Master Cylinders, Boosters, Brackets, Valves and Vacuum Pumps

When adapting larger brakes to your car we need to ensure that the volume displacement of the master cylinder matches the requirements of the bigger calipers, and that brake boosters are adequately sized and have sufficient vacuum to operate properly.

The majority of **Hoppers Stoppers** kits require a 1-inch bore master cylinder; larger cars use these as standard. Typically full size Holden's, Fords and Valiants, with Australian PBR equipment used these from the 60,s to current times, with tandem master cylinders becoming standard late 60's.

XB Ford P6258A on Left
3/8 long fittings with ball flares.

HQ Holden P7210 on Right
½ & 9/16 fittings with double flares.

Chrome master tin lid on left

Chrome master billet lid on right

These have outlets both sides and are supplied with plugs for unused ports.

Aftermarket Boosters

As well as availability of reconditioned original boosters we have 7 inch dual diaphragm aftermarket boosters in Gold Zinc and Chrome plate.
XB and HQ master cylinders can fit these with little effort.

A selection of booster adaptation brackets supplied by Hoppers Stoppers, eg Chev 55-58, Camaro, Mustang 66 to 70, Chrome universal for 59-68 Chev.

3/ Proportioning valves.

Some cars with rear drum brakes will have a proportioning valve; these are often set in the range of 150 to 250 psi. As rear discs are not self energizing like drums they need higher pressure settings, typically 500 to 800 psi.
Possibly the rear requirements of your car might need a pressure so high that no off the shelf valve comes in this setting. You might be able to delete the nylon spool from inside the existing prop valve so that it no longer works at all, this means that in an emergency you might lock the rear brakes if you press hard enough, but usually well after the front brakes have locked. The acceptability of this will depend on how the rears perform in emergency situations, which means a careful road test.

Late type PBR master cylinder with combined proportioning valve and brake fail switch on left.
HJ to HZ combined proportioning valve and fail switch on top right.
HQ Brake fail switch lower right.

Adjustable Proportioning valve at top, fixed setting 150psi HQ prop valve on right, 2psi in line residual valve on Left, Booster fitted one way vacuum valve on lower left, inline vacuum valve on lower right.

In practice you always want the front to lock first, but ideally the rear should never lock as this makes the car spin out, that's the purpose of a proportioning valve. If your car is retaining rear drum brakes, you can fine tune the brake action by fitting smaller bore wheel cylinders for less braking and larger for more braking.

4/ Residual valves

Some systems use residual valve in outlets of master cylinders feeding drums brakes, this keeps around 10psi on the wheel cylinders to ensure that air isn't drawn over the cups as brake fluid returns up the line.

Typically on Holden's HK to HZ and similar Torana's this valve is fitted behind the brass seat in the outlet port where the tube nut screws in. To remove this valve you need to pull the seat out using a small self tapper screw as a puller tool, dispose of the valve and reassemble. You can test for the presence of a residual valve by opening a bleeder screw at the caliper, brakes fluid should drip out with gravity. If fluid drip unimpeded then there is no valve present.

HK -HZ or Torana Master cylinder, check for residual valve by probing with paperclip, pull brass seat with self tapper. Discard valve when using discs on this system.
Combined fail switch and Proportioning valve, discard nylon poppet if no rear prop valve required, better still fit an adjustable unit.

Vacuum Pumps

Brake boosters take engine vacuum on one side of a diaphragm and atmospheric air pressure on the other to apply force to the master cylinder. The amount of this force is therefore proportional to the amount of vacuum available. Standard Engines usually make around 18 inches Hg of Vacuum. Engines with large camshaft overlap sometimes have as low as 5 inches at idle and may still only make 10 inches on over run, meaning the booster will never see good enough vacuum to do its job.
When parking the car and using the brakes repeatedly at idle the amount of assist can change making braking unpredictable.

A vacuum tank can help apply a few more stops but it can only store whatever the engine can supply, not more. If the engine never makes enough vacuum then you only alternative is a remote electric vacuum pump. These connect to 12 volts off ignition, run until the system has its full 18 inches in the booster, and then switch off until the brakes are used.

Vacuum pump kit, can be mounted in engine bay or boot, are a bit noisy for fitting in cabin.

Small cars

Smaller cars such as Gemini's, Cortina's, Escorts, Mazda's etc were originally fitted with smaller bore master cylinders, these will produce excessive pedal travel and softness if used with big calipers.

On some occasions the original boosters can be adequate so it's often easier to keep these and adapt a 1-inch bore unit where possible.

When doing this there are obviously some that adapt better but rarely do they bolt right on without any alterations.

Typically we find some things may need changing.

1/ The Pushrod out of the booster needs to be correctly set to the recess in the master cylinder, so that the pistons in the master cylinder begin to move as soon as the pedal moves.
However it is also important that the piston seals are not set past the ports as this will cause the brakes to drag and lock on. What we want is the seal in the master to be almost level with the ports so that minimal movement is needed before the seals covers the ports and begin pressurizing the brake fluid.
Most master cylinders have the piston closest to the booster retained by a circlip, this being the correct set position. In that case you might need to lengthen or shorten the pushrod to ensure that it just touches the recess at the exact time the master is fully bolted home. Do this at the front of the booster, **not** at the brake pedal clevis.

Typical example - 1 inch Nissan Master Cylinders

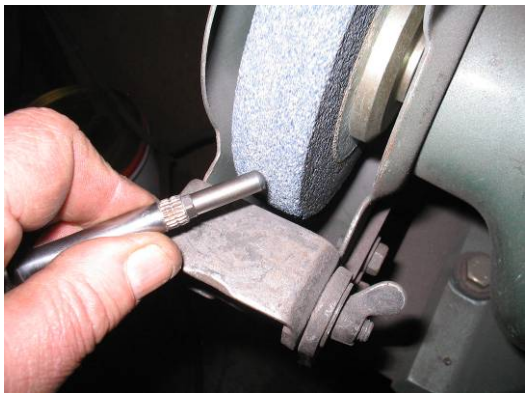
These suit a number of cars due to the compact size of the unit and have the piston retained as described above.

1/ This master cylinder was originally intended for a 4 wheel drum brake car and has residual valves intended for drum brakes in the outlet ports. Before commencing installation ensure that the residual valves are removed, from the front system only for cars having rear drums or from both sides for cars having 4 wheel discs.

2/ Remove the old master cylinder by unbolting at the booster and undoing the outlet pipes.

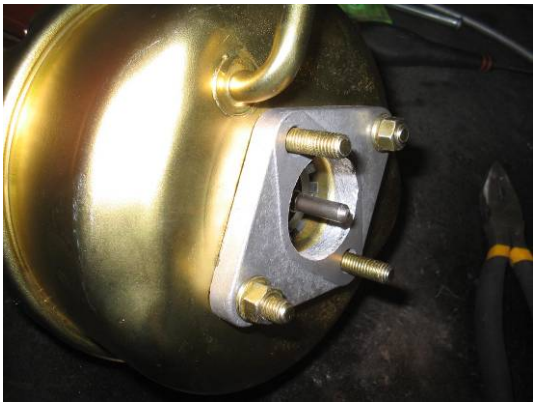
3/ On small Nissan cars and RX2, RX3, RX4 and early RX7 remove the alloy spacer block and grind/file a small amount from the inside diameter so the new master will fit into it.

4/ Screw the adjuster bolt on the booster outlet shaft all the way in.
Refit the alloy spacer block. It is easier if you remove the pushrod from the booster but be careful not to lose the reaction disc. This should set the pushrod so that it just touches the master cylinder as they are bolted home.



5/ At this point the booster pushrod should just neatly sit in the recess in the master cylinder so that that there is no preload on the master cylinder but also with no free-play between the push rod and the master cylinder piston. (This seems to work on most RX cars but if you feel any preload grind 1 mm or so off the end)

This will ensure that pedal travel is a minimum but the brakes will still release. Finish bolting the master cylinder onto the booster.



5/ The existing junction blocks and lines can be refitted, by bending the pipes down so they can reattach underneath. Use new 10mm banjo bolts and copper washers supplied by us.

6/One banjo bolt may need shortening so that it properly compresses the coppers washers and does not bottom out.

7/ Fill the master cylinder with brake fluid and bleed the system.
You will find it easiest if you **first** bleed all the air from the master by removing the bleed valves on the side of the master, have an assistant push the brake pedal down, hold two fingers over the outlet holes, then keeping

the fingers over the holes, let the pedal up, allowing brake fluid to be drawn down into the cylinder. Repeat several times until brake fluid with no air left is being expelled from the bleeder ports.
Refit and tighten the bleeder screws for now.

8/ Bleed the brakes at all wheels, in this case doing the front brakes first until all air is removed, then the rear brakes. Lastly again do a quick single bleed at the master cylinder and the front calipers to check for any remaining air. If you would like to check that the master cylinder is returning sufficiently you should open a bleeder at a caliper, or at the master cylinder fitting closest to the booster, and see that brake fluid slowly drips out. This shows that the compensating ports are not restricted.

9/ Check that you have a firm pedal and then check all connections for leaks before test-driving the car.

XA/XB Master Cylinders.

These are a very good adaptation to quite a few boosters but these don't have a circlip retaining the first piston set; it is free to fall out and will sit out a few mm in the relaxed position. These need to be preloaded a couple of mm as they are bolted to the booster. Too little and you get free travel in the pedal (plus they will leak) and too much and they will hold the brakes on.
When correct the piston will be level with the end of the master.
We suggest you might be able to carefully probe the first larger hole in the master to ensure the seal is not covering it, and another check is to fill the assembled master with brake fluid and watch that fluid drips out of the outlet, confirming that the port is not restricted.

When discussing XA/XB masters as fitted to Gemini boosters these came in three basic types; the early TX cars used remote fill reservoirs and a four-bolt mounting between master and booster. If you can keep the booster then we have a 1-inch remote fill master that is a straight bolt on.

Later TC to TE cars had a horizontal two-bolt arrangement. This is the typical Hot Rod set up and we find an XA/XB Falcon master fits, but you need to extend the output pushrod length to 74.5mm to correctly preload the master and repipe to 3/8 ball flare fittings, or use 3/8 to 10mm adapters.

The TF and TG series used an angle bolt master cylinder with a plastic reservoir, and to date we have not found a 1-inch replacement for this unit.

Pipe fittings

You may need to make new brake pipes or new flares to suit the new master. Most older type 1-inch tandem masters had imperial threads, later are metric.

Eg 1/ XA/XB were 3/16 UNF and used a ball flare, with a drill point seat in the master instead of a double flare seat.

Eg 2/ Holdens HK to early HZ had a ½ inch front and 9/16 rear with double flares and a residual valve under the brass seat for the rear drums. If fitting rear discs you should remove this valve. One way to do this is to screw a small self-tapper into the hole in the brass seat, pulling the seat out with a pair of pliers, discard the little rubber valve and spring, then refit the seat.

Eg 3/ Late 70's and 80's PBR master cylinders with the bolts on an angle and a plastic reservoir usually have 10mm and 12mm outlets, some with ball flares and some with double flares, usually with both proportioning valves and a brake fail switch all in the one unit. Check if yours is set for rear disc or drum brakes. (Some even do both with the same unit.)

As you are building a modified car with many variables beyond our control it is up to you to carefully determine the front/rear balance of your brakes and correct use and setting of a proportioning valve, be it a preset factory unit or an aftermarket adjustable unit.