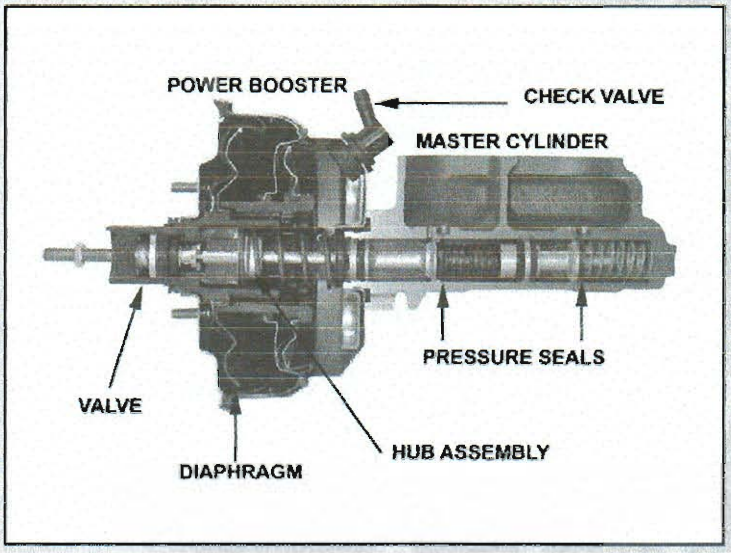
POWER BOOSTERS AND MASTER CYLINDERS

Your braking system is really quite simple in function. It can be divided into three segments:

1. The master cylinder and power booster
2. The disc brake calipers and rotors or drums
3. The valving

The **master cylinder** converts the force applied by your foot into hydraulic pressure which is then used to force a friction material against either the spinning rotor or drum. The master cylinder uses a rubber pressure seal to push the non compressible brake fluid which then moves a caliper or wheel cylinder piston. The disc brake caliper will squeeze the spinning rotor between two friction pads while the drum brake wheel cylinder forces a friction shoe against the drum. This friction converts the cars energy into heat as it slows down the vehicle. The rapid and efficient dissipation of this heat determines how well your vehicle will stop. If you use an inexpensive low quality pad or rotor, your stopping efficiency will be reduced. Always use a high quality component to assure yourself of the best in stopping efficiency. **Remember this: You get what you pay for!**

The **power booster** uses the vacuum produced by your engine to assist in the application of force to the master cylinder. The booster is divided into two halves by a rubber diaphragm. With no pedal pressure applied to the booster there will be vacuum on both sides of the diaphragm. When you step on the pedal, a valve on the firewall side of the booster opens allowing atmospheric pressure in. This pressure pushes the rubber diaphragm toward the master cylinder. A hub assembly in the center of the booster transfers this force to a steel rod which pushes the master cylinder piston. NOTE: A vacuum level lower than 18" will not allow the booster to operate correctly.



The amount of power assist that a booster produces is proportional to the diameter of the booster. The larger the booster can, the more assist it will produce. To reduce the size of the booster can, engineers came up with a dual diaphragm design. The use of two diaphragms produces significantly more assist than a single, thus allowing a smaller design.

When designing a power brake system always keep in mind that a disc brake system will require significantly more pressure than a drum system to operate effectively. It takes at least 800-1,000 psi to stop a spinning rotor. Never underpower a disc brake system. Even though the vehicle may appear to stop correctly under normal conditions, it may not stop in a panic situation. If you have any questions feel free to call us. That's what we're here for.

VALVES

The **valving** in a disc brake system is needed to supply the correct front to rear balance. There are three types of valves used in a braking system: metering, proportioning and residual.

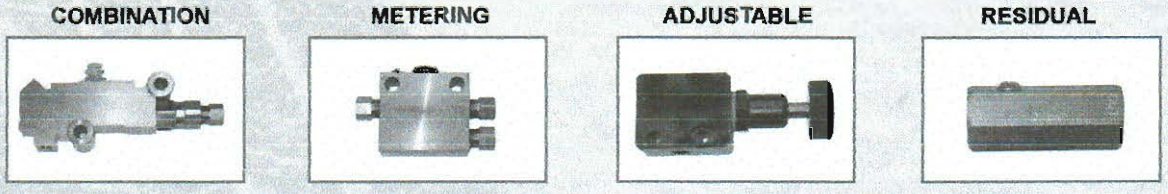
A **metering valve** is needed in the front disc portion of a disc/drum system to allow the rear drums to contribute to the braking. The rear drums react more slowly than the front discs. The metering valve retards the application of the front disc brakes slightly allowing the rears to catch up. Without a metering valve the car will nose dive and you will experience excessive front pad wear.

A **proportioning valve** modulates the pressure to the rear drum brakes. The modulation is necessary to minimize rear wheel lock-up found in heavy braking and to compensate for the difference in braking conditions in front disc/rear drum systems. As pressure is applied to the system, full pressure is allowed to the rear drums up to a certain point. Beyond that point pressure to the rear is limited, preventing rear wheel lock-up.

There are two types of **residual valves** used in a braking system. A **ten pound** residual valve will maintain line pressure to the rear drum brakes, giving a higher firmer pedal. Without this 10 lb. residual valve to the rear, you will experience a spongy pedal. A **two pound** residual valve is required whenever the master cylinder is lower than the disc brake calipers to maintain system pressure from the calipers to the master. These 2 pound valves are typically used when the master cylinder is mounted under the floor in a street rod application.

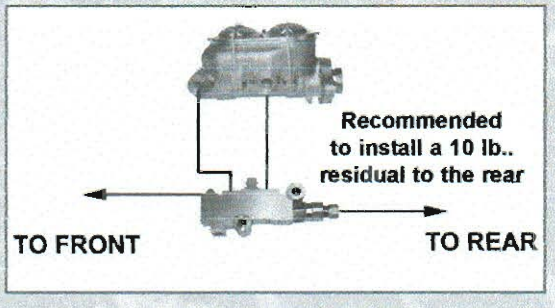
A **combination valve** incorporates metering and proportioning as well as a system failure switch into one valve. Combination valves are available for disc/drum and disc/disc applications.

An **adjustable proportioning valve** is used when you have a special rear condition that requires higher or lower pressure than normal conditions. You should always use a metering valve to the front when using the adjustable valve to the rear.

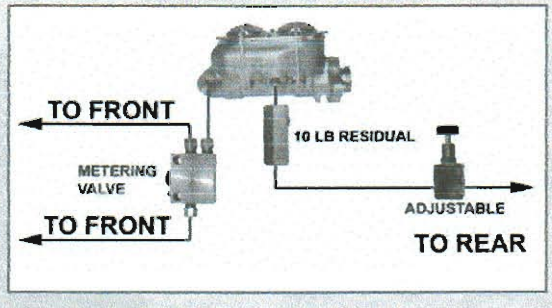


SOME TYPICAL VALVE INSTALLATIONS

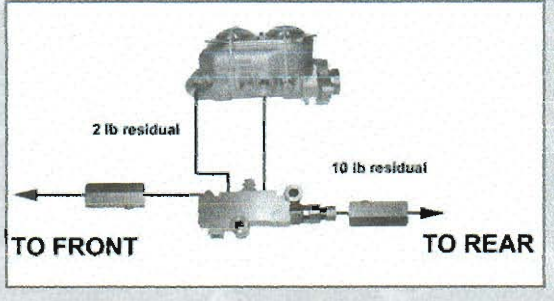
DISC/DRUM FIREWALL MOUNT
WITH COMBINATION VALVE



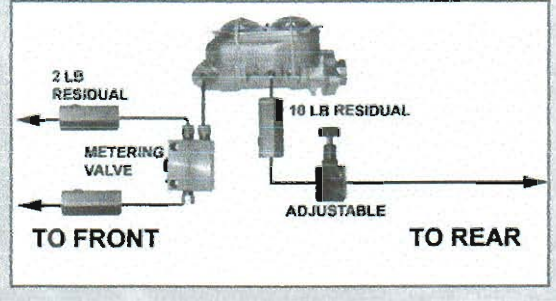
DISC/DRUM FIREWALL MOUNT
WITH ADJUSTABLE VALVE



DISC/DRUM UNDER FLOOR
WITH COMBINATION VALVE



DISC/DRUM UNDER FLOOR
WITH ADJUSTABLE VALVE



TROUBLESHOOTING BOOSTERS

WHAT TO DO IF YOU SUSPECT YOUR BOOSTER IS NOT WORKING

It is rare that one of our kits will contain a defective power booster but if you suspect that your booster is not functioning correctly perform the following tests:

BASIC TEST

1. With the engine off, depress and release the brake pedal several times to eliminate vacuum from the power section.
2. Depress the pedal and hold down with light pressure, 15 to 25 pounds.
3. Start engine.
4. If the power unit is operating the pedal will drop slightly. Less pressure will be needed to hold the pedal down.

IF BOOSTER IS NOT OPERATING, GIVING A VERY HARD PEDAL

1. Disconnect the vacuum hose from the booster check valve and check the vacuum level at this point with the engine running with a vacuum gauge. You should have at least 18" vacuum to the booster at idle in park. Anything lower will begin to give a hard pedal. If the vacuum level is too low you may be able to tune the engine and bring the vacuum level up to the proper level. If the vacuum level is around 16" the addition of a vacuum reserve canister will improve the braking. If the vacuum level is below 16" you will need to add an electric vacuum assist pump to supplement the engine vacuum.

2. If your vacuum level at the check valve is 18" check that the booster check valve is working. Disconnect the vacuum hose at the check valve and attach a piece of tubing. Blow into the valve. If air passes through, the valve is defective and must be replaced. Also look into the hose attachment neck on the check valve and be sure there is no obstruction inside the valve.

3. Check your booster for a vacuum leak. With everything hooked up run the engine at moderate speed. Release the accelerator and turn the engine off. Wait 90 seconds and apply the brakes. If the brake applications are power assisted there is no leak. If there is no power assist the booster is defective and must be replaced.

IF THE BOOSTER IS OPERATING, BUT YOU STILL HAVE A HARD PEDAL

1. Your combination valve may have tripped shutting off fluid flow to the front or rear brakes. This condition will produce a very hard pedal. Check that fluid passes through the valve to both the front and rear by cracking a bleeder screw and observing a good flow of fluid. If one half of the system does not have flow, re-center the valve.

2. You may have frozen rear wheel cylinders or frozen caliper pistons. If these components freeze you can get a very hard pedal.

3. Your pedal ratio may be too low. Check your pedal ratio. It must be between 4:1 to 5:1. Some of the older cars that had power brakes used a ratio of almost 1:1. If you add a vacuum booster to this type of car you will have a very hard pedal. Typically we are talking about late 50's cars. Adjust ratio as necessary.

4. Your booster may be undersized for the weight of the vehicle or the bore size of the master. If you try to use a small diameter booster such as a 7" street rod booster for a heavy car you will get a very hard pedal. Compounding the problem is an attempt to use a large bore master (1-1/4" or larger) on a small booster.

IF YOUR BRAKE PEDAL IS VERY SENSITIVE AND THE BRAKES GRAB

1. Your pedal ratio may be too high. Power brakes will require a 4:1 to 5:1 ratio. If your ratio is around 6:1 you are getting too much mechanical advantage making the brakes extremely sensitive. Adjust the ratio to correct level.

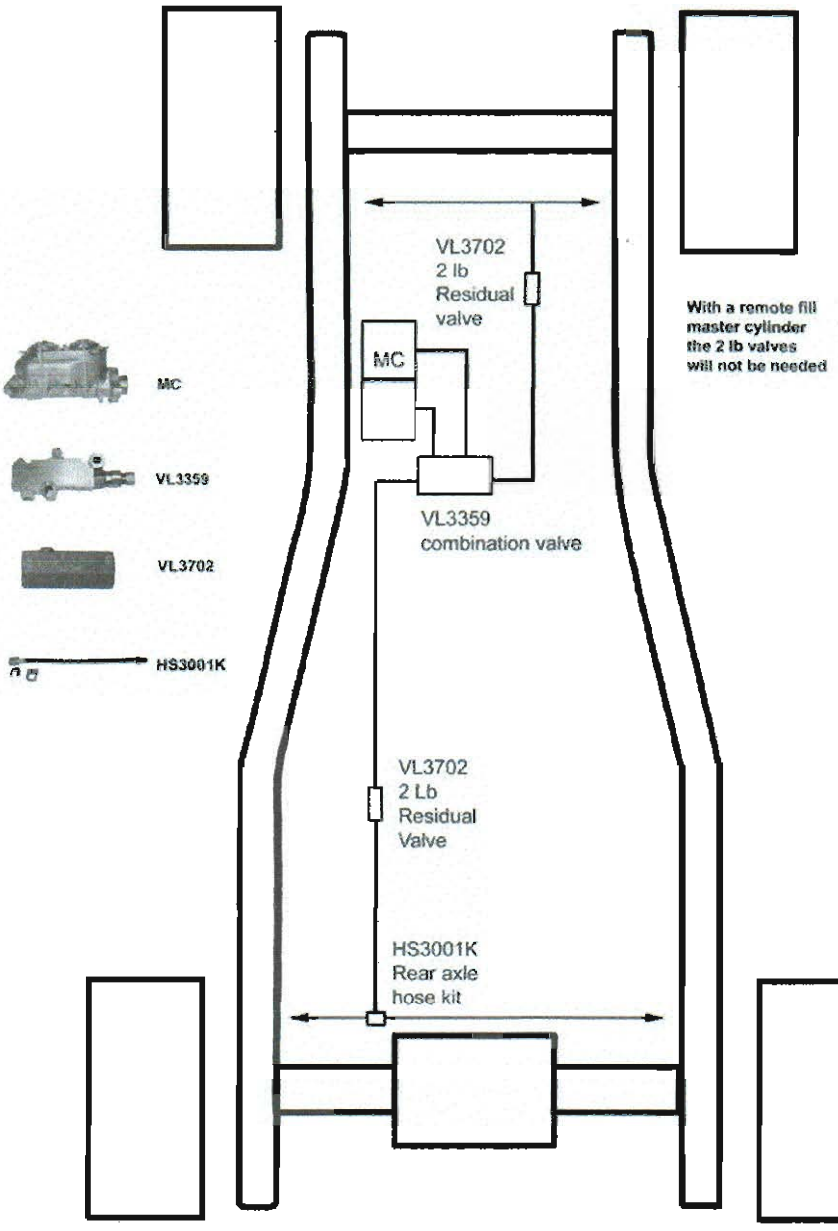
2. The booster may be too large for the weight of the vehicle. Lightweight vehicles with large boosters gives "touchy brakes". This effect may be dampened somewhat by going to a larger bore master.

3. Too large a booster for front drum brakes. Drum brakes do not require as much pressure as disc brakes (500 psi vs 1,000 psi) . If your booster is very large (11") and you have drum brakes you are overboosted. Do a pressure test to determine what you have.

4. The booster has a cracked internal hub. When there is a crack in the phenolic hub inside the booster, it will be either totally on or totally off. Any slight pressure to the pedal will cause the brakes to lock up. The booster must be replaced.

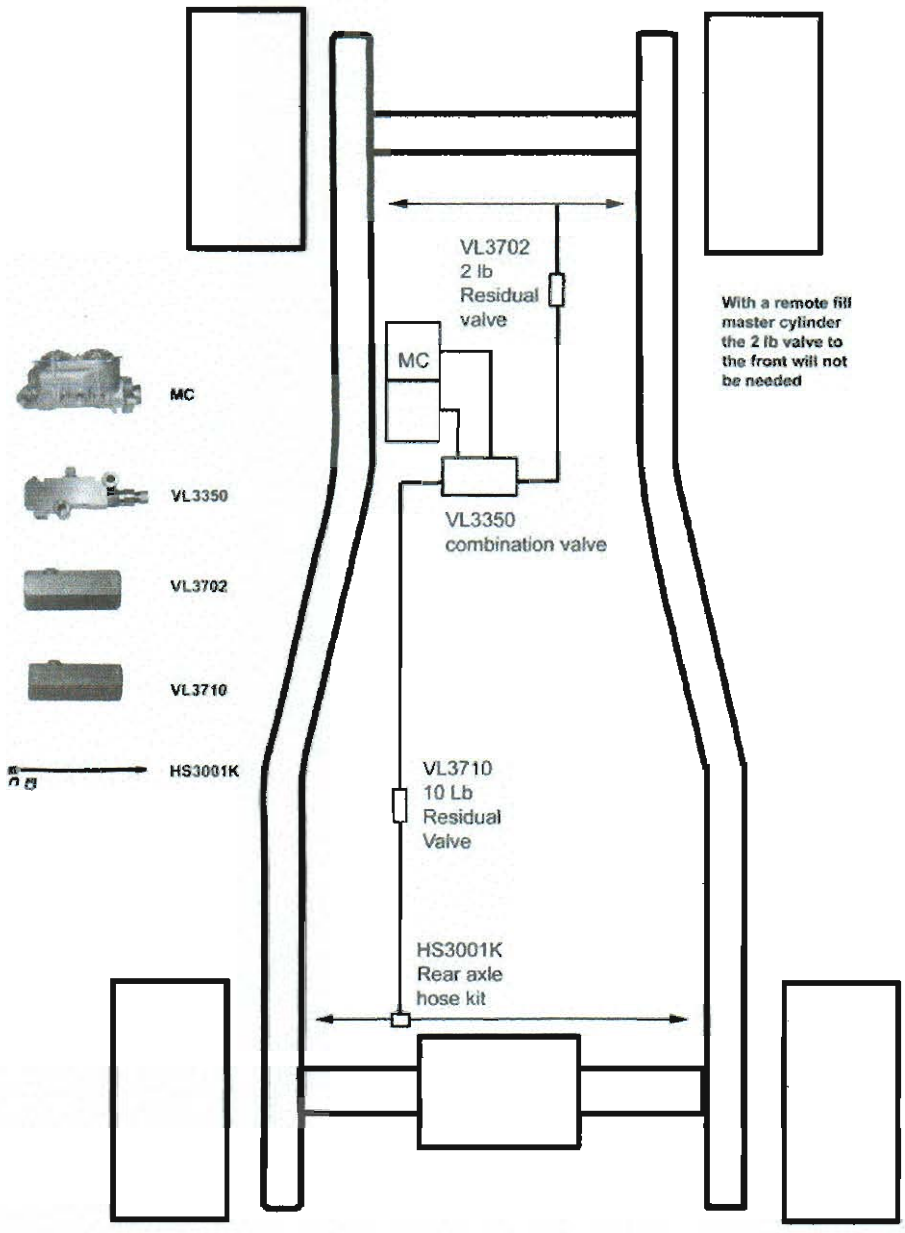
Typical plumbing for a disc/disc system on a street rod with the master under the floor

HOW TO PLUMB YOUR ROD FOR DISC/DISC SYSTEM AND MASTER UNDER FLOOR



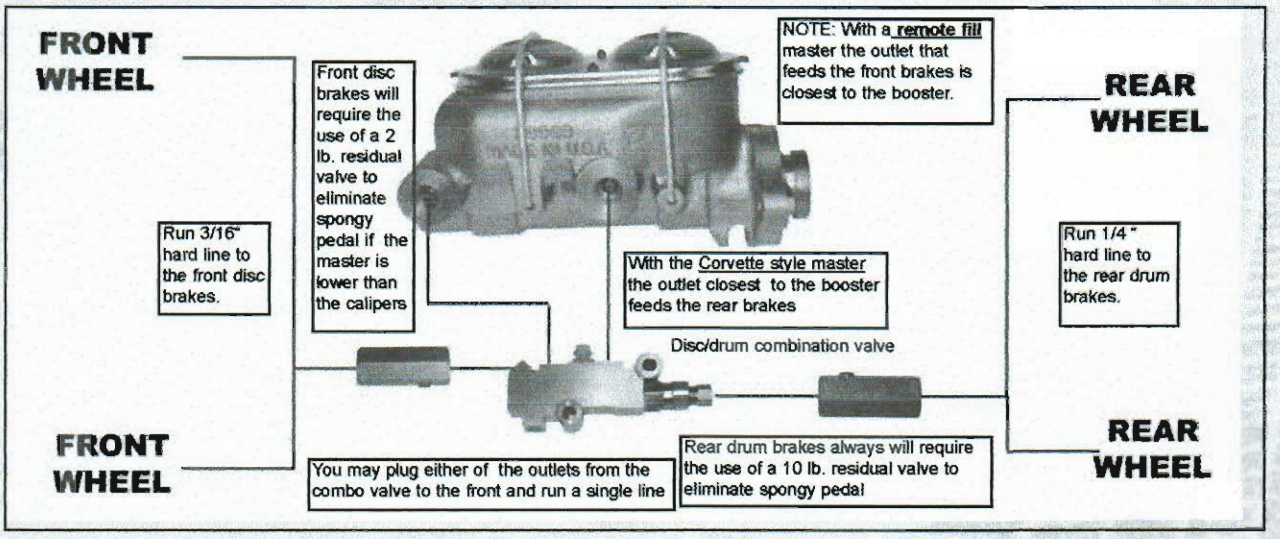
Typical plumbing for a disc/drum system on a street rod with the master under the floor

HOW TO PLUMB YOUR ROD FOR DISC/DRUM SYSTEM AND MASTER UNDER FLOOR

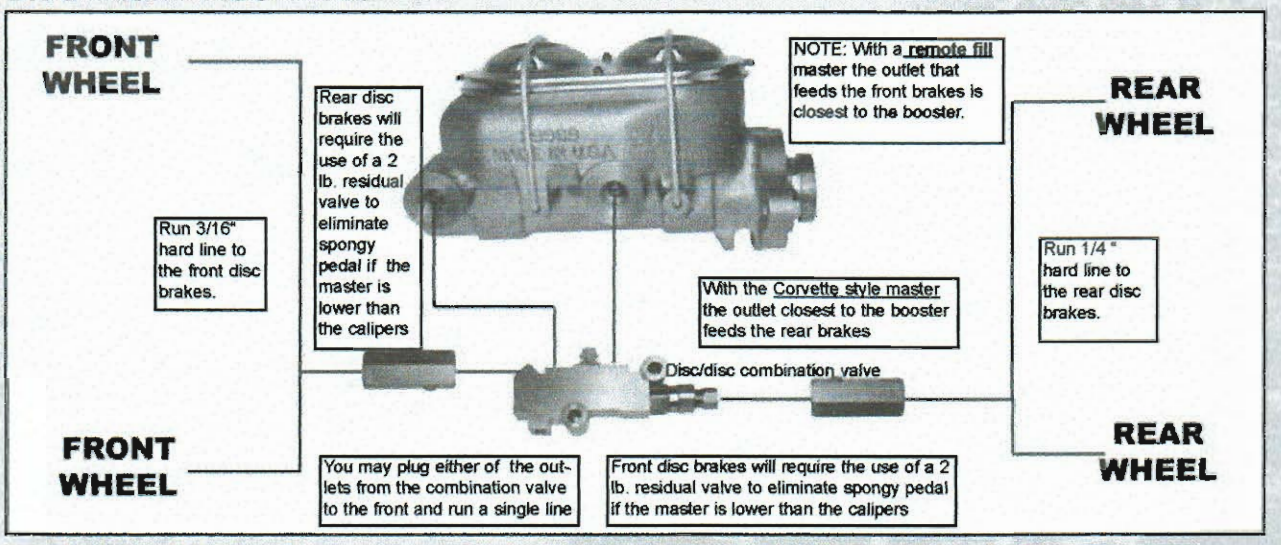


PLUMBING UNDER FLOOR SYSTEMS

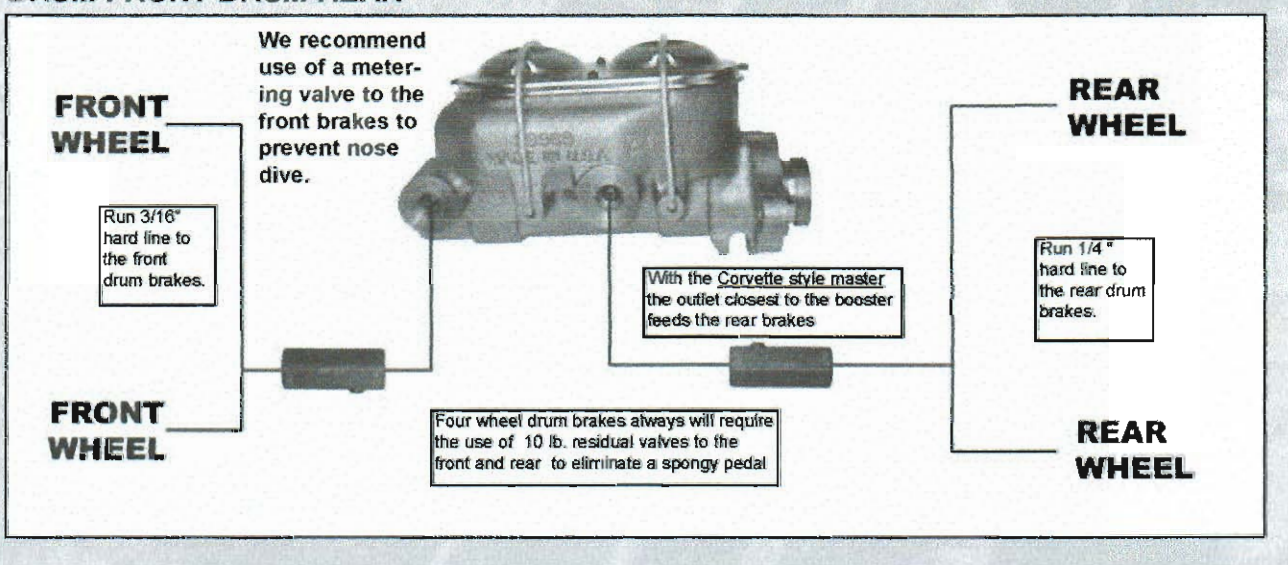
DISC FRONT DRUM REAR



DISC FRONT DISC REAR



DRUM FRONT DRUM REAR



POWER BRAKES WITH DISC FRONT AND DRUMS REAR

SPONGY PEDAL
Defective master
No residual valve to rear drums
Air in system
Small master cylinder bore diameter
Drums too large
Incorrectly arched shoes

HARD PEDAL
Defective booster
Low vacuum condition

NO PEDAL
Defective master
Booster pin too short
Air in system
Low drag calipers
Caliper bleeder screws not up

BRAKE DRAG
Booster pin too long
Frozen parking brake cable
Binding pedal linkage
Incorrectly adjusted drums
Drum master being used

MANUAL BRAKES WITH DISC FRONT AND DRUMS REAR

SPONGY PEDAL
Defective master
No residual valve to rear drums
Air in system
Small master cylinder bore diameter
Drums too large
Incorrectly arched shoes

HARD PEDAL
Master cylinder bore too large
Insufficient pedal ratio
Frozen wheel cylinder

NO PEDAL
Defective master
Air in system
Low drag calipers
Caliper bleeder screws not up

BRAKE DRAG
Manual brake push rod too long
Frozen parking brake cable
Binding pedal linkage
Incorrectly adjusted drums
Drum master used for disc brakes

POWER BRAKES WITH DISC FRONT AND DISC REAR

SPONGY PEDAL
Defective master
Air in rear calipers
Air in system
Not using 4 wheel disc master

HARD PEDAL
Defective booster
Low vacuum condition
Frozen booster linkage

NO PEDAL
Defective master
Booster pin too short
Air in rear calipers
Low drag calipers
Caliper bleeder screws not up
Rear calipers not adjusted

BRAKE DRAG
Booster pin too long
Frozen parking brake cable
Binding pedal linkage
Frozen caliper piston
Too much fluid in master

MANUAL BRAKES WITH DISC FRONT AND DISC REAR

SPONGY PEDAL
Defective master
Air in system
Not using 4 wheel disc master
Air in rear calipers

HARD PEDAL
Master cylinder bore too large
Insufficient pedal ratio

NO PEDAL
Defective master
Air in system
Low drag calipers
Caliper bleeder screws not up
Rear calipers not adjusted

BRAKE DRAG
Manual brake push rod too long
Frozen parking brake cable
Binding pedal linkage
Drum master used for disc brakes
Frozen caliper piston or wheel cylinder

TROUBLESHOOTING

HOW TO DIAGNOSE A BRAKE PROBLEM

If you have very poor brakes, a spongy pedal or no pedal at all you will have to do some diagnostics to determine where the problem is. Perform this simple test to find where the problem is:

1. Disconnect the brake lines from the master cylinder while leaving it on the vehicle.
2. Obtain solid plugs for the master cylinder outlets with the correct thread pitch.
3. Plug the master cylinder outlets and try the pedal. If the pedal remains firm then the master cylinder is good. If the pedal sinks to the floor then the cylinder is bad.
4. If the master cylinder is fine, connect the line to the front brakes. If the pedal remains firm then the problem is not coming from the front brakes.
5. Connect the rear and if the pedal goes bad then the problem is in the rear.

THE MOST COMMON REASONS FOR A POOR BRAKE PEDAL:

1. The bleeder screws on the front calipers not facing up.
2. Rear calipers not being bled properly.
3. Rear caliper parking brake / pistons not set properly.
4. No residual valve to rear drum brakes.
5. Master cylinder bore size too small for the system volume requirements.
6. Use of a disc/drum master for a 4 wheel disc system.
7. Low drag metric calipers without the use of a quick take up master cylinder.
8. Defective rebuilt master cylinder with pitted cylinder bore or defective pressure seals.
9. Drum brake wheel cylinders too large for the size of the master cylinder.
10. Silicone brake fluid which tends to trap air and can cause seals to swell.

POWER BRAKES WITH DRUMS FRONT AND DRUMS REAR

SPONGY PEDAL
Defective master
No residual valves
Air in system
Small master cylinder bore diameter
Drums oversized
Incorrectly arched shoes

HARD PEDAL
Defective booster
Low vacuum condition

NO PEDAL
Defective master
Booster pin too short
Air in system

BRAKE DRAG
Booster pin too long
Frozen parking brake cable
Binding pedal linkage
Incorrectly adjusted drums

MANUAL BRAKES WITH DRUMS FRONT AND DRUMS REAR

SPONGY PEDAL
Defective master
No residual valves
Air in system
Small master cylinder bore diameter
Drums too large
Incorrectly arched shoes

HARD PEDAL
Master cylinder bore too large
Insufficient pedal ratio
Frozen wheel cylinder

NO PEDAL
Defective master
Air in system

BRAKE DRAG
Manual brake push rod too long
Frozen parking brake cable
Binding pedal linkage
Incorrectly adjusted drums

DISC BRAKES

Q. Why are disc brakes better than drum brakes?

A. Disc brakes are not subject to fade from excessive heat or moisture. Also, they do not drift out of adjustment like drum brakes.

Q. I have drum brakes now with 14" wheels, if I change to disc brakes can I keep the wheels?

A. In most cases no. Typically you will need to go to a 15" wheel when converting to disc brakes. However you may be able to find a 14" disc brake wheel if you search.

Q. Do disc brakes require more pressure than drum brakes?

A. Yes. Disc brakes require significantly more pressure than drum brakes. For disc brakes to operate properly you will need at least 1000 psi.

Q. Can I use my drum brake master cylinder for disc brakes?

A. No, for two reasons. you will not be able to provide enough fluid pressure or volume and the drum master will have a residual valve that will cause the disc brakes to drag.

Q. Can I run disc brakes with a non power assisted master?

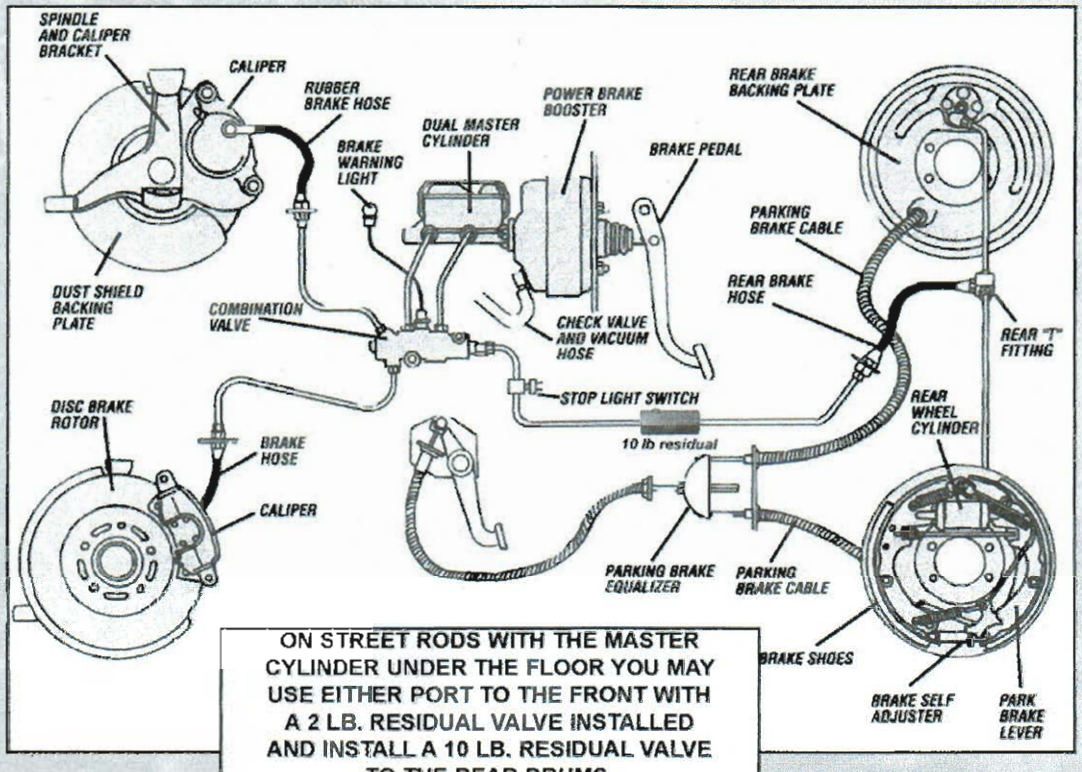
A. Yes, but the bore size of the master cylinder must not be larger than 1" and your pedal ratio must be 5:1.

Q. If I add disc brakes to the front will I have to change my valving?

A. Yes. You must use a disc/drum combination valve.

Q. I have converted my car to disc brakes and now I can't get a pedal no matter how much I bleed it. What could cause this?

A. Check the bleeder screw orientation on the calipers. The bleed hole in the caliper must be in the 12:00 position to allow all air to escape.



ON STREET RODS WITH THE MASTER CYLINDER UNDER THE FLOOR YOU MAY USE EITHER PORT TO THE FRONT WITH A 2 LB. RESIDUAL VALVE INSTALLED AND INSTALL A 10 LB. RESIDUAL VALVE TO THE REAR DRUMS.

FREQUENTLY ASKED QUESTIONS

VALVING

Q. Why do you need valving in a brake system?

A. Valving is needed to properly balance your braking system and to insure that all components are synchronized.

Q. What will happen if I don't use any valves?

A. You may experience a number of different problems such as rear wheel lock up, nose dive, excessive front pad wear, spongy pedal and very poor stopping.

Q. What does a proportioning valve do?

A. A proportioning valve is used in the rear drum brakes of a disc/drum system to prevent the rear wheels from locking up under severe braking conditions.

Q. What does a metering valve do?

A. A metering valve or hold-off valve is used to the front of a disc/drum system to hold off the application of the faster-reacting disc brakes. This allows the slower rear drums to catch up and contribute to the braking.

Q. What does a 10 lb. residual valve do?

A. A 10 lb. residual valve in a drum brake system will maintain line pressure to the rear drum brakes, giving a higher firmer pedal.

Q. What is a combination valve?

A. A combination valve has metering and proportioning as well as a system failure switch within one valve body. It's a later technological development by vehicle manufacturers to simplify your braking system.

Q. Should I use an adjustable proportioning valve?

A. It's advisable to use the pre-set combination valve whenever possible, however if you use the adjustable valve be sure to include a metering valve to the front brakes to balance the system.

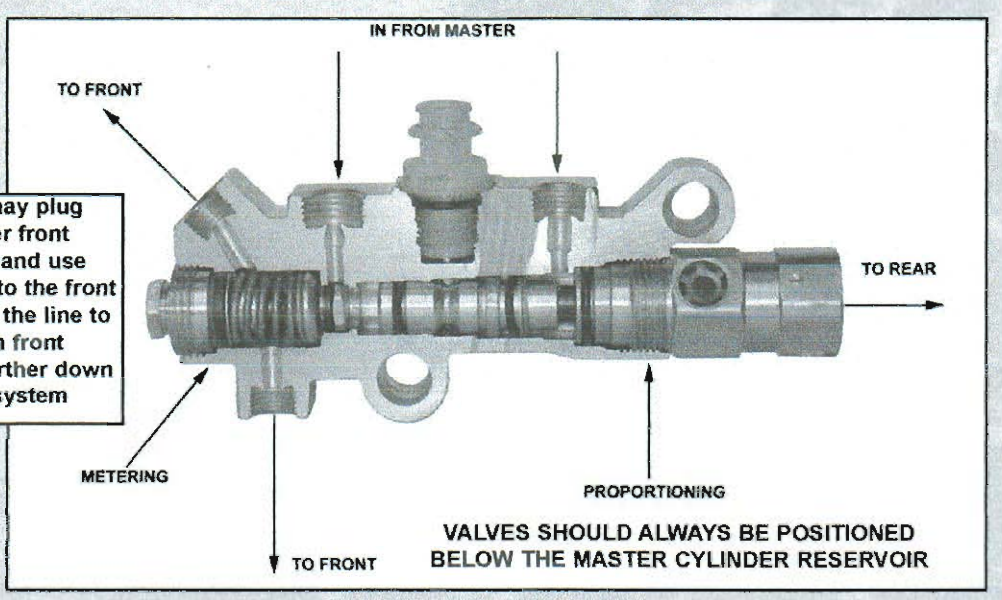
Q. Why do I need a 2 lb. residual valve when my master cylinder is mounted under the floor on a street rod?

A. The 2 lb. residual valve is used with disc brakes to maintain system pressure from the calipers to the under floor master cylinder, eliminating spongy pedal.

Q. Do I need a proportioning valve with drum brakes.

A. No, a proportioning valve is only needed for disc/drum systems, but it is advisable to use a metering valve to the front with 4 wheel drums.

THE COMBINATION VALVE



MASTER CYLINDERS

Q. How can I tell if my master cylinder is bad?

A. When your master cylinder goes bad you will have a very spongy pedal and if you keep pressure on the brake pedal it will slowly sink to the floor.

Q. What's the advantage of replacing my original single piston master cylinder with a dual piston?

A. Safety. If you break a line with a dual piston master cylinder you will still have 1/2 the system available as a backup. With a single piston master you will lose all your brakes.

Q. Should I purchase a new or rebuilt master cylinder?

A. Given the opportunity choose the new over the rebuilt. The additional cost of a new master is easily justified by the fact that new master cylinders have a much lower failure rate than a rebuilt.

Q. Can I use a replacement master cylinder that doesn't look like the original?

A. Probably yes. Many aftermarket master cylinders have a different casting but internally they are the same. Avoid cheap masters!

Q. How does a disc brake master cylinder differ from a drum brake master?

A. A drum brake master will differ from a disc brake master in two ways. The amount of fluid that a drum brake master moves is less than that moved by a disc master and drum masters have 10 lb. residual valves to the drums. If you use a drum master for disc brakes you would move an insufficient volume of fluid and the disc brakes would drag because of the residual valves.

Q. What is the difference between a power brake master and a manual brake master cylinder?

A. As a general rule, a power brake master cylinder will have a larger bore diameter than a manual brake master. Also, a manual master will usually have a deep piston hole to accept the manual brake push rod while a power brake master will normally have a shallow hole.

Q. What bore size and pedal ratio is needed for a manual brake master cylinder?

A. For manual brakes you should always use a master cylinder with a bore size 1" or smaller with a pedal ratio of 6:1.

Q. I have manual brakes with an extremely hard pedal. Why?

A. Check the bore size of the master, it's probably larger than 1". Also check that your wheel cylinders are not frozen.

Q. Can I use my disc/drum master for four wheel disc brakes?

A. No. The addition of rear disc brakes requires a true four wheel disc brake master cylinder which will supply more fluid pressure and volume to the rear calipers.

Q. Why is one chamber in a disc/drum master larger than the other?

A. The master cylinder chamber that feeds the front disc brakes will have its fluid level drop faster than the drum brake chamber because the front pads wear faster allowing the caliper pistons to extend outward.

Q. Can I use my manual brake master cylinder on a power booster?

A. Yes. However you must be sure that the booster pin length matches the hole depth of the master cylinder pistons.

Q. Can I use my power brake master cylinder for manual brakes?

A. No. The bore size of the power master will probably be too large and the piston hole depth will be too shallow.

Q. How do I increase my pedal ratio when I convert from power to manual brakes?

A. Attach the manual brake push rod 1" higher on the pedal than the power brake attachment point.

Q. Do I need to bench bleed my master cylinder before installing it?

A. Yes, always bench bleed before installation.

FREQUENTLY ASKED QUESTIONS

POWER BOOSTERS

Q. How much power assist should I expect from my power booster?

A. Typically you would want about 1000-1100 psi of power assist from your booster with a disc brake car. A lower amount of assist is acceptable for drum brakes since they will require less pressure.

Q. What size booster will I need?

A. Since the size of the power booster will determine the amount of assist, the weight of your vehicle and the type of brakes you have will factor into this equation. A heavy vehicle needs a larger booster than a lighter one and disc brakes require more pressure than drum. Call us to help you determine which booster will work best for your application.

Q. How much vacuum is needed for the booster to operate properly?

A. You should always **maintain at least 18" of vacuum at idle in park**. Anything less will start to give you a hard pedal and poor braking.

Q. Where do I get vacuum from?

A. You can pull vacuum from the intake manifold or the back of the carburetor. You may also use an auxiliary vacuum pump as a supplement or the sole source.

Q. Is there any way to decrease the size of a booster and still provide adequate assist?

A. Yes. By going to a dual diaphragm design you may achieve this. We offer dual diaphragm boosters for most applications.

Q. What will happen if my booster is undersized?

A. You will be able to stop gradually but you will have very poor brakes in a panic stop situation.

Q. What are the symptoms of a bad booster?

A. A bad booster will make your pedal very hard and the vehicle will feel like it will not stop.

Q. I have a radical cam and the low vacuum condition it causes prevents my booster from working. What are my options?

A. In this situation there are only two options that will work. You must either remove the booster and go to manual brakes or add an accessory electric vacuum pump.

Q. Will a reserve canister work?

A. Reserve canisters for vacuum rarely help much.

Q. How do I check if my booster is working correctly?

A. Shut off the engine. Depress the pedal a few times to evacuate the booster. Apply a steady pressure to the brake pedal and start the engine. If the booster is working the pedal will fall slightly.

Q. Can I use a power booster with drum brakes?

A. Yes. A power booster will work fine with drum brakes.

Q. I have installed a power booster on my car and now the brakes drag.

A. Check the length of the booster pin that pushes on the master cylinder. If this pin is too long the brakes will drag. Shorten the pin as necessary.

Q. Will I need a special booster for four wheel disc brakes?

A. A four wheel disc brake system will require more pressure than a disc/drum system. Generally speaking a dual diaphragm booster will be needed for four wheel disc brakes. Remember....the larger the better!

Q. Can I rebuild my own booster?

A. This is not recommended. A power booster is a very complex piece and it should only be repaired by an experienced technician.

Q. Can I use a Ford master cylinder on a GM booster?

A. No. The mounting flange spacing will be a different size depending on who produced the master cylinder.

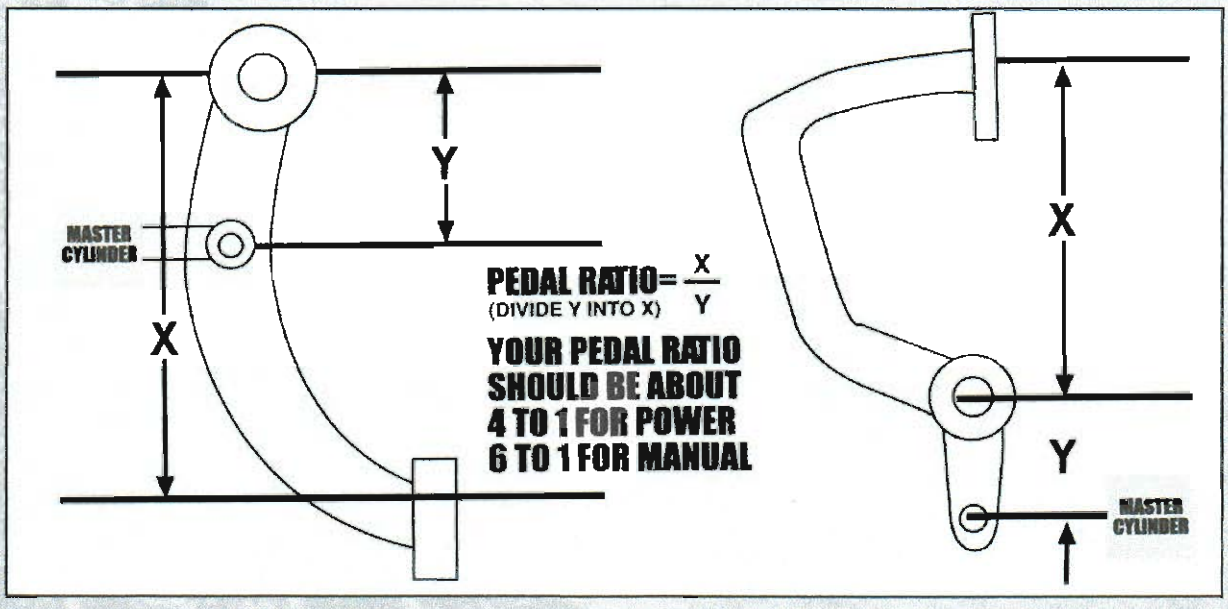
PEDAL RATIO

Your pedal ratio is important for either power or manual brake systems. With a power brake system if your pedal ratio is too high, you will have sensitive brakes, and if it's too low, your braking will be poor. With a manual brake system the same will apply, although too high a pedal ratio is rarely a problem.

As a general rule of thumb your pedal ratio should not exceed:

6:1 for manual brakes with a 1" bore master cylinder
4:1 for power brakes with a 1-1/8" bore master cylinder

HOW TO CALCULATE YOUR PEDAL RATIO



MODIFYING YOUR BRAKE SYSTEM

Your vehicle's brake system is really very simple, yet you can get into trouble very easily when you start modifying it or try to correct a problem by switching parts. You usually can't change just one component without affecting the way the whole system operates. Pedal ratio and the ratio between the bore sizes of the master cylinder, caliper pistons and wheel cylinders are all critical to maintaining the correct system pressure, and safe braking performance.

Most people get into trouble doing a disc brake conversion and not changing the drum brake master cylinder to the correct disc brake master. Usually disc brake masters are sized differently to compensate for the increased capacity and surface area of a disc brake caliper piston. Disc brake master cylinders also don't have built in residual pressure valves like drum brake masters. When you change rear axles and have drum brakes, you also have to be careful of wheel cylinder size. It is easy to wind up with either too much or not enough rear brakes if the rear wheel cylinders are not sized to the master cylinder you are using.

Above all, if you are doing a disc brake conversion on a 40s, 50s or 60s car, **DON'T USE THE ORIGINAL SINGLE RESERVOIR MASTER CYLINDER!** There is a good reason that Detroit switched to dual brake systems in the sixties - if you lose a brake line on a dual system you still have half of the brakes - on a single system you will have none! Unless you are doing a 100 point restoration and are going to trailer your car around, switch to a dual master cylinder, even if you are restoring the original drum brake system.

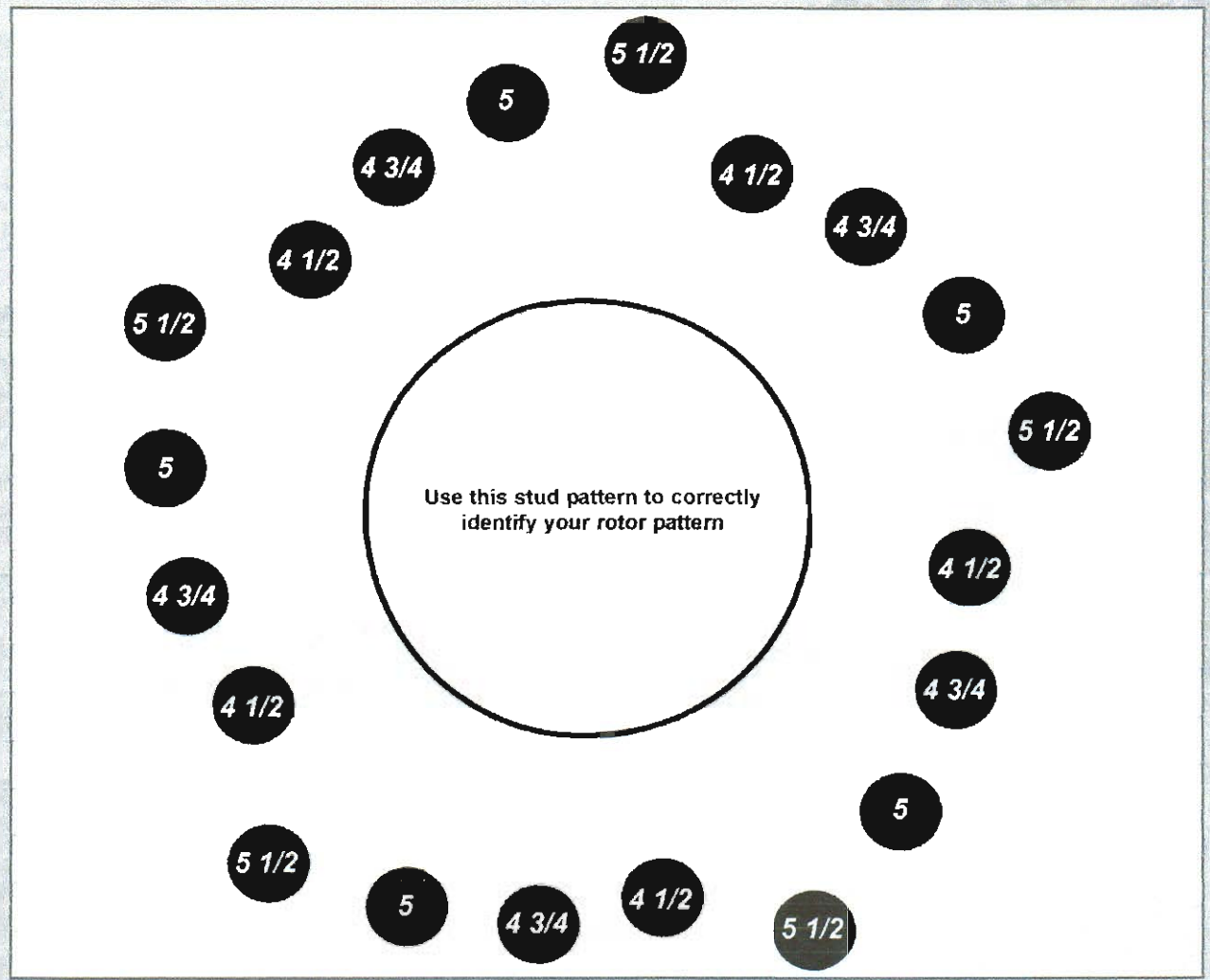
Just remember, whether you buy the parts from us or the salvage yard, treat your brakes as a complete system. All components must be compatible to give you safe, high performance braking. If you have any questions, call us and we can help you design your brake system and do it right the first time!

CALIPERS AND ROTORS

The **caliper and rotor** in a disc brake system have the function of converting the car's energy into heat to stop the vehicle. This is accomplished when the hydraulic pressure generated by the master cylinder forces the caliper piston to clamp the rotor between the brake pads. The friction generated by this generates heat. It's the effective dissipation of this heat that provides effective stopping. Master Power Brakes uses only the highest quality components in our braking systems giving you high friction and rapid dissipation of heat.

Three designs of calipers are used in the disc brake kits we offer. Most of our kits use a single piston caliper. This design is very simple and very reliable. One side of the caliper has a fixed pad while the other side holds a pad against the movable caliper piston. Another caliper design used in a few of our kits is the dual piston. It works the same as the single piston design, except with two pistons on the movable side. The third caliper design we use in a few kits is the four piston. This design uses four smaller caliper pistons which squeeze the rotor between two movable pads. The advantage of this design is a higher clamping pressure and a pad with more surface area. For almost all street applications the single piston caliper will work fine.

All rotors used in our disc brake kits are high quality rotors which meet original equipment specs for material composition and cooling vane configuration. All are of the vented design which allows for a quicker dissipation of heat. This quick dissipation of heat will eliminate fade.



TROUBLE SHOOTING POWER BRAKES

BASIC TEST

ENGINE OFF. Depress and release brake pedal several times to remove vacuum from power section

Depress pedal and hold with light pressure, 15 to 25 lbs., and START ENGINE

If power section is operating, pedal will fall slightly and then hold. Less pressure will be needed to hold pedal down.

IF POWER SECTION IS NOT OPERATING – disconnect vacuum hose from power section vacuum valve. Then, with ENGINE RUNNING, check vacuum supply with a vacuum gauge. There should be at least 14 inches of vacuum.

IF VACUUM SUPPLY IS BELOW 14 INCHES – replace or repair vacuum hose and vacuum fittings. Also, tune or repair engine as required.

When adequate vacuum supply is obtained, repeat BASIC TEST.

IF VACUUM SUPPLY IS 14 INCHES OR MORE – power section is defective and should be replaced.

IF POWER SECTION IS OPERATING – do the following VACUUM LEAK TEST.

VACUUM LEAK TEST

Run engine to medium speed. Release accelerator and turn ENGINE OFF. This builds up vacuum.

Wait 90 seconds and apply brakes. Two or more applications should be power assisted.

IF APPLICATIONS ARE NOT POWER ASSISTED – disconnect vacuum hose from intake manifold or power section check valve, whichever is easier. If disconnected at check valve, attach a short length of hose to valve.

Blow into hose attached to check valve. If air passes through, valve is defective.

IF VALVE IS DEFECTIVE – install new check valve and repeat the VACUUM LEAK TEST.

IF CHECK VALVE IS O.K. – power section is leaking and should be replaced.

IF APPLICATIONS ARE POWER ASSISTED – there is no vacuum leak. Do the following HYDRAULIC LEAK TEST.

HYDRAULIC LEAK TEST

Depress and release brake pedal several times. Then hold pedal depressed with medium pressure, 25 to 35 lbs.

IF PEDAL DOES NOT FALL AWAY – hydraulic system is not leaking.

IF PEDAL FALLS AWAY – hydraulic system is leaking. Check for external leakage at wheel cylinders, hydraulic lines and hoses. If there is no external leak, there may be an internal leak (master cylinder cups).

Dual Master Cylinder Test Procedure

Disc brake side of master requires min. 700 psi. Drum brake side requires min. 400 psi.

Insert "T" fitting in brake line at hose connection. → Good pressure. Test other system.

NO LOW PRESSURE

Disconnect "T" fitting. Connect gauge to feed line. → Good pressure. Pedal ratio too high or not enough master cylinder capacity.

NO LOW PRESSURE

Connect gauge directly to master cylinder outlet port. → Bad proportioning valve.

NO LOW PRESSURE

Bad master cylinder.

Bleed system and/or gauge line at each step. Make sure bleeder fitting is above gauge to eliminate all the air in the system.