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POWER BRAKE UNIT OPERATION, DIAGNOSIS, AND SERVICE

Figure 105-1 Typical vacuum brake booster assembly. The vacuum hose attaches to the intake manifold of the engine. The brake pedal travel sensor is an input sensor for the antilock braking system.

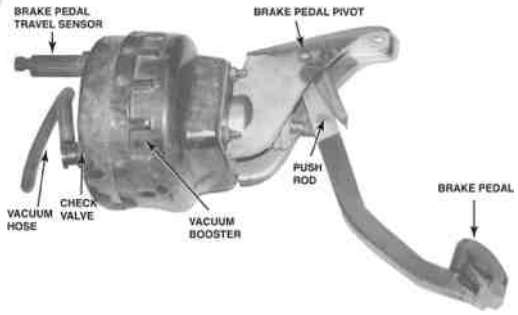

Figure 105-2 A wide brake pedal allows two-foot braking if power assist is lost.

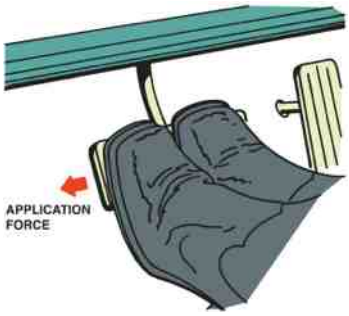

Figure 105-3 Atmospheric pressure varies with altitude.

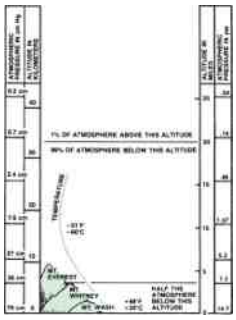

Figure 105-4 A belt-driven auxiliary vacuum pump.

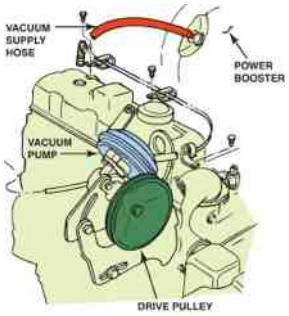

Figure 105-5 An electrically powered vacuum pump.

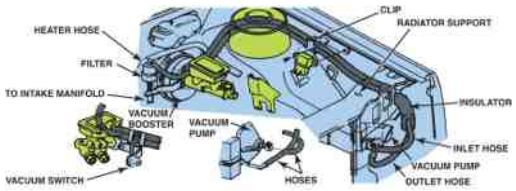

Figure 105-6 Vacuum brake boosters operate on the principle of pressure differential.

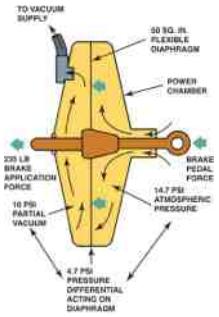

Figure 105-7 The charcoal filter traps gasoline vapors that are present in the intake manifold and prevents them from getting into the vacuum chamber of the booster.

TECH TIP

Check the Vacuum, Then the Brakes

A customer complained of a very rough idle and an occasional pulsating brake pedal. The customer was certain that the engine required serious work since there were over 150,000 miles on the vehicle. During the troubleshooting procedure, a spray cleaner was used to find any vacuum (air) leaks. A large hole was found melted through a large vacuum hose next to the vacuum hose feeding the vacuum-operated power brake booster.

After repairing the vacuum leak, the vehicle was test driven again to help diagnose the cause of the pulsating brake pedal. The engine idled very smoothly after the vacuum leak was repaired and the brake pulsation was also cured. The vacuum leak resulted in lower-than-normal vacuum being applied to the vacuum booster. During braking, when engine vacuum is normally higher (deceleration), the vacuum booster would assist, then not assist when the vacuum was lost. This on-and-off supply of vacuum to the vacuum booster was noticed by the driver as a brake pulsation. Always check the vacuum at the booster whenever diagnosing any brake problems. Most vehicle manufacturers specify a minimum of 15 in. Hg of vacuum at the booster. The booster should be able to provide at least two or three stops even with no vacuum. The booster should also be checked to see if it can hold a vacuum after several hours. A good vacuum booster, for example, should be able to provide a power assist after sitting all night without starting the engine.

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Figure 105-8 (a) Many vacuum brake booster check valves are located where the vacuum hose from the engine (vacuum source) attaches to the vacuum booster.

(a)

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Figure 105-8 (b) This one-way valve prevents the loss of vacuum when the engine is off. The diaphragm inside allows air to flow in one direction only.

(b)

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Figure 105-9 Not all check valves are located at the vacuum line to the booster housing connection. This vehicle uses an inline check valve located between the intake manifold of the engine and the vacuum brake booster.

Figure 105-10 Cross-sectional view of a typical vacuum brake booster assembly.

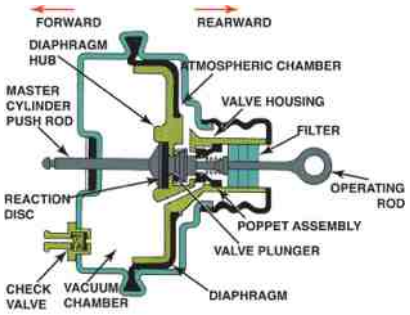


Figure 105-11 In the release position (brake pedal up), the vacuum is directed to both sides of the diaphragm.

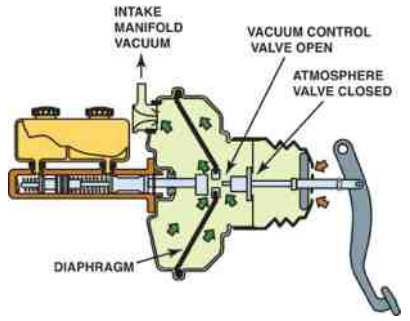


Figure 105-12 Simplified diagram of a vacuum brake booster in the apply position. Notice that the atmospheric valve is open and air pressure is being applied to the diaphragm.

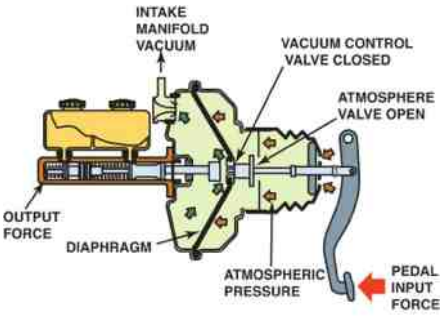


Figure 105-13 Cross section of a vacuum brake booster in the hold position with both vacuum and atmospheric valves closed. Note that the reaction force from the brake fluid pressure is transferred back to the driver as a reaction force to the brake pedal.

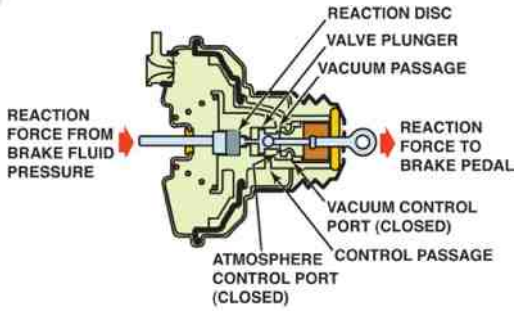
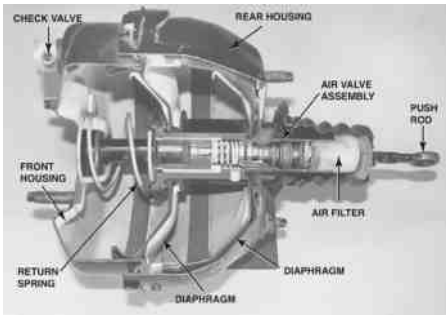


Figure 105-14 Cutaway showing a dual-diaphragm (tandem) vacuum brake booster.



TECH TIP

A Low, Soft Brake Pedal Is Not a Power Booster Problem

Some service technicians tend to blame the power brake booster if the vehicle has a low, soft brake pedal. A defective power brake booster causes a hard brake pedal, not a soft brake pedal. A soft or spongy brake pedal is usually caused by air being trapped somewhere in the hydraulic system.

Many times, the technician has bled the system and, therefore, thinks that the system is free of any trapped air. According to remanufacturers of master cylinders and power brake boosters, most of the returned parts under warranty are not defective. Incorrect or improper bleeding procedures account for much of the problem.

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Figure 105-15 A typical brake assist system uses a brake pedal travel sensor and a BAS solenoid to apply the brakes during a panic condition.

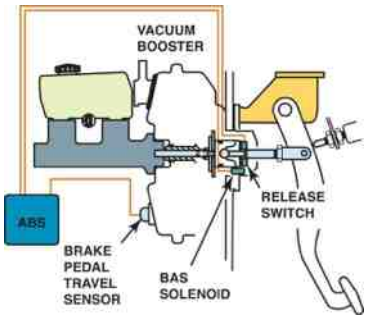

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Figure 105-16 When the brake assist function operates, the brake force is much higher than normal.

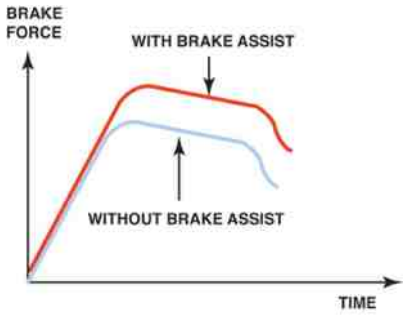

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Figure 105-17 Typical adjustable pushrod. This adjustment is critical for the proper operation of the braking system. If the pushrod is too long, the brakes may be partially applied during driving. If the rod is too short, the brake pedal may have to be depressed farther down before the brakes start to work.

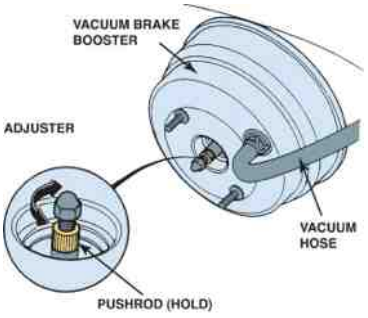

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Figure 105-18 (a) Typical vacuum brake booster pushrod gauging tool. (a) The tool is first placed against the mounting flange of the master cylinder and the depth of the piston determined.

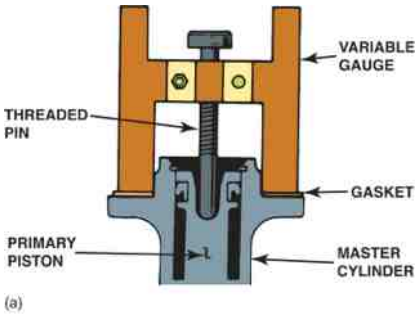

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Figure 105-18 (b) Typical vacuum brake booster pushrod gauging tool. (b) The gauge is then turned upside down and used to gauge the pushrod length. Some vacuum brake boosters do not use adjustable pushrods. If found to be the incorrect length, a replacement pushrod of the correct length should be installed.

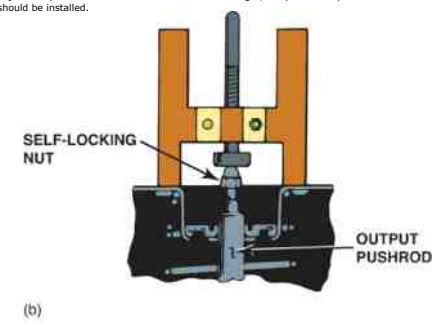

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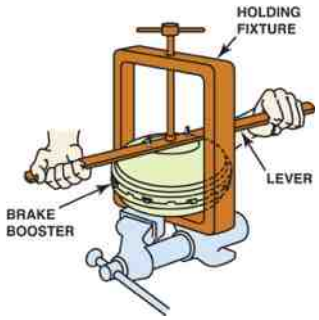
Figure 105-19 A holding fixture and a long tool being used to rotate the two halves of a typical vacuum brake booster.



FREQUENTLY ASKED QUESTION

What Is Supplemental Brake Assist?

Supplemental brake assist, SBA, is a motor-driven vacuum pump that can supplement engine vacuum to the vacuum brake booster. This unit is used on some General Motors vehicles. When a vehicle is driven under a heavy load, engine vacuum is low. To meet the brake standards, some vehicles are equipped with the brake assist system that consists of the following components:

- A pressure sensor that is used to measure the vacuum in the vacuum booster.
- An intake manifold check valve that is used to prevent vacuum from escaping the vacuum boost.
- A motor-driven vacuum pump.

The vacuum pump motor will start and run if the pressure sensor detects the vacuum in the booster is below 7 in. Hg and will shut off after the vacuum level increases to 9 in. Hg.

Figure 105-20 Exploded view of a typical dual-diaphragm vacuum brake booster assembly.

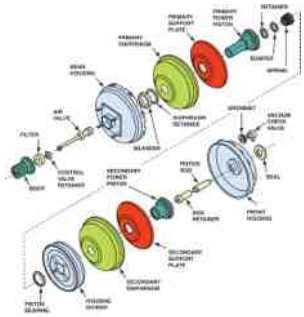


Figure 105-21 Hydro-Boost unit attaches between the bulkhead and the master cylinder and is powered by the power steering pump.

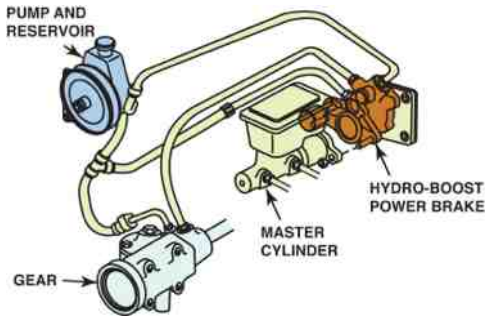


Figure 105-22 Exploded view of the Hydro-Boost unit.

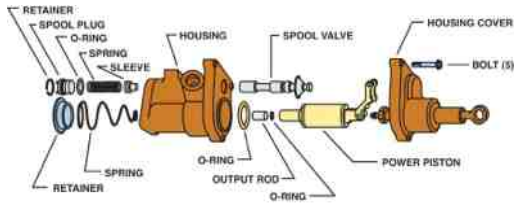


Figure 105-23 A Hydro-Boost hydraulic booster in the unapplied position.

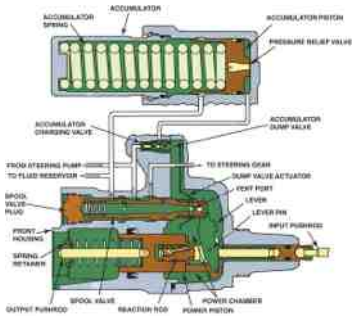


Figure 105-24 A Hydro-Boost hydraulic booster as the brakes are applied.

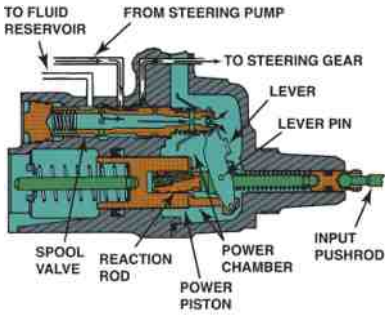


Figure 105-25 A Hydro-Boost hydraulic booster in the holding position.

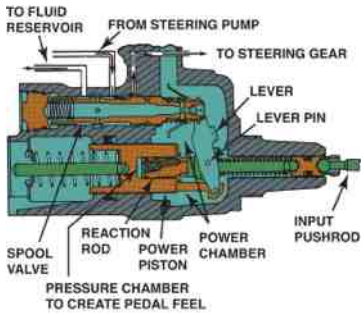


Figure 105-26 A typical Hydro-Boost hydraulic line arrangement showing the pump, steering gear, and brake booster assembly.

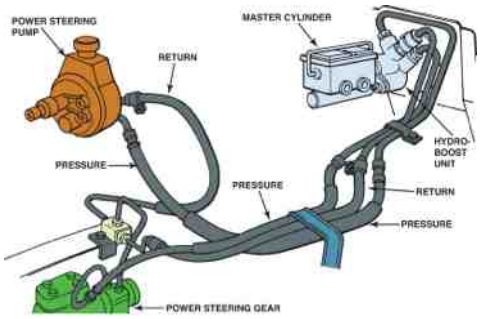
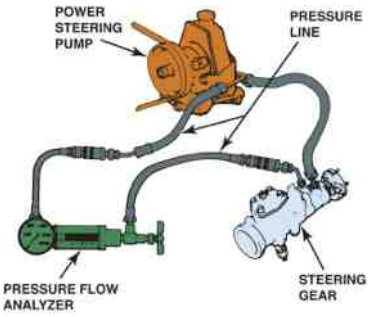


Figure 105-27 Pressure and flow analyzer installation to check the power steering pump output.



TECH TIP

The Hydro-Boost Accumulator Test

The accumulator stores hydraulic fluid under pressure to provide a reserve in the event of a failure of the power steering system. The accumulator is designed to provide three or more power-assisted stops with the engine off.
● **SEE FIGURE 105-28.**

If the accumulator fails, it does not hold pressure. To easily check whether the accumulator has lost its charge, simply grasp the accumulator with your hand and try to twist or move it. The accumulator should have so much pressure on it that it should not move or wiggle. If the accumulator moves, it has lost its ability to hold pressure and the Hydro-Boost unit should be replaced.

Figure 105-28 The accumulator should be able to hold pressure and feel tight when hand force is used to try to move it.