What do you look for when checking the brake master cylinder for serviceability?

Like any other component that receives constant use, the master cylinder eventually wears out. Stop-and-go city driving is a lot harder on a master cylinder than highway driving, so a master cylinder that travels 150,000 or more kilometres in one vehicle may only last 120,000 kilometres in another.

The Creeping Brake Pedal Check

The creeping brake pedal check is one of the first tests you should conduct when driving the vehicle into the workshop.

Has your customer complained about "loss of brake pedal"? Have they mentioned it only happened once when they were sitting at the traffic lights and it has not happened since. This is an early warning sign.

Turn off the engine, pump the brake pedal a few times to bring the vacuum booster to atmospheric pressure (no vacuum).

Rest your foot on the brake pedal with light pressure, not much, just enough to move it. If the master cylinder is faulty, the pedal will gradually creep to the floor, indicating that the fluid is bypassing between the rubber cups and the cylinder bore inside the master cylinder and it is in need of overhauling or being replaced. Note: it is recommended to replace the unit.

This syndrome can also be caused by sticking a modulator valve in the ABS control unit. The loss of the brake pedal caused by the unit may only manifest itself after the ABS was activated. The only fix is to replace the unit as they are not repairable.

Loss of Brake Fluid but no Visible Signs of Leakage

Inspect the area around the master cylinder for fluid leaks. If you notice any brake fluid leaking out of the master cylinder, then it is not functioning properly and will most likely need to be replaced.

If you cannot detect any signs of fluid but the back reservoir constantly requires “topping up” there is a good chance the rear seal in the master cylinder has failed allowing fluid to ingress the master vac.

On rare occasions, the car may exhaust smoke, this is caused by the brake fluid being taken into the engine via the vacuum hose. Check the hose for dampness.
Brake Drag
This is when hydraulic pressure is not fully released after the pressure on the brake pedal has been released and there is still residual brake line pressure in the system.

What are the symptoms?
- Poor economy.
- Overheating brakes (blue Rotors).
- Feels like the engine has lost power.
- Premature wear of brake Pads or Shoes.
- Loss of brake pedal, as fluid might have overheated.
- ABS Modulator may activate.
- Brake pedal vibration, possible warped rotors from overheating.

What causes this?
- No brake pedal free play.
- No clearance between the push rod of the booster to the master cylinder piston. (diag. 1)
- Brake booster internal reaction disc faulty or not enough clearance. (diag. 2)
- Cups in the master cylinder contaminated and increased in size and blocking the fluid return port.
- Driver error, bad habit of resting foot on brake pedal.
- Incorrect DOT brake fluid in system.
- Contamination of brake fluid, mixed with mineral oil.

Soft or Long Travel Brake Pedal
A common problem and a question that is asked quite often, is “Why does my pedal feel soft?” One of the most overlooked things is probably the simplest fix.

Extending out of the booster is a pin. This pin simply extends into the piston in the back of the master cylinder. Have you ever checked this distance? If you answered no, not only is this something you must do, it may be the reason for the soft pedal. Diagram 2 can have two problems, not enough clearance or too much. The reaction disc can be dislodged when the push rod is pulled out. This can be difficult to detect but will hinder a good brake pedal.

It is recommended that the distance between the pin from the booster and the hole in your master cylinder be approximately 0.5mm. If this distance is greater than 0.5mm, when you first push the pedal, you will have to overcome this distance and get the pin to the master cylinder. This will cause your soft pedal. If the distance is less than 0.5mm, the master cylinder may not be returning the entire amount and therefore causing a different problem of brake drag.
Brake Fluid

Brake fluid is another source for a soft or “doughy” brake pedal. Brake fluid has a limited life and definitely has a “use by date”.

Because brake fluid is Hygroscopic, which means it absorbs water, the integrity diminishes in that the boiling point drops as the moisture content rises.

Because there is moisture in the fluid, when it boils, it creates a gas (air) and we are all aware gases are compressible where fluids are not. When this happens a spongy brake pedal is experienced and the efficiency of braking ability of the car is affected.

All brake fluids must comply to a minimum standard. Under this standard are four DOT minimum specifications for brake fluids. They are DOT 3, DOT 4, and DOT 5.1 for fluids typically based with Polyalkylene Glycol Ether and DOT 5 for silicone-based fluids.

It is recommended that all vehicles with DOT 3, DOT 4, and Dot 5.1 brake fluid should have it changed between 2 to 3 years, under normal operating conditions and even more often under extreme conditions.

Warning: DOT 5 is not compatible with any of the Glycol based brake fluids.

Dry Boiling Point

For all DOT-compliant fluids, this is the temperature at which the fluid begins to boil when tested in the manner specifically described by the DOT. The correct term is the Equilibrium Reflux Boiling Point (ERBP). This basically means the fluid is tested brand-new, right out of a freshly opened bottle, before being contaminated by moisture.

<table>
<thead>
<tr>
<th>Brake Fluid</th>
<th>Dry Boiling Point</th>
<th>Wet Boiling Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOT 3</td>
<td>205 °C (401 °F)</td>
<td>140 °C (284 °F)</td>
</tr>
<tr>
<td>DOT 4</td>
<td>230 °C (446 °F)</td>
<td>155 °C (311 °F)</td>
</tr>
<tr>
<td>DOT 5</td>
<td>260 °C (500 °F)</td>
<td>180 °C (356 °F)</td>
</tr>
<tr>
<td>DOT 5.1</td>
<td>270 °C (518 °F)</td>
<td>190 °C (374 °F)</td>
</tr>
</tbody>
</table>

Wet Boiling Point

This is a similar test to the Dry Boiling Point, but this time performed on the fluid after it has had time to absorb moisture from its surroundings. Specifically called the Wet Equilibrium Reflux Boiling Point (Wet ERBP), this is the temperature the fluid begins to boil when tested in accordance with the DOT procedure. An interesting fact is that the fluid being tested is not checked for moisture content, but a reference fluid sitting close to it is. When the reference fluid reaches 3.70%±0.05% water content by weight, the fluid being tested is then put through the same procedure as for Dry ERBP to get the Wet ERBP.

Viscosity

This is where the DOT 3 spec could be interpreted as actually being better for the miniature passages of an ABS system than the DOT 4 spec. Thinking about motor oil, the higher the viscosity number, the slower the flow of the (thicker) oil. The same basic principle applies to brake fluid, although the measurement technique is different. The DOT 3 specification for viscosity at -40°F is 1500 mm2/s, where DOT 4 is 1800 mm2/s. So, the DOT 3 fluid flows better at the cold testing temperature than the DOT 4.

![Effects of Water Contamination on the Boiling Temperature (ERBP) of DOT 3 Brake Fluid](image)
How does brake fluid become contaminated?

Moisture can (and does) enter a brake system in several ways. The most common are:

- Using old or pre-opened fluid. Keep moisture out by only using fluid from tightly sealed bottles and not storing them for long periods of time.
- When changing or bleeding brake fluid, always replace master cylinder caps as soon as possible to prevent moisture from entering into the reservoir.
- Condensation (small moisture droplets) can form in lines and calipers. As caliper and line temperatures heat up and then cool repeatedly, condensation occurs, leaving behind moisture/water. When water reaches 212ºF at ambient pressure, it turns to steam. The build up of steam will create pressure in the system, sometimes to the point that caliper pistons are pushed into the brake pad. The resulting brake drag creates even more heat in the system. Many times air in the brake system is a result of water that has turned to steam and cooled back down, leaving spongy pedal.
- Diffusion through rubber brake hoses over a period of time.

Techstop Hints

- When checking the serviceability of the brake fluid, which should be done at every service check, take samples from the master cylinder reservoir and one front caliper* and one rear caliper*. The reason for this is:
  1) They are closest the flexible brake hose.
  2) This is where the temperature extremes vary the most.
- The brake fluid should be changed at a minimum period of 24 months.

- Only use the DOT rating brake fluid that is recommended by O.E.M. The reason being, if the car is subject to cold temperatures, the viscosity may affect the operation of the ABS.
- When flushing the hydraulic system, it may be necessary to use a scan tool to activate the ABS module, as this will purge all the contaminated fluid from the complete system.
- When replacing the Master Cylinder, “Bench” bleed it before fitting it to the car, this could save time and there is a good chance that all the air be will expelled from the new unit and the bleeding process will be easier. Also it will not be as messy.
- When bleed or flushing the hydraulic system, place a block of wood under the brake pedal, so the pedal does NOT go to the floor and push the piston to the end of the cylinder and pick up solid contaminates. Especially on old units.
- Flushing or bleeding is generally a two person operation, make sure the reservoir is topped up regularly. You do not want to run dry as the process will have to start all over again.
- Vacuum out the old fluid from the reservoir, clean out the reservoir and top up with fresh new fluid prior to commencing. It would be best practice not to flush old contaminated fluid through the system.
- When changing brake pads and a flush is not scheduled, clamp the flexible hose, place the bleed hose on the bleed nipple, open it and then push back the piston, then close the nipple. This will get rid of the brake fluid that has experienced extreme fluctuations in temperature. Place the new pads, pump the brake pedal and top up the master cylinder.

* Depending on the vehicle.