



**DRIVEN BY POSSIBILITY™**

# **TROUBLESHOOTING GUIDE ACCESSORY BELT DRIVE SYSTEM**



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# A ROADSIDE FAILURE IS THE LAST THING YOU OR YOUR CUSTOMERS NEED...



**...ESPECIALLY WHEN THE CAR WAS  
JUST IN THE WORKSHOP FOR A SERVICE.**

To help you accurately diagnose accessory belt drive component failures, Gates has developed this troubleshooting manual. The information included in this manual will help you detect an accessory belt drive component that is past its service life, so you can keep your customers on the road.





**DRIVEN BY POSSIBILITY™**





# WHY PROFESSIONALS CHOOSE GATES®

## THE ONLY THING MISSING WILL BE THAT NEW CAR SMELL

No matter where you travel around the globe, chances are when you look under the bonnet, Gates is there. Gates is one of the world's largest manufacturers and suppliers of original equipment (OE) belts and metal parts. With a century of global innovation and technology in every component, you can feel confident that Gates products will restore your customers' vehicles to factory-original condition.

**GATES IS THE WORLD'S LARGEST SUPPLIER OF OE BELTS. THE WORLD'S LEADER IN OE DRIVE DESIGN TECHNOLOGY.**

### GLOBAL MANUFACTURERS THAT GATES SUPPLIES TO INCLUDES:

- Alfa Romeo • Audi • BMW • Chrysler • Citroën • Fiat • Ford • Holden • Honda
- Hyundai • Jaguar • Kia • Land Rover • Lexus • Mazda • Mercedes • Mitsubishi
- Nissan • Opel • Peugeot • Porsche • Renault • Saab • Seat • Subaru • Suzuki
- Toyota • Lada • Volkswagen • Volvo

If all major car manufacturers use Gates parts, why shouldn't you?

## TIPS AND TRICKS FROM YOUR AUTOMOTIVE SPECIALIST

So Gates provides the aftermarket with products that are of original equipment (OE) quality. But that's not all. Drawing upon our OE knowledge we anticipate the needs of the aftermarket and offer true customer support: superior cataloguing, specialist tools, hands-on training seminars, comprehensive technical bulletins, detailed fitting instructions and so on.

## LET US SHOW YOU HOW WE ARE THERE TO HELP YOU.



# WHAT YOU SHOULD KNOW BEFORE YOU START

## **GATES IS THERE TO GUIDE YOU... EVERY STEP OF THE WAY**

Correct installation of the right replacement part. That's where it all begins...

### **SELECTING THE RIGHT REPLACEMENT PART IS EASY THANKS TO SUPERIOR CATALOGUING**

Gates offers a better market coverage than any other automotive market player. By constantly scanning the market for new developments, our specialised application research team ensures we have the widest range. What's more, our team also provides up-to-date application data on virtually every car on the road.

All this information is freely and readily available in the Gates application catalogue range, including catalogues for Drive Belts & Components, Water Pumps, Timing Belts & Timing Component Kits and Radiator Hose. And since it is more important than ever to have the right information at the right time, we have an online version of all our application catalogues available at [www.gatesaustralia.com.au/autocatalogues](http://www.gatesaustralia.com.au/autocatalogues).

### **SPECIALIST TOOLS ENSURE PERFECT INSTALLATION AND EASY MAINTENANCE**

In order to ensure that installation can be achieved correctly and according to the vehicle manufacturer's recommendations you also need the right tools. Without these tools, installation errors can occur. Consequences include premature component failure, damaged components or even the complete destruction of the engine itself. The last thing you want is your customer left stranded on the roadside with a vehicle failure... So, rely on our wide range of professional tools for proper installation, tensioning, alignment and maintenance.



### **THE RIGHT TRAINING GIVES YOU THE RIGHT KNOW-HOW**

Doing the job properly to keep your customers satisfied and eliminate costly comebacks. That is what every car mechanic aims to do. Installation procedures are increasingly drive system specific and engines become more and more complex... so premium quality products and specialist tools are not enough.

You have to be regularly kept up-to-date with in-depth training and feedback from experts. Our technical team develops training initiatives and technical service concepts to help you with new technology and complex drive problems. Our face-to-face training seminars for example cover a wide range of topics associated with product knowledge and installation and maintenance issues. Course participants can benefit from the opportunity to directly interact with an experienced Gates automotive specialist who can resolve a technical question or problem on the spot.

### **EXPERT KNOWLEDGE IS EASILY ACCESSIBLE IN GATES TECHNICAL BULLETINS**

Sometimes problems are systematic or original equipment design flaws, and not due to improper belt tension, pulley misalignment or excessive component wear. It is a good idea to check the Gates Technical Bulletins for any vehicle manufacturing defects or other issues that could cause problems with the belt drive system. Our Technical Bulletins tackle specific belt drive system problems and contain troubleshooting instructions which help prevent installation errors. They are freely available from the Gates website. If you wish to receive the Gates Technical Bulletins by e-mail, you can subscribe by registering on the website.

Gates keeps your knowledge up to date.

Get immediate access to the cataloguing data, troubleshooting manuals and technical bulletins that are critical in keeping you informed and knowledgeable about today's automotive systems by visiting

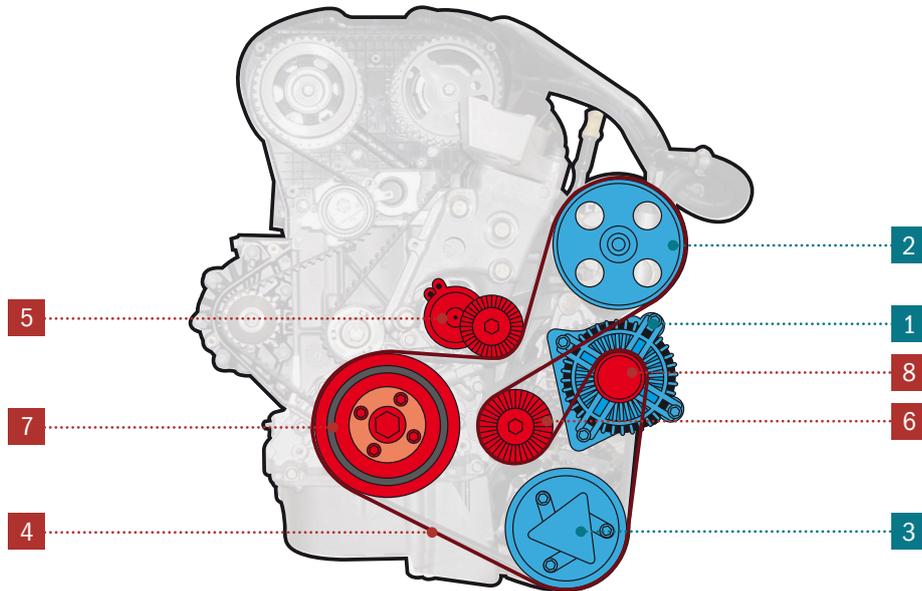
[www.GatesAustralia.com.au](http://www.GatesAustralia.com.au)

## INTRODUCTION TO THE ACCESSORY BELT DRIVE SYSTEM

The engine accessory drive is called the Accessory Belt Drive System (ABDS). The alternator, power steering pump, air conditioning compressor and water pump are typically driven by a multi-ribbed belt via the crankshaft. If any of these components fail, the car will not function optimally and its driver will suffer the adverse consequences of this.

- 1 The alternator:**  
Converts mechanical energy to electrical energy that is needed to keep the battery charged.
- 2 The power steering pump:**  
Uses hydraulics to push fluid into the power steering rack to ensure adequate power steering.
- 3 The air conditioning compressor:**  
Builds up the pressure of the refrigerant to start the car interior cooling process.  
  
**The water pump:**  
Circulates engine coolant from the radiator to the engine and back again.  
  
**The fan:**  
Draws fresh air from outside onto the engine cooling system's radiator.
- 4 The multi-ribbed belt:**  
Transfers power from the crankshaft pulley to all belt-driven accessories.
- 5 The tensioner:**  
Maintains the correct tension on the belt at all times throughout its duty cycle.
- 6 The idler:**  
Is a free-spinning wheel around which the belt travels to optimise belt routing and suppress belt flutter.
- 7 The torsional vibration damper:**  
Is a relatively new type of crankshaft pulley with a rubber damping element to absorb vibrations from the crankshaft and extend the lifespan of the crankshaft, the multi-ribbed belt and all belt-driven components.
- 8 The overrunning alternator pulley:**  
Is a relatively new type of alternator pulley that allows the alternator to "free-wheel" or "overrun" every time the engine decelerates and, at the same time, dampens vibrations at the alternator. This component extends the lifespan of the alternator, the multi-ribbed belt and all belt-driven components.

Modern accessory belt drive systems can malfunction in a number of different ways which can sometimes be tricky to diagnose. Further on in this manual we give you detailed troubleshooting information. But before we come to that, let us remind you of a very important rule of thumb.



**WEAR PARTS / HARD PARTS**

## UNDERSTANDING FAILURE OF THE ACCESSORY BELT DRIVE SYSTEM

The multi-ribbed belt is an essential part of the engine. It powers all belt-driven accessories, revolving around the peripheral belt drive components: tensioner, idler, torsional vibration damper and overrunning alternator pulley. Once an engine is running, the belt operates continuously. High under-bonnet temperatures plus constant flexing ultimately take their toll; over time even the best belt will wear and need replacement.

But the other belt drive components don't last forever either. Belt tensioners, idlers, torsional vibration dampers and overrunning alternator pulleys are wear parts, not "hard parts", as many technicians believe. The wear of these components affects the belt's, and subsequently, the complete system's performance.

So putting a new belt on old peripheral belt drive components is never a good idea. The new belt's service life will be greatly reduced in doing so. The best long-term solution is to replace all wear parts simultaneously.

In addition, Gates advises replacement of all wear parts every 100,000 km. Although not every case of ageing is clearly evident in the form of a wear pattern, proper functioning of the engine is greatly impaired nonetheless.

**Avoid comebacks. Gates recommends that when replacing one of the wear parts, you replace all.**

In this way, you ensure the best long-term solution and improve the customer satisfaction levels for your garage.



# DIAGNOSING BELT DRIVE RELATED PROBLEMS

## DIAGNOSING ACCESSORY BELT DRIVE PROBLEMS

Now we are ready to go into more detail.

When experiencing any operational problems, use the following troubleshooting methods to resolve the problem.

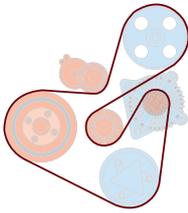
### ALWAYS START BY DETERMINING THE CORRECT PART APPLICATION

Always double-check all parts to ensure that the proper belts, tensioners, pulleys etc. are installed for the particular vehicle and engine in question. Parts which are not made to the proper specifications may cause the entire system to malfunction.

Be certain that all parts are designed for the specific application and installed properly. If any component within the belt drive system has been recently replaced (water pump, power steering pump, compressor etc.), check that part for correct installation and alignment. Any component installed improperly can throw the entire belt circuit out of alignment, resulting in less than optimum performance.



### INSPECTING THE MULTI-RIBBED BELT



The majority of vehicles today use multi-ribbed belts to power their front-end accessories. Multi-ribbed belts work better inside today's smaller, more complex engine compartments, where space is limited and one flexible multi-ribbed belt can do the job formerly carried out by several V-belts.

The multi-ribbed belt's exclusive job is to transmit power, via the ribs as well as the backside of the belt, from the crankshaft pulley to all belt-driven accessories through wedging and tension.

### EXPECTED BELT LIFE

Because today's belts operate under heavier loads and are exposed to extreme temperature fluctuations, as well as water, dirt, grease, oil and other environmental contaminants, normal failure may occur differently on different applications. For example, air conditioning and higher output alternator drives are more demanding; power steering and water pumps are less so. Also, it is not always possible to tell if a belt is still good by visual inspection alone. Statistics show that failures increase dramatically after the fourth year of service, so Gates recommends that multi-ribbed belts be replaced at least every four years or 100,000 km.

### BELTS CAN FAIL FASTER

While the four-year replacement interval is a basic rule of thumb, it is not exact. Idling time in traffic, for instance, takes a major toll on belt life. Today's normal urban driving patterns constitute extreme operating conditions, exposing belts to excessive stress and wear. Therefore, it is imperative to periodically inspect belts – even belts less than four years old – whenever a vehicle comes in for service. If there is ever any doubt, recommend replacement of the multi-ribbed belt. If the belt exhibits any of the tell-tale signs of wear, it should be replaced immediately. See pages 12-18 for wear patterns.

**Keep in mind that problems with the belt are often caused by a malfunction in the belt drive**

In that case, replacing the belt will not be sufficient. Gates advises a thorough inspection of all belt drive related components to find the real cause of the problem and recommends that all wear parts are replaced at the same time.

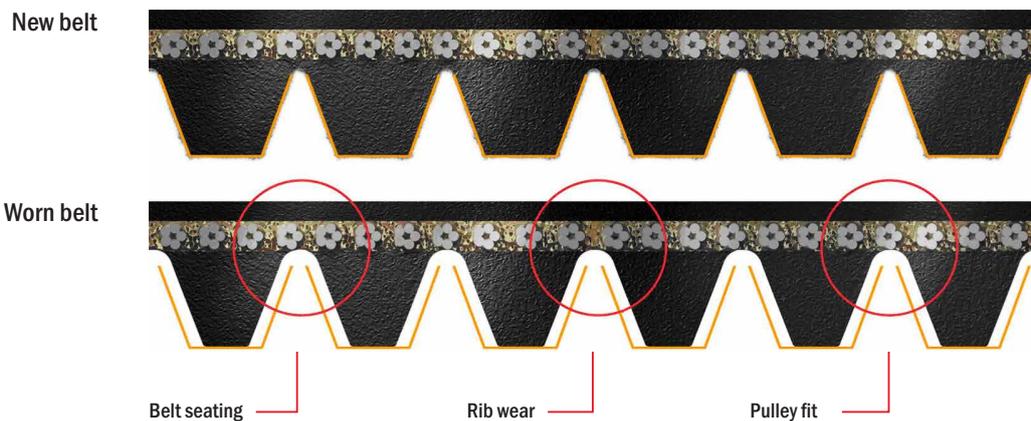


### SPECIAL NOTE: IDENTIFYING AN EPDM BELT THAT IS NEAR FAILURE

It used to be that a simple visual inspection of the belt would reveal problem areas like cracking, chunk-out and rib separation. Those symptoms/indicators signalled that a replacement was needed. But today, a visual inspection isn't always enough. That's because Gates exclusively uses EPDM for all its multi-ribbed belts, in an on-going effort to create superior products. EPDM provides a significant benefit over older belts which used chloroprene in their construction – they last longer. While longer life is an advantage, EPDM belts don't necessarily exhibit traditional signs of wear even though they might be at or near failure as much of the material has worn away.

As EPDM belts age, they gradually lose rubber material – similar to the way tyres wear out. This material loss results in weakened belt performance. When is it best to replace an EPDM belt? Visual inspection is still a good idea, but don't just look for cracking or other traditional signs of wear. Look closely at the belt ribs: if the belt exhibits one or more of the symptoms depicted, it needs to be replaced.

The diagram below shows how EPDM belts wear as they age:



In other words, the bottom line is to make sure that belt inspection goes beyond looking for traditional signs of wear. Belts must also be inspected for material loss to guarantee that the diagnostics is done thoroughly and the belt is in good shape.

To help you accurately diagnose belt wear in EPDM belts, Gates has developed a belt wear gauge tool and PIC Gauge smartphone app so you can recommend belt replacement at the appropriate time. Visit [www.GatesAustralia.com.au/beltwear](http://www.GatesAustralia.com.au/beltwear) for more information.

**More detailed information on the material loss test can be found on page 18 of this manual.**

All Gates Micro-V® AT™ multi-ribbed belts are EPDM, for longer life, superior grip and temperature resistance.

Technology so advanced, it's patented.  
It's what you expect from the world leader in belt technology.

Find out everything there is to know about Gates Micro-V® AT™ multi-ribbed belts on pages 37-40.



## BELT WEAR PATTERNS

The following signs of wear indicate that a multi-ribbed belt needs to be replaced:

To inspect a belt, first make sure the engine is off and wait until the engine has cooled down.

### 1. Random cracking across the ribs



**Appearance:** Small yet visible cracks along the length of a rib or ribs.

**Cause:** In addition to continuous exposure to high temperatures, the stress of bending around the pulleys leads to cracking. Cracks begin at the rib top and grow to the cord line. As a rule, if cracks appear 1 or 2 cm apart, 80% of the life is gone and the belt should be replaced.

**Solution:** Replace with a Gates Micro-V® AT™ belt, which is engineered to withstand higher temperatures and resist cracking.



## 2. Chunk-out



**Appearance:** Pieces or chunks of rubber material have come off the belt. When chunk-out has occurred, a belt can fail at any moment.

**Cause:** Chunk-out can happen when several cracks in one area move parallel to the cord line. Heat, age and stress are the primary contributors.

**Solution:** Replace with a Gates Micro-V® AT™ belt, which is designed for greater flexibility and heat tolerance in today's smaller engine compartments.

---

## 3. Pilling



**Appearance:** Belt material wears off from the ribs and builds up in the belt grooves.

**Cause:** There are a number of causes, including misalignment, new belt on worn pulleys, lack of tension or a combination of these factors. Pilling will occur most frequently in diesel engines, but is not isolated to them.

**Solution:** When pilling leads to belt noise or excess belt vibration, the belt should be replaced. Make sure the new belt runs on perfect pulleys. Check the tensioner and ensure proper belt tension on a properly aligned drive.



#### 4. Abrasion



**Appearance:** Backside of belt appears shiny or glazed. In advanced stages, the fabric or even the cord becomes exposed and gets damaged.

**Cause:** When in motion, the belt makes contact with a foreign object in its path such as a flange or bolt. This may be caused by improper belt tension or by belt flutter (vibrations) on longer span lengths between two pulleys.

**Solution:** Replace the belt and make sure to observe the complete tracking of the belt as it revolves around the pulleys. Check the tensioner and ensure proper belt tension.

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#### 5. Rib separation



**Appearance:** A belt rib shears off or begins to separate from the belt base.

**Cause:** The belt is not correctly positioned. One of the belt ribs is placed outside the pulley groove, causing a belt rib to run without a supporting or aligning pulley groove.

**Solution:** The belt's life has been severely limited, so the belt should be replaced immediately. Make sure all ribs of the replacement belt fit into the pulley grooves. Run the engine and then, with the engine off and battery disconnected, inspect the belt for proper installation.



## 6. Uneven rib wear



**Appearance:** Wear that is more severe on one rib than on the others or one rib that exhibits a different wear pattern than the others. A thumping or grinding noise may also be heard.

**Cause:** A foreign object – such as a pebble – in the pulley will cause uneven wear and can cut into the belt and break the tensile cords. Cars where the engine protection shield is missing are likely to have this problem.

**Solution:** Replace the belt and make sure the new belt runs on perfect pulleys. Install an engine protection shield.

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## 7. Gravel penetration



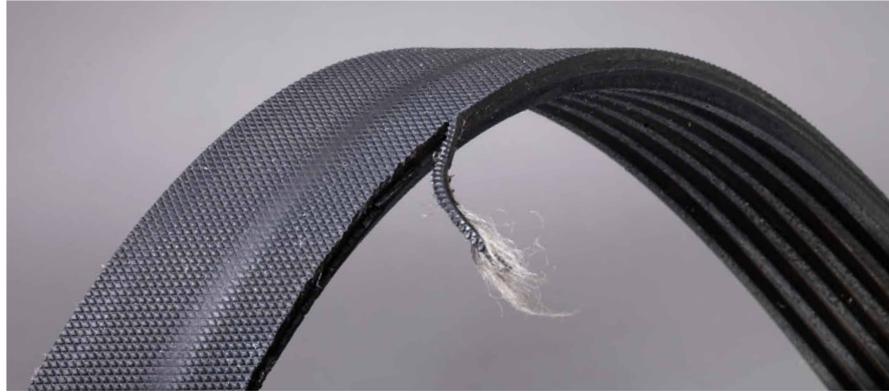
**Appearance:** Small pinholes are visible on the backside of the belt. Bumps may be visible and fabric around the holes can be frayed.

**Cause:** Granular gravel or pebble gravel is wedged between the belt groove(s) and pulley ridge(s). Cars where the engine protection shield is missing are likely to have this problem.

**Solution:** Check the entire drive and then replace with a Gates Micro-V® AT™ belt, which is precision ground in the factory for a better pulley fit. Make sure the new belt runs on perfect pulleys. Install an engine protection shield.



### 8. Damaged outermost ribs



**Appearance:** Sidewalls of the belt may appear glazed or the edge-cord may become frayed and ribs removed. A noticeable noise may result. In severe cases, the belt can get pulled into the timing belt drive causing catastrophic engine damage.

**Cause:** Pulley misalignment is a common cause of premature belt failure. Misalignment forces the belt to kink or twist while running, causing premature wear.

**Solution:** Replace the belt and make sure to realign the pulleys. Also check that the pulleys, pulley brackets and shafts are not bent or broken.

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### 9. Oil contamination



**Appearance:** The belt surface is flaky, sticky or swollen.

**Cause:** Oil and grease are a rubber compound's worst enemies, weakening the compound's bonds and making the belt soft and spongy. Eventually, such a belt will slip, create heat and fail.

**Solution:** Eliminate sources of oil, grease or chemical contamination. Replace the belt. Do not use belt sprays.

## 10. Broken belt



**Appearance:** The belt is broken.

**Cause:** A large foreign object between the belt and pulley can cut into the belt and break the tensile cords. Tensile break may occur but go unnoticed when the belt is forced or pried on during installation. Other possible causes may be severe shock loads or a blocked pulley and/or accessory.

**Solution:** Carefully check all components of the drive for foreign objects or damage. All pulleys in the drive should rotate freely. Replace the belt. Make sure not to force the new belt onto the drive with unsuitable tools.

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## 11. Belt noise

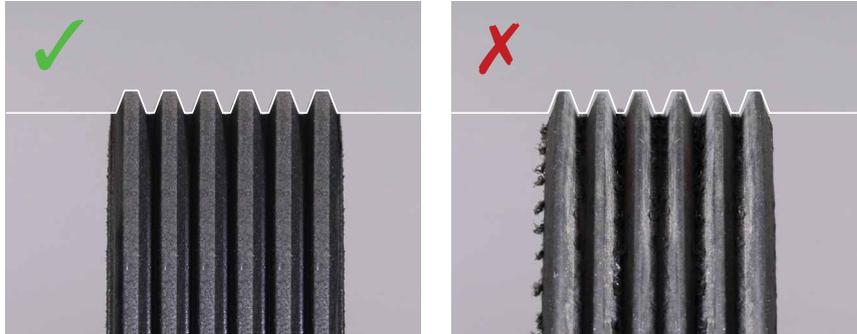
For chloroprene belts, noise caused by pulley misalignment or improper belt tension may be diagnosed by using a simple “water spray test”. How exactly? Fill a spray bottle with water and spray the ribbed side of the noisy chloroprene belt with a light mist, while the engine is running. If the noise volume decreases for a few seconds, the problem is likely to be misalignment. If the noise pitch increases for a few seconds, the problem is an under-tensioned belt.

For EPDM belts, there is no such test. If the noise emitted during idling can be characterised as a “steady, uninterrupted rhythm”, the problem is likely to be misalignment. If the noise is “irregular”, chances are it is a belt tension problem.

In any case, Gates advises against using belt sprays. A spray may quieten the belt as it will cause the belt to slip quietly, but the belt material will absorb this spray and cause the rib surface to dry which means the noise will return. In addition, the spray can cause degradation of the belt compound. Appropriate corrective action should be taken to eliminate the root cause of the problem. **More detailed information on drive noise diagnostics can be found on page 34 of this manual.**



## 12. Material loss – the new diagnostic standard



Gates ABDS (Accessory Belt Drive System) wear indicator helps you assess wear on EPDM belts and pulleys and determine when a belt or a pulley has lost so much material it negatively affects its performance and should be replaced. The tool is simple to use and allows you to quickly gauge wear – either on the engine or off.

### ABDS BELT WEAR GAUGE (MAKE SURE THE ENGINE IS OFF).

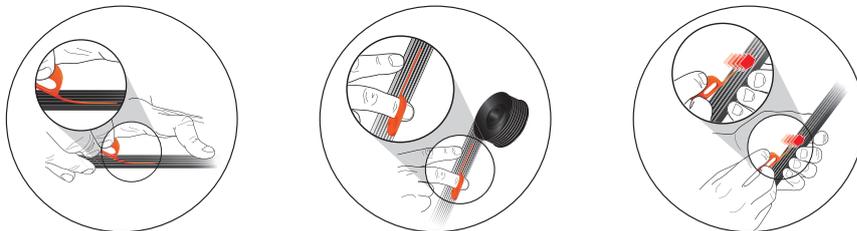


Belt checked on/off the engine:

Reach under a straight section of the belt and insert the belt wear gauge into the grooves between the belt ribs. The indicator should fit perfectly within the profile of the ribs of the belt. No side-to-side movement of the tool is possible without lifting the tool out of the grooves. If side-to-side movement is possible, too much rubber compound is worn away from the belt for optimal power transmission.

Pulley checked on/off the engine:

Insert the “pulley profile” of the wear indicator into the grooved pulley to be checked. The teeth of the indicator should fit perfectly into the pulley or should only leave a thin but parallel space between the pulley and the teeth of the indicator. No side-to-side movement is possible without lifting the tool out of the pulley grooves. If side-to-side movement is possible or if the pulley-ribs are rounded instead of straight, too much metal/plastic is worn away. A new belt running on a used pulley will not have optimal grip for power transmission. As a consequence, the life-time of the belt will seriously decrease.

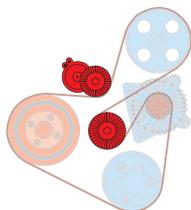


For a free belt wear gauge tool, send your request to [marketingAUS@gates.com](mailto:marketingAUS@gates.com).

Now you can use your smartphone to diagnose belt wear with Gates PIC Gauge app. For more information visit [www.GatesAustralia.com.au/beltwear](http://www.GatesAustralia.com.au/beltwear).



## INSPECTING THE TENSIONER AND IDLER



The vast majority of vehicles using a multi-ribbed belt employ an automatic belt tensioner. Designed to apply a constant force on the belt, the tensioner compensates for belt length changes due to wear or changes in accessory drive operating loads. This automatic re-tensioning reduces maintenance by eliminating the need to re-tension belts periodically, as the proper tension will be applied for the life of the belt.

Older engines are sometimes equipped with manual tensioners which require the intervention of a car mechanic to determine the correct installation tension as well as for periodic re-tensioning.

The main difference between an automatic and a manual tensioner is the presence of a powerful spring and a damping mechanism located within a small canister-like housing to which a pulley is attached. The pulley pivots around the spring housing and generates a constant tension on the belt.

Idlers are free-spinning wheels around which the belt travels to optimise belt routing and suppress belt flutter.

### The importance of correct belt tension

If the belt tension is too low, the belt will slip causing noise, extremely high temperatures and premature belt wear, all of which can lead to the poor functioning of the belt-driven accessories. If the tension is too high, this will cause excessive wear to the belt as well as to the belt-driven accessories.

As a general rule of thumb, it can be assumed that the required tension for a new belt is 10 kg/rib while for a used belt this should be 6 kg/rib.

### How to diagnose tensioner failure

Tensioners, like any other part, don't last forever. It is difficult to tell if a tensioner is ready to fail. Sometimes the tensioner pulley will show signs of wear such as damage to the pulley belt track section or grease leaking from the bearing seal. The rest of the tensioner is sealed to keep moisture and contaminants out, which makes a visual inspection difficult and unreliable. See pages 20-24 for wear patterns.

### Facts to know about tensioner replacement

It should be clear by now that a tensioner helps protect other components such as the alternator and water pump from undue stress and premature failure. In addition, a tensioner is a relatively inexpensive part to replace.

So, every time you replace a multi-ribbed belt, be sure to replace the tensioner at the same time.

Moreover, when a tensioner has reached the end of its service life Gates recommends that all wear parts are replaced at the same time to ensure the best long-term solution.

**Gates DriveAlign® tensioners are OE equivalent or even better in both performance and fit.**

With Gates DriveAlign® tensioners, you will get performance and fit that are equal to or better than the original.

Find out everything there is to know about Gates DriveAlign® tensioners on pages 41-42.



## TENSIONER WEAR PATTERNS

The following signs indicate that a tensioner needs to be replaced:

With the engine off, operate the tensioner through its entire range of motion.

### 1. Rust bleed and cracks



**Appearance:** Rust is bleeding between arm and base or dripping from the tensioner. Also, check the tensioner for cracks or damage to arm, housing and bracket. Some damage can't be seen unless the tensioner has been removed.

**Cause:** Rust bleeding or dripping is a sign of internal component wear. Most common crack damage occurs at tensioner "stops" and mounting bolts.

**Solution:** Replace the tensioner.

### 2. Pulley bearing wear



**Appearance:** With the engine off and the belt removed, manually rotate the pulley. If you notice noise, resistance or roughness, the problem is likely to be pulley bearing wear.

**Cause:** Defective bearing and/or pulley.

**Solution:** Replace the complete tensioner. Do not attempt to replace a worn pulley in a used tensioner assembly but always replace the entire tensioner assembly, as part failure will inevitably follow quickly.



### 3. Pulley wear



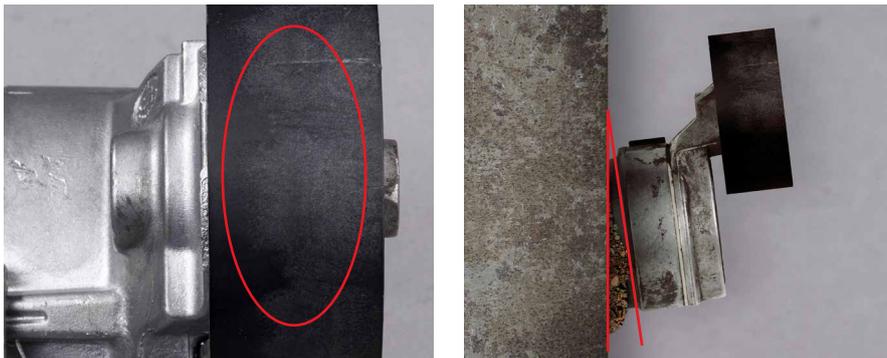
Pulleys are made from plastic, nylon or steel and have either a flat or grooved surface.

**Appearance:** Flat surfaces should be smooth and free from chips, cracks and dents. Surfaces should be even without steps or channels. Grooved surfaces should be free of chips, cracks, dents and embedded debris within the grooves. The high points of the grooves should not be worn down and be of equal height. Plastic pulleys have fins in sidewalls that should not be cracked or broken.

**Cause:** Belt wearing into the pulley.

**Solution:** Replace the complete tensioner. Do not attempt to replace a worn pulley in a used tensioner assembly but always replace the entire tensioner assembly, as part failure will inevitably follow quickly.

### 4. Tensioner assembly misalignment



**Appearance:** Abnormal belt tracking on tensioner pulley.

**Cause:** Bent or misaligned mounting bracket, improper tensioner installation or corrosion/contamination between tensioner base and mounting surface. A small amount of contamination results in a large amount of misalignment at tensioner pulley.

**Solution:** Misalignment is easy to diagnose thanks to Gates DriveAlign® laser alignment tool (see also page 47) which allows you to identify the two most common types of misalignment, even in the tight confines of the engine compartment. If misalignment persists, replace the tensioner.



### 5. Tensioner noise

**Appearance:** Squeaks and rattles coming from the tensioner.

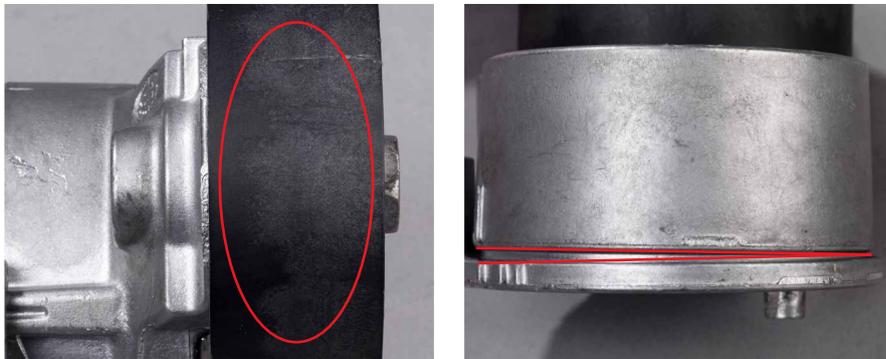
**Cause:** Failure of bearings or pivot area will cause excessive noise.

**Solution:** Replace the tensioner.

More detailed information on drive noise diagnostics can be found on page 35 of this manual.

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### 6. Tensioner arm misalignment



**Appearance:** Abnormal belt tracking on tensioner pulley. Shiny, smooth streaks or gouges in tensioner housing or arm.

**Cause:** Metal-to-metal contact between arm and spring housing.

**Solution:** If tensioner arm misalignment is apparent, the pivot bushing has worn down and the tensioner should be replaced.

## 7. Excessive tensioner arm oscillation

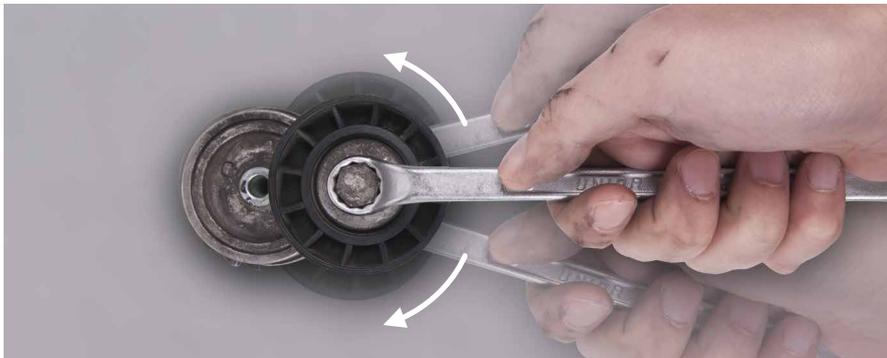


**Appearance:** Back and forth sway of tensioner arm during operation.

**Cause:** If large swings occur or continual oscillation is evident, the damping system or spring torque has most likely failed. Excessive tensioner oscillation reduces tensioner life, belt and component bearings. Another possible cause can be torsional vibration damper or overrunning alternator pulley failure (see page 26 and 31).

**Solution:** If excessive oscillation is observed, replace the tensioner and always pay particular attention to the condition of the torsional vibration damper and overrunning alternator pulley as well.

## 8. Binding or grinding tensioner arm movement



**Appearance:** Cycle the tensioner (mounted on the engine) through the entire range of motion (from stop to stop) by applying torque to the arm with a wrench. The tensioner arm should move smoothly and freely.

**Solution:** If you notice a binding, sticking or grinding tensioner arm, the tensioner should be replaced.

**NOTE:** The positioning of the wrench depends on the tensioner type (tensioner end, tensioner hole...). Simply position it in the same way as to install the tensioner.



### 9. Loss of spring force



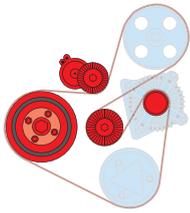
**Appearance:** Move the tensioner arm (tensioner being mounted on the engine) through its entire range of motion with a wrench. There should be resistance to this movement. If there is none, the spring has lost its force. Other indicators are belt squeal from slippage, or loss of rotation of a belt-driven component.

**Solution:** If any of these are present, replace the tensioner.

**NOTE:** The positioning of the wrench depends on the tensioner type (tensioner end, tensioner hole...). Simply position it in the same way as to install the tensioner.



## INSPECTING THE PULLEYS



Pulleys are susceptible to damage and wear and should also be inspected regularly, especially before installing a new belt.

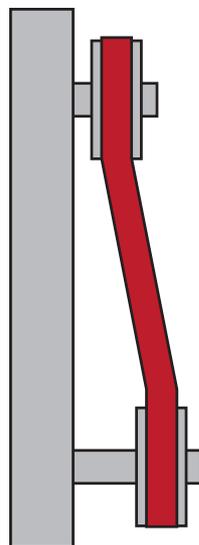
The most common issue with pulleys is pulley misalignment, which also is the most common cause of premature belt failure. Improper belt tension is the second most common cause.

### The importance of correct pulley alignment

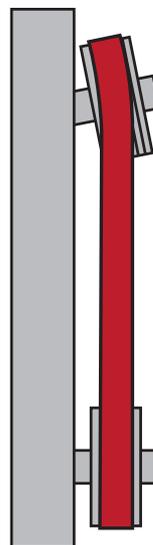
Misalignment generally refers to two types: parallel or angular. Parallel misalignment refers to pulleys that are outside the plane of other pulleys in the drive system but whose shafts remain parallel with the other components. Proper positioning of a pulley on a shaft will help ensure all pulleys are in a common plane. Angular misalignment refers to pulleys which are within the drive system plane but are tilted because their shafts are not parallel. A combination of both is also possible. Possible causes of misalignment include design errors, component wear, incorrect component installation and over-tensioning which causes the pulley bearing to incline and eventually break.

Both misalignment conditions can create belt routing problems, excessive wear, noise and belt stability problems. Just a few degrees of misalignment can increase belt operating temperature by 15°C, reducing belt life by as much as 75 percent.

Not correcting misalignment will result in comebacks because it will be perceived as belt failure, so misalignment must be found and corrected before installing a new belt.



Parallel misalignment



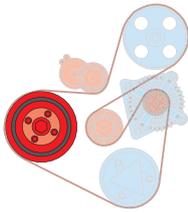
Angular misalignment

If misalignment is the problem, Gates DriveAlign® laser alignment tool allows you to quickly ascertain and correct it.

Read more about the Gates DriveAlign® laser alignment tool on page 47.



### SPECIAL PULLEY TYPE: INSPECTING THE TORSIONAL VIBRATION DAMPER



Vehicle manufacturers are looking to make engines smaller and lighter by using more compact and lightweight components. At the same time modern engines are becoming more powerful. More power means more strain on the lightweight components causing more vibrations.

To address this, some vehicle manufacturers have replaced the ordinary crankshaft pulleys with torsional vibration dampers. Torsional vibration dampers are crankshaft pulleys with a rubber damping element between the two main metal parts to absorb vibrations from the crankshaft, and in general improve the drive NVH characteristics (noise, vibration and harshness).

#### Identifying a worn torsional vibration damper

Over time, the harsh working conditions will inevitably affect the torsional vibration damper and it will wear because of the material of its damping elements (rubber) and its purpose (constantly damping vibrations). The torsional vibration damper can break; deformation, wear and hardening can occur; the rubber can loosen, crack, get stuck between the pulleys or wear out; the outer ring can start slipping and even separate from the rest, or the damper can come off the engine completely. See pages 27-30 for wear patterns.

#### Facts to know about torsional vibration damper replacement

A torsional vibration damper that is worn out cannot properly dampen vibrations. If the vibrations are not controlled, the engine accessories can be compromised, hence the importance of checking the torsional vibration damper at each service interval.

Replacement is required when the damping device is no longer able to provide reduction of vibrations due to wear.

Furthermore, when a torsional vibration damper has reached the end of its service life Gates recommends that all wear parts are replaced at the same time to ensure the best long-term solution.

Rely on Gates for a torsional vibration damper that fits and functions like the original one.

As a complete system supplier, Gates offers you a wide range of OE equivalent DriveAlign® torsional vibration dampers that fit the application perfectly and cover all the major models in the market.

Read more about Gates DriveAlign® torsional vibration dampers on pages 43-44.



## TORSIONAL VIBRATION DAMPER WEAR PATTERNS

Great care should be taken when inspecting torsional vibration dampers since the damage is not always obvious.

### 1. Micro cracks in the rubber damping element



**Appearance:** There are fine cracks in the rubber.

**Cause:** Hardening of the surface due to ageing which ultimately leads to failure of the damper. As rubber ages, its physical and chemical properties degrade due to exposure to air, heat and other environmental factors. The rubber loses its elasticity and hardens which results in micro cracks.

**Solution:** Replace the torsional vibration damper.

**NOTE:** 45° angle cracks are a typical sign of wear due to excessive engine idling.



## 2. Deformation of the rubber damping element



**Appearance:** The ring of elastomeric material is clearly deformed. The deformation initially becomes visible on the rear side of the damper. This kind of damage is frequently overlooked in inspections because the pulley itself is often not removed for visual inspection purposes and is only examined from the front.

**Cause:** The rear side of the damper is situated closer to the engine subjecting it to more heat and contamination.

**Solution:** Replace the torsional vibration damper.

---

## 3. Rubber separation



**Appearance:** The rubber loosens and gets stuck between the pulleys and the belt.

**Cause:** The harsh working conditions (vibrations, shocks, heat and contamination) inevitably affect the damping device. Over time, this results in rubber separation: break-outs in the rubber itself as well as separation from the metal.

**Solution:** Replace the torsional vibration damper.



#### 4. Damaged slotted holes



Only for those types of torsional vibration dampers that have wear indicating tabs which allow checking the angular displacement of the rubber versus the pulley.

**Appearance:** Clear contact marks from the metal wear tabs in the slotted holes.

**Cause:** The metal wear tab is prevented from contacting the slotted hole until the rubber damping element has severely worn out. Once worn out, the tab repeatedly hits the slotted hole leaving clear contact marks.

**Solution:** Replace the torsional vibration damper.

---

#### 5. Damaged bushes



**Appearance:** Cracked or split bushes which will result in strong vibrations.

**Cause:** Wrong torque settings at installation.

**Solution:** Replace the torsional vibration damper.

**NOTE:** Exact torque settings are required for every model.



## 6. Total failure



**Appearance:** The torsional vibration damper physically falls apart. It can also come off the engine completely, resulting in an immediate breakdown and collateral damage.

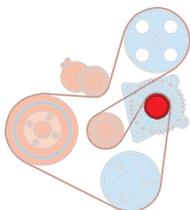
**Cause:** Excessive vibrations due to lack of maintenance.

**Solution:** Replace the torsional vibration damper and make sure to check all the other components for possible damage. Check whether the engine vibration levels are within tolerance. Make sure the dual mass flywheel and overrunning alternator pulley function properly.

**NOTE:** A worn dual mass flywheel can also cause extra stress on the accessory belt drive system.



### SPECIAL PULLEY TYPE: INSPECTING THE OVERRUNNING ALTERNATOR PULLEY



Seat heating, air conditioning and other additional accessories require extra electrical power, which causes the vehicle manufacturers to utilise ever heavier alternators, compromising the belt performance during deceleration of the engine.

To address this, drive system specialists have created the overrunning alternator pulley which, as opposed to a conventional solid alternator pulley, allows the alternator to “free-wheel” or “overrun” every time the engine decelerates and, at the same time, dampens vibrations at the alternator. Overrunning alternator pulleys come in two types: one-way clutches (OWC) rotate freely in one direction and lock immediately in the other direction; overrunning alternator decouplers (OAD) rotate freely in one direction and allow a small angular rotation in the other direction. As none of the alternator pulley types are interchangeable, it is very important only to use the pulley type that the vehicle was originally equipped with. The alternator pulley makes up part of an entire drive system in which all parts are tuned to work flawlessly together. Replacing one part in the system with a non OE prescribed part will disturb the tuning of the drive, causing excessive wear to all components and premature failure of the alternator pulley because it was not designed for the given drive loads and vibrations. So if the application calls for a solid pulley, OWC or OAD, be certain to fit the part specifically designed for the vehicle (unless in exceptional cases explicitly stated otherwise by Gates or on OE level). With conventional solid alternator pulleys there is a recommendation to only replace if damaged or worn, not as part of preventive maintenance.

#### Identifying a worn overrunning alternator pulley

Wear affects not only the multi-ribbed belt, tensioner, idler and torsional vibration damper but also the overrunning alternator pulley. Like any other part, overrunning alternator pulleys don't last forever, and technicians will be replacing more and more of them. Failure of the pulley, wear and tear on the inner spring and malfunction of the overrunning clutch mechanism can occur. See pages 32-33 for wear patterns.

#### Facts to know about overrunning alternator pulley replacement

A damaged overrunning alternator pulley cannot effectively dampen vibrations nor properly transmit power to the alternator; this can compromise the engine accessories, hence the importance of checking the overrunning alternator pulley at each service interval. Replacement is required when the overrunning alternator pulley exhibits any of the tell-tale signs of wear. Furthermore, when an overrunning alternator pulley has reached the end of its service life Gates recommends that all wear parts are replaced at the same time to ensure the best long-term solution. It is also important to replace the overrunning alternator pulley when installing a new alternator.

Gates DriveAlign® overrunning alternator pulleys are the OE replacement part you need. They are the exact part that came on the vehicle from the OE.

By adding the DriveAlign® overrunning alternator pulley to its range Gates offers the aftermarket all service parts for a complete overhaul of the accessory belt drive.

Read more about Gates DriveAlign® overrunning alternator pulleys on pages 45-46.



## OVERRUNNING ALTERNATOR PULLEY WEAR PATTERNS

Great care should be taken when inspecting overrunning alternator pulleys since they do wear out, but this is not always visible to the naked eye.

### On-vehicle testing

Follow this on-vehicle test to help you identify an overrunning alternator pulley that is near failure:

- Have the engine running at idle and check belt tensioner movement. If excessive, this may be the first indication of a worn overrunning alternator pulley.
- Rev up the engine to approximately 2000-2500 revolutions per minute (rpm). Then shut it off and listen for a buzzing sound coming from the alternator. If you hear a short buzzing sound (1 to 5 seconds), the pulley's bearing may have worn out and the overrunning alternator pulley may require replacement.
- A short chirp noise during engine start-up or shut down is most likely caused by a worn overrunning alternator pulley. A worn overrunning alternator pulley often blocks and performs like a solid pulley. This will cause the belt to slip across the pulley surface during belt and alternator speed fluctuations.

### Off-vehicle testing

If one of below tests fails, the overrunning alternator pulley should be replaced immediately:

#### TEST 1



1. Hold the inner ring.
2. Try to rotate the outer ring in the same direction as the belt would.
3. The outer ring should not move.  
If it does, replace the overrunning alternator pulley.



## TEST 2



1. Hold the inner ring.
2. Rotate the outer ring in the opposite direction as the belt would.
3. The outer ring should rotate.  
If it doesn't, replace the overrunning alternator pulley.

### Special test for overrunning alternator decouplers

OADs have an additional functionality and require special testing.

OADs should have a smooth spring feel in the drive direction and spin freely in the opposite direction. If not, the OAD requires replacement.

**NOTE:** The internal spring is strong and will require use of a wrench and special tool to properly diagnose the pulley.



### SPECIAL CASE: DIAGNOSING A NOISY DRIVE

Whenever a vehicle owner complains of under-the-bonnet noise, it is important to determine the type of noise and under what circumstances it occurs. A solution to a noise problem caused by pulley misalignment is not likely to resolve a slip noise problem that may be caused by insufficient tension.

In any case, a noisy drive indicates a malfunction, and appropriate corrective action should be taken to eliminate the problem.

To accurately check for noise symptoms, the system must be loaded:

- Air conditioner and fan on full
- Lights on
- Wheels turned 3/4 to the left or right
- Defroster on

#### Belt noise

A **chirping noise** that increases in frequency as the engine is revved up can be the result of belt vibration caused by misaligned pulleys – the leading cause of belt noise.

As a misaligned multi-ribbed belt span enters the grooves of a pulley, initial contact is made with only one side of the groove. The greater the misalignment angle, the greater the radial sliding length experienced by the belt ribs as the belt seats in the pulley causing frictional vibrations, or chirping.

A high-pitched **squealing noise** that occurs when pulling away from a stop normally indicates a lack of tension – the second most common cause of belt noise. Without proper tension a belt will slip, the sidewalls will wear smooth, and the belt will eventually harden through “heat-ageing”, a process referred to as glazing. The more glazed the belt surface is, the more likely it is to make a squealing noise.

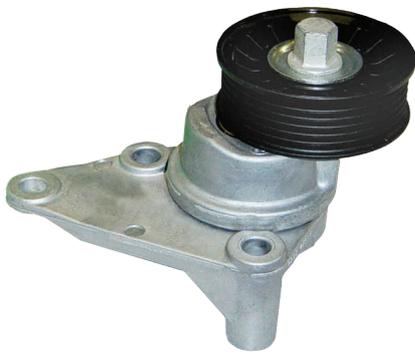
Also, a pebble or other foreign object can become imbedded in the belt, causing a **tapping, ticking or grinding noise**.

#### Tensioner noise

A **squeaking or rattling noise** coming from the tensioner indicates wear on the tensioner’s internal components and impending tensioner failure.

#### Pulley noise

A **grinding noise** can also result from damaged bearings in a pulley assembly. Bearing damage can often be detected by continuous grinding noises that increase as an engine’s rpm is increased. To locate the noise: turn off the engine, remove the belt, then hand spin all the pulleys to see if any are hard to turn, feel rough or rattle.





# REPLACE WORN PARTS WITH PREMIUM PRODUCTS BY GATES

## **GATES, YOUR ONE-STOP-SHOP FOR ALL ACCESSORY BELT DRIVE SYSTEM SERVICE PARTS**

What makes an engine perform at its best? The answer: when belts, tensioners, idlers and pulleys work together smoothly.

It really is no coincidence that Gates is the number 1 supplier for accessory belt drive system service parts. Gates simultaneously produces belts, tensioners, idlers and pulleys, so all products perform seamlessly together on the belt drive system. This universal approach to ABDS production ensures a flawless engine performance.

Offering you the biggest added value through superior, reliable products, full service, precise tools and in-depth expert training, Gates has everything you need to tackle the challenges you are faced with.

Gates gives you top-quality belt drive components to service your customers' cars. And we back up every product we sell with the most up-to-date cataloguing, technical support and training programmes you will find anywhere.



## **GATES MICRO-V® AT™ MULTI-RIBBED BELTS make accessory belt drive systems run like new again**



Multi-ribbed belts must be flexible enough to smoothly transmit power around smaller pulleys that rotate at thousands of revolutions per minute (rpm). They must be structurally sound to handle high loads under proper tension. In addition, they must endure extremes of cold and heat without losing their structural integrity while functioning properly amid environmental contaminants such as dirt, grease and oil...

Gates Micro-V® AT™ - technology so advanced, it's patented.

### **Facts about Gates Micro-V® AT™ belts**

Gates is the only manufacturer who exclusively uses EPDM for the entire multi-ribbed belt range. Gates EPDM Micro-V® AT™ belts show excellent resistance to wear, help correct instability in aged systems by minimising misalignment from worn component bearings, boast spectacular resistance to flex fatigue and high and low temperatures, and ensure optimal load characteristics.

At Gates we know our Micro-V® belt is the best in the business. We truly believe in the quality of our products and their effectiveness at boosting in-car performance. The Micro-V® AT™ is quiet, efficient and offers optimum performance on every car.

### **The truth about multi-ribbed belt length**

There are at least 1,575 different OE lengths. Offering multi-ribbed replacement belts that match OEM specs down to the millimetre does not make sense. First of all, tolerances are a normal occurrence in OE belts. The belt gets longer over time, due to wear and stretch. Small length differences never compromise belt performance. It is a misconception to believe that small length differences cause belts to fail. The real causes of belt problems and failures are – as explained in the previous chapters – wrong belt tension, misalignment and damage to other belt drive system components. And secondly, this creates an unacceptable range of belts for aftermarket distribution, which is neither profitable nor efficient.

The correct solution to the multi-ribbed belt length quandary is consolidation. Consolidation is necessary to avoid massive stocks with too many references. By carefully balancing the number of references to the needs of the market, the Gates consolidation principle saves space and unnecessary stock investments. The Gates Micro-V® AT™ belt range is the most well-thought-out range covering the vast majority of applications in the Australian and New Zealand car parc. In addition, standard tolerance for OE belts is  $\pm 5$  mm. The Gates Micro-V® AT™ range works with narrower tolerances, exceeding OE tolerance requirements, and ensures a perfect fit.

**The Gates consolidation principle ensures you cover the needs of the car parc, while keeping stock costs low.**

Gates offers you a perfectly balanced range of stock which is well respected and there is technically no compromise made.

**The benefits of Gates Micro-V® AT™ belts include:**

- Made in the same high-tech materials as the OE belts
- Designed to meet or exceed OE requirements
- Largest aftermarket car parc coverage
- Back provides high resistance to wear
- Polyester tensile cords offer optimum load-carrying capacity and low stretch at higher tensions
- Fibre-reinforced EPDM compound guarantees optimum resistance to high low temperature, wear, pilling, oil drops and ozone, and improved coefficient of friction
- Low belt profile ensures excellent flexibility, increased belt stability and reduced belt slip
- Optimum resistance to vibrations
- Silent-running operation
- Size-based numbering system

**Special note: Micro-V® Stretch Fit™ multi-ribbed belts**

Vehicle manufacturers are bringing car models into the market that are not equipped with a tensioning device. For those special accessory belt drive systems Gates offers the ideal response with its Micro-V® Stretch Fit™ belt programme. Gates Micro-V® Stretch Fit™ belts are pre-tensioned over the pulleys, thus maintaining tension that is capable of efficient power transmission over a long period of time, yet low enough to allow for easy installation and to prevent component failure.

Although this self-tensioning belt does not require the presence of a tensioner, we note that in some exceptional cases you can come across a vehicle equipped with a Micro-V® Stretch Fit™ belt and tensioner. Please always verify you have the correct belt at hand by checking the application in Gates catalogues.

Micro-V® Stretch Fit™ belts, like any other elastic belt, need to be installed using the appropriate mounting tool. Gates developed re-usable Stretch Fit™ installation tools offering the mechanic everything he needs to guarantee a perfect fitting procedure. In order to offer an even more complete service, Gates designed specific installation instructions for each of its Micro-V® Stretch Fit™ belts. These instructions are printed on the inside of the belt sleeve and refer to the appropriate Stretch Fit™ installation tool.

For more information visit: [www.GatesAustralia.com.au/abds](http://www.GatesAustralia.com.au/abds)



## GUIDELINES FOR REPLACING BELTS

Remember. These are only general guidelines. Always refer to the vehicle manufacturer's recommended procedures for replacement, tensioning and maintenance of multi-ribbed belts. Failure to follow these instructions could result in injury or property damage. Gates disclaims all liability due to failure to follow these instructions.

### STEP 1 – Safety first

First and foremost, for your own safety, disconnect the car's battery and set the hand brake.

### STEP 2 – Draw a sketch or take a picture of the belt routing

Before removing the old multi-ribbed belt, look under the bonnet and around the engine compartment for the belt routing, make sure you are familiar with the configuration.

### STEP 3 – Release the tension

You can easily slide the belt off the pulleys, once the tension is relieved.

Many new cars use an automatic tensioner which makes servicing easy. Release the tension by means of a spanner or socket wrench and block the tensioner in the retracted position.

Other cars use tensioners or accessories which have to be locked down manually to provide the correct tension. These are called locked centre drives. To remove the belt, release the tension.

### STEP 4 – Check belt, tensioner, idler and pulleys for wear and dirt

With the belt removed from the drive, check belt, tensioner, idler and pulleys for signs of wear – as described earlier in this manual. Make sure the tensioner is in perfect condition and the new belt will run on perfect pulleys.

### STEP 5 – Check for misalignment

Before installing the new belt, check the alignment of the pulleys as this is a very critical factor for multi-ribbed belts (see also page 25). Misalignment can cause severe belt wear and damage. It can also create noise or cause belts to get pulled into the timing belt drive. Misalignment can be caused by non-parallel shafts on drive accessories or pulleys located incorrectly on the shafts. If misalignment is due to non-parallel shafts, it may be caused by a damaged accessory bracket. Replace the bracket if necessary.

The accessory pulley may be seated too far forward or backward on the shaft. In this case, add or remove metal shims to reposition the pulley or accessory.

Misalignment is now easy to diagnose thanks to Gates DriveAlign® laser alignment tool (see also page 47) which allows you to identify the two most common types of misalignment, even in the tight confines of the engine compartment.

**STEP 6 – Install a new Gates Micro-V® AT™ belt**

Once you have thoroughly checked the entire drive and, if necessary, replaced any worn components, install the belt according to your sketch or picture. Carefully align the belt ribs with the pulley grooves and check that the belt is squarely on each pulley. Pulleys that cannot be visually inspected should be felt to ensure proper installation. If not properly installed, the belt can ride up on the pulley or skip grooves resulting in severe belt damage.

**STEP 7 – Apply the correct tension**

If the drive has an automatic tensioner, slowly release the tensioner and it will automatically apply the right tension. If the car has a manual tensioner, you need to carefully apply the right tension yourself. Applying the right tension is easy with Gates STT-1 sonic tension tester (see also page 47). The STT-1 ensures a simple and extremely accurate tension measurement. It is important that you measure the belt installation tension before letting the engine run. So after having mounted the new belt correctly, you use the STT-1 to check whether the tension is OK, too high or too low. If necessary, adjust the tension and measure again. When the installation tension proves to be correct, start up the engine and let the drive run for a few minutes to ensure proper functioning of the belt and even distribution of the tension along the belt's length. Installation tension should not be re-measured and adjusted after the drive test run.



## GATES DRIVEALIGN® TENSIONERS

### fit and perform like the original



The vast majority of vehicles using a multi-ribbed belt have an automatic belt tensioner. Tension is provided by a powerful spring, located within a small canister-like housing to which a pulley is attached. The pulley pivots around the spring housing and generates a constant belt tension. Automatic belt tensioners are designed into the belt drive system for several reasons:

- Proper tension is maintained throughout the belt life.
- They increase belt life because the belt is maintained at an ideal tension under all conditions.
- They eliminate the need for an initial very high tension to compensate for tension loss during service – thereby increasing bearing life of the accessories.

Gates also has manual tensioners in its range for older vehicle models, to optimally serve your needs. These tensioners require the intervention of a car mechanic to determine the correct installation tension as well as for periodic re-tensioning.

### Facts about Gates DriveAlign® tensioners

With Gates DriveAlign® tensioners, you will get performance that is equal to or better than the original. In fact, Gates engineers analyse the failure modes of OE designs and make any necessary adjustments to improve performance.

Plus, we are one of the largest manufacturers of tensioners for accessory belt drive systems in around the world.

### The benefits of Gates DriveAlign® automatic tensioners include:

- Patented asymmetric damping mechanism – Specifically designed to increase belt and tensioner life.  
The presence of a damping mechanism is a great advantage to the life of a tensioner and the proper function of the drive as a whole. Gates DriveAlign® tensioners have a damping mechanism made of a highly engineered composite. We have the technology to offer an asymmetric damping capability which means we can control the damping force to the optimum level no matter which way the tensioner is rotating and in a way other tensioners simply cannot. Essentially, a damper acts like a shock absorber does on a vehicle's suspension system, reducing tensioner motion and minimising vibration and noise.
- Patented round spring – Chrome-silicone torsion spring for less flex fatigue than flat spring designs.  
Gates automatic tensioners use a patented round spring design that is stronger and more contamination-resistant than the flat spring design. The chrome-silicone spring coils do not rub against each other, so they are quiet. And because of their careful design, they are much less subject to flex fatigue.
- Patented bush design – Reduces wear and ensures proper alignment for the life of the tensioner.



- Unique labyrinth sealing – Prevents contamination of internal parts for maximum durability and service life
- Computer aided component design – Engineered for minimum unit weight but maximum strength and durability
- Pulley – Reduces surface wear
- Precision bearings – Premium bearings minimise friction for reduced bearing wear and noise
- Installation feature - Gates have added a feature which allows easier fitment of the tensioner, in some case Gates also provide an easy lift feature as an installation aid. This, making the Gates tensioner easier to install than the OE.
- OE fit, not retrofit.

For more information visit: [www.GatesAustralia.com.au/abds](http://www.GatesAustralia.com.au/abds)

## GUIDELINES FOR REPLACING TENSIONERS

Remember. Every vehicle has tensioners designed for that particular engine assembly, which means there is no universal replacement procedure. Always refer to the vehicle manufacturer's recommended procedures for replacement and maintenance of tensioners. Failure to follow these instructions could result in injury or property damage.

Gates disclaims all liability due to failure to follow these instructions.

In general, the proper guidelines for automatic tensioners are as follows:

**STEP 1** – Draw a sketch or take a picture of the belt routing

**STEP 2** – Unload the belt from the tensioner by rotating the tensioner

**STEP 3** – Remove the old tensioner from the engine

**STEP 4** – Place a new Gates DriveAlign® tensioner on the engine

**STEP 5** – Torque the mounting bolts to 1/3 of the installation torque in a star pattern

**STEP 6** – Retighten the bolts to 2/3 torque, then tighten to full torque as specified by the vehicle manufacturer

**STEP 7** – Install a new Gates Micro-V® AT™ belt and make sure the new belt will run on perfect pulleys

**STEP 8** – Load the belt on the tensioner by rotating the tensioner to its correct position

## GATES DRIVEALIGN® TORSIONAL VIBRATION DAMPERS for a smooth accessory belt drive system



Torsional vibration dampers are vital in keeping the crankshaft and engine working properly, so you need replacement parts of the highest quality. They positively affect the entire system's performance:

- Prevent failure of the crankshaft by fatigue.
- Decrease wear and tear on the belt, tensioner and other components in the driven assembly.
- Improve noise, vibration and harshness (NVH) characteristics, and therefore increase the comfort of vehicle drivers and their passengers.

As a complete system supplier, Gates offers you a wide range of OE equivalent DriveAlign® torsional vibration dampers that fit the application perfectly and cover all the major models in the market.

### Watch out for fake torsional vibration dampers.

Those cheap pulleys do not have any damping function at all as there is no rubber element inside. They only have a rubber O-ring on the outside.

For more information visit: [www.GatesAustralia.com.au/abds](http://www.GatesAustralia.com.au/abds)



## GUIDELINES FOR REPLACING TORSIONAL VIBRATION DAMPERS

Remember. These are only general guidelines. Always refer to the vehicle manufacturer's recommended procedures for replacement and maintenance of torsional vibration dampers. Failure to follow these instructions could result in injury or property damage. Gates disclaims all liability due to failure to follow these instructions.

**STEP 1** – Draw a sketch or take a picture of the belt routing

**STEP 2** – Unload the belt from the tensioner by rotating the tensioner

**STEP 3** – Remove the torsional vibration damper from the crankshaft by fixating the torsional vibration damper and loosening the mounting bolts

For torsional vibration dampers that are fitted with one central expansion bolt it is necessary to block the flywheel. With every replacement the expansion bolt must also be replaced since it cannot be reused.

Torsional vibration dampers that are fitted with more than one mounting bolt can be replaced without having to block the flywheel. In that case, simply hold the torsional vibration damper. These regular mounting bolts can be reused.

**STEP 4** – Place a new Gates DriveAlign® torsional vibration damper on the engine

**STEP 5** – Torque the mounting bolts to 1/3 of the installation torque (in a star pattern in case the torsional vibration damper is fitted with more than one mounting bolt)

**STEP 6** – Retighten the bolts to 2/3 torque, then tighten to full torque as specified by the vehicle manufacturer

**STEP 7** – Install a new Gates Micro-V® AT™ belt and make sure the tensioner and overrunning alternator pulley are in perfect condition

**NEVER** start the engine without a belt fitted as this might cause damage to the newly installed torsional vibration damper.

**STEP 8** – Load the belt on the tensioner by rotating the tensioner to its correct position



## **GATES DRIVEALIGN® OVERRUNNING ALTERNATOR PULLEYS lengthen the life of your components**



Every time the engine decelerates, for example during gear changing or engine shutdown, the alternator's inertia creates resistance against the belt. An overrunning alternator pulley allows the alternator to "free-wheel" or "overrun" when the belt suddenly slows down. This prevents the belt from slipping and reduces vibration, wear and chirp noises.

Almost every recent car model is equipped with an overrunning alternator pulley. That is why Gates decided to add a line of DriveAlign® overrunning alternator pulleys to its range. Gates now has everything you need to guarantee a fully reliable accessory belt drive system.

Specially adapted tools are required to remove and install the overrunning alternator pulley.

Gates offers you the 91024 tool kit, containing a complete set of OAP removal and installation tools.

For additional info on the Gates professional automotive tool range, go to page 47.

For more information visit: [www.GatesAustralia.com.au/abds](http://www.GatesAustralia.com.au/abds)



## GUIDELINES FOR REPLACING OVERRUNNING ALTERNATOR PULLEYS

Remember. These are only general guidelines. Always refer to the vehicle manufacturer's recommended procedures for replacement and maintenance of overrunning alternator pulleys. Failure to follow these instructions could result in injury or property damage. Gates disclaims all liability due to failure to follow these instructions.

### **STEP 1 – Make sure to use the appropriate tools**

Special tools are needed to remove and install an overrunning alternator pulley. Use Gates 91024 tool kit, containing the complete set of required removal and installation tools.

### **STEP 2 – Use the proper alternator pulley type for the specific vehicle**

Solid pulleys, OWCs and OADs are not interchangeable, so it is very important to install the alternator pulley type that the vehicle was originally equipped with (see also page 31).

### **STEP 3 – Proceed with caution**

This type of installation requires the pulley shaft to be held with a calibrated torque wrench and the correct tool, the alternator rotor shaft is then rotated with a torque wrench (counter clockwise for right-hand threaded pulleys and clockwise for left-hand threaded pulleys).

Typically installation torque is 65 ft-lb/90 Nm unless otherwise specified.

In many cases it is possible to remove and install the overrunning alternator pulley while the alternator is still on the engine.

### **Special note when replacing OAPs**

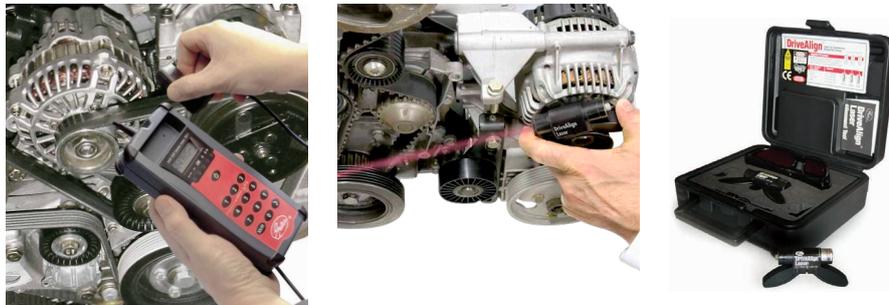
The plastic protective cap cannot be re-used after it has been removed from the pulley. A replacement cap is supplied with the new part. Don't fit the new cap until you are absolutely sure the new overrunning alternator pulley is fixed correctly. Some caps cannot be removed without damaging them after installation.

## GATES PROFESSIONAL AUTOMOTIVE TOOL RANGE

### high-grade tools for professional use

In order to ensure that installation can be achieved correctly and according to the vehicle manufacturer's recommendations the correct tool must be used. Without the correct tool, installation errors can occur. Consequences include: premature failure of the drive belt or tensioner, damaged belt drive system components or even the complete destruction of the engine itself.

Being aware of the implications of premature belt failure for the garages and attempting to address the growing need for greater expertise, Gates has chosen to complement its broad range of replacement parts with professional tools that ensure a perfect installation and offer the mechanic all he needs for a thorough belt drive overhaul. The Gates professional automotive tool range is a very broad range of universal and engine-specific tool kits for both accessory and synchronous belt drive systems. And here are some tools that will certainly interest you.



For tensioning belts with manual tensioners, you can rely on the Gates STT-1 sonic tension tester.

STT-1 analyses sound waves (natural frequencies) from the belt through the sensor. That is the most accurate way to measure belt tension, and the principle is approved and used by vehicle manufacturers all over the world. Simply position the sensor close to the belt, flick the belt and the tester processes the input signals and compares them with the values stored in its memory. In this way, it is very easy for you to determine whether the tension is OK, too high or too low, and to adjust it.

For aligning, use the Gates DriveAlign® laser alignment tool (91006).

Simply position the tool within the grooves of a pulley and aim its bright laser beam at an opposite pulley. Any misalignment is instantly visible. This exclusive lightweight and easy-to-use Gates tool is compatible with all automotive serpentine belt drives.

For more information visit: [www.GatesAustralia.com.au/autoaftermarket](http://www.GatesAustralia.com.au/autoaftermarket)



# NOTES

# LET'S RECAP



## THE INTERCONNECTIVITY OF THE SYSTEM

The multi-ribbed belt plays a critical role in the performance of the accessory belt drive system. Components like the alternator, water pump, power steering pump and air conditioning compressor depend on the belt to be operational and keep the system running.

It is important to understand the relationship the multi-ribbed belt has with the rest of the belt drive components. The belt depends on the other components to function properly: the tensioner to provide the proper amount of tension, the idler to follow the best possible routing, the torsional vibration damper to dampen harmful vibrations and the overrunning alternator pulley to help prevent slippage and reduce wear and noise. So without the multi-ribbed belt, tensioner, idler, torsional vibration damper and overrunning alternator pulley working together properly, the system will not function efficiently.

The danger of not understanding these parts' relationship may result in premature failure of the drive or one of its components, or in extreme cases catastrophic failure of the entire accessory belt drive system.

## A REPUTATION DEPENDS ON SATISFIED CUSTOMERS

These days, keeping expenses down gets more attention than ever. Replacements are often postponed because they aren't deemed "essential" at that particular moment. However, when you consider that the largest contributor to breakdowns is improper maintenance and taking into account the much higher cost of repair that this brings about, Gates is convinced that proper maintenance is the best way to keep cars in good shape and to keep customer satisfaction levels for your garage high:

### 1. Make at least a visual inspection of all components whenever the bonnet of the engine is lifted

The consequences of overlooking a problem for too long could be potentially dangerous for both the engine of your customer's car and the reputation of your garage.

### 2. Replace when you see obvious signs of wear

If a belt drive component shows obvious signs of wear, it needs to be replaced immediately.

As multi-ribbed belts, tensioners, idlers and pulleys are designed to have similar lifespans Gates recommends that when replacing one of these components, you replace all. In this way, you ensure the best long-term solution and improve the customer satisfaction levels for your garage.



### 3. Replace every four years or 100,000 km as part of preventive maintenance

If your customer's vehicle has four years or over 100,000 kilometres of service on the belt, Gates advises replacement of all wear parts, since not every case of ageing is clearly evident in the form of a failure pattern, although it very much impairs the proper functioning of the engine nonetheless.

### 4. Special note

While the four-year replacement interval is a basic rule of thumb, it's not exact. Idling time in traffic and excessive use of accessories for passenger comfort (air conditioning, seat heating, on-board navigation etc.) take a major toll on component life. The engine runs hotter, and components wear much more rapidly in a car exposed to sustained periods of stop and go driving, idling and excessive use of certain accessories. Environmental circumstances like extreme temperatures, dusty roads, flooding, road salt etc. also negatively affect component lifespan.

Components should also not come into contact with oils, acids, fuels, etc.

Last but not least, all components should be installed according to the manufacturer's recommendations.

## KEEP YOUR CUSTOMERS SATISFIED.

**REPLACE WORN BELTS, TENSIONERS, IDLERS AND PULLEYS  
WITH PREMIUM PRODUCTS BY GATES.**



## REVIEW QUIZ

1. Which critical parts and systems on an engine can be affected by a failed multi-ribbed belt?

- A. water pump
- B. fan
- C. alternator
- D. air conditioning compressor
- E. power steering pump
- F. all of the above

2. If any component within the belt drive system has been recently replaced, the best way to start your inspection is to

- A. apply the water spray test
- B. check that part for correct installation and alignment
- C. consult the vehicle's shop manual

3. Match the following descriptions with their correct names.

- A. pilling
- B. cracking
- C. glazing
- D. chunk-out
- E. oil contamination

\_\_\_ small, yet visible cracks along the length of a rib(s)

\_\_\_ slick or shiny belt sidewalls caused by friction

\_\_\_ belt sidewalls soaked by degrading engine fluids

\_\_\_ belt material sheared off from ribs and built up in belt grooves

\_\_\_ pieces of rubber material broken away from belt

4. You can always determine if a multi-ribbed belt is still good by merely visually inspecting it.

True or false?

5. Belt sprays can solve problems and improve belt life.

True or false?

6. The two major causes of belt noise are

- A. engine vibration and belt elongation
- B. belt slip and excessive hub loads
- C. improper belt tension and pulley misalignment
- D. pulley misalignment and glazing
- E. improper belt tension and vibration



- 7. Automatic tensioners are designed to**
- A. apply a constant force to the multi-ribbed belt
  - B. reduce belt wear
  - C. protect the belt and all belt-driven components
  - D. all of the above
- 8. Misalignment can reduce belt life by up to**
- A. 10 percent
  - B. 25 percent
  - C. 50 percent
  - D. 75 percent
- 9. Which condition exists when pulleys are outside the plane of other pulleys but their shafts remain parallel?**
- A. angular misalignment
  - B. parallel misalignment
  - C. pulley incompatibility
- 10. Noise and vibrations are the first indications of a worn torsional vibration damper.**
- True or false?
- 11. Which part is the core feature that makes a torsional vibration damper work properly?**
- A. mounting bolts
  - B. rubber element
  - C. bearing
- 12. When replacing an overrunning alternator decoupler, it can be replaced by**
- A. an alternator pulley type of your choice, since the type is no determining factor
  - B. a one-way clutch or an overrunning alternator decoupler, since the modern-type alternator pulleys feature different characteristics than conventional solid alternator pulleys
  - C. an overrunning alternator decoupler only, as none of the alternator pulley types are interchangeable
- 13. Specially adapted tools are required to remove and install an overrunning alternator pulley.**
- True or false?
- 14. What is the average expected lifespan of a multi-ribbed belt in kilometres/years?**
- A. 80,000 km / 3 years
  - B. 100,000 km / 4 years
  - C. 120,000 km / 5 years



15. As multi-ribbed belts, tensioners, idlers and pulleys are designed to have similar lifespans it is advisable that when replacing one of these components, you replace all.

True or false?

1. F
2. B
3. B, C, E, A, D
4. False

Over the last decade, EPDM has replaced chloroprene as the preferred material for multi-ribbed belt construction, and a visual inspection is still a good idea but should be expanded with a material loss test using the Gates ABDS wear indicator.

5. False

A belt spray may quieten the belt as it will cause the belt to slip quietly, but the EPDM material will absorb this spray and cause the rib surface to dry which means the belt noise will return. What is more, the spray can cause degradation of the EPDM material.

6. C
7. D
8. D
9. B
10. True
11. B

Don't forget to watch out for fake torsional vibration dampers that only have a rubber O-ring on the outside but no proper rubber damping element on the inside.

12. C
13. True
14. B

Keep in mind that the four-year or 100,000 km replacement interval is a basic rule of thumb, it's not exact. Therefore, it is imperative to periodically inspect all components.

15. True

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