GROUP 35A INDEX

SPECIFICATIONS

Vacuum Booster and Brake Master Cylinder

Item				Specifications
Vacuum booster	Boosting type			Except COE 50
	Diaphragm diameter		inch	ϕ9 + ϕ10
	Manufacturer			Bosch
Brake master cylinder	Inner diameter		mm {in}	ϕ31.75 {1.25}
	Stroke	Front	mm {in}	16.0 {0.63}
		Rear	mm {in}	16.0 {0.63}
	Manufacturer			NISSIN KOGYO

Hydraulic Booster and Brake Master Cylinder

Item				Specifications
				COE 50
Hydraulic booster	Boosting type			Hydraulic type
	Manufacturer			Bosch
Brake master cylinder	Inner diameter		mm {in.}	ϕ33.34 {1.31}
	Stroke	Front	mm {in.}	17.5 {0.69}
		Rear	mm {in.}	16.0 {0.63}
	Manufacturer			Bosch

Front Disc Brake

Item		Specifications	
		COE 40/45	COE 50
Brake type		Twin caliper type	
Effective diameter for braking	mm {in}	ϕ235 {9.25}	ϕ252 {9.92}
Disc rotor outer diameter × thickness	mm {in}	ϕ293 × 40 {11.5 × 1.57}	ϕ310 × 40 {12.2 × 1.57}
Caliper piston inner diameter	mm {in}	ϕ51.1 {2.01}	ϕ54 {2.13}
Thickness of pad	mm {in}	14 {0.55}	14 {0.55}

Rear Disc Brake

Item		Specifications	
		COE 40/45	COE 50
Brake type		Twin caliper type	
Effective diameter for braking	mm {in}	ϕ235 {9.25}	ϕ252 {9.92}
Disc rotor outer diameter × thickness	mm {in}	ϕ293 × 40 {11.5 × 1.57}	ϕ310 × 40 {12.2 × 1.57}
Caliper piston inner diameter	mm {in}	ϕ51.1 {2.01}	ϕ54 {2.13}
Thickness of pad	mm {in}	14 {0.55}	14 {0.55}

Vacuum Pump

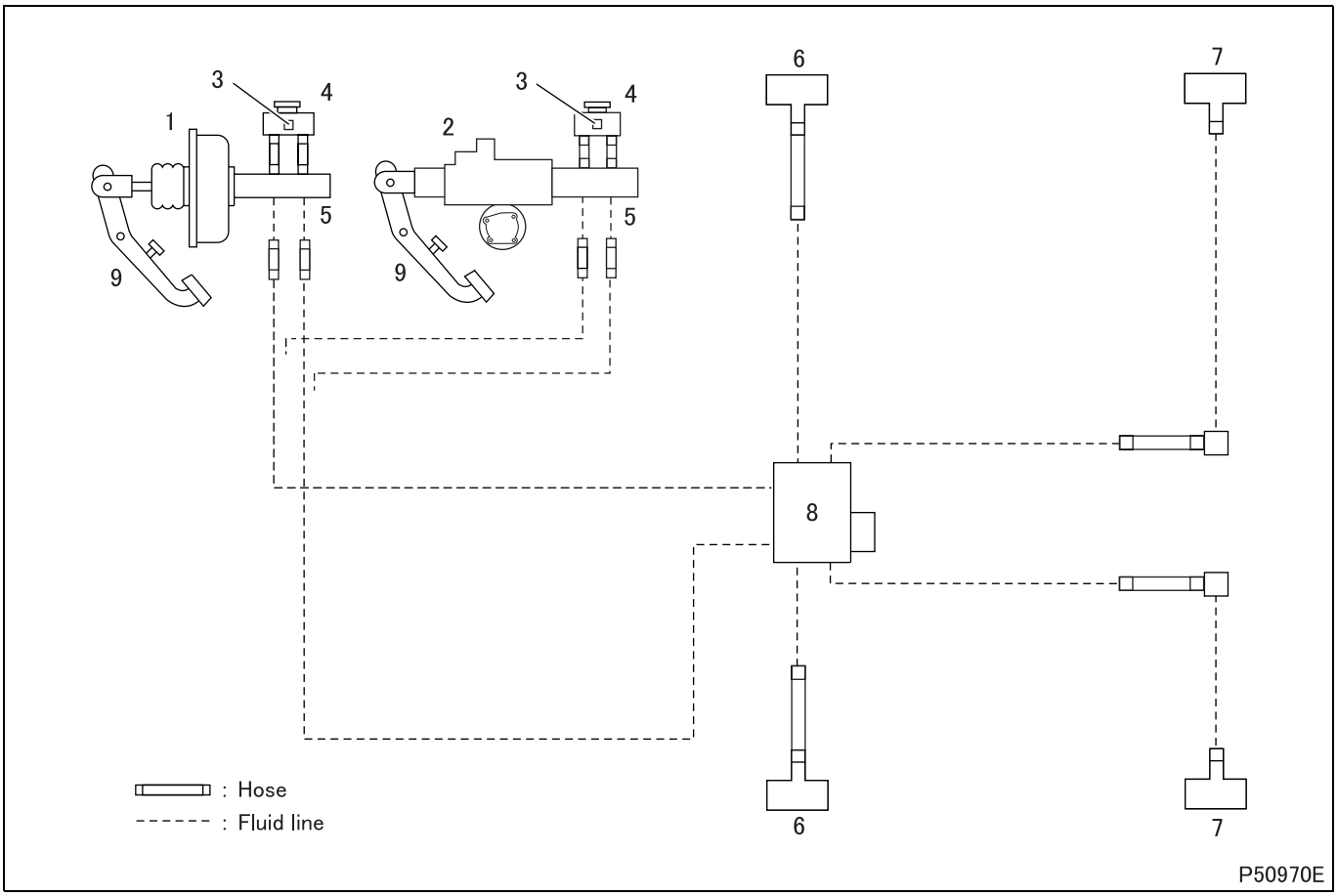
Item		Specifications
Type		Vane type
Output	cm^3 {cu.in}	60 {3.66}
Manufacturer		Mitsubishi Electric

Exhaust Brake

Item	Specifications
Control type	Combined electric and vacuum control
Valve type	Butterfly valve type

1. Brake System

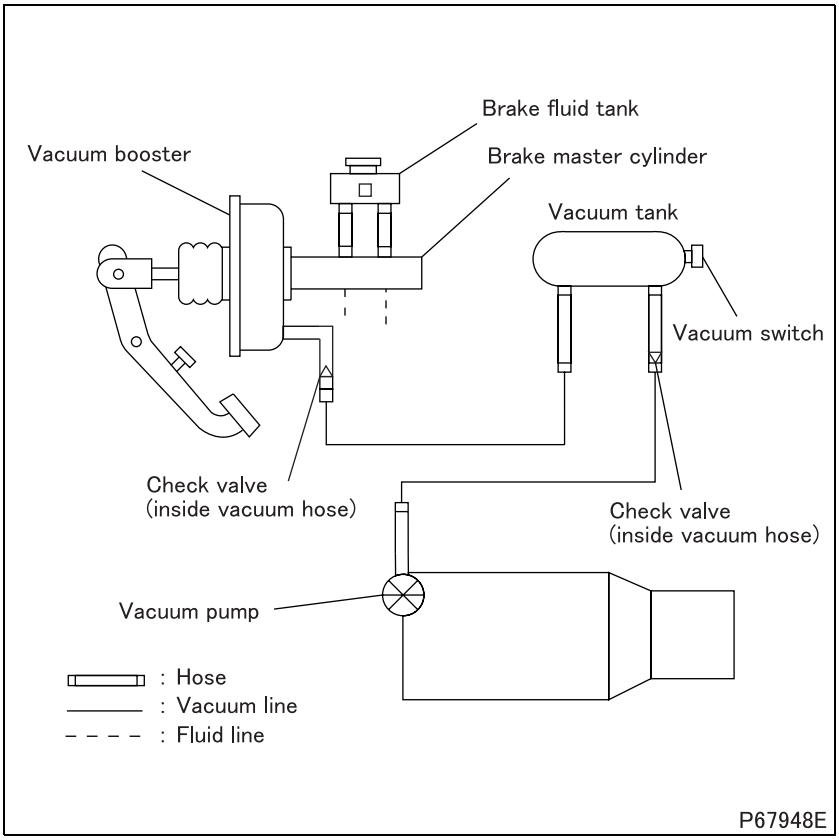
1.1 Brake fluid line



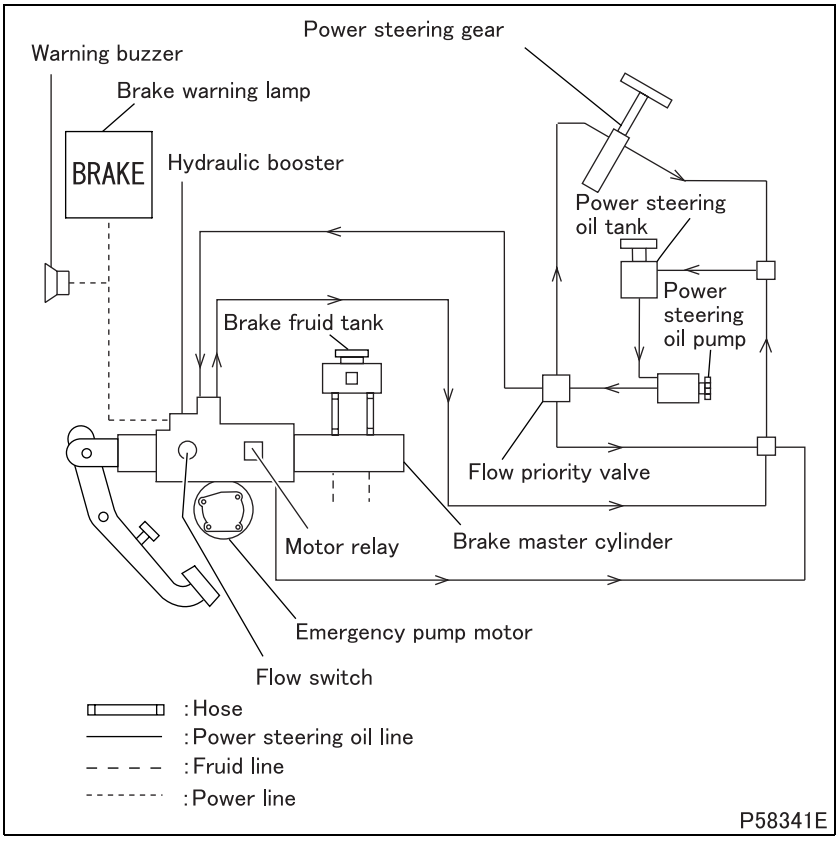
1 Vacuum booster
2 Hydraulic booster
3 Brake fluid level switch
4 Brake fluid tank
5 Brake master cylinder
6 Front wheel brake
7 Rear wheel brake
8 Hydraulic unit (antilock brake system)
9 Stop lamp switch

- The brake system incorporating the vacuum booster uses vacuum to provide servo-assisted braking to all wheels of the vehicle onto which it is mounted. <COE 50>
- The brake system incorporating the hydraulic booster uses the power steering oil pump pressure to provide servo-assisted braking to all wheels of the vehicle onto which it is mounted. <COE 50>

1.2 Vacuum booster line <Except COE 50>



1.3 Hydraulic booster line <COE 50>



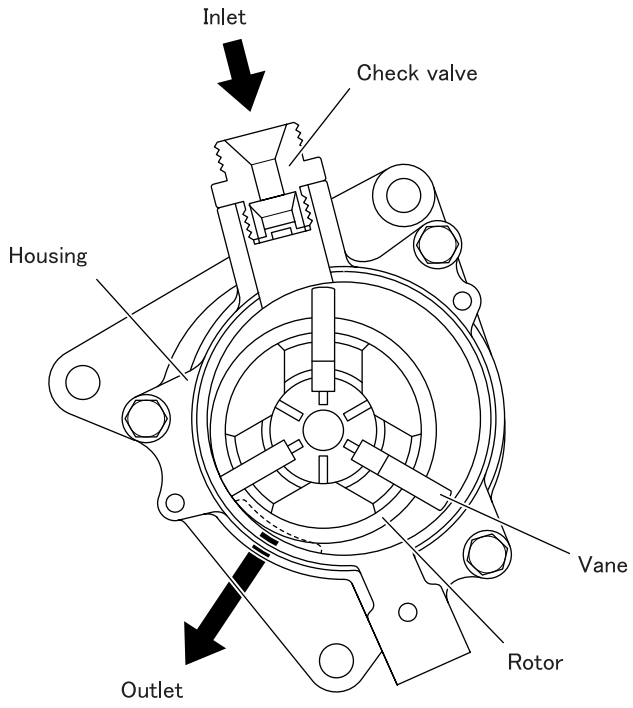
- The stepping force applied on the brake pedal is boosted by the hydraulic booster which operates on the pressure provided by the power steering oil pump.
- When brakes are applied hard while the steering wheel is turned, the associated steering shock is dampened by the flow priority valve in the system.
- When engine stall, power steering oil pump failure, or oil leakage from the power steering line causes oil pressure to drop, the flow switch detects this. This causes the motor relay to switch over, providing power to the emergency pump motor which then turns to generate emergency oil pressure.

- The emergency pump motor operates only when the brake pedal is pressed. The motor has various operating modes, as summarized below.

Starter switch	Engine	Parking switch	Warning		Power steering oil pressure	Emergency pump motor O: ON ×: OFF	Vehicle state
			Brake warning lamp O: ON ×: OFF	Warning buzzer O: ON ×: OFF			
ON	Run	ON (pulled)	O	×	Available	×	Normal
			O	×	Not available	O	* Oil leakage from power steering line
		OFF (released)	×	×	Available	×	Normal
			O	O	Not available	O	* Oil leakage from power steering line
	Stop	ON (pulled)	O	×		O	At engine start
						O	Engine stalled at uphill start
		OFF (released)	O	O		O	Engine stall
OFF		ON (pulled)	×	×		O	Vehicle moved after parked (parking brake lever pulled insufficiently)
		OFF (released)	×	×		O	Engine stopped before vehicle came to complete halt

*: The failsafe feature of the hydraulic booster cuts off oil supply to the power steering line to maintain oil pressure.

2. Vacuum Pump



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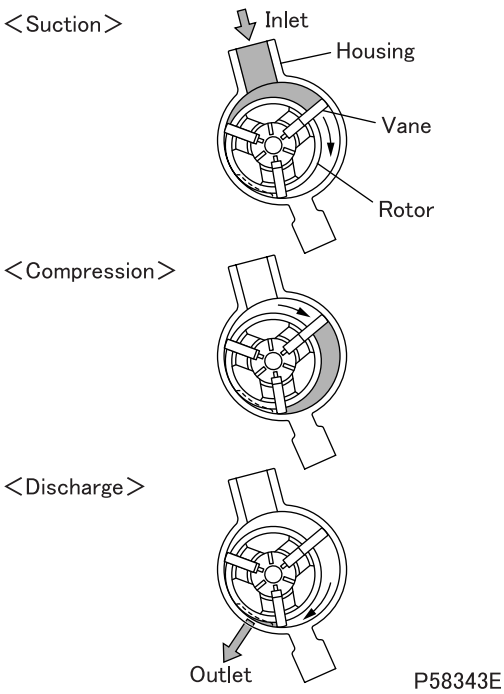
- The vacuum pump is mounted onto the timing gear case, and is driven by the idler gear.
- The check valve is provided to ensure that no air or engine oil flow from the vacuum pump back to the vacuum tank when the engine is stationary.



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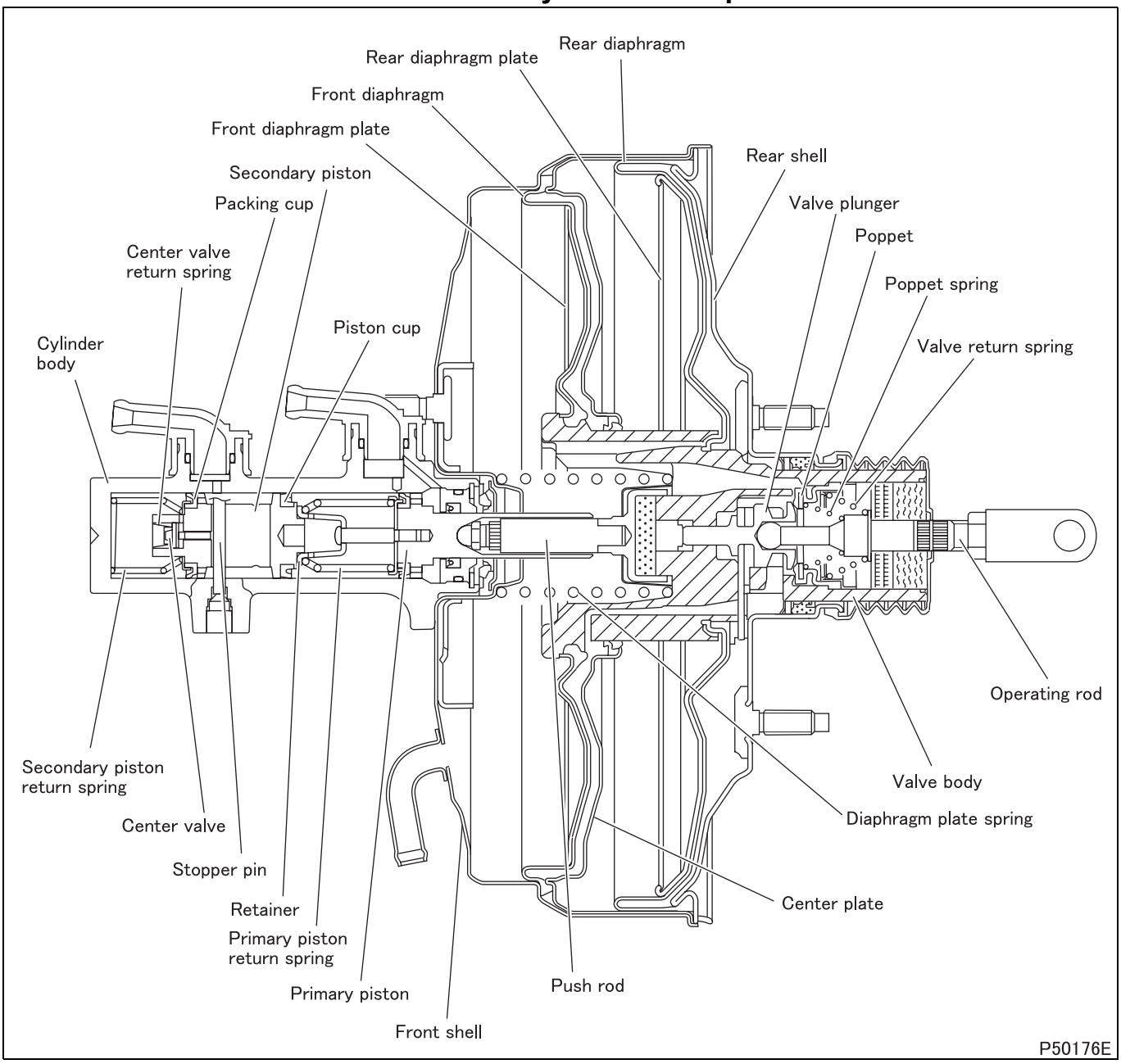
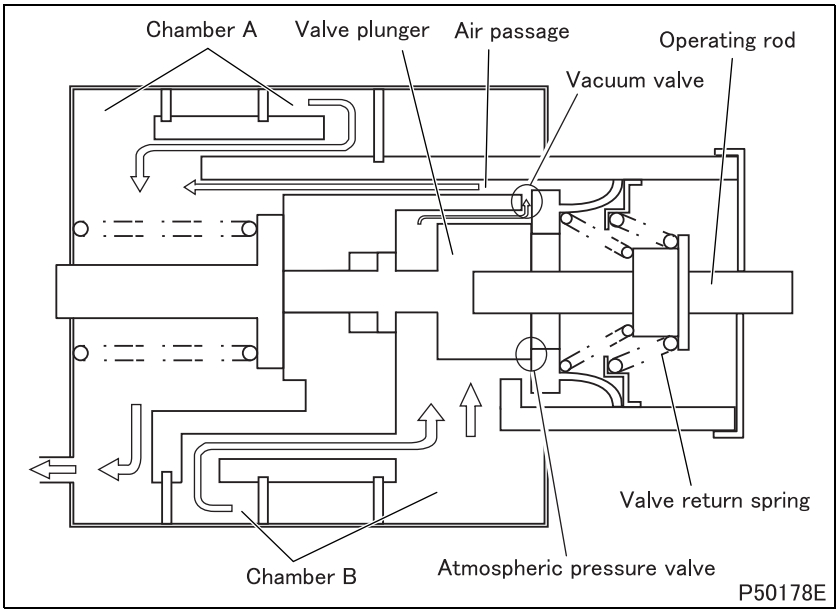
2.1 Operation

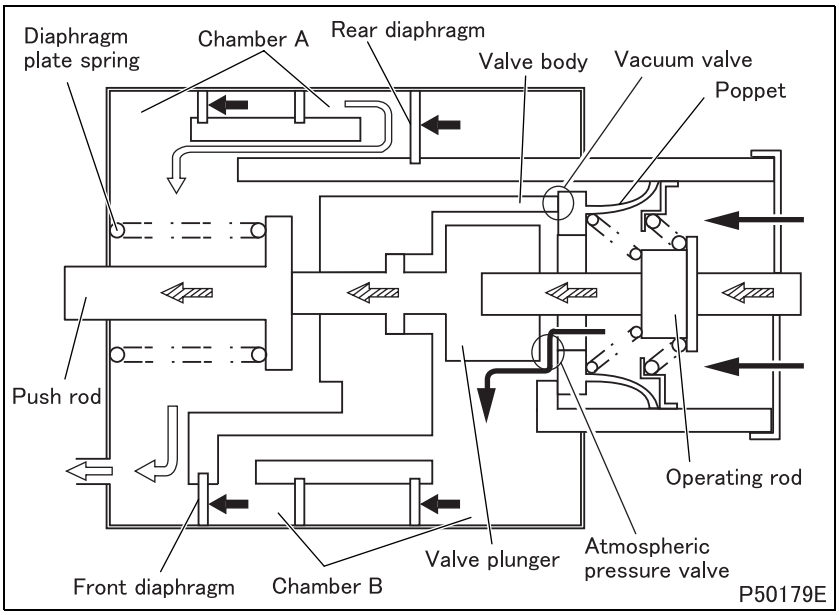
- A rotor with 3 movable vanes is housed in a cylindrical housing. As the rotor rotates, the vanes are pressed against the inner face of the housing by centrifugal force.
- The rotor is eccentrically mounted relative to the housing. As the rotor rotates, air in the vacuum tank is sucked through the pump inlet and then compressed before being discharged through the outlet. The suction-compression-discharge cycle is repeated to generate vacuum in the vacuum tank.
- The inside of the housing is lubricated and cooled by engine oil. After lubrication/cooling, the engine oil together with the compressed air is returned through the pump outlet and into the oil pan.

3. Vacuum Booster and Brake Master Cylinder <Except COE 50>



- The vacuum booster magnifies the stepping force applied onto the brake pedal (therefore reduces the operator's pedal effort) through the utilization of pressure difference between the vacuum it generates and the atmospheric pressure. The system is of a tandem type and has 2 vacuum chambers, achieving size reduction while offering a great capacity for highly efficient boosting performance.
- The brake master cylinder serves both the front and rear brake systems that are independent of each other. Should fluid leakage occur in either the front or rear brake system, stopping power can still be provided by whichever system is intact.

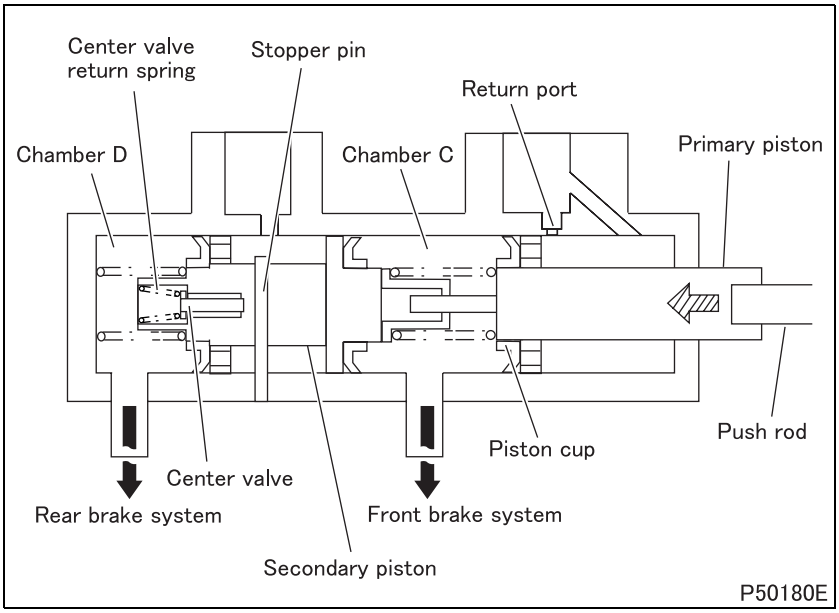




3.1 When brake pedal is pressed

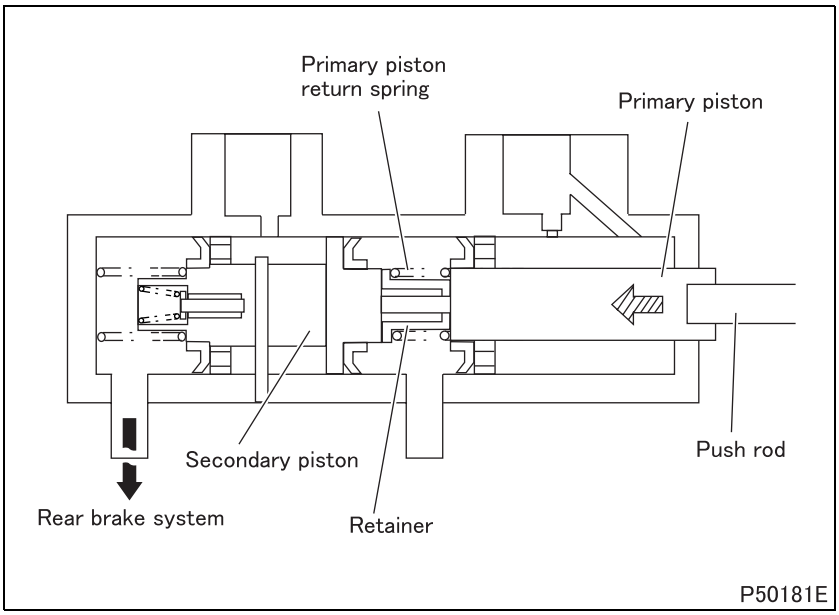
(1) Vacuum booster operation

- With the brake pedal released and no stepping force applied to the brake pedal, the operating rod and the valve plunger are held to the right by the force of the valve return spring. The atmospheric pressure valve remains closed while the vacuum valve remains open.
- The vacuum pump creates vacuum in chamber **A**. As the atmospheric pressure valve is closed, no outside air flows into chamber **B**. Instead, vacuum in chamber **A** flows through the air passage and into chamber **B**. Chambers **A** and **B** are both filled with vacuum, and there is no pressure difference between the chambers. No boosting occurs.
- As the brake pedal is pressed, the stepping force acts on the operating rod. This seats the poppet onto the valve body, closing the vacuum valve and cutting off vacuum supply into chamber **B**. As the brake pedal is pressed further, the valve plunger separates from the poppet. This opens the atmospheric pressure valve, allowing outside air into chamber **B**. There is now a pressure difference between chambers **A** and **B**.
- The stepping force, boosted as a result of the pressure difference between chambers **A** and **B**, overcomes the force of the diaphragm plate spring, pushing the front and rear diaphragms and the push rod to operate the brake master cylinder.



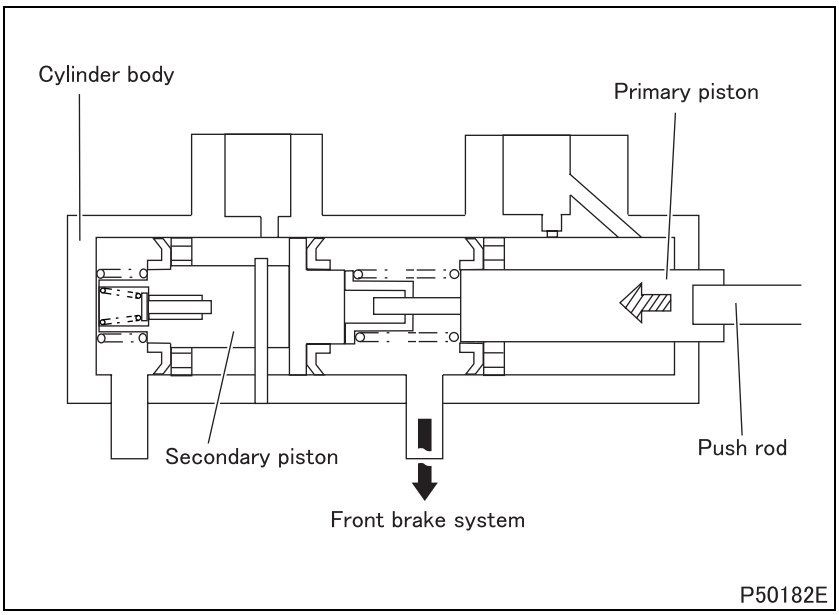
(2) Brake master cylinder operation

- As the push rod pushes the primary piston, the return port is closed by the piston cup. Fluid pressure now builds up in chamber **C**.
- The pressure buildup is sent to the front brake system and at the same time pushes the secondary piston.
- The center valve in front of the secondary piston separates from the stopper pin. The center valve return spring now closes the center valve, seating it onto the secondary piston.
- Fluid pressure now builds up in chamber **D** in front of the secondary piston, and the pressure is sent to the rear brake system.



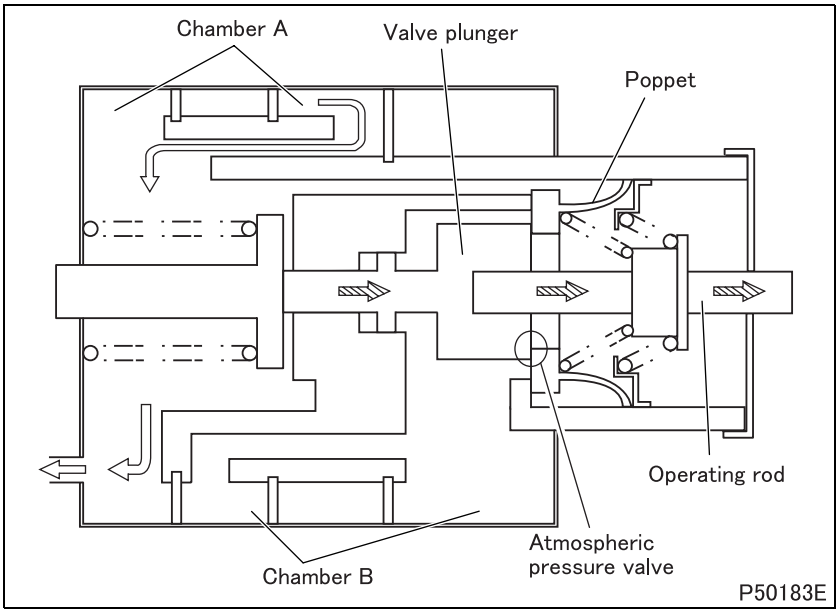
3.2 Fluid leakage in front brake system

- As the brake pedal is pressed, the push rod moves to push the primary piston. As there is fluid leakage in the front brake system, no fluid pressure builds up in that system.
- As the brake pedal is pressed further, the primary piston overcomes the force of the primary piston return spring and, via the retainer, pushes the secondary piston. Fluid pressure is now sent to the rear brake system.



3.3 Fluid leakage in rear brake system

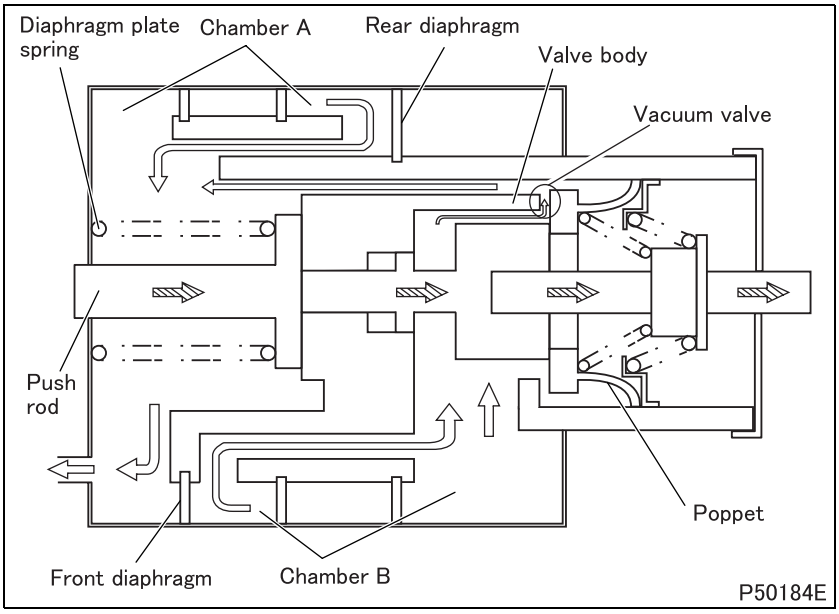
- As the brake pedal is pressed, the push rod moves to push the primary and secondary pistons. As there is fluid leakage in the rear brake system, no pressure builds up in that system.
- As the brake pedal is pressed further, the tip of the secondary piston contacts the cylinder body while the primary piston continues to be pushed. Fluid pressure builds up further in the front brake system.



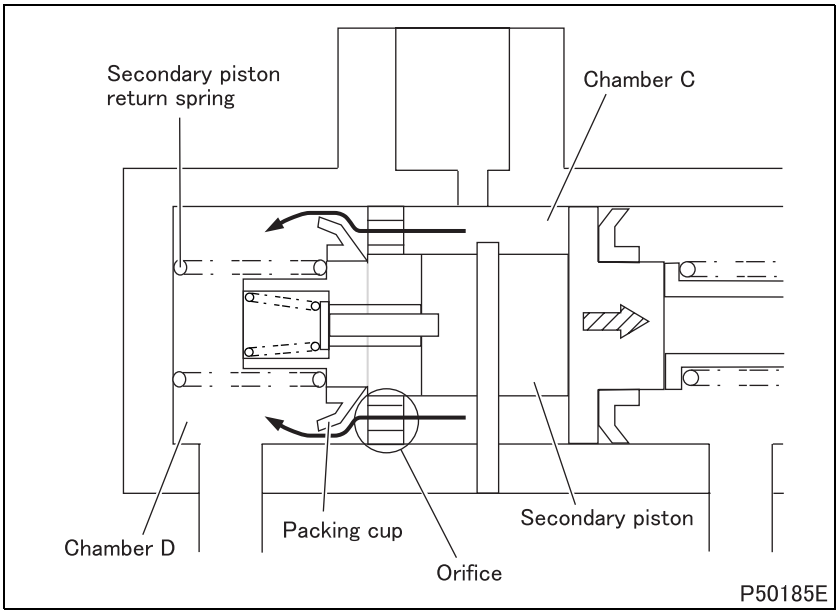
3.4 When brake pedal is released

(1) Vacuum booster operation

- With the brake pedal pressed, chamber **A** is filled with vacuum generated by the vacuum pump while chamber **B** is open to the atmosphere. When the brake pedal is released, the stepping force no longer acts on the operating rod. This causes the valve plunger to seat on the poppet, closing the atmospheric pressure valve and cutting off air flow into chamber **B**.

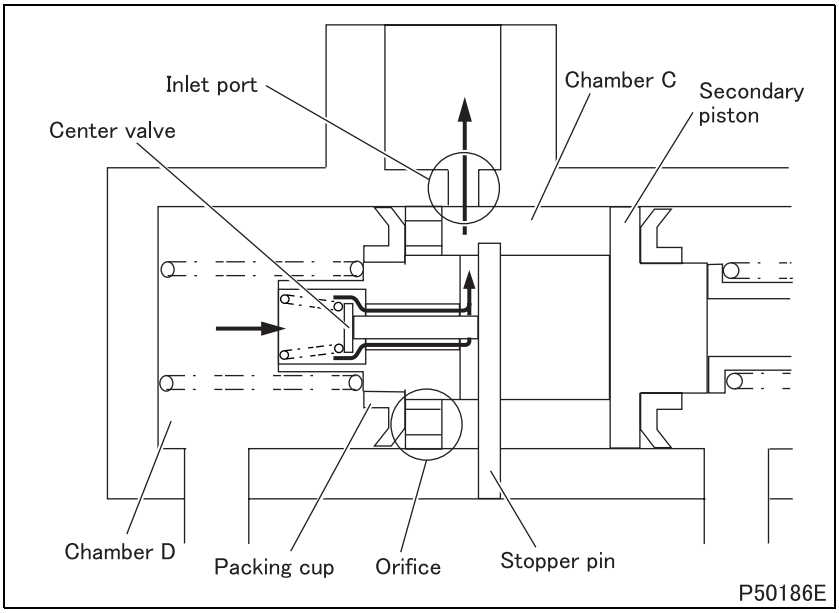


- In further progression, the poppet separates from the valve body. This opens the vacuum valve, allowing vacuum from the vacuum pump to flow into chamber **B**. As there is now no pressure difference between chambers **A** and **B**, the diaphragm plate spring pushes back the front and rear diaphragms and also the push rod to their original positions.

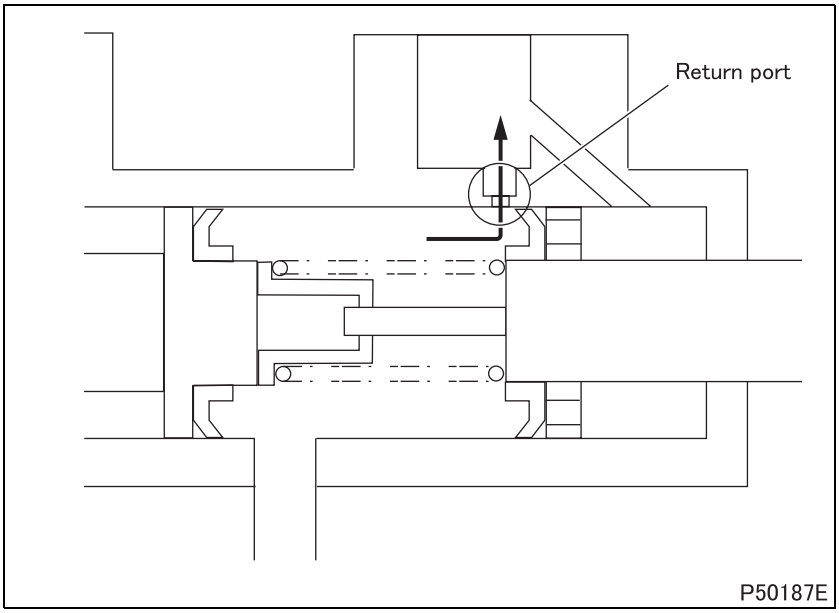


(2) Brake master cylinder operation

- As the push rod returns to its original position, the secondary piston immediately starts to be pushed back by the force of the secondary piston return spring. The speed of return is gradual as there is no difference between chambers **C** and **D** in fluid pressure supplied by the brake master cylinder.
- As the secondary piston starts to return to its original position, the pressure in chamber **D** becomes lower than the pressure in chamber **C**. The pressure difference causes the packing cup to buckle, allowing the fluid pressure in chamber **C** to flow through the orifices and into chamber **D**.



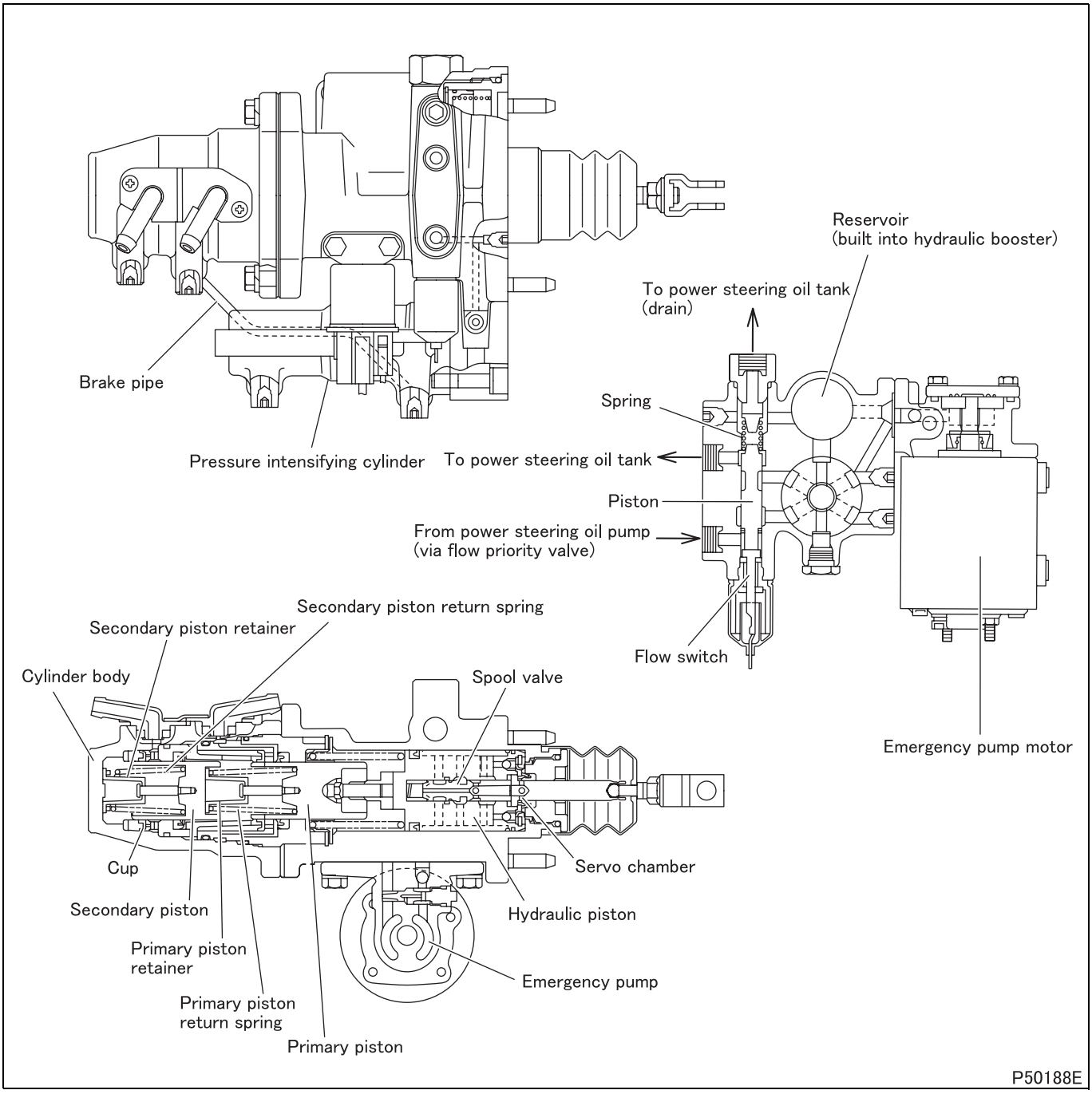
- With the secondary piston back in its original position, there is no difference in fluid pressure between chambers **C** and **D**. The packing cup restores its original shape, blocking the orifices. The liquid pressure in the brake line now flows through the center valve, which has been open since hitting the stopper pin. The liquid pressure then returns through the inlet port to the brake fluid tank.



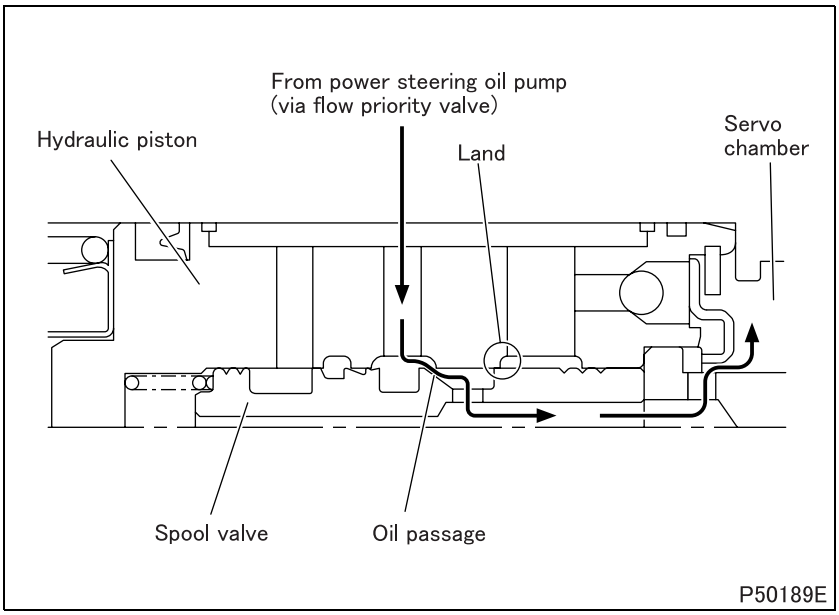
- The fluid pressure in the primary (front) brake line returns through the return port to the brake fluid tank.

M E M O

4. Hydraulic Booster and Brake Master Cylinder <COE 50>



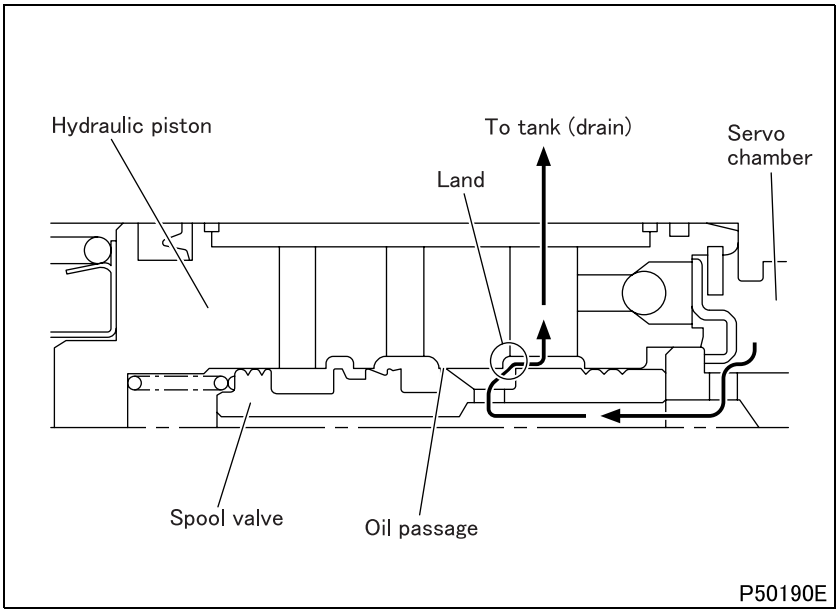
- The hydraulic booster magnifies the stepping force applied onto the brake pedal (therefore reduces the operator's pedal effort) through the utilization (via the flow priority valve) of the steering pump pressure.
- The brake master cylinder serves both the front and rear brake systems that are independent of each other. Should fluid leakage occur in either the front or rear brake system, stopping power can still be provided by whichever system is intact.
- The spool valve is connected to the brake pedal, and generates oil pressure proportional to the pedal stepping force.
- The hydraulic piston, which is connected to the brake master cylinder, operates to store oil supplied via the spool valve into the servo chamber for pressure boost.
- Should oil pressure is lost, the piston is pushed to the left by the force of the spring, blocking oil flow from the power steering oil pump and to the power steering oil tank. At the same time, the flow switch is turned ON, providing power to the emergency pump motor. The emergency pump generates oil pressure for the hydraulic booster to continue to operate.



4.1 Spool valve

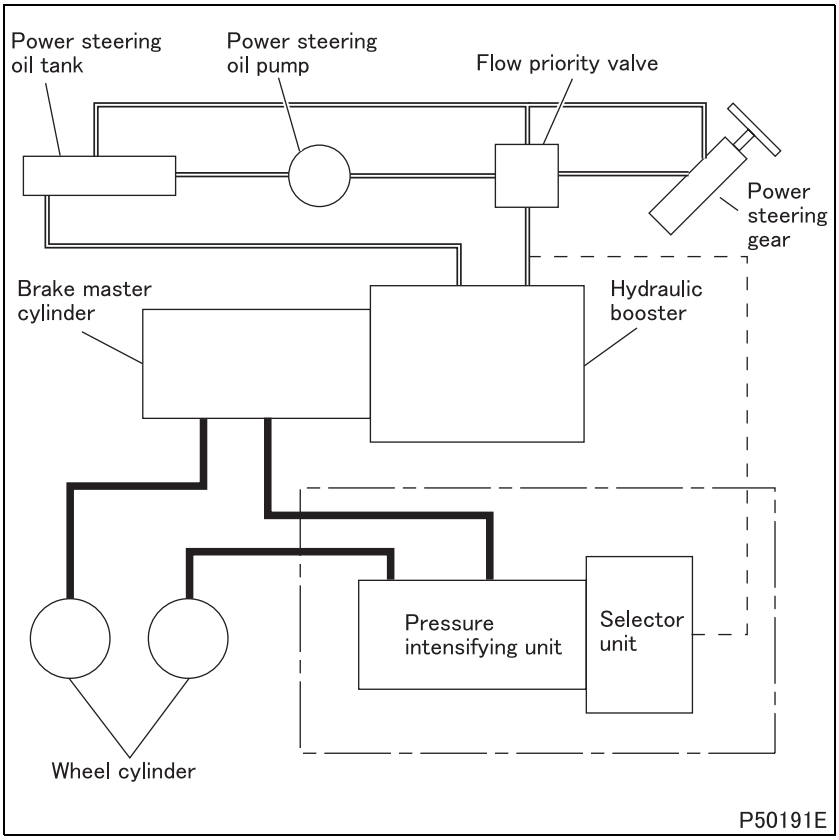
(1) When brake pedal is pressed

- As the brake pedal is pressed, the spool valve moves to the left, closing the land.
- Oil pressure from the flow priority valve builds up.
- The high pressure oil flows through the oil passage and into the servo chamber.
- The hydraulic piston is pushed to the left.
- The pistons in the brake master cylinder are moved, supplying pressure for brake application.



(2) When brake pedal is released

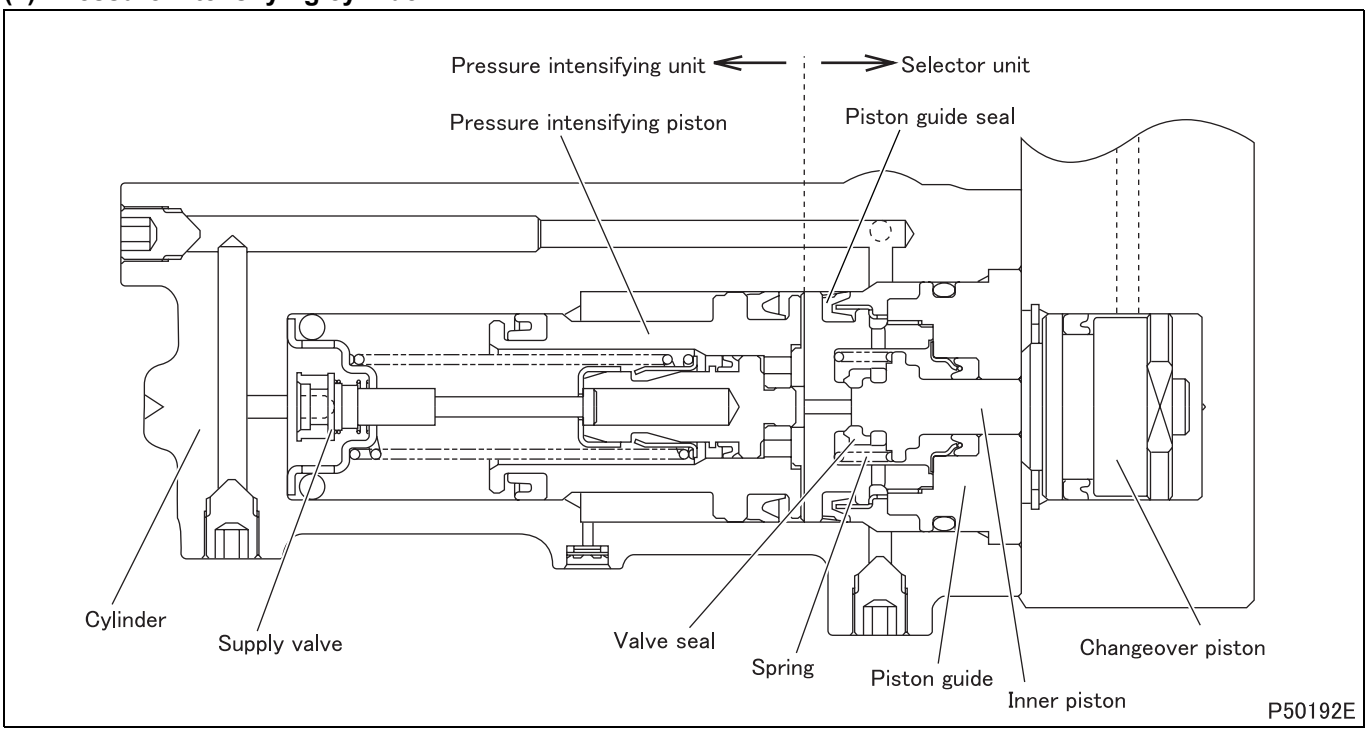
- As the brake pedal is released, the spool valve moves to the right. This opens the land while the oil passage is closed.
- Oil pressure from the flow priority valve drops.
- The oil in the servo chamber drains to the tank as well as to the reservoir.
- The hydraulic piston returns to its original position.
- Pressure acting on the pistons in the brake master cylinder is released.



4.2 Pressure intensifying cylinder system

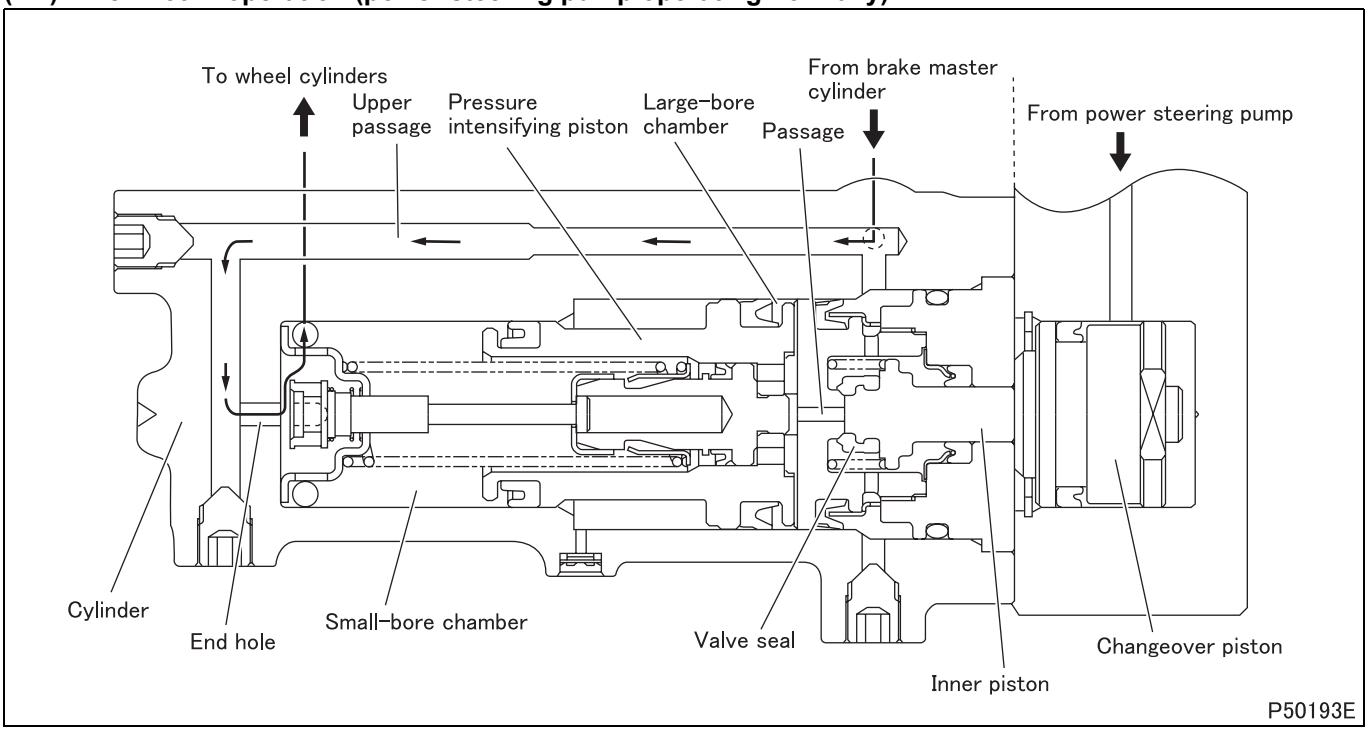
- The pressure intensifying cylinder system is attached onto the hydraulic booster which operates on the power steering oil pump pressure.
- Should the pump fail, pressing the brake pedal causes the system to boost the fluid pressure from the brake master cylinder and send it to the wheel cylinders.

(1) Pressure intensifying cylinder



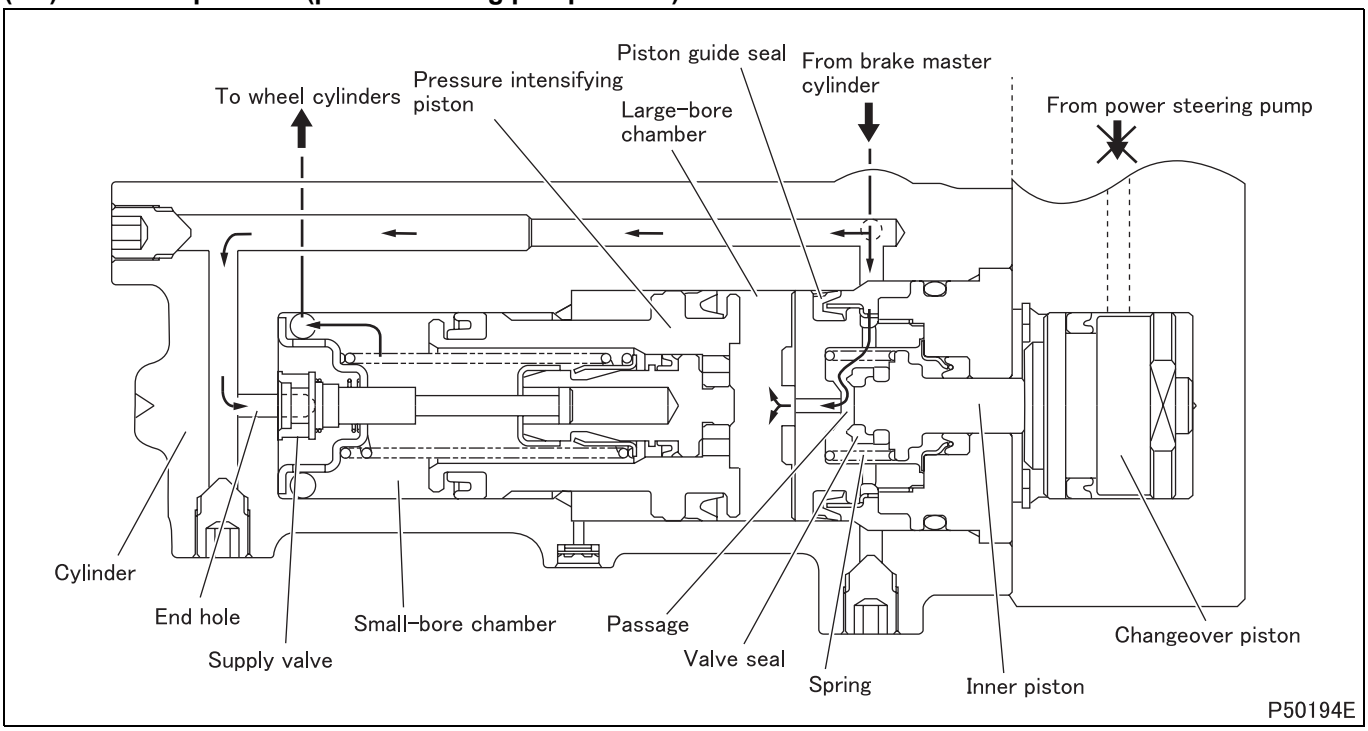
- Should the power steering pump fail to discharge oil, the selector unit detects this. The unit also ensures that pressure not be intensified when the power steering pump is functioning normally.
- Should the power steering pump fail, the pressure intensifying unit comes into action, boosting the fluid pressure from the brake master cylinder before sending it to the wheel cylinders.

(1.1) When not in operation (power steering pump operating normally)



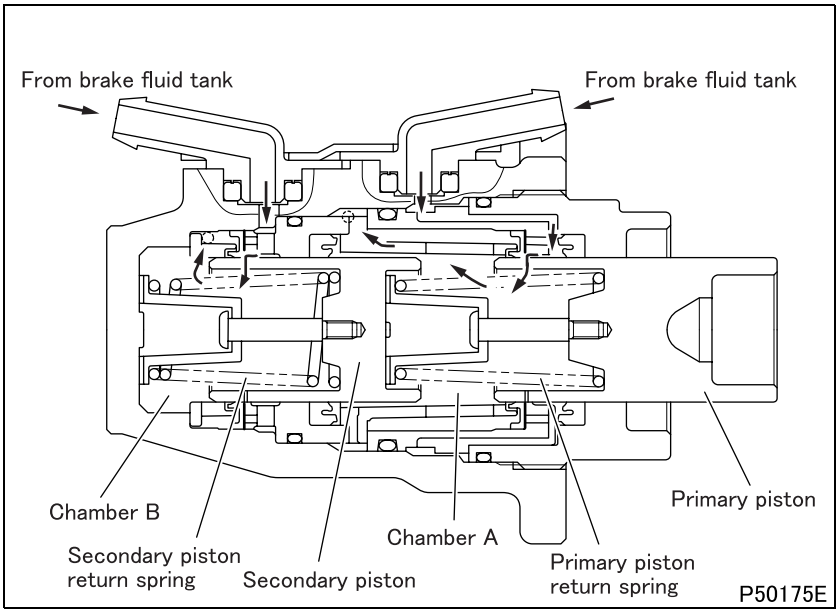
- Power steering oil pump pressure pushes the changeover piston, which then moves the inner piston. As a result, the passage to the large-bore chamber is blocked by the valve seal. Fluid pressure from the brake master cylinder flows through the upper passage, the end hole, the small-bore chamber, and into the wheel cylinders. As fluid pressure acts only on the small-bore end of the pressure intensifying piston, the piston remains in the same position.

(1.2) When in operation (power steering pump failure)



- When the power steering oil pump fails to discharge oil, the spring at the end of the inner piston pushes back the inner and changeover pistons. This opens up the passage through the valve seal into the large-bore chamber.
- Fluid pressure from the brake master cylinder flows into both the large- and small-bore chambers. As the large-bore end of the pressure intensifying piston has a larger area than the small-bore end, the piston moves to the left. As a result, the end hole is blocked by the supply valve.

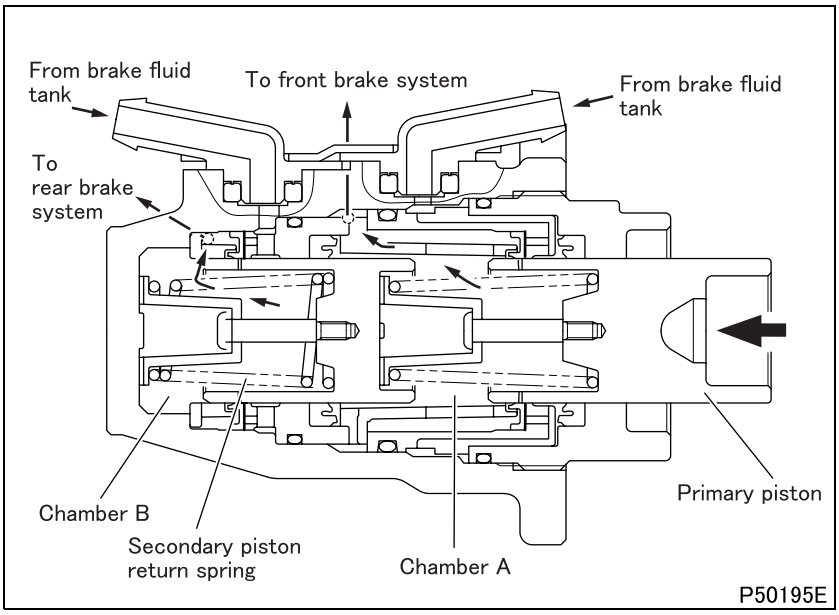
- The brake master cylinder continues to supply fluid into the pressure intensifying cylinder, which in turn sends the increasing pressure to the wheel cylinders.
- When the brake pedal is released, pressure fluid in the large-bore chamber flows through the valve seal, the back of the piston guide seal, and to the brake master cylinder.



4.3 Brake master cylinder

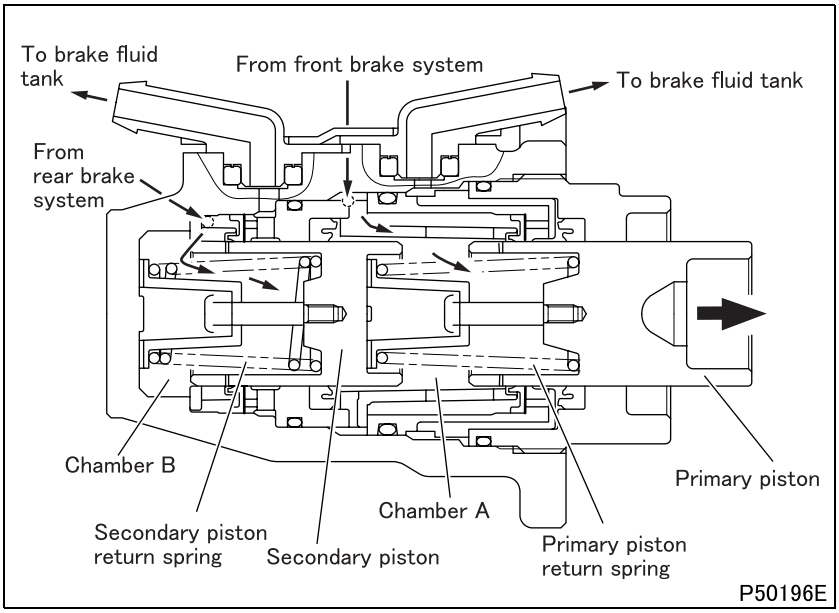
(1) When not in operation

- With the brake pedal released, the primary and secondary pistons are held to the right by the forces of the primary and secondary piston return springs respectively.
- Chambers **A** and **B** are open to the brake fluid tank.



(2) When brake pedal is pressed

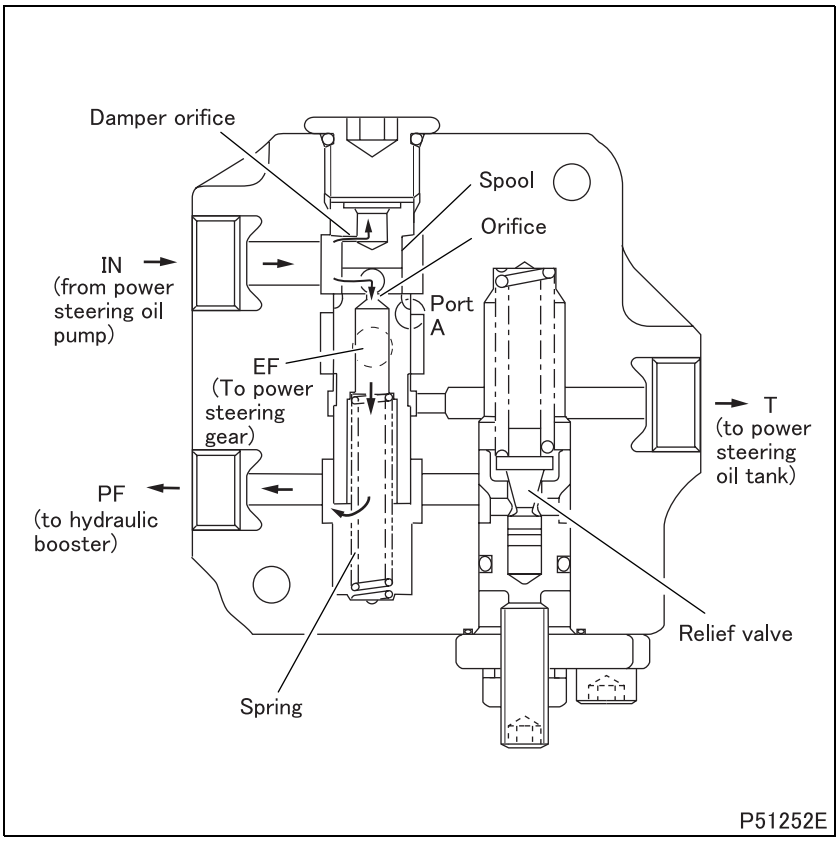
- As the brake pedal is pressed, the primary piston is pushed via the push rod.
- The secondary piston return spring is compressed, and the passages from chambers **A** and **B** to the brake fluid tank are blocked.
- As the brake pedal is pressed further, the primary piston is pushed. Fluid pressure builds up in chambers **A** and **B**, and is sent to the front and rear brake systems respectively.
- When fluid leakage occurs in either the front or rear brake system, the master cylinder operates basically in the same manner as the master cylinder with the vacuum booster.



(3) When brake pedal is released

- As the brake pedal is released and the push rod returns to the original position, the primary piston return spring pushes back the primary piston. Chamber **A** restores the original volume and the pressure in the chamber drops accordingly.
- The secondary piston return spring pushes back the secondary piston. Chamber **B** restores the original volume and pressure.
- Chambers **A** and **B** open up to the brake fluid tank.
- Pressure fluid in the front and rear brake lines flows back into chambers **A** and **B**.

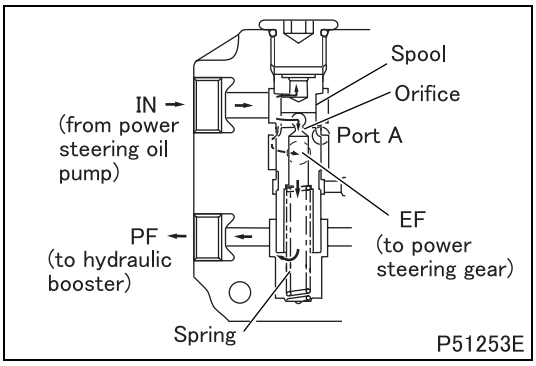
5. Flow Priority Valve <COE 50>



- When brakes are applied hard while the steering wheel is turned, the flow priority valve dampens the associated steering shock by appropriately distributing the flow from the power steering oil pump between the hydraulic booster and the power steering gear.

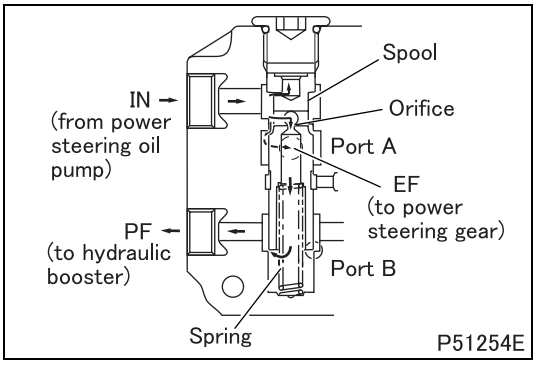
5.1 When pump output is at or below regulated flow rate

- The power steering oil pump output flows through the orifice and to the hydraulic booster.
- The pressure difference across the orifice acts on the spool which is then pushed down against the spring. However, port **A** remains blocked by the spool. As a result, the full flow from the pump is directed to PF.



5.2 When pump output exceeds regulated flow rate

- When the pump output exceeds the regulated flow rate, the pressure difference across the orifice becomes greater and acts on the spool such that the spool is pushed down against the spring until port **A** opens. Excess flow is directed through port **A** and into EF.
- In this state, if the hydraulic booster is operated and a greater flow is demanded by PF line (PF pressure > EF pressure), the spool moves to reduce the opening of port **A** so that the required pressure and the regulated flow rate are both achieved.



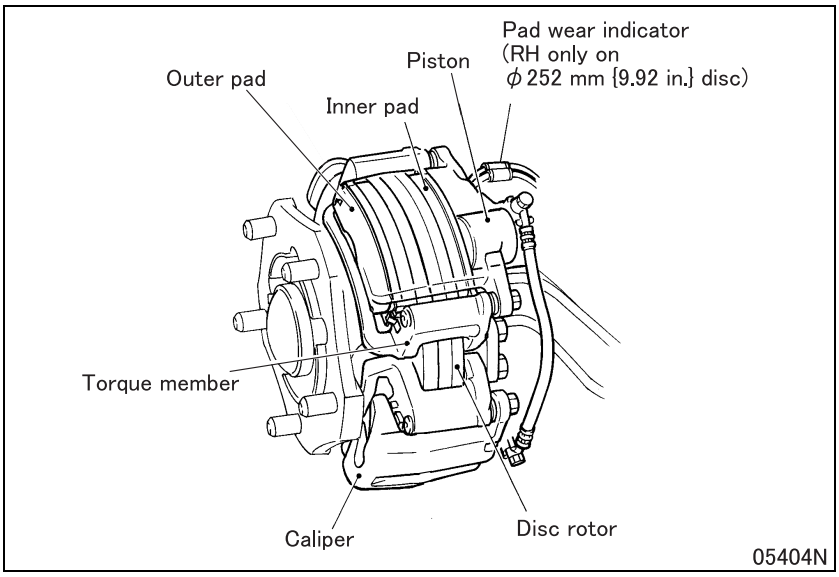
5.3 When power steering gear (EF line) is operated

- When power steering gear (EF line) is operated and a greater flow is demanded by EF line (PF pressure < EF pressure), the pressure difference across the orifice acts on the spool such that the spool is pushed down against the spring until the opening of port **B** is reduced. As a result, the required pressure and the regulated flow rate are both achieved.

5.4 When hydraulic booster (PF line) and power steering gear (EF line) are both operated

- When the hydraulic booster (PF line) and the power steering gear (EF line) are both operated and greater flows are demanded by these lines, the spool is moved against the spring such that the openings of ports **A** and **B** are appropriately balanced to achieve the regulated flow rate.

6. Front Disc Brake

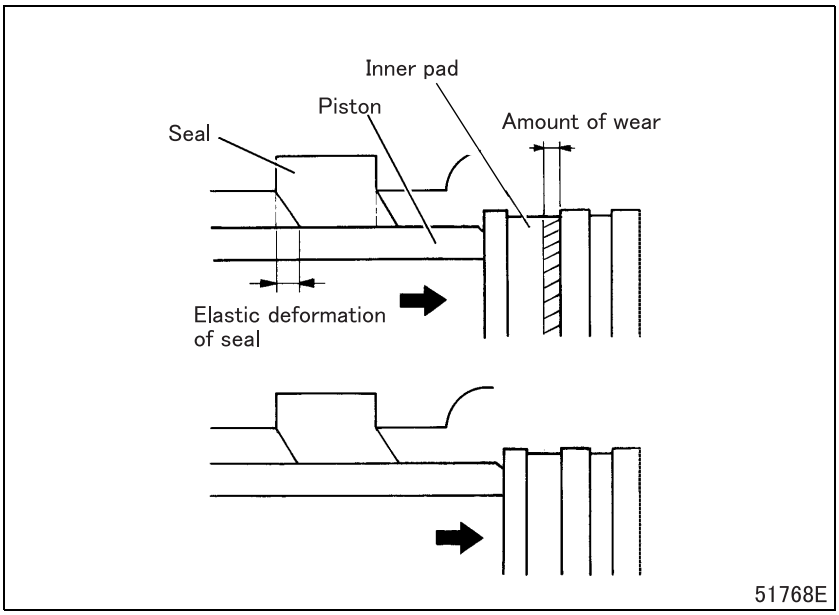


- The front disc brake uses a twin floating-type calipers.
- The caliper houses one each of cylinder and piston. Stopping power is generated by squeezing the disc rotor between the pads, with the outer pad pressed against the disc rotor by reaction.
- The inner pad is equipped with wear indicator which serves to indicate replacement timing for both the inner and outer pads.
- The front disc brake is equipped with a self-adjusting mechanism to compensate for pad wear and maintain the correct clearances between the disc rotor and the inner and outer pads. The adjustment is made each time braking is performed.

6.1 Self-adjusting mechanism

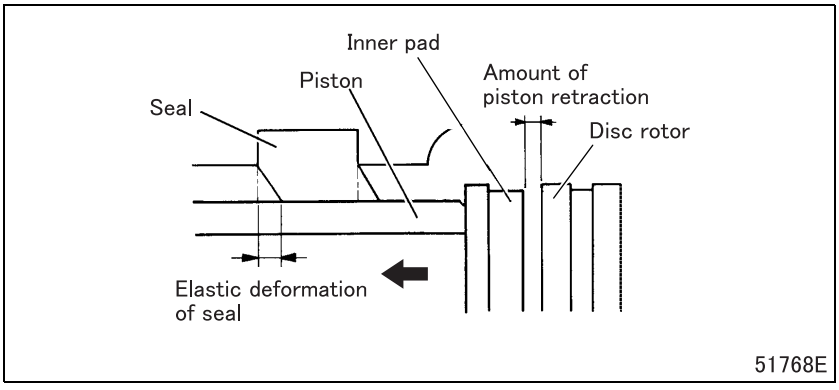
(1) Operation

(1.1) When brake pedal is pressed



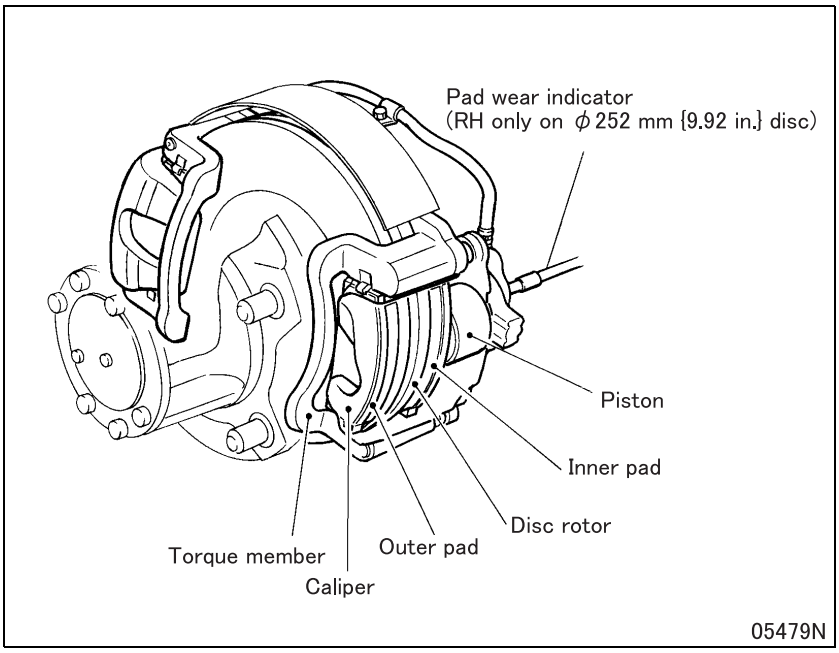
- The piston extends in excess of the seal's elastic deformation by the amount of inner pad wear (shown hatched).

(1.2) When brake pedal is released



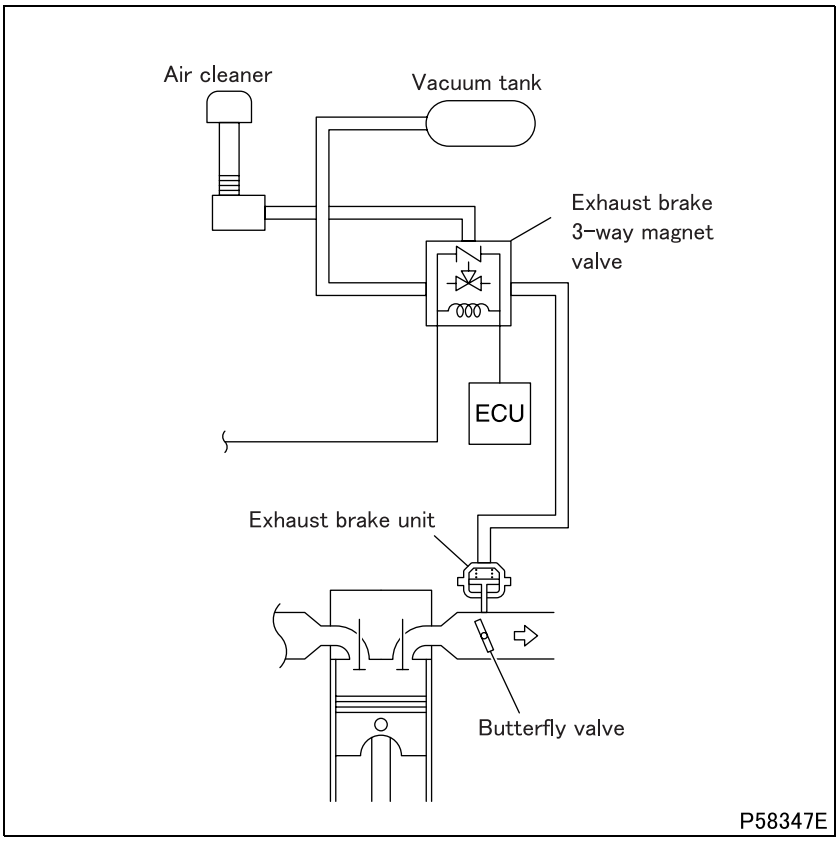
- The piston retracts as much as the amount of the seal's elastic deformation, thus maintaining the correct clearance between the disc rotor and the inner pad.

7. Rear Disc Brake



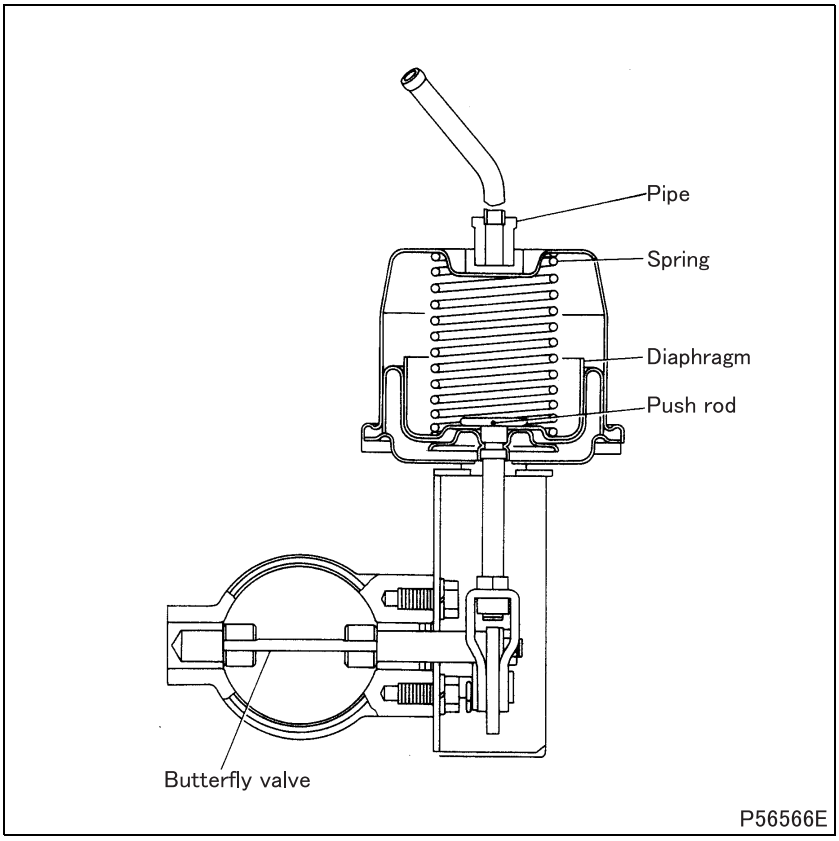
- The rear disc brake uses a twin floating-type calipers.
- The caliper houses one each of cylinder and piston. Stopping power is generated by squeezing the disc rotor between the pads, with the outer pad pressed against the disc rotor by reaction.
- The inner pad is equipped with wear indicator which serves to indicate replacement timing for both the inner and outer pads.
- The rear disc brake is equipped with a self-adjusting mechanism to compensate for pad wear and maintain the correct clearances between the disc rotor and the inner and outer pads. The adjustment is made each time braking is performed.
- The self-adjusting mechanism operates in the same manner as that of the front disc brake.

8. Exhaust Brake System



- The exhaust brake system provides stopping power by closing the exhaust piping. Specifically, pressure builds up in the blocked exhaust piping, which then is used to resist the pistons as they move to discharge exhaust in the exhaust stroke.
- The exhaust brake system supplements the foot brake. It is equipped with the exhaust brake unit incorporating a butterfly valve.
- When the exhaust brake switch is turned ON, the excitation winding within the exhaust brake 3-way magnet valve is magnetized. This closes the atmospheric pressure valve while opening the vacuum valve. Vacuum in the vacuum tank acts on the exhaust brake unit, closing the butterfly valve and bringing the exhaust braking in operation.

8.1 Exhaust brake unit (power chamber)



Wheel Brake

Possible causes	Symptoms	Brake application one sided							Noise and shock when brake pedal pressed		Reference Gr
		Brake drag (slow disengagement after pedal release)	Stopping power different from right to left	Unstable stopping power	Locking point varies	Other	Insufficient stopping power	Reduced pedal travel	Continuous noise during brake application (at low vehicle speed)	Other	
Wheel brake	Backing plate surface rough	O		O							
	Backing plate deformed or incorrectly installed			O							
	Lubricant or moisture on brake pad surface		O		O						
	Deterioration or incorrect material used for brake pad		O								
	Brake pad unevenly worn or with rough surface		O								
	Fade (pad surface deterioration)				O						
	Brake pad worn to limit								O		
	Incorrect contact of brake pad		O		O		O				
	Disc rotor worn unevenly		O								
	Disc rotor deformed			O							
	Disc rotor worn				O						
	Disc rotor surface rough						O				
	Disc rotor inaccurately machined									O	
	Movable parts insufficiently lubricated									O	

Possible causes \ Symptoms		Brake application one sided							Noise and shock when brake pedal pressed		Reference Gr
		Brake drag (slow disengagement after pedal release)	Stopping power different from right to left	Unstable stopping power	Locking point varies	Other	Insufficient stopping power	Reduced pedal travel	Continuous noise during brake application (at low vehicle speed)	Other	
Brake pedal	Incorrect pedal travel						O				
	Incorrectly adjusted, too much play							O			
Brake fluid	Fluid level low							O			
	Fluid leakage							O			
	Air ingress							O			
	Vapor lock							O			
Vacuum system	Vacuum drop						O				
Vacuum booster	Faulty						O	O			
Hydraulic booster	Faulty hydraulic booster						O	O			
	Faulty piston cup							O			
Tire	Tire pressure uneven between wheels					O					Gr31
	Different tire sizes from left to right					O					
Axle	Wheel hub bearing incorrectly adjusted					O			O		Gr26, 27
	Wheelbase different from left to right					O					
	Incorrect wheel alignment					O					Gr26

Possible causes / Symptoms		Brake noise			Judder	Abnormal brake pedal return	Brake drag	Reference Gr
		Noisy when vehicle is new, or after brake lining/pad replacement	Brakes used under severe conditions	Other				
Wheel brake	Lubricant or moisture on brake pad surface		O					
	Wear powder attached on brake pad			O				
	Brake pad worn			O				
	Incorrect contact of brake pad	O						
	Disc rotor glazed		O					
	Disc rotor thickness uneven				O			
Brake pedal	Pedal play insufficient						O	
	Linkage rusted or deformed					O		
	Return spring fatigued or broken					O		
	Vacuum/hydraulic booster operating rod thrust					O		
Brake master cylinder	Faulty piston cup						O	
Axle	Wheel hub bearing incorrectly adjusted			O	O			Gr26, 27
	King pin bushing worn				O			Gr26

Exhaust Brake

Symptoms / Possible causes		Exhaust brake not effective	Exhaust brake does not disengage	Reference Gr
Vacuum system	Insufficient vacuum	O		
	Collapsed piping	O		
Faulty 3-way magnet valve		O	O	Gr54
Exhaust brake unit	Faulty valve	O	O	
	Stuck valve shaft	O	O	
	Faulty valve chamber	O		
Faulty electric system		O	O	Gr54

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Replacement of Brake Fluid

- Brake fluid is shared by the brake and clutch systems, and is divided in the brake fluid tank into the two systems. This section describes the replacement of the brake fluid for the brake system. In order to completely replace the brake fluid, the brake fluid in the clutch system should also be replaced.

Torque: N·m {lbf·ft}

Mark	Component	Torque value	Remarks
–	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Brake fluid tank	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required

WARNING ⚠

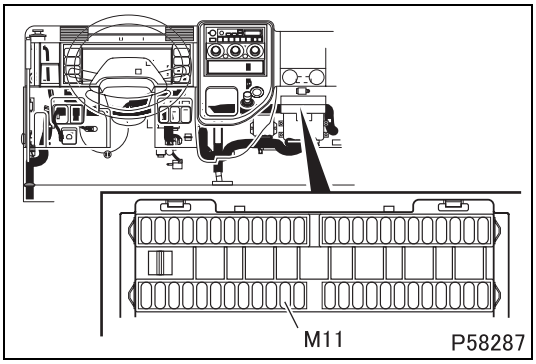
- **Be sure to use new brake fluid. Do not mix it with brake fluid of different properties or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.). This will alter the original properties of FUSO Brake Fluid, causing the boiling point to drop as well as the brake rubber parts to swell. Faulty operation of the brake will result.**
- **Ensure that no foreign matter or water enter into the brake fluid when refilling it, as they will cause faulty brake operation.**
- **Use a mug exclusively kept for the specified brake fluid. This ensures that no brake fluid of different properties or mineral oil enter into the system.**

CAUTION ⚠

- **Brake fluid is corrosive on paint work. Be careful not to spill it onto the paint work. If brake fluid is spilled onto the paint work, immediately wipe it off.**

NOTE

- **During brake fluid replacement operation, a change in color of the brake fluid being discharged indicates that the old brake fluid in the system has been replaced with new brake fluid.**
- **During the replacement, be sure to keep the brake fluid level at the “MAX” mark on the tank.**



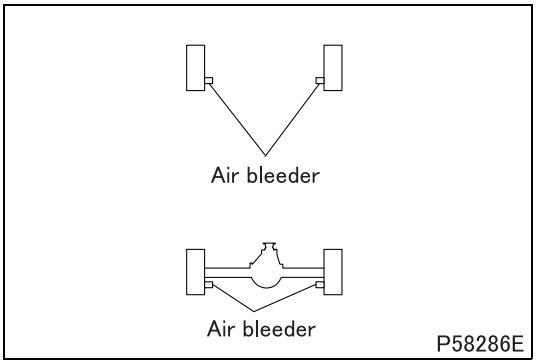
1.1 Work before replacement

- Remove the power fuse (M11) for the electronic control unit of antilock brake system.

WARNING ⚠

- **Do not install the power fuse until after the brake fluid replacement is completed. Otherwise, the initial system check starts, possibly causing air to enter into the secondary system (antilock brake system operating circuit).**

- On vehicles equipped with a vacuum booster, in order to ensure that the vacuum booster function properly, start the engine and keep it running at idle until the replacement is completed.
- On vehicles equipped with a hydraulic booster, the emergency pump is used for the replacement operation. Therefore, shut down the engine and turn the ignition switch ON.
- Install one end of a vinyl pipe onto each air bleeder. Place the loose end into a container.



1.2 Replacement of brake fluid

- Loosen each bleeder screw, and press and release the brake pedal repetitively until brake fluid is no longer discharged from the pipes.
- While filling the brake fluid tank with new brake fluid up to the “MAX” mark, cycle the brake pedal repetitively until the old brake fluid being discharged is replaced with new brake fluid. Tighten each air bleeder to the specified torque.
- Proceed to Air Bleeding of Brake System.

2. Air Bleeding of Brake System

- Brake fluid is shared by the brake and clutch systems, and is divided in the brake fluid tank into the two systems. This section describes the air bleeding of the brake system.

Torque: N·m {lbf·ft}

Mark	Component	Torque value	Remarks
–	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Brake fluid tank	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required

WARNING ⚠

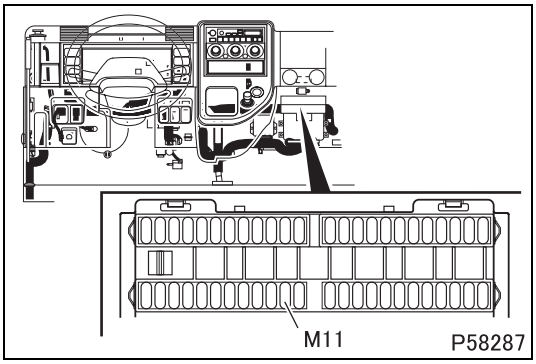
- **Be sure to use new brake fluid. Do not mix it with brake fluid of different properties or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.). This will alter the original properties of FUSO Brake Fluid, causing the boiling point to drop as well as the brake rubber parts to swell. Faulty operation of the brake will result.**
- **Ensure that no foreign matter or water enter into the brake fluid when refilling it, as they will cause faulty brake operation.**
- **Use a mug exclusively kept for the specified brake fluid. This ensures that no brake fluid of different properties or mineral oil enter into the system.**

CAUTION ⚠

- **Brake fluid is corrosive on paint work. Be careful not to spill it onto the paint work. If brake fluid is spilled onto the paint work, immediately wipe it off.**

NOTE

- **Brake fluid level drops during the air bleeding operation. Be sure to keep the brake fluid level at the "MAX" mark on the tank.**



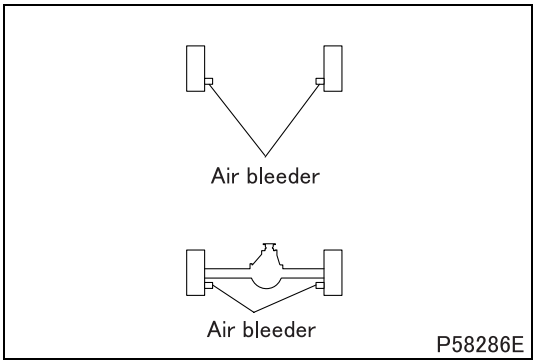
2.1 Work before replacement

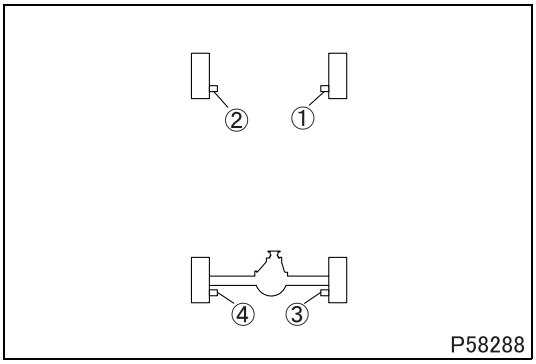
- Remove the power fuse (M11) for the electronic control unit of antilock brake system.

WARNING ⚠

- **Do not install the power fuse until after the air bleeding of the primary brake system (normal circuit) is completed. Otherwise, the initial system check starts, possibly causing air to enter into the secondary system (antilock brake system operating circuit).**

- On vehicles equipped with a vacuum booster, in order to ensure that the vacuum booster function properly, start the engine and keep it running at idle until the replacement is completed.
- On vehicles equipped with a hydraulic booster, the emergency pump is used for the replacement operation. Therefore, shut down the engine and turn the ignition switch ON.
- Install one end of a vinyl pipe onto each air bleeder. Place the loose end into a container.





2.2 Air bleeding of brake system

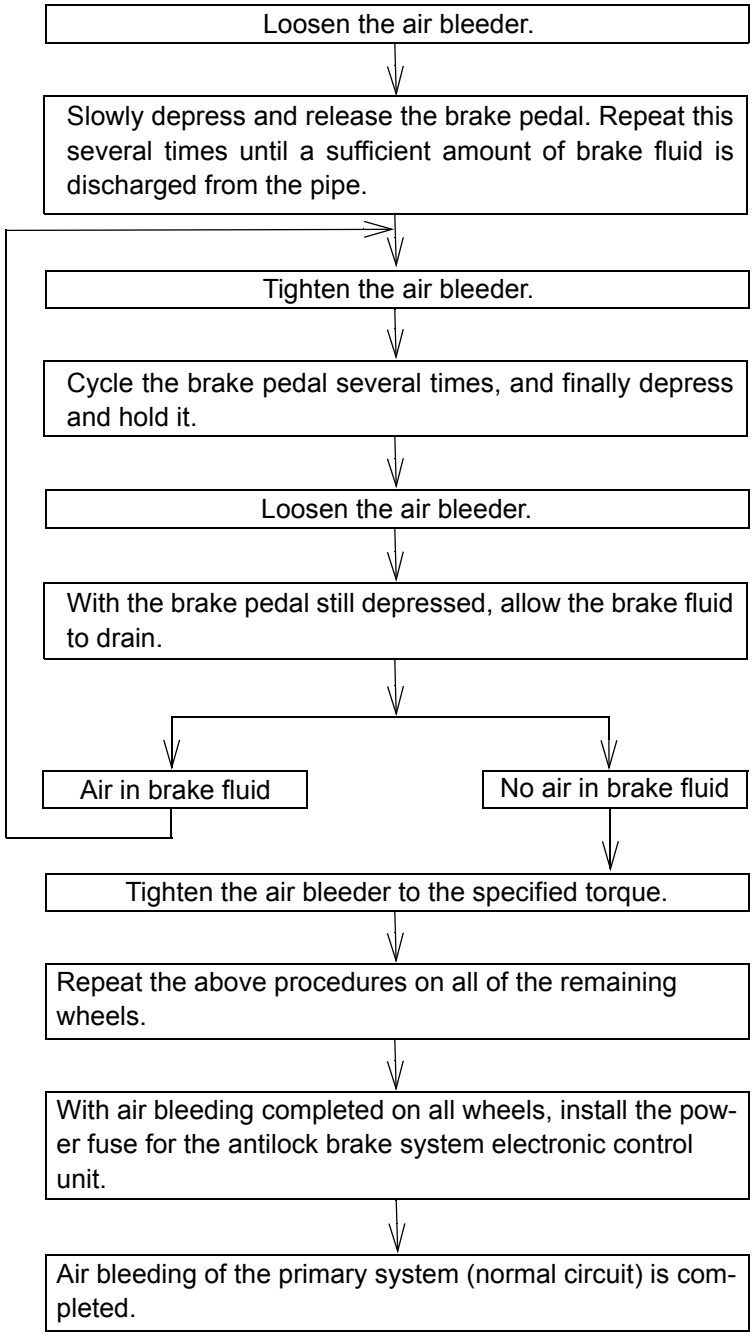
(1) Air bleeding of primary brake system (normal circuit)

- Perform the air bleeding sequence described below on each of the 4 wheels in the order of the following table.

Order of air bleeding	Brake system	Wheel
(1)	Front	Front right
(2)		Front left
(3)	Rear	Rear right
(4)		Rear left

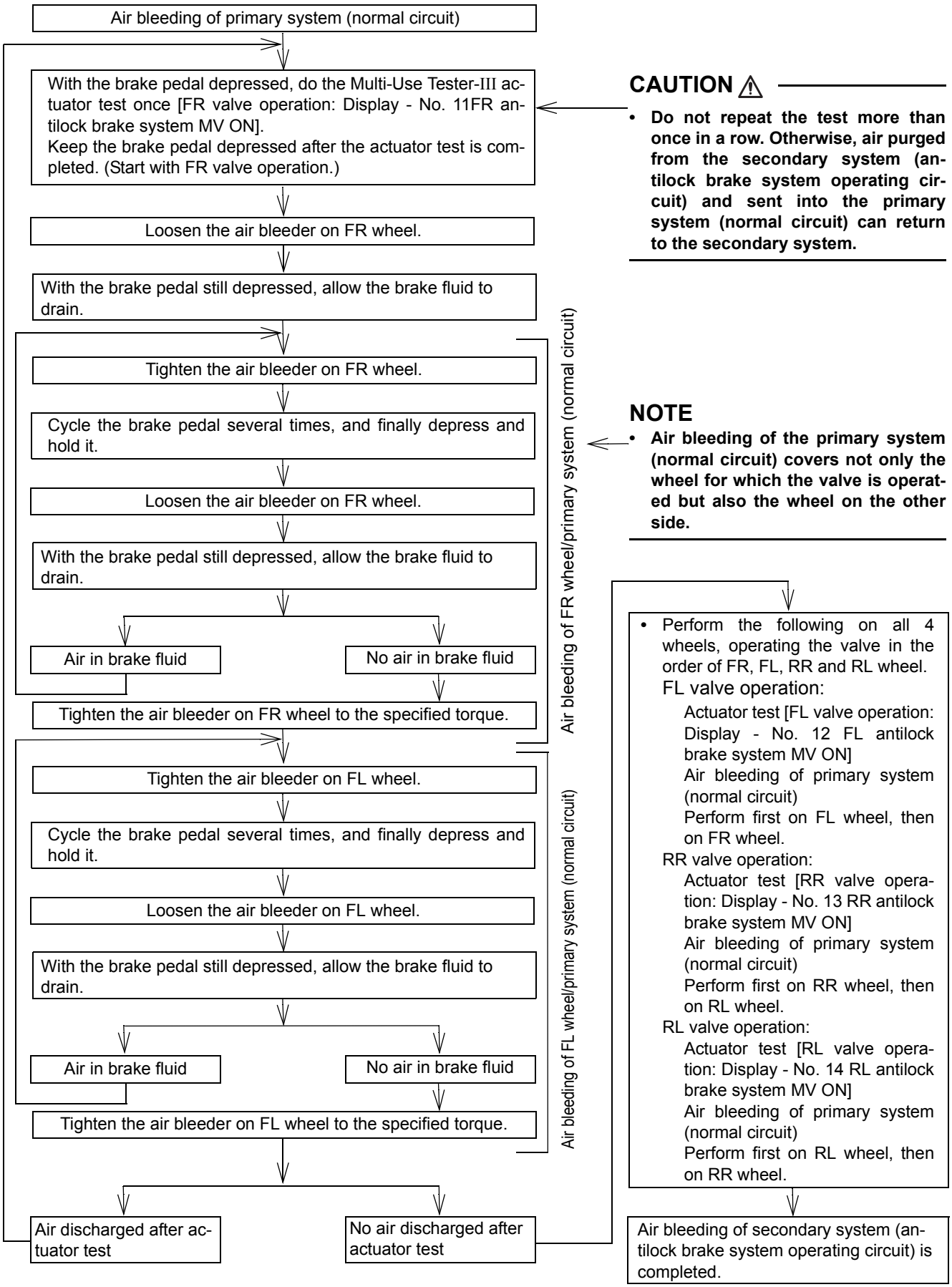
NOTE

- **If air has entered into the secondary brake system (antilock brake system operating circuit), bleed air from the secondary system after completing the air bleeding of the primary system (normal circuit).**
- **Normally, during air bleeding or hydraulic unit replacement operation, air cannot enter into the secondary system (antilock brake system operating circuit) which is filled with brake fluid and is closed off. Therefore, only the primary system (antilock brake system operating circuit) needs to be bled of air.**



(2) Air bleeding of secondary brake system (antilock brake system operating circuit)

- If the antilock brake system is operated with air still remaining in the primary brake system (normal circuit), air can enter into the secondary brake system (antilock brake system operating circuit).
- If air has entered into the secondary system (antilock brake system operating circuit), that air can also flow into the primary system (normal circuit) when the antilock brake system is operated, possibly causing the brake pedal stroke to extend.
- Multi-Use Tester-II or Multi-Use Tester-III actuator test (antilock brake system operating mode) is performed as part of the air bleeding procedures.



CAUTION ⚠

- **Do not repeat the test more than once in a row. Otherwise, air purged from the secondary system (antilock brake system operating circuit) and sent into the primary system (normal circuit) can return to the secondary system.**

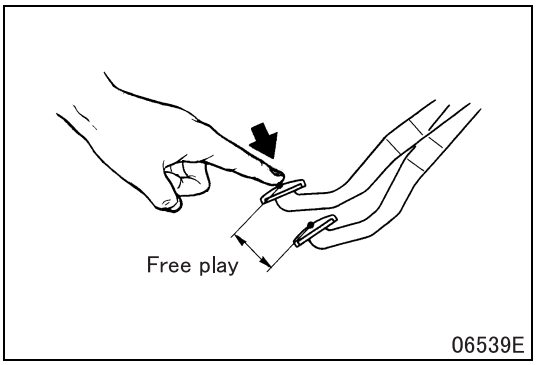
NOTE

- **Air bleeding of the primary system (normal circuit) covers not only the wheel for which the valve is operated but also the wheel on the other side.**

3. Inspection and Adjustment of Brake Pedal Free Play

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
–	Pedal free play	0.1 to 3 {0.0034 to 0.12}	–	Adjust



[Inspection]

- With the engine stationary, ensure that the pedal play conforms to the standard value.
- If the measured value does not conform to the standard value, adjust the installed height of the brake pedal.

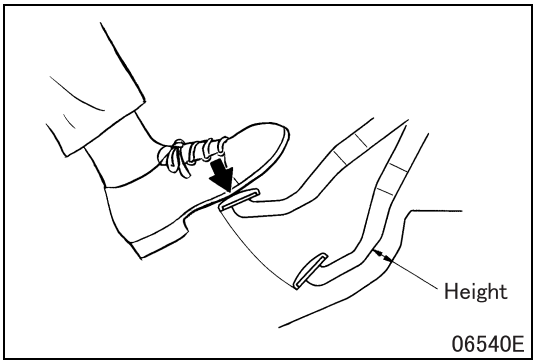
[Adjustment]

- For adjustment procedures, see “5. Inspection of Brake Pedal Full Stroke and Adjustment of Installed Height of Brake Pedal.”

4. Inspection and Adjustment of Brake Pedal Pressed Height from Floor

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
–	Brake pedal height from floor (when pressed with a force of 490 N {110 lbf}	20 {0.79} or above	–	Adjust



[Inspection]

- With the engine running at idle, press the brake pedal with a force of 490 N {110 lbf} and measure the brake pedal height from the floor.
- If the measured value does not conform to the standard value, adjust the installed height of the brake pedal.

[Adjustment]

- For adjustment procedures, see “5. Inspection of Brake Pedal Full Stroke and Adjustment of Installed Height of Brake Pedal.”

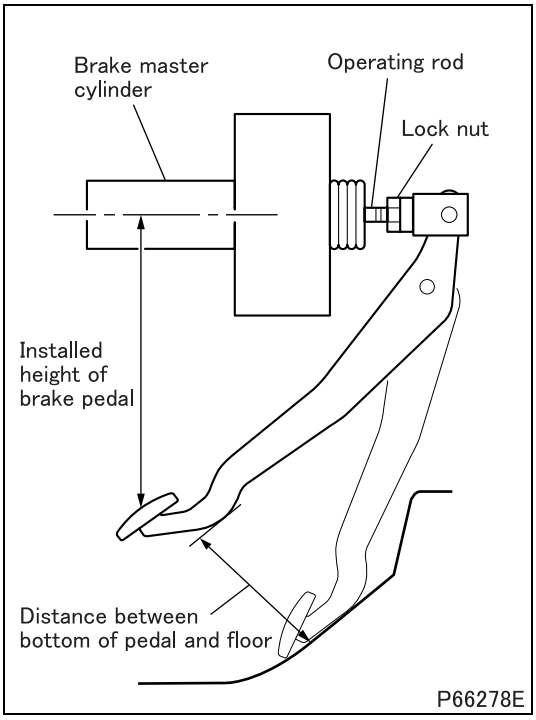
5. Inspection of Brake Pedal Full Stroke and Adjustment of Installed Height of Brake Pedal

Service standards: mm {in}

Location	Maintenance item		Standard value	Limit	Remedy
–	Pedal full stroke (distance between bottom of pedal and floor with brake pedal released)	Except COE 50	170 to 177 {6.68 to 6.97}	–	Adjust
		COE 50	173 to 181 {6.82 to 7.11}	–	
	Installed height of brake pedal (pedal pad center to brake master cylinder center)	Except COE 50	233 ± 3 {9.17 ± 0.12}	–	Adjust
		COE 50	230.2 ± 3 {9.06 ± 0.12}	–	

Torque: N·m {lbf·ft}

Mark	Fastener		Torque value	Remarks
–	Lock nut	Except COE 50	21.6 ± 2.94 {16 ± 2.2}	–
		COE 50	9.8 to 15.7 {7.2 to 12}	–



5.1 Inspection of pedal stroke

- With the brake pedal released, measure the distance between the bottom of pedal and the floor. If the measurement conforms to the standard value, the pedal full stroke is correctly adjusted.
- If the above measurement does not conform to the standard value, adjust the installed height of the brake pedal.

5.2 Adjustment of installed height of brake pedal

- After loosening the lock nut, turn the operating rod of the vacuum booster/hydraulic booster until the distance from the pedal pad center to the axis of brake master cylinder conforms to the standard value.
- Tighten the lock nut to the specified torque.
- With the lock nut correctly tightened, adjust the stop lamp switch and inspect the brake pedal play.

CAUTION ⚠

- **When the pedal is fully depressed, the vacuum booster/hydraulic booster operating rod functions as a stopper for the brake pedal.**
- **To prevent brakes from dragging, ensure that the threaded end of the stop lamp switch does not touch the brake pedal stopper.**

6. Inspection and Replacement of Disc Brake Pad

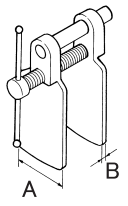
Service standards: mm {in}

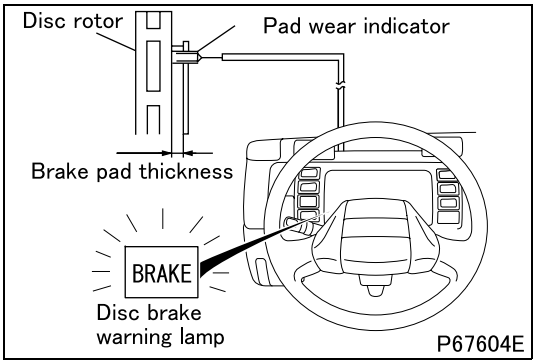
Location	Maintenance item	Standard value	Limit	Remedy
–	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
–	Pin bolt	40 to 50 {30 to 37}	–

Special tools: mm {in}

Mark	Tool name and shape	Part No.	Application
a	Piston expander A: 50 {1.97}, B: 5 {0.20}  06815	MB990520	Pressing piston during brake pad replacement



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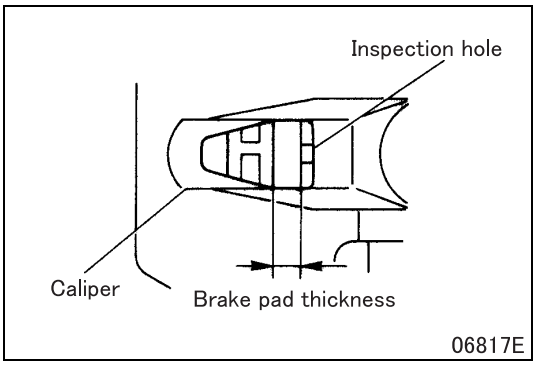
[Inspection]

- When a brake pad has worn down to a thickness of approximately 4 mm {0.16 in}, the pad wear indicator contacts the disc rotor. This breaks the circuit, illuminating the disc brake warning lamp on the meter cluster to tell the operator that the brake pads need replacement.



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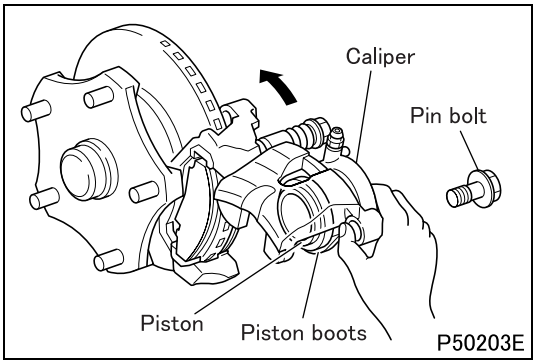
- Through the inspection hole in the caliper, measure the brake pad thickness. If the measured value is less than the limit, replace all of the brake pads on that axle with a new kit.



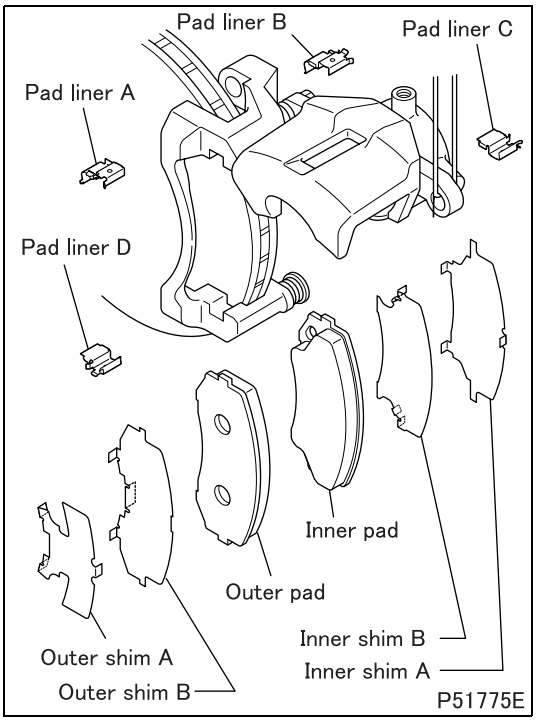
[Replacement]

- Remove the lower pin bolt. Flip the caliper upwards and suspend it in place using a wire or the like.

CAUTION ⚠

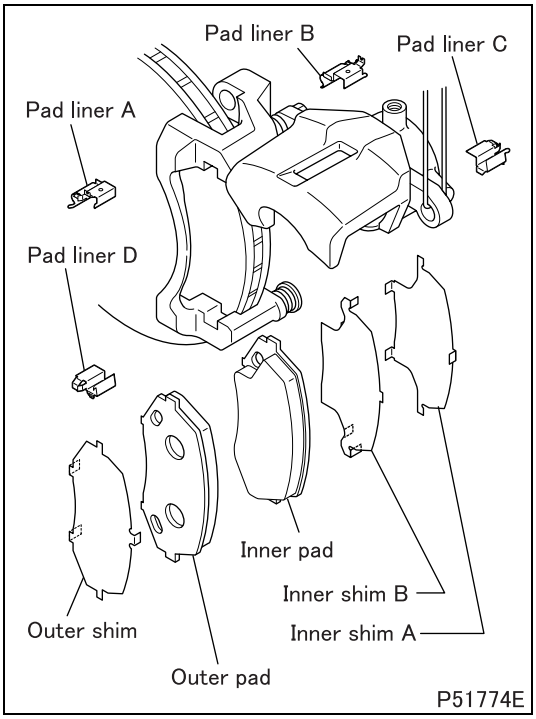
- **Suspend the caliper firmly in place so that it does not drop, which could result in stretching, squeezing or otherwise damaging the brake plumbing or harness.**

- Inspect the piston for fluid leakage. Inspect the piston boots for damage. Faulty parts must be replaced.
- Remove the following parts. Installation follows the removal procedure in reverse. When installing shims onto the pads, be sure to face them in the illustrated directions.



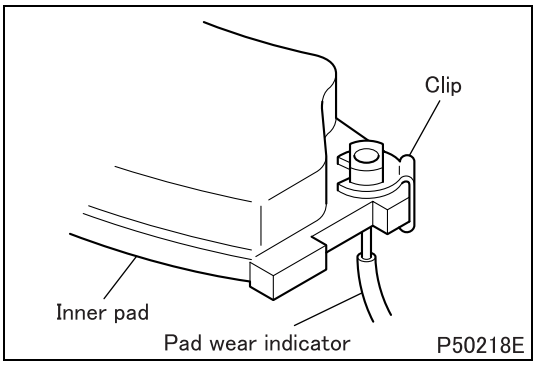
<ϕ235 mm {9.25 in} disc>

- The inner pad on the R/H wheel and the inner pad on the L/H wheel are both equipped with a pad wear indicator.



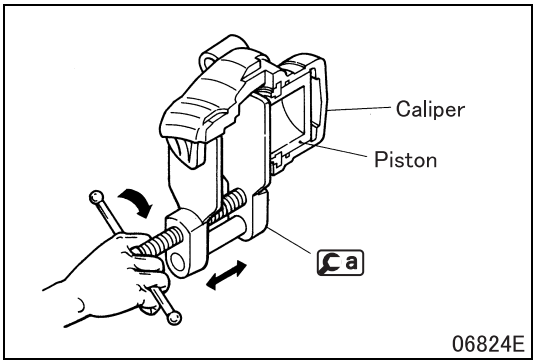
<ϕ252 mm {9.92 in} disc>

- The inner pad on the R/H wheel and the inner pad on the L/H wheel are both equipped with a pad wear indicator.

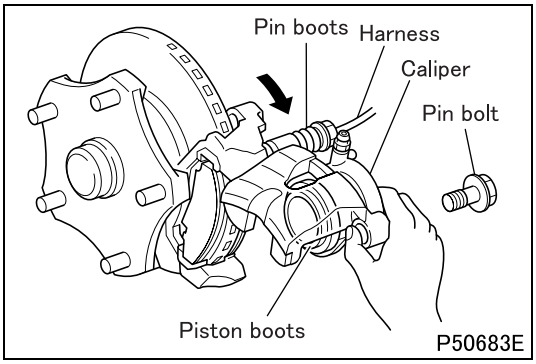


- Install a pad wear indicator onto the inner pad (included in the pad kit) using a clip (included in the pad wear indicator kit).

Pad wear indicator to be installed on	Inner pads on R/H and L/H wheels



- Using the piston expander [a], screw in the piston of the caliper until it bottoms on the back of the caliper.



- Move the caliper back to the original place while taking care not to damage the piston boots.
- Bleed the pin boots of air.
- Ensure that the pin boots are firmly attached into the groove on the slide pin.
- Tighten the pin bolt to the specified torque.
- Correctly route the harness(es) for the pad wear indicator(s).
- Measure the drag torque of the disc brake.
- Cycle the brake pedal several times, and check the brake fluid level in the tank. The fluid level should be at the “MAX” mark on the tank. Add brake fluid as required.

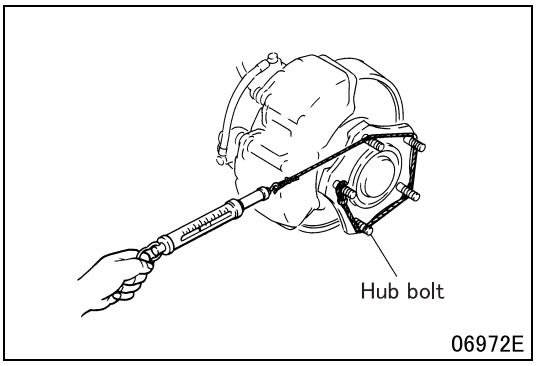
7. Measurement of Disc Brake Drag Torque

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Drag torque of disc brake (inertial force at hub bolts)	Approx. 5 sec. after releasing brake pedal	9.8 N·m {7.2 lbf·ft} or less	–	Inspect
		After turning disc rotor 10 revolutions	6.9 N·m {5.1 lbf·ft} or less	–	

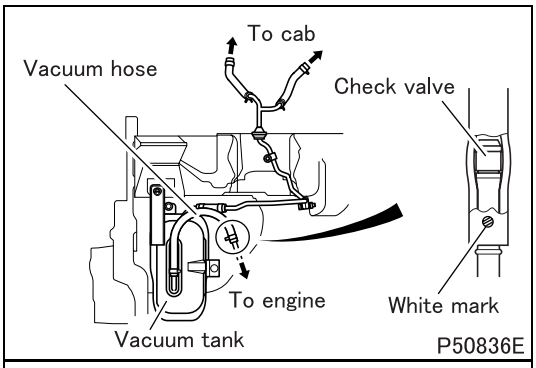
Table of inertial forces

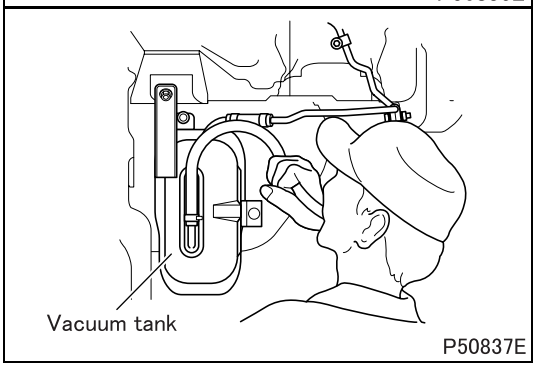
	Approx. 5 sec. after releasing brake pedal	After turning disc rotor 10 revolutions
Front	81 N {18.2 lbf}	57 N {12.8 lbf}
Rear	83 N {18.7 lbf}	59 N {13.3 lbf}



- Ensure that the starting torque of the wheel hub bearings conforms to the standard value.
- Using a spring balance, measure the inertial force at the hub bolts.
- The inertial force is calculated by the following formula.
  Inertial force = Dragging torque / (hub bolt P.C.D. / 2)
- If the measured inertial force conforms to the specified value, this means that the drag torque of the disc brake conforms to the standard value.
- If the measured value does not conform to the specified torque, check the sliding portions of the piston and piston seal.

8. Inspection of Check Valve in Vacuum Line Hose





NOTE

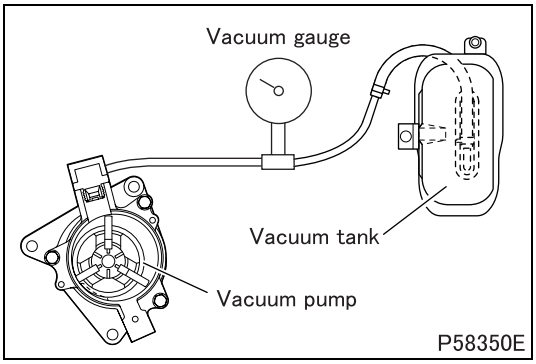
- **Be careful not to allow moisture into the check valve.**
- **During the inspection, ensure that the check valve opens as well as closes correctly.**
- **Do not attempt to remove the check valve from the vacuum hose.**

- Perform the following inspections. If the check valve does not pass both inspections, replace the check valve complete with the vacuum hose.
  - Blow into the hose. The check valve should close, preventing the breath from passing it.
  - Suck on the hose. The check valve should open, allowing air to pass.

9. Inspection of Vacuum Pump

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Time to reach vacuum of 80 kPa {23.6 inHg}	At 1500 rpm	Within 20 sec.	–	Replace
		At 3000 rpm	Within 12 sec.	–	



- Install a vacuum gauge between the vacuum tank and the vacuum pump.
- Start the engine and measure the time taken to reach the specified degree of vacuum.
- If the measured time does not conform to the standard value, disassemble and service the vacuum pump.

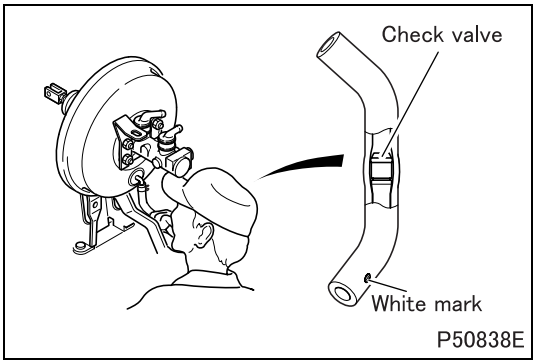
M E M O

10. Inspection of Vacuum Booster <Except COE 50>

- The vacuum booster can be inspected in 2 ways: one without using any tester and the other using a simplified tester. In either way, ensure that the brake piping and hosing and their connections are free of leakage, damage, or other faults.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	Precision inspection (vacuum loss) (vacuum of 67 kPa {19.8 inHg}, 15 sec. after engine shutdown)	3.3 kPa {0.97 inHg} or less	–	Replace
–	Fluid pressure at vacuum of 67 kPa {19.8 inHg}	4360 kPa {630 psi} (pedal pressed with a force of 98 N {22.0 lbf})	–	Replace
		8800 kPa {1280 psi} (pedal pressed with a force of 295 N {66.3 lbf})	–	
–	Fluid pressure at vacuum of 0 kPa {0 inHg}	315 kPa {46 psi} (pedal pressed with a force of 98 N {22.0 lbf})	–	Replace
		1550 kPa {225 psi} (pedal pressed with a force of 295 N {66.3 lbf})	–	



10.1 Inspection of check valve in vacuum hose

CAUTION ⚠

- **Be careful not to allow moisture into the check valve.**
- **During the inspection, ensure that the check valve opens as well as closes correctly.**
- **Do not attempt to remove the check valve from the vacuum hose.**

- Start the engine and charge the vacuum tank with vacuum.
- Shut down the engine, and immediately remove the clamp that attaches the vacuum hose to the vacuum line.
- Blow into the hose. The check valve should close, preventing any air from passing through it.
- Apply suction to the hose while pressing the brake pedal. The check valve should immediately open, allowing air to pass.
- If any problem is discovered during these inspections, replace the check valve and vacuum hose.

10.2 Operational check of vacuum booster

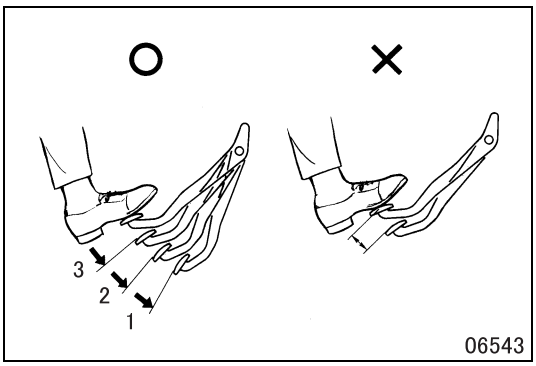
CAUTION ⚠

- **The vacuum booster operational checks described below are preliminary. If the vacuum booster continues to malfunction, remove the vacuum booster from the vehicle.**
- **If the vacuum booster is found to be faulty during the more detailed testing, return it to the manufacturer for repairs.**

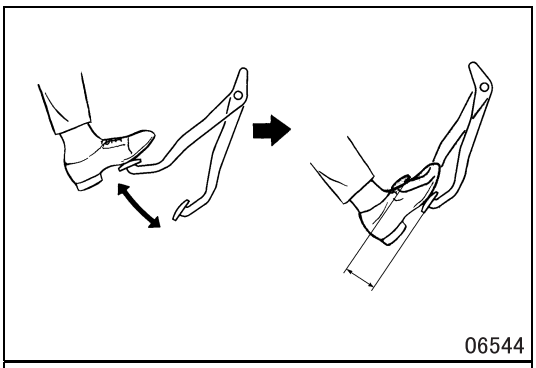
(1) Operational check without any tester

- Inspect the check valve in the vacuum hose for normal operation.

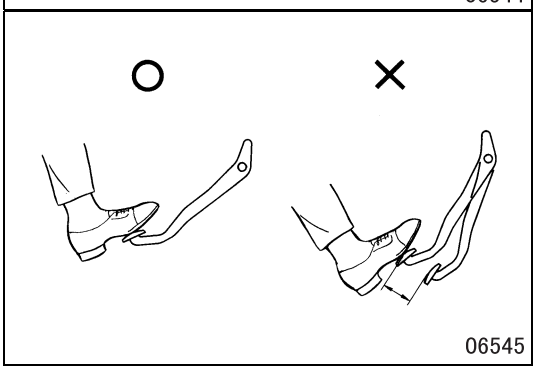
- Perform the checks described below. If any fault is found during these checks, inspect the following parts.
  - Vacuum booster
  - Vacuum pump



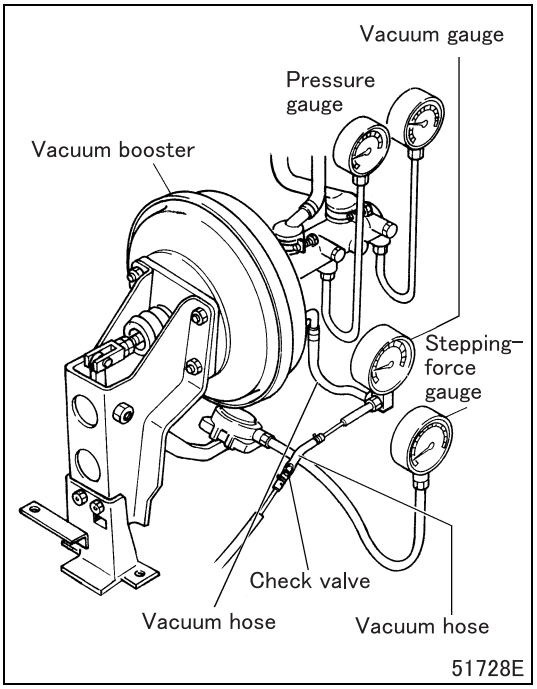
[Check 1]
- Start the engine and run it for 1 to 2 minutes. Shut down the engine.
- Press the brake pedal repetitively with the normal stepping force.
- The pedal stroke should become smaller each time the pedal is pressed.



[Check 2]
- With the engine stationary, press the brake pedal several times.
- With the brake pedal pressed, start the engine. The pedal should sink slightly.



[Check 3]
- With the engine running and the brake pedal pressed, shut down the engine.
- The brake pedal should maintain the same height for approximately 30 seconds.



(2) Operational check with a simplified tester

(2.1) Airtightness check

- Inspect the check valve in the vacuum hose for normal operation.
- Remove the vacuum hose from the vacuum booster and connect it to the vacuum gauge.
- Connect another hose (not equipped with a check valve) onto the vacuum booster and the vacuum gauge.
- Install 2 pressure gauges and 1 stepping-force gauge as illustrated. Bleed the pressure gauges of air.
- Perform the following checks. If any fault is encountered during these checks, inspect the vacuum booster.

[Check 1]

- Start the engine. When the reading on the vacuum gauge has reached 67 kPa {19.8 inHg}, shut down the engine.
- The vacuum lost in approximately 15 seconds of the engine stop should conform to the standard value.

[Check 2]

- Start the engine, and press the brake pedal. When the reading on the vacuum gauge has reached 67 kPa {19.8 inHg}, shut down the engine.
- The vacuum lost in approximately 15 seconds of the engine stop should conform to the standard value.

(2.2) System characteristics check

- Perform the following system characteristics checks after the airtightness check described above is completed.
- Perform the following checks. If any fault is encountered during these checks, inspect the vacuum booster.

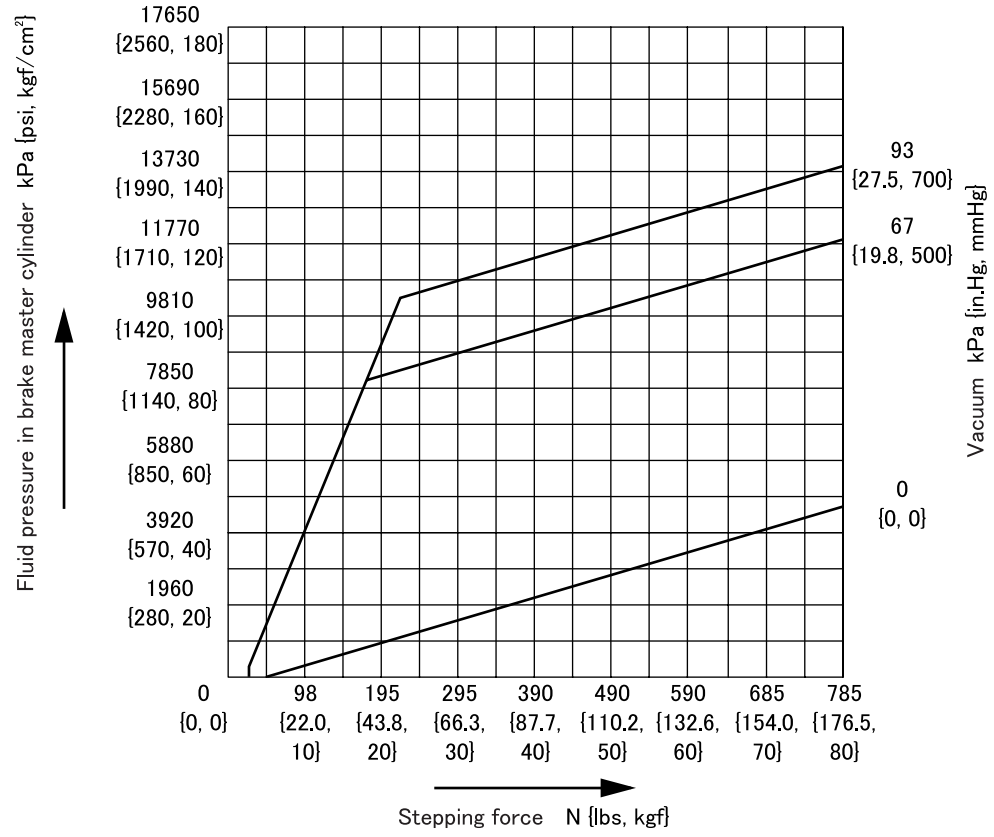
[Check 1]

- Start the engine. When the reading on the vacuum gauge has reached 67 kPa {19.8 inHg}, press the brake pedal with the specified stepping forces.
- The fluid pressures indicated on the pressure gauges should conform to the specified values.

[Check 2]

- Start the engine. When the reading on the vacuum gauge shows zero pressure, press the brake pedal with the specified stepping forces.
- The fluid pressures indicated on the pressure gauges should conform to the specified values.

(2.3) Vacuum booster performance graph



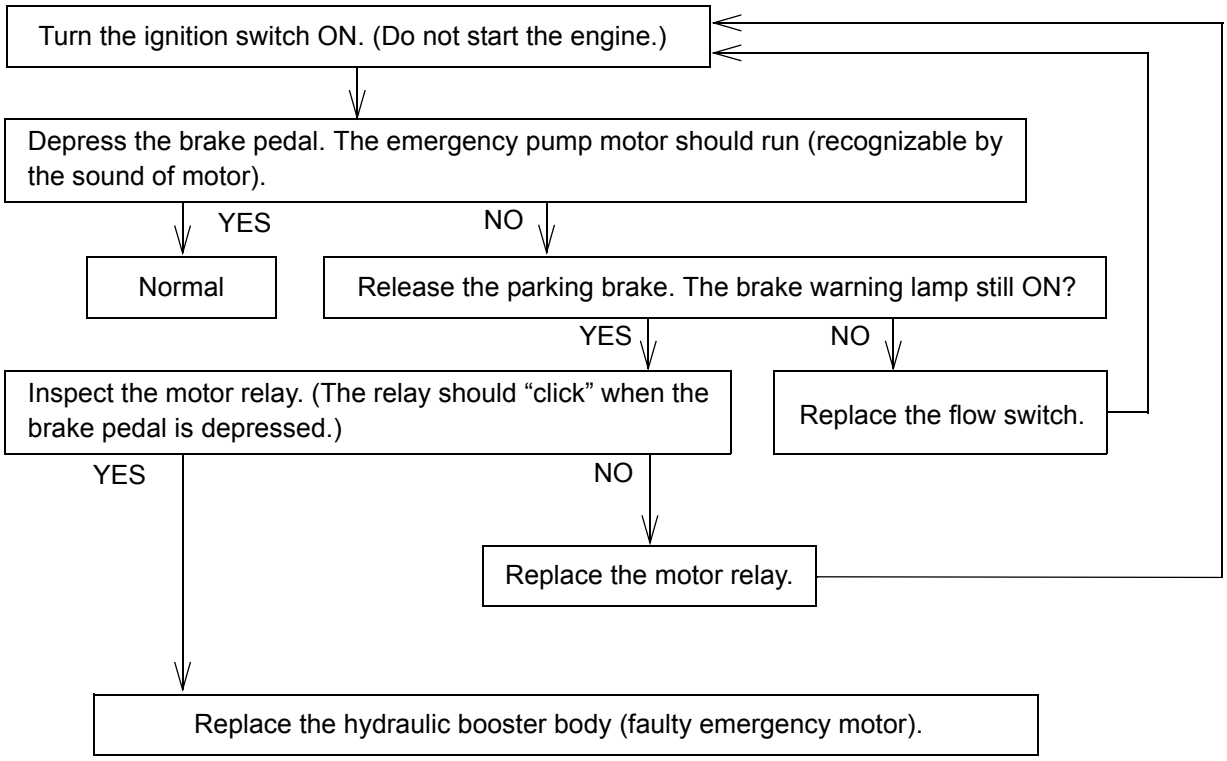
11. Inspection of Hydraulic Booster <COE 50>

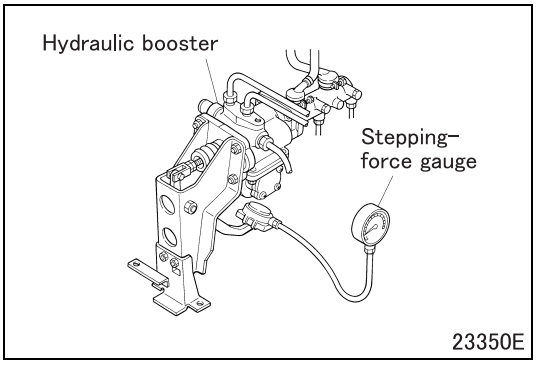
Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Fluid pressure at power steering oil temperature of 60°C {140°F} or below	Pedal pressed with a force of 98 N {22.0 lbf)	4620 kPa {670 psi)	–	Replace
		Pedal pressed with a force of 295 N {66.3 lbf}	13600 kPa {1970 psi}	–	

11.1 Inspection of electric equipment

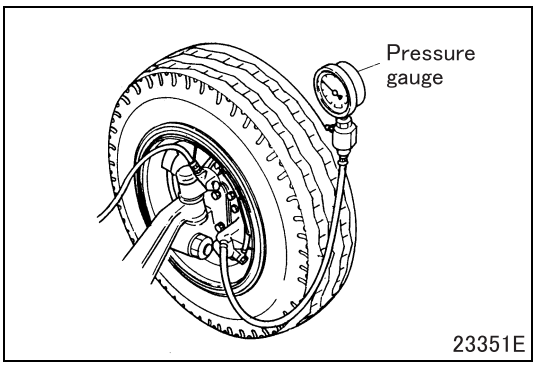
- Inspect in accordance with the following flow chart.
- Before inspection, park the vehicle on a flat surface, apply the parking brake firmly, and chock the wheels.





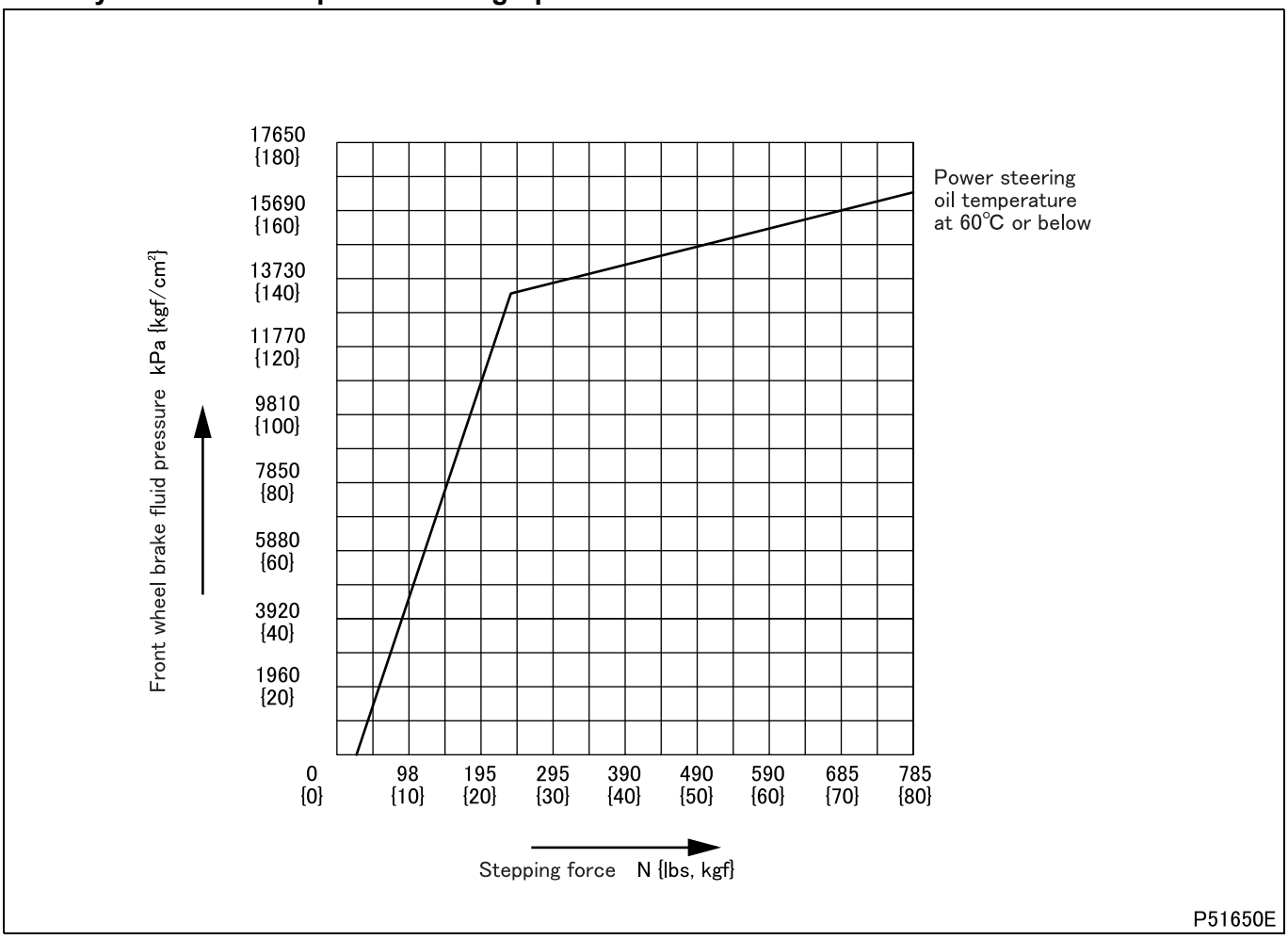
11.2 Functional check

- Install a stepping-force gauge onto the brake pedal. Remove an air bleeder from the front wheel brake, and install a pressure gauge. Bleed the gauge of air.
- Carry out performance test on the power steering system. Ensure that the system pressure is to specification.
- After confirming that the electric equipment has passed the inspection described above, press the brake pedal with varying forces. The reading of the front wheel brake fluid pressure should follow the pressure line of the graph.

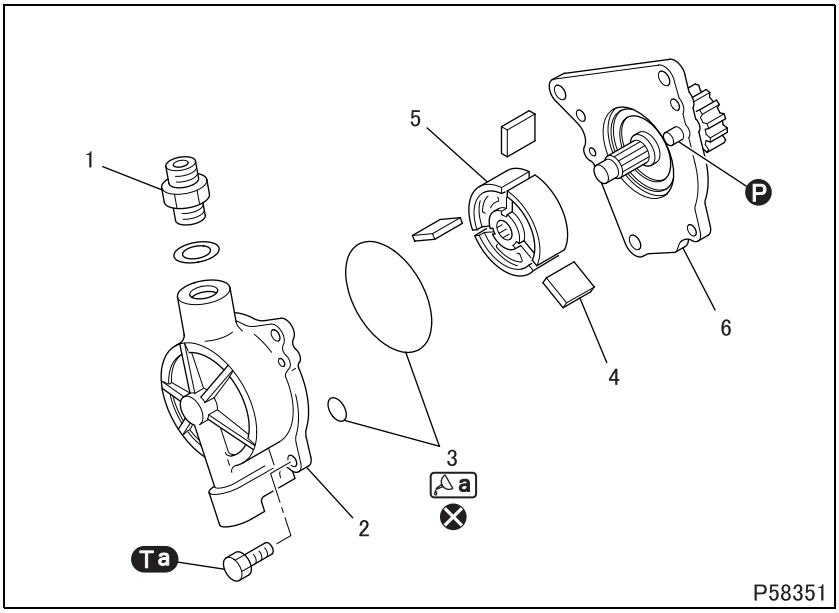


- If any fault is observed during these checks, replace the hydraulic booster.

11.3 Hydraulic booster performance graph



VACUUM PUMP



● Disassembly sequence

1 Check valve
2 Housing
3 O-ring
4 Vane
5 Rotor
6 Bracket

Ⓟ: Locating pin
⊗: Non-reusable parts

NOTE

- **For removal and installation procedures, see Gr11.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Time to reach vacuum of 80 kPa {23.6 inHg} (vacuum tank capacity: 10 L {11 qt})	At 1500 rpm	Within 20 sec.	–	Replace
		At 3000 rpm	Within 12 sec.	–	

Torque: N·m {lbf·ft}

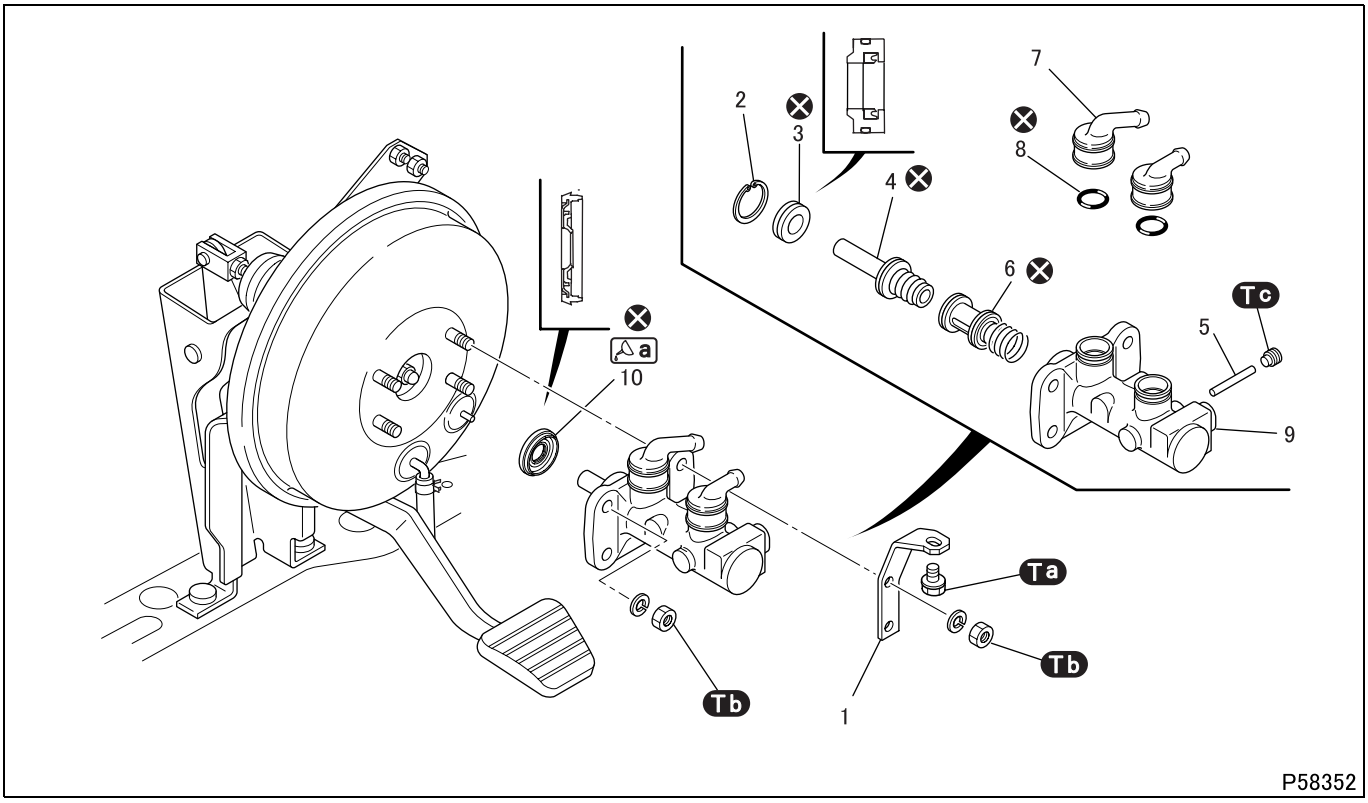
Mark	Fastener	Torque value	Remarks
Ta	Bolt (housing and bracket assembling)	8.8 ± 2 {6.5 ± 1.5}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required

M E M O

BRAKE MASTER CYLINDER <WITH VACUUM BOOSTER>



● **Disassembly sequence**

1 Bracket
2 Retaining ring
3 Piston guide
4 Primary piston
5 Set pin
6 Secondary piston
7 Connector
8 O-ring
9 Cylinder body
10 Seal

⊗: Non-reusable parts

CAUTION ⚠

- **For cleaning, use brake fluid.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: Master cylinder repair kit

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
4	Primary piston spring load	113.7 to 125.4 N {26 to 28 lbf}	110.7 N {25 lbf}	Replace
4, 6, 9	Clearance between primary and secondary pistons and cylinder body	0.02 to 0.10 {0.00079 to 0.0039}	0.2 {0.0079}	Replace
6	Secondary piston spring load	81.3 to 91.1 N {18 to 20 lbf}	79.4 N {18 lbf}	Replace

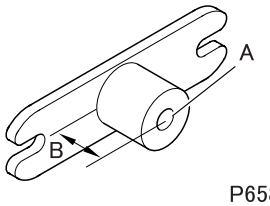
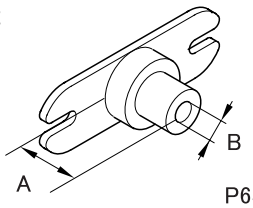
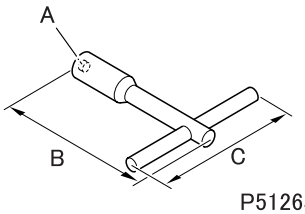
Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
Ta	Bolt (bracket mounting)	9 to 14 {6.6 to 10}	–
Tb	Nut (brake master cylinder mounting)	9.8 to 15.7 {7.2 to 12}	–
Tc	Screw (set pin mounting)	8.8 to 11.8 {6.5 to 8.7}	–

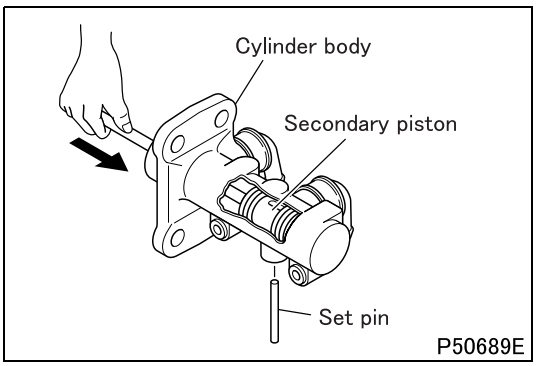
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Seal lips and outer periphery	Rubber grease	As required
	Seal ring groove		

Special tools: mm {in}

Mark	Tool name and shape	Part No.	Application
a	Support tool A: No. of splines: 23 B: 30 {1.18}  P65860	MK528895	Adjustment of vacuum booster push rod
b	Support tool for measurement A: 36 {1.42} B: ϕ11.5 {0.45}  P65861	MK528896	
c	Box spanner A: Width across flats: 8 B: 120 {4.72} C: 120 {4.72}  P51263	MB999062	

◆Removal procedure◆

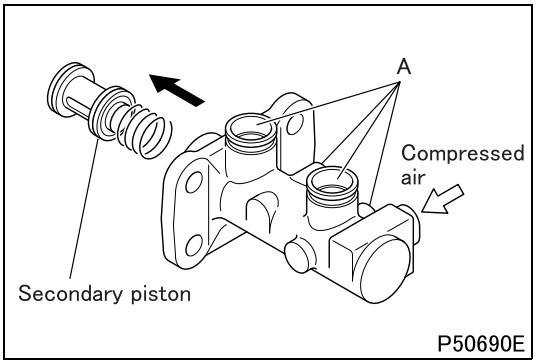


■ **Removal: Secondary piston**

- Position the cylinder body such that the set pin faces down. Using a rod or the like, compress the secondary piston to ease out the set pin. Be ready to catch the set pin when it falls out. Do not allow it to drop.

CAUTION ⚠

- **Do not allow the set pin to drop on the floor. This may damage the set pin.**

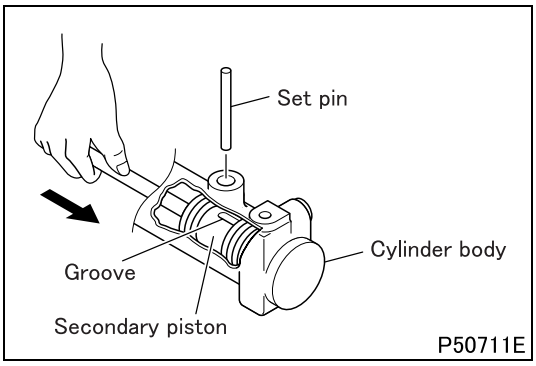


- With the ports marked **A** blocked, feed compressed air in the direction of the arrow, gradually increasing the pressure from zero until the secondary piston is ejected.

WARNING ⚠

- **Do not apply compressed air suddenly and at high pressure. The secondary piston may fly out with great force and cause a personal injury.**

◆Installation procedure◆

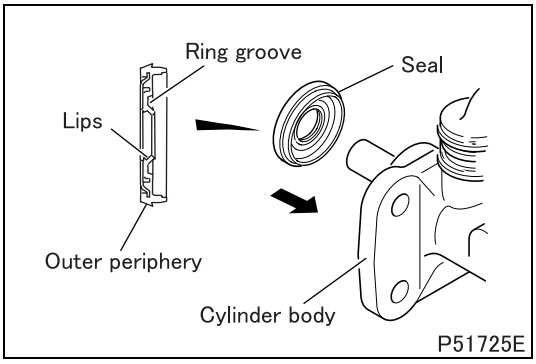


■ **Installation: Secondary piston**

- Position the cylinder body with the set pin hole facing up. Using a thin rod or similar tool, insert the secondary piston into the cylinder body. At the same time, try to insert the set pin.

NOTE

- **If necessary, rotate the secondary piston to align the groove on the piston with the set pin hole.**



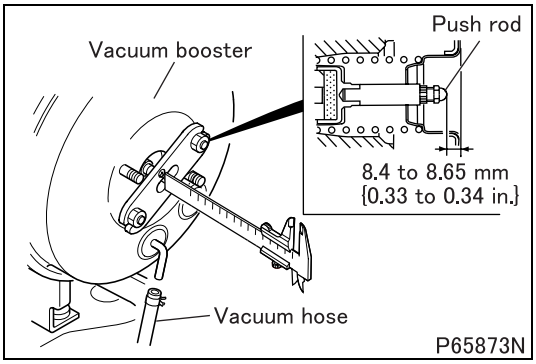
■ **Installation: Seal**

- Apply grease on the lips and outer periphery of the seal. Also, pack grease into the seal's ring groove. Then, face the seal in the illustrated direction before installing it onto the cylinder body.

CAUTION ⚠

- **Ensure that the seal is facing as shown in the illustration and is installed correctly, without roll-up or damage. An improperly installed seal will not hold vacuum.**

◆Work after installation◆



■ **Inspection: Brake pedal & vacuum booster**

NOTE

- **If the brake master cylinder or the primary piston is replaced, be sure to inspect and, if required, adjust the illustrated distance between the push rod and the end of the brake pedal & vacuum booster.**

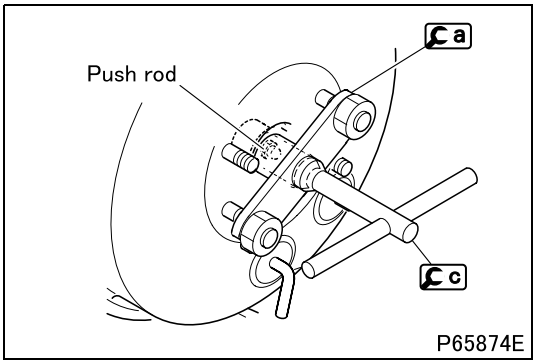
[Inspection]

- Remove the vacuum hose from the brake pedal & vacuum booster to fill the vacuum booster with the atmospheric pressure.

NOTE

- **The vacuum booster must be filled to atmospheric pressure to obtain accurate results from this inspection.**

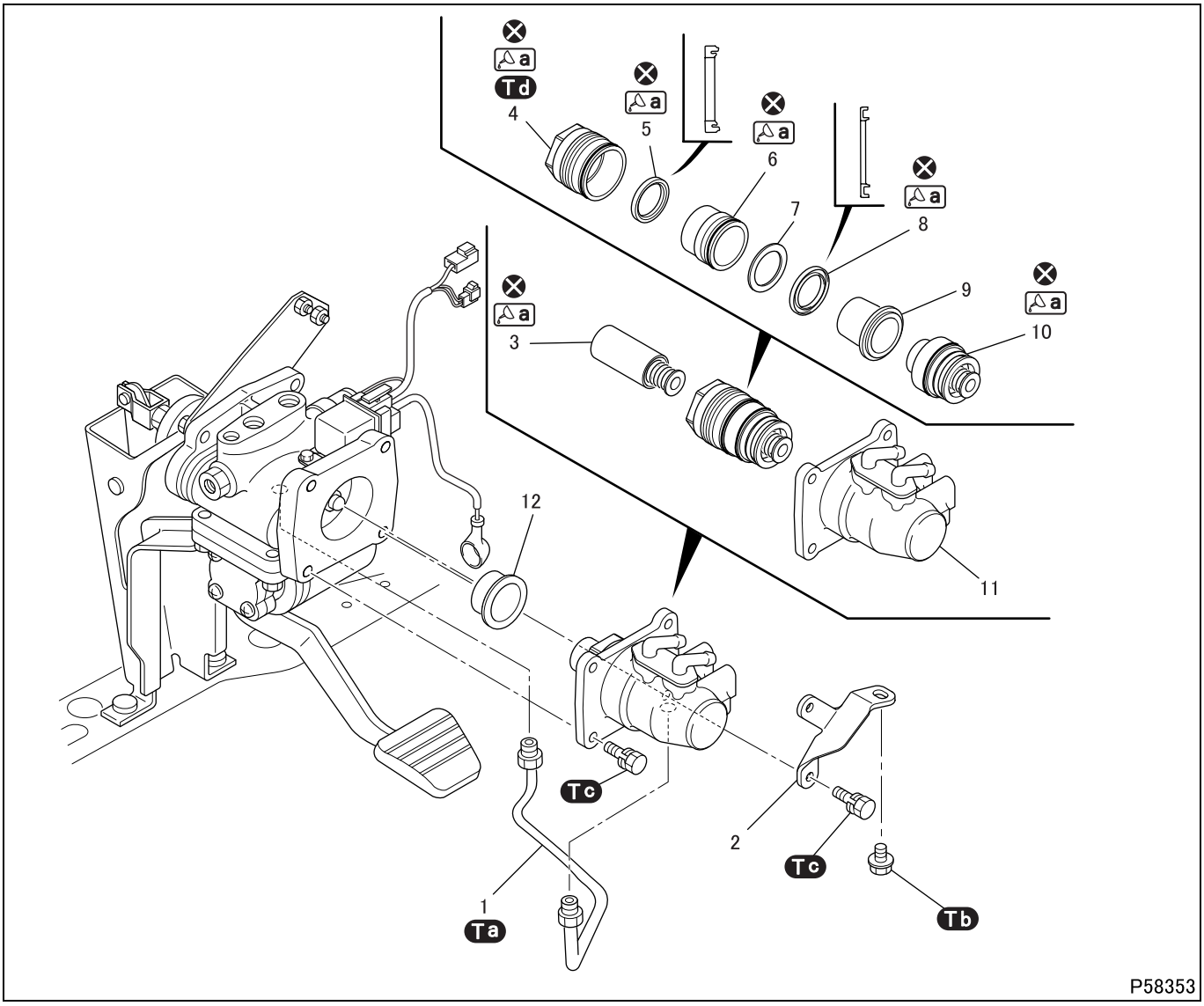
- Measure the distance (as shown in the illustration) between the push rod and the end of the brake pedal & vacuum booster.
- If the measured value does not conform to the specified value, adjust the distance as follows.



[Adjustment]

- Set the distance to the specified value by turning the push rod in or out.

BRAKE MASTER CYLINDER <WITH HYDRAULIC BOOSTER>



● **Disassembly sequence**

1 Brake line
2 Bracket
3 Primary piston
4 Cap
5 Secondary cup
6 Bushing
7 Cup spacer
8 Primary cup
9 Cup retainer
10 Secondary piston
11 Cylinder
12 Piston protector

⊗: Non-reusable parts

CAUTION ⚠

- **For cleaning, use brake fluid.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: Master cylinder repair kit, Cap kit

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
3	Primary piston spring load (installed length: 49.7 {1.96})	130 to 140 N {29 to 31 lbf}	125 N {28 lbf}	Replace
3, 10, 11	Clearance between primary and secondary pistons and cylinder	0.065 to 0.125 {0.0026 to 0.0049}	0.13 {0.0051}	Replace
10	Secondary piston spring load (installed length: 44.5 {1.75})	102 to 118 N {23 to 27 lbf}	96 N {22 lbf}	Replace

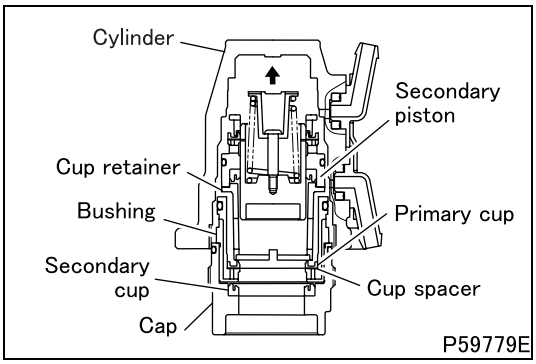
Torque: N·m {lbf·ft}

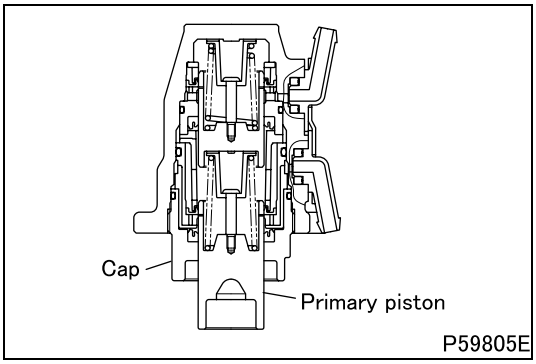
Mark	Component	Torque value	Remarks
Ta	Brake line	17.2 ± 2.5 {13 ± 1.8}	–
Tb	Bolt (bracket mounting)	9 to 14 {6.6 to 10}	–
Tc	Bolt (brake master cylinder mounting)	17.6 to 27.4 {13 to 20}	–
Td	Cap	68.6 to 78.4 {51 to 58}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Sliding face of primary piston	Rubber grease	As required
	O-ring on cap		
	Secondary cup		
	O-ring on bushing		
	Primary cup		
	Sliding face of secondary piston		

◆Installation procedure◆





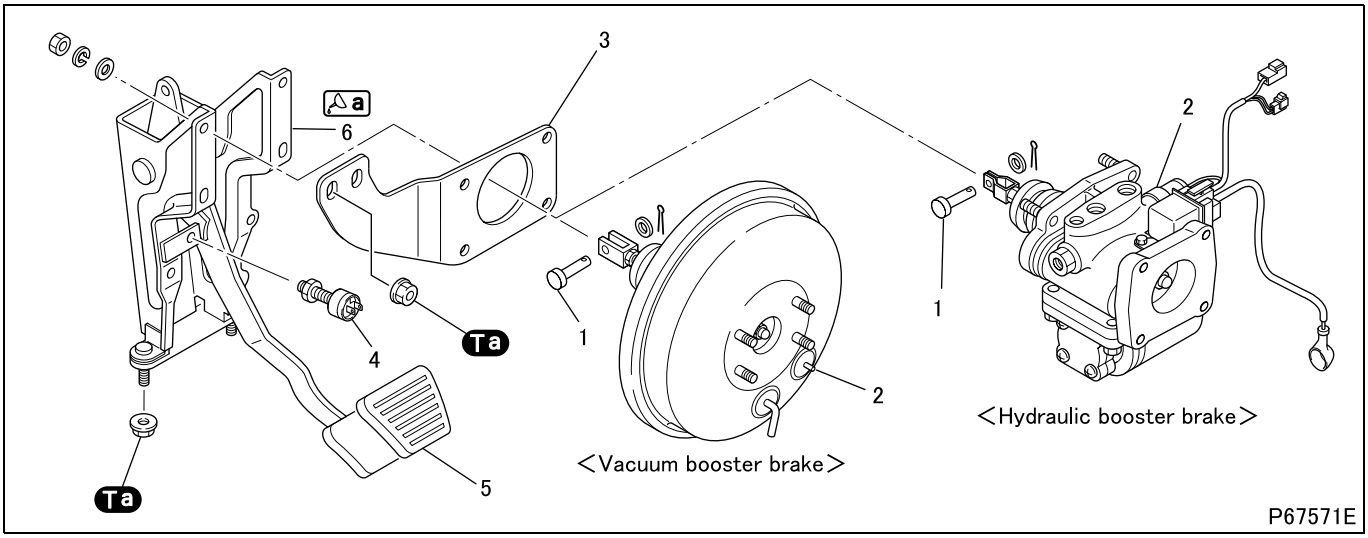
■ **Installation: Cap, secondary cup, cup spacer, primary cup, bushing, cup retainer, secondary cup and primary piston**

- With the end of the cylinder facing upward, insert each assembled part slowly.

CAUTION ⚠

- **To prevent the cup retainer from falling off, hold the cylinder with its end upward until the cap is screwed into the cylinder.**

- After screwing the cap into the cylinder, tighten it to the specified torque.
- Slowly insert the primary piston through the cap.



● Disassembly sequence

1 Clevis pin
2 Vacuum booster
<Vacuum booster brake>
Hydraulic booster (See later section.)
<Hydraulic booster brake>
3 Bracket <Vacuum booster brake>
4 Stop lamp switch
5 Pedal pad
6 Brake pedal & pedal support

CAUTION ⚠

- **Do not attempt to disassemble the vacuum booster.**

● Assembly sequence

Follow the disassembly sequence in reverse.

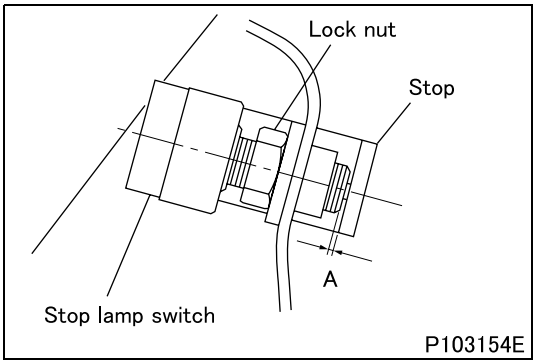
Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
Ta	Nut (bracket mounting)	9 to 14 {6.6 to 10}	–
	Nut (brake pedal & pedal support mounting)		

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Return spring of brake pedal & pedal support; Inner periphery of clevis pin hole	Chassis grease [NLGI No. 1 (Li soap)]	As required

◆Installation procedure◆



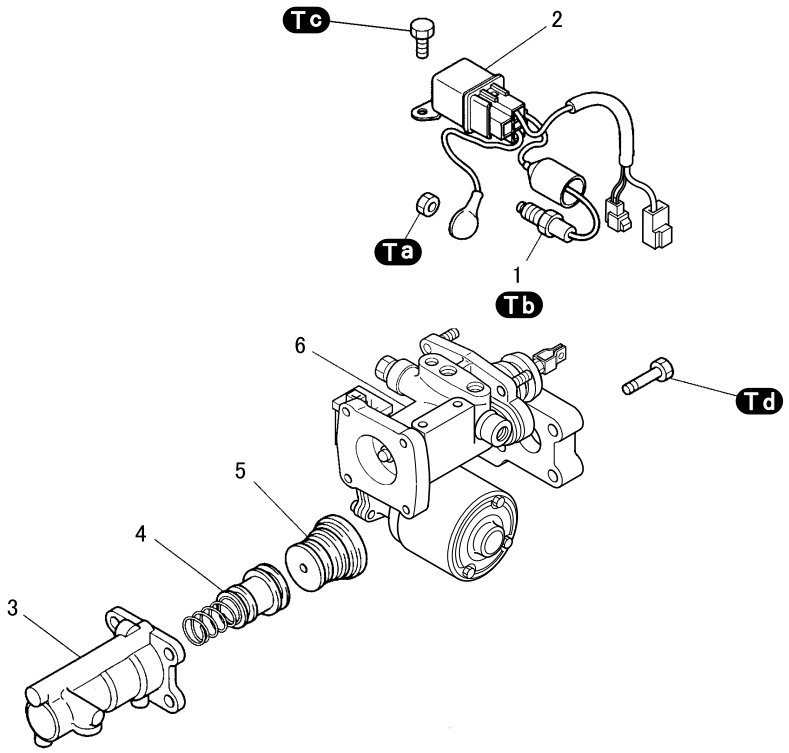
■ Installation: Stop lamp switch

- Set the distance A between the threaded end of the stop lamp switch and the stop for the brake pedal & pedal support to the illustrated value. Then, fix the assembly with the lock nut.
  A: 0.5 to 1.5 mm {0.020 to 0.059 in.} <Without auto cruise>
  1.5 ± 0.5 mm {0.059 ± 0.020 in.} <With auto cruise>

CAUTION ⚠

- **To prevent brake drag, ensure that the threaded end of the stop lamp switch does not interfere with the stop for the brake pedal.**

Hydraulic Booster



● Disassembly sequence

1 Flow switch
2 Motor relay
3 Pressure intensifying cylinder
4 Valve piston guide
5 Pressure intensifying piston
6 Hydraulic booster body

● Assembly sequence

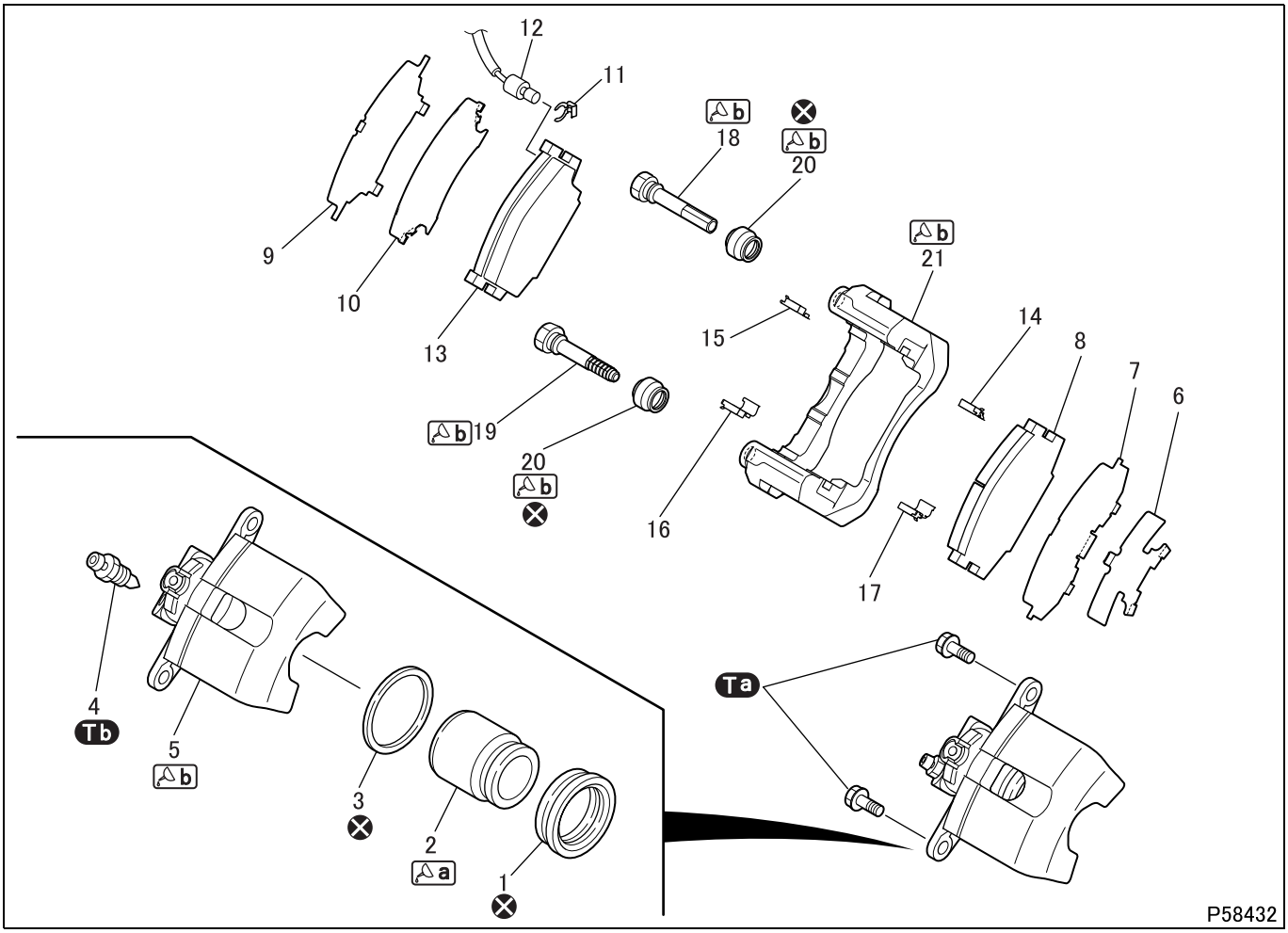
Follow the disassembly sequence in reverse.

Repair kit: Valve piston guide, Pressure intensifying piston

Torque: N·m {lbf·ft}

Mark	Component	Torque value	Remarks
Ta	Nut (motor relay earth mounting)	2.45 to 4.41 {1.8 to 3.3}	–
Tb	Flow switch	24.5 to 34.3 {18 to 25}	–
Tc	Bolt (motor relay mounting)	4.41 to 7.35 {3.3 to 5.4}	–
Td	Bolt (pressure intensifying cylinder mounting)	17.6 to 27.4 {13 to 20}	–

FRONT DISC BRAKE <ϕ235 mm {9.25 in} DISC>



● **Disassembly sequence**

1 Piston boots
2 Piston
3 Piston seal
4 Air bleeder (lower)
5 Caliper
6 Outer shim A
7 Outer shim B
8 Outer pad
9 Inner shim A
10 Inner shim B
11 Clip
12 Pad wear indicator
13 Inner pad
14 Pad liner A
15 Pad liner B
16 Pad liner C
17 Pad liner D
18 Main slide pin
19 Sub slide pin
20 Pin boots
21 Torque member

⊗: Non-reusable parts

NOTE

- **For removal and installation of the front disc brake, see Gr26.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION ⚠

- **Rubber parts that are disassembled must be replaced as a seal kit.**
- **Items included in a seal kit must be lubricated with grease supplied with the kit before installation.**
- **Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.**
- **Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)**

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
8, 13	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

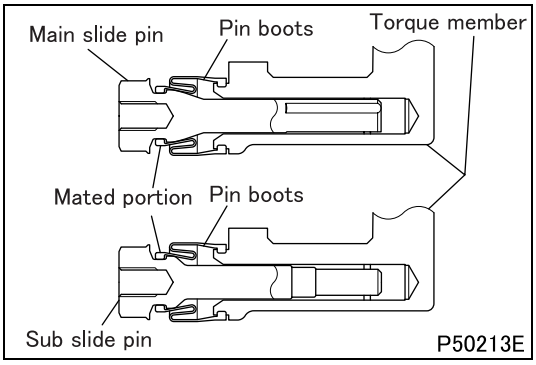
Torque: N·m {lbf·ft}

Mark	Component	Torque value	Remarks
Ta	Pin bolt	40 to 50 {30 to 37}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

Lubricant and/or sealant

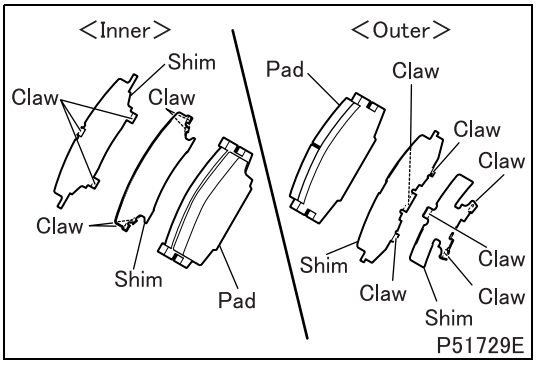
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

◆Installation procedure◆



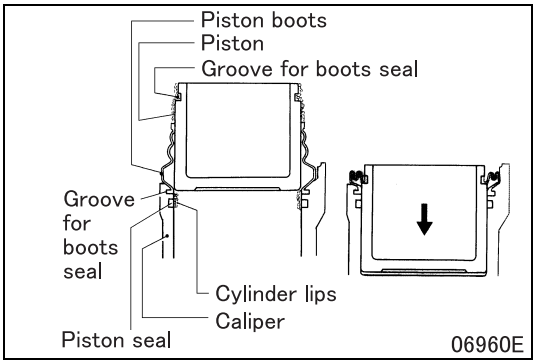
■ **Installation: Main slide pin, sub slide pin, pin boots, and torque member**

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.



■ **Installation: Shims**

- Position shims such that they face the illustrated directions before installing them onto the pads.

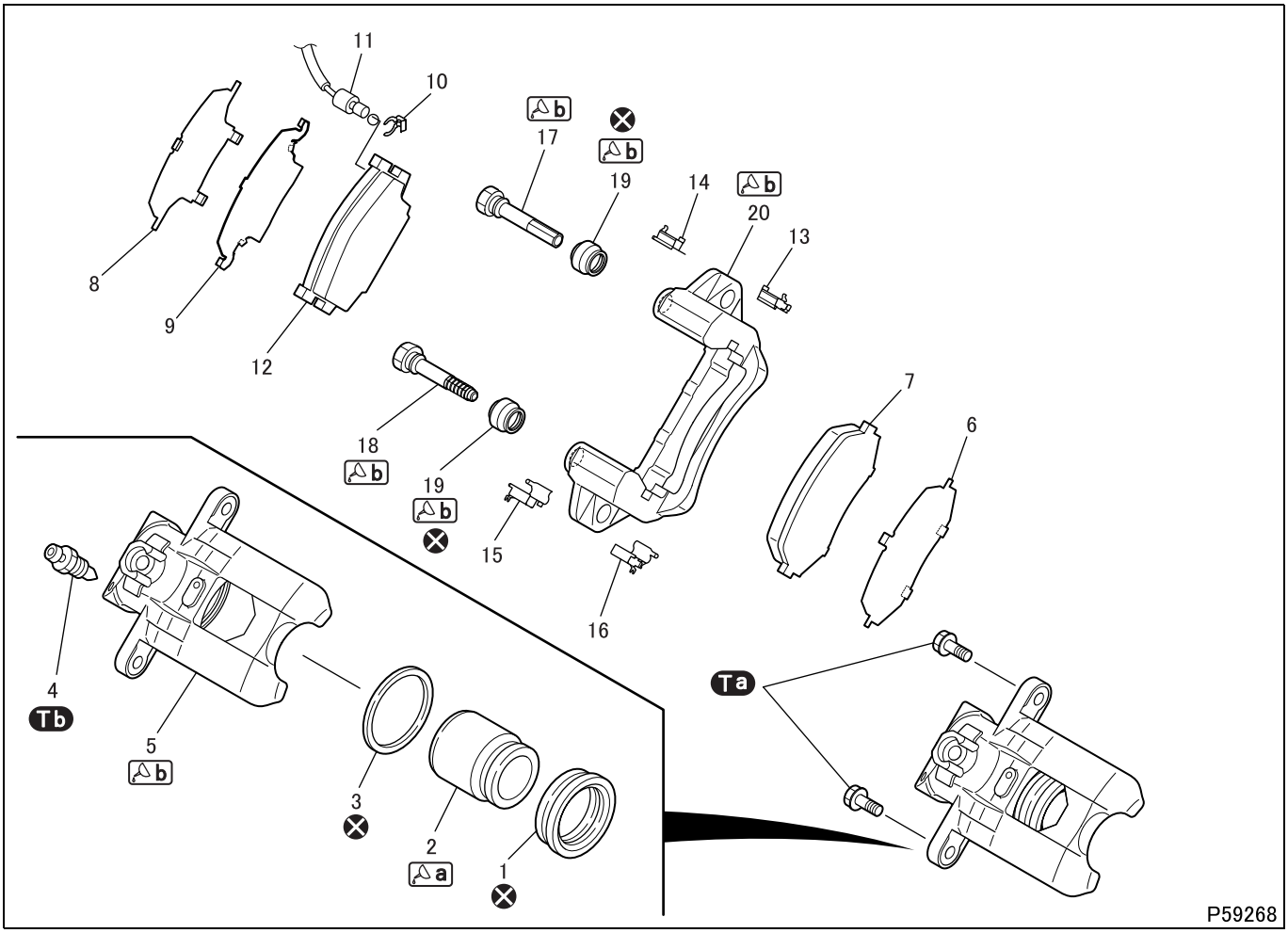


■ **Installation: Piston boots, piston, and piston seal**

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

M E M O

FRONT DISC BRAKE <ϕ252 mm {9.92 in} DISC>



● Disassembly sequence

1 Piston boots
2 Piston
3 Piston seal
4 Air bleeder (lower)
5 Caliper
6 Outer shim
7 Outer pad
8 Inner shim A
9 Inner shim B
10 Clip (upper R/H only)
11 Pad wear indicator (upper R/H only)
12 Inner pad
13 Pad liner A
14 Pad liner B
15 Pad liner C
16 Pad liner D
17 Main slide pin
18 Sub slide pin
19 Pin boots
20 Torque member

⊗: Non-reusable parts

NOTE

- **For removal and installation of the front disc brake, see Gr26.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION ⚠

- **Rubber parts that are disassembled must be replaced as a seal kit.**
- **Items included in a seal kit must be lubricated with grease supplied with the kit before installation.**
- **Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.**
- **Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)**

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
7, 10	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

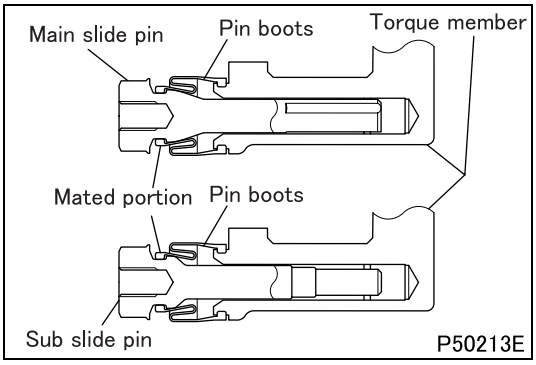
Torque: N·m {lbf·ft}

Mark	Component	Torque value	Remarks
Ta	Pin bolt	40 to 50 {30 to 37}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

Lubricant and/or sealant

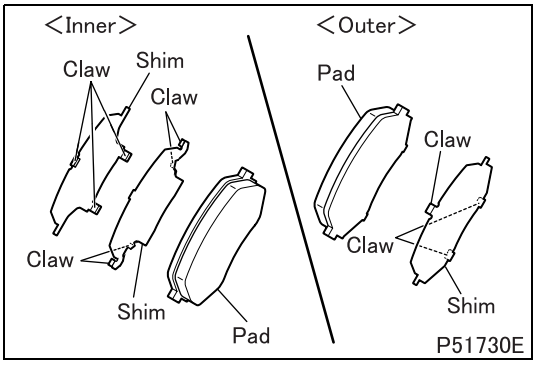
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

◆Installation procedure◆



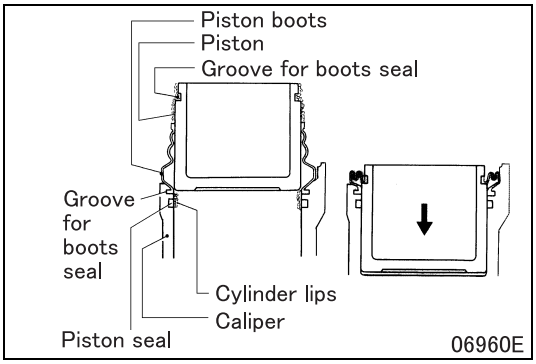
■ Installation: Main slide pin, sub slide pin, pin boots, and torque member

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.



■ Installation: Shims

- Position shims such that they face the illustrated directions before installing them onto the pads.

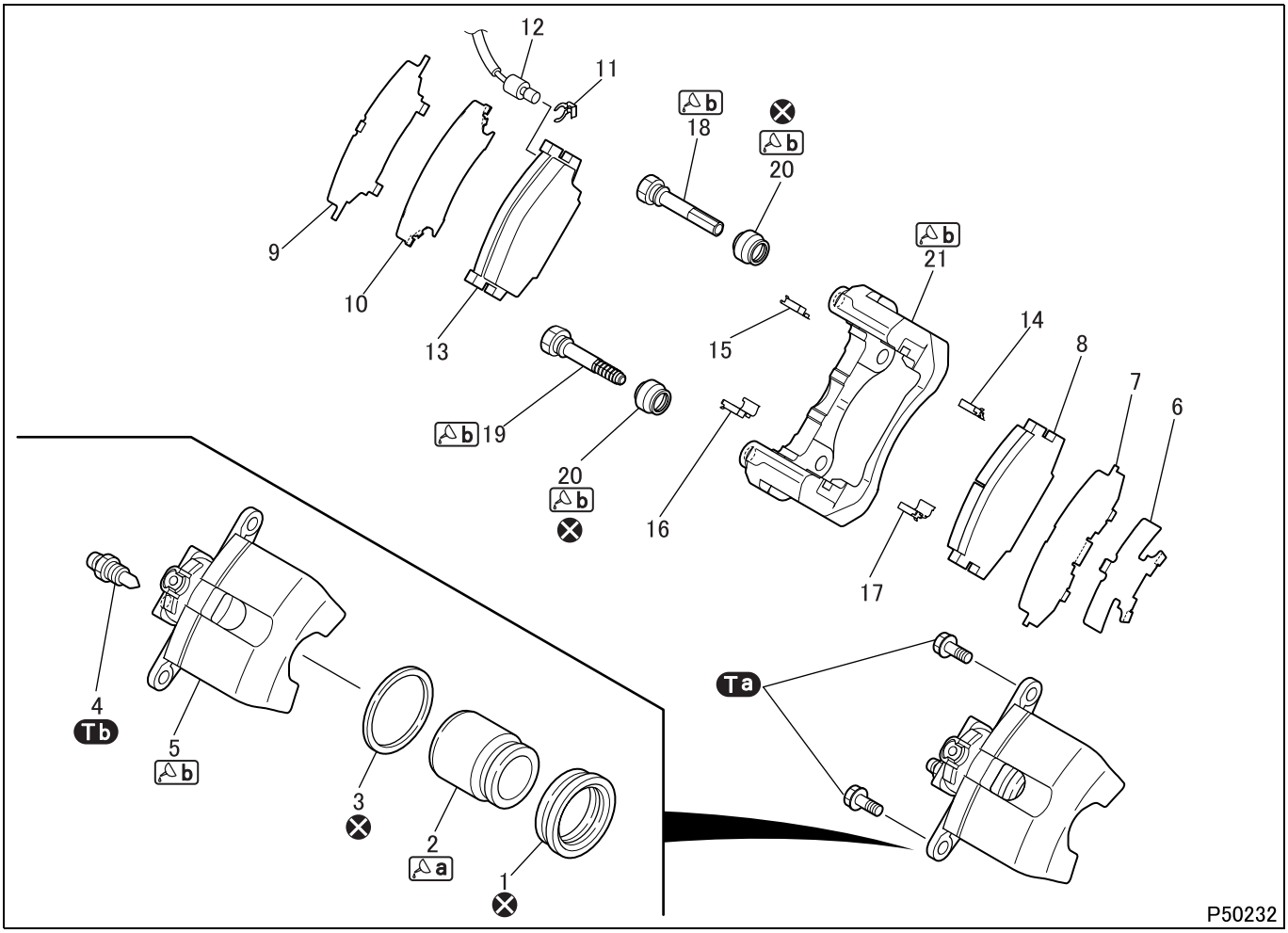


■ **Installation: Piston boots, piston, and piston seal**

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

M E M O

REAR DISC BRAKE <ϕ235 mm {9.25 in} DISC>



● **Disassembly sequence**

1 Piston boots
2 Piston
3 Piston seal
4 Air bleeder (front)
5 Caliper
6 Outer shim A
7 Outer shim B
8 Outer pad
9 Inner shim A
10 Inner shim B
11 Clip (rear)
12 Pad wear indicator (rear)
13 Inner pad
14 Pad liner A
15 Pad liner B
16 Pad liner C
17 Pad liner D
18 Main slide pin
19 Sub slide pin
20 Pin boots
21 Torque member

⊗: Non-reusable parts

NOTE

- **For removal and installation of the rear disc brake, see Gr27.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION ⚠

- **Rubber parts that are disassembled must be replaced as a seal kit.**
- **Items included in a seal kit must be lubricated with grease supplied with the kit before installation.**
- **Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.**
- **Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)**

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
8, 13	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

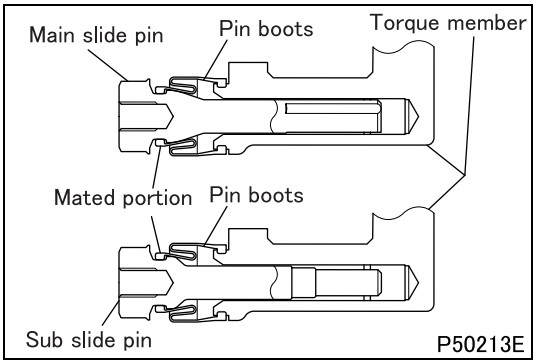
Torque: N·m {lbf·ft}

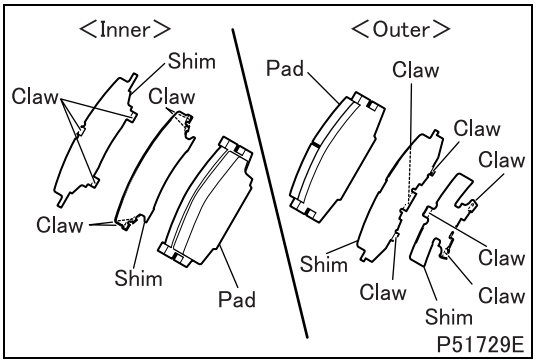
Mark	Component	Torque value	Remarks
Ta	Pin bolt	40 to 50 {30 to 37}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

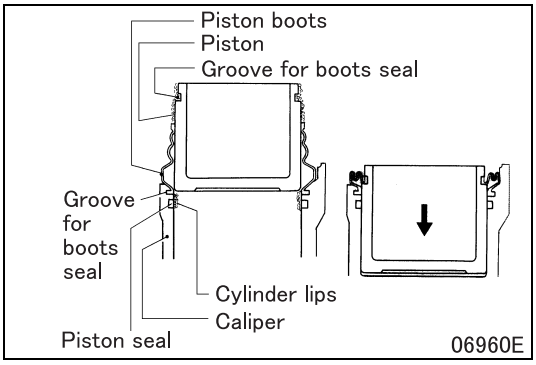
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

◆Installation procedure◆







■ Installation: Main slide pin, sub slide pin, pin boots, and torque member

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.

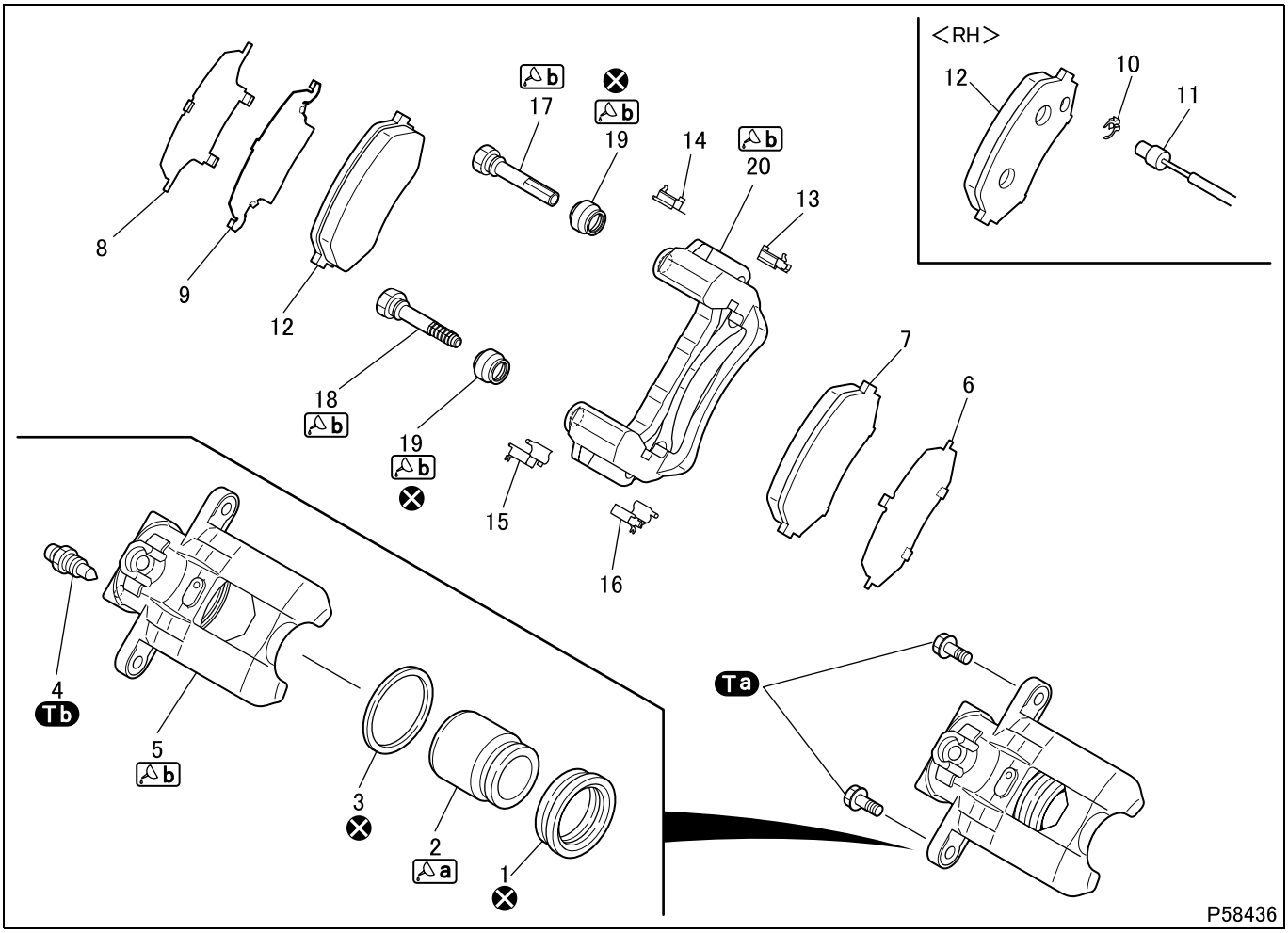
■ Installation: Shims

- Position shims such that they face the illustrated directions before installing them onto the pads.

■ Installation: Piston boots, piston, and piston seal

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

REAR DISC BRAKE <ϕ252 mm {9.92 in} DISC>



● **Disassembly sequence**

1 Piston boots
2 Piston
3 Piston seal
4 Air bleeder (front)
5 Caliper
6 Outer shim
7 Outer pad
8 Inner shim A
9 Inner shim B
10 Clip (rear R/H only)
11 Pad wear indicator (rear R/H only)
12 Inner pad
13 Pad liner A
14 Pad liner B
15 Pad liner C
16 Pad liner D
17 Main slide pin
18 Sub slide pin
19 Pin boots
20 Torque member

⊗: Non-reusable parts

NOTE

- **For removal and installation of the rear disc brake, see Gr27.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION ⚠

- **Rubber parts that are disassembled must be replaced as a seal kit.**
- **Items included in a seal kit must be lubricated with grease supplied with the kit before installation.**
- **Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.**
- **Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)**

Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
7, 12	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

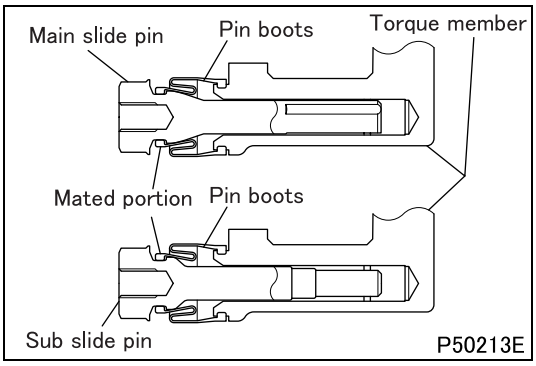
Torque: N·m {lbf·ft}

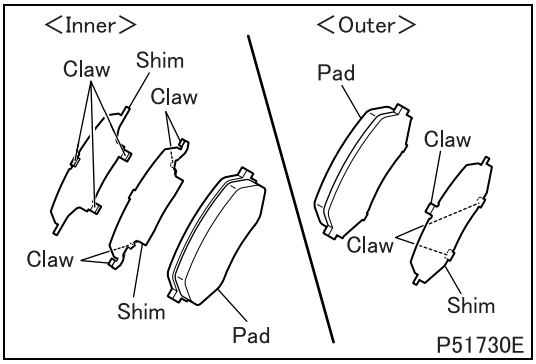
Mark	Component	Torque value	Remarks
Ta	Pin bolt	40 to 50 {30 to 37}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5}	–

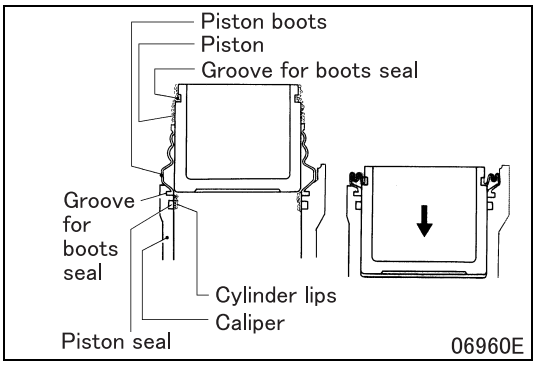
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

◆Installation procedure◆







■ Installation: Main slide pin, sub slide pin, pin boots, and torque member

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.

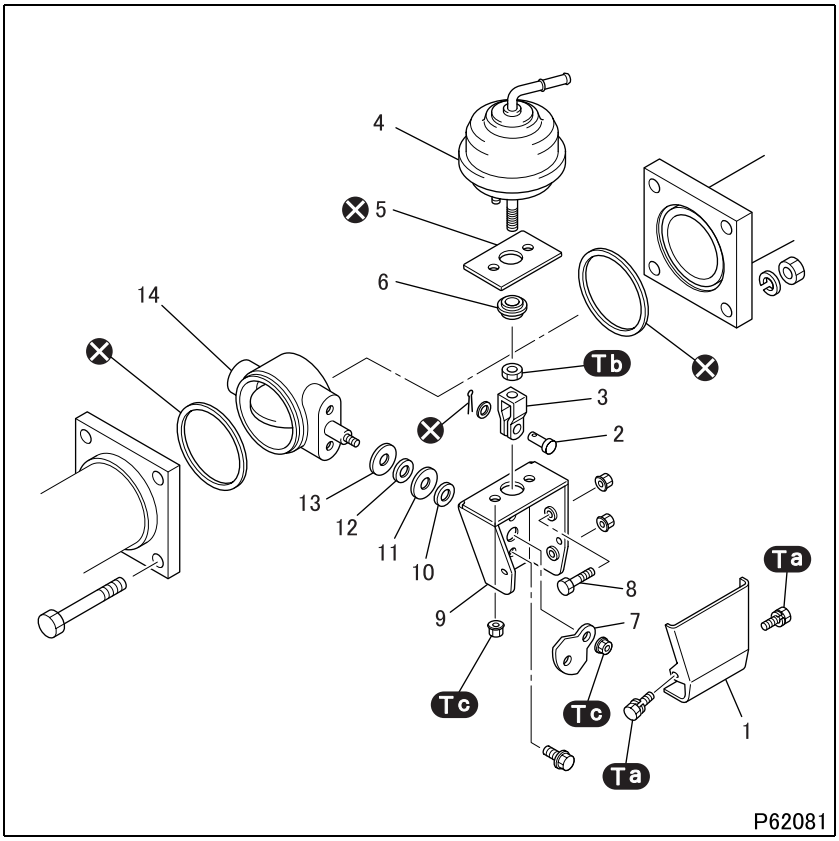
■ Installation: Shims

- Position shims such that they face the illustrated directions before installing them onto the pads.

■ Installation: Piston boots, piston, and piston seal

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

Exhaust Brake Unit



● Disassembly sequence

1 Cover
2 Clevis pin
3 Clevis
4 Power chamber
5 Gasket
6 Bearing
7 Lever
8 Adjust bolt
9 Bracket
10 Seal ring A
11 Seal ring B
12 Seal ring A
13 Seal ring B
14 Valve

⊗: Non-reusable parts

CAUTION ⚠

- **Do not attempt to disassemble the power chamber.**

NOTE

- **For removal and installation procedures of the exhaust brake unit, see Gr15.**

● Assembly sequence

Follow the disassembly sequence in reverse.

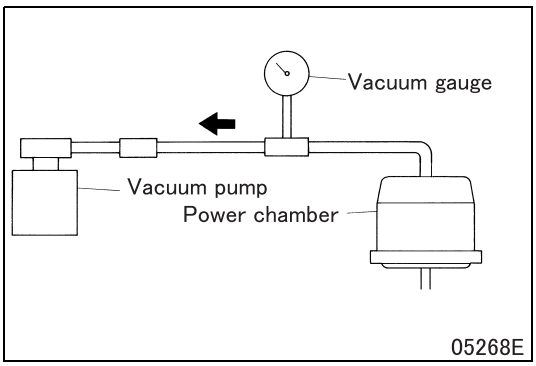
Service standards: mm {in}

Location	Maintenance item	Standard value	Limit	Remedy
–	Average of top and bottom clearances between butterfly valve and body with valve fully closed (with power chamber vacuum of 87 to 93 kPa {25.7 to 27.5 inHg} or above)	0.10 to 0.25 {0.0039 to 0.0098}	–	Adjust
4	Air-tightness of power chamber (at 15 sec. after vacuum of 67 kPa {19.8 inHg} is achieved in chamber)	63 kPa {18.6 inHg} or above	–	Replace

Torque: N·m {lbf·ft}

Mark	Fastener	Torque value	Remarks
Ta	Bolt (cover mounting)	4.9 to 6.9 {3.6 to 5.1}	–
Tb	Lock nut (clevis retention)	9.8 to 16 {7.2 to 12}	–
Tc	Nut (power chamber mounting)	11 to 17 {8.0 to 12}	–
	Nut (lever mounting)		

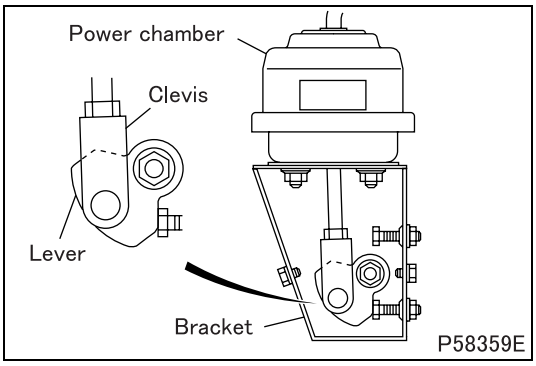
◆Inspection procedure◆



■ **Inspection: Power chamber air-tightness**

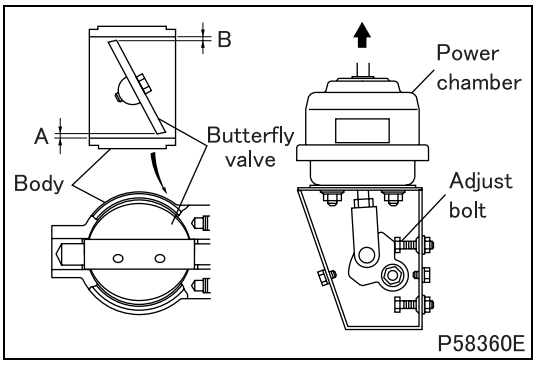
- Connect the components with piping as illustrated. When a vacuum of 67 kPa {19.8 inHg} or above is applied to the power chamber, stop the vacuum pump.
- Fifteen seconds later, the reading on the vacuum gauge should conform to the standard value.
- If not, replace the power chamber.

◆Adjustment after installation◆



■ **Adjustment: Clevis**

- Assemble the power chamber onto the bracket. Then, adjust the location of the clevis such that the hole in the clevis is aligned by half with the hole in the lever.

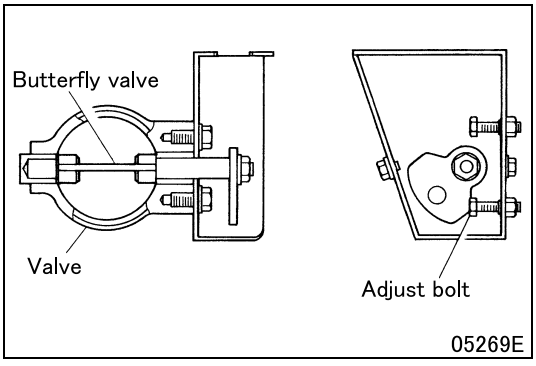


■ **Adjustment: Butterfly valve**

(1) Butterfly valve fully-closed position

- Apply a vacuum of 87 to 93 kPa {25.7 to 27.5 inHg} to the power chamber to fully close the butterfly valve. With the valve fully closed, measure the top and bottom clearances **B** and **A** between the valve and the body, and obtain the average of the two. The average value should conform to the standard value. Adjust with the adjust bolt as required.

$$\text{Average clearance} = \frac{(\mathbf{A} + \mathbf{B})}{2}$$



(2) Valve fully-open position

- Adjust the butterfly valve to the full open position using the adjust bolt.