DESIGN SUPPORT

FLANGED PULLEYS / TENSION IDLERS

Flanged pulleys

The pulleys may be fitted with flanges on one or both sides to assist the smooth running of the timing belt.
If the drive centre distance is ≥ 8 d_{wk} one pulley should be equipped with flanges on both sides.
We recommend the use of standard pulleys. If this is not possible due to design reasons, special pulleys may be employed.

Small pulley with flanges on both sides

Flanges on alternate sides

Both pulleys with flanges on both sides

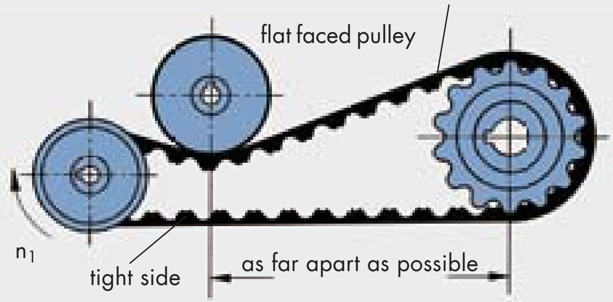
Maximum timing belt width

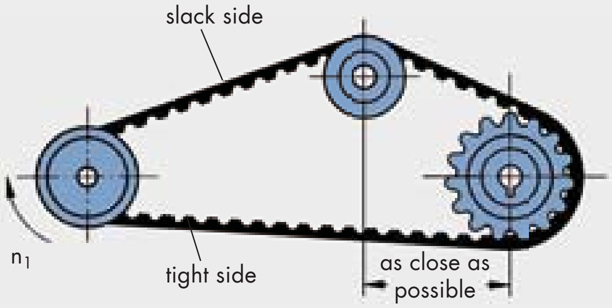
The maximum timing belt width should not exceed the pitch diameter of the smallest pulley in the drive.

Tension idlers

Idlers are grooved or flat faced pulleys that do not transmit power within the drive system. Because they create additional bending stresses within the belt, their use should be used according to the following guidelines:

- Diameter of the tension idler ≥ according to the smallest recommended pulley diameter for the profile
- Width of the idler ≥ widths of the timing belt pulleys in the drive
- Always install idlers in the slack side of the drive
- Inside idlers:
  ≤ 40 teeth always use a timing belt pulley
  > 40 teeth a flat belt pulley can be used
- In general, outside idlers should always be flat faced as they run on the top surface of the belt
- Crowned idlers should never be used
- Fit the tension idlers in such a way as to enable as many teeth as possible to mesh with the small pulley
- Keep the arc of contact on the tension idler as small as possible





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Safety hints

Drives which are correctly designed according to geometric and performance aspects using Optibelt timing belts ensure a high level of operational safety and optimum belt life.
It has been proved in practice that unsatisfactory service life is frequently due to installation and maintenance errors.
We recommend that the following precautions be taken:

- **Timing belt pulleys**
  The teeth should be clean and comply with standard specifications.

- **Alignment**
  All shafts and pulleys should be aligned before belt installation.
  Maximum deviation in shaft parallel alignment:

Belt width n [mm]	Angle deviation
≤ 25	± 1°
> 25 ≤ 50	± 0.5°
> 50 ≤ 100	± 0.25°
> 100	± 0.15°

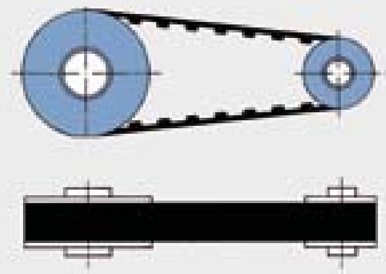
- **Timing belt sets**
  Timing belts which run in pairs or in multiples on the one drive system must always be ordered as sets. This way it is guaranteed that all belts are cut from the same production sleeve and have an identical length.

- **Installation**
  Before installation, the drive centre distance should be reduced to enable the timing belts to be fitted with absolutely no force. If this is not possible the timing belts must be fitted together with one or both of the pulleys. Any use of force during the fitting of the belt will result in damage to the high quality low-stretch tension cord and other components; this damage may not be immediately apparent.
  In case taper bushes are used, the studs should be checked after 0.5 to 1 hour via torque wrench. Tightening torque values see page 91.

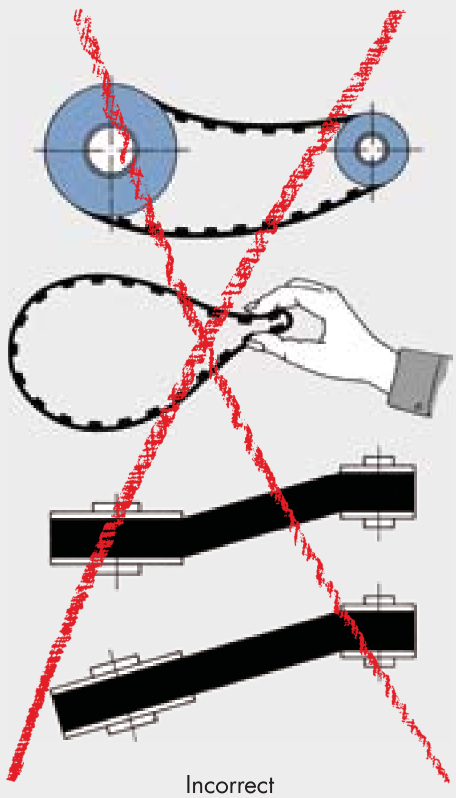
- **Tensioning**
  Tensioning should be carried out in accordance with the guidelines on page 44. Once fitted, no further checking or adjustment is necessary.

- **Idlers**
  Idlers should be avoided. If this is not possible, please follow our recommendations on page 112 of this manual.

- **Maintenance**
  Optibelt timing belts require virtually no maintenance if they are used under normal environmental conditions.



Correct



Incorrect

DESIGN HINTS
PROBLEMS – CAUSES – REMEDIES

Problems	Causes	Remedies
Severe wear on the belt tooth faces	Incorrect belt tension Tooth pitch selection error Overloading	Adjust belt tension Check profile selected, and replace if necessary Use wider belts with higher power transmission capability
Excessive wear at the tooth basis	Excessive belt tension Drive design too weak Incorrect pulleys	Reduce the tension Increase belt width or pulley diameters Replace pulleys
Unusual wear on the edges of the belt	Shafts not parallel Incorrect flanged pulleys Drive centre distance varying during running	Realign the shafts Replace flanges Strengthen mountings and chassis
Belt teeth shearing off	Too few teeth in mesh Overloading	Increase diameter of the small pulley or choose wider belts Redesign using wider belts or larger pulleys
Excessive lateral belt movement	Shafts not parallel Pulleys not in line Shock loading with belt tension too great	Realign the shafts Realign pulleys Reduce the belt tension
Flanges becoming detached	Pulleys not in line Very high lateral pressure of the timing belt Incorrect flange installation	Realign the pulleys Realign the shafts Install flanges correctly
Apparent belt stretch	Incorrect storage	Adjust belt tension, reinforce and secure bearing support
Excessive operating noise	Incorrect shaft alignment Belt tension too high Pulley diameter too small Belt overloaded Belt width too great at higher speeds	Realign shafts Reduce the tension Increase pulley diameter Increase belt width or number of teeth in mesh Reduce the belt width by redesign using larger belt profile
Unusual wear on the pulleys	Unsuitable material Incorrect tooth pitch Insufficient surface hardness	Use stronger materials Replace pulleys Use harder material or carry out surface hardening
Top surface of the belt brittle and cracking	Ambient temperature above +100 °C Unacceptable radiation	Replace belt with extra heat-resistant design Screen or use suitable belt design
Cracks in the belt surface	Ambient temperature below –30 °C	Replace belt with extra cold-resistant design
Softening of belt surface	Effects of contamination	Screen or use suitable belt design

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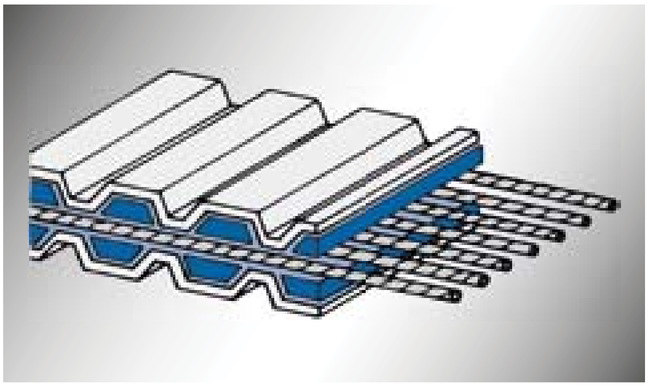
DESIGN SUPPORT

optibelt ZR TIMING BELTS, DOUBLE-SIDED ACCORDING TO ISO 5296

Structure



Tension cord

As standard belts, the tension cord consists of continuous, spirally wound glass fibre. This material ensures high tensile strength with the minimum stretch. Exceptional flexibility is achieved by embedding the cord in the centre.

Teeth

The teeth are arranged directly opposite each other and are manufactured from a medium hard, shear- and wear-resistant rubber compound. They mesh exactly with the tooth groove of the pulley with minimum resistance. As long as six teeth or more are in mesh, the capacity of the belt is used optimally.

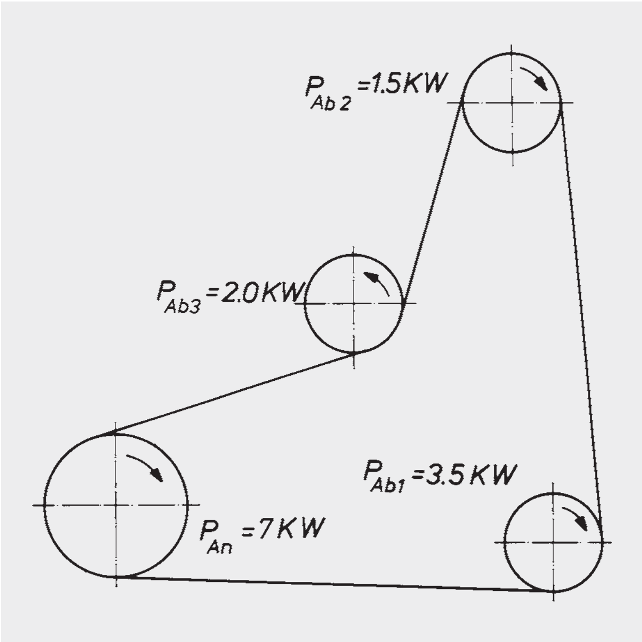
Fabric cover

Both sides of the teeth are covered with a tough, friction resistant fabric. This fabric with its low coefficient of friction is therefore characterised by a long operational life.

Drive design

The protective covering on both tooth faces and the resultant identical power transmission capability of both sides of the belt, allow for an unlimited distribution of the power to be transmitted. The maximum allowed nominal power rating can be transmitted from either the inner or the outer tooth face. With several driven pulleys the power can be distributed in any combination through both sides of the belt.
The total power transmitted cannot, however, exceed the maximum permitted levels.

Example:



The design must be based on the nominal power values for standard belts (see pages 60 to 71). All available sizes on pages 32 to 34.

DESIGN SUPPORT
ATTACHMENTS
OVERVIEW OF STANDARDS

Federal Republic of Germany

DIN 109 Sheet 1	– Drive Elements; Circumferential Speeds
DIN 109 Sheet 2	– Drive Elements; Centre Distances for V-Belt Drives
DIN 111	– Pulleys for Flat Transmission Belts; Dimensions, Nominal Torque
DIN 111 Sheet 2	– Pulleys for Flat Transmission Belts; Classification for Electrical Machines
DIN 2211 Sheet 1	– Grooved Pulleys for Narrow V-Belts; Dimensions, Materials
DIN 2211 Sheet 2	– Grooved Pulleys for Narrow V-Belts; Inspections of Grooves
DIN 2211 Sheet 3	– Grooved Pulleys for Narrow V-Belts; Classification for Electrical Machines
DIN 2215	– Endless V-Belts, Classic Profiles; Minimum Datum Diameter of the Pulleys, Internal and Datum Belt Length
DIN 2216	– Open-Ended V-Belts; Dimensions
DIN 2217 Sheet 1	– V-Belt Pulleys for Classic Profiles; Dimensions, Materials
DIN 2217 Sheet 2	– V-Belt Pulleys for Classic Profiles; Inspections of Grooves
DIN 2218	– Endless V-Belts, Classic Profiles for Mechanical Engineering; Calculation of Drives, Performance Data
DIN 7716	– Rubber Products; Requirements for Storage, Cleaning and Maintenance
DIN 7719 Part 1	– Endless Wide V-Belts for Industrial Speed Changers; Belts and Groove Profiles for Corresponding Pulleys
DIN 7719 Part 2	– Endless Wide V-Belts for Industrial Speed Changers; Measurement of Centre Distance Variations
DIN 7721 Part 1	– Synchronous Belt Drives, Metric Pitch; Synchronous Belts
DIN 7721 Part 2	– Synchronous Belt Drives, Metric Pitch; Tooth Space Profile of Synchronous Pulleys
DIN 7722	– Endless Hexagonal Belts for Agricultural Machines and Groove Profiles of Corresponding Pulleys
DIN 7753 Part 1	– Endless Narrow V-Belts for Mechanical Engineering; Dimensions
DIN 7753 Part 2	– Endless Narrow V-Belts for Mechanical Engineering; Drive Calculation, Performance Data
DIN 7753 Part 3	– Endless Narrow V-Belts for the Automotive Industry; Dimensions
DIN 7753 Part 4	– Endless Narrow V-Belts for the Automotive Industry; Fatigue Testing
DIN 7867	– V-Ribbed Belts and Pulleys
DIN/ISO 5290	– Grooved Pulleys for Joined Narrow V-Belts; Groove Profiles: 9J; 15J; 20J; 25J
DIN/ISO 5294	– Synchronous Belt Drives; Pulleys
DIN/ISO 5296	– Synchronous Belt Drives; Belts
DIN 22100-7	– Articles from Synthetics for Use in Underground Mines, Paragraph 5.4 – V-Belts
DIN EN 60695-11-10	– Fire Hazard Testing

ISO – International Organization for Standardization

ISO 22	– Widths of Flat Transmission Belts and Corresponding Pulleys
ISO 63	– Flat Belt Drives; Lengths
ISO 99	– Diameter of the Belt Pulleys for Flat Belts
ISO 100	– Bulging Height of the Belt Pulleys for Flat Belts
ISO 155	– Belt Pulleys; Limiting Values for Adjustment of Centre Distances
ISO 254	– Quality, Finish and Balance of Belt Pulleys
ISO 255	– Pulleys for Classic V-Belts and Narrow V-Belts; Geometric Testing of Grooves
ISO 1081	– Vocabulary from V-Belts, V-Ribbed Belts and Pulleys
ISO 1604	– Endless Speed Changer Belts and Pulleys for Mechanical Engineering
ISO 1813	– Electrical Conductibility of V-Belts, Kraftbands, V-Ribbed Belts, Wide V-Belts, Double Profile V-Belts
ISO 2230	– Please Consult DIN 7716
ISO 2790	– Narrow V-Belt Drives for the Automotive Industry; Dimensions
ISO 3410	– Endless Speed Changer Belts and Pulleys for Agricultural Machinery
ISO 4183	– Grooved Pulleys for Classic V-Belts and Narrow V-Belts
ISO 4184	– Classic V-Belts and Narrow V-Belts; Lengths
ISO 5256	– Synchronous Belt Drives; Belt Tooth Pitch Code Part 1 MXL; XL; L; H; XH; XXH Part 2 MXL; XXL Metric Dimension
ISO 5287	– Narrow V-Belts for the Automotive Industry; Fatigue Testing
ISO 5288	– Vocabulary from Timing Belt Drives
ISO 5289	– Endless Double Profile V-Belts and Pulleys for Agricultural Machinery
ISO 5290	– Grooved Pulleys for Joined Narrow V-Belts; Profiles: 9J; 15J; 20J; 25J
ISO 5291	– Grooved Pulleys for Joined Classic V-Belts; Profiles: AJ; BJ; CJ; DJ
ISO 5292	– Industrial V-Belt Drives; Calculations of the Performance Data and Centre Distance
ISO 5294	– Synchronous Belt Drives; Pulleys – "Inch Pitch"
ISO 5295	– Timing Belts; Calculations of the Performance Data and Centre Distance – "Inch Pitch"
ISO 5296	– Synchronous Belt Drives; Belts – "Inch Pitch"
ISO 8370-1	– Dynamic Test to Determine Pitch Zone Location with V-Belts
ISO 8370-2	– Dynamic Test to Determine Pitch Zone Location with V-Ribbed Belts
ISO/DIS 8419	– Belt Drives, Joined Narrow V-Belts; Lengths in Effective System; 9N/J, 15N/J, 25N/J
ISO 9010	– Synchronous Belt Drives – Automotive Belts
ISO 9011	– Synchronous Belt Drives – Automotive Pulleys
ISO 9563	– Antistatic Endless Synchronous Belts; Electrical Conductibility; Characteristics and Testing Method
ISO 9980	– Belt Drives; V-Belt Pulleys; Geometric Inspection of Grooves
ISO 9981	– Belt Drives – Pulleys and V-Ribbed Belts for the Automotive Industry; PK Profile
ISO 9982	– Belt Drives; Pulleys and V-Ribbed Belts for Industrial Requirements; Geometric Data PH, PJ, PK, PL and PM
ISO 11749	– Belt Drives – V-Ribbed Belts for the Automotive Industry, Fatigue Testing
ISO 12046	– Synchronous Belt Drives, Automotive Belts; Physical Characteristics
ISO/CD 13050	– Synchronous Belt Drives, Curvilinear Timing Belts
ISO/CD 17396	– Synchronous Belt Drives; Metric Pitch, Profiles T and AT

USA

RMA/MPTA IP-20	– Classic V-Belts and Sheaves (A; B; C; D; Cross Profiles)
RMA/MPTA IP-21	– Double (Hexagonal) Belts (AA; BB; CC; DD Cross Profiles)
RMA/MPTA IP-22	– Narrow Multiple V-Belts (3V; 5V; and 8V Cross Profiles)
RMA/MPTA IP-23	– Single V-Belts (2L; 3L; 4L; and 5L Cross Profiles)
RMA/MPTA IP-24	– Synchronous Belts (MXL; XL; L; H; XH; and XXH Belt Profiles)
RMA/MPTA IP-25	– Variable Speed V-Belts (12 Cross Profiles)
RMA/MPTA IP-26	– V-Ribbed Belts (PH; PJ; PK; PL; and PM Cross Profiles)
RMA/MPTA IP-27	– Curvilinear Toothed Synchronous Belts (8M – 14M Pitches)
ASAE S 211....	– V-Belt Drives for Agricultural Machines
SAE J636b	– V-Belts and Pulleys
SAE J637	– Automotive V-Belt Drives

DESIGN HINTS

DATA SHEET FOR THE CALCULATION/CHECKING OF TIMING BELT DRIVES

Company: ____
Street address/P.O. Box number: ____
Town or city/Post code: ____
Contact person: ____
Department: ____ Date: ____
Phone: ____ Fax: ____
E-mail: ____

Currently fitted with:

pitch length	profile	width	manufacturer

For test ☐ New drive ☐
For pilot production ☐ Existing drive ☐
For series production ☐ Requirement_____ Pieces/Year

Prime mover

Type (e.g. electric motor, diesel engine 3 cylinders) ____
Size of the starting torque (e.g. MA = 1.8 MN) ____
Type of start (e.g. star delta) ____
Daily operating time ____ ____ hours
Number of starts ____ per hour ☐ per day ☐
Change in the direction of rotation ____ per minute ☐ per hour ☐
Power: P normal ____ kW
P maximum ____ kW
or max. torque ____ Nm at n_1 ____ min^{-1}
Speed n_1 ____ min^{-1}
Shaft layout: horizontal ☐ vertical ☐
inclined ☐ ∢ ____ °
Maximum allowed shaft loading $S_{a\ max}$ ____ N
Pitch diameter or number of teeth on the pulley:
d_{w1} ____ mm z_1 ____ mm
$d_{w1\ min}$ ____ mm $z_{1\ min}$ ____ mm
$d_{w1\ max}$ ____ mm $z_{1\ max}$ ____ mm
Maximum pulley face width ____ mm

Driven machine

Type (e.g. lathe, compressor) ____
Start: under load ☐ no load ☐
Type of load: steady ☐ pulsating ☐
shock ☐
Required power transmission: P normal ____ kW
P maximum ____ kW
or max. torque ____ Nm at n_2 ____ min^{-1}
Driven speed n_2 ____ min^{-1}
$n_{2\ min}$ ____ min^{-1}
$n_{2\ max}$ ____ min^{-1}
Maximum allowed shaft loading $S_{a\ max}$ ____ N
Pitch diameter or number of teeth on the pulley:
d_{w2} ____ mm z_2 ____ mm
$d_{w2\ min}$ ____ mm $z_{2\ min}$ ____ mm
$d_{w2\ max}$ ____ mm $z_{2\ max}$ ____ mm
Maximum pulley face width ____ mm

Drive ratio i ____ i_{min} ____ i_{max} ____
Centre distance a ____ mm a_{min} ____ mm a_{max} ____ mm
Tensioning/idler pulley: inside idler ☐ in tight side ☐
outside idler ☐ in slack side ☐
d_w mm pulley ☐ moveable ☐ (e.g. spring loaded) ____
d_a mm flat pulley ☐ fixed ☐

Operating conditions: Ambient temperature ____ °C minimum
____ °C maximum
Influence of oil ☐ (e.g. oil mist, drops) ____
water ☐ (e.g. spray water) ____
acid ☐ (type, concentration, temperature) ____
dust ☐ (type) ____

Special drives: e.g. for drives with tensioning/idler pulleys, three or multi-pulley drives or for drives with contra rotating pulleys drawings are necessary. Please use the other side of this page for this drawing.