

ANTI-LOCK BRAKE SYSTEM

Description

Beginning in 1990, the Taurus and Sable (except 2.5L engine) were available with Anti-lock Braking System (ABS) as an option on vehicles with four wheel disc brakes. The system was standard on the Taurus SHO starting in 1990. The system prevents wheel lock-up by automatically modulating the brake pressure during emergency stopping. The system controls each front brake separately and the rear brakes as an axle set. During ABS operation, the driver will sense brake pedal pulsation, along with a slight up-and-down movement in the pedal height and a clicking sound; this is normal.

Component Operation

The ABS system consists of the following major components.

POWER BRAKE BOOSTER

The power brake booster is a self-contained unit that is mounted on the engine compartment side of the dash panel and uses engine intake manifold vacuum and atmospheric pressure for its power. If it becomes damaged or stops functioning properly, it must be replaced as an assembly, except for the power brake booster check valve.

BRAKE MASTER CYLINDER

The brake master cylinder is a tandem master cylinder. The primary (rear) circuit feeds the right-hand front and left-hand rear brakes. The secondary (front) circuit feeds the left-hand front and right-hand rear brakes. The master cylinder is serviced as a complete assembly.

HYDRAULIC CONTROL UNIT

The anti-lock brake Hydraulic Control Unit (HCU) is located in the front of the engine compartment on the left-hand side of the vehicle. It consists of the brake pressure control valve block assembly, pump motor, and the master cylinder filler cap with fluid level indicator assembly.

During normal braking, fluid from the brake master cylinder enters the HCU reservoir through two inlet ports at the rear of the HCU. The fluid then passes through four normally open inlet valves, one to each wheel. If the ABS control module senses that a wheel is about to lock, the module activates the appropriate inlet valve which closes that valve. This prevents any more fluid from entering the affected brake. The ABS control module then opens the normally closed outlet valve which decreases the pressure trapped in the line.

The brake pressure control valve block, pump motor and HCU reservoir are serviced separately. Other than seals and gaskets, no internal parts can be

serviced.

ANTI-LOCK BRAKE (ABS) CONTROL MODULE

The Anti-lock Brake System (ABS) control module is located on the front right-hand side, next to the windshield washer reservoir for all vehicles except the SHO. On the Taurus SHO, it is mounted on top of the front left brake anti-lock sensor.

It is an on-board diagnostic, non-serviceable unit consisting of two microprocessors and the necessary circuitry for their operation. The module monitors system operation during normal driving, as well as during anti-lock braking. Under normal driving conditions, the ABS control module produces short test pulses to the solenoid valves that check the electrical system without any mechanical reaction. Impending wheel lock conditions trigger signals from the ABS control module that open and close the appropriate solenoid valves. This results in moderate pulsations in the brake pedal.

If brake pedal travel exceeds a preset dimension determined by the anti-lock brake pedal sensor switch setting, the ABS control module will send a signal to the pump motor to turn on and provide high pressure to the brake system. Each time the vehicle is driven, as soon as the speed reaches 42 mph (70 km/h), the ABS control module turns on the pump motor for about $\frac{1}{2}$ second (a mechanical noise will be heard; this is normal). When the pump motor starts to run, a gradual rise in brake pedal height will be noticed. The rise will continue until the sensor switch closes, and the pump motor will shut off until the brake pedal travel again exceeds the anti-lock brake pedal sensor switch setting.

Most malfunctions to the anti-lock braking system will be stored as a Diagnostic Trouble Code (DTC) in the keep-alive memory of the ABS control module.

ANTI-LOCK BRAKE SENSOR

Four sets of variable-reluctance brake anti-lock sensors and sensor indicators which determine the rotational speed of each wheel are used in the ABS system. The sensors operate on magnetic induction principle. As the teeth on the ABS sensor indicators rotate past the sensors, a signal proportional to the speed of rotation is generated and sent to the ABS control module.

The front brake anti-lock sensors are attached to the front wheel spindles. The front brake anti-lock sensor indicators are pressed into the outer CV-joints. The rear brake anti-lock sensors are attached to the right and left-hand rear disc brake adapters. The rear brake anti-lock sensor indicators are pressed into the wheel hub assemblies.

BRAKE PEDAL TRAVEL SWITCH

The brake pedal travel switch monitors brake pedal travel, then sends this information to the ABS control module through the wire harness. The brake pedal sensor switch adjustment is critical to pedal feel during ABS cycling. The switch is mounted in a hole in the right-hand side of the brake pedal support bracket, and to a pin on the speed control dump valve adapter bracket.

The switch is normally closed. When brake pedal travel exceeds the switch setting during an anti-lock stop, the ABS control module senses that the switch is open and grounds the pump motor relay coil. This energizes the relay and turns the

pump motor on. When the pump motor is running, the HCU reservoir is filled with high pressure brake fluid, and the brake pedal will be pushed up until the brake pedal travel switch closes.

When the switch closes, the pump motor is turned off; the brake pedal will drop some with each ABS control cycle until the switch opens again and the pump motor is turned on again. This minimizes pedal feedback during ABS cycling. If the switch is not adjusted properly or is not electrically connected, it will result in objectionable pedal feel during ABS stops.

Anti-Lock Brake System Service

PRECAUTIONS

Failure to observe the following precautions may result in system damage.

- **Before servicing any high pressure component, be sure to discharge the hydraulic pressure from the system.**
- **Do not allow the brake fluid to contact any of the electrical connectors.**
- **Use care when opening the bleeder screws due to the high pressures available from the accumulator.**

RELIEVING SYSTEM PRESSURE

Before servicing any components which contain high pressure, it is mandatory that the hydraulic pressure in the system be discharged. To discharge the system, turn the ignition **OFF** and pump the brake pedal a minimum of 20 times until an increase in pedal force is clearly felt.

Hydraulic Control Unit (HCU)

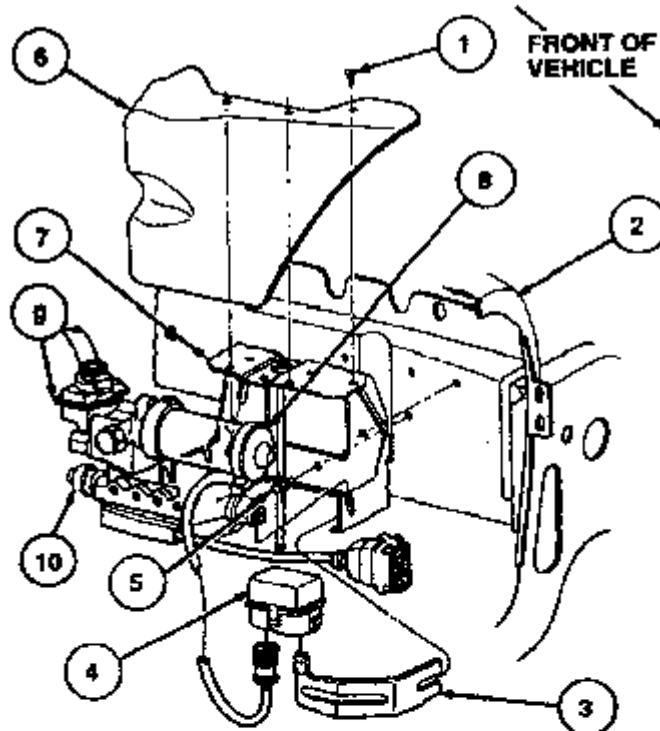
The anti-lock brake Hydraulic Control Unit (HCU) is located in the front of the engine compartment on the left-hand side of the vehicle. It attaches to a bracket that is mounted to the left-hand front inside rail inside the engine compartment. The battery and battery tray sit atop the hydraulic control bracket.

REMOVAL & INSTALLATION

1. **On all vehicles, except Taurus SHO, disconnect the battery cables, then remove the battery from the vehicle. Remove the battery tray. Remove the three plastic push pins holding the acid shield to the HCU mounting bracket, then remove the acid shield.**
2. **On Taurus SHO, it is only necessary to disconnect the negative battery cable and remove the electronic control unit and its mounting bracket from the top of the HCU mounting bracket.**
3. **Unfasten the 19-pin connector from the HCU to the wiring harness, then detach the 4-pin connector from the HCU to the pump motor relay.**
4. **Remove the two lines from the inlet ports and the four lines from the outlet ports of the HCU. Plug each port to prevent brake fluid from spilling onto the paint and wiring.**

The nut on the front of the HCU also retains the relay mounting bracket.

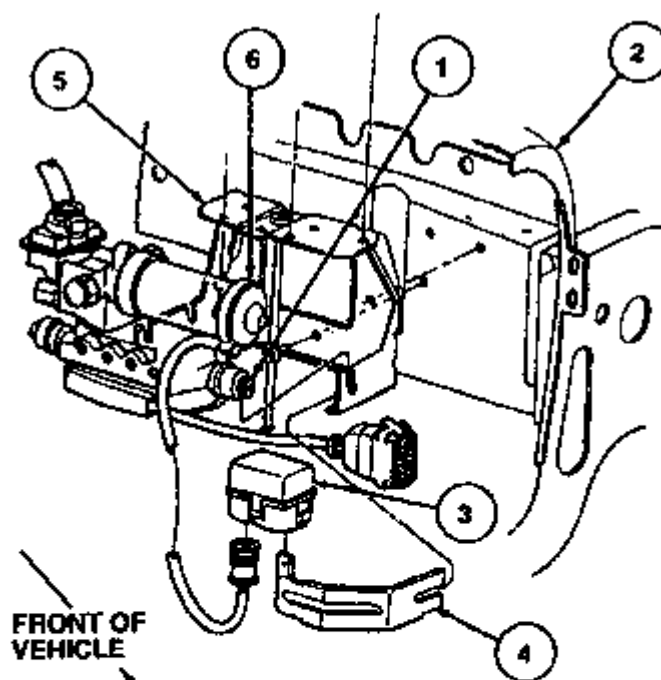
5. Remove the three nuts retaining the HCU assembly to the mounting bracket, then remove the assembly from the vehicle.



Item	Part Number	Description
1	N805636S	Push Pin (3 Req'd)
2	16138	Radiator Support
3	2C303	Anti-Lock Brake Pump Bracket
4	--	Pump Relay (Part of 2C303)
5	N606888558	Bolt (3 Req'd)
6	2C314	Acid Shield
7	2C304	Anti-Lock Brake Hydraulic Control Bracket
8	2C256	Pump Motor
9	2C246	Hydraulic Control Unit Reservoir
10	2C266	Brake Pressure Control Valve Block

HCU location and related components-except SHO vehicles

[Click to enlarge](#)



Item	Part Number	Description
1	N606688-S56	Bolt (3 Req'd)
2	16 138	Radiator Support
3	2C303	Anti-Lock Brake Pump Bracket
4	—	Relay Bracket (Part of 2C303)
5	2C304	Anti-Lock Brake Hydraulic Control Bracket
6	2C256	Pump Motor

HCU location and related components-SHO vehicles only

[Click to enlarge](#)

To install:

Attach the relay mounting bracket with the nut on the front of the hydraulic control unit reservoir.

6. Position the HCU reservoir assembly into the mounting bracket, then secure using the three retaining nuts. Tighten the nuts to 12-18 ft. lbs. (16-24 Nm).
7. Connect the four lines to the outlet ports on the side of the HCU reservoir and the two tubes to the inlet ports on the rear of the HCU reservoir, then tighten to 10-18 ft. lbs. (14-24 Nm).
8. Fasten the 19-pin connector to the harness, then attach the 4-pin connector to the pump motor relay.
9. On all vehicles except SHO, install the acid shield and the three plastic push pins holding the acid shield to the HCU bracket. Install the battery tray, then install the battery and connect the cables.
10. On the SHO, install the anti-lock brake control module to the top of the anti-lock brake control module mounting bracket. Connect the negative battery cable.

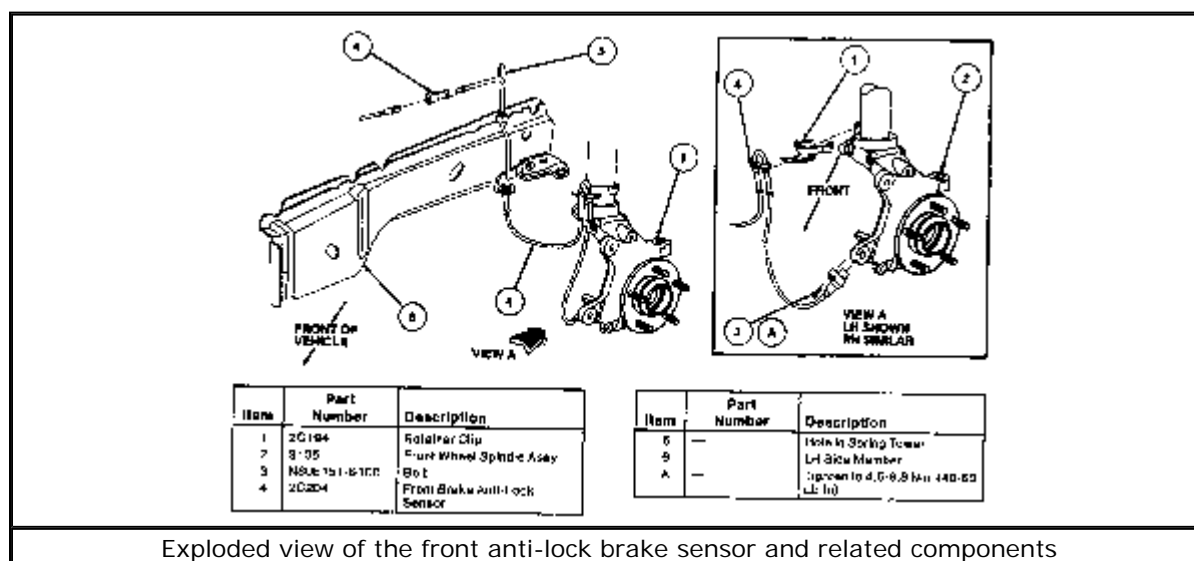
11. Bleed the brake system, then check for fluid leaks.

Wheel Sensors

REMOVAL & INSTALLATION

Front

1. Disconnect the negative battery cable.
2. Disengage the sensor connector located in the engine compartment.
3. For the right front sensor, remove the two plastic push studs to loosen the front section of the splash shield in the wheel well. For the left front sensor, remove the two plastic push studs to loosen the rear section of the splash shield.
4. Thread the sensor wire(s) through the holes in the fender apron. For the right front sensor, remove the two retaining clips behind the splash shield.
5. Raise and safely support the vehicle. Remove the wheel and tire assembly.
6. Disengage the sensor wire grommets at the height sensor bracket and from the retainer clip on the shock strut just above the spindle.
7. Loosen the sensor retaining screw, then remove the sensor assembly from the front knuckle.



[Click to enlarge](#)

To install:

8. Align the sensor with its mounting holes on the front wheel spindle. Tighten the retaining screws to 40-60 inch lbs. (4.5-6.8 Nm).
9. Install the grommets at the height sensor bracket, then install the retainer clip at the shock absorber.
10. Thread the wire through the holes in the fender apron. For the right-hand sensor only, install the retainer clips. Secure the splash shield with the plastic push studs.
11. Engage the sensor connector to the wiring harness from the engine compartment.
12. Connect the negative battery cable.

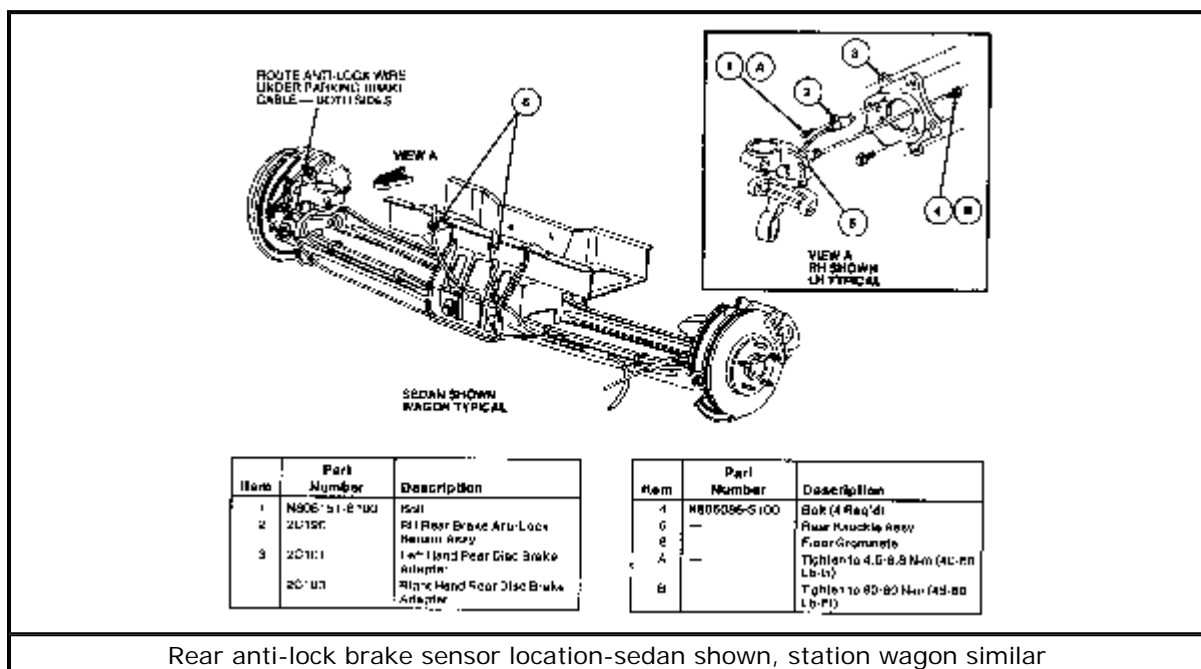
Rear

EXCEPT STATION WAGON

1. Disconnect the negative battery cable.
2. Remove the rear seat and seat back insulation.
3. Disengage the sensor wire from the harness, then tie one end of a string or wire to the sensor connector and the other end to the rear seat sheet metal bracket.
4. Push the sensor wire grommet and connector through the floorpan, drawing the string or wire with the sensor connector.
5. Raise and safely support the vehicle.
6. Disconnect the string or wire from the sensor from underneath the vehicle.
7. Disconnect the routing clips from the suspension arms, then unfasten the sensor retaining bolts from the rear brake adapters and remove the sensor from the vehicle.

To install:

8. Insert the sensor into the hole in the right or left-hand rear disc brake adapter, then install the retaining bolt. Tighten to 40-60 inch lbs. (4.6-6.8 Nm).
9. Install the sensor wire routing clips to the suspension arms.
10. Attach string or wire to the new sensor connector, then pull the sensor connector through the hole in the floor pan using the string or wire.
11. Install the sensor wire grommet into the hole in the floorpan.
12. Remove the string or wire, then connect the rear brake anti-lock sensor to the wire harness.
13. Install the rear seat back, then connect the negative battery cable.



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STATION WAGON

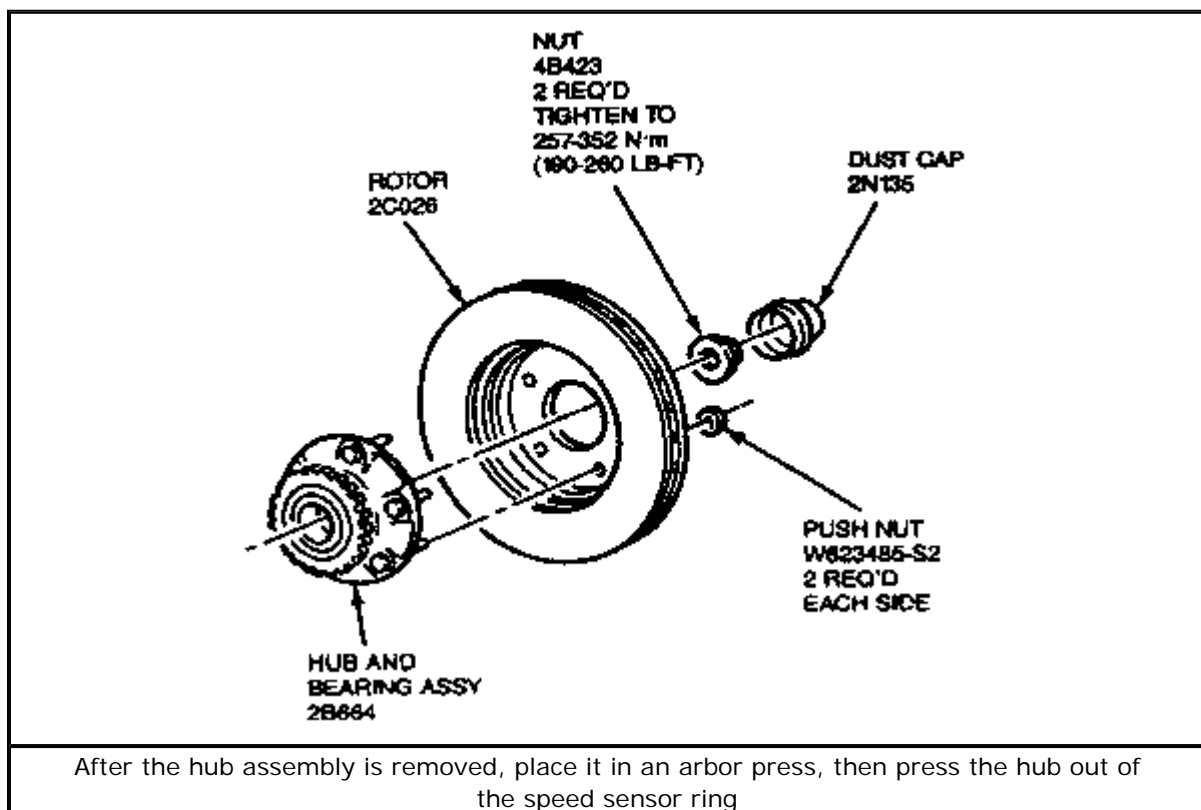
1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. Disengage the sensor electrical connector from the harness.
4. Remove the sensor wire with the attached grommet from the hole in the floorpan.
5. Remove the routing clips, then unfasten the sensor retaining bolt and remove the sensor from the vehicle.

To install:

6. Install the sensor, then secure using the retaining bolt. Tighten the bolt to 40-60 inch lbs. (4.6-6.8 Nm).
7. Route the sensor wire, then install the clips.
8. Engage the sensor electrical connector to the wiring harness, then push the grommet through the hole in the floorpan and into position.
9. Lower the vehicle, then connect the negative battery cable.

Rear Speed Indicator Ring**REMOVAL & INSTALLATION**

1. Raise and safely support the vehicle. Remove the tire and wheel assembly.
2. Remove the caliper, rotor and rear hub assemblies.
3. Position the hub assembly in an arbor press, then press the hub out of the speed sensor ring.



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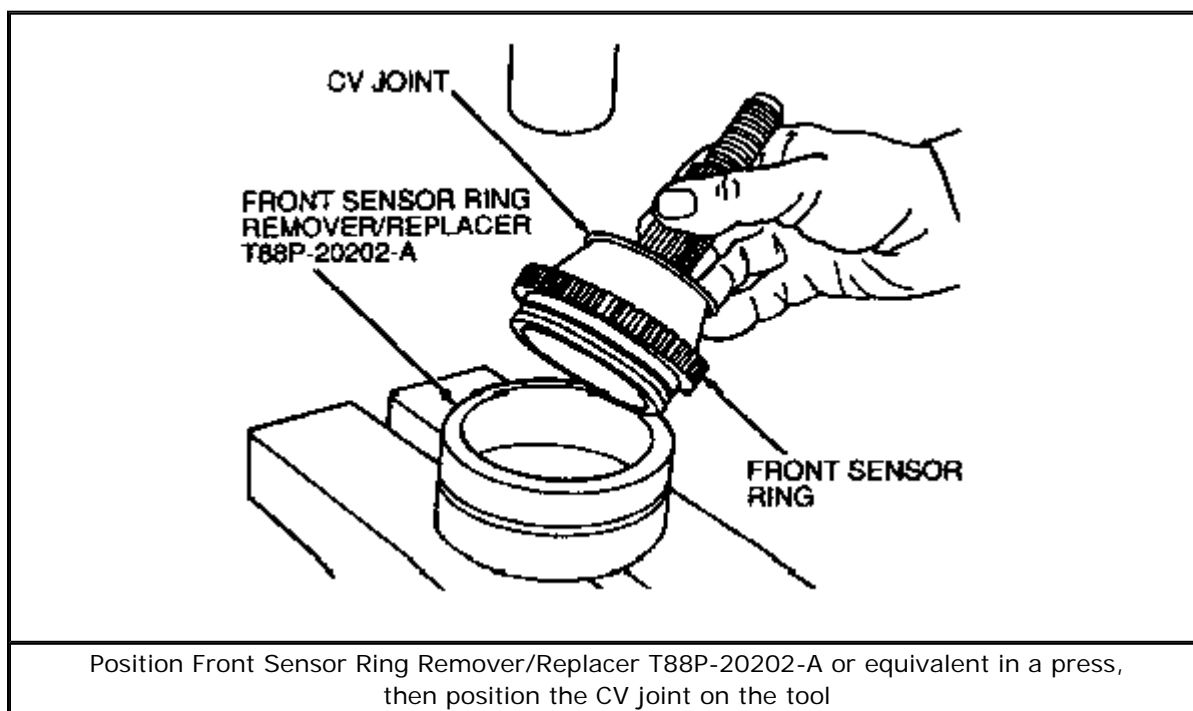
To install:

4. Position the rear speed sensor ring over the hub.
5. Using a flat piece of steel or similar tool, press the ring down until it is flush with the top of the hub.
6. Install the rear hub, rotor and caliper. Install the wheel and tire assembly, then carefully lower the vehicle.

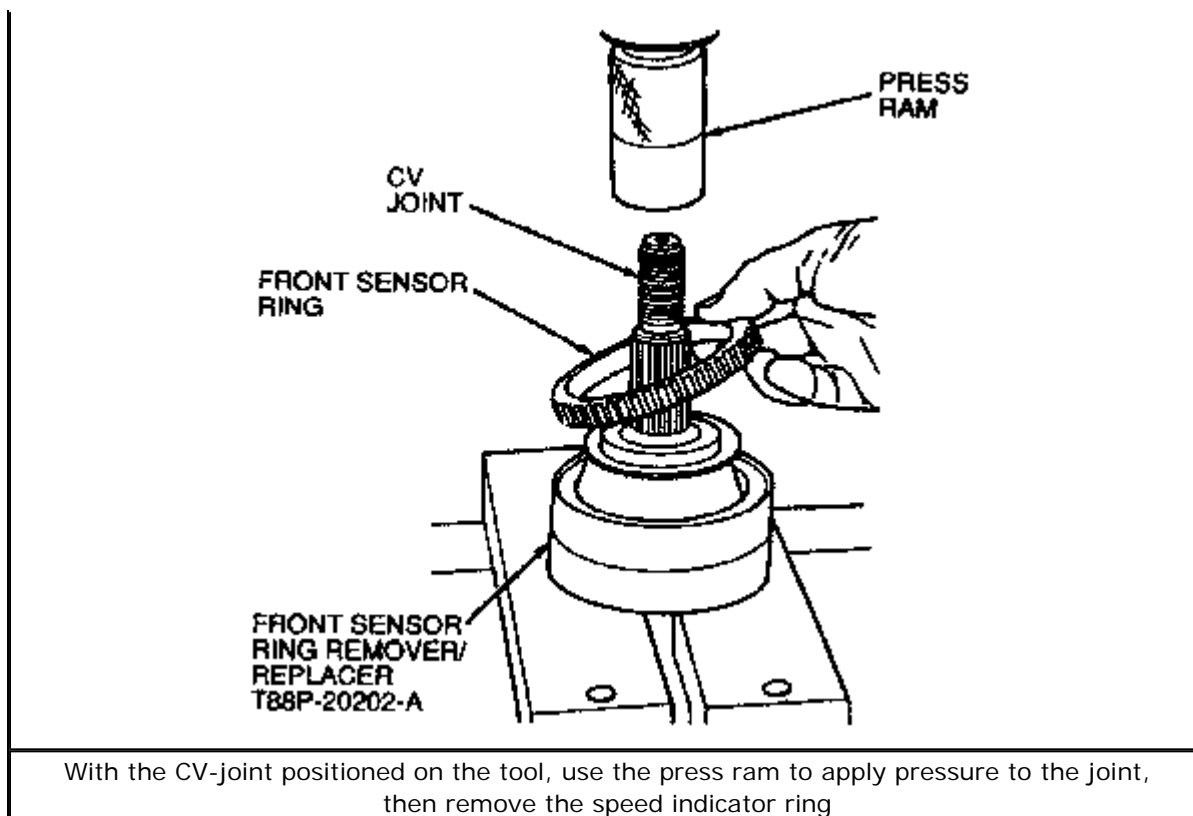
Front Speed Indicator Ring

REMOVAL & INSTALLATION

1. Raise and safely support the vehicle.
2. Remove the outboard CV-joint. For details, please refer to the procedure in *Section 7* of this manual.
3. Position Front Sensor Ring Remover/Replacer T88P-20202-A or equivalent, in a press. Position the CV-joint on the tool.



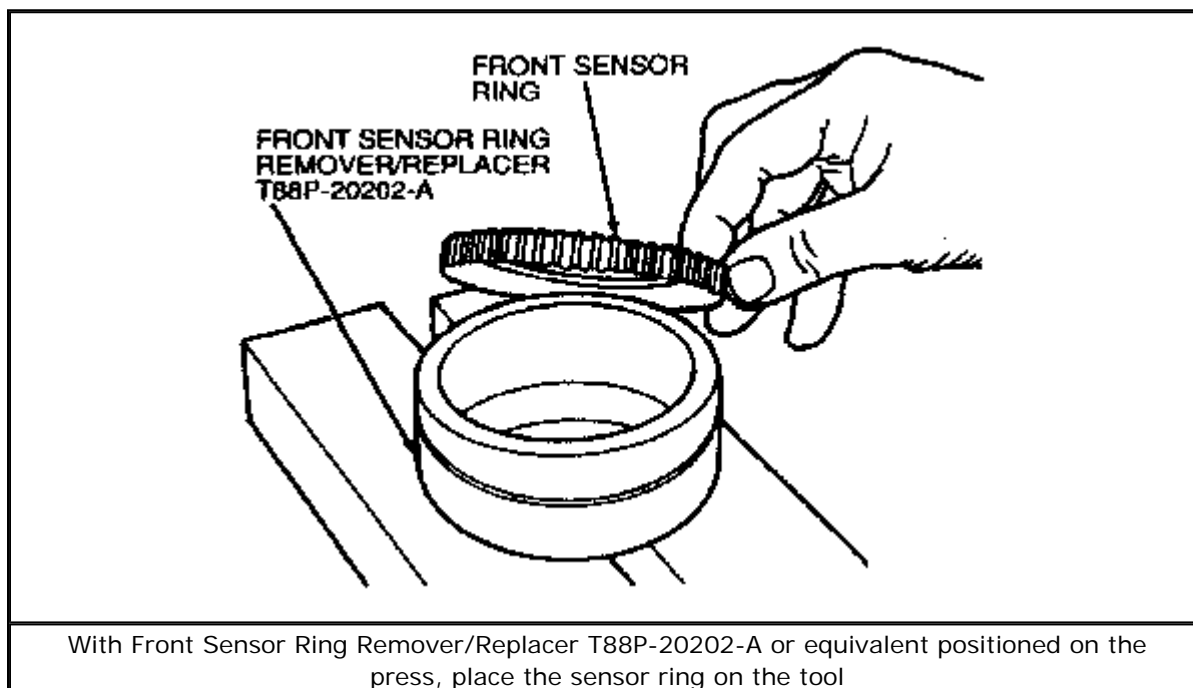
4. With the CV-joint positioned on the tool, use the press ram to apply pressure to the joint, then remove the speed indicator ring.



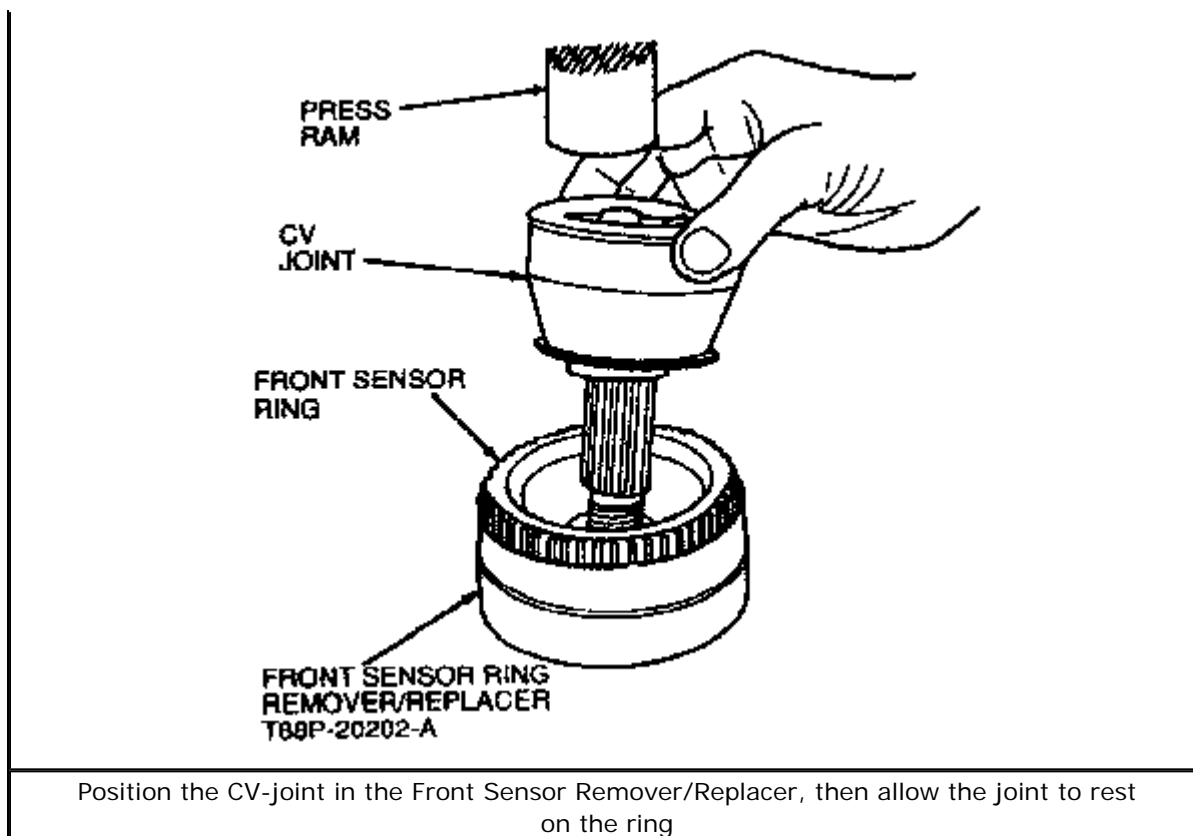
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To install:

5. With Front Sensor Ring Remover/Replacer T88P-20202-A or equivalent positioned on the press, place the sensor ring on the tool.



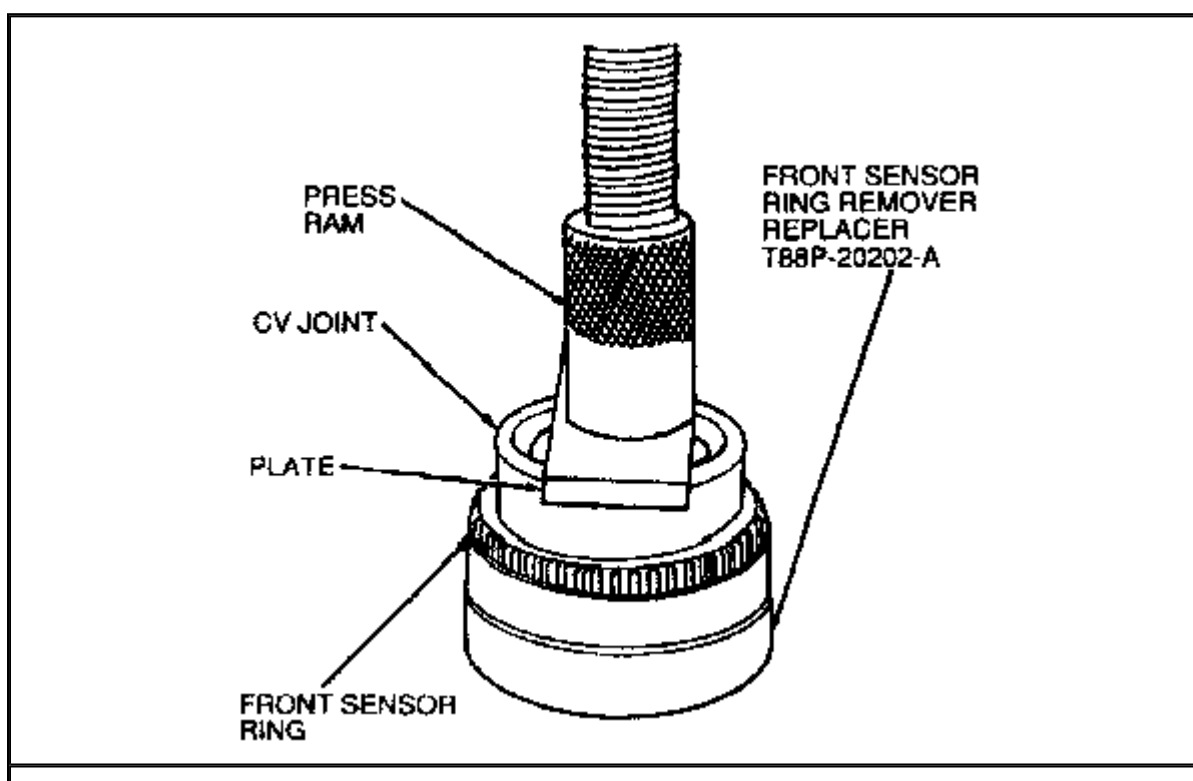
6. Position the CV-joint in the Front Sensor Remover/Replacer, then allow the joint to rest on the ring.



[Click to enlarge](#)

Be very careful not to damage the sensor during installation. If the teeth on the sensor are damaged, brake performance will be affected.

7. With the CV-joint installed in the tool, place a steel plate across the CV-joint back face. Press the CV-joint until the joint bottoms out in the tool; the ring will then be properly installed.



With the CV-joint installed in the tool, place a steel plate across the CV-joint back face. Press the CV-joint until the joint bottoms out in the tool; at that point, the ring will be properly installed

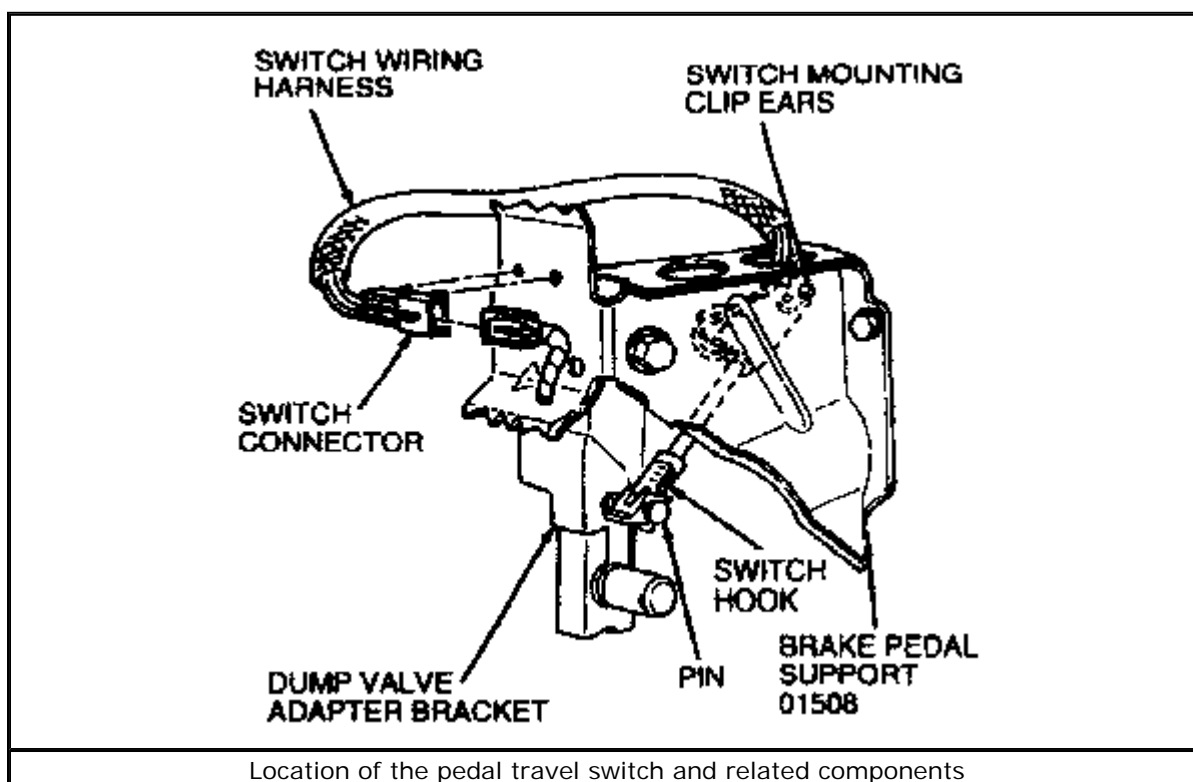
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8. Install the outboard CV-joint. For details, please refer to the procedure in *Section 7* of this manual.
9. Carefully lower the vehicle.

Pedal Travel Switch

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. Detach the wiring harness lead at the switch connector.
3. Using a suitable prytool, carefully pry the connector's locator pins from the holes in the brake pedal support.
4. Unsnap the switch hook from the pin on the dump valve adapter bracket.
5. Using needlenose pliers, squeeze the tabs on the switch mounting clip, then push the clip through the hole in the pedal support bracket.
6. Remove the switch by feeding the switch harness through the hole in the top of the pedal support bracket.



Location of the pedal travel switch and related components

[Click to enlarge](#)

To install:

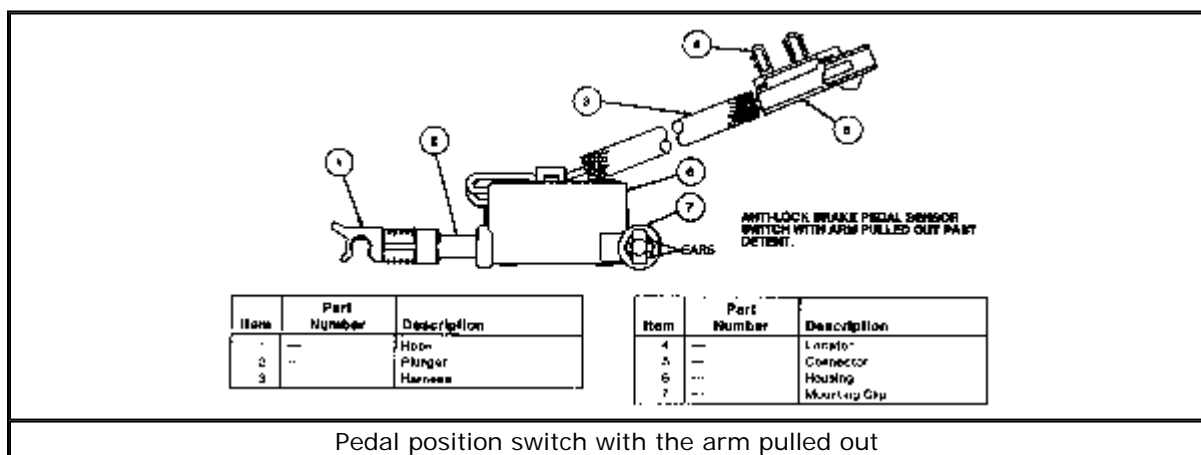
Make sure the wiring from the harness is restricted from coming in

contact with the steering universal joint.

7. Feed the switch harness through the forward hole in the top of the pedal support bracket. Route the harness around the left-hand side of the support, then install the locator pins to the holes in the brake pedal support with the open side of the connector facing the center of the vehicle.
8. Attach the switch connector to the wiring harness.
9. Insert a switch mounting clip to the hole in the pedal support bracket, then press firmly toward the brake pedal support sidewall until a click is heard.
10. Route and attach the switch, then make sure the mounting clip tabs are fully engaged.

Any time the switch is unhooked from the pin, the following resetting procedure should be used to make sure the switch is adjusted properly.

11. Adjust the switch as follows:
 1. Push the switch plunger fully into the switch housing as shown in the accompanying figure. This zeroes out the switch adjustment so that it can be automatically reset to the correct dimension during the following steps.
 2. Slowly pull the arm back out of the switch housing past the detent point. At this point, it should be impossible to reattach the arm to the pin unless the brake pedal is forced down.
 3. To complete the adjustment, press the brake pedal until the switch hook can be snapped onto the pin. Snap the hook onto the pin and pull the brake pedal back up to its normal at-rest position. This automatically sets the switch to the proper adjustment.



[Click to enlarge](#)

12. Connect the negative battery cable.

Electronic Control Unit (ECU)/Anti-Lock Brake (ABS) Control Module

REMOVAL & INSTALLATION

The ECU or ABS module is located on the front right side of the engine compartment next to the windshield washer bottle, except on Taurus SHO. On Taurus SHO it is mounted on the top of the front left brake anti-lock sensor.

1. **Disconnect the negative battery cable.**
2. **Disengage the 55-pin connector from the ECU/ABS module. Unlock the connector by completely pulling up the lever. Move the top of the connector away from the ECU/ABS module until all terminals are clear, then pull the connector up out of the slots in the ECU/ABS module.**
3. **Remove the screws attaching the ECU/ABS module, then remove the ECU/ABS module from the vehicle.**
4. **Install in the reverse order of removal. Fasten the 55-pin connector by installing the bottom part of the connector into the slots in the ECU/ABS module and pushing the top portion of the connector into the module. To ensure proper installation, pull the locking lever completely down. Tighten the retaining screws to 15-20 inch lbs. (1.7-2.3 Nm).**

Filling and Bleeding

PROCEDURE

When any part of the hydraulic system has been disconnected for service, air may enter the system and cause spongy pedal action. Bleed the system after it has been opened to be sure that all air is expelled.

The anti-lock brake system must be bled in 2 steps; both the master cylinder and hydraulic control unit reservoir must be bled using Rotunda Anti-Lock Brake Breakout Box/Bleeding Adapter tool No. T90P-50-ALA or equivalent. If this procedure is not followed, air will be trapped in the hydraulic control unit, and will eventually lead to a spongy brake pedal.

1. **Disconnect the 55-pin plug from the electronic control unit/ABS control module, then install Anti-Lock Brake Breakout Box/Bleeding Adapter tool No. T90P-50-ALA or equivalent to the wire harness 55-pin plug.**
 1. **Place the Bleed/Harness switch in the BLEED position.**
 2. **Turn the ignition to the ON position. At this point the red OFF light should come ON.**
 3. **Push the motor button on the adapter down to start the pump motor. The red OFF light will turn OFF, and the green ON light will turn ON. The pump motor will run for 60 seconds after the motor button is pushed. If the pump motor is to be turned off for any reason before the 60 seconds have elapsed, push the abort button to turn the pump motor off.**
 4. **After 20 seconds of pump motor operation, push and hold the valve button down. Hold the valve button down for 20 seconds, then release it.**
 5. **The pump motor will continue to run for an additional 20 seconds after the valve button is released.**
2. **The brake lines can now be bled in the normal fashion. Bleed the brake system by removing the rubber dust cap from the caliper fitting at the right rear of the**

vehicle. Place a suitable box wrench on the bleeder fitting and attach a rubber drain tube to the fitting. The end of the tube should fit snugly around the bleeder fitting. Submerge the other end of the tube in a container partially filled with clean brake fluid and loosen the fitting $\frac{3}{4}$ turn.

3. Have an assistant push the brake pedal down slowly through its full travel. Close the bleeder fitting and allow the pedal to slowly return to its full release position. Wait 5 seconds and repeat the procedure until no bubbles appear at the submerged end of the bleeder tube. Secure the bleeder fitting and remove the bleeder tube. Install the rubber dust cap on the bleeder fitting.
4. Repeat the bleeding procedure at the left front, left rear and right front (in that order). Refill the master cylinder reservoir after each caliper has been bled, and install the master cylinder cap and gasket. When brake bleeding is completed, the fluid level should be filled to the maximum level indicated on the reservoir.
5. Always make sure the disc brake pistons are returned to their normal positions by depressing the brake pedal several times until normal pedal travel is established. If the pedal feels spongy, repeat the bleeding procedure.

Power Brake Booster

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable. Pump the brake pedal until all vacuum is removed from the booster. This will prevent the O-ring from being sucked into the booster during disassembly.
2. Disconnect the manifold vacuum hose from the booster check valve, and the electrical connector from the master cylinder reservoir cap.
3. Remove the brake lines from the primary and secondary outlet ports of the master cylinder, then remove the Hydraulic Control Unit (HCU) supply hose. Plug the ports and reservoir feed to prevent brake fluid from leaking onto paint and wiring.
4. Under the instrument panel, remove the stop light switch wiring connector from the switch. Disengage the pedal travel switch from the stud. Remove the hairpin retainer and outer nylon washer from the pedal pin. Slide the stop light switch off the brake pedal just far enough for the outer arm to clear the pin. Remove the switch.
5. Remove the booster-to-dash panel attaching nuts. Slide the bushing and booster pushrod off the brake pedal pin.
6. Move the booster forward until the booster studs clear the dash panel. Remove the booster and master cylinder assembly.
7. Place the booster and master cylinder assembly on a bench. Unfasten the 2 nuts attaching the master cylinder to the booster, then remove the master cylinder.

To install:

8. Slide the master cylinder onto the booster studs. Make sure the O-ring is in place in the groove on the master cylinder and install the 2 attaching nuts. Tighten the nuts to 13-25 ft. lbs. (18-34 Nm).
9. Under the instrument panel, install the booster pushrod and bushing on the brake pedal pin. Fasten the booster to the dash panel with self-locking nuts. Tighten the nuts to 13-25 ft. lbs. (18-34 Nm).
10. Position the stop light switch so it straddles the booster pushrod with the switch slot towards the pedal blade, and with the hole just clearing the pin. Slide the switch completely onto the pin.

11. **Install the outer nylon washer on the pin, then secure all parts to the pin with the hairpin retainer. Make sure the retainer is fully installed and locked over the pedal pin. Attach the stoplight switch wiring connector.**
 12. **Install and adjust the pedal travel switch, as detailed earlier in this section.**
 13. **Connect the brake lines to the master cylinder, then tighten to 10-18 ft. lbs. (14-24 Nm). Attach the HCU supply hose to the reservoir.**
 14. **Connect the manifold vacuum hose to the booster check valve, then engage the electrical connector to the master cylinder reservoir cap.**
 15. **Connect the negative battery cable, then bleed the brake system.**
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