

DRIVE-CONTROL COMPONENTS

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SUSPENSION

A coil spring-type double wishbone independent suspension has been used at the front, and a multi-link-type double wishbone independent suspension has been used at the rear.

FEATURES

High Steering Stability	1. Wider tread 2. Optimization of suspension geometry 3. Improved turning performance and direct steering performance through adoption of zero initial camber, high caster and a small kingpin angle. 4. Improved braking performance through extremely small kingpin offset 5. Adoption of in-wheel type kingpin axis layout that reduces shimmy and kickback
Enhanced Riding Comfort	1. Large increase in suspension stroke at both the front and rear 2. Optimization of suspension geometry 3. Optimization of damping force and spring constant of the coil spring 4. Adoption of sub-frames (front and rear frames)
Reduced road noise	1. Adoption of sub-frames (front and rear frames)

FRONT SUSPENSION

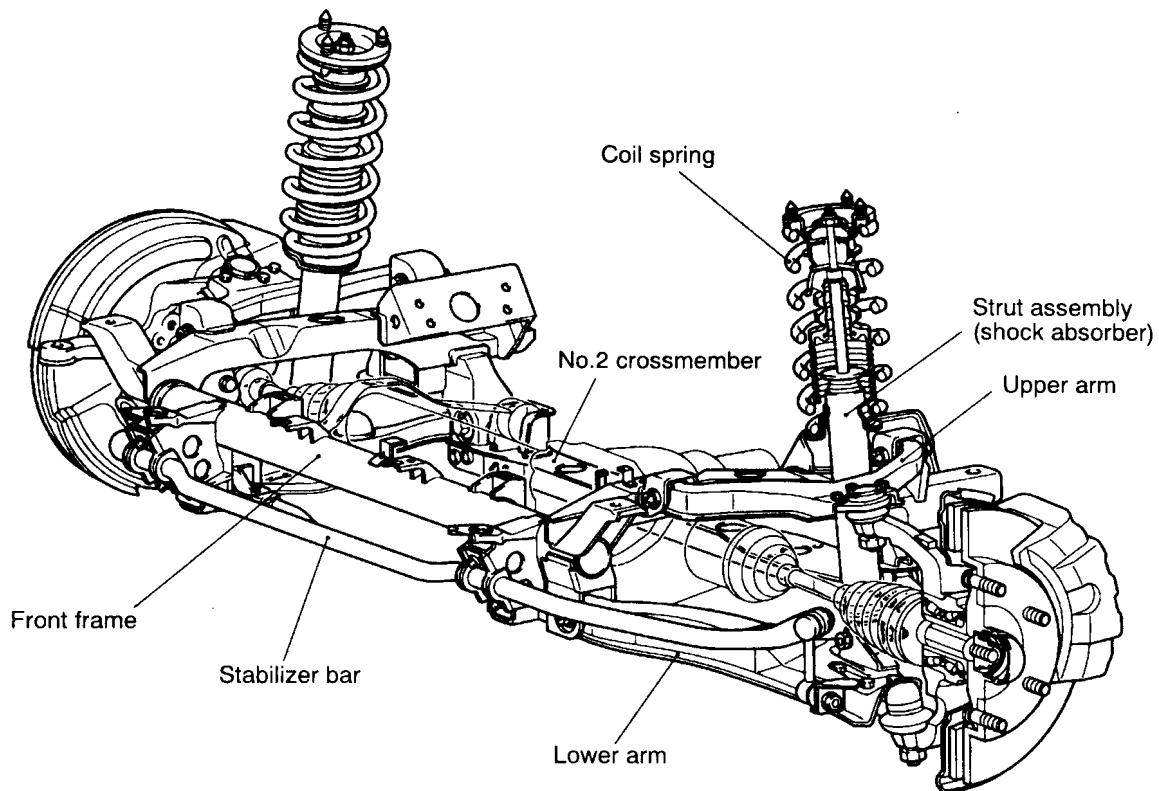
FEATURES

A coil spring-type double wishbone independent-type suspension has been adopted as the front suspension. This type of suspension is rigid, has very little variation in roll centre height and provides excellent riding comfort, making it ideal for cross-country vehicles.

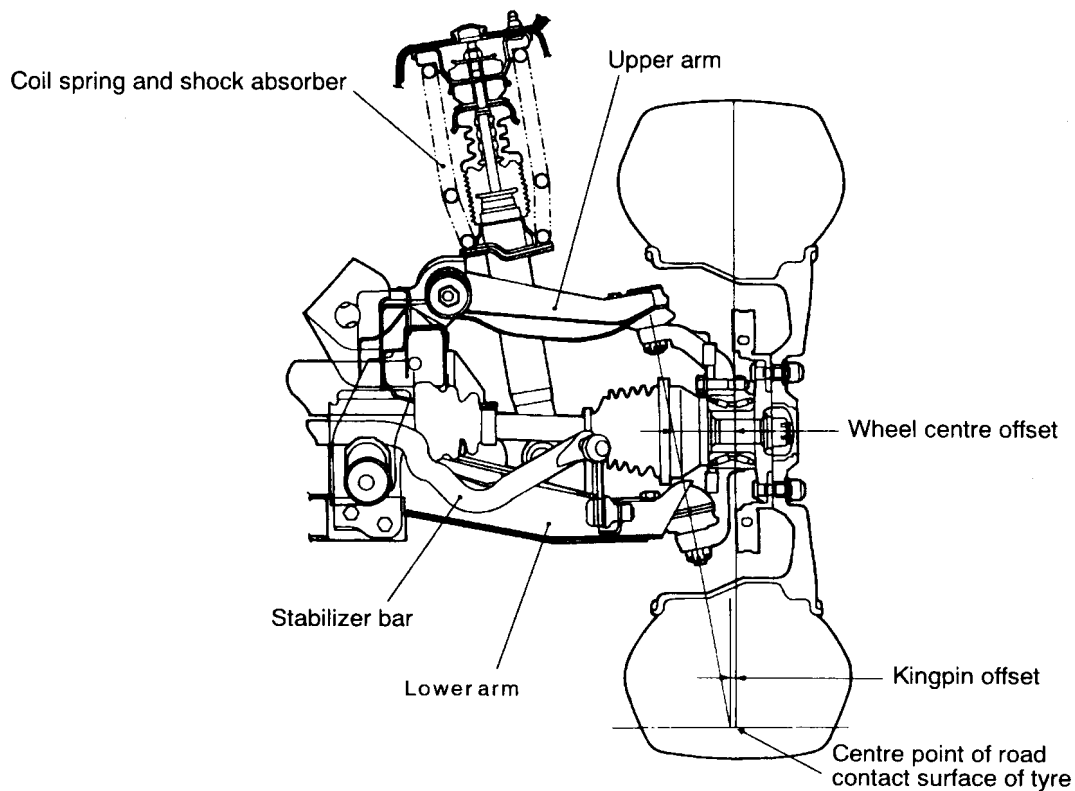
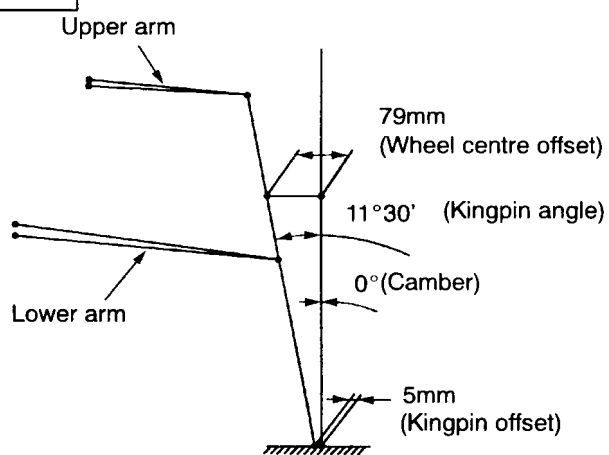
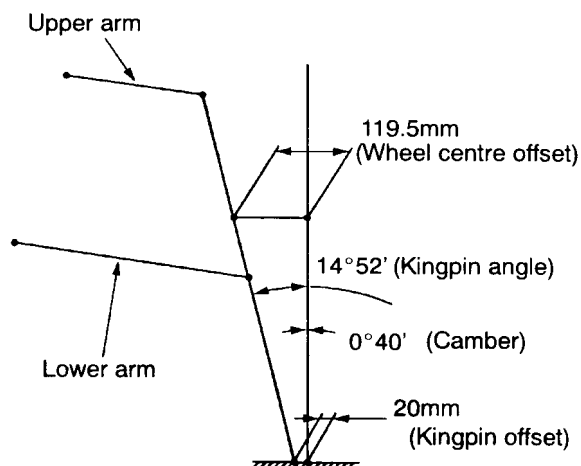
- Wide tread has been adopted to improve steering stability.
- The suspension geometry has been optimized to improve steering stability, turning performance and riding comfort.
- Zero initial camber, high caster and a small kingpin angle provide improved turning performance and straight driving performance.
- An extra-small kingpin offset provides improved braking stability.

- An in-wheel type kingpin axis layout in which the upper arm ball joints and lower arm ball joints are located at the centre of the wheel to reduce the wheel centre offset, and thus reduce the feeling of shimmy and kickback.
- The suspension stroke has been greatly increased to improve road contact, drivability on poor road surfaces, critical turning performance and riding comfort.
- Changes in vehicle posture during acceleration and deceleration have been reduced.
- The adoption of a front sub-frame improves riding comfort and also reduces road noise.

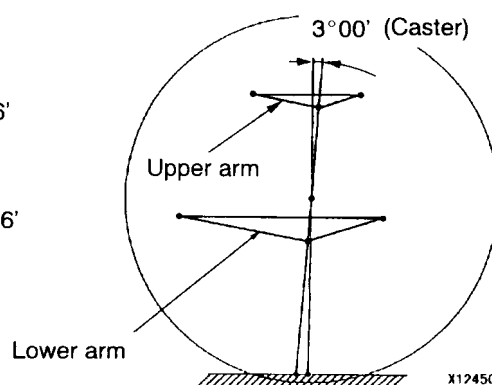
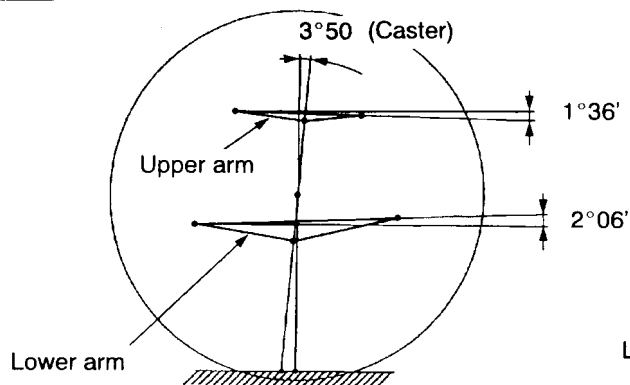
CONSTRUCTION DIAGRAM



AX0120CA

**Front view****<New model>****<Previous models>**

X1243CA

Side view

X1245CA

SPECIFICATIONS**SUSPENSION SYSTEM**

Item	Specification
Suspension method	Double wishbone independent type

WHEEL ALIGNMENT

Items	Specification
Camber	0°
Caster	3°50'
Kingpin inclination	11°30'
Toe-in	At the centre of tyre tread mm
	2.5
	Toe-angle (per wheel)
	0°05'
Toe-out angle on turns (inner wheel when outer wheel at 20°)	21°48'

COIL SPRING

Item	Short wheelbase-2500,3500, Long wheelbase -2500 (GL,GLX),3500 (GLX)	Short wheelbase-3200, Long wheelbase -2500 (GLS),3200,3500 (GLS)
Wire diameter × average diameter × free length mm	16 × 109 × 322	16 × 109 × 327

REAR SUSPENSION

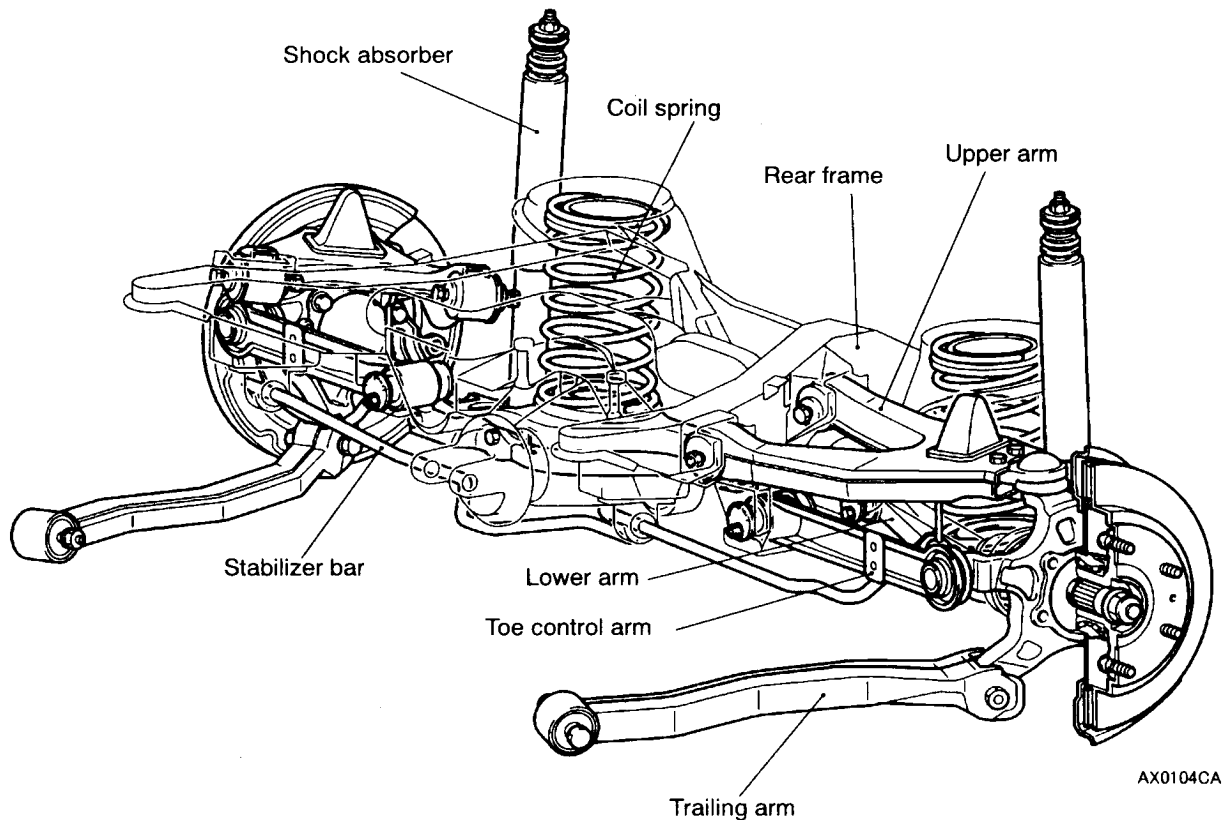
FEATURES

A multi-link type double wishbone independent suspension has been adopted as the rear suspension. Because the left and right wheels move independently with almost no change in tyre posture, the tyres contact the ground firmly, providing excellent steering stability as well as offering improved riding comfort.

- Wide tread has been adopted to improve steering stability.
- The suspension geometry has been optimized to improve steering stability, turning performance and riding comfort.

- Zero initial camber provides improved turning performance.
- The suspension stroke has been greatly increased to improve road contact, drivability on poor road surfaces, critical turning performance and riding comfort.
- Changes in vehicle posture during acceleration and deceleration have been reduced.
- The adoption of a rear sub-frame improves riding comfort and also reduces road noise.

CONSTRUCTION DIAGRAM



SPECIFICATIONS**SUSPENSION SYSTEM**

Item	Specification
Suspension method	Multi-link type double wishbone independent type

WHEEL ALIGNMENT

Items	Specifications
Camber	0°
Toe-in	At the centre of tyre tread mm
	3
	Toe-angle (per wheel)
	1°06'

COIL SPRING

Item	Short wheelbase -2500 (GL)	Short wheelbase -except 2500 (GL)	Long wheelbase
Wire diameter × average diameter × free length mm	16 × 133 × 330	17 × 134 × 336	18 × 134 × 337

WHEEL AND TYRE

The wheels and tyres of the following specifications have been established.

SPECIFICATIONS

Items		4D5, 4M4		6G7
		GL, GLX	GLS	
Wheel	Type	Steel type Aluminium type*	Aluminium type	Aluminium type
	Size	16 × 6JJ 16 × 7JJ*	16 × 7JJ	16 × 7JJ
	Amount of wheel offset mm	46	46	46
	Pitch circle diameter (P.C.D.) mm	139.7	139.7	139.7
Tyre	Size	235/80R16 109S 265/70R16 112S*	265/70R16 112S	265/70R16 112H

NOTE

*: Optional items

POWER STEERING

FEATURES

Power steering has been adopted in all vehicles to make the steering system easier to handle.

- A 4-spoke steering wheel (made from urethane and covered with leather, or made from wood and covered with leather) with a built-in SRS air bag has been adopted.
- A steering column with a shock absorbing mechanism and a tilt steering mechanism has been adopted. In addition, a damper is provided on the lower shaft assembly to reduce vibration and to improve steering stability.
- Integral-type rack and pinion gear with high rigidity and excellent response has been adopted. In addition, there is a check valve built into the high pressure-side power steering fluid inlet of the steering gear, to prevent the fluid from flowing back

into the pressure hose when force is applied from the tyres when driving on uneven roads, and to reduce kickback.

- A variable capacity pump has been adopted to reduce power losses and improve fuel consumption. When the engine speed increases, the pump chamber capacity is reduced proportionally so that only the necessary amount of power steering fluid is discharged.
- The pump is an integral type with the reservoir tank made of sheet metal that is light weighted and the suction resistance for power steering fluid is reduced <4M4>. The separate plastic resin reservoir tank structure is adopted to reduce weight and to make the fluid level check easy <6G7, 4D5>.

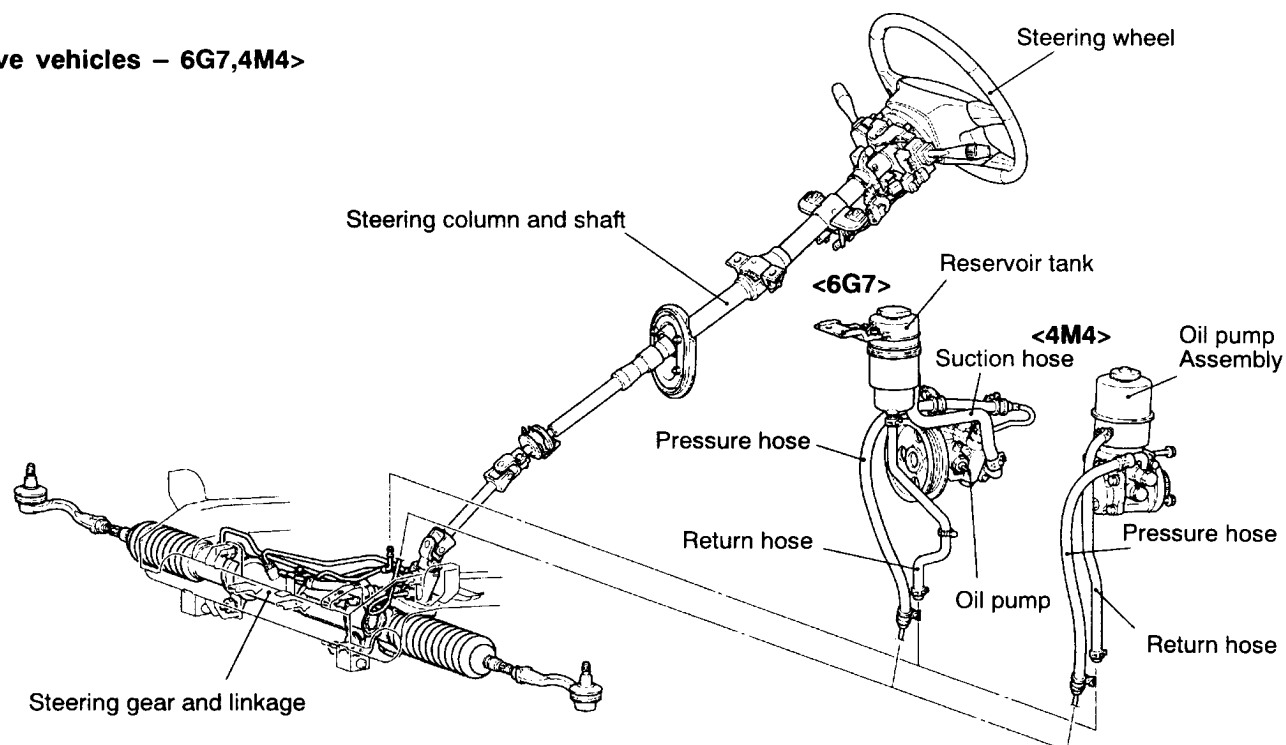
SPECIFICATIONS

Item			Specifications
Steering wheel	Type		4-spoke type
	Outside diameter mm		396
	Maximum number of turns		3.61
STEERING COLUMN	Column mechanism		Tilt steering
	Tilt amount mm		38±2
Power steering type			Integral type
Oil pump	Type		Variable capacity type (vane pump)
	Drive method	4M4	Gear drive
		6G7, 4D5	Belt drive
	Basic discharge amount cm ³ /rev.		10.0
	Relief pressure MPa		8.8
	Reservoir type	4M4	Integrated type (sheet metal)
		6G7, 4D5	Separate type (plastic)
	No-load pressure MPa	4M4	0.29
		6G7, 4D5	0.34
	Steering gear hold pressure MPa		8.8
	Pressure switch	6G7, 4M4	Equipped
		4D5	Not equipped
Pressure switch operation pressure MPa	OFF→ON	1.5 ~ 2.0	
	ON→OFF	1.5 ~ 2.0	
Steering gear and linkage	Type		Rack and pinion
	Stroke ratio (Rack stroke/Steering wheel Maximum turning radius)		45.95
	Rack stroke mm		166
Steering angle	Inner wheel		37°
	Outer wheel		32°

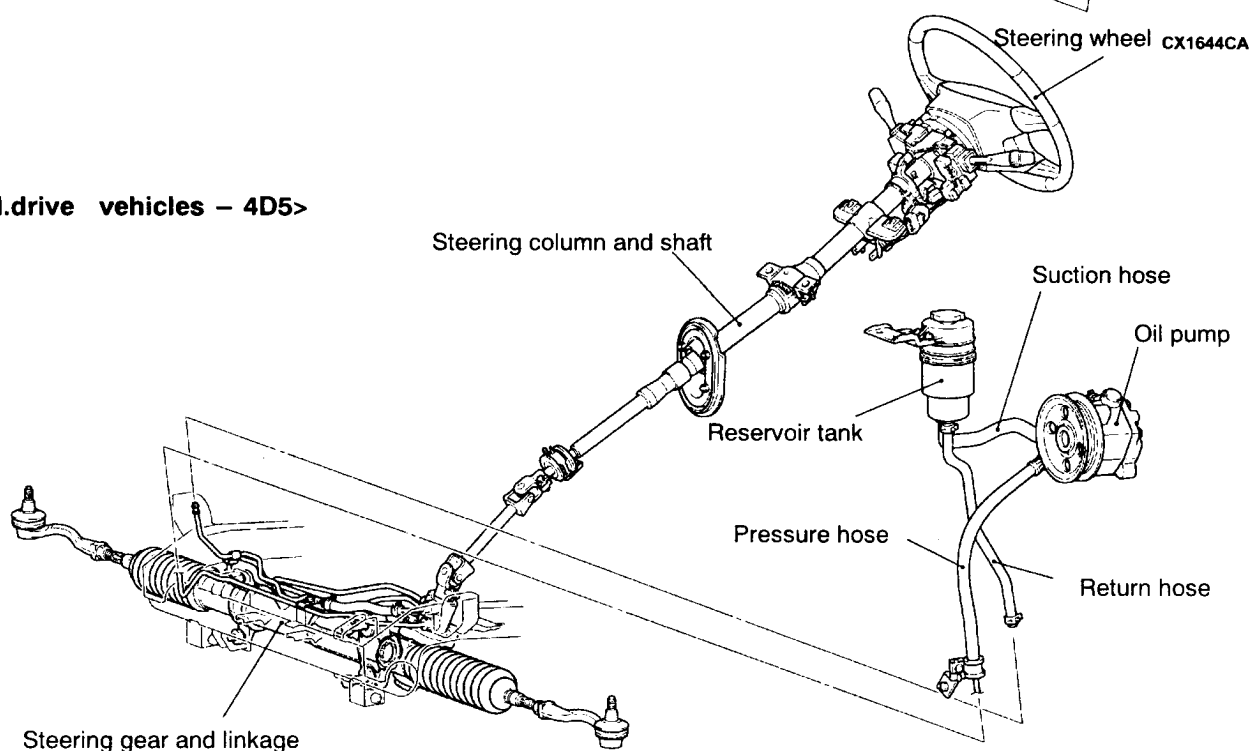
Item		Specifications
Power steering fluid	Specified lubricants	Automatic transmission fluid DEXRON II
	Quantity dm ³	Approximately 0.6

CONSTRUCTION DIAGRAM

<L.H.drive vehicles – 6G7,4M4>

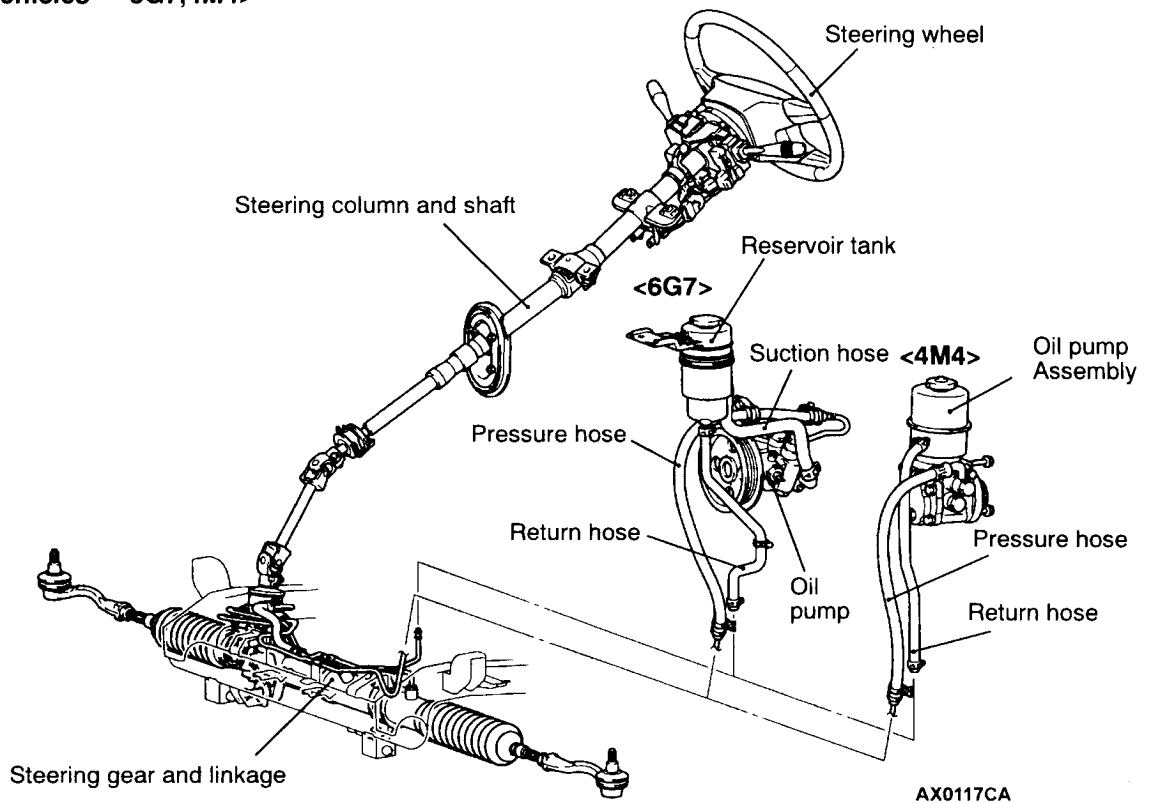


<L.H.drive vehicles – 4D5>

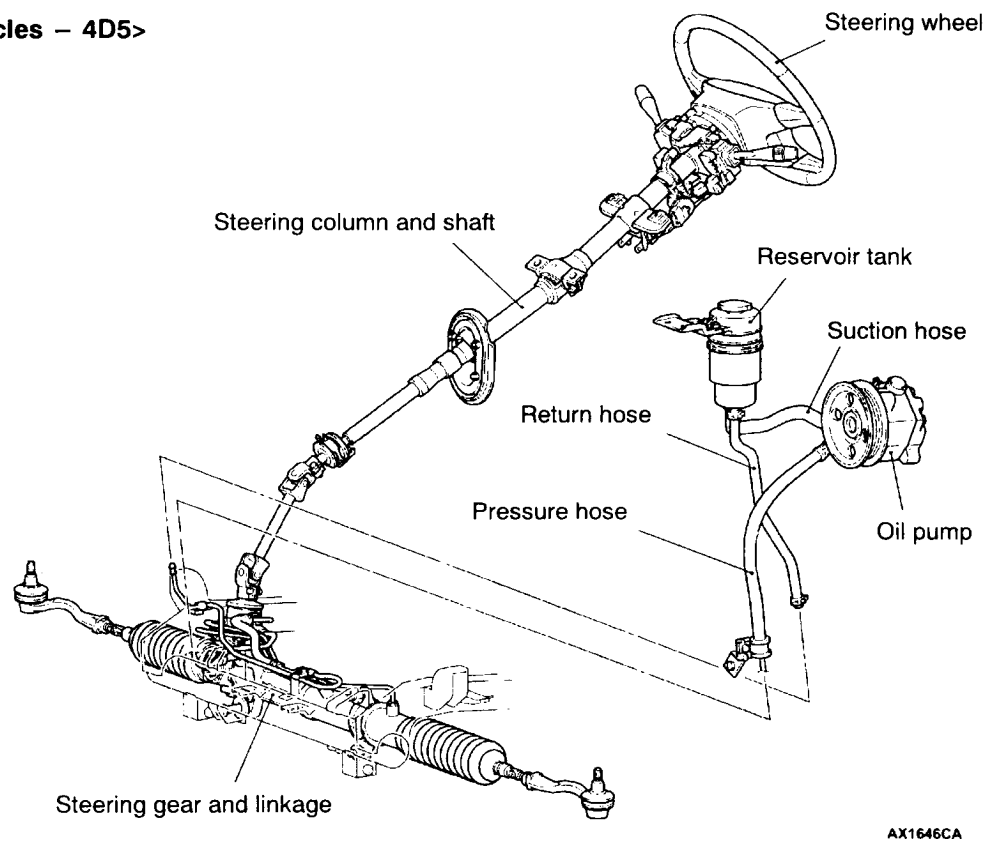


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<R.H.drive vehicles – 6G7,4M4>

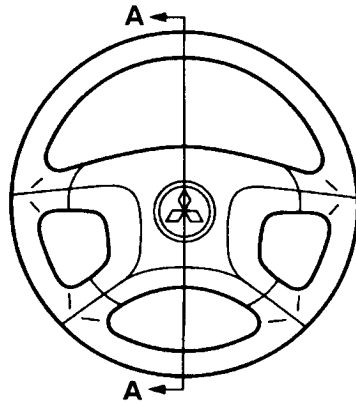


<R.H.drive vehicles – 4D5>

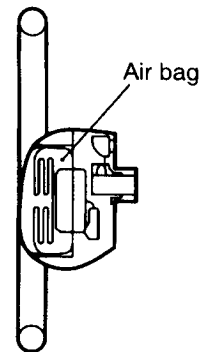


STEERING WHEEL

- The air bag module has been built into the steering wheel. Furthermore, the structure of the steering wheel and air bag module allow them to be removed as a unit without using the special tool (steering wheel puller).
- In addition, the air bag module uses an inflator which does not contain any sodium azide.



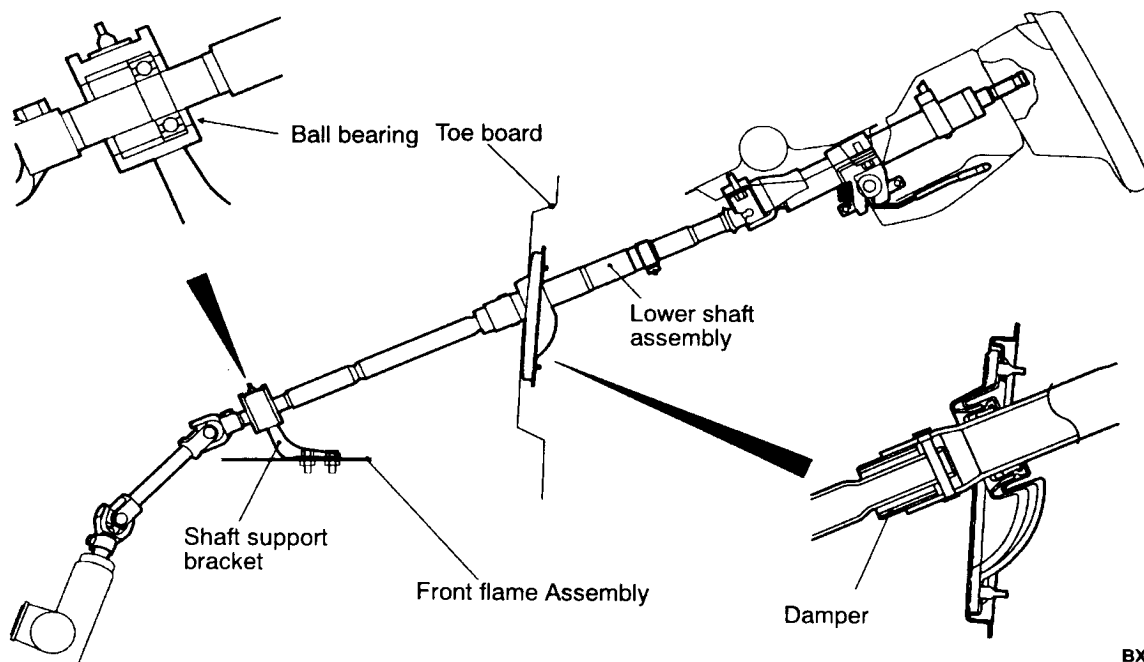
Section A – A



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STEERING COLUMN

- A damper is provided on the lower shaft assembly to reduce vibration and to improve steering stability.
- A shock absorbing mechanism which absorbs the energy from shocks received during an impact has been adopted.

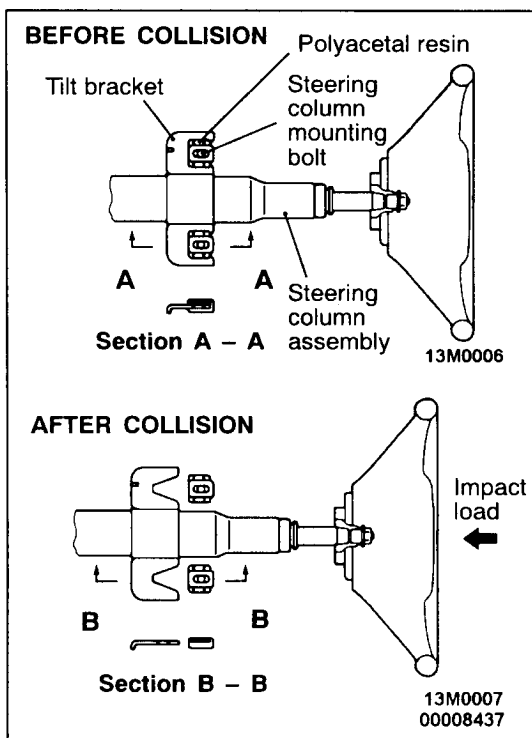
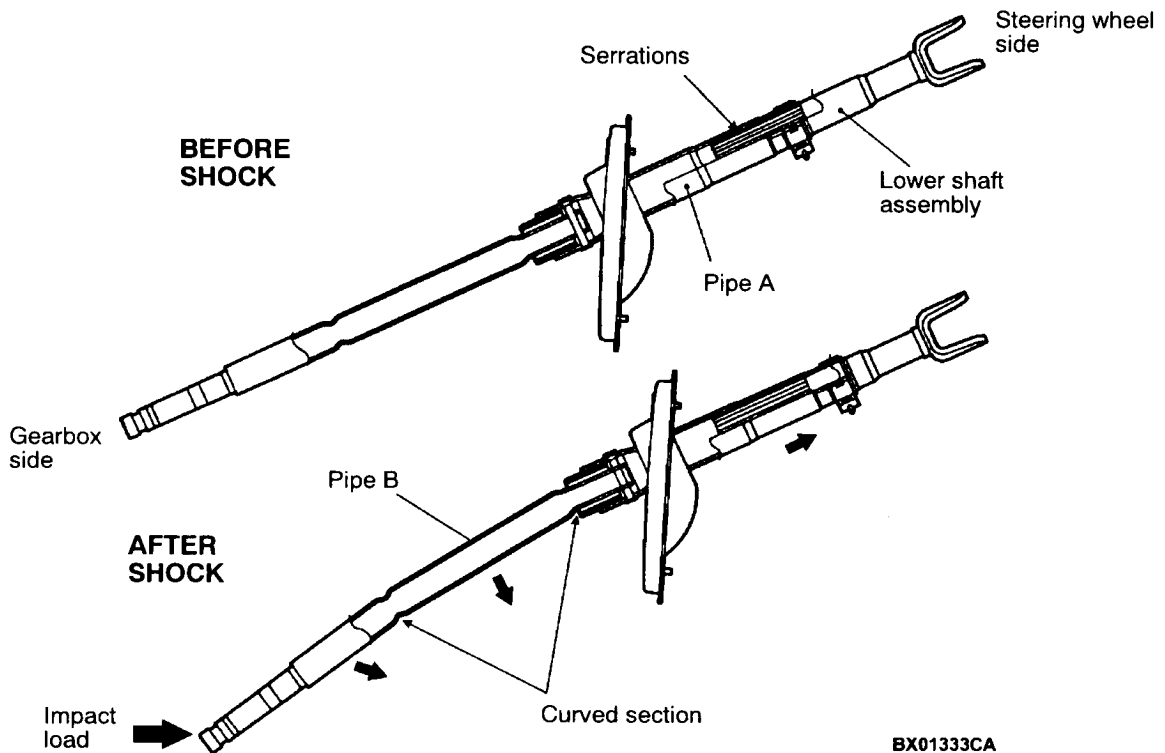


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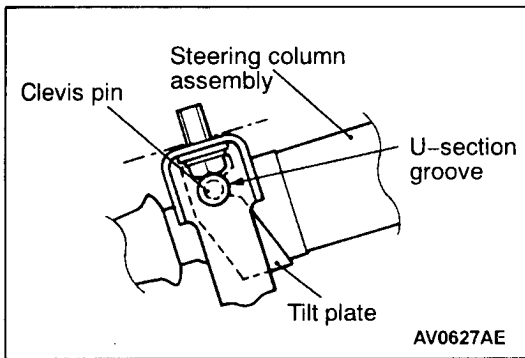
SHOCK ABSORBING MECHANISM**1. Primary impact**

The shaft and pipe A of the lower shaft assembly engage by means of serrations so that the lower shaft assembly is collapsible. When the vehicle collides with something and there is a load added to the lower shaft

assembly from the gearbox, the curved section of the lower shaft assembly fractures pipe B, and pipe A slides above the shaft to absorb the shock load. This prevents the steering column from moving backwards during the impact.

**2. Secondary impact**

- (1) When the driver's body falls against the developed air bag, the tilt bracket moves forwards by crushing the polyacetal resin, causing the steering column assembly to move into the engine compartment.

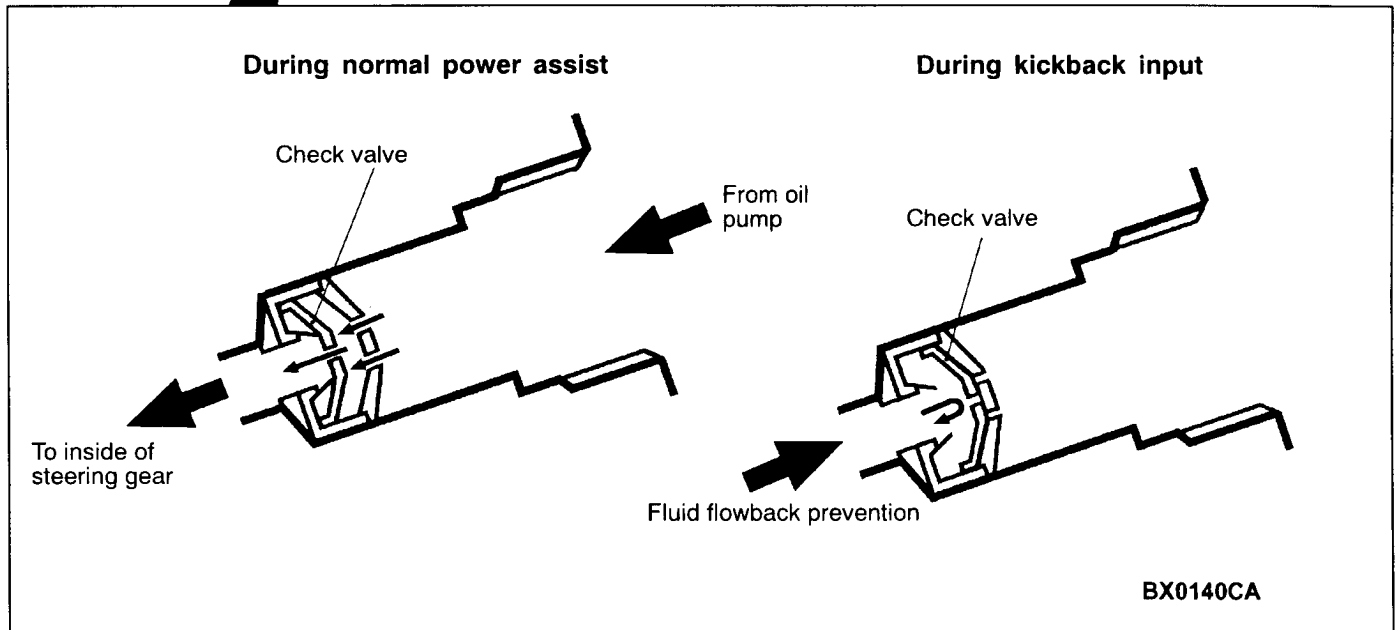
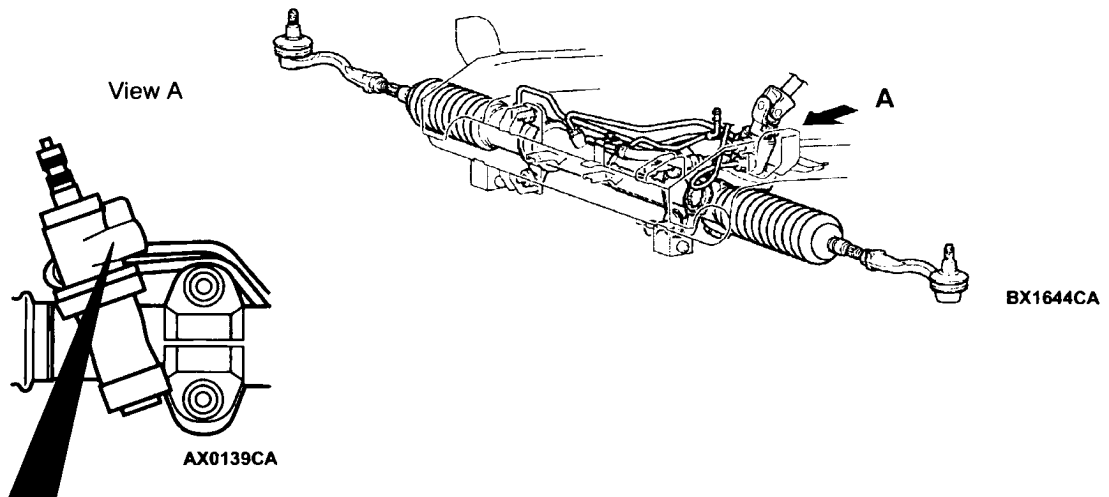


- (2) As the tilt bracket breaks free, the clevis pin comes out of the U-section groove in the tilt plate, allowing the steering column assembly to move forward.

STEERING GEAR

A check valve is built into the high pressure-side power steering fluid inlet of the steering gear, to prevent the fluid from flowing back into the pressure

hose when force is applied from the tyres when driving on uneven roads, and to reduce kickback.



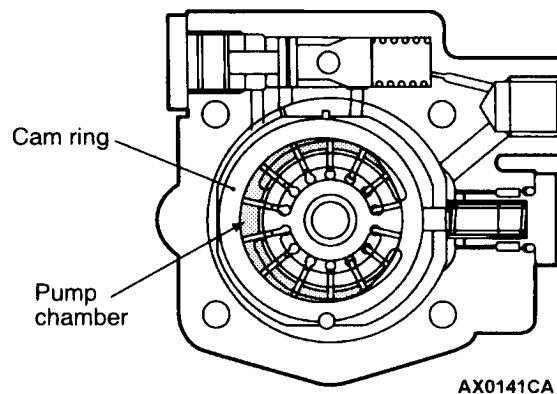
OIL PUMP

- The oil pump is driven by the gear for the 4M4 engine equipped vehicle and by the belt for the 6G7 and 4D5 engine equipped vehicle.
- A variable capacity pump has been adopted to reduce power losses and improve fuel consumption. With this pump, the cam ring moves in accordance with the increase in engine

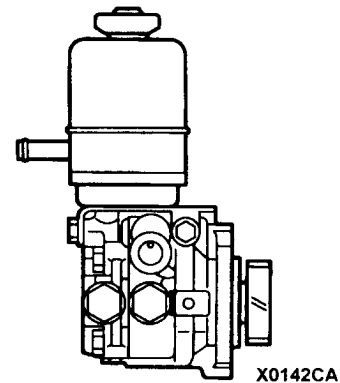
speed, and this reduces the capacity of the pump chamber so that only the required amount of power steering fluid is discharged.

- The pump is integrated with the reservoir tank to reduce weight and to decrease the power steering fluid pumping resistance.<4M4>

Variable capacity pump (cross-section)



Reservoir tank integrated-type oil pump <4M4>



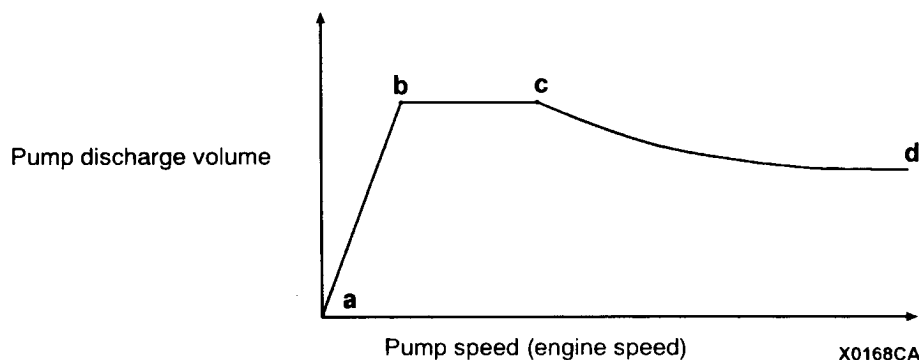
VARIABLE CAPACITY PUMP (CROSS-SECTION)

The discharge volume characteristics of the pump are shown by a to d in the graph. At low engine speeds, the discharge volume is greater, and the volume increases as the engine speed increases in order to maintain the optimum level of steering force. The discharge volume of the variable capacity pump is controlled by changing the capacity of the pump

chamber (the volume defined by the cam ring and the rotor) as described in (1) to (3) below.

In contrast, previous pumps had a constant pump chamber capacity, so that unneeded fluid was recirculated inside the pump in order to control the pump discharge volume. Thus the operation of the variable capacity pump results in less power losses.

PUMP DISCHARGE VOLUME CONTROL

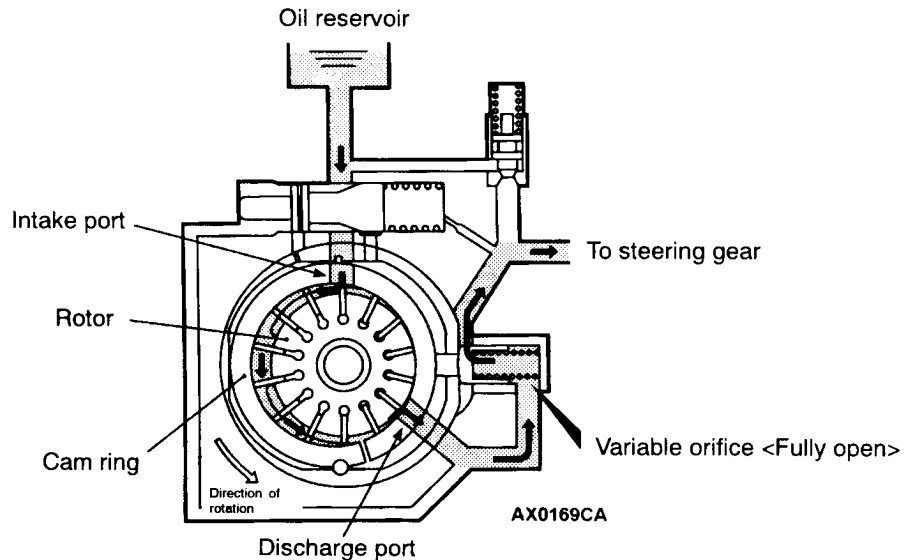


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1. Pump discharge volume increases in direct proportion to the engine speed (a–b)

When the engine starts, the fluid which is pumped from the oil reservoir passes through the intake port to the discharge port and is discharged. The discharged fluid passes

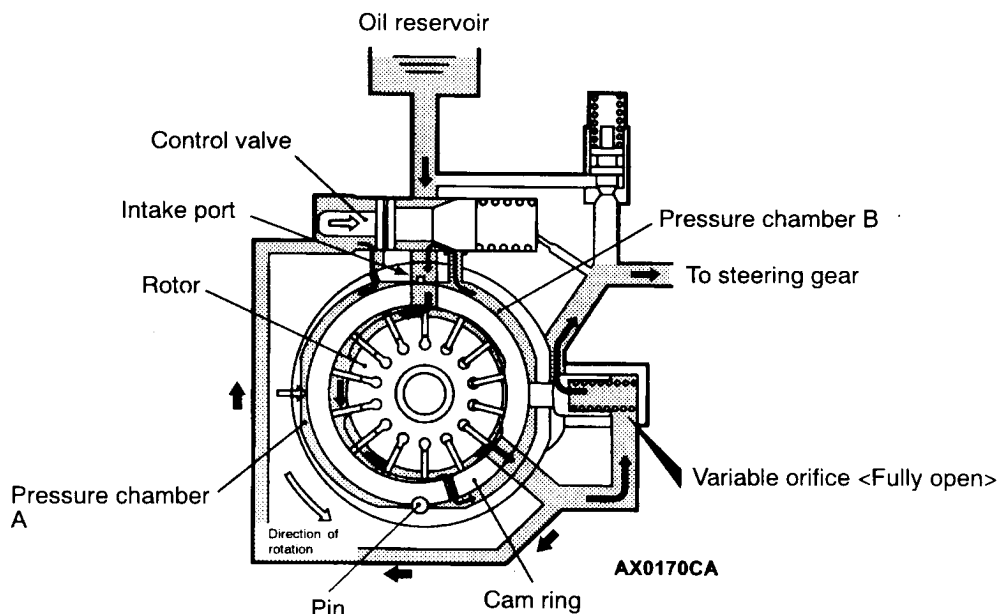
through a variable orifice and is sent to the steering gear. The cam ring is fixed at this time, so that the discharge volume increases in direct proportion to the increase in the engine speed.



2. Discharge volume does not change even when engine speed increases (b–c)

When the engine speed passes point b, the control valve moves so that the discharge pressure is introduced into pressure chamber A. In addition, fluid is also introduced from pressure chamber B to the intake port, so that the pressure in pressure chamber B drops. The result of this is that the difference in pressure

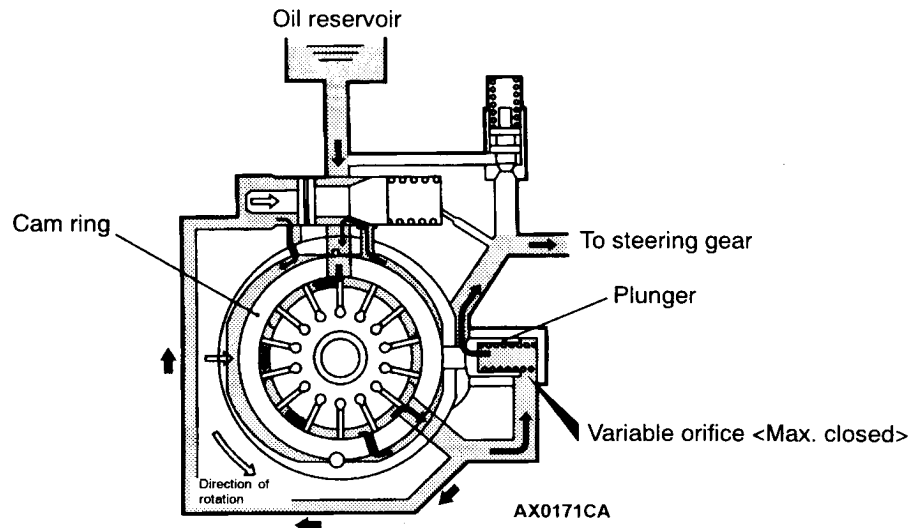
between pressure chamber A and pressure chamber B ($A > B$) causes the cam ring to move to the right. The pump chamber capacity is reduced by the movement of the cam ring, so that the discharge volume per cycle is reduced. Thus the overall discharge volume does not change even if the pump speed increases.



3. Pump discharge volume drops in inverse proportion to the engine speed (c–d)

When the engine speed passes point c, the surface area of the variable orifice starts becoming smaller. (The plunger moves in conjunction with the movement of the cam ring so that the surface area of the variable orifice gradually closes.) As a result, the pressure

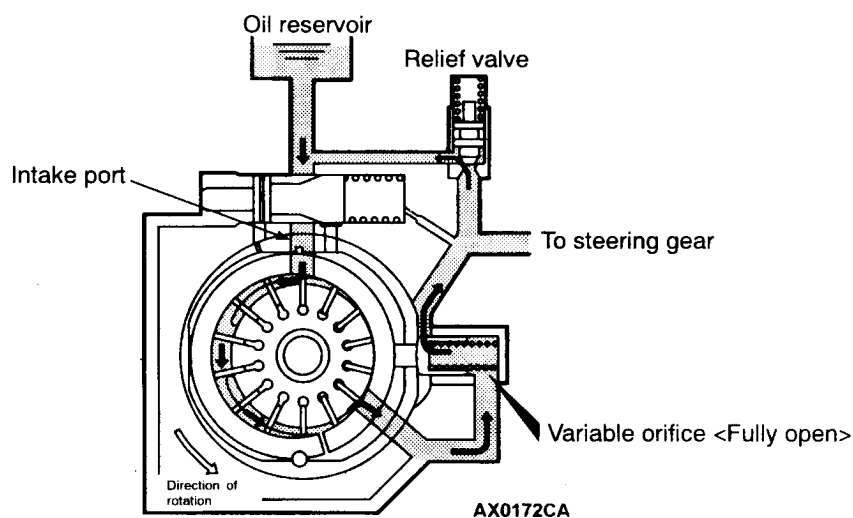
difference between the pressures on both sides of the orifice increases, causing the cam ring to move much further than at the stage between b and c, so that the discharge volume gradually decreases.



4. Pump discharge pressure control (pressure relief)

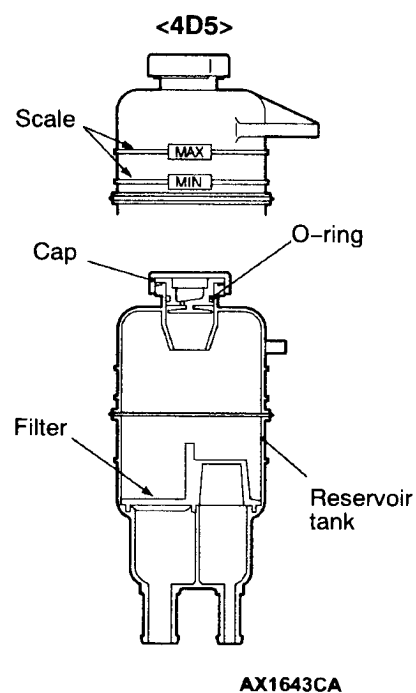
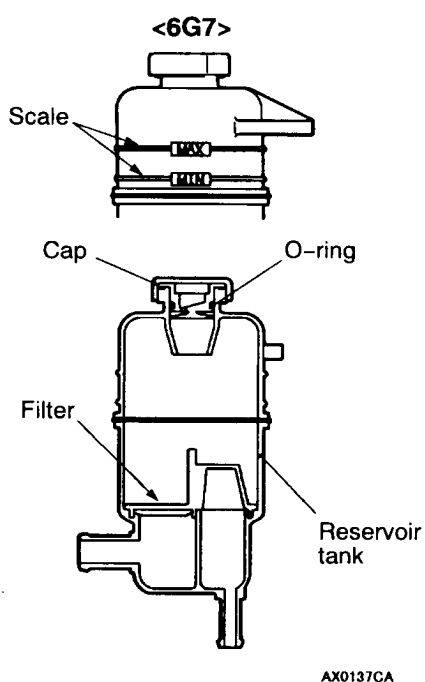
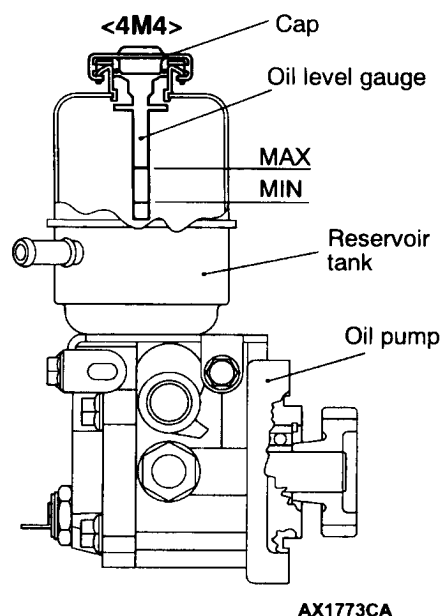
As the pump discharge pressure increases, the pressure applied to the base of the relief valve also increases. When this pressure reaches a specified level, the valve defeats the force of the spring and opens to allow fluid to flow back to

the intake port. In this way, the discharge pressure is controlled so that the power steering fluid does not flow to the steering gear at a pressure which is greater than the specified pressure.



RESERVOIR TANK

- The pump is an integral type with the reservoir tank made of sheet metal that is light weighted and the suction resistance for power steering fluid is reduced and the integrated oil level gauge in the tank cap is provided to make the inspection work easy <4M4>.
- A plastic reservoir tank has been adopted to reduce weight. It also allows the tank itself to be semi-transparent, and it has a scale (MAX and MIN lines) which lets you check the fluid level visually, making inspection much easier. <6G7, 4D5>



BRAKES

The brake system has been designed to give greater reliability and durability and to provide excellent braking performance.

FEATURES

Improved braking performance

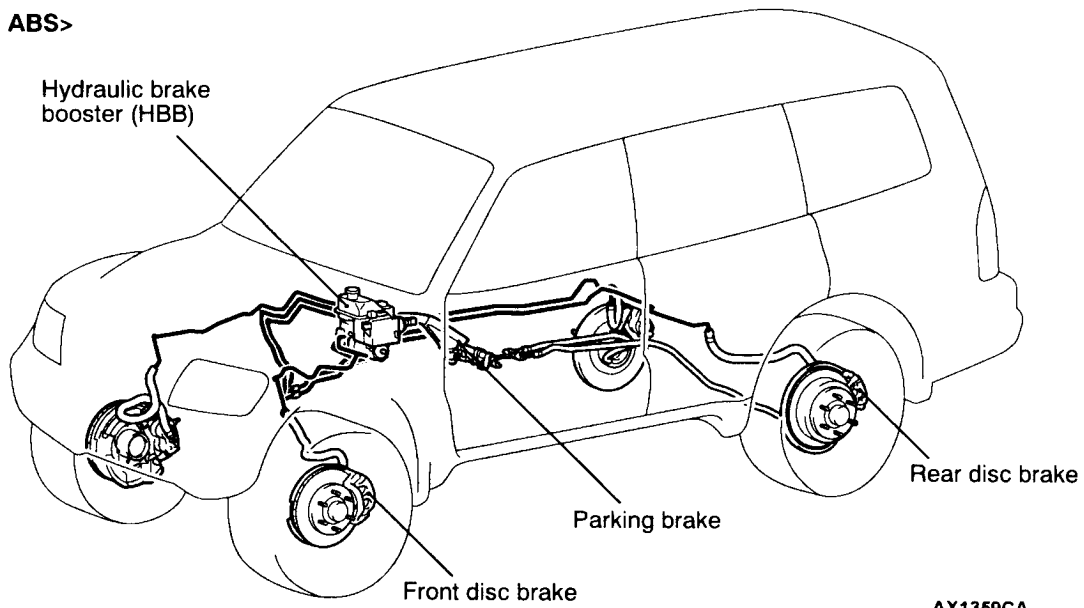
1. Adoption of a hydraulic brake booster (HBB) which maintains a high brake-assisting force even in high deceleration ranges. <Vehicles with ABS>
2. A 8.5-inch brake booster has been adopted to provide large braking force with a small pedal depression force. <Vehicles without ABS>
3. 16-inch ventilate disc brakes have been adopted to provide stable braking force and improved braking feel.

Improved stability

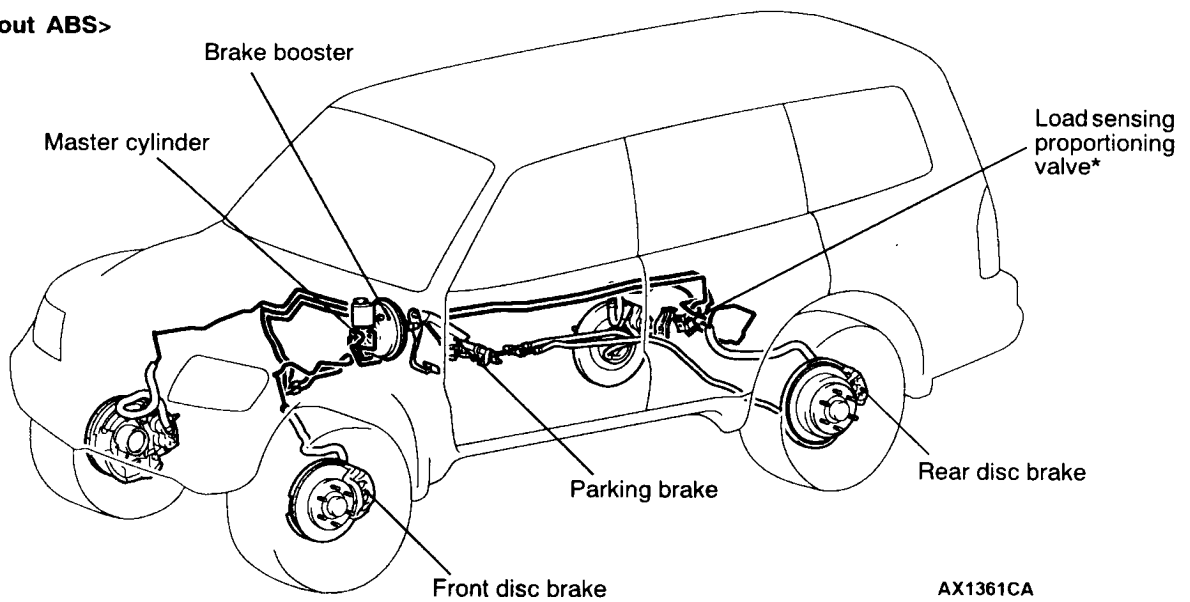
1. A 4-wheel anti-skid braking system (4ABS) has been adopted to prevent slipping caused by the vehicle wheels locking up in order to maintain an appropriate braking distance, and also to maintain a stable vehicle posture and steering performance. <Vehicles with ABS>
2. Adoption of an electronic brake-force distribution (EBD) which makes it possible to maintain the maximum amount of braking force even when the vehicle's load is unevenly distributed. <Vehicles with ABS>
3. A rear wheel early lock-prevention load sensing proportioning valve has been adopted. <Vehicles without ABS>
4. Adoption of independent front and rear wheel brake lines (H piping).
5. Ventilated discs have been adopted for front wheel and rear wheel in order to improve anti-fading performance.

Improved serviceability

1. A diagnosis function has been adopted for the HBB and ABS system in order to make inspection easier. <Vehicles with ABS>
2. For the front and rear disc brakes, an outer disc method separated hub and rotor has been adopted to make removal and installation easier.
3. The master cylinder reservoir tank cap has been coloured white to make identification easier.
4. Parking brake cable adjustment is now carried out from inside the passenger compartment.
5. Reduction in number of brake pipes <Vehicles with ABS>

CONSTRUCTION DIAGRAM**<Vehicles with ABS>**

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<Vehicles without ABS>

AX1361CA

NOTE

For short wheelbase, only the position indicated by the * is symmetrical.

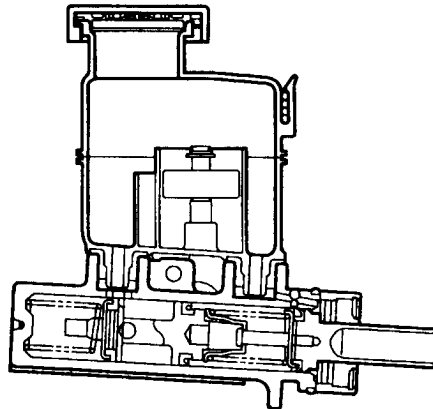
SERVICE BRAKES

SPECIFICATIONS

Items		Vehicles without ABS	Vehicles with ABS
Hydraulic brake booster (HBB)	Master cylinder type	–	Single type (with center valve)
	Master cylinder I.D. mm	–	22.22
	Boosting ratio	–	5.4 (Pedal depressing force: 274 N)
Master cylinder	Type	Tandem type	–
	I.D. mm	23.81	–
Brake booster	Type	Vacuum type, tandem	–
	Effective dia. of power cylinder mm	216 + 217	–
	Boosting ratio	6.5 (Pedal depressing force: 240 N)	–
Rear wheel hydraulic control method		Load sensing proportioning valve	Electronic brake-force distribution (EBD)
Load sensing proportioning valve	Decompression ratio	0.3	–
Front brakes	Type	Floating caliper, 2 piston, ventilated disc	
	Disc effective dia. × thickness mm	241 × 26	
	Wheel cylinder I.D. mm	45.4	
	Pad thickness mm	10.0	
	Clearance adjustment	Automatic	
Rear brakes	Type	Floating caliper, 1 piston, ventilated disc	
	Disc effective dia. × thickness mm	256 × 22	
	Wheel cylinder I.D. mm	44.5	
	Pad thickness mm	10.0	
	Clearance adjustment	Automatic	
Brake fluid		DOT3 or DOT4	

MASTER CYLINDER <Vehicles without ABS>

The master cylinder is a tandem-type, with a structure that emphasises safety.

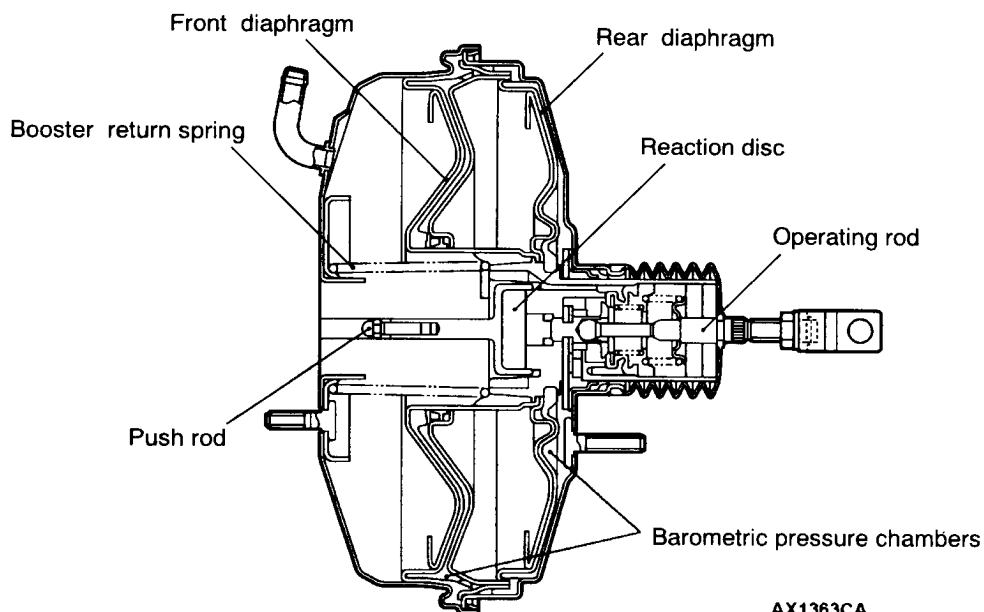


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BRAKE BOOSTER <Vehicles without ABS>

An 8.5-inch tandem-type brake booster has been adopted. The tandem-type brake booster has two diaphragms which allows the difference between the barometric pressure and the negative pressure

to act in two stages, so that a greater boosting effectiveness can be obtained with a smaller diameter. This means that the brake booster as a whole is more compact and lighter in weight.



AX1363CA

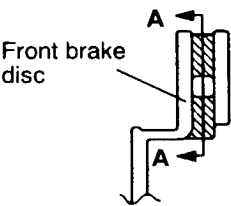
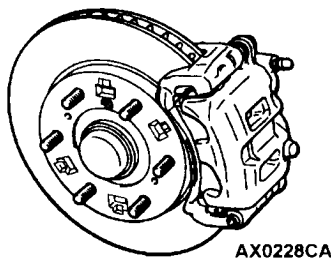
DISC BRAKES

Brakes with the following specifications have been adopted.

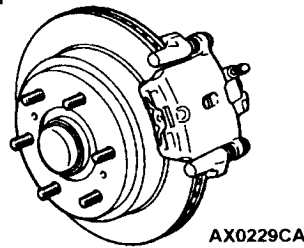
- V6-W45 2-piston ventilate discs for the front brakes
- V6-S44 1-piston ventilate discs for the rear brakes
- An outer disc method in which the wheels and discs are tightened together has been adopted to improve the ease of brake disc removal and installation.

- The front brakes (L.H. and R.H.) and the rear brake (L.H.) are equipped with mechanical-type audible wear indicators on the brake pads (inner side) to notify the driver when the usage limit (2 mm) has been reached.
- Cross-patterned split fins adopted as the disc fins to improve cooling and noise performance of the front brakes

Front



Rear



Section A – A	
MONTERO	PREVIOUS MODELS
Rotation direction Y0152CA Cross-patterned split fin	Rotation direction AV0301AE Radial-patterned split fin

V	6	-	W	45
1	2		3	4

DISC BRAKE NOMENCLATURE

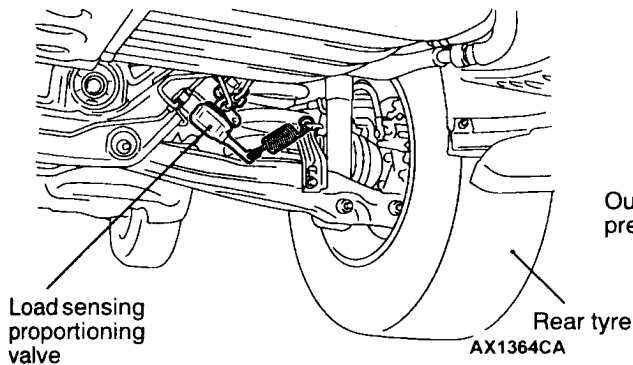
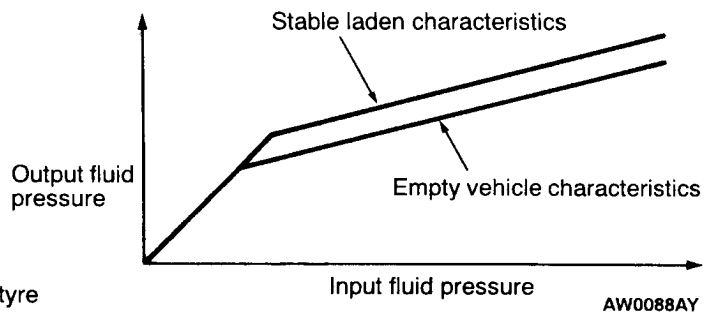
No.	Item	Contents
1	Brake disc type	V: Ventilated
2	Brake size (Minimum applicable disc wheel)	6: 16-inch
3	No. of pistons	S: 1 piston (floating type) W: 2 piston (floating type)
4	Piston size (rounded to nearest integer)	44: φ44 mm 45: φ45 mm

BRAKE LINE**LOAD SENSING PROPORTIONING VALVE <Vehicles without ABS>**

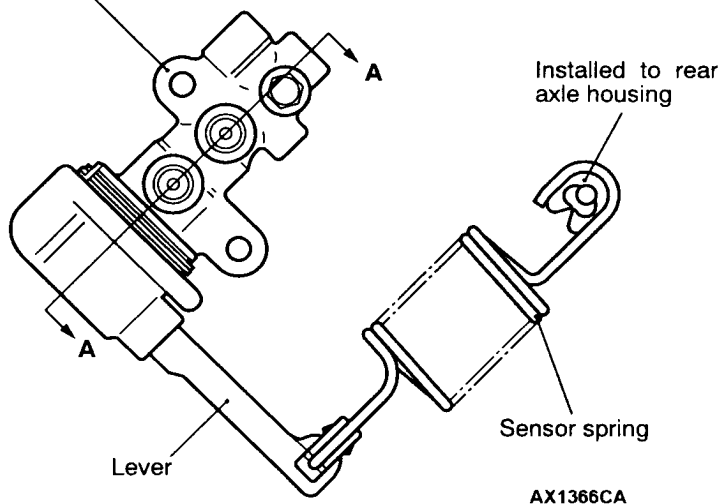
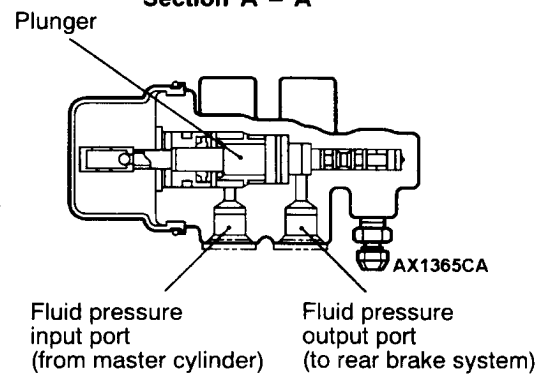
The load sensing proportioning valve controls the brake fluid pressure from the master cylinder in accordance with changes in the laden weight of the vehicle to prevent early locking of the rear wheels, in order to provide improved stability during braking.

NOTE

In terms of structure and operation, the load sensing proportioning valve is basically the same as that of the 1995 L400.

Brake input/output fluid pressure characteristics

Valve body (installed to vehicle)

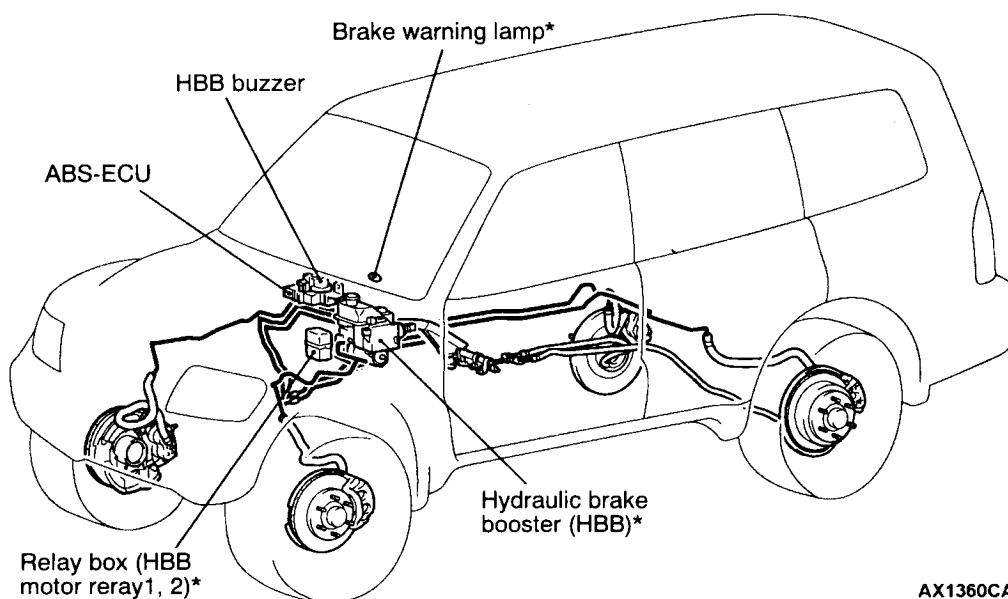
**Section A – A****NOTE**

The illustration shows the proportioning valve for vehicles with long wheelbase. The proportioning valve for vehicles with short wheelbase is symmetrical to the one shown in the illustration.

HYDRAULIC BRAKE BOOSTER (HBB) <Vehicles with ABS>

A hydraulic brake booster system (HBB) has been adopted to Improve the braking performance.

CONSTRUCTION DIAGRAM



NOTE

For R.H. drive vehicles, only the positions indicated by the * are symmetrical.

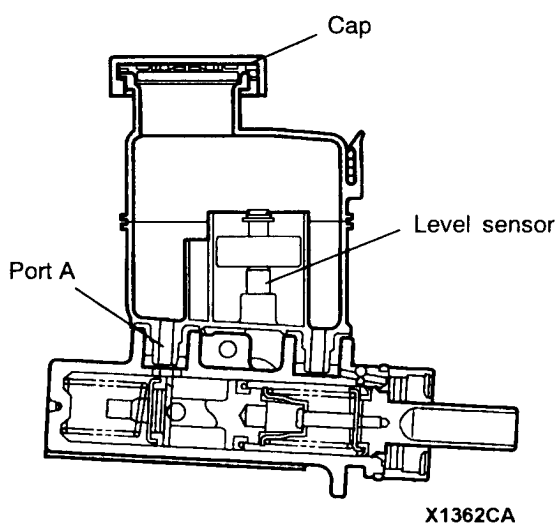
FEATURES

The HBB has the following features in comparison to the previous master cylinder/brake booster system.

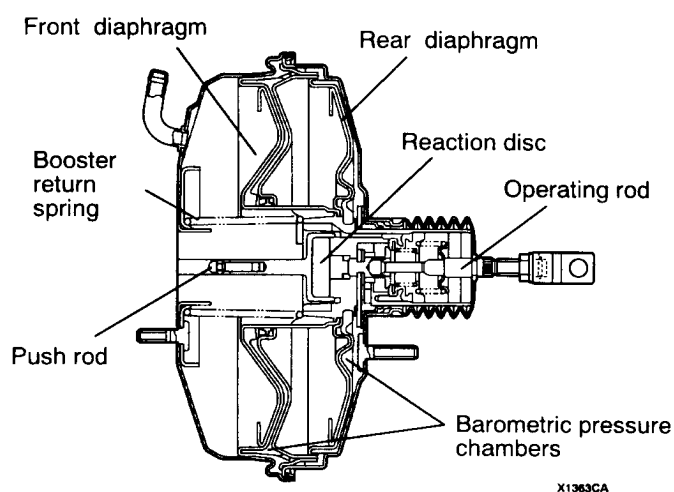
Item	Master cylinder /brake booster	HBB	HBB advantages
Assist force power supply	Engine	Electronic pump motor	- Has its own power source, so that a stable power supply can be maintained at all times regardless of the engine condition. - The need for a negative pressure line from the engine has been eliminated.
Assist force generation	The negative pressure generated by the engine is transferred to the power cylinder in the brake booster, and the difference between it and the barometric pressure is used to generate the assist force.	The hydraulic pressure generated by the electronic pump motor is temporarily stored in an accumulator and this hydraulic pressure becomes the assist force.	The use of accumulated pressure means that the operating responsiveness for each wheel cylinder can be increased during sudden braking.

Item	Master cylinder /brake booster	HBB	HBB advantages
System space requirements	The master cylinder and brake booster are individual components. A brake booster with a large volume is required to generate large assist forces.	The master cylinder, brake booster, hydraulic unit and pump motor are integrated into a single assembly.	• More compact in size. • The assembly also includes the ABS hydraulic unit, so provides even greater space savings in comparison to previous systems. • The number of brake lines required can be reduced.

<Previous master cylinder/brake booster system>

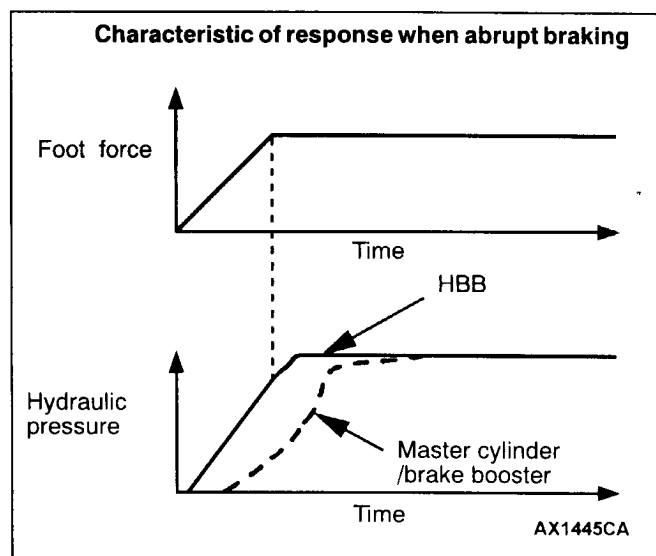
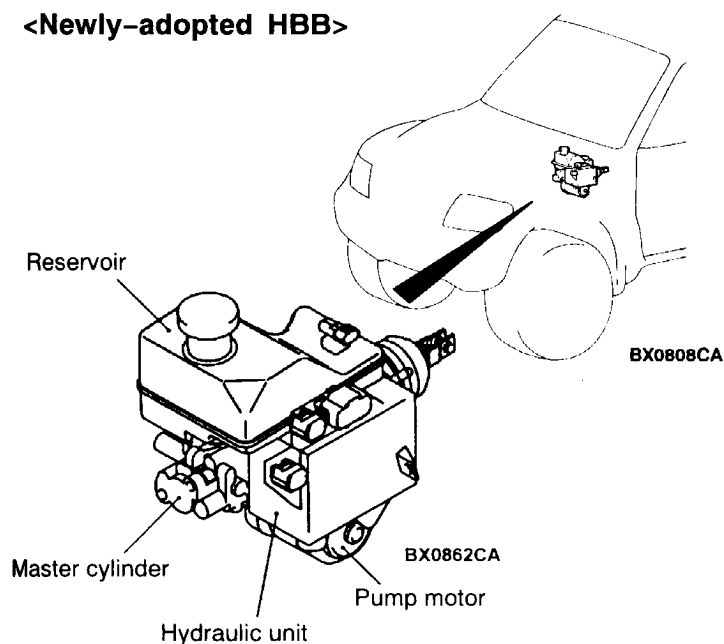


MASTER CYLINDER



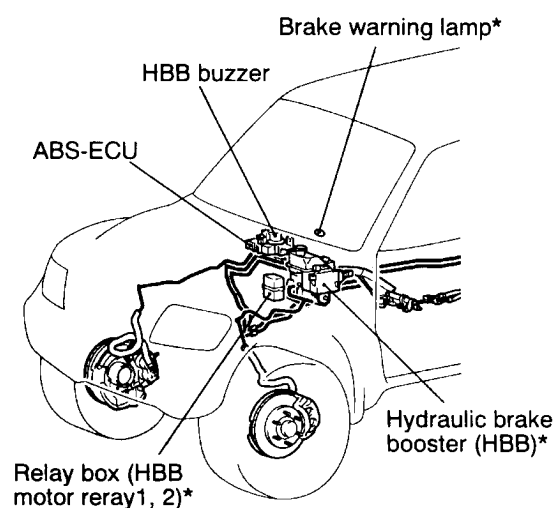
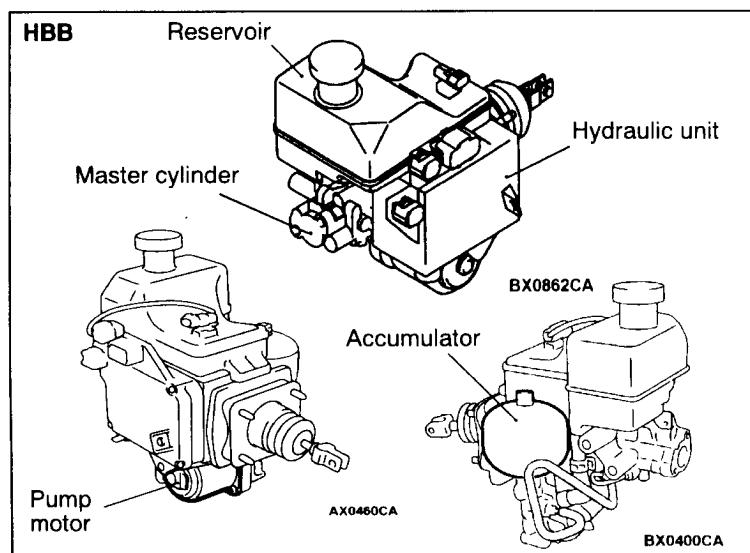
BRAKE BOOSTER

<Newly-adopted HBB>



SYSTEM CONFIGURATION DIAGRAM**MAJOR COMPONENTS AND FUNCTION**

Name of part	Outline of function
ABS-ECU	Controls the HBB system.
HBB buzzer and brake warning lamp	Operates and illuminates in response to signals from the ABS-ECU to notify the driver of any abnormalities in the HBB system.
Pump motor	Piston type pump motor pumps up brake fluid from the reservoir and sends it to the accumulator under high pressure.
Accumulator	The accumulator is pressurised with nitrogen gas and collects the hydraulic pressure which is generated by the pump motor.
Select solenoid valve (built into hydraulic unit)	These two solenoid valves switch the hydraulic pressure line which supplies the front brakes during ABS control from the master cylinder hydraulic pressure to the hydraulic pressure which is generated by the accumulator and stored by the spool valve. This is done in order to reduce the kickback in the brake pedal.
Control solenoid valve (built into hydraulic unit)	These eight (2 x 4) solenoid valves increase, hold and reduce the hydraulic pressures which are supplied to the wheel cylinders during ABS control and EBD control.
Pressure switch (built into hydraulic unit)	Two switches are included: a switch for pump control and a switch for low-pressure warning control. The former switch outputs a pump motor drive signal when the accumulator hydraulic pressure drops below the specified hydraulic pressure. If the accumulator pressure drops further, the low-pressure warning control switch turns off so that a warning lamp illumination signal and an HBB buzzer operating signal are output.
Relief valve (built into hydraulic unit)	This is a mechanical valve which is used to prevent excessively high pressure from building up in the power supply system. If the pump motor keeps operating continuously because of a problem such as a pressure switch malfunction, this valve allows excess brake fluid to be returned to the reservoir.
Master cylinder	The master cylinder is a single-piston type which generates hydraulic pressure which is transmitted to the front brakes.
Brake booster	Converts the accumulator high pressure into a pressure which corresponds to the brake pedal depression force, and transmits this to the rear brakes, and also to the booster chamber to generate the brake assist force.
Reservoir	Stores the brake fluid for the master cylinder and the power supply.
Brake fluid level warning switch (built into reservoir)	When the level of brake fluid inside the reservoir drops, this switch turns on and causes the brake warning lamp to illuminate.



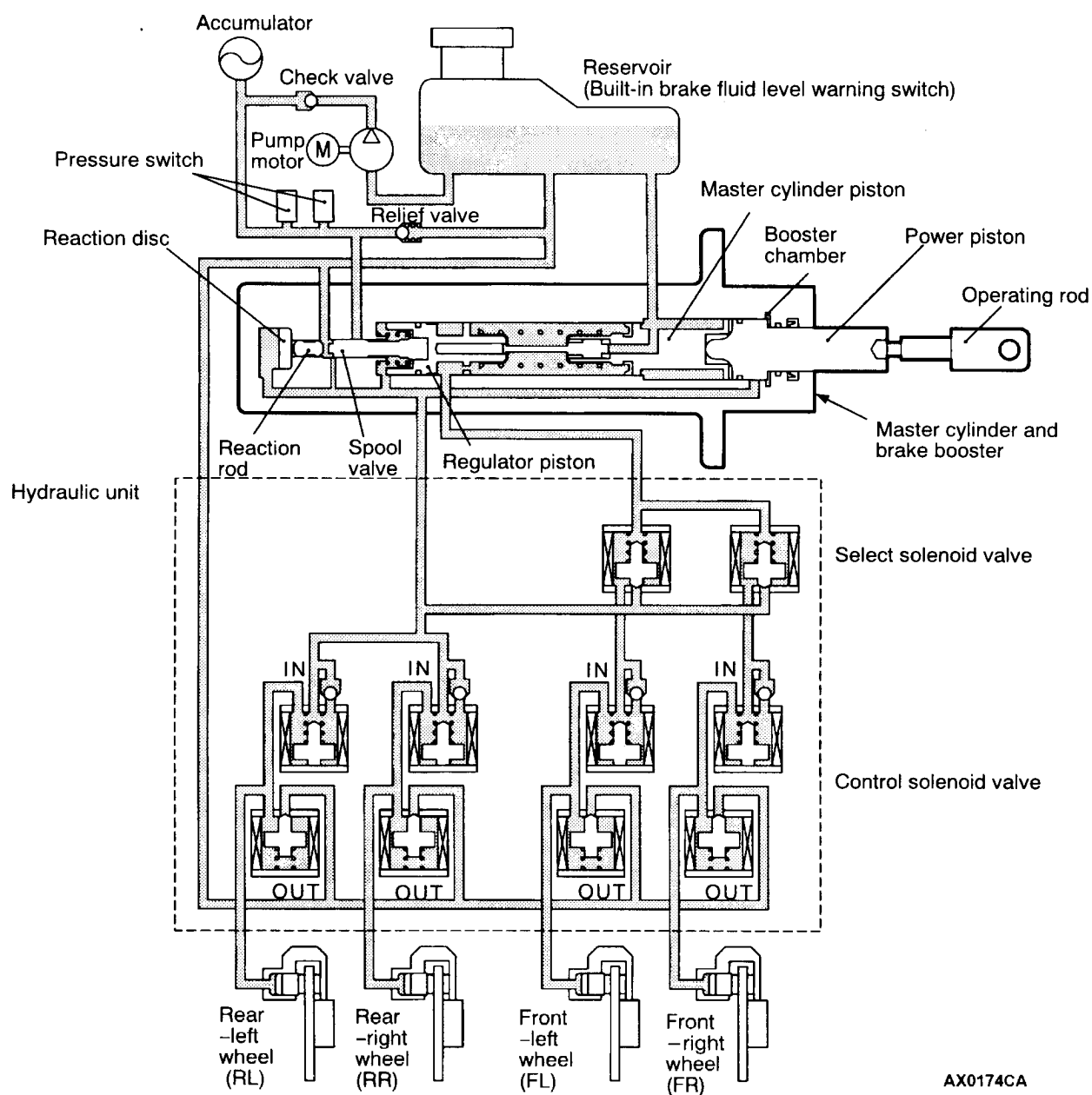
NOTE

For R.H. drive vehicles, only the positions indicated by the * are symmetrical.

FLUID PRESSURE DIAGRAM

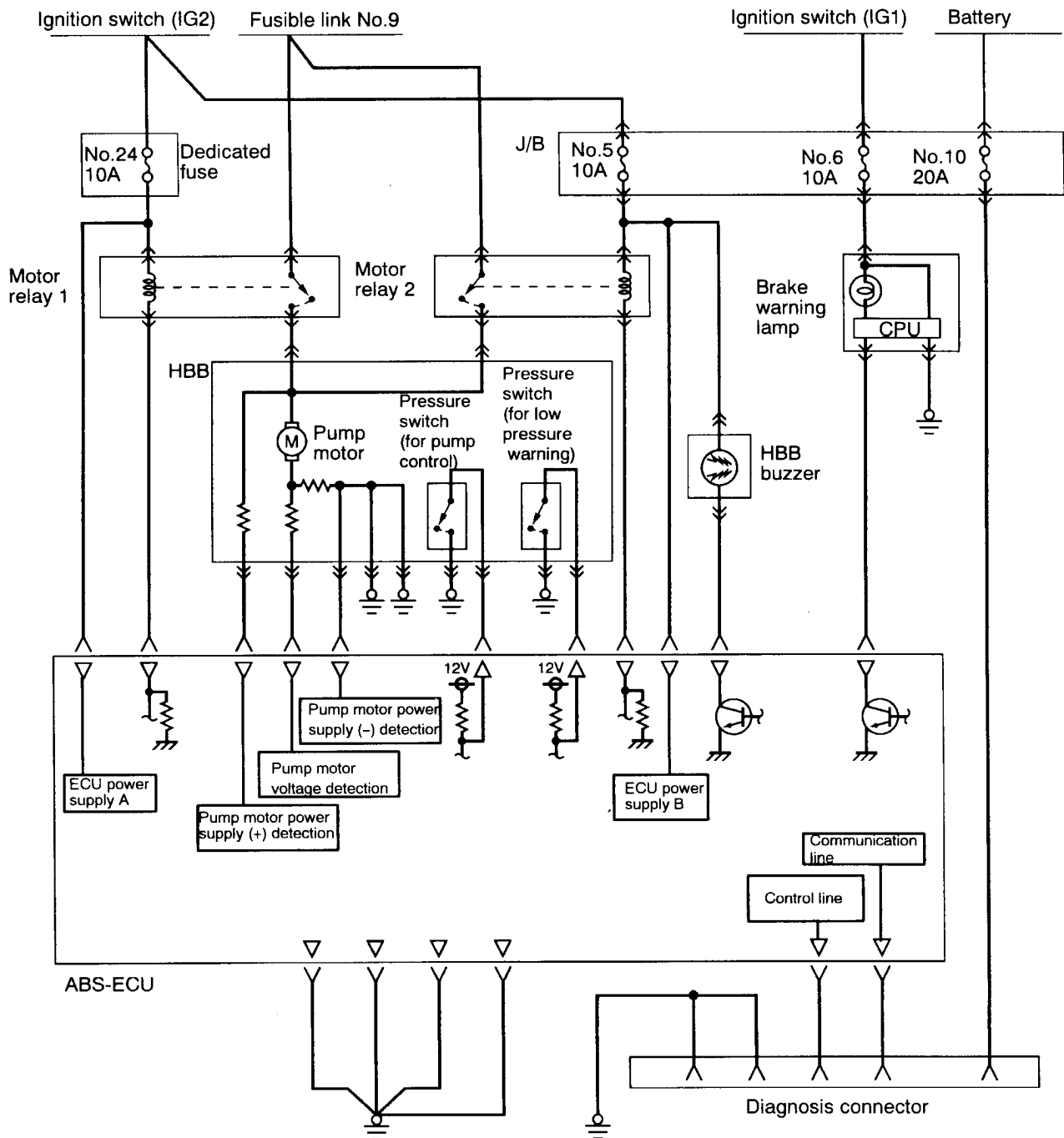
The master cylinder hydraulic pressure for the front brakes is assisted by a brake booster which utilises accumulator pressure; the hydraulic pressure gen-

erated by the accumulator is introduced directly to the rear brakes.



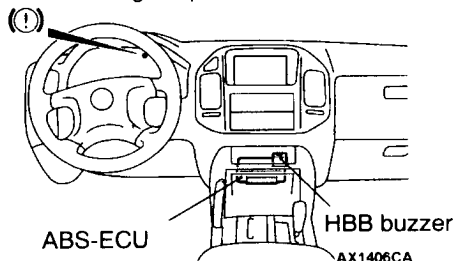
AX0174CA

ELECTRICAL CIRCUIT DIAGRAM

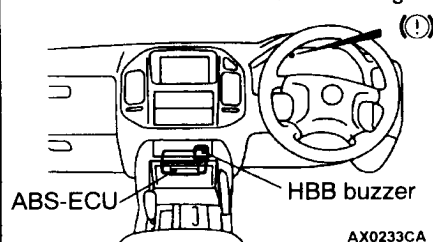


L.H. drive vehicles

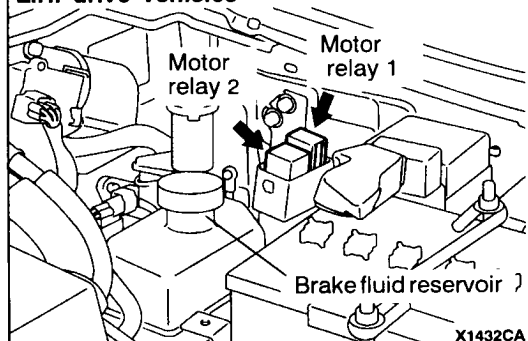
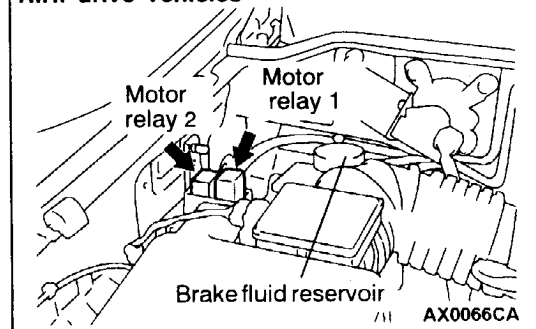
Brake warning lamp

**R.H. drive vehicles**

Brake warning lamp

**ABS-ECU, HBB BUZZER, BRAKE WARNING LAMP**

The ABS-ECU carried out ABS control, EBD control and HBB control. Refer to P.3-44 for details of ABS control and EBD control. The HBB buzzer and the brake warning lamp operate and illuminate in accordance with signals from the ABS-ECU to give notification if there is a problem with the system.

L.H. drive vehicles**R.H. drive vehicles****HBB MOTOR RELAY**

The motor relays control the pump motor of the hydraulic brake booster according to signals from the ABS-ECU. In addition, there are two motor relays. If one relay should malfunction, the other relay can still operate to control the pump motor.

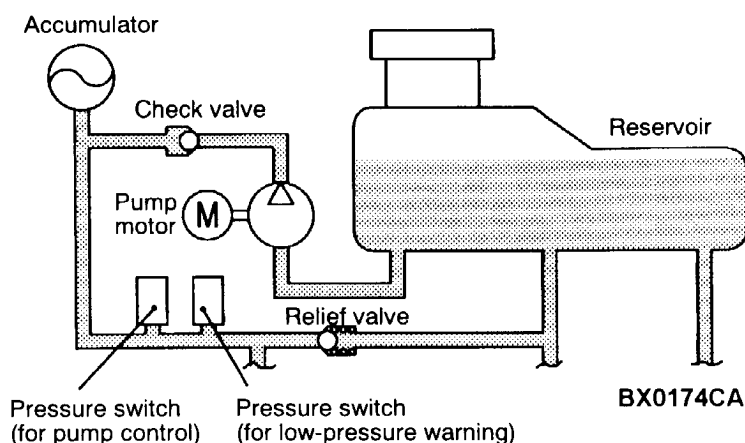
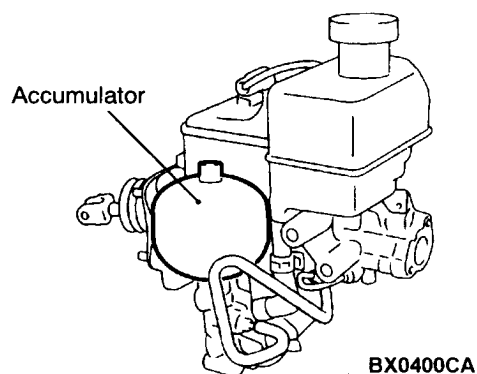
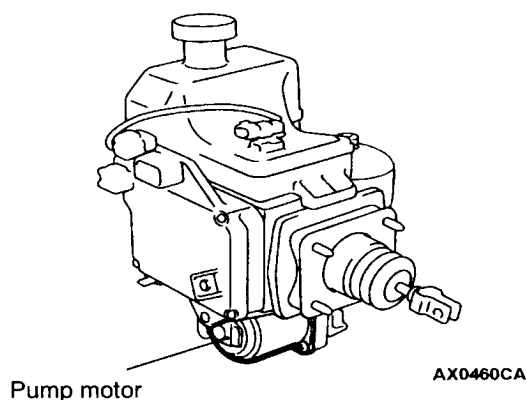
PUMP MOTOR, ACCUMULATOR

An electric pump motor (piston type) has been adopted. The accumulator is pressurised with nitrogen gas and collects the hydraulic pressure which is generated by the pump motor.

When the accumulator hydraulic pressure drops to approximately 16.1 MPa or below, the pressure switch (for pump control) turns off, and a pump motor drive signal is output from the ABS-ECU to make the pump motor operate. When the pump motor operates, it pressurises the brake fluid, which is discharged through the check valve to be stored in the accumulator.

The operation described above generates the hydraulic pressure (high pressure) which is required for normal brake operation and also EBD and ABS operation. When the accumulator hydraulic pressure drops to approximately 10.8 MPa or below, the pressure switch (for low pressure warning) turns off, and this causes the brake warning lamp to illuminate and the HBB buzzer to sound.

Then, when the accumulator hydraulic pressure rises to approximately 18.3 MPa, the pressure switch (for pump control) turns on, and after approximately 1 second, the pump motor stops opening. If there is a malfunction of the pressure switch at this time, the release valve opens when the pressure reaches approximately 24 MPa to prevent excessive pressure from building up.

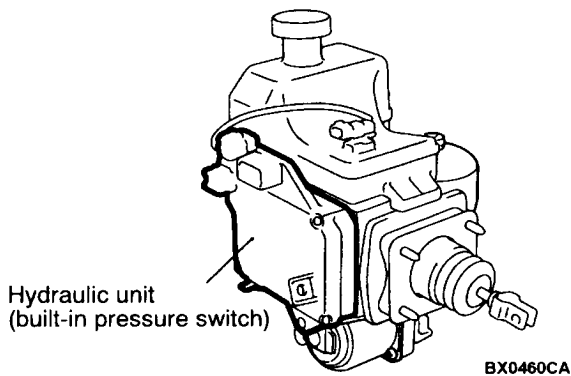
**SELECT SOLENOID VALVE, CONTROL SOLENOID VALVE**

Refer to P.3-42.

PRESSURE SWITCH

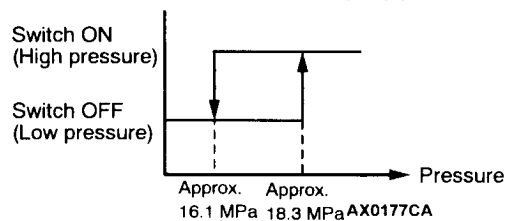
There are two types of pressure switch: one for pump control and one for low pressure warning control. They are both built into the hydraulic unit.

- The pressure switch for pump control outputs a low pressure signal (switch: OFF) to the ABS-ECU to cause the pump motor to operate when the hydraulic pressure drops to approximately 16.1 MPa or lower. In addition, when the hydraulic pressure is high (approximately 18.3 MPa or higher), the pressure switch outputs a high pressure signal (switch: ON) to the ABS-ECU to cause the pump motor to stop operating.

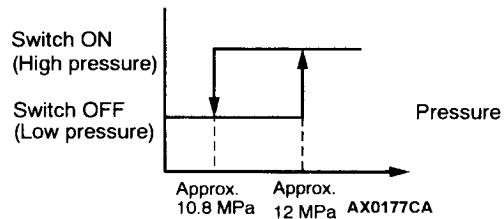


- The pressure switch for low pressure warning control outputs a low pressure signal (switch: OFF) to the ABS-ECU to cause the brake warning lamp to illuminate and the HBB buzzer to sound when the hydraulic pressure drops to approximately 10.8 MPa or lower. In addition, when high hydraulic pressure is being restored (approximately 12 MPa or higher), the pressure switch outputs a high pressure signal (switch: ON) to the ABS-ECU so that normal hydraulic pressure is transmitted.

PRESSURE SWITCH (FOR PUMP CONTROL) OUTPUT CHARACTERISTICS

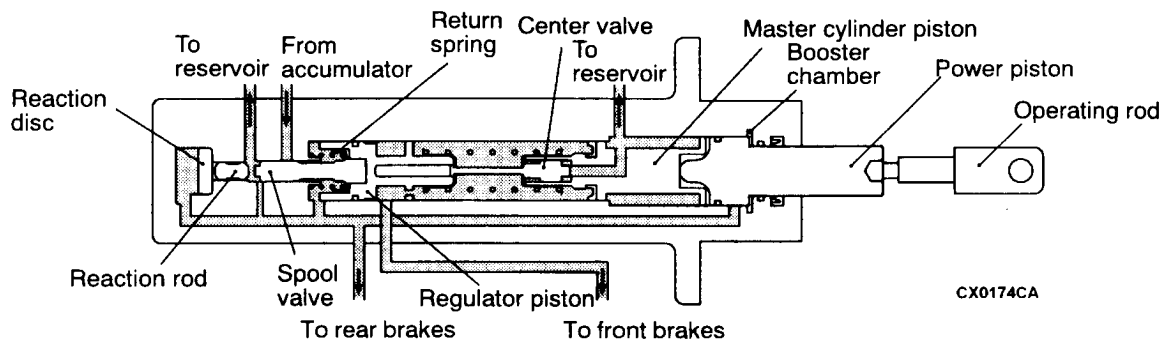


PRESSURE SWITCH (FOR LOW PRESSURE WARNING) OUTPUT CHARACTERISTICS



MASTER CYLINDER, BRAKE BOOSTER

- The master cylinder piston is a single-type piston with a center valve, and it controls only the front brakes.
- The brake booster has an integrated structure which envelopes the master cylinder at the front and rear. The front section consists of a regulator piston, a return spring, a spool valve for switching the brake fluid line, a reaction rod and a reaction disc which changes shape in response to the pressure in that order, and the rear section consists of an operating rod, a power piston and a booster chamber in that order.
- The operating rod and the power piston are directly linked, and the regulator piston which transmits the pedal operating force and the spool valve are also directly linked.
- The force from the master cylinder is applied to the regulator piston in the forward direction (to the left in the illustration), and the power assist force from the booster is applied to the regulator piston in the reverse direction (to the right in the illustration). This produces a balance between the two via the reaction disc, so that a hydraulic pressure is generated which is proportional to the pedal depression force.
- The regulator piston is equipped with a return spring to maintain the spool return force when there is no power assist force being applied by the booster.

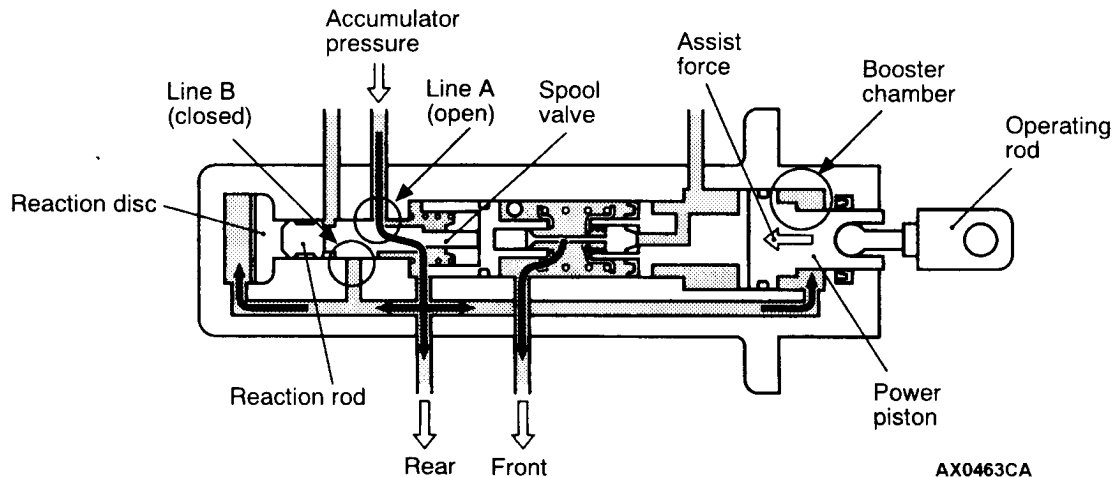


1. When the pedal operating force is transmitted in turn by the operating rod, the power piston and the master cylinder piston, the regulator piston and the spool valve move to the left.
2. When the spool valve opens line A and closes line B, the accumulator pressure is supplied to the rear brakes. This pressure is introduced to the booster chamber and provides power assistance to move the master cylinder piston to the left.

3. Then, when the pressure in the booster chamber increases, the pressure which is applied to the rear (left side) of the reaction disc also increases, and the reaction disc starts to change shape. The reaction disc contacts the reaction rod, and the reaction rod in turn contacts the spool valve, so that the master cylinder pressure being applied towards the left and the booster pressure being applied to the right are brought into balance by the reaction disc. This allows the power-assist hydraulic pressure generated by the pedal operating force to be kept at an equilibrium.

[illegible]

<When booster is operating>



<When a loss of accumulator pressure occurs>

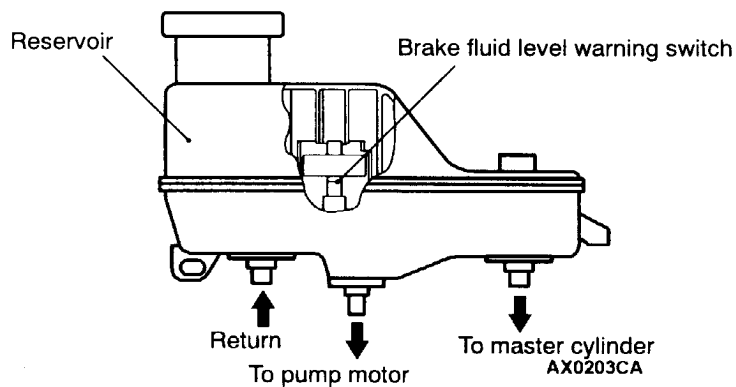
If a loss of accumulator pressure occurs because of a problem such as a pump motor problem, the power assist force and rear brake pressure cannot increase in response to the input from the brake

pedal. Accordingly, the front brakes can be operated directly by depressing the brake pedal, but the rear brakes do not operate at all.

RESERVOIR, BRAKE FLUID LEVEL WARNING SWITCH

The reservoir is equipped with brake fluid supply ports for the pump motor and for the master cylinder and brake booster, and return ports for returning the brake fluid from the booster and the various solenoid valves. In addition, the brake fluid level

warning switch which is built into the reservoir detects the brake fluid level, and causes the brake warning lamp to illuminate when the fluid level drops below a specified level.



FAIL-SAFE FUNCTION

Refer to P.3-47.

DIAGNOSIS FUNCTIONS

Refer to P.3-47.

4-WHEEL ANTI-SKID BRAKE SYSTEM (4ABS)

FEATURES

ABS has been adopted as standard equipment in all vehicles to maintain directional stability and steering performance during sudden braking.

The ABS control method used is a 4-sensor, 4-channel method (previous models: 4-sensor, 3-channel method) which allows the brake pressures for all four wheels to be controlled independently of each other. The system has the following features.

- EBD* (Electronic Brake-force Distribution system) control has been added to provide the ideal braking force for the rear wheels.
- The hydraulic unit function has been integrated with the hydraulic brake booster (HBB).
- Select solenoid valves (two valves for FL and FR) have been adopted in order to reduce the pedal kickback and improve the operation feeling when the ABS is operating.
- Independent 4-wheel control is carried out while the vehicle is turning in order to increase the braking force.

EBD CONTROL

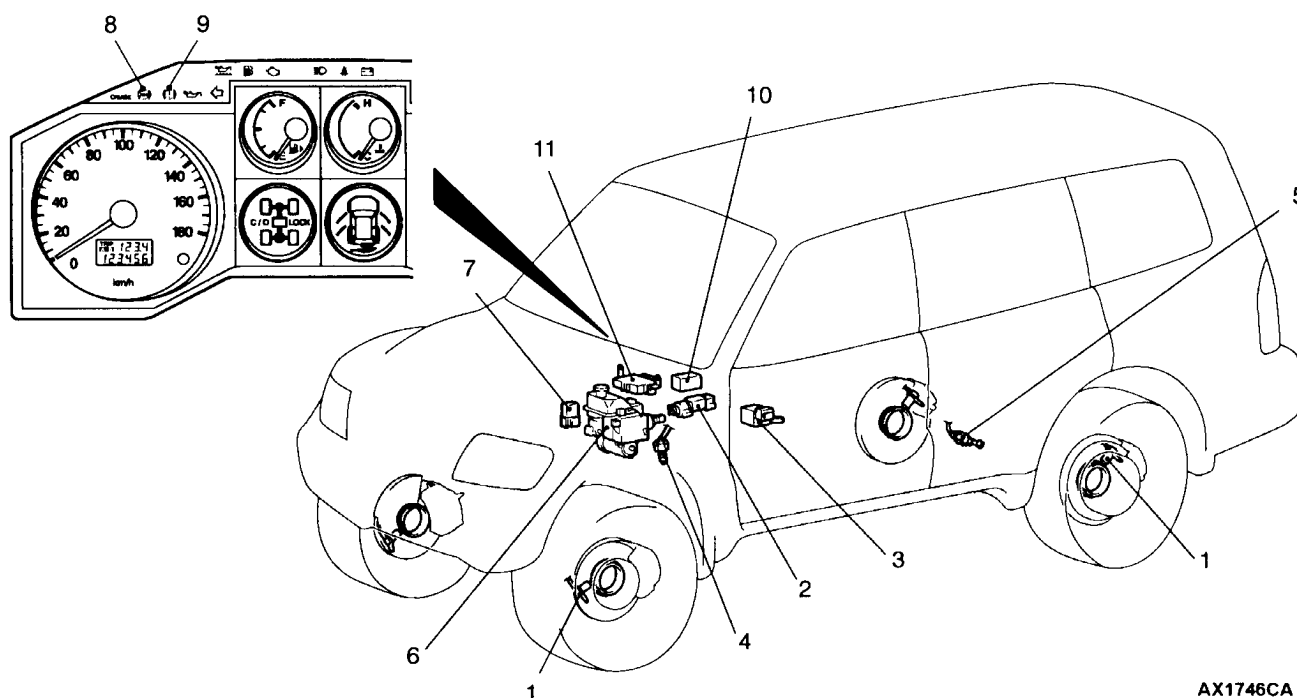
In ABS, electronic control method is used whereby the rear wheel brake hydraulic pressure during braking is regulated by rear wheel control solenoid valves in accordance with the vehicle's rate of deceleration and the front and rear wheel slippage which are calculated from the signals received from the various wheel sensors. EBD control is a control system which provides a high level of control for both vehicle braking force and vehicle stability. The system has the following features.

- Because the system provides the optimum rear wheel braking force regardless of the vehicle laden condition and the condition of the road surface, the system reduces the required pedal depression force, particularly when the vehicle is heavily laden or driving on road surfaces with high frictional coefficients.
- Because the duty placed on the front brakes has been reduced, the increases in pad temperature can be controlled during front brakes applying to improve the wear resistance characteristics of the pad.
- Control valves such as the proportioning valve are no longer required.

SPECIFICATIONS

Item		Specifications
ABS control method		4-sensor, 4-channel
No. of ABS rotor teeth	Front	50
	Rear	50
ABS speed sensor	Type	Magnet coil type
	Gap between sensor and rotor mm	0.9 (non-adjustable type)

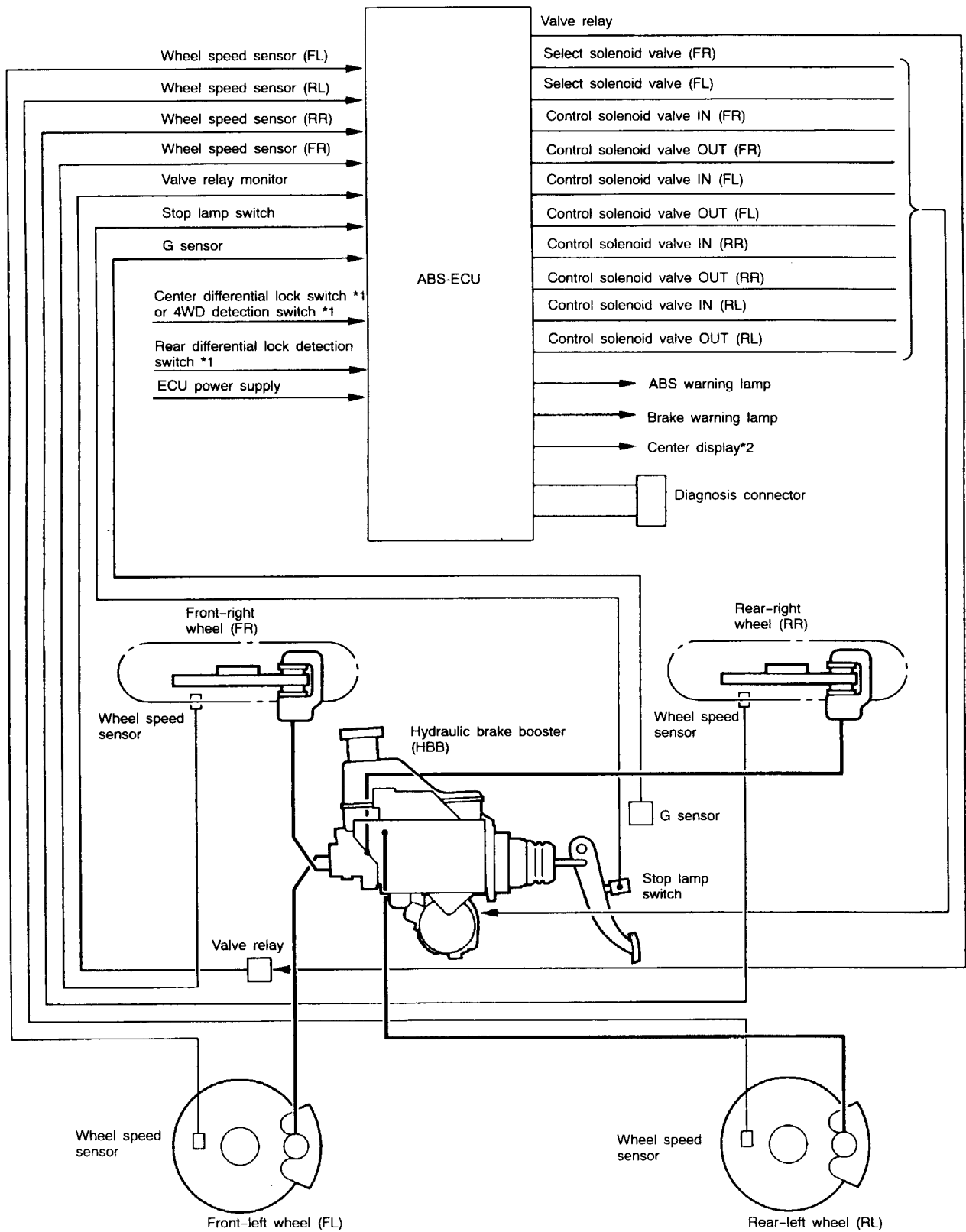
CONSTRUCTION DIAGRAM



AX1746CA

Name of part		Number	Outline of functions
Sensor	Wheel speed sensor	1	Send alternating current signals at frequencies which are proportional to the rotation speeds of each wheel to the ABS-ECU.
	Stop lamp switch	2	Sends a signal to the ABS-ECU to indicate whether the brake pedal is depressed or not.
	G sensor	3	Detects the rate of deceleration of the vehicle in the longitudinal direction, and converts this into a voltage and sends the resulting signal to the ABS-ECU.
	Center differential lock switch or 4WD detection switch	4	Sends ON and OFF signals to the ABS-ECU corresponding to the condition of the power transmission system.
	Rear differential lock detection switch	5	
Actuator	Hydraulic unit in hydraulic brake booster (HBB)	6	Drives the select solenoid valves and control solenoid valves according to signals from the ABS-ECU in order to control the brake hydraulic pressure for each wheel.
	Valve relay	7	Turns on when a signal comes from the ABS-ECU, and supplies power to the select solenoid valves and control solenoid valves inside the hydraulic unit in HBB.
	ABS warning lamp	8	Illuminates in response to signals from the ABS-ECU when a problem develops in the system.
	Brake warning lamp	9	Illuminates in response to signals from the ABS-ECU when a problem which affects the HBB and EBD function develops in the system.
Diagnosis connector		10	Outputs the diagnosis codes and allows communication with the MUT-II.
ABS control unit (ABS-ECU)		11	Controls actuators (described above) such as the HBB based on the signals coming from each sensor.
			Controls the self-diagnosis and fail-safe functions.
			Controls the diagnosis function (MUT-II compatible).

SYSTEM CONFIGURATION DIAGRAM



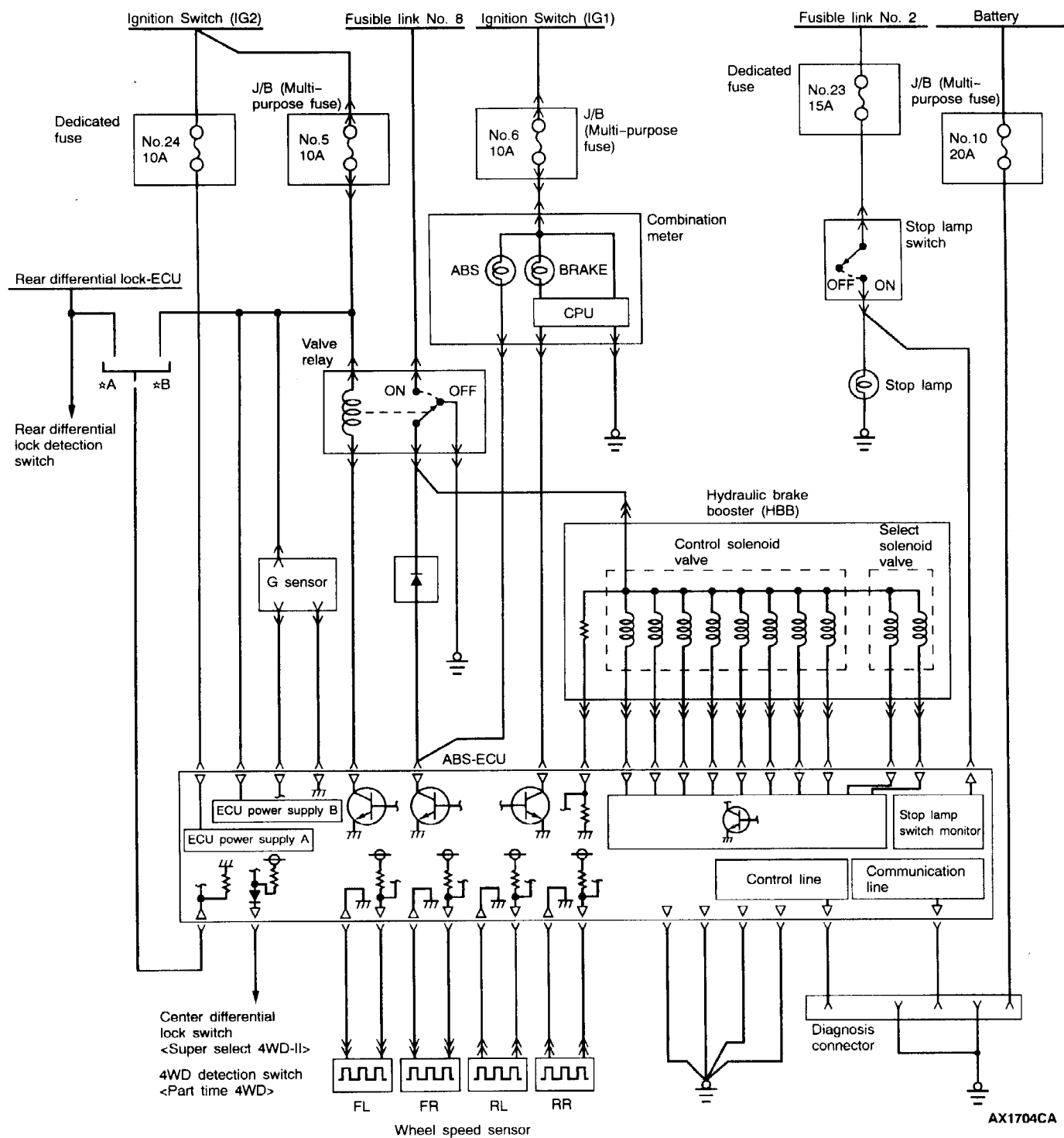
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NOTE

*1: This switch is also used by the transfer system.

*2: Outputs wheel speed data which is required for center display wheel speed information.

ABS ELECTRICAL CIRCUIT DIAGRAM

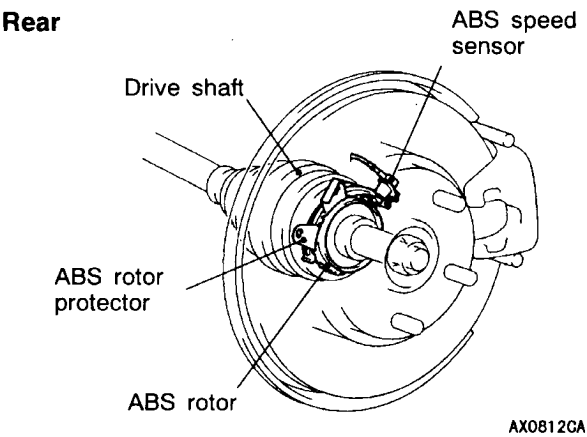
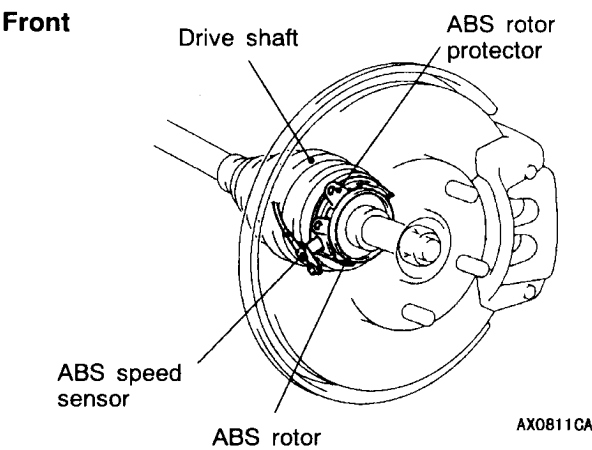


SENSORS

WHEEL SPEED SENSOR

The wheel speed sensors consist of fixed ABS speed sensors and the ABS rotors that rotate at the same speed as the wheels, and output alternating current signals at frequencies which are proportional to the wheel speed.

- The ABS rotors (50 teeth) are installed to the drive shafts at both front and rear, and the ABS speed sensors are installed to knuckles.
- The gap between the ABS rotors and the ABS speed sensors are non-adjustable at both the front and rear to improve serviceability.



G SENSOR

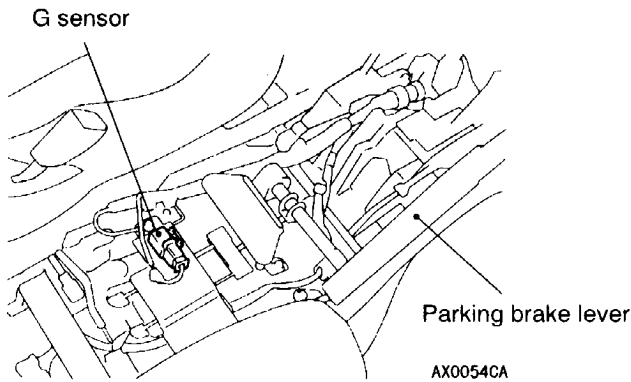
The semi-conductor type G-sensor detects the longitudinal deceleration of vehicle and outputs the voltage signal in proportion to the acceleration/deceleration of the wheel speed to the ABS-ECU. If a malfunction occurs on the power line or the

ground line of G-sensor, the G-sensor outputs the abnormal voltage to the ABS-ECU as shown below.

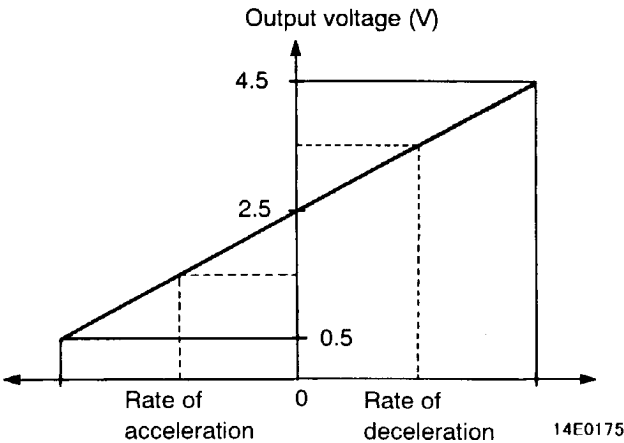
Details of problem	G sensor output voltage
Open circuit or short-circuit in G sensor power supply line	0.3 V or less
Open sensor in G sensor earth line	4.7 V or higher

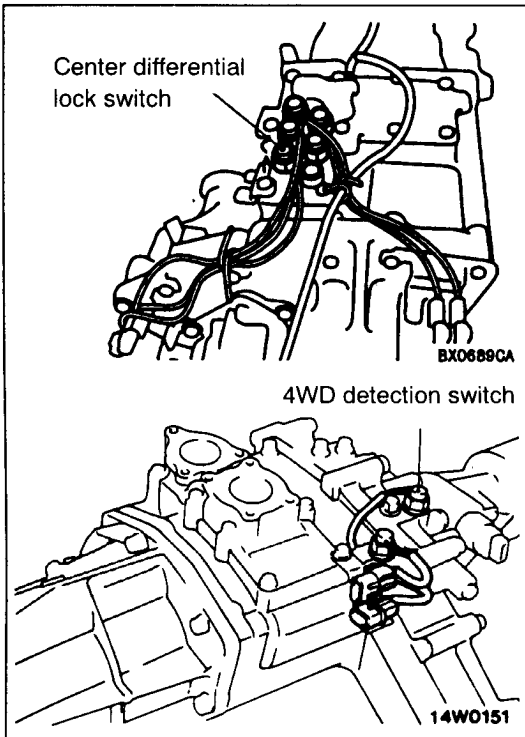
NOTE

In term of sttructure and operation, the G sensor is basically the same as that of the 2000 PAJERO PININ.



G SENSOR OUTPUT CHARACTERISTICS

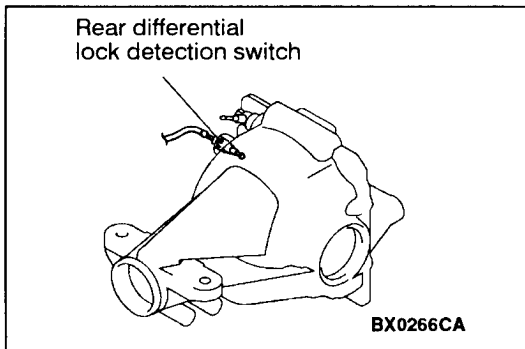




CENTER DIFFERENTIAL LOCK SWITCH, 4WD DETECTION SWITCH

These switches are also used for the 4WD system, and output the drive system state to the ABS-ECU. The ABS-ECU can change the control according to the drive system state with this signal.

Drive system state	Center differential lock switch <Super select 4WD-II system>	4WD detection switch <Part time 4WD system>
2WD	OFF	OFF
4WD <Part time 4WD system>	—	ON
4WD (Center differential : Free) <Super select 4WD-II system>	OFF	—
4WD (Center differential: Lock) <Super select 4WD-II system>	ON	—



REAR DIFFERENTIAL LOCK DETECTION SWITCH

This switch is also used as the rear differential lock switch. The ON signal is output to the ABS-ECU when the rear differential is locked, and the OFF signal is output in the free state.

When the ON signal from this switch is input, the ABS-ECU compensates the ABS control to prevent locking of the rear wheels at an early stage.

STOP LAMP SWITCH

This switch turns on when the brake pedal is depressed, and turns off when the brake pedal is released. The ABS-ECU detects whether the stop lamp switch is on or off by means of fluctuations in voltage (ON: system voltage; OFF: Approxmately 0 V). This data is used for ABS-ECU fail-safe/diagnosis function.

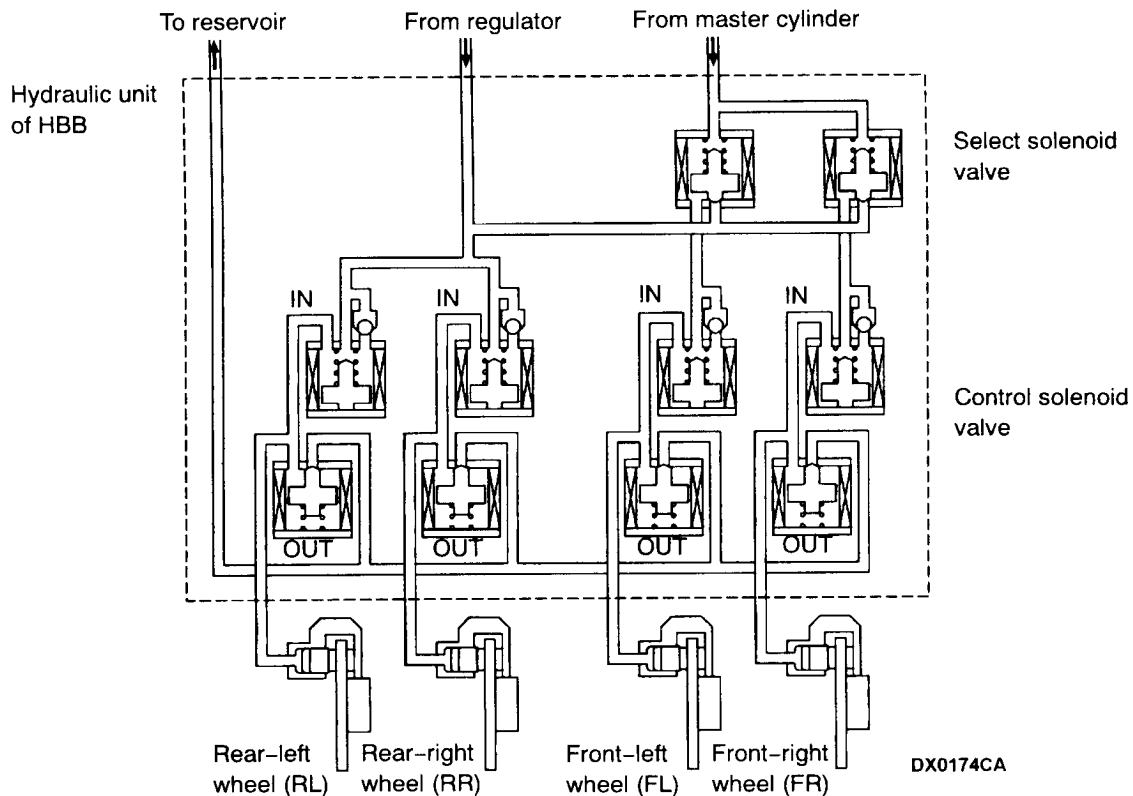
ACTUATORS

SOLENOID VALVES

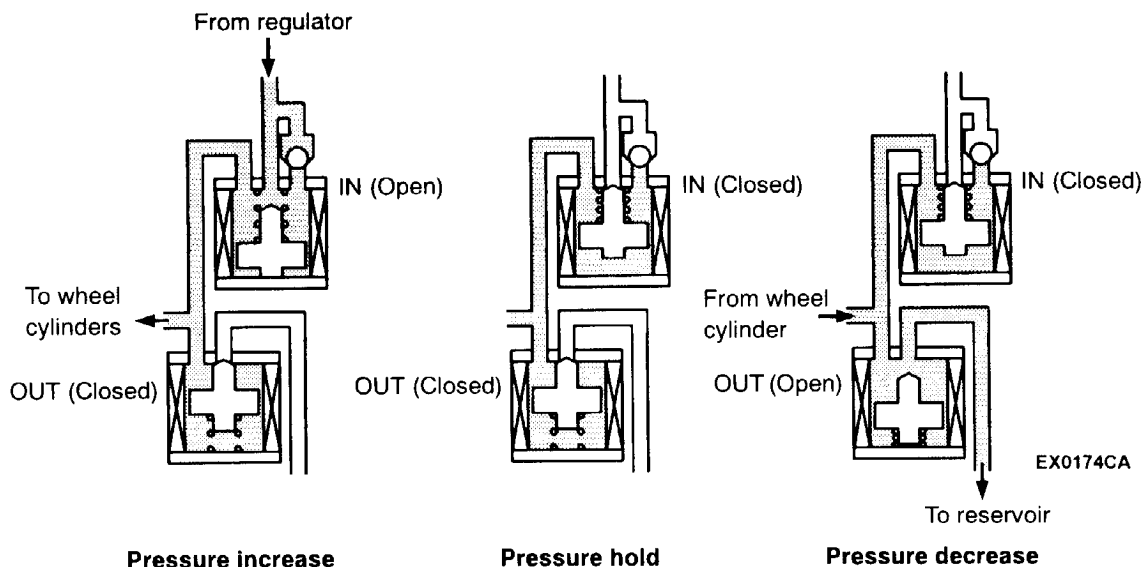
Signals from the ABS-ECU cause the solenoid valves to open and close in order to change the brake fluid lines.

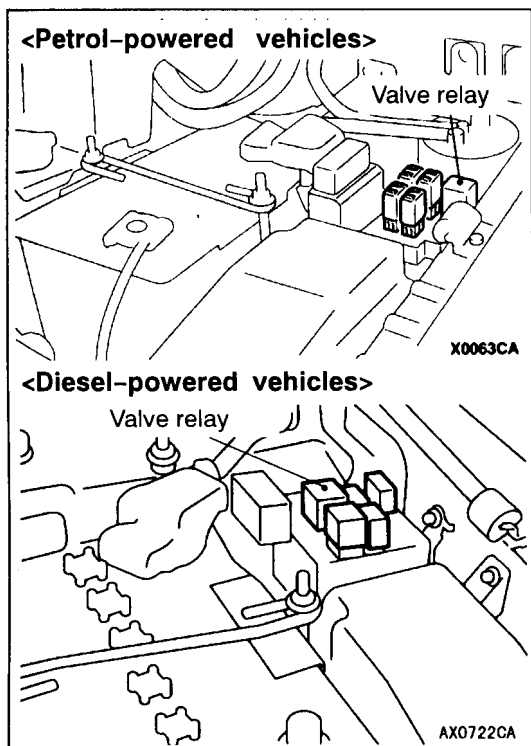
- Select solenoid valves (two valves for the front-left wheel and the front-right wheel) are located inside the hydraulic unit of HBB, and change when the ABS is operating.

- Each wheel is provided with both an IN and OUT control solenoid valve, to make a total of eight valves for four wheels. The brake hydraulic pressure is increased, held and decreased by the combined opening and closing of these solenoid valves.



CONTROL SOLENOID VALVE PRESSURE INCREASE, PRESSURE HOLD AND PRESSURE DECREASE MODES

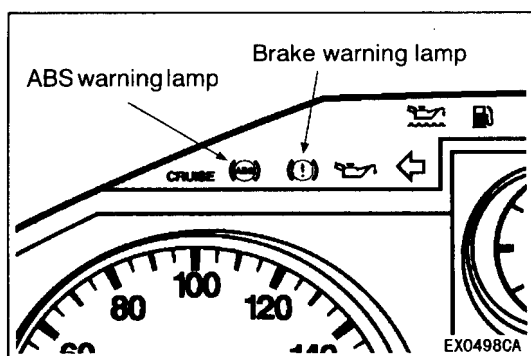




VALVE RELAY

The relay has two contacts: a normally closed contact and a normally open contact which act as follows. [Refer to ABS Electrical Circuit Diagram (P.3-39).]

Valve relay	Hydraulic brake booster solenoid valve power supply	ABS warning lamp
OFF	OFF	Illuminated
ON	ON	Switched off



ABS WARNING LAMP AND BRAKE WARNING LAMP

The ABS-ECU controls the power transistor in ABS-ECU to turn on and causes the ABS warning lamp and the brake warning lamp to illuminate in the following cases.

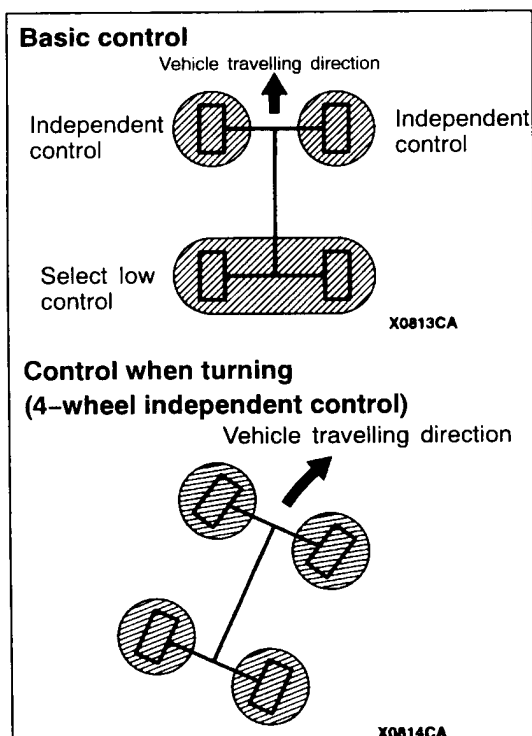
Item		ABS warning lamp	Brake warning lamp
During the initial check when the ignition switch is at the ON position (for approx. 3 seconds)		Illuminates	Illuminates
When a problem develops in the ABS/EBD system	When there is no effect on the EBD	Illuminates	Illuminates
	When there is an effect on the EBD	Illuminates	Switches off
When a problem develops in the HBB system		Switches off	Illuminates
Poor ABS-ECU connector connection		Illuminates	Illuminates
Poor HBB connector connection		Switches off	Illuminates

NOTE

For details on brake warning lamp illumination when a problem develops in the system, refer to P.3-47.

ABS-ECU

- The ABS-ECU detects the vehicle speed and the rate of deceleration using the signals from the wheel speed sensors and the G sensor in order to determine the rotating condition of the wheels, and also to predict the slipping condition of the wheels based on a predetermined logic. Based on this information, the ABS-ECU controls the solenoid valves inside the HBB in order to control the brake pressures.
- The ABS-ECU includes a diagnosis (self-diagnosis) function and a memory function. If the diagnosis function determines that there is a problem with the ABS, it activates the fail-safe function and also causes the ABS warning lamp and the brake warning lamp to illuminate.



ABS HYDRAULIC PRESSURE CONTROL

ABS Control Cycle

This is basically the same as for the PAJERO PININ.

4-wheel Control

ABS hydraulic pressure control basically consists of independent left and right control for the front wheels and integrated control (select low control) for the rear wheels which controls both wheels simultaneously.

However, when the vehicle is turning, the ABS-ECU determines the turning condition using signals from the vehicle speed sensors and controls the left and right front wheels and rear wheels (all wheels) independently in order to improve braking at this time.

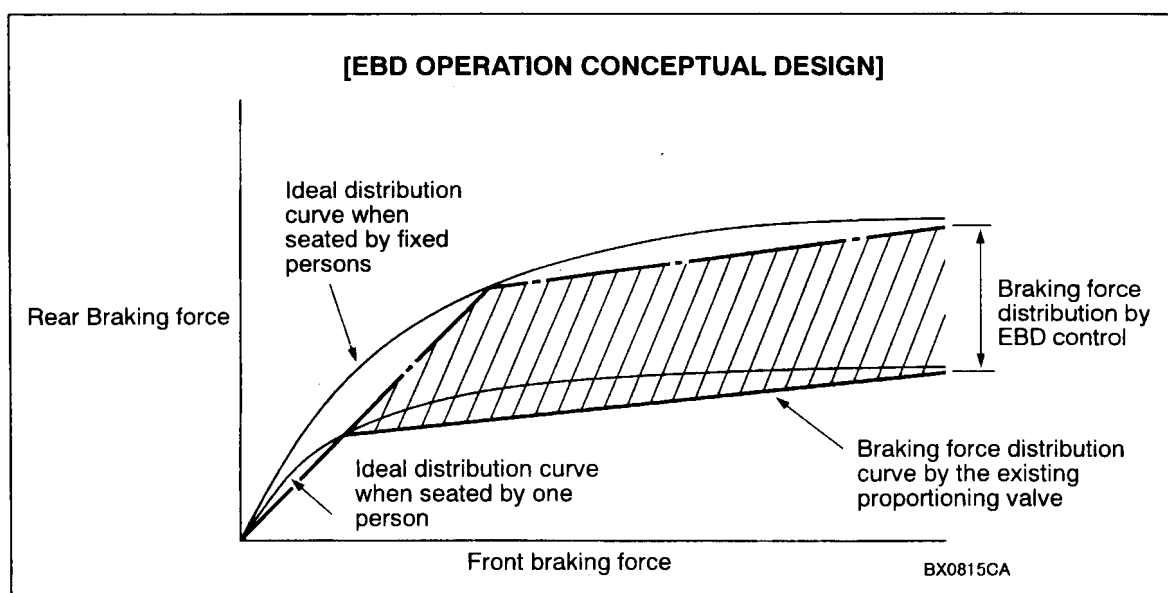
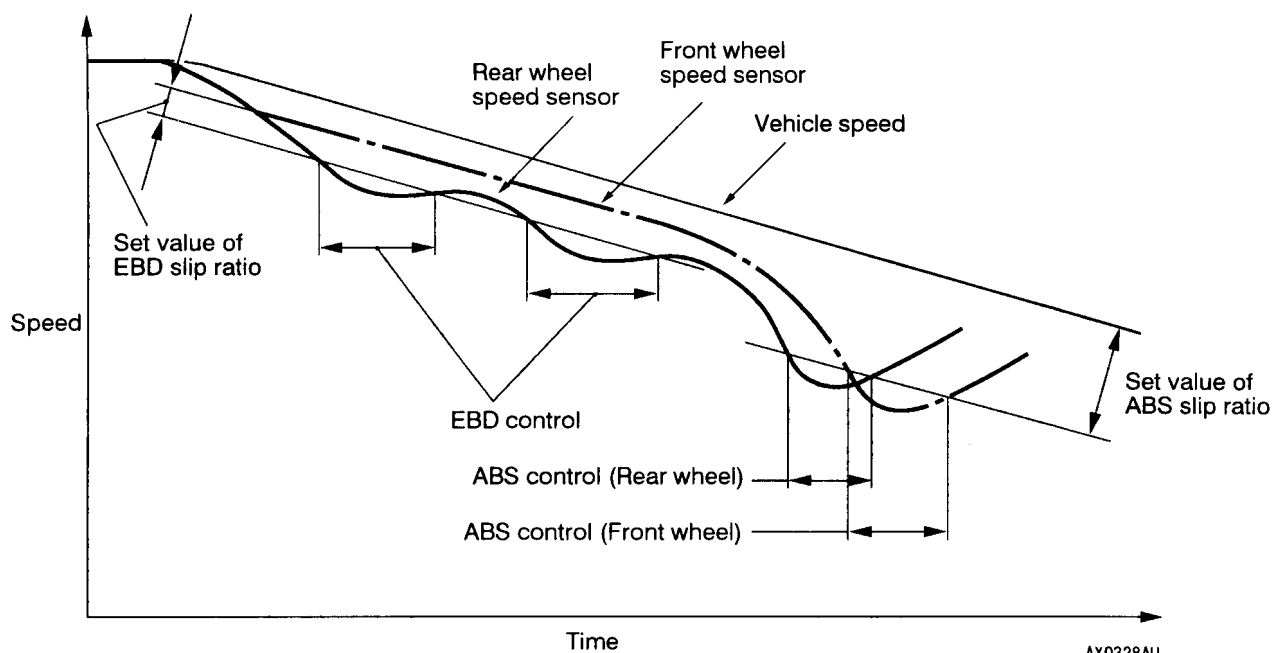
EBD HYDRAULIC PRESSURE CONTROL

The EBD control operates at the low slip region where the ABS does not operate.

The EBD control calculates the vehicle deceleration and the slip amount of front/rear wheels based on the wheel speed sensor signal. When the difference between the rear wheel speed and the front wheel speed exceeds the set value, the solenoid valve for the rear wheel in the hydraulic unit is operated

through the pressure conditions of increase, hold and decrease to control the braking hydraulic pressure to the value almost near the ideal distribution curve.

When the slip ratio of each wheel increases, the control is switched to the ABS control.



INITIAL CHECK

The ABS-ECU uses the diagnosis function to carry out the following checks.

For approximately 3 seconds* after the ignition switch is turned to the ON position, which includes the initial check, the ABS valve relay turns off and the ABS warning lamp illuminates. In addition, if a problem develops, the ABS warning lamp illumination is interrupted and ABS control is stopped.

NOTE

*: The ABS warning lamp may remain illuminated after the ignition switch is turned to the ON position and the vehicle starts moving until the vehicle speed reaches approximately 8 km/h. This only occurs if a

STARTING-OFF CHECK

The ABS-ECU carries out the following checks at the point where the vehicle speed reaches 8 km/h.

1. Solenoid valve check (during initial starting off* only)

The select solenoid valves and Control solenoid valves inside the HBB are energised for a short period of time to check the driving of each solenoid valve.

CONSTANT CHECKS

The ABS-ECU carries out the following constant checks after the initial check when the ignition switch is at the ON position.

1. ABS-ECU

Self-diagnosis of the ABS-ECU itself is carried out.

2. ECU power supply

It checks whether the ECU power supply voltage is within the operating range.

3. Valve relay

- It checks whether the valve relay monitor voltage is within the operating range.
- It checks that the output signals (ON signals) from the ABS-ECU itself match the valve relay drive condition (ON).

4. Wheel speed sensor

- It monitors the output voltages for the sensor signal lines and checks that there are no abnormal voltages (open circuits or short-circuits).
- It checks that other wheel speed inputs are normal when the vehicle speed of any of the wheels is at 8 km/h or higher.

diagnosis code relating to a wheel speed sensor malfunction was generated when the ignition switch was last turned to the ON position and is still stored in the ABS-ECU. The ABS-ECU will cause the ABS warning lamp to illuminate until the point where it can ascertain (during the starting-off check) that the problem associated with this diagnosis code has returned to normal.

<Initial check items>

1. Self-diagnosis of the ABS-ECU itself is carried out.
2. The valve relay is turned OFF → ON → OFF → ON to check for valve relay ON problems.

NOTE

*: The initial starting-off means the time when the vehicle first starts off after the ignition switch is turned to the ON position.

2. Wheel speed sensor check

The ABS-ECU checks whether any of the wheel speed sensors do not input signals when the vehicle starts off.

- It checks that none of the wheel speed sensors emit no pulse if sudden braking occurs while driving.
- It checks whether any wheel speed sensor inputs are abnormally high or low when the vehicle speed is approximately 20 km/h or higher.

5. G sensor

- It checks for abnormal output voltages from the G sensor in order to detect open circuits or short-circuits in the G sensor circuit.
- It checks the G sensor output voltage to determine if the G sensor has problems when the output voltage is intermittently at a constant voltage or higher for a constant period or longer.

6. Stop lamp switch

It monitors the output voltages for the stop lamp switch signal lines and detects for short-circuits and ON problems in the stop lamp switch circuit.

7. Select solenoid valves and control solenoid valves

It checks that the output signals from the ABS-ECU itself match the solenoid valve drive conditions.

FAIL-SAFE AND DIAGNOSIS FUNCTIONS

If the ABS-ECU judges during the initial check or constant various checks described earlier that there is a problem, the ABS warning lamp illuminates. At the same time, the system operation is interrupted and normal braking operation is activated. Furthermore, if the problem has an effect on the EBD function, the brake warning lamp also illuminates and the HBB system is interrupted to stop EBD control operations. When the ABS-ECU detects a problem with the HBB system, it causes the brake warning lamp to illuminate. If the problem at this time

is a drop in the brake assist force, the HBB buzzer also sounds as a warning in addition to the lamp illuminating.

The ABS-ECU includes the following functions to make system inspection easier.

- Diagnosis code output
- Service data output
- Actuator test

All of the above operations can be carried out using the MUT-II.

FAIL-SAFE FUNCTION <HBB>

Diagnosis code No.	Item		Action during fail-safe operation			
			Pump motor control	Brake warning lamp	HBB buzzer	ABS control
16	Abnormal drop or rise in ABS-ECU power supply voltage		Normal control	Illuminated	Not sounded	Control permitted
17	Open circuit or short-circuit in ABS-ECU power supply A					
18	Open circuit or short-circuit in ABS-ECU power supply B					
53	Motor relay system problem	Motor relay open circuit problem	Normal control	Illuminated	Not sounded	Control stopped
		Motr relay short circuit problem				Control permitted
		Motor relay coil problem				
55	Pump motor system problem	Pump motor lock problem	Intermittent drive control	Illuminated	Sounded	Control stopped
		Current detection circuit problem	Normal control		Not sounded	
63	ABS-ECU system problem		Normal control	Illuminated	Not sounded	Control stopped
78	Accumulator problem	Motor long-term energisation problem	Intermittent drive control	Illuminated	Sounded	Control stopped
		Accumulator low pressure problem	Normal control			
79	Pressure switch system problem	PH open circuit problem	Normal control	Illuminated	Not sounded	Control stopped
		PL open or short circuit problem				
		PH open circuit problem and PL open or short circuit problem	Intermittent drive control		Sounded	

FAIL-SAFE FUNCTION <ABS/EBD>

Diagnosis code No.	Item	Action during fail-safe operation			
		ABS control	ABS warning lamp	EBD control	Brake warning lamp
11	Open circuit or short-circuit in wheel speed sensor (FR)	When there is a problem with 1 or 2 wheels: Control stopped When there is a problem with 3 wheels: System interrupted	Illuminated	When there is a problem with 1 wheel: Control using the other front wheel or rear wheel speeds is carried out	Switched off
12	Open circuit or short-circuit in wheel speed sensor (FL)				
13	Open circuit or short-circuit in wheel speed sensor (RR)			When there is a problem with 2 wheels: Control using the other wheel speeds for the two normal wheels is carried out (pressure increase forbidden). When there is a problem with 3 wheels: System interrupted	Illuminated
14	Open circuit or short-circuit in wheel speed sensor (RL)				
15	Problem with any one of the four wheel speed sensors				
16	Abnormal drop or rise in ABS-ECU or valve relay power supply voltage	Control stopped	Illuminated	Control stopped	Illuminated
21	Wheel speed sensor (FR) system	When there is a problem with 1 or 2 wheels: Control stopped When there is a problem with 3 wheels: System interrupted	Illuminated	When there is a problem with 1 wheel: Control using the other front wheel or rear wheel speeds is carried out	Switched off
22	Wheel speed sensor (FL) system				
23	Wheel speed sensor (RR) system			When there is a problem with 2 wheels: Control using the other wheel speeds for the two normal wheels is carried out (pressure increase forbidden). When there is a problem with 3 wheels: System interrupted	Illuminated
24	Wheel speed sensor (RL) system				
26	Center differential lock switch system <Super select 4WD-II> 4WD detection switch <Part time 4WD>	Control stopped	Illuminated	Control carried out	Switched off
27	Rear differential lock detection switch system				
32	G sensor system	Control stopped	Illuminated	Control carried out	Switched off
33	Stop lamp switch system	Control stopped	Illuminated	Control carried out	Switched off

Diagnosis code No.	Item	Action during fail-safe operation			
		ABS control	ABS warning lamp	EBD control	Brake warning lamp
41	Control solenoid valve (FR) system	For ON problem: System interrupted For front wheel OFF problem: Control stopped For rear wheel OFF problem: System interrupted	Illuminated	For ON problem: Sys-tem interrupted	Illuminated
42	Control solenoid valve (FL) system			For front wheel OFF problem: Control car-ried out	Switched off
43	Control solenoid valve (RR) system			For rear wheel OFF problem: System inter-rupted	Illuminated
44	Control solenoid valve (RL) system				
45	Select solenoid valve (FR) system	For ON problem: System inter-rupted; For OFF problem: Control stopped	Illuminated	For ON problem: Sys-tem interrupted	Illuminated
46	Select solenoid valve (FL) system			For OFF problem: Con-trol carried out	Switched off
51	Valve relay ON problem	Control stopped	Illuminated	Control carried out	Switched off
52	Valve relay OFF problem	System interrupted	Illuminated	System interrupted	Illuminated
55	HBB system	Control stopped	Illuminated	Control carried out (pressure reduction for-bidden)	Switched off
63	ABS-ECU abnormality	System interrupted	Illuminated	System interrupted	Illuminated

NOTE

Control stopped: Control is not carried out until the ignition switch is turned to the OFF position. However, if the problem returns to normal, control is carried out again.

System interrupted: Control is not carried out until the valve relay turns off and the ignition switch is turned to the OFF position.

DIAGNOSIS CODE OUTPUT

There are 24 diagnosis items related to the 4ABS/EBD system and 8 items related to the HBB system. In addition, a non-volatile memory (EEPROM*) is used to store the results of diagnosis, so that the results are still stored even if the battery terminals are disconnected.

NOTE

1. Refer to P.3-47 for details of the diagnosis items.
2. *: EEPROM = Electrical Erasable Programmable ROM (a ROM in which the data is written electronically and erased electronically)

DIAGNOSIS CODE READING PROCEDURE

The diagnosis codes can be read using the MUT-II or by the flashing of the ABS warning lamp or brake warning lamp. (Refer to Workshop Manual.)

DIAGNOSIS CODE MEMORY ERASING PROCEDURE

The diagnosis code memory can be erased using the MUT-II or by special operation for the brake pedal. (Refer to Workshop Manual.)

SERVICE DATA OUTPUT

The following input data from each sensor and switch can be read using the MUT-II.

When system is normal

Item No.	Check item	Inspection conditions		Normal condition
11	Front-right wheel speed	When vehicle is being driven		Speedometer display and MUT-II display are identical.
12	Front-left wheel speed			
13	Rear-right wheel speed			
14	Rear-left wheel speed			
16	System voltage	Ignition switch: ON		6.5 – 22.3 V
26	Center differential lock switch <Super select 4WD-II>	Ignition switch: ON	Transfer selector lever position: 2H, 4H	OFF
			Transfer selector lever position: 4HLc, 4LLc	ON
26	4WD detection switch <Part time 4WD>	Ignition switch: ON	2WD	OFF
			4WD	ON
27	Rear differential lock switch	Ignition switch: ON	When rear differential is free	OFF
			When rear differential is released	ON
32	G sensor	- Ignition switch: ON - When vehicle is stationary (level)		2.4 – 2.6 V
		When vehicle is being driven		1.0 – 4.0 V
33	Stop lamp Switch	Ignition switch: ON	When brake pedal is depressed	ON
			When brake pedal is released	OFF

When system is interrupted by the ECU

When the diagnosis function has caused the operation of the ABS-ECU to be stopped, the MUT-II display data may be different from the actual condition.

ACTUATOR TEST

The MUT-II can be used to force-drive each solenoid valve, HBB pump motor and HBB buzzer. In addition, an air bleeding mode has been included to allow air-bleeding of the ABS system.

NOTE

1. Actuator tests cannot be carried out when the operation of the ABS-ECU has been stopped by the fail-safe function.
2. Actuator tests can only be carried out while the vehicle is stopped.

ACTUATOR TEST SPECIFICATIONS <ABS/EBD SYSTEM>

Item No.	Check item	Drive Contents
01	FR wheel solenoid valve	HBB select solenoid valves and control solenoid valves for the respective channel
02	FL wheel solenoid valve	
03	RR wheel solenoid valve	
04	RL wheel solenoid valve	
27	Air bleeding (1)	HBB select solenoid valves and control solenoid valve OUT (FR, FL)
28	Air bleeding (2)	HBB control solenoid valve OUT (RR, RL)

ACTUATOR TEST SPECIFICATIONS <HBB SYSTEM>

Item No.	Inspection item	Drive contents
01	HBB pump motor	Operate the pump motor for one second.
02	HBB buzzer	Sound the buzzer for three seconds.

SYSTEM OPERATION

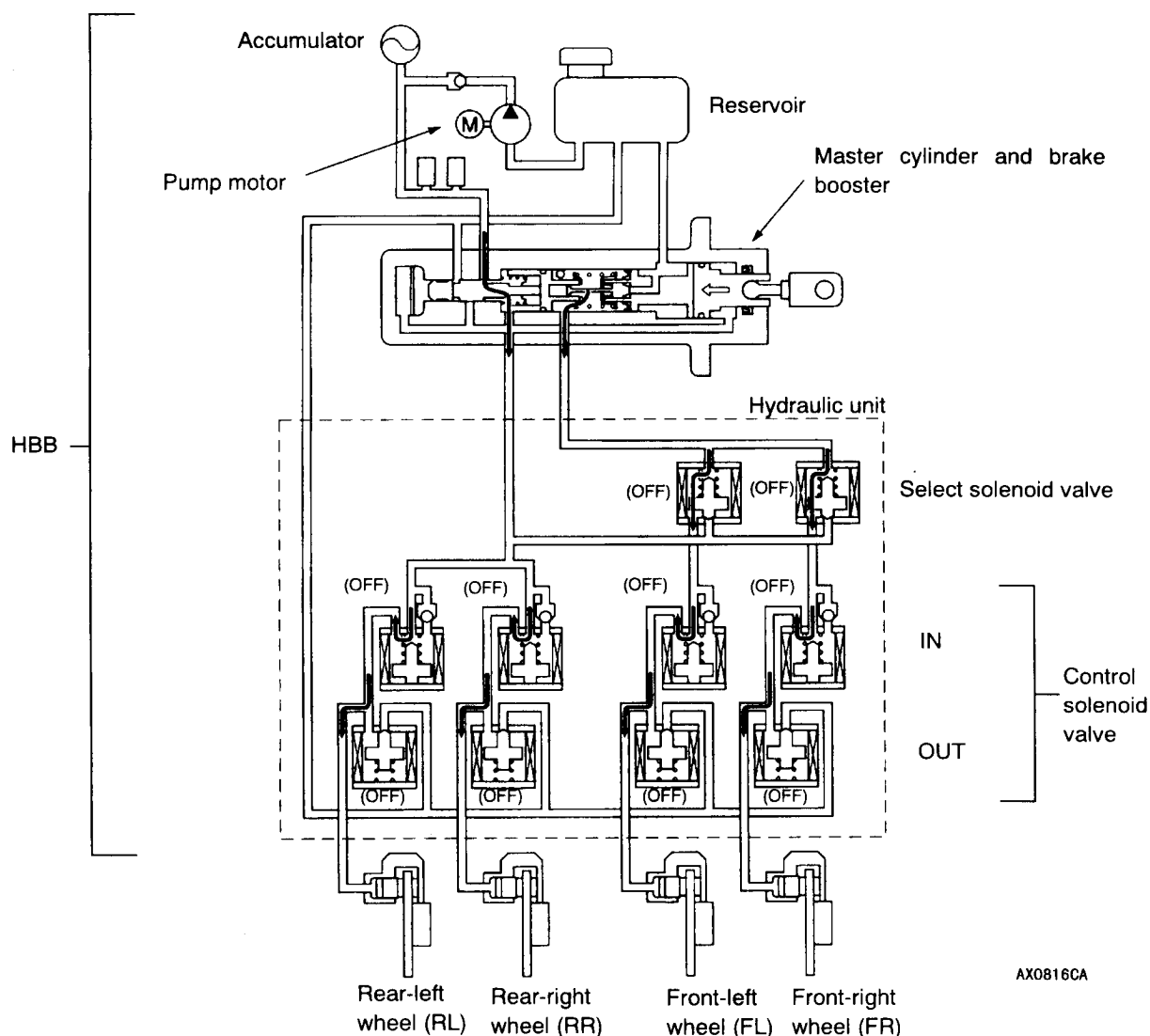
DURING NORMAL BRAKING (WHEN ABS IS NOT OPERATING)

During normal braking, the front select solenoid valve and the front wheel control solenoid valves are not energised, so that the hydraulic pressure generated by the HBB master cylinder passes straight through the select solenoid valve and front control solenoid valves (IN) to act on the front brakes.

In the case of the rear brakes, the EBD control function of the ABS-ECU operates the rear control solenoid valves to carry out pressure increase, pressure hold and pressure decrease operations in order to control the brake pressures to the ideal levels. The rear brakes are acted upon by hydraulic pressure which is generated by the HBB booster.

NOTE

1. Refer to P.3-33 for details on HBB operation.
2. The operation of the control solenoid valves when carrying out pressure increase, pressure hold and pressure decrease operations during EBD control is the same as when ABS control is operating.



NOTE

← : Indicates the flow of brake fluid when the brake pedal is depressed

DURING SUDDEN BRAKING (WHEN ABS IS OPERATING)

If it appears that the vehicle wheels may lock up at times such as during sudden braking, the ABS-ECU controls the control solenoid valves as described below, repeatedly activating pressure increase, pressure hold and pressure decrease modes to control the brake pressure being supplied to the wheel(s) which are showing a tendency to lock. At the same time, the select solenoid valves (two valves for FL and FR) are also energised during ABS operation, so that when the select solenoid valves turn on, the hydraulic pressure acting on the front brakes is changed from the HBB master cylinder pressure to the booster pressure, to reduce the pedal kickback which is generated when the ABS operates.

NOTE

Refer to P.3-33 for details on HBB operation.

Pressure reduction (rear wheel condition in the illustration below)

The control solenoid valve (IN) turns ON and the

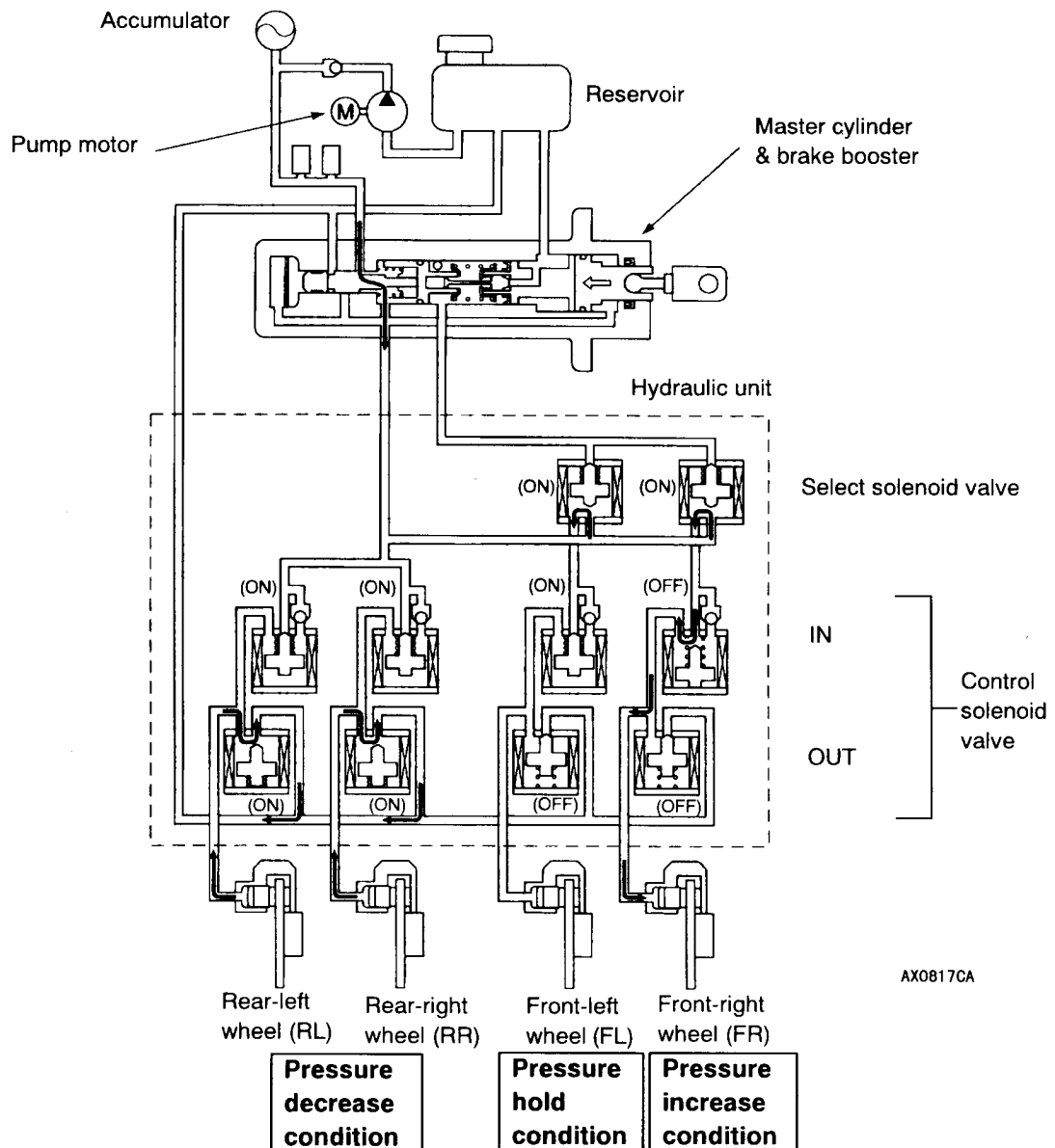
fluid line from the HBB booster is interrupted. At the same time, the control solenoid valve (OUT) turns ON and the fluid line from the wheel cylinder to the reservoir is opened so that the hydraulic pressure inside the wheel cylinder is reduced.

Pressure hold (front-left wheel condition in the illustration below)

From the pressure decrease condition, energisation of the rear control solenoid valve (OUT) is stopped, and the fluid line from the wheel cylinders to the reservoir is interrupted. As a result, the hydraulic pressure inside the wheel cylinder is maintained at the current pressure.

Pressure increase (front-right wheel condition in the illustration below)

Energisation of both the control solenoid valves (IN) and (OUT) is stopped, and the hydraulic pressure generated by the HBB booster acts upon the wheel cylinder to increase the pressure.



PARKING BRAKE

FEATURES

The parking brakes are a mechanical rear wheel brake design incorporating drum-in-disc brakes and controlled by a lever.

- The parking brake lever is offset towards the driver's seat to make it easier to use.
- The cable adjustment location has been moved to inside the passenger compartment to improve serviceability.

CONSTRUCTION DIAGRAM

