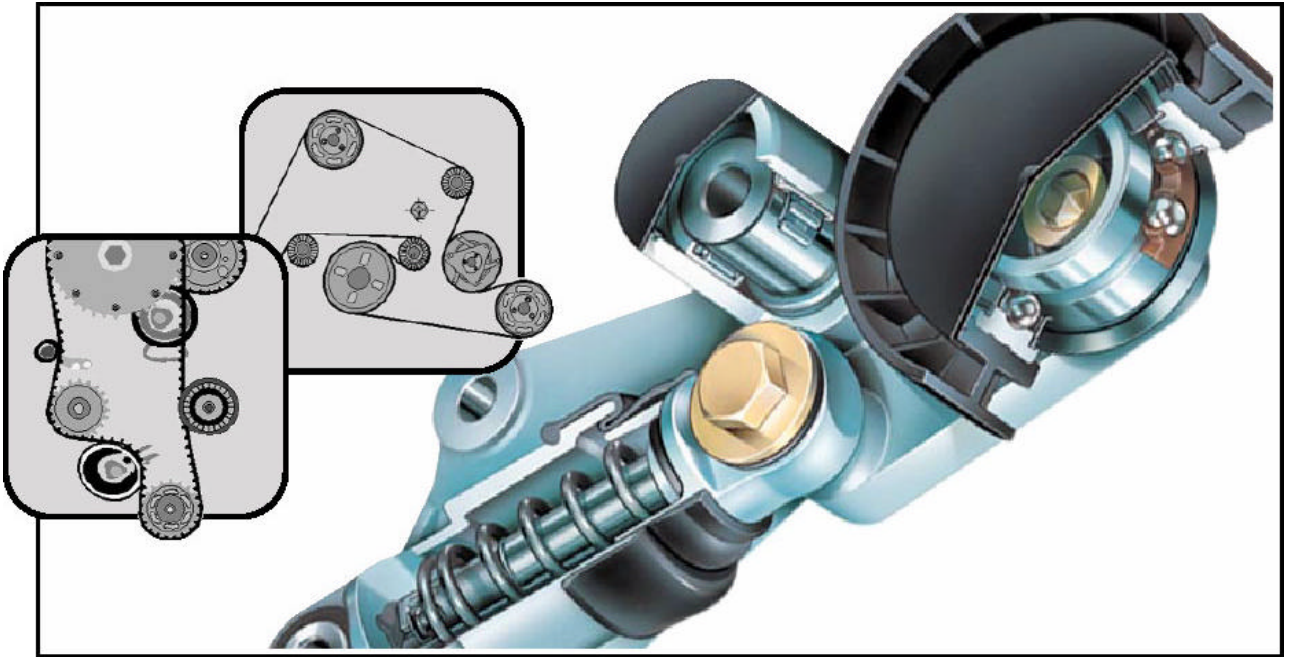


Belt Drive Components

Product Information

Belt Drive Components

Foreword

INA belt drive components are essential elements in motor vehicles which are used in both petrol and diesel engines and make a significant contribution to a comfortable drive.

Belts and their associated elements are subjected to extremes of demands in petrol and diesel engines such as high speeds, oscillations and extreme temperatures.

This can have a negative effect on the function of tensioning elements and idler pulleys.
Cracks under the surface of the metal, overheating and worn out seals in the bearing lead to increased abrasion as well as blockages in the tensioning elements and idler pulleys.

If the control drive fails while the engine is running, this usually leads to damage to the engine and substantial repair bills for the owner of the vehicle.

In ancillary drives with V-ribbed belts, failure does not normally have any influence on the function of the enginer but damage can cause a substantial detrimental influence on the driven ancillary units. For example, the power steering pump can fail and as a result, the steering wheel becomes difficult to move.

It is therefore recommended that **all** belt drive components which are required for correct function of a belt drive are replaced at the service intervals stated by the manufacture.

We have produced this brochure in order to provide information on INA products in this field and to show the technological know-how associated with these products.
INA's aim is to substantially optimize the operating life of our products. Our products are constantly improved and inspected through tests and simulations at our research and development centre in Herzogenaurach.

Operating life and functional test rigs are set up here and test are carried out on our products in conjunction with the engine or vehicle manufacturer.

Belt Drive Components

Contents

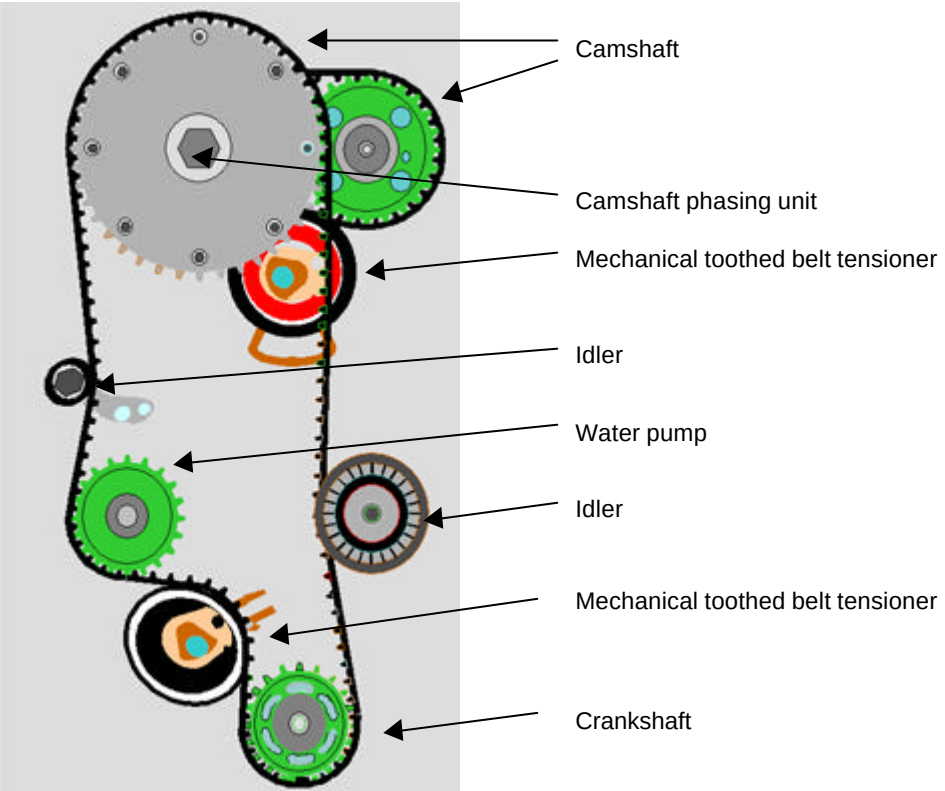
Belt Drive Components

Product Overview

BSR	Belt tensioner
BSRE	Belt tensioner with eccentric hole in the stud
BSRS	Belt tensioner with back plate
GPL	Base plate
HEB	Lever
KA	Cap
LS	Washer
RSH	Hydraulic belt tensioner
RSM	Mechanical belt tensioner
RSEM	Mechanical belt tensioning unit
RSEMZ	Mechanical belt tensioning unit for toothed belt drive
RSEMZK	Mechanical belt tensioning unit with centrally mounted cone type tensioner
RSEH	Hydraulic belt tensioning unit
RSU	Undamped belt tensioner for all positions
RSEU	Undamped belt tensioning unit for all positions
RMSE	Over-running alternator pulley
SHR	Screw

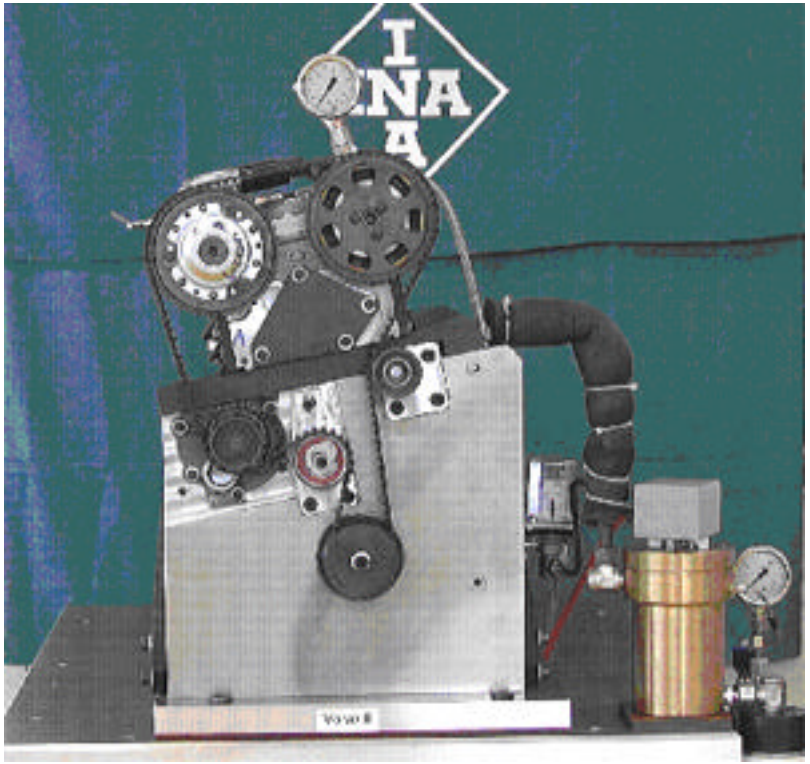
Primary Drive

System diagram



Primary Drive

Simulation and measuring test rig



Simulation test rig for primary drive with camshaft phasing unit

The aim of the test rig is to test the function of the primary drive and to test it over an extended period. The attached measuring devices retain the measured results.

The test rig comprises an original cylinder head and an original primary drive. An electric motor provides the drive and the oil supply is regulated by an external oil pump.

The measured values are the belt tension force on the tensioning path, the speeds on the camshaft and the crankshaft and the toothed belt oscillations.

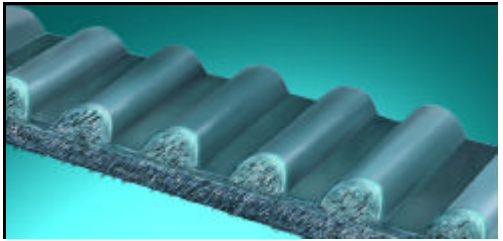
This allows possible defects or problems to be eliminated before the engine is put into bulk production.

Primary Drive

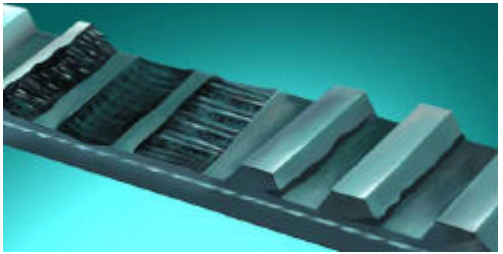
Possible causes of failure and precautions against failure

Possible causes of failure

Failure	*Cause*
Running noise in belt drive	• Belt tension too high • Contamination in belt drive • Edge wear on belt • Wear on tooth flank on belt • Pulley out of alignment
Bearing noise in tensioner or idler	• Seal squeak due to dry sealing lip (come to end of life!) • Impermissible reduction in bearing clearance due to deformation of the inner ring due to excessive tightening torque on the fixing screw • Pulley on the belt tensioner or idler damaged • Grease operating life achieved



Edge wear on belt



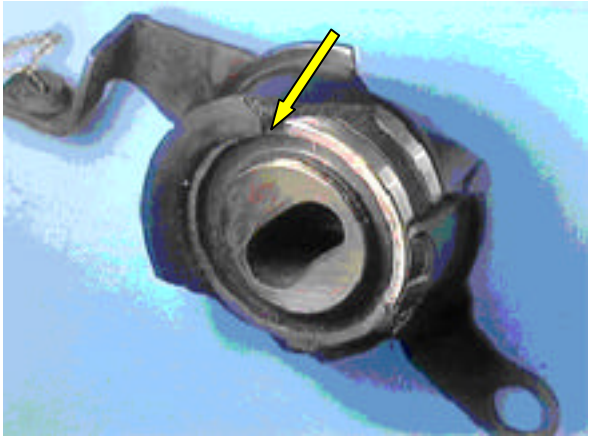
Wear on tooth flank on belt

Precautions against failure

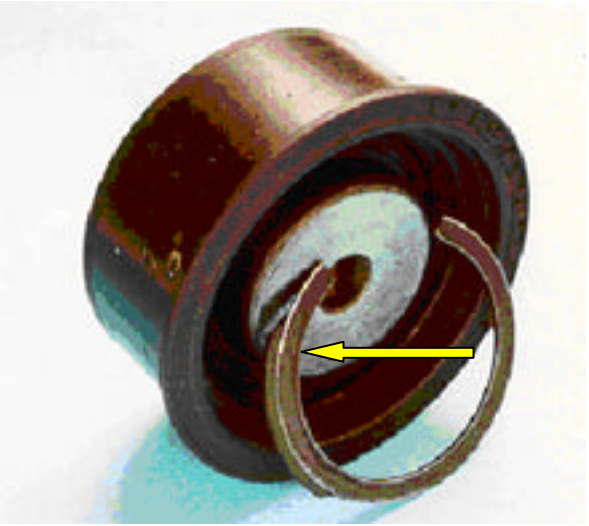
1. Check condition of belt
2. Check correct adjustment on automatic tensioners
3. Reduce tension on fixed tensions with special measuring device
4. Check components for corrosion

Primary Drive

Possible causes of failure and precautions against failure



Pulley on tensioner broken



Sealing ring detached from idler

Primary Drive

Advantages of INA products

BSR, BSRE, BSRS (also applies to ancillary drives!)

- Long operating life due to increased grease volumes in specially designed bearing
- Designs with optimized mass and pulleys made from plastic
- Reduced frictional losses in the bearing for pulleys with steel half shell
- Low noise levels

RSEMZ

- Straightforward, semi-automatic adjustment of required belt tension during assembly
  - ⇒ Compensation of diameter and positional tolerances on individual pulleys and length tolerances on the toothed belt due to adjustable eccentric
- Retention of a virtually constant belt tension under all operating conditions and over the entire operating life of the belt and tensioner
  - ⇒ Compension of thermal expansion, wear and settling of the toothed belt
- Minimizing of noise and belt oscillation
- Jumping of teeth avoided due to integral return stop

INA tensioners and idlers

Mechanical belt tensioning unit for primary drive components

Primary Drive

Tips for fitting INA products

BSR, BSRE, BSRS (also applies to ancillary drives!)

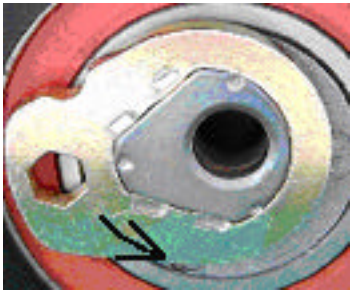
1. Check the pulley functions correctly before each fitting by lightly rotating by hand
2. Before fitting the new pulley, check the mating surface on the engine is clean
3. Clean the fitting point with a cloth if necessary
4. If tightening the pulley or bracket with a tool:
   Note: do not tilt!
   There is a danger that the belt will slip off or wander during operation
5. Always tighten the pulley or bracket with a torque wrench so that the correct tightening torque is achieved and not exceeded

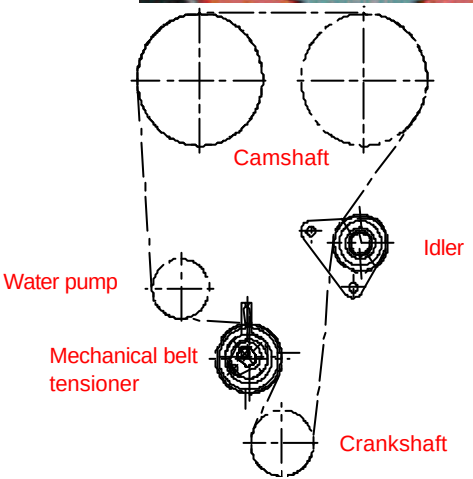
Primary Drive

Tips for fitting INA products

RSEMZ

1. The new tensioner is placed in the appropriate position in the engine. The locating feature must engage at the specified position on the engine block or cylinder head. Care should be taken that the mating surface is clean.
2. Tighten the fixing screw on the tensioner by hand and ensure that the assembly is not tilted. It is recommended the screw thread is checked to ensure it is in perfect condition. Rotate the tensioner as far as possible away from the drive by moving the eccentric adjuster in the opposite direction to the arrow.
3. Now put the toothed belt in place.
4. Rotate the adjusting washer with the corresponding tool until the indicator on the eccentric adjuster is in the „nominal position“ i.e. the positions of the indicator and the locating feature coincide.
   Note the direction of adjustment (arrow) on the adjusting washer (see figure).
5. While holding the adjusting washer with a tool, tighten the fixing screw on the tensioner with a torque wrench to the specified tightening torque



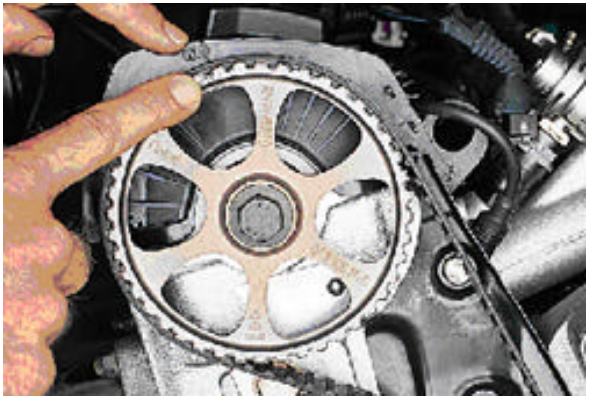


Fitting arrangement for a toothed belt tensioning unit RSEMZ

Primary Drive

Changing a toothed belt

1. Disconnect the earth lead from the battery.
2. Remove all drive belts, pulleys and hoses which would hinder removal of the belt cover.
3. Remove the cover and the toothed belt.
4. Rotate the crank shaft in the engine's direction of rotation to the "Top Dead Centre" position and align the marking on the engine housing with the marking on the crank shaft wheel and camshaft wheel.



5. Clamp the camshaft using the correct special tool.
6. Now loosen the fixing screws on the relevant tensioner(s) and remove these.
7. Remove the existing toothed belt.
8. Then remove any idlers which are present.
9. Fit (if necessary) the new idler(s) at the relevant position and tighten these to the specific tightening torque using a torque wrench.
10. Put the new toothed belt in place.

Primary Drive

Changing a toothed belt

11. Rotate the crank shaft through at least two complete revolutions in the engine's direction of rotation in order ensure optimum tensioning of the toothed belt by the tensioner.
12. Check the belt tension again. Adjust the tensioner(s) if necessary and repeat the relevant steps.
13. Fit the toothed belt cover and all drive belts, pulleys and hoses which have been removed.
14. Reconnect the earth lead to the battery.
15. Start the engine and check for any unusual noises.

Belt drive system with „rigid“ tensioner

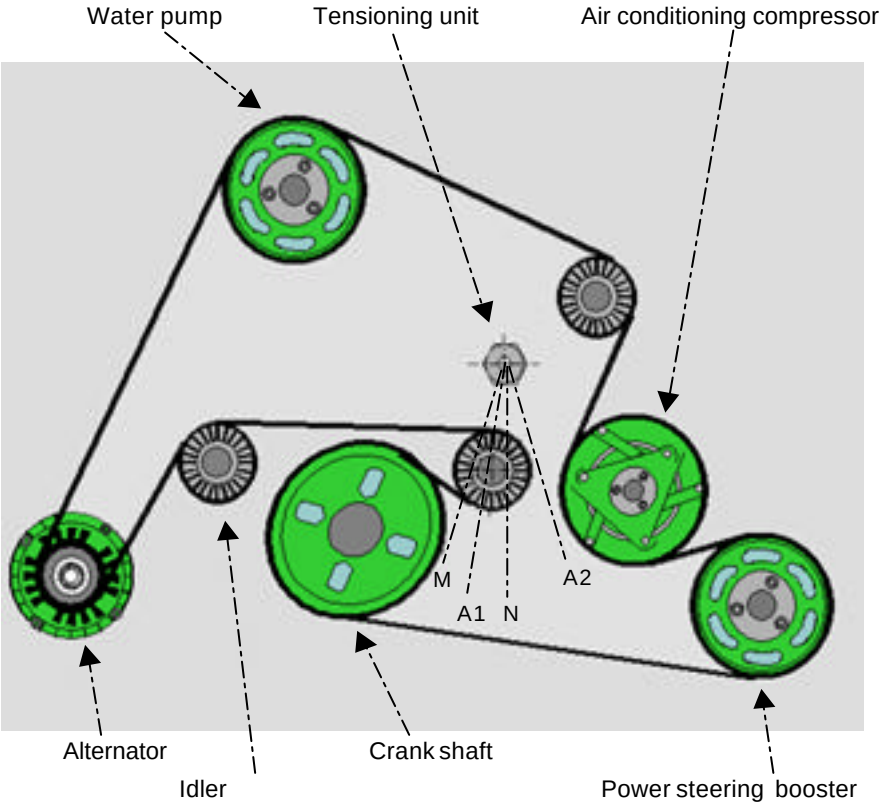
1. Place the new tensioner(s) in the correct position and tighten by hand.
2. Tension the toothed belt in accordance with the manufacturer's specification. Adjust the tension as required, tightening the fixing screw to the correct tightening torque with a torque wrench. Check the tension with a suitable tension checking device. The values can be taken from, for example, a workshop manual for changing toothed belts.

Belt drive system with semi-automatic belt tensioner

Note: In this instance, please go to section *Tips for fitting INA products*, page 11.

Ancillary Drive

System diagram



M: Belt assembly

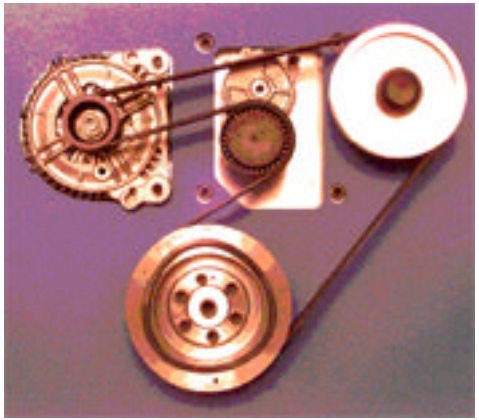
A1: Star of work area

N: Nominal position

A2: End of work area

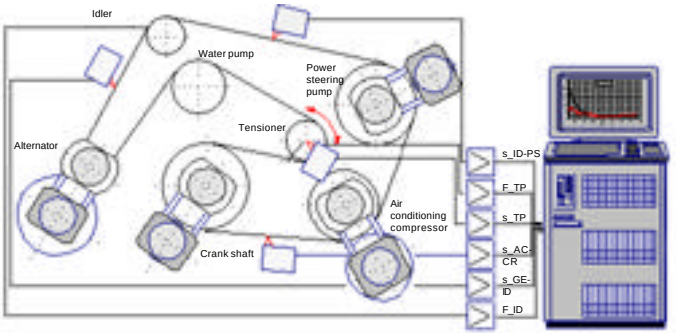
Ancillary Drive

Simulation and measuring test rig



Simulation test rig for ancillary drive

A special electric motor drive the crank shaft belt pulley taking into consideration the calculated or, if available, the measured irregularity of the simulated engine.
The idler and the alternator are driven by a belt, a mechanical belt tensioner (RSM) supplies the correct belt force and damps oscillations in the drive.
This type of simulation test rig allows belt drives to be tuned whilst dispensing with the requirement of an internal combustion engine.



Component drive with measuring equipment

s: Distance
F: Force

Online representation of slip

AD converter period measurement
16 bit / 33 MHz
2 CPU / 25 MHz
2 FPU (Weitek)
1 Vector processor
24 MB RAM
1 GB hard disk

Electronic measurement of slip on a belt drive for an ancillary unit

Values for all relevant positions on the belt drive are electronically determined here and evaluated on a computer so that slippage points can be clearly identified.

Ancillary Drive

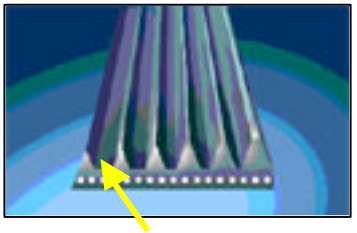
Possible causes of failure and precautions against failure

Possible causes of failure

Failure	*Cause*
Vee-belt squeaks, flaps or knocks	• Wear belt • Belt ageing (micro cracks in the profile) • Pulley not aligned • Defective tensioner (possible spring fracture in mechanical tensioner or oil loss in hydraulic tensioner) • Defective overrunning alternator pulley if present (clutch wil not function) • Conatmination in belt drive
Bearing noise on tensioner or idler	• Seal squeak due to dry sealing lip (come to end of life!) • Impermissible reduction in bearing clearance due to deformation of the inner ring due to excessive tighteining torque on the fixing screw • Pulley on belt tensioner or idler damaged • Grease loss possibly due to incorrect engine wash down (end cap present?) • Inadequate grease operating life

Precautions against failure

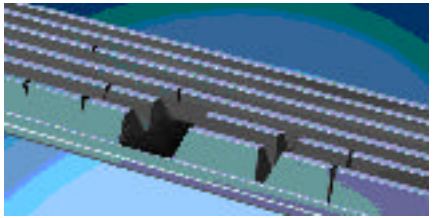
1. Check condition of bee-belt.
2. Check components for corrosion.
3. Check condition of profiled tensioners and idler (if present).
4. End cap present?
5. Check for oil traces in hydraulic tensioners and check condition of fixing eye.
6. Check tensioner for movement.



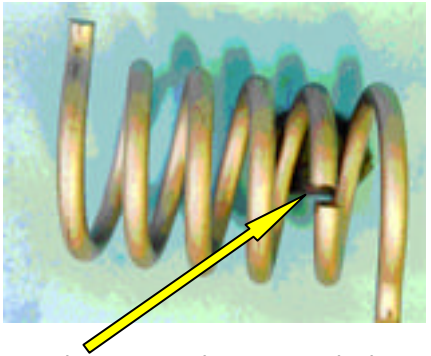
Worn Vee-belt

Ancillary Drive

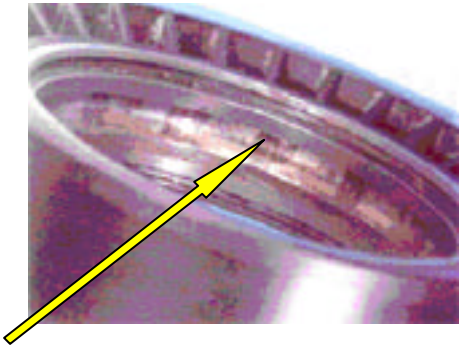
Possible causes of failure and precautions against failure



Incipient fractures and cracks in the belt profile



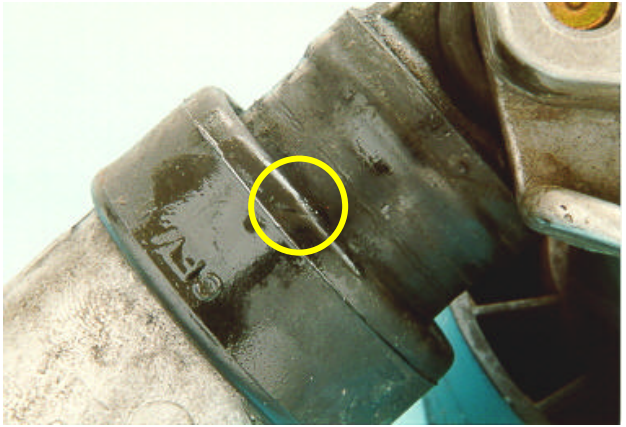
Broken spring on a tensioner or tensioning unit



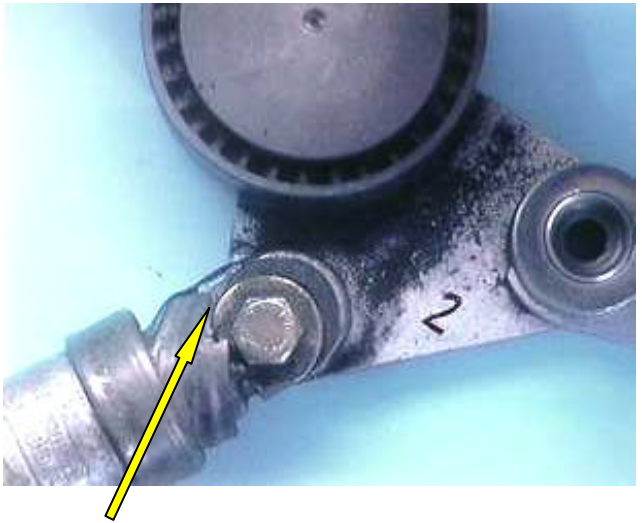
Corrosion in the rolling bearing raceway on the outer ring

Ancillary Drive

Possible causes of failure and precautions against failure



Oil loss in hydraulic belt tensioner on sealing bellow due to cracks



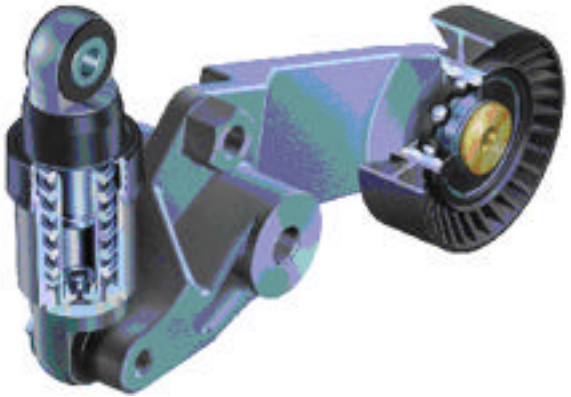
Broken fixing eye

Ancillary Drive

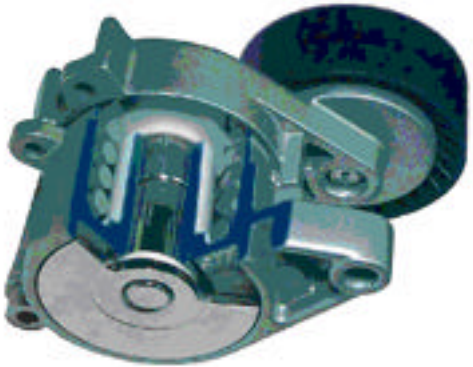
Advantages of INA products

RSH, RSEH →

- Automatic adjustment of required belt tension during assembly
  ⇒ Tolerance compensation!
- Constant belt tension over the whole operating life of the belt and tensioner
  ⇒ Compensation of belt lengthening and belt wear
- Smoothing out of force peaks (dynamic) in belt drive
- Minimization of slip and noise
- Reduced axial space requirement



Hydraulic belt tensioning unit for ancillary drive



Mechanical belt tensioning unit for ancillary drive

← **RSM, RSEM**

- Compensation of wear
- Damping irrespective of position
- Constant belt tension over the whole operating life of the belt and tensioner
- Minimization of slip and noise
- Reduced axial space requirement
- Compact design

Ancillary Drive

Advantages of INA products

RMSE

- Provides decoupling for the alternator from irregularities in rotation of the crank shaft
- Mainly used in vehicles with diesel engines, twin mass flywheel, automatic gearboxes with severe shift jolt and alternators with high moments of inertia
- Smooths out belt oscillations
- Reduces tensioning distances
- Increases belt operating life
- Reduces force levels around vee-belt drives
- Improves noise behaviour in the belt drive

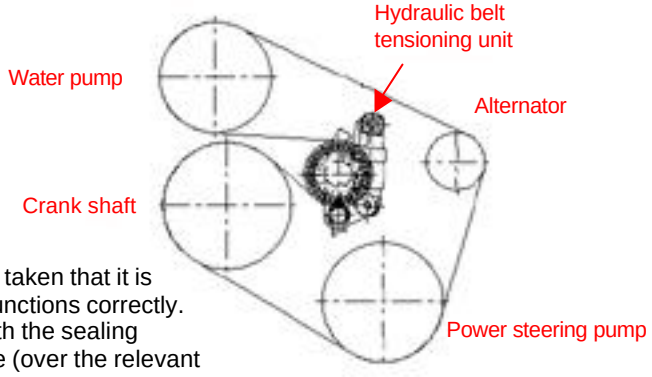
Over-running pulley with end cap

Ancillary Drive

Tips for fitting INA products

RSH, RSU, RSEH

1. For levers with a bearing arrangement on the swivel point, check whether all components are firmly connected to each other.
2. If the hydraulic belt tensioner is already on the lever, check that the complete hydraulic belt tensioning unit is not tilted at more than 45° to the vertical axis as there is otherwise a danger of the high pressure chamber emptying. Care should be taken in general that the hydarulic belt tensioner is always supported vertically.
3. When fitting the hydraulic belt tensioner, particular care should be taken that it is fitted with the correct orientation in order to ensure the tensioner functions correctly. The hydraulic belt tensioners are marked with an arrow underneath the sealing bellow to ensure correct orientation. When putting the belt in place (over the relevant loading point on the base plate), it must be swivelled as the required force is otherwise too great.
4. The correct tightening torque is also important when fitting hydraulic belt tensioners and hydraulic belt tensioners for any installation position in order to avoid „squashing“ the fixing eye and thus ensuring the swivel point bearing arrangement on the lever can function correctly.
   Always use a torque wrench!



Note: The tensioning unit must always be changed as a complete unit (lever with pulley and tensioner) as this is the only way to achieve correct tensioning of the belt.

Ancillary Drive

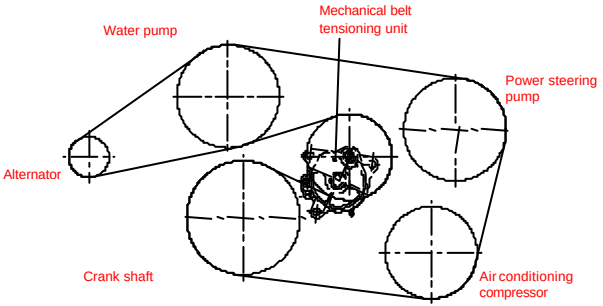
Tips for fitting INA products

RSM, RSEM

1. Before fitting the new tensioner, check that the mating surface on the engine is free of contamination. Clean the mating surface if necessary with a rag.
2. Always use a torque wrench for tightening the tensioner in order to achieve the correct tightening torque.
   Now place the belt around the relevant ancillay drive pulley and the idler and „unlock“ the tensioner by pulling out the split pin (if present).
   When unlocking the tensioner, the tensioning arm must be held against its actuation direction and then slowly moved against the belt.
4. It is important to ensure that the belt is around the tensioner before it is „released“ and it is only then that the split pin (if present) should be removed in order to „unlock“ the tensioner and bring it to its functional position.

Note: The complete tensioning unit (tensioner and pulley) must always be replaced as the pulley cannot be dismantled.
The pulley is fitted with a self-tapping screw and is also secured against rotation with thread locking compound.

„Unlocking “ a mechanical belt tensioning unit



Installation position for a mechanical belt tensioning unit in an ancillary drive

Ancillary Drive

Tips for fitting INA products

RSME

1. The washer and the inner ring on the over-running pulley are turned components and are **not** hardened.
   ⇒ Take care during handling (vee-belt profile)!
2. Miniscule scratches on the surface of the washer cannot be completely avoided due to the low coating thickness (3-10 µm) and are permissible.
3. The tightening torque for fixing the over-running pulley to the alternator is 80 ±10 Nm. Fitting is determined by the frictional torque and the angle of rotation.
4. The spline fitting tool according to DIN 5481-17x20 must be hardened.
5. The end cap supplied with the delivery can be easily fitted by hand and may **not** be used more than once.
   The over-running pulley must **not** be used without the end cap as the sealing is otherwise inadequate.
6. The maximum permissible imbalance once coupled is 20 gmm.
7. The over-running pulley can be dismantled from the alternator shaft using the fitting tool described above.

Alternator with fitted over-running pulley and end cap

Ancillary Drive

Changing a vee-belt

Note: If an over-running alternator pulley is used in an ancillary drive, change this as described on page 23.

Belt drive with „rigid“ tensioner

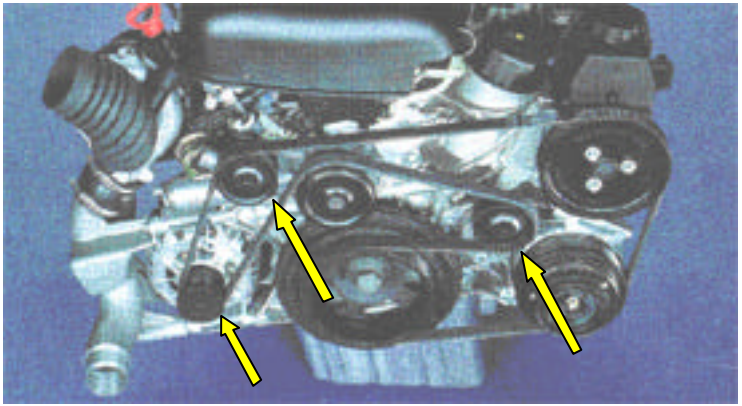
1. Note the course of the belt (drawing a sketch helps!).
2. Loosen the tensioner and rotate this away from the drive so that tension on the belt is released.
3. Remove the used belt.
4. Dismantle all used idlers (if present).
5. Dismantle the used tensioner and place the new tensioner in the relevant position, tighten by hand and then fit the new idlers (if present) using the correct tightening torque.
6. Place the new belt on the smooth tensioners and idlers (if present).
7. Check the belt is in the correct position in the grooves.
8. Swivel the tensioner against the belt and adjust to the correct torque.
9. Check the preload on the tensioned side (strand tension) with a „Krikit 2“ or another suitable measuring device and adjust the tensioner if necessary.
10. Start the engine and follow the progress of the belt for a few minutes.
11. Switch off the engine and check the tension again. Adjust the tensioner if necessary.

Ancillary Drive

Changing a vee-belt

Belt drive with mechanical tensioning system

1. Note the course of the belt (drawing a sketch helps!).
2. Rotate the tensioner with the corresponding tools as shown in the belt dismantling diagram.
3. Lock the tensioner with the relevant tool.
4. Remove the used belt.
5. Dismantle all used idlers (if present). Fix the new idlers (if present) using the correct tightening torque. Note further steps as described in the section *Tips for fitting INA products*, see page 22.
6. Start the engine and follow the progress of the belt for a few minutes.
7. Switch off the engine and check the tensioner and belt drive again.



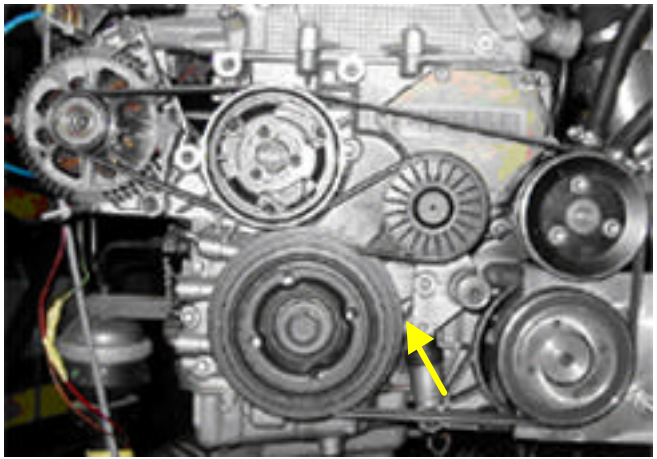
Ancillary drive with mechanical tensioner, idler and over-running pulley

Ancillary Drive

Changing a vee-belt

Belt drive with hydraulic tensioning system

1. Note the course of the belt (drawing a sketch helps!).
2. Rotate the tensioner with the corresponding tools as shown in the belt dismantling diagram.
3. Lock the tensioner with the relevant tool.
4. Remove the used belt.
5. Dismantle all used idlers (if present).
6. Fix the new idlers (if present) using the correct tightening torque. Note further steps as described in the section *Tips for fitting INA products*, see page 21.
7. Start the engine and follow the progress of the belt for a few minutes.
8. Switch off the engine and check the tensioner and belt drive again.



Ancillary drive with hydraulic tensioning unit

Belt Drive Components

Practical notes

1. When fitting, always use the special tools as stipulated by the vehicle manufacturer.
2. Always put the belt in place by hand and not under tension and never use a screwdriver or similar tool as the belt drive components can be damaged by the tool slipping off.
3. Never treat belt drive components with aggressive solvents as corrosion can occur in the bearings in the tensioners and idlers.
4. Use of belt wax or similar materials is not advised as this leads to a reduction in the performance of the ancillary units.
5. Irrespective of which individual components are defective, all the other components must also be changed in order to ensure complete safety in the drive whilst travelling in the vehicle.
6. **Note:** When fitting a mechanical belt tensioner or a mechanical belt tensioning unit, care should be taken to ensure the hand is not left between the tensioner and the belt when removing the split pin or the clip (if present) as high forces are released when the tensioner is „unlocked“ (up to 800 N!) and this can cause serious personal injury.
7. If the required tightening torque cannot be reached when tightening a screw, check that thread or change the screw if necssary.
8. Always use original parts as only these parts have been through the prescribed tests and have been released by the engine or vehicle manufacturer.
   The required operating life is achieved only with original parts.
9. Always read the fitting instructions from the vehicle manufacturer or use the manual for the specific vehicle which contains all fitting and dismantling notes for belt drive components (primary drive).

Belt Drive Components

Further information

For further information, please contact:

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