

# Drive Belt Training

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# Introduction

Over the past 25 years, serpentine belts have changed considerably. 25 years ago vehicles had multiple serpentine belts that only had up to 4 points of contact. Today, serpentine belts can have over 10 points of contact, creating very complicated drive systems. These complicated drives offer many more opportunities for issues such as pulley misalignment, resulting in unwanted noise. Today's belts are also made to last longer than their predecessors of 25 years ago. Years ago, belts were made with a Neoprene rubber compound that lasted 50-80,000 miles before failure or replacement. Today's serpentine belts are made with an EPDM (Ethylene Propylene Diene Monomer) compound and should be inspected for wear starting at 60,000 miles and worn components should be replaced at 90,000 miles.

As mentioned, automotive belt drive systems have become significantly more complicated over the past 25+ years. OEM's (original equipment manufacturers) continue to add accessories and are looking for the most efficient way to power these accessories. Over the years, OEM's moved from multiple serpentine belts to one belt driving all the accessories. This was accomplished by working with belt manufacturers to develop belts to withstand these high loading requirements while also providing an increase in durability under extreme temperature conditions.

#### **BELTS 10-15 YEARS AGO**

Compound = Neoprene Life = 50,000 to 80,000 miles Failure Mode = Cracking Drive Design = Simple Application = One construction

### **BELTS TODAY**

Compound = EPDM Life = 90,000 - 100,000 miles Failure Mode = Loss of rubber material Drive Design = Complicated Application = Multiple constructions



The upside is that now only one belt is required. The downside is that if this one belt fails, the vehicle is usually stranded. For belts to last over 90,000 miles, the belt material was changed to an EPDM rubber compound, which is inherently stiffer than the older neoprene compounds. This stiffer compound can be less resistant to minor pulley misalignments and will tend to make noise if these misalignments are not corrected. This is one of the reasons that noise is a bigger complaint today especially in colder weather. Remember, if there is noise coming from the new belt, there is a reason and the majority of the time it's NOT the belt. Something is causing the belt to make noise and it's usually a misalignment or tension issue.



# Belt Drives are not all Created Equal

The image to the right is a demanding belt drive that is prone to make noise. Why? Notice that there is a long belt span from the power steering pulley to the backside water pump pulley, and then a very short span from the water pump pulley to the crank shaft pulley. Any misalignment between the power steering pulley and the crankshaft pulley will NOT be corrected as the belt enters the backside water pump pulley. The belt will travel around the backside pulley in the same plane that it enters, which means that the belt will have to make up the misalignment caused by a worn-out water pump bearing, will create a higher force on one side of the belt ribs as it is being forced into the crankshaft pulley grooves, thus creating a likely condition for noise to occur. This application is known for both misalignment caused by a worn water pump pulley and bearing pulley being out of plane, and (2) a misalignment caused by a worn water pump pulley and bearing.

Misalignment reacts differently depending on the spans of the belt. You will notice the angle the belt is entering the pulley differs depending on the span of the belt. This is a critical element in determining noise on demanding drives such as the drive represented above.

This belt drive is an example of a well designed system that is not prone to belt noise. Accessories are spaced apart without aggressive directional changes in the belt. Even though this vehicle has the exact belt part numbers as the drive mentioned above, this vehicle has virtually no complaints for belt noise.









# Belt Noise — Causes & Solutions

As discussed previously, if a newly installed belt is making noise, there is a problem within the belt drive and 9 times out of 10; it's not the belt causing the noise. Belt noise is the equivalent to a "check engine" light that indicates something is wrong with the belt drive system. First, there are 2 types of noise, Chirp and Squeal.

### **CHIRP – CAUSES & SOLUTIONS**

"Chirp" is described as a sharp, high-pitched, repetitive noise of short duration, usually worse at low engine speeds (idle). As the belt speed increases, the belt noise will blend and most likely seem to go away. Most chirp noises occur as a short belt span enters into a grooved pulley, typically after exiting a backside pulley.

### Causes of Chirp include:

- Pulley misalignment (#1 cause of noise is misalignment)
- Mis-installation
- · Belt ribs extremely worn
- · Worn pulley bearings (causing pulley wobble/excessive free-rock)
- Contamination (oil, power steering fluid, antifreeze, belt dressing, etc.)
- · Low quality belt

### **Misalignment Solutions:**

- Check alignment of all pulleys, either with a straight edge or a laser alignment tool.
- · Insure all accessory pulleys and brackets are tightened snug to mounting surfaces.
- Inspect and replace all accessories/pulleys that are difficult to rotate (i.e. rough/seized bearings) or show excessive wobble/free-rock.
- Power steering pulleys are a common cause for misalignment.
- · A worn harmonic balancer can also cause misalignment.

Note: Since any existing misalignment condition will cause premature wear of the belt ribs, a new belt is recommended once the accessory drive is realigned

### DEGREES OF MISALIGNMENT FAILURE MODE

0° to 1.0°	Very low potential for chirp noise
1.0° to 1.5°	Potential for chirp noise
1.5° to 2.5°	High probability of chirp noise
>2.5°	Extreme chirp noise / Probability of belt jump

**Tricks of the trade:** If you rev the motor and the noise appears to go away, it's typically a chirp noise and usually due to a misalignment. Another method is to spray the rib side of the belt with a small amount of water and if the chirp goes away, it is misalignment.



# Belt Noise — Causes & Solutions

# **SQUEAL – CAUSES AND SOLUTIONS**

"Squeal" is described as a high pitched noise, typically lasting several seconds in duration. This type of noise will typically increase in volume as the engine speed increases, and is caused by relative slip between the belt pulleys.

### Causes of Squeal include:

- Low belt tension low installation tension (manual tensioned drives), belt stretch, extreme belt wear, tension spring degradation or the belt is too long.
- High accessory/idler pulley drag seized bearings, accessory failure/lock-up
- Contamination /Environment fluid contamination on the belt (belt dressing, oil, antifreeze, power steering fluid). Hard splash of water such that the belt hydroplanes and looses traction

### **Tension Solutions:**

- Belts installed on manual tensioned applications should be properly tensioned during installation (35 lbs per rib) and then re-tensioned after 5 minutes of run-in (30 lbs per rib). This allows the belt to seat in the pulleys. See chart below for Dayco recommended tensioning levels.
- On vehicles with automatic belt tensioners, the tensioner pulley should turn freely without binding, the tensioner arm should move smoothly through its entire range of motion and there should be adequate tension. Always check the tensioner bearing for noise and wear. Replace any tensioner where the bearing feels rough or pulley had run-out (wobble).
- While the belt is removed, inspect all accessory pulleys and idlers to insure free and smooth rotation. If there is binding or rough rotation (dry bearing), then the pulley and/or accessory should be replaced.
- If the belt is contaminated with motor oil, power steering fluid, antifreeze or any other petroleum based lubricants, it will weaken and even cause the EPDM belt to swell, causing noise. Other than washer fluid, replace any serpentine belt that has been oil soaked.
- NEVER try to solve issues with belt dressing.

Note: A belt installed incorrectly will make noise and if not remedied quickly, will need to be replaced because of irreversible damage to the ribs.

Tricks of the trade: If you rev the motor and the noise gets louder, it's typically a squeal and is usually due to a low tension condition. Another method is to spray the rib side of the belt with a small amount of water and if the Squeal gets louder, it's most likely a tension issue.



# When Will Belts Fail?

Over 80% of all belt failures and replacements occur after the vehicle passes 85,000 miles. The fact is, peak belt replacements occur between 90-100,000 miles; on vehicles that are 7 to 10 years old. Consequently, the average age of cars on the road today is nearly 10 years old with over 100,000 miles. The graphs shown below represent a study of over 300,000 belt replacements over the past 12 months. This directly identifies the target market for belt replacements.

Dayco recommends inspecting belts at 60,000 miles and replacing worn components at 90,000 miles.



Industry Note: Over the past 5 years, the Automotive Aftermarket Industry Association (AAIA) published the results of their Car Care Check Lanes showing 20% of the vehicles on the road have a worn belt that needs replaced. That's 1 out of every 5 vehicles!







# When Will Belts Fail?

### How to Identify Worn Belts?

As discussed earlier, EPDM belts wear differently than the earlier neoprene constructed belts. Belt wear can be difficult to detect because they tend to wear like a tire tread, i.e. there is a material loss from the rib surface. A new EPDM belt will have a traditional "V" profile in the grooves between the ribs. With a worn EPDM belt however, the groove profile has the appearance of a "U", because of the material lost from the rib. Once the rib profile is changed, there is less material (and therefore less surface area) coming into contact with the pulleys. This material loss can cause slippage that will affect the performance of the accessories and possibly result in an annoying, noisy belt.



All serpentine belts need to be closely inspected to identify any signs of wear. These belts are asked to perform in some of the most hostile environments because of high heat, contaminates and debris. Regular inspection of all drive belts, tensioners and accessories should be recommended once the vehicle passes 60,000 miles. Vehicles today have more accessories being driven by a single belt than in years past. Checking for belt wear is an important necessity for proper vehicle maintenance.



# **Tools to Identify Worn Belts**

Dayco developed an innovative tool to help identify worn EPDM belts. Remember, these EPDM belts don't crack as easily as their Neoprene predecessors. The Dayco aWEARness Belt Gauge measures wear in 3 different ways (rib profile, rib depth and cracking). The illustration below demonstrates these 3 ways.

# INSTRUCTIONS FOR DAYCO® AWEARNESS™ BELT GAUGE



There are three measurement indicators on the AWEARNESSTM Tool



Grasp the tool like this when using the Rib Wear Indicator Bar.



Keep the tool level -- do not tilt it up or down across the belt.



In a new belt, the top of the bar will be higher than the tops of the rib tips.



If there are four or more cracks in the window when placed flat on belt, recommend replacement.







In a worn belt, the bar will be lower than the tops of the rib tips.



With the Rib Profile Indicator on a new belt, there is neither side nor flank clearance on the ribs.



out" so voids appear on the flanks of the belt ribs.



# **Examples of Worn Belts**



# **RIB WEAR (NORMAL)**

**Cause:** Long term operation (i.e. high mileage) on an EPDM belt will cause the loss of rib material. A typical rib profile will wear from a "V" profile to a "U" profile.

**Solution:** Replace the belt immediately with a new Dayco Poly Rib "W" EPDM belt. Always check the condition of the tensioner, pulleys and drive alignment.



### CHUNK OUT

**Cause:** Rib chunk out occurs when small sections of the rib material are broken off due to excessive cracking. A neglected belt with excessive cracking will lead to chunk out. As with cracking, this is caused by continuous flexing and is accelerated by excessive heat.

**Solution:** Replace the belt with a new Dayco Poly Rib "W" EPDM belt. Always check the condition of the tensioner, pulleys and drive alignment.



# **Examples of Worn Belts**



# CRACKING

**Cause:** Rib cracking is caused by continuous flexing over a long period of time, but is accelerated by excessive heat (high temperature environment and/or excessive belt slippage). Dayco recommends that if you have 4 cracks within an inch you should replace your belt. Although a belt can still perform when cracked, if the cracks move into the cord layer, belt failure is likely.

**Solution:** Replace the belt with a new Dayco Poly Rib "W" EPDM belt. Always check the condition of the tensioner, pulleys and drive alignment.

### ABRASION

**Cause:** Improper belt tension can cause excessive slip and abrasion to the belt rib surface or back of belt. Also, debris thrown into the drive system can cause the belt to appear ruffed up, and can actually cause puncture marks into the belt.

**Solution:** Ensure that all debris and foreign objects are removed from the drive system; check the tensioner for proper tension and replace the belt. For locked center drive applications, use proper belt tensioning methods (including a 5 minute run-in).



# **Examples of Worn Belts**



### **RIB WEAR (MISALIGNMENT)**

**Cause:** Worn pulley/idler bearings, a worn water pump bearing, misaligned power steering pulley or other accessory pulleys, and/or a faulty harmonic balancer can cause misalignment wear. Severe misalignment can also cause a belt to lose one or more outside ribs. Misalignment is apparent when the belt ribs show uneven wear, with possible frayed sidewalls.

**Solution:** Immediately correct all misalignments prior to installing a new belt. Alignment should be checked with every belt installation today. The #1 cause of belt noise is misalignment.

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### PILLING

**Cause:** Rib pilling is the shiny rubber deposits that get compacted into the belt grooves, and is caused by pulley misalignment, rough or worn out pulleys, lack of tension, newly coated/painted pulleys, fluid contamination, and/or rough running engines.

**Solution:** All pulley misalignments need to be corrected; All pulleys will need to be cleaned thoroughly; Any pulley that shows damage to the riding surface (dings, cuts, etc) needs to be replaced; A rough running engine will need to be corrected. Once these items are satisfied, replace the belt with a new Dayco Poly Rib "W" EPDM Belt.



# The Importance of Attachment Selling

If you are replacing a worn belt on a vehicle with over 90,000 miles, there is a good chance that other components such as the tensioner and idler pulleys will also be worn. The life of a newly installed serpentine belt will be greatly reduced if a worn tensioner or even a worn pulley isn't replaced at the same time. Worn tensioners can cause belts to slip and therefore glaze, destroying a new belt. Worn tensioners can also cause belts to slip on the alternator causing a "check engine" light. A pulley with a worn bearing can cause misalignment, causing wear to the sidewall of the belt and belt noise.

Belts should also be considered when installing an alternator or water pump. Alternators and water pumps have nearly the same life expectancy as belts. To ensure long lasting maintenance free performance, do the job right and replace all worn components.

### Why is Dayco National Brand the Best Solution?

In today's competitive aftermarket, innovation is even more important than ever before. Dayco understands that the demands on today's belts have increased dramatically. The accessory drive has become even more convoluted, with belts driving 10 or more points of contact. Belt materials have also advanced using long lasting rubber compounds. But, these new EPDM compounds are stiffer than the previous neoprene belt constructions (especially in lower temperatures), which can mean less resistance to pulley misalignments. Dayco confronted these new serpentine belt demands with the same innovative focus that has driven us for over 100 years.

The Dayco Poly-V belt is engineered for high mileage vehicles. The Dayco Poly-V line of belts has various constructions based on the demands of the specific application. The Poly-V belt was developed by the Dayco engineering team to conform to slight misalignments in today's high mileage vehicles, without making noise. Belts are being replaced on vehicles with over 90,000 miles and they are far from perfect. The Dayco Poly-V belt offers a better solution.





# The Importance of Attachment Selling

Dayco engineers have also discovered that some import applications have very sharp pulley tips which can cause premature belt rib wear, resulting in a loss of tension and ultimately serious noise issues. Dayco re-engineered these specific part numbers to incorporate a deeper rib design that eliminates the excessive and premature rib wear, allowing for improved tension maintenance properties, thus insuring peak, quiet performance.

### Summary of Benefits:

- Engineered to maintain a quiet, vibration-free belt drive system
- Designed to maintain required belt tension over the life of the belt and resist elongations
- Designed to elongate over the pulley system, maximize belt life and load carrying requirements





MOVE FORWARD. ALWAYS.™

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