BMW E9 – BRAKE PROBLEM DIAGNOSIS

A starting guide to diagnosing brake problems

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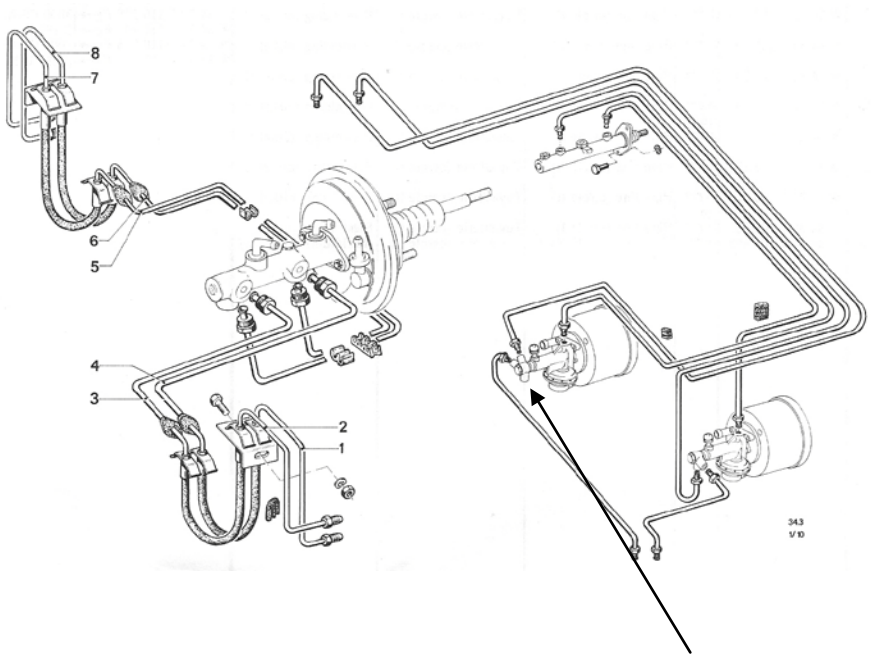


Rear brake pipe connection.

This diagram shows both left hand drive (on the left!) and right hand drive brake system layouts. Only the left hand drive layout includes the front flexible pipes and the connections attached to the front struts which connect to the callipers. Neither diagram shows the additional pipe which goes from a bottom outlet on the single left hand drive combined servo and master cylinder OR from the top (front) single servo (the upper one in the diagram) for the right hand drive system (as shown) to the rear brake pressure limiter and thence the two rear brake callipers.

The tandem ATE master cylinder and twin servo installation used for right hand drive E9s has never been as “long term” reliable as the left hand drive combined master cylinder/servo combination. It was designed in 1972 about 3 years after CS production started and has always been considered a bit complicated and difficult to service. But in terms of brake systems the E9 has built in safety as the brake circuits are duplicated and if one leaks then the other should still work to get you home. After 40 years your brake system will inevitably develop problems. This paper gives some basic diagnostic guidance to help you towards solving any problems.

THE E9 BRAKE SYSTEM AND ITS PROBLEMS.

DIAGNOSTICS.

This is for right hand drive cars only.

With twin servos and twin circuits, diagnosing brake problems is not straight forward because a problem with one circuit can be masked by the other circuit which is still working. In over 40 years as an engineer the double fault situation is the worst type of problem you can encounter so try to work logically and, if you can, split the system into discrete sections so that you can "rule out" the problem being in that section before trying the next.

PITFALLS FOR THE UNWARY. If a **front** brake calliper jams then the brake disc will heat up quickly overheating BOTH circuits and you will get mega brake fade as the brake fluid boils. It happened to me. It is a problem which affects both circuits equally and you need to consider having breakdown recovery as your car will definitely not stop reliably from then on. You might get home slowly using the hand brake but as it is for parking only it requires almost two hands to get any useful braking – risky unless you are an easy drive home. A pre-symptom will be that the steering will feel "funny" and with one wheel "braking" all the time and the steering wheel will be vibrating before you realise the brakes are failing.

The other cause of either a **front or rear** calliper sticking can be due to the rubber flexible hoses to the front suspension uprights or trailing arms respectively having degenerated so that their inner bores have swollen up to become like a one way valve. Brake pressure can operate the brake pistons but the hose then prevents the pressure being released. In the case of a front calliper you may get brake fade, as above, or with a rear calliper you will get reduced breaking but a very hot (sometimes smoking) rear wheel. If however later your diagnosis is that the callipers are OK (pistons free) then fit new stainless steel braided brake hoses from Jaymic.

Perhaps servo problems are easier to diagnose. If the brake pedal pressure is "hard" yet your car does not seem to be pulling up as easily as normally then first check your brake fluid reservoir level and look under the car where it is parked. If there are traces of brake fluid on the floor **and** the brake fluid level is down, then first try to find where the fluid is leaking from. The leaks on the garage floor might be coming from your callipers, servos or a damaged brake pipe/ joint although this can be unlikely except for stone damage.

If the brake fluid level is down but there are no leaks then the fluid will be filling up one of the brake servo vacuum cylinders and you might get through a litre of fluid topping up before it starts leaking out of its air valve onto the garage floor. This can take some weeks to develop.

An alternative/additional check is to put your hand under each servo and feel around the air inlet port (where the gauze is). If there is any brake fluid, then there is a seal with a small leak moistening the gauze. In time this will turn into a larger leak and evidence on the floor and drop in level of the reservoir.

To test servo operation, push down hard on the brake pedal several times and then hold the pedal down before starting the engine. As soon as the engine starts you should be able to feel the pedal go down a little further. Unfortunately if one servo

has failed then the pedal will not go “down” quite as far as it should and it is unlikely you will be to tell the difference between “full” and “half” down. But you might then be able to diagnose which servo is failing by clamping off the vacuum pipe from the manifold to each servo in turn. With the servo which has failed “clamped off” the “pedal test” may work, and the pedal will depress on starting the engine. With the “good” servo clamped off the pedal will not depress as the test is operating the failed servo. Sadly it is not always that easy to tell.

In any case servos are best changed in pairs so if one fails, change both.

Brake master cylinder failure is less easy to diagnose. First it helps to know how the system is duplicated.

- The front chamber of the tandem master cylinder feeds the TOP, front servo, which feeds the bottom pair of pistons of both front callipers AND both rear callipers via the brake pressure limiting valve mounted adjacent to the differential.
- The rear chamber of the tandem master cylinder feeds the BOTTOM, rear servo, which feeds the top pair of pistons of both front callipers ONLY.

If you have access to an MoT brake test rig and can detect that the rear brakes are not efficient, then you might assume that it is the brake master cylinder, front chamber and/or top servo which has the problem. But as you are going to be dealing with items involving both circuits this is of only marginal interest. A rear brake test failure is an MoT failure in any case.

The more meaningful test is to push down hard on the brake pedal (engine not running). The pedal should stay “hard” for over 30 seconds, and NOT depress slowly. If it does then brake fluid is probably leaking within the cylinder past one or other of the chamber seals. The problem here is if one of the seals is leaking, the other chamber may hold its pressure and the pedal will not depress that much.

The other test is to lever off the corrugated gaiter over the brake pedal piston rod which is attached to the brake pedal. If the gaiter is filled with brake fluid (and it will probably be dribbling down the engine bulkhead under the floor carpet into the foot well at the same time) then the rear piston seal has failed and possibly one of the others too.

Of course there is the dreaded double fault. Let us just suppose that a master cylinder seal has failed on one circuit and a brake servo on the other. All the above tests are not really going to pin point the problem although if there is no loss of brake fluid I would go for the brake master cylinder having defective seals.

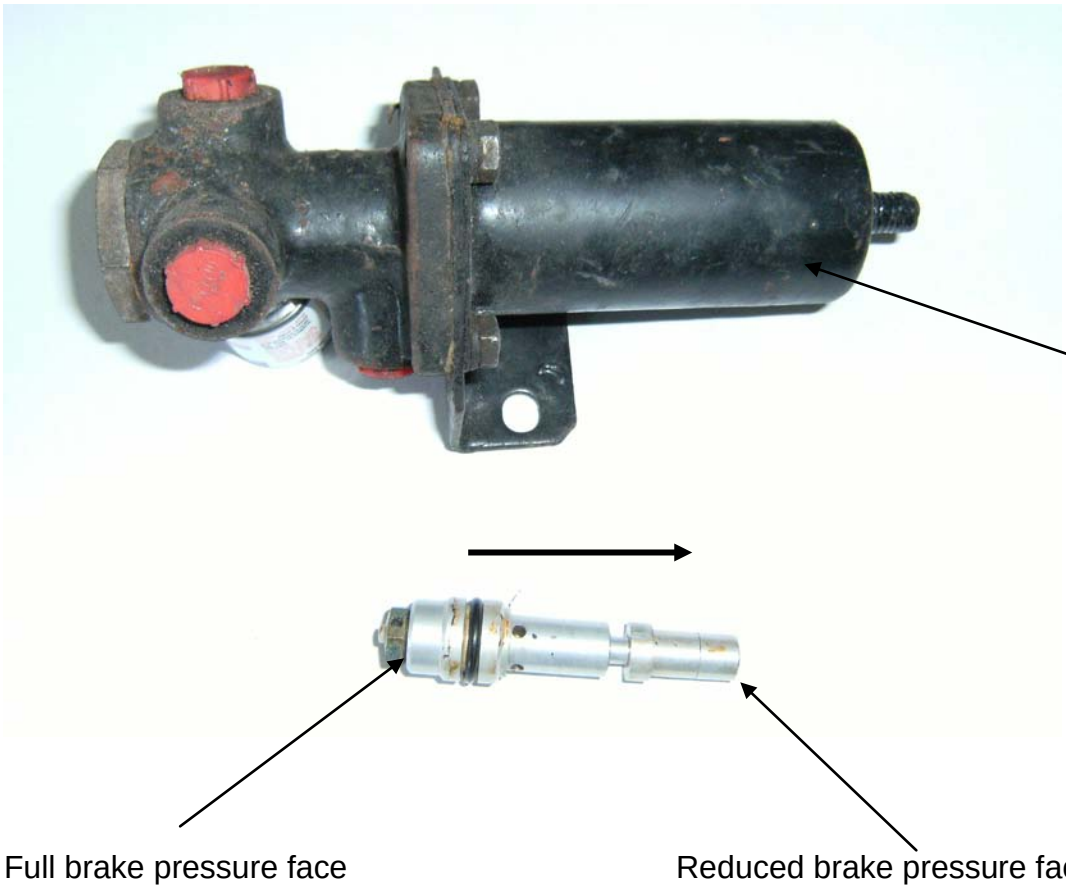
So always first eliminate that it is not a calliper problem, then think master cylinder and finally (clutching your wallet) think servos.

PITFALL FOR THE UNWARY. When looking at the brake fluid reservoir level remember that it is also feeding the clutch system on manual E9s. If the fluid level has fallen only as far as the outlet about 20mm above the bottom, which is for the clutch system, then check the clutch slave cylinder for leaks and, as you would for the brake master cylinder by pulling back the corrugated gaiter, the clutch master cylinder. Failure of either of these cylinders will manifest itself as a “crunch” selecting reverse or difficulty changing gear.

Finally, the rear brake pressure limiter. When BMW introduced rear disc brakes for all 3 litre models in April 1971 they had competition experience from Alpina, Schnitzer and others concerning the low rear axle loading which made the rear of an E9 very skittish in wet weather and/or braking whilst turning. They clearly took this to heart because without a method of limiting the rear braking effort of the disc brakes, the rear of an E9 could lock up as the weight transferred forwards under braking. Or put another way, BMW would not have introduced the additional cost and complexity of a limiter unless they felt it was necessary, possibly for safety. I have spoken to members who have experienced their limiter by-passed so that full brake pressure was always applied to the rear brakes and they confirmed that it could be extremely alarming with the back end of the car going walk about especially if the steering was not straight ahead.

So the limiter is important but sadly almost impossible to check without some very sophisticated ATE test equipment. My only guidance is if you feel the rear wheels of your car are inclined to lock up under heavy braking in dry weather, then the limiter may have failed. I am trying to find a company to undertake repairs.

The limiter works by having a single operating piston which has two different sized piston faces ie it is a stepped piston. This is the limiter and its piston.



Operation is simple. Full brake pressure forces the front of the piston back (in the direction of the arrow) against a strong adjustable spring in a housing. This spring “absorbs” an increasing amount of the pressure (Hooks Law) as you push harder on the brake pedal. This leaves the “remaining” pressure to be applied to the rear brakes by the smaller rear piston face. The small brass feature on the front of the piston is a non return valve which allows brake fluid to pass through the limiter to make up any requirement for more fluid as the pads wear down when the limiter is

not under pressure. It makes bleeding the rear brakes a little more tricky if your pressure bleeder is being used at too high a pressure.

And finally:-

This is a brief list of those brake problems I have had since 1971 running a 2002Tii, 2000 Touring and my E9 CSLs.

- 2000 Touring. MoT Unequal rear brake efforts. Leaking rear brake cylinder. Replaced cylinder and brake shoes.
- 2000 Touring. MoT failure. Unequal hand brake efforts. Re-adjusted rear brake shoe stops. A right pain as they tend to rust into their bushes.
- MoT failure. 2002 Tii Unequal front brake efforts. Front calliper, one piston jammed. Replaced the piston seal.
- 2002Tii. Just occasionally the brakes were soft and I had to pump the pedal. Frequency of problem (alarming) began to increase. In the brake master cylinder one of the seals had torn where it passed over one of the fluid inlet holes. Overhauled the cylinder.
- 2002Tii. Brake effort increasing and fluid level needed more frequent topping up. At first no fluid leaks until one day fluid started dribbling out of the lower servo air valve. Replaced servos. When I removed the lower servo about a litre of brake fluid poured out of the vacuum chamber air connection.
- 2002 Tii. MoT failure. Rear brakes clearly not releasing properly. Old flexible hoses (say 30 years!). Replaced flexible hoses to rear trailing arms with braided stainless steel hose from Jaymic.
- CSL. Almost total brake failure on first run after winter storage. Steering vibration. Very hot front wheel (smoking). Calliper piston jammed. Refurbished calliper.
- CSL. MoT failure. Rear brake efforts unequal. Piston on one side jammed! 8 years use.
- CSL. Mot advisory. Hand brake efforts unequal. Seized hand brake cable. Freed up cable but it took several attempts to adjust both hand brake drums to give even effort. If over tightened the drum heated up giving a “hot” wheel after a few miles. Frustrating problem to solve and require stripping and cleaning up the handbrake adjustment mechanisms. Definitely a poor design.
- CSL rebuild this year. Long brake pedal travel even before the engine was started. Defective master cylinder seal. Replaced seals.

4 different cars over 44 years.