■BRAKE CONTROL SYSTEM (ABS and BRAKE ASSIST)

1. General

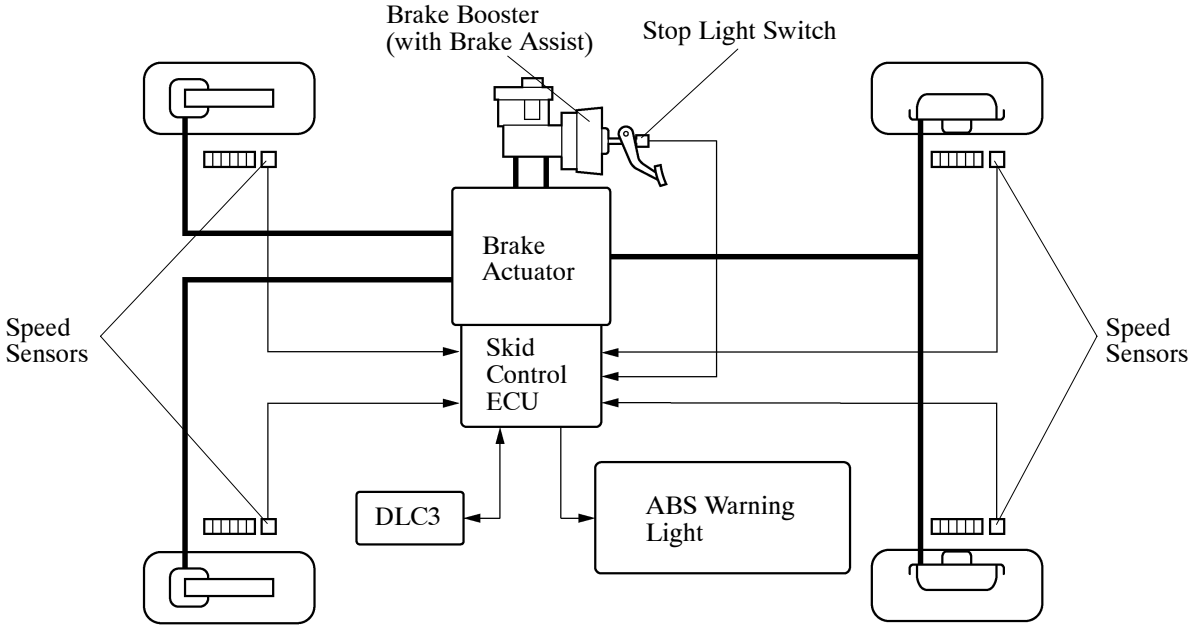
The brake control system (ABS and Brake Assist) of new Hiace has a following functions:

Function	Outline
ABS (Anti-lock Brake System)	The ABS helps prevent the wheels from locking when the brakes are applied firmly or on a slippery surface.
Brake Assist (Mechanical Type)	The primary purpose of the Brake Assist system is to provide an auxiliary brake force to assist the driver who cannot generate a large brake force during emergency braking, thus helping draw the vehicle's brake performance.

Service Tip

When brake control system (except Brake Assist) is activated, the brake pedal could shudder, which is a normal condition of the system in operation and should not be considered a malfunction.

▶ System Diagram ◀

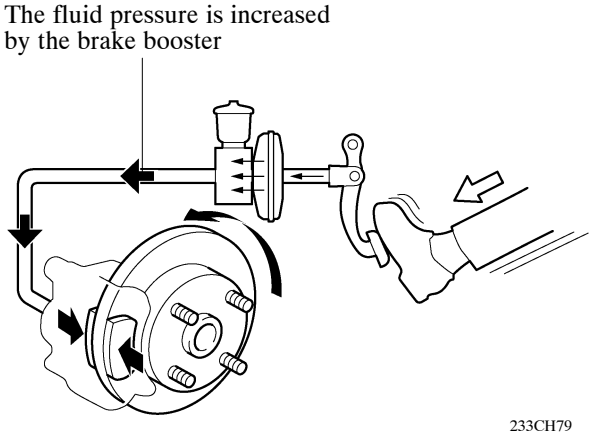


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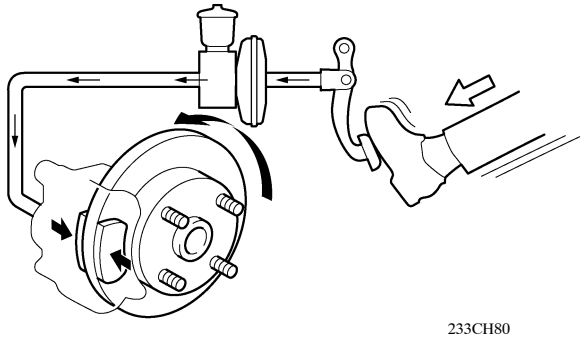
2. Outline of Brake Assist (Mechanical Type)

- The Brake Assist in combination with ABS helps improve the vehicle's brake performance.
- The Brake Assist interprets a quick push of the brake pedal as emergency braking and supplements the brake force applied if the driver has not stepped hard enough on the brake pedal. In emergencies, the driver, especially inexperienced one, is often in panic and do not apply sufficient pressure on the brake pedal.
- A key feature of Brake Assist is that the timing and the degree of braking assistance are designed to ensure that the driver does not discern anything unusual about the braking operation. When the driver intentionally eases up on the brake pedal, the system reduces the amount of assistance it provides.
- The mechanical type Brake Assist uses the brake assist mechanism in the brake booster to mechanically activate the brake booster function in order to increase the brake force. For details, see page CH-51.

▶ In case that the driver's depressing force is small when applying emergency braking ◀

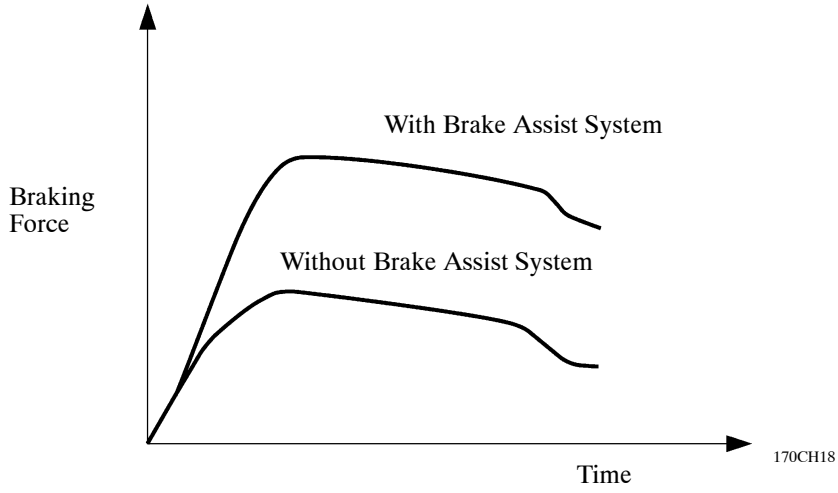


with Brake Assist



without Brake Assist*

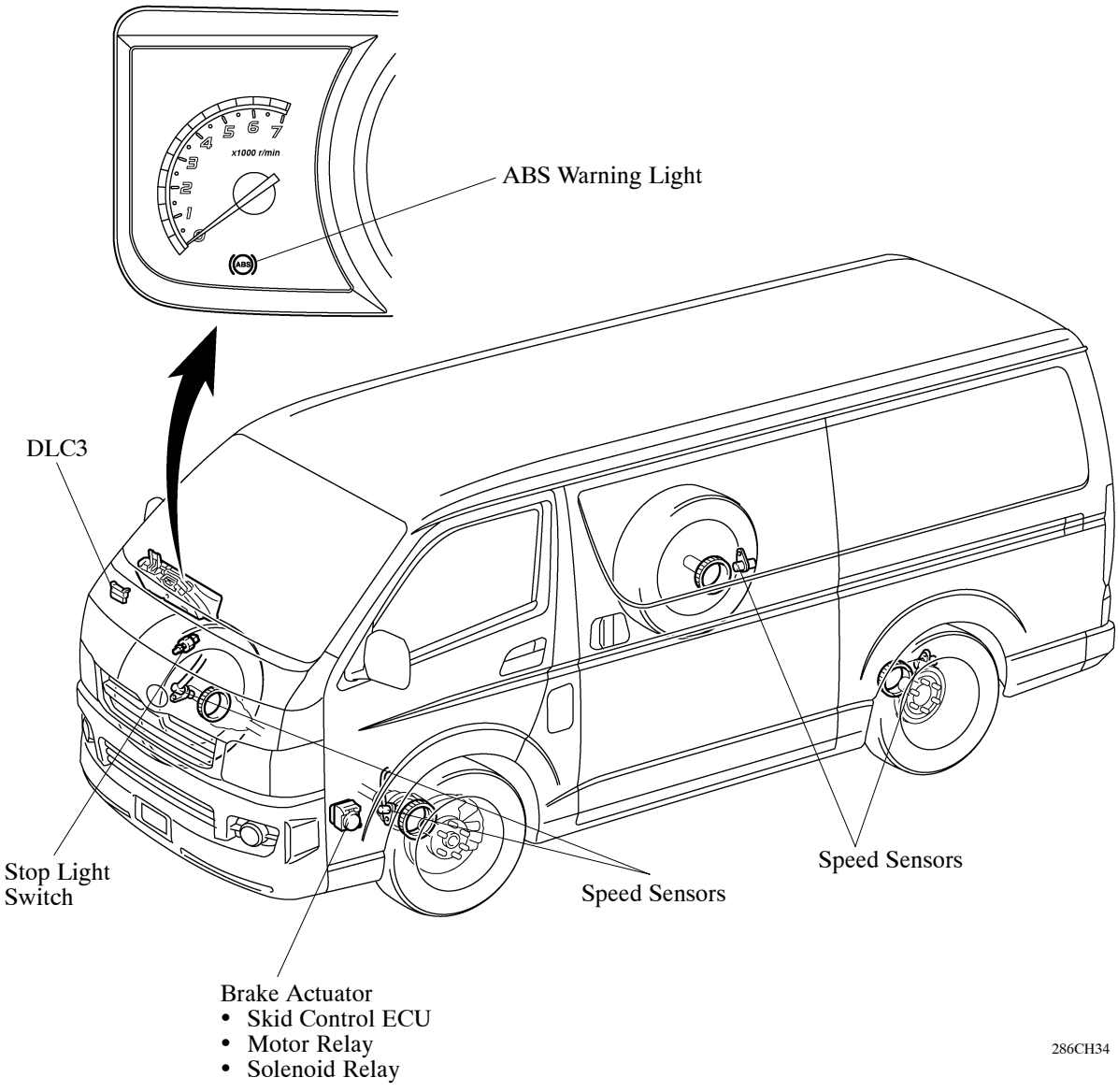
*: The basic performance of the brake is the same as that of the models with the brake assist.



Service Tip

When the mechanical type Brake Assist is in operation, or the brake pedal is deeply depressed during normal braking, noise and vibration may occur in the brake booster and should not be considered as a malfunction.

3. Layout of Main Components



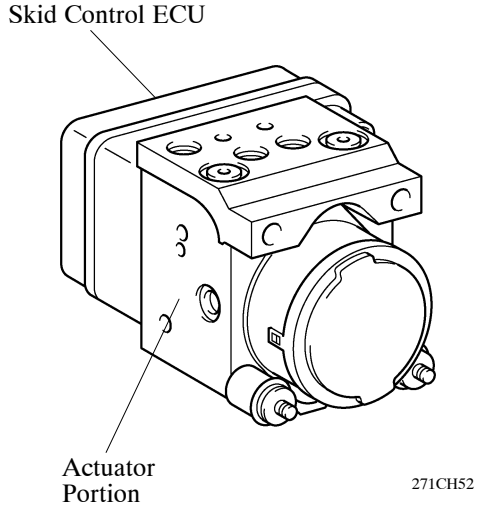
4. Function of Main Components

Components		Function
Brake Actuator		Changes the fluid path based on the signals from the skid control ECU during the operation of the ABS, in order to control the fluid pressure that is applied to the wheel cylinders.
	Skid Control ECU	Judges the vehicle driving condition based on the signals from each sensor, and sends brake control signals to the brake actuator.
	Motor Relay	Supply or cut off power to motor.
	Solenoid Relay	Supply or cut off power to solenoid valves.
Combination Meter	ABS Warning Light	Lights up to alert the driver when the skid control ECU detects a malfunction in the ABS.
Speed Sensor (FL, FR, RL, RR)		Detects the wheel speed of each four wheels.
Brake Booster (with Brake Assist Mechanism)		• Increases the brake pedal effort. • Operates the brake assist mechanism to mechanically activate the brake assist function.
Stop Light Switch		Detects the brake pedal depressing condition.
Parking Brake Switch		Detects that the parking brake lever is pulled.

5. Brake Actuator

General

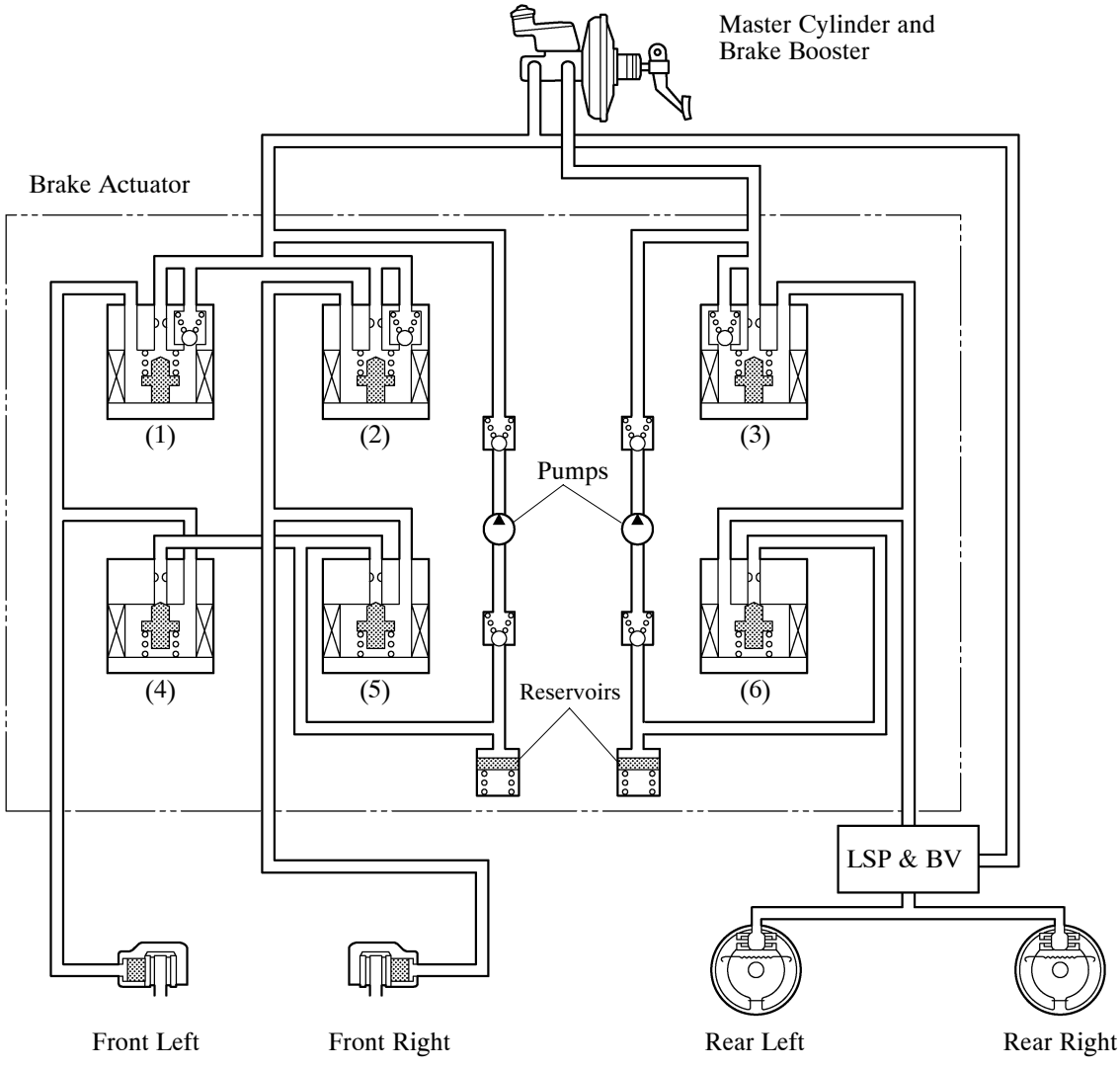
- The brake actuator consists of the actuator portion, skid control ECU, ABS solenoid relay, and ABS motor relay.
- The 2 relays are built in the skid control ECU.



Actuator Portion

The brake actuator consists of 6 two-position solenoid valves, 1 motor, 2 pumps and 2 reservoirs. The 6 two-position solenoid valves consists of 3 pressure holding valves [(1), (2), (3)] and 3 pressure reduction valves [(4), (5), (6)].

▶ Hydraulic Circuit ◀

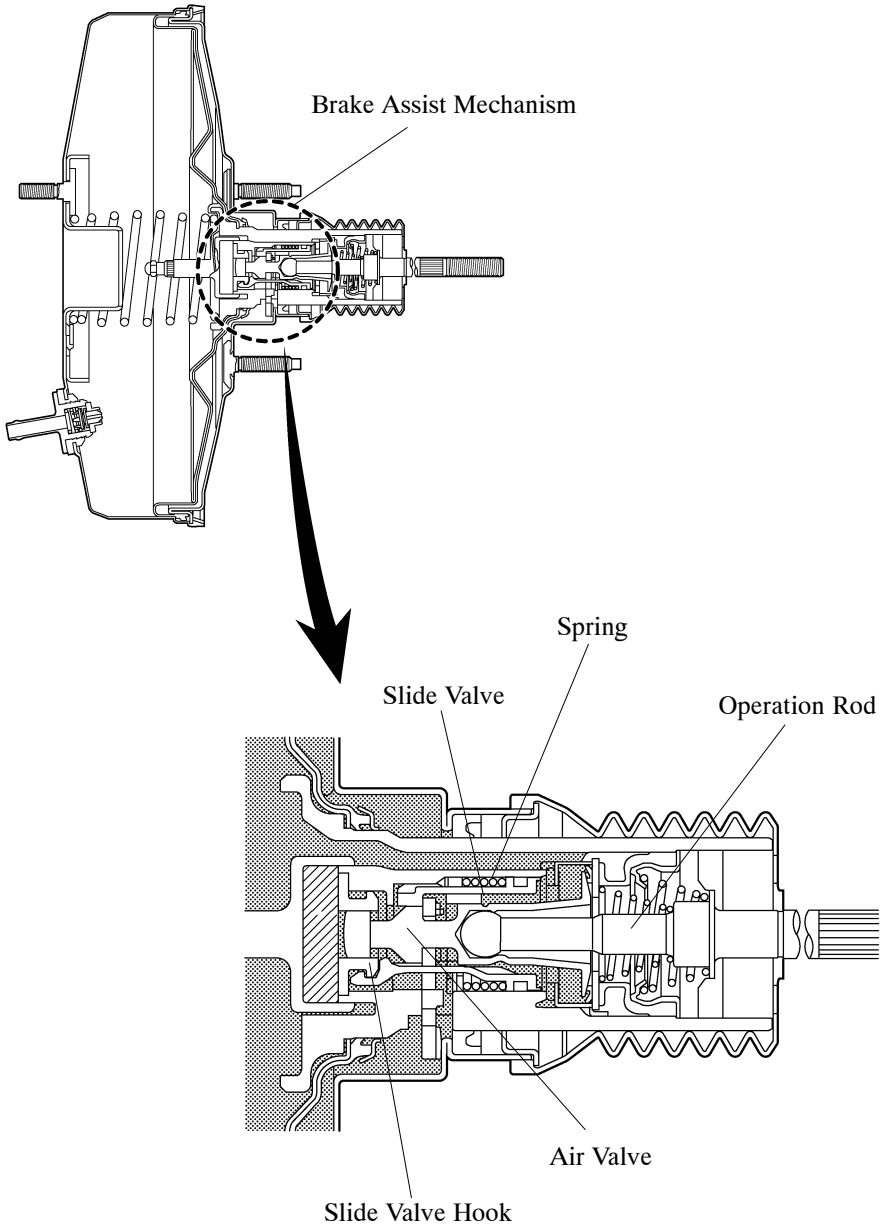


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6. Brake Booster (with Brake Assist Mechanism)

General

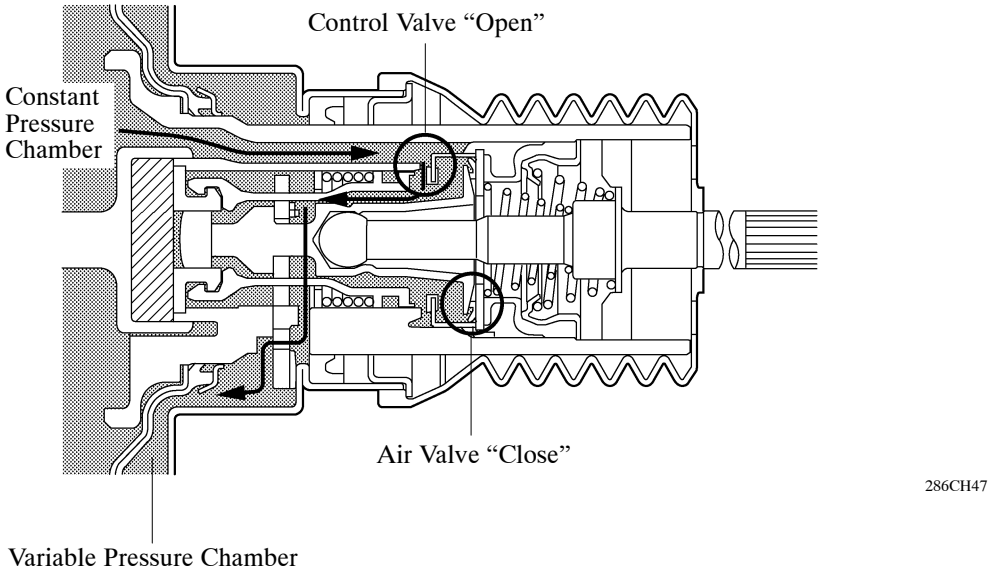
This brake booster consists of conventional type brake booster to which a brake assist mechanism has been added. During a normal brake operation, the function of the brake booster is the same as in the conventional type. The major difference in construction between this booster and the conventional type is the addition of the slide valve, the slide valve hook and the spring.



Operation

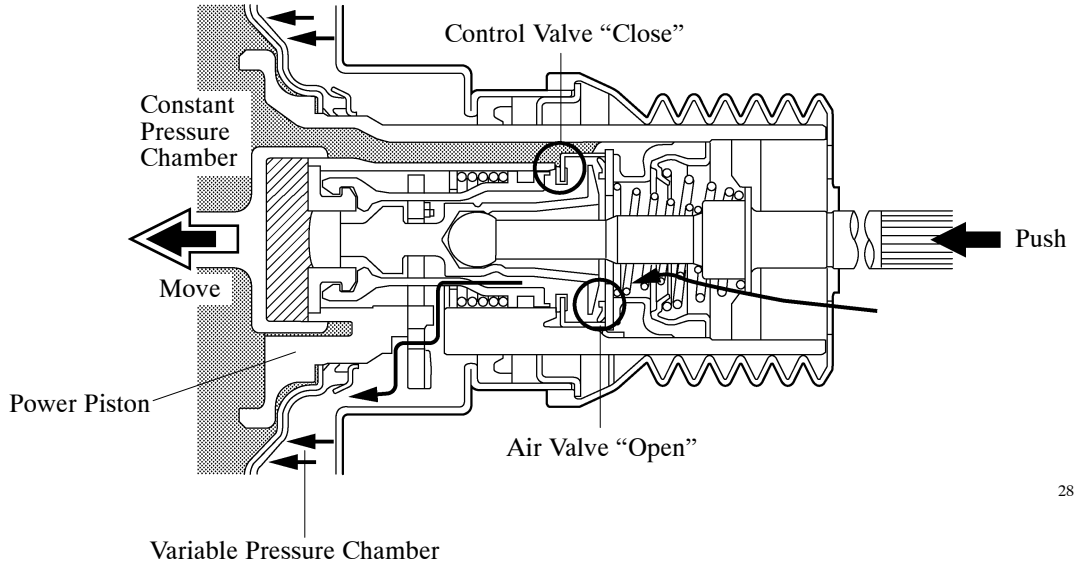
1) No Braking Condition

The air valve closes and the control valve opens. The pressure in the variable pressure chamber is the same as that in the constant pressure chamber.



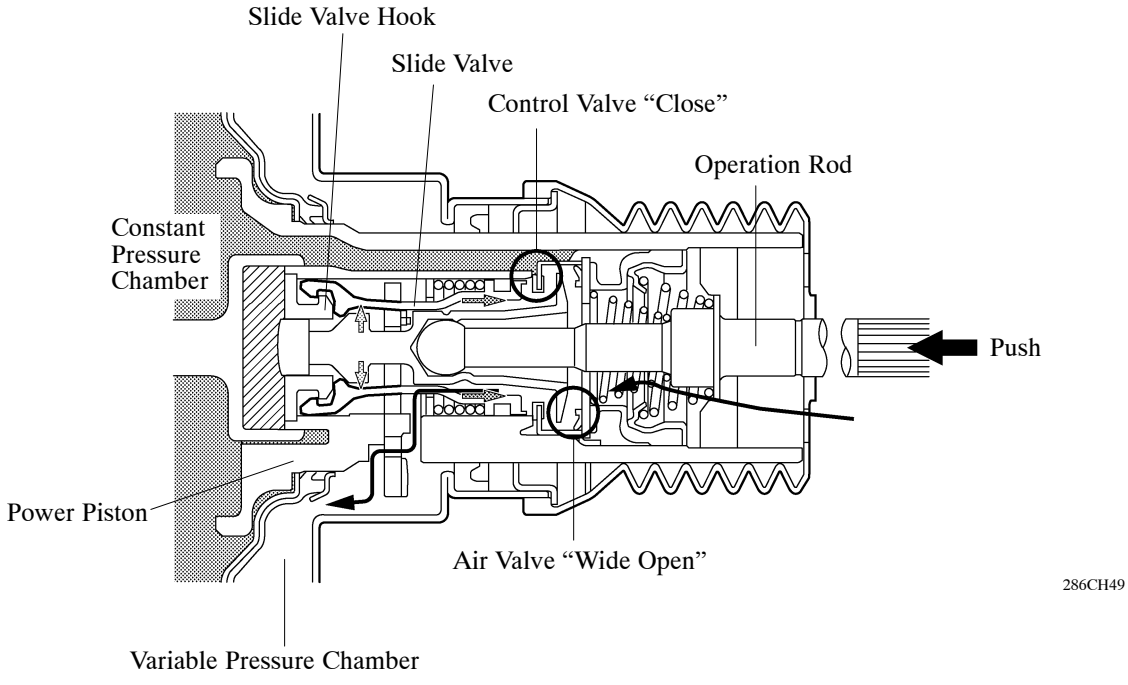
2) Normal Braking Condition (Operation Rod Speed = Power Piston Speed)

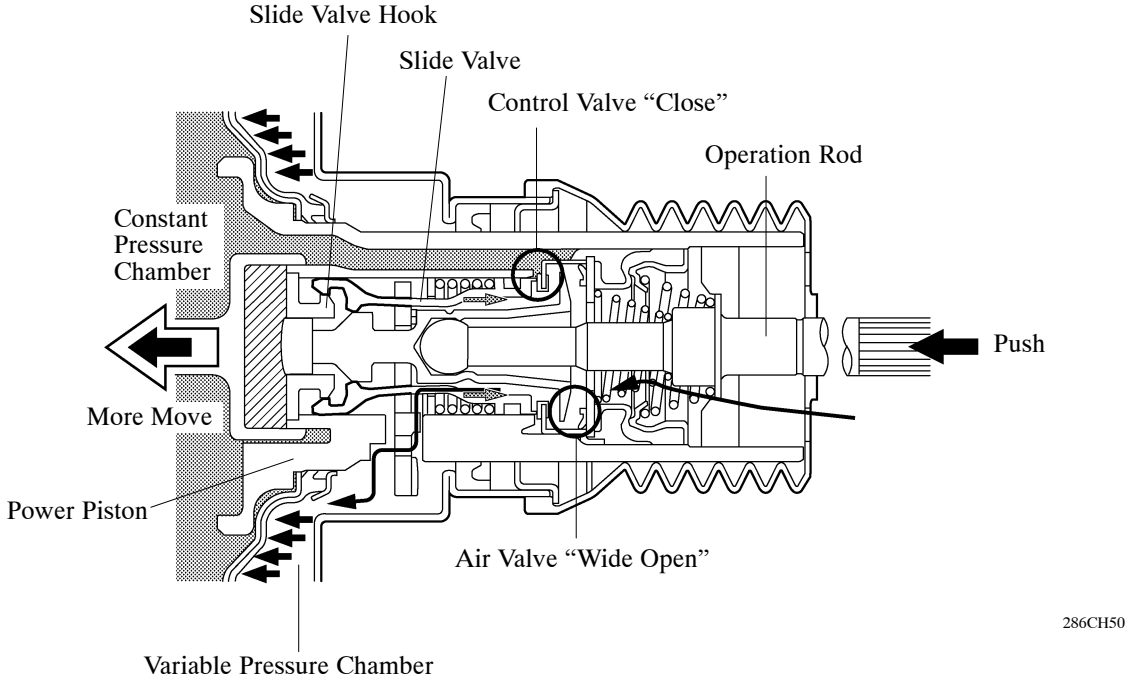
During normal braking, the air valve opens and the control valve closes to activate the brake booster function.



3) Brake Assist Condition (Operation Rod Speed > Power Piston Speed)

When the operation rod speed is faster than the power piston speed, the air valve pushes the slide valve hook. Consequently, the slide valve separates from the slide valve hook, the spring pushes the control valve, and the control valve closes. Thus, the opening of the air valve becomes enlarged and increases the volume of air that is introduced. As a result, a brake assist force powerfully push the power piston.



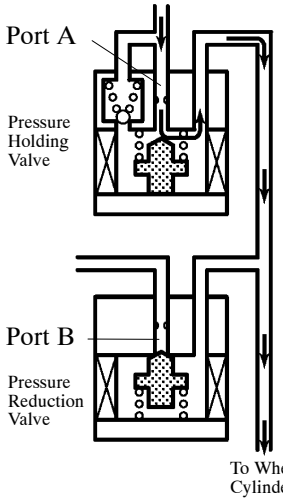
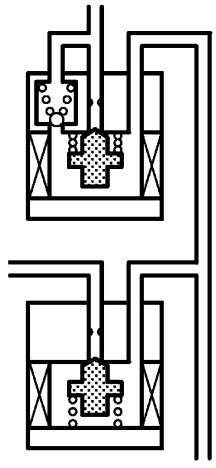
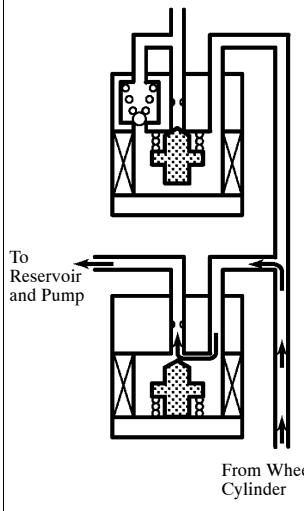


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7. System Operation

ABS Operation

Based on the signals received from the 4 wheel speed sensors, the skid control ECU calculates each wheel speed and deceleration, and checks wheel slipping condition. According to the slipping condition, the ECU controls the pressure holding valve and pressure reduction valve in order to adjust the fluid pressure of each wheel cylinder in the following 3 modes: pressure reduction, pressure holding, and pressure increase modes.

Not Activated	Normal Braking	—	—
Activated	Increase Mode	Holding Mode	Reduction Mode
Hydraulic Circuit			
Pressure Holding Valve (Port A)	OFF (Open)	ON (Close)	ON (Close)
Pressure Reduction Valve (Port B)	OFF (Close)	OFF (Close)	ON (Open)
Wheel Cylinder Pressure	Increase	Hold	Reduce

8. Skid Control ECU

Initial Check

After the ignition switch is turned ON, and the vehicle attains an approximate speed of 6 km/h (4 mph) or more only at first time, the skid control ECU performs the initial check.
The functions of each solenoid valve and pump motor in the brake actuator are checked in order.

Self-Diagnosis

- If the skid control ECU detects a malfunction in the ABS system, the ABS warning light that corresponds to the function in which the malfunction has been detected indicates or lights up, as indicated in the table below, to alert the driver of the malfunction.

○: Light ON —: Light OFF

Item	ABS	Skid Control ECU
ABS Warning Light	○	○

- At the same time, the DTCs (Diagnostic Trouble Codes) are stored in memory. The DTCs can be read by connecting the SST (09843-18040) between the Tc and CG terminals of the DLC3 and observing the blinks of the ABS warning light (2-digit code), or by connecting an intelligent tester II (5-digit code).
- This system has a sensor signal check (test mode) function. This check function performs speed sensor check. This function is activated by connecting an intelligent tester II.
- If the skid control ECU detects a malfunction during a sensor check, it stores the DTC in its memory. This DTC can be read during a sensor signal check operation by connecting the Tc and CG terminals of the DLC3 and observing the blinking of the ABS warning light, or on an intelligent tester II.
- For details concerning the above, see the Hiace Repair Manual (Pub. No. 1171E).

Fail-Safe

If a malfunction occurs in the signal system of the ABS system, the skid control ECU disables the ABS control.