

GIMME A BRAKE!

John Hinckley

Eventually, every classic Corvette owner will experience some sort of brake problem, which is a good reason to completely rebuild or replace every component of the brake system during a restoration or as part of routine maintenance when weird brake symptoms arise; when you step on that pedal, you want the car to STOP.

We'll confine this article to replacement of the master cylinder; when the pedal heads for the floor and there's no air in the system (doesn't respond to bleeding) and there are no visible leaks anywhere, chances are the master cylinder has gone south and needs rebuild or replacement.

Which Path To Take: There are two options available when this happens – buy a replacement or rebuilt unit, or have yours rebuilt. If you're not concerned about originality, the rebuilt replacement option will work just fine; if your master cylinder is original, don't turn it in as a core – it's worth some money to someone who needs that casting number and broadcast code to complete a correct restoration.

If you have the original master cylinder and want to keep the car original, you can either rebuild it yourself with a kit (assuming you find no wear or pitting in the bore when you disassemble it), or you can send it out to be sleeved and rebuilt or install the rebuild kit yourself after it's sleeved if the bore won't clean up with a light hone. If a light hone won't produce a perfect bore surface, don't waste your money putting a kit in it – even the slightest imperfections in the bore will damage the new seals and it will fail again.

What Is "Sleeving"?: Sleeving a master cylinder restores the bore to correct diameter and smooth surface finish, using a sleeve material that won't corrode like the original cast iron surface is prone to do over the years with exposure to moisture in the brake fluid. Some companies use a stainless steel sleeve, and some use brass; in either process, the bore is machined slightly oversize. The stainless sleeve is then pressed into the bore and the compensating port and outlet port orifices are drilled through the sleeve.

The brass sleeve process is similar, except the I.D. of the brass sleeve is machined again to the original diameter after it's installed, followed by drilling the orifices. Either process produces an essentially "lifetime" bore surface that won't corrode and ensures long seal life.

Removal: Removing the master cylinder is pretty straightforward – with manual brakes, get under the dash and remove the clevis pin and retainer clip where the pushrod attaches to the pedal; there's usually a wave washer between one ear of the clevis and the pedal as well to prevent rattles. Pry the special retainer clip

gently – you'll re-use it later; pry the end of the clip up just enough to be able to slide it sideways out of the groove in the end of the pin. If the rubber boot on the back of the master cylinder is in bad shape, make a note to order a new one.

In the engine compartment, have rubber caps (from the "Help" section of your auto parts store) ready to cap off the master cylinder lines, and use two more to cap off the plastic fitting plugs that came with your bench-bleeding kit (also from the "Help" section). Place a newspaper or old towel below the master cylinder to catch any brake fluid drips (it'll eat the paint off anything it touches), and use a turkey baster (yours, not your wife's) or a suction bulb to remove all the fluid from the master cylinder reservoir and replace the cap.

Remove the two nuts that secure the master cylinder to the firewall studs or to the booster studs.

Using a line wrench, loosen the outlet port fittings, pull them back, and cap each one immediately; if you have a '67 or later with a distribution block, remove the bolt that secures it to its mounting bracket first so it can move freely to pull the lines back. As soon as each fitting is pulled back, install the plastic fitting with the cap on it you prepared earlier in each outlet port to minimize fluid drippage.

The master cylinder is now free; before removing it, wipe it down (especially on the bottom) to remove any brake fluid, and pitch the rag in the trash; paper towels work fine for this. Now you can pull the master cylinder and distribution block bracket free, put a fresh paper towel under it (so it can't drip on the painted fender), and remove it from the car; have a foil baking pan or something similar already laid out to place it in to contain any brake fluid. With power brakes, the pushrod will remain in the booster; with manual brakes, the pedal pushrod and clevis will come out with the master cylinder. Remove the outlet port plastic plugs – you'll need them later when we bench-bleed the new master cylinder.

With manual brakes, chances are the gasket between the back of the master cylinder and the firewall will be history; make a note to order one along with the boot if necessary.

What Kind Of Fluid Is In There? If you haven't been through the brake system on your car before or you bought it recently and don't know for sure what kind of brake fluid is in it, you need to find that out before you do anything else. There are only two basic types – glycol-based conventional DOT3 or DOT4 (which are compatible with each other and will mix with no problem), and silicone-based DOT5 fluid, which is NOT compatible with DOT3/4 and will NOT mix with it under any circumstances.

Take a couple of ounces of the old fluid from the master cylinder and pour it in a small glass container (like a small jelly jar); then add an equal amount of water, cap it, shake it up well, and set it on the bench and observe what happens. If two distinct layers form with the water on top and the brake fluid on the bottom, it's DOT5 silicone fluid. If no layers form and the liquid appears homogeneous, it's

DOT 3/4 conventional glycol-based brake fluid. You can't tell just from the color of the fluid; although DOT5 silicone fluid is usually purplish in color, as it ages and oxidizes it turns an amber color, similar to fresh DOT 3/4 fluid.

Whatever the "shake test" shows, that's the fluid you'll need to use. Converting from one fluid type to the other requires disassembly and flushing of the entire brake system and its components, and that's beyond the scope of this article. Don't even THINK about mixing the two fluids in the same system.

Rebuild: We won't cover the rebuild here – it's covered in detail in the applicable GM Chassis Service Manual. To inspect the bore, remove the spring retainer clip at the back of the cylinder, and remove all the pistons, seals, springs, etc. from the bore; keep the parts in order of removal, lay them out on the bench, and either take pictures or make a sketch of where everything goes for later reference. Inspect the bore very closely with a bright light to see if it's a candidate for a straight rebuild – if you see any pits or surface imperfections/scrape marks, it's time to send it out to be sleeved. Some minor imperfections can be taken out with a light cylinder honing, but personally, I don't recommend it – this is a primary safety system, and it should be perfect, not just "looks pretty good".

If the bore looks smooth and flawless, buy a quality rebuild kit (Wagner, EIS, etc.) and follow the instructions to the letter, using fresh brake fluid as an assembly lubricant. If your master cylinder isn't original, take it with you to the parts store so they can match up the correct rebuild kit for its configuration – you never know what a previous owner may have installed.

If it isn't a candidate for a straight rebuild, pack it up and send it to a reputable company to be sleeved (Stainless Steel Brake Co., White Post Restorations, and Apple Hydraulics, to name just a few, do this work every day, and guarantee it).

If you buy a generic rebuilt replacement instead, make sure it's the correct one for your application; correct bore diameter, outlet port location/size to match your lines and fittings, and correct depth hole in the rear piston to match up with your power booster pushrod or manual pedal pushrod.

Bench-Bleeding: When your rebuild is complete or you have the sleeved master cylinder back and it's ready to install, take the time to bench-bleed it properly before installing it. Bench-bleeding fills the cylinder bore and outlet ports with fluid and drives out all the trapped air inbetween all the moving components and in the drilled passages so you don't introduce any more air into the brake system when you install and connect it in the car. Occasionally you'll get really lucky if you capped off the brake pipes on the car immediately and work quickly to un-cap and re-connect them to a properly bench-bled master cylinder, and you may not need to bleed the brakes at all if no air has entered the system.

If you don't bench-bleed the master cylinder, it'll take **forever** to bleed the system and get a hard pedal, as air will still be trapped in the master cylinder's bore; don't skip this step – it's essential, and simplifies the project enormously.

The bench-bleeding kit from the "Help" section will have plastic fittings to fit your outlet ports, rubber or vinyl hoses, and a retainer to hold the hoses in place on the reservoir. Clamp the master cylinder in a vise (pad the jaws first), install the outlet port fittings, install the hoses so the ends are well below the normal fluid level in the reservoirs, and install the retainer to hold the hoses securely in position so they don't pop loose during bleeding and spray fluid all over.

Fill the reservoirs with fresh new brake fluid and let it sit for a few minutes. Using a #3 Phillips screwdriver or similar rod-type tool, gently push the rear piston forward and allow it to return, while observing the ends of the hoses; you'll see lots of air bubbles from the first few strokes. Let the master cylinder sit for 15-20 seconds between strokes to give the fluid in the reservoirs a chance to refill the bore, and continue this process until no air bubbles are seen exiting the ends of the hoses. Use full strokes, but don't bottom the piston out hard at the end of each stroke – it can damage the internal components.

When bleeding is complete, pull each hose off its plastic fitting and immediately install the rubber caps (which you used earlier) on the fitting nipples to contain the fluid and prevent air from entering the outlet ports. Remove the hoses and retainer, wipe down the seal surface on the reservoir, install the cap and bails, and wipe down the entire master cylinder again. Then (on manual brake cars) install the pushrod/clevis and rubber boot, and the finished assembly is ready to install on the car.

Installation: Clean off the firewall surface and place the new master cylinder gasket over the mounting studs (manual brake cars); on power brake cars, make sure the booster-to-master cylinder pushrod and rubber seal are in place.

Slide the master cylinder into place on the mounting studs, and check under the dash on manual brake cars to ensure that the clevis legs properly straddle the brake pedal arm; assemble the distribution block bracket, and install and torque both master cylinder retaining nuts and lockwashers.

Place the newspaper or towel below the master cylinder again to catch any drips, have your line wrench handy, and remove the rubber caps from the brake pipe ends on the car; then remove the plastic fittings from the master cylinder, push the pipes into the outlet ports, and snug up the fittings finger-tight. This should be done as quickly as possible to minimize loss of fluid and to avoid introducing any air at the connections. Now use the line wrench to tighten the fittings, wipe down the fittings, lines, and master cylinder to remove any brake fluid drippage, and remove the newspaper or towel and pitch it in the trash. Now you can re-install the mounting bolt for the distribution block to its bracket on '67-up cars.

On manual-brake cars, get back under the dash and install the clevis pin, wave washer, and spring retainer clip (with some Lubriplate), and check the pedal free play (1/16" - 1/4"); if necessary, adjust by loosening the clevis lock nut, turning the pedal pushrod, and re-tightening the lock nut. Proper free play is essential to ensure that the compensating ports in the master cylinder are uncovered with the pedal in the rest position; without any free play, system pressure won't be relieved when you take your foot off the pedal, and the brakes will drag or lock up.

Bleeding: Now sit in the seat and step on the brake pedal; if you got lucky and were really nimble in capping-off and re-connecting the lines and did a thorough job of bench-bleeding, you may have a good, high, hard pedal, and won't have to bleed the system. If the pedal is low and/or soft, you'll need to bleed the system.

Everyone has their favorite method of bleeding Corvette brakes, and some work better (and faster) than others, whether it's gravity-bleed, 2-person pump-and-hold, MityVac vacuum bleeding, Phoenix Injector reverse-bleeding, or pressure-bleeding (my favorite).

It's no longer necessary to go to a dealer or brake shop to pressure-bleed the system; I heartily recommend the Motive Power home pressure bleeder (www.motiveproducts.com), which is well worth the \$60.00 price. It's a heavy-duty plastic container with its own pressure gauge, built-in pump, and master cylinder adapter, and it makes bleeding the traditionally-frustrating Corvette disc brake calipers a piece of cake. It's also a one-person operation; anyone who has spent hours under their Corvette trying to get the air out of the system will appreciate the speed and simplicity of the pressure-bleeding process.

If your system has DOT5 silicone fluid in it, pressure-bleeding isn't a great idea; silicone fluid does NOT like to be agitated in any way, as it entrains any air it picks up in nearly-microscopic bubbles which cling to the walls of the hydraulic system and components and are next to impossible to bleed out. If you have DOT5 fluid, bleed the system "gently" to avoid agitating the fluid and entraining tiny air bubbles (this is why DOT5 can't be used with ABS systems).

Brake System Maintenance: I won't get into a discussion of the pros and cons of DOT3/4 glycol-based fluid vs. DOT5 silicone-based fluid, except to say that I prefer the conventional DOT4 fluid (Castrol GT LMA, available at any parts store), and do a flush/bleed on each of my cars every two or three years to replenish the system with fresh fluid and flush out any moisture and oxidation with the old fluid. Rubber flex hoses should be replaced every ten years – they're dated on the outside so you know how old they are, and check all the connections and calipers periodically for any seepage or leaks.

Don't take short cuts when working on your brake system; use only quality components and follow instructions and Shop Manual procedures to the letter – your life could depend on it.