

BRAKE SYSTEMS

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BRAKE SYSTEM

DESCRIPTION AND OPERATION

The front and rear brakes are caliper and disc operation, while the hand brake via a lever and cable, uses brake pads to apply a clamping force on the rear drum/discs.

The master cylinder has a twin back-up cylinder system to prevent brake failure. The PBR back-up master cylinder is a compensating type featuring a "fast fill" system. The primary and secondary pistons each operate a separate hydraulic system connecting one front and one, diagonally opposite, rear brake.

The master cylinder also incorporates the proportioning valves and a brake failure warning lamp switch. Utilities do not have a proportioning valve fitted to master cylinder.

Utilities have a Load Sensing Valve fitted to the vehicle frame, above the rear axle, connected to the parhard rod via a spring lever and chain. This valve monitors the vehicle load, if fully loaded the rear brakes receive full brake line pressure, lightly loaded the rear brakes receive lower brake line pressure. Utilities do not have a booster.

The master cylinder is assisted by the function of vacuum operated brake booster. The brake booster is a self-contained vacuum-hydraulic braking unit mounted on engine side of the dash panel. Utilities do not have a booster.

The brake booster is of the vacuum suspended type which utilizes engine intake manifold vacuum and atmospheric pressure for its power. The booster unit is to be exchanged when found to be defective.

ABS brake systems are designed to stop wheel lockup when brakes are applied at full pressure. Wheel lockup can cause the driver to lose some control over the steering of the vehicle. Also wheel lockup can lengthen the vehicle stopping distance.

ABS systems use a different master cylinder, it has only two pipes connected and the reservoir is a greenish colour.

OPERATION

Initial pedal travel produces pressure in large diameter primary piston bore which closes the fast fill flap valve to prevent fluid entering the reservoir port. This high volume, low pressure fluid flows over primary piston primary cup into smaller bore to cater for low pressure brake displacement, ie. caliper piston movement.

With further movement pressure in large bore increases until, at a predetermined point the ball in the fast fill valve unseats preventing additional pressure rise and allowing fluid to flow from large bore into reservoir port.

At this point the small diameter bore section functions as a conventional tandem master cylinder to produce high line pressure with minimal piston travel.

As primary piston returns on release of brake pedal, fluid recuperation, from reservoir to large and small diameter bores, occurs through the replenishing holes in the fast fill valve.

With the primary piston fully returned, the compensating port in the master cylinder is uncovered, thus fluid returning from the caliper pistons can flow into the reservoir through the compensating passage in the master cylinder and relieve all pressure in the brake system.

The vacuum assisted brake booster is fitted between the brake pedal and brake master cylinder and supplements the driver's pedal effort. It derives power from permanent use of depression or vacuum existing in intake manifold of engine and controlled application of atmospheric pressure. Engine intake manifold vacuum is relayed to the unit through a hose fitted with a vacuum check valve.

In the case of engine failure and consequent loss of engine vacuum, two application of brakes are possible by using vacuum retained in the power unit. In case of complete vacuum loss, brakes can be applied in the conventional manner, although more effort is required.

When the brake pedal is applied, brake fluid is displaced into the caliper bore moving the piston outwards. This action forces the inner pad assembly against the disc. The resultant reaction forces the caliper body and outboard pad assembly inwards against the disc.

The piston seal retracts the piston a small amount allowing the pads to clear the disc, when brake pedal is released.

ABS system uses electrical sensors at each wheel to detect the rotation of wheels, three independent systems one for each front wheel and one for the two back wheels.

As a wheel is slowing down compared to others wheels the control unit via a solenoid valve attached to each of the three systems alters the brake fluid pressure to stop wheel lockup.

ROUTINE MAINTENANCE

HAND BRAKE CABLE

Check

Place the transmission in neutral.

Jack the rear of the vehicle and place on safety stands.

DO NOT START ENGINE.

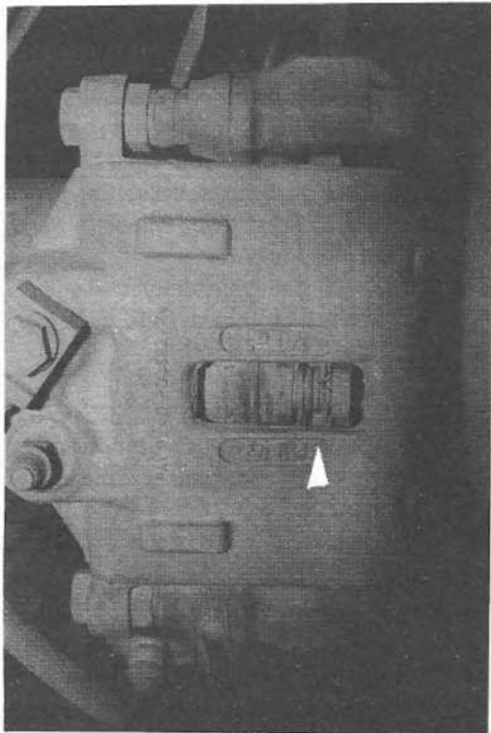
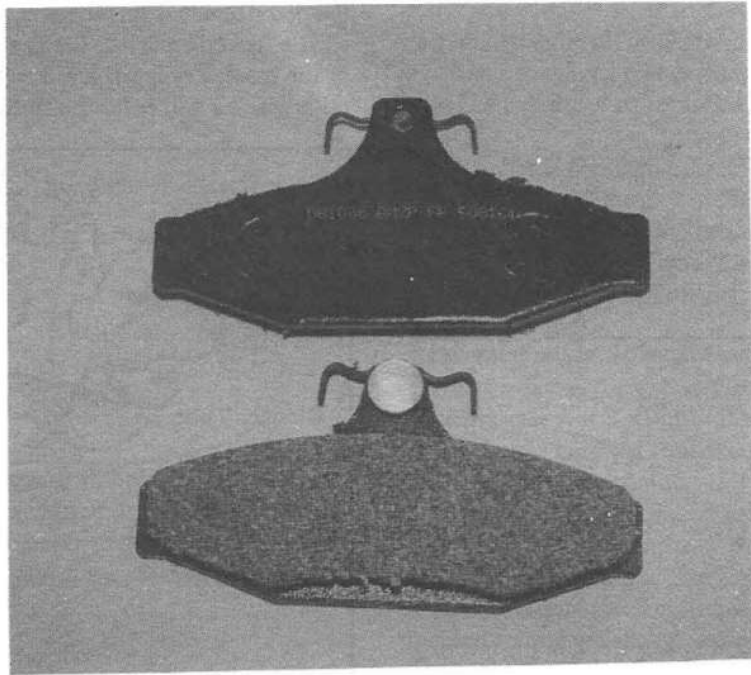
Place safety blocks both sides of both front wheels.

Pull the hand brake lever up until there is sufficient resistance that the hand brake should be fully functional (this should be approximately 4-5 clicks from fully down).

BRAKE SYSTEM

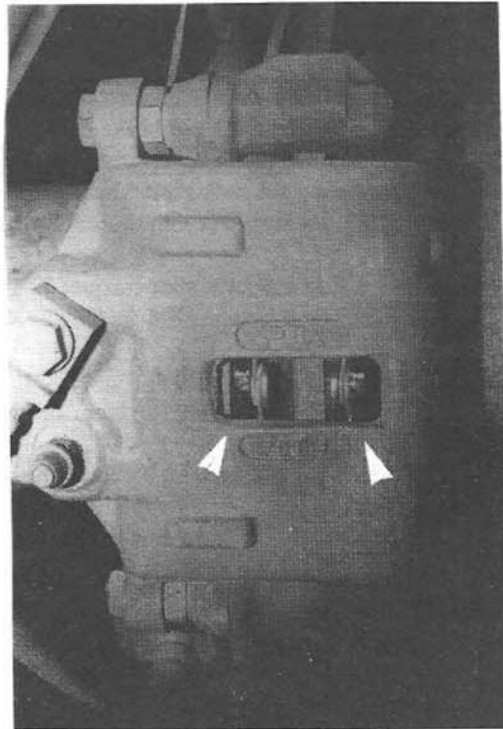
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New Disc Pads



Note Inspection Hole:

Pads worn very low, almost touching each other, anti-rattler springs very close.



New pads fitted pads anti-rattler springs apart.

Check the back wheels for resistance, there should be enough resistance that the wheels are impossible to turn by hand.

Release hand brake lever and check the back wheels for resistance, there should not be any resistance.

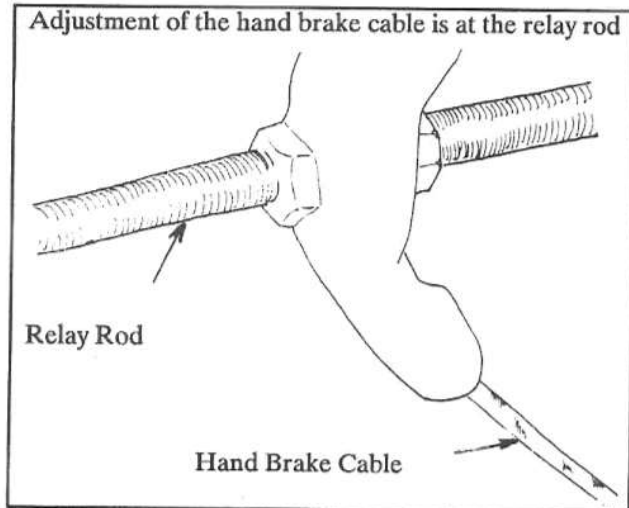
Adjustment

Place the transmission in neutral.

Jack the rear of the vehicle and place on safety stands. **DO NOT START ENGINE.**

Place safety blocks both sides of both front wheels.

Hand brake lever in the full down position, that is fully released.



Loosen the lock nut on the relay rod, turn the adjusting nut 3 full turns up to tighten the hand brake cable.

Check hand brake as described above, tighten the adjusting nut further if required, when the hand brake has been adjusted tighten the locking nut on the relay rod to specification.

Hand Brake Relay Rod Locknut spec torque: 12-16Nm
Lower back wheels, remove safety blocks

BLEEDING THE BRAKE SYSTEM

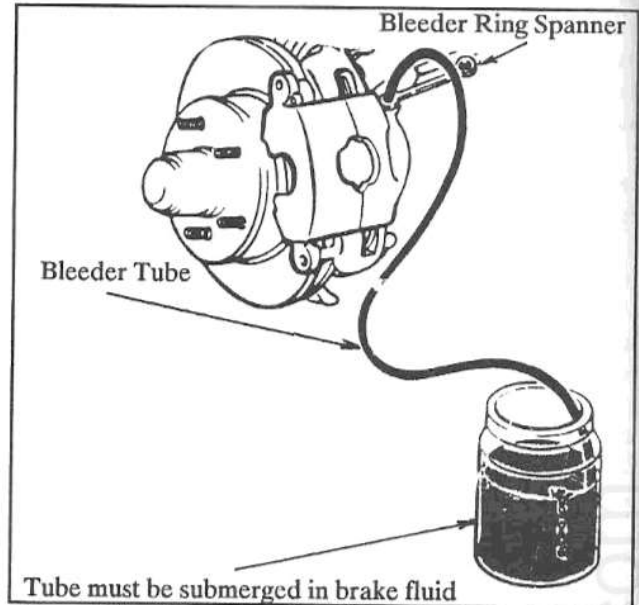
Clean dust grease and foreign matter from the brake bleeding valves on all four calipers.

At the back left wheel prepare to start bleeding the brake system. Always bleed the caliper with the longest length of brake fluid pipe first, this to help ensure there are no air traps in the brake pipe system.

Use a ring spanner on the bleeder valve, then connect a clear plastic tube to the end of the bleeder valve, insert the other end of the plastic bleeder hose into a clean container half filled with clean brake fluid.

Have an assistant press the brake pedal 3 or 4 times and hold his foot on the pedal, this is pumping the brakes. After your assistant has pumped the brakes, with his/her foot still on the pedal, loosen the bleeder valve with the ring spanner approximately half a turn. This will allow fluid and air to pass out of the bleeder valve through the bleeder hose into the container with the brake fluid. When

the assistant's foot on the brake pedal has travelled to the floor, tighten the bleeder valve before the assistant allows the pedal to rise from the floor, otherwise old fluid and air will be sucked back into the brake system. Check the level of the master cylinder and keep topping it up with fluid otherwise air will enter the system.



Repeat the above procedure (pumping the brakes) until all of the air has been released from the back left brake bleeder valve. Tighten the bleeder valve, remove the hose and spanner.

Repeat the bleeding procedure on the right rear wheel, left front wheel then right front wheel.

Then repeat the pumping and bleeding procedure on the left back wheel and right back wheel, this is to ensure the pedal will not be spongy.

Check the level of the master cylinder.

*** Do not use the old brake fluid as a top up into the master cylinder.**

CHECKING BRAKE LINES, HOSES AND LININGS

Raise the rear of vehicle, position on safety stands and remove rear wheels. Inspect braking disc, linings and caliper. Check all brake tube connection for possible leaks and flexible hoses for deterioration. Install new flexible hoses if required.

NB: Ensure hose is not twisted more than 15° after final fitting.

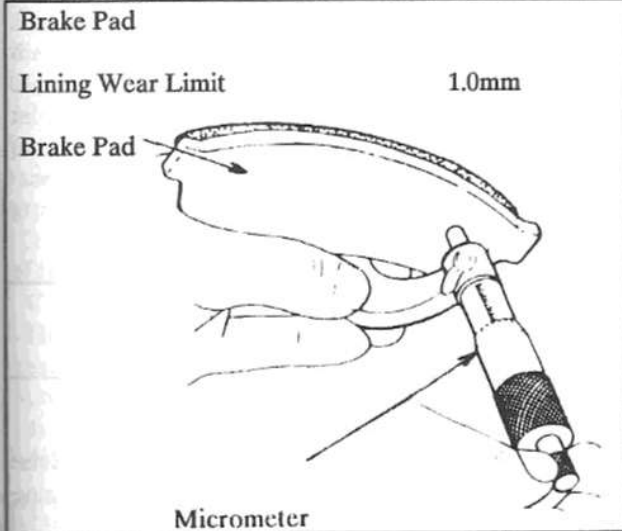
If a brake pad lining has worn to the minimum specification, replace both inboard and outboard pads. It is necessary that both rear wheel sets be replaced whenever a respective brake pad is worn beyond specifications or damaged.

BRAKE PAD WEAR

If a visual inspection doesn't adequately determine condition of lining, a physical check will be necessary. To

BRAKE SYSTEM

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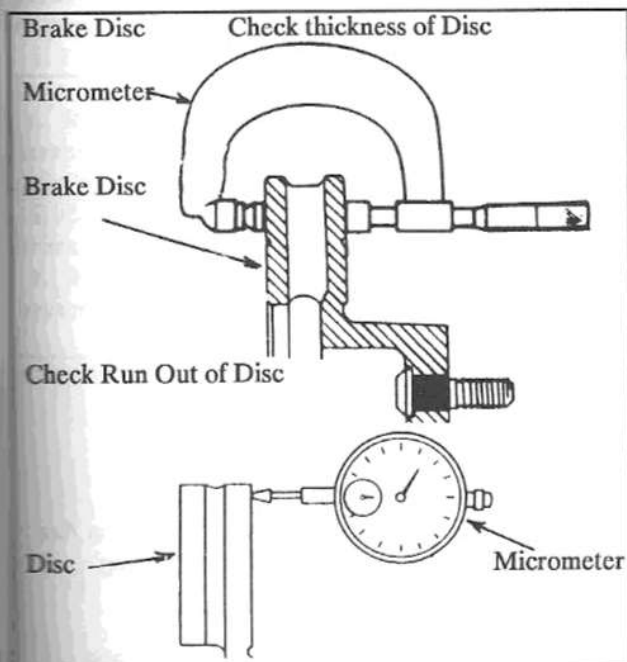


check amount of lining wear, remove brake pad assemblies (see "Pad Replacement"). Three thickness measurements with a micrometer should be taken across the centre of each pad assembly; one reading at each end and one in the centre.

BRAKE ROUGHNESS

The most common cause of brake roughness (or chatter) with disc brake is excessive disc face run-out. This is easily checked with a dial indicator. If measurement is out of specification, disc must be re-surfaced or replaced.

Maximum Disc Runout specification: 0.1mm
Minimum Disc Thickness is stamped on Hub:
 e.g. 21.00mm



Other less prevalent causes of roughness can be the use of some type of non-standard lining material and extreme abrasion of the disc faces. Vehicles which stand unused

for periods of time in areas of high humidity or salt air may incur rust on the disc which could cause a temporary brake surge and roughness. Normally, however, this condition should correct itself after a short period of usage. If rust is severe enough, roughness will not clear up and the disc must be resurfaced or replaced.

DISC BRAKE SERVICE PRECAUTIONS

Grease and any foreign material must be kept off caliper assembly and surfaces of braking disc during service procedures. The braking disc and caliper should be handled, avoiding deformation of the disc and scratching or nicking of the pad linings.

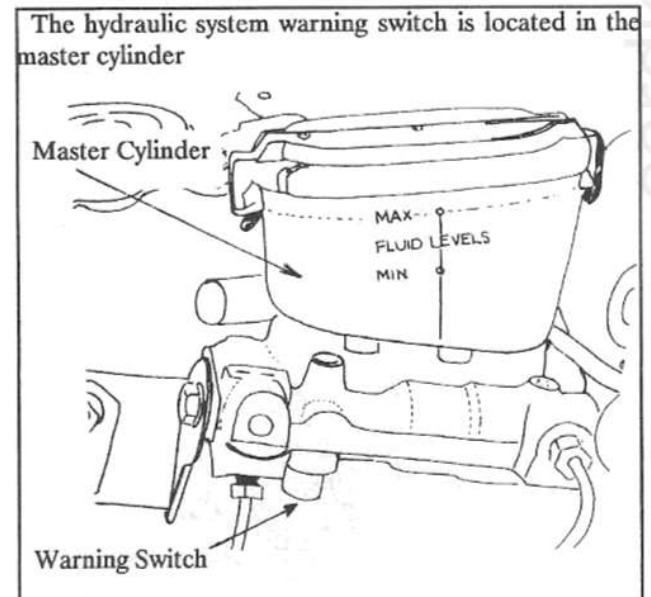
If inspection reveals square sectioned caliper piston seal is worn or damaged, it should be replaced immediately.

During removal and installation of a wheel and tyre assembly, use care not to strike the caliper.

Before vehicle is moved after any brake service work, obtain a firm brake pedal by using correct bleeding procedures.

Dragging the brakes (common result of left foot application on vehicles with automatic transmission) should be avoided during vehicle operation.

As brake pad lining wears, reservoir level will go down. If fluid has been added between relines, then reservoir overflow may occur when piston is pushed back into new lining position. Overflow can be avoided by removing a small amount of fluid from reservoir.

HYDRAULIC SYSTEM FAILURE WARNING SWITCH

The hydraulic system warning switch located in the master cylinder, is used to warn the vehicle operator that one of the hydraulic systems has failed.

A failure in one circuit doesn't result in an entire brake system failure.

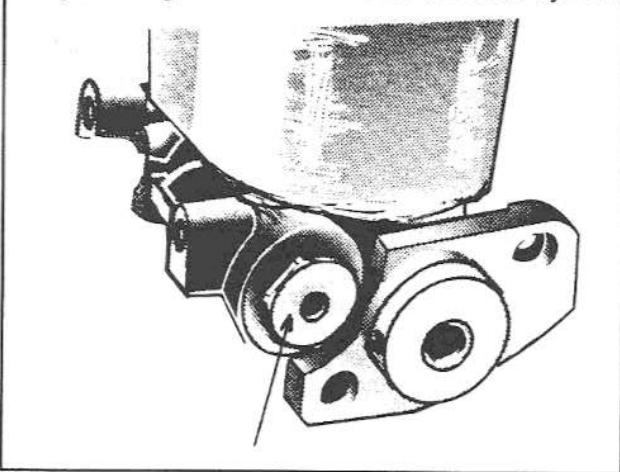
As pressure in one circuit falls, the uneven pressure on the spool valve forces the valve to move and contact switch terminal thus lighting the brake and failure warning lamp on instrument cluster.

The warning lamp switch spool valve is self neutralising, thus it is not necessary to remove the switch to allow the valve to centralise.

The switch can be removed or replaced without loss of fluid.

PROPORTIONING VALVES

Proportioning valve is located at rear of Master Cylinder



Proportioning valves are fitted into the master cylinder. Their purpose is to regulate the amount of fluid pressure transmitted to the rear hydraulic circuits thus preventing premature rear wheel "lock-up" resulting in improved braking and steering control under braking.

The valves contain a stepped piston working against a pre-loaded spring and poppet valve. This allows the front and rear hydraulic pressure to increase at the same rate until the piston overcomes the spring force. At this point the piston will begin to move across to the poppet valve, thus restricting the pressure increase to the rear brakes.

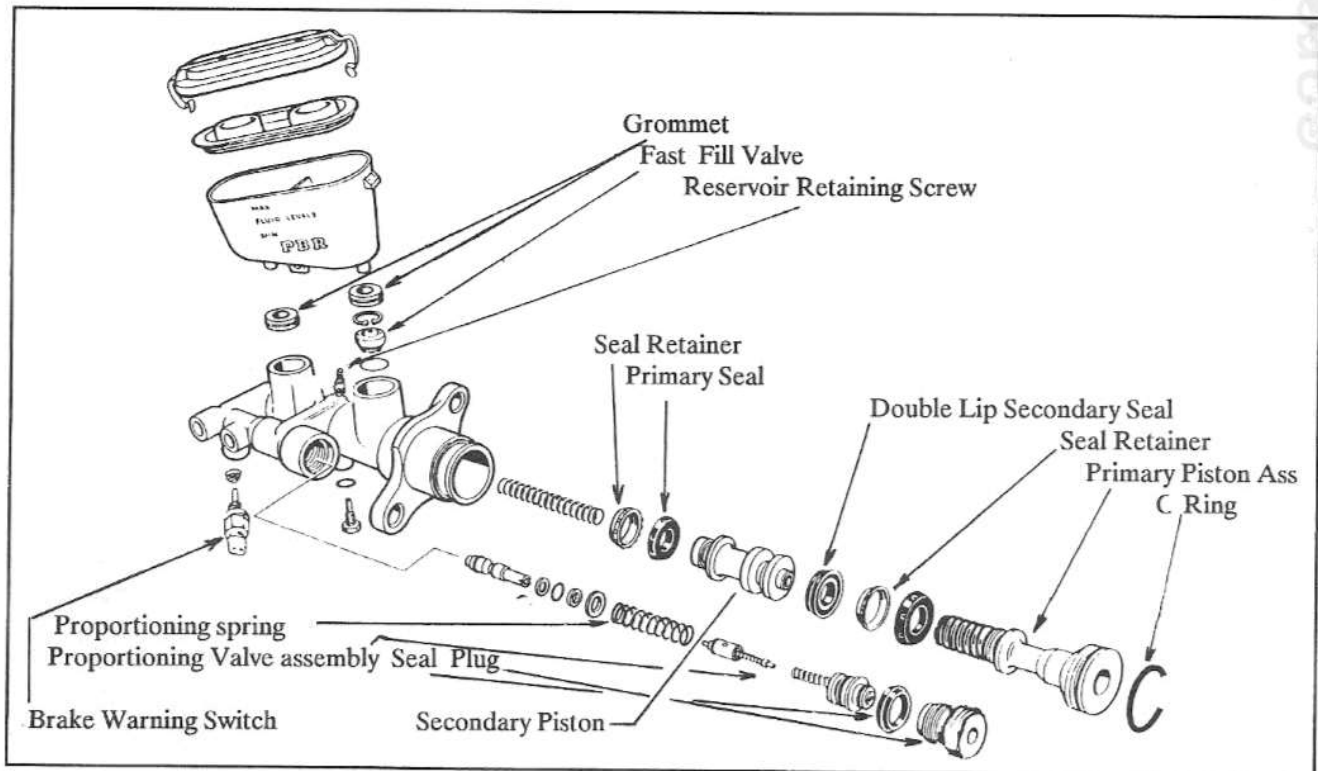
MAJOR REPAIRS

MASTER CYLINDER

Remove

1. Remove the brake tubes from the outlet ports of the master cylinder. Disconnect the plug from the warning light switch.
2. Remove two nuts and two lock washers attaching the master cylinder to the brake booster assembly. Slide the master cylinder forward and upward from the vehicle.
3. The 'crack' pressure of the proportioning valve is stamped on the front of the master cylinder body, and it is important that, if a cylinder needs replacing, a cylinder the same may be used.
4. Take care not to disturb the pushrod and not to depress the brake pedal after the cylinder is removed, or when removing the master cylinder. Failure to observe this may result in the reaction disc becoming dislodged inside the booster.

Master Cylinder Main Bore Dismantle



1. Place the master cylinder on a clean bench, any dirt that may enter the unit, could cause a brake failure. Unclip the reservoir cap and remove. Empty fluid from reservoir.

2. Unscrew reservoir to body retaining bolt located at bottom of reservoir. Separate by hand, the plastic reservoir from aluminium body. Remove the reservoir sealing grommets.

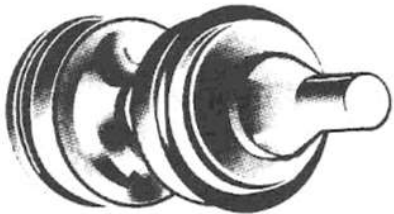
3. Remove pressed steel end cap, fitted to the opening of the main bore, by prising up the two locating lugs.

Caution:

Hold cap firmly with one hand during this operation to ensure that the primary piston does not spring out of the bore once the cap is free.

4. Carefully remove primary piston assembly from main bore of master cylinder.

Primary Piston



* Caged spring on primary piston has been set to a predetermined length-Do Not attempt to adjust the screw or remove the caged spring.

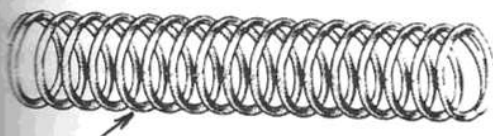
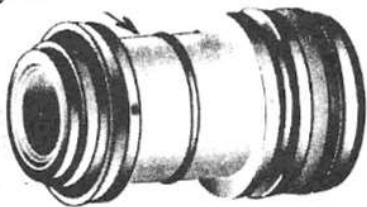
5. Fully depress and hold secondary piston down the bore, then remove stop screw and 'O' ring from cylinder.

6. Remove secondary piston and return spring by using compressed air or lightly tapping the open end of the cylinder bore squarely onto a soft piece of wood.

7. Cut and remove the plastic cup retaining ring on both primary and secondary main bore pistons.

8. Remove all rubber seals from both pistons taking extreme care not to damage pistons.

Secondary Piston

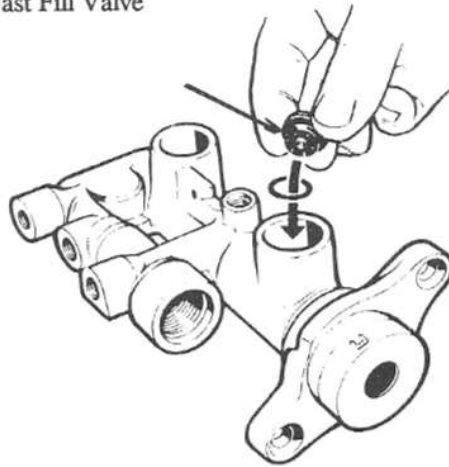


Secondary spring

Fast-Fill Valve

Using circlip pliers, remove circlip retaining the fast-fill valve in the primary reservoir port of the cylinder.

Fast Fill Valve



Face reservoir port down to allow this valve to fall out. If valve is stuck in position, lightly tap cylinder on piece of wood to assist valve removal. Remove the valve sealing 'O' ring from bottom of reservoir port.

Proportioning Valve

Unscrew and remove the hexagon fitting located at the flange end of the cylinder.

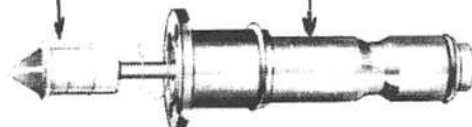
Caution: Hold firmly with one hand during this operation to ensure the internal parts do not spring out.

The proportioning piston, seal block and poppet sub assembly, with the exception of the proportioning spring, should withdraw from the bore with the removal of the hexagon fitting. However, if these parts remain in the bore, lightly tap the body on a piece of wood to remove.

Remove proportioning spring from bore. Remove proportioning spring location washer from bottom of proportioning bore. Separate proportioning piston, seal block and poppet sub assembly from hexagon fitting.

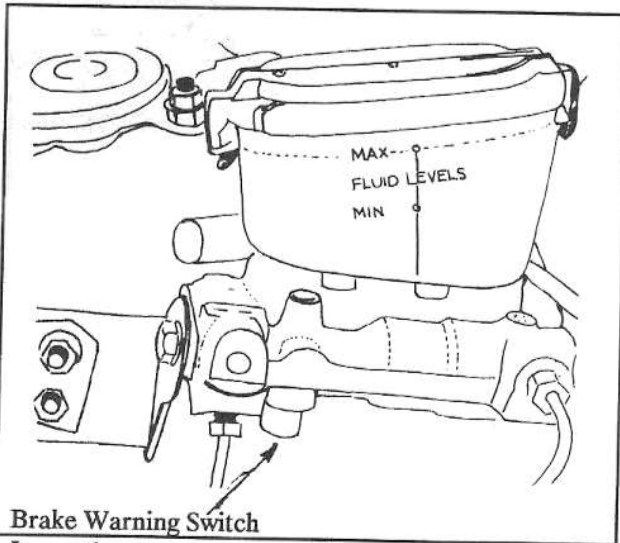
Poppet Valve

Spool



Brake Warning Switch Section

Unscrew the plastic brake warning switch from the master cylinder body. Ensure electrical earthing spring remains on plunger. Carefully withdraw spool assembly from bore, using long nose pliers. Carefully remove both 'O' rings and washers from spool.

**Brake Warning Switch****Inspection**

Inspect the master cylinder bores for signs of etching, pitting or scoring and if in poor condition, replace the cylinder assembly.

DO Not Hone This Cylinder.

Wash all internal parts in clean brake fluid and inspect the parts for excessive wear damage. Place all parts on clean pan or paper prior to assembly.

Master Cylinder Main Bore**Assembly**

Lubricate internal parts and master cylinder bore with clean, recommended brake fluid from sealed container, or special PBR Brake lubricant.

Assemble the double-lip secondary cup seal onto the secondary piston into groove.

Install primary cup seal onto the other end of piston into groove with sealing lip facing away from seal already assembled. The primary cup seal can be identified by six shallow recuperating grooves around the seal's outside surface.

Locate part of the plastic cup retainer groove on piston and hold in piston with thumb. Using a small pointed tool, clip the retainer into the remaining part of groove ensuring the complete location is achieved.

*** Care should be taken to avoid damage to piston or cup seal.**

Install large 'O' ring into groove at the pushrod end of primary piston ensuring 'O' ring is assembled in groove.

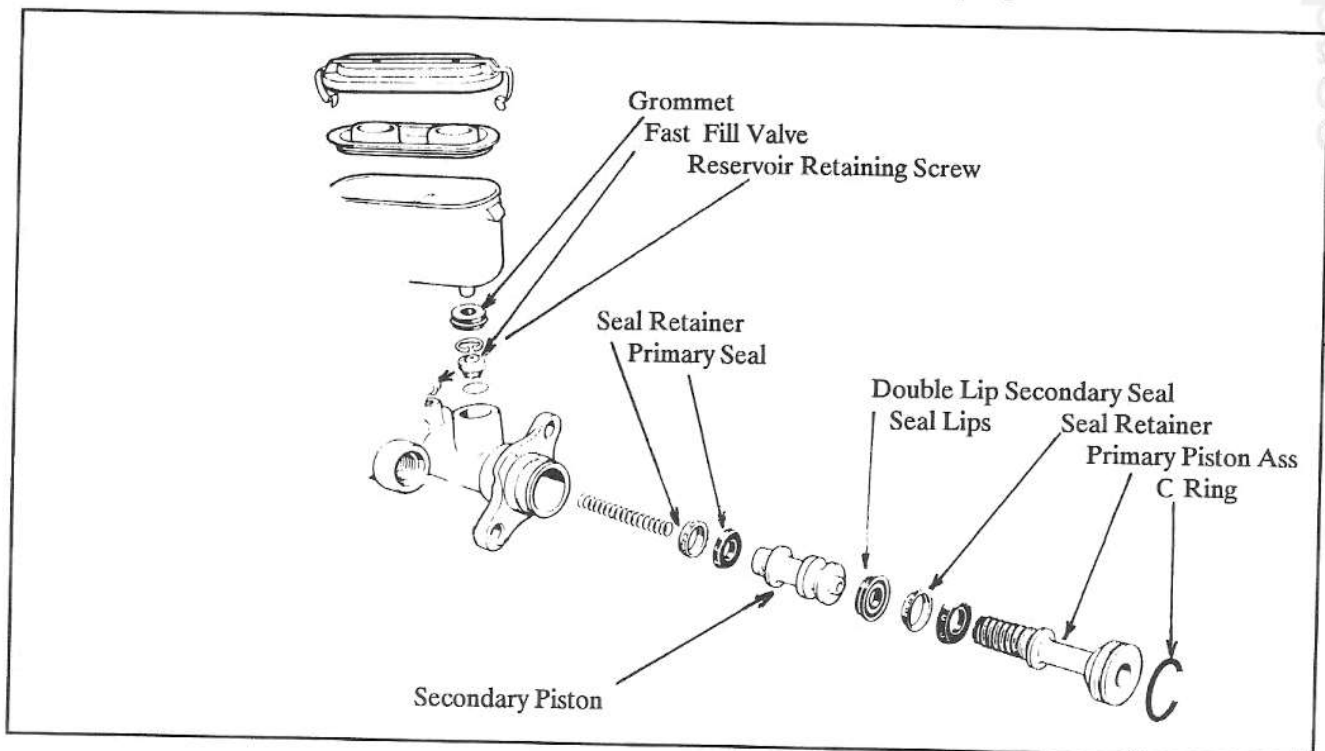
Install the primary cup seal into remaining groove on primary piston ensuring that the seal lip faces away from the pushrod hole end of the piston. Fit remaining plastic retainer to primary piston as described above.

*** Cup seal and plastic retainer must be carefully installed over a caged spring assembly to avoid damage.**

Assemble secondary piston return spring into end of secondary piston.

*** The main bore is 'stepped'.**

While holding the cylinder in a vertical position with the bore opening facing down, carefully install the secondary piston, spring end first, through the large bore and into smaller bore until the spring 'bottoms'.



BRAKE SYSTEM

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Fully stroke secondary piston and while held at the bottom of the bore install stop screw and new 'O' ring. Assemble stop screw (reservoir attaching bolt) the full length of thread by hand before tightening to 6.5 Nm.

Insert primary piston, spring end first, into the main bore and against the secondary piston. Then carefully push both pistons down the bore until the primary piston is flush with bore opening. With pistons held in position assemble piston retainer cap.

* The caged spring on primary piston has been set to a predetermined length-Do Not attempt to adjust the screw or remove caged spring.

Differential Warning Switch Section

1. Before assembly, lubricate bore and internal parts with clean recommended brake fluid from a sealed container.

2. Assemble the steel back up washer onto the spool smaller diameter and against shoulder, followed by the large 'O' ring and plastic washer.

3. Install the small 'O' ring into the spool groove, opposite end.

* To assist spool assembly into body, a smooth plastic or metal tube is required that will locate over the spool small diameter and has an outside diameter no larger than the steel back up washer.

4. Locate assembly tube over the spool small diameter against the plastic washer and carefully insert spool assembly into the bore to bottom steel back up washer against spool bore location shoulder.

Proportioning Section

* When using a repair kit install all new parts supplied. The new proportioning piston and seal block sub assembly has been prelubricated and sealed in plastic bag. Don't wash - assemble as supplied.

Assemble the rubber breather washer onto the hexagon fitting and proportioning spring location washer against shoulder in proportioning bore.

Install proportioning spring into bore against location washer.

Assemble proportioning piston and seal block sub assembly into hexagon fitting bore. Securely attach small end of poppet retraction spring onto end of proportioning piston.

Insert poppet sub assembly through retraction spring into proportioning piston, ensuring large end of poppet retraction spring bottoms in retractor. Carefully install the proportioning piston and seal block sub assembly and hexagon fitting into the proportioning bore compressing the proportioning spring. Screw the hexagon fitting by hand into the bore and tighten to 40-46 Nm.

Electrical Switch

Ensure the conical electrical earthing spring is installed on switch plunger.

Install electrical switch and tighten to a torque of 2 Nm.

* Electrical spring must remain attached to plunger when switch is held vertically. Small end of spring may need to be closed down to give required attachment.

Reservoir

Lightly smear reservoir bores and grommets with clean brake fluid. Carefully assemble grommets into reservoir bores to locate against the shoulder in each bore. Assemble reservoir into grommets.

Push on reservoir to align the retaining screw hole in the reservoir and cylinder body, then assemble retaining screw - and tighten to 4-5 Nm.

* Both holes must be aligned to avoid cross threading.

Push cap and seal assembly onto reservoir and secure by pressing clip at each end location on reservoir lugs. Cap should be fitted so that lettering on cap is the correct way when viewed from the right hand side of vehicle.

Install

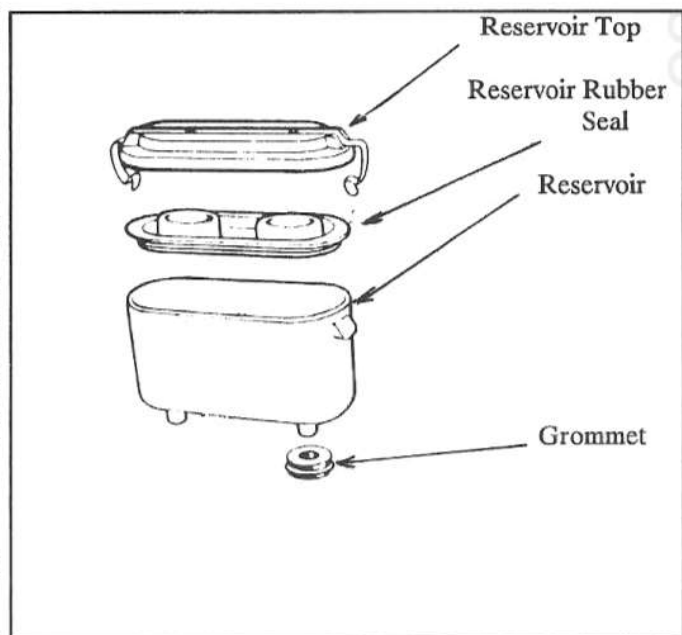
1. Position the master cylinder assembly over the booster push rod and onto the two studs on the booster assembly.

2. Install the attaching nuts and lock washers and torque them to specifications.

3. Install the front and rear brake tubes to the master cylinder outlet fittings.

4. Fill the master cylinder with the specified brake fluid to the level marked on the side of the dual reservoirs.

5. Bleed the brake system. Operate the brake several times, check for external hydraulic leaks.



VACUUM BRAKE BOOSTER

On Vehicle Test

Check the hydraulic brake system for leaks or insufficient fluid.

With the transmission in neutral, stop the engine and apply the parking brake. Depress the brake pedal several times to exhaust all vacuum in the system. With the engine shut off and all vacuum in the system exhausted, depress the pedal, and hold it in the applied position. Start the engine. If the vacuum system is operating, the pedal will tend to fall away under foot pressure and less pressure will be required to hold the pedal in the applied position. If no action is felt, the vacuum booster system is not functioning.

Remove the vacuum hose from the brake booster check valve connection. Manifold vacuum should be available at the check valve end of the hose with the engine at idle speed and the transmission in neutral. Operate the engine a minimum of 10 seconds at fast idle. Stop the engine and let the vehicle stand for 10 minutes; then, depress the brake pedal. The pedal feel (brake application) should be the same as that noted with the engine operating. If the pedal feels hard (no power assist), replace the brake booster.

If the brake pedal movement feels spongy, bleed the hydraulic system to remove air from the system.

Removal

*** Operate the brake pedal several times without the engine running to exhaust the vacuum from the booster.**

Inside the vehicle below the instrument panel, disconnect the booster push rod from the brake pedal assembly. Remove the hairpin retainer from the brake pedal pin and then remove the booster push rod and the nylon spacer and bushing off the brake pedal pin.

Remove the master cylinder from the booster. It is not necessary to disconnect the brake lines. Disconnect the manifold vacuum hose from the booster unit.

Remove the booster to dash panel attaching nuts. Remove the booster assembly to the dash panel, sliding the push rod link out from the engine side of the dash panel.

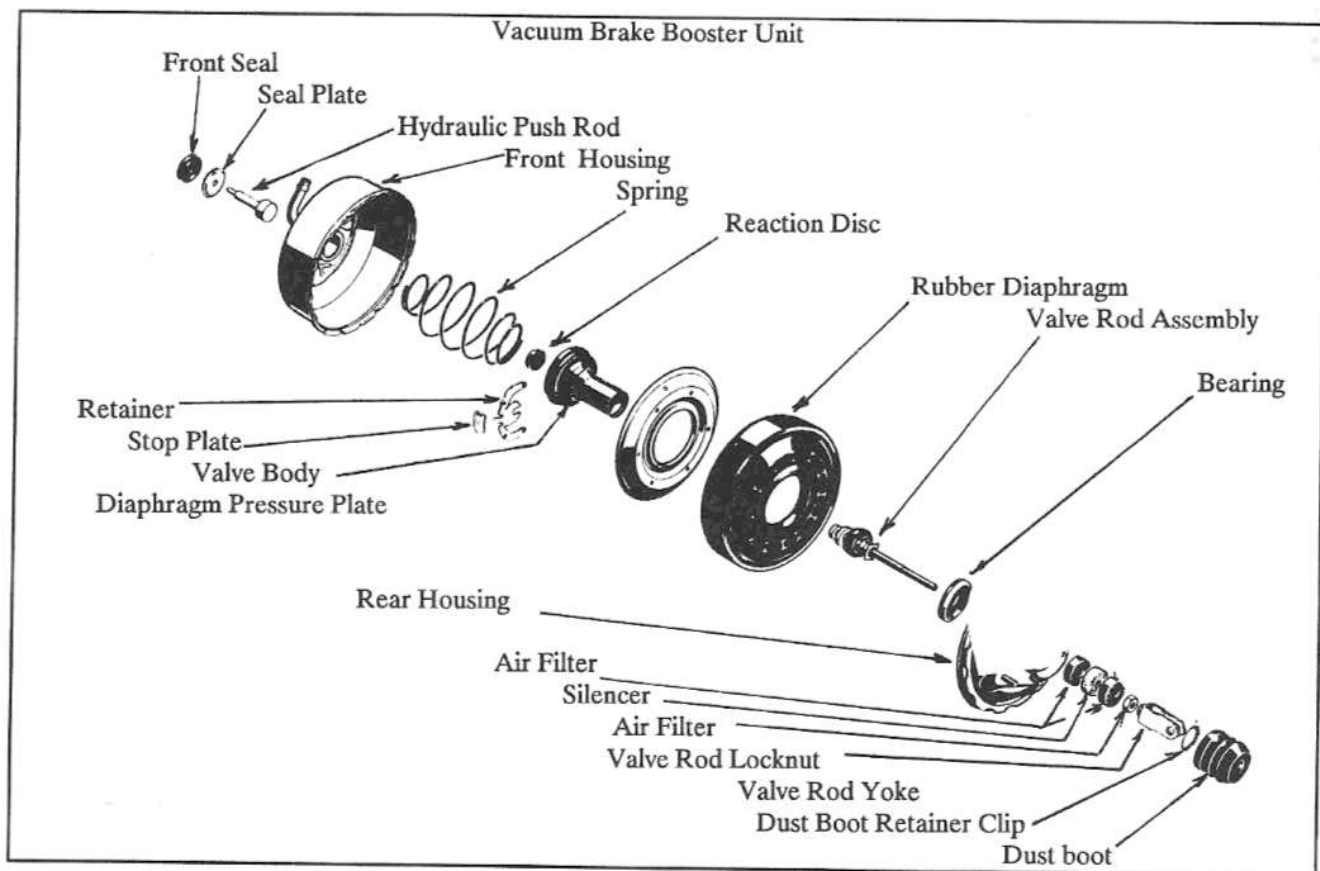
Install

Check the booster mounting gaskets. Mount the booster and bracket assembly to the dash panel by inserting the push rod and boot through the hole in the dash panel. Loosely install the booster to dash panel attaching nuts.

Install the inner nylon spacer, the booster push rod, and the bushing on the brake pedal pin. Secure these parts to the pin with the hairpin retainer.

*** Don't pull the booster into position on the dash panel by pulling rearwards on the brake pedal.**

Tighten booster to dash panel attaching nuts, then connect the manifold vacuum hose to the booster. Install the master cylinder and torque the attaching nuts.

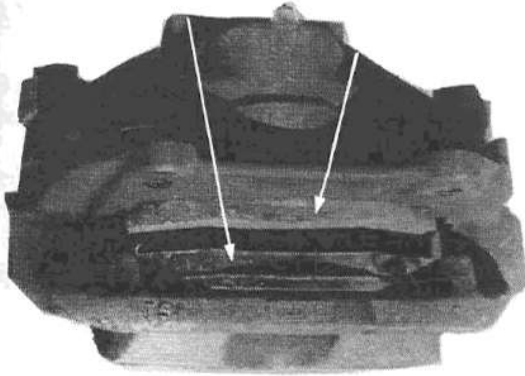


DISC BRAKES

Disc Pads Remove

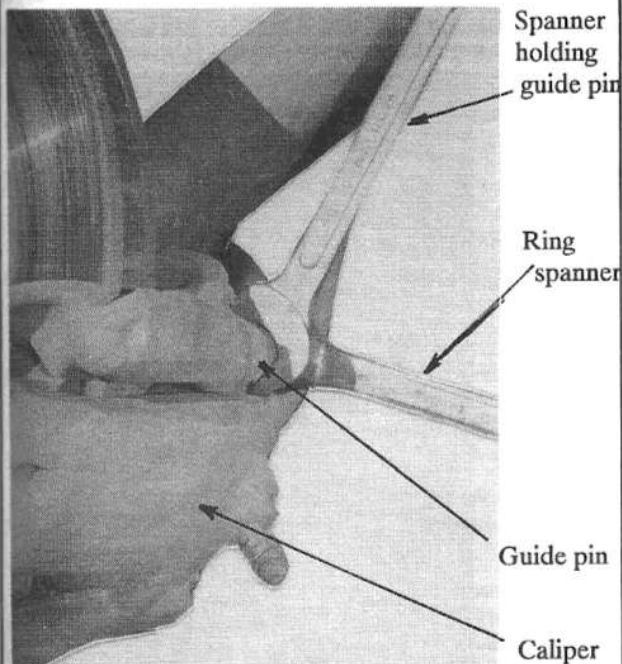
Front Brake Caliper

Outer Brake Pad Inner Brake Pad



1. Remove one half of the total fluid capacity. Do not remove the brake line or completely empty the reservoir

Front or Rear Caliper assemblies are very similar
Use an opened spanner to hold guide while loosening caliper bolt with a ring spanner.



or it will be necessary to bleed the hydraulic system. Discard the brake fluid.

*** Removal of the fluid is necessary to prevent reservoir overflow when the caliper piston is pushed back in its bore during pad replacement.**

2. Remove the wheels. If more than one brake requires service, work on only one brake at a time. Pad assemblies must always be replaced as sets either front or rear.

3. Remove the two mounting bolts which hold the caliper to the caliper frame, lift the caliper away from the disc and caliper frame. It is not necessary to disconnect the brake hose at the caliper for pad replacement.

4. Lift the brake pads out of the caliper frame from either side of the disc rotor.

Install

1. Push piston into the caliper bore, by hand if the caliper has been overhauled, or by using a piston retracting tool, a suitable "G" clamp.

Retract the piston slowly to permit the piston to move in the seal. If the piston is not sufficiently retracted the spacing between the linings is inadequate to permit the pad and caliper assembly to be mounted over the rotor.

2. Locate the inboard pad in caliper housing next to the disc.

3. Slide the outboard pad into the caliper.

4. Position caliper correctly over rotor and slide straight into position until caliper head bolt holes align with their respective holes on the caliper frame.

5. Install both caliper mounting bolts and torque to specification.

Front Brake Caliper Mounting Bolts spec torque:
115-120Nm

6. Replenish the brake fluid in the master cylinder. Pump the brake pedal several times to position the shoe and pad assemblies.

7. Check for leakage of fluid at all connections under pedal pressure. Check fluid level, install wheel and tighten wheel nuts, tighten nuts to specification.

Wheel Nut specified torque: 100-125Nm

8. Road test the vehicle and make several light stops to seat the linings.

Front Brake Calipers and Disc Pads

Remove

1. Remove one half of the total fluid capacity. Do not remove the brake line or completely empty the reservoir or it will be necessary to bleed the hydraulic system. Discard the brake fluid.

*** Removal of the fluid is necessary to prevent reservoir overflow when the caliper piston is pushed back in its bore during pad replacement.**

2. Remove front wheels. If more than one brake requires service, work on only one brake at a time. Pad assemblies must always be replaced in both brakes.

3. Remove the two mounting bolts which hold the caliper to the axle spindle and lift the caliper radially away from

the disc. It is not necessary to disconnect the brake hose at the caliper for pad replacement.

4. Lift the brake pads out of the caliper frame which were either side of the disc rotor.

5. Remove the bolts holding the caliper to the caliper frame, separate the caliper and caliper frame.

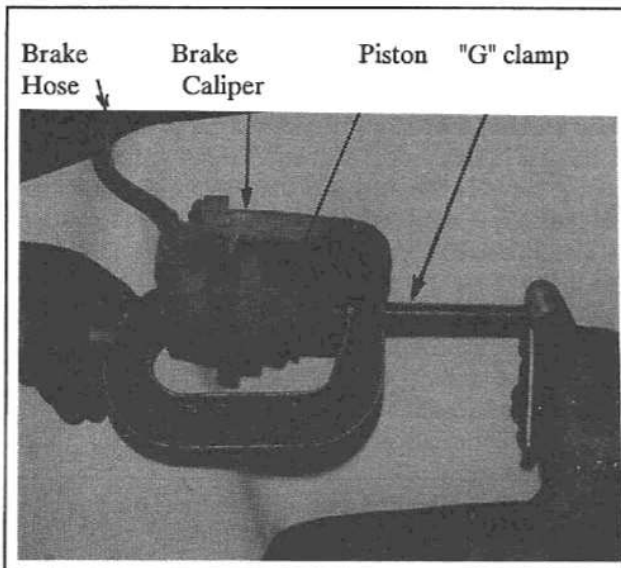
Install

1. Install caliper frame to the axle spindle on torque to correct specification.

Front Brake Caliper Frame Bolts spec torque:

115-120Nm

2. Push piston into the caliper bore, by hand if the caliper has been overhauled, or by using a piston retracting tool, a suitable "G" clamp.



Retract the piston slowly to permit the piston to move in the seal. If the piston is not sufficiently retracted the spacing between the linings is inadequate to permit the pad and caliper assembly to be mounted over the rotor.

3. Locate the inboard pad in caliper housing.

4. Slide the outboard pad into the caliper.

5. Position caliper correctly over rotor and slide straight into position until caliper head bolt holes align with their respective holes on the caliper frame.

6. Install both caliper mounting bolts and torque to specification.

Bolts to Guide Pins spec torque: 38-48Nm

Bolts to Guide Pins Heavy Duty Brake spec torque: 30-34Nm

7. Replenish the brake fluid in the master cylinder. Pump the brake pedal several times to position the shoe and pad assemblies.

8. Check for leakage of fluid at all connections under pedal pressure. Check fluid level, install wheel and tighten wheel nuts, tighten nuts to specification.

Wheel Nut specified torque: 100-125Nm

9. Road test the vehicle and make several light stops to seat the linings.

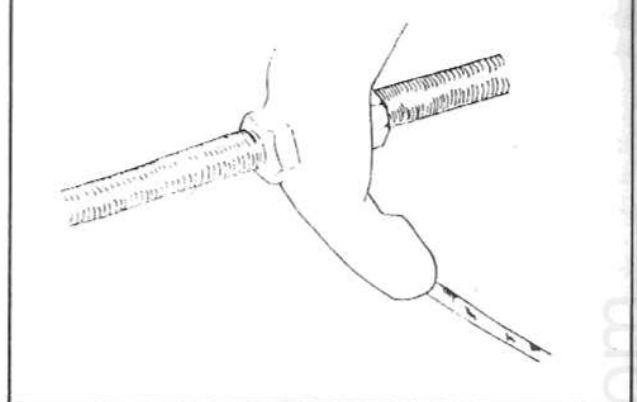
Rear Brake Calipers and Disc Pads

Remove

1. Remove one half of the total fluid capacity. Do not remove the brake line or completely empty the reservoir or it will be necessary to bleed the hydraulic system. Discard the brake fluid.

*** Removal of the fluid is necessary to prevent reservoir overflow when the caliper piston is pushed back in its bore during pad replacement.**

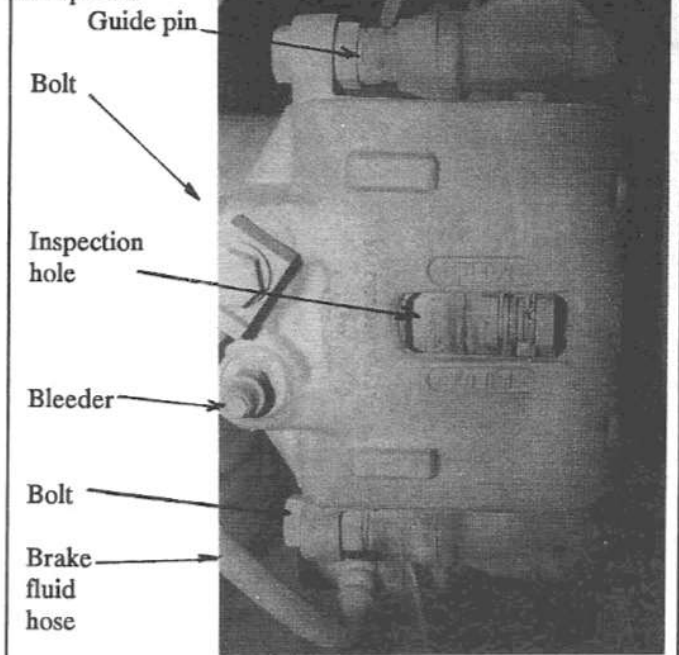
With the park brake lever released disconnect the cable at the equalizer



2. Remove rear wheels. If more than one brake requires service, work on only one brake at a time. Pad assemblies must always be replaced in both brakes.

3. Remove the two mounting bolts which hold the caliper to the axle spindle and lift the caliper radially away from the disc. It is not necessary to disconnect the brake hose at the caliper for pad replacement.

Remove the two mounting bolts which hold the caliper to the axle spindle

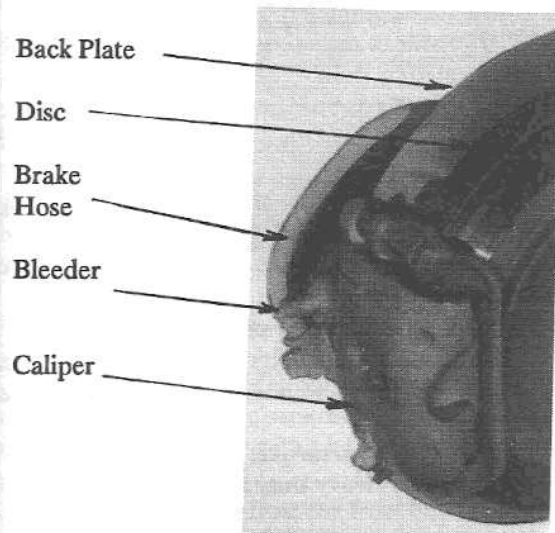


4. Lift the brake pads out of the caliper frame which were either side of the disc rotor.

5. Remove the bolts holding the caliper to the caliper frame, separate the caliper and caliper frame.

Install

Rear Brake Caliper



1. Install caliper frame to the axle housing, torque to correct specification.

Rear Brake Caliper Frame Bolts spec torque:
115-120Nm

2. Push piston into the caliper bore, by hand if the caliper has been overhauled, or by using a piston retracting tool, a suitable "G" clamp.

Retract the piston slowly to permit the piston to move in the seal. If the piston is not sufficiently retracted the spacing between the linings is inadequate to permit the pad and caliper assembly to be mounted over the rotor.

3. Locate the inboard pad in caliper housing next to the disc.

4. Slide the outboard pad into the caliper.

5. Position caliper correctly over rotor and slide straight into position until caliper head bolt holes align with their respective holes on the caliper frame.

6. Install both caliper mounting bolts and torque to specification.

Bolts to Guide Pins spec torque: 38-48Nm

Bolts to Guide Pins Heavy Duty Brake spec torque:
30-34Nm

7. Replenish the brake fluid in the master cylinder. Pump the brake pedal several times to position the shoe and pad assemblies.

8. Check for leakage of fluid at all connections under pedal pressure. Check fluid level, install wheel and tighten wheel nuts, tighten nuts to specification.

Wheel Nut specified torque: 100-125Nm

9. Road test the vehicle and make several light stops to seat the linings.

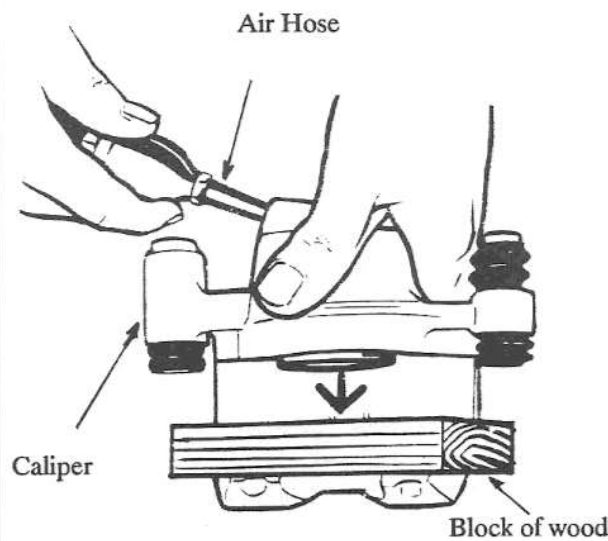
Caliper Overhaul and Disc Pad Replacement Dismantle

1. Position the caliper in a vice equipped with padded jaws. Unscrew the two guide pins and boots from the caliper body.

Caution: Do not hit the guide pins with a hammer, if they will not unscrew, as this will damage the caliper.

2. Remove piston by carefully gradually increasing compressed air at the fluid inlet port of the caliper until the

Use compressed air at the fluid inlet port of the caliper to force the piston out of the bore



Do not put your finger inside the caliper when removing the piston using air pressure.

piston is forced out of the bore. A block of wood or hard-board or a wad of cloth located in the position of the outboard pad will guarantee the piston is not damaged.

Caution: Keep fingers from the inside of caliper when removing the piston using air pressure.

3. While the piston slides out, the I.D. of the rubber boot in the groove of the piston should stretch out around the large portion of the piston allowing the piston to slide out and be removed.

4. Remove the boot out of cylinder groove and dispose of it. Using a small pointed wood or plastic tool remove the piston seal from its groove in the cylinder bore and dispose of the seal, be careful not to damage the seal seat.

5. Clean and inspect all parts as described below.

Clean and Inspect

1. Wash all parts with methylated spirits and dry with compressed air or lint free cloth.

2. Blow out the caliper bore and all drilled passages with compressed air.

3. Inspect the piston for scoring, pitting, corrosion or areas where the chrome plating has worn off. If damage is present replace piston.

4. Inspect the caliper bore for scoring, pitting, corrosion or damage and replace the caliper if any of these factors are present.

5. If light scuff marks exist on the piston or in the caliper bore, rub down lightly by hand with '600' wet and dry paper and thoroughly rinse with methylated spirits.

The caliper must not be honed.

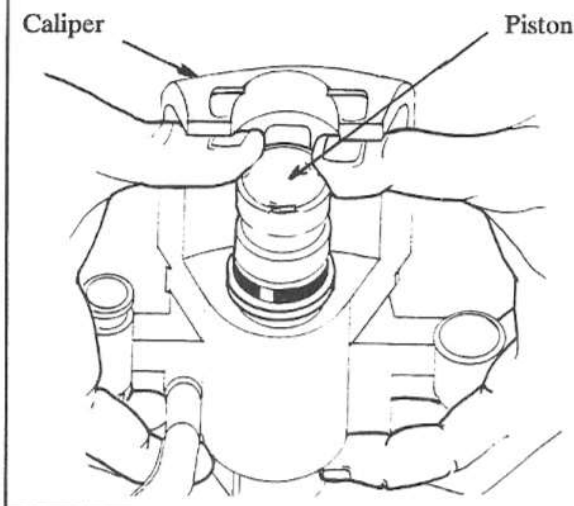
6. Inspect all other components and replace if wear or damage exists.

Assembly

1. Position caliper assembly on a clean bench area with the open end of cylinder up.

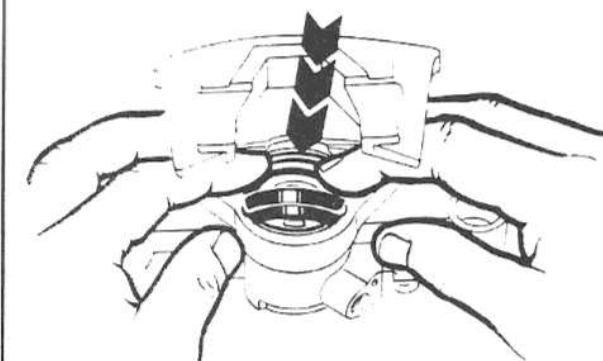
2. Dip new piston seal in clean disc brake fluid and

Gently push piston into bore, inner ring of boot must slip into position.



install in cylinder groove. Place seal in the groove and gently work around cylinder bore with a finger until the

Locate boot into groove in caliper body at the rear and work forward



seal is properly seated. Check to be sure the seal is not twisted or rolled in its groove.

3. Coat piston boot in rubber grease. Place piston boot over end of piston. Liberally coat the outside diameter of piston with rubber grease.

4. Locate boot into groove in caliper body. Start this procedure at the rear of the body and gradually feed boot around groove until completely assembled.

5. Lubricate inside of caliper head guide pin bores with approved high melting point grease.

6. Assemble the sleeve boot into the larger sleeve hole in the caliper body by squeezing with fingers into bore and pushing in.

7. Thoroughly lubricate inside of boot with High Melting Point Grease and assemble the straight slider sleeve and guide pins, make sure the boot and the slider and pin are lubricated and move freely.

8. Fit the caliper to the anchor plate.

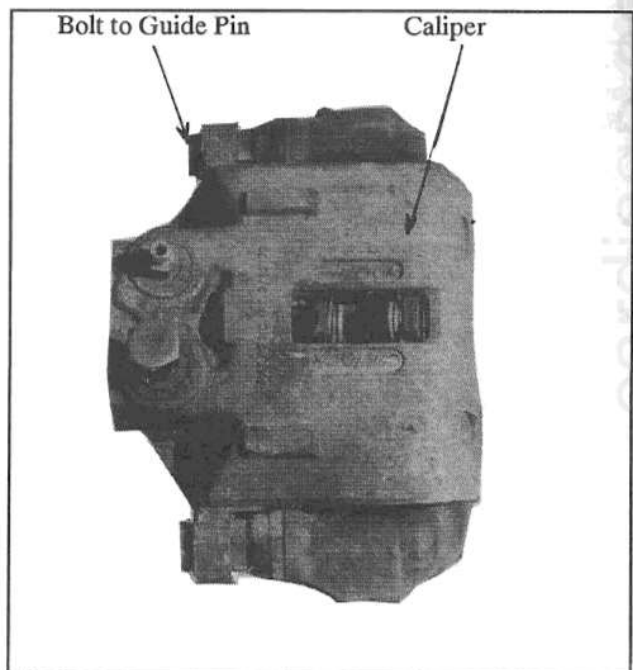
9. Tighten the guide pins bolts to specification, use a spanner to hold guide pins while tightening the guide pin bolts.

Bolts to Guide Pins spec torque:

38-48Nm

Bolts to Guide Pins Heavy Duty Brake spec torque:

30-34Nm



10. Install the brake hose to the caliper, if applicable.

11. Install the bleeder screw valve.

Note: the unit does not have the pads fitted as they will, installed as the unit is fitted to the disc (rotor) on the vehicle.

Front Disc

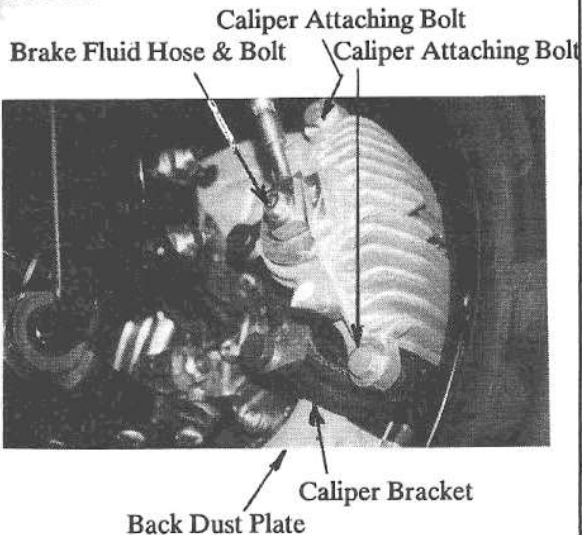
Remove

1. Remove the caliper assembly as described above.

BRAKE SYSTEM

Page 349

Front Disc



There is no need to disconnect the brake hose, if the caliper does not require servicing. Place the caliper out of the way, and support it with a wire to avoid damaging the caliper or the hose.

2. Lift the brake disc from the front hub.
3. Remove the front hub from the steering knuckle, attached by 3 Allen head bolts.
4. Remove the disc shield from the front hub, attached by 3 bolts.

Install

1. Install the disc shield to the front hub, attached by 3 bolts, tighten to specification.

Disc Shield to Front Hub Bolt Torque: 9-14Nm

2. Install the front hub to the steering knuckle, attached by 3 Allen head bolts, tighten to specification.

Front Hub to Steering Knuckle bolt Torque: 120-140Nm

3. Install the brake disc onto the front hub.
4. Install the caliper assembly as described above.

Front Caliper Attaching Bolts: 80-90Nm + 45° turn

Rear Disc

Note: IRS and Conventional diffs use different rear disc.

Remove

Park brake control released, disconnect the park brake cable at the equaliser.

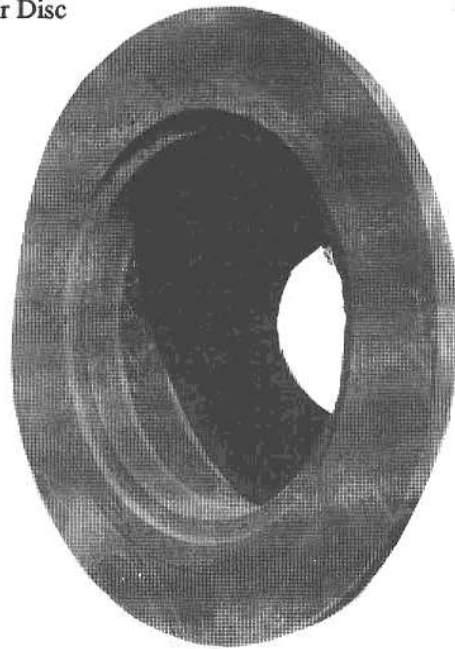
Disconnect the cable from the rear brakes. Remove the caliper head attaching bolts and remove the caliper assembly from the rotor and mounting bracket.

Caution: Do not allow the caliper to hang from the hydraulic line.

Install

Place the rotor on the axle flange, ensuring that all mounting surfaces are clean and free from contamination which could cause possible disc runout. Install the securing screw.

Rear Disc



Place the caliper correctly over the rotor and slide straight into location until caliper head bolts align with their respective holes in the mounting bracket.

Install caliper mounting bolts and torque to specification, connect the park brake cables to the caliper levers and the equalizer. Adjust the park brake.

Disc Inspection and Machining

The finished braking surfaces of the rotor must be flat and parallel within 0.13mm, overall thickness across braking surfaces after machining must not be less than specified minimum.

Front Disc minimum thickness spec: marked on disc

Rear Disc minimum thickness specification: 22.2mm.

HAND BRAKE**Adjust Hand Cable**

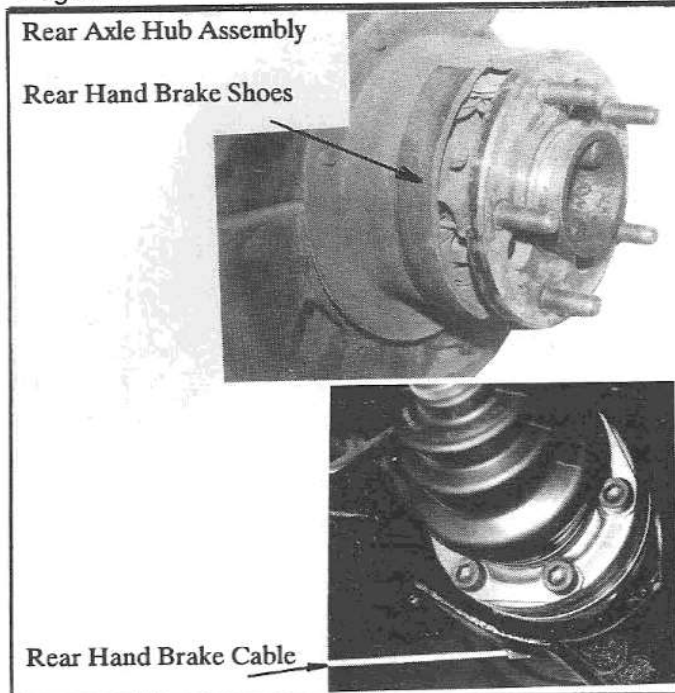
Check the parking brake cables with the park brake handle fully released. If the cables are loose, adjust as described on next page.

Hand Brake Lever Assembly**Remove**

1. Disconnect the hand brake front cable from the relay equaliser beneath the vehicle.
2. Remove the lever dust cover from inside the vehicle.
3. Remove the two nuts attaching the lever to the side rail and withdraw the lever from underneath the vehicle.

Install

1. Replace the hand brake lever assembly to the vehicle from under the vehicle and attach to the side rail and tighten the attaching nuts.



2. Install the dust cover to the hand brake lever from inside of the vehicle.
3. Reconnect the hand brake cable to the equaliser.

Hand Brake Shoes Replace and Adjust

1. Remove the rear disc as previously described.
2. Release the upper and lower hand brake shoe springs.
3. Release the hand brake shoe adjuster at the top of the backing plate.
4. Remove the hold down clips and springs.
5. Pull the shoes out from the brake assembly, disconnecting the shoes from the activating lever.
6. Replace the shoes to the backing plate, and connect the activating lever.
7. Position the adjuster between the shoes at the top of the backing plate.
8. Connect the hold down clips and springs.
9. Connect the lower and upper hand brake shoe springs.

Adjust

Adjust the outside diameter of the hand brake shoes to 159.5mm, using the adjuster located between the top of the two hand brake shoes.

* Ensure that the outside shoe diameter is the same at various points otherwise the rear brake disc will not fit over the handbrake shoes.

Problem Diagnosis and Tests

Preliminary Tests

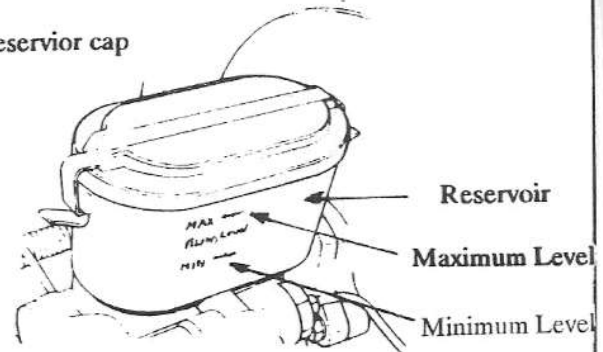
Fluid Level

Check the fluid level in the brake master cylinder reservoirs before performing the test procedures.

Top up the master cylinder reservoirs to the level indicated on the side of the reservoir

Brake Master Cylinder

Reservoir cap



If necessary, top up the master cylinder reservoirs to the level indicated on the side of the reservoir.

Brake Pedal Clearance Check

The brake system is designed to permit full stroke of the master cylinder when the brake pedal is fully depressed.

There is no need for brake pedal clearance adjustment. With the brake master cylinder outlet lines disconnected and the brake pedal fully depressed, the centre of the top surface of the brake pedal pad should be 25mm from the floor surface.

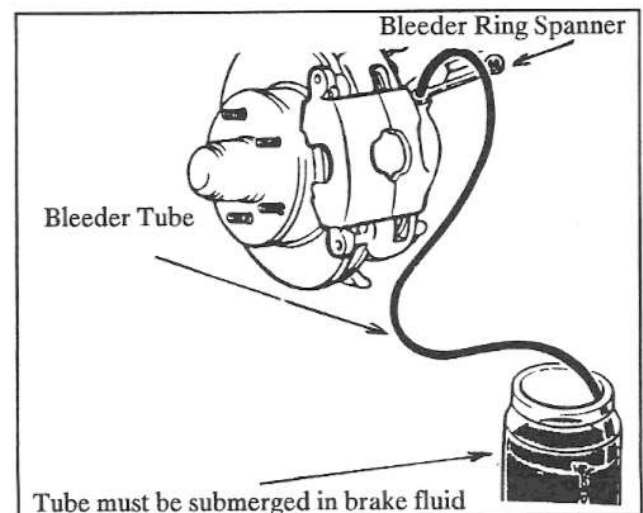
If the pedal height is below specification make the necessary repairs.

Hydraulic System Test

Turn the engine off and exhaust all vacuum from the booster system by depressing the brake pedal several times, before performing this test.

Depress the brake pedal and hold it in the applied position. If the pedal gradually falls away under this pressure, the hydraulic system is leaking. Check all tubing, hoses, and connections for leaks.

If the brake pedal movement is spongy, bleed the hydraulic system to remove air from the brake system.



ABS System

The basic brake system is the same except for the speed sensors and ABS unit mounted in front of master cylinder.

ABS Unit / Hydraulic Modulator / Pump / Relays

Remove

1. Remove ABS unit cover attaching screw and cover.
2. Remove relays, valve relay centre, pump relay at side, if necessary.

3. Remove hydraulic modulator.

(a) Label brake pipes as marked on modulator that is "l"-left front, "r"-right front, "h"-rear brakes, "V"-master cylinder front, "H"-master cylinder rear.

(b) Remove brake pipes, fluid will weep from pipes so place a cloth underneath the modulator.

(c) Remove modulator wiring loom and earth strap.

(d) Remove 3 mounting nuts and washers, lift unit up and slide out, take care of insulators when lifting out.

Install

1. Install modulator.

(a) Fit insulators to unit, slide unit in and down.

(b) Fit 3 washers and nuts and tighten to specification.

ABS Modulator Attaching Nuts Torque: 5-12Nm

(c) Install brake fluid pipes to modulator as per labels, that is "l"-left front, "r"-right front, "h"-rear brakes, "V"-master cylinder front, "H"-master cylinder rear.

(d) Replace modulator wiring loom and earth strap.

2. Replace relays, valve relay centre, pump relay at side, if necessary.

3. Install ABS unit cover and attaching screw.

4. Bleed brake system as per normal at wheels.

ABS Control Unit

Remove

1. Disconnect battery.

2. Remove cabin right side kick panel as described in body section.

3. Remove 35 pin loom connector, held by spring clip.

4. Remove three screws and earth wire, lift out unit.

Install

1. Install unit (IRS vehicles Bosch last 3 numbers 060, Conventional diff vehicles Bosch last 3 numbers 069) replace three screws and earth wire.

2. Replace 35 pin loom connector, held by spring clip.

3. Replace cabin right side kick panel as described in body section.

4. Connect battery.

ABS High Voltage Protection Relay

Replace

1. Located to the left of the fuse panel behind lower right dash panel. Turn 2 locking screws 90° and lower panel.

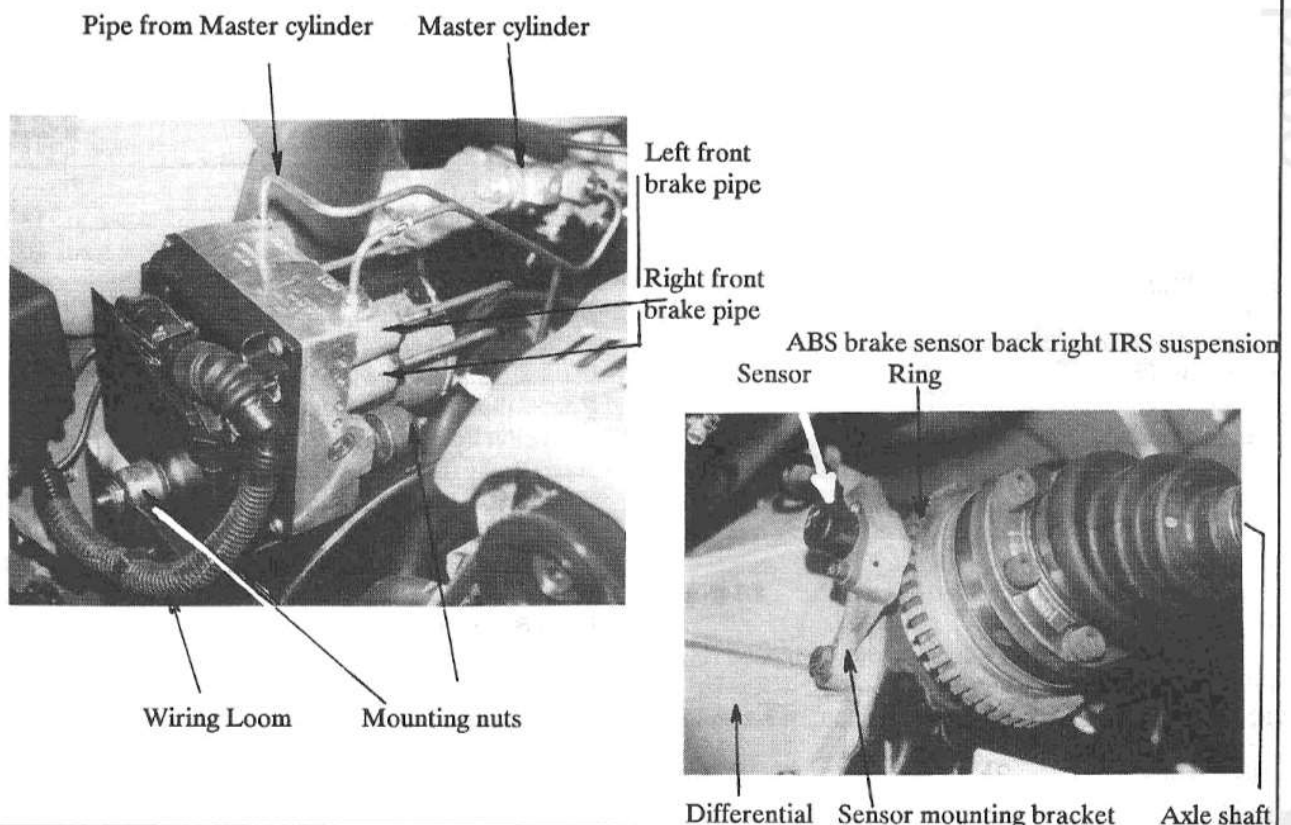
2. Remove wiring loom connector.

3. Remove relay securing screw, lift out relay.

4. Replace relay and securing screw.

5. Reconnect wiring loom.

VR ABS Unit



6. Lift lower dash panel into place, turn lock screws 90°.

Pulse Rings / Hubs

Front Pulse Rings and Hub

Front hubs for ABS incorporate the pulse rings, there to replace front pulse rings replace front hub as described in "Front Suspension" chapter "Front Hubs".

Note: Vehicles with ABS need the correct front hub check with part numbers in specifications.

Rear Pulse Rings

Conventional Differential

Take care not to damage pulse ring or bearing cone when sliding axle shaft out or in. Also do not turn axle still assembled if one axle is removed, other diff cone will be out of alignment.

Remove

1. Remove axle shaft as described in "Rear Axle" chapter.
2. Press pulse ring from axle shaft.

Install

1. Press new pulse ring onto axle shaft, 116mm from outer edge of axle flange to inside surface of pulse ring.
2. Install axle shaft as described in "Rear Axle" chapter.

IRS differential

Replace

Remove axle drive shaft as described in "Rear Axle" chapter.

1. As the pulse ring and the inner axle are one unit, use a slide hammer to remove inner axle and pulse ring.
2. Install inner axle shaft, align spring clip and diff cone, then tap into place.
3. Install axle drive shaft as described in "Rear Axle" chapter.

Speed Sensor

Front Speed Sensor and Rear Wheel Conventional Diff

Remove

Remove sensor retaining bolt, remove sensor & "O" ring.

Install

Fit new "O" ring slide in sensor. Fit retaining bolt and tighten to specification.

Sensor Retaining Bolt Specified Torque: 8-14Nm

Rear Wheel IRS

Remove

Remove the sensor retaining bolt, remove sensor, donot loose shims if fitted.

Install

Clean sensor and apply high temp melting grease such as Dow Corning FB 180 on surface contacting mounting bracket.

Slide in sensor, fit original shims. Fit retaining bolt and tighten to specification.

Sensor Retaining Bolt Specified Torque: 8-14Nm

Adjust

Use shims to adjust the air gap of the sensor to pulse ring within specification.

IRS - ABS Sensor Airm Gap specification. 0.3-1.3mm

SPECIFICATIONS

MASTER CYLINDER

Main Bore Diameter (Standard) ID 15/16 23.83 mm

Main Bore Diameter (Heavy duty) ID 1 25.4 mm

Stroke 28.5 mm

DISC BRAKE CALIPER

Bore Diameter (FRONT) 54.0 mm

Bore Diameter (REAR) 38.0 mm

DISC (FRONT)

Diameter 289 mm

Thickness (New) 22.0/21.7 mm

Max. Runout 0.10 mm

Thickness Variation 0.013mm

Min. Thickness Refaced (overall) 20.0 mm

DISC (REAR)

Diameter 279 mm

Thickness (New) 10.50/10.30 mm

Max. Runout 0.10 mm

Thickness Variation 0.013mm

Min. Thickness Refaced (overall) 8.5 mm

Drum Diameter (New) 160.0 mm

DISC PADS

Lining Wear Limit 1.0 mm

BRAKE PEDAL HEIGHT

Minimum height without fluid in system and master cylinder bottomed out 25 mm

ABS

IRS - ABS Sensor Airm Gap specification 0.3-1.3mm

Front Wheel Hub No Teeth ID Cover Colour

With Convent Diff 32 LH32 / RH32 Black

With IRS Diff 48 LH48 / RH48 Light Grey

BRAKE FLUID

Brake fluid spec. HMC - HN 1796

TORQUE LIMITS

Nm

Master Cylinder to Booster	13-14
Booster to Fire Wall	20-25
Brake Tube Nuts	8-11
Brake Hose to Caliper	32-37
Front Caliper Anchor Bracket to Front Axle Spindle	80-90 + 45° turn or 115-120 with no turn
Rear Caliper Anchor Bracket to Rear Axle	35-50
Guide Pin Bolts	30-34
Hand Brake Cable to Backing plate	12-16
Hand Brake Equalizer Adjuster Nuts	12-16
Stop Light Warning Switch	2
Proportioning Piston Plug Fitting.....	35-40
Wheel Nuts	100-125
Hand Brake Lever Mounting Nuts	12-16
Cable Bracket Nuts	5-8
Reservoir Attaching Nut	5-5.5
ABS Modulator Attaching Nuts Torque	5-12