

Lotus Esprit S1/S2 Brake Servo Diagnostic Testing

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Background

This investigation was performed on my 1979 Lotus Esprit S2. I had noticed that the brakes were just not performing like they used to. When I first got my car and I stood on the brakes, I had to wipe the nose prints off the windscreen. I have wider than stock tires, and I don't think I've ever locked the wheel up where it would skid. If I had, it had been decades ago. I've also consulted with other Esprit owners with their braking issues, who were also complaining about poor brake performance, where they couldn't lock up their tires either. I decided it was time to dig into the brake boost system and get this resolved, for myself and others.

Parts and Cross-Reference

- Brake Servo Unit - Girling 74049019. You probably won't find one.
- Brake Servo Repair Kit - Girling SP2495, also Lockheed SSB 80015. You won't find this either.
- Non-Return Valve Kit - Lotus part A075J6081F, also Girling 64949063 (TR6 MGC TVR Lotus Jaguar) (also called check valve or one-way valve). About \$58 from SJ Sportcars, unknown from US suppliers but probably similar. Alternative: Dorman 80189 has a non-return valve and two grommets that can be glued together that will work.
- Non-Return grommet – about \$35 (£25) for the Lotus part, or Dorman 80191 works, about \$6 on Amazon, but you only need the large grommet. This is a good alternative, especially since this grommet is likely to be the source of your problem.

Symptoms

My car was suffering the following symptoms:

- Soft and spongy brake pedal
- Very poor braking performance (long distance to decelerate)
- Difficulties in getting the same air flow through the #1 carb as the other 3. My servo was leaking massively, so it didn't need to pull as much air through the carb.

Diagnostics

The simplest test doesn't require any equipment, just a car that will start. To check the performance of the servo:

1. Press the brake pedal several times with the engine off to release any residual vacuum. The brake pedal should be high, and very firm. If not firm, there is probably air in the system.
2. With the brake pedal partially depressed, start the engine. The brake pedal should move further down and the force required should decrease. The pedal should be firm once it stops moving.

If your car doesn't pass that simple test, additional testing is required. The equipment that you will need is:

- A vacuum source. I use an air conditioning vacuum pump. They are available on Amazon for \$55 and up. An air compressor-power vacuum pump, available for around \$30, would probably work, although I did not try it. A hand pump is not sufficient.
- For the connection to my vacuum pump, I had to get a 3/8" barb to 1/4" FIP connector, from a hardware or home improvement store.
- Automotive vacuum gauge, around \$14 on Amazon.
- 3/8" vacuum tubing, maybe 6 feet. Do I have to say "Amazon" again?
- 3/8" quarter-turn valve and T connection

A word about test equipment: Yeah, you hate spending \$100 on test equipment, but what will it cost to have someone else perform these tests for you. You'll probably pay \$100-\$150 per hour at a shop (£75 per hour at SJ Sportcars) for them to run these diagnostic tests, repair what is wrong, plus your time spent getting the car to the shop and picking it up when it is finished. Where's the fun in that?

The connection diagram is the same, but the location of where you connect the test equipment will vary. Connect your equipment up like this:

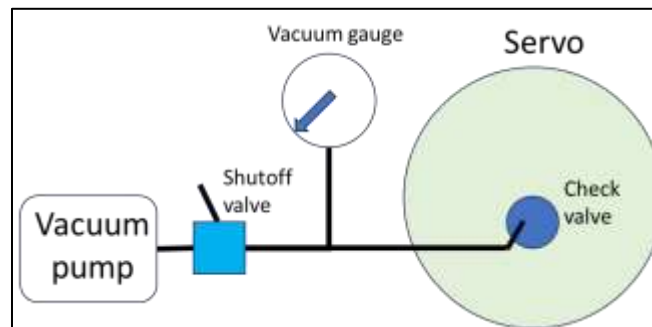


Figure 1 Test equipment setup

These are my recommended steps:

1. Disconnect the vacuum hose on the #1 intake runner and connect the test equipment to that vacuum hose at the intake manifold.
2. Vacuum the system down. It will probably stabilize at about 20-24 in Hg. Note the indication for future reference. If it is less than that, you probably have a sizeable leak some place.
3. Depress the brake pedal with the vacuum pump running. The vacuum should remain. If it falls to 0, your servo is leaking massively and needs to be replaced or rebuilt.
4. Close the shutoff valve, then turn the pump off. The vacuum should hold, ideally for a long time (hours), but it should be sufficient if it holds for many minutes (say 5-10 minutes).
5. Depress the brake pedal. You should get 2-4 pumps before the vacuum is all used up and the needle falls to zero. If you don't, the servo needs to be rebuilt or replaced.

It's a good idea to test hoses at both ends (engine and servo).

6. Disconnect the vacuum hose at the check valve and plug it. A golf tee will usually do the job.
7. Repeat the vacuum test from the intake manifold to the golf tee, which checks both hoses and the metal tube running through the chassis. This should hold a vacuum. If it does not, one or both of your hoses is leaking (the metal pipe could also be leaking, but not common). If the

hoses show any signs of ageing, or are NOT vacuum hose, replace them. Fuel hose is NOT an acceptable hose to use. Repeat this test until the vacuum holds.

A common source of vacuum leak is the grommet for the non-return valve. It can be difficult to get the non-return valve out, especially giving its location. Before removing it, ensure that you have a replacement grommet for it. Remove the non-return valve and the grommet. If the grommet is damaged or the servo is rusty around the grommet hole, this is a likely place where the vacuum is leaking. If it is just some minor rust or damaged grommet, you might get lucky and just have to replace the grommet. (Of course, clean up minor rust).

I searched for another non-return valve that was the same size, but I was unsuccessful. I did find a grommet that will work, at least for buyers in the US. The part number is Dorman 80189 Check Valve. See Figure 2. It is available on Amazon and possibly at your local parts store. This is available from Amazon for under \$9, and probably your local parts store for a few dollars more. Dorman 80190 appears to be the same check valve without the grommets. It is confusing why they offered them like that, but whatever. It is possible that a check valve from a 2001 (give or take) Jeep Cherokee is the same size, but I did not get a caliper on one to check. I saw a video where the Dorman check valve 80189 was used on a Jeep Cherokee, so it is possible.

While the Dorman check valve will fit into the smaller grommet, and the smaller grommet fits into the larger grommet, there is nothing locking the two grommets together. You might be able to get by with some sealant between these two, but that should only be considered a temporary fix until you can get the correct check valve. If this joint fails, you will lose your power brakes, so will have to rely only on the manual braking.



Figure 2 - Dorman 80189 Check Valve

With the non-return valve out, blow into it and see if any air flows. It shouldn't. Suck on it, and air should flow. If you can blow air and/or can't suck air, the non-return valve is bad and should be replaced.

Reinstall the non-return valve with a new grommet and run your vacuum test again. You can connect the test equipment directly to the non-return valve, or at the intake manifold hose. If it is still leaking, you will have to remove the servo from that car. This involves disconnecting the brake bar from the pedal so that the servo can be removed. While you can get it out without removing the driver's seat, you will most likely need to remove the seat to get it back in.

Servo Removal

1. Remove the fluid from the brake master cylinder (BMC) and clutch master cylinder (CMC). Large (150 cc) syringes really come in handy here. Surprise, surprise. Amazon for a few bucks.
2. Remove the BMC and CMC from the car.
3. From inside the car, remove the hitch pin and clevis pin from the top of the brake pedal. See Figure 3 and Figure 4.
4. Remove the four nuts securing the servo and bracket to the firewall and remove the servo from the car. Remove the supporting bracket from the servo.



Figure 3 brake clevis pin and hitchpin



Figure 4 Clutch clevis pin and hitchpin. Note bent pedal box for clearance

My servo happened to look like this:



I think we can see where it was leaking vacuum, between the servo and the BMC. There is a rubber O-ring there between the servo and BMC, but it can only do so much.

I cleaned up the rust, then primed and painted it. I attached the BMC to it so that I could bench test it. While it held a vacuum like that, once the input level was depressed, the vacuum was dumped immediately and completely. This servo needs to be rebuilt.

Of course, installation is just the reverse of the removal. Getting the clevis pin into the brake pedal and input bar is challenging. You will be in the Lotus Position¹ on your back on the floorboard. I've found it easier to insert the pin if you bend the metal of the pedal box out a bit with a pair of pliers. See Figure 4.

Servo replacement

A replacement servo is difficult to find. The servo for the Lotus Esprit seems to be a unique beast.

I have a theory on that. Lotus needed to space the servo out from the firewall due to clearance issues with the servo and CMC. Therefore, it was a unique item from Girling. The difference is in the input shaft. The Lotus Esprit has a threaded rod which gets an extension bar from the brake pedal. Others, such as the Triumph TR6 as shown, have a fork that attaches directly to the brake pedal.



Figure 5 Triumph TR6 servo



Figure 6 Lotus Esprit Servo

Since this is a unique item, they are scarce, and finding a rebuild kit is very difficult. On some servos, the two halves are rotated to allow some tabs to release to separate the two halves. On the Esprit servo, there are several places where it is crimped. See Figure 7.

¹ I define the Lotus Position is where you get into a position which you can neither define nor duplicate, wishing that one or more of your joints bent the other way.



Figure 7 Crimped edge on Esprit servo

I'm normally the type to tackle anything like this, but I started on it, and it was going to be a HUGE task to get all of those crimps straightened out or drilled out. Even if I did that, I didn't have the correct rebuild kit on hand, and didn't know if the Lockheed kit that I had would work, so I decided to let someone else rebuild it for me. There are several companies in the US that will do this. If you live in the UK, SJ Sportscars has rebuilt units with your exchange, and there are other companies that will rebuild yours for you. I HIGHLY recommend taking that approach.

Brake and Clutch Hydraulics

Bleeding Brakes

Over the years, I've found it challenging to bleed the brakes on my Esprit. It took several attempts to get all of the air out of the system. I would bench bleed the BMC if it was being replaced. I tried pressure bleeding them, reverse pressure bleeding with a pump-up garden sprayer, one-way bleeder valves (Speed Bleeders), one-way valve into a bottle, etc. Most recently, I wasn't getting any fluid flow out of the rear brakes. A pump-up garden spray bottle just wasn't pushing any fluid that I could see.

I eventually switched to a pair of large 150 ml syringe that I purchased from Amazon. I prefer the concept of reverse bleeding, because it pushes air bubble up instead of down. There is also a nice reservoir at the top to collect your old dirty fluid. I used one syringe to suck the old fluid out of the reservoir, and the other to force fluid up from the caliper. I estimated that there should be less than 2 oz of fluid, about 60 ml, in the caliper and lines to the reservoir.

When I first tried this, I couldn't get ANY fluid flowing from either rear caliper. I removed the steel line at the BMC and put it into a small bottle. I then used compressed air to blow from the hose at the caliper. That cleared the line, and expelled any old fluid remaining lines. There was a little bit of crap in the discharge bottle. I think my clog was at the T connection, which is what I would have removed and examined if the compressed air hadn't worked. I could then use the syringe to reverse bleed the brakes, and actually see how much fluid was flowing into the lines. I put about 2 oz into each line. I then went back and did a conventional pedal press, with a small bottle and one-way valve attached to the bleeder. Note that the bottle has to be higher than the bleeder. One light partial stroke for each caliper was sufficient to remove any remaining air in the system. My brakes were then rock hard. I did this with a BMC that was empty of fluid and had not been bench bled, and I experienced no sponginess due to air in the system.

I find this method much easier to bleed the brakes and clutch systems. Since they are supposed to be flushed every 2 years, making it easier is important to me.

Rear calipers locking up

I've experienced times when the left rear caliper would not release fully when you press the brake down. With it dragging, you could feel the acceleration was hindered. Of course, if you look under there, the rotor would be glowing red hot. I'd let it sit overnight to cool down, but the next day, the brake was working as normal. I somehow traced this down to a faulty brake hose. With it being near the exhaust, I believe what was happening was that the hose was being affected by the heat, and either pinching off or it had scaled on the inside, so that it was acting like a one-way valve. It would hold part of the pressure and drag the brake, but eventually it would leak down, or when it cooled down, the pressure was released and it worked normally. I now replace my stainless-steel braided brake hoses every 10 years. I've also added some insulation around the left rear brake hose.

Seized Parking Brake Actuator

Seized parking brake actuators in the rear calipers is a frequent issue. I've successfully freed up several of these units with a pretty simple trick. The best penetrating fluid is a 50/50 mixture of acetone and automatic transmission fluid. Let the actuator soak in a closed container of this for several days. If the container isn't closed, the acetone evaporates. Use a container with a lid or a Ziplock plastic bag. Take it out 1-2 times a day and try to move the lever. After 3-4 days, you should get some movement out of it, and after several days, it should be completely freed up.

Clutch Hydraulics

We can also talk about clutch hydraulics at this point. It is of course much simpler than the brake system. Two items that I want to point out.

The plastic clutch hose on my car, way back when, looped up to about the level of the carbs before going down to the clutch slave cylinder. I thought that was pretty stupid, since air travels to the highest point. When I replaced the plastic hose with the braided stainless steel covered hose, I tried to make it so that the hose was always lower than the slave cylinder.

The other point is the location of the bleed valve. I've seen many cars with the bleeder below the hose connection. Dumb position, as you can't get all the air out. I don't know if it left the factory that way, or when the slave cylinder has been replaced over the years, that where it happened to be. I think it is better with the bleeder on top.

