ELATECH® Drive Calculation
Drive calculation guidelines

Pulleys
It is recommended to use pulleys with the maximum diameter allowed by the application in order to maximise the number of teeth in mesh and increase the belt peripheral speed. For applications where high positioning precision is required, it might be useful to use zero backlash pulleys.
In order to guarantee a reliable drive, it is recommended to use superior quality pulleys.

Minimum pulley diameter
Minimum pulley diameter depends on belt construction but also on the load and the configuration of the drive. The values reported in the catalogue have been calculated and proven for drives with maximum allowable load and standard configurations.
For drives where smaller pulleys are needed, please apply to ELATECH® technical department.

Clamping plates
In case of use of clamping plates, they must have the belt profile, be rigid and guarantee a uniform clamping force on all the surface. It is recommended to have a minimum of 7 teeth in clamp to guarantee catalogue performances. In case of belts with HPL cords, the recommended number of teeth in clamp is 12.

Machine structure
For a trouble free drive, it is recommended that the structure of application of the timing belt drive is as rigid as possible. That will guarantee high work repeatability.

Angular drives
Elatech belts can be used in angular drives as a “Twisted” drive. In such an application, it is recommended to keep a span length “lt” > 20 • b (belt width) for 90° twist.

Omega drive
In case of omega drive application it is recommended to keep a span length between driver pulleys and idlers > 3 • b (belt width)

Belt life
Due to the wide application range and considering the fact that belts are one component of complex equipment, the loads in the belt itself are very seldom precisely predictable. This fact makes it impossible to confirm a precise belt service life. In order to optimize belt life of the belts, it is important to follow the catalogue technical specifications related to pulley geometry and belt storage and installation. When all catalogues specifications are followed, a belt life of 3 million reverse bending cycles occurring over 10 years can be expected. This value was measured in tests under laboratory conditions.
Belt installation

Drive installation
When installing belts on pulleys, before tensioning the drive, check that the belt teeth and pulley grooves correctly match.

Breaking load
Belt breaking load is highly dependent on several factors including pulley alignment, clamping system and others. The data given in the catalogue are average values tested in our laboratory. It is recommended to use adequate safety factors and ask the ELATECH® technical department for minimum guaranteed breaking load in applications where it is needed.

Belt drive tension
Correct belt drive tension and alignment are very important to optimize belt life and minimize noise level. In fact, improper tension in the belt drive will affect belt fit in the pulley grooves while correct tension minimizes belt pulley interference reducing the noise in the drive.

Drive Alignment
Pulley misalignment will result in an unequal tension, edge wear and reduction of belt life. Also, misaligned drives are much noisier than correctly aligned drives due to the amount of interference that is created between the belt teeth and the pulley grooves. Proper pulley alignment should be checked with a straight edge or by using a laser alignment tool.

<table>
<thead>
<tr>
<th>Belt width [mm]</th>
<th>10</th>
<th>16</th>
<th>32 over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowable pulley misalignment [°]</td>
<td>0,28</td>
<td>0,16</td>
<td>0,1</td>
</tr>
</tbody>
</table>

Idlers
Idlers are often a means to apply tension to the drive when the centre distance is fixed but also to increase the number of teeth in mesh of the small pulley. A toothed idler on the inside of the belt on the slack side is recommended with respect to a back side idler. Drives with inside flat idlers are not recommended as noise and abnormal belt wear may occur.

- Idler location is on the slack side span of the belt drive
- Diameter for inside toothed idler must be ≥ of the diameter of the small pulley in the drive
- Idler must be mounted on a rigid support
- Idlers both flat and toothed, should be uncrowned with a minimum arc of contact
- Idler should be positioned respecting: 2 • (dwk + dwg)< A
- Idler width should be ≥ of pulley width B

Backside idlers, however, increase the teeth in mesh on both pulleys in the drive and force a counter flexure of the belt and thus contribution to premature belt failure. When such an idler is necessary, it should be at least 1,25 times the diameter of the small pulley in the drive and it must be located as close as possible to the small pulley in the drive in order to maximise the number of teeth in mesh of the small pulley.

Belt handling and storage

Proper storage is important in order avoid damaging the belts which may cause premature belt failure. Do not store belts on the floor unless in a protective container to avoid damages which may be accidentally caused by people or machine traffic. Belts should be stored in order to prevent direct sunlight and in a dry and cool environment without presence of chemicals in the atmosphere. Avoid belt storage near windows (to avoid sunlight and moisture), near electric motors or devices which generate ozone, near direct airflow of heating/cooling systems.

Do not crimp belts while handling or when stored to avoid damage to tensile cords. Belts must not be hung on small pins to avoid bending to a small diameter. Handle belts with care while moving and installing. On installation, never force the belt over the pulley flange.
ELADRIVE
online calculation software for quick and reliable drive calculation

Elatech online drive calculation support at:
www.elatech.com

ELATECH’s ELADRIVE is a drive calculation program allowing efficient and
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ELADRIVE online version is always up to date.

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ELADRIVE offers a step by step drive calculation by an easy to follow menu
with improved screen layouts for quicker navigation.

SAVE YOUR TIME!

Comprehensive application range
ELADRIVE offers a drive calculation for all application technology fields: power
transmission, linear, transport. Two pulley drives are calculated and multiple
drive design solutions are generated.

IMPROVE EFFICIENCY!
LINEAR drives calculation

Definitions and transmission cycle

In most cases linear drives may be taken back to one of the two layouts shown, where a specific system of forces acts.

Transmission cycle (rpm/time)
### Definitions and abbreviations

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_a$</td>
<td>[m/s²]</td>
<td>Acceleration</td>
</tr>
<tr>
<td>$a_s$</td>
<td>[m/s²]</td>
<td>Deceleration</td>
</tr>
<tr>
<td>$B$</td>
<td>[mm]</td>
<td>Pulley width</td>
</tr>
<tr>
<td>$b$</td>
<td>[cm]</td>
<td>Belt width</td>
</tr>
<tr>
<td>$t$</td>
<td>[mm]</td>
<td>Belt pitch</td>
</tr>
<tr>
<td>$C$</td>
<td>[N/mm]</td>
<td>Belt modulus / spring rate</td>
</tr>
<tr>
<td>$C_{spez}$</td>
<td>[N/mm]</td>
<td>Belt modulus / spring rate</td>
</tr>
<tr>
<td>$A$</td>
<td>[mm]</td>
<td>Centre distance</td>
</tr>
<tr>
<td>$A_{eff}$</td>
<td>[mm]</td>
<td>Effective centre distance</td>
</tr>
<tr>
<td>$d$</td>
<td>[mm]</td>
<td>Bore diameter</td>
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<tr>
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<td>[mm]</td>
<td>Outside pulley diameter</td>
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<td>[mm]</td>
<td>Pitch circle diameter</td>
</tr>
<tr>
<td>$d_U$</td>
<td>[mm]</td>
<td>Idler pulley diameter</td>
</tr>
<tr>
<td>$F_{dyn}$</td>
<td>[N]</td>
<td>Dynamic shaft load</td>
</tr>
<tr>
<td>$F_{sta}$</td>
<td>[N]</td>
<td>Static shaft load</td>
</tr>
<tr>
<td>$F_{max}$</td>
<td>[N]</td>
<td>Maximum span force</td>
</tr>
<tr>
<td>$F_R$</td>
<td>[N]</td>
<td>Resisting force of friction</td>
</tr>
<tr>
<td>$F_{Upez}$</td>
<td>[N/cm]</td>
<td>Specific tooth shear strength</td>
</tr>
<tr>
<td>$F_{Tzul}$</td>
<td>[N/cm]</td>
<td>Specific spring rate</td>
</tr>
<tr>
<td>$F_{Tmax}$</td>
<td>[N]</td>
<td>Maximum span force</td>
</tr>
<tr>
<td>$F_{Tzul}$</td>
<td>[N]</td>
<td>Allowable tensile load</td>
</tr>
<tr>
<td>$F_U$</td>
<td>[N]</td>
<td>Peripheral force</td>
</tr>
<tr>
<td>$F_V$</td>
<td>[N]</td>
<td>Vertical lifting force</td>
</tr>
<tr>
<td>$F_{ab}$</td>
<td>[N]</td>
<td>Acceleration force</td>
</tr>
<tr>
<td>$F_{av}$</td>
<td>[N]</td>
<td>Deceleration force</td>
</tr>
<tr>
<td>$g$</td>
<td>[m/s²]</td>
<td>Acceleration due to gravity (= 9.81 m/s²)</td>
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<tr>
<td>$\Delta l$</td>
<td>[mm]</td>
<td>Elongation</td>
</tr>
<tr>
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<td>[mm]</td>
<td>Difference of position due to force</td>
</tr>
<tr>
<td>$L_1-L_2$</td>
<td>[mm]</td>
<td>Length of light and slack side</td>
</tr>
<tr>
<td>$L_R$</td>
<td>[mm]</td>
<td>Belt length</td>
</tr>
<tr>
<td>$M$</td>
<td>[Nm]</td>
<td>Torque</td>
</tr>
<tr>
<td>$M_{av}$</td>
<td>[Nm]</td>
<td>Torque during acceleration</td>
</tr>
<tr>
<td>$m$</td>
<td>[kg]</td>
<td>Total mass</td>
</tr>
<tr>
<td>$m_R$</td>
<td>[kg]</td>
<td>Mass of belt</td>
</tr>
<tr>
<td>$m_c$</td>
<td>[kg]</td>
<td>Mass of carriage / slide</td>
</tr>
<tr>
<td>$m_{Sred}$</td>
<td>[kg]</td>
<td>Pulley mass</td>
</tr>
<tr>
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<td>[kg]</td>
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<tr>
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<td>Rpm</td>
</tr>
<tr>
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<td>[min⁻¹]</td>
<td>Rpm driver pulley</td>
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<tr>
<td>$\Delta n$</td>
<td>[min⁻¹]</td>
<td>Rpm variation</td>
</tr>
<tr>
<td>$c_1$</td>
<td>-</td>
<td>Service factor</td>
</tr>
<tr>
<td>$P$</td>
<td>[kW]</td>
<td>Power</td>
</tr>
<tr>
<td>$s_{ges}$</td>
<td>[mm]</td>
<td>Total travel</td>
</tr>
<tr>
<td>$s_{ab}$</td>
<td>[mm]</td>
<td>Travel during acceleration</td>
</tr>
<tr>
<td>$s_{av}$</td>
<td>[mm]</td>
<td>Travel during deceleration / braking</td>
</tr>
<tr>
<td>$s_c$</td>
<td>[mm]</td>
<td>Travel at constant speed</td>
</tr>
<tr>
<td>$t_{ges}$</td>
<td>[sec⁻¹]</td>
<td>Total time of travel</td>
</tr>
<tr>
<td>$t_{ab}$</td>
<td>[sec⁻¹]</td>
<td>Acceleration time</td>
</tr>
<tr>
<td>$t_{av}$</td>
<td>[sec⁻¹]</td>
<td>Deceleration time / braking time</td>
</tr>
<tr>
<td>$t_c$</td>
<td>[sec⁻¹]</td>
<td>Time at constant speed</td>
</tr>
<tr>
<td>$v$</td>
<td>[m/s]</td>
<td>Peripheral speed</td>
</tr>
<tr>
<td>$z$</td>
<td>-</td>
<td>No. of teeth of pulley</td>
</tr>
<tr>
<td>$z_s$</td>
<td>-</td>
<td>No. of teeth of small pulley</td>
</tr>
<tr>
<td>$z_B$</td>
<td>-</td>
<td>No. of teeth of belt</td>
</tr>
<tr>
<td>$z_{Sred}$</td>
<td>-</td>
<td>No. of teeth in mesh</td>
</tr>
<tr>
<td>$\omega$</td>
<td>[s⁻¹]</td>
<td>Angular velocity</td>
</tr>
<tr>
<td>$\mu$</td>
<td>-</td>
<td>Coefficient of friction</td>
</tr>
</tbody>
</table>
Calculation formula

Torque
\[ M = \frac{F_u \cdot d_w}{2000} = \frac{P \cdot 9550}{n} \]

Power
\[ P = \frac{M \cdot n \cdot F_u \cdot v}{9550 \cdot 1000} \]

Peripheral force
\[ F_u = \frac{2000 \cdot M}{d_w} = \frac{P \cdot 1000}{v} \]

Linear speed
\[ v = \frac{d_w \cdot n}{19100} = \frac{n \cdot z \cdot t}{60000} \]

Angular velocity
\[ \omega = \frac{\pi \cdot n}{30} \]

Rpm
\[ n = \frac{19100 \cdot v}{d_w} = \frac{60000 \cdot v}{z \cdot t} \]

Acceleration time
\[ t_{ac} = \frac{v}{a_b} = \frac{\sqrt{2 \cdot s_{ab}}}{a_b \cdot 1000} \]

Acceleration travel
\[ s_{ab} = a_b \cdot t_{ac} \cdot 1000 = \frac{v^2 \cdot 1000}{2 \cdot a_b} \]

Braking time
\[ t_{av} = \frac{v}{a_v} = \frac{\sqrt{2 \cdot s_{av}}}{a_v \cdot 1000} \]

Braking travel
\[ s_{av} = a_v \cdot t_{av} \cdot 1000 = \frac{v^2 \cdot 1000}{2 \cdot a_v} \]

Total time
\[ t_{gos} = t_{ac} + t_c + t_{av} \]

Total travel
\[ s_{gos} = s_{ab} + s_c + s_{av} \]

Time at constant speed
\[ t_c = \frac{s_c}{v \cdot 1000} \]

Travel at constant speed
\[ s_c = v \cdot t_c \cdot 1000 \]

Safety factor
ELATECH® belts do not need any safety factor. However if there are unknown peaks or shock loads or swings in the peripheral force unknown at design time, which therefore can not be included in the calculation parameters, a suitable safety factor should be considered by the designer.

Steady load \( c_1 = 1 \)

Peak or fluctuating loads:
- Light \( c_1 = 1.4 \)
- Medium \( c_1 = 1.7 \)
- Heavy \( c_1 = 2.0 \)
Calculation

Linear drives are correctly dimensioned when the total peripheral force, necessary for the requested work, satisfies the 3 technical parameters of the selected belt:

- tooth shear strength
- allowable tensile load
- flexibility

The necessary data for the calculation are: the mass to be moved, the transmission cycle, the drive layout with the related forces, the resisting force of friction.

Friction force is generally determined by the linear bearing manufacturer.

In case of conveying applications, it is resulting from the weight of the conveyed goods and the coefficient of friction between slider bed and belt surface. In case of accumulating conveyors the friction between the conveyed goods and the backside of the belt must be considered additionally.

Select belts and pulleys

For initial belt profile and pitch selection, use the graphs available in the related catalogue section.

For the choice of the pulleys it is recommended to use pulleys with the largest possible diameter.

That will reduce the belt width and optimise drive performances.

**Calculate total mass in motion (m)**

\[ m = m_a + m_R + m_{\text{sled}} + m_{\text{uked}} \]

With:

\[ m_{\text{sled}} = \frac{m_s}{2} \left( 1 + \frac{d^2}{d_a^2} \right) ; \text{ inertia of the idler timing pulley} \]

\[ m_{\text{uked}} = \frac{m_u}{2} \left( 1 + \frac{d^2}{d_u^2} \right) ; \text{ inertia of the idler tensioning pulley} \]

**Calculate the necessary total peripheral force \( F_U \) and torque \( M \)**

\[ F_U = m \cdot a_a + m \cdot g + m \cdot g \cdot \mu \]

\[ F_U = F_{ab} + F_R + F_R \]

The load \( m \cdot g \cdot \sin(\alpha) \) must be considered only in vertical or inclined drives when a mass is lifted against gravity.

\[ M = \frac{F_U \cdot d_a}{2000} \]

**Determine the belt width**

\[ b = \frac{F_U \cdot C_t}{F_{Uspez} \cdot z_a} \]

with \( F_{Uspez} \) depending on the rpm of the small pulley (see technical data on tooth shear strength for the selected belt type).

Note: \( z_{\text{emax}} = 12 \) for belts ELATECH® M

\( z_{\text{emax}} = 6 \) for belts ELATECH® V

**Determine installation pretension \( F_{TV} \)**

Linear motion drives are correctly tensioned when in the slack side a minimum tension is guaranteed in all working conditions and for every value of \( F_{\text{max}} \) (acceleration, deceleration).

It is recommended a pretension of:

\[ F_{TV} \geq F_U \quad \text{for linear drives with ELATECH® M belts} \]

\[ F_{TV} \geq 0.5 \cdot F_U \quad \text{for conveying applications with ELATECH® V belts} \]

**Verify of allowable tensile load**

The maximum load on the belt will appear when both the pretension \( F_{TV} \) and the working load \( F_U \) will act at the same time:

\[ F_{\text{max}} = F_{TV} + F_U \]

The maximum allowable tensile load of the belt \( F_{\text{zul}} \) (see technical tables of corresponding selected belt) must be greater than the maximum working load:

\[ F_{\text{zul}} > F_{\text{max}} \]

**Verify flexibility**

The diameter of the chosen pulleys, must be greater or equal to the minimum recommended diameter for the specific belt profile chosen (see technical data).
Calculate shaft load

The shaft load under static conditions is:

\[ F_{Wsta} = 2 \cdot F_{TV} \]

The shaft load under dynamic conditions is:

\[ F_{Wdyn} = 2 \cdot F_{TV} + F_U \]

Calculate necessary static elongation

Installation tension generates a belt elongation \( \Delta l \) between the shafts (for linear drives) or the clamping plates (for "Omega" drives).

Linear drive

\[ \Delta l = \frac{F_{TV} \cdot L_R}{2 \cdot C_{spez}} \]

"Omega" drive

\[ \Delta l = \frac{F_{TV} \cdot L_R}{C_{spez}} \]

If the resulting elongation is not acceptable for the application, it is possible to reduce it by increasing the belt width or by increasing belt rigidity (HPL cords).

Determine the positioning accuracy

The stiffness coefficient of linear drives depends on the length of slack and tight side in the drive. Every position of the system has its own stiffness coefficient calculated with the formula:

\[ C = \frac{L_R}{L_1 \cdot L_2} \cdot C_{spez} \]

\[ L_R = L_1 + L_2 \]

For \( C_{spez} \) value see technical data of selected belt type.

Stiffness coefficient will be minimum when slack and tight side will have the same length during the working cycle.

\[ C_{min} = \frac{4 \cdot C_{spez}}{L_R} \]

With \( L_R \) equal to the belt length free to elongate (excluding contact length on timing pulleys).

Being \( F_U \) the resulting force on the slide, the positioning deviation generated by belt elongation is:

\[ \Delta_s = \frac{F_U}{G} \]

The positioning accuracy is also depending on other parameters and therefore for an accurate calculation, please consult our technical department. When positioning is reached from both directions the actual position is affected by an error caused by backlash between belt and pulley. The use of zero backlash pulleys helps reduce the positioning error.

Installation and drive pretensioning:

In order to pretension a drive it is possible to use one of the following methods:

1) Measuring elongation

ELATECH® timing belts with steel cords have a constant elongation to the maximum allowable load \( F_{TZul} \). Therefore the correct pretension can be set by measuring the belt elongation with a gauge and using as a reference the graph load/elongation of the selected belt type. This is a simple method but requires good accessibility of the drive.

2) Using span deflection

The pretension is checked by applying a force in the centre of the span length and measuring the span deflection.

3) Measuring frequency

The tension of the belt is calculated from the natural frequency of vibration of the belt span which is measured by means of a special belt tension meter. This is the most accurate and easiest method.

A suitable belt tension meter is available from ELATECH®
Selection graphs mass / acceleration
LINEAR drives

The selection graphs mass/acceleration, are a useful aid to the designer for the initial selection of the belt type and width in the linear motion applications. The graphs have been designed considering the maximum speed (rpm) generally used in the applications for every belt profile and pitch and have included a safety factor increasing with the acceleration. Therefore, depending on the specific values of the application, it might be necessary to change the belt width upon calculation.
XL

L

H

XH
Selection graphs corrected peripheral force / belt width
LINEAR drives

The selection graphs corrected peripheral force / belt width provide a quick indication on the belt width needed for each belt profile when a specific corrected load is applied. The graphs have been designed considering the maximum speed (rpm) generally used in the applications for every belt profile and pitch. No safety factor is included as safety factor usually depends on acceleration. Therefore, depending on the specific values of the application, it might be necessary to change the belt width upon calculation.
Power transmission drives ELA-flex SD™ and iSync™

Definitions

- **b** [cm]: Belt width
- **L**: [mm]: Belt length
- **z_k**: - Number of teeth of the belt
- **B**: [mm]: Pulley width
- **A**: [mm]: Center distance
- **A_{eff}**: [mm]: Effective center distance
- **d**: [mm]: Pulley bore diameter
- **d_{a1}**: [mm]: Pulley outside diameter
- **d_{a2}**: [mm]: Large pulley outside diameter
- **d_{a3}**: [mm]: Small pulley outside diameter
- **d_{a4}**: [mm]: Large pulley pitch circle diameter
- **F_{Wdsc}**: [N]: Static Shafts load
- **F_{TV}**: [N]: Pretension force per belt side
- **F_{Taul}**: [N]: Allowable tensile load
- **F_U**: [N]: Peripheral force
- **M**: [Nm]: Torque
- **P**: [kW]: Power
- **t_{a0}**: [s]: Acceleration time
- **t_{p0}**: [s]: Deceleration time
- **v**: [m/s]: Peripheral speed
- **v**: [rpm]: Rpm
- **n**: [min^{-1}]: Rpm of driver pulley
- **ω**: [s^{-1}]: Angular speed
- **β**: [°]: Wrap angle
- **ρ**: [kg/dm^3]: Specific weight
- **J**: [kgm^2]: Moment of inertia
- **t**: [mm]: Pitch
- **n**: [min^{-1}]: Rpm
- **n1**: [min^{-1}]: Rpm of driver pulley
- **ω**: [s^{-1}]: Angular speed
- **β**: [°]: Wrap angle

Calculation formula

### Power

\[
P = \frac{M \cdot n}{9550}
\]

### Peripheral force

\[
F_u = \frac{19100 \cdot P \cdot 10^3}{n \cdot d_u}
\]

### Torque

\[
M = \frac{F_u \cdot d_u}{2000}
\]

### Moment of inertia

\[
J = 98,2 \cdot 10^{-15} \cdot B \cdot \rho \cdot (d_u^4 - d_1^4)
\]

### Angular speed

\[
\omega = \frac{\pi \cdot n}{30}
\]

### Peripheral speed

\[
v = \frac{d_w \cdot n}{19100}
\]

### Acceleration torque

\[
M_{ab} = \frac{J \cdot \Delta n}{9.55 \cdot t_{ab}}
\]

### rpm

\[
n = \frac{19100 \cdot v}{d_u}
\]
Safety factors

Belt selection is made according to a constant working load. For start up torque and in case of peak loads and vibrations a safety factor $c_1$ must be considered.

Transmission with steady load $c_1 = 1.0$

Transmission with peak or fluctuating loads:

- Light $c_1 = 1.4$
- Medium $c_1 = 1.7$
- Heavy $c_1 = 2.0$

For speed up driver factor $c_2$ must be considered:

<table>
<thead>
<tr>
<th>$i$</th>
<th>$c_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 0.66 to 1</td>
<td>1.1</td>
</tr>
<tr>
<td>from 0.40 to 0.66</td>
<td>1.2</td>
</tr>
<tr>
<td>$&lt; 0.40$</td>
<td>1.3</td>
</tr>
</tbody>
</table>

The resulting total safety factor is:

$$c_0 = c_1 \cdot c_2$$

Drive calculation

The necessary data for drive calculation are:

- Power to be transmitted $P$ [kW]
- Driver rpm $n_1$ [min$^{-1}$]
- Motor starting torque $M_{ab}$ [Nm]
- Required center distance $A$ [mm]
- Maximum driver pulley diameter $d_{w1}$ [mm]

Select type of belt

For the initial drive selection, use the selection graphs illustrated in the relative ELA-flex SD™ catalog section. For initial pulley choice, it is recommended to use the driver pulley with maximum diameter allowable in the application.

Calculate drive ratio

$$i = \frac{n_{ driven}}{n_{ driven}}$$

Calculate belt length

Belt length for drive with ratio $i \neq 1$

$$L_R = \frac{1}{2} \left( z_s + z_a \right) \cdot 2A + \frac{1}{4A} \left( \frac{z_a - z_s}{\pi} \right)^2$$

and more precisely:

$$L_R = 2A \cdot \sin \frac{\beta}{2} + \frac{1}{2} \left( z_s + z_a + \left( 1 - \frac{\beta}{180} \right) \left( z_s - z_a \right) \right)$$

Belt length for drive with ratio $i = 1$

$$L_R = 2 \cdot A + \pi \cdot d_{w} = 2 \cdot A + z \cdot t$$

Calculate teeth in mesh

$$z_t = \frac{\beta}{360} \cdot z_a$$

with $\beta$ [°] = wrap angle

$$\beta = 2 \cdot \arccos \left[ \frac{1}{2} \cdot \frac{z_a - z_s}{z_a} \right]$$

Determine belt width

$$b = \frac{P \cdot 1000 \cdot c_0}{z_s \cdot z_a \cdot P_{spez}}$$

Verify allowable tensile load

The allowable tensile load of the belt must be higher than the total corrected peripheral force.

$$F_{Tzul} > c_0 \cdot F_U \quad \text{with} \quad F_u = 2000 \cdot \frac{M}{d_w}$$

Calculate shaft load

$$F_{wa} = 2 \cdot F_n \cdot \cos \cdot \beta \quad \text{for } i = 1$$

Determine installation tension

A drive is correctly tensioned when the belt slack side is tensioned in all working conditions. It is also important to use the minimum necessary tension to minimize shaft loads. Belt tension is dependent also on belt length $L_R$ and its number of teeth $Z_R$. According to belt number of teeth, following tension is suggested:

2 shafts drive

- $Z_R < 75$ \quad $F_{TV} = 1/3 \cdot F_U$
- $75 < Z_R < 150$ \quad $F_{TV} = 1/2 \cdot F_U$
- $Z_R > 150$ \quad $F_{TV} = 2/3 \cdot F_U$

More than 2 shafts drive

$$F_{TV} > F_U$$

In order to ensure the correct drive installation tension, it is recommended to use the special belt tension meter available from ELATECH®.
Selection graphs
ELA-flex SD™

The selection graphs allows the customer to select the most suitable timing belt pitch for each belt profile and for the power to be transmitted. The rpm on the horizontal axis refers to the small pulley. The corrected power (safety factor x nominal power) is read on the vertical axis.
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Selection graphs
iSync™ high performance timing belts