Carl's Tech Tip #2: The Brake System

Rebuilding the 308 Brake System

(Remark: Carl is referring to various illustrations in this article. They can mainly be found in the 308 parts book.)

Hello everyone.We are going to discuss brakes today. A word of warning first. There are two parts to a cars construction that are really important. Brakes and steering. Basically, if either of these fail, control of the vehicle is lost. If you do not feel confident working on your car just yet, don't start with these two fundamental systems! However, as we shall see, the braking system is very simple on the 308 series, and very easy to maintain yourself.

Apart from changing pads and discs, the only other general maintenance item is changing the brake fluid. A slightly more complicated job is rebuilding the calipers and the master cylinder. A really complicated job is replacing the booster and adjusting the control linkages. These jobs though are not beyond the home mechanic.

Let's start with the calipers. Some time ago I was bleeding the brakes on my Father's car, a 1987 911 Carrera. I thought I was going mad as I had just performed the same job on my own car and I was sure the calipers were the same. I checked and sure enough they were. The calipers for the 308 GTB, GTS and GT/4 are the same as on 1974 to 1989 911's. What this means is that parts are really easy (and cheap) to find. The only difference is the Ferrari rear calipers have an integral hand brake assembly whereas the Porsche's do not. The calipers are manufactured by ATE. Some of the early calipers in the mid 1970's were cast iron as opposed to the later aluminium ones, however the design is identical.

If your braking system has not been checked for some time, let's say 12 months, itÕs time to have a look.

Tools Required: 22mm. Socket to remove wheels. 8mm. Ring spanner to undo bleed screws. Bleeding tool (it's just a tube with a one way valve to extract the old fluid). Available at most auto accessory shops. 17 or 19mm. Socket to remove calipers. Small hammer and centre punch. 5mm. Allen key to remove discs. 6mm. Allen key to retract pistons (rear only) Modified circlip pliers to remove pistons.

Parts Required: New pads, discs, seals and fluid (see text).

The first thing to do is to take your car for a really hard run making sure you give the brakes a good work out. Assuming you had clean wheels to start with, have a look at the colour of the "brake dust" on your rims. If the colour is a dark, sooty black, it means that disc material (ie metal) is being worn away. If the colour is a slightly red or copper colour it means the pad is being worn. (this is better if you want to minimise disc wear). The discs are very expensive to replace so I run a softer pad as I don't want to keep replacing discs. This just gives you a guide as to how the pad and the disc are working together. Wearing out the disc with a "hard" pad is not a bad thing, it is just easier to replace pads than discs.

Remove the front wheels from the car. (Front brakes are the upper diagram of figure one). Check that there is enough pad material left. Be aware that most pad material contains a small quantity on asbestos. Don't clean the caliper with compressed air. If you want to clean it, a brush with some warm, slightly soapy water carefully applied will do the job. The workshop manual recommends a minimum of 3mm. pad thickness. I think this is a bit too thin to maintain reasonable fade resistance, but it really depends how hard you drive the car. If your pads are not worn, you can go on to the section on bleeding the brakes. If you need to replace the pads, remove the retaining pins (No. 24). Lightly "tap" the pins from the inside of the caliper with the hammer and centre punch. The spring (No. 14) will also drop out. To

remove the pads, the pistons may have to be retracted slightly. Undo the bleed screw (with the bleeding tube attached). If you “wriggle” the pad back and forth, this will allow the pad to slide out. Check the condition of the pad and take particular notice of whether the pad is tapered. If so, the pistons are not in the correct position. Taper wear is caused by the leading edge of the pad “gripping” the disc more effectively than the trailing edge. In a four piston set up, manufacturers like Brembo and AP use a differential bore where the pistons are smaller on the leading edge than the trailing edge. In this two piston set up, taper wear is controlled by a cut out in the side of the piston. If this is not aligned properly in relation to the disc, your brakes will either pull to one side or not work as efficiently as they should. The pistons should be offset 20 degrees. Please see figure two for details. This taper problem does not apply to the rear brakes as the pistons are symmetrical.

Also check the condition and thickness of the discs. The minimum thickness is stamped on the hub of the disc. If it is under size, or close (say _ a millimetre) replace the disc. If the disc is fine thickness wise, but shows signs of scoring, have it ground. The discs are very easy to remove as they are only located in place with a 5mm. Allen key. Most of the clamping is done by the wheel bolts. I don’t have any experience purchasing discs but I have spoken to Howard Pigdon from GTB parts and he has front and rear discs in stock at very good prices. Please call him for further information. His details are advertised in this newsletter.

The master cylinder and booster are beyond the scope of this article for now however I will come back to these two at a later stage.

Check that there is no obvious signs of leaking fluid. If you see dampness around the pistons, your seals are faulty and will need replacing. A tell tale sign that something is wrong is if your car is consuming brake fluid. Check the area around the master cylinder. If you spot a leak in this area, your master cylinder will need an overhaul. This will involve either new seals or replacing. If it’s not the master cylinder or a leaky junction in the hoses it must be the caliper seals. Please note though, your car will consume a small quantity on brake fluid as the calipers take up the wear of the pads. This consumption is very gradual. A 2 to 3mm. decrease in the fluid level over the life of the pad is normal.

To check the calipers thoroughly have a look at the piston dust covers (No. 12) They are subjected to extreme temperatures and prevent brake dust and disc material from wearing out the seals (No. 11). If they are in an undamaged state, your seals will probably be in good condition. If your dust covers are damaged, I would suggest changing the seals. This is not as difficult as is sounds but you do need to be very careful to maintain absolute cleanliness. Never allow any petroleum based anything near the braking system. Carelessness and contamination have no place here.

Firstly, remove the calipers from the car taking care to seal the disconnected brake lines. The hardest thing to do is to remove the pistons. I find the easiest way is to modify a pair of circlip pliers (internal type) so they grip the inside of the piston. Gently rotate the piston whilst pulling it out. Do the same for the other side taking care to ensure the pistons are not transposed when replaced. Remove the old seals by levering them out with a wooden pencil. This will not damage the bore if you slip. Check the bore for corrosion or scoring. If the bore is damaged, show the calipers to a brake specialist and get an expert opinion as to whether the caliper is serviceable. You may be able to get away with a very light honing of the bore. If not, you may be up for new calipers. Now the caliper is ready for cleaning. I can not recommend splitting the caliper halves. It is not necessary and makes sealing them again very difficult. Only separate them if they are leaking, taking care to install new “o” rings (No. 21). Remember, keep everything spotless. Flush the caliper with denatured alcohol. Flush it a few times. Finally, flush the caliper with fresh brake fluid. Brake fluid is nasty stuff. It is very caustic and makes an excellent skin irritant, clothes bleach and paint stripper. Be careful. Now to the seals. You can purchase these at most brake specialists however I can recommend: South Yarra Auto Parts 550 Malvern Road Prahran 3181 ph. 9529 6933 Contact: Dean.

Dean specialises in Porsche, B.M.W., and Mercedes-Benz parts so don’t call him if you are after specialised Ferrari bits! However, he is a Bosch and ATE brake and clutch distributor so if you can quote

a part number he can probably get the parts for you.

The caliper kit for the front consists of the piston seal, dust boot and the boot retaining ring (No. 13) The ATE part number is: 901 351 998 00. The price from Dean is $36.00 per kit. One kit does one caliper.

The rear kit is as above except the ATE part number is: 911 352 905 00. The price is $19.35 from Dean. Again, one kit does one caliper.

The procedure is identical for the rear except you must first retract the pistons with the 6mm. Allen key. You also have to remove the clips (No. 25, lower illustration) before you can drift out the pad retaining pins. Make sure the hand brake is released. This is part of the hand brake assembly so don't forget to wind the pistons out again so the pad is just off the disc ie: you can still turn the hub.

You may be surprised to see how worn the rear pads are. The rear brakes on these cars do much more than on a front engined car. With a rear weight bias and a small pad to start with, the rear's do more than their fair share of the braking.

Assembly is basically the reverse of disassembly but make sure the seals and pistons are lubricated with brake fluid before assembly. Take care to align the pistons as outlined in figure two. When mounting the calipers back on the suspension, be sure to torque them correctly. (see below). Some manufacturers recommend fitting new caliper mounting bolts (No. 15) and whilst this seems like good practice, Ferrari don't mention it in the workshop manual. To do the job properly, place a small "smear" of high temperature grease on the back of the pad. This will minimise corrosion between the pad and the piston.

Take care when replacing the pads that the spring (No. 14) is held in properly with the two pins (No. 24). This keeps the pads sitting in the calipers firmly. After the calipers are mounted and new pads (and discs if needed) are installed, the system needs only to be bled and flushed. Attach the bleeding tool to the bleed nipple on the front calipers first. You just need to undo the screw and pump the brake pedal until fresh fluid appears with no air bubbles. If your system has not been flushed for sometime, the colour of the fluid may be a dark green or worse, black! Don't worry, just keep pumping making sure that you are topping up the reservoir. When the fluid coming out turns the colour of the fluid you are using; and there are no more air bubbles you can tighten the bleed screw. I find if I let the fluid bleed itself using gravity for a few minutes after pumping with the pedal this removes all the air. Don't let the reservoir empty as you will fill the system with air again. I can usually get about ten pumps of the pedal before the reservoir needs topping up. After the fronts, perform the same for the rear. Finally, mount the wheels and take the car out. Initially, braking will be very inefficient as the pads need to bed in. That is they just need to wear slightly to the physical characteristics of the disc. After bedding in (probably 50 to 100 km.), take the car up to a higher speed and give the brakes a good shove, making sure the car pulls up straight, and quickly with a nice firm pedal.

Brake fluid is almost as confusing as pads in terms of what is available but any fluid that conforms to the Dot 4 specifications and has a high boiling point (around 300 degrees) will be good. I have used two fluids that work well from both AP and Performance Braking. There are plenty of other brands to choose from, just make sure the fluid has the above specifications. These two products are from the U.K. and are expensive. Expect to pay around $50.00 per litre. Your will need about two litres to flush the braking system after rebuilding the calipers.

Maintaining the braking system on your Ferrari is very easy. All you have to do is to keep an eye on pad and disc wear and replace when worn. The one job that seems to always be neglected is flushing the brake system. Brake fluid absorbs water. This has the effect of lowering the boiling point of the fluid. When the fluid boils the pedal sinks to the floor! Secondly, water in the system causes corrosion. If there was corrosion when checking your caliper bores, that's why. I think flushing the brake system every six months is reasonable. If you do a lot of track work, then after each meeting will keep your fluid in top condition.

Regarding pads, there is a very large range available. If you would like to run the stock pads you have two choices. You can purchase the genuine ones (which are made by Textar or ATE although in the 1970's Ferodo was the supplier) for around $500 front and rear, but come in an attractive yellow box. If you can do without the box but would like to run the standard compound from ATE, South Yarra Auto Parts can supply:

Pads part number: 911 351 950 02 $66.00

Rear pads part number: 911 352 951 02 $81.30

I don't know why the rear's (smaller pad) should be more than the front's, but they are.

I tried the standard pad and found it worked quite well but was a little abrasive on the disc. It was not totally linear in response either, that is, for a given increase in retardation, you had to press proportionally harder. However, this was only really noticeable when braking really hard. It was difficult to fault for street use. There really are so many materials available for this caliper it would take months of testing. Bendix also make a compound to suit this caliper. I have heard that for street use it is quite good but prone to early fade when used hard.

One pad that comes highly recommended from our editor Jack, is the Pagid brand. They are original equipment for models like the F-40. These are distributed by GTB parts, who had them in stock at the time of writing. The fronts are $115 a set and the rears are $90 a set. I am looking forward to trying a set as they are supposed to be excellent. I will fit a set next time my pads are due for replacement and let you know.

The above brake maintenance job is described in detail in the GT/4 factory workshop manual page H 11. It reads:

"Check brake disc faces and without withdrawing the pistons, make sure of the piston correct sliding inside cylinders."

I am not joking, this is the manual word for word, but there is more!

"Besides, it is absolutely necessary to replace the rubber sealings when withdrawing the pistons from cylinders."

As you can see, the factory manual is a goldmine of information! It does however provide torque settings for the above job (one does wonder how accurate they are though).

Brake calipers (front and rear) to suspension mounting: 72 lb.ft.

Brake discs to wheel hubs: 18 lb.ft.

Wheels to hubs: 65 lb.ft.

I hope this information is of use and helps to explain a little more about the braking system.

Good Luck, Carl.