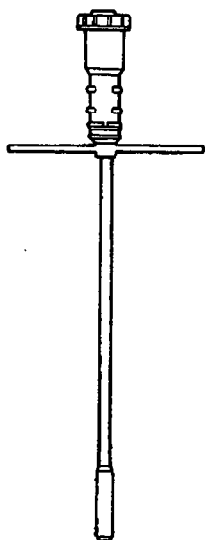


# BRAKES - ABS

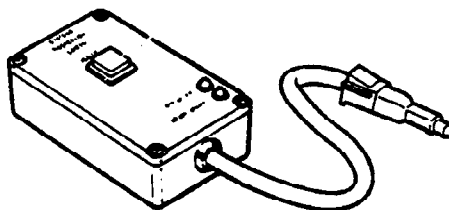
## SPECIAL TOOLS

No.	Honda Number	Rover Number	Description
1	07HAA-SG00101 or 07HAA-SG00100	18G 1568	Bleeder T-wrench
2	-	SMD 4081	Bleed control unit

*The tools illustrated in this section are Honda tools, and Rover do not always have an equivalent. Where an equivalent Rover tool is available, it may not be visually identical to the Honda tool.*



1

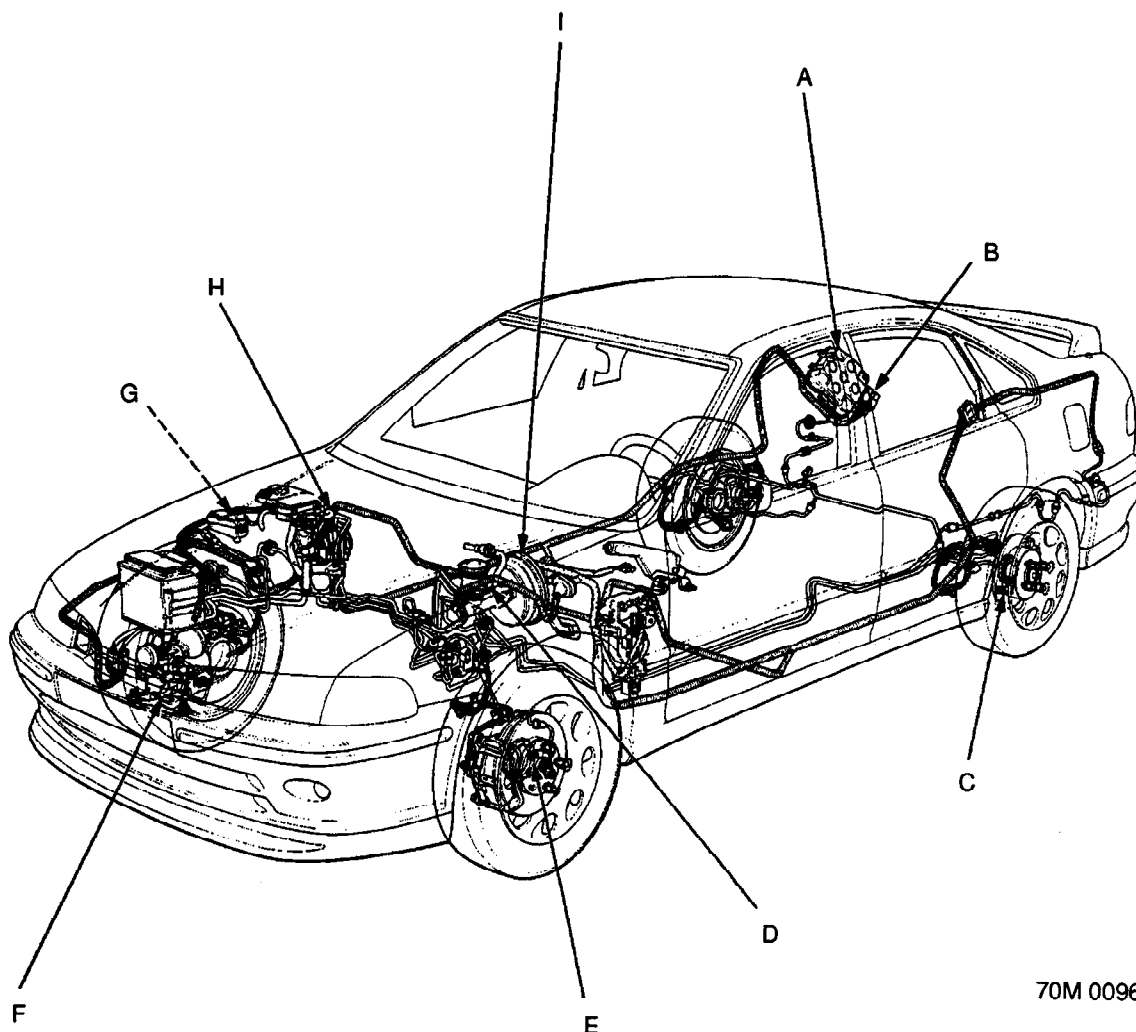


2

70M0317



## COMPONENT LOCATION



70M 0096

- A ABS control unit
- B Fail-safe relays
- C Rear wheel sensor
- D Master cylinder
- E Front wheel sensor

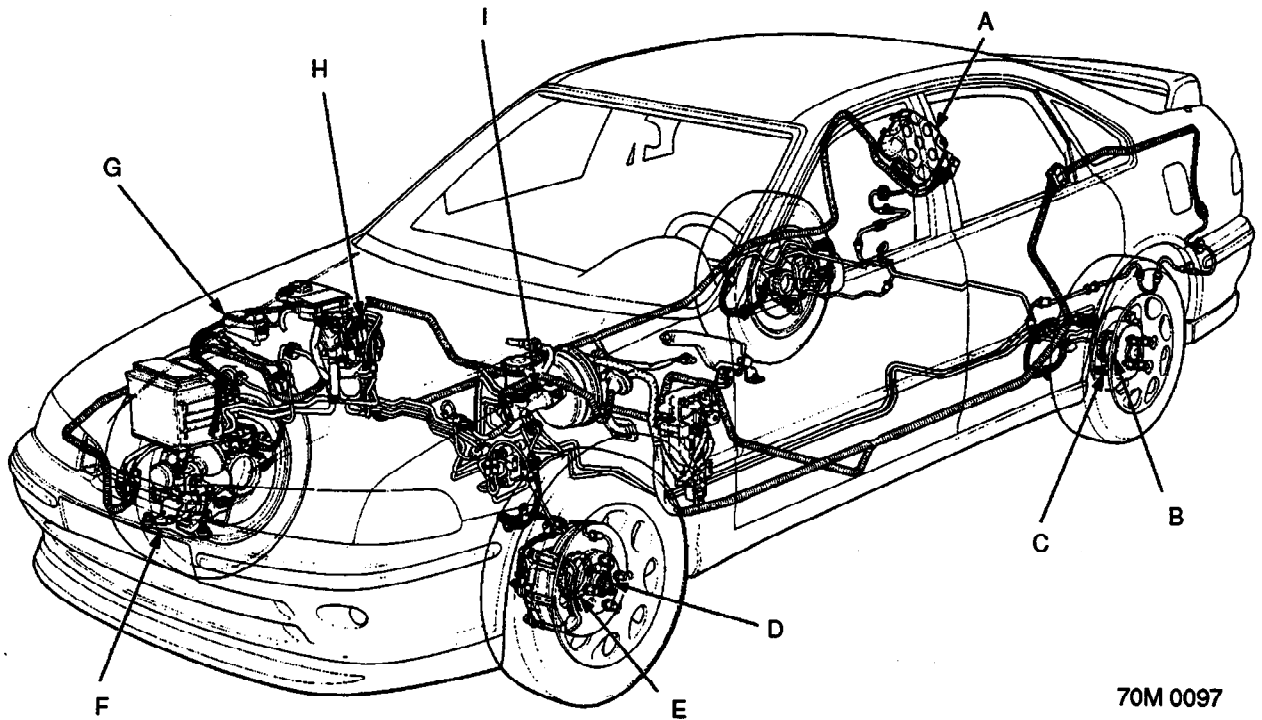
- F ABS pump assembly
- G ABS motor relay
- H Modulator unit
- I Brake booster

**WARNING:** The accumulator contains high pressure nitrogen gas, do not puncture, expose to flame or attempt to disassemble the accumulator or it may explode; severe personal injury may result.





## CONSTRUCTION AND OPERATION



70M 0097

- |   |                    |   |                                 |
|---|--------------------|---|---------------------------------|
| A | ABS control unit   | F | ABS pump assembly               |
| B | Gear pulser        | G | Under-bonnet ABS fuse/relay box |
| C | Rear wheel sensor  | H | Modulator unit                  |
| D | Front wheel sensor | I | Master cylinder                 |
| E | Gear pulser        |   |                                 |

In a conventional brake system, if the brake pedal is depressed very hard, the wheels can lock before the vehicle comes to a stop. In such a case, the stability of the vehicle is reduced if the rear wheels are locked, and manoeuvrability of the vehicle is reduced if the front wheels are locked, creating an extremely unstable condition.

The Anti-lock Brake System (ABS) modulates the pressure of the brake fluid applied to each front caliper or both rear calipers, thereby preventing the locking of the wheels, whenever the wheels are likely to be locked due to hard braking. It then restores normal hydraulic pressure when there is no longer any possibility of wheel locking.

### Features

- Increased braking stability can be achieved regardless of changing driving condition.
- The manoeuvrability of the vehicle is improved as the system prevents the front wheels from locking.
- When the anti-lock brake system goes into action, a kickback is felt on the brake pedal.
- The system is equipped with a self-diagnosis function. When an abnormality is detected, the ABS indicator light comes on. The location of the system's trouble can be diagnosed from the frequency of the system indicator light blinks.



# **BRAKES – ABS**

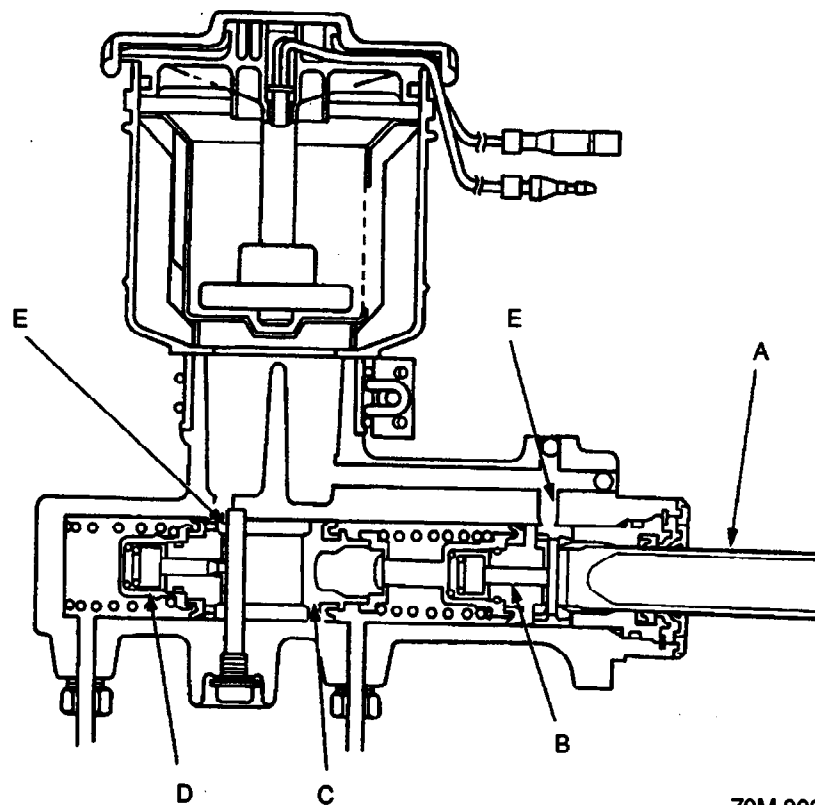
- This system has individual control of the front wheels and common control ("Select low") for the rear wheels. "Select Low" means that the rear wheel that would lock first (the one with lowest resistance to lock-up) determines anti-lock brake system activation for both rear wheels.
- The system has a fail-safe function that allows normal braking if there's a problem with the anti-lock brake system.

## **Construction**

In addition to the conventional braking system, the anti-lock brake system consists of: gear pulsers attached to the rotating part of individual wheels; wheel sensors, which generate pulse signals corresponding to the revolution of the gear pulsers; ABS control unit, which controls the working of the anti-lock brake system by performing calculations based on the signals from the individual wheel sensors and the individual switches; modular unit, which adjusts the hydraulic pressure applied to each caliper on the basis of the signals received from the ABS control unit; an accumulator, in which high-pressure brake fluid is stored, a pressure switch, which detects the pressure in the accumulator and transmits signals to the ABS control unit; an ABS pump assembly, which supplies the high-pressure working fluid to the accumulator by means of a pump; a motor relay for driving the ABS pump assembly; fail-safe relays, which cut off the solenoid valve ground circuit when the fail-safe device is at work; and, an ABS indicator light.



## Master Cylinder



70M 0098

A Secondary piston  
B Centre valve (B)  
C Primary piston

D Centre valve (A)  
E Port

### 1. Construction

A tandem master cylinder is used to improve the safety of the braking system. In addition, centre valves are used to synchronise the anti-lock brake system operation.

The master cylinder has one reservoir tank which is connected to the cylinder sections by two small holes. It has two pistons primary and secondary, which are cross-connected with the calipers so that the fluid pressure works separately on each system (front right wheel & rear left wheel, and front left wheel & rear right wheel).

A stop bolt for controlling movement of the primary piston is provided at the side of the master cylinder body. A reed switch for detecting the brake fluid volume is also provided in the cap of the reservoir tank.

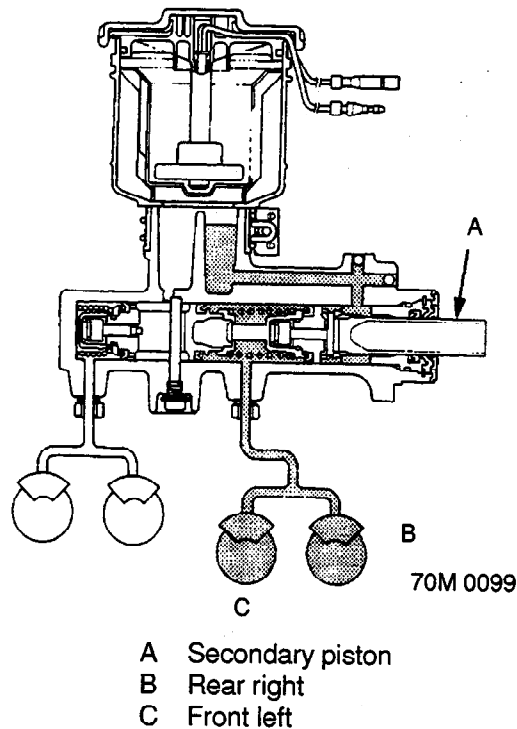
### 2. Operation

When the brake pedal is depressed, the secondary piston is pushed through the brake booster and the centre valve B is closed so that fluid pressure is generated on the secondary side. At the same time, the primary piston is pushed by the secondary fluid pressure and the centre valve A is closed so that braking fluid pressure is generated both on the primary and secondary sides.

When the brake pedal is released, the primary and secondary pistons are returned to the original position by the brake fluid pressure and piston spring.

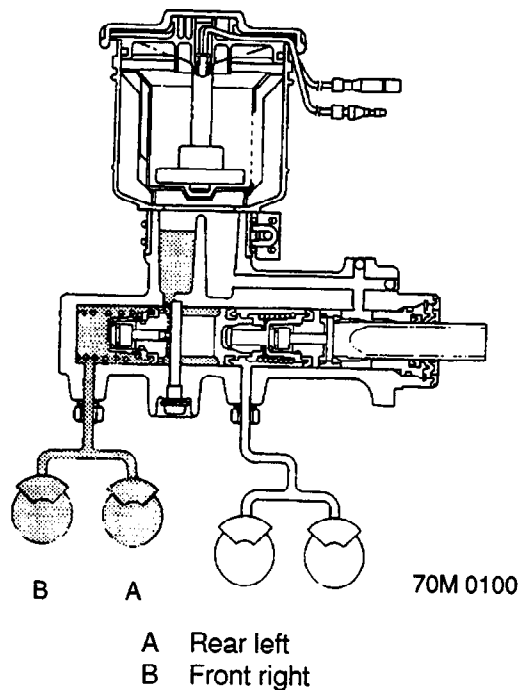
# BRAKES – ABS

## 3. Responses when fluid is leaking



(1) In case of leaking from the primary system:

Since the fluid pressure on the primary side does not rise, the primary piston is pushed by the fluid pressure of the secondary piston and the tension of the piston spring until the end hits on the cylinder. The braking is performed by the fluid pressure on the secondary side.

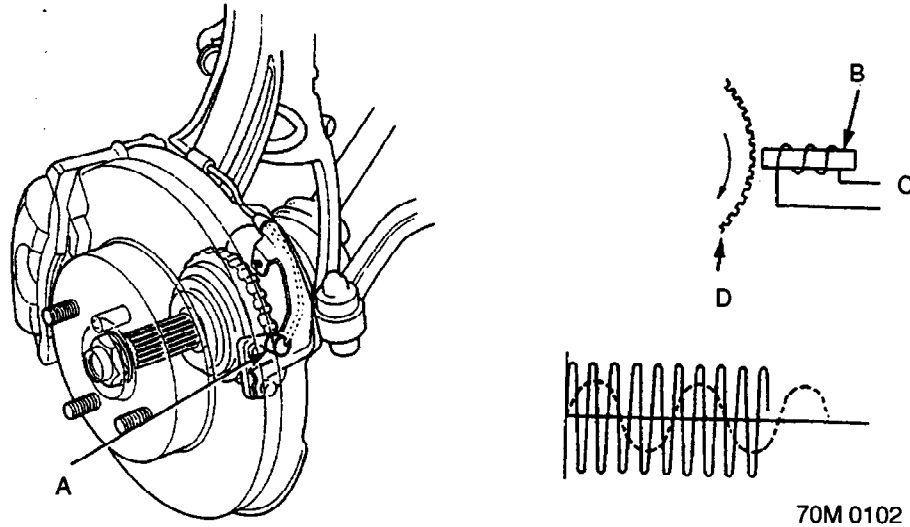


(2) In case of leaking from the secondary system:

The secondary piston does not produce fluid pressure, keeps moving forward until it contacts the end surface of the primary piston so that the primary piston is pushed under the same condition as an ordinary rod. Therefore, the braking is conducted by the fluid pressure on the primary side.



## Wheel Sensor



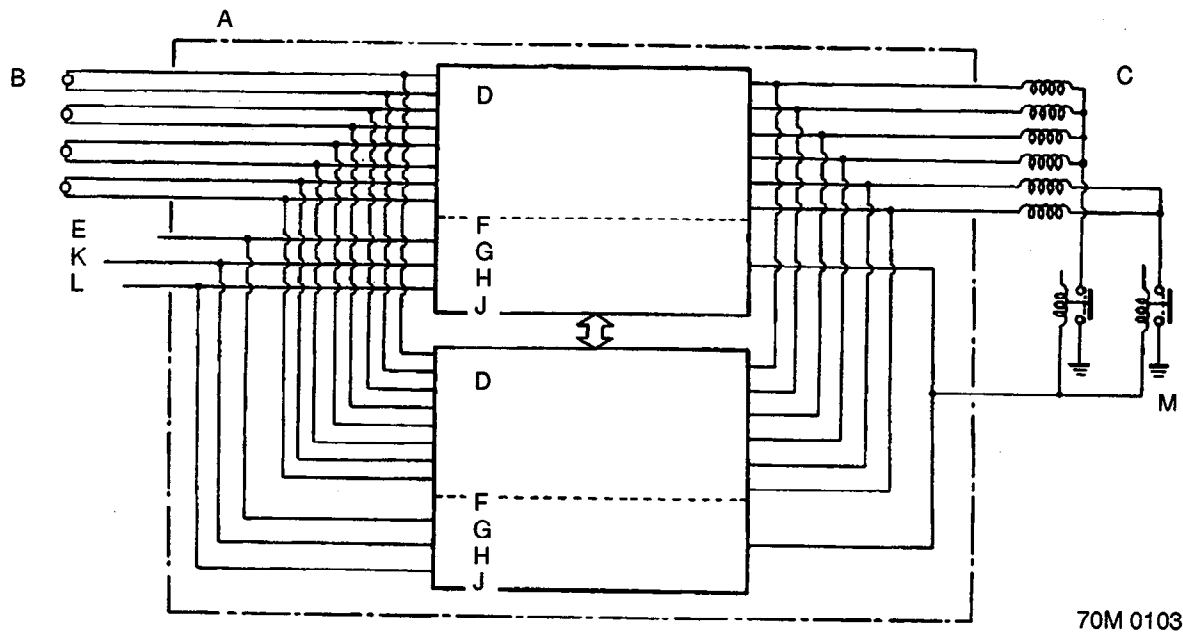
70M 0102

- A Wheel sensor
- B Permanent magnet
- C Output
- D Gear pulser

The wheel sensor is a contactless type and it detects the rotating speeds of a wheel. It comprises a permanent magnet and coil. When the gear pulsers attached to the rotatory parts of each wheel (front wheel: outboard joint of the driveshaft, rear: hub bearing unit) turn, the magnetic flux around the coil in the wheel sensor alternates, generating voltages with frequency in proportion to wheel rotating speed. These pulses are sent into the ABS control unit and the ABS control unit calculates the wheel speeds.

# BRAKES – ABS

## ABS Control Unit:



- |   |                  |   |                      |
|---|------------------|---|----------------------|
| A | ABS Control unit | G | Fail-safe            |
| B | Wheel sensor     | H | Pump motor control   |
| C | Solenoid valves  | J | Self-diagnosis       |
| D | Main function    | K | Pump motor           |
| E | Pressure switch  | L | Parking brake switch |
| F | Sub-function     |   |                      |

The ABS control unit consists of a main function section, which controls the operation of the anti-lock brake system, and sub-function, which controls the pump motor and “self-diagnosis.”

### 1. Main Function

The main function section of the ABS control unit performs calculations on the basis of the signals from each wheel sensor and controls the operation of the anti-lock brake system by operating the solenoid valves in the modulator unit for each front brake and for the two rear brakes.

### 2. Sub-function

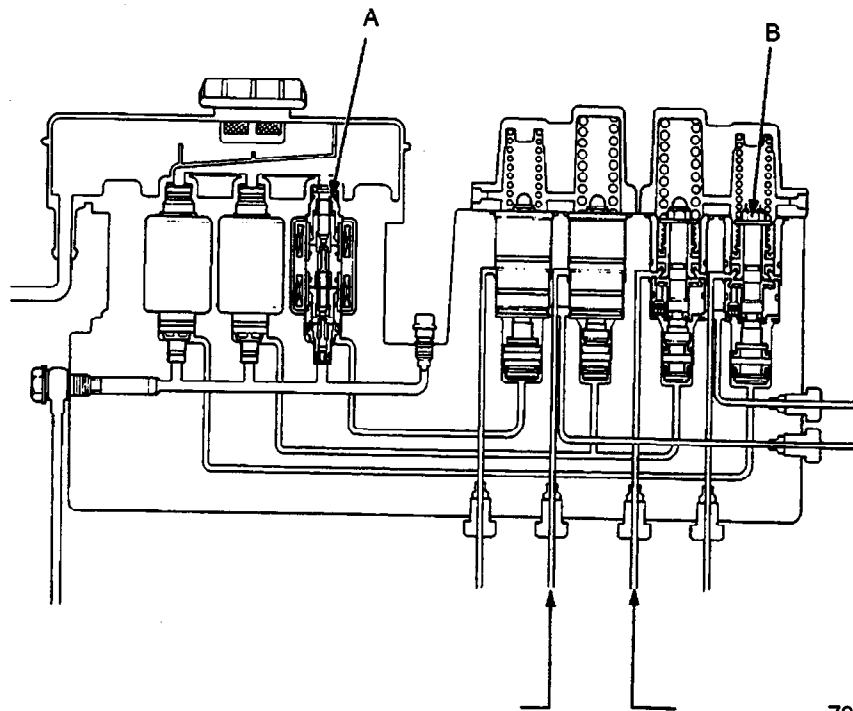
The sub-function section gives driving signals to the pump motor and also gives “self-diagnosis” signals, necessary for backing up the anti-lock brake system.

#### 1. Self-Diagnostic Function

Since the anti-lock brake system modulates the braking pressure when a wheel is about to lock, regardless of the driver's intention, the system operation and the braking power will be impaired if there is a malfunction in the system. To prevent this possibility, at speeds above 10 km/h (6 mph) the self-diagnosis function, provided in the sub-function of the ABS control unit, monitors the main system functions. When an abnormality is detected, the ABS indicator light goes on. There is also a check mode of the self-diagnosis system itself; when the ignition switch is first turned on, the ABS indicator light comes on and stays on for a few seconds after the engine starts, to signify that the self-diagnosis system is functional.

#### 2. Fail-Safe Function

When abnormality is detected in the control system by the self-diagnosis, the solenoid operations are suspended by turning off the relay (fail-safe relay) which disconnects the ground lines of all the solenoid valves to inhibit anti-lock brake system operations. Under these conditions, the braking system functions just as an ordinary one, maintaining the necessary braking function. When the ABS indicator light is turned on, it means the fail-safe is functioning.

**Modulator Unit**

70M 0104

- A Solenoid
- B Piston

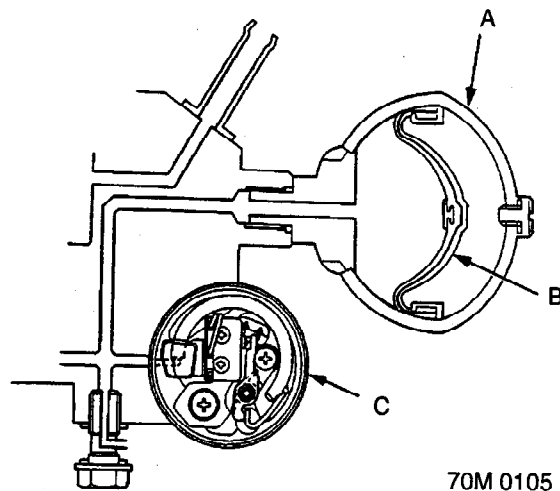
Modulators for each wheel and solenoid valves are integrated in the modulator unit.

The modulators for front and rear brakes are of independent construction and are positioned vertically for improved maintainability. The modulators for rear brakes are provided with a proportioning control valve function in order to prevent the rear wheel from locking when the anti-lock brake system is malfunctioning or the anti-lock brake system is not activated. The solenoid valve features quick response (5 ms or less).

The inlet and outlet valves are integrated in the solenoid valve unit. There are three solenoid valves, one for each front wheel, and one for both rear wheels.

# BRAKES – ABS

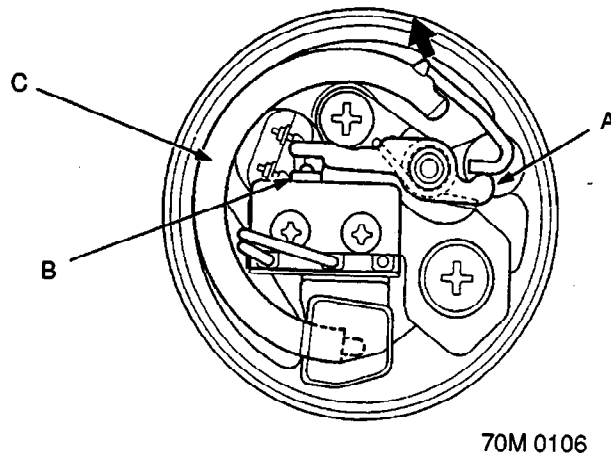
## Accumulator



- A Accumulator
- B Bladder
- C Pressure switch

The accumulator is a pneumatic type which accumulates high-pressure brake fluid fed from the pump incorporated in the ABS pump assembly. When the anti-lock brake system operates, the accumulator and the ABS pump assembly supply high-pressure brake fluid to the modulator valve via the inlet side of the solenoid valve.

## Pressure Switch



- A Sensing lever
- B Micro-switch
- C Bourdon tube

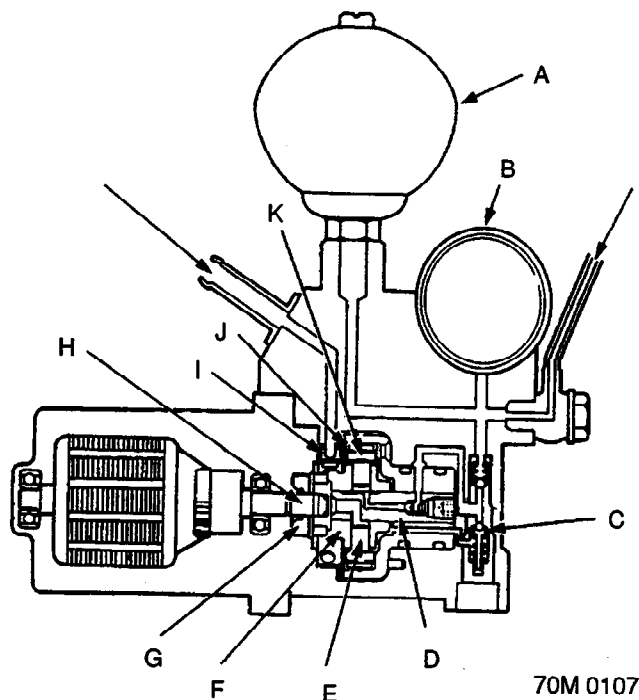
The pressure switch monitors the pressure accumulation (pressure from the pump) in the accumulator and is turned off when the pressure becomes lower than a prescribed level. When the pressure switch is turned off, the switching signal is sent to the ABS control unit. Upon receiving the signal, the ABS control unit activates the pump motor relay to operate the motor. If the pressure does not reach the prescribed value, the ABS indicator light comes on.

## Operation

When the pressure in the accumulator rises, the Bourdon tube in the pressure switch deforms outwards. When the free end of the Bourdon tube moves more than the prescribed amount, the micro-switch is activated by the force of the spring attached to the sensing lever. When the pressure in the accumulator decreases due to anti-lock brake system operations, the Bourdon tube moves in the direction opposite to the one described above, and the micro-switch is eventually turned off. Upon receiving this signal, the ABS control unit activates the motor relay to operate the motor.



## ABS Pump Assembly



- |   |                 |   |              |
|---|-----------------|---|--------------|
| A | Accumulator     | G | Oil seal     |
| B | Pressure switch | H | Motor shaft  |
| C | Relief valve    | I | Filter       |
| D | Valve rod       | J | Pump bearing |
| E | Piston rod      | K | Guide        |
| F | Cylinder body   |   |              |

The ABS pump assembly consists of a motor, filter, guide, piston rod and cylinder body. Since a guide is positioned off-set to the centre of the motor shaft, the rotation of the motor and cylinder body provides the reciprocating motion to the piston rod. The brake fluid is thus pressurized and fed to the relief valve, accumulator and modulator.

As the pressure in the accumulator exceeds the prescribed level, the pressure switch is turned on. Approx. 0.5 seconds after receiving the ON-signal, the ABS control unit stops the motor relay operation. In this state, the pressure in the accumulator reaches 23,000 kPa (230 kg/cm<sup>2</sup>, 3,270 psi).

If the pressure doesn't reach the prescribed value after the motor has operated continuously for a specified period, the ABS control unit stops the motor and activates the ABS indicator light.

### Anti-lock Brake System (ABS) Indicator Light

The ABS control unit turns on the ABS indicator light when one or more of the below described abnormalities is detected. This is only a partial list.

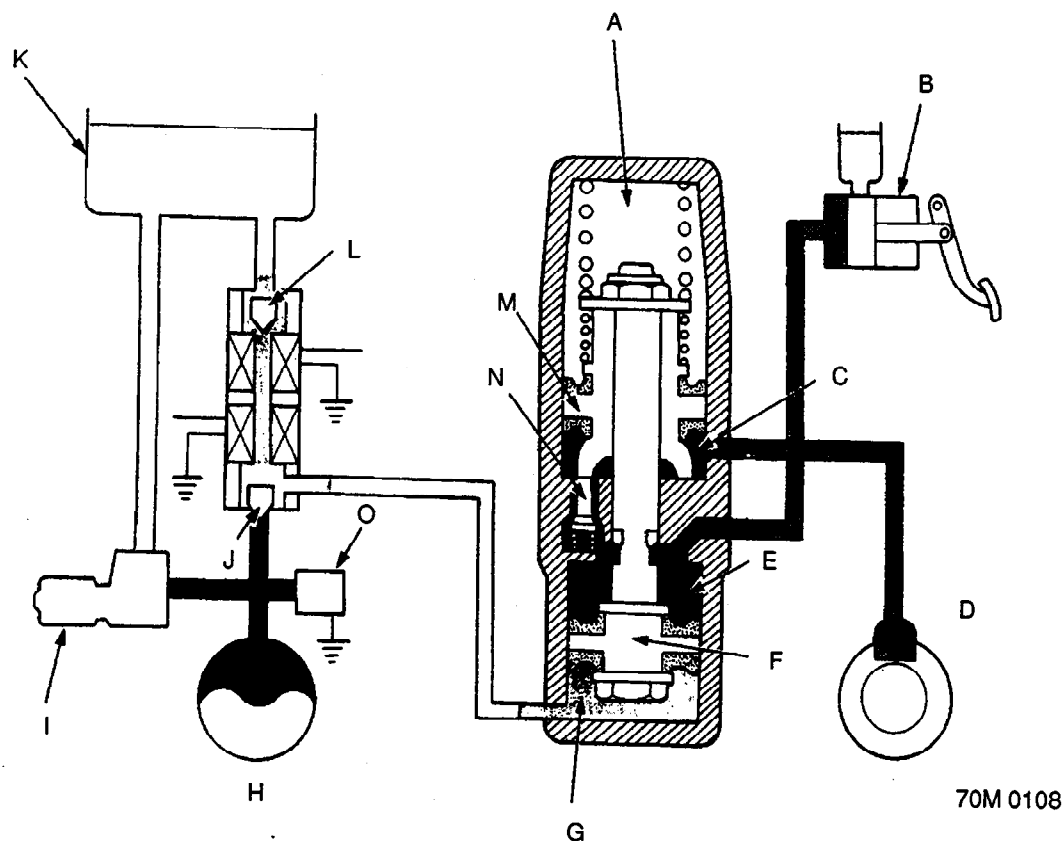
- When the operating time of the motor in the ABS pump assembly exceeds the specified period.
- When vehicle running time exceeds 30 seconds without releasing the parking brake lever.
- When one of the rear wheels is locked during running.
- When absence of speed signals from any of the four wheel sensors is detected.
- When the activation time of all solenoids exceeds a given time or an open circuit is detected in the solenoid system.
- When solenoid output is not detected in the simulated anti-lock brake system operation carried out during running at speeds of 10 km/h (6 mph) or more.

To check the ABS indicator light bulb, the light is activated when the ignition switch is turned on. It is turned off after the engine is started if there is no abnormality in the system.



# BRAKES – ABS

## Operation



A Chamber D  
B Master cylinder  
C Chamber B  
D Caliper  
E Chamber A  
F Piston  
G Chamber C  
H Accumulator

I Pump  
J Inlet valve  
K Reservoir  
L Outlet valve  
M Slide piston  
N Cut-off valve  
O Pressure switch

### 1. Ordinary Braking Function

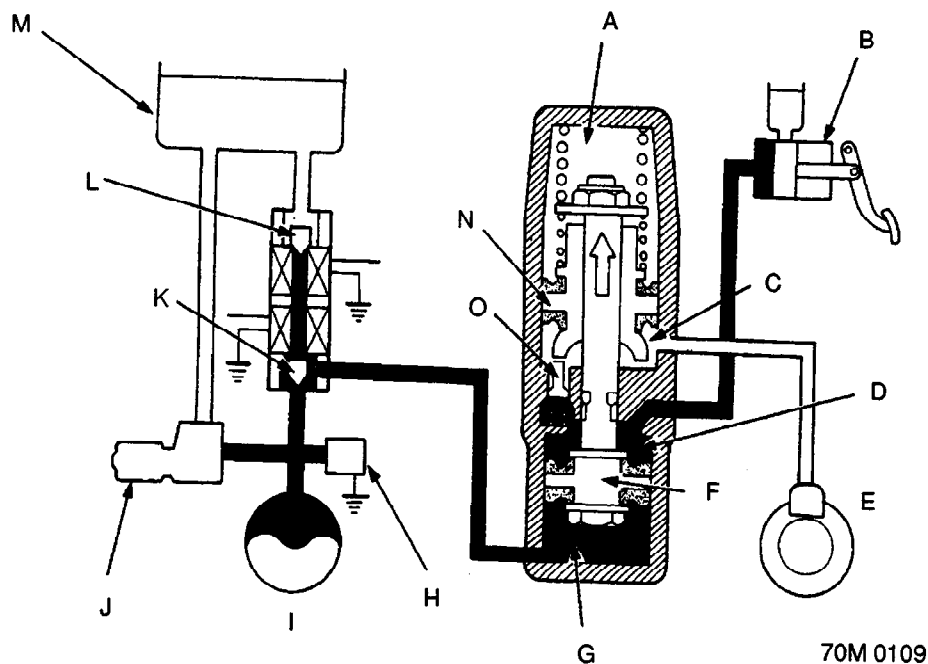
In ordinary brake operations, the cut-off valve in the modulator is open, transmitting the hydraulic pressure from the master cylinder to the brake calipers via chamber A and chamber B.

Chamber C is connected to the reservoir through the outlet valve, which is normally open. It is also connected to the hydraulic pressure source (pump, accumulator, pressure switch, etc.) via the inlet valve, which is normally closed.

Chamber D serves as an air chamber. Under these conditions, the pressures of chambers C and D are maintained at about atmospheric pressure, permitting regular braking operations.



Process	Caliper Pressure	Outlet Valve		Inlet Valve	
		Electric power	Hydraulic Circuit	Electric power	Hydraulic Circuit
Caliper pressure declining		ON	Close	ON	Open
Caliper pressure constant		ON	Close	OFF	Close
Caliper pressure increasing		OFF	Open	OFF	Close



- A Chamber D
- B Master cylinder
- C Chamber B
- D Chamber A
- E Caliper
- F Piston
- G Chamber C
- H Pressure switch

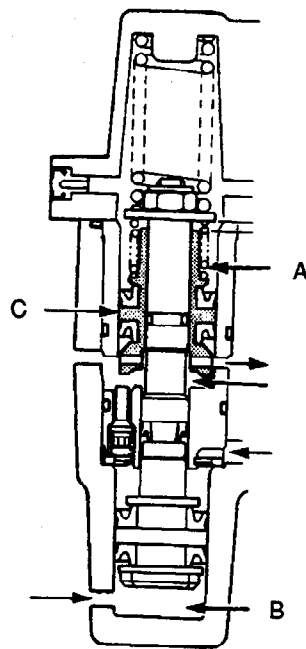
- I Accumulator
- J Pump
- K Inlet valve
- L Outlet valve
- M Reservoir
- N Slide piston
- O Cut-off valve

If brake inputs (force exerted on brake pedal) are excessively large to the point where the wheels may lock, the ABS control unit operates the solenoid valve, closing the outlet valve and opening the inlet valve. As a result, the high pressure is directed into chamber C, the piston is pushed upward, causing the slide piston to move upward and the cut-off valve to close. As the cut-off valve closes, the flow from the master cylinder to the caliper is interrupted, the volume of chamber B, which is connected to the caliper, increases, and the fluid pressure in the caliper declines.

When the possibility of wheel locking ceases, it is necessary to restore the pressure in the caliper. The solenoid valve is therefore turned off (outlet valve: open, inlet valve closed).

# BRAKES – ABS

## 2. Slide Piston Function



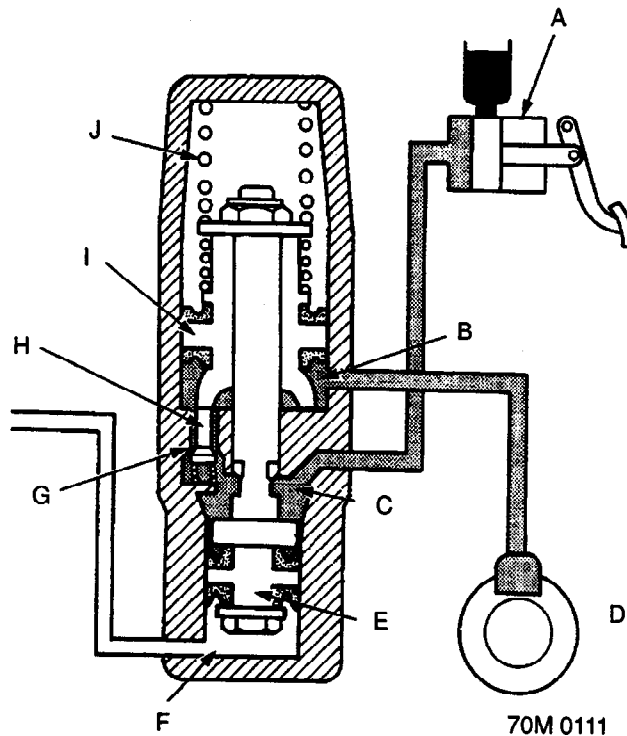
70M 0110

- A Spring
- B Chamber C
- C Slide piston

When the car is used on rough roads where the tyres sometimes lose adhesion, the anti-lock brake system may function excessively, causing a very large volume of brake fluid to flow into chamber C. When this occurs, the piston is moved excessively, resulting in an abnormal loss of pressure in the chamber B. In order to overcome this problem, the slide piston is kept in a proper position by spring force to prevent the pressure in chamber B from becoming negative.



## 3. Kickback



- |   |                 |   |               |
|---|-----------------|---|---------------|
| A | Master cylinder | F | Chamber C     |
| B | Chamber B       | G | Sleeve        |
| C | Chamber A       | H | Cut-off valve |
| D | Caliper         | I | Slide piston  |
| E | Piston          | J | Spring        |

When the anti-lock brake system is functioning, the piston moves upward, the volume of chamber B increases, and the fluid pressure on the caliper side is reduced. At the same time, the volume of chamber A is reduced and the brake fluid is pushed back to the master cylinder, the driver can feel the anti-lock brake system is operating because the brake pedal is kicked back.

## 4. Proportioning Control Valve Function

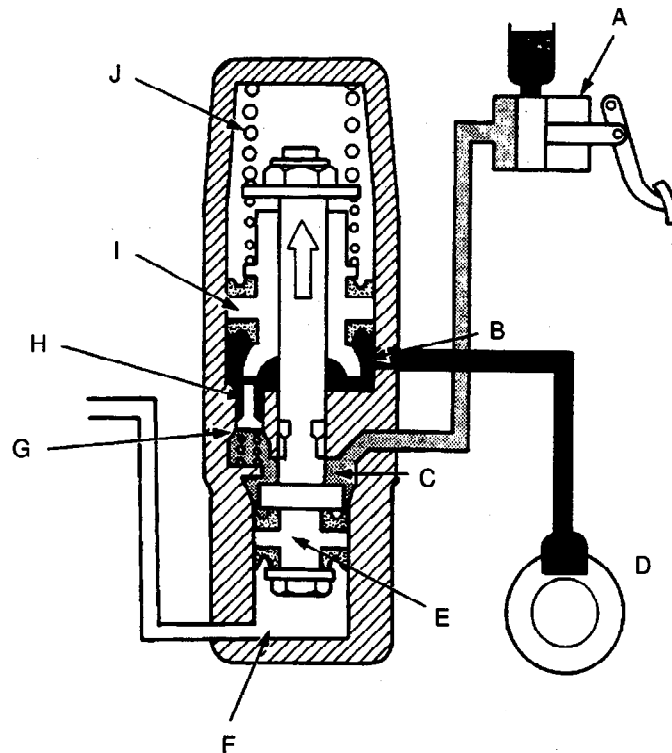
In the modulator for the rear wheels, the diameters of the piston and the slide piston are distinctly different. This provides a proportioning control valve function to prevent the rear wheels from locking during an emergency stop.

### (1) Before the spring force is overcome:

- 1) When the fluid pressure from the master cylinder is less than the force exerted by the slide piston on the spring, the cut-off valve will always be pushed downward.

Under these conditions, there is a gap between the cut-off valve shoulder and the sleeve. Chamber A and Chamber B are therefore connected through the gap. The pressure from the master cylinder flows into the rear calipers through chamber A and chamber B.

# BRAKES – ABS



70M 0112

- |   |                 |   |               |
|---|-----------------|---|---------------|
| A | Master cylinder | F | Chamber C     |
| B | Chamber B       | G | Sleeve        |
| C | Chamber A       | H | Cut-off valve |
| D | Caliper         | I | Slide piston  |
| E | Piston          | J | Spring        |

- 2) When the fluid pressure from the master cylinder reaches the point where it exceeds the force exerted by the slide piston and spring, the slide piston will travel upward.

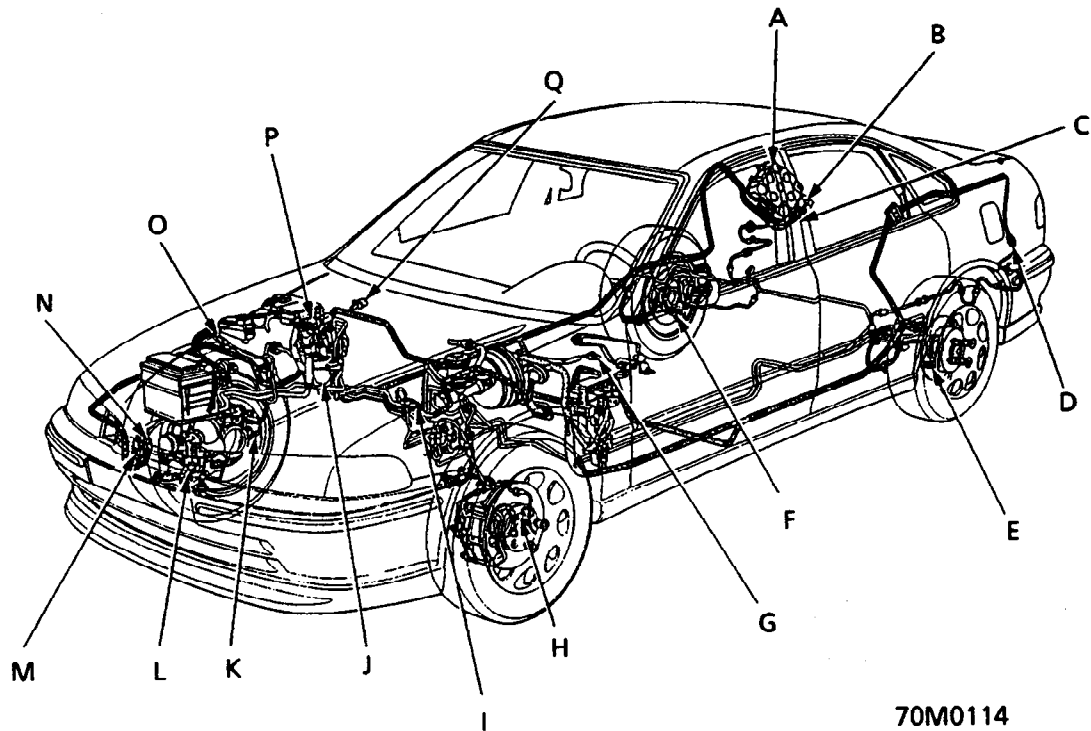
The cut-off valve, previously in contact with the bottom of the slide piston, then moves upward and the cut-off valve shoulder hits the sleeve, blocking the fluid passages.

## (2) After the spring force is overcome:

As the fluid pressure from the master cylinder further increases, so the pressure in chamber A increases, causing a force to push down the large diameter portion of the piston. Consequently, the slide piston comes down, the cut-off valve is pushed downward by the bottom of the slide piston, allowing chambers A and B to connect momentarily. As this occurs, pressure in chamber B increases, the slide piston is pushed upward, the cut-off valve goes up, and the connection between chamber A and chamber B is blocked again. As described above, when the pressure in the master cylinder has surpassed the force exerted by the slide piston and spring, the slide piston reduces the pressure in the rear caliper to the prescribed pressure by repeating these processes.



## WIRING/CONNECTOR LOCATION

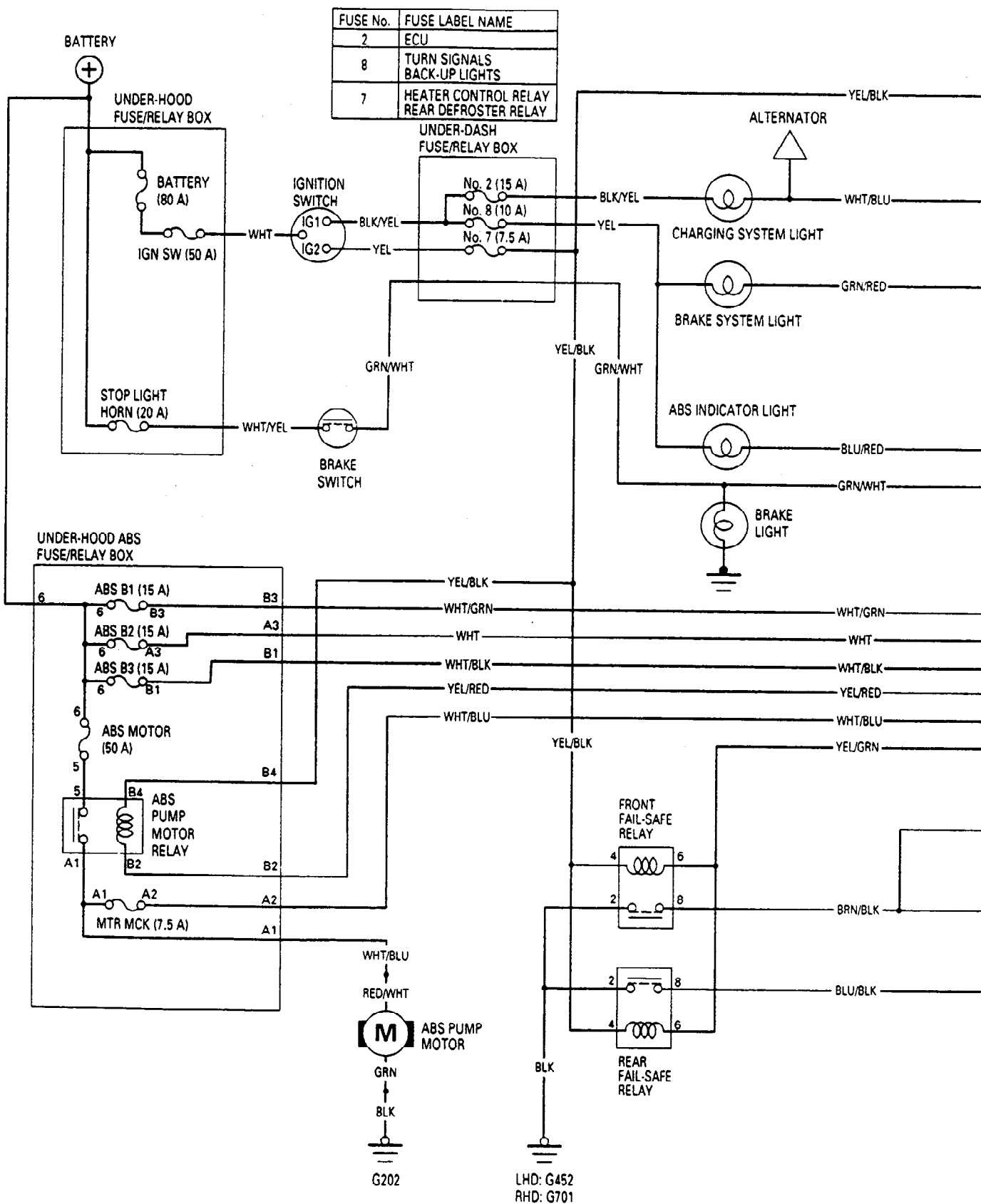


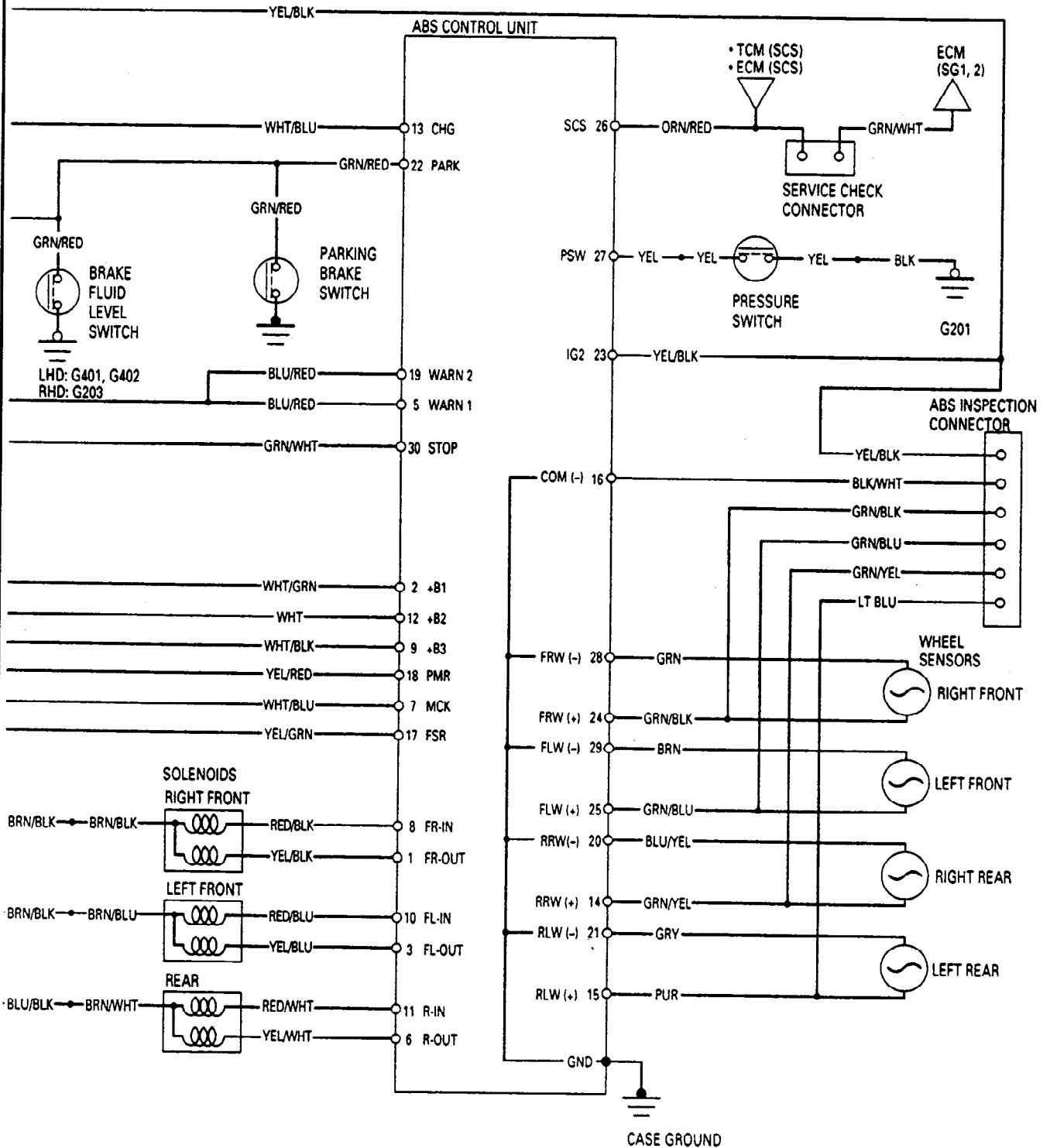
70M0114

- |   |                                   |   |                                      |
|---|-----------------------------------|---|--------------------------------------|
| A | ABS control unit                  | K | Right front wheel sensor             |
| B | Fail-safe relays                  | L | ABS pump/accumulator pressure switch |
| C | Right rear wheel sensor connector | M | ABS pump motor connector             |
| D | Left rear wheel sensor connector  | N | Pressure switch connector            |
| E | Left rear wheel sensor            | O | Right front wheel sensor connector   |
| F | Right rear wheel sensor           | P | Solenoid connector (10P)             |
| G | ABS inspection connector (6P)     | Q | Service check connector (2P)         |
| H | Left front wheel sensor           |   |                                      |
| I | Left front wheel sensor connector |   |                                      |
| J | Modulator unit                    |   |                                      |

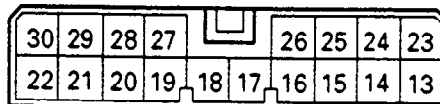
- The ABS inspection connector (6P) is located on the cross-member under the passenger's seat.
- The service check connector (2P) is located under the dash on the passenger side of car.
- The under-dash fuse/relay box is located under the dash on the driver side of car.

# BRAKES – ABS



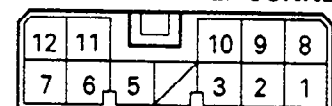


ABS CONTROL UNIT 18P CONNECTOR



View from terminal side.

ABS CONTROL UNIT 12P CONNECTOR



View from terminal side.

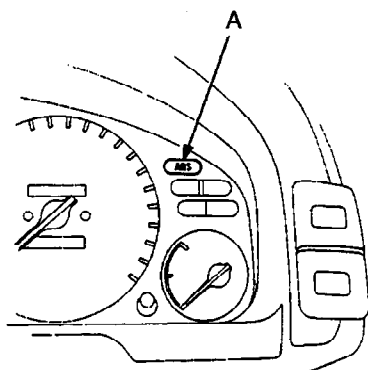
70M0316



# BRAKES – ABS

## FAULT FINDING

### Anti-lock Brake System (ABS) Indicator Light



70M 0115

A ABS indicator light

#### Temporary Driving Conditions:

1. The ABS indicator light comes on and the ABS control unit memorizes the diagnostic trouble code (DTC) under certain conditions.
2. If you receive a customers report that the ABS indicator light sometimes comes on, check the fault code in the ECU memory. Then use microcheck to determine the fault. Do not use microcheck before checking the fault code as this disconnects the ECU from the battery and will cause any fault codes to be lost.
  - The tyre(s) adhesion is lost due to excessive cornering speed.  
DTC: 5, 5-4, 5-8.
  - The vehicle loses traction when attempting to move from rest on a muddy, snowy, or sandy road.  
DTC: 4-1, 4-2, 4-4, 4-8
  - When the parking brake is applied for more than 30 seconds while the vehicle is being driven.  
DTC: 2-1
  - The vehicle is driven on an extremely rough road.

The ABS is OK, if the ABS indicator light goes off after the engine is restarted.

3. If you receive a customer's report that the ABS indicator light sometimes comes on, check the system using the ALB checker to confirm whether there is any trouble in the system.
4. The ABS indicator light will come on and the ABS control unit will memorize a DTC when there is insufficient battery voltage to the ABS control unit. An example would be when the battery is so weak that the car must be jump-started. After the battery is sufficiently recharged, the ABS indicator light will work normally after the engine is stopped and restarted.

However, after recharging the battery, the DTC must be cleared from the ABS control unit's memory by disconnecting the ABS B2 (15 A) fuse in the under-hood ABS fuse/relay box for at least three seconds.

#### ABS Indicator Light Circuit:

**CAUTION:** Use only the digital multimeter to check the system.

1. The ABS indicator light does not go on when the ignition switch is turned on.

Check the following items. If they are operational, check the ABS control unit connectors. If not loose or disconnected, substitute a known-good ABS control unit and recheck.

- Blown ABS indicator light bulb.
- Open circuit in YEL wire between the No. 8 TURN SIGNALS, BACK-UP LIGHTS (10 A) fuse in the under-dash fuse/relay box and gauge assembly.
- Open circuit in BLU/RED wire between the gauge assembly and ABS control unit.
- Poor ground connection between the ABS control unit and the body.



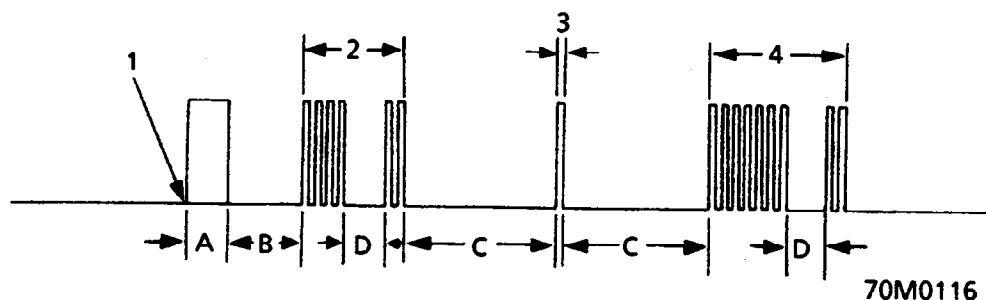
2. The ABS indicator light remains ON after the engine is started, however the ABS indicator light does not blink any DTC. Check the following items:

- Loose or poor connection of the wire harness at the ABS control unit.
- Faulty ABS B2 (15 A) fuse in the under-hood ABS fuse/relay box.
- Open circuit in WHT wire between the ABS B2 (15 A) fuse in the under-hood ABS fuse/relay box and ABS control unit.
- Open circuit in YEL/BLK wire between the No. 7 HEATER CONTROL RELAY, REAR DEFROSTER RELAY (7.5 A) fuse in the under-dash fuse/relay box and ABS control unit.
- Short circuit in BLU/RED wire between gauge assembly and ABS control unit.
- Open circuit in WHT/BLU wire between alternator and ABS control unit.

If the problem is not found, substitute a known-good ABS control unit and recheck whether the ABS indicator light remains ON.

# BRAKES – ABS

## Diagnostic Trouble Code (DTC)



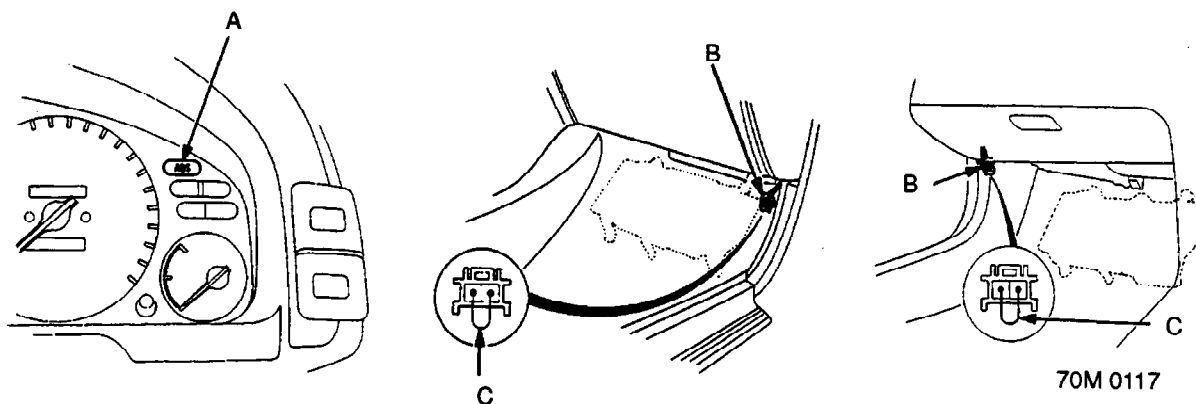
- 1 Ignition on
- 2 Fault code 1 (4-2)
- 3 Fault code 2 (1)
- 4 Fault code 3 (7-2)

- A ABS warning light on for 1 second
- B 2 second pause
- C 5 second pause
- D 1 second pause

1. Disconnect the service check connector (2P) from the connector cover located under dash of the passenger's seat side. Connect the two terminals of the service check connector with a link wire.
2. Turn the ignition switch on, but do not start the engine.

3. Record the flashing frequency from the ABS indicator light. The frequency of flashes indicates the diagnostic trouble code (DTC).

**CAUTION:** Before starting the engine, disconnect the link wire from the service check connector, otherwise the Malfunction Indicator Lamp (MIL) will stay on with the engine running.



- A ABS indicator light
- B Service check connector (2P)
- C Jumper wire

### Note:

- The ABS control unit can indicate three DTCs (one, two or three problems).
- If the ABS indicator light does not illuminate, see Troubleshooting of ABS Indicator Light Circuit.
- If you miscount the frequency of flashes, turn the ignition switch off then on to cycle the ABS indicator light again.
- After the repair is completed, disconnect the ABS B2 (15 A) fuse in the under-hood ABS fuse/relay

box for at least three seconds to erase the ABS control unit's memory. Then turn the ignition key on again and recheck.

- The memory is erased if the connector is disconnected from the ABS control unit or the ABS control unit is removed from the body.
- After recording the DTC (if applicable), refer to the Symptom-to-System Chart.



## ECU FAULT CODES

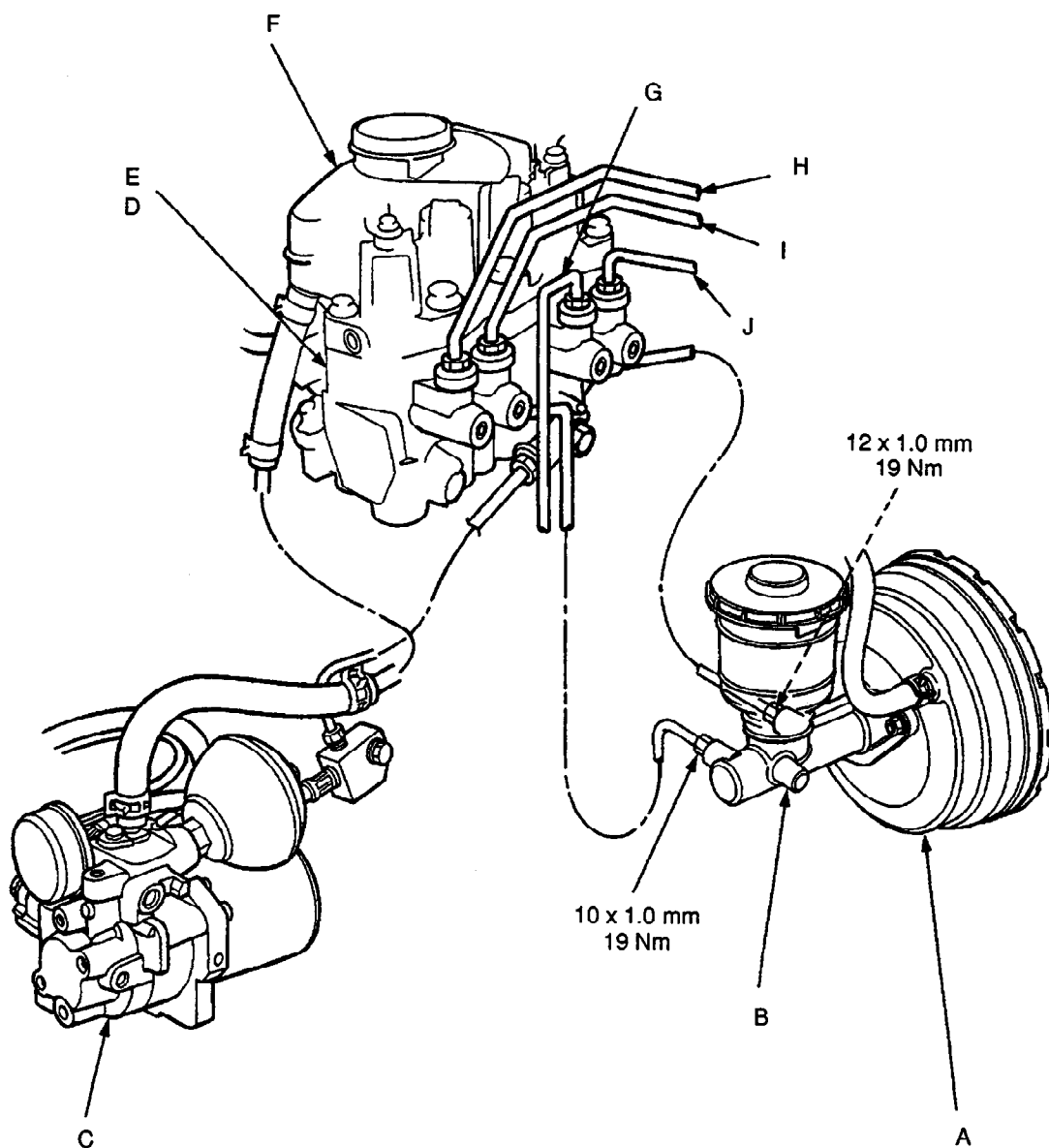
MAIN CODE	SUB CODE	PROBABLE FAULT	OTHER RELATED COMPONENTS
1	–	Pump motor over-run	Motor fuse Motor relay Pressure switch
1	2	Pump motor circuit problem	Motor relay unit fuse
1	3	High pressure leakage	Solenoid
1	4	Pressure switch	–
1	8	Accumulator gas leakage	–
2	1	Handbrake switch related problem	Brake fluid level switch warning light
3	1	Right front pulser	–
3	2	Left front pulser	–
3	4	Right rear pulser	–
3	8	Left rear pulser	–
4	1	Front right speed sensor	–
4	2	Front left speed sensor	–
4	4	Rear right speed sensor	–
4	8	Rear left speed sensor	–
5	–	Right/left rear speed sensor	Modulator
5	4	Right rear speed sensor	Modulator
5	8	Left rear speed sensor	Modulator
6	–	Fail-safe relay (short circuit)	Front or rear fail-safe relay
6	1	Fail-safe relay (short circuit)	Front fail-safe relay
6	4	Fail-safe relay (short circuit)	Rear fail-safe relay
7	1	Front right solenoid (open circuit)	Fuse 7
7	2	Front left solenoid (open circuit)	Fuse 7, fail-safe relay 1
7	4	Right/left rear solenoid (open circuit)	Fail-safe relay 2

**Note:** Always use Microcheck and associated corrective service to effect a repair.





## HYDRAULIC CONNECTIONS

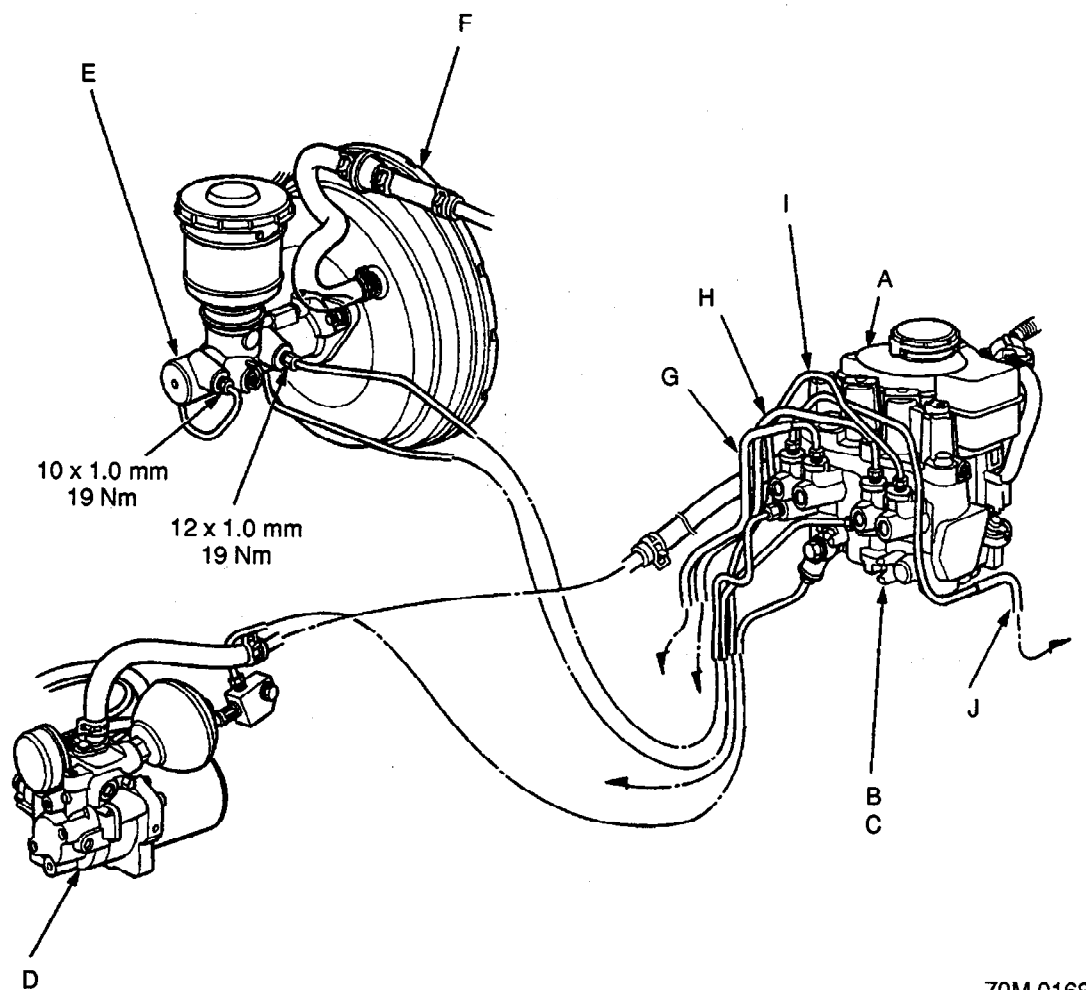


70M 0167

- |   |                   |   |                      |
|---|-------------------|---|----------------------|
| A | Brake booster     | F | Reservoir            |
| B | Master cylinder   | G | To right rear brake  |
| C | ABS Pump assembly | H | To right front brake |
| D | Solenoids         | I | To left rear brake   |
| E | Modulator unit    | J | To left front brake  |

**CAUTION:** Do not allow brake fluid to come into contact with paintwork as it will cause surface damage. If brake fluid does contact the paint, wash it off immediately with water.

# BRAKES – ABS

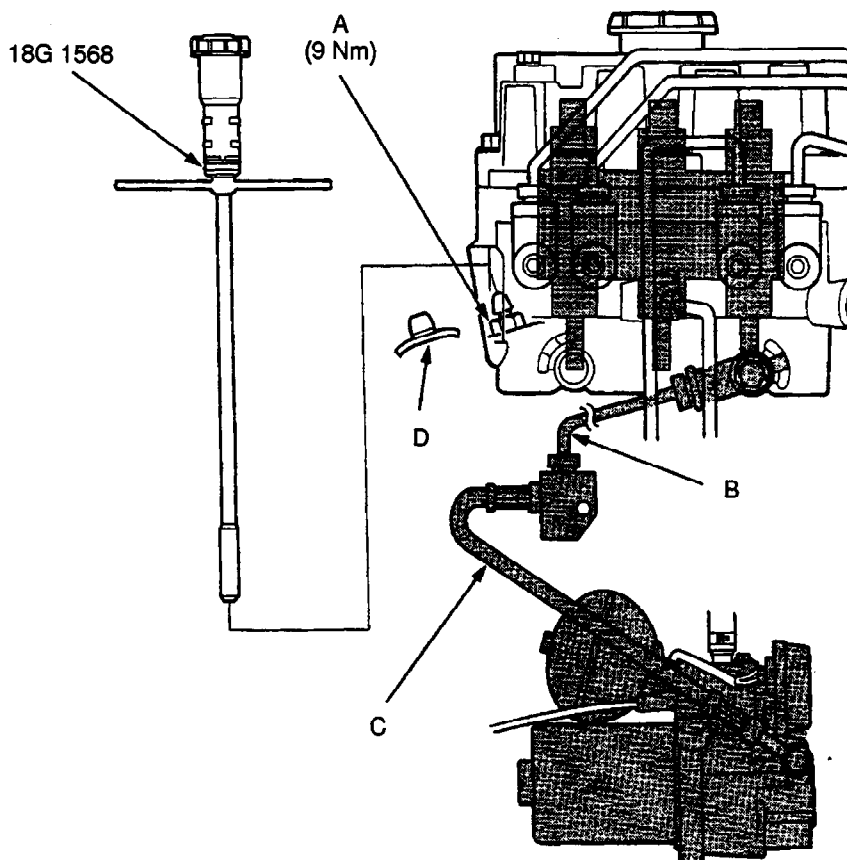


70M 0168

- |                     |                        |
|---------------------|------------------------|
| A Reservoir         | F Brake booster        |
| B Modulator unit    | G To right rear brake  |
| C Solenoids         | H To left rear brake   |
| D ABS Pump assembly | I To right front brake |
| E Master cylinder   | J To left front brake  |



## RELIEVING ACCUMULATOR/LINE PRESSURE



A Maintenance bleeder  
B High-pressure pipe

C High-pressure hose  
D Red cap

**WARNING:** Use the Bleeder T-wrench before disassembling the parts shaded in the illustration.

1. Open the hood.
2. Remove the red cap from the bleeder on the modulator.
3. Install the special tool on the maintenance bleeder and turn it out slowly 90° to collect high-pressure fluid into the reservoir. Turn the special tool out one complete turn to drain the brake fluid thoroughly.
4. Retighten the maintenance bleeder and discard the fluid.
5. Reinstall the red cap.

### Reservoir Brake Fluid Draining

1. Draining brake fluid from modulator reservoir:

The brake fluid may be extracted through the top of the modulator reservoir with a syringe. It may also be drained through the pump joint after disconnecting the pump hose.

2. Draining brake fluid from master cylinder.

Loosen the bleed screw and pump the brake pedal to drain the brake fluid from the master cylinder.

#### **WARNING:**

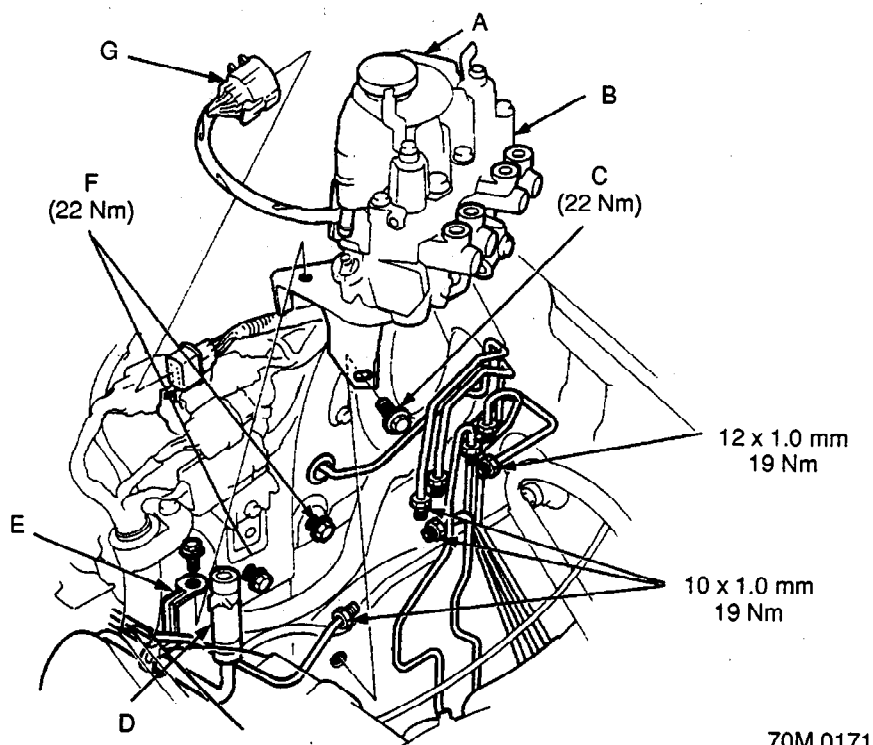
- A jet of fluid under high pressure will be expelled if the shaded pipe/hose is removed.
- To drain high-pressure brake fluid, follow the procedure on this page.



# BRAKES – ABS

## MODULATOR UNIT

### Removal/Installation (for LHD)



- A Reservoir
- B Modulator unit
- C Lower mounting bolt
- D Brake hose

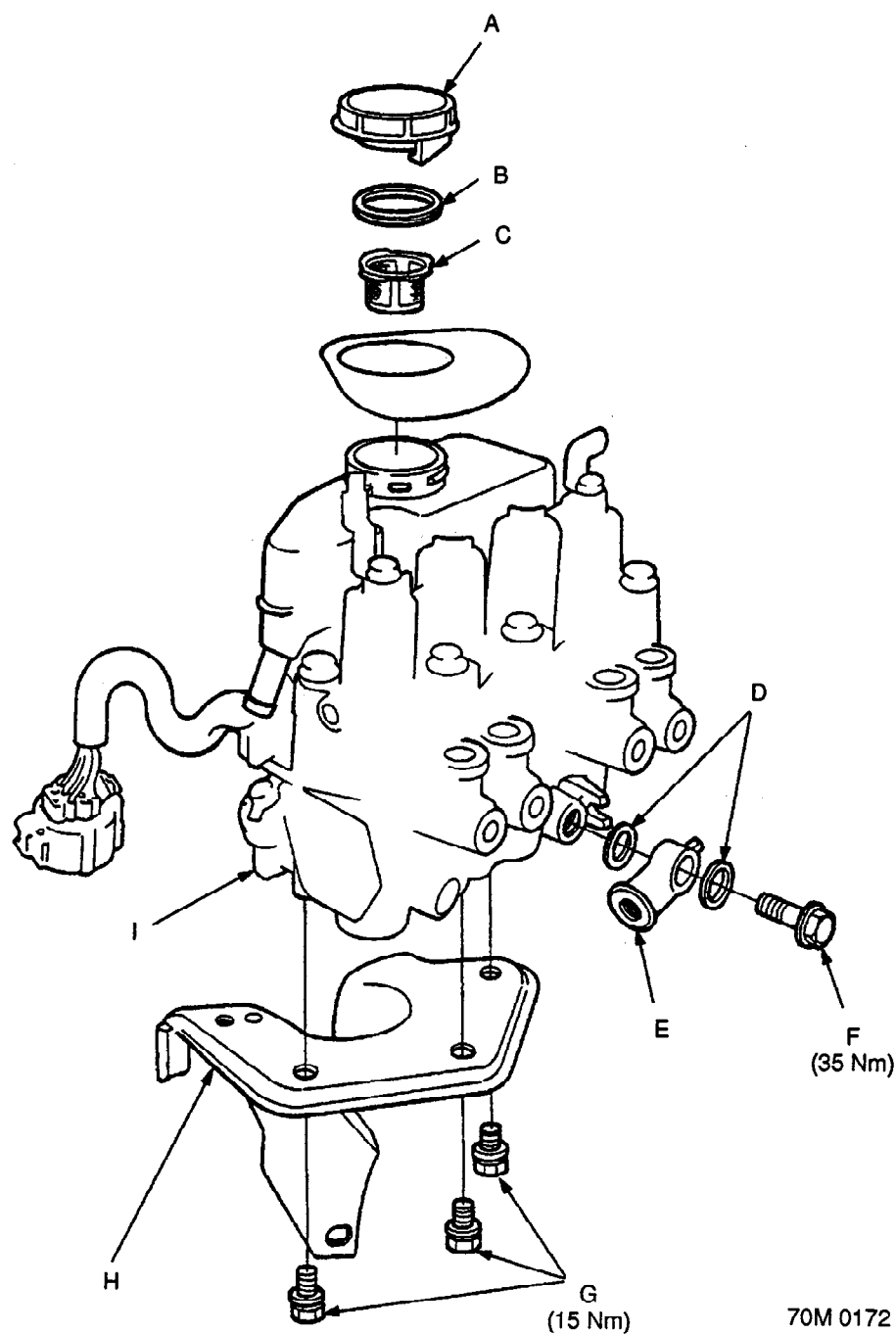
- E Clamp
- F Upper mounting bolts
- G Solenoid connector

**WARNING:** Before removing the modulator-to-ABS pump assembly high-pressure line, be sure to relieve the high pressure fluid from the maintenance bleeder.

#### CAUTION:

- Be careful not to bend or damage the brake pipes when removing the modulator unit.
- Do not allow brake fluid to come into contact with paintwork as it will cause surface damage. If brake fluid does contact the paint, wash it off immediately with water.
- To prevent spills, cover the hose joints with cloth or disposable towels.
- Before reassembling, check that all parts are free of dust and other foreign particles.
- Do not mix different brands of brake fluid as they may not be compatible.
- Do not reuse the drained fluid. Use only clean DOT 4 brake fluid.
- When connecting the brake pipes, make sure that there is no interference between the brake pipes and other parts.

1. Drain the brake fluid from the master cylinder.
2. Drain the brake fluid from the modulator reservoir.
3. Relieve the high pressure fluid.
4. Remove the intake air duct.
5. Remove the emission control box.
6. Disconnect the solenoid connector.
7. Disconnect the seven brake pipes from the modulator unit.
8. Disconnect the brake hose from the modulator reservoir.
9. Remove the clamp from the modulator bracket.
10. Loosen the two upper mounting bolts, and remove the one lower mounting bolt and the modulator unit.

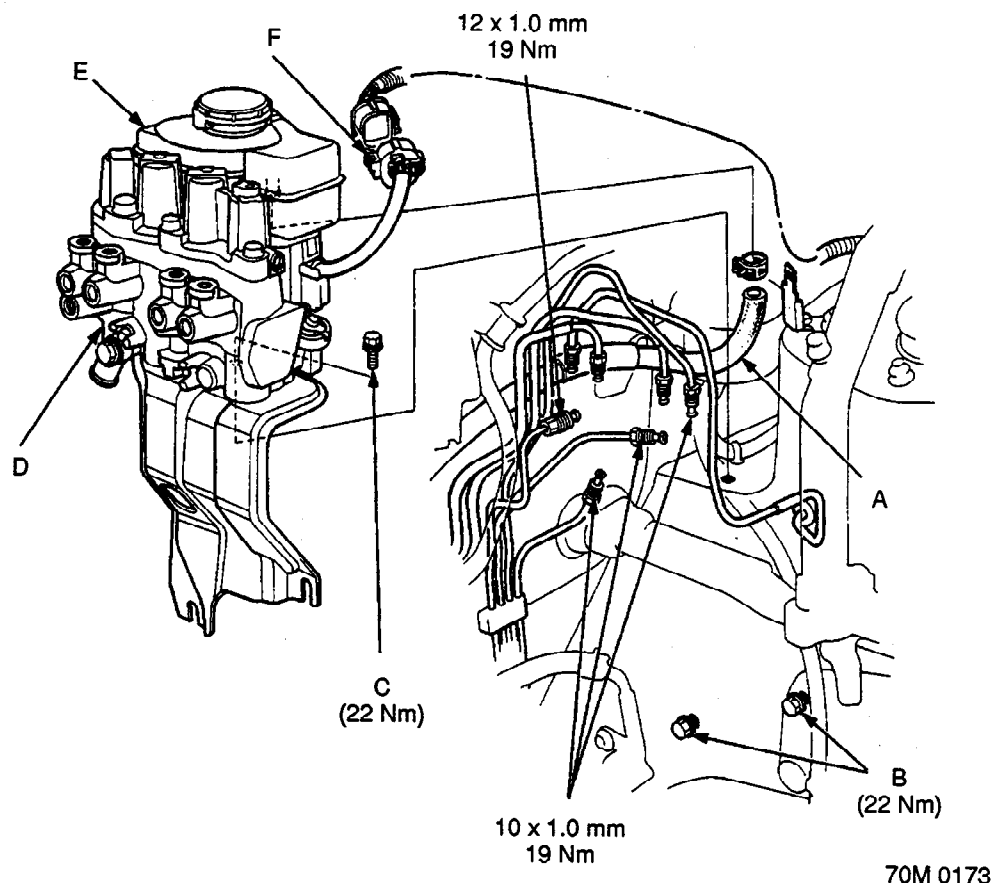


- |   |                 |   |                   |
|---|-----------------|---|-------------------|
| A | Reservoir cap   | F | Banjo bolt        |
| B | Cap seal        | G | 8 mm bolts        |
| C | Strainer        | H | Modulator bracket |
| D | Sealing washers | I | Modulator unit    |
| E | Inlet joint     |   |                   |

11. Remove the modulator bracket from the modulator unit.
12. Install the modulator unit in the reverse order of removal.
13. After installation, fill and bleed air from the conventional brake system and ABS.

# BRAKES – ABS

## Removal/Installation (for RHD)



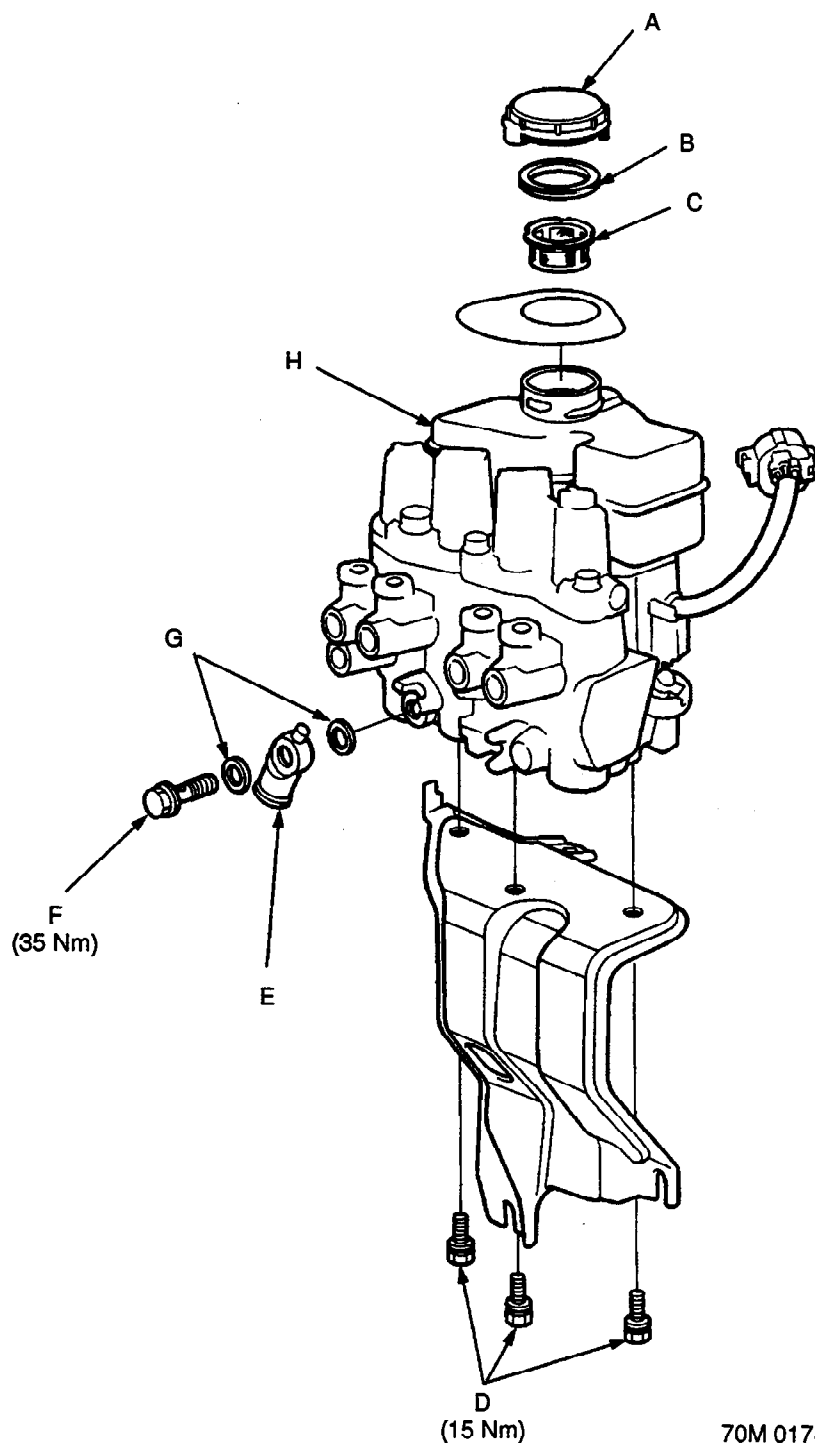
- |   |                      |   |                    |
|---|----------------------|---|--------------------|
| A | Brake hose           | D | Modulator unit     |
| B | Lower mounting bolts | E | Reservoir          |
| C | Upper mounting bolt  | F | Solenoid connector |

**WARNING:** Before removing the modulator-to-ABS pump assembly high-pressure line, be sure to relieve the fluid pressure from the maintenance bleeder.

### CAUTION:

- Be careful not to bend or damage the brake pipes when removing the modulator unit.
- Do not allow brake fluid to come into contact with paintwork as it will cause surface damage. If brake fluid does contact the paint, wash it off immediately with water.
- To prevent spills, cover the hose joints with cloth or disposable towels.
- Before reassembling, check that all parts are free of dust and other foreign particles.
- Do not mix different brands of brake fluid as they may not be compatible.
- Do not reuse the drained fluid. Use only clean DOT 4 brake fluid.
- When connecting the brake pipes, make sure that there is no interference between the brake pipes and other parts.

1. Drain the brake fluid from the master cylinder.
2. Drain the brake fluid from the modulator reservoir.
3. Relieve the high pressure fluid.
4. Disconnect the solenoid connector.
5. Disconnect the seven brake pipes from the modulator unit.
6. Disconnect the brake hose from the modulator reservoir.
7. Relieve fuel pressure, then disconnect the fuel pipe from the fuel filter.



A Reservoir cap  
B Cap seal  
C Strainer  
D 8 mm bolts

E Inlet joint  
F Banjo bolt  
G Sealing washers  
H Modulator unit

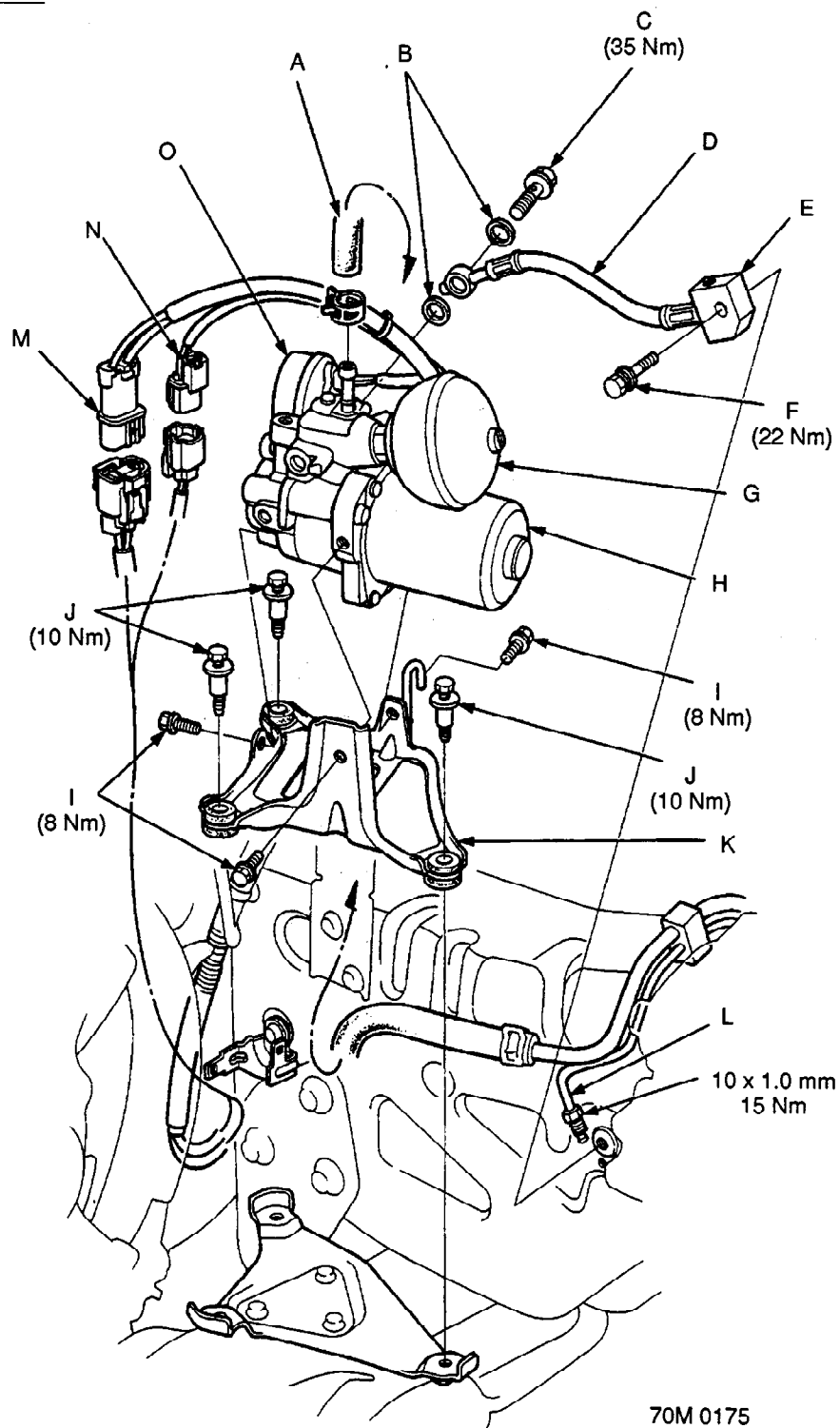
8. Loosen the two lower mounting bolts, and remove the one upper mounting bolt and the modulator unit.
9. Remove the modulator bracket from the modulator unit.

10. Install the modulator unit in the reverse order of removal.
11. After installation, fill and bleed air from the conventional brake system and ABS.

# BRAKES – ABS

## ABS PUMP ASSEMBLY

### Removal/Installation



- |                       |                             |                             |
|-----------------------|-----------------------------|-----------------------------|
| A Brake hose          | G Accumulator               | L High-pressure pipe        |
| B Sealing washers     | H ABS Pump assembly         | M Motor connector           |
| C Banjo bolt          | I 6 mm bolts                | N Pressure switch connector |
| D High-pressure hose  | J Mounting bolts            | O Pressure switch           |
| E Pressure hose joint | K ABS Pump assembly bracket |                             |
| F 8 mm bolt           |                             |                             |



**WARNING:** Before removing the modulator-to-ABS pump assembly high-pressure line, be sure to relieve the high pressure fluid from the maintenance bleeder.

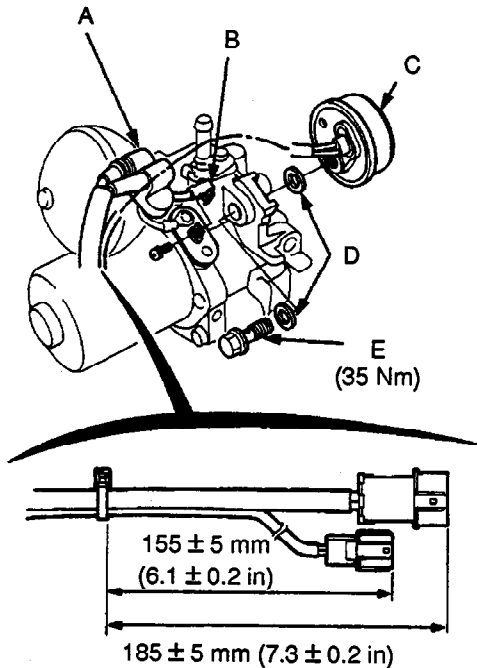
**CAUTION:**

- Be careful not to bend or damage the brake pipes when removing the ABS pump assembly.
- Do not allow brake fluid to come into contact with paintwork as it will cause surface damage. If brake fluid does contact the paint, wash it off immediately with water.
- To prevent spills, cover the hose joints with cloth or disposable towels.
- Before reassembling, check that all parts are free of dust and other foreign particles.
- Do not mix different brands of brake fluid as they may not be compatible.
- Do not reuse the drained fluid. Use only clean DOT 4 brake fluid.
- When connecting the brake pipes, make sure that there is no interference between the brake pipes and other parts.
- Do not disassemble the ABS pump assembly except the pressure switch.

1. Drain the brake fluid from the modulator reservoir.
2. Relieve the high pressure fluid.
3. Remove the battery tray.
4. Disconnect the motor and pressure switch connectors.
5. Disconnect the high pressure pipe from the pressure hose joint.
6. Disconnect the brake hose from the ABS pump assembly.
7. Remove the three mounting bolts, and the ABS pump assembly.
8. Remove the ABS pump assembly bracket.
9. Remove the high-pressure hose from the ABS pump assembly.
10. Install the ABS pump assembly in the reverse order of removal.
11. After installation, fill and bleed air from the ABS.

# BRAKES - ABS

## Pressure Switch Replacement



70M 0176

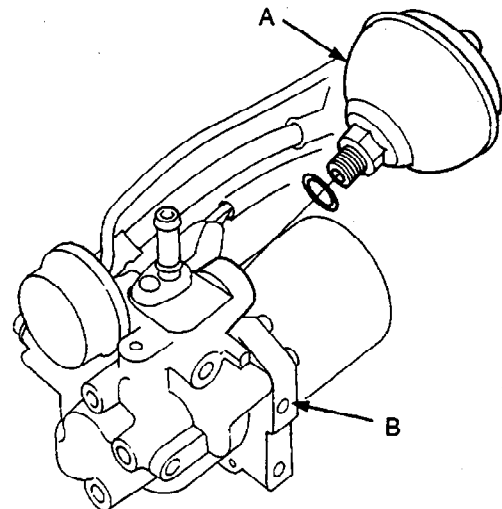
- A Motor terminal cover
- B Motor terminal
- C Pressure switch
- D Sealing washers
- E Banjo bolt

1. Secure the pump assembly in a vice.
2. Remove the harness band.
3. Slide the motor terminal cover off, then remove the motor terminal.
4. Remove the pressure switch.
5. Install the pressure switch in the reverse order of removal.

**Note:** Install the harness band at the correct position as shown below.

## Accumulator Disposal

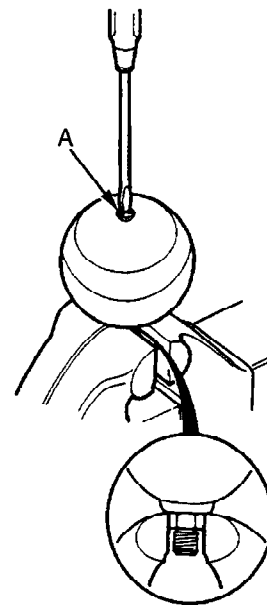
**WARNING:** The accumulator contains high pressure nitrogen gas. Do not puncture, expose to the flame, or attempt to disassemble the accumulator or it may explode and severe personal injury may result.



70M 0177

- A Accumulator
- B Pump assembly

1. Secure the pump assembly in a vice and remove the accumulator by turning it counterclockwise with a 19 mm open-end spanner.



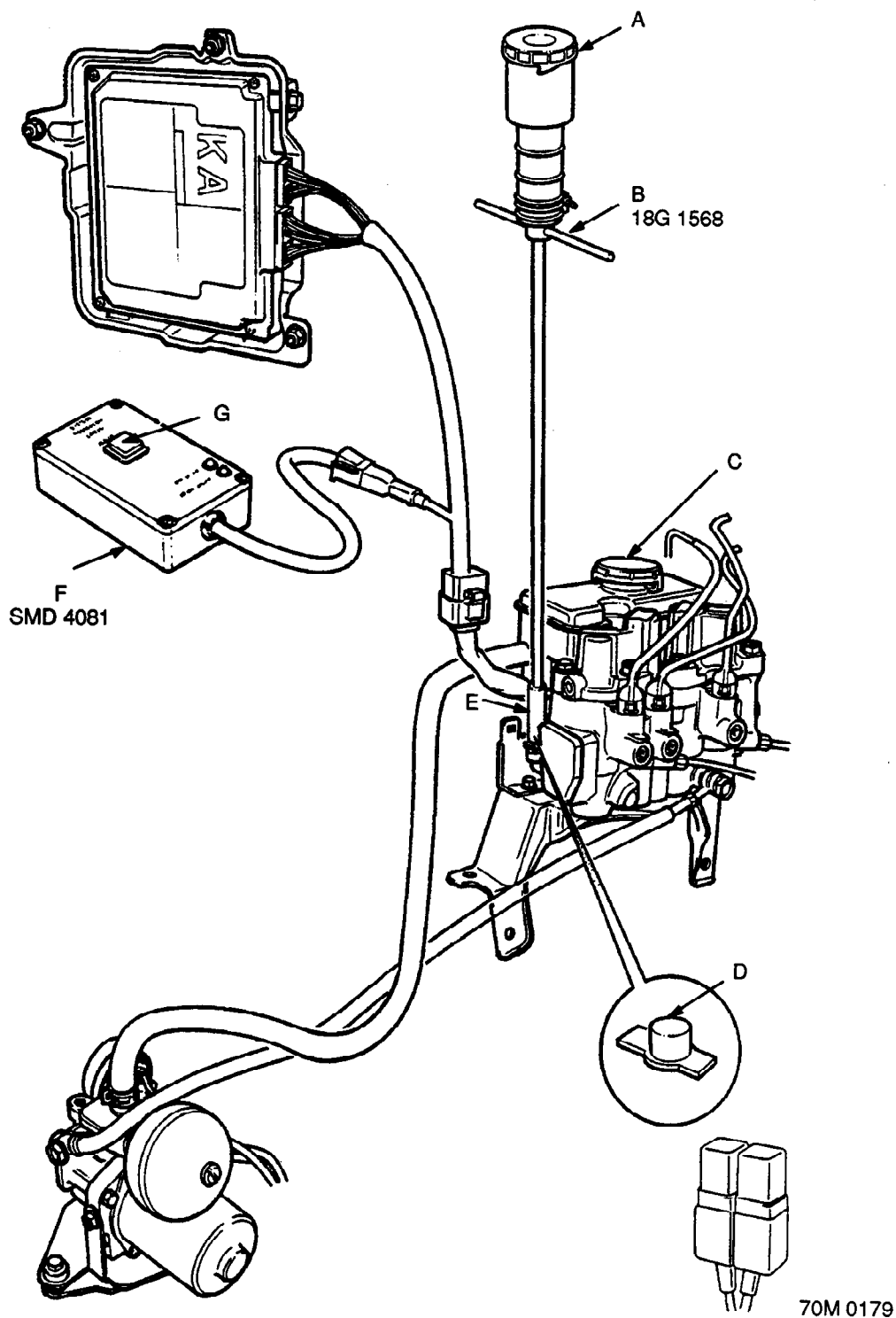
70M 0178

- A Relief plug

2. Secure the accumulator in a vice so that the relief plug points straight up.
3. Slowly turn the plug 3-1/2 turns and then wait 3 minutes for all pressure to escape.
4. Remove the plug completely and dispose of the accumulator.



## ABS HIGH PRESSURE SYSTEM – BLEED



- |   |                      |   |                      |
|---|----------------------|---|----------------------|
| A | Filler cap           | E | 'T' Wrench tool      |
| B | 'T' Wrench reservoir | F | Bleed control unit   |
| C | Pump reservoir       | G | 'START CYCLE' button |
| D | Bleed screw cap      |   |                      |



# BRAKES – ABS

This procedure covers bleeding the high pressure system and must be carried out when any part of the high pressure circuit is disconnected. If the braking system requires bleeding, it must be bled before the high pressure system.

**CAUTION:** *Never re-use fluid which has been bled from the brake system. The pump reservoir must be full to the MAX mark before bleeding. Check reservoir fluid level during bleeding and keep topped-up using recommended brake fluid. Do not fill to above the MAX mark.*

**CAUTION:** *Do not allow brake fluid to contact paint finished surfaces as paint may be damaged. If spilled, remove fluid and clean area with clean warm water.*

## Bleed

1. Disconnect vacuum pipe from air cleaner and intake trunking clips.
2. Disconnect intake trunking from air cleaner and release from clips.
3. Clean area around reservoir filler cap.
4. Check that all pipe and hose connections are tight and that there are no leaks in the system.
5. Top-up pump reservoir with recommended brake fluid.
6. Clean area around bleed screw and remove cap from bleed screw.
7. Fit 'T' wrench to tool to bleed screw. Ensure filler cap is fitted to 'T' wrench reservoir.

8. Connect bleed control unit **SMD 4081** to multiplug under R.H. seat.
9. With the car in Neutral start the engine and allow to idle.
10. Apply the footbrake and hold down.
11. Press 'START CYCLE' button on the bleed control unit to start the bleed sequence. While the bleed sequence is running the red 'BLEED CYCLE IN PROGRESS' LED will pulse and 'kickback' will be felt on the brake pedal. When the bleed is complete the red LED will extinguish and the green 'CYCLE COMPLETE' LED will illuminate.
12. Switch off the engine and **SLOWLY** open bleed screw using 'T' wrench, allow brake fluid to enter 'T' wrench reservoir. Close bleed screw when fluid stops or when reservoir is full.

**CAUTION:** *Bleed screw must be opened very slowly to avoid aerating the fluid.*

13. Remove filler cap and check condition of fluid in 'T' wrench reservoir.  
If aerated, dispose of fluid in 'T' wrench reservoir. Wait a few minutes for air to disperse in system. Repeat bleed process until fluid in reservoir is air-free.  
If air-free, tighten bleed screw, top up reservoir and fit cap.
14. Wash away any brake fluid from around bleed screw with clean water. Fit protective cap to bleed screw.

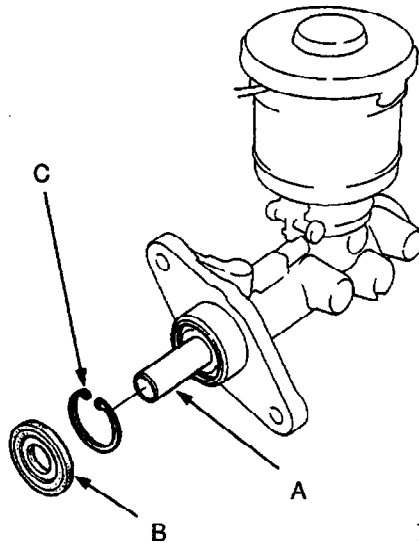


## MASTER CYLINDER

### Disassembly

#### CAUTION:

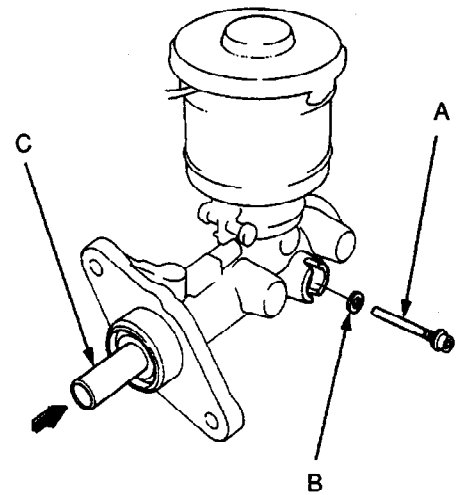
- Do not allow brake fluid to come into contact with paintwork as it will cause surface damage. If brake fluid does contact the paint, wash it off immediately with water.
- Clean all parts in brake fluid and air dry; blow out all passages with compressed air.



70M 0183

- A Secondary piston
- B Rod seal
- C Circlip

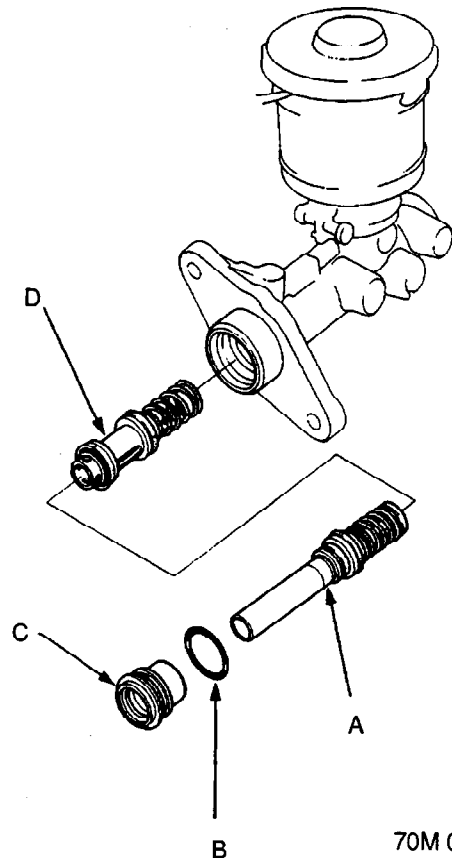
1. Remove the master cylinder.
2. Remove the rod seal.
3. Remove the circlip while pushing in the secondary piston.



70M 0184

- A Stop bolt
- B Sealing washer
- C Secondary piston

4. Remove the stop bolt while pushing in the secondary piston.



70M 0185

- A Secondary piston assembly
- B O-ring
- C Piston guide
- D Primary piston assembly

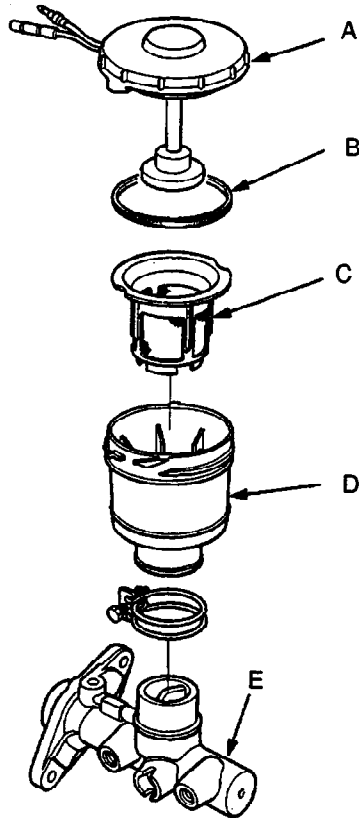
5. Remove the piston guide, secondary piston assembly and primary piston assembly.

## BRAKES - ABS

**Note:** If the primary piston assembly is difficult to remove, apply compressed air from the primary piston side port.

**CAUTION:**

- Do not use high pressure air or bring the nozzle too close to the port.
- Place a suitable piece of cloth over the master cylinder to collect the primary piston when it is ejected.



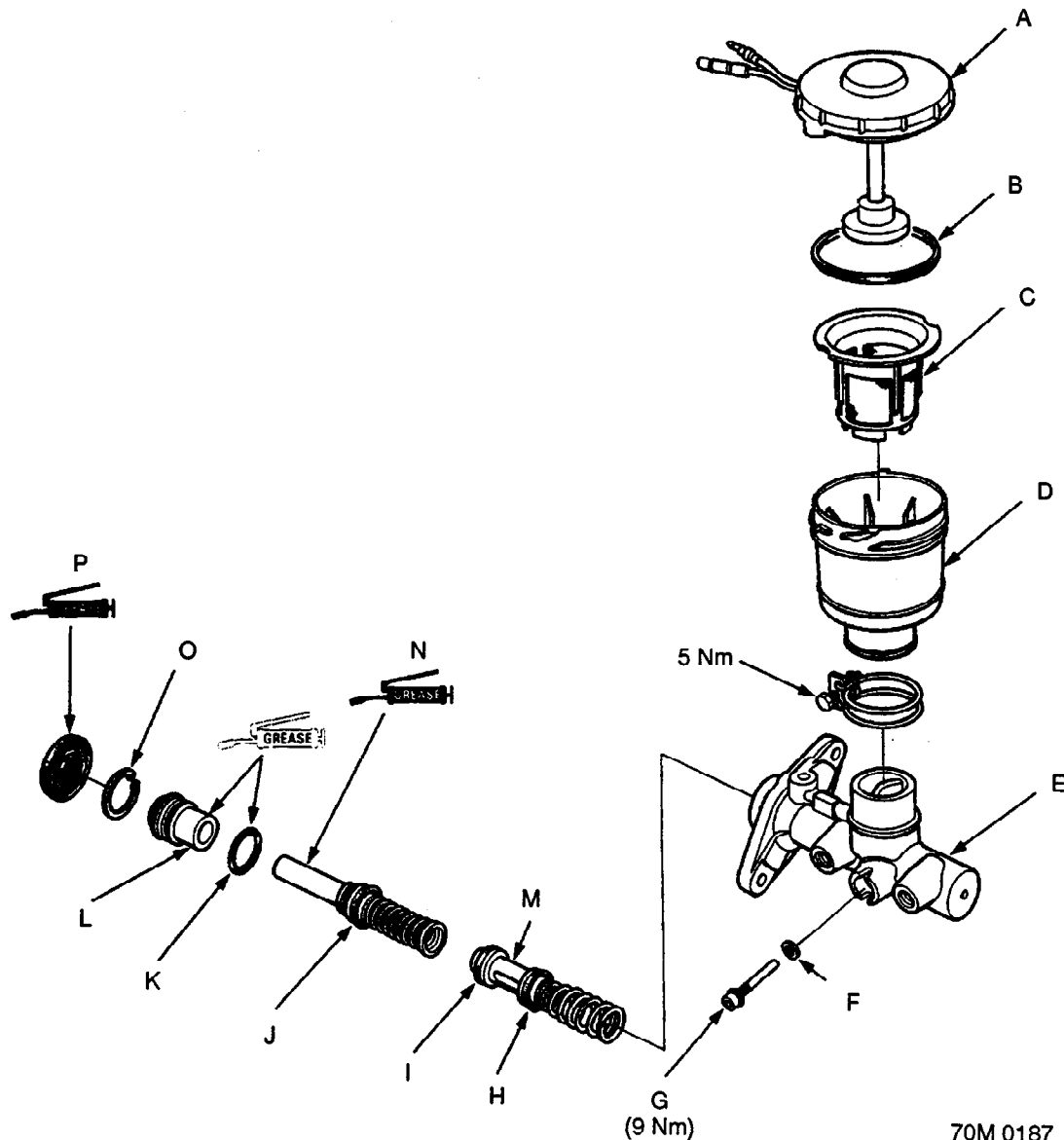
70M 0186

- A Reservoir cap
- B Reservoir seal
- C Strainer
- D Reservoir
- E Master cylinder

6. Remove the reservoir cap, strainer and reservoir from the master cylinder.
7. Remove the reservoir seal from the reservoir cap.



## Reassembly



- |   |                 |   |                           |
|---|-----------------|---|---------------------------|
| A | Reservoir cap   | I | Pressure cup              |
| B | Reservoir seal  | J | Piston cup                |
| C | Strainer        | K | O-ring                    |
| D | Reservoir       | L | Piston guide              |
| E | Master cylinder | M | Primary piston assembly   |
| F | Sealing washer  | N | Secondary piston assembly |
| G | Stop bolt       | O | Circlip                   |
| H | Piston cup      | P | Rod seal                  |

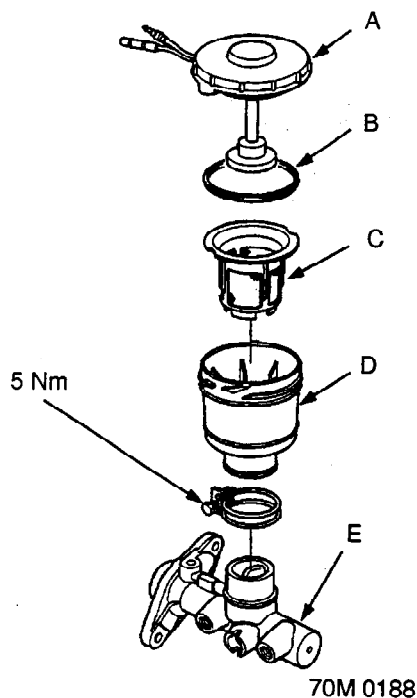
### CAUTION:

- Do not allow brake fluid to come into contact with paintwork as it will cause surface damage. If brake does contact the paint, wash it off immediately with water.
- Clean all parts in brake fluid and air dry; blow out all passages with compressed air.
- Before reassembling, check that all parts are free of dust and other foreign particles.
- Make sure no dirt or other foreign matter is allowed to contaminate the brake fluid.
- Do not mix different brands of brake fluid as they may not be compatible.
- Do not reuse the drained fluid. Use only clean DOT 4 brake fluid.
- Replace the master cylinder if the bore is damaged or worn. Do not attempt to repair the bore.

# BRAKES – ABS

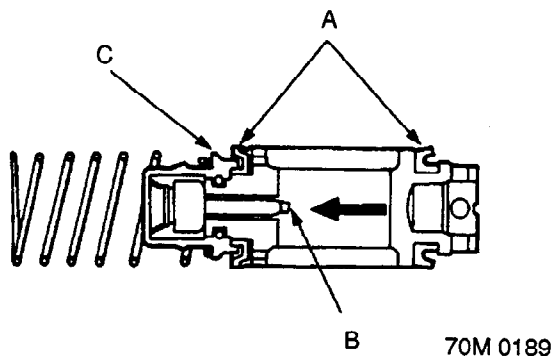
## Note:

- Coat new piston cups, pressure cup and master cylinder bore with clean brake fluid.
- Use recommended greases in the master cylinder seal set.



- A Reservoir cap
- B Reservoir oil seal
- C Strainer
- D Reservoir
- E Master cylinder

1. Install the reservoir on the master cylinder with a clamp as shown.
2. Install the reservoir seal in the groove of the reservoir cap.
3. Install the strainer and reservoir cap on the reservoir.

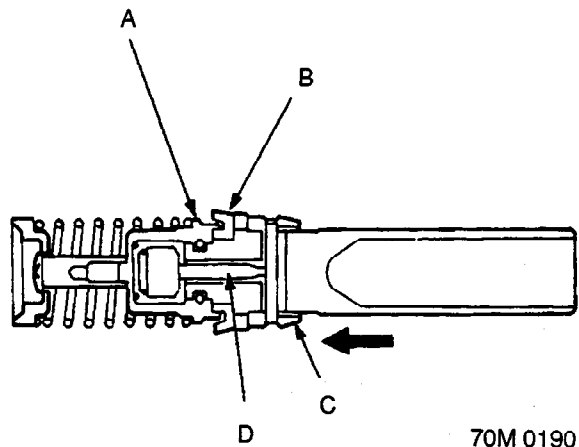


- A Cups
- B Valve stem
- C Primary piston assembly

4. Coat the cups of a new primary piston assembly with clean brake fluid, then install the primary piston assembly into the master cylinder.

## Note:

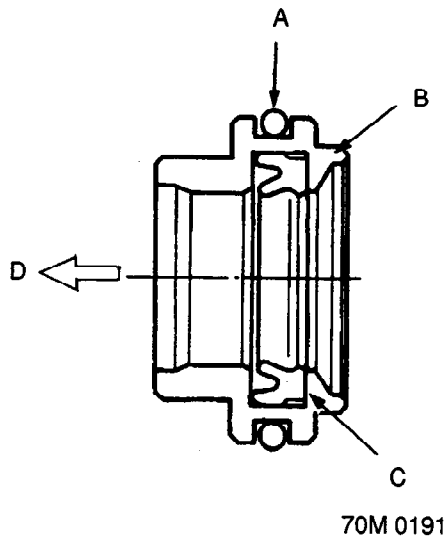
- Before installation, check that the valve stem moves smoothly by lightly pushing it through the slot in the piston.
- Install the piston so that the slot in the piston aligns with the stop bolt hole in the master cylinder.



- A Secondary piston assembly
- B Cup
- C Stop pin guide
- D Valve stem

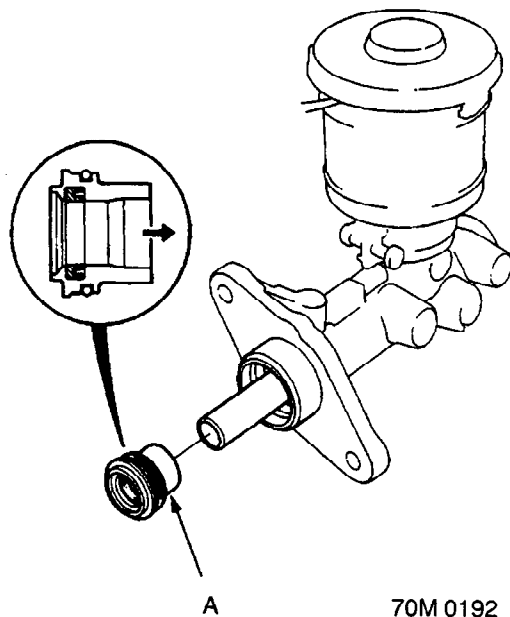
5. Coat the cup of a new secondary piston assembly with clean brake fluid.
6. Apply recommended grease in the master cylinder seal set to the piston and install the piston into the master cylinder.

**Note:** Check that the valve stem moves smoothly by pushing the stop pin guide.



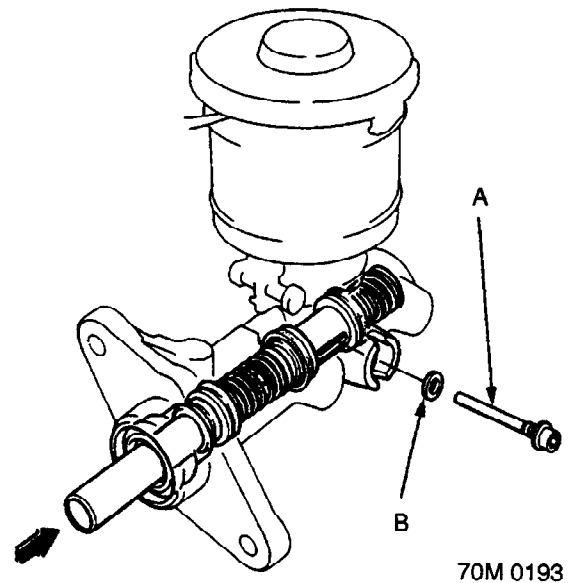
- A O-ring
- B Piston guide
- C Secondary cup
- D Front

7. Apply recommended grease in the master cylinder seal set to a new O-ring and the secondary cup in a new piston guide, and install the O-ring onto the piston guide.



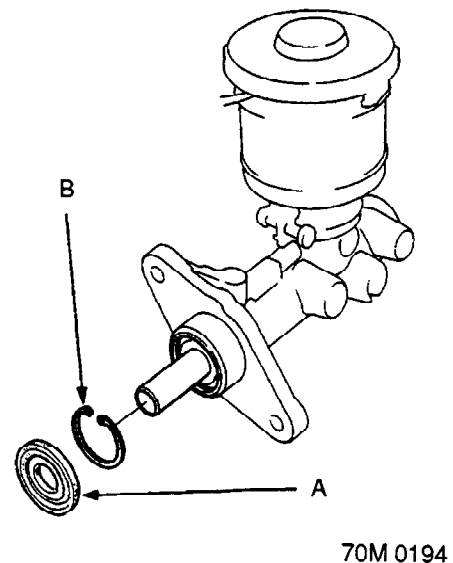
- A Piston guide assembly

8. Install the piston guide assembly into the master cylinder.



- A Stop bolt
- B Sealing washer

9. Align the slot in the primary piston with the stop bolt hole by pushing the secondary piston in, and install the stop bolt with a new sealing washer.



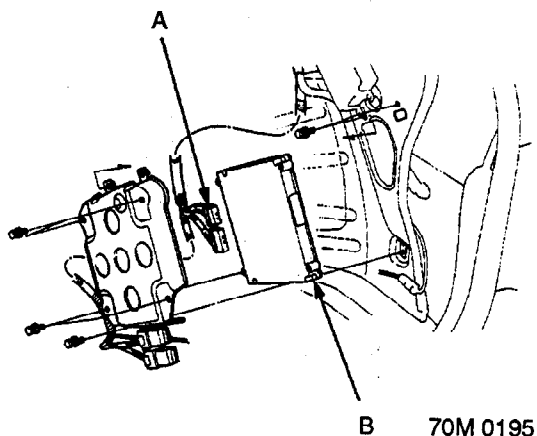
- A Rod seal
- B Circlip

10. Install a new circlip while pushing in the secondary piston.
11. Apply recommended grease in the master cylinder set to a new rod seal, and install the seal onto the master cylinder.
12. Adjust the pushrod clearance.
13. Install the master cylinder.

# BRAKES – ABS

## ELECTRONIC COMPONENTS

### ABS Control Unit Replacement

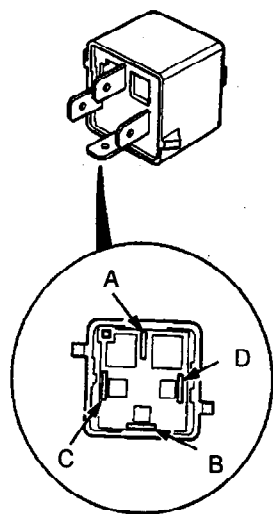


- A ABS control unit connectors  
B ABS control unit

1. Remove the right quarter trim panel.
2. Disconnect the ABS control unit connectors.
3. Remove the ABS control unit mounting bolts, then remove the control unit.
4. Install the ABS control unit in the reverse order of removal.

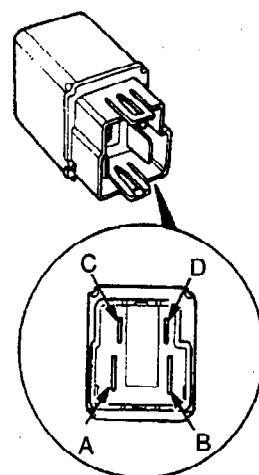
### Relay Inspection

#### Fail-safe Relay



70M 0196

#### Motor Relay



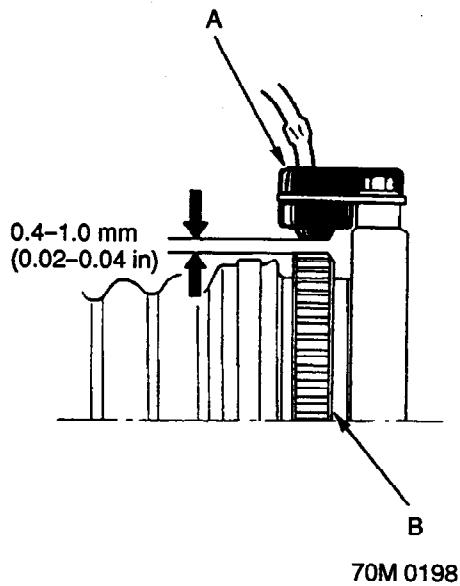
70M 0197

1. Remove the fail-safe relays and motor relay.
2. Check for continuity between the terminals C and D.  
There should be continuity.
3. Check for continuity between the terminals A and B.  
There should be continuity when the battery is connected between the terminals C and D.  
There should be no continuity when the battery is disconnected.



## Wheel Sensor Inspection

### Front



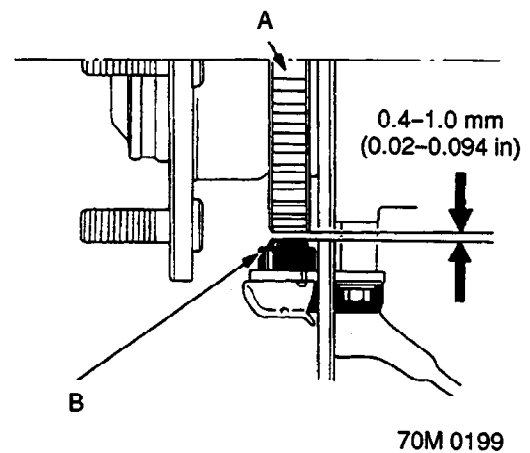
- A Front wheel sensor
- B Front pulser

1. Check the front pulser for chipped or damaged teeth.
2. Measure the air gap between the wheel sensor and pulser all the way around while rotating the driveshaft by hand.

Standard: 0.4–0.1 mm (0.02–0.04 in)

**Note:** If the gap exceeds 1.0 mm (0.04 in), the probability is a distorted knuckle which should be replaced.

### Rear



- A Rear pulser
- B Rear wheel sensor

1. Check the rear pulser for chipped or damaged teeth.
2. Measure the air gap between the wheel sensor and pulser all the way around while rotating the hub bearing unit by hand.

Standard: 0.4–0.1 mm (0.02–0.04 in)

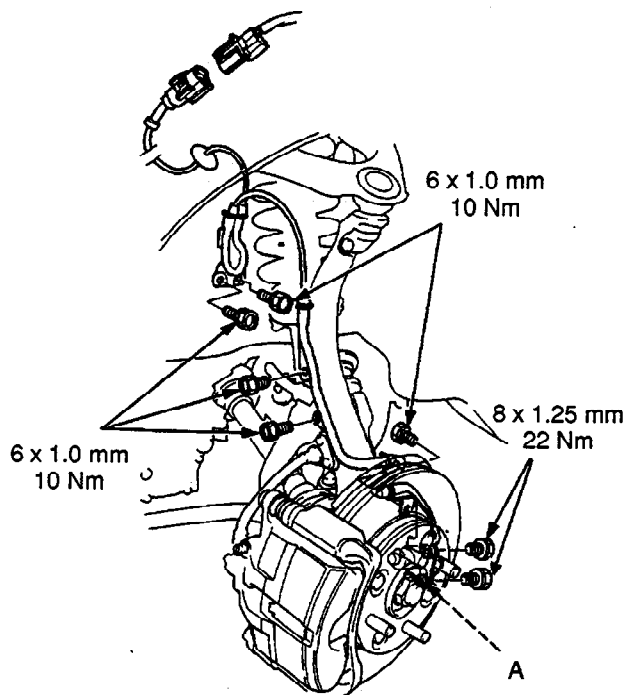
**Note:** If the gap exceeds 1.0 mm (0.04 in), the probability is a distorted knuckle which should be replaced.



# BRAKES – ABS

## Wheel Sensor Replacement

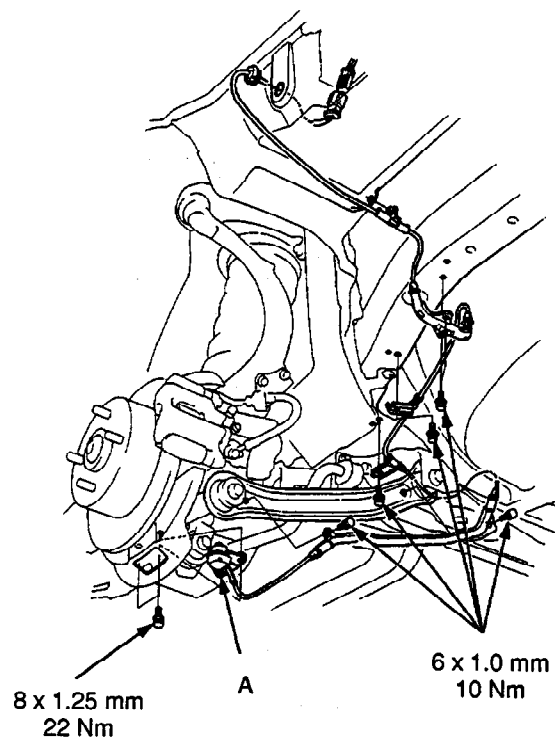
### Front



70M 0200

A Front wheel sensor

### Rear



70M 0201

A Rear wheel sensor

### Note:

- Be careful when installing the sensors to avoid twisting the wires.
- After sensor replacement, confirm correct operation.

# BRAKES - ABS BY4

## CONTENTS

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<hr/>	
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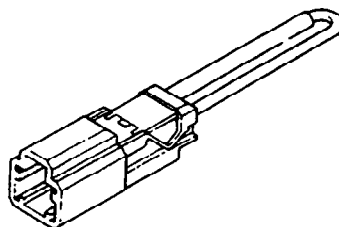


## BRAKES - ABS BY4

### SPECIAL TOOLS - ABS BY4

No.	Honda Number	Rover Number	Description
1	07PAZ - 0010100	18G 1724	SCS Short connector

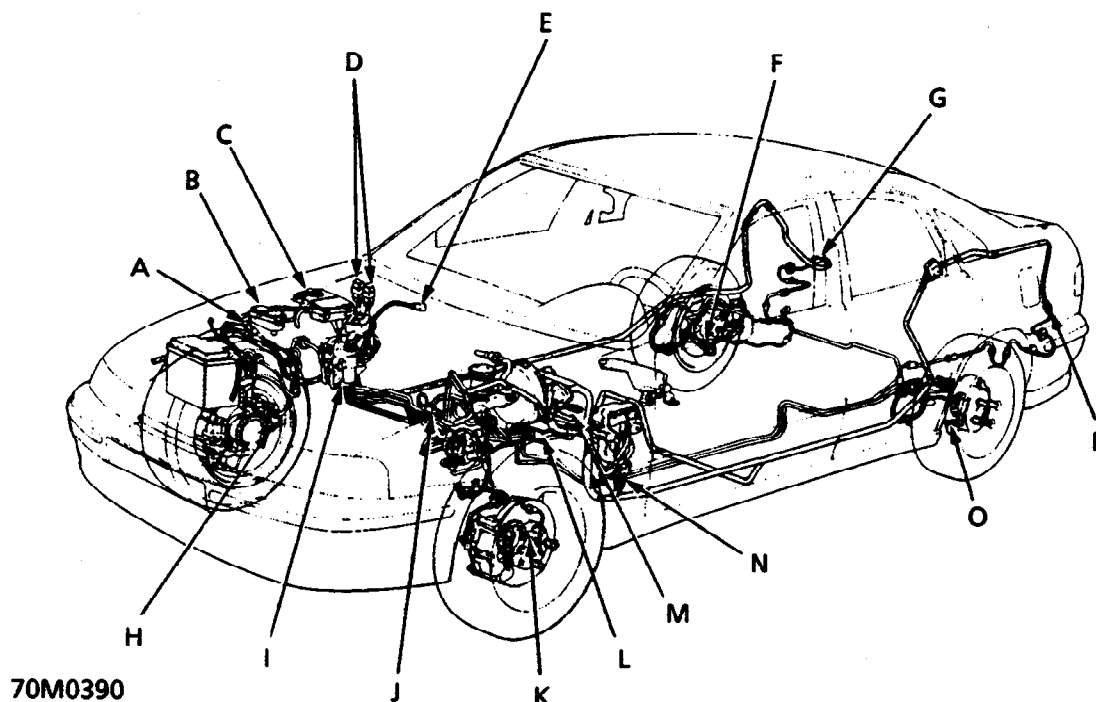
*The tools illustrated in this section are Honda tools, and Rover do not always have an equivalent. Where an equivalent Rover tool is available, it may not be visually identical to the Honda tool.*



70M0418



## COMPONENT LOCATION

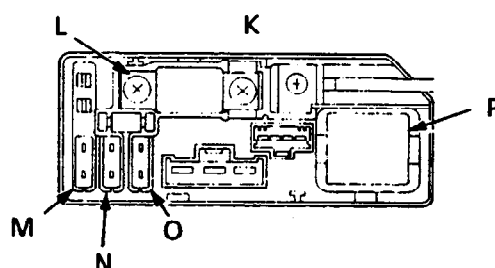
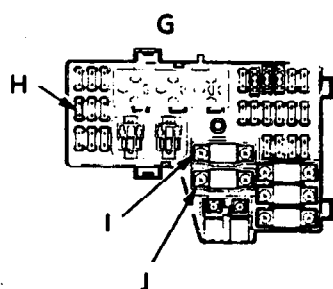
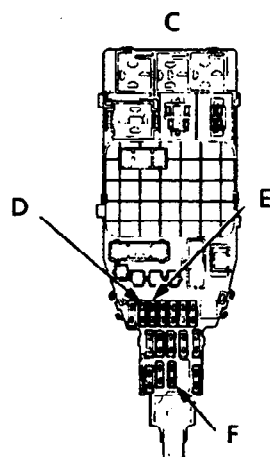
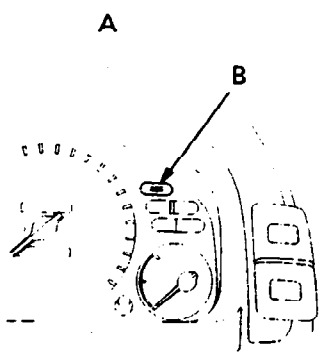


- |   |                                     |   |                               |
|---|-------------------------------------|---|-------------------------------|
| A | Sensor connector - right front      | I | Modulator unit                |
| B | Under - bonnet fuse/relay box*      | J | Sensor connector - left front |
| C | Under - bonnet fuse/relay box*      | K | Wheel sensor - left front     |
| D | Fail - safe relays - under fusebox* | L | ABS control unit              |
| E | Service check connector - 2P        | M | ABS inspection connector - 6P |
| F | Wheel sensor - right rear           | N | Under - dash fuse/relay box   |
| G | Sensor connector - right rear       | O | Wheel sensor - left rear      |
| H | Wheel sensor - right front          | P | Sensor connector - left rear  |

\* Refer to BRAKES - ABS for Inspection and Repairs

**WARNING:** The accumulator contains high pressure nitrogen gas, do not puncture, expose to flame or attempt to disassemble the accumulator or it may explode; severe personal injury may result.

# BRAKES - ABS BY4



70M0391

- |   |   |   |                                   |
|---|---|---|-----------------------------------|
| A | Gauge assembly  | I | Ignition switch fuse - 50A        |
| B | ABAS indicator light                                  | J | Battery fuse - 80A                |
| C | Under - dash fuse/relay box                           | K | Under - bonnet ABS fuse/relay box |
| D | Heater control relay/rear defroster relay fuse - 7.5A | L | ABS motor fuse - 40A              |
| E | Direction indicator/reversing lights fuse - 10A       | M | Motor check valve fuse - 7.5A     |
| F | ECU fuse - 15A  | N | ABS B2 fuse - 15A                 |
| G | Under - bonnet fuse/relay box                         | O | ABS B1 fuse - 15A                 |
| H | Stop light/horn fuse - 20A                            | P | ABS pump motor relay              |



## ABS SYSTEM CONSTRUCTION

### ABS BY4 system from VIN 144845

The Anti-lock Brake System (ABS) modulates the pressure of the brake fluid applied individually to each front caliper and to both rear calipers, thereby preventing the wheels locking, even under hard braking. It then restores normal hydraulic pressure when there is no longer a possibility of a wheel locking.

#### **Gear pulser and wheel sensor**

The slotted gear pulser is attached to the rotating part of the wheel hub. The wheel sensor detects the slots and generates pulse signals corresponding to the revolutions of the gear pulser.

#### **ABS control unit**

Controls the working of the anti-lock brake system by performing calculations based on the signals from the individual wheel signals and the individual switches.

#### **Modulator unit**

Adjust the hydraulic pressure applied to each caliper on the basis of the signals received from each ABS control unit.

#### **Motor relay**

Controls the ABS pump motor's power supply according to the signal from the ABS control unit.

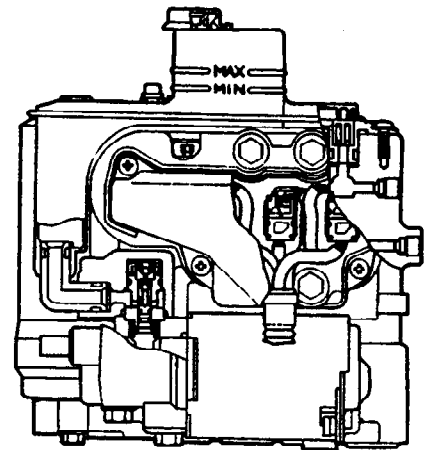
#### **Fail-safe relay**

Cuts off the solenoid valve ground circuit when the fail-safe device is at work.

#### **Features**

- Kickback is felt on the brake pedal when the anti-lock brake system is operating.
- The system is equipped with a self-diagnosis function (DTC). When an abnormality is detected, the ABS indicator light comes on. The system's fault can be diagnosed from the frequency of the system indicator light blinks.
- This system has individual control of the front wheels and common control ("Select low") for the rear wheels. "Select Low" means that the rear wheel that would lock first (the one with lowest resistance to lock-up) determines anti-lock brake system activation for both rear wheels.
- The system has a fail-safe function that allows normal braking if there is a problem with the anti-lock brake system.

### Modulator unit



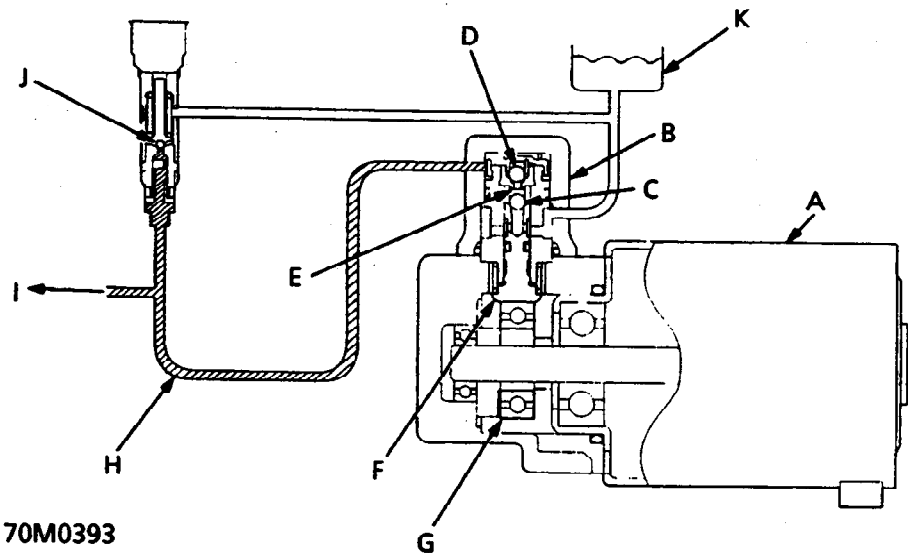
70M0392

The modulators unit, adjusts the hydraulic pressure to each caliper on the basis of the signals received from the ABS control unit, and consists of the following sub-units.

- **ABS pump and motor:** Supplies high-pressure brake fluid to the ABS operation.
- **Accumulator:** Stores high-pressure brake fluid.
- **Pressure switch:** Detects the pressure in the accumulator and transmits signals to the ABS control unit.
- **Solenoid valves:** Switches the ABS high-pressure passage according to the signals from the ABS control unit.
- **Pistons and related parts:** Receives the high-pressure brake fluid and controls pressure to the calipers accordingly.

# BRAKES - ABS BY4

## Motor and pump



70M0393

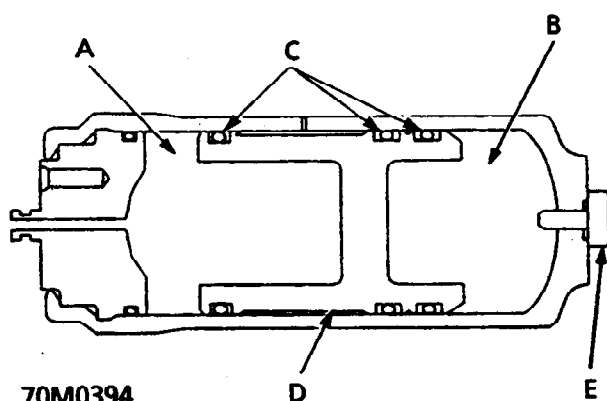
- |   |                      |   |                                       |
|---|----------------------|---|---------------------------------------|
| A | Motor                | G | Eccentric bearing                     |
| B | Pump                 | H | High pressure circuit                 |
| C | Check valve - inlet  | I | To accumulator, solenoids and pistons |
| D | Check valve - outlet | J | Relief valve                          |
| E | Plunger chamber      | K | Reservoir                             |
| F | Plunger              |   |                                       |

As the motor rotates, it drives the plunger - type ABS pump and raises the brake fluid pressure to approximately 25,000 kPa, 250 bar, 3,600 lb/in<sup>2</sup>. The eccentric bearing is attached to the motor shaft end; it contains the pump plunger.

When the plunger is pushed, the brake fluid in the plunger chamber is pressurised and fed to the accumulator, solenoid and pistons, via the check valve. When the pressure in the accumulator exceeds 35,000 kPa, 350 bar, 5,000 lb/in<sup>2</sup>, the relief valve opens to release the excess pressure to the reservoir.



## Accumulator



70M0394

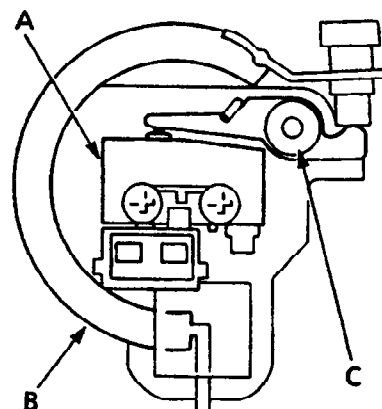
- A Fluid chamber
- B Gas chamber - nitrogen gas filled
- C 'O' rings
- D Free piston
- E Relief plug

The high - pressure brake fluid discharged from the pump is fed to the solenoids and pistons, but the passage to the solenoids and pistons is normally closed. Consequently, the high pressure brake fluid is accumulated in the accumulator.

The accumulator consists of two chambers separated by a free piston; that is, a fluid chamber where the brake fluid is accumulated and a chamber filled with high pressure nitrogen gas to maintain the fluid at a given pressure.

When the ABS operates, the constant high - pressure brake fluid in the accumulator is supplied to the pistons.

## Pressure Switch



70M0395

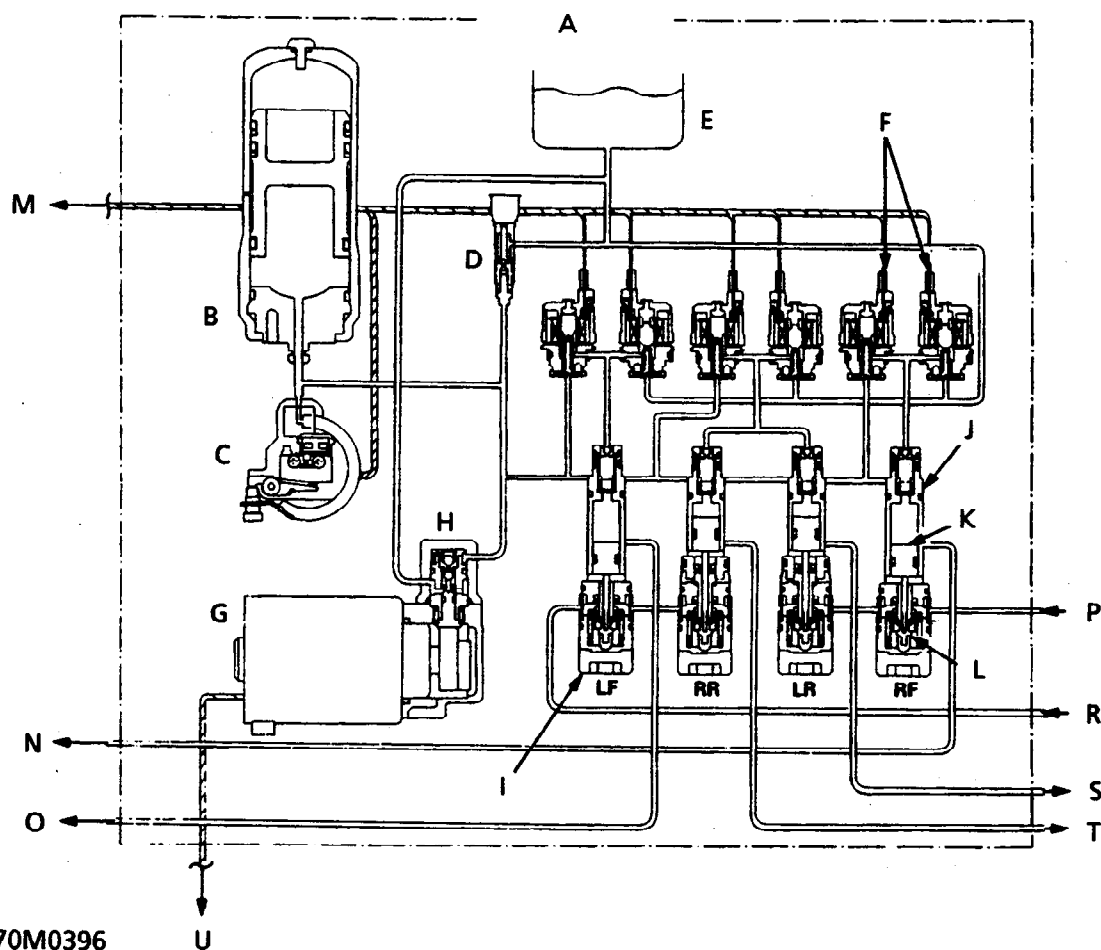
- A Micro - switch
- B Bourdon tube
- C Sensing lever

The pressure switch monitors the pressure accumulation (pressure from the pump) in the accumulator. When the pressure in the accumulator rises, the Bourdon tube in the pressure switch deforms outward, which in turn activates the micro - switch by the force of the spring attached to the sensing lever. When the pressure in the accumulator drops due to ABS operation, the Bourdon tube moves in the opposite direction and the micro - switch is eventually turned off.

The ABS control unit detects the fluid pressure in the accumulator by the ON/OFF signals from the pressure switch.



# BRAKES - ABS BY4



A	MODULATOR UNIT	L	Cut valve
B	Accumulator	M	to ABS control unit
C	Pressure switch	N	to right front wheel
D	Relief valve	O	to left front wheel
E	Reservoir	P	from master cylinder primary piston
F	Solenoid valves (3 sets)	R	from master cylinder secondary piston
G	Motor	S	to left rear wheel
H	Pump	T	to right rear wheel
I	Piston valve	U	to pump motor relay
J	Sleeve		
K	Piston		

## Piston/valve

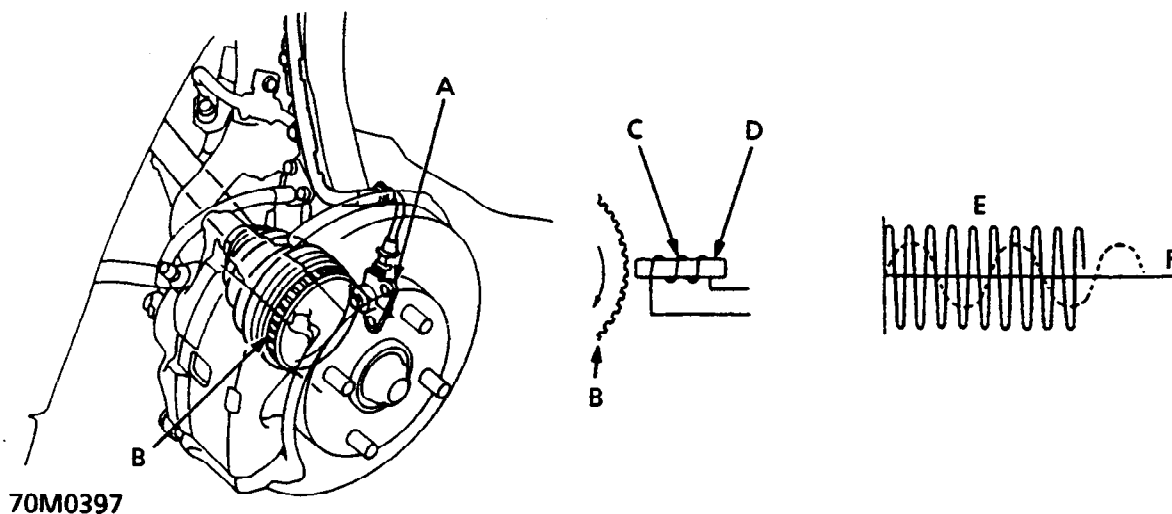
The piston/valve assembly consists of the piston, cut valve and sleeve. There are 4 piston/valve assemblies in the modulator unit to control the brake fluid pressure to each caliper. The piston/valve assemblies for the rear brakes also serve as proportioning control valves to prevent the rear wheels from locking if the ABS malfunctions or when the ABS is not activated.

## Solenoid valves

The modulator unit opens and closes the inlet and outlet solenoid valves, and shifts the ABS high - pressure passage according to the signals from the ABS control unit. There are 3 solenoid valve assemblies, each containing an inlet and outlet valve, in the modulator unit; one for each front wheel, and one for both rear wheels. The inlet valves are normally open (open when the coil is not energized), while the outlet valves are normally closed.



## Wheel sensor



- A Wheel sensor
- B Gear pulser
- C Coil

- D Permanent magnet
- E at high speed
- F at low speed

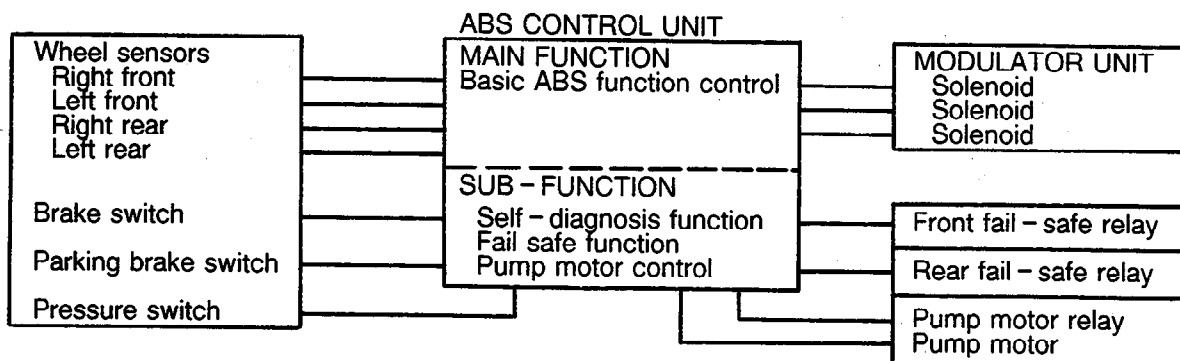
The contactless type wheel sensor is comprised of a permanent magnet and coil which detects the rotational speed of the gear pulser on each wheel hub (**front wheel:** outboard joint of the driveshaft, **rear wheel:** hub bearing unit). The magnetic flux around the coil in the wheel sensor alternates, generating voltages with frequency in proportion to wheel rotational speed. These pulses are feed into the ABS control unit and the control unit identifies the individual wheel speeds.

# BRAKES - ABS BY4

## ABS CONTROL UNIT

The ABS control unit consists of a main function section, which controls the operation of the anti-lock brake system, and sub-function, which controls the pump motor and Self-diagnosis.

For safety, the main function consists of 2 systems, thus the ABS control unit will only activate a solenoid valve when the outputs of the 2 systems agree.



### Main Function

The main function section of the ABS control unit performs calculations on the basis of the signals from each wheel sensor and controls the operation of the anti-lock brake system by operating the solenoid valves in the modulator unit for each front brake and Select Low control for the two rear brakes. Select Low control of the rear wheels means that the rear wheel that would lock first determines the ABS activation for both rear wheels.

### Sub-function

The sub-function section gives driving signals to the pump motor and also gives Self-diagnosis signals necessary for backing up the anti-lock brake system.

### Pump motor control

The control unit monitors the brake fluid pressure in the accumulator by the pressure switch ON/OFF signals. The ABS control unit turns the pump on when the pressure in the accumulator drops, and stops the pump when the pressure rises to the specified value.

If the pressure does not reach the specified value after the motor has operated continuously for a specified period, the ABS control unit stops the motor and activates the ABS indicator light.

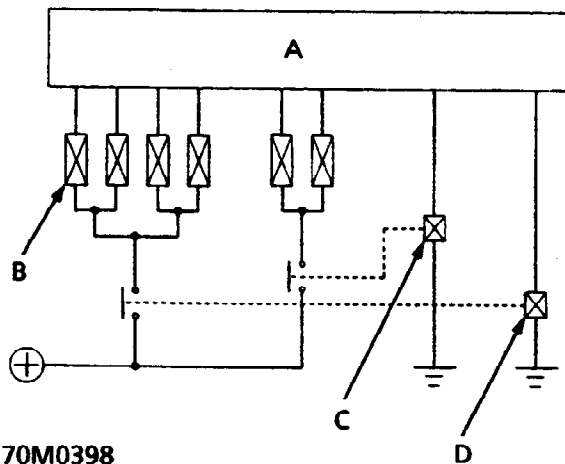
### Self-Diagnostic Function

The self-diagnosis function, provided by the sub-function of the ABS control unit, monitors the main system functions by constantly transmitting the data between the 2 Central Processing Units (CPU's). When an abnormality is detected, the ABS control unit turns the ABS indicator light on and ABS is inhibited. The diagnostic trouble code (DTC) is recorded in the control unit, which can be read from the frequency of blinks given by the ABS indicator light. The basic braking system continues to operate normally.

There is also a check mode of the self diagnosis system, when the ignition is switched on. The ABS indicator light comes on and stays on for a few seconds after the engine has started to signify that the self diagnosis system is functional.



## Fail - Safe Function



70M0398

- A ABS control unit
- B Solenoid valves
- C Rear fail - safe relay
- D Front fail - safe relay

When abnormality is detected in the control system by the self - diagnosis, the solenoid operations are suspended by turning off the 2 fail - safe relays. This disconnects the earth paths of all the solenoid valves to inhibit ABS operation.

## ABS indicator light

The ABS control unit turns on the ABS indicator light when one or more of the following abnormalities is detected. This is only a partial list.

- When the operating time of the motor in the ABS pump assembly exceeds the specified period.
- When vehicle running time exceeds 30 seconds without releasing the parking brake lever.
- When one of the rear wheels is locked during running.
- When absence of speed signals from any of the four wheel sensors is detected.
- When the activation time of all solenoids exceeds a given time or an open circuit is detected in the solenoid system.
- When solenoid output is not detected in the simulated anti - lock brake system operation carried out during running at speeds of 10 km/h (6 mph) or more.

To check the ABS indicator light bulb, the light is activated when the ignition switch is first turned on. It is turned off after the engine is started if there is no abnormality in the system.

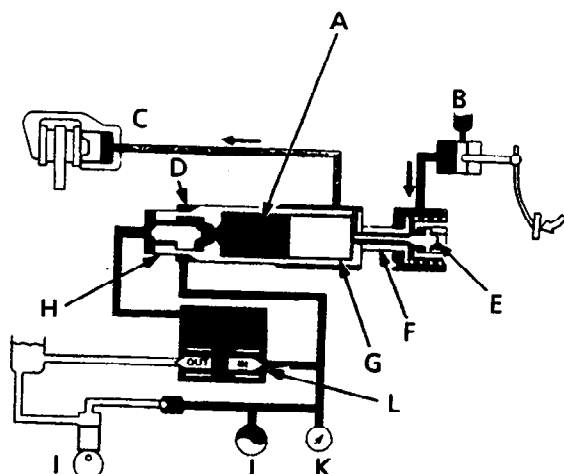
# BRAKES - ABS BY4

## ABS SYSTEM OPERATION

### ABS BY4 system from VIN 144845

The following description of ABS operation is for one of the front wheels. The remaining wheels operate in the same way.

#### Normal Braking Function



70M0399

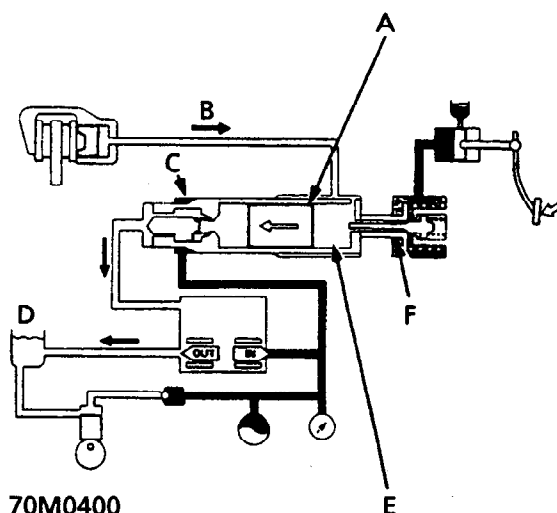
- A Back - pressure chamber
- B Master cylinder
- C Caliper
- D Chamber A
- E Cut valve - open
- F Cut valve seat
- G Piston
- H Sleeve
- I Pump
- J Accumulator
- K Pressure switch
- L Solenoid valve

In normal braking operations when ABS is not functioning, the solenoid outlet valve is closed and the inlet valve is open, transmitting the hydraulic pressure to the back - pressure chamber between the sleeve and piston, the cut valve is thus pushed by the piston. As the high - pressure is also transmitted to chamber A between the sleeve and cylinder, the sleeve also pushes the cut valve seat towards the cut valve.

Under these conditions, the cut valve is kept open, and the hydraulic pressure from the master cylinder is transmitted to the caliper for normal operation of the braking system.

#### When ABS is functioning

#### Control by reducing caliper fluid pressure



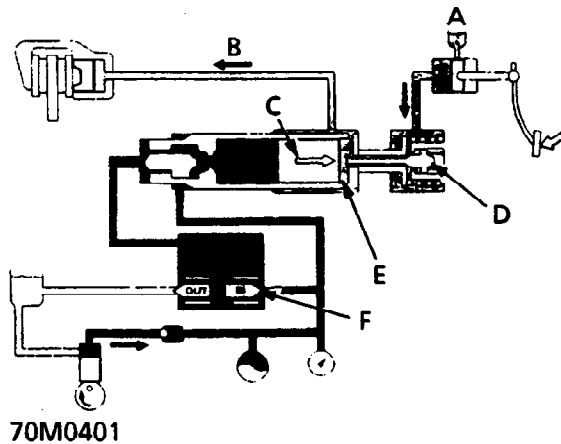
70M0400

- A Piston slides
- B Pressure reduces
- C Chamber A
- D Reservoir
- E Pressure reduction chamber
- F Cut valve - close

When brake pedal pressure is excessively high, and a possibility of wheel locking occurs, the ABS control unit operates the solenoid valve, closing the inlet valve and opening the outlet valve. As a result, the high pressure in the back - pressure chamber is released to the reservoir, the piston is pushed by the caliper fluid pressure towards the back - pressure chamber. However, the cut valve seat is kept in the extended position because high pressure is transmitted to the chamber A. As the piston moves, the cut valve moves and shuts off the flow from the master cylinder, the volume of the pressure reduction chamber connected to the caliper increases, and the fluid pressure in the caliper reduces, reducing the braking force. The wheel speed is therefore restored, preventing the wheel from locking.



## Control by increasing caliper fluid pressure



- A Piston slides
- B Pressure reduces
- C Chamber A
- D Reservoir
- E Pressure reduction chamber
- F Cut valve - closed

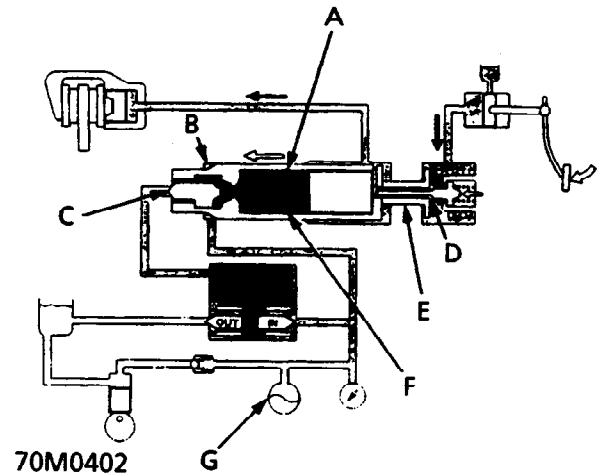
When the ABS control unit senses that the caliper fluid pressure has reduced, and the wheel speed is restored, it signals the solenoid inlet valve to open and the solenoid outlet valve to close.

As a result, the high pressure brake fluid is transmitted to the back - pressure chamber, and the piston is pushed towards the pressure reduction chamber, increasing caliper fluid pressure and thereby regaining the braking force.

When the fluid pressure on the master cylinder side is low, the cut valve is slightly opened as the piston moves, and the caliper fluid pressure is transmitted to the master cylinder. The 'kickback' is felt on the brake pedal this time.

When the force depressing the brake pedal is relieved while the ABS is functioning, the cut valve seat is opened and the pressure in the pressure reductions chamber is returned to the master cylinder side. As a result, the caliper fluid pressure is relieved.

## When high - pressure reduces



- A Hydraulically locked back pressure chamber
- B Chamber A
- C Valve closed
- D Cut valve - opens
- E Cut valve seat moves
- F Sleeve moves
- G Pressure drops

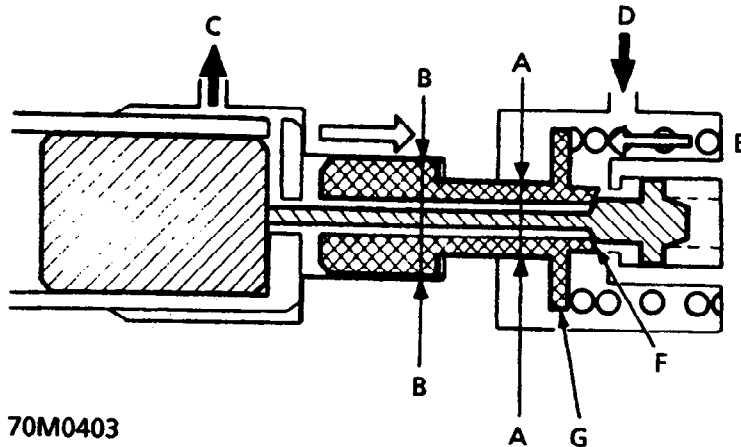
The ABS control unit monitors the pressure in the high - pressure passage by means of the pressure switch signals. The ABS control unit turns the ABS indicator light on, and stops the ABS when it detects an excessive drop in pressure in the high - pressure passage.

When the pressure reduction is due to leakage from the passage, for example, the pressure in chamber A reduces also, and the cut valve seat and sleeve return towards chamber A.

As a result, the valve at the sleeve end closes, which hydraulically locks the back - pressure chamber and blocks the piston movement. Because the cut valve opens as the cut valve seat moves, this connects the brake fluid passage between the master cylinder and caliper normal brake operation.

# BRAKES - ABS BY4

## Proportioning control valve function



70M0403

- A Section where pressure from master cylinder is applied
- B Section where pressure from rear caliper is applied
- C to rear brake caliper

- D from master cylinder
- E Spring force
- F Cut valve - closed
- G Cut valve seat

To prevent the rear wheels from locking, the proportioning control valve function changes the distribution rate of the fluid pressure to the rear wheels when the pressure in the rear brake system exceeds the given value of the fluid pressure from the master cylinder. The fluid pressure point where the distribution rate changes is called the Turning Point.

The cut valve seat in the rear brake system has a shoulder between sections A and B. Section A, where pressure from the master cylinder is applied, has a smaller diameter than section B, where pressure from the rear brake calipers is applied. This arrangement provides the proportioning control valve function as follows.

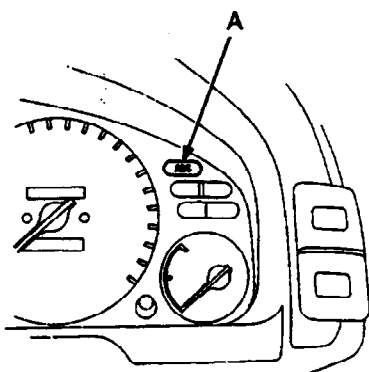
1. When the fluid pressure from the master cylinder is below the Turning Point, the cut valve seat is pushed by the spring force and the cut valve is open. Therefore, the fluid pressure from the master cylinder is transmitted to the rear brake caliper side. Under these conditions, fluid pressure from the master cylinder is equal to the pressure to the rear brake caliper, but because of the diameter difference between section A and B, the force on the cut valve overcomes the spring force, moving the cut valve seat slowly towards the cut valve.

2. When the fluid pressure to the rear brake caliper reaches the Turning Point, the cut valve is closed by the cut valve seat, blocking the fluid passage between the master cylinder side and rear wheel cylinder side.
3. When fluid pressure from the master cylinder exceeds the Turning Point, the fluid pressure from the master cylinder rises, while the pressure to the rear brake caliper remains at the Turning Point value. As a result, the cut valve seat moves away from the cut valve and the cut valve opens. The passage between the master cylinder and the caliper opens momentarily, but it is blocked again because the fluid pressure to the brake caliper rises, and the cut valve seat moves to close the cut valve. As explained above, when the pressure in the master cylinder is above the Turning Point, the cut valve seat reduces the pressure in the rear brake caliper to the prescribed amount by repeating the process.



## FAULT FINDING

### ABS Indicator Light



70M 0115

A ABS indicator light

The ABS indicator light comes on for 3 seconds and then goes off when the control unit detects no problems during the initial diagnoses after the engine is started.

However, the ABS indicator light can stay on for up to 40 seconds when the engine control unit starts to check for pump overrun, during the initial diagnosis.

The ABS indicator comes on, and the ABS control unit memorizes the diagnostic trouble code (DTC) under the following conditions.

- When the parking brake is applied for more than 30 seconds while the vehicle is being driven.  
DTC: 2 - 1
- The transmission has downshifted excessively.  
DTC: 4 - 1, 4 - 2
- The vehicle loses traction, with wheel spin for more than a minute, when attempting to move from rest on a muddy, snowy, or sandy road.  
DTC: 4 - 8
- The tyre(s) adhesion is lost due to excessive cornering speed.  
DTC: 5, 5 - 4, 5 - 8
- The vehicle is driven on an extremely rough road.  
DTC: 8 - 1
- The vehicle is affected by strong (illegal) radio waves (noise)  
DTC: 8 - 2

**Note:** If there is a problem in the system whilst driving, the ABS indicator light will come on.

### Diagnostic Trouble Code - DTC

- When the control unit detects a problem and the ABS indicator comes on, the ABS control unit memorizes the DTC.
- The control unit has 3 memory registers. When a problem occurs, the control unit stores the DTC in the first register. Should another problem occur, or the same problem occurs again, the register moves the first DTC up to the next memory, and stores the second DTC in the first register. If a third fault occurs, the 2 previous DTC's move up one register, and the third DTC is stored in the first register. If problems continue to occur, the problem in the third register is lost each time.
- The most recent DTC is indicated first, and the the oldest DTC is the third.
- The DTC's are erased from the control unit when the ABS + B2 power supply is disconnected.
- The control unit's memory can be erased by disconnecting the ABS B2 fuse for more than 3 seconds.

**Note:** If you receive a customer's report that the ABS indicator light sometimes comes on, check the fault code in the ECU memory first and use Microcheck. Do not use Microcheck before checking the fault code since this disconnects the ECU from the battery and any fault codes stored will be lost.

### Self - diagnosis

- There are 3 self - diagnosis systems:
  1. Initial diagnosis: Performed immediately after the engine is started until the ABS indicator light goes out.
  2. Regular diagnosis: Continuously performed (certain conditions) after the ABS indicator light goes out and until the engine is switched off.
  3. Individual part/system diagnosis: Diagnosis about a specific part/system under its operating conditions.
- The CPU (central processing unit) controls the following when it detects a problem under self - diagnosis:
  1. Turns the ABS indicator light ON.
  2. Turns the front and rear fail - safe relays off.
  3. Stops the ABS control.
  4. Stops the ABS pump (the pump may work under some conditions)



# BRAKES - ABS BY4

## Kickback and Pump Operation

- When the engine is started, the ABS control unit begins the initial diagnosis and operates the solenoid valve one time. The kickback may be felt when the brake pedal is depressed.
- When the ABS control unit detects the pressure switch Off signal during the initial diagnosis, it operates the pump, and performs the pump motor over - run diagnosis. Therefore, there are 2 cases where the pump motor operates or does not operate after the engine is started.
- Normally, after the initial diagnosis, the pump operates based on the pressure switch signal, regardless of the vehicle speed.

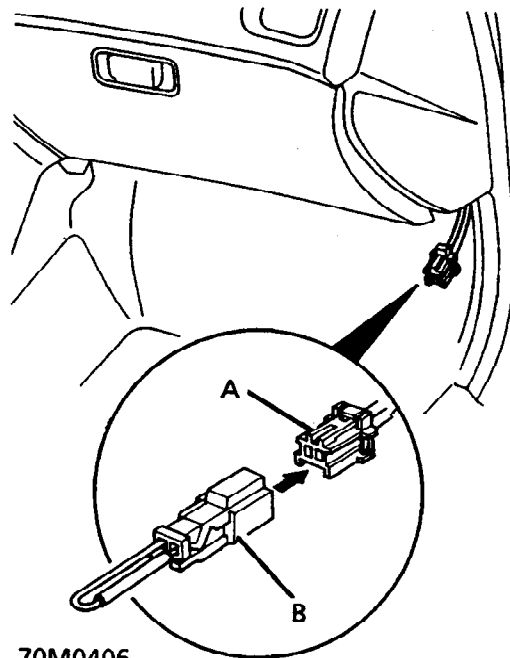
## Fault Finding

- When 2 or 3 DTC's are stored in the control unit, perform fault finding for the DTC that appears first.
- When a customer's reported problem cannot be verified on the car, ask the customer about the conditions when the ABS indicator light came ON, and test drive the car under those conditions, if possible. When the ABS indicator light does not come ON during the test, check for loose terminals and check by shaking the harness and connectors.
- The connector terminal numbers are viewed from the WIRE SIDE of the female terminals, and from the TERMINAL SIDE for the male terminals

**Note:** The ABS indicator light will come on and the ABS control unit will memorize a DTC when there is insufficient battery voltage to the ABS control unit. An example would be when the battery is so weak that the car must be jump - started. After the battery is recharged, the ABS indicator light will work normally after the engine is stopped and restarted.

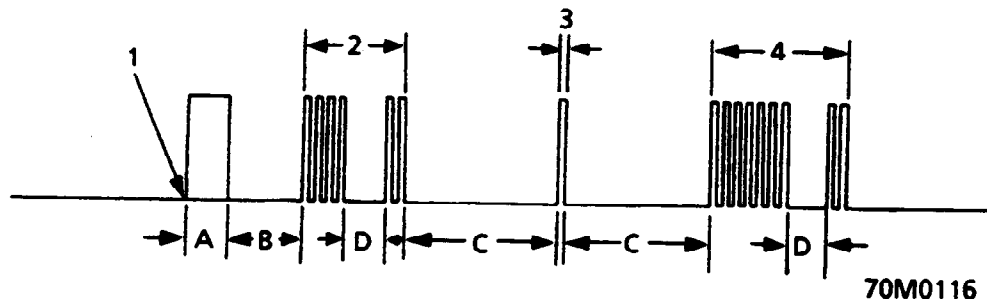
However, after recharging the battery, the DTC must be cleared from the ABS control unit memory by disconnecting the ABS B2 (15 amp) fuse in the under bonnet fuse box for at least three seconds.

## Diagnostic Trouble Code (DTC):



- A Service check connector (2P)
- B SCS Short connector 18G 1724

1. Locate service check connector (2P) above the side panel (passenger's side) and connect SCS short connector **18G 1724**.
2. Turn the ignition switch on, but **do not** start the engine.
3. Record the frequency of flashes from the ABS indicator light.  
The frequency of flashes indicates the diagnostic trouble code (DTC).



- 1 Ignition ON
- 2 Fault code 4 - 2
- 3 Fault code 1
- 4 Fault code 7 - 2

- A ABS indicator light on for 1 second
- B 2 second pause
- C 5 second pause
- D 1 second pause

**Note:**

- The ABS control unit can indicate three DTCs (one, two or three problems).
- If the ABS indicator light does not illuminate, use Microcheck to find the problem.
- If you miscount the frequency of flashes, turn the ignition switch OFF then ON to cycle the ABS indicator light again.
- After the repair is completed, disconnect the ABS B2 (15 A) fuse in the under - bonnet ABS fuse/relay box for at least three seconds to erase the ABS control unit's memory. Then turn the ignition key on again and recheck.
- The memory is erased if the connector is disconnected from the ABS control unit or the ABS control unit is removed from the body.
- After recording the DTC (if applicable), refer to the Diagnostic Trouble Code Chart.

# BRAKES - ABS BY4

## DIAGNOSTIC TROUBLE CODE (DTC) CHART

MAIN CODE	SUB CODE	SYMPTOM/DIAGNOSIS	PROBABLE CAUSE
-	-	ABS indicator light does not illuminate when ignition switch is turned ON.	Blown DIRECTION INDICATORS/REVERSING LIGHTS (10A) fuse. 1. Open circuit between DIRECTION INDICATORS/REVERSING LIGHTS (10A) fuse and ABS indicator light. 2. Blown ABS indicator light bulb. 3. Open circuit between ABS indicator light and ABS control unit. 4. Open circuit between ABS control unit and body earth. 5. Poor body earth. 6. Faulty ABS control unit.
-	-	ABS indicator light does not extinguish after engine is started.	Blown HEATER CONTROL RELAY/REAR DEFROSTER RELAY (7.5A) fuse. 1. Open circuit between under dash fuse/relay box and ABS control unit. 2. Open circuit between battery and engine compartment ABS fuse/relay box. 3. Blown ABS B2 (15A) fuse. 4. Open circuit inside engine compartment ABS fuse/relay box. 5. Open circuit between engine compartment ABS fuse/relay box and ABS control unit. 6. Faulty alternator. 7. Open circuit between alternator and ABS control unit. 8. Short circuit to body earth in WARN circuit between ABS indicator light and ABS control unit. 9. Faulty ABS control unit.
1	-	ABS pump motor over - run. ABS indicator light illuminates when pump motor relay ON signal is detected for more than 40 seconds while ABS is not functioning.	Pressure switch stuck OFF. 1. Air mixed in high pressure fluid. 2. Open circuit between pressure switch and ABS control unit. 3. Open circuit in P - SW circuit between pressure switch and body earth, or poor body earth. 4. Drop in pump discharge volume. 5. Leaking outlet valve. 6. Leaking relief valve. 7. ABS brake fluid leakage. 8. Faulty ABS control unit.



MAIN CODE	SUB CODE	SYMPTOM/DIAGNOSIS	PROBABLE CAUSE
1	2	Pump motor ABS indicator light illuminates when battery voltage is detected at MCK terminal and pump motor relay OFF signal is detected. ABS indicator light illuminates when 0 Volts is detected at MCK terminal and pump motor relay ON signal is detected.	<p>Open or short circuit to body earth between HEATER CONTROL RELAY/REAR DEFROSTER RELAY (7.5A) fuse and engine compartment ABS fuse/relay box.</p> <ol style="list-style-type: none"> <li>1. Open or short circuit to body earth in PMR circuit inside engine compartment ABS fuse/relay box.</li> <li>2. Faulty pump motor relay. Open or short circuit to body earth in PMR circuit between engine compartment fuse/relay box and ABS control unit.</li> <li>3. Open circuit between battery engine compartment ABS fuse/relay box.</li> <li>4. Blown ABS MOTOR (40A) fuse.</li> <li>5. Blown MTR CHK (7.5A) fuse.</li> <li>6. Open or short circuit to body earth in motor drive circuit and MCK circuit inside engine compartment ABS fuse/relay box.</li> <li>7. Open or short circuit to body earth in MCK circuit between engine compartment ABS fuse/relay box and ABS control unit.</li> <li>8. Open or short circuit to body earth between engine compartment ABS fuse/relay box and pump motor.</li> <li>9. Faulty pump motor.</li> <li>10. Open circuit between pump motor and body earth, or poor body earth.</li> <li>11. Faulty ABS control unit.</li> </ol> <p>Symptom does not reappear:  A. Intermittent fault in MCK circuit.  B. Intermittent fault in pump motor relay drive circuit.  C. Intermittent fault in pump motor drive circuit.</p>
1	3	High pressure leakage ABS indicator light illuminates as a result of frequent ON/OFF cycle of pressure switch signal, due to pump motor repeatedly starting and stopping. Count is reset when ABS functions.	<p>Leaking outlet valve.</p> <ol style="list-style-type: none"> <li>1. Leaking relief valve.</li> <li>2. Poor contact in pressure switch circuit.</li> </ol> <p>Symptom does not reappear:  Intermittent fault in pressure switch.  Intermittent fault in pressure switch circuit.</p>
1	4	Pressure switch ABS indicator light illuminates during initial diagnosis when pressure switch ON signal is continuously detected and OFF signal is not detected. Count of pressure switch ON signal is reset when ABS control unit detects pressure switch OFF signal.	<p>Short circuit to body earth between ABS control unit and pressure switch.</p> <ol style="list-style-type: none"> <li>1. Pressure switch stuck ON.</li> <li>2. Faulty ABS control unit.</li> </ol>

# BRAKES - ABS BY4

MAIN CODE	SUB CODE	SYMPTOM/DIAGNOSIS	PROBABLE CAUSE
1	8	High pressure system ABS control unit detects pressure switch is OFF during initial diagnosis. ABS pump motor operates until pressure switch turns ON and solenoid valve is momentarily activated. ABS indicator light illuminates if switch signal changes from ON to OFF.	Accumulator gas leakage. 1. Relief valve pressure incorrect. 2. Rear outlet solenoid valve closing late. 3. Pressure switch pressure incorrect.  Symptom does not reappear: ABS indicator light may illuminate in a very cold climate but does not indicate a fault at normal temperatures.
2	1	Parking brake ABS indicator light illuminates when parking brake signal is detected for more than 30 seconds during driving.	Low fluid level in master cylinder reservoir. 1. Open circuit between DIRECTION INDICATORS/REVERSING LIGHTS (10A) fuse and brake system light. 2. Blown brake system light bulb. 3. Open or short circuit to body earth between brake system light and ABS control unit. 4. Parking brake switch stuck ON. 5. Short to body earth between brake system light and parking brake switch. 6. Brake fluid level switch stuck ON. 7. Short circuit to body earth between brake system light and brake fluid level switch. 8. Faulty ABS control unit.  Symptom does not reappear: ABS indicator light illuminates when parking brake signal is detected for more than 30 seconds during driving.
3	1	Pulser: Right - front ABS indicator light illuminates when wheel sensor signal is periodically not detected during driving.	Chipped pulser gear. 1. Improperly installed wheel sensor.  Symptom does not reappear: Intermittent interruption in wheel sensor.
3	2	Left - front	
3	4	Right - rear	
3	8	Left - rear	
3	12	Different diameter tyre ABS indicator light may be illuminated during driving when different diameter tyres are installed. This diagnosis is not performed when parking brake switch is ON.	Different diameter tyre installed.  Symptom does not reappear: No problem.



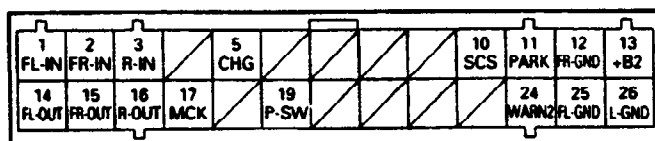
MAIN CODE	SUB CODE	SYMPTOM/DIAGNOSIS	PROBABLE CAUSE
4	1	Wheel sensor Right - front	<p>Open circuit, internal short or short circuit to body earth in wheel sensor.</p> <ol style="list-style-type: none"> <li>1. Open or short circuit to body earth in positive ( + ) wire between wheel sensor and ABS control unit.</li> <li>2. Open or short circuit to body earth in negative ( - ) wire between wheel sensor and ABS control unit.</li> <li>3. Positive ( + ) wire shorted to negative wire between wheel sensor and ABS control unit.</li> <li>4. Loose connector or terminals making poor contact.</li> <li>5. Improper wheel sensor air gap.</li> <li>6. Faulty ABS control unit.</li> <li>7. Missing pulser.</li> <li>8. Modulator does not decrease pressure properly.</li> </ol> <p>Symptom does not reappear: Intermittent interruption in the wheel sensor Wheel spin of both front wheels (DTC 4 - 8, no problem) The transmission downshift excessively (DTC 4 - 1 and 4 - 2, no problem)</p>
4	2	Left - front	
4	4	Right - rear	
4	8	Left - rear ABS indicator light illuminates when wheel sensor signal is missing at speeds above 6 mph (10 km/h). This diagnosis is not performed when parking brake switch is ON.	
5	-	Rear wheel lock Right/left	<p>Open circuit, internal short or short to body earth in wheel sensor system.</p> <ol style="list-style-type: none"> <li>1. Rear brake drag.</li> <li>2. Modulator does not decrease pressure properly.</li> <li>3. Faulty ABS control unit.</li> </ol> <p>Symptom does not reappear: Intermittent interruption in wheel sensor. Wheel spin caused by operating parking brake while parking brake switch is stuck OFF. Car spun - out - (No problem).</p>
5	4	Right	
5	8	Left ABS indicator light illuminates when either or both rear wheels lock and wheel sensor signal is not detected during driving. This diagnosis is not performed when parking brake switch is ON.	
6	-	Fail - safe relay: Front/rear	<p>Short circuit to power in relay drive circuit between fail - safe relay and ABS control unit.</p> <ol style="list-style-type: none"> <li>1. Faulty relay drive transistor (ON) in ABS control unit.</li> <li>2. Fail - safe relay stuck ON.</li> <li>3. Short circuit to power in solenoid drive circuit between fail - safe relay and ABS control unit.</li> </ol>
6	1	Front	
6	4	Rear ABS indicator light illuminates when battery voltage is detected at solenoid terminal before fail - safe relays are turned on during initial diagnosis.	

# BRAKES - ABS BY4

MAIN CODE	SUB CODE	SYMPTOM/DIAGNOSIS	PROBABLE CAUSE
7	1	Solenoid: Right - front	Fail - safe relay stuck OFF.
7	2	Left - front	1. Open circuit in solenoid drive circuit between engine compartment ABS fuse/relay box and ABS control unit.
7	4	Rear Each solenoid valve is momentarily activated at initial diagnosis and when the engine is started. ABS indicator light illuminates when battery voltage is detected at solenoid terminal. ABS indicator light is illuminated when 0V is detected at solenoid terminal and solenoid OFF signal is detected during regular diagnosis.	2. Short circuit to body earth in solenoid drive circuit between solenoid and ABS control unit. Faulty solenoid drive transistor (ON) in ABS control unit. 1. Short circuit to power in solenoid drive circuit between solenoid and ABS control unit. 2. Faulty solenoid drive transistor (OFF) in ABS control unit. 3. Short circuit to power in drive circuit inside solenoid. 4. Short circuit to outlet circuit in inlet circuit between solenoid and ABS control unit.  Symptom does not reappear: Intermittent interruption in solenoid valve drive circuit. Intermittent interruption in solenoid valve earth circuit. Intermittent interruption in fail - safe relay circuit.
8	1	ABS function ABS indicator light illuminates when ABS functions continuously.	Wheel sensor signal disappears at speeds below 6 mph (10 km/h). 1. Faulty ABS control unit.  Symptom does not reappear: Intermittent interruption in wheel sensor. Rough road driving - (No problem).
8	2	CPU comparison ABS indicator illuminates when a difference between CPU data is detected.	Faulty ABS control unit.  Symptom does not reappear: No problem.
8	4	IC (integrated circuit) ABS indicator illuminates if any integrated circuit abnormalities are detected during regular diagnosis.	Faulty ABS control unit.  Symptom does not reappear: No problem.



## ABS CONTROL UNIT TERMINALS



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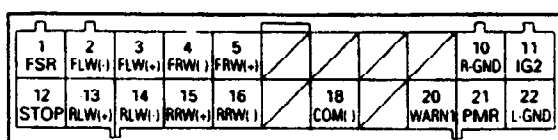
## 26P CONNECTOR

Number	Wire colour	Terminal name	Description
1	RU	FL – IN front left inlet solenoid valve	Drives left front inlet solenoid valve <sup>1</sup>
2	RB	FL – IN front right inlet solenoid valve	Drives right front inlet solenoid valve <sup>1</sup>
3	RW	R – IN rear inlet solenoid valve	Drives rear inlet solenoid valve <sup>1</sup>
5	WU	CHG Charge	Detects engine operation, activates ABS control unit with engine ON Engine running: 12V Engine stopped: 0V
10	OR	SCS Service check signal	Detects service check connector signal, DTC identification Connected: 0V Disconnected 12V
12	B	FR – GND Front right solenoid valve earth	Earth for front right inlet and outlet solenoid valves
13	W	+ B2 + B2 power source	Power source for ABS control unit control circuit Power source for DTC memory 12V at all times
14	YU	FL – OUT Front left outlet solenoid	Drives front left outlet solenoid valve <sup>2</sup>
15	YB	FR – OUT Front right outlet solenoid valve	Drives front right outlet solenoid valve <sup>2</sup>
16	YW	R – OUT Rear outlet solenoid valve	Drives rear outlet solenoid valve <sup>2</sup>
17	WU	MCK Motor check	Detects pump motor drive signal. ABS indicator light is turned ON if there is open or short circuit Motor ON: 0V / OFF: 12V Open: 12V
			<sup>1</sup> Engine running: Solenoid ON 0V/ Solenoid OFF 12V Engine OFF, ignition ON: 0V <sup>2</sup> Engine running: Solenoid ON 0V/ Solenoid OFF 12V Engine OFF, ignition ON: 0V



## BRAKES - ABS BY4

Number	Wire colour	Terminal name	Description
19	Y	P - SW Pressure switch	Detects switch signal Switch turns ON at approx. 22000 kPa, 3100 lb/in <sup>2</sup> and pump motor is stopped ON: 0V / OFF: 12V
24	UR	WARN 2 Warning lamp	Drives ABS indicator light Shuts off the indicator light earth circuit inside the ABS control unit to turn off the light when the system is normal. Light ON: 0V / Light OFF: 12V
25	B	FL - GND Front left solenoid valve earth	Earth for the front left inlet and outlet solenoid valves
26	B	L - GND Logic earth	Earth for the ABS control unit control circuits



70M0405

## 22P CONNECTOR

Number	Wire colour	Terminal name	Description
1	YG	FSR Fail - safe relay	Drives fail - safe relay Fail - safe relay is turned OFF to shut off power source to the solenoid when a problem occurs ON: 12V / OFF: 0V
2	N	FLW ' - ' Front left wheel speed, negative	Detects front left wheel speed, earth level <sup>1</sup>
3	GU	FLW ' + ' Front left wheel speed, positive	Detects front left wheel speed <sup>1</sup>
4	G	FRW ' - ' Front right wheel speed, negative	Detects front right wheel speed, earth level <sup>2</sup>
5	GB	FRW ' + ' Front right wheel speed, positive	Detects front right wheel speed <sup>2</sup>
10	B	R - GND Rear solenoid valve earth	Detects ignition switch IG2 signal, when IG2 is input, + B2 power source is switched to the power source for the ABS control unit (Vcc). Also IG2 monitors P - SW and MCK lines and drives fail - safe relay. ON: 12V / OFF: 0V
12	GW	STOP Foot brake	Detects brake switch signal. Prevents unnecessary ABS operations when the brake pedal is not pressed ON: 12V / OFF: 0V
			<sup>1</sup> No. 2 - 3 terminals When the wheel is turned at 1 turn/second: 70 mV or above on digital tester (AC range) <sup>2</sup> No. 3 - 4 terminals When the wheel is turned at 1 turn/second: 70 mV or above on digital tester (AC range). Reference: 200 mVP - P or above on oscilloscope.

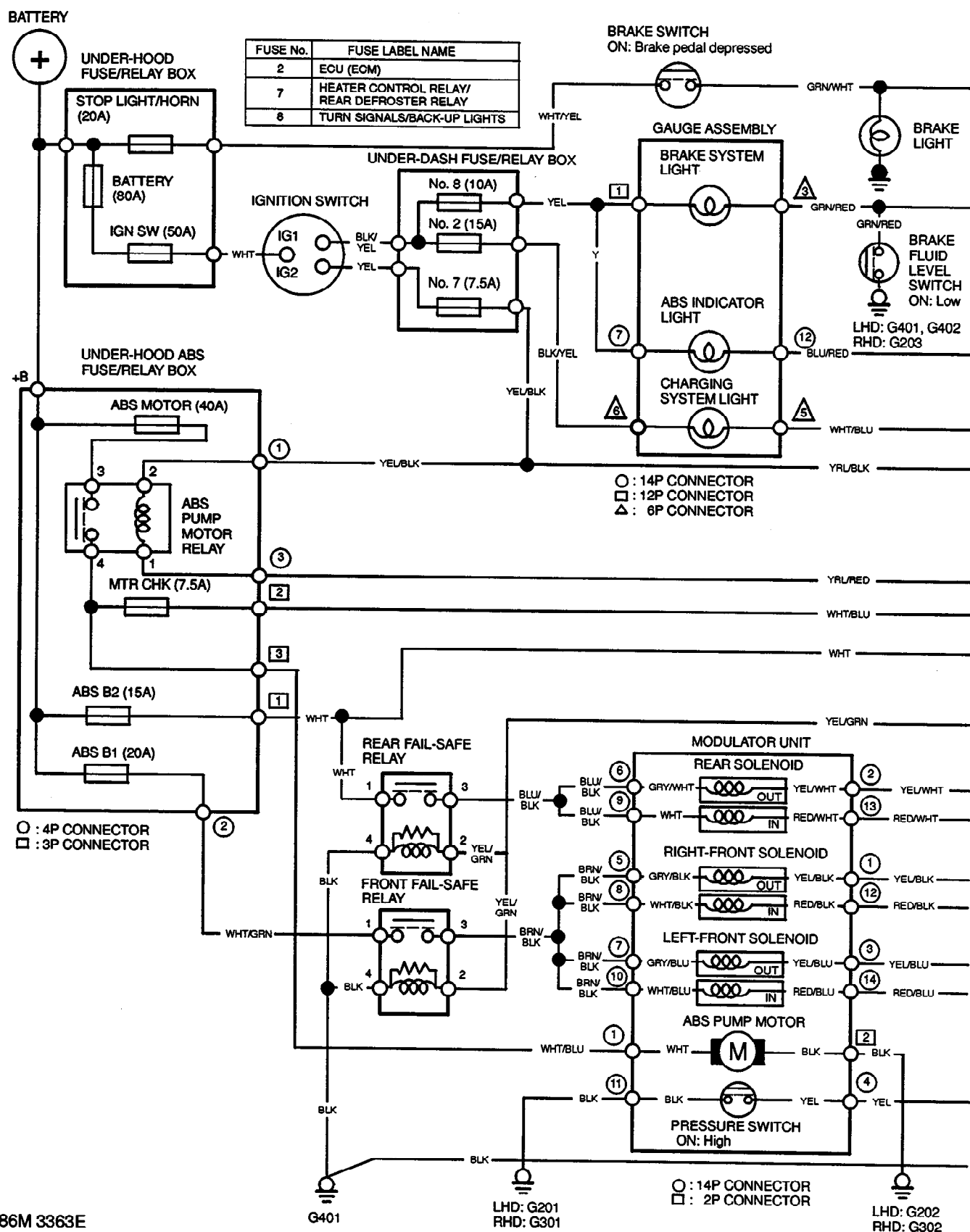
## BRAKES - ABS BY4

Number	Wire colour	Terminal name	Description
13	LTU	RLW ' + ' Rear left wheel sensor, positive	Detects left rear wheel speed, earth level <sup>1</sup>
14	S	RLW ' - ' Rear left wheel sensor, positive	Detects rear left wheel speed <sup>1</sup>  <sup>1</sup> No. 13 – 14 terminals When the wheel is turned at 1 turn/second: 70 mV or above on digital tester (AC range)
15	GY	RRW ' + ' Rear right wheel speed, positive	Detects rear right wheel speed <sup>2</sup>
16	UY	RRW ' - ' Rear right wheel speed, negative	Detects rear right wheel speed <sup>2</sup>
18	BW	COM ( - ) Common negative	Earth for ABS tester
20	UR	WARN 1 Warning lamp	Drives ABS indicator light. Shuts off indicator light earth circuit inside the ABS control unit to turn off the light when the system is normal. Light ON: 0V Light OFF: 12V
21	YR	PRM Pump motor relay	Drives pump motor relay is turned ON to drive the pump motor when P – SW OFF signal is detected. Light ON: 0V Light OFF: 12V
22	B	L – GND Logic earth	Earth for the ABS control unit control circuits.
			<sup>1</sup> No. 13 – 14 terminals When the wheel is turned at 1 turn/second: 70 mV or above on digital tester (AC range) <sup>2</sup> No. 15 – 16 terminals When the wheel is turned at 1 turn/second: 70 mV or above on digital tester (AC range). Reference: 200 mVP – P or above on oscilloscope.



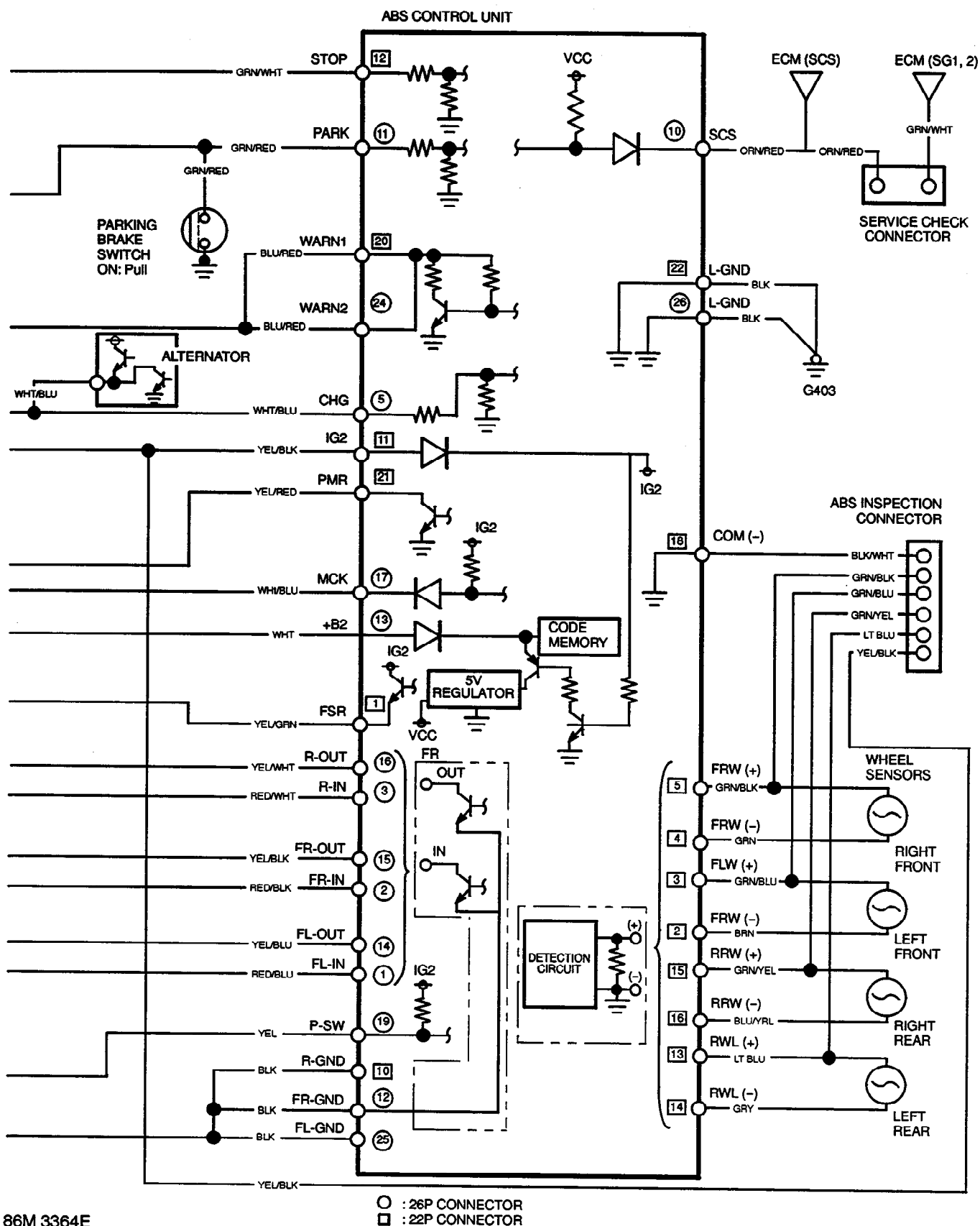
## BRAKES - ABS BY4

### CIRCUIT DIAGRAM





## CIRCUIT DIAGRAM







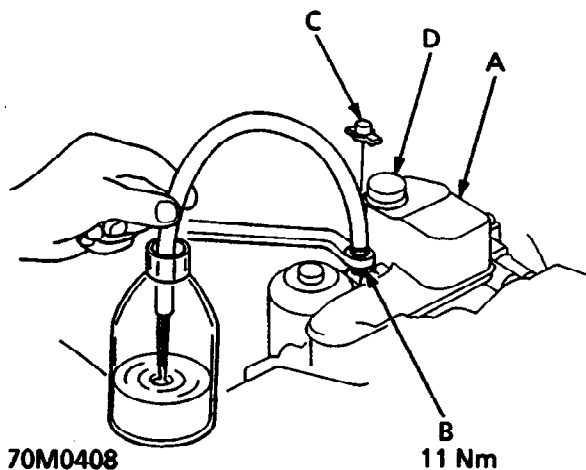
## MODULATOR FLUID

**CAUTION:** Do not spill brake fluid it may damage painted surfaces, wash it off immediately with water.

Do not reuse drained brake fluid.

DO NOT loosen the relief plug on the accumulator.

### Release fluid pressure



- A Modulator unit
- B Bleed screw
- C Bleed screw cap
- D Reservoir filler cap

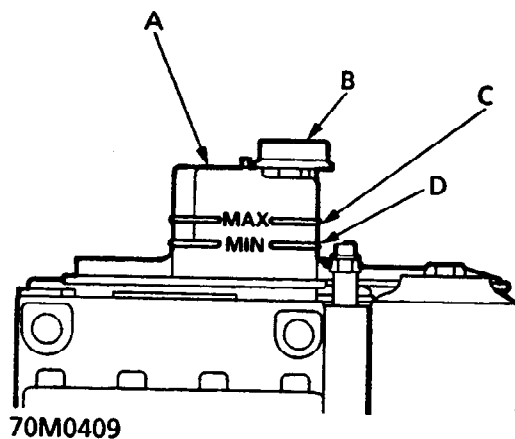
1. Remove bleed screw cap and place ring spanner over bleed screw.
2. Connect bleed tube to the bleed screw.
3. While holding bleed tube in container, slowly loosen bleed screw 1/4 turn and collect brake fluid in container.

**CAUTION:** Do not over loosen bleed screw, release high pressure fluid gradually.

4. Tighten bleed screw to specified torque.

### Bleeding

When the brake fluid is completely drained from the reservoir, air enters the modulator unit.



- A ABS fluid reservoir
- B Reservoir filler cap
- C MAX level line
- D MIN level line

1. Remove filler cap and refill reservoir to MAX level with DOT 4 brake fluid.

**Note:** Pour slowly and wait for foam to disperse.

2. Remove bleed screw cap and place ring spanner over bleed screw.
3. Connect bleed tube to the bleed screw with other end in container.
4. Loosen bleed screw 1/2 turn, start engine and idle.
5. Tighten the bleed when fluid starts to flow from bleed tube. Remove bleed tube and fit bleed screw cap.
6. Stop engine after the pump motor stops.
7. Check the brake fluid level in reservoir, top - up to MAX level line.



# BRAKES - ABS BY4

## MODULATOR FUNCTION CHECK

This check determines whether the basic brake system continues to operate normally when the modulator unit fluid pressure is low.

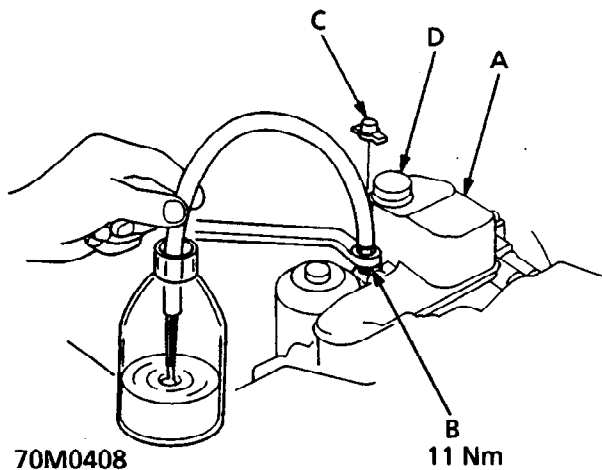
**CAUTION:** This check is made by relieving the high - pressure fluid in the modulator unit and checking for brake operation. After inspection, be sure to top - up brake fluid to MAX line on reservoir and start engine to restore ABS system.

Do not spill brake fluid it may damage painted surfaces, wash it off immediately with water.

Do not reuse drained brake fluid.

DO NOT loosen the relief plug on the accumulator.

### Check



- A Modulator unit
- B Bleed screw
- C Bleed screw cap
- D Reservoir filler cap

1. Remove bleeder cap and place ring spanner over bleed screw.
2. Connect bleed tube to the bleed screw.
3. While holding bleed tube in container, slowly loosen bleed screw 1/4 turn and collect brake fluid in container.

**CAUTION:** Do not over loosen bleed screw, release high pressure fluid gradually.

4. When brake fluid stops flowing, loosen bleed screw more to release pressure completely.
5. Tighten bleed screw to specified torque.
6. Raise front of vehicle.

**WARNING: Support on safety stands.**

7. Use assistance: Depress brake pedal firmly and check that front wheels cannot be rotated.
8. Remove stand(s) and lower vehicle.
9. Remove filler cap and refill reservoir to MAX level with DOT 4 brake fluid.

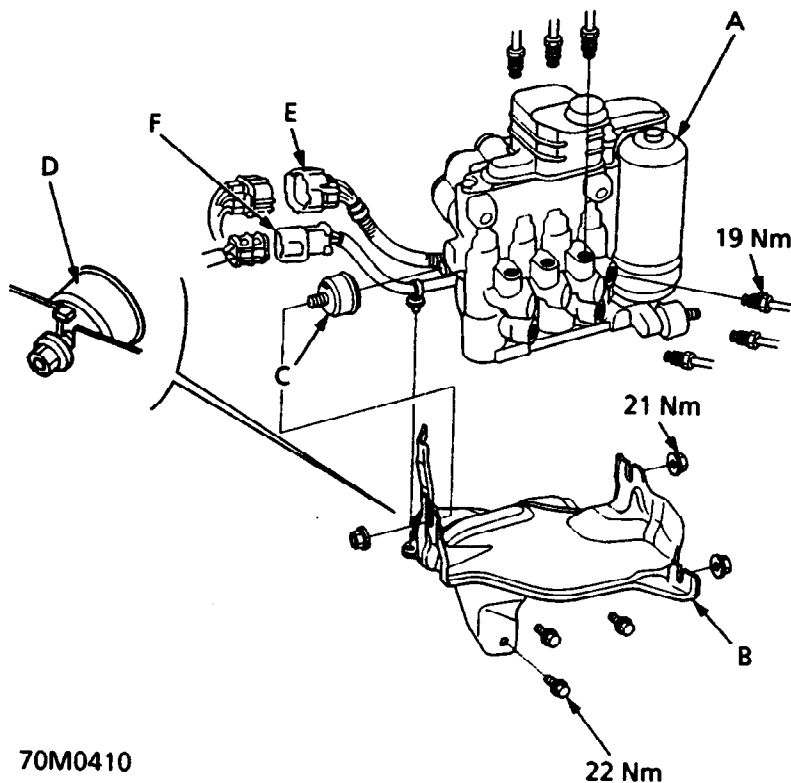
**Note:** Pour fluid slowly and wait for bubbles to disperse.

10. Start engine and idle for one minute. Stop engine.
11. Check the brake fluid level in reservoir, it should be below MAX level line. Top - up to MAX level line.



## MODULATOR UNIT

### Removal/Installation



70M0410

- A Modulator unit  
B Modulator bracket  
C Mount rubber

- D Mount rubber alignment tab  
E Connector 14P  
F Connector 2P

**WARNING:** Before removing the modulator, be sure to relieve the high pressure fluid from the bleed screw.

**CAUTION:** Be careful not to bend or damage the brake pipes when removing the modulator unit. Do not allow brake fluid to come into contact with paintwork as it will cause surface damage. If brake fluid does contact the paint, wash it off immediately with water.

To prevent spills, cover the hose joints with cloth or disposable towels.

Before reassembling, check that all parts are free of dust and other foreign particles.

Do not mix different brands of brake fluid as they may not be compatible.

Do not reuse the drained fluid. Use only clean DOT 4 brake fluid.

When connecting the brake pipes, make sure that there is no interference between the brake pipes and other parts.

1. Drain the brake fluid from the brake master cylinder.
2. Release modulator fluid pressure and drain fluid.
3. Disconnect modulator 14P and 2P connectors from harness.
4. Release modulator harness clip bracket.
5. Disconnect 2 the master cylinder pipe unions from the modulator unit.

**CAUTION:** Position absorbent cloth below pipe unions

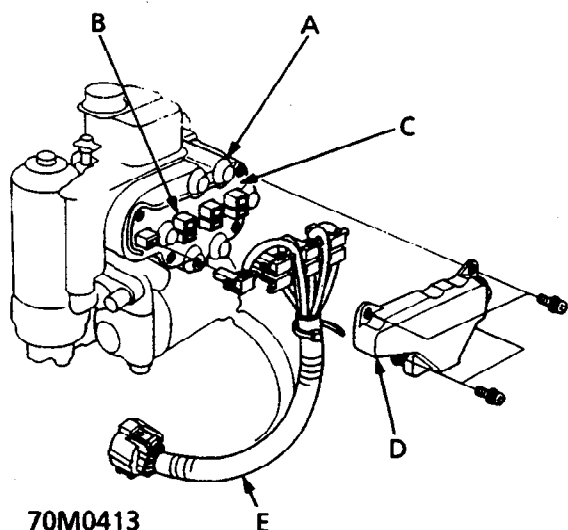
6. Disconnect the 4 brake pipes from the modulator unit.

**Note:** Fitting reference codes stamped on modulator body.

7. Remove 3 nuts securing modulator to bracket.
8. Remove modulator assembly from bracket.

**Do not carry out further dismantling if component is removed for access only**

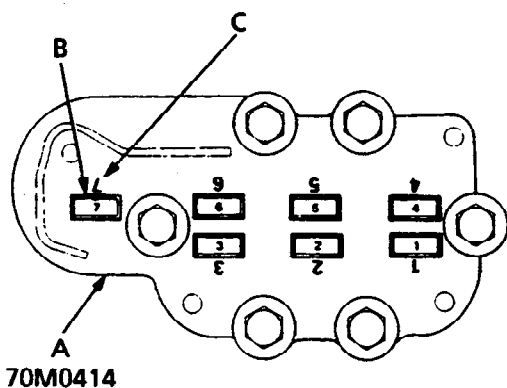
# BRAKES - ABS BY4



- A Modulator unit
- B Solenoid connectors
- C Set plate
- D Cover
- E Harness

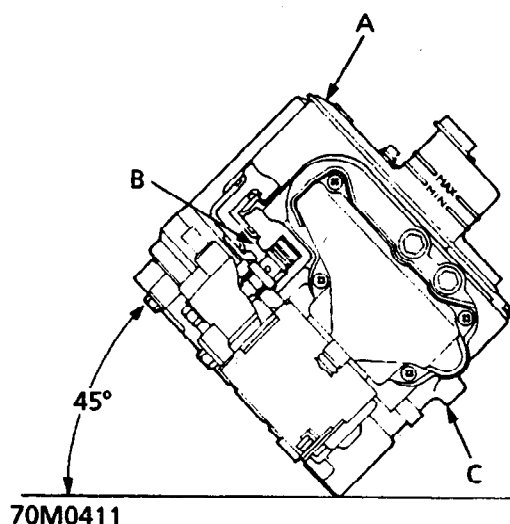
9. Release 3 screws and remove the modulator unit cover.
10. Note the connector numbers and disconnect the harness.

## Installation



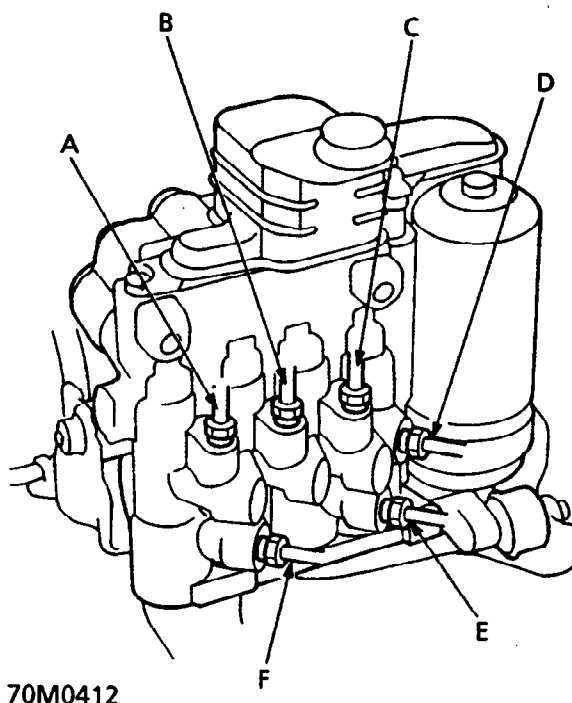
- A Set plate
- B Connector
- C Stamped number

1. Check numbers on set plate and insert each connect to its corresponding number. Ensure each connector is securely locked by its 2 locking tabs.
2. Refit the cover plate.



- A ABS reservoir
- B Suction port
- C Modulator unit

3. Check fluid level in reservoir, top - up the MAX level mark with DOT 4 brake fluid.
4. Bleed air from the suction port by leaning modulator unit over to 45° (as shown).



- A FL front LH wheel
- B RR rear RH wheel
- C RL rear LH wheel
- D FR front RH wheel
- E Pipe from primary master cylinder
- F Pipe from secondary master cylinder



5. Install the modulator unit in the reverse order of removal.

**Note:** Insure each outlet pipe is fitted to the correct port identified by code letters, tighten to 19 Nm.

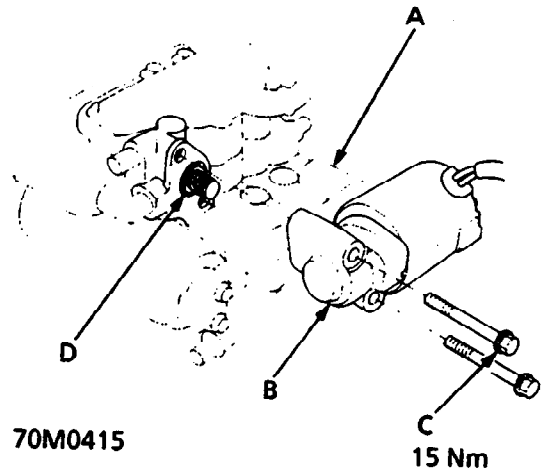
6. After installation: Fill the brake master cylinder reservoir.
7. Start engine and idle for one minute.  
Check that:  
ABS warning light is OFF.  
Brake fluid is not leaking from pipe unions.
8. Stop engine and check fluid level in reservoir, top - up to MAX level.
9. Bleed the brake system.
10. Check ABS function using TestBook.

## MODULATOR PUMP

### Removal/Installation

**WARNING:** Before removing the modulator, be sure to relieve the high pressure fluid from the bleed screw.

1. Remove the modulator assembly,



- A Modulator unit
- B Pump motor
- C Flange bolt
- D 'O' ring

2. Remove 2 flange bolts securing pump motor to modulator.
3. Remove pump motor from modulator.
4. Remove and discard 'O' ring seal.
5. Install the pump motor in the reverse order of removal, use a NEW 'O' ring seal.

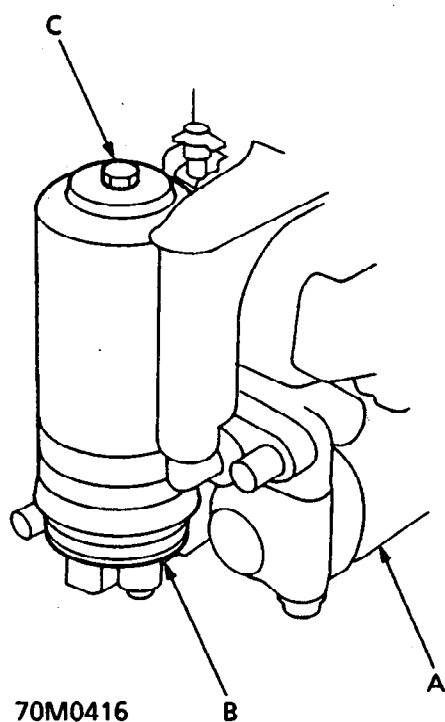
**Note:** After installing the modulator, bleed air from the system,  
Check ABS warning light operation

# BRAKES - ABS BY4

## MODULATOR UNIT DISPOSAL

**WARNING:** The accumulator contains high pressure nitrogen gas. Do not puncture, expose to flame, weld or apply impact to the accumulator in an attempt to remove the accumulator from the modulator. The modulator unit may explode and severe injury may result. The accumulator pressure must be discharged before disposal of the modulator unit.

1. Remove the modulator assembly,



- A Modulator unit  
B Accumulator  
C Relief plug

2. Hold modulator in a vice, relief plug uppermost.
3. Slowly loosen relief plug  $3\frac{1}{2}$  turns and wait 3 minutes for all pressure to escape.
4. Remove the relief plug from the accumulator.
5. Modulator unit is now safe for disposal.

## ABS CONTROL UNIT

### Removal/Installation

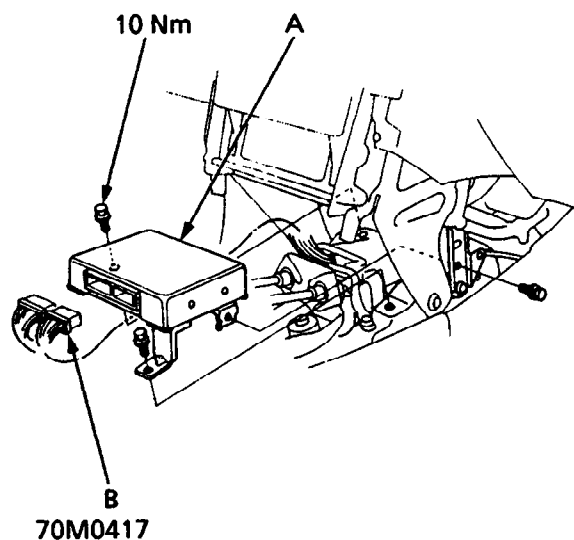
**CAUTION:** SRS harnesses are routed near the ABS control unit.

All SRS harnesses are covered with YELLOW Cinsulation.

Before disconnecting any part of the SRS harness, connect short connectors.

Replace the entire affected SRS harness assembly if it has open circuit or damaged wiring.

1. Remove the front console assembly, see **BODY**



- A ABS control unit  
B ABS control unit connectors

2. Disconnect 2 connectors from the ABS control unit.
3. Remove 3 bolts securing the mounting brackets.
4. Remove the ABS control unit.
5. Install the ABS control unit in the reverse order of removal.
6. Install the front console assembly, see **BODY**

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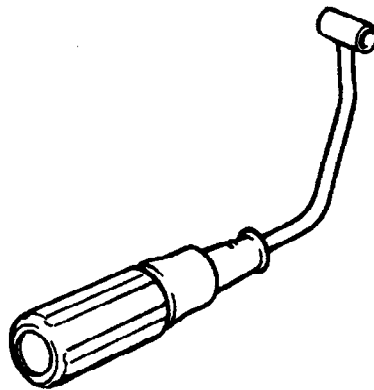




**SPECIAL TOOLS**

No.	Honda Number	Rover Number	Description
1	07GAZ-SE30100	18G 1704	Torsion Bar Assembly Tool

*The tools illustrated in this section are Honda tools, and Rover do not always have an equivalent. Where an equivalent Rover tool is available, it may not be visually identical to the Honda tool.*



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