H31 BOOSTER REBUILD & MASTER CYLINDER

Rebuild hydraulic booster and replace Master Cylinder.
Master Cylinder Removal & Brake Booster Rebuild

Car: 1991 BMW 750iL, mfg 4/91

Symptoms:

- Leaking brake fluid between the Master Cylinder and Hydraulic Brake Booster
- Brake Booster leaking Pentosin (drip point at grub screw under the booster)

I won’t be going into the theory of operation in this instruction, but will illustrate the steps I followed to fix the leaks and point out the lessons learned along the way.

Note: I had previously removed the coolant expansion tank, intake manifold, valve covers & auxiliary water pump while in the process of doing a valve cover gasket/manifold gasket reseal job so I have a little more room than typical for this job.

My main goal was to repair the leaking H31 Brake Booster “In Situ”, as I did not want the headache and additional work of removing the assembly from the engine bay. It just so happened I noticed the master cylinder was leaking so I also replaced it as part of the process.
Master Cylinder Removal

Begin by disconnecting the electrical connector from the brake fluid float switch and then remove the lid of the brake fluid reservoir. Using a turkey baster or syringe, suck out all the brake fluid that can be removed. You won’t get it all out so be prepared for spills when you pull off the plastic reservoir.

The Reservoir is mounted into the master cylinder by two grommets.

Note: If you are not planning to replace your master cylinder, you will need to replace these two grommets.

Firmly grasp the reservoir and pull it while rocking to get it out. Mine was in there pretty tight. Make sure you clean up any spilled fluid, it’s not kind to paint.
Master Cylinder Removal

If you will be reusing your master cylinder, make sure dirt & debris are kept out of the system. Spray it down with brake cleaner and wipe it down as necessary. You don’t want to introduce contaminants into it.
Master Cylinder Removal

Remove the brake line nuts circled below.

These will require an 11mm flare nut wrench. You might be able to use a standard open end wrench but it’s not advised - these are tight! You don’t want to risk rounding them.
Next remove the 13mm socket head bolts circled at the left. The top one is easy to get to, the bottom one was extremely difficult as all the combinations of sockets or wrenches I tried would not fit the allotted space. I finally was able to break it loose with a ½" socket wrench and unscrewed it with a cut-off 13mm combination wrench. I’m sure others with a wider assortment of sockets will find a small ratchet/socket that can fit. My versions are shown to the left.

With the two bolts removed, the master cylinder can be maneuvered out.
Master Cylinder Removed

Note the “Grub Screw” under the brake booster flange with the Pentosin drip forming from it.

This is considered a “low pressure” leak, which should be repairable by an O-ring replacement.
H31 Hydraulic Brake Booster Cut-Away

Note the “Grub Screw” from the previous picture, below.

In my case, the leak was from Pentosin bypassing the Low Pressure Body Seal. If you're lucky, this will be the case for you too. A less common low pressure leak is from the shaft. (I don’t believe as of this writing this is available. If these two areas are not the cause of the leak, you will need to replace O-rings from within the control piston (beyond the scope of this document).

The Low Pressure Body Seal can be picked up at any Napa Auto Parts store. There are multiple references in the various BMW forums to a BELKNP O-Ring PN 727-2222, but I found this O-ring too thick (it's SAE). Instead I went with the Metric version O-Ring, PN 727-2626
H31 Hydraulic Brake - remove the Endcap

“Disclaimer”, this picture is out of sequence but is for illustration only. (I can’t find the correct picts.)

Prior to removing the Grub Screw, you need to secure the endcap, and more importantly, that vicious coiled spring just behind it for when the grub screw is removed. (See illus. previous page)

Using the bolts from the Master Cylinder, find some washers/spacers that will overlap the endcap as shown below. Screw in the bolts until the washers are flush with the face of the booster flange.
H31 Hydraulic Brake - remove the Endcap

Now, using some vise-grips, remove the Grub Screw.

Next, start backing out the bolt/washer combo’s. As they get ready to release from the last threads of the flange, put a towel or rag over the end and apply pressure against the end cap.

BE CAREFUL - That Endcap WILL FLY OUT with incredible force and your bolts and washers will fly everywhere!!
H31 Hydraulic Brake - Inspect the Bore

The bore looked very good on my booster.
H31 Hydraulic Brake - reassemble the Encap

Again, sorry for the lack of pictures, but the drawing below shows the sequence of components for reassembly.

Putting the spring back in and getting the bolt/washers to hold the whole assembly was too much for me to accomplish alone with bad shoulders. I got a strong friend to compress the spring and he even started the master cylinder bolts in one try.
H31 Hydraulic Brake - re-insert the Encap

Before I gave up on getting the spring in by myself, I made a tool to help hold and center the Endcap while pushing it into the bore of the booster.

It did help somewhat pushing the beast back in. Just make sure the notch in the bottom of the Endcap that receives the Grub Screw is in the bottom or 6:00 o’clock orientation. At this point it’s not critical that it be exact, just close.
H31 Hydraulic Brake - re-insert the Encap

With the spring compressed and the bolts holding everything in, tighten them until there is about 1/4", (6 - 7 mm) of Endcap protruding from the face of the flange as shown below.

Now, with your fingers on the top and bottom of the Endcap, push in hard and twist (rotate) a few degrees at a time until the notch is lined up exactly with the grub screw hole.

Now tighten the bolts until the Endcap is flush with the booster flange and tighten the grub screw.

As you slowly back out the bolts, the Endcap should stay in place. Congratulations! that was the hardest part.
Install the Master Cylinder (MC)

If reusing your old Master Cylinder, remember to replace the grommets, you don't want to risk brake fluid leaking past hardened seals.

If your master cylinder is new, you'll need to bench bleed before installation. Using a bit of fresh brake fluid, wet the seals on the top of the MC and then grasp the reservoir and install into the grommets. It may help to rock it a bit while pushing.

To bleed it, I first added 3 to 4 ozs. of fresh brake fluid (about 100ml) to the reservoir. Holding the assembly in my left hand and covering the outlets with my thumb and base of my hand, I pushed on the plunger to get the brake fluid moving. Depressing the plunger will first push out air followed by fluid, do this several times until all the air has been purged and fluid is pushing past your fingers. Make sure you cover the MC with a shop towel as you do this because the brake fluid will squirt out.

You'll now have to remove the reservoir to install the MC. Installation is the reverse of removal, if you are reusing the MC, clean off the mounting bolts and apply some blue loctite to the threads, otherwise use the new bolts that come with the MC.
It will be necessary to bleed the brakes after installation. While there are several ways to accomplish this, I found pressurizing the reservoir to be one of the easier methods next to using a vacuum. I picked up a replacement reservoir cap and drilled it to accept a male quick disconnect fitting. Using odds and ends from the shop, I put together a system with a pressure regulator and set the air pressure to about 15psi. Fill up the reservoir, screw on the cap and attach the air hose/pressure regulator. Start from the passenger side rear wheel and work your way around clockwise, bleeding each corner of the car.