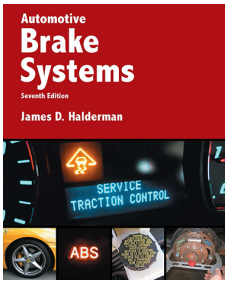
Automotive Brake Systems



CHAPTER 16

Power Brake Unit Operation, Diagnosis, and Service

OBJECTIVES

- State the principles of vacuum and the vacuum booster theory.
- Discuss how a vacuum brake booster operates.
- Discuss the vacuum booster operation test, vacuum booster leak test and the hydraulic system leak test.
- Explain the operation and diagnosis of Hydro-boost hydraulic brake booster.

PRINCIPLES OF VACUUM

- Most vacuum-powered brake boosters get their vacuum supply from the engine intake manifold.
- An engine is essentially a big air pump
  - Because the pistons move up and down in the cylinders to pump in air and fuel, and pump out exhaust.

PRINCIPLES OF VACUUM

- They do this by creating differences in air pressure.
- As a piston moves downward on an intake stroke with the intake valve open, it creates a larger area inside the cylinder for air to fill.

PRINCIPLES OF VACUUM

- This lowers the air pressure within the cylinder
  - And the higher-pressure air outside the engine flows in through the intake manifold in an attempt to fill the low-pressure area.

PRINCIPLES OF VACUUM

- Although it may seem as though the low pressure is pulling air into the engine, it is really the higher pressure outside that forces air in.
- The difference in pressure between two areas is called a pressure differential.

PRINCIPLES OF VACUUM

- Vacuum is measured in inches of mercury (in. Hg) or in millimeters of mercury (mm Hg)
  - A figure that indicates how far a column of mercury in a tube will rise when a vacuum is applied at one end, and atmospheric pressure at the other.

PRINCIPLES OF VACUUM

- Vacuum is a measurement of the pressure differential between the lower pressure inside the tube, and the higher pressure outside it.

PRINCIPLES OF VACUUM

- Vacuum boosters get their vacuum supply from the engine intake manifold.
- Diesel engines, however, run unthrottled (engine speed is controlled strictly by the amount of fuel injected) and have little or no intake manifold vacuum.

PRINCIPLES OF VACUUM

- If a vehicle with a diesel engine is equipped with a vacuum-powered brake booster, it must also be fitted with an auxiliary vacuum pump.

VACUUM BOOSTER THEORY

- Vacuum boosters use the principle of pressure differential to increase brake application force.
- The typical vacuum booster has a power chamber separated into two smaller chambers by a flexible diaphragm.
- When air pressure is greater on one side of the diaphragm than the other, a pressure differential is created.

VACUUM BOOSTER THEORY

- In an attempt to equalize pressure in the two chambers, the higher pressure exerts a force that moves the diaphragm toward the lower-pressure area.
- Rods attached to the diaphragm transmit this force, plus the force the driver exerts on the brake pedal, to the master cylinder.

VACUUM BRAKE BOOSTER OPERATION

- A vacuum power-brake booster contains a rubber diaphragm(s) connected to the brake pedal at one end and to the master cylinder at the other end.
- When the brakes are off or released, there is equal vacuum on both sides of the diaphragm.

VACUUM BRAKE BOOSTER OPERATION

- The vacuum power unit contains the power-piston assembly, which houses the control valve and reaction mechanism, and the power-piston return spring.

APPLIED-POSITION OPERATION

- As the brake pedal is depressed, the floating control valve is moved toward its seat in the power piston, away from the rear of the booster.
- The smaller air valve spring causes the air valve to stretch out toward the retreating floating control valve until it bottoms out on the lip of the power piston's vacuum passage.

APPLIED-POSITION OPERATION

- This closes off the vacuum supply to the rear section of the housing.
- Since the floating control valve travels farther than the sealing end of the air valve:
  - Atmospheric air is allowed to enter between the air valve and the floating control valve pressurizing the rear section of the housing.

APPLIED-POSITION OPERATION

- At this point, the rear section of the housing is pressurized and the front section is under vacuum.
- Atmospheric pressure can then force the power piston forward.

HOLD-POSITION OPERATION

- When the desired brake pedal force is reached and there is balance between the opposing forces of the brake pedal and the master cylinder:
  - The power piston moves forward “around” the floating control valve and reaction disc until the air valve sealing end “catches up” with the floating control valve.

HOLD-POSITION OPERATION

- At this point, the air valve is once again sealed against the floating control valve and is no longer blocking the vacuum passage in the power piston.
- The floating control valve is again held away from its seat.

VACUUM BOOSTER OPERATION TEST

- With the engine "off," apply the brakes several times to deplete the vacuum.
- With your foot on the brake pedal, start the engine.
- The brake pedal should drop.
- If the brake pedal does not drop, check for proper vacuum source to the booster.

VACUUM BOOSTER LEAK TEST

- To test if the vacuum booster can hold a vacuum perform the following steps:
  - STEP 1 Operate the engine to build up a vacuum in the booster, then turn the engine off.
  - STEP 2 Wait one minute.
  - STEP 3 Depress the brake pedal several times. There should be two or more power-assisted brake applications.

HYDRAULIC SYSTEM LEAK TEST

- An internal or external hydraulic leak can also cause a brake system problem.
- To test if the hydraulic system (and not the booster) is leaking, depress and release the brake pedal (service brakes) several times.
- This should deplete any residual power assist.

HYDRO-BOOST HYDRAULIC BRAKE BOOSTER

- Hydro-Boost is a hydraulically operated power-assist unit built by Bendix.
- The Hydro-Boost system uses the pressurized hydraulic fluid from the vehicle's power steering pump as a power source
  - Rather than using engine vacuum as is used with vacuum boosters.

HYDRO-BOOST HYDRAULIC BRAKE BOOSTER: DIAGNOSIS

- Perform a thorough visual inspection, including the following:
  - 1. Checking for proper power steering fluid level
  - 2. Checking for leaks from the unit or power steering pump
  - 3. Checking the condition and tightness of the power steering drive belt
  - 4. Checking for proper operation of the base brake system

SUMMARY

- Most vacuum-powered brake boosters get their vacuum supply from the engine intake manifold.
- Vacuum boosters use the principle of pressure differential to increase brake application force.
- Hydro-Boost is a hydraulically operated power-assist unit built by Bendix.