Belt Drive Systems

Technical Information





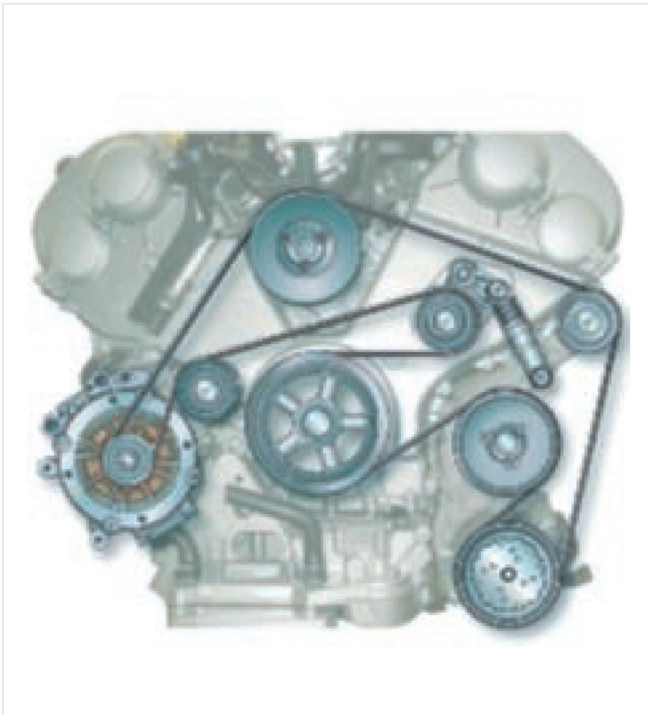
Content

1. Belt drive systems in motor vehicles

Belt drive systems in motor vehicles perform two tasks: the timing belt drive controls the valves by means of a toothed belt which transmits the radial movement of the crankshaft to the camshaft with a ratio of 2:1, thus ensuring that piston motion and valve timing are perfectly synchronised.

The so-called accessory drive is used to drive auxiliary equipment, such as alternator, coolant pump, power steering pump or A/C compressor. This function used to be performed by the V-ribbed belt which ensured a non-positive transmission of the torque from the crankshaft to the alternator and the coolant pump.

However, in state-of-the-art vehicles more and more electronic equipment is used for enhanced driver comfort. As a result, one V-ribbed belt is no longer sufficient to drive the high-power alternator and front-end accessories, such as A/C compressor or power steering pump. To remedy this problem, a poly V-belt is used, allowing for reduced wrap radii and therefore increased transmission ratios. With particularly small installation space available, accessories can be driven by the front and reverse side of the poly V-belt.



1.1 Timing belt drive / Toothed belt systems

The toothed belt is made from rubber, with the belt structure being reinforced by a glass fibre cord and backed with a polyamide fabric. A temperature-resistant intermediate layer ensures ideal performance of the materials used. The teeth are also polyamide-reinforced in order to increase resistance to wear. Since the toothed belt, unlike in the timing chain, does not require lubrication, the environment in which it is operating need not be sealed. A simple plastic cover provides sufficient protection against intrusion of impurities.

Characteristics of toothed belt systems:

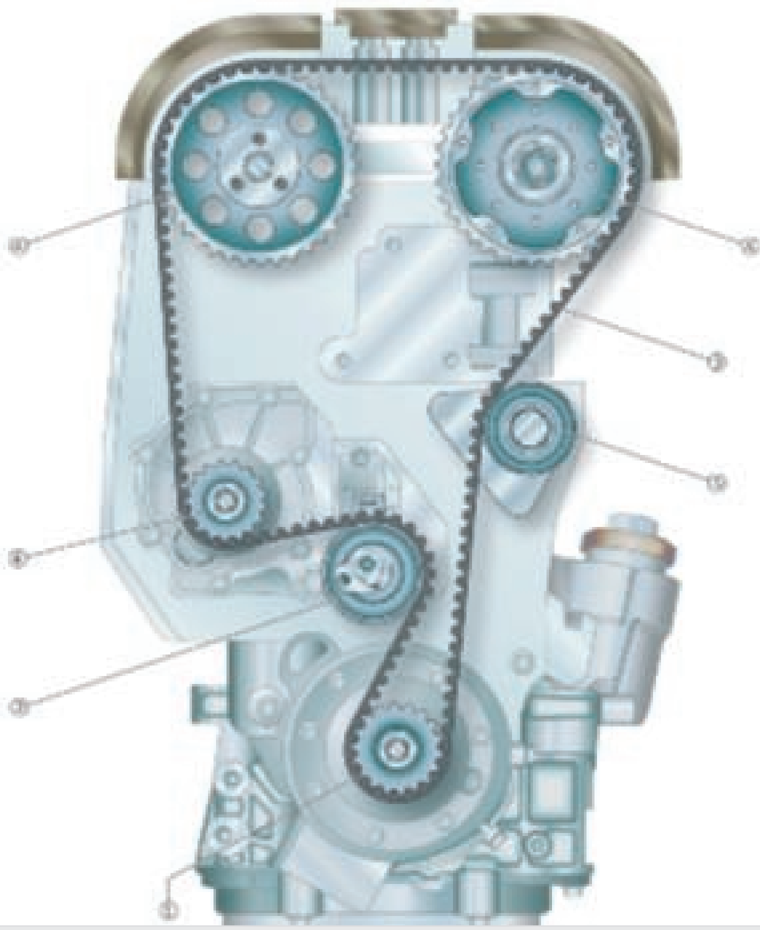
- Link the crankshaft to the camshaft(s).
- May be used to transmit driving power to injection and water pump
- Drive balancer or intermediate shaft
- May consist of one, two or several separate systems

Benefits/advantages of state-of-the-art toothed belt drive systems:

- Excellent valve timing precision over the entire service life
- Long service life/low noise levels during operation
- Easy and cost-effective servicing and fitting
- Dry operation, no oil feed required
- Compact design
- Minimal friction
- High efficiency rate

Timing belt drive

(1) crankshaft pulley
(2) belt tensioner
(3) toothed belt
(4) camshaft pulleys
(5) idler pulleys (optional)
(6) water pump (optional)



1.2 Accessory belt drive / Accessory belt drive systems

Accessory belt drive systems can be composed of one, two or several separate systems, but normally are designed as a serpentine belt. Accessories are driven by a PK profile multi-ribbed or poly V-belt (f) the tension of which is precisely adjusted to the required loads using a mechanical or hydraulic tensioning system. Idler rollers are used to create the correct wrap radius to drive engine accessories. They may also be used as stabilizers to eliminate belt span vibration. Poly V-belts are designed to perform at high loads transmitting the engine torque – upto 350 Nm is not unusual in modern cars, without slip from the crankshaft (a) to all its accessories.

Benefits/advantages of state-of-the-art accessory belt drive systems:

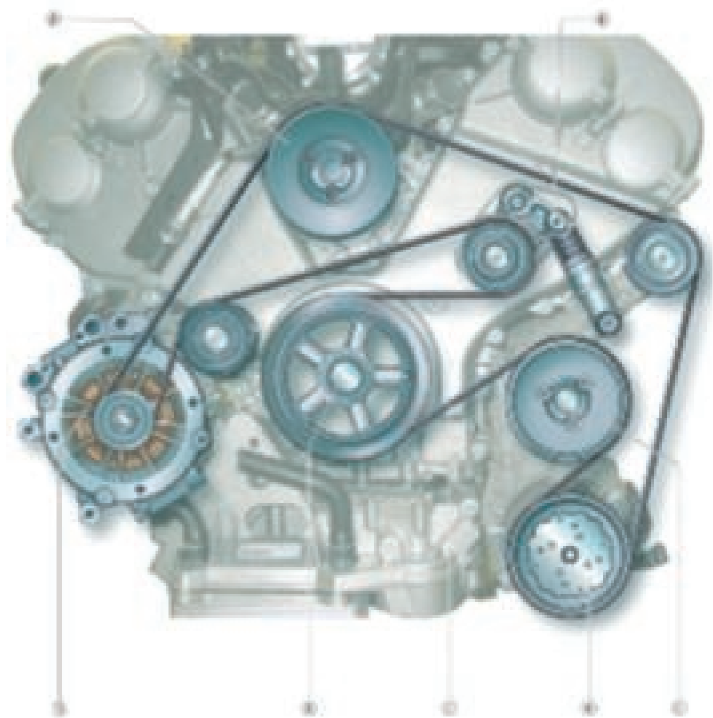
- Enhanced slip control in the accessory drive,
- Long service life (160,000km or more),
- Reduced noise emission during operation,
- Require small installation space,
- Simple servicing.

Accessory belt drive systems

Poly V-belts are designed to perform at high loads transmitting the engine torque without slip from the crankshaft (a) to all accessory assemblies, such as:

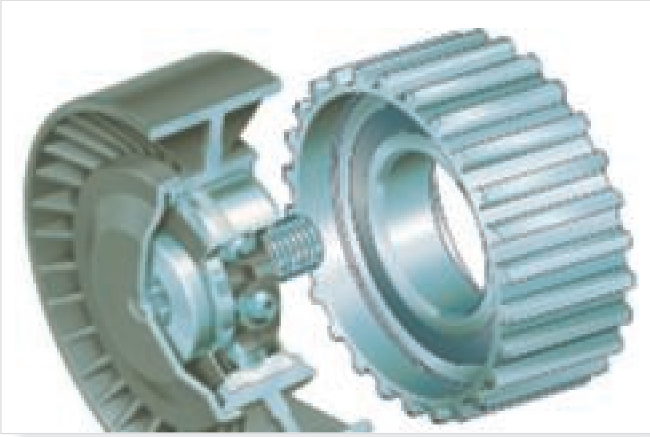
Alternator (b),
Power steering pump (c),
Water pump (d),
A/C compressor (e)

and other equipment such as fan or mechanical supercharger.



2. Tension rollers and idlers for timing and accessory drives

Tension rollers and idlers are used for both the timing and accessory drives.
Tension rollers transmit the force from the belt tensioner to the belt, thus ensuring constant belt tension. Idlers are used to change the belt routing according to the existing front-end accessories or serve to stabilize the belt and to eliminate belt vibration in excessive belt span lengths.
Tension rollers and idlers consist of a steel or plastic pulley with integral single or double row deep groove ball bearing. The running surface can be either smooth or grooved. After mounting the roller, a protective plastic cover is snapped on the unit. Especially formed covers made of steel may also be used to protect the idler bearing. These are bolted to the idler.



(a) Single-row deep groove roller bearing ECO III

- Further development of 6203 model, running more smoothly,
- Broadened design and increased grease volume,
- Enhanced rated load compared to similar bearings,
- Special characteristic: knurls on the outer ring ensure positive engagement of the tyre,
- Cost-effective

(b) Double-row deep groove ball bearings

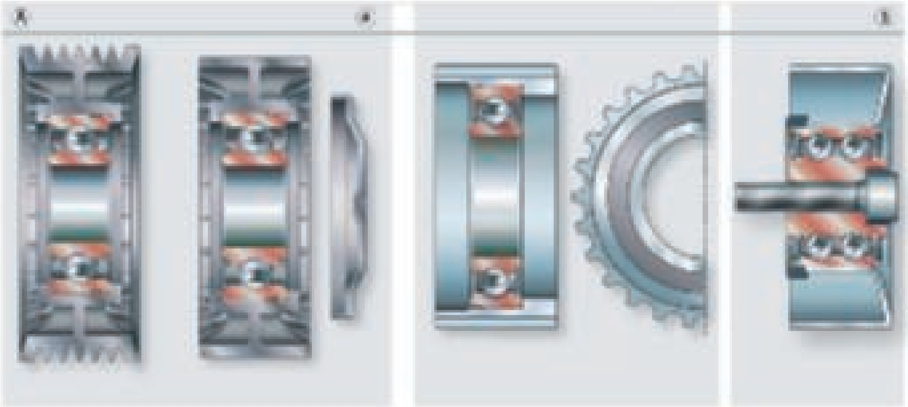
- Withstand extreme loads,
- Broadened design and increased grease volume,
- Special characteristic: knurls on the outer ring,
- Meet smaller tolerances for misalignment.

Tension rollers and idlers

(A) Design principles

(a) Tension roller /
idler with toothed profile

(b) Double-row tension roller / idler

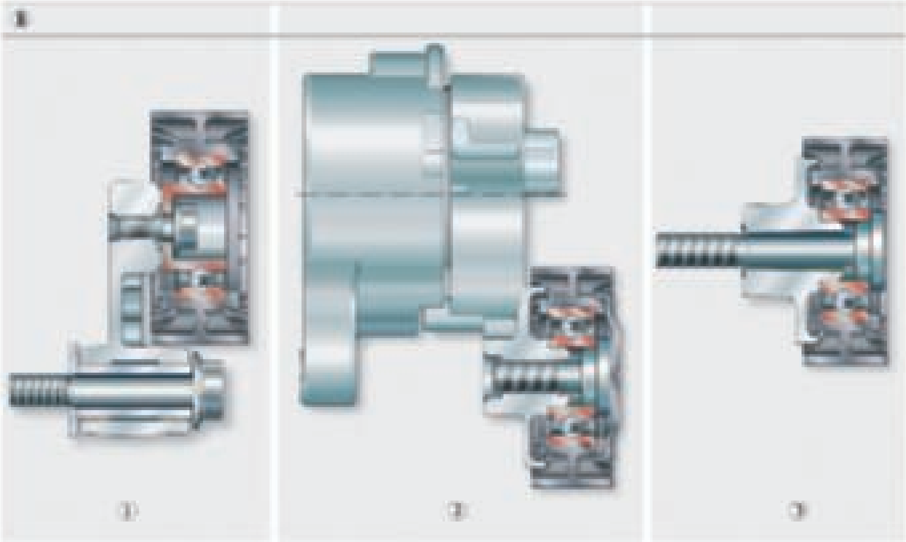


(B) Examples of application

(1) Tension roller with friction
bearing mounted lever

(2) Automatic belt tensioner with
tension roller

(3) Idler, assembly



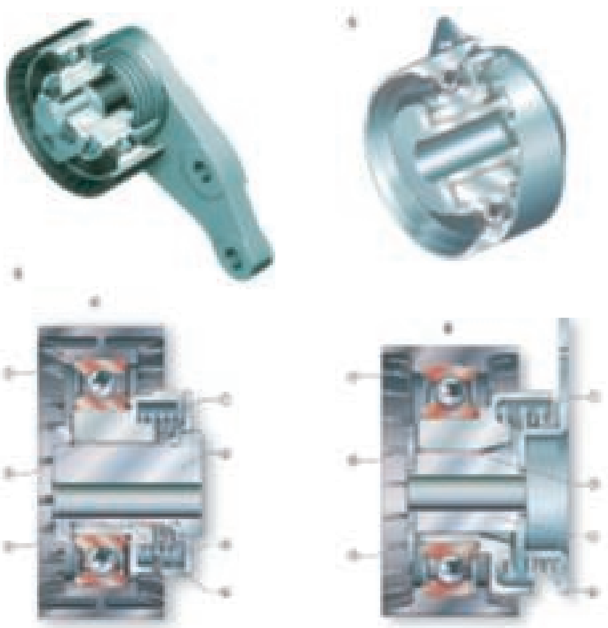
Benefits/advantages of tension rollers and idlers:

- Ensure precise routing of the belt,
- Allow for individually designed and optimised belt drive layout,
- Are matched to the specific application,
- Reduced grease losses,
- Reduced noise emission during operation,
- Resistant to temperature and environmental influences,
- Recyclable (marked as plastic material),
- Knurls ensure positive engagement between outer ring and plastic running pulley.

2.1 Tensioning units for the toothed belt drive

A critical prerequisite for trouble-free operation of the timing belt drive is the correct tension of the toothed belt. Only the correct belt tension can ensure positive engagement over the entire service life. Just one tooth skipped will impair precise valve timing which – especially in diesel engines – can cause the valves to "collide" with the piston and eventually the engine to fail.
During long-term operation, the timing belt will slightly elongate due to the tensile load of the crankshaft and the normal temperature fluctuations, resulting in late valve timing as the rotation speed of the camshaft falls behind the rotation speed of the crankshaft. Temperature fluctuations occurring during normal operation may also cause the belt to elongate and shorten periodically. For this reason, the latest generation of tension rollers has an "adjustment range" allowing the tensioner to self-adjust to length differences of the belt. However, it is imperative during vehicle inspection to check the functioning of the tension roller and check the tension of the timing belt and correct it if required.

Designs



A – Double eccentric principle
(1) cylindrical helical coiled spring
(2) adjusting eccentric
(3) base plate
(4) friction bearing
(5) adjusting shim
(6) working eccentric
(7) tension roller

B – Single eccentric principle
(1) cylindrical helical coiled spring
(2) friction bearing
(3) central tube
(4) base plate
(5) eccentric
(6) front shim
(7) tension roller

There are two different types of timing belt tensioners – manual and automatic belt tensioners.
For manual belt tensioning units, the correct belt tension at ambient temperature is set manually according to the specifications of the manufacturer and needs to be checked in the specified service intervals and adjusted if required.

Benefits of manual tensioning units:
- Easy and cost-effective servicing and fitting
- Compact design

Drawbacks of manual tensioning units:
- No self-adjustment to temperature fluctuations, load changes and belt elongation due to long-term operation

Auto-tensioning units tighten the belt automatically during installation. An internal set of springs ensures that the belt tension remains almost unchanged throughout the entire service life by self-adjusting to temperature and load changes. Another benefit of an automatic tensioning unit consists in its ability to damp out belt vibration under all operating conditions of the belt drive. As a result, the belt tension can remain very low thus reducing noise emission whilst increasing service life.

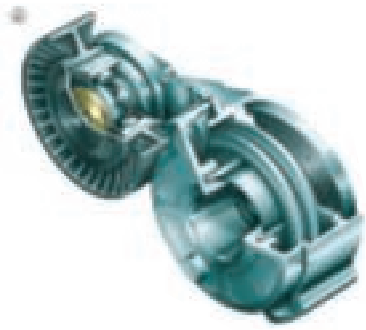
Benefits of automatic tensioning units:
Automatic tensioning systems provide an additional integral mechanical damping function. They ...
- Tighten the belt automatically during installation,
- Compensate manufacturing tolerances (diameter, positions, belt length),
- Provide constant belt force (irrespective of temperature, load and service life),
- Eliminate nearly all drive train resonance under all operating conditions,
- Prevent "tooth jump",
- Reduce noise owing to improved adjustability of required belt preload,
- Extend service life of the system.

The double eccentric principle (A) separates the dynamic tensioning function of the tolerance compensation system and can be precisely adjusted to the dynamic requirements of the toothed belt drive.
The single eccentric principle (B) simplifies fitting of the tensioning system on the engine assembly line and prevents setting errors.

2.2 Tensioning units for the accessory belt drive

In order to avoid excessive slip and belt vibration, the correct tension of the poly V-belt in the accessory drive is crucial just as much as the correct setting of the toothed belt tension in the timing drive.
There are two different types of tensioning systems.

Belt tensioning unit with mechanical damping function



For example

Long-arm tensioner (a)

Short-arm tensioner (b)

Cone-shaped tensioner(c)

Belt tensioning units with hydraulic damping function

For example

Tensioner with bellows seal (a)

Tensioner with piston rod seal (b)

The belt tensioning units will compensate for tolerances, thermal expansion of the driving components, belt elongation and normal wear and tear.
The belt preload is adjusted automatically during installation and service thus remaining practically constant throughout the entire engine temperature range and service life of the belt drive.

Further benefits of belt drive systems with auto-tensioning units:

- Load peaks of the belt dynamics are eliminated,
- Slip, noise and belt wear are reduced

Belt tensioners with mechanical damping function use a cylindrical helical coiled spring or torsional spring to generate the required preload of the belt.
The damping effect is achieved by means of mechanical friction. The damping component of a long-arm (a) or short-arm tensioner (b) is a flat friction plate; that of a cone-shaped tensioner (c) is a friction cone.

Installation space available will decide which type of mechanical tensioner is used.

Belt tensioners with mechanical damping function

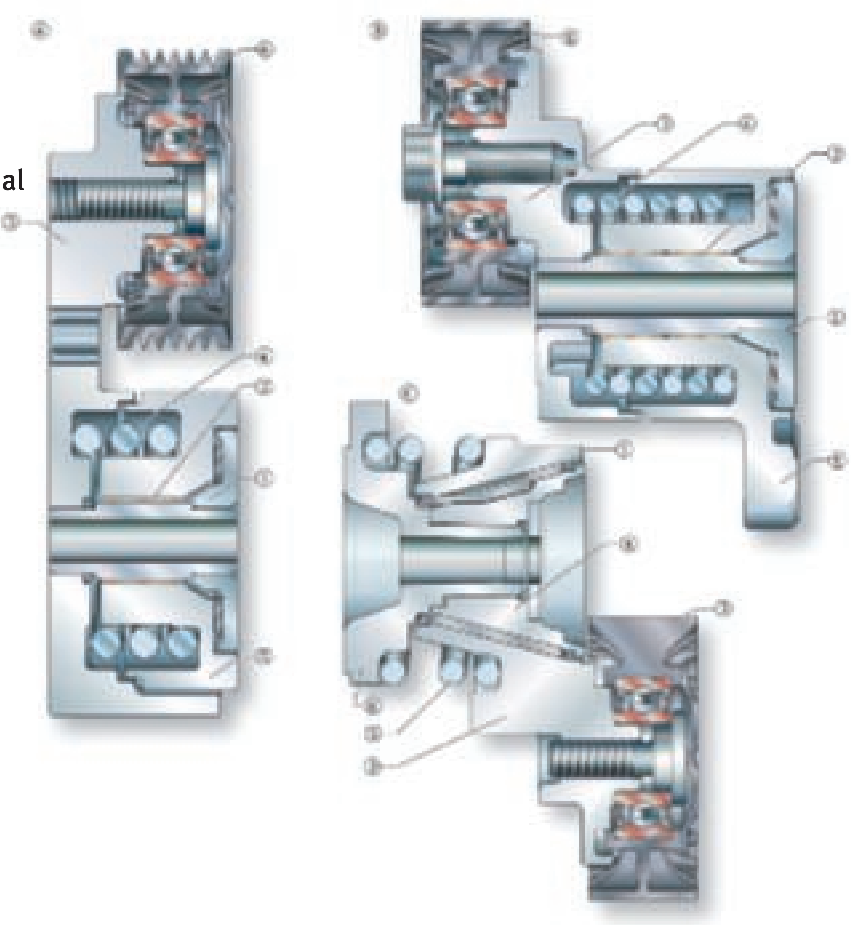
Long-arm tensioner (a)

Short-arm tensioner (b)

(1) friction plate and friction material
(2) friction bearing
(3) lever
(4) cylindrical helical coiled spring
(5) base plate
(6) tension roller

Cone-shaped tensioner (c)

(1) friction cone with seals
(2) lever
(3) tension roller
(4) inner cone
(5) cylindrical helical coiled spring
(6) base plate



Function of belt tensioning units with mechanical damping function

Belt preload

- The belt preload required is generated by the torque of the cylindrical helical coiled spring and the lever arm.

Damping

- The axial force of the spring generates the preload in the damping assembly (spring and friction plate/cone).
- With each movement, the lever arm creates relative motion in the damping assembly thereby creating friction and thus damping.

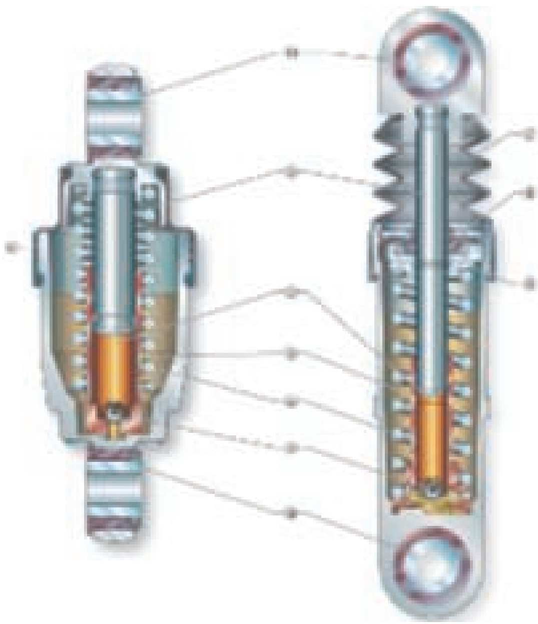
Belt preload and damping independently adjust to the respective operating conditions.

Belt ttensioning units with hydraulic damping function

Tensioning units with hydraulic damping function use the pressure spring in the hydraulic element to generate the belt preload which is transmitted via the lever to the tension roller.
The damping of the hydraulic element happens in a controlled manner and proportionally to the speed (hydraulic leakage gap damping).
Owing to the controlled damping function, hydraulic systems are especially suited to stabilize more dynamic belt drive systems (cyclic irregularities of the engine, for example diesel applications). Furthermore, the controlled damping allows for an optimisation of the belt preload.
Installation space available and operating conditions are key factors for the decision as to which hydraulic belt tensioner is to be used.

Belt tensioning units with hydraulic damping function

(1) piston
(2) high-pressure chamber/oil
(3) reservoir/oil
(4) pressure spring
(5) non-return valve
only with bellows seal (a):
(6) bellows seal
only with piston rod seal (b):
(7) protective bellows
(8) piston rod seal
(9) piston rod guide
(10) lower mounting bore
(11) upper mounting bore



Functioning of hydraulic Belt Tensioning Units

- Compressing the hydraulic element will force the oil out of the high-pressure chamber through the leakage gap thus generating damping.
- With the non-return valve separating high-pressure chamber and reservoir, there is only one direction the oil can flow (controlled damping).
- When relaxing the hydraulic element, oil is drawn from the reservoir into the high-pressure chamber via the non-return valve.
- Tensioning and damping forces are transmitted via the lever and the tension roller to the belt.
- The tensioning force can be adjusted by choosing a different pressure spring and lever ratio.
- The damping force is adjusted through the size of the leakage gap:
  → the smaller the leakage gap, the stronger the damping force.

3. Overrunning alternator pulleys

The power and compression strokes of internal combustion engines involve the acceleration and deceleration of the crankshaft. The resulting rotational irregularities of the crankshaft are transferred to the engine accessories by the belt drive and cause the rotational masses in the accessory drive to speed up and slow down continually. This has undesirable effects on the accessory drive, e.g. unacceptable noise behaviour, high tensioner and belt forces, excessive belt vibration and premature belt wear.

Each of the front–end accessories has a different impact on the overall behaviour of the FEAD system. The component with the highest mass moment of inertia, the alternator, has the biggest impact on the accessory drive. In order to decouple the alternator from the rotational irregularities of the crankshaft, INA has developed the overrunning alternator pulley. The belt pulley is mounted on the alternator shaft to be an integral part of the belt drive.

Overrunning alternator pulley on the alternator

INA overrunning alternator pulleys

- Decouple the alternator from the rotational irregularities of the crankshaft induced by internal combustions engines
- Damp out belt vibration
- Reduce the load level in the belt drive
- Improve the noise behaviour of the belt drive
- Extend the service life of the belt
- Reduce tensioner load and travel
- Increase the average alternator speed in the idling speed range
- Have an economical modular design, which includes the standard decoupling unit.

These units are predominantly used on:
- Diesel engines
- DI petrol engines
- V-engines with cylinder-bank cut-off
- Systems with low idling speeds
- Vehicles with automatic transmission and substantial gearshift shock
- Applications with increased noise requirements in the idling speed range (use of a dual mass flywheel)
- Alternators with high mass moment of inertia

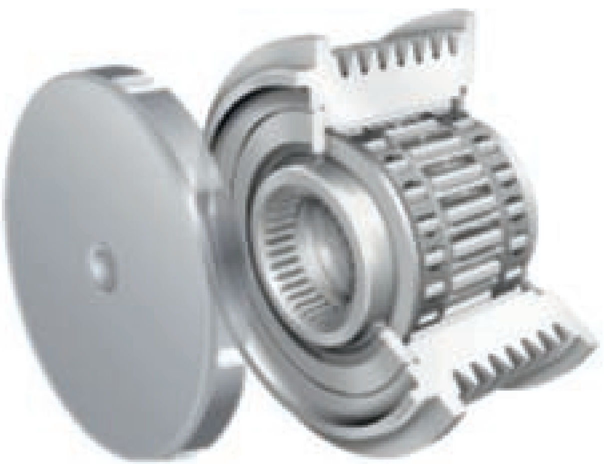
3.1 Technical characteristics and operating principle

Overrunning alternator pulleys

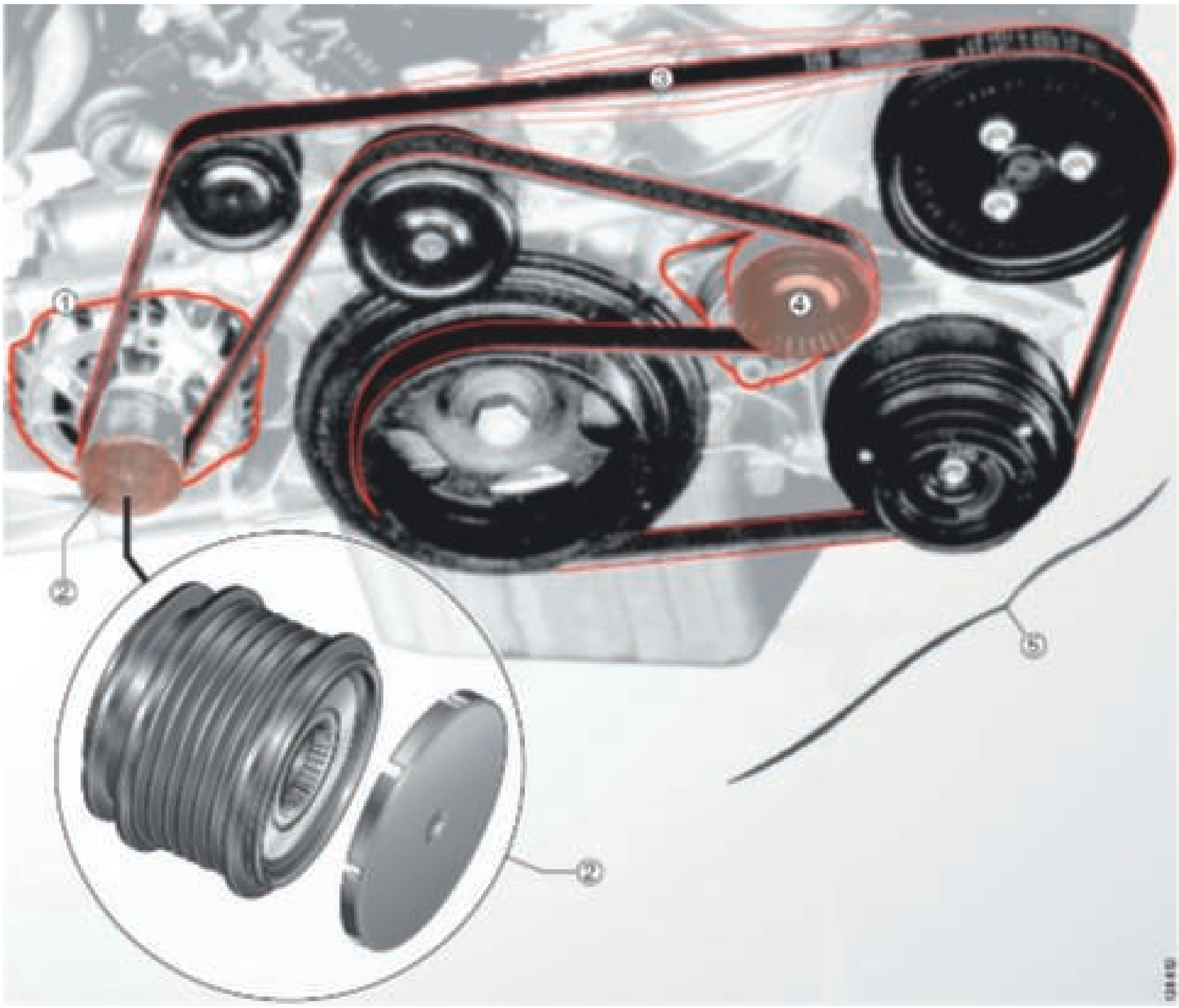
- Are modular assemblies consisting of:
  - ⇢ a belt pulley with poly V-belt profile
  - ⇢ a sleeve-type overrunning clutch unit with two radial support bearings
  - ⇢ an inner ring with centring bore to receive the transmission shaft stud, and serrated profile to transmit the tightening torque during installation
  - ⇢ seals on the alternator and front sides
  - ⇢ a protective cap on the front.
- Decouple the alternator in internal combustion engines from the rotational irregularities of the crankshaft and, in so doing, reduce the influence of the alternator mass on the belt drive
  - ⇢ In this way, the alternator is driven only by the acceleration movement of the rotational irregularity of the crankshaft.
- Possess no natural frequency unlike belt pulleys with springs or elastomer components between inner and outer ring
- Increase the service life of the belt by
  - ⇢ damping belt vibration,
  - ⇢ reducing the load level in the belt drive
- Reduce tensioner load and movement
  - ⇢ increase belt tensioner service life
- Optimise noise behaviour at idling speeds and during start/stop operation
- Prevent possible whistling noise (slip) of the belt when shifting up under full load
- Unlike rigid belt pulleys, cannot be extracted from the alternator shaft (self-locking)
- Have a modular design (standard decoupling unit). This makes it possible to meet individual customer demands quickly and economically.

Overrunning alternator pulley structure

- Belt pulley with poly V-belt profile
- Overrunning clutch unit with double bearing support
- Inner ring made from steel
- Lip-type seal on both sides
- Plastic protective cap
- Belt pulley surface with anti-corrosion protection



Typical front-end accessory drive layout



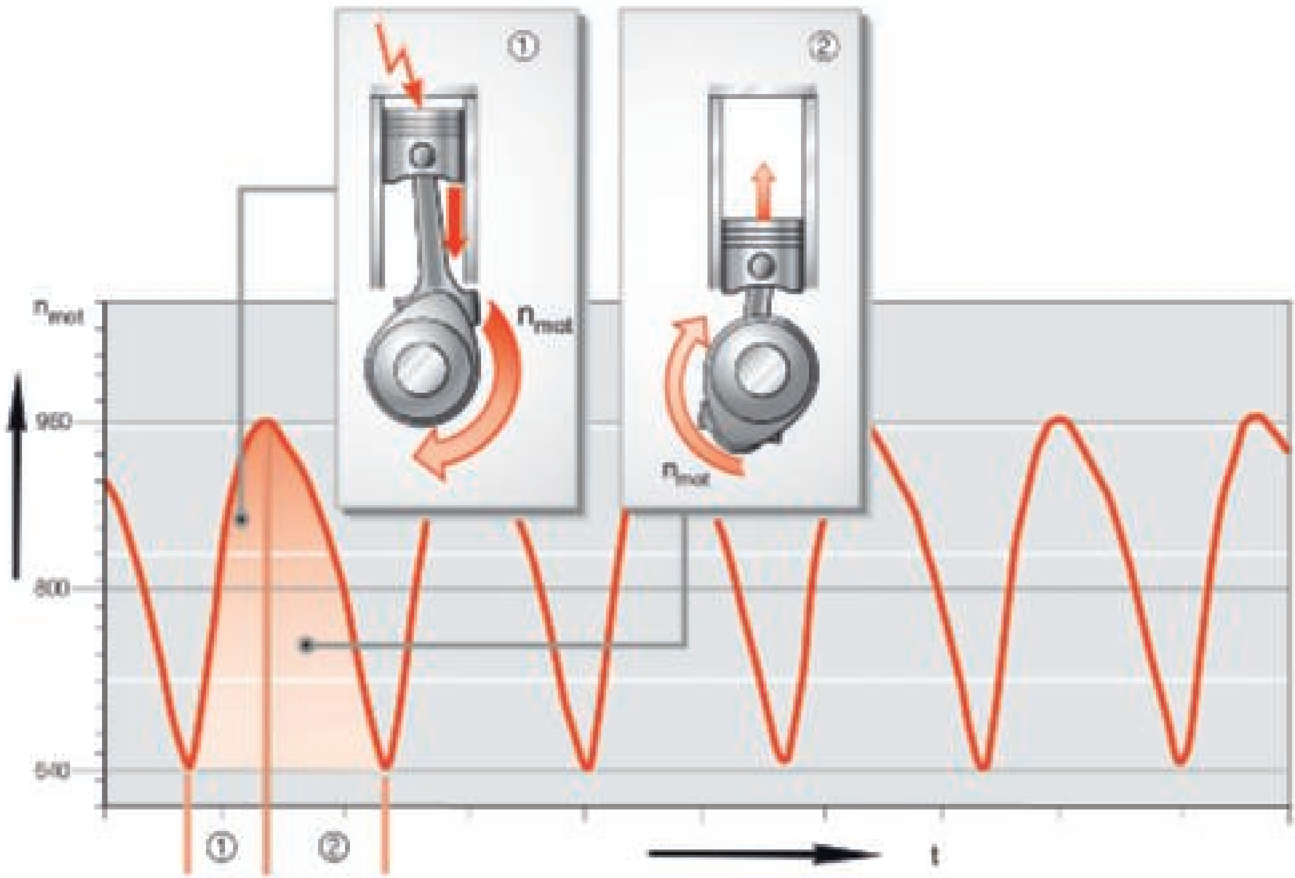
- Use of alternators with increased mass moment of inertia (1)
- Standard decoupling unit (overrunning alternator pulley) without natural frequency (2)
- Damping of belt vibration and extension of the belt life thanks to an overrunning clutch (3)
- Reduced tensioner force and travel, and therefore increased tensioner life (4)
- Extended system service life and improved noise behaviour (5)

Rotational irregularities of the crankshaft

The periodic combustion processes of IC piston engines cause a substantial rotational irregularity of the crankshaft which the belt drive transfers to the engine accessories. Irregularities result from the engine's power and compression strokes. The power stroke (1) accelerates the crankshaft while the compression and exhaust strokes (2) slow it down.

In a four-cylinder engine the frequency of the rotational irregularity corresponds to the second engine order; i.e. two ignition processes per revolution. Thus for example, the speed of a diesel engine with a 40% rotational irregularity and an average engine speed of 800 rpm varies between 640 rpm and 960 rpm at a frequency of 26.7Hz.

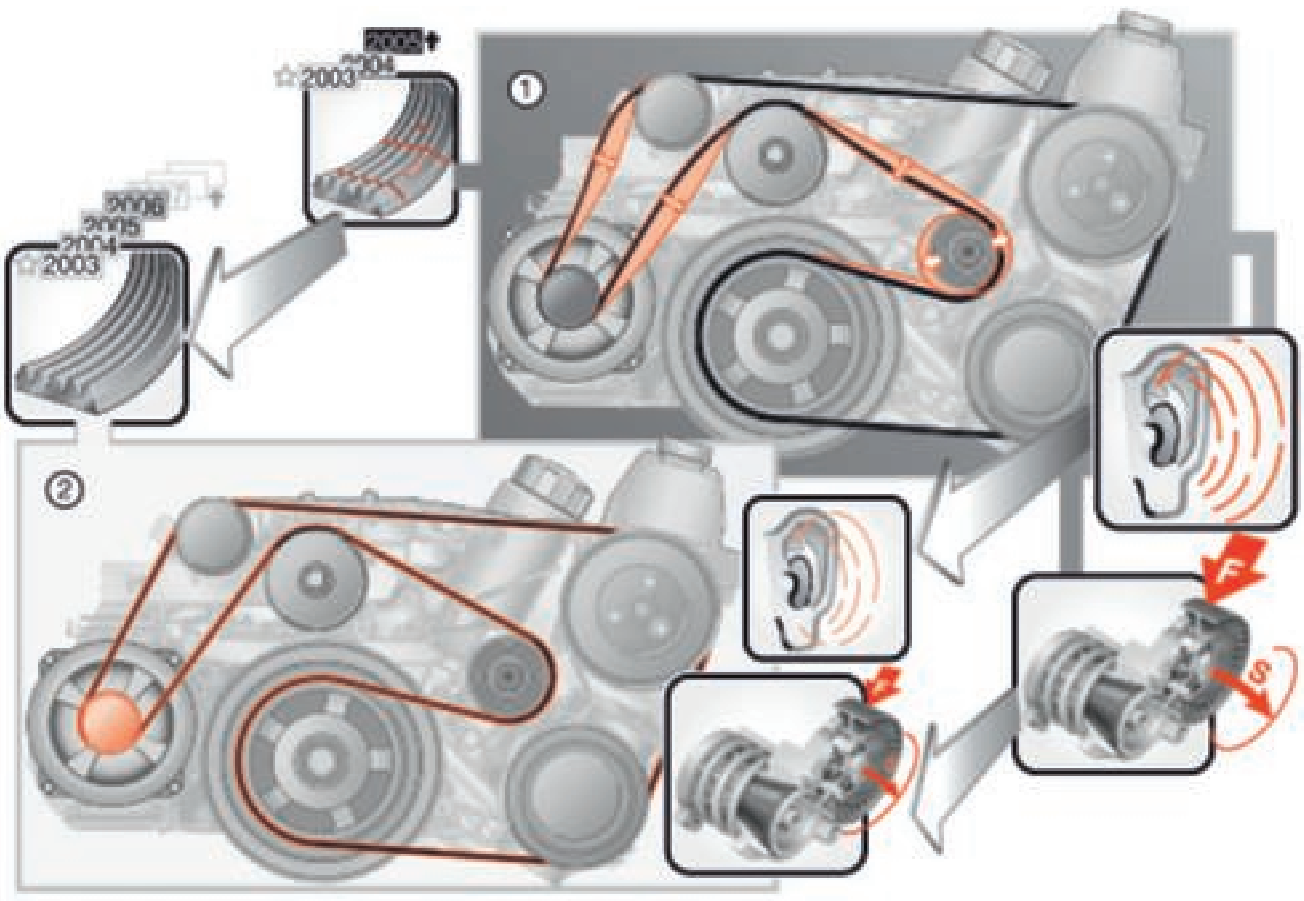
Causes of the rotational irregularities of the crankshaft



Depending on the accessory drive concept as well as the load level of the engine and the front-end accessories, the acceleration and deceleration of the masses can entail undesirable reactions in the belt drive system.

This includes for example unacceptable noise levels, high tensioner and belt forces, increased belt vibration and premature belt wear.

Effects on the front-end accessory drive

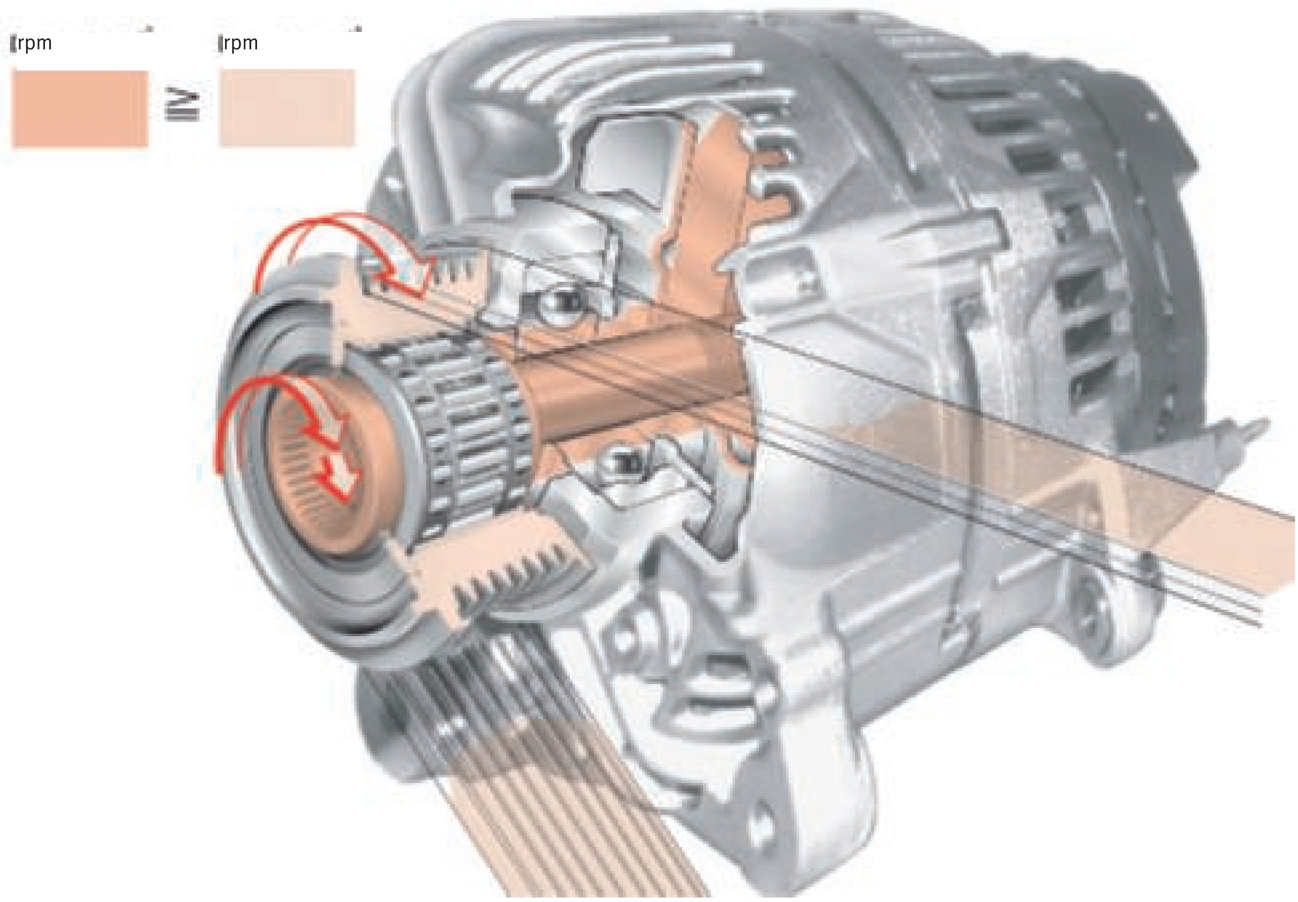


Effects on the front-end accessory drive
(1) Operating conditions *without* overrunning alternator pulley
(2) Operating conditions *with* overrunning alternator pulley

Decoupling of the alternatorr

The individual front-end accessories have a varying level of influence on the overall behaviour of the belt drive. Designed to posses the highest mass moment of inertia and also the highest transmission ratio (i = 2.5 ... 3.2), the alternator has the biggest impact on the accessory drive. The growing demand for electrical power, in addition, brings ever higher performance alternators with a generally higher mass moment of inertia and therefore greater impact on the belt drive. In order to decouple the alternator from the rotational irregularities of the crankshaft, INA has developed an overrunning alternator pulley which is mounted on the alternator shaft and integrated in the belt drive. The overrunning alternator pulley has been in volume production since 1995, which gives evidence of the company's extensive experience in volume production.

Decoupling of the alternator by the overrunning alternator pulley

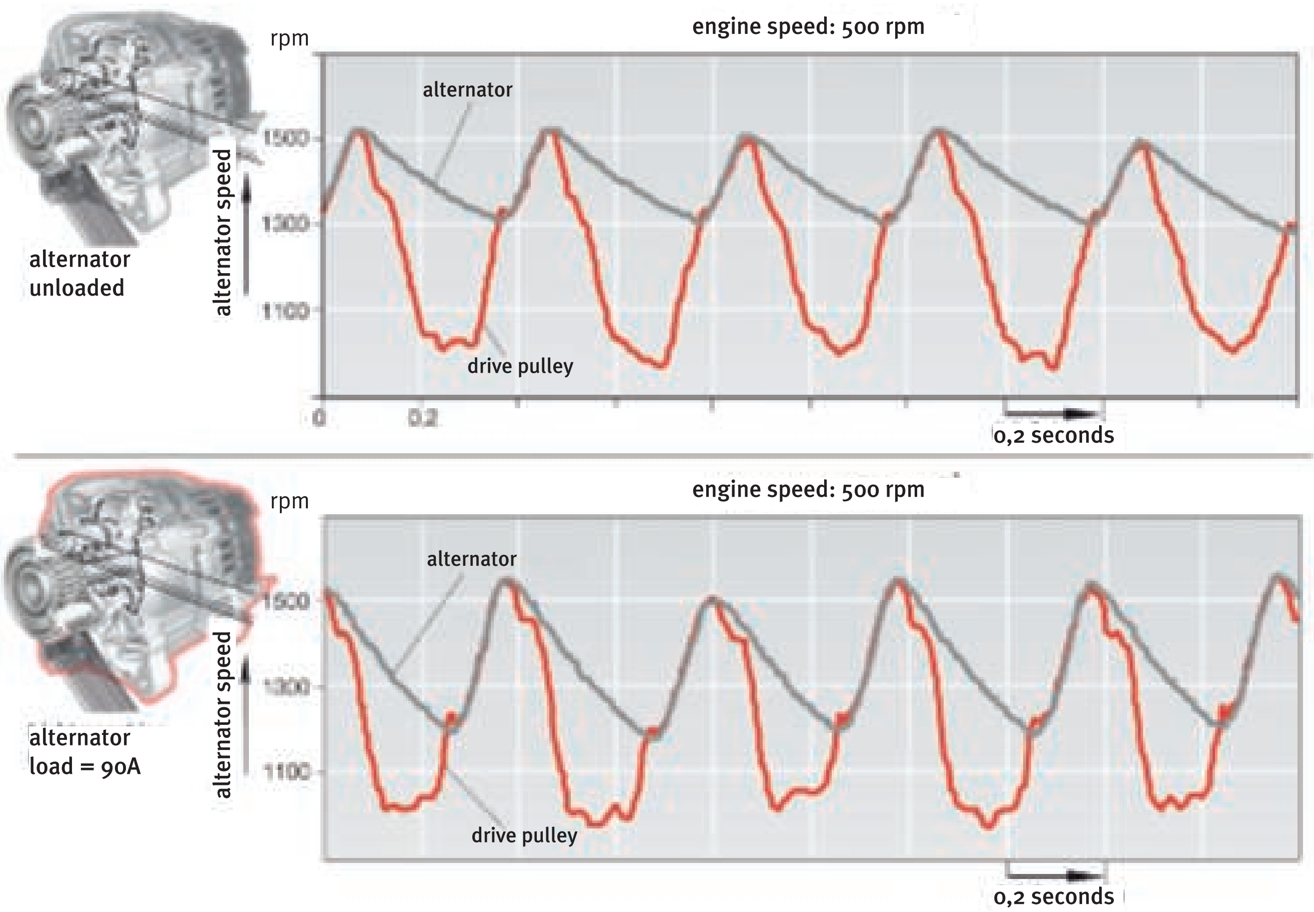


Operating principle

The decoupling effect results from the kinetic energy of the alternator rotor overrunning the belt pulley decelerated by the belt, and mainly occurs at engine speeds below 2,000 rpm. It is highly dependent on the drive concept, the amplitude of the rotational irregularities of the crankshaft, the flexibility of the belt, the electric load of the alternator and its mass moment of inertia. As a result, the alternator is driven only by the acceleration movement of the rotational irregularity of the crankshaft.

During shifting (transmission) the alternator shaft is also decoupled from the decreasing engine speed. This prevents unwanted noise due to belt slip. The current output slows down the alternator. Consequently, the speed differential between the alternator shaft and the belt pulley is slightly reduced as the load on the alternator increases. However, this does not impair the optimization effect achieved by the overrunning alternator pulley.

Impact of the overrunning alternator pulley on the alternator speed

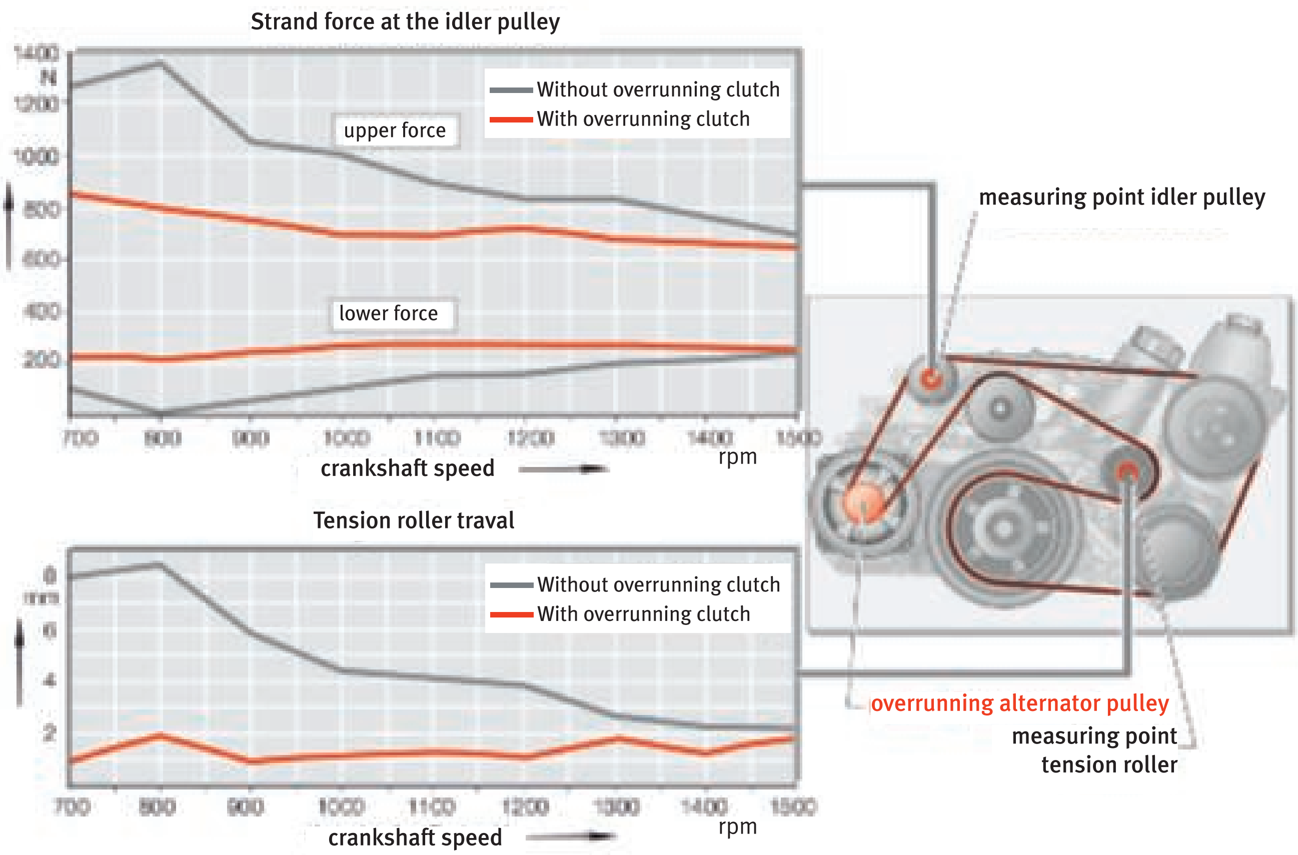


Combustion engine measurements

Sample measurements of the dynamic forces applied on the accessory drive reveal the advantages of the overrunning alternator pulley over concepts with a fixed belt pulley. Measurements were taken to determine the belt force at the idler pulley and the travel of the tension roller. Depending on the firing order, the belt force varies between upper and lower force. The results show that thanks to the overrunning alternator pulley the maximum loads could be reduced from 1,300Nm to 800Nm.

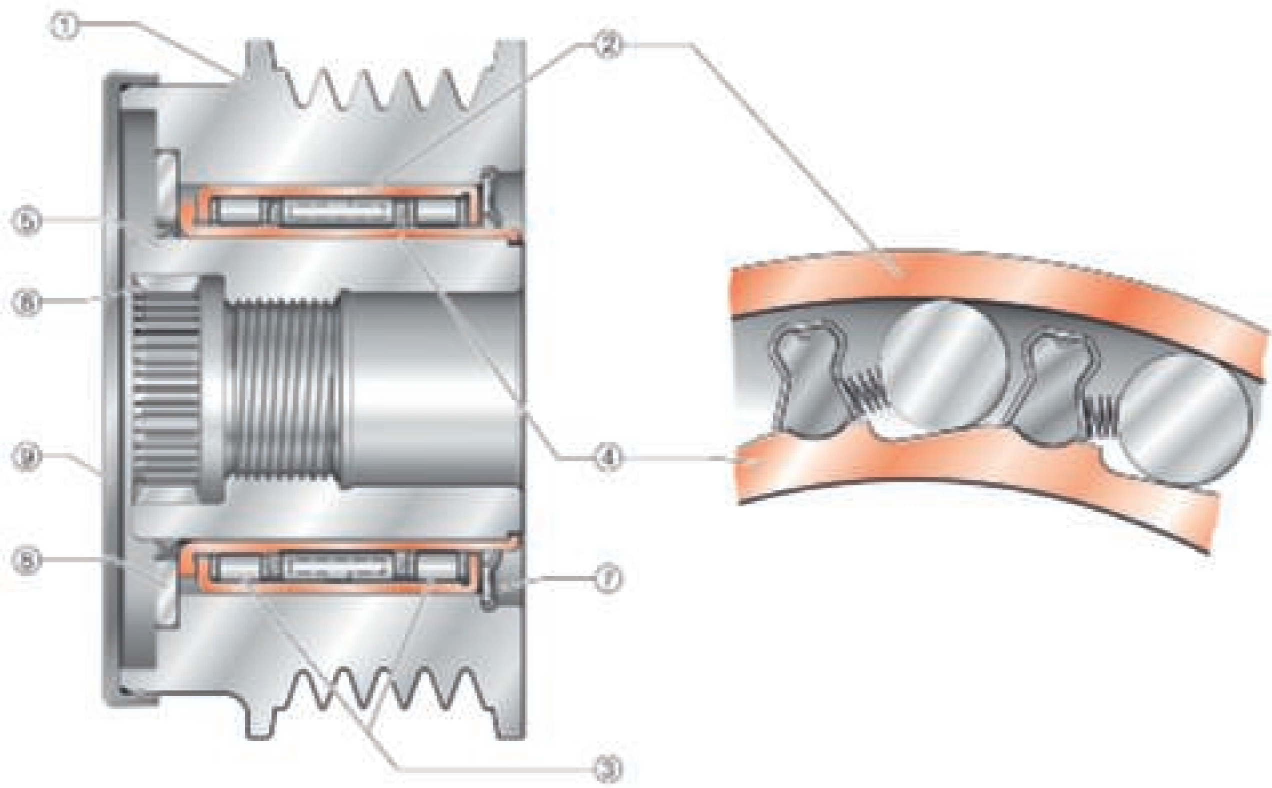
In addition, the minimal loads were slightly increased which prevents the risk of belt slip. The vibration amplitude of the belt tensioner is reduced from 8mm to 2mm. As a result, the load on the belt is considerably reduced which in turn extends belt life significantly. Load and wear reduction also increases the service life of the belt tensioner.

Idler pulley strand force and tensioner shaft travel – measured on a four-cylinder diesel engine



3.2 Overrunning alternator pulley design

INA Overrunning alternator pulley design



An overrunning alternator pulley consists of the following components: belt pulley (1), overrunning clutch unit (2) with integrated radial support bearings (3) and inner sleeve with ramp profile (4), inner ring (5) with serration (6), elastomer seal (7), thrust plate with lip-type seal (8) and plastic protective cap (9). Both inner ring and belt pulley are machined to match the required geometries. The modular design concept of INA overrunning alternator pulleys allows for a quick production setup according to the required specifications. Thanks to the axial play, the belt track is self-adjusting.

This significantly improves the noise behaviour of the belt running in the pulley profile, since the belt is not positively driven on the alternator drive pulley. The overrunning alternator bore is designed in a way that requires no changes to the alternator shaft stub. The inner ring is mounted on the shaft by a fine thread. The purpose of the serration (6) is to transfer the tightening torque. A protective cap on the front protects the overrunning clutch unit against dirt and water splash. The visible surface of the belt pulley has an anti-corrosion coating.

3.3 Overrunning alternator pulley storing and handling

Overrunning alternator pulleys must be handled with great care before and during installation. They must be installed with utmost care to ensure correct functioning.

Storing

Overrunning alternator pulleys come dry-preserved and packed in VCI paper. Store the product:

- **in its original packaging**
- **in a dry, clean room at constant ambient air temperature**
- **at a relative air humidity below 65%**

The storage life is limited due to the limited shelf life of the grease. Remove the packaging only immediately before installing the overrunning alternator pulley. When using dry-preserved parts from a multipack make sure to re-seal the packaging. The protective vapour phase generated by the VCI paper can only be maintained, if the packaging is thoroughly closed.

Removal

To remove an overrunning alternator pulley one of the following tools must be used – depending on the installation situation and on the space available use either the long or short special tools.

Installation

Handling
Depending on the customer requirements, overrunning alternator pulleys are supplied in either singularly or in multi packs. The belt pulley and inner ring of the overrunning alternator pulley are lathe-cut non-cured components made from free-cutting steel. To avoid damage, in particular on the poly V-profile, handle the parts with great care.

Installation on the alternator
To install the belt pulley apply a tightening torque of 80Nm (max. 85Nm) using a torque wrench.

Mounting of the protective cap
The inner or outer snap-fit protective cap requires a force of approx. 10N. It is easy to install by hand and is fitted to in a number of volume production items. The protective caps must only be used once, since they can easily be damaged during removal. Installing an overrunning alternator pulley without protective cap is not permissible due to the resulting lack of sealing.

Mounting tool - short

Torx
Part no.: 400 0235 10

Multipoint
Part no.: 400 0234 10

Mounting tool - long

Torx
Part no.: 400 0201 10

Multipoint
Part no.: 400 0200 10

3.4 Function test

It is very difficult to evaluate the functioning of an overrunning alternator pulley while it is mounted. It is therefore recommended to uninstall the overrunning alternator pulley first.

Function test

1

→ Clamp the inner ring between thumb and index finger of one hand

2

→ Close your thumb and index finger around the outer ring

3

→ Rotate the outer ring in the driving direction of the alternator while holding in place the inner ring. The outer ring will not move, if the part works properly

4

→ Rotate the outer ring against the driving direction of the alternator while holding the inner ring in place. The outer ring can be moved against slight resistance, if the part works properly.

→ If one of the two tests fails, the overrunning alternator pulley must immediately be replaced.

End stop damaged, stop-pin distorted/broken

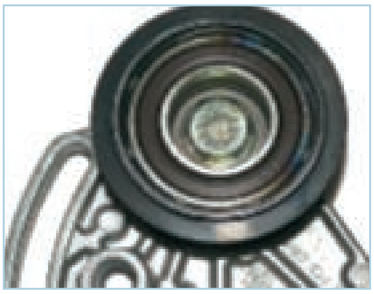
Cause:
⇢ Incorrect setting of tension roller.

- **Incorrect fitting**


Signs of "temper colour" leading from fringe to centre

Cause:
⇢ Belt slip

Note:
Defect in the belt drive caused by front-end accessory not working properly, for example water pump, or insufficient belt tension.

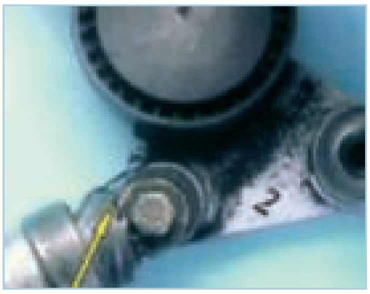



Fouling marks on the outside of the tension roller/idler caused by the belt

Cause:
⇢ Misalignment

Note:
Belt runs off centre, may be caused by a faulty water pump bearing etc.


Mounting bore of hydraulic belt tensioner damaged



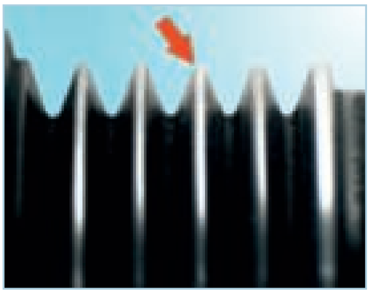
Cause:
- Belt tensioner unit life exceeded
- Fixing bolt on mounting bore was released and not torqued down again correctly
- Defective OAP (if fitted)

Oil loss at bellows seal of hydraulic belt tensioner

Cause:
- Split in the bellows

- **Incorrect fitting**
  Bellows was damaged during installation

Profile tips heavily worn



Cause:
- Insufficient tension in the FEAD makes the belt slip over the overrunning alternator pulley
- The OAP is not functioning correctly

Guides worn off

Cause:
- Misalignment between the rollers and accessories
- Belt installed incorrectly

Important: Always observe the scheduled intervals for checking and replacing of belt drive components as specified by the manufacturer

Timing drive – servicing checklist

1. Check the condition of the toothed belt.
2. When has the toothed belt last been replaced and at what mileage?
3. Do you have the vehicle's inspection record? Has the car been serviced regularly?
4. Is the vehicle used in demanding operating environments, requiring shorter replacement intervals for components of the timing belt drive?
5. Are accessory components in the environment of the toothed belt in good shape, for example camshaft, water pump, power steering pump or does a part emit noise?
6. Use a measuring device to measure the belt tension in systems with "rigid" tension rollers and adjust if necessary.
7. Check plastic running pulleys for signs of wear.
8. Check bearing seals for signs of leakage.
9. Check parts for signs of corrosion.
10. Does the overall condition of the toothed belt allow you to guarantee for a failsafe operation until the next scheduled service?

Note:
A faulty toothed belt can cause enormous damage to the engine and entail considerable repair costs. The costs for the replacement of a toothed belt are by far lower than the repair costs of a damaged engine caused by a faulty timing belt. There must not be any doubt as to the reliability of the timing belt. If unsure, always advise the customer to have the belt replaced.

Timing drive – possible causes of failure

- Belt tension too tight or too slack,
- Impurities in the belt drive,
- Belt edges worn out,
- Tooth flanks of the belt worn out,
- Dry bearing sealing lip causes seal squeal,
- Reduced bearing clearance below limit caused by the deformation of the bearing inner ring:
  → Wrong tightening torque,
- Pulleys' running surface damaged,
- Bearing grease too old.

Accessory drive – servicing checklist

1. Check the condition of the poly V-belt.
2. Check the settings of the automatic belt tensioners.
3. Use a measuring device to measure the belt tension in systems with "rigid" tension rollers and adjust if necessary.
4. Check the condition of the grooved rollers.
5. Make sure, protective covers are used.
6. Check the mounting bores of hydraulic tensioning units for damage and the bellows seal for oil loss.
7. Check the belt tensioner is free to rotate through its range of movement.
8. Check parts for signs of corrosion.

Accessory drive – possible causes of failure

- Belt tension too tight or too slack,
- Impurities in the belt drive,
- Poly V-belt worn out,
- Belt profile partially fractured,
- Dry bearing sealing lip causes seal squeal,
- Pulley bearing lost grease:
  → Protective cover missing!
- Hydraulic belt tensioner damaged:
  → Oil loss of the belt tensioning unit,
- Overrunning alternator pulley damaged:
  → Poly V-belt flaps and squeals!

Notes

Notes

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