

# Tips & Technology

For Bosch business partners

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## Brake technology



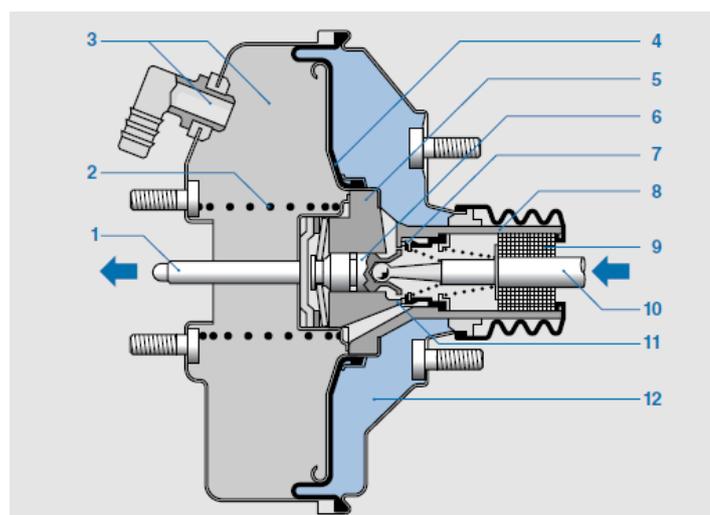
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## Brake booster

The brake booster amplifies the force applied by the foot when actuating the brakes and in this way reduces the amount of force needed. In combination with the brake master cylinder, it is part of passenger car brake systems. The two common types of brake booster are the vacuum brake booster and the hydraulic brake booster.

### Design

Passenger cars are usually equipped with vacuum brake boosters. In cars with a gasoline engine, vacuum brake boosters use the vacuum (0.5...0.9 bar) generated in the engine's intake manifold by the intake stroke to amplify the force applied by the driver's foot, while in cars with a diesel engine or hybrid drive a vacuum pump is used. A diaphragm separates the vacuum chamber with its vacuum connection from the working chamber. The piston rod transmits the force applied by the driver's foot to the working piston; the amplified brake force is transmitted to the brake master cylinder via the push rod.



- |  |                                       |
|--|---------------------------------------|
| 1 Push rod<br>(output force to tandem master cylinder) | 7 Double valve                        |
| 2 Compression spring                                   | 8 Valve body                          |
| 3 Vacuum chamber with vacuum connection                | 9 Air filter                          |
| 4 Diaphragm with diaphragm plate                       | 10 Piston rod (force applied by foot) |
| 5 Working piston                                       | 11 Valve seat                         |
| 6 Sensing piston                                       | 12 Working chamber                    |

## Operating principle

When the brake is not actuated, the vacuum chamber and working chamber are connected to one another via channels in the valve body. A vacuum is created in both chambers via the vacuum connection. As soon as the driver applies the brakes, the piston rod moves toward the vacuum chamber and presses the cup of the double valve against the valve seat. This separates the vacuum chamber from the working chamber. Since the sensing piston pulls away from the cup of the double valve as the piston rod continues to move, atmospheric air flows into the working chamber. The pressure in the working chamber is now greater than that in the vacuum chamber. The atmospheric pressure acts on the diaphragm plate via the diaphragm, with which it is in contact. Because the valve body is moved in the direction of the vacuum chamber by the diaphragm plate, the force applied by the driver's foot is amplified. The force applied by the driver's foot and the assisting force now press the diaphragm plate against the force of the compression spring. This moves the push rod, which then transmits the output force to the master cylinder. When the brakes are no longer applied, the vacuum chamber and working chamber are again connected to one another and under vacuum.

## Test

A faulty brake booster is indicated when considerably more force than normal must be applied to the brake pedal and, as a consequence, reliable braking is no longer assured. Accordingly, when braking action declines, the brakes should be checked by a brake specialist and the brake booster replaced if necessary.

The test then proceeds in the following steps:

1. Shut off engine. A vacuum is still present in the system.
2. Depress the brake pedal several times until significant resistance is noted. The vacuum has now been dissipated.
3. Continue to depress the brake pedal.
4. Now start the engine. If the brake pedal now rebounds, the brake booster is OK.

If the brake pedal remains depressed, a fault exists. In addition to the brake booster being faulty, the vacuum hose may also be faulty. Accordingly, it is always necessary to first check whether a hose is faulty or has become loose. A faulty brake booster can be assumed only if no fault involving the vacuum hose is found.

When replacing the brake booster, special attention is required to ensure that no hoses are damaged or overlooked during the repair.