Front Crankshaft Seal Replacement

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1976 Jaguar XJ-S

Background

In a 25-year-old car, you can expect crankshaft seals to leak. In fact, I think my seals were leaking noticeable well before its 25th year. When I decided to replace the front seal was when it got so bad that it would spot the driveway while waiting for the garage door to go up. Even then I didn't want to believe, so I put it on ramps and cleaned it up the lower front of the engine to be sure that's where it was coming from. But where else is a front dead-center engine oil drop going to come from? After confirmation, it still took me the better part of a year to get up the courage to go after it. I don't mind working topside, but hate working under the beast!

What Is Involved

The front seal is a flat rubber ring, bonded to steel, that is pressed into the timing chain cover on the front of the engine. The crankshaft passes out of the crankcase through this seal. Its function, of course, is to keep the oil in the engine. In time, heat causes it to harden and wear causes it to begin leaking. Also, the sleeve over the shaft on which the seal rides can wear significantly.

Naturally, the seal is behind the main pulley and vibration damper that attach to the front end of the crankshaft. To replace it you have to take off all the belts, and then the pulley, damper, and finally a slotted conical sleeve that the damper rides on. Behind the cone there is a straight sleeve (called a "distance piece" in the Repair Operations Manual (ROM), i.e., spacer) that the seal rides on. Once it is slipped off of the shaft, the seal can be extracted from its recess in the timing chain cover. The parts are shown in Figure 1. At the left you see the new seal and sleeve near the box. Below are the old sleeve, the slotted cone, the damper, pulley, and the bolt. Unfortunately, I forgot to show the hex post that bolts onto the pulley as discussed below.

Figure 1. Front seal and related parts.

However, before you begin taking off belts and pulleys a bunch of other stuff has to come off so as to give working space.

The Repair Operations Manual (ROM) shows a couple of nice pictures and a step-by-step procedure. You should look these over to see what the various pieces look like and where they fit. However, you don't necessarily have to begin by taking out the radiator. Read on.

Things to Take Apart to Get near the Seal

Radiator?

Whether or not to remove the radiator is the first question you will have to ask yourself. The ROM says you should. Kirby Palm's Book says you don't have to, and this has been confirmed by many XJ-S owners/mechanics on the XJ-S Lovers mail list.

I set out to do it without radiator removal since I recently had a re-cored radiator installed by Britalia Motors (Fullerton, CA) precisely because removal is so hard in the early XJ-S cars. Also, I had just rebuilt my air conditioning system, including a new high-tech condenser, and I didn't want to mess that up. Nonetheless, halfway through the disassembly process I changed my mind and decided I had to remove it or risk destroying it. The space is tight in there, and with all the prying and pulling to get the pulleys, cones, keys, and seal out you will almost certainly ding the radiator more than once. Moreover, any difficulties along the way, such as a stuck cone or seal, will make you wish you had more space to work on it.

But, in the end I *did not* remove it. I did remove the top rail, all the hoses, and unhooked the condenser from it, but it would not lift out. This was probably because of the notorious oil cooler mounting tabs at the bottom. But whatever the source of the resistance, it slowed me down enough to see that if I removed the fan/idler pulley mount from the engine block I could remove the fan shroud. With that out of the way, the space down there suddenly looked like the Grand Canyon! Figure 2 shows the view from the right side. Since at this point I had removed everything, you can see the bare shaft near the center to the left of the photo.

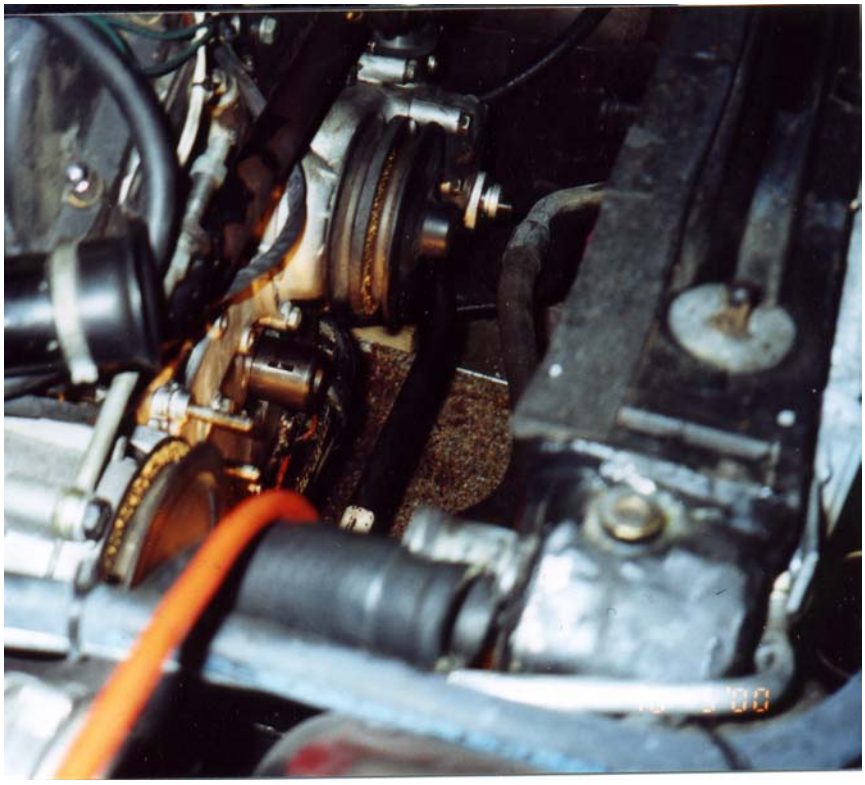

Figure 2. The bare shaft.

So, my answer to the question is *remove the radiator*. You will regret it constantly if you don't. That said, I will continue here to describe how I did it without radiator removal.

If you don't remove the radiator you will have to remove the fan in its entirety, rather than just the blade and clutch as I originally did, then remove the shroud. On my car, I also had to remove the radiator top rail to get the shroud. While you are at it, remove the electric fan. On my car the shroud is really two pieces screwed together in the middle, with the electric fan mounted on the left part, so after I had removed the right part the other came out with little extra work. Although I did not do so, you should also tape a piece of cardboard to the radiator to prevent any dings, as you will still be doing some heavy work in a cramped area. I think it's probably overkill to remove the radiator hoses, but then it might be a good time to replace them anyway. With all that space, it will never be easier. By the way, if you have the style of fan for which the clutch mount with a single bolt like mine, you should remove the fan and clutch, then remove the idler mounting bracket from the engine. Otherwise, you will risk damaging the radiator.

Radiator Top Rail

Remove it. Otherwise, you will not be able to remove the fan shroud.

Radiator Hoses

Planning to remove the radiator, I took off all my hoses. I am not sure this is really necessary, but you will surely appreciate the extra space and simply being able to see the seal from all possible angles. And there is no better time to replace them.

Fan Shroud, Mechanical Fan, and Electric Fan

In my opinion, all of these should be removed. I first removed only the mechanical fan and torqcontrol clutch, then worked for a day and a half with the other things in the way. I wound up with a lot of cuts on my forearms from the shroud, and damage to the radiator fins.

On my car the shroud is in two pieces, screwed together in the middle. The left part holds the electric fan, and the right is the mechanical fan shroud. I separated the two halves, hoping to be able to get the mechanical fan part out without fussing with disconnecting the electric fan. In the end, I wound up taking out both for easier access. I may have been easier to remove it as one piece.

Some say you can get the fan shroud out of there without removing the fan/idler pulley mounting bracket. On some cars that may be possible, but I don't see how you can do it if you have the "single bolt" style fan clutch. Four bolts, one of which is really hard to get at, and the fan/idler mounting bracket is in your hand. And then you can remove the right shroud easily. Suddenly, you can see things down there! (See Figure 2). After removal, place a piece of cardboard over the face of the radiator. I did not, but wished I had.

Spoiler Undertray

In spite the improved work space afforded by fan and shroud removal, some of the work still has to be done from below. This will be much easier if you remove the spoiler undertray. In my case this required also removing the access panels in the front wheel wells to get at the fastening screws. This is probably non-standard, as the ROM does not mention this when it describes the undertray removal. My mechanic may have added some extra screws trying to secure the undertray better after I damaged it on a parking curb.

Getting At the Seal

Belts

Before you can get at the seal you obviously have to remove the pulley and vibration damper. This means all the fan belts have to come off. So after removal of the fan shroud and fan, remove the power steering/water pump belt, the smog pump belt, and finally the alternator belt, in that order. By the way, you should **disconnect the battery** first, because when you are trying to loosen the generator your wrench may hit the cable at the back. I didn't, and had some sparks flying.

Pulley

What looks like a single pulley on the front of the crankshaft is really two pieces (See Figure 1). The forward three belt grooves are on the pulley proper. It is bolted to the vibration damper, which has the forth belt groove. The pulley is fastened to the vibration damper with four bolts. Two of these bolts also serve to fasten a hex post in the center of the pulley, not shown in my edition of the ROM. This is probably for manually turning the crankshaft, as you might want to do if you are trying to set A1 to top-dead-center or something like that. So remove the bolts holding the hex post first, being sure to catch the

spacers that fall out. Then remove the other two, shorter, bolts and the pulley will separate from the vibration damper with a gentle tap. Be careful that it does not fall into the radiator, as it is heavy and could do damage. Note that if you have removed the fan and shroud all of this work can be done most easily from the top.

Damper

A large center bolt holds on the damper. You will need a 1 5/6" socket to loosen it. The usual advice, which worked fine for me, is to use the starter to loosen and remove the bolt. Think this through before you begin because if you do it wrong there might some serious damage done by a flying breaker bar! Keep in mind that the engine will be turning clockwise as you face it in front of the car. The nut will be held stationery as the engine rotates. To accomplish this, use a bungy cord or something to lash a breaker bar so it is braced against upward motion at the right side of the car. Then, remove ignition power from the coil and crank the engine. Some say to keep cranking till the bolt is totally extracted. I just loosened it with the starter and turned it out the rest of the way by hand.

Once the bolt is removed, use a plastic hammer or block of wood to tap it loose from the cone. This is not hard. It comes off easily.

Cone

Getting the cone off can be easy or hard. Some say they just pried on it a bit with a screw driver or pry bar, then slipped it off. Mine was too tight, so this didn't work. Other advice was to drive a screw driver blade into the slots to expand it a bit. Didn't work. What did work, not surprisingly, was a "Preston arm puller." At least that's what guy at the equipment rental store called it, as if everyone ought to know. The important attributes are (a) the feet on the arms have to be thin enough (perhaps 1/8") to fit behind the cone, and (b) the length has to short enough to fit between the crankshaft end and the radiator. Take some measurements before you head off to the rental store.

A small point: When you set up the puller, use a couple 1 ½" fender washers on the front of the crankshaft (some wheel bearing grease will hold them in place) to keep the puller shaft from screwing into the damper bolt hole. I didn't at first, and I turned and turned but nothing moved. I finally realized that the puller was threading into bolt threads! Fortunately, the threads must have been the same because no damage was done.

Woodruff Key

There are two Woodruff (half-moon) keys. One locates the cone t the crankshaft and the other the damper to the cone. The one in the crankshaft has to come out in order to remove the distance piece (see What Is Involved above). Like the cone, many different methods of removing this key have been proposed and used successfully. The method that worked for me was the side of a wood chisel. But first, I tapped the rear of the key with a long wooden dowel and hammer so as to drive it down and lift the front. Then I held the flat of the chisel on the surface of the crankshaft so that the beveled side edge was under the lifted end of the key. A couple strong whacks with a hammer on the other side of the chisel and the key was on the garage floor. (It was my old chisel, not my new one…)

Distance Piece (Sleeve or Spacer)

I was apprehensive when I got to this point since some people have had trouble getting this out. It protrudes only about 3/16" out of the seal, so it's hard to see how you could get a grip on it if any serious yanking was required. Fortunately, it slipped right out. I fashioned a hook by bending the end of a short length of tough wire and forced it through the lip of the seal. By turning the wire I was able to hook the back end of the sleeve and pull it out. This was the easiest part so far.

By the way, the distance piece should be replaced along with the seal. Mine had a surprisingly deep wear groove. Although some have suggested simply reversing it on reassembly, I would be reluctant to do so because the wear groove is so close to the center. The Jaguar seal comes with a new spacer, which together cost only $40.

Seal

Getting the seal out was a major challenge. As with other steps in this long process, several methods have been proposed and used successfully. Ones that didn't work for me were

- *Prying out with screwdriver.* There are indentations on each side of the recess apparently for this purpose, but I could not get a bite into the exposed side of the seal.
- *Driving a pick into the side of it and prying.* I bent my pick on this one, and mangled the seal, but got no movement.
- *Use a puller.* I rented the puller that seemed most likely to fit into the space between the seal and the crankshaft. Turned out to be a pilot bearing puller, which would have worked if the crankshaft had not been there. Forgot to take the damn thing back and wound up paying two days rent for no benefit at all.

What did work was a variation on a method devised by Ray Schmitt using an ordinary *paint can opener*. I did not understand how Ray used the device so I invented my own way. My method used *a needle nosed vise-grip pliers* to hold the opener and to act as a lever, Figure 3. Note how the opener is gripped ½" or so back from the nose of the pliers. This is so you can put the nose on the end of the crankshaft and get a lot of leverage. The point of gripping the opener along its length is also critical; it has to be found by trial and error so as to be able to get the hook behind the seal.

Figure 3. Special tools

The hook is inserted behind the seal, and the nose of the pliers is placed on the flat front end of the crankshaft. The handles of the vise-grips are then pulled away from the engine. This gives a lot of leverage, so it didn't take much force to pull one side loose. Then I moved over to the other side and repeated the same thing, and the seal was in my hand. Trust me, all of this will be clearer when you start trying to get the seal out.

Later, I got Ray to explain how he used the opener. First, he left the distance piece in place on the crankshaft. (Actually, he couldn't get the distance piece out with the seal in place because it was stuck to the shaft.) With that in mind, here is what Ray says:

> "As I recall, I used the end of the spacer, angled off a bit so as to clear the crankshaft. That is, the opener is not levered along a diameter of the crankshaft, but rather along a tangent. A bit of side force keeps it in position against the crank and spacer. So if you put it over the top of the crank, slip the hook end under the inner seal, and keep it pulled down against the crank, you can push the end of the opener toward the engine and it will lever against the spacer and lift the seal out a bit. Switch to the other side and it should be free."

Cleaning

While the pulley and damper is off you will want to clean the front of the engine. First, cover the alternator with a plastic grocery bag and pack the seal cavity with a shop towel. Then drag your oil drop tray up under the front of the engine (surely you have one of these!). Spray the front of the engine with Gunk and scrape around a bit, then hose it off. A little effort, and you will feel even better about the job.

Reassembly

Clean the recess

Be sure to clean the recess in the timing cover before inserting the seal. I sprayed a cleaning solvent in there and poked around with a shop towel and screwdriver. Later, I wished I had used a mirror to examine it carefully to be sure no fragments of the old seal were sticking in the corners, but everything worked out OK. The danger, of course, is

something getting in the way of proper seating of the seal and/or the distance piece, or worse getting lodged in the new seal.

Seal

The seal has to be pressed evenly into the recess in the timing chain cover. The ROM says "gently tap it into place." Some XJ-S Lovers list members have reported that this is more difficult than it sounds. One suggestion was to use large PVC tubing fitting and the damper bolt as a press to insert the seal. This is what I did. In Figure 3 you can see a white 2" PVC cap with a 1" hole bored in the center. The fitting was selected to have a diameter that matched the face of the seal, and a length to accommodate allow the damper bolt to reach the crankshaft. I used a 1" flat boring bit to drill the hole. Placing this on the face of the seal and screwing the nut in with hand force only pressed the seal gently into the recess. The mistake I made was failing to observe that the bit wandered off center a little. This made one edge of the hole a little closer to the opposite face of the fitting than the other, resulting in the seal coming to rest a little uneven. Some work with sandpaper on the fitting hole edge got it more even, and the seal got properly seated.

Distance Piece (Sleeve, Spacer)

The important thing here is to remember that this goes on after the seal, not before. Otherwise, you will have to either remove the distance piece or somehow coax the lip of the seal over the distance piece diameter while fighting with the other task of getting it to slide neatly into the recess. The problem here is some have reported a minor interference fit between the new distance piece and the crankshaft, in which case you will be faced with a tough extraction problem. Put the seal in first. My distance piece slipped easily over the shaft, so I have nothing further to report.

Woodruff Key

After the distance piece is inserted you can put a new key into the crankshaft. Using the old one is not a good idea because it was probably damaged during extraction. I got a Jaguar part, but some people get them at the hardware store. Probably the same part.

Getting it started is a challenge because the fit is very tight. I gripped it with a pliers and sort of wiggled it in a bit, then tapped with a plastic hammer (one of the new tools I got while doing this job). The next challenge is seating it properly. If it is not fully pressed into its slot, or if one end is higher than the other is, there will be interference with the key slot in the cone when you try to put it on. In fact, I believe this what caused my cone to be so hard to get off. My technique in this regard used a precision tool and a not so precision tool. The precision tool was a Helios caliper, the only thing left from my days as an apprentice toolmaker. With it I measured from the top of the key to the opposite side of the crankshaft at the front and back of the key. If they were unequal, I tapped on the on the high end. The non-precision tool was a hammer and a length of aluminum angle stock that I could position carefully at the high end of the key. If the key is riding on the bottom of its slot, as it should be at this point form earlier taps at the center, it takes pretty hard whacks to get it to move. I finally got it even after two or three tries, and the cone slipped right over.

Cone

Before installing the cone, inspect it for damage that you may have done during removal. I had to do some filing because I had tried to drive a screwdriver into the slots. The key in the cone should not need replacing, since there was no need to remove it.

As mentioned above, the cone should slip easily over the shaft if the key is seated properly. Well, I actually had to tap the last ¼" or so with a plastic mallet. Much easier than the removal.

Damper

Putting the damper on is easy. Just slip it over the cone and screw in the large bolt. Tightening is another matter. The ROM calls for tightening to 125 foot-pounds, but word has it that 150 should be the target. Reportedly, it is friction between the cone and the shaft and the cone and the damper that keeps the damper from slipping while driving the heavy load of fans, alternator, power steering pump, smog pump and air conditioner. That is, the key is for alignment only; it is not strong enough to take the load. To get the torque you need to securely lock the crankshaft. What worked for me were two wooden wedges driven into between the teeth on the flywheel and the bellhousing, right side of the vehicle. One wedge didn't work. It took several tries with two, whittling a bit with a saber saw to get them the right size an shape. Figure 3 shows these "special tools." They really have to be driven in, too. It did not hold the first two or three tries, so I had to keep crawling under and pounding the wedges in tighter.

Figure 4 shows me with the giant torque wrench, prepared to give it the final twist. I put a piece of tape on the dial so I could better see it, as you can't get a good direct look at it because of the bonnet.

Figure 3. Tightening the damper bolt.

Pulley

Getting the pulley back on is a little difficult because of working blind into the deep cavity. I put in the two short screws first and snugged them, then put in the hex post, spacers, and long bolts. I did not torque these, but put my full might with a socket and 3/8” ratchet. Since that’s what I took them off with, I figure that would be tight enough.

Other Tasks

While the front of the engine is fully exposed, you may not be able to resist doing some other work. Things I did were:

- While the damper is off, take the opportunity to dab some with paint over the timing marker. Clean it up with a wire brush first, then some solvent. After it has dried, sand it off to leave only that in the mark.
- Replaced the power steering pump and low-pressure hose. It was leaking, and easy to do because I already had the radiator hose off. Also, I doused the power steering fluid cooler with Gunk and cleaned it up.
- Replaced all radiator hoses. They were not in bad shape, but I had damaged one in removal, and decided to replace them all. By the way, don't call your Jag parts house and say "send me a complete set of hoses" or you will get far more than you expect. I had no idea there were so many, mostly for the heater. And if you have switched to an aftermarket heater valve, you may not be able to use two or three of them.
- Cleaned up and tried to repair the radiator drain valve, which was leaking a bit. Wound up replacing it, as I could not get it to stop leaking. The seal is another problem, as it is no longer available. The idea of using oil pan drain plug seals described in Kirby's book doesn't work all that well. I used a 7/16" ID, 1/16" thick rubber washer from the hardware store sandwiched between the Jaguar fiber washers, no longer listed but available from Coventry West. (I've done a separate write-up on the drain valve matter.)
- Replaced the timing tensioner access plug. Getting the old one out was difficult because it had hardened. A spiral wine opener worked for me.
- Patched up my damaged and drooping spoiler undertray. (Separate write-up underway.)
- Painted the radiator top rail and fan shrouds, and coolant crossover pipe. The latter was pretty badly rusted at the connection points, so I hope the cleanup and priming with Rustolium will extend the life of this no longer available part.

Results

The front seal no longer leaks. However, I am now irritated by the drips from the rear seal, but that will have to wait till another time.

Acknowledgements

Although I do think things through myself, I also seek advice as widely as possible. The XJ-S Lovers list is always the best source. The Book provided a lot of food for thought, even though the techniques given there did not always work for me. I also got good guidance from several listers, especially Ray Schmitt and Bob Gallivan who provided step-by-step procedures from their own experiences. And thanks to Robert Warnicke and Craig Sawyers who provided tips and encouragement along the way.