

## 413-901 Red Shift Dual Piston Cam Chain Tensioners

### Tensioner Shoe Wear Q&A

The following document was created to address any questions or concerns about the Red Shift Dual Piston Cam Chain Tensioner Shoes, their expected wear patterns, operation, and overall lifespan.

**Tensioner Shoe Lifespan:** Many factors will ultimately determine the lifespan of your Red Shift Dual Piston Cam Chain Tensioners. Due to the large number of variables, an exact lifespan cannot be determined, but many safeguards are designed into the system to maximize the lifespan of all of the parts in your valve train.

- 1.) **Valve Spring Pressure** – Increased Valve Spring Pressure will increase the load on the entire valve train, including the cam chains and their cam chain tensioners.
- 2.) **Cam Acceleration Rate** – A more aggressive camshaft will also alter the loading on the cam chain. Any aftermarket performance cams will increase the loading seen at the tensioner shoes, which is why it's critical that the cam chain tensioners are working properly. The Dual Piston Cam Chain Tensioners were designed to withstand greater loads than a factory valve train.
- 3.) **Oil Pressure** – The hydraulic tensioner bodies are designed to retain pressure by a check ball as the oil pressure and surface loading fluctuates. As the overall oil pressure is increased, by adding high volume oil pumps or altered Oil Pressure Relief Valves, the pressure held by the cam chain tensioners increases.
- 4.) **Dual Pistons** – Since Red Shift Dual Piston Cam Chain Tensioners have two equally fed hydraulic bodies, with a common plenum prior to the oil pressure rail, the support area under the tensioner shoe is doubled over a single piston hydraulic design. A significant benefit to a hydraulic system is the shoe pressure rises as the RPM rises, directly related to the oil pump's output curve. The geometric location of the hydraulic bodies also alters the location of the wear, in comparison to the factory single piston design.
- 5.) **Debris** – One of the most common things to affect shoe life is foreign material passing between the chain and the tensioner shoe. Foreign objects generally cause tearing or "chunking" of the shoe surface.

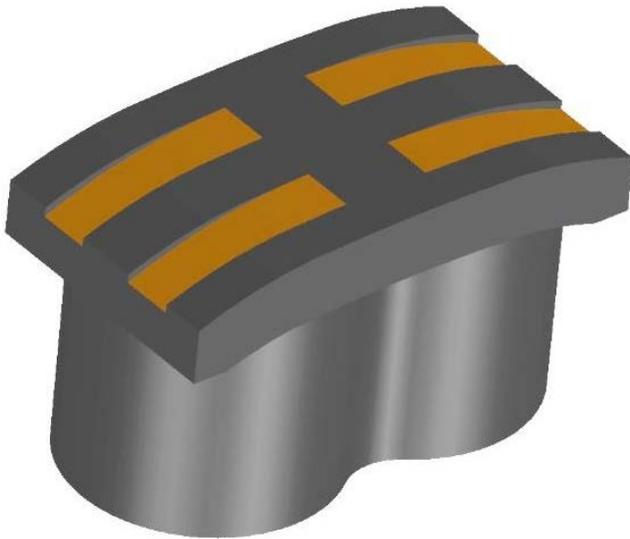
**Wear Patterns on Red Shift Cam Chain Tensioners:** To illustrate the thickness and typical wear patterns on the cam chain tensioner shoes, several 3-d models of parts taken out of service were created in Solidworks. The models were created to show a cross-sectional view of the tensioner shoe, so the wear can be quantified and compared to the remaining material. The following two models were created off of actual run tensioner shoes by Red Shift customers, independent of our own positive test results during the product development.

- 1.) **Break-in wear** – Each chain tensioner will have a break in period, resulting in what appears to be an accelerated wear rate from new. The cam chain shoe is wearing away to create the ideal chain arc for your engine. Once the arc is created, and full contact is seen on the tensioner shoe face, it is fully broken in. It may take a couple of thousand miles for the shoe to show full contact with the chain, depending on the variables affecting the tensioner shoe pressure. Although the pressure put on the cam chain does not change in regards to time, the surface loading reduces significantly after break-in.

The following shoe is almost fully broken in, at roughly 2,000 miles. The wear rate will dramatically reduce once the shoe is fully broken in to the engine combination. The wear always shows heavier on the leading and trailing edges of the shoe, simply due to the thrusting that the chain puts upon the shoe. Additional material was added on these thrust edges, so that once broken in, the remaining wear material is consistent across the face.

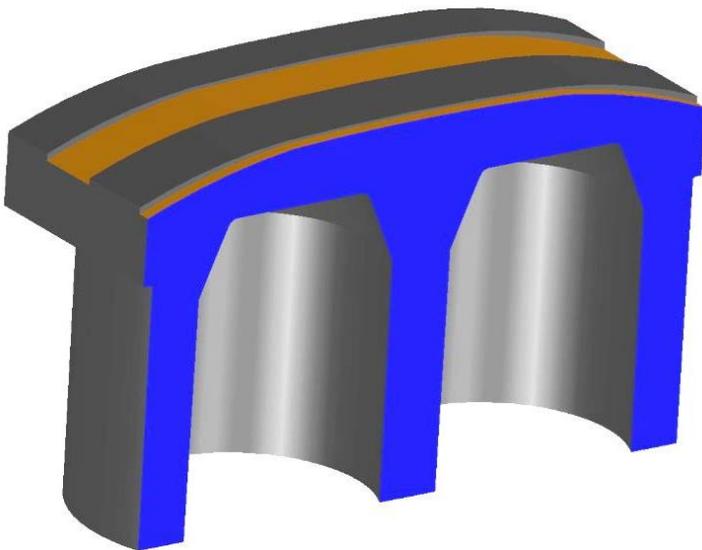
Due to the geometrical and pressure differences between a factory cam chain tensioner and a Red Shift Dual Piston Cam Chain tensioner, it is not appropriate to directly compare the wear rate of the two shoes. The OEM cam chain tensioners generally do not provide enough supporting pressure to the cam chain, and as a result, the cam chain tensioner shoe has an exceptional lifespan.

## 2,000 Miles



This part has roughly 6,000 miles on it, and is controlling the cam chain very evenly. There are no signs of loss of valve train control on this tensioner! The pressure applied to the chain is even and controlled.

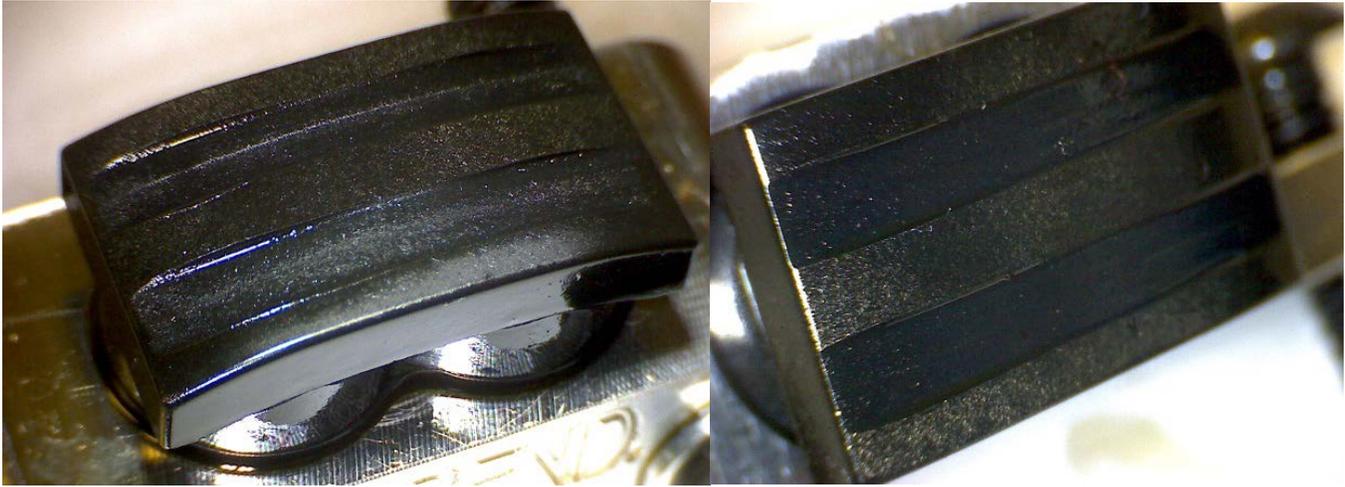
## 6,000 Miles



- 2.) **Long-Term Wear** – Once broken in, the wear rate will diminish significantly. The loading is now properly distributed across the tensioner shoe and the surface forces reduce.

The two pictures below demonstrate 45,000 street miles on a set of Red Shift Dual Piston Cam Chain Tensioners. These tensioners have had a hard life, and have always proven up to the task. Removed from a long distance rider's motorcycle, these shoes have seen the extremes in real world testing. Once broken in, the wear rate almost slowed to a crawl. These higher mileage cam chain shoes only show a couple of thousandths of depth of wear past its break in point! Substantial material thickness remains at this point, and these shoes were put back in service.

**45,000 Miles**

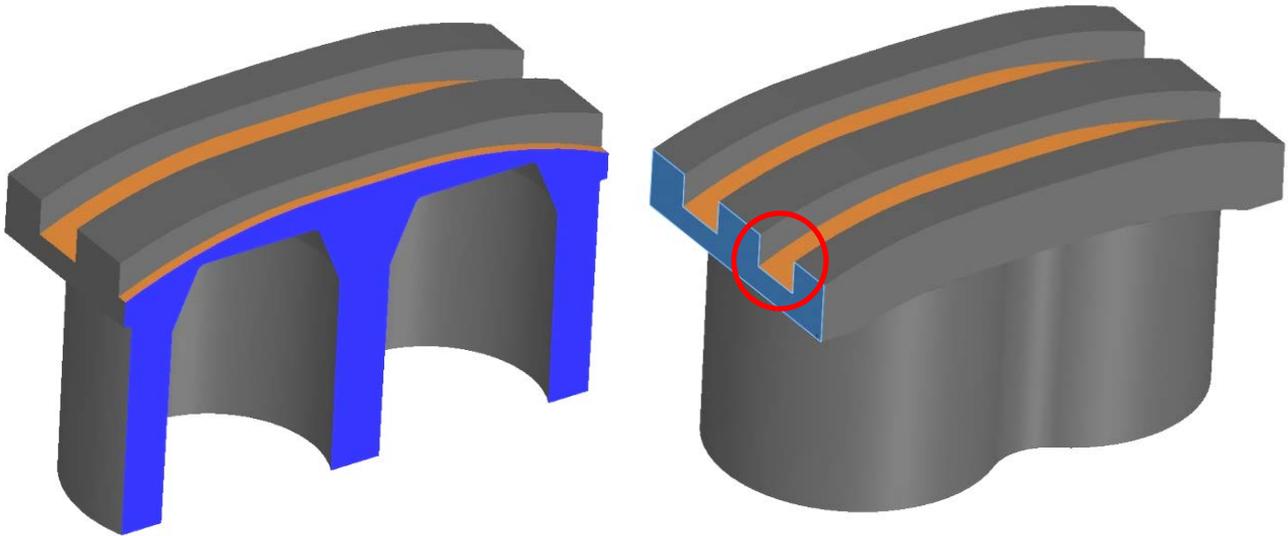


### 3.) Evaluating the Wear

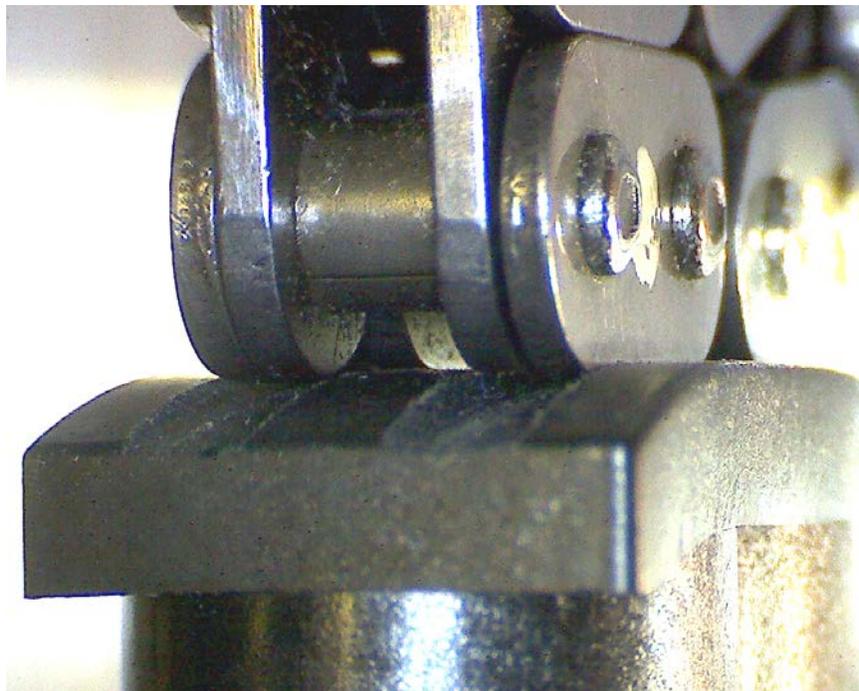
- a. The most important thing to look at is the wear pattern. Are the tensioners evenly applying pressure on the chain? If not, were the tensioners pumped up when removed?
- b. Are there signs that the shoe is being damaged by a burr on the chain? Typically this creates a slice into the shoe, from one of the edges of the chain link.
- c. Does the shoe show signs of foreign material getting between the chain and the plastic? Chunks missing are a good sign of material run between the chain and shoe.

## Critical Points of Wear:

- 1.) The cam chain tensioner shoe can wear down roughly 0.065" into the shoe face before the chain's roller pins begin touching the shoe surface. This is the point when Zipper's recommends shoe replacement. By eye, the wear pattern will be almost 3/4 of the way through the end of the shoe (circled in red), and the wear marks will be visually substantial. If you haven't even worn into the side of the tensioner shoe, you've barely broken the surface of the wear material!

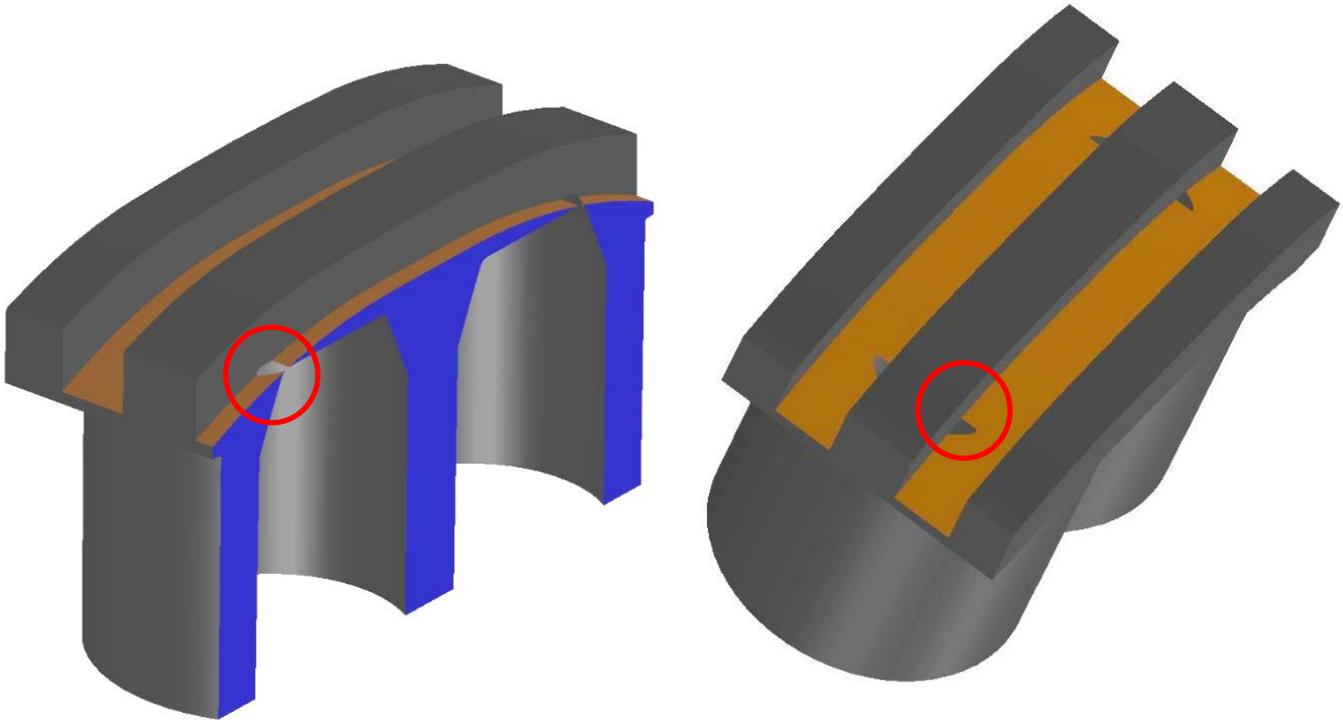


This picture illustrates the factory driven cam chain on a Red Shift Dual Piston Cam Chain Tensioner after break in. The shoe can continue wearing until the roller starts hitting the shoe. This particular shoe has most of its life left, and looks normal for the amount of use.



- 2.) Is it possible for the chain to make contact with the metal hydraulic bodies pressed inside the shoes? It would take over 0.100" of wear before the chain breaks into the pocket for the hydraulic bodies. If you look at the side view of this, you have to wear through the majority of the shoe's pad before hitting the hydraulic bodies.

This is far past the point of the chain's roller pins contacting and wearing on the shoe, which makes it very unlikely to ever occur. The shoe was specifically designed with as much material as possible between the chain and the hydraulic bodies, to prevent a metal on metal contact scenario.



## Shoe Design & Materials:

- 1.) Extremely durable, reinforced, heat stabilized plastic. The material chosen is a commonly used plastic in cam chain tensioner application. No expense was spared in the American-made injection mold tooling, with the entire injection molding process being performed in the U.S. Although it was an expensive task to make these parts in the U.S., the quality of the process, the injection molding machines, and the materials used are second to none.
  - a. Automotive grade, high temperature, reinforced, wear resistant polymer.
  - b. Peak Operating Temperature – 480°F. This represents the highest temperature that this plastic can operate in. If the chain tensioner shoes heat soak above 480°F, you will start to see a much faster wear rate. However, other serious problems are present if your bottom end ever reaches this temperature. Typical bottom end temperatures are in the low 200's when fully heat soaked.
  - c. Melting Point – The melting point of the plastic shoes is 563°F.
- 2.) Easy and inexpensive to replace – The tensioner shoe is the wear item in your valve train! Although you should expect to get many miles from your Red Shift Dual Piston Cam Chain Tensioner, the shoes are the cheapest parts to replace in the entire system. Your cams, lifters, rocker arms, and valves will ultimately have significantly increased lifespans if your cam chain tensioners are properly controlling your valve train.

## When to Inspect:

If you have a concern or hear an unusual noise in the engine, you should always take the time to perform a general inspection of the cam chest, oil pump and lifters. As a guide for a general inspection you can download the Redshift cam chest blueprinting worksheet, found in the Red Shift Cams installation instructions. Red Shift recommends that you always install new lifters when replacing your camshafts, and then inspect the lifters every 20-25,000 miles on any Twin Cam engine, to prevent a catastrophic failure. While replacing these common wear items, we recommend that you pull your cam chest apart, and inspect the following items:

- a. Tensioner Shoe Wear & Pattern
- b. Oil Pump Condition
- c. Crankshaft run-out

Replacement shoes are available from Zipper's. These are available as raw shoes or as shoes with new hydraulic bodies installed. The hydraulic bodies are designed for automotive use, so it is unlikely that they ever wear out. Replacements are available if the hydraulic bodies are damaged by debris from a catastrophic engine failure. The typical replacement shoe kit can be purchased from Zipper's, part number 413-990. The kit provides 2 new shoes for you, at a reasonable price point.

## Patented Design:

After several years of hard work, the United States Patent and Trademark office recently issued Zipper's Cycle a patent on features of the Red Shift Dual Piston Cam Chain Tensioners. Patent # 8,535,187.