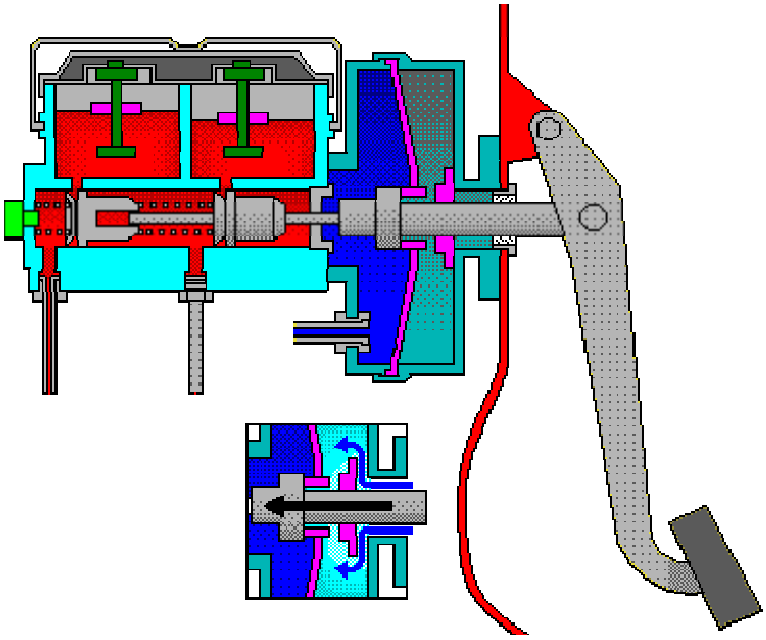
Brake System Operation



Below is an explanation of this system's operation

Master Cylinder

The master cylinder displaces hydraulic pressure to the rest of the brake system. It holds THE most important fluid in your car, the brake fluid. It actually controls two seperate subsystems which are jointly activated by the brake pedal. This is done so that in case a major leak occurs in one system, the other will still function. The two systems may be supplied by seperate fluid reservoirs, or they may be supplied by a common reservoir. Some brake subsystems are divided front/rear and some are diagonally separated. When you press the brake pedal, a push rod connected to the pedal moves the "primary piston" forward inside the master cylinder. The primary piston activates one of the two subsystems. The hydraulic pressure created, and the force of the primary piston spring, moves the secondary piston forward. When the forward movement of the pistons causes their primary cups to cover the bypass holes, hydraulic pressure builds up and is transmitted to the wheel cylinders. When the brake pedal retracts, the pistons allow fluid from the reservoir(s) to refill the chamber if needed.

Electronic sensors within the master cylinder are used to monitor the level of the fluid in the reservoirs, and to alert the driver if a pressure imbalance develops between the two systems. If the brake light comes on, the fluid level in the reservoir(s) should be checked. If the level is low, more fluid should be added, and the leak should be found and repaired as soon as possible. BE SURE TO USE THE RIGHT BRAKE FLUID FOR YOUR VEHICLE. Use of improper brake fluid can

"contaminate the system". If this occurs, ALL of the seals in the brake system will need replacement, and that is usually a VERY expensive operation.

Brake Warning System

The brake warning system has been required standard equipment since 1970, and is connected to the master cylinder. It monitors differences in pressure in the brake lines of the two hydraulic sub-systems, and alerts the driver with a light if an imbalance occurs. When you turn the key to the Ignition position, the brake warning light on the dash comes on during a "self-test". You should not drive a car if the warning light does not come on during the startup self test.

The brake system is divided into two sub-systems to increase safety. A pressure differential switch, connected to the warning light, is positioned between the two. If a major leak occurs, and therefore pressure in one of the lines is sharply reduced, pressure from the other side forces a piston to move, activating the pressure differential switch and turns on the dashboard warning light.

There are two types of pressure differential switches; mechanical or hydraulic. Mechanical switches are activated by excessive brake travel. Hydraulic switches are activated by a difference in pressure between the front and rear system. When pressure in one of the lines is sharply reduced, pressure from the other side forces a piston to move. A plunger pin then drops into a groove in the piston, activating a switch that turns on a dashboard warning light.

The brake warning light is also connected to the brake fluid level sensors in the master cylinder reservoir(s). If the brake warning light comes on, the fluid level should be checked. If the level is low, more fluid should be added, and the leak should be found and repaired as soon as possible. BE SURE TO USE THE RIGHT FLUID. NEVER IGNORE THE BRAKE WARNING LAMP, AND ALWAYS NOTE WETHER IT WORKS DURING THE STARTING SELF-TEST.

Power Brakes

Power brakes (also called "power assisted" brakes) are designed to use the power of the engine and/or battery to enhance braking power. The four most common types of power brakes are: vacuum suspended; air suspended; hydraulic booster, and electro-hydraulic booster. Most cars use vacuum suspended units (vacuum boosters), which employ a vacuum-powered booster device to provide added thrust to the foot pressure applied.

In a vacuum booster type system, pressure on the brake pedal pushes forward a pushrod connected to the pistons within the master cylinder. At the same time, the pushrod opens the vacuum-control valve so that it closes the vacuum port and seals off the forward half of the booster unit. The engine vacuum line then creates a low-pressure vacuum chamber. Atmospheric pressure in the control chamber then pushes against the diaphragm. The pressure on the diaphragm forces it forward, supplying pressure on the master cylinder pistons.

Hydraulic booster systems usually tap into the power steering pump's pressure, and use this power to augment pressure to the master cylinder. Electro-hydraulic booster

systems use an electric motor to pressurize a hydraulic system which augments pressure to the master cylinder. This allows the vehicle to have power assisted brakes even if the engine quits.

You may wish to compare the difference between power and non-assisted braking in a safe area; while driving slowly, turn the ignition key off (don't turn it into the locked position, because the steering wheel will lock, which is highly unsafe.) As the car coasts along, press the brakes hard. The force of your foot is now the only thing stopping the car. The safe driver is always ready to apply the total force needed to stop their vehicle, even if the engine quits (thereby removing the power assist).

Filler Cap (Brake Fluid Reservoir Cover)

The cap on the brake fluid reservoir has a hole for air, or is vented, to allow the fluid to expand and contract without creating a vacuum or causing pressure. A rubber diaphragm goes up and down with the fluid level's pressure, and keeps out any dust or moisture. If the cap's seal becomes distorted, it usually indicates a brake fluid contamination problem.

Vacuum From The Engine

Engine intake manifold vacuum is used for augmenting the foot's braking power in vacuum assisted power brakes. This vacuum is created by the pistons as they draw downward, sucking air into the cylinders. When you push the brake pedal down, the vacuum control valve lets the engine draw a vacuum in the front section of the booster unit. The atmospheric pressure on the other side of the diaphragm provides significant additional braking force.

Brake Fluid

Brake fluid is a special liquid for use in hydraulic brake systems, which must meet highly exact performance specifications. It is designed to be impervious to wide temperature changes and to not suffer any significant changes in important physical characteristics such as compressibility over the operating temperature range. The fluid is designed to not boil, even when exposed to the extreme temperatures of the brakes.

Different types of brake fluid are used in different systems, and should NEVER be mixed. Most cars use "DOT 3" or "DOT 4" brake fluid. Some newer cars use silicone brake fluids. These should NEVER be mixed together, because the seals in each car are designed to work with only their specific fluid types. For example, the mixing of "Silicone" brake fluid and conventional glycol based DOT 3 or DOT 4 fluids should be avoided, as the two fluid types are not miscible (they will not mix together). DOT 3 brake fluids and DOT 4 brake fluids can be mixed.

One of the WORST things that can happen to your car is if the brake fluid becomes contaminated, because the seals are designed to work with only pure brake fluid. "System contamination" means that all of the piston seals and hoses are deteriorating, and therefore must be replaced, a MAJOR expense. So, be VERY careful what you put in the master cylinder reservoir!

It should be noted that brake fluid is highly corrosive to paint, and care should be used not to get it on your car's finish.

The brake fluid in your car should be changed every (See Owners Manual) to prevent corrosion of the braking system components.