TR250 & TR6 Brakes
Overhauling Master Cylinder & PDWA

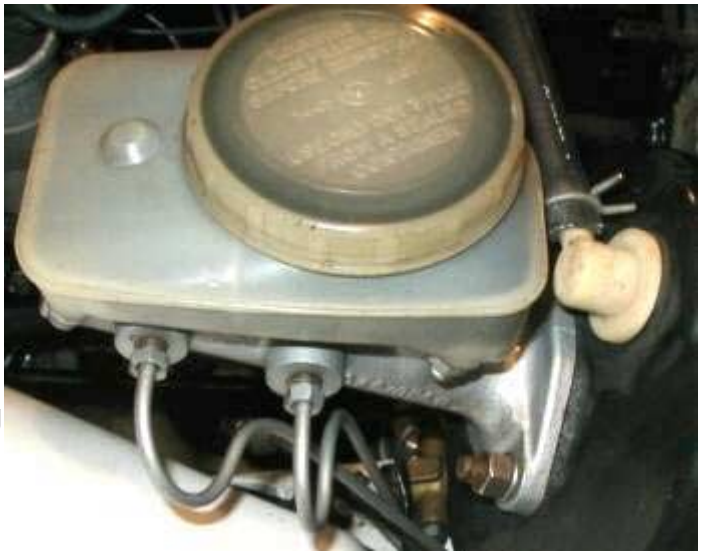
By Nelson Riedel, nelson@buckeyetriumphs.org
Initial 4-03-02, Last Revised 4-17-02

These notes describe what I did on my car for my personal use and are provided here for entertainment; they are not meant to be instructions for others to do maintenance on their vehicles.

This section describes how I overhauled the front master cylinder and PDWA brakes for my '70 TR6. As mentioned in other notes, the car is completely disassembled so I didn't have to deal with removing them from the car. However, I thought it appropriate to include a description of how I remove them.

Draining the system: Most of the fluid must be removed from the system before either the master cylinder or the PDWA can be removed. You can either remove the fluid intentionally or it'll leak out when you open the pipes. Normal DOT3/4 brake fluid is a very effective paint remover so it is wise to avoid getting it all over the engine compartment and to clean up any spills. The DOT3/4 fluid absorbs moisture so it's a good idea to get completely drain the system and install new fluid whenever the system is opened. To completely drain the system I connect a 3-foot length of 1/4 inch ID plastic hose from one of the caliper bleed nipples to an old radiator overflow bottle. I then open the bleed screw and gently pump the brakes until the large (back) part of the reservoir is empty. I've always had trouble with the bottle falling over, hose coming out, etc so this is a good opportunity to get the significant other or one of the kids to lend a foot. The helper pumps the brake while I deal with the hose, bottle and opening the bleed nipple. (If she pumps and nothing comes out, I suggest she pump the other middle pedal.) Once the reservoir for the front has been drained I move the hose and bottle to one of the rear cylinders and repeat the process to drain the other reservoir. (One can also use the pressure tool described in the bleeding and adjusting note to blow all the fluid out of the system.)

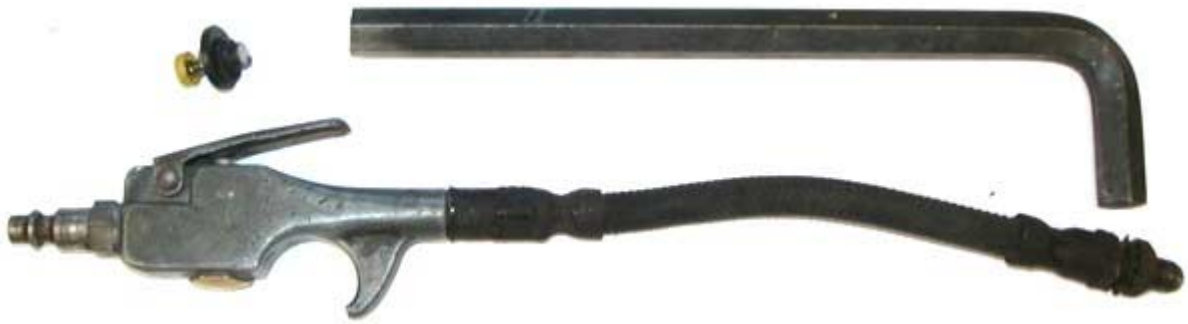
Removing the MC: The photo on right is of my '76 TR6. To remove the MC, I first disconnect the two brake lines from the side of the cylinder. Fluid will likely drip from the pipes so it's a good idea to wrap the pipes with a large rag or towel. The two nuts and lock washers are then removed from the studs that secure the MC to the servo and the MC can be lifted off. If I plan to remove the PDWA and/or plan to drain the entire system, I open one wheel caliper/cylinder bleed nipple at a time, drape a large rag or towel over the nipple and then use an air gun to apply ~10 psi air to the associated brake line fitting previously disconnected from the MC. If I'm not removing the PDWA, I cover the end of the brake lines with tape and then scrub both the engine compartment and the area around the wheels to remove any fluid.



Removing the PDWA: The photo on right shows the PDWA on my '76 TR6. Before removing the PDWA I blow the fluid out of the system as described above. Next, I disconnect the electrical connector to the switch on the top and then disconnect the two pipes from the engine side of the PDWA and then remove the bolt securing the PDWA to the body. The PDWA will then lift off with the pipes that connect between

the MC and PDWA still attached to the PDWA. I then seal the ends of the two pipes still attached to the frame with tape and scrub everything down with soapy water and hose it off.

Disassembling the MC: As with any TR project, a couple special tools will come in handy here. The1/2 inch hex wrench shown in photo below is to remove the nut that retains the tip over valve in the MC. The little part to the left of the wrench is an old tip over valve with the end cut off so it won't tip over. The lower tool is a bow gun with an old rear brake hose screwed into it. The blowgun has1/8 inch pipe threads and the hose is 3/8-24, which is the right TPI, but a little loose. A few wraps of Teflon makes it nearly air tight.



The photos below show disassembling the MC. The reservoir is being removed on the left and the nut (hollow plug) that holds the tip over valve in place is being removed in the center photo. The tip over valve with nut is shown in the right photo. The first time I disassembled one of these I discovered I didn't have the correct hex wrench at like 3 AM. I shoved the hex head of an old 5/16-inch bolt into the retaining nut and used a small pipe wrench on the shaft of the bolt. (Pipe wrenches are really handy ---- one step above vise grips.)

The next task is to remove the two pistons. With a little luck they'll come out when the cylinder is shook. However, we have other methods for the difficult ones. The scheme is to blow out the pistons with

compressed air. However, for this to work all the openings except the end must be sealed. The tip over valve with the end cut off mentioned earlier can be installed to seal that opening. The tip over valve just removed can be used (with end sawed off) since there is a new one in the rebuild kit. The front brake port is plugged with a 7/16 -20 bolt and the air connection hose & gun pictured above is attached to the rear brake line port. The port to the rear brake reservoir can be covered with a finger. I pointed the end in a trashcan with some impact absorbing material (loose trash) in the bottom. I was really careful here because the pistons usually leave the cylinder with some dispatch. If the pistons don't come out I disconnect the air and then use a hammer and punch to drive the pistons into the cylinder a little to break them free --- then the air again. The pistons and springs are shown below. This stuff was set aside till later.

Checking the MC Bore Size: The standard MC bore is of two sizes; the rear slightly smaller than the front. If you shine a light down the bore you should see a small but definite reduction in bore size just beyond the front brake port, about two thirds of the way into the bore. I measured the bore on this MC and found the smaller inner part to be 0.774 inches diameter and the larger part to be 0.812 inches diameter. I've heard that some master cylinders have been bored oversized and possibly to one diameter throughout. If there is not a clear step near the closed end of the cylinder or if the diameters differ greatly from those measured here, the standard MC replacement seals will likely not work properly.

Cleaning up the MC casting: The master cylinder casting has a yellow cast when new; I think due to a chromium or cadmium plating. This usually starts to disappear after a couple years and areas of the surface then start to corrode. If one is satisfied with this appearance one merely has to give the inside a quick inspection and run a hone down the cylinder if it is rough then go on to replacing the seals. I prefer to clean the casting and coat the outer surface so that it looks nice -- at least for a while. In the past I've used clear coat and aluminum paint finishes. More recently I've used my home powder coating system to finish the castings. There is a note on the website describing the equipment needed to do the powder coating.

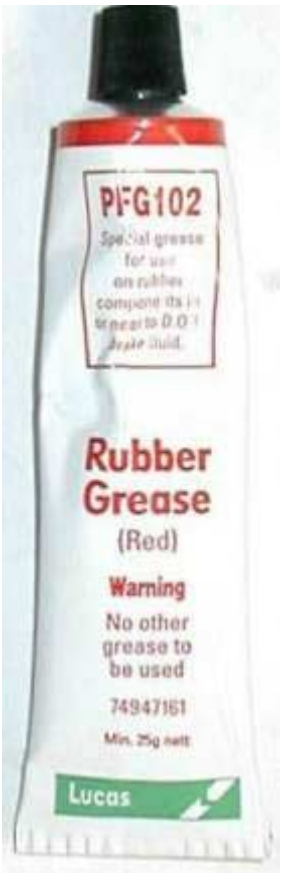
I first soaked the casting in the degreaser and then washed it in hot soapy water followed by blasting to remove all corrosion. I then ran a spring-loaded hone with a little brake fluid for lubricant down the cylinder to clean up any imperfections. See adjacent photo. The inside of the cylinder should be smooth and free of all pits. Sometimes there are pits very near the open end of the cylinder that can be ignored because they are beyond the travel of the primary piston seal. It is very important to get then back end of the cylinder clean to insure that the secondary supply valve seals properly. That end is more prone to having built up residue from old seals than corrosion so it isn't too hard to cleanup with a little effort.

Once the bore was in good shape I washed it again, gave it a touchup blast, then washed with metal prep, rinsed with water and

dried with air. I then sprayed on the powder and baked to cure. This time I was able to salvage the pipes between the MC and PDWA so they were also cleaned by blasting followed by metal prep and powder coated at the same time as the MC using aluminum coating. The screws and lock washers were ignored as I planned to replace them with stainless components.

There are photos in the powder coating note that show this process and a photo at the end of this note showing the completed product. After the cylinder was cured and cooled down I ran a tap into each port to clean the threads, lightly honed the cylinder and then washed with soapy water, rinsed and dried with air. I then coated the inside of the cylinder with hydraulic fluid ---- in my case DOT5 (silicone) fluid.

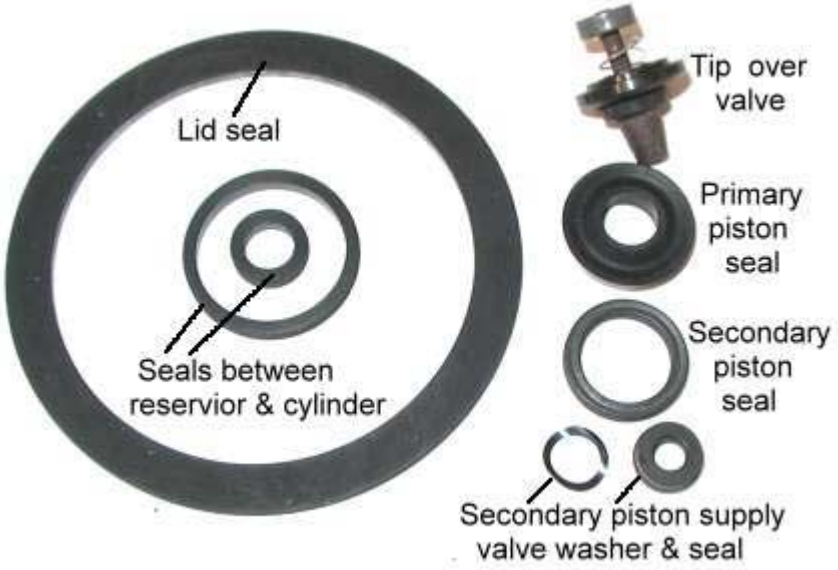
Rubber Grease: I think one of the keys to a lasting brake job is the use of grease on all threads, rubber seals and exposed unfinished metal such as the exposed ends of the cylinders. Greasing the pipe and bleed nipple threads often eliminates problems 10 to 20 years hence at the next rebuild. Greasing the exposed metal prevents the corrosion and pitting that sometimes destroys the components. Girling and Lockheed sell red rubber grease that is compatible with the rubber seals and brake fluid for just this purpose. Unfortunately, I had a hard time securing the grease recently. None of the local parts stores (Auto Zone, NAPA, etc.) carry it or are interested in getting any for me. The clutch MC rebuild kit comes with a small packet, not so the brake rebuild kits. TRF lists a Girling tube but has had it backordered for a year. Moss sells the small Lockheed packets called sachets, but was out when I tried to order some recently, and didn't expect to have any for six weeks. Victoria British said it was no longer manufactured. I inquired on the email lists was given three sources:



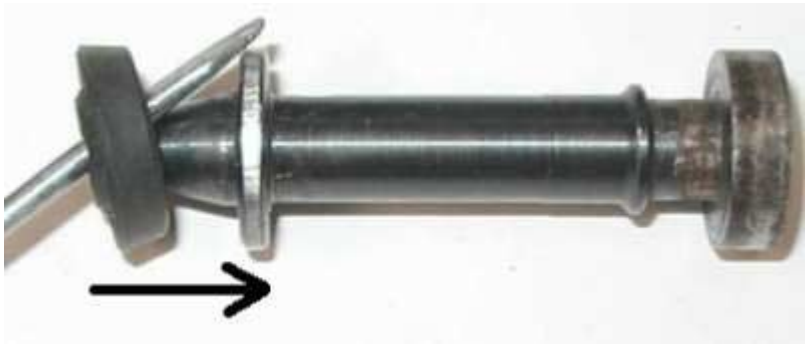
- r.d. enterprises, ltd,
- H.D Rogers & Sons
- Little British Car Company

I ended up ordering a couple tubes from r. d. enterprises, ltd. They handle Lotus parts, but the guy who answered the phone assured me the grease would also work in a TR. They also carry other "British" chemicals, such as Wellseal, Hylomar, Firegum and Graphogen. See the website for more information but don't get your hopes up, that stuff won't stop your TR from leaking for more than a day or two.

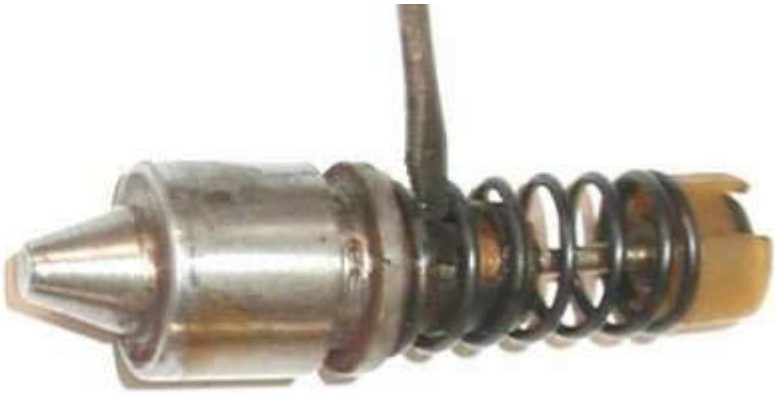
Replacing the MC Seals: The parts of the rebuild kit are shown on the right. The tip over valve seal is easy to deal with --- you get a new valve in the rebuild kit.

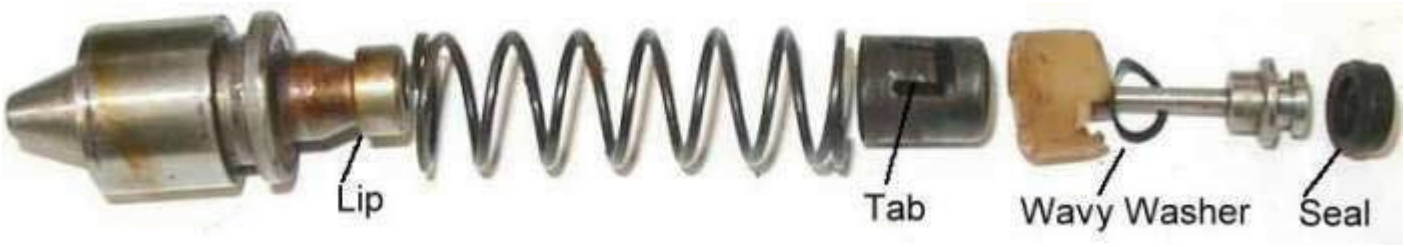


The seal on the primary piston is sometimes difficult to install. I coated the seal with grease and slipped it on over the pointed end. The correct orientation is with the largest part of the seal to the inside of the cylinder (the pointed end of the piston) as shown being installed in the top photo on the right. As you see, a small screwdriver helps. Caution, the seal will tear if stretched only slightly more than necessary to get it over the disk on the end of the piston.



The secondary piston must be disassembled to get at the supply valve seal and wavy washer. **I wore eye protection for this procedure.** I used a small screwdriver to lift the thimble tab over the lip on the piston. The spring usually propels the pieces in all directions if they are not secured --- a rag over the whole mess sometimes helps. Once apart, the old wavy washer and seal were removed and discarded and new parts installed. The lip on the outside of the seal is positioned toward the end of the cylinder. It looks like it may be position in the other direction in the photo below.

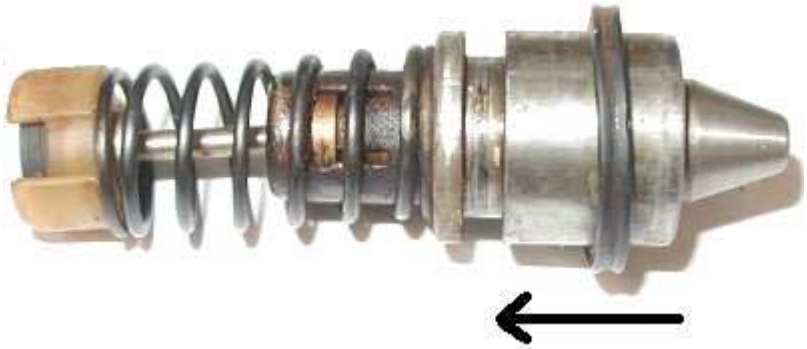




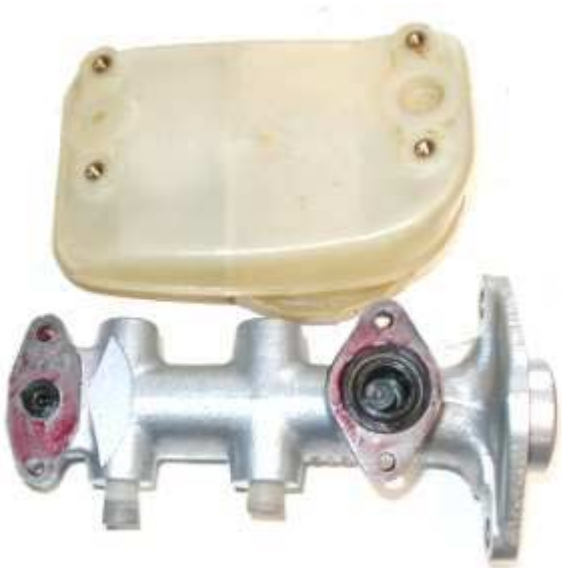
The next step is to put the secondary piston back together. I used the vise to squeeze the spring (I held the parts with one hand as shown in photo) and then used a small screwdriver in the other hand to push the thimble over the end of the piston and pressed the tab down behind the lip.

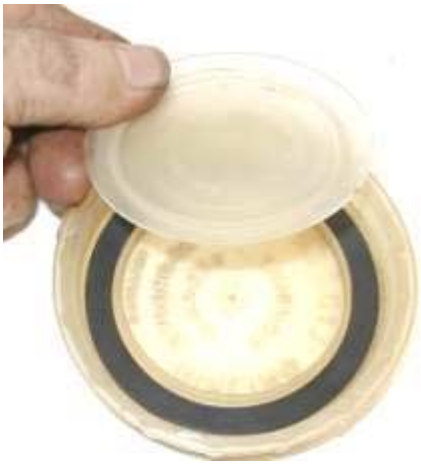
After the secondary piston was back together I slid the new seal onto the piston as shown on the right. This one was much easier to install than the one on the primary piston.

The pistons with new seals are shown below. I applied a little more grease to the seals and then slid the secondary piston, then spring and then primary piston into the cylinder. I held the primary piston in with a finger and then dropped the tipping valve into position and secured with the nut and tightened with the hex wrench.

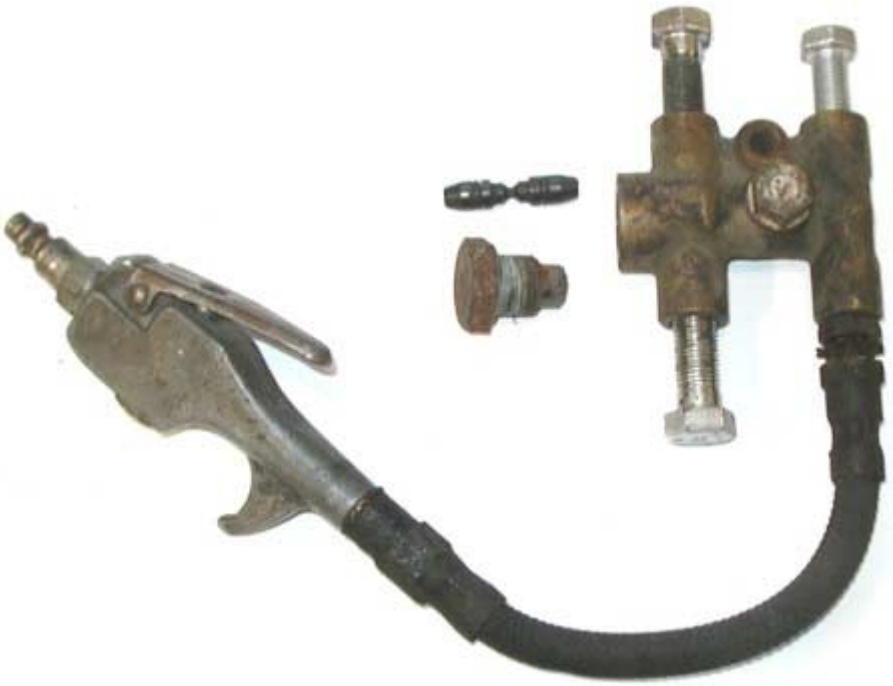


The final assembly steps were to replace the two seals between the cylinder and reservoir, attach the reservoir and replace the seal in the reservoir lid see photos below. I cleaned the reservoir as much as possible with hot soapy water and then dried with air before attaching it to the casting. Red rubber grease was spread over the joint areas (left photo below) and the original screws were replaced with hex head stainless steel screws with stainless lock washers. The seal retainer on the underside of the reservoir lid was prided off, the old seal replaced (right photo below) and the retainer pushed into place to hold the new seal.

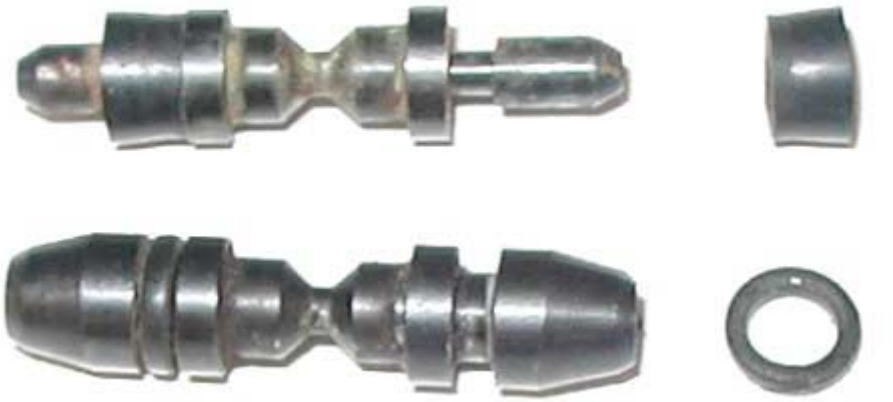




PWDA Disassembly: The major task with the PDWA was to get the piston out so that I could replace the seals. I used compressed air as shown in the photo on the right. I removed the switch and end plug and then plugged the ports for the front brakes with 7/16" bolts and the switch hole and one of the ports for the rear brakes with 3/8 bolts. The airline connects to the last rear brake port. I pointed it in the trashcan and fireed. (If the local do-gooders saw me doing this, they'd make me get a permit and register this thing.) If it doesn't let go, I disconnect the air, use a punch drive the piston in to break it free and then hook up the air and fire again.



I've been told there were PDWAs made with different size cylinders. I have PDWAs from years '68,'70, '73 & '76 and all have 5/16" cylinders. Three use O-Ring seals as the lower piston in the photo and one uses the more substantial seal as the upper piston in the photo. I haven't been able to find a source for the upper piston seals. The O-Rings for the lower piston are 3/16" ID & 5/16" OD with 1/16" cross section --- O-Ring size # 008.; See http://www.marcorubber.com/ . Ethylene Propylene (EP/EPR/EPDM) is the correct material. I understand they are available from American Packing and Gasket Co, www.apandg.com (713) 675-5271 or (800) 888-5223. I bought 100 from McMaster - Carr for a little over $8.

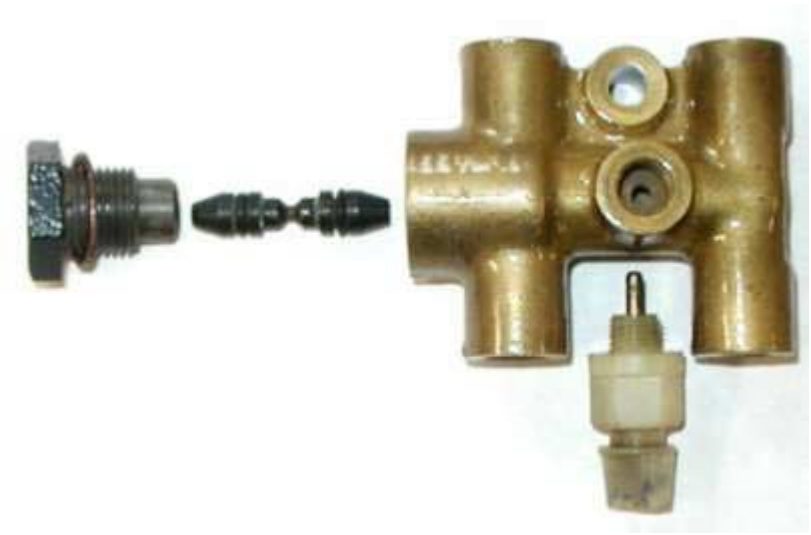


The PDWA is neat looking if clean and shiny so I blasted mine and powder coated the brass part with clear and the end plug shiny black.

PDWA Reassembly: I coated the piston with rubber grease and slid two new O-Rings into position on the piston. I then poured a little silicone fluid into the PDWA bore and then slid the piston into position. I looked down into the hole for the switch and positioned the piston such that the narrow part is exactly under the middle of the hole. I used the sharp end of a scribe (a nail would work as well) through the switch hole to work the piston into the exact middle. I then installed and tightened the plug, making sure that there was a copper washer under the head of the plug. The ready to assemble parts are shown in the next photo.

Before installing the switch I tested it by pressing the switch plunger in and verified operation by measuring the resistance between one of the switch terminals and the plunger with an ohmmeter. (Note: the two terminals at the top of the switch are wired together. When the plunger is pushed up it connects ground from the plunger via the piston and PDWA housing to the terminals.) In this case the resistance went to

less than 1ohm between the plunger and the switch terminals when the plunger was pushed in, indicating that the switch was good. The switch exerts considerable force on the piston requiring that there be a considerable difference in pressure between the two sides of the PDWA before the piston moves operating the switch. This allows for normal bleeding of the brakes with light brake pressure (engine off so that there is no boost from the servo). If the piston gets off center after the PDWA has been installed I remove the switch and center the piston with the aid of a small flashlight and a scribe.



The assembled master cylinder with PDWA and connecting pipes are shown on the right.

The final step is to install the components in the car, which for this stuff is at least a year away. I will use stainless steel nuts and lock washers to connect the MC to the servo. I'll also use a stainless steel bolt with lock washer to secure the PDWA.

Filling the reservoir is described in the note on bleeding the system.

Links to other notes on TR250 & TR6 Brakes:

[Brake Theory & Overview](#)
[Overhauling Brake Servo](#)
[Overhauling Pedal Assembly](#)
[Overhauling Front Brakes](#)
[Overhauling Rear Brakes](#)

Overhauling Handbrake
Overhauling Brake Pipes
Selecting Brake Fluid
Bleeding & Adjusting Brakes
Troubleshooting Brakes

***Buckeye TRIUMPHS* Technical Page**