Gates Automotive Educators Training Series 2011

Understanding Loss of Tension in the Accessory Belt Drive System

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Automotive Educator Training Syllabus

Understanding the Impact of Loss of Tension in the Accessory Belt Drive System

The purpose of this syllabus is to supply standardized training that will assist you in teaching the attributes of the Tech Tips concerning failure associated with Loss of Tension in the Accessory Belt Drive System. This information highlights the Accessory Belt Drive System (ABDS) and failure modes associated with the belt and tensioner.

Syllabus Overview:

It's important to understand that the serpentine belt has only one job and that is to transmit the torque or power from the crank to all accessories in the system. This is accomplished by the wedging force of the belt ribs which creates friction between the belt/ pulley interface as they are forced into the pulley grooves. The belts wedging force is maintained by the tension placed on it by the tensioner. If either the belt or tensioner is failing, there is less chance the belt can transfer the energy from the crank to all the power hungry accessories until both the belt and tensioner are replaced.

As the belt begins to slip due to loss of tension, excessive heat is generated and migrates through the belt, into the pulley and shafts of the accessories and then into the bearings creating premature grease boil out or bearing failure. Loss of tension can also play a part in excessive belt or potential pulley wear as well.

Today's EPDM belt can run well over 100,000 miles, be totally worn out but yet still look brand new because of its material makeup. The danger of not understanding how to read this failure creates comebacks and loss of profits. A possible example of this could be your customer comes in for an alternator replacement. You replace the alternator and reuse the old belt because it still looks almost new. Within a few days your customer returns because the alternator is not charging correctly as the worn belt could not effectively transfer the power as the accessories turned on and off. This is why it is important to understand the root cause of any belt failure or problem in the ABDS before recommending the corrective action. The end result will be a more satisfied customer, increased profits along with reduced comebacks for the shop or tech.

> ***Key Points*** have been developed to assist you in providing the verbiage you need when presenting the material. ***An example of a Key Point would be:*** If a customer complains of belt noise such as chirping or squealing it's not a belt problem, it's a system issue and normally beginning with loss of tension in the system.

• **Associated Gates Tech Tips to use with this training**

a. Belt Performance Directly Affects Other Components

b. Pulley Alignment Tension (PAT)

c. The Role of the Automatic Tensioner

d. Belt Tension Is Critical

e. Neoprene vs. EPDM Construction

f. Gates Belt Wear Flyer (443-0373)

g. Belt Wear Inspection Changes

h. Understanding Loss of Tension Poster

Serpentine Belt:

A high quality belt such as Gates Micro-V AT® will normally not "just fail" but can be caused to fail by something else.

> ***Key Point:*** It is important to find the root cause of the failure. The reason is if they (tech) just install a new belt, as soon as the engine starts, the failure begins all over again creating a future comeback and potential loss of profits.

Discuss Tech Tips such as Neoprene vs. EPDM Construction, Belt Wear Inspection Changes and Pulleys Alignment and Tension (PAT) to create understanding when working on customers ABDS. Understanding the importance of how each impact the system will help circumvent many potential comebacks because of perceived belt problems.

Spend a few minutes discussing each belt failure along with corrective actions with your students:

> ***Key Point:*** It's important to point out that any glazing (shiny) on the *underside* of the belt indicates that the belt has been slipping. Slippage can be caused by a variety of reasons such as not enough spring tension on the tensioner, failing component bearing, contaminated pulleys or an elongated belt due to rib wear or material loss. Note that a slipping belt is the worst thing that can happen to the ABDS.

> ***Key Point:*** Cracks on the underside of a serpentine belt is normal with age. With Neoprene constructed belts, if more than three cracks are counted in a three inch section on any one rib, the belt has already used up 80% of its intended life. Newer belts constructed with EPDM inherently resist cracking because of the increased elasticity. For EPDM belts, the proper diagnostic method is to inspect for loss of rib material using a belt wear gauge.

Key Point: Any side abrasion on the belt is a prime indicator that there is misalignment in the system. It must be found and corrected first, before reinstalling a new belt. A good place to start would be checking for a worn pivot bushing in the tensioner.

Key Point: Pilling can be identified by the shiny streaks of material bonded to the apex of the belt. Pilling indicates the belt is no longer griping the pulley effectively and has begun riding on top of the pulleys apex. Belt is no longer performing its job properly and should be replaced along with the tensioner. Pilling may also be an indication that a pulley may be failing as well so inspection and cleaning of all pulleys is very important at this point to find the probable cause.

Key Point: Belt wear is a critical failure for belts. You can find belt wear in a glazed and shiny, pilling, cracked belt or simply by itself with no other apparent damage. As little as 5% material loss in either a Neoprene or EPDM belt can facilitate loss of tension. A slipping belt is absolutely the worst thing that can happen in the ABDS system.

Key Point: Customers complaint of any belt noise such as chirp or squeal should be the first clue that they are experiencing loss of tension in the system due to a slipping belt or a failing tensioner. It is now a systems issue and not a belt problem. As the belt slips it allows **every** accessory to operate at a diminished output and creates heat for the bearings and complaints of noise from the customer.

Belt slip also has the ability to generate false codes for the sensors that are situated in or around the ABDS. These false codes can be extremely difficult to track back to the root cause which might be a slipping belt or a failing tensioner.

- Known false trouble codes that can be generated due to a slipping belt.
  - P0300 – P0312 (Pertains to Engine Misfire)
  - P0325 – P0334 (Pertain to Knock Sensor Area)
  - P0550 – P0554 (Pertain to Power Steering Pressure)
  - B1849 – B1862 (Pertain to Climate Control Area) NOTE: “B” codes are body control
  - B1969 – A/C Clutch Magnetic Control Circuit Failure
  - B2119 – A/C Compressor Failure

Key Point: The corrective action can be as simple as replacing the belt/tensioner to eliminate the slip that caused the Check Engine light to illuminate in the first place. When all other corrective actions have been eliminated to turn the light off, replace the belt and tensioner.

Tensioners:

Tensioners today are extremely important in the proper operation of the ABDS. The automotive tensioner performs two important jobs. The first is to maintain the correct amount of tension on the belt at all times throughout its duty cycle. The second is to dampen the impulses that are transmitted throughout the system as each cylinder fires.

There are three distinct issues associated with tensioner failure. All of these issues lead to one corrective action which is tensioner replacement.

1. The first area of concern is undue belt noise or squeal. Squealing, among other things, indicates the spring inside the tensioner has lost its tensioning ability or the belt has experienced material loss allowing the belt to slip. In addition to being noisy and creating heat for the accessory bearings, the system may also have lost its ability for the alternator to charge or the A/C to cool efficiently.

   As loads are applied by the accessories, the more the belt wants to slip. Hearing belt squeal and seeing glazing on the underside of the belt is a good indication that tension has been lost and the tensioner along with the belt must be replaced.

2. The second area of concern is pivot bushing wear which results in the tensioner arm moving away from its base. This separation is very difficult to see because the tensioner is firmly bolted to the engine. The pivot bushing inside the base has begun to wear and allows the arm of the tensioner to lean causing misalignment in the system. Look for belt "Off Tracking" on the pulley or any indication of ***side wear*** on the belt. Belt side wear can go from a slight scrubbing on one side to huge chunks lost. In any case, both belt and tensioner must be replaced to correct the problem.

3. The third area of concern is damper failure and should not be confused with loss of spring tension. Just like the Original Equipment (OE), Gates DriveAlign® tensioners have a damper built inside the case which acts like a brake on the arm. Its job is to dampen the pulsation of the engine on the ABDS system as the cylinders fire. Once it has lost its dampening ability the arm begins to oscillate more resulting in increased loads on the pulley and shaft bearings and/or seals of adjacent accessories. Essentially, a failed damper creates a situation where the tensioner and belt will start to "hammer" the accessory next to it.

   Slight arm movement of the tensioner is normal as accessories turn on and off. However, chattering or excessive tensioner arm oscillation should be viewed as a warning sign the damper has possibly failed and the tensioner needs replacement now!

Please note that there is a universal style low cost flat spring tensioner that exists in the Aftermarket that does not have an OE style dampening system built into it. It relies on spring tension to act as the dampening devise. Because it can lose its ability to dampen very quickly, it may have to be replaced more often.

Failure to replace the tensioner because of any one of these three areas of concern is a recipe for a future comeback or breakdown. Alternator bearings and water pump seals are very susceptible to any form of excessive vibration or heat. For this reason it's important when installing a replacement accessory component, to check/observe the tensioner in operation to ensure it is operating properly.

Remember: If you have seen signs of premature failure in an alternator, water pump or any accessory upstream from the tensioner, it may be a failed tensioner that is causing this component to fail as well.

Tensioner Inspection Procedures:

It's a good rule to observe the system in operation before removing or replacing any belt. This allows you to observe two particular areas of concern while the engine is in operation such as belt tracking and tensioner operation.

With the Engine Running:

1. Observe the tracking of the belt as it revolves around the pulleys. Pay attention to the flat idler pulleys, especially on the tensioner arm. The belt, for the most part should run true to the center of the pulley. As noted above, if the belt is "off tracking" on the tensioner arm pulley, pivot bushing wear is the likely cause and allowing the arm to pull away from the base. Though you might not be able to see this separation, side scuffing, or chirping of the belt will probably confirm this at some point.

   Key Point: Any abrasion or rubbing on one side of the belt indicates there is misalignment in the ABDS system. Not correcting this particular root cause failure quickly will result in numerous comebacks because of a perceived belt failure.

2. Observe the tensioner arm movement as the belt runs over it. There should be a gentle arm motion as accessories turn on and off **(i.e. A/C compressor clutch engaging and disengaging)**. If it doesn't move at all, there may be a possibility that the tensioner is stuck. You can test for this later with the engine off.

3. Look for excessive chattering or tensioner arm oscillation. This is not the result of poor spring tension but is caused by a worn component inside the tensioner called a damper. Excessive arm oscillation should be viewed as a warning sign that the damper has possibly failed or is failing and the tensioner needs replacement now! Failure to do so can lead to additional problems in the system later as noted above.

   Key Point: Excessive arm oscillation creates a hammering effect on the accessory next to it which can cause premature failure of that component as well.

4. Lastly, listen for any hissing or growling that could indicate a potential pulley bearing failure. Continue to listen for chirping or squealing of the belt as it runs around the pulleys. This can be an indication of poor tension due to material loss, rib wear poor spring tension or misalignment in the system. To help identify whether it is an alignment or tension issue, perform the spray bottle test which is noted at the end of this document.

Key Point: Squealing indicates a loss of tension, heat from the bearings and an inefficient ABDS system.

With the Engine Off:

1. Remove belt and visually inspect each pulley. Running surfaces must be in good working order, free and clear of dirt grease and grime. Clean all pulleys to provide an excellent griping surface and minimize slippage of the new belt. Any residue oil on a pulley will coat the new belt as soon as the engine is started and the failure process starts all over again.

   Check the belt for belt wear using the belt wear gauge. Remember, a belt can only perform as well as the system will allow. Poor pulley quality means poor belt service life and an inefficient system which result in comebacks at a later date.

   Inspect the outside of the tensioner for rust bleed seeping from inside the tensioner. This is normally an indication that there is metal on metal wear on the inside of the tensioner and a clue that it is failing from the inside out. Replace immediately.

2. **Spin** the pulleys. Pulleys should spin freely without any undue bearing noise. Check for any grease seepage or smudging around the pulley bearing.

   Seepage is an indication that the bearing seal has been compromised and grease has leaked from the bearing. The pulley bearing will begin to make noise and eventually seize if not replaced soon.

   The most sensible repair when identifying pulley problems on the tensioner is not to just replace the pulley but to replace the complete tensioner as a unit. The tensioner was built as such and the internal parts of the tensioner have received just as much wear as the pulley. Doing so will eliminate a potential comeback later.

3. Place your wrench on the tensioner and **Cycle** the tensioner arm through its complete motion path. Do this a minimum of three times. Feel for spring tension along with a fluid motion throughout its arm path. Any sticking or notchy movement may indicate a problem with the spring or pivot bearing. While cycling the tensioner feel for base arm separation which is the result of pivot bushing wear. The tensioner arm should not rock from side to side at all and if it does will cause misalignment (side abrasion on a belt) and customer comebacks.

The **"Spin Cycle"** test as noted above is a recommended starting point for checking a tensioner for potential problems. If at any point during the test one of the above noted concerns is found, it is highly recommended that the tensioner and belt be replaced immediately. Failure to do so will provide the possibility of repeated comebacks, lost profits and a less satisfied customer.

Alternator Decoupler Pulley (ADP):

On some of the newer systems today you may find an alternator decoupler pulley or ADP on the alternator. The purpose of the ADP is to work as a vibration damper and a one-way clutch which allows the high amperage alternator to overrun or freewheel as the engine RPM slows down. It's important to understand the relationship the ADP plays with the rest of the system.

If during operation you hear noise or feel a vibration emanating from the ADP replace immediately. Another symptom of failure may be the alternator has quit charging or a buzzing sound is emitted from the ADP which can last for up to 5 to 10 seconds after the engine has been shut off.

> ***Key Point:*** A failing ADP can cause the belt and tensioner to fail prematurely or, if the tensioner is failing (hammering), it may cause the ADP to fail prematurely as well. To bring the system back to "like new "condition it is highly recommended to inspect or replace the tensioner, ADP and belt together when possible.

Spray Bottle Test Disclaimer:

This test is a simple process for determining if the chirping/squealing that is emanating from the ABDS System is an alignment or tension related problem. Before beginning it is highly recommended that this test be performed by a professional technician. The test is performed with the engine running and all clothing along with body parts must be kept clear of the engine. Failure to do so can result in severe injury or even death.

With the engine running, take a spray bottle filled with water and spray the underside of the belt. If possible spray towards the affected pulley. The purpose of the spray of water is to act as a lubricant (only use water). If the squealing becomes more pronounced when sprayed there is not enough tension on the belt. Replace belt and tensioner together.

A chirping belt may indicate that there is misalignment in the system. Again spray towards the underside of the belt close to where the noise is coming from. If chirping dissipates momentarily when sprayed and then returns, there is evidence that there is misalignment in the system. Check for alignment problems or a bent or warped pulley.

Thank you for taking the time to review Understanding the Loss of Tension in the Accessory Belt Drive System. It has provided you with the most current knowledge you need to teach and understand Accessory Belt Drive Systems on today's modern vehicle.

> The ***Key Point*** of this training is that the relationship the belt shares with all the components in the ABDS is not understood by most service writers /technicians/countermen or consumers. This lack of knowledge creates a "no urgency" situation to replace a failing belt or tensioner until they fall apart. Understanding the root cause failures will help eliminate customer come backs and lost profitability for everyone involved.

If we can assist in anyway please don't hesitate to give your local Gates representative a call, drop us a note at AftermarketTraining@gates.com or visit our training page on www.Gates.com

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