength check fails if resultant service factor $C_{PR} < C_p$

Number of belts required

$$z_{er} = \frac{c_2 \cdot P}{P_R}$$

Over-tensioning inspection

Maximum allowable tension in belt is determined as

$$F_{max} = \frac{P_R}{v}$$

Strength check fails if $F_{max} < F_{t\,max}$ or $F_{max} < F_t$

Valid belt speed and flexing frequency inspection

If belt flex frequency $f_b > f_{max}$ the reduced efficiency and premature belt damage might appear. The error warning is displayed.

If belt speed $v > v_{max}$ the error warning is displayed as the belt is not designed for such speed.

Meaning of used variables:

f_{max} Maximum belt flex frequency [Hz]
f_b Belt flex frequency for given belt drive [Hz]
n Speed of given pulley [rmp]
D_P Flat pulley nominal and outside diameter [m]
i Transmission ratio (speed ratio) of given pulley [-]
c_1 Arc of contact correction factor [-]
c_2 Service factor [-]
c_3 Belt length correction factor [-]
c_4 Number of belts correction factor [-]
c_5 Number of pulleys correction factor [-]
z Number of belts [-]
P_R Belt power rating for given transmission layout [W]
P power to transmit [W]
v Belt speed [m/s]
v_{max} Maximum allowable belt speed [m/s]
V-belts of standard cross-sections. Calculation of transmissions and transmitted powers.

alculation basics

First pulley is considered to be a driver pulley. The rest of the pulleys are driven pulleys or idlers. Input power can be split among several driven pulleys by using power ratio factor of each pulley. The forces and torques are calculated accordingly. Flat pulleys are considered as idlers.

Service factor c_P

Total service factor takes into account the safety factors required to compensate for belt life-reducing factors encountered during service, such as load, acceleration and fatigue. Load factor depends on the type of the driver and driven machine. The acceleration add-on factor c_{pa} can be considered if speed up ratio is> 1.24, please see table below. Fatigue add-on factor takes into account operational hours per day and unusual service conditions.

Speed up ratio 1/i	c_{PA}
1.00 - 1.24	0.0
1.25 - 1.74	0.1
1.75 - 2.49	0.2
2.50 - 3.49	0.3
3.5 and more	0.4

Teeth in mesh factor k_z

Teeth in mesh factor take into account the number of teeth in contact zc of the synchronous pulley. If the teeth in contact of the given synchronous pulley is less than 6 it can have significant impact on belt power capacity. Application finds a minimum value of teeth in contact among all synchronous pulleys within belt drive and then use following rule to obtain k_z factor.

$z_c \leq 6 k_z = 1$

$z_c < 6$

$$k_z = 1 - \frac{1}{5}(6 - z_c)$$

Number of teeth in contact is determined based on arc of contact angle of each individual pulley as follows

$$z_c = abs\left(z \cdot \frac{\beta}{360}\right)$$

Tension factor k_1

Tension factor gives an option to adjust belt initial tension. When belt drive operates under load tight and slack side develops. The initial tension prevents the slack side from sagging and ensures proper tooth meshing. In most cases, synchronous belts perform best when magnitude of the slack side tension is 10% to 30% of the magnitude of effective pull {$k_1 = 1.1 \sim 1.3$}.

Efficiency η

When properly designed and applied, belt drive efficiency is usually high as 96%-98% {η 0.96 ~ 0.98}. This high efficiency is primarily due to the positive, no slip characteristic of synchronous belts. Since the belt has a thin profile, it flexes easily, thus resulting in low hysteresis losses as evidenced by low heat buildup in the belt.

Belt length correction factor c_L

Belt length correction factor takes into account modification of belt power rating of extreme belt length. By default the value is 1.0 what does not affect the results.

Resultant service factor c_{PR}

The resultant service factor is determined from equation below. The belt power rating for given transmission layout is compared with power to transmit. The resultant service factor gives fast answer of how much the belt drive is over designed.

$$c_{PR} = \frac{P_R}{P}$$

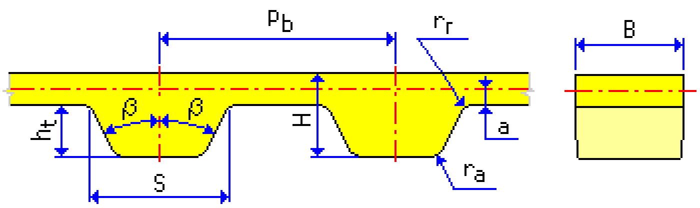
$c_{PR} < c_P$ Strength check fails
$c_{PR} \geq c_P$ Strength check succeeds
$c_{PR} > c_P$ Consider to change transmission layout, use different belt or decrease belt width

Meaning of used variables:

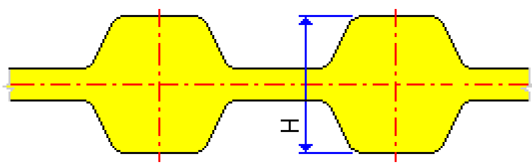
z_c Number of teeth in contact of given pulley [-]
z Number of teeth of given pulley/ Number of belt teeth [-]
β Arc of contact [deg]
P power to transmit [W]
P_R Belt power rating for given transmission layout [W]
c_p Service factor [-]

eometry design properties

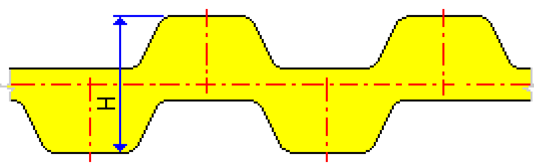
Belt with trapezoidal teeth



Symmetrical double-sided teeth



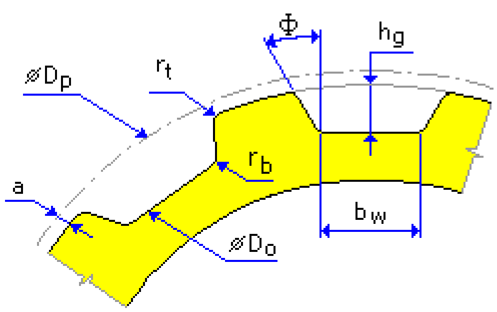
Staggered double-sided teeth



Pitch belt length can be determined as

$L = z\, p_b$

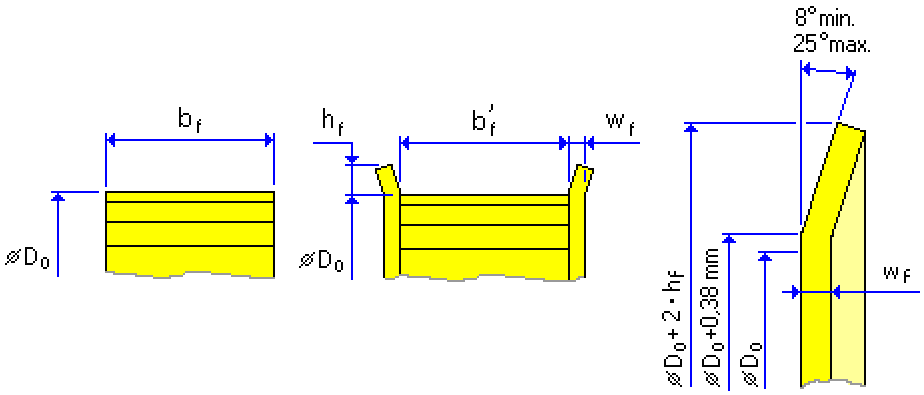
Straight-sided Teeth Pulley



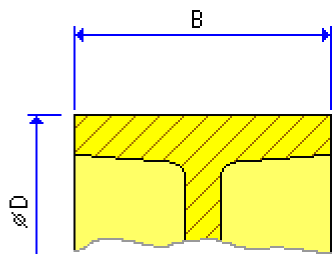
Outside pulley diameter can be determined as

$$D_0 = \frac{z \cdot p_b}{\pi} - 2 \cdot a$$

Unflanged pulley Flanged pulley Flange detail



Flat pulley



Meaning of used variables:

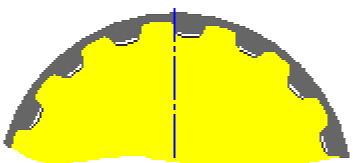
z Number of teeth of given pulley/ Number of belt teeth [-]
p_b Circular pitch [m]
a Pitch line offset [m]

Belt length calculation

Belt pitch length is given by number of belt teeth and circular pitch. The belt trajectory is based on individual pulley position. The pitch diameter of each pulley is determined based on the following equations. The sliding pulley position is adjusted to accomplish standard belt length criteria. The calculation uses an iteration solution to find the appropriate sliding pulley position that is closest to the desired sliding pulley position.

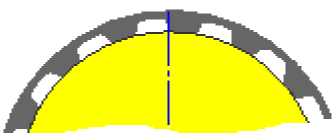
Determine exact pitch diameter

Synchronous pulley clockwise or double-sided belt



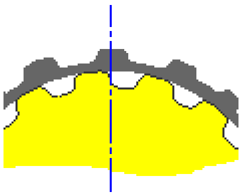
$$D_p = \frac{z \cdot p_b}{\pi}$$

Flat pulley clockwise or double-sided belt



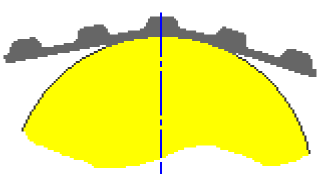
$D_p = D + 2(a + h_t)$

Synchronous pulley counterclockwise and single-sided belt



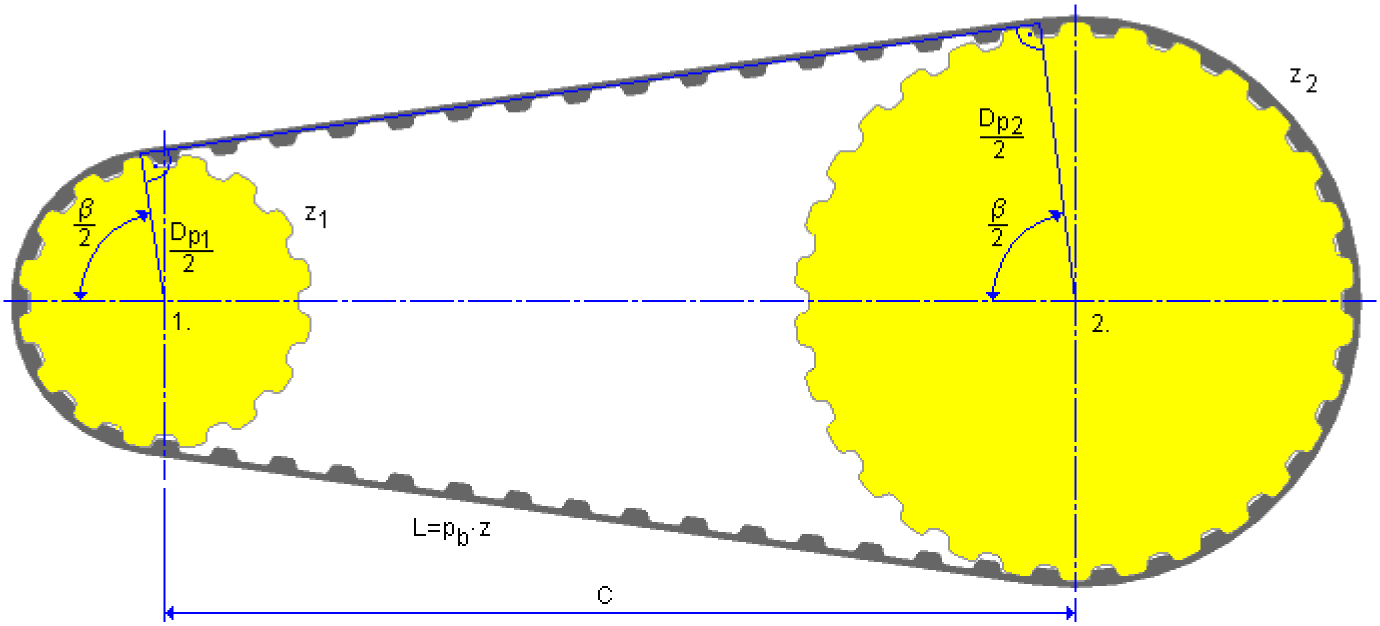
$D_p = D_0 + 2(H - a - h_t)$

Flat pulley counterclockwise and single-sided belt



$D_p = D + 2(H - a - h_t)$

Example of power transmission with 2 pulleys



Arc of contact

$$\beta = 2 \cdot \arccos\left[\frac{p_b \cdot (z_2 - z_1)}{2 \cdot \pi \cdot C}\right]$$

Pitch belt length

$$L = 2 \cdot C \cdot \sin\frac{\beta}{2} + \frac{p_b}{2}\left[z_1 + z_2 + \left(1 - \frac{\beta}{180}\right) \cdot (z_2 - z_1)\right]$$

Center distance

$$C \approx \frac{1}{4} \cdot \left[L - \frac{p_b}{2} \cdot (z_2 + z_1) + \sqrt{\left[L - \frac{p_b}{2} \cdot (z_2 + z_1)\right]^2 - 2 \cdot \left[\frac{p_b}{\pi} \cdot (z_2 - z_1)\right]^2}\right]$$

Following formula is recommended when determining the center distance of a new drive

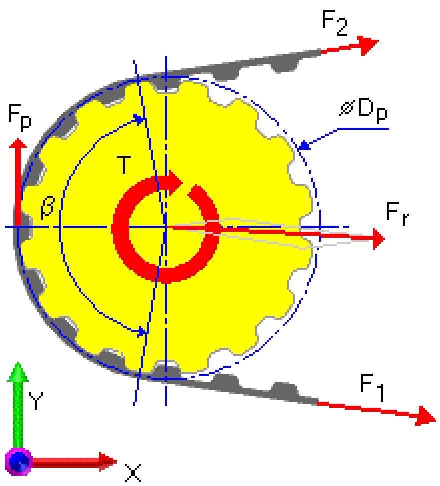
$0.2\ p_b (z_1 + z_2) \leq C \leq 0.7\ p_b (z_1 = z_2)$

Meaning of used variables:

z   Number of teeth of given pulley/ Number of belt teeth [-]
p_b Circular pitch [m]
D   Nominal flat pulley diameter [m]
a   Pitch line offset [m]

h_t Belt tooth height [m]
D_0 Outside synchronous pulley diameter [m]
H Belt height [m]
C Center distance of given pulley and driver pulley [m]
β Arc of contact [deg]

Calculation of strength proportions



For each pulley

$F_2 - F_1 + F_p = 0$

$$\vec{F}_r = \vec{F}_1 - \vec{F}_2$$

$$F_r = \sqrt{F_1^2 + F_2^2 - 2 \cdot F_1 \cdot F_2 \cdot \cos\beta}$$

$$F_v = (F_1 + F_2) \cdot \sin\frac{\beta}{2}$$

For the driver pulley

$$P = \frac{T \cdot \pi \cdot n}{30}$$

$$v = \frac{D_p \cdot \pi \cdot n}{60}$$ $v \leq v_{max}$

$$f_b = \frac{v \cdot k}{L}$$ $f_b \leq f_{max}$

$$F_p = \frac{P}{v}$$

$F_c = mv^2$

$F_{Tmax} = k_1 F_p + F_c$

$F_1 = F_{tmax}$

$F_2 = F_1 - F_p$

For individual driven pulleys and idlers

i-index of the pulley

$F_{Pi} = P_{xi} F_p$

$$T_i = \frac{D_{pi}}{2} \cdot F_{Pi} \cdot \eta$$

$$n_i = \frac{n}{i_i}$$

$$P_i = \frac{T_i \cdot \pi \cdot n_i}{30}$$

$F_{1i} = F_{2i-1}$

$F_{2i} = F_{1i} + F_p i$

where:

$i_i = \frac{z_i}{z_1}$ for synchronous pulley

$i_i = \frac{D_{Pi}}{D_{P1}}$ for flat pulley

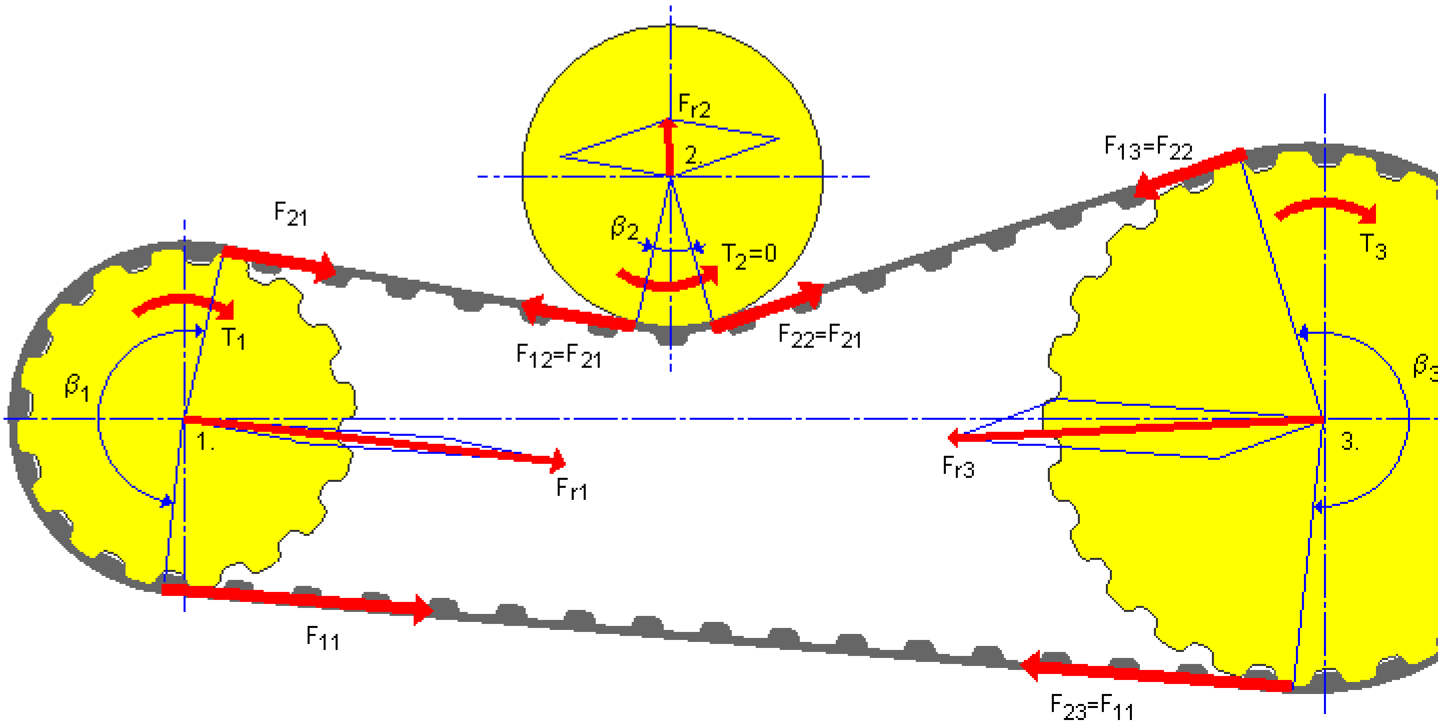
For entire belt drive

$$P_{x1} = \sum_{2}^{k} P_{xi} = 1$$

Required belt installation tension is determined from forces at driver pulley as follows

$$F_t = \frac{F_1 + F_2}{2}$$

Example of power transmission with idler



Driver pulley

$P_{x1} = 1$

$$P = \frac{T_1 \cdot \pi \cdot n_1}{30}$$

$$D_{p1} = \frac{z_1 \cdot p_b}{\pi}$$

$$v = \frac{D_{p1} \cdot \pi \cdot n_1}{60}$$

$$f_b = \frac{v \cdot 2}{L}$$

$$F_p = \frac{P}{v} = F_{p1}$$

Flat idler

$P_{x2} = 0$

$$F_{p2} = 0 \cdot F_p \Rightarrow T_2 = P_2 = 0$$

$$i_{12} = \frac{D + 2 \cdot (H - a - h_t)}{D_{p1}}$$

$$n_2 = \frac{n_1}{i_{12}}$$

$F_{12} = F_{21}$

$F_{22} = F_{12} + F_{p2} = F_{12}$

Driven pulley

$P_{x3} = 1$

$F_{P3} = P_{x3} F_p$

$$D_{p3} = \frac{z_3 \cdot p_b}{\pi}$$

$$T_3 = \frac{D_{p3}}{2} \cdot F_{p3} \cdot \eta$$

$$i_{13} = \frac{z_3}{z_1}$$

$$n_3 = \frac{n}{i_{13}}$$

$F_c = m\, v^2$

$$F_{r2} = \sqrt{F_{12}^{\ 2} + F_{22}^{\ 2} - 2 \cdot F_{12} \cdot F_{22} \cdot} \quad P_3 = \frac{T_3 \cdot \pi \cdot n_3}{30}$$

$F_{Tmax} = k_1 F_p + F_C$ -

$F_{11} = F_{Tmax}$ -

$F_{21} = F_{11} - F_p$ -

$F_{13} = F_{22}$

$F_{23} = F_{13} + F_{p3} = F_{11}$

$$F_{r3} = \sqrt{F_{13}^{\ 2} + F_{23}^{\ 2} - 2 \cdot F_{13} \cdot F_{23} \cdot}$$

-

-

$$F_{r1} = \sqrt{F_{11}^{\ 2} + F_{21}^{\ 2} - 2 \cdot F_{11} \cdot F_{21} \cdot}$$

Meaning of used variables:

F_p Effective pull [N]
F_1 Belt tension on input side of the given pulley [N]
F_2 Belt tension on output side of the given pulley [N]
z Number of teeth of given pulley/ Number of belt teeth [-]
β Arc of contact / tooth angle of side inclination [deg]
P power to transmit [W]
P_R Belt power rating for given transmission layout [W]
c_L Service factor [-]
β Arc of contact [deg]
T Torque acting on given pulley [Nm]
n Speed of given pulley [rpm]
D_p Pitch pulley diameter [m]
v Belt speed [m/s]
k Number of pulleys within belt transmission [-]
L Belt pitch length [m]
P power to transmit [W]
m Specific belt weight for given width [Kg/m]
k_1 Belt tension factor [-]
F_p Effective pull [N]
F_c Centrifugal force [N]
F_t Minimum belt installation tension [N]
P_{xi} Power ratio of given pulley [-]
D_{pi} Pitch pulley diameter [m]
i Transmission ratio (speed ratio) of given pulley [-]
T_i Torque acting on given pulley [Nm]
η Efficiency [-]
p_b Circular pitch [m]

D Nominal flat pulley diameter [m]
H Belt height [m]
h_T Belt tooth height [m]
a Pitch line offset [m]

Standards

ISO 5294:1989	Synchronous belt drives - Pulleys
ISO 5295:1987	Synchronous belts - calculation of power rating
ISO 5296:1989	Synchronous belt drives - Belts
DIN 7721	Synchronous belt drives, metric pitch
ANSI/RMA IP-24	Synchronous Belts
JIS B 1856	Synchronous Belts Drives - Pulleys
JIS K 6372	Synchronous Belts for General Power Transmissions

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