1996-97 Discovery VSS Repair/Refurbish.

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Applies to:

Discovery series I, 1996 and 1997.

The VSS (Vehicle Speed Sensor) is a pickup mounted to the side of the transfer casing It takes the place of the old speedometer cable, and was designed to fit in that spot without any change to the transfer casing itself. In fact, it has an input shaft exactly like a speedometer cable.

Another thing it has in common with the speedometer cable is the fact that it wears out. A replacement speedometer cable is only about $20. A replacement for the VSS is about $80-$180 depending on where you get it. This made it something that was worth taking a close look at.

Based on the description, and Technical Service bulletin TEC190397, malfunction of the VSS can cause misfiring or stalling of the engine. The VSS itself consists of a magnet mounted on the speedometer input shaft that triggers a magnetic reed switch. The reed switch provides input to the speedometer, the cruise control system ,and the engine ECU. A defective VSS may cause a codes P0500, P0300, P1316 and any combination of P0301, P0303, P0305 and P0307. It may also show no codes at all.

Now this tech note was issued in 1997. Most of these trucks have come a long way since then. Presumable any issues with the VSS were ironed out way back then. But it's been 15 years. If they caused problems when new, how good are they after that length of time?

I bought a used VSS off of EBay for $35, to play with. I found it was easy to open, simple inside and can be easily repaired in an hour or so. So I pulled the VSS from my truck, and documented the process.

Here's a teardown, my conclusions, and a method of repair.

I had already pulled apart the unit I got from Ebay, so I pulled the VSS from my truck:

Figure 1: VSS from my truck – yuck!

Figure 2: Other side is worse

The first thing you notice is that these things get dirty. The position of the VSS on the transfer casing seems to trap dirt on it.

The second thing I noticed was the input shaft:

Figure 3: Input shaft

Wear on the input shaft is not unexpected on something that's gone 132000 miles. However, if you look at the shaft, it's got notching far back on it. This indicated that the shaft has been tilting, and has had some force applied to it. It's probably been binding.

The first thing to do is to clean the outside thoroughly. You don't want any of this stuff inside your expensive sensor. Then just grab the input shaft with a pair of pliers and pull it out. Yeah, I know, "why would you think that would work?". The answer is that for the first one, I didn't. I just wanted to get it apart to satisfy my curiosity. Now I know. The shaft is held to the internal working with silicone gasket adhesive. It comes apart and can be put back together.

Figure 4: Input shaft

Here we see the shaft with the grease and silicone seal on it. You need to clean all of this thoroughly.

Figure 5: VSS body with shaft removed

After removing the shaft, we get to the part that probably would concern most people. We need to disassemble the case of the VSS. Since there are no screws, that would indicate that it's either glued or ultrasonically welded.

It turns out that it's held together by the same silicone gasket adhesive used to hold the shaft in place. Anyway here's how you open it:

Figure 6: Opening the housing

Take a small blade screwdriver, wedge it between the two parts of the housing, and whack it with a hammer. Yep, whack it with a hammer.

The part of the housing that faces the transfer casing seems to be some type of powdered non-ferrous metal, probably a shield to prevent the metal of the transfer casing from affecting the VSS. You will likely knock a chip out of it as you open it, but it's a small ship and affects nothing.

Figure 7: Bigger yuck!

Now you get to see the inside of the housing. There's a 0.016 inch thick plastic shim, the round magnet driven by the input shaft, and a whole bunch of stuff that at first glance looks like rust. It's not.

Figure 8: Housing with magnet removed

After pulling out the magnet, you can see more debris, along with the rear plastic bearing/thrust washer. The brown stuff turns out to be plastic shavings coated with brown grease.

Figure 9: Rear bearing/thrust washer

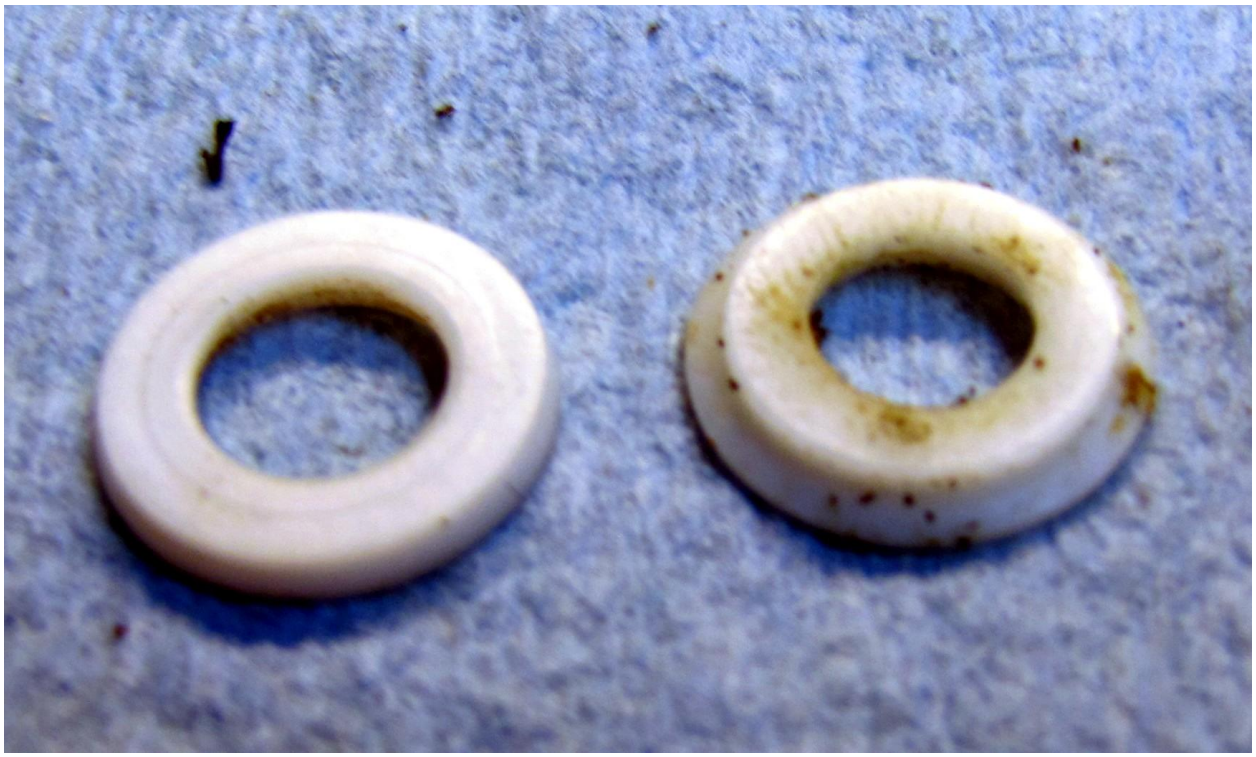

Figure 10: Two different VSS bushings

The plastic shavings come mostly from the rear bearing. Originally a flat washer with an inside diameter of .257 inches, the inside diameter now is .3 inches. This allows the shaft with the magnet on it to move around so much that you get this:

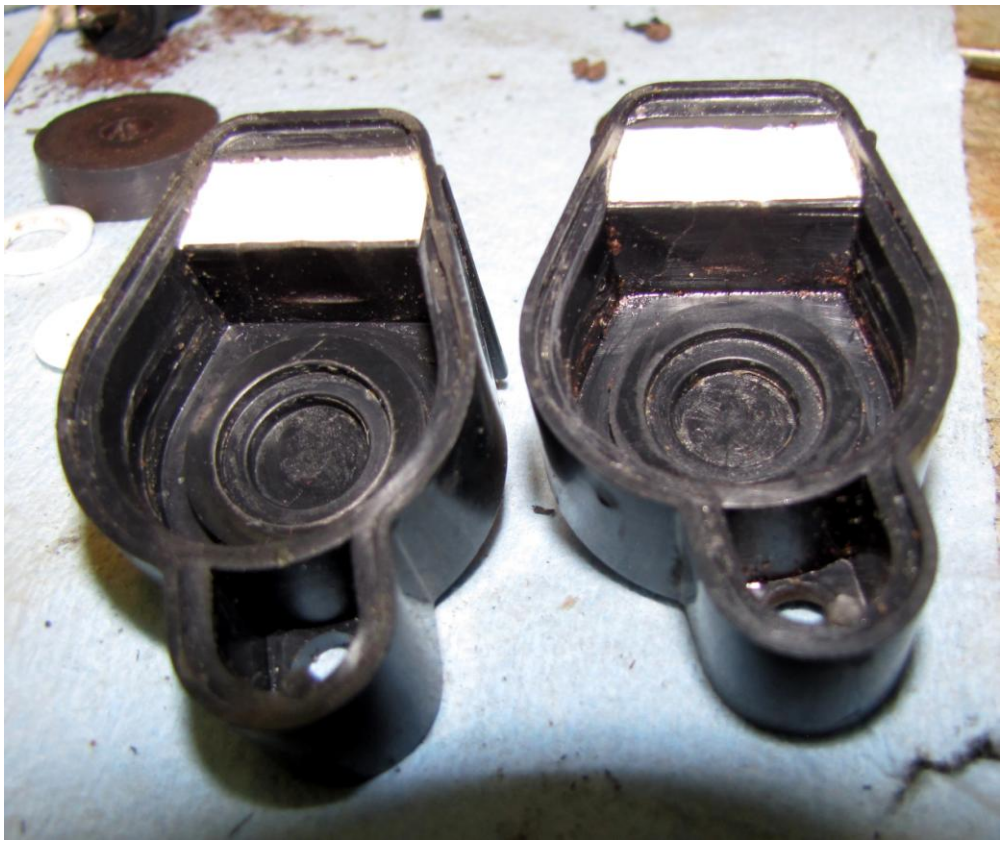

Figure 11: Two VSS housings showing wear from magnet rubbing.

The magnet moves around so much it causes wear in the sides of the case.

Figure 12: Side wear as well

So, it looks like what happens is the bushing/bearing/thrust washer that is supposed to hold the magnet in position as it spins wears down. This is not surprising as the shaft that sits in it is hard material, and has flat sides that can gouge the bushing. As the material wears, the shaft wobbles more, and wears faster. Eventually the bushing has worn so much that the magnet starts to hit the sides of the housing. At this point, it bounces and binds, causing an unpredictable response from the magnetic reed switch, and as a result, from the ECU.

The dimensions of the plastic washer are :

Inside Diameter: 0.257 inches

Outside Diameter: 0.56 inches

Thickness: 0.067 inches.

I was unable to find anything off the shelf to do this locally, but I've order some things that might work. I'll update this when I get something that fits without modification, but for now, I'll explain how you can make something.

I started by finding the closest thing I could to what's needed. I got these washers at Home Depot. They've got the correct center dimension, but are too wide and a little bit less thick than the correct ones.

The thickness is not much of an issue, but the outside diameter is. The needed to be shaved down to 0.56” to fit in the spot needed. A little bit undersize is ok, as long as it doesn’t allow too much wobble.

I adapted these by using a ¼-20 bolt to hole them in the jaw of my drill press and using a file on them as they spun. I used this in a drill press with a file, but you could use a hand drill and sandpaper. Just sand or file it down little by little, using a gauge to check the size.

Figure 13: Washer filing adapter- patent pending!

Figure 14: Tool installed in drill press

Once I got them to the correct size, I checked the fit. This method produced parts that had the hole slightly off center, but this is not important, they just need to keep the magnet from hitting or binding.

Here you can see the main housing with the washer installed, and the upper housing with the shaft, shim and magnet installed. I use a small bit of white lithium grease on the shaft, and smeared a bit of silicone gasket sealer on the flat sides of the shaft before pushing the magnet all the way up the shaft.

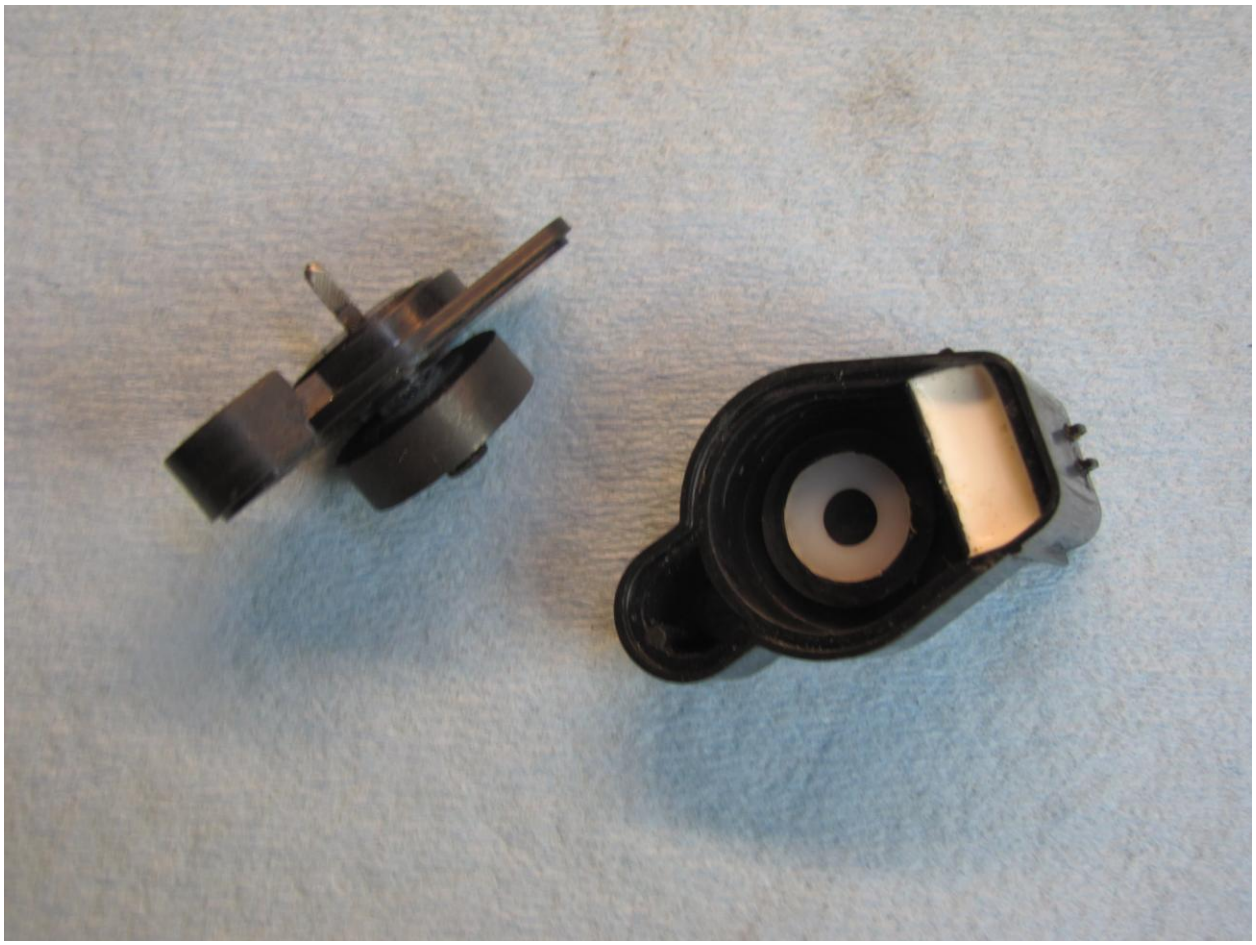

Figure 15: two parts of housing read to go together

I then put a small amount of lithium grease behind the thrust washer and sealed the two parts of the housing together with silicone gasket adhesive.

The rebuilt units spin much more smoothly than they did before, and the magnets don't wobble or hit the sides of the housings. These should be good for another 30,000 miles I'd guess, and then you get to do it again!

Figure 16: Finished VSS