Introduction to Accessory Belt Drive Systems
Note: The majority of new vehicles use Micro-V® belts to power their front end accessories. However, V-belts (not shown in this engine illustration) are still used on some vehicles.
In modern cars, there are generally two types of belts used on front-end accessory drive systems: V-belts or Micro-V belts.

The big difference between the two belts is in the profile. Micro-V belts are flatter and wider than V-belts, with multiple “V-shaped ribs” extending along the belt’s length.

Micro-V work better inside today’s smaller, more complex engine compartments, where space is limited and one flexible Micro-V belt can do the job formerly carried out by several V-belts.

The Micro-V belt was designed to transmit power via the backside of the belt as well as the ribs. This allows the belt to perform in “serpentine” drives – drives that require one belt to power all accessories in the drive system.

V-belts have a “V”-shaped” profile designed to wedge into a corresponding pulley groove of similar profile. To accommodate small pulleys, the underside of the belt is notched, which allows greater flexibility and a decreased bend radius. The variable notch pattern used on NAPA Belts/Hose belts also reduces noise.
Front-end belts used on a car engine drive many critical parts and systems including these accessories:

**The alternator** – which supplies electrical power to the vehicle.

**The water pump** – which circulates coolant.

**The fan** – which draws in air to cool liquid flowing through the radiator.

**The air conditioning compressor** – which circulates the refrigerant in the air conditioning system.

**Any number of other accessories**, from power steering pumps to air pumps, and other equipment.

Without belts, or when a belt fails, the engine will not run long, or it may not run at all.

A failed belt may also hinder the safe operation of other important vehicle systems.
Belt Construction

Micro-V belts and V-belts consist of three bonded sections – the *undercord*, the *tensile cord*, and the *overcord*. The overcord is made of advanced elastomeric composites and fabric. It protects the tensile cord from dirt, oil and other environmental contaminants. It also gives the cords additional transverse (side-to-side) support on the pulley by sustaining a firm gripping surface.
Tensile cords are what make the belt strong. Cords generally consist of twisted polyester bands. These bands allow flexibility while maintaining belt integrity by providing stretch resistance. The cords provide enough strength to stand up to the shock of high load-carrying and are exceptionally durable.

The undercord ribbed section supports the other layers and transfers their load directly to the pulleys. Precision grinding assures a secure fit and consistent tension.

The adhesive material used to join the belt sections consists of advanced bonding agents and liquid elastomers that provide protection and cushion for the tensile cords and prevent separation. These bonding agents and elastomers are adhered during the vulcanization process in which rubber is cured with the assistance of heat and chemical agents.

Both Micro-V belts and V-belts are engineered to exact tolerances. Combined, all three layers act as one fully integrated component that is flexible enough to transmit power around small pulleys that rotate at thousands of revolutions per minute. They must also be structurally strong enough to handle the load under the proper tension.
**Expected Belt Life**

Because today’s belts operate under heavier loads, are exposed to greater heat and 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’s 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 automotive experts recommend that all belts be replaced at least every four years, as part of routine maintenance.
Belts Can Fail Faster

While the four-year replacement interval is a basic rule of thumb, it’s not exact. Idling time in traffic takes a major toll on belt life. The engine runs hotter, and belts can break down much more rapidly in a car exposed to sustained periods of stop and go driving. Today’s normal urban driving patterns constitute extreme operating conditions, exposing belts to excessive stress and wear.

Sometimes, the first indication of a faulty belt is a squeaking noise coming from the engine compartment. While a warning of a possible malfunction, this noise is not a precise indicator. 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 belts. The alternative could be a customer stranded in the middle of rush hour with a broken belt and a disabled vehicle.

To inspect a belt, first make sure the engine is off. If a belt exhibits any of the telltale signs of wear, it should be replaced. See Page 16 for belt wear guidelines.
Vehicles using a single serpentine belt often employ an automatic belt tensioning system. Designed to apply a constant force to a belt, the tensioner compensates for belt length changes due to wear or changes in accessory drive operating loads. The tension is supplied through a component consisting of a spring mechanism housed behind a pulley.
This automatic re-tensioning reduces maintenance by eliminating the need to re-tighten belts periodically, as the proper tension will be applied for the life of the belt. Also, when tension is maintained at an optimal level as belt wear occurs, the life of bearings and accessories, as well as the belt itself, is increased.

Automatic tensioners are generally used with Micro-V belts only, though some have been effectively applied to V-belt drives. A specially designed V-belt may be required when a tensioner is applied to the backside of a belt since most V-belts are not designed to accommodate reverse bending.

While these Special Application belts are ideal for backside idler drives, they are not recommended on traditional drives. These Special Application belts may also be required on those pulley applications that do not conform to SAE standards. These belts have the exact measurement as the OE belt.

Because of the excellent performance of automatic belt tensioners, more and more vehicles are being built with this type of system. Like any other component, automatic belt tensioners wear out, and should be replaced periodically for the belt system to work properly.
Pulleys and Idlers

A pulley is a grooved wheel whose purpose is to transmit torque to driven components in the accessory drive system. In contrast, an idler is either flat for the backside of the belt or grooved for the bottom of the belt. It is generally free spinning and does not transmit torque to an accessory component. An idler’s purpose can be to optimize belt routing, suppress belt span vibration, or provide a means for tensioning the belt.

Periodic inspection of the accessory drive system should be performed at regularly scheduled maintenance intervals.
The important role of the pulley

How the belt rides in the pulley groove is an important factor affecting a belt’s life and ability to transmit power. The belt should ride slightly above the top of the pulley groove. If it rides too high, the edges of the pulley will wear into the belt sides and eventually cut through the cover (or into the exposed internal parts of the belt.)

If the belt rides too low, it will soon bottom out in the pulley groove. The belt then acts like a flat belt and loses its wedging grip on the sides of the pulley groove. This will cause the belt to slip, accelerating belt wear, glazing the belt sidewalls and increasing pulley groove wear.

Note: When components are replaced, be sure to check for the correct match.
An automatic tensioner is a spring-loaded device consisting of eight basic parts.
**Base** – The base is a stationary part, bolted to the engine block or other accessory. Each base design is different but they all usually feature a “locating pin” and mounting holes where the base is bolted to the engine. The locating pin and bolt holes position the entire tensioner assembly properly in relation to other pulleys.

**Damper or Bushing** – The damper is a plastic ring designed to reduce vibration in the tensioner. Often it will wear during operation and require tensioner replacement.

**Spring** – The spring is the core feature that makes the tensioner work, by providing tension to the belt. Tension is pre-loaded at the factory, so never try to disassemble a tensioner as a sudden release of the spring could cause injury.

**Arm** – The arm connects the spring to the tensioner pulley. It is usually an aluminum casting.
Pulley – Pulleys transmit torque to driven components and come in a range of diameters, styles and materials. Materials include engineered plastic nylon or steel. Styles can be grooved, flat, or flat with flanges. Pulleys should be periodically inspected for damage or wear. Nylon pulleys are vulnerable to wear and should be replaced if wear is excessive. See the troubleshooting guide on page 25 for inspection guidelines.

Pulley Bearing – Do not attempt to replace a failed bearing in a used pulley, as proper alignment will be impossible. The entire pulley assembly should be replaced. NAPA Belts/Hose supplies premium replacement pulley and bearing assemblies that are factory assembled and ready to install.

Dust Shield – The dust shield is a small washer that protects the bearings from environmental contaminants.

Pulley Center Bolt – The pulley center bolt attaches the pulley to the arm.
Some tensioners have a belt length variation gauge (see page 23 for two-mark and three-mark type gauges), indicating the belt’s length. It usually consists of a pointer and either two or three marks to show the range of tensioner movement. The marks are designed to indicate “minimum,” “ideal,” and “full” or “maximum” take-up length. The gauge window is located on or along the break between the base and arm of the tensioner assembly, or it may be in a position that is harder to see. Locate the gauge to determine the relative length of the belt.

Premium NAPA Belts/Hose belts are designed for minimal stretching as the belt wears. Some competitive belts, however, stretch excessively, resulting in belt noise. If noise is a problem on older belts, check the tensioner gauge. If the gauge shows minimum take-up length, replace the belt with the correct size NAPA Belts/Hose XL belt.
Micro-V belts for the growing Sports Compact Tuner market are now available from NAPA Belts/Hose under the brand name Hyoshi Performance. Unlike traditional belt products, these performance belts are bright red and blue, colors popular with this growing market. NAPA Belts/Hose also offers Timing Component Kits, PowerGrip hose clamps, coolant hose kits, cam sprockets and silicone vacuum hoses.
A NAPA Belts/Hose DriveAlign® replacement tensioner/pulley assembly is made specifically for each vehicle. Other aftermarket tensioner manufacturers try to use common base and tensioner arm assemblies that often do not fit on applications without filing, grinding or application of quick-drying cement to secure the locator pin and bushing.

NAPA Belts/Hose DriveAlign tensioners look and fit like original equipment. More importantly, they perform like original equipment, with more than three times the service life of “universal” type tensioners.
Belt Noise

Terms such as chirp, squeal, squeak, hoot and yelp have been used to describe noises caused by friction-induced vibration in engine accessory drive belts. These noises may indicate underlying damage to tensioners, bearings, pulleys and other components. Untended, they could lead to belt failure. The two major causes of belt noise are improper tension and misalignment.

Improper tension is caused by a number of factors:

- Insufficient installation tension
- No run in and retension when the belt is new
- No continuing tension maintenance
- Insufficient installation allowance in the drive
- Insufficient take-up allowance in the drive
- Change in drive center distance
- Pulley groove wear
- Belt sidewall wear
- Belt permanent elongation
Without proper tension, a belt will slip, the sidewalls will wear smooth, and the belt will eventually harden through “heat-aging”, a process referred to as glazing. The more glazed the belt surface is, the more likely it is to be noisy and lack sufficient ability to transmit power.

**Note:** Technicians often refer to belt “stretch” as a cause of belt noise. Use of the term “stretch” is actually an inaccurate identification for what is, in fact, a loss of tension caused by one of the factors listed above. Belt deformation is usually not a sufficient reason for loss of tension. See page 31 of the troubleshooting guide for proper corrective action.

**Note:** Belts tensioned too high may not cause noise, but can shorten pulley bearing life from excessive hub loads. Too much tension can also result in excessive belt wear, increased belt temperatures, and premature belt failure.

Because tension levels in a belt will normally decrease with use over time, new belts are typically installed with a higher degree of tension necessary to prevent slip. The tension decay properties of a belt are designed to provide minimal tension loss with a decay rate that is both gradual and predictable.

Never use belt dressing or any type of substance to coat the belt to eliminate belt squeal or noise. Contamination from applying a substance on the belt will adversely affect belt life.
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.
Both misalignment conditions can create belt tracking problems, excessive wear, chirp noise and belt stability problems. Just a few degrees of misalignment can increase belt operating temperature by 30° F, reducing belt life by as much as 50 percent.

Misalignment noise occurs most frequently on the shortest spans in a drive, which often arise between a backside pulley and an adjacent grooved accessory pulley. Proper pulley alignment is particularly critical in these locations. Misalignment noise is generally loudest at idle speed and diminishes with increasing engine rpm. The presence of high humidity (or a damp belt) often increases the likelihood for misalignment noise to occur.

High output alternators used on today’s cars can produce other noises and add extra stress to the belt system. These high-power alternators result in higher belt loads and a higher likelihood of belt slip. This can result in excessive heat, belt wear, premature belt and tensioner failure and noise.
Low belt tension, contamination by grease or oil, and belt vibration are also sources of belt noise. “Wet slip” is another type of belt noise and can be aggravated by worn or glazed belts and/or worn pulleys that are water soaked. When the engine is idling, this situation can be checked and the noise can be replicated by misting the belt with water as it rotates. See the “Water Spray Test” on page 21 of this manual for more specific information on how to test for improper tension or misalignment problems.

Also, a pebble or other foreign object can become imbedded in the belt, causing a tapping or grinding noise. Both the belt and pulley can be affected. If a foreign object has damaged a belt, it should be changed immediately.

If bearings are noisy, the belt tensioner/pulley assembly should be replaced and the belt examined for replacement at the same time.

Vibration and noise can develop over time as drive components such as pulleys, bearings, and spring tensioners wear out of tolerance, and brackets loosen, or as belts wear.

In any case, noise from the belt system indicates a malfunction, and corrective action should be taken to eliminate the problem.
NAPA Belts/Hose belts use new elastomeric compounds and fiber loads that are noise-resistant under various environmental and wear conditions. These new belts feature additives that enable them to slide easily into and out of the pulley. This low-noise construction helps eliminate belt noise from most misalignment situations.

NAPA Belts/Hose tighter-than-OEM Micro-V belt fit tolerances allow a properly functioning tensioner to maintain proper tension throughout the life of the belt.

This chart compares NAPA Belts/Hose belts and competitive belts in regard to length differences between parts. The “0” on the chart represents the optimal OEM length. While NAPA Belts/Hose belts tested within .3 inches, competitive belts proved to be up to 1.2 inches longer than the OEM belt.
Pulley Incompatibility

There are two forms of V-belt pulley incompatibility: **pulley groove size mismatch** and **pulley groove spacing mismatch**.

Pulley groove size mismatch (Fig. 1) occurs when an original equipment accessory is replaced in the vehicle. The new or rebuilt accessory may come with a pulley attached or a new pulley may be used to replace the old pulley. The new pulley may be designed for a different belt cross section or a different number of V-ribs, thus leading to a pulley groove size mismatch. The belt will not seat properly and misalignment occurs.
Multiple groove “V” pulleys incorporate a ridge between the grooves to separate the belts. The groove spacing can vary from pulley to pulley around the accessory drive. Pulley groove spacing mismatch (Fig. 2) can occur during the design and manufacture of a vehicle when parts produced by different suppliers are combined. Often these suppliers used different standards to produce their pulleys, resulting in a mismatch between pulley dimensions on the various accessories.

Pulley groove size mismatch and pulley groove spacing mismatch can both result in irregular belt wear, inefficient load transmission, belt turnover, improper span tensions, noise, and excessive bearing wear.
Diagnosing Belt Warranty Returns

This chart indicates the difference between valid and invalid manufacturing warranty issues.

Improper Installation/Uncontrollable Factors (Non-Warranty Issues)

Misinstallation – A belt rib begins separating from the joined strands.

Repair Damage – The belt is accidentally cut during underhood repair work. Note the existence of a clean cut in the edge or surface of the belt.
Gravel Penetration – A pebble, sand or other foreign object became embedded in the bottom of the belt or the pulley grooves during vehicle operation. Example: Frayed portion of belt.

Bearing Failure – Often a belt is broken and shows excessive localized wear, where the belt has melted into a smaller diameter bend.

Abrasion – The backside of the belt appears shiny or glazed. When in motion, the belt makes contact with an object in its path such as a flange or bolt.
Uneven Rib Wear – Damage to the side of the belt, a possible break in a tensile cord or jagged-edge ribs.

Belt Turn-over (not shown) – A condition that applies to V-belts only in which the belt twists out of its upright position as a result of pulley misalignment, excessive belt span vibration, or excessive pulley or belt wear.

Normal Wear Factors (Non-Warranty Issues)

Cold Cracking – Excessive cracking after a period of severely cold weather of -20°F or below.
Normal Cracking — Small, yet visible cracks along the length of a rib or ribs. Normal wear after more than 50,000 miles of service or under extreme operating conditions.

Chunk-Out — Pieces or chunks of rubber material have broken away from the belt. Generally another high-mileage condition. When chunk-out has occurred, a belt can fail at any moment.

Glazing — Friction, created by a loose belt slipping in the pulley, causes the belt sidewalls to become slick and shiny. This action accelerates belt degradation, leading to cracking and chunking.
Pilling – Belt material is sheared off from the ribs and builds up in the belt grooves. This action makes the belt’s grooved surface uneven, and causes vibration and belt noise, belt slip, or in severe cases allows the belt to “walk off” the drive.

Oil Saturation – Grease, oil, coolant solutions and other degrading engine fluids can soak the belt sidewalls, resulting in a glazed belt that slips. Prolonged contact with petroleum can lead to adhesion breakdown of belt materials and cause premature failure.

Edge Cord/Sidewall Wear – A foreign object, such as a pebble, can cut perpendicularly into the belt, causing the exposed tensile cord to separate or break away from the belt.
Manufacturing Defects (Warranty Issues)

Rib Defect – May be a smooth cut ground into the belt during manufacturing.

Backside Defect – Inconsistent appearance prior to installation.

Grinder Defect – Uniform indentation left in belt ribs by the manufacturing grinder.

Mispackaged – Wrong sleeve on a belt that misidentifies it. Be sure to keep both the belt and the package for the NAPA Belts/Hose representative to verify.
Pulley Noise

A grinding sound can also result from damaged bearings in the pulley assembly. Bearing damage can often be detected by continuous hissing or grinding noises that increase as engine rpm is increased. It can begin with a continuous growling noise, which changes to a whine with the increase in rpm.

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. A combination of growling, whining and hissing during engine operation usually means that a bearing has lost lubrication and is about to fail.
Tensioner Wear or Failure

Automatic tensioners wear or fail in a number of ways as indicated below. See the troubleshooting guide for proper corrective action.

**Pulley wear/failure** – All Micro-V and V-belt pulleys will show wear with extended usage. Smaller pulleys usually will indicate wear first. Damage from stones is not uncommon and will appear as deep scratches or pits in the pulley grooves. Burns or pulley distortion will effect belt-to-pulley fit and, in severe cases, can cause excessive pilling, noise, belt slip, belt turn-over, irregular belt wear, and reduced belt life.

Visible signs of wear or damage can contribute to tensioner failure. Use the troubleshooting guide at the end of this manual to determine proper corrective action.

**Pulley/bearing assembly wear or failure** – Pulley bearings can fail due to excessive use or loss of lubrication. Intermittent bearing irregularities are generally an early indication of eventual component failure. If the grease seal appears damaged, replacement is the best remedy. Also, rotate the pulley and feel for sticking, roughness, or unnatural vibration.

There are no serviceable parts inside a tensioner. The entire tensioner/pulley assembly should be replaced.
Pulley alignment – Proper alignment is generally more critical to Micro-V belts than V-belts. Maximum recommended misalignment for Micro-V belts is 1/16 inch per 12 inches of belt span length (1/3 degree). Pulley alignment can be checked using a straightedge. (See NAPA Belts/Hose AutoSmarts Automotive Training Video (474-0836) for more information on checking pulley alignment.)

Damping failure – Excessive oscillation of the tensioner arm while the engine is running may indicate a worn out damper or bushing. The tensioner needs to be replaced. With the engine off, operate the tensioner through its entire range of motion. Sticking or roughness may indicate wear on the tensioner bearing surfaces.

Tensioner rattle – A rattling noise during operation indicates wear on the internal components. It could also indicate that the belt is too long and the free arm stop is being contacted. In either case, the tensioner should be replaced.

Note: “Heat Check” marks on aluminum castings are sometimes mistaken for cracks. This is not a product defect, but a normal occurrence during the die casting process.

Note: Some tensioners have no spring pre-load at the free arm position (i.e. belt not installed) and are sometimes returned as “defective”. For example, tensioner part number 38109 has no pre-load on the spring. This is not a “No Load” or weak spring condition.
Proper belt tension and pulley assembly operation depends on correct installation and maintenance. When experiencing any operational problems, use the following troubleshooting methods to resolve the problem.

**Determining Correct Part Application**

Always double-check all parts to ensure that the proper belt, tensioners, pulley assemblies, etc. are installed for the particular vehicle and engine in question.

Incorrect parts or aftermarket parts that 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 (power steering pumps, water pumps, compressors, etc.), check that part for correct installation and alignment. Any component installed improperly throws the entire belt circuit out of alignment, resulting in less than optimum performance.
**Water Spray Test**

Noise caused by misalignment and/or improper tension may be diagnosed by using the “Water Spray Test.”

Fill a spray bottle with water and spray the belt with a light mist, while the engine is running. If the noise occurs after misting, there may be problems with tension or misrouted belts. If the noise decreases for a few seconds, then returns even louder, the problem is likely to be misalignment. A misalignment-generated noise will not be corrected by increasing tension or simply replacing the belt. All pulleys and tensioner assemblies should be checked for proper installation and alignment to correct a misalignment problem.

If the noise increases immediately after misting the belt with water and the noise does not become louder, chances are it is a tension problem. The belt may be excessively worn and need replacement, the belt may be misrouted, or there may be a tensioner problem.
Removing and Re-Installing the Belt/
Changing Belt Direction

Because misalignment noise is influenced by the direction of
misalignment in the drive, removing the belt, turning it around,
and re-installing it should eliminate or significantly reduce
noise caused by misalignment – temporarily. This action may
confirm or disprove a misalignment problem.

Replacing Tensioners

Sometimes, tensioners fail because of careless belt
replacement. The old belt must be removed properly
and carefully to ensure that the tensioner does not spring
down and crack. If the new belt is too short, it can snap
the tensioner. If the belt is too long, it will slip or cause the
tensioner to rattle. Some tensioners may be replaced by
removing a single bolt, while others may have seals or
gaskets that are integral parts of the cooling system.
Others may involve removing several other components
to access the tensioner base.

Caution: The
tensioner is
manufactured
containing a
pre-loaded spring.
Never try to
disassemble the
tensioner unit!
Doing so could
result in personal
injury. Consult the
vehicle’s shop
manual for specific
instructions.
Every vehicle has tensioners designed for that particular engine assembly; there is no universal replacement procedure. Consult the proper vehicle shop manual for correct replacement procedures. In general, the proper guidelines are as follows:

1. Mark the rotation direction on the belt.

2. Unload the belt from the tensioner by rotating the tensioner as indicated (See “Rotate to Load” arrow).

3. Remove the old tensioner from the engine.

4. Place the new tensioner on the engine.

5. Torque the mounting bolts to 1/3 installation torque in a star pattern.

6. Retighten the bolts to 2/3 torque, then to full torque.

7. Install the belt in the same direction of rotation as the old belt.

8. Load the belt on the tensioner by rotating the tensioner as indicated (See “Rotate to Load” arrow).

**NOTE:** Any time you replace a tensioner, replace the belt. Make sure it’s the right belt for the application and the correct length.
Determining Correct Belt Length

On either the two-mark type or three-mark type gauge, the indicator should point to a spot in the middle of the gauge, indicating ideal belt length. A worn belt will put the indicator toward the maximum belt length indicator mark. It is best to replace any belt that is worn beyond the ideal belt length indicator mark.
When a new belt is installed, the pointer should fall between the minimum belt length mark and half way through the gauge. As belts age, they wear, and the tensioner automatically moves to keep tension constant. When the pointer on the belt length variation gauge is within five percent of the “full” or “maximum” take-up mark, the belt should be replaced. At this point, the tensioner is out of its useful range, and the belt has worn to the point of failure.

New belt - correct length

Normal wear on used belt
If a new belt is outside the normal new belt range, it is too long for the application and may result in reduced belt life. A shorter belt should be used to bring the pointer into the proper range.

- **Time for belt replacement**
  - Pointer at 5% Maximum Belt Length Mark

- **New belt too long – tensioner out of range**
  - Pointer at New belt range
Using the Technical Service Bulletins Manual

Sometimes problems are systematic or original equipment design flaws, and not due to belt tension, misalignment or excessive wear. It’s a good idea to check the NAPA Belts/Hose Technical Service Bulletins manual (Part No. NBH129) or CD-ROM (Part No. NBH129CD) for any vehicle manufacturing defects or other problems that could cause noises within the front end accessory drive system.
Proper operation of accessory belt drive systems depends on locating and correcting operational problems. The following charts provide detailed directions on how to identify possible causes, conduct a proper and safe inspection, and take corrective action. To accurately check for the causes of noise, the system must be loaded:

- Air conditioner on full
- Air conditioner fan on full
- Head lights on high beam
- Rear window defroster on
- Wheels turned 3/4 to the left or right
<table>
<thead>
<tr>
<th>Name</th>
<th>Symptoms</th>
<th>Probable Causes</th>
<th>Inspection and Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Belt Slip</td>
<td>Chirping noise, usually when the system is under load (e.g. engine start-up)</td>
<td>Belt worn or stretched, insufficient tensioner damping or spring load</td>
<td>Check belt length marks on tensioner to determine if belt has worn or stretched, or is the wrong length. If length is wrong, change belt.</td>
</tr>
<tr>
<td></td>
<td>Loss of function of component (i.e. A/C, ALT, P/S, water pump)</td>
<td>Belt/pulley surfaces glazed or worn.</td>
<td>Run engine under normal load to determine if tensioner arm is adjusting properly. If not, turn engine off, remove belt and hand cycle tensioner to check for seizure or low spring load. If tensioner does not respond, change tensioner.</td>
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<tr>
<td></td>
<td></td>
<td>Incorrect belt length</td>
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<tr>
<td></td>
<td></td>
<td>Groove profiles not correct</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contamination (fluid, environmental)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Seized component (idlers pulleys, AC compressor bearing)</td>
<td>If tensioner arm moves excessively (more than 1/4”) damping is too low. If damping is too low, change tensioner. If neither is the cause, check belt for glazing and check pulleys and belts for paint residue. Change belt or pulley as necessary.</td>
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<td></td>
<td>Mis-installed or incorrectly routed belt</td>
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</tr>
<tr>
<td>Wet Belt Slip</td>
<td>Chirping noise when belt is wet.</td>
<td>Belt/pulley surfaces are glazed.</td>
<td>Run engine under load. Attempt to reproduce chirping noise by soaking belt with water. If noise occurs, change belt.</td>
</tr>
<tr>
<td></td>
<td>Loss of accessory component function</td>
<td>Excessive fluid or humidity on belt surface or pulley.</td>
<td>Inspect belt for contamination. If contaminated, clean pulleys and change belt.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Check belt grooves for debris buildup or paint balling from pulleys. Clean pulleys. Change belt if necessary.</td>
</tr>
<tr>
<td>Name</td>
<td>Symptoms</td>
<td>Probable Causes</td>
<td>Inspection and Corrective Action</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------------------------------------</td>
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<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Misalignment</td>
<td>Squealing or screeching noise, usually when system is being loaded.</td>
<td>New accessory drive component was misinstalled.</td>
<td>Noise is typically a low-mileage failure due to factory misalignment. For older vehicles, this noise indicates that something must have changed in the system. Check alignment on newly installed belt system components.</td>
</tr>
<tr>
<td></td>
<td>Belt profile is worn excessively or glazed.</td>
<td>Accessory component has shifted or the original belt was removed and reinstalled in backwards rotation.</td>
<td>Check original system components including brackets for movement. If belt is original, mark rotation direction and reinstall in the opposite direction. If belt is new, determine which component pulley is the noise source and adjust the component.</td>
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<tr>
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<td></td>
<td>Improper accessory component was installed (e.g. larger alternator).</td>
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<tr>
<td></td>
<td></td>
<td>New belt not “broken in” to the existing system.</td>
<td>Check newly installed system components for proper alignment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Untuned or poorly running engine. Example: Vacuum leaks</td>
<td>Check for match between pulley and belt interface.</td>
</tr>
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<td></td>
<td></td>
<td>Loose fasteners on components.</td>
<td>Check pulleys for parallel or non-parallel alignment.</td>
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<td>Check power steering reservoir for correct level.</td>
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<td>Check for crankshaft misalignment.</td>
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<td></td>
<td>Check for crankshaft misalignment due to thrust bearing wear.</td>
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<td></td>
<td>Check for damper creak on crankshaft pulley.</td>
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<td></td>
<td>Install new belt, then check for any prior symptoms.</td>
</tr>
<tr>
<td>Name</td>
<td>Symptoms</td>
<td>Probable Causes</td>
<td>Inspection and Corrective Action</td>
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</tr>
<tr>
<td>Bearing Noises/ Bearing Hoot</td>
<td>Continuous hissing and grinding noise that gets louder as engine rpm increases.</td>
<td>Hissing and grinding noise – no bearing lubricant.</td>
<td>Use an automotive stethoscope to locate the source of noise. Turn engine off and hand spin pulley. If it is hard to turn, feels rough or rattles, replace pulley assembly.</td>
</tr>
<tr>
<td></td>
<td>Continuous growling noise that changes to a whine as engine rpm increases.</td>
<td>Growl and whine – a bearing is about to fail.</td>
<td>Visually inspect bearing in question for signs of heat “bluing” of metal or grease purge.</td>
</tr>
<tr>
<td></td>
<td>Hoot noise that occurs at lower temperature (below −20 degrees).</td>
<td>Excessive idler pulley wobble.</td>
<td>Check for bracket movement due to loose or misaligned fasteners.</td>
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<td>Contamination of other fluids through pulley seal.</td>
<td>Check for proper belt mounting.</td>
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<td>Insufficient grease or improper bearing grease.</td>
<td>If belt has glazing, cracks, or other visible defects, replace belt.</td>
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<td><strong>Caution:</strong> (a) Replace pulley bearings (b) replace tensioner pulley. Replace as assemblies only!</td>
</tr>
<tr>
<td>Name</td>
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<tr>
<td>Belt Span Vibration</td>
<td>Rumbling noise at certain engine rpms, usually when system is loaded. Excessive belt movement can be seen on the span between any two pulleys on an accessory drive system.</td>
<td>Belt is stretched too long to be properly tensioned. Insufficient tensioner damping or spring load. Loose component or bracket resonance. Backside fabric of belt lap excessively raised. Seized components (alternator, idler pulley). Backside fabric of belt lap excessively raised. Incorrect engine calibration, rough running, or modified engine. Belt contamination.</td>
<td>Check belt length marks on tensioner. If worn, change belt. Check belt for contamination. If contaminated, change belt. Check for loose or rattling components. Tighten or adjust as necessary. Check for seized components. Replace as necessary. Check for excessive raised laps. Replace belt as necessary. Confirm smooth operation of engine. Adjust as necessary. Check for mis-shaped pulley(s). Replace as necessary. Run engine under load to determine if tensioner arm is adjusting properly. If not, turn engine off and hand cycle tensioner to determine if it is seized. If tensioner feels like it has no resistance during hand cycling or does not return to stop, replace tensioner. If arm movement is excessive (more than 1/4”) damping is too low. Change tensioner. If tensioner motion is greater than tensioner range, change tensioner.</td>
</tr>
<tr>
<td>Name</td>
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<td>Inspection and Corrective Action</td>
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</tr>
<tr>
<td>A/C Stumble or A/C Slugging</td>
<td>Engagement and disengagement of the AC clutch during duty cycle.</td>
<td>Broken A/C belt.</td>
<td>Use A/C gauges to determine if AC head pressures are within manufacturers specifications. If pressures are within specifications, check the cooling system. Ensure engine coolant fan is operating correctly and to specifications.</td>
</tr>
<tr>
<td>Fluid or chemical contamination</td>
<td>Slipping, rumbling, squealing, and other friction-related problems.</td>
<td>A substance which is found on belt or pulleys affects the frictional properties between the belt and pulley. Examples of possible contaminates are: oil, antifreeze, brake fluid, grease, solvents (e.g. WD-40).</td>
<td>Repair leak or prevent contaminating substance from getting in the drive. Clean pulleys on the drive with alcohol. Replace belt. If belt dressing was used, clean drive and replace belt.</td>
</tr>
<tr>
<td>Name</td>
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<td>Probable Causes</td>
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</tr>
<tr>
<td>Intermittent noise/</td>
<td>Transient noise, vibration, or loss of function of an accessory component</td>
<td>Belt slipping due to insufficient tension.</td>
<td>Check belt for correct tension. If incorrect, replace belt. If still incorrect, replace tensioner. Physically examine belt for even tension across belt width. Check for proper belt routing. Make adjustments to correct problems with either belt routing or uneven tension across belt width.</td>
</tr>
<tr>
<td>Intermittent function</td>
<td>occurs at certain loading conditions. Examples: cycling of air conditioner,</td>
<td>Loading of components too great or incompatible with system. Additional compo-</td>
<td>Check A/C refrigerant pressure. Adjust level if necessary. Check power steering fluid levels, and adjust if necessary. Check to see if any component has been added or modified from the original manufacturer.</td>
</tr>
<tr>
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<td>windshield wiper, turning of power steering, headlights, or engine cooling</td>
<td>nents may have been added or changed.</td>
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<td>fans.</td>
<td>Loose component brackets. Some may work at increased belt loading but not at</td>
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<td>lower loading or vice versa.</td>
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<td>System vibration due to changes in belt, tensioner, or component location.</td>
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<td>Marginal bearing performance. Components may have been added.</td>
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<tr>
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<tr>
<td>Power Steering Noise</td>
<td>Transient noise, vibration, or loss of accessory component function occurs at certain loading conditions of power steering, such as turning. Turning the wheel is difficult or uneven</td>
<td>Low power steering fluid level&lt;br&gt;Belt slipping due to insufficient tension&lt;br&gt;Loading of components too great or incompatibe with system. Additional components may have been added or changed.&lt;br&gt;Loose component brackets. Some may work at increased belt loading but not at lower loading or vice versa.&lt;br&gt;System vibration due to changes in belt, tensioner, or component location.&lt;br&gt;Low tire pressure&lt;br&gt;Defective power steering pump</td>
<td>Check belt for correct tension on tensioner marks. If incorrect, replace belt.&lt;br&gt;If still incorrect, replace tensioner. Examine belt for even tension across belt width. Check for proper belt routing. Adjust to correct problems with either belt routing or uneven tension across belt width.&lt;br&gt;Check power steering fluid levels, and adjust as necessary. Check for added or modified components.&lt;br&gt;Check power steering pump for freedom of pulley movement. Bearings and pulley should turn. Replace as necessary.&lt;br&gt;Check for loose components, brackets, or fasteners. Tighten any loose pieces.&lt;br&gt;Check belt tensioner and other components for correct part number, manufacturer and location. Replace as necessary.</td>
</tr>
<tr>
<td>Name</td>
<td>Symptoms</td>
<td>Probable Causes</td>
<td>Inspection and Corrective Action</td>
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</tr>
<tr>
<td>Appearance/Worn</td>
<td>Plastic idler pulley appears to be worn on</td>
<td>Extreme environmental wear (i.e. heat, water, stones).</td>
<td>Replace idler.</td>
</tr>
<tr>
<td>Pulley</td>
<td>belt tracking area.</td>
<td>Stone damage.</td>
<td></td>
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<tr>
<td></td>
<td>On steel idlers, pulley has been marr in</td>
<td>Faulty installation practices.</td>
<td>Replace idler if chip is in</td>
</tr>
<tr>
<td></td>
<td>belt tracking area.</td>
<td>Coating on pulley has worn off. Note: It is normal for coating to wear off</td>
<td>belt tracking area.</td>
</tr>
<tr>
<td></td>
<td>On plastic idlers, pulley is chipped.</td>
<td>belt tracking area.</td>
<td>Replace idler.</td>
</tr>
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<td></td>
<td>Pulley shows signs of corrosion.</td>
<td>Bearing failure.</td>
<td></td>
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<td></td>
<td>Idler has excessive wobble (free rock).</td>
<td>Excessive load on pulley.</td>
<td>Replace idler.</td>
</tr>
<tr>
<td></td>
<td>Belt is not tracking properly over pulley.</td>
<td></td>
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<tr>
<td>Name</td>
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<td>Probable Causes</td>
<td>Inspection and Corrective Action</td>
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</tr>
<tr>
<td>Tensioner</td>
<td>Tensioner arm is cracked.</td>
<td>Excessive force is used in removal.</td>
<td>Replace tensioner.</td>
</tr>
<tr>
<td>Appearance</td>
<td>Tensioner vibration during engine idle is excessive.</td>
<td>Long-term fatigue failure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grease appears to be leaking out of bearing.</td>
<td>Tensioner was allowed to snap back into stop position.</td>
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<td></td>
<td>Bearing seal is missing or damaged. Tensioner tilted or mis-aligned, or</td>
<td>Tensioner damper is worn.</td>
<td>Replace tensioner.</td>
</tr>
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<td>gap exists between tensioner arm and base.</td>
<td>Accessory is out of round.</td>
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<td>Grease purge.</td>
<td>Replace idler</td>
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<td></td>
<td>Seal degradation.</td>
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<td></td>
<td>Excessive radial internal clearance in bearing.</td>
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<td></td>
<td>Worn pulley.</td>
<td>Replace idler.</td>
</tr>
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<td></td>
<td></td>
<td>Environmental damage (e.g. heat, water, stones).</td>
<td>Replace tensioner.</td>
</tr>
<tr>
<td>Name</td>
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<td>Inspection and Corrective Action</td>
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</tr>
<tr>
<td>Loose, Sticking or Seized Tensioner</td>
<td>Tensioner does not operate smoothly.</td>
<td>Bearing surface damaged.</td>
<td>Replace tensioner.</td>
</tr>
<tr>
<td></td>
<td>Pulley is seized and will not rotate freely.</td>
<td>Damper damaged.</td>
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<td>Pulley does not rotate smoothly or has a sticky feel to it when rotated by hand.</td>
<td>Spring is broken.</td>
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<td>Pulley and bearing have relative motion.</td>
<td>Bearing is damaged.</td>
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<td>Radial internal clearance in bearing is too low.</td>
<td>Replace idler.</td>
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<td></td>
<td></td>
<td>Bearing fit in pulley is tight.</td>
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<td></td>
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<td>Bearing is not being constrained in idler pulley.</td>
<td>Replace idler.</td>
</tr>
<tr>
<td>Name</td>
<td>Symptoms</td>
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</tr>
<tr>
<td>Noise</td>
<td>Belt squeal noise.</td>
<td>Belt worn or stretched to maximum take-up length of system.</td>
<td>Check belt length window. If belt is correct length, replace tensioner.</td>
</tr>
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<td></td>
<td>Tensioner clatters or rattles during engine operation.</td>
<td>Tension force not sufficient.</td>
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<td></td>
<td>Belt chirping due to system misalignment.</td>
<td>Belt too long or stretched.</td>
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<td>Pulley makes a high-pitched whine or hooting noise after the engine is started.</td>
<td>Damper is worn.</td>
<td>Replace tensioner.</td>
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<td></td>
<td>Noise lasts up to three minutes.</td>
<td>Bearing surfaces within tensioner are worn.</td>
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<td></td>
<td>Pulley exhibits noise during normal operation.</td>
<td>Pulley or tensioner are worn.</td>
<td>Replace worn or cracked tensioner. Tighten loose bolts to vehicle manufacturer’s specifications. Check entire system for misalignment.</td>
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<td>Pulley and bearing assembly rattle when shaken.</td>
<td>Cracks in tensioner base or arm.</td>
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<td>Mounting bolts are loose.</td>
<td>Replace idler.</td>
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<td></td>
<td></td>
<td>Worn bearing.</td>
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<td>Bearing fit to pulley is incorrect.</td>
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<td>Bearing is not functioning properly.</td>
<td>During normal operation, an idler pulley is very quiet. Replace idler.</td>
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<td>Bearing cage is broken.</td>
<td>Replace idler assembly.</td>
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<td>Balls in bearing are loose.</td>
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<td>Bearing contains no lubricant.</td>
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<td>Name</td>
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<td>Inspection and Corrective Action</td>
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</tr>
<tr>
<td>Belt Tracking</td>
<td>Belt does not track properly on idler.</td>
<td>Bearing is not fixed to the correct depth in pulley.</td>
<td>Replace idler.</td>
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<td>Belt tracking surface is not square to bearing mounting surface.</td>
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<td>Pulley tracking surface is tapered. (Crowning or bowing of belt tracking surface is sometimes intentional).</td>
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</tr>
</tbody>
</table>
1. Which of the following characteristics demonstrates the biggest difference between Micro-V belts and V-belts?
   a. belt construction
   b. profile
   c. variable notch pattern

2. Which critical parts and systems on a car engine can be affected by a failed belt?
   a. water pump
   b. fan
   c. alternator
   d. air conditioning compressor
   e. power steering pump
   f. all of the above
3. Which section of a Micro-V belt helps provide transverse support on the pulley?
   a. undercord
   b. tensile cord
   c. overcord

4. You can always determine if a belt is still good by visually inspecting it.
   True or False?

5. Automatic belt tensioners are designed to
   a. reduce maintenance
   b. apply a constant force to a belt
   c. reduce belt wear
   d. all of the above
6. An idler transmits torque to an accessory component.  
   True or False?

7. Which part is the core feature that makes a tensioner work?
   a. pulley bearing
   b. pulley center bolt
   c. arm
   d. spring

8. The two major causes of belt noise are
   a. engine vibration and belt elongation
   b. belt slip and excessive hub loads
   c. improper tension and misalignment
   d. misalignment and glazing
   e. improper tension and vibration
9. Which condition exists when pulleys are outside the plane of other pulleys in the drive system but their shafts remain parallel?
   a. misalignment
   b. pulley incompatibility

10. Misalignment can reduce belt life by
    a. as much as 25 percent
    b. as much as 50 percent
    c. as much as 75 percent
    d. as much as 90 percent

11. Misalignment occurs most frequently on the longest spans in a drive.
    True or False?
12. List five sources of belt noise.
   a.
   b.
   c.
   d.
   e.

13. When parts produced by different suppliers are combined on a vehicle, pulley incompatibility can result from
   a. pulley groove spacing mismatch
   b. pulley groove size mismatch

14. Which of the following is not a result of pulley incompatibility?
   a. belt turnover
   b. excessive belt wear
   c. vibration
   d. improper span tensions
   e. inefficient load transmission
   f. irregular belt wear
15. Match the following descriptions with their correct names.

<table>
<thead>
<tr>
<th>Description</th>
<th>Correct Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. gravel penetration</td>
<td>Damage to the side of the belt, tensile cord break or jagged edge ribs.</td>
</tr>
<tr>
<td>b. bearing failure</td>
<td>Backside of belt appears shiny or glazed.</td>
</tr>
<tr>
<td>c. misinstallation</td>
<td>Belt is accidentally cut during repair work.</td>
</tr>
<tr>
<td>d. repair damage</td>
<td>Belt is broken and shows excessive wear.</td>
</tr>
<tr>
<td>e. abrasion</td>
<td>A belt rib begins separating from the joined strands.</td>
</tr>
<tr>
<td>f. uneven rib wear</td>
<td>A pebble, sand or other object was embedded in the belt.</td>
</tr>
<tr>
<td>g. belt turnover</td>
<td>Belt twists out of its upright position.</td>
</tr>
</tbody>
</table>
16. Match the following descriptions with their correct names.

a. pilling  ____ Belt sidewalls soaked by degrading engine fluids.
b. cold cracking  ____ Small, yet visible cracks along the length of a rib(s).
c. glazing  ____ Slick or shiny belt sidewalls caused by friction.
d. chunk-out  ____ Belt material sheared off from ribs and built up in belt grooves.
e. normal cracking  ____ Pieces of rubber material broken away from belt.
f. oil saturation  ____ Excessive cracking after a period of cold weather.
g. edge cord/sidewall wear  ____ Damage from a foreign object that cuts into the belt.
17. A combination of growling, whining and hissing during engine operation usually means that
   a. a belt has lost its tension
   b. two pulleys are misaligned
   c. a bearing has lost its lubrication

18. A failed or worn tensioner should be disassembled and the non-serviceable part(s) replaced.
   True or False?

19. Proper alignment is generally more critical to V-belts than to Micro-V belts.
   True or False?
20. If any component within the belt drive system has been recently replaced, the best way to ensure optimum performance is to
   a. apply the water spray test
   b. check that part for correct installation and alignment
   c. consult the vehicle’s shop manual

21. Any time you replace a tensioner you should replace the belt.
   True or False?

22. Belt dressing can improve belt life.
   True or False?
Answers

1. b. profile
2. f. all of the above
3. c. overcord
4. False
5. b. apply a constant force to a belt
6. False
7. d. spring
8. c. improper tension and misalignment
9. a. misalignment
10 b. as much as 50 percent
11. False
12. oil, grease, low belt tension, belt vibration, foreign objects
13. a. pulley groove spacing mismatch
14. c. vibration
15. f, e, d, b, c, a, g
16. f, e, c, a, d, b, g
17. c. a bearing has lost its lubrication
18. False
19. False
20. B. check that part for correct installation and alignment
21. True
22. False