

FLUSHING YOUR BRAKE SYSTEM

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It's a dark and stormy night, with steady rain and scattered lightning. But traffic moves along smartly—until it doesn't. You wind up hammering the brake pedal to keep from eating the license plate in front of you. Naturally, you expect—you count on—the antilock braking on your new car to ensure a safe, controllable, steady stop. Instead, the car begins to fishtail and it takes a monumental struggle to keep the car in a single lane as it comes to a stop. The extra distance you had from the car in front of you saves a collision, but you know something is wrong with the antilock braking system, a.k.a. ABS.

The shop gives you the bad news: The actuator is defective, and you can figure on \$1400 for a replacement (or even worse, it's part of an integrated unit with the brake master cylinder and the price is even higher). No, it didn't log an ABS trouble code, but that doesn't mean anything. It's not a bad connection and it's not a factory defect. What caused it? Maybe even the technician will shrug his shoulders, but there's a good chance it's contaminated brake fluid.

The brake fluid reservoir is vented, so that's an entry point for dirt and moisture. And the rubber brake hoses are permeable—they allow even more moisture to get into the fluid. Dirt and moisture move through the lines. Most goes to the calipers and wheel cylinders, and some may get to the ABS actuator, where it can cause the delicate solenoids or motors inside to behave erratically.

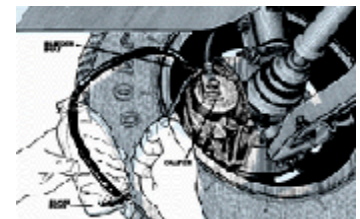
And if you or the shop does a disc caliper brake job, and someone pushes back the caliper pistons, the possibilities are ominous. A lot of the dirty, moisture-laden fluid in the calipers is pushed back, where some of it gets into the ABS actuator. The prospects for an ABS failure go up, up, up.

Even if you don't have ABS, contaminated brake fluid can affect caliper and wheel cylinder bores. The older systems with the reservoir built into the master cylinder are even more prone to contamination, because the reservoir cover gasket may have taken a set and be leaking. Or a lot of dirt may have gotten into the system when the cover was removed as part of a brake job. Even simple moisture in the fluid is a real problem, because the heat of braking will cause it to boil, causing brake fade.

DEGREE OF DIFFICULTY

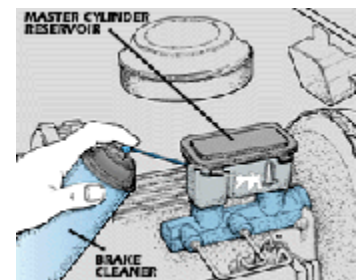


MODERATE



CLICK TO ENLARGE

Use a box wrench or tubing wrench to loosen the bleeder bolt while a helper depresses the brake pedal. Tighten the bolt after brake fluid stops flowing, but before your helper releases. Repeat until clear fluid comes out.



CLICK TO ENLARGE

Clean the master cylinder reservoir to prevent dirt from falling in.

Flushing the system is not a difficult job. There is equipment for a one-man bleeding job, but the good stuff is expensive and we have reservations about trying to use the low-cost alternatives (hose with a one-way valve, and manual vacuum pump are examples). A simpler, effective approach is to have a helper step on the brake pedal. If you can line up someone, the only equipment you need is:

- Ramps or jack and stands to raise the vehicle a few inches in front and back, so you have access to the bleeder valves. However, it's possible to reach them on some vehicles with the wheels on the ground.
- Piece of clear hose to fit on the bleeder valve.
- Tight-fitting wrench for the bleeder (like a tubing wrench). Don't use an ordinary open-end wrench.
- Spray can of automotive cleaning solvent and a spray can of penetrating oil.
- Turkey baster to draw fluid out of the reservoir. A baster costs under \$1, so don't try to clean and reuse one from the kitchen.
- A pint container of brake fluid for an econobox, a quart for a larger car. The brake fluid may be labeled DOT 3 (minimum boiling point of 400 degrees F), DOT 4 (minimum boil of 450 degrees) or even DOT 5.0 or 5.1 (500 degrees F). Your system contains DOT 3 or DOT 4. These two are fully compatible, so you can mix them without worry, and one of these is what you should use.

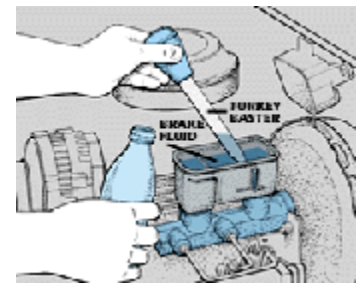
Brake fluid is hygroscopic, which means it's like a sponge. But it's supposed to be, so if any moisture can get in, the fluid embraces it. However, moisture causes the normal boiling point of the fluid to drop. Just 2% moisture in a fluid is considered excessive. There are moisture testers, but we don't know a repair shop that has one. And there's no guarantee that the moisture level in the reservoir is the same as at the caliper - it may be higher at the caliper.

p>Warning: There are silicone brake fluids (labeled DOT 5) that are immune to moisture (5.1 is nonsilicone, but DOT 3 and 4 are what you should use). Don't even think about using DOT 5 silicone fluid in an automotive braking system, because it may cause faster wear of the seals, and if enough water gets into a system it could cause loss of pedal. DOT 5 and 5.1 have application in some racing vehicles.

Flush Twice

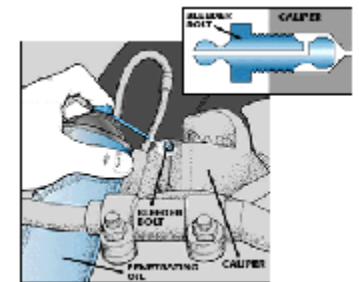
Now for the flushing job itself: Raise the vehicle a few inches on ramps or with a jack and stands.

Begin by cleaning the master cylinder's brake fluid reservoir (or top and sides of the master cylinder with the integral reservoir), using aerosol cleaning solvent and paper towels or a clean rag. Don't remove the reservoir cover until



CLICK TO ENLARGE

Remove almost all of the old brake fluid with a turkey baster before adding fresh fluid.



CLICK TO ENLARGE

Spray the bleeder bolt with penetrating oil and tap lightly with a hammer to loosen it.

the area is squeaky clean.

If it's an older style - the master cylinder with the integral reservoir - you'll find a rubber gasket. Inspect the perimeter for deterioration and replace the gasket if necessary. Otherwise, just clean it with some fresh brake fluid. Siphon most of the fluid out of the reservoir, then add fresh fluid up to the level mark.

On front-drive vehicles, where the hydraulic system is split left front/right rear and right front/left rear, start at the left rear wheel. Next, go to the right front, then right rear and last, the left front wheel. On rear-drives with a diagonal split, do the same. If the rear-drive split is front/rear, however, start at the right rear, then left rear, right front and left front. The object is to begin at the wheel brake farthest away from the master cylinder and gradually work toward the closest.

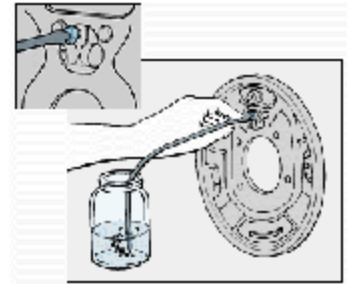
If the bleeder valve can be loosened with the wrench, you're golden. If not, spray it first with penetrating oil, let that work in, and try again with the wrench. Won't loosen? Clean the penetrating oil and heat the bleeder with a propane torch. Try again. If your wrench handle isn't that long, or if the fit isn't very tight, you can try locking pliers. Some tapping on the wrench or pliers end with a hammer may help.

When the bleeder just breaks loose, stop and push the end of the clear hose onto the bleeder nipple. Aim the other end of the hose into a clear glass or bottle.

Put a block of wood under the pedal to prevent the piston from bottoming out in the master cylinder. Then tell your helper to step on the pedal and press down gently but firmly. Open the bleeder valve and watch the fluid as it flows through the clear hose into the clear glass or bottle. If you don't get any fluid movement at the rear brakes on a car with ABS, close the bleeder valve. Have your helper turn on the ignition and apply the brakes once, then turn off the ignition and just lightly rest his/her foot on the pedal. Open the bleed valve slowly. If a stream of fluid flows from the valve, allow it to come for about 10 seconds, then close the valve and add fluid to the master cylinder. Depending on the system, the pressurized reservoir may push out enough fluid. Or the flow may continue only if the helper presses down on the pedal. On most cars, the flow will start and continue without the preliminaries—only the helper's foot pressing on the pedal.

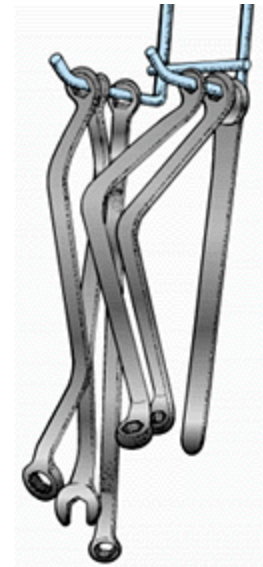
When the pedal hits the wood block, tell your helper to hold it there. If you had a lot of trouble loosening the bleeder, remove it completely. Apply a thin film of anti-seize compound to the threads of the bleeder valve, then reinstall and close the valve. Add fresh fluid to the master cylinder reservoir again and repeat the procedure. When the fluid color changes from grungy black to something closer to what the new fluid looks like, you can stop. Close the bleeder valve and go to the next wheel brake. Be very sure to add fresh brake fluid up to the level in the reservoir every single time.

Before you do the final top-off, however, have your helper apply the brakes over and over, to exhaust the high-pressure reservoir of the ABS. This will



CLICK TO ENLARGE

A hose over the bleeder bolt will keep fluid off of your arm and out of your eyes.



You may need to use a special wrench.

cause the level in the master cylinder reservoir to rise slightly. It may take 25 to 35 pedal applications to do this, but when the level stops rising after a couple of dozen, that should be it. If you don't do this, the reservoir might overflow under some conditions.

When you're done, a hard brake application should extinguish the brake warning light.

And remember when you next do a disc brake job, don't just push back the piston with a C-clamp. First, clamp the brake hose with locking pliers, wrapping the hose with a protective sheath of thick rubber, perhaps from an old radiator hose. Open the bleeder (and with antiseize on the threads, it should cooperate quite nicely actually), attach a hose to the nipple, then push the piston back, collect the fluid in a container and discard.

This job is about more than saving money on an ABS actuator. No matter how new or old your car, it's about saving your skin.



How It Works: Testing Brake Fluid With Dip Strips

If the brake fluid in the reservoir is obviously dirty, flush the system. If it isn't, flush if it contains excess moisture, which you now can determine with "reagent dip strips." Reagents are substances used in a chemical reaction to detect other substances, and Wet Check strips for brake fluid now are marketed by Wagner Brake. Insert the strip into the fluid, remove it in a second, wait 30 seconds and compare the change in color of the two pads with a chart.

One pad merely identifies the type of fluid—DOT 3 or DOT 4. They're compatible, so this is not critical (and a 50/50 mixture of the two merely produced an ID color close to that of DOT 4, in our tests). The pad closest to the end, however, turns tan if moisture content is excessive.

We tested the strips in separate containers of DOT 3 and DOT 4, with different percentages of water. With pure brake fluid, the color was in the definitely okay range: dark green. At 1.64% water content, there was a very slight indication (some lightening of the green) that the fluids were less than pure.

At 3.25% water, there would be at least a 25% drop in brake fluid boiling point with DOT 3. It could be as much as 50% with DOT 4. The color change to tan was unquestionable in three of four tests. In the fourth, there was some indication of less-than-perfect fluid—fuzziness in the light green—but not tan.

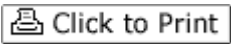
At 5% water the pad turned tan as soon as it was taken out of the fluid—we

didn't even have to wait the 30 seconds. Read the strip almost exactly 30 seconds after removal from the fluid. If you read it too early, you might get an okay indication with 3% water. If you put the strip down for a few minutes, it can absorb enough moisture from a humid room to indicate contaminated fluid when none is actually present.

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