Component Procedures: Power Brake Assist

Table of Contents

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Parts and Labor (itype_189)

Labor

Operation	Qualifier Path	Skill	Std Hrs	Wty Hrs
Remove & Replace	Hydraulic System > Booster Check Valve, R&R	B	0.3	0.0
Remove & Replace	Hydraulic System > Brake Booster, R&R	B	1.7	1.2
Remove & Replace	Hydraulic System > Sensor, R&R	B	0.3	0.2
Remove & Replace	Hydraulic System > Vacuum Pump, R&R	B	0.5	0.3

Brake Assist System (Article 10639)

System Component Description

The brake assist system consists of the following:

Receives, multiplies and transfers brake system input force from driver.

Transfers multiplied input force received from brake pedal to brake booster .

Uses source vacuum to decrease effort required by driver when applying brake system input force.

At rest, source vacuum is applied to both sides of the vacuum diaphragm for single boosters, or to both sides of each of the diaphragms for tandem boosters. Return springs maintain the booster in a rest position.

When brake system input force is applied, vacuum to the rear of the diaphragm(s) is cut off, and air at atmospheric pressure is admitted in its place. This provides a decrease in brake pedal effort required. When input force is removed, vacuum again replaces atmospheric pressure within the booster.

Supplies force used by vacuum brake booster to decrease brake pedal effort.

The primary source for vacuum is typically the vehicle's internal combustion engine. Some vehicles may use a vacuum pump to ensure and adequate supply of vacuum under various operating conditions, such as during cold start-up, heavy throttle, and high altitude.

Vehicles equipped with a vacuum pump will typically be equipped with a relay used to provide voltage to the vacuum pump motor , when commanded by the powertrain controller.

Provides a feedback voltage signal relative to the amount of vacuum available for the vacuum power brake booster .

This typically consists of a vacuum sensor mounted either into the power vacuum brake booster, integrated with the vacuum check valve, or in-line within the vacuum hose. The sensor feedback is typically monitored by the powertrain control module(s).

If equipped with a system to monitor available levels of vacuum for the brake assist system, the powertrain control module(s) typically perform the primary monitoring function.

The powertrain controller will typically monitor the feedback signal of a vacuum sensor, as it relates to available vacuum at the vacuum power brake booster. The powertrain controller uses the information to make sure available vacuum remains above predetermined levels. If additional vacuum is required, the powertrain controller may reactivate engine cylinders, if equipped, or command a vacuum pump ON, if equipped, and/or may alter the operation of various other engine controls and devices, as necessary.

Enables delivery and retention of source vacuum for vacuum brake booster.

This typically consists of a vacuum check valve and a vacuum hose or pipe. If a vacuum pump is used, additional check valves may be used.

System Operation

Brake system input force from the driver is multiplied by the brake pedal and transferred by the pedal pushrod to the hydraulic brake master cylinder . Effort required to apply the brake system is reduced by the operation of the vacuum brake booster.

When brake system force is applied, vacuum to the rear of the diaphragm(s) is cut off, and air at atmospheric pressure is admitted in its place. The vacuum acts to pull the diaphragm(s) forward, while the atmospheric pressure acts to push from behind. As a result, the amount of effort required by the driver is reduced. When input force is removed, vacuum again replaces atmospheric pressure within the vacuum power brake booster to help return the booster to rest. Return springs maintain the system in a rest position.

If the vehicle is equipped with a vacuum monitoring system, the powertrain control module(s) typically will alter powertrain functions and/or command the vacuum pump ON, if equipped, to provide for the vacuum needs of the brake assist system, as operating conditions warrant.

Brake Booster Vacuum Assist (Article 10640)

System Component Description

Figure 1: Hydraulic Brakes Block Diagram

The brake booster vacuum assist system consists of the following:
The brake booster vacuum pump is a secondary vacuum supply to the brake booster to maintain sufficient vacuum for brake assist .
Uses source vacuum to decrease effort required by driver when applying the brake.
When brake system input force is applied, air at atmospheric pressure is admitted to the rear of both vacuum diaphragms, providing a decrease in brake pedal effort required. When input force is removed, vacuum replaces atmospheric pressure within the booster.
Vacuum is supplied by engine vacuum or by the brake booster vacuum pump.
System Operation
The engine control module (ECM) actuates the brake booster vacuum pump to generate additional vacuum to the vacuum brake booster if low vacuum is detected by the ECM.

Brake Assist System Diagnosis (Article 10643)

Step Action Yes No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the brake ASSIST system in order to determine if the brake ASSIST system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.
1 Were you sent here from a Brake Symptom table? Go to Step 3 Go to Step 2
2 Were you sent here directly from an electrical diagnostic to investigate vacuum as a possible concern? Go to Step 5 Go to Diagnostic Starting Point - Vehicle
3 Inspect for proper brake pedal travel. Refer to Brake Pedal Travel Measurement and Inspection . Is the brake pedal travel distance within the acceptable limits? Go to Step 5 Go to Step 4
4 Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. For the brake pedal pushrod component inspection, refer to Brake Pedal Pushrod Inspection . Inspect the brake pedal bushings for excessive wear and/or damage and inspect the brake pedal for a misaligned, bent and/or damaged condition. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components? Go to Step 5 Go to Hydraulic Brake System Diagnosis to check for internal and external fluid leaks and air in the hydraulic brake system
- Inspect for worn, missing, misaligned, bent or damaged brake pedal system components.
- For the brake pedal pushrod component inspection, refer to Brake Pedal Pushrod Inspection .
- Inspect the brake pedal bushings for excessive wear and/or damage and inspect the brake pedal for a misaligned, bent and/or damaged condition.
- Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged.
5 Check the engine vacuum source that supplies vacuum to the vacuum brake booster . Refer to Brake System Vacuum Source Test . Is the vacuum reading within the acceptable limits? Go to Step 6 Go to Engine Controls Diagnostics Information to check for vacuum issues, including vacuum pump operation, if equipped
6 Does the condition occur during cold start-up conditions? Go to Step 7 Go to Step 8
7 Check engine vacuum, and vacuum pump operation, if equipped, under the same cold start-up conditions. Refer to Engine Controls Diagnostics. Did you find and correct a condition? Go to Step 22 Go to Step 9
8 During the vacuum source test, did the vacuum booster check valve operate properly? Go to Step 10 Go to Step 9
9 Replace the vacuum booster check valve. Refer to Power Brake Booster Vacuum Check Valve and Hose Replacement . Did you complete the replacement? Go to Step 10 —
10 If equipped with a booster mounted separate vacuum sensor , inspect the vacuum sensor grommet for cracks, cuts, dry-rot, or damage. Does the vacuum sensor grommet exhibit any of the conditions listed? Go to Step 11 Go to Step 12
11 Replace the vacuum sensor grommet. Did you complete the replacement? Go to Step 12 —
12 If the vehicle is equipped with a vacuum sensor, install a scan tool. Using the Data Display function, determine if brake booster vacuum sensor data is available within either the chassis brake controls area or the powertrain engine controls area. Is vacuum sensor data available through the scan tool? Go to Step 13 Go to Step 16
- If the vehicle is equipped with a vacuum sensor, install a scan tool.
- Using the Data Display function, determine if brake booster vacuum sensor data is available within either the chassis brake controls area or the powertrain engine controls area.
13 Perform the vacuum booster leak-down test using a scan tool: Release the brake pedal. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2–3 seconds and repeat once. Turn the ignition OFF. Turn the ignition ON. Do not start the engine. Note: Vacuum readings will decrease by approximately 2.7 kPa (0.8 Hg) for every 305 m (1000 ft) of elevation above sea level. Observe and record the vacuum sensor reading on the scan tool over a period of 60 seconds. Determine the rate of vacuum leak. Specification Maximum

allowable vacuum leak rate: 10 kPa (3 in Hg) in 60 seconds Was the rate of vacuum leak within the specified allowable range? Go to Step 18 Go to Step 14
- Release the brake pedal.
- Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2–3 seconds and repeat once.
- Turn the ignition OFF.
- Turn the ignition ON. Do not start the engine.
- Observe and record the vacuum sensor reading on the scan tool over a period of 60 seconds.
- Determine the rate of vacuum leak. Specification Maximum allowable vacuum leak rate: 10 kPa (3 in Hg) in 60 seconds
Maximum allowable vacuum leak rate: 10 kPa (3 in Hg) in 60 seconds
14 Deplete the vacuum reserve by pressing the brake pedal several times, or by removing the vacuum booster check valve. Separate the master cylinder from the vacuum brake booster . Do not disconnect any brake pipes . Refer to Brake Master Cylinder Replacement . If equipped with a vacuum seal on the rear of the master cylinder, inspect the seal for damage and correct positioning on the master cylinder. Replace the vacuum seal as necessary. Carefully reinstall the master cylinder to the brake booster. Refer to Brake Master Cylinder Replacement . Did you complete the operation? Go to Step 15 —
- Deplete the vacuum reserve by pressing the brake pedal several times, or by removing the vacuum booster check valve.
- Separate the master cylinder from the vacuum brake booster . Do not disconnect any brake pipes . Refer to Brake Master Cylinder Replacement .
- If equipped with a vacuum seal on the rear of the master cylinder, inspect the seal for damage and correct positioning on the master cylinder. Replace the vacuum seal as necessary.
- Carefully reinstall the master cylinder to the brake booster. Refer to Brake Master Cylinder Replacement .
15 Perform the vacuum booster leak-down test using a scan tool: Release the brake pedal. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2–3 seconds and repeat once. Turn the ignition OFF. Turn the ignition ON. Do not start the engine. Note: Vacuum readings will decrease by approximately 2.7 kPa (0.8 Hg) for every 305 m (1000 ft) of elevation above sea level. Observe and record the vacuum sensor reading on the scan tool over a period of 60 seconds. Determine the rate of vacuum leak. Specification Maximum allowable vacuum leak rate: 10 kPa (3 in Hg) in 60 seconds Was the rate of vacuum leak within the specified allowable range? Go to Step 22 Go to Step 21
16 Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipe s. Before removing the master cylinder, first deplete the vacuum by removing the check valve or applying the brake pedal several times. Refer to Brake Master Cylinder Replacement . If equipped with a vacuum seal on the rear of the master cylinder, inspect the seal for damage and correct positioning on the master cylinder. If equipped with a vacuum seal that is part of the booster, inspect the seal for damage. Does the vacuum seal exhibit any of the conditions listed? Go to Step 17 Go to Step 18
- Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipe s. Before removing the master cylinder, first deplete the vacuum by removing the check valve or applying the brake pedal several times. Refer to Brake Master Cylinder Replacement .
- If equipped with a vacuum seal on the rear of the master cylinder, inspect the seal for damage and correct positioning on the master cylinder.
- If equipped with a vacuum seal that is part of the booster, inspect the seal for damage.
17 If equipped with a vacuum seal on the rear of the master cylinder, replace the vacuum seal as necessary. Ensure the seal is positioned correctly during installation. If equipped with a vacuum seal that requires replacement and which is part of the booster, the booster assembly must be replaced. Carefully reinstall the master cylinder to the brake booster. Refer to Brake Master Cylinder Replacement . Did you complete the replacement? Go to Step 18 —
- If equipped with a vacuum seal on the rear of the master cylinder, replace the vacuum seal as necessary. Ensure the seal is positioned correctly during installation.
- If equipped with a vacuum seal that requires replacement and which is part of the booster, the booster assembly must be replaced.
18 Perform the vacuum boost functional test: If still separated, reinstall the master cylinder to the booster. Refer to Brake Master Cylinder Replacement . If the engine was started after reinstalling the master cylinder to the booster, perform the following: With the engine OFF, depress the brake pedal several times to deplete the vacuum reserve. Depress and maintain moderate foot pressure on the brake pedal. Start the engine and observe pedal operation. Observe for audible vacuum leaks. The brake pedal should fall slightly, then hold. Is there an audible vacuum leak coming from the brake pedal area? Go to Step 21 Go to Step 19
- If still separated, reinstall the master cylinder to the booster. Refer to Brake Master Cylinder Replacement
.

- If the engine was started after reinstalling the master cylinder to the booster, perform the following: With the engine OFF, depress the brake pedal several times to deplete the vacuum reserve.
- Depress and maintain moderate foot pressure on the brake pedal.
- Start the engine and observe pedal operation.
- Observe for audible vacuum leaks. The brake pedal should fall slightly, then hold.

19 Did the brake pedal fall slightly after the engine was started, then hold? Go to Step 20 Go to Step 21

20 Perform the vacuum booster leak-down test: Release the brake pedal. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2–3 seconds and repeat once. Turn the ignition OFF. Wait 60 seconds. Depress the brake pedal 2 times to check for vacuum booster available vacuum reserve. Observe pedal effort. Both pedal applies should be assisted The amount of assist could diminish slightly with the second apply Were both pedal applies power assisted? Go to Step 22 Go to Step 21

- Wait 60 seconds.
- Depress the brake pedal 2 times to check for vacuum booster available vacuum reserve. Observe pedal effort.
- Both pedal applies should be assisted
- The amount of assist could diminish slightly with the second apply

21 Replace the vacuum brake booster. Refer to Power Vacuum Brake Booster Replacement . Did you complete the replacement? Go to Step 22 —

22 Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation? Brake Assist System OK Return to Symptom Table —