Timing Belt Design Hints

A guide to Timing Belt drives

Design Hints
Properties

This table is provided to assist in specifying an Optibelt drive element for a particular drive application.	Ambient temperature Maximum/minimum (°C)		Oil resistant			Stretch
	Standard construction	Special construction XHR	Standard construction	Antistatic (after testing)	Smooth running	Standard construction Special Construction
Omega **Timing belts**	-30 +85		Limited	Yes	Very good	None
ZR **Timing belts**	-30 +85	-30 +120	Limited	Yes	Very good	None
ZRM **Polyurethane Timing belts**	-30 +80		Good	No	Good	None

This table is provided to assist in specifying an Optibelt drive element for a particular drive application.	Recommended max. belt speed (m/s)	Efficiency	Behavior under shock loading	Vibration Behavior	Synchronous	Recommended max. speed ratio	Use with outside idlers		Maintenance	Recommended applications
							Standard construction	Special construction		There are number of applications that can be covered by more than one type of belt. In these instances, belt selection must be made on an individual basis
Omega **Timing belts**	Depends on section ≤80	Up to 98%	Sensitive	Depends on speed	Not possible	Up to 1:10	Good	Very Good	Free	Textile machines, printing machines, machine tools, conveyors, packing machines, gate openers
ZR **Timing belts**	Depends on section ≤80	Up to 98%	Sensitive	Depends on speed	Not possible	Up to 1:10	Good	Very Good	Free	Copiers, food processors, robotics, blower drives, printing machines, conveyors, X-Ray equipment
ZRM **Polyurethane Timing belts**	Depends on section ≤80	Up to 98%	Sensitive	Depends on speed	Not possible	Up to 1:10	Good	Very Good	Free	Cameras, plotters, printers, main and feed drives, sample conveyors, material feed, cameras

Design Hints
Installation & Maintenance

Correctly designed drives with Optibelt-HTD timing belts will be very reliable and have a long service life.

Practice has shown that unsatisfactory running times are very frequently attributable to installation and maintenance errors. In order to prevent this we recommend the following:

- **Timing belt pulleys**
  The teeth must be produced in accordance with the relevant standards and be clean

- **Alignment**
  Shafts and pulleys should be aligned prior to installation.

  Maximum deviation of shaft parallelism

Belt width b_{St} (mm)	Shaft misalignment
≤ 25	$\pm 1°$
$> 25 \leq 50$	$\pm 0.5°$
$> 50 \leq 100$	$\pm 0.25°$
> 100	$\pm 0.15°$

- **Timing belt sets**
  Timing belts which run in pairs or run several at a time on a drive system must in all cases be ordered as a set. This ensures that all the belts are from the same production sleeve and that their lengths are identical.

- **Installation**
  Prior to installation, the drive centre distance should be reduced so that the timing belt can be installed without force. If this is not possible, the timing belt must be installed together with one or both of the timing belt pulleys. Installation with the use of the force is NOT permissable at any time.

- **Tensioning**
  Tension should be applied guidelines listed. Further inspection after installation will not be necessary.

- **Idlers**
  Idlers should be avoided. Refer the sections on idlers in this guide.

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

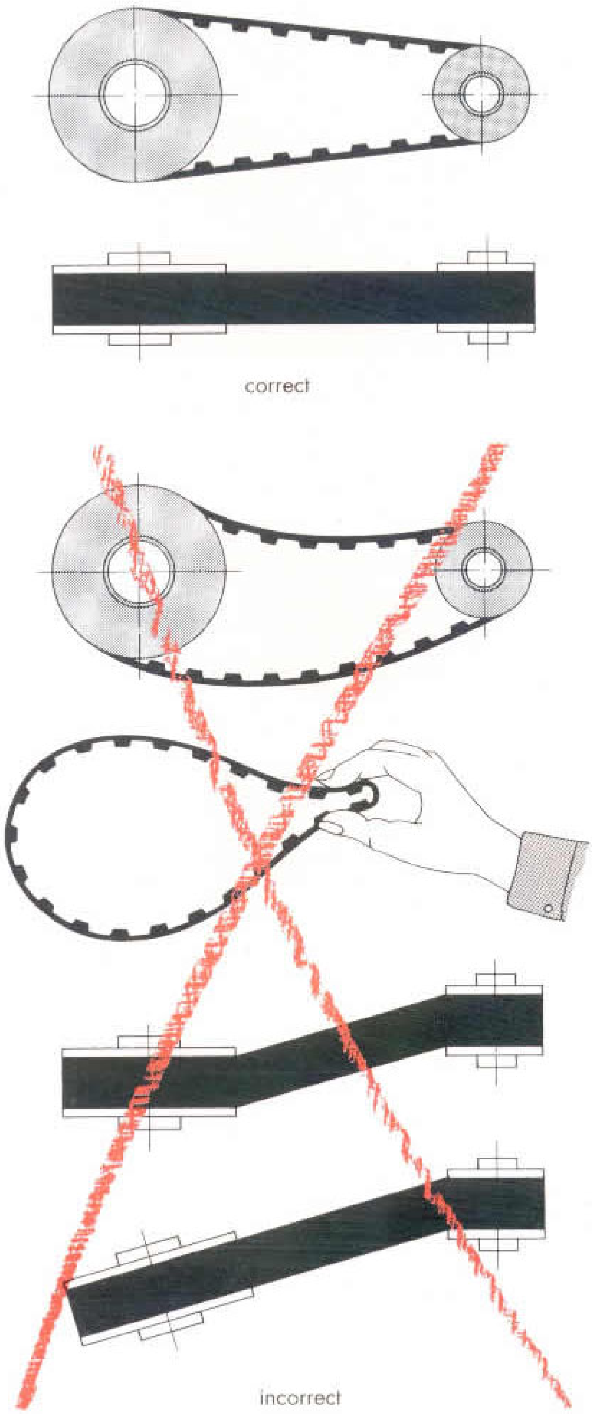


Fig. 1a

Design Hints
Tensioning

Tension for Optibelt Timing Belts

The correct belt tension is of crucial importance for trouble free transmission of power, and for the achievement of an acceptable belt service life. Often tension which is too high or too low results in premature belt failure. A belt which is overtensioned can cause bearing failure.

It has been shown that the more common tension instructions – e.g. using the "thumb pressure deflection method" – do not result in a tension level which allows the drive to operate at maximum efficiency. It is therefore recommended that the static belt tension be calculated individually for each drive using the following Optibelt formulae.

Their extremely low stretch properties mean that once they have been fitted the Optibelt timing belts require no further re-tensioning.

Formula symbols:

f	= Deflection force	(N)
S_{n3}	= Effective tension	(N)
E_a	= Belt Deflection for a given span length	(mm)
L	= Drive span length	(mm)

1. Calculation of the load f at the centre of the span

$$f = \frac{S_{n3}}{20}$$

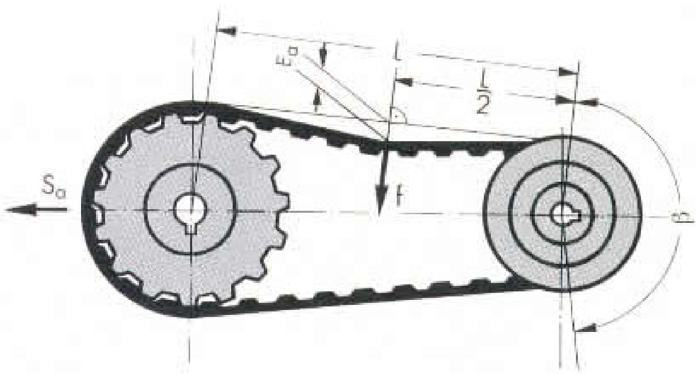
$$S_{n3} = \frac{P \times 1000}{v}$$

2. Calculation of the belt deflection for a span length E_a for the given drive span length L

$$E_a = \frac{L}{50}$$

$$L = \sqrt{e^2_{nom} - \left(\frac{d_{pg} - d_{pk}}{2}\right)^2}$$

Apply the load f in the centre of, and at a right angles to, the span as shown in the diagram below. Calculate E_a – the belt deflection for a given span length – and check the deflection achieved against this figure. Adjust the tension if necessary.



Length tolerance / minimum adjustment

Length tolerance for timing belts are checked on a two pulley measuring machine. Provision should be made for the adjustment of the drive centre distance to allow for these tolerance.

For fixed centre drives without idler contact the Optibelt Technical Department.

L_{pSt} (mm)	≥91.44 ≤254	≥255 ≤381	≥382 ≤508	≥509 ≤762	≥763 ≤1016	≥1017 ≤1270	≥1271 ≤1524	≥1525 ≤1778
Belt length tolerance (mm)	±0.20	±0.23	±0.25	±0.30	±0.33	±0.38	±0.41	±0.43

For each additional 30mm add 0.03mm.

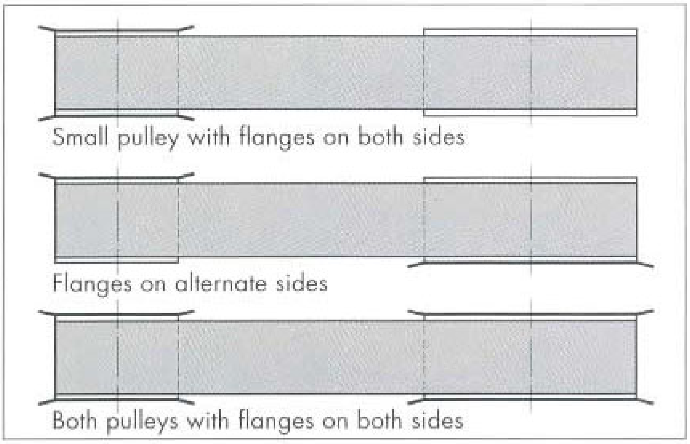
Design Hints
Flanges/Pulley Diameters

Flanges

The pulleys may be fitted with flanges on one or both sides the assist the smooth running of the belt.

If the drive centre distance is $\geq 8d_{pk}$ then one pulley should be equipped with flanges on both sides.

We recommend the use of standard pulleys. If this is not possible for design reasons, special pulleys may be employed.



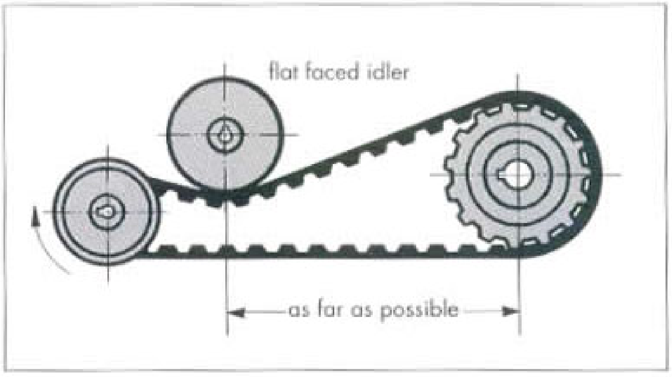
Max Timing Belt Width

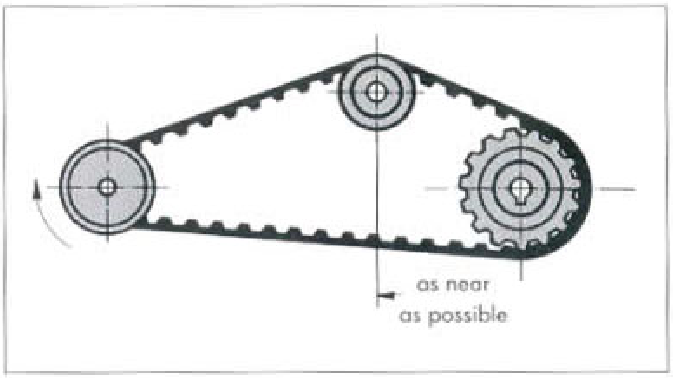
The maximum timing belt width should not exceed the pitch diameter of the smallest pulley being used.

Tension or Guide Idlers

Idlers are either toothed 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 restricted to the following applications:

- Diameter of the idler $\geq$ the smallest pulley in the drive system.
- Width of the idler $\geq$ the smallest pulley in the drive system.
- Always locate any idlers on the slack side of the drive
- Inside idlers : $\leq$ 40 teeth always use a toothed pulley
  $>$ 40 teeth a flat faced pulley can be used
- Because they run on the back of the belt, flat pulleys must always be used as outside idlers.
- Crowned pulleys must never be used.
- Ensure that the idler is positioned to ensure that the maximum possible number of teeth are in mesh on the smallest possible drive pulley.
- Keep the arc of contact on idlers to a minmum (outside idler)





Design Hints

Problems, causes, remedies

Problems	Causes	Remedies
Pronounced wear on loaded side of belt tooth	Incorrect belt tension Pitch of belt or pulley incorrect Overload	Correct tension Check tooth profile, replace if necessary Use wider belts with higher power transmission capability
Excessive wear in tooth root	Excessive belt tension Drive design incorrect Defective pulleys	Reduce tension Increase size of belts and or/or pulleys Replace pulleys
Unusually high wear on belt sides	Faulty axial parallelism Defective flanges Variance of drive centre distance	Realign shafts Replace flanges Use heavier duty bearings and/or housing
Shearing off of belt teeth	Insufficient teeth in mesh	Increase diameter of small pulley or choose wider belt Use wide belts and/or larger pulleys
Excessive lateral movement	Faulty axial parallelism Pulleys out of alignment Shock loading with excessive belt tension	Realign shafts Align pulleys Reduce belt tension
Flanges of pulleys becoming detached	Pulleys out of alignment Very pronounced lateral pressure form timing belt Defective assembly of flanges	Realign pulleys Realign shafts Fit flanges correctly
Apparent belt stretch	Bearings flexing	Correct belt tension, reinforce and secure bearing mounting
Excessive running noise	Defective shaft alignment Excessive belt tension Pulley diameter too small Belt overloading Excessive belt width with high speeds	Realign shafts Reduce tensions Increase pulley diameter Increase belt width and/or teeth in mesh Reduce belt width by selection of heavier belt section
Abnormal wear on pulleys	Unsuitable material Belt/pulley mismatch Insufficient surface hardness on pulley	Use stronger material Replace pulleys Use harder material or surface harden the pulleys
Embrittlement of belt top surface	Ambient temperature in excess of +85°C Excessive radiated heat	Select special heat resistant quality Shield or use suitable belt quality
Cracks in belt top surface	Ambient temperatures below –30°C	Use special cold-resistant belt quality