

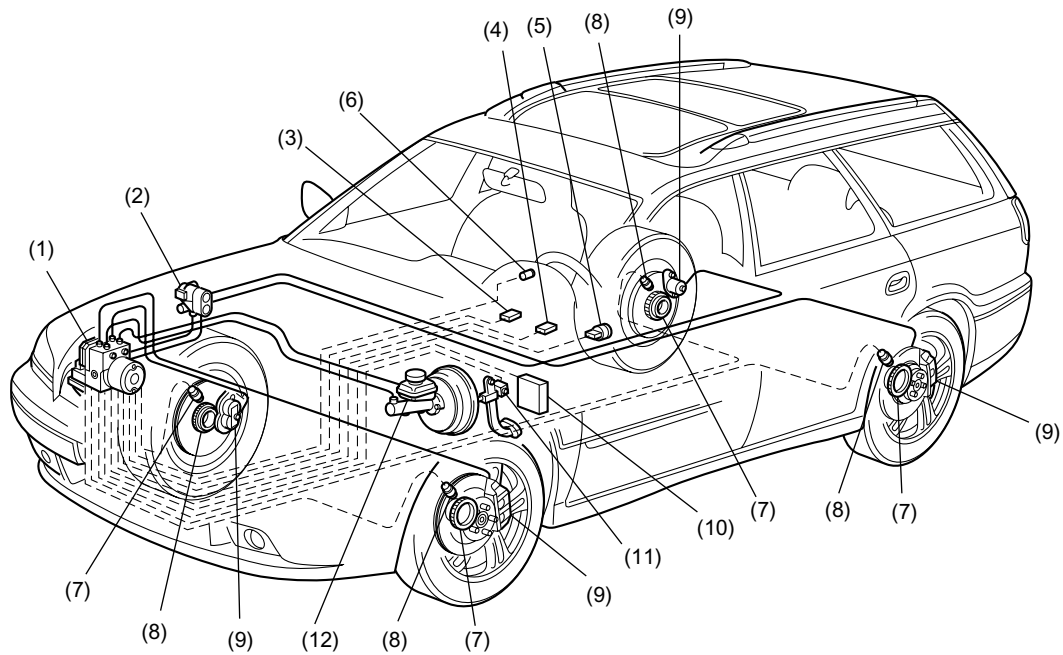
1. Anti-lock Brake System (ABS)

A: FEATURES

- The 5.3i type ABS used in the Legacy has a hydraulic control unit, an ABS control module, a valve relay and a motor relay integrated into a single unit (called ABSCM & H/U) for circuit simplicity and reduced weight.
- The ABS electrically controls the brake fluid pressure to each wheel to prevent the wheel from locking during braking on slippery road surfaces, thereby enabling the driver to maintain the directional control.
- If the ABS becomes inoperative, a fail-safe system is activated to ensure same level of braking performance as with a conventional brake system. In that case, the warning light comes on to indicate that the ABS is malfunctioning.
- The ABS is a 4-sensor, 4-channel system; the front wheel system is an independent control design^{*1}, while the rear wheel system is a select-low control design^{*2}.

*1: A system which controls the front wheel brakes individually.

*2: A system which applies the same fluid pressure to both the rear wheels if either wheel starts to lock. The pressure is determined based on the lower of the frictional coefficients of both wheels.



ABS00275

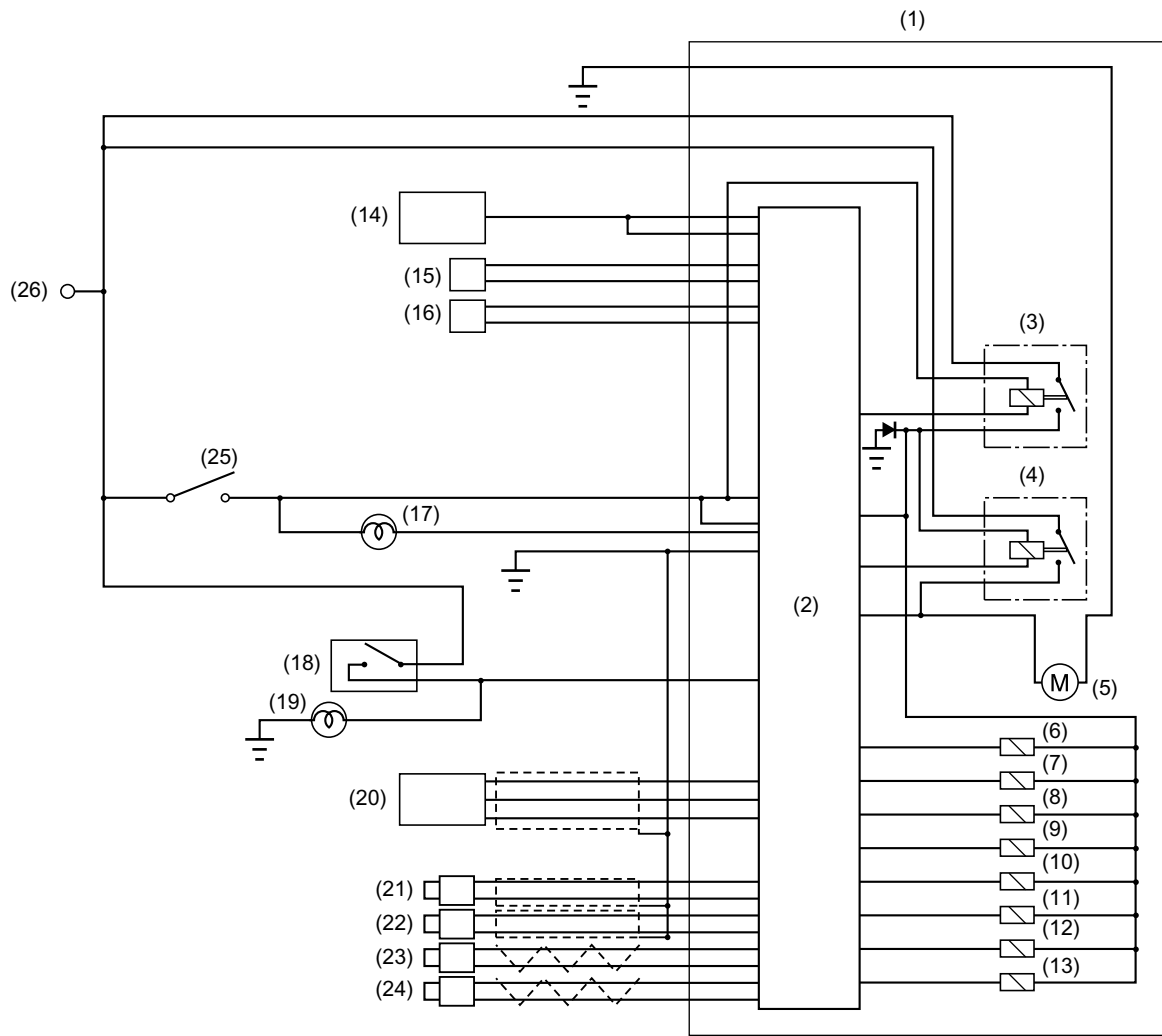
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|---|-----------------------|--|
| (1) ABS control module and hydraulic control unit (ABSCM & H/U) | (5) G sensor | (9) Wheel cylinder |
| (2) Proportioning valve | (6) ABS warning light | (10) Automatic transmission control module |
| (3) Diagnosis connector | (7) Tone wheels | (11) Brake switch |
| (4) Data link connector (for SUBARU select monitor) | (8) ABS sensor | (12) Master cylinder |

ANTI-LOCK BRAKE SYSTEM (ABS)

ABS

B: FUNCTIONS OF SENSORS AND ACTUATORS

Name		Function
ABS control module and hydraulic control module (ABSCM & H/U)	ABSCM section	• It determines the conditions of the wheels and the vehicle body from the wheel speed data and controls the hydraulic control unit depending on the result. • When the ABS is active, the ABSCM provides the automatic transmission control module with control signals which are used by the module for co-operative control of the vehicle with the ABSCM. • Whenever the ignition switch is placed at ON, the module performs a self diagnosis sequence. If anything wrong is detected, the module cuts off the system. • It communicates with the SUBARU select monitor.
	H/U section	• When the ABS is active, the H/U changes fluid passages to the wheel cylinders in response to commands from the ABSCM. • It constitutes the brake fluid passage from the master cylinder to the wheel cylinders together with the piping.
	Valve relay section	It serves as a power switch for the solenoid valves and motor relay coil. It operates in response to a command from the ABSCM.
	Motor relay section	It serves as a power switch for the pump motor. It operates in response to a command from the ABSCM.
ABS sensor (wheel speed sensor)		They detect the wheel speed in terms of a change in the density of the magnetic flux passing through them and convert it into an electrical signal. The electrical signal is sent to the ABSCM.
Tone wheels		They give a change in the magnetic flux density by the teeth around themselves to let the ABS sensors generate electrical signals.
G sensor		It detects a change in acceleration in the longitudinal direction of the vehicle and outputs it to the ABSCM as a voltage signal.
Stop light switch		It provides information on whether the brake pedal is depressed or not to the ABSCM. The ABSCM uses it to determine ABS operation.
ABS warning light		It alerts the driver to an ABS fault. When the diagnosis connector and diagnosis terminal are connected, the light flashes to indicate a diagnostic trouble code stored in the ABSCM.
Automatic transmission control module		It provides gear controls and changing power transmission to front and rear wheels in response to control signals from the ABSCM.



ABS00276

- | | | |
|---|--|-----------------------------|
| (1) ABS control module and hydraulic control unit | (10) Rear left inlet solenoid valve | (19) Stop light |
| (2) ABS control module section | (11) Rear left outlet solenoid valve | (20) G sensor |
| (3) Valve relay | (12) Rear right inlet solenoid valve | (21) Front left ABS sensor |
| (4) Motor relay | (13) Rear right outlet solenoid valve | (22) Front right ABS sensor |
| (5) Motor | (14) Automatic transmission control module | (23) Rear left ABS sensor |
| (6) Front left inlet solenoid valve | (15) Diagnosis connector | (24) Rear right ABS sensor |
| (7) Front left outlet solenoid valve | (16) Data link connector | (25) IGN |
| (8) Front right inlet solenoid valve | (17) ABS warning light | (26) Battery |
| (9) Front right outlet solenoid valve | (18) Stop light switch | |

C: PRINCIPLE OF ABS CONTROL

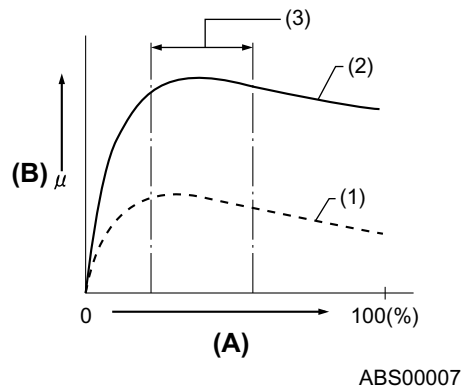
When the brake pedal is depressed during driving, the wheel speed decreases and the vehicle speed does as well. The decrease in the vehicle speed, however, is not always proportional to the decrease in the wheel speed. The non-correspondence between the wheel speed and vehicle speed is called “slip” and the magnitude of the slip is expressed by the “slip ratio” which is defined as follows:

$$\text{Slip ratio} = (\text{Vehicle speed} - \text{Wheel speed}) / \text{Vehicle speed} \times 100\%$$

When the slip ratio is 0%, the vehicle speed corresponds exactly to the wheel speed; when it is 100%, the wheels are completely locking (rotating at a zero speed) while the vehicle is moving.

The braking effectiveness is represented by the “coefficient of friction” between the tire and road surface. The larger the coefficient, the higher the braking effectiveness. The diagram below shows the relationship between the coefficient of friction and the slip ratio for two different road surface conditions (asphalt-paved road and icy road), assuming that the same tires are used for both the conditions and the vehicles are moving forward. Although the braking effectiveness (coefficient of friction) depends on the road surface condition as shown and also on the type of the tire, its peak range generally corresponds to the 8 – 30% range of the slip ratio.

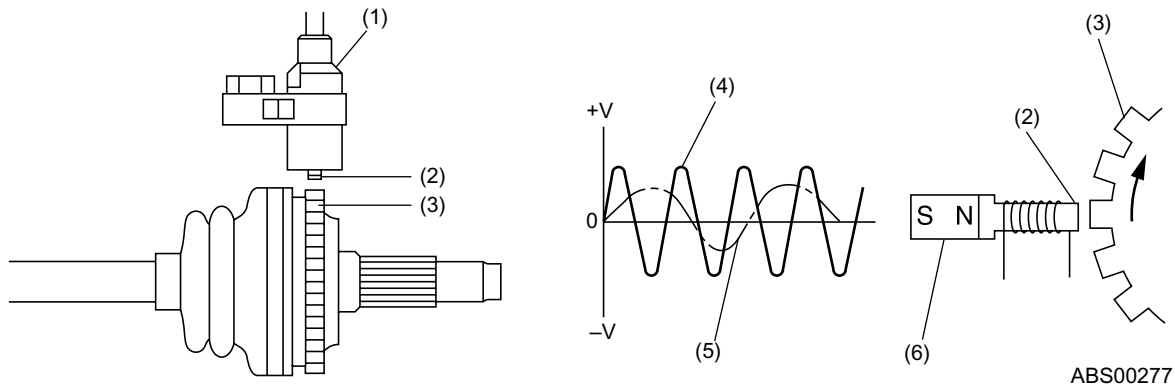
The ABS controls the fluid pressure to each wheel so that a coefficient of friction corresponding to this slip ratio range is maintained.



- | | |
|---|--------------------------|
| (A) Slip ratio | (1) Icy road |
| (B) Coefficient of friction between tire and road surface | (2) Asphalt-paved road |
| | (3) Control range by ABS |

D: ABS SENSOR

Each of the ABS sensors detects the speed of the corresponding wheel. The sensor consists of a permanent magnet, coil and tone wheel. The magnetic flux produced by the permanent magnet changes as each tooth of the tone wheel (which rotates together with the wheel) passes in front of the magnet's pole piece. The changing magnetic flux induces voltages at a frequency corresponding to the wheel speed.



ABS00277

- (1) Sensor body
- (2) Pole piece
- (3) Tone wheels

- (4) Full speed
- (5) Low-speed
- (6) Permanent magnet

E: ABS CONTROL MODULE AND HYDRAULIC CONTROL UNIT (ABSCM & H/U)

● ABS control module section (ABSCM)

The ABSCM contains two micro control modules (MCMs) that complement each other. Both the MCMs process the same program and each MCM monitors the other's outputs. If a mismatch occurs between their outputs, the ABSCM cuts off the system and activate the fail-safe function.

The ABSCM can store a maximum of 3 diagnostic trouble codes in an EEPROM. If more than 3 faults have occurred, only the 3 most recent failures are stored and others are erased. Trouble diagnostic trouble codes remain stored until they are internally or externally erased.

The ABSCM has a test routine (sequence control pattern) which facilitates checking of the hydraulic control unit.

● ABS control

Using primarily the wheel speed data from each ABS sensor and secondarily the vehicle deceleration rate data from the G sensor as parameters, the ABSCM generates a simulated vehicle speed when there is a risk of wheel lock-up. Using the simulated vehicle speed (called "dummy" vehicle speed) as a reference, the ABSCM determines the state of the wheel in terms of the tendency toward lock-up. If the result shows that the wheels are about to lock, the ABSCM issues commands to energize or de-energize the solenoid valves and activate the motor pump of the H/U to modulate the brake fluid pressures that act on the wheel cylinders, thereby preventing the wheels from locking.

The ABSCM controls the right and left front wheel fluid pressures independently and the rear wheel fluid pressures based on the wheel which is the most likely to lock (select-low control).

● Functions available using SUBARU select monitor

When the SUBARU select monitor is connected, the ABSCM allows it

- To read out analog data
- To read out ON/OFF data
- To read out or erase diagnostic trouble codes
- To read out status information in the event of a fault (freeze frame data)
- To initiate ABS sequence control pattern

● Indication functions

Under the control of the ABSCM, the ABS warning light provides the following three indication functions:

- ABS fault alerting
- Diagnostic trouble code indication (by flashing in the diagnosis mode)
- Valve ON/OFF indication (when sequence control pattern is initiated)

● Hydraulic control unit section (H/U)

The H/U is a fluid pressure controller consisting of, among others, a motor, solenoid valves, a housing and relays. It also constitutes passage of the two diagonally split brake circuits.

- The pump motor drives an eccentric cam which in turn moves the plunger pump to generate hydraulic pressure.
- The housing accommodates the pump motor, solenoid valve and reservoir. It also constitutes a brake fluid passage.
- The plunger pump, when operated, draws the brake fluid from the reservoir, lets the fluid in a wheel cylinder drain into the reservoir, and/or forces the fluid into the master cylinder.
- The outlet solenoid valve is a 2-position type. It opens or closes the brake fluid passage between a wheel cylinder and the reservoir according to commands from the ABSCM.
- The inlet solenoid valve is duty-controlled to reduce brake fluid pulsation for minimum ABS operation noise.
- The reservoir temporarily stores the brake fluid drained from a wheel cylinder when pressure “decrease” control is performed.
- The damper chamber suppresses brake fluid pulsation which would occur during pressure “decrease” control in the fluid discharged from the plunger pump to minimize kickbacks of the brake pedal.
- The valve relay controls power supply to the solenoid valves and motor relay in response to a command from the ABSCM. In normal (IG ON) condition, the relay is closed to supply power to the solenoid valves and motor relay. When an error occurs in the system, the valve relay is turned OFF to keep the fluid pressure circuit in the normal mode (non-ABS mode).
- The motor relay closes and supplies power to the pump motor in response to a command from the ABSCM during the ABS drive mode operations.

The H/U has four operating modes; normal mode (non-ABS mode), and three ABS active modes, i.e., “increase”, “hold” and “decrease” modes.

ANTI-LOCK BRAKE SYSTEM (ABS)

ABS

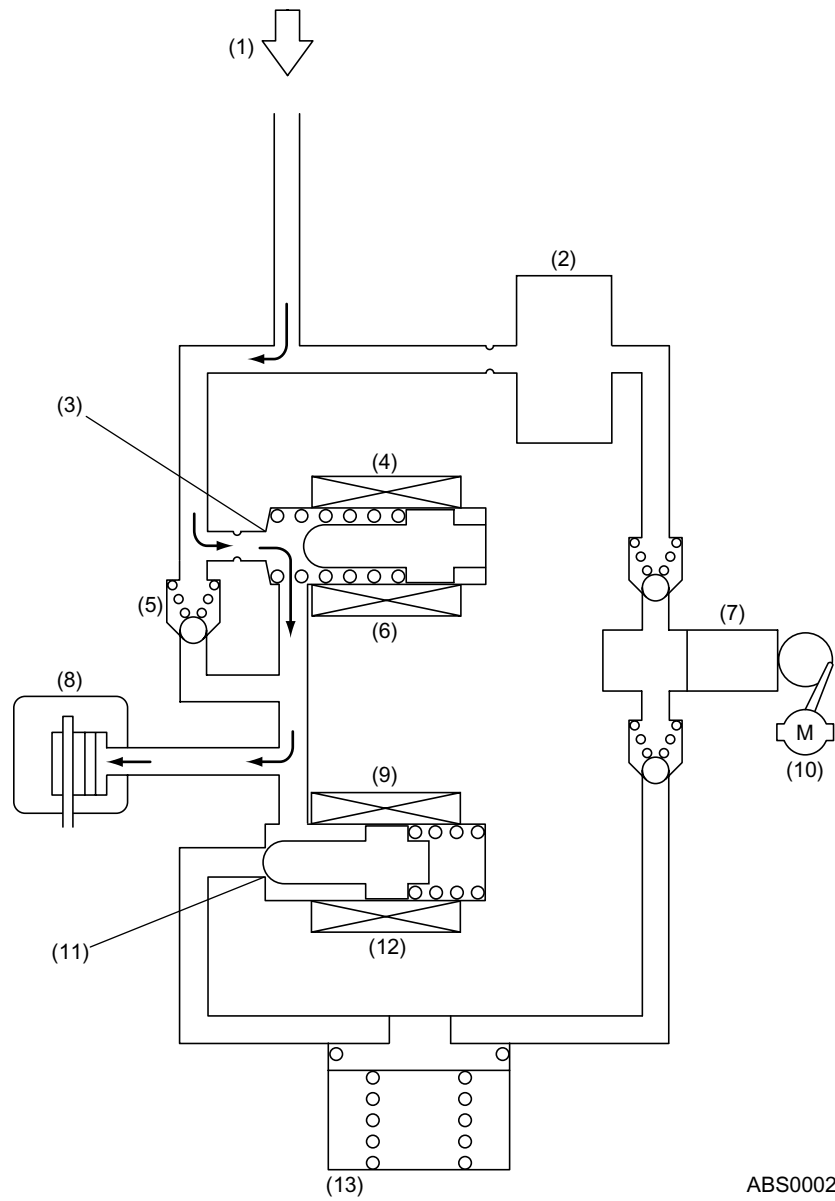
1. DURING NORMAL BRAKING (ABS NOT ACTIVE)

Both the inlet and outlet solenoid valves are not energized.

This means that the inlet port of the inlet solenoid valve is open, whereas the outlet port of the outlet solenoid valve is closed. So the fluid pressure generated in the master cylinder is transmitted to the wheel cylinder, producing a brake force.

NOTE:

For simplicity of explanation, operation of the hydraulic control unit is represented by operation of a single wheel circuit.



ABS00020

- (1) From master cylinder
- (2) Damper chamber
- (3) Inlet port open
- (4) Inlet solenoid valve
- (5) Check valve
- (6) Deenergized
- (7) Pump

- (8) Wheel cylinder
- (9) Outlet solenoid valve
- (10) Motor
- (11) Outlet port closed
- (12) Deenergized
- (13) Reservoir

2. PRESSURE “DECREASE” CONTROL (ABS ACTIVE)

Both the inlet and outlet solenoid valves are energized, which means that the inlet port is closed and the outlet port is open.

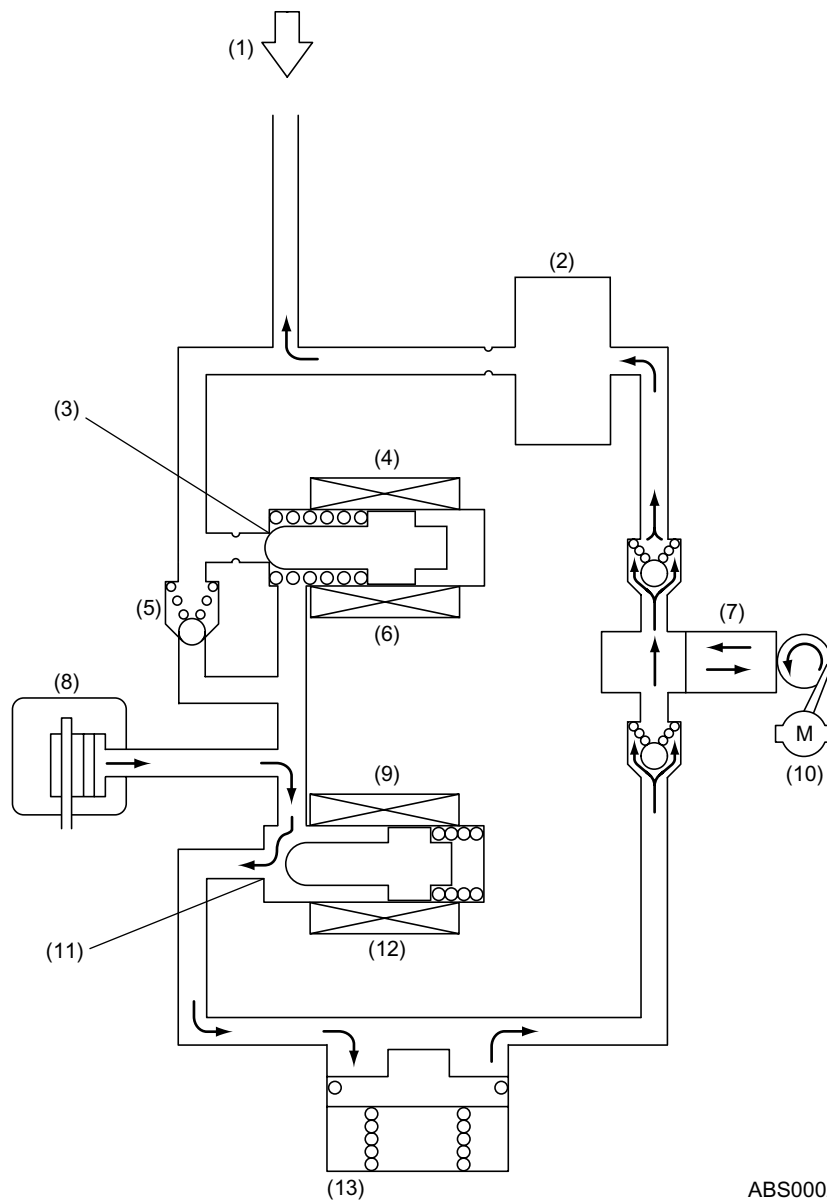
In this state, the wheel cylinder is isolated from the master cylinder but open to the reservoir, so the brake fluid in it can be drained into the reservoir, decreasing its pressure and reducing the braking force of the wheel.

The brake fluid collected in the reservoir is forced into the master cylinder by the pump.

During this phase of ABS operation, the pump motor continues operating.

NOTE:

For simplicity of explanation, operation of the hydraulic control unit is represented by operation of a single wheel circuit.



ABS00026

- (1) From master cylinder
- (2) Damper chamber
- (3) Inlet port closed
- (4) Inlet solenoid valve
- (5) Check valve
- (6) Energized
- (7) Pump

- (8) Wheel cylinder
- (9) Outlet solenoid valve
- (10) Motor
- (11) Outlet port open
- (12) Energized
- (13) Reservoir

3. PRESSURE HOLD CONTROL (ABS ACTIVE)

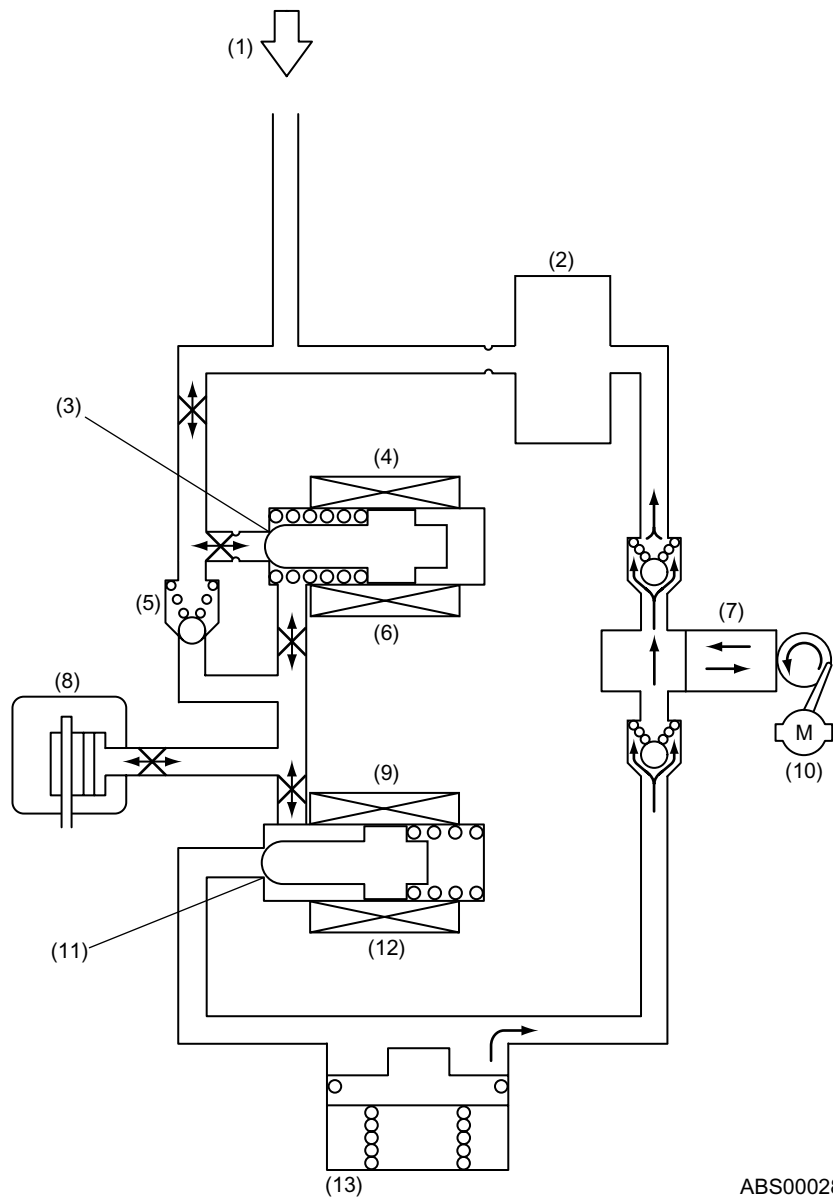
The inlet solenoid valve is energized, so the inlet port is closed.

On the other hand, the outlet solenoid valve is de-energized, so the output port is also closed. In this state, all the passages connecting the wheel cylinder, master cylinder and reservoir are blocked. As a result, the fluid pressure in the wheel cylinder is held unchanged.

During this phase of ABS operation, the pump motor continues operating.

NOTE:

For simplicity of explanation, operation of the hydraulic control unit is represented by operation of a single wheel circuit.



- | | |
|--------------------------|---------------------------|
| (1) From master cylinder | (8) Wheel cylinder |
| (2) Damper chamber | (9) Outlet solenoid valve |
| (3) Inlet port closed | (10) Motor |
| (4) Inlet solenoid valve | (11) Outlet port closed |
| (5) Check valve | (12) Deenergized |
| (6) Energized | (13) Reservoir |
| (7) Pump | |

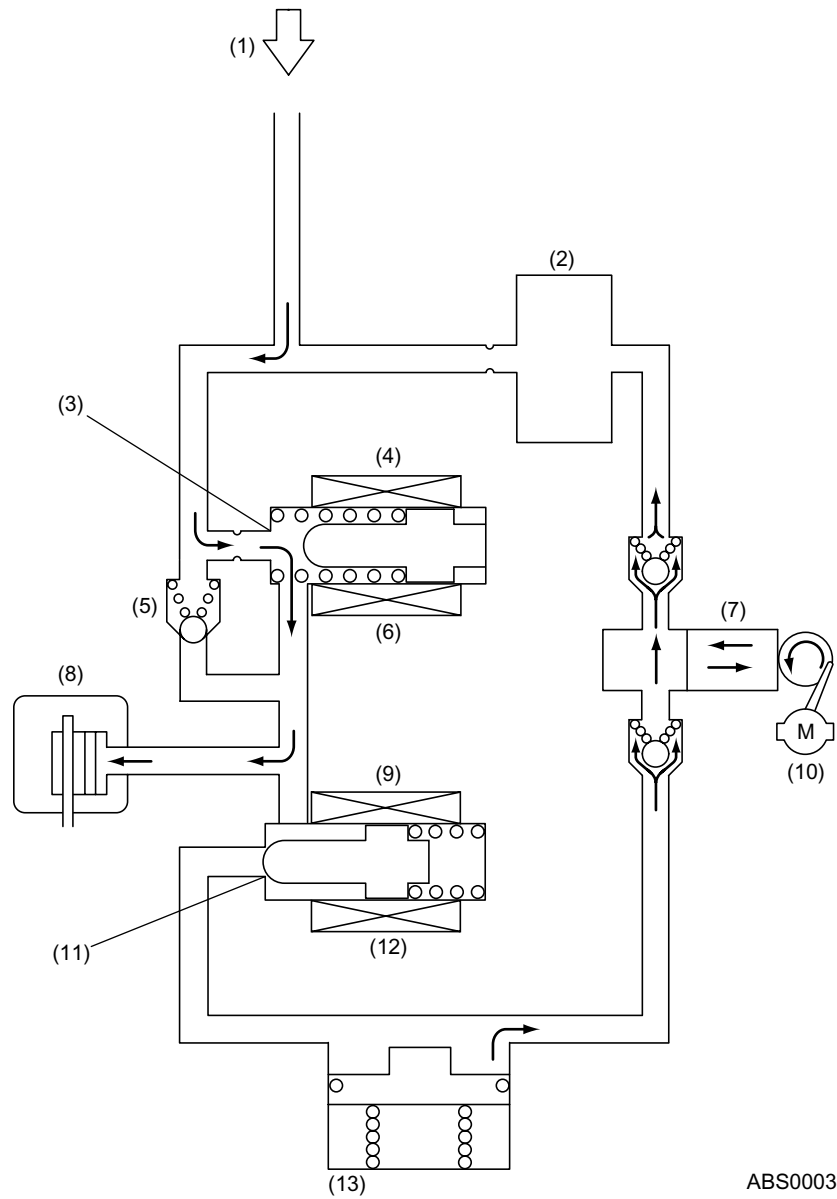
4. PRESSURE “INCREASE” CONTROL (ABS ACTIVE)

Both the inlet and outlet solenoid valves are de-energized, which means that the inlet port of the inlet solenoid valve is open, whereas the outlet port of the outlet solenoid valve is closed. So the fluid pressure generated in the master cylinder is transmitted to the wheel cylinder and increased fluid pressure in the wheel cylinder applies the brake with a larger force.

During this phase of ABS operation, the pump motor continues operating.

NOTE:

For simplicity of explanation, operation of the hydraulic control unit is represented by operation of a single wheel circuit.



- (1) From master cylinder
- (2) Damper chamber
- (3) Inlet port open
- (4) Inlet solenoid valve
- (5) Check valve
- (6) Deenergized
- (7) Pump

- (8) Wheel cylinder
- (9) Outlet solenoid valve
- (10) Motor
- (11) Outlet port closed
- (12) Deenergized
- (13) Reservoir

F: ABS CONTROL CYCLE CURVES

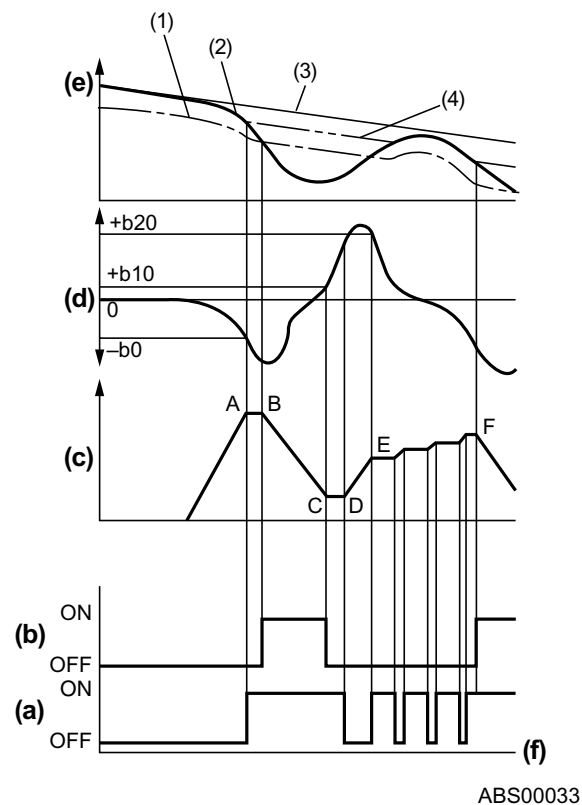
Depressing the brake pedal increases the brake fluid pressure in each wheel cylinder, which in turn decreases the wheel speed (or increases the wheel deceleration rate). When the brake fluid pressure is increased to a level of point “A” of the brake fluid pressure curve in the diagram below (at which the wheel deceleration rate exceeds threshold $-b_0$), the ABSCM makes a pressure “hold” control. At the same time, the ABSCM calculates a “dummy” vehicle speed which is a reference speed it uses in the next stage of control.

When the wheel speed then drops below the slip ratio setting, i.e., a speed lower than the “dummy” vehicle speed by the predetermined value (at point “B” of the pressure curve), the ABSCM makes a control to prevent the wheel from locking, or a pressure “decrease” control.

As the wheel cylinder pressure decreases, the wheel speed starts increasing (or the wheel acceleration rate starts rising). When the wheel acceleration rate exceeds threshold $+b_{10}$ (at point “C” of the pressure curve), the ABSCM makes a pressure “hold” control. When the wheel acceleration rate exceeds threshold $+b_{20}$ (at point “D” of the pressure curve), the ABSCM recognizes that wheel lock-up will not occur and then makes a pressure “increase” control.

When the wheel acceleration rate drops below threshold $+b_{20}$, (at point “E” of the pressure curve), the ABSCM starts pressure “hold” and “increase” control cycles at a given interval.

When the wheel deceleration rate then exceeds threshold $-b_0$ (at point “F” of the pressure curve), the ABSCM immediately makes a pressure “decrease” control.



- (a) Inlet valve

(b) Outlet valve

(c) Brake fluid pressure

(d) Wheel acceleration/deceleration

(e) Speed

(f) Time
- (1) Slip ratio setting

(2) Wheel speed

(3) Vehicle speed

(4) Dummy vehicle speed

Brake fluid pressure	Inlet valve	Outlet valve
Increase	OFF	OFF
Hold	ON	OFF
Decrease	ON	ON

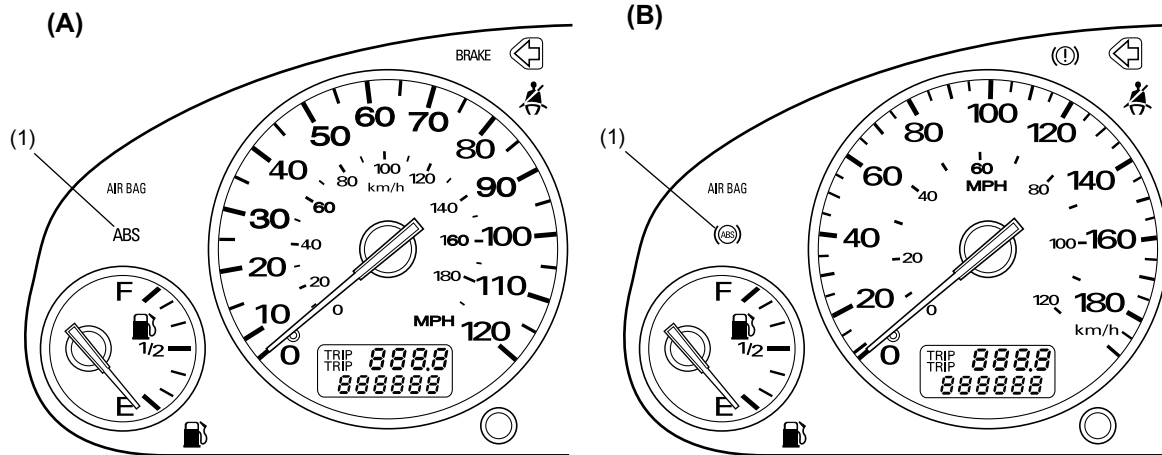
ANTI-LOCK BRAKE SYSTEM (ABS)

ABS

G: ABS WARNING LIGHT

When a fault occurs in the signal transmission system or the ABSCM, the ABS warning light in the combination meter comes on. At the same time, the current to the hydraulic control unit is interrupted. The brake system then functions in the same manner as a system without ABS. The warning light utilizes a dual circuit design.

If the warning light comes on, one or more diagnostic trouble codes should be stored in the ABSCM. They must be identified using the warning light's code indicating function.



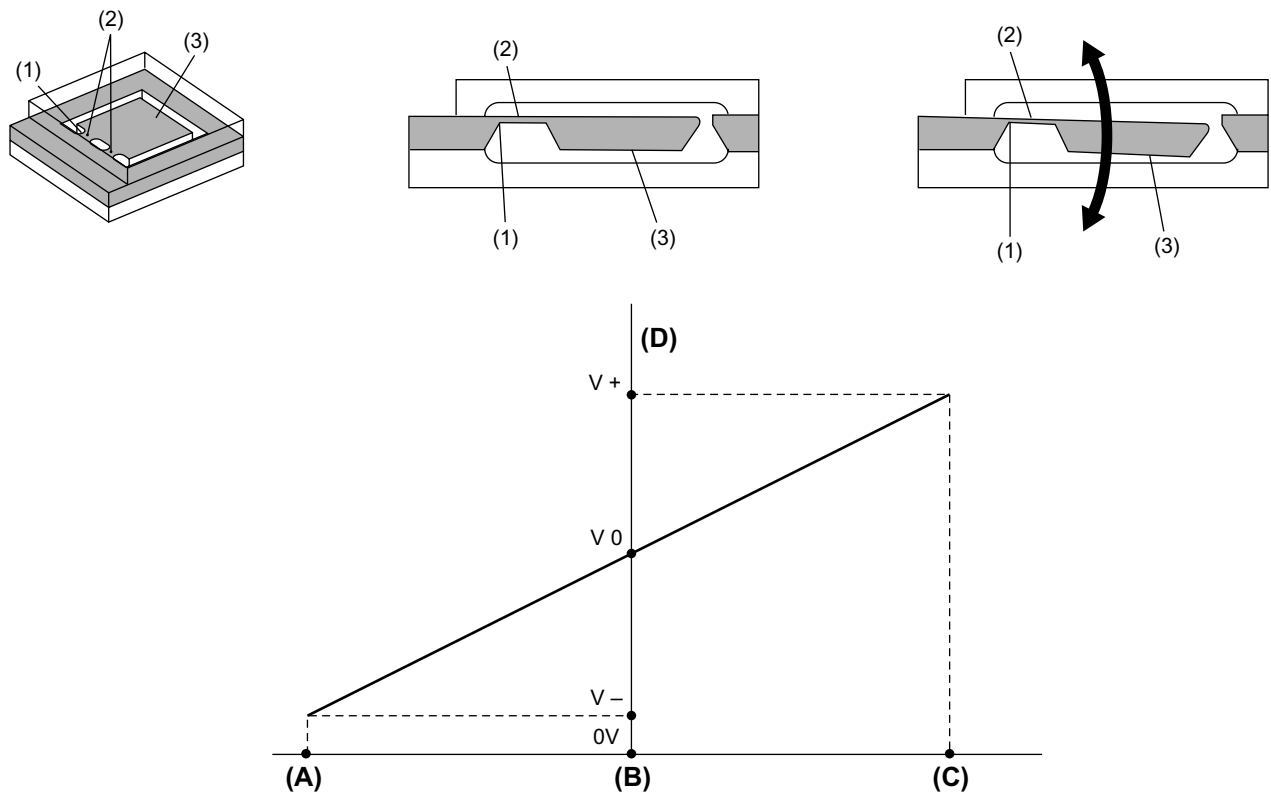
ABS00278

- (A) U.S. spec. vehicle
- (B) Canada spec. vehicle
- (1) ABS warning light

H: G SENSOR

The G sensor detects changes in the vehicle's acceleration/deceleration rate in the longitudinal direction.

A piezo-resistor is formed on the beam. When the mass area moves during acceleration and deceleration, the beam distorts causing the resistance of the piezo-resistor to change. This change is converted into change in voltage and sent to the ABSCM.



ABS00035

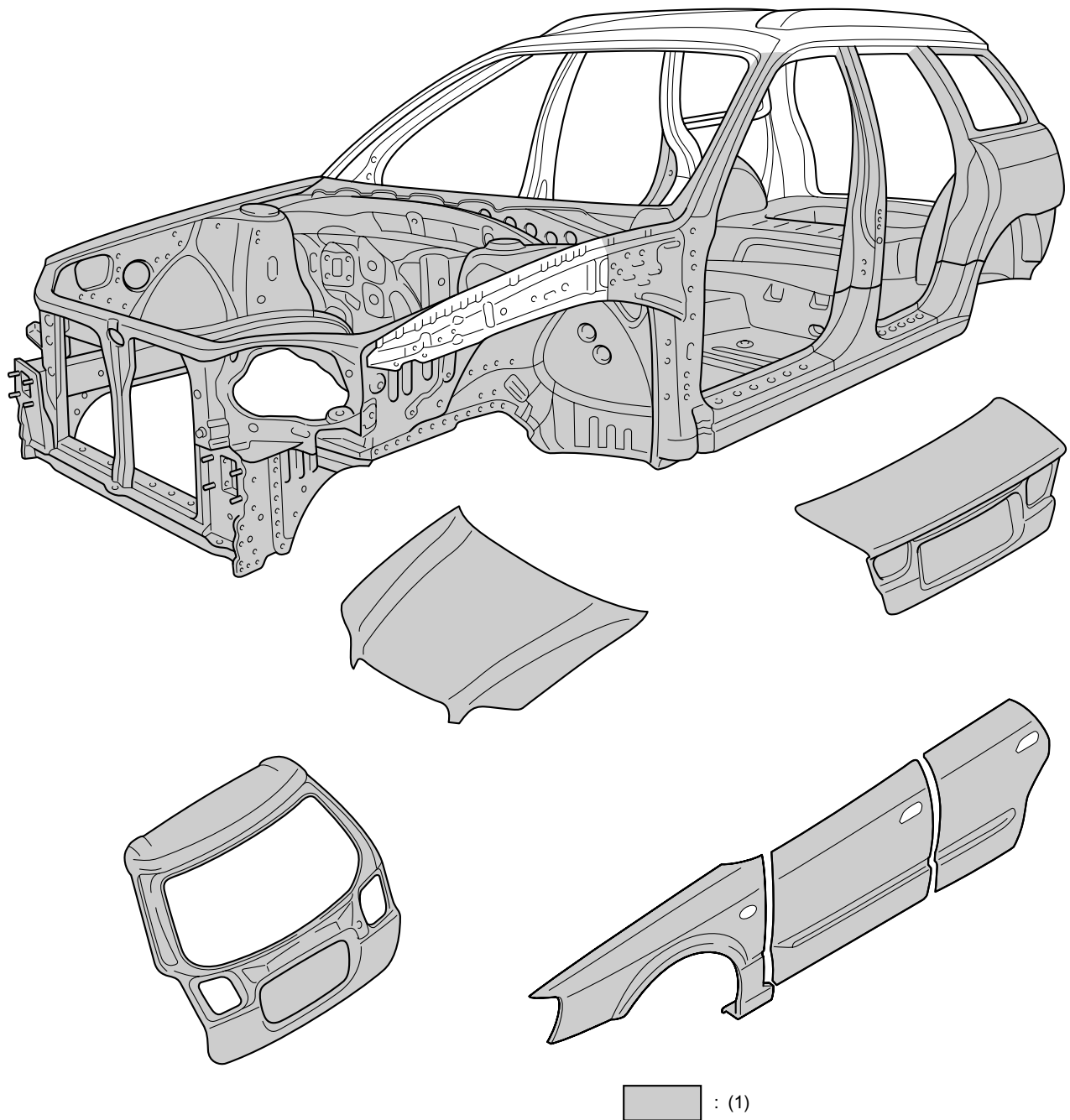
- | | | |
|-----------------------------|--------------------|------------------|
| (1) Beam | (2) Piezo-resistor | (3) Mass area |
| (A) Accelerating | (B) Cruising | (C) Decelerating |
| (D) G sensor output voltage | | |

ANTI-LOCK BRAKE SYSTEM (ABS)

ABS

MEMO

13. Galvanized Sheet Metal Parts



■ : (1)

BS-00061

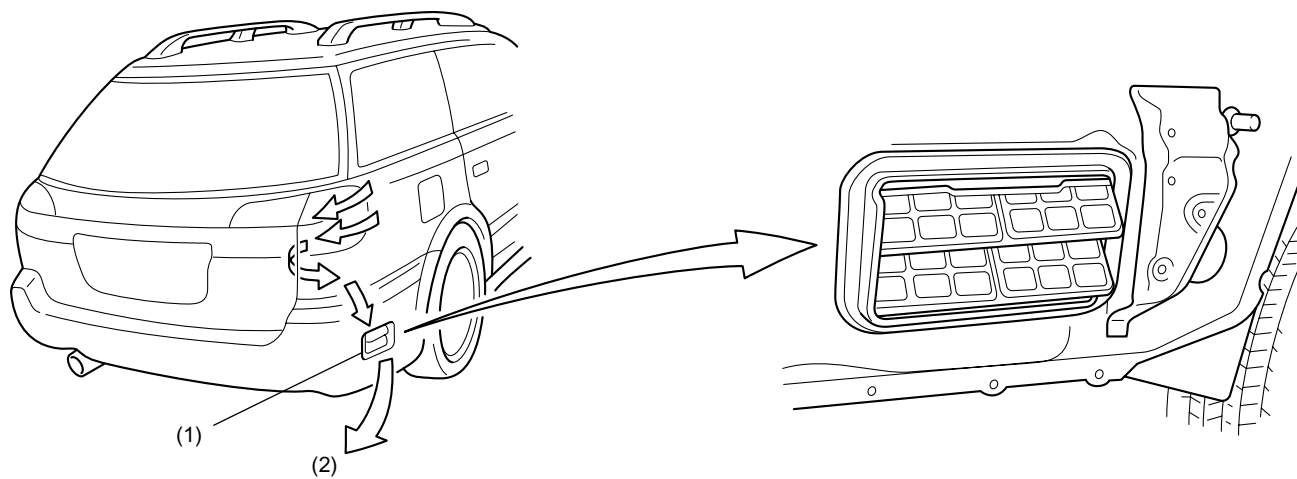
(1) Galvanized on both sides

1. General

- The Legacy's body structure is of a semi-monocoque design mainly consisting of press-formed steel sheets welded together.
- A combination of longitudinal frames and annulus frames arranged like a cage forms both a crushable zone that collapses in a controlled manner in the event of a collision (thus absorbing the impact force) and a rigid cabin that is highly resistant to deformation stresses (thus maintaining a survival space for the occupants).

14.Ventilation

A: OUTLET PORT

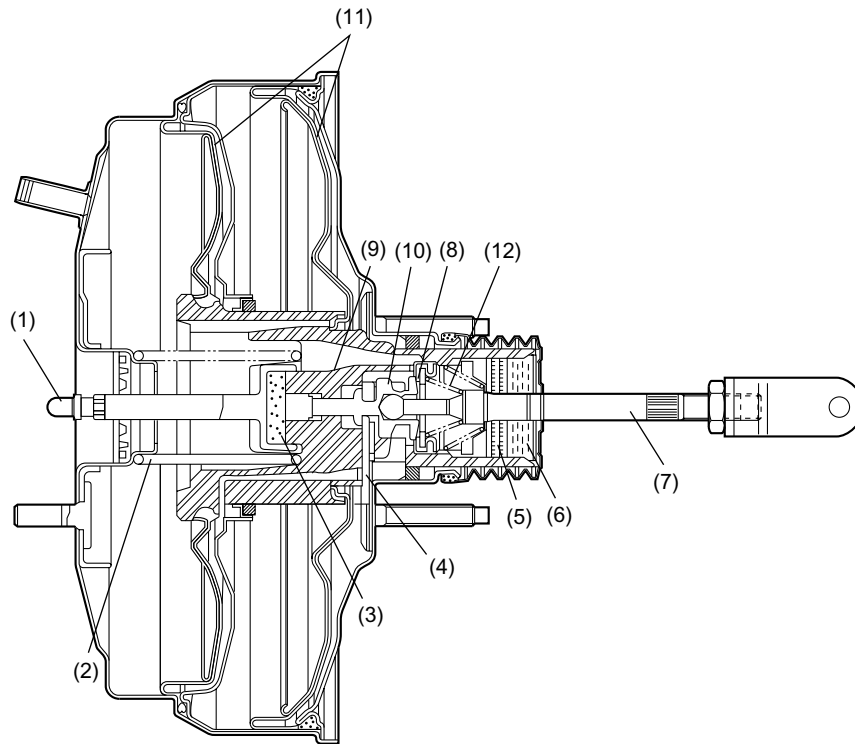


BS-00062

- (1) Outlet port
- (2) Air flow

3. Brake Booster

- The brake booster is a tandem type that uses two diaphragms. This design provides high brake boosting effects in spite of a reduced diameter.
- All models are equipped with an 8 inch + 9 inch booster.



BR-00057

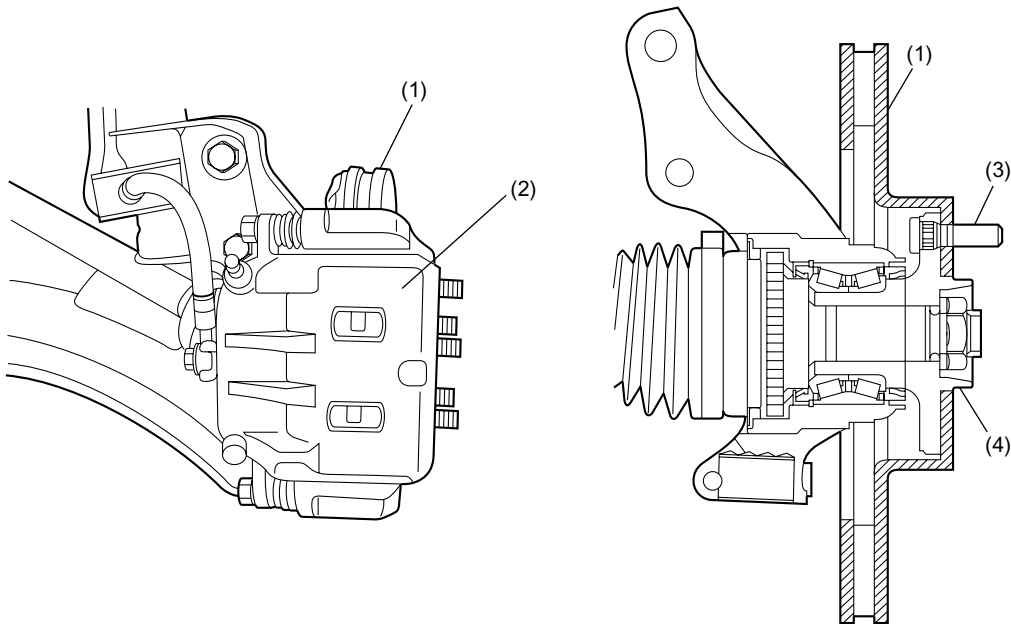
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|-------------------|-------------------|--------------------------|
| (1) Pushrod | (5) Filter | (9) Valve body |
| (2) Return spring | (6) Silencer | (10) Plunger valve |
| (3) Reaction disc | (7) Operating rod | (11) Diaphragm plate |
| (4) Key | (8) Poppet valve | (12) Valve return spring |

FRONT AND REAR DISC BRAKES

BRAKE

1. Front and Rear Disc Brakes

- The front disc brakes are of a ventilated disc type which features high heat dissipation and superb braking stability. In addition, the front brakes quickly restore their original braking performance even when they get wet.
- The rear brakes are disc brakes.
- Each disc rotor, which is fitted on the outside of the hub, is secured together with the wheel using the hub bolts. This facilitates its removal and installation.
- The inner brake pad is provided with a wear indicator.



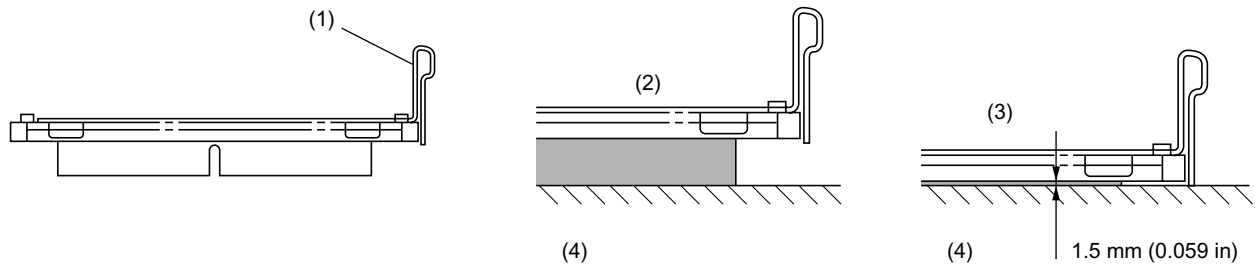
BR-00011

- (1) Disc rotor
- (2) Caliper body

- (3) Hub bolt
- (4) Hub

A: PAD WEAR INDICATOR

A wear indicator is provided on the inner disc brake pads. When the pad wears down to 1.5 mm (0.059 in) the tip of the wear indicator comes into contact with the disc rotor, and makes a squeaking sound as the wheel rotates. This alerts the driver to the situation.



BR-00186

(1) Wear indicator

(2) New pad

(3) Worn pad

(4) Disc rotor

B: FRICTIONAL MATERIAL OF BRAKE PADS

The brake pads materials do not contain any asbestos which is harmful to human body.

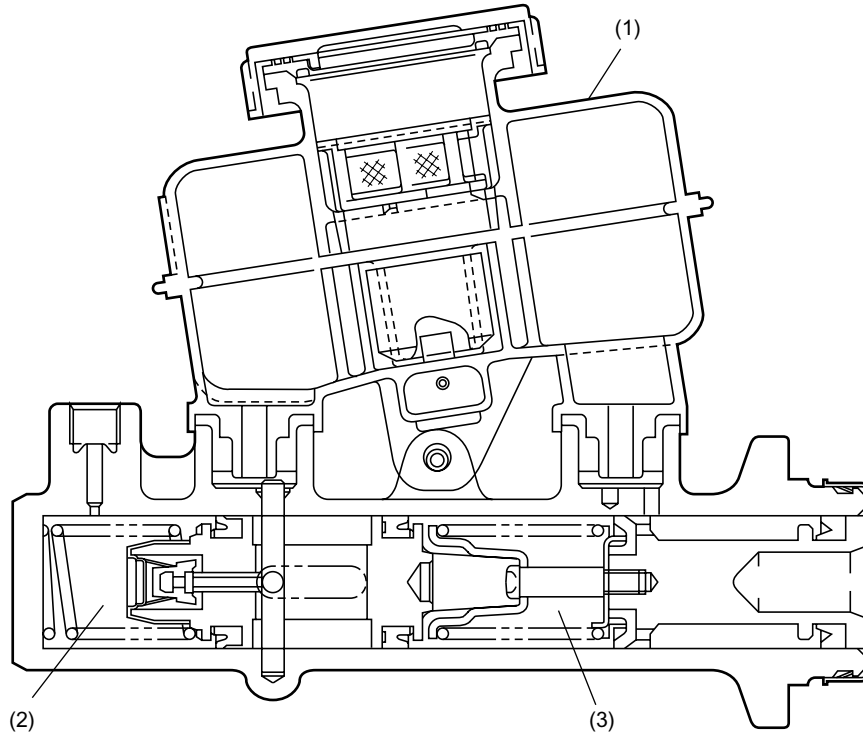
MASTER CYLINDER

BRAKE

2. Master Cylinder

- There is a brake fluid reservoir tank on the master cylinder.

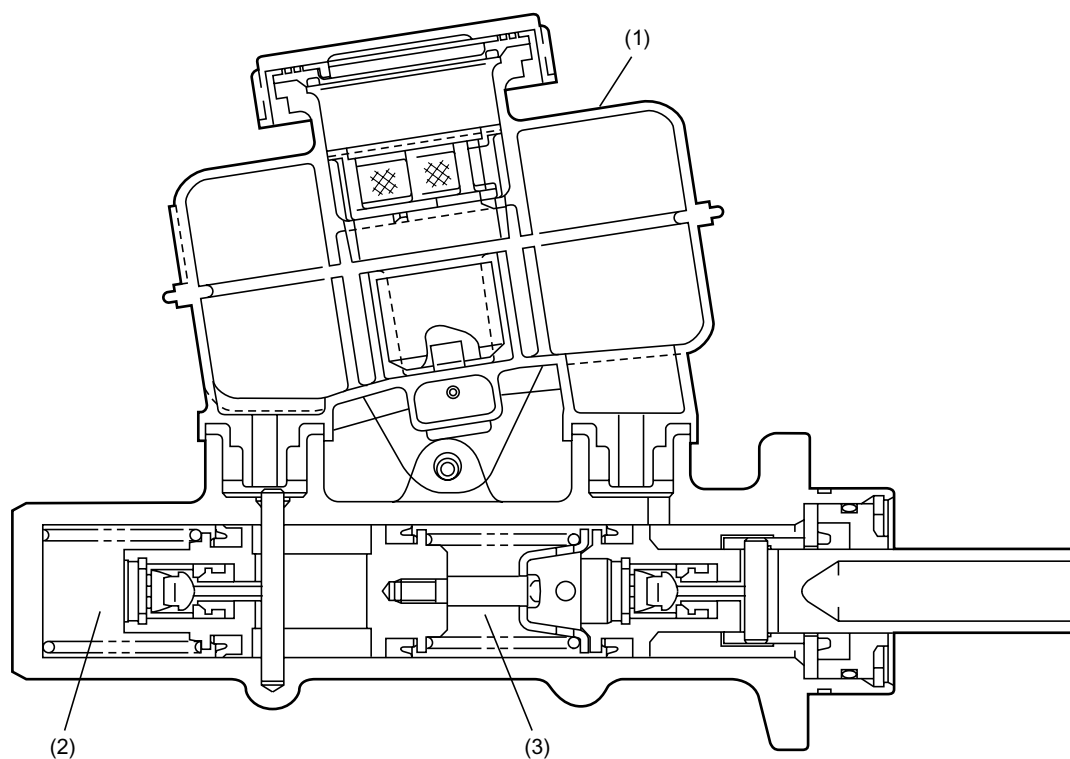
ABS models



BR-00187

- (1) Reservoir tank
- (2) Secondary hydraulic chamber (chamber S)
- (3) Primary hydraulic chamber (chamber P)

VDC models



BR-00188

- (1) Reservoir tank
- (2) Secondary hydraulic chamber (chamber S)
- (3) Primary hydraulic chamber (chamber P)

MASTER CYLINDER

BRAKE

A: BRAKE FLUID LEVEL SWITCH

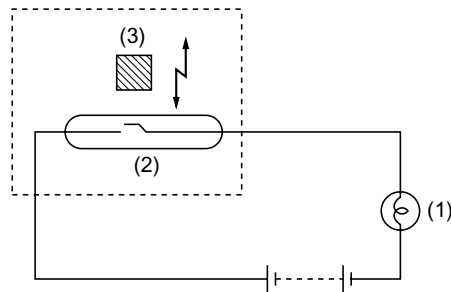
The brake fluid level switch is located inside the brake fluid reservoir tank and causes the brake system warning light on the combination meter to come on when the fluid level has dropped below the predetermined level.

The switch assembly consists of a reed switch (normally open) and a permanent magnet that is incorporated in a float.

When the brake fluid level is normal, the float is far above the reed switch, so the force of the magnet is unable to act on the reed switch. The warning light circuit, therefore, remains open.

When the brake fluid level drops to a level approximately 30 mm (1.18 in) below the maximum level and the float lowers accordingly, the magnet aligns with the reed switch, activating the reed switch contact. The warning light then comes on to warn the driver of the situation.

The warning light may, although momentarily, illuminate even when the brake fluid level is normal if the vehicle tilts or swing largely.



BR-00147

(1) Warning light

(2) Reed switch

(3) Permanent magnet

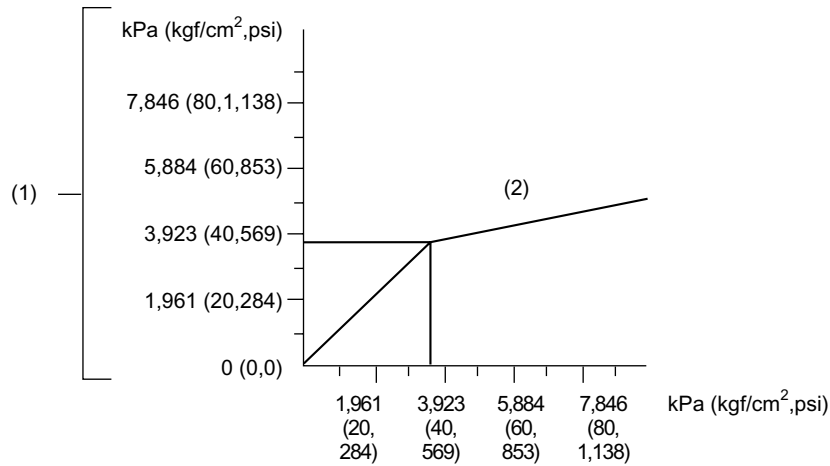
PROPORTIONING VALVE

BRAKE

4. Proportioning Valve

The proportioning valve prevents the rear wheels from locking and resultant skidding that would occur during hard braking due to transfer of vehicle weight toward the front wheels. The valve distributes a reduced pressure to the rear wheel brakes as compared with the pressure to the front wheel brakes when a specified master cylinder fluid pressure (called “split point”) is exceeded as shown in the diagrams below.

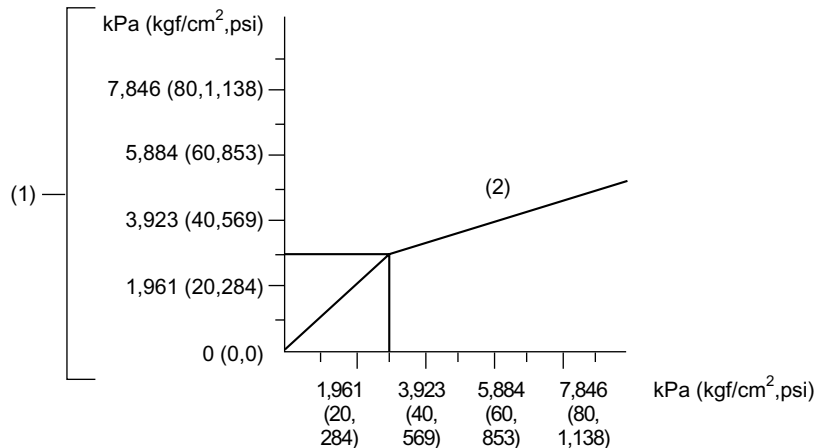
VDC models



BR-00191

- (1) Rear wheel cylinder fluid pressure
- (2) Master cylinder fluid pressure in case of split point 3,677 kPa (37.5 kgf/cm², 533 psi)

Except VDC models



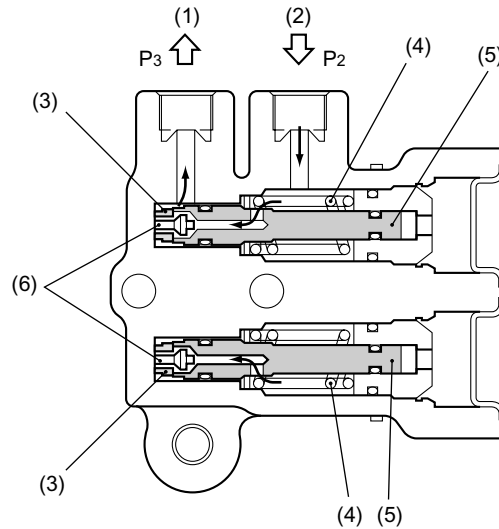
BR-00192

- (1) Rear wheel cylinder fluid pressure
- (2) Master cylinder fluid pressure in case of split point 2,942 kPa (30 kgf/cm², 427 psi)

A: OPERATION

1) Operation before the split point

The piston is held pressed toward the left by the spring so that the valve is kept away from its seat. Under this condition, fluid pressure " P_3 " to the rear wheel cylinders is equal to fluid pressure " P_2 " from the master cylinder.



BR-00193

- (1) To rear wheel cylinder
- (2) From master cylinder
- (3) Seat

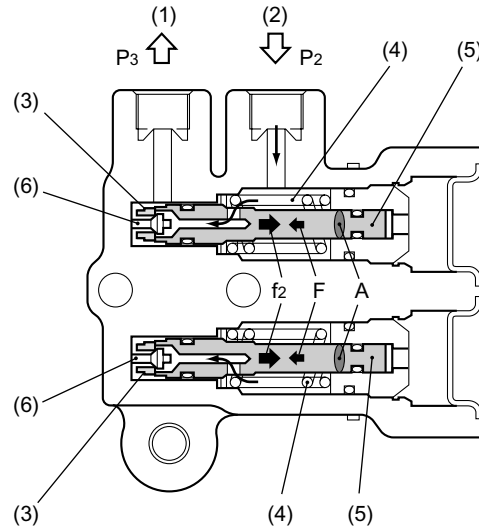
- (4) Spring
- (5) Piston
- (6) Valve

PROPORTIONING VALVE

BRAKE

2) Operation at the split point pressure

When pressure " P_2 " increases to the split point pressure, force " f_2 " is generated. (Pistons cross sectional area A has been selected so that the force is generated starting with the split point pressure.) The pressure pushes the piston rightward, overcoming spring force F . As a result, the valve seat moves together with the piston rightward and comes in contact with the valve, blocking the passage toward the rear wheel cylinders.



BR-00194

- (1) To rear wheel cylinder
- (2) From master cylinder
- (3) Seat

- (4) Spring
- (5) Piston
- (6) Valve

3) Operation after reaching the split point pressure

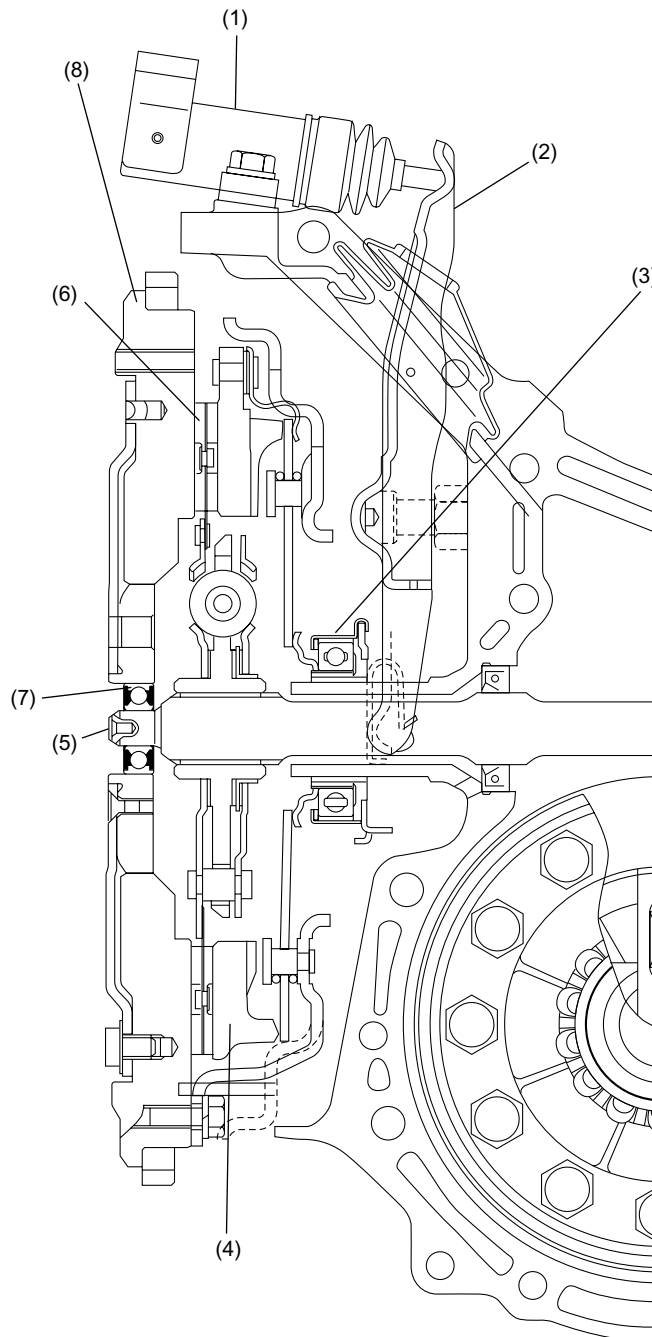
Immediately before the fluid passage toward the rear wheel cylinders is closed, pressure " P_2 " is slightly higher than pressure " P_3 ". So the piston can move in the spring force acting direction and the fluid can flow to the wheel cylinders. However, as soon as pressure " P_2 " becomes equal to " P_3 ", the valve closes.

This cycle is repeated as long as the pedal is depressed further, but pressure increasing rate of the rear wheel cylinders is smaller than that of the front wheel cylinders.

CROSS SECTIONAL VIEW

3. Cross Sectional View

A: NON-TURBO MODELS



CL-00085

CROSS SECTIONAL VIEW

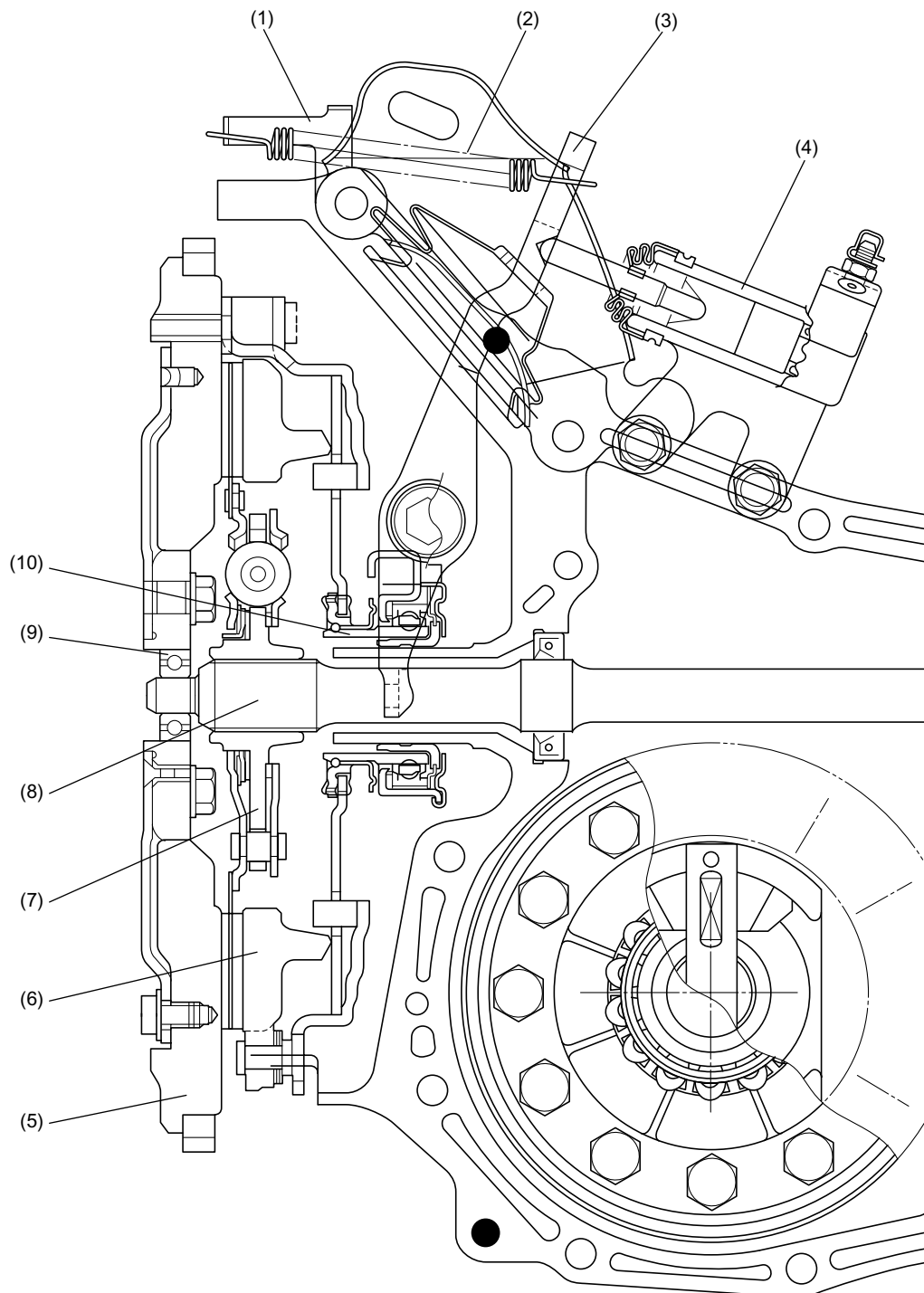
CLUTCH

- | | | |
|------------------------|-----------------------------|-------------------|
| (1) Operating cylinder | (4) Clutch cover | (7) Pilot bearing |
| (2) Release lever | (5) Transmission main shaft | (8) Flywheel |
| (3) Release bearing | (6) Clutch disc | |

CROSS SECTIONAL VIEW

CLUTCH

B: TURBO MODELS



CL-00119

CROSS SECTIONAL VIEW

CLUTCH

- | | | |
|------------------------|-----------------------------|----------------------|
| (1) Spring bracket | (5) Flywheel | (9) Pilot bearing |
| (2) Spring | (6) Clutch cover | (10) Release bearing |
| (3) Release lever | (7) Clutch disc | |
| (4) Operating cylinder | (8) Transmission main shaft | |

4. Flywheel

A: GENERAL

The flywheel is of a flexible type, consisting of a drive plate, reinforcement, and mass flywheel.

This type of flywheel is characterized by less vibration and less noise, since it transmits the engine power from the crankshaft through the drive plate and mass flywheel to the clutch disc.

1. General

A: NON-TURBO MODELS

- The clutch control operates the release fork using the hydraulic pressure generated in the master cylinder when the pedal is depressed.
- The clutch itself is a push type clutch. When the clutch pedal is depressed, the self-aligning release bearing is caused to slide on a guide pressing the center of the diaphragm spring. The warped diaphragm spring disengages the pressure plate from the clutch disc. The clutch using a diaphragm spring has the advantage of little variation in push load even when the clutch disc facing is worn. The diaphragm spring is located inside the clutch cover.
- The clutch has a clutch disc between the flywheel and the pressure plate.
- Inside the clutch cover, there is a cover and a pressure plate combined with each other by means of strap plates, which also serve to prevent the pressure plate from relatively turning.

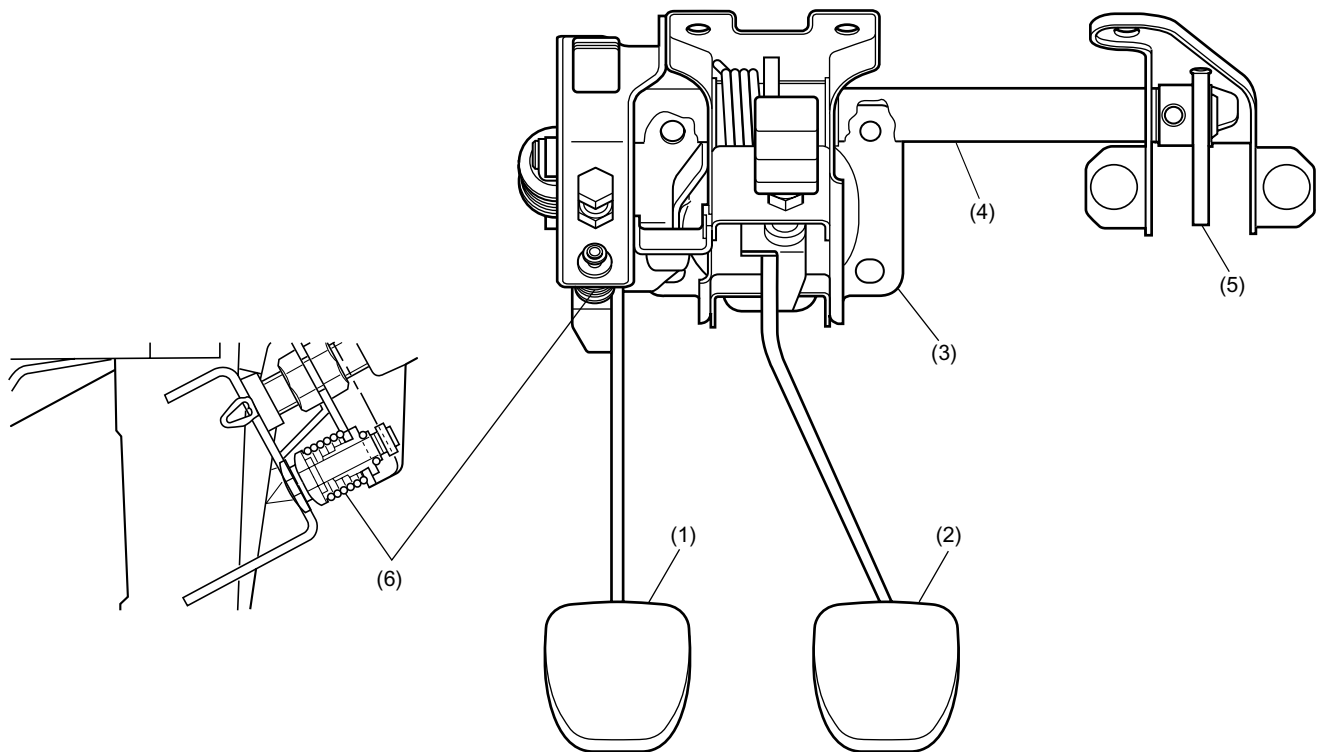
B: TURBO MODELS

- Turbo models adopt a clutch system which is appropriate for increased clutch load.
- The clutch control operates the release fork using the hydraulic pressure generated in the master cylinder when the clutch pedal is depressed.
- The clutch itself is a pull type clutch. When the clutch pedal is depressed, the self-aligning release bearing is caused to slide on a guide pulling the center of the diaphragm spring. The warped diaphragm spring disengages the pressure plate from the clutch disc. The clutch using a diaphragm spring has the advantage of little variation in push load even when the clutch disc facing is worn. The diaphragm spring is located inside the clutch cover.
- The clutch has a clutch disc between the flywheel and the pressure plate.
- Inside the clutch cover, there is a cover and a pressure plate combined with each other by means of strap plates, which also serve to prevent the pressure plate from relatively turning against to the clutch cover.

5. Hydraulic Clutch Pedal System

A: CONSTRUCTION

- The hydraulic clutch pedal is connected to the master cylinder via a rod.
- The clutch pedal and brake pedal are mounted on the same bracket.
- The clutch pedal has a mechanism that reduces (assists) the force required to depress the clutch pedal and reduce the initial pedal depressing force.
- A starter interlock mechanism is provided to prevent the engine from starting unless the clutch pedal is pressed.



CL-00272

- | | |
|------------------------------------|---|
| (1) Clutch pedal | (4) Rod |
| (2) Brake pedal | (5) Lever |
| (3) Brake and clutch pedal bracket | (6) Initial pedal effort reducing mechanism |

HYDRAULIC CLUTCH PEDAL SYSTEM

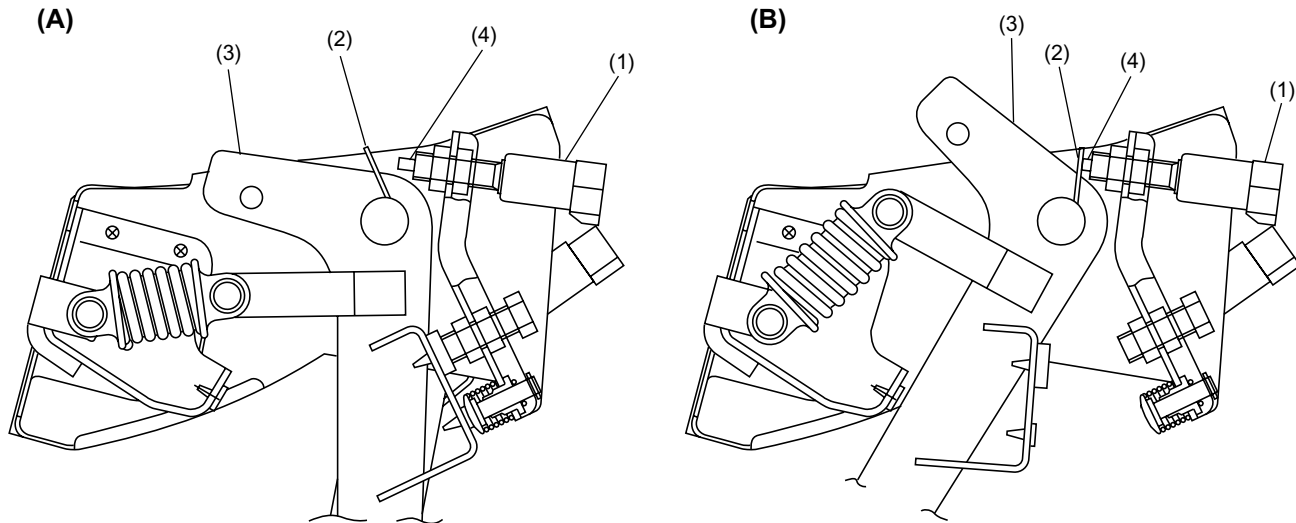
CLUTCH

B: OPERATION

1. STARTER INTERLOCK MECHANISM

When the clutch pedal is fully depressed, the stopper on the pedal pushes the clutch switch pushrod inwards.

When the pushrod is pressed in, the switch turns ON and connects the ignition switch to the starter circuit enabling engine start.



CL-00138

(A) When clutch switch is OFF

(1) Clutch switch

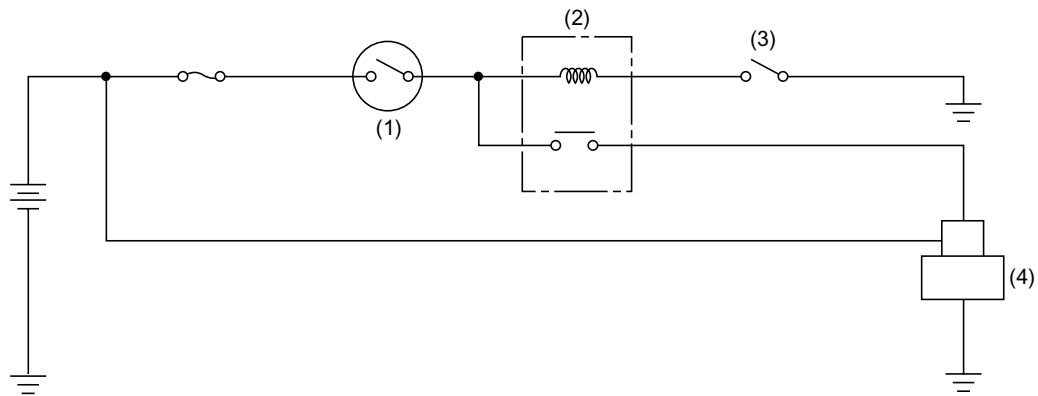
(2) Stopper

(B) When clutch switch is ON

(3) Clutch pedal

(4) Pushrod

- Schematic drawing



CL-00137

- (1) Ignition switch
- (2) Starter relay

- (3) Clutch switch
- (4) Starter motor

HYDRAULIC CLUTCH PEDAL SYSTEM

CLUTCH

MEMO

2. Operation

A: NON-TURBO MODELS

Applying foot pressure to the clutch pedal moves the release lever. This causes the release bearing to slide on the guide, pressing the center of the diaphragm spring. The diaphragm spring is warped and the force having pressed the pressure plate is released. As a result, the flywheel, clutch disc and pressure plate are disengaged, disconnecting the driving power.

The push type clutch has the point of action at the peripheral tips of the diaphragm spring fingers, through which the pressure plate is pressed to the clutch disc. When the power transmission is to be interrupted, the diaphragm spring is forced to warp using the pivots established on the inward side of the spring finger tips (on the principle of the lever and fulcrum) to disengage the pressure plate from the clutch disc.

B: TURBO MODELS

Applying foot pressure to the clutch pedal moves the release lever. This causes the release bearing to slide on the guide, pulling the center of the diaphragm spring. The diaphragm spring is warped and the force having pressed the pressure plate is released. As a result, the flywheel, clutch disc and pressure plate are disengaged, disconnecting the driving power.

In the pull type clutch, the diaphragm spring has the point of action located inward from the tip, through which the pressure plate is pressed against the clutch disc. When the power transmission is to be interrupted, the diaphragm spring is forced to pivot on the tip and warp away from the pressure plate (on the principle of lever and fulcrum).

LIMITED SLIP DIFFERENTIAL (LSD)

DIFFERENTIALS

2. Limited Slip Differential (LSD)

A: GENERAL

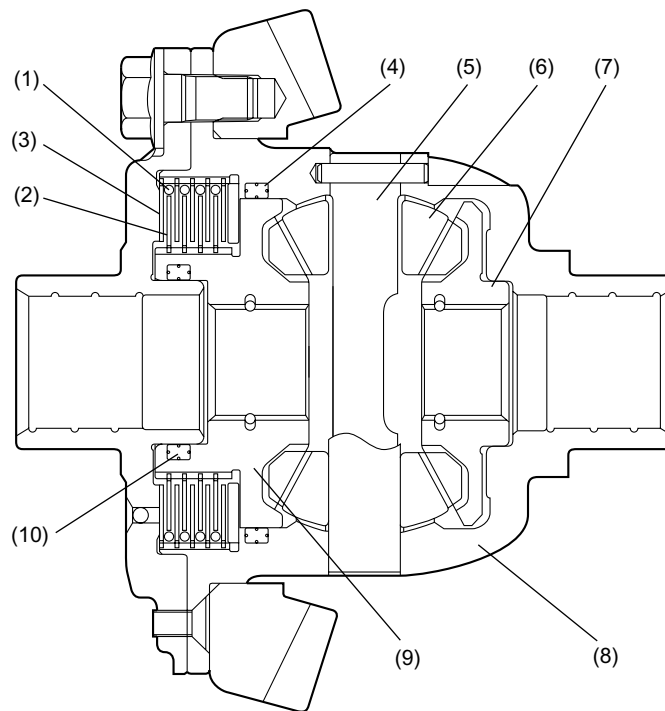
The limited slip differential is of a viscous coupling (V/C) type which automatically limits the differential action and distributes torque to the left and right wheels adequately to enhance driving stability when the left and right wheels are rotating at speeds different from each other during driving on a slippery road (muddy, snow-covered or slushy road) or cornering.

B: CONSTRUCTION

The V/C type LSD has outer plates and inner plates arranged alternately. Each outer plate is splined to the inside of the differential case at its outer periphery and each inner plate is splined to the outer circumference of the left side gear at its inner periphery.

The outer plates are held in position by spacer rings while the inner plates can slide in the axial direction along the spline teeth.

The space between the differential case and the left side gear is filled with a mixture of high viscosity silicone oil and air and hermetically sealed with X-rings.



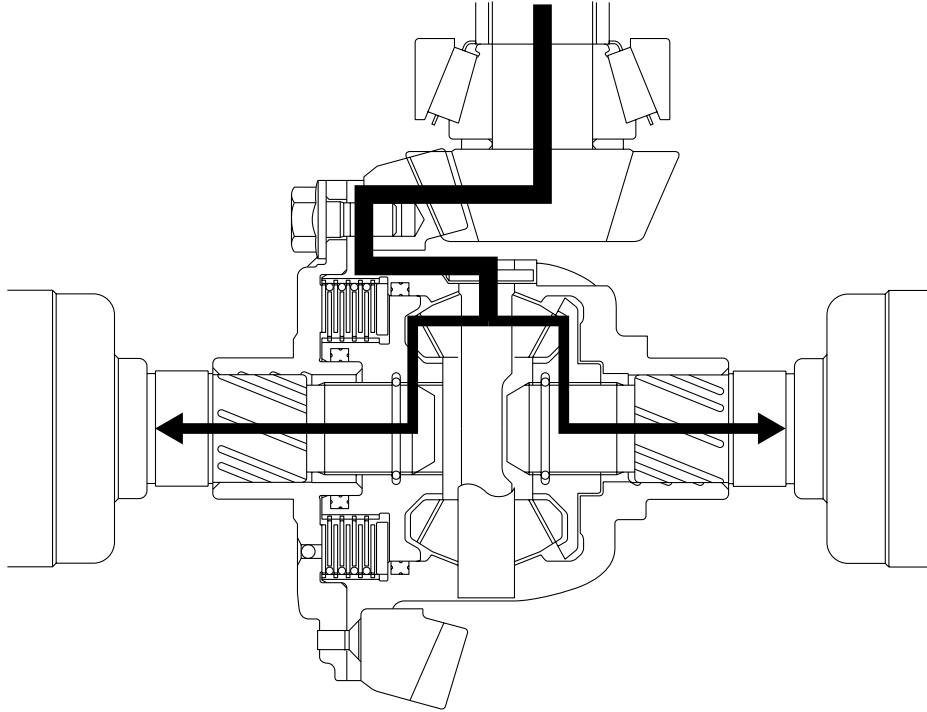
DI-00295

- | | |
|------------------|-----------------------|
| (1) Spacer ring | (6) Pinion gear |
| (2) Inner plate | (7) Side gear (right) |
| (3) Outer plate | (8) Differential case |
| (4) X-ring | (9) Side gear (left) |
| (5) Pinion shaft | (10) X-ring |

C: OPERATION

1. WHEN RIGHT AND LEFT WHEELS ROTATE AT THE SAME SPEED

During normal straight-ahead driving where the right and left wheels rotate at the same speed, the differential case and side gears rotate together, just as in conventional differentials. As a result, driving torque is distributed equally to the right and left side gears.



DI-00296

LIMITED SLIP DIFFERENTIAL (LSD)

DIFFERENTIALS

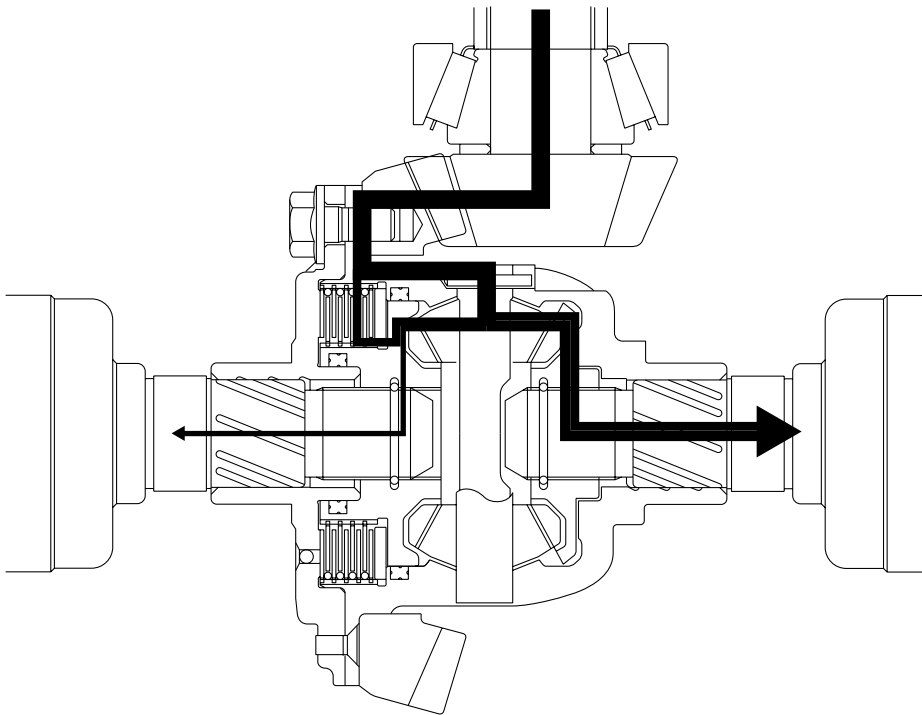
2. WHEN RIGHT AND LEFT WHEELS ROTATE AT DIFFERENT SPEEDS

When a speed difference occurs between the right and left wheels, the differential case and the left side gear do not rotate at the same speed any more. The speed difference between them corresponds to that between both the wheels. Because of the viscosity shearing force caused in the silicone oil, a differential torque is then generated, which limits differential action.

For example, if the left wheel spins due to small road resistance, a speed difference occurs between the right and left wheels. Since there is the V/C between the differential case and left side gear, a differential torque corresponding to the speed difference is generated in the V/C. This differential torque is transferred from the left wheel to the right wheel. As a result, a greater driving torque is distributed to the right wheel which is rotating at a lower speed.

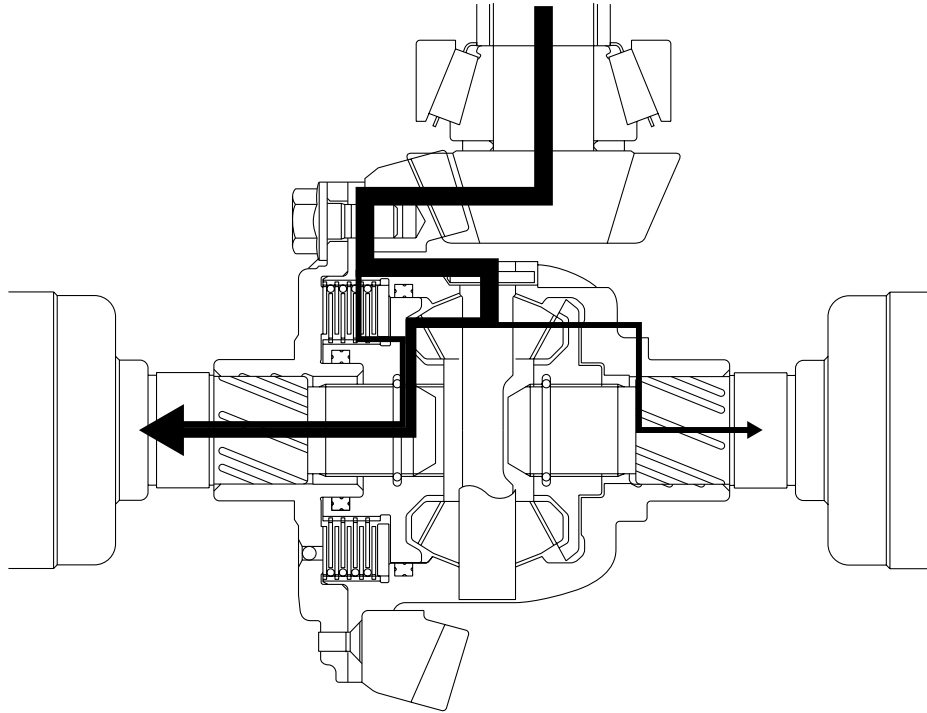
When the right wheel spins, the differential torque is transferred from the right wheel to the left wheel. Also in this case, a torque greater by the differential torque than the torque to the spinning wheel is transmitted to the wheel rotating at the lower speed.

When left wheel spins



DI-00297

When right wheel spins



DI-00298

D: SERVICE PROCEDURES FOR LSD

It is not recommended to disassemble the LSD assembly as component parts of LSD assembly are not available individually.

LIMITED SLIP DIFFERENTIAL (LSD)

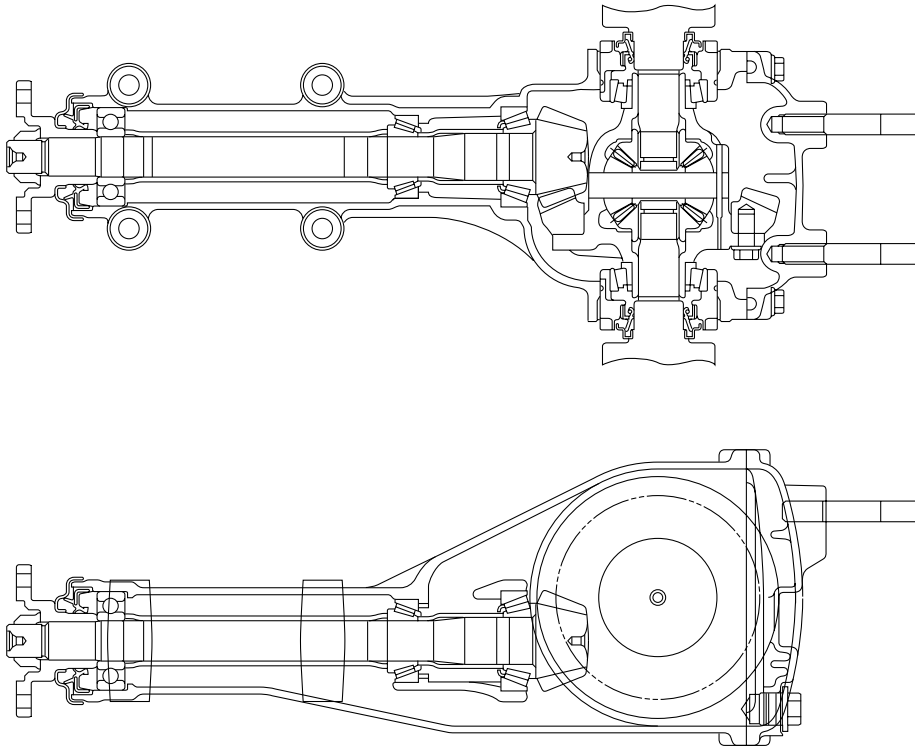
DIFFERENTIALS

MEMO

1. Rear Differential

A: VA-TYPE

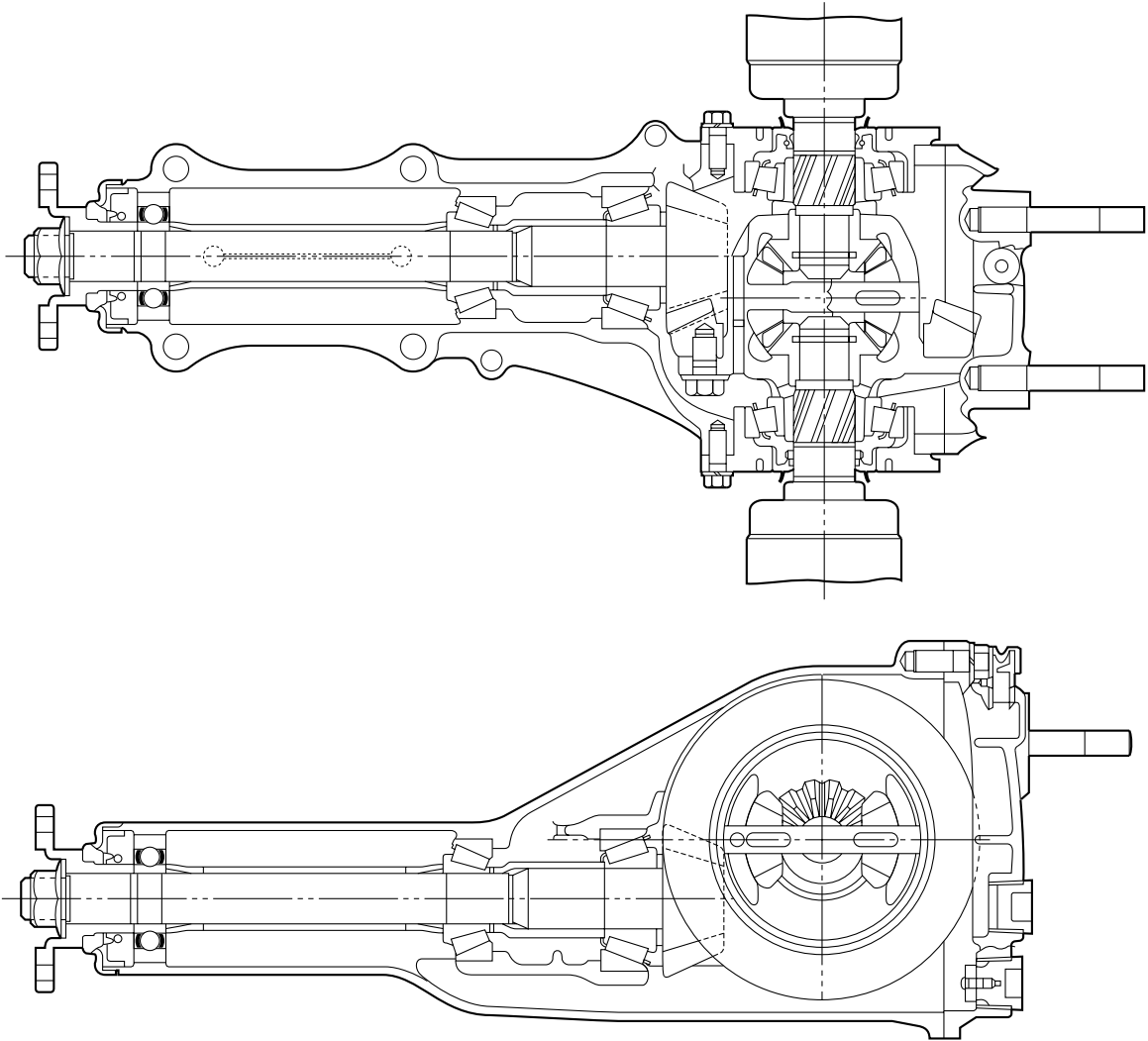
The drive gear is a hypoid gear with nominal diameter of 152 mm (5.98 in). The drive pinion shaft is supported by three bearings. The bearing preload is adjusted by selecting a spacer and washer combination of a proper thickness. The drive pinion height is adjusted by properly selecting the thickness of the washers located at the drive pinion neck using a dummy shaft and gauge.



DI-00390

B: T-TYPE

The drive gear is a hypoid gear with nominal diameter of 160 mm (6.30 in). The drive pinion shaft is supported by three bearings. The bearing preload is adjusted by selecting a spacer and washer combination of a proper thickness. The drive pinion height is adjusted by properly selecting the thickness of the washers located at the drive pinion neck using a dummy shaft and gauge.



DI-00231

2. Front Axle

A: GENERAL

- The inboard end of each axle shaft is connected to the transmission via a constant velocity joint which is flexible in the axial directions while the outboard end is connected via a bell joint (BJ) to the wheel hub which is supported by a taper roller bearing located inside the axle housing. The BJ features a large operating angle.

Both the constant velocity joints ensure smooth, regular rotation of the drive wheels with minimum vibration.

- The bearing is a preloaded, non-adjustable tapered roller unit bearing.

Each hub is fitted in the axle housing via the tapered roller bearing.

- The BJ's spindle is splined to the hub and is secured with an axle nut clinched to it.

- The disc rotor is an external mounting type. It is secured to the disc wheel using hub bolts to facilitate maintenance of the disc rotor.

1) 3.0 L engine models

- The hubs are induction-hardened.

2) 2.5 L engine models

- The hubs are same as those used in the previous model.

3) Driveshaft types

- BAJA non-turbo AT models: AARi type (female spindle)

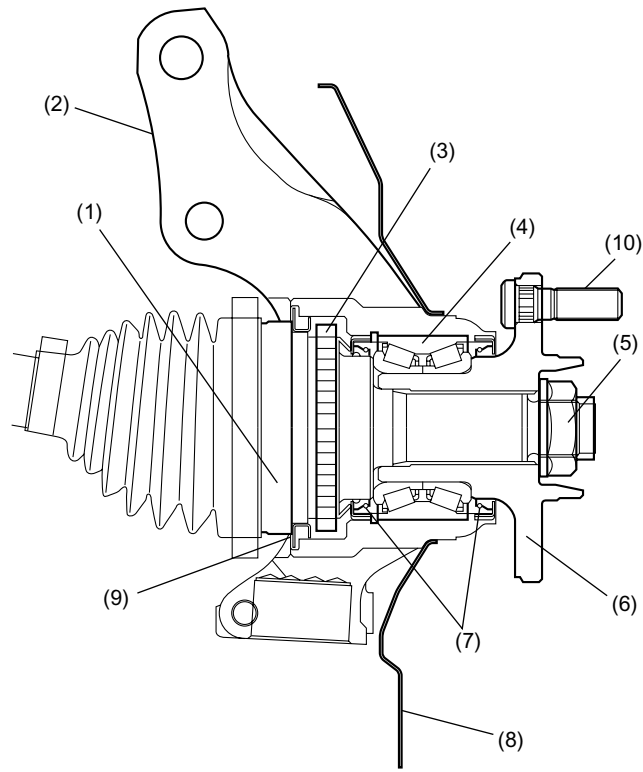
- BAJA turbo AT models: AARi type (male spindle)

- BAJA turbo MT models: AARi type (male spindle)

- Others: SFJ type

FRONT AXLE

DRIVE SHAFT SYSTEM

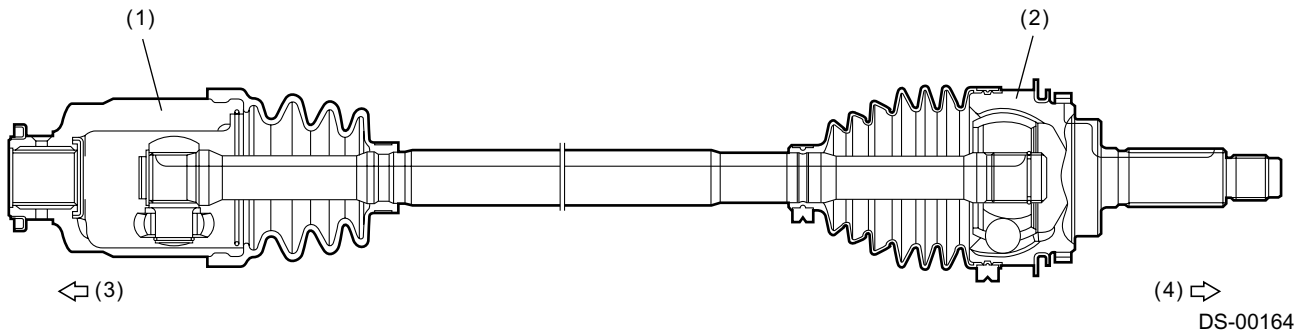


DS-00163

- | | | |
|---------------------|-------------------------|------------------|
| (1) Bell joint (BJ) | (5) Axle nut | (9) Baffle plate |
| (2) Axle housing | (6) Hub | (10) Hub bolt |
| (3) Tone wheels | (7) Oil seal | |
| (4) Bearing | (8) Brake backing plate | |

B: FRONT DRIVE SHAFT**1. SFJ TYPE**

- A shudder-less free ring tripod joint (SFJ) is used on the differential side of each front drive shaft. The SFJ can be disassembled for maintenance. It provides a maximum operating angle of 25° and can move in axial directions.
- A bell joint (BJ) is used on the wheel side of each front drive shaft. The BJ's maximum operating angle is 47.5° .



(1) Shudder-less free ring tripod joint (SFJ)

(2) Bell joint (BJ)

(3) Transmission side

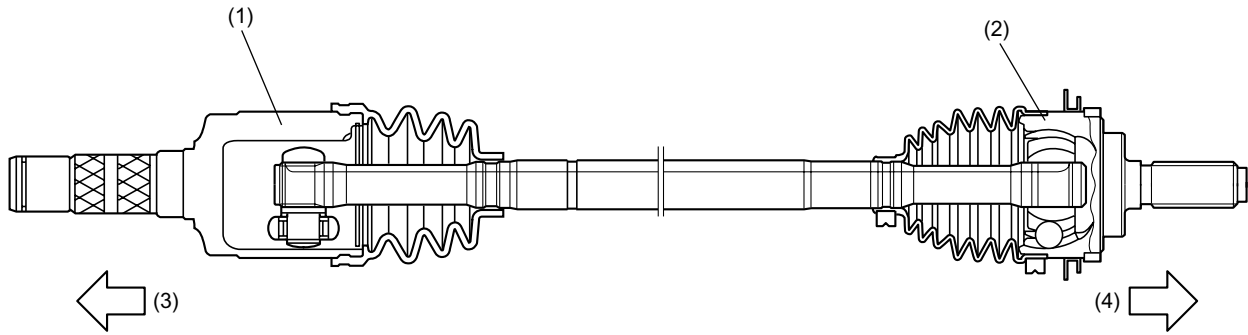
(4) Wheel side

FRONT AXLE

DRIVE SHAFT SYSTEM

2. AARi TYPE

- An AARi (Angular Adjusted Roller-improved) joint is used on the transmission side of each front drive shaft. The AARi can be disassembled for maintenance. The AARi provides a maximum operating angle of 23° and can move in axial directions.
- An AC (Angular Contact) joint is used on the wheel side of each front drive shaft. The AC's maximum operating angle is 47.5° .



DS-00010

- (1) AARi
- (2) AC

- (3) Transmission side
- (4) Wheel side

NOTE:

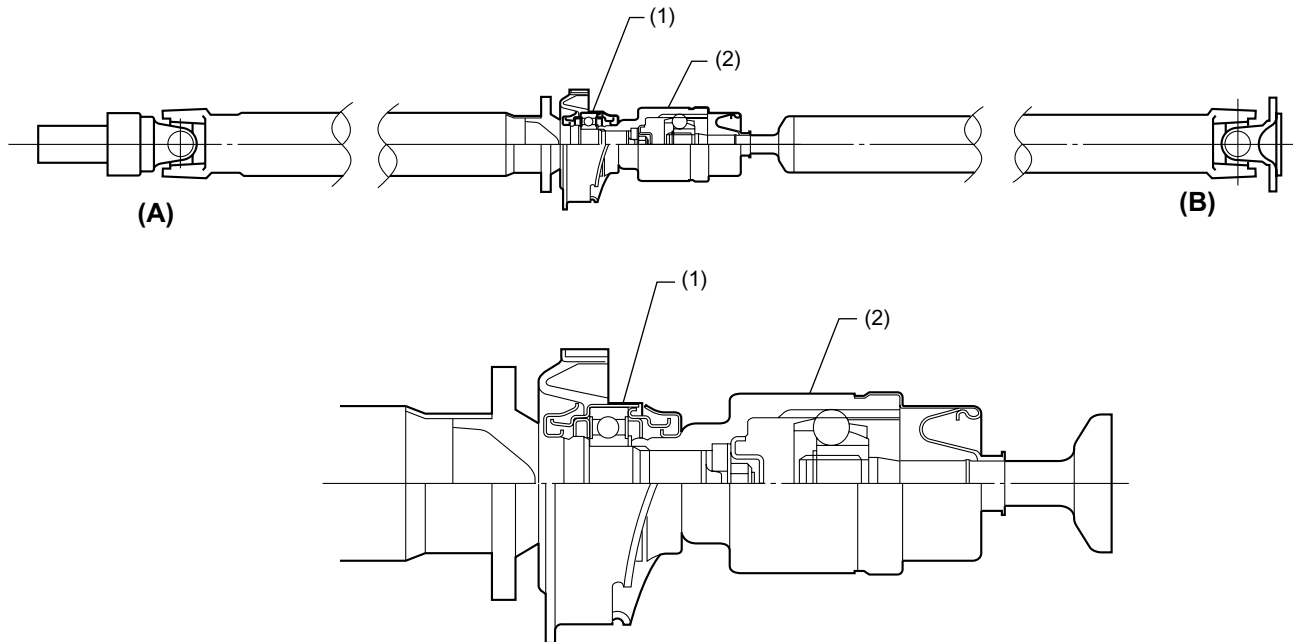
- The male spindle type is shown.
- AARi with female spindle also exists. (for BAJA non-turbo AT models)

PROPELLER SHAFT

DRIVE SHAFT SYSTEM

1. Propeller Shaft

The propeller shaft uses constant velocity joints for quiet operation of the driveline components. The center joint is a double offset joint (DOJ) type which can extend and retract in the axial directions.



DS-00162

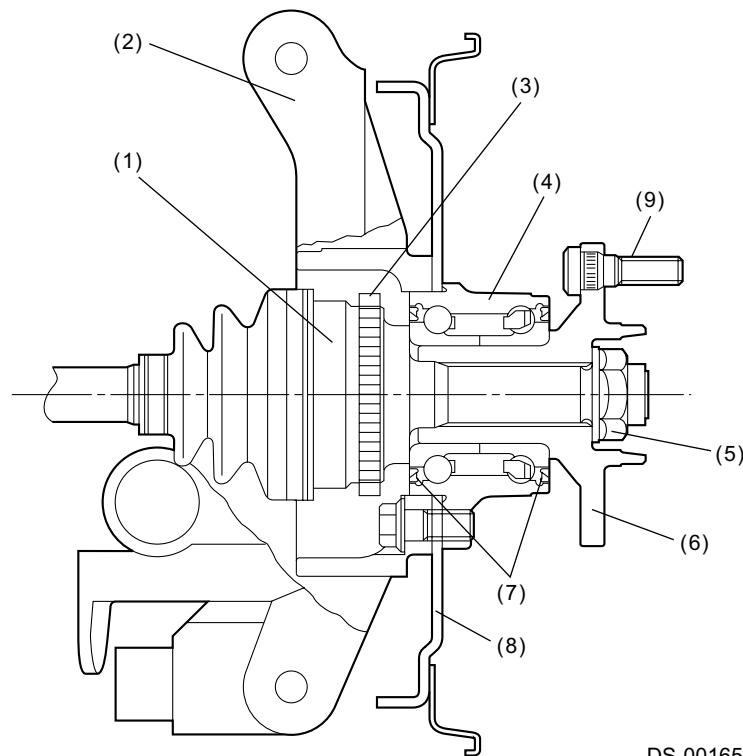
- (1) Center bearing
- (2) Double offset joint (DOJ)

- (A) Transmission side
- (B) Rear differential side

3. Rear Axle

A: GENERAL

- The inboard end of each axle shaft is connected to the differential via a constant velocity joint (double offset joint: DOJ) which is flexible in the axial directions.
- The axle shaft's outboard end is connected via a bell joint (BJ) to the wheel hub which is supported by the hub unit bearing. The BJ features a large operating angle. Both the constant velocity joints (DOJ and BJ) ensure smooth, regular rotation of the drive wheels with minimum vibration.
- The hub unit bearing's outer race forms integral part of the mounting flange. The hub unit bearing is bolted to the rear knuckle arm with the brake backing plate in between. Oil seals are fitted on both sides of the bearing. The bearing is a preloaded, non-adjustable angular contact ball unit bearing.
- The BJ's spindle is splined to the hub and is secured with an axle nut clinched to it.
- The disc rotor and drum are an external mounting type. It is secured to the disc wheel using hub bolts to facilitate maintenance of the disc rotor and drum.



DS-00165

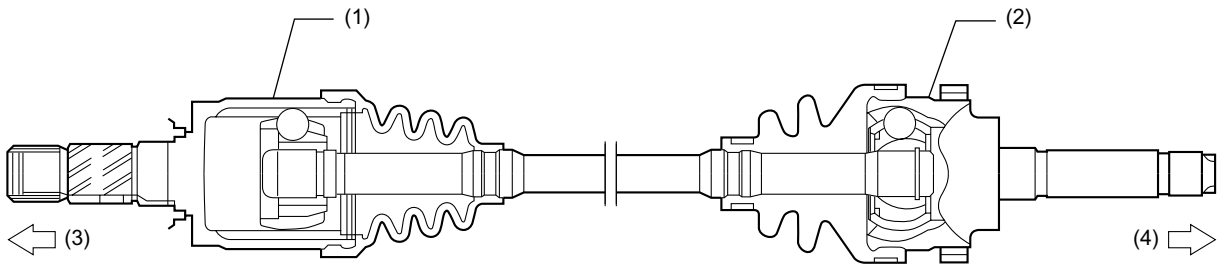
- | | |
|----------------------|-------------------------|
| (1) Bell joint (BJ) | (6) Hub |
| (2) Rear knuckle arm | (7) Oil seal |
| (3) Tone wheels | (8) Brake backing plate |
| (4) Hub unit bearing | (9) Hub bolt |
| (5) Axle nut | |

REAR AXLE

DRIVE SHAFT SYSTEM

B: REAR DRIVE SHAFT

- A double offset joint (DOJ) is used on the differential side of each rear drive shaft. The DOJ can be disassembled for maintenance. It provides a maximum operating angle of 23° and can move in axial directions.
- A bell joint (BJ) is used on the wheel side of each rear drive shaft. Its maximum operating angle is 42° .



DS-00166

- (1) Double offset joint (DOJ)
- (2) Bell joint (BJ)
- (3) Differential side
- (4) Wheel side

AUDIO SYSTEM

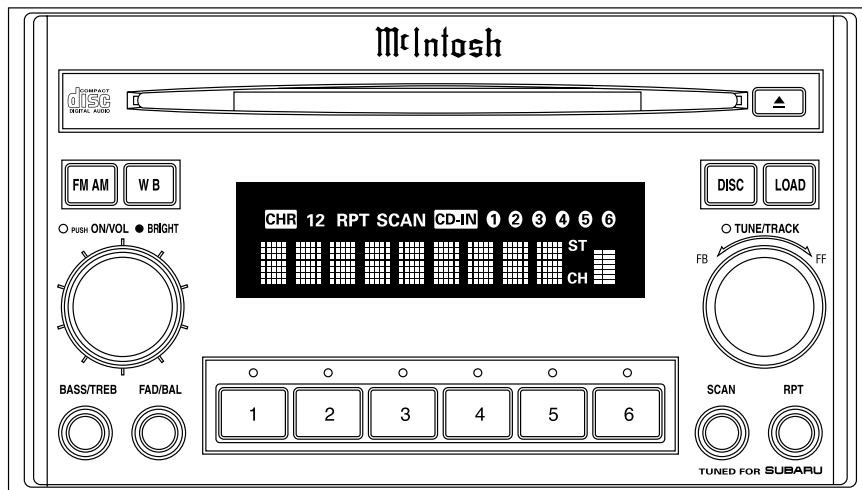
ENTERTAINMENT SYSTEM

1. Audio System

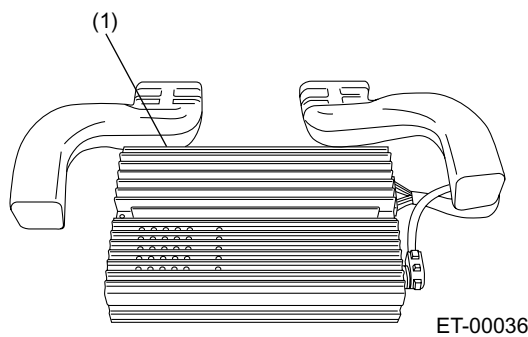
A: DESCRIPTION

The McIntosh™ system consists of a head unit, a speaker amplifier, two tweeters, four mid-range speakers and a woofer. The speaker amplifier is located below the front passengers seat and the woofer at the right rear quarter trim (wagon models) or left rear shelf trim (sedan models).

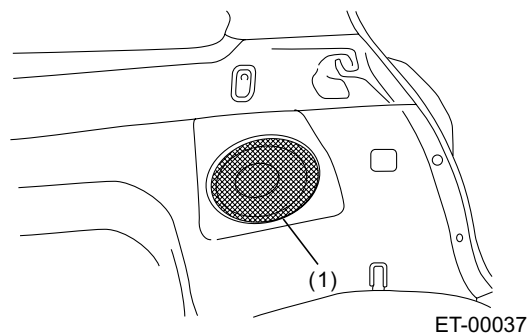
The output power to each of the four channels is 24 W and that to the woofer is 60 W. The total harmonic distortion of the system is as low as 0.05% which is comparable to that of high-class home-use audio systems.



ET-00038



(1) Speaker amplifier



(1) Woofer

Speakers

Type	Diameter	Number
Front tweeter	20 mm (0.8 in)	2
Front mid-range speaker	160 mm (6.3 in)	2
Rear mid-range speaker	160 mm (6.3 in)	2
Woofer (oval shaped)	152 mm (6 in) × 229 mm (9 in)	1

McIntosh™: McIntosh™ is the registered trademark of McIntosh Laboratory, Inc.

AUDIO SYSTEM

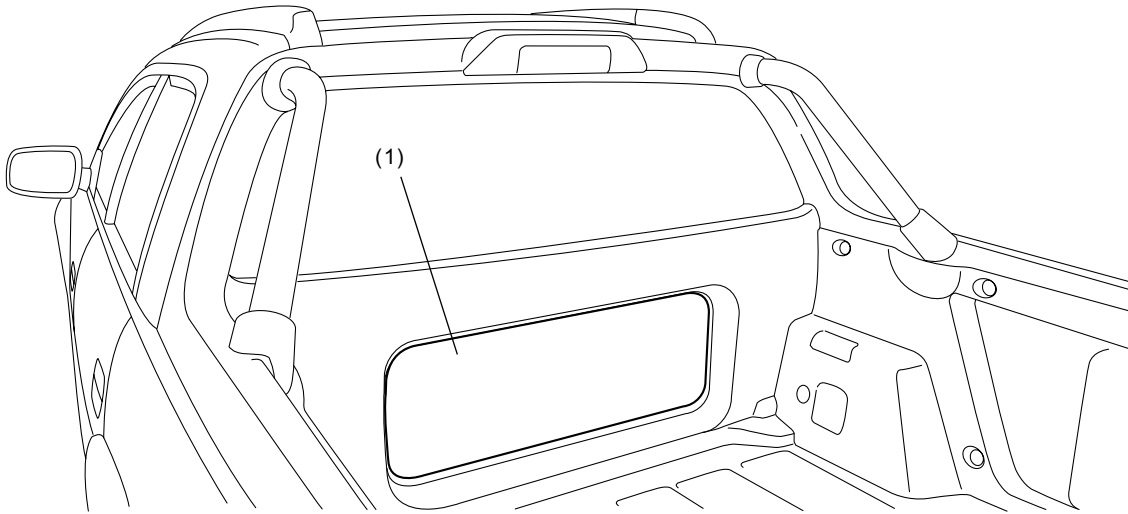
ENTERTAINMENT SYSTEM

MEMO

2. Baja

A: SWITCH BACK GATE

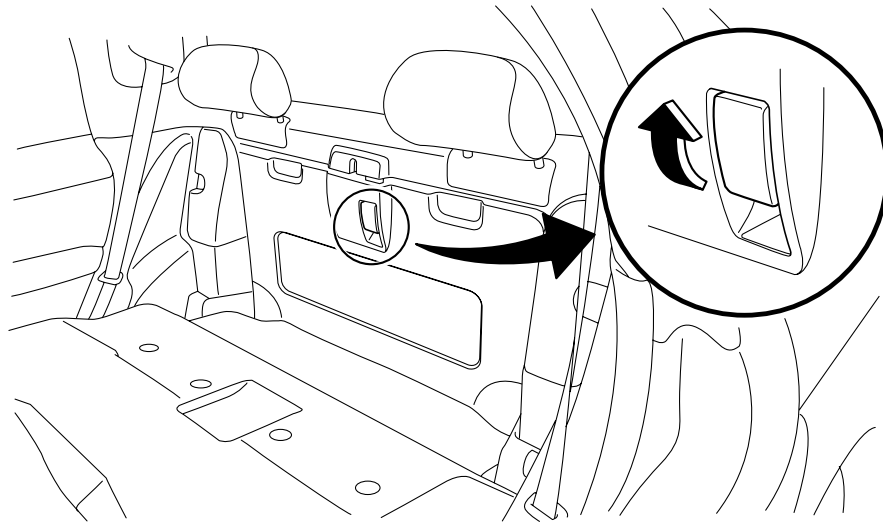
The bulkhead panel is equipped with a switch back gate.



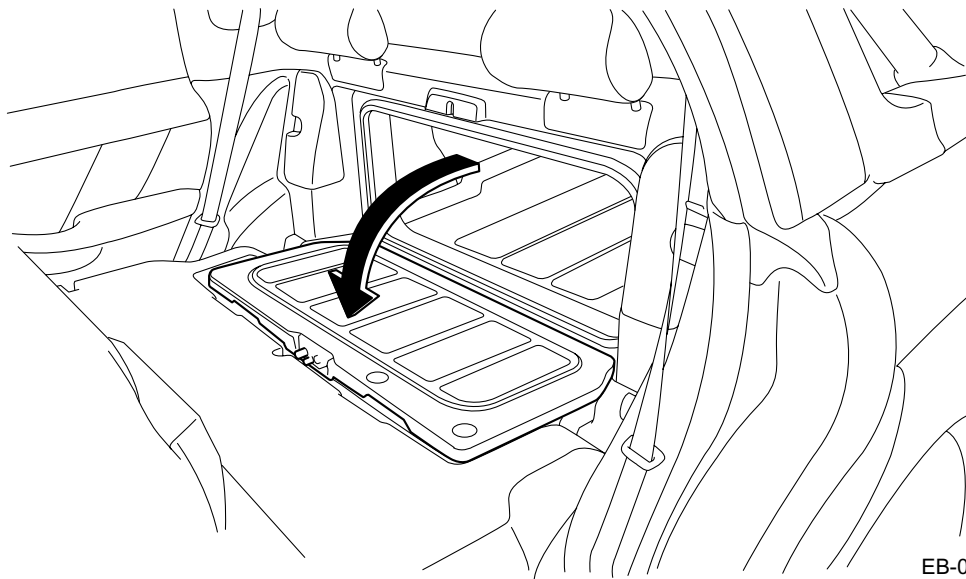
EB-00081

(1) Switch back gate

By opening the switch back gate the cargo bed and the cabin can be connected and this allows loading of long items.

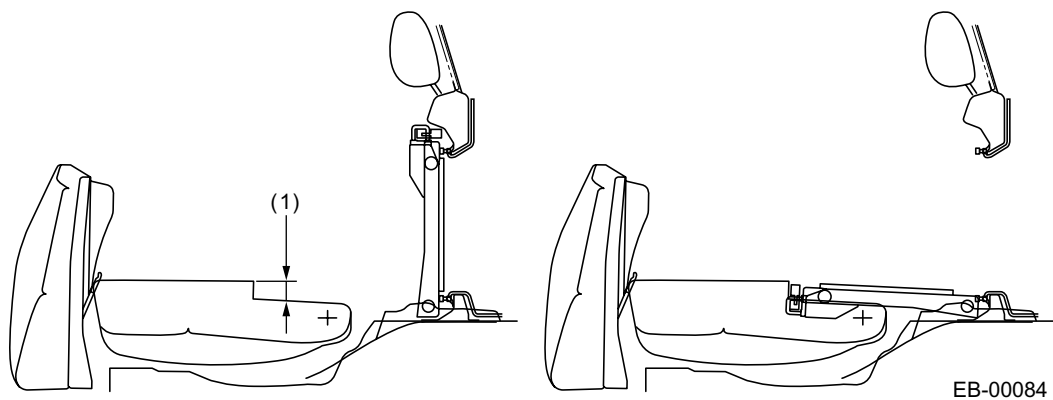


EB-00082



EB-00083

Releasing the switch back gate when double folding the rear seat will eliminate the unevenness in height at the rear of the rear seat backrest.



(1) Height unevenness

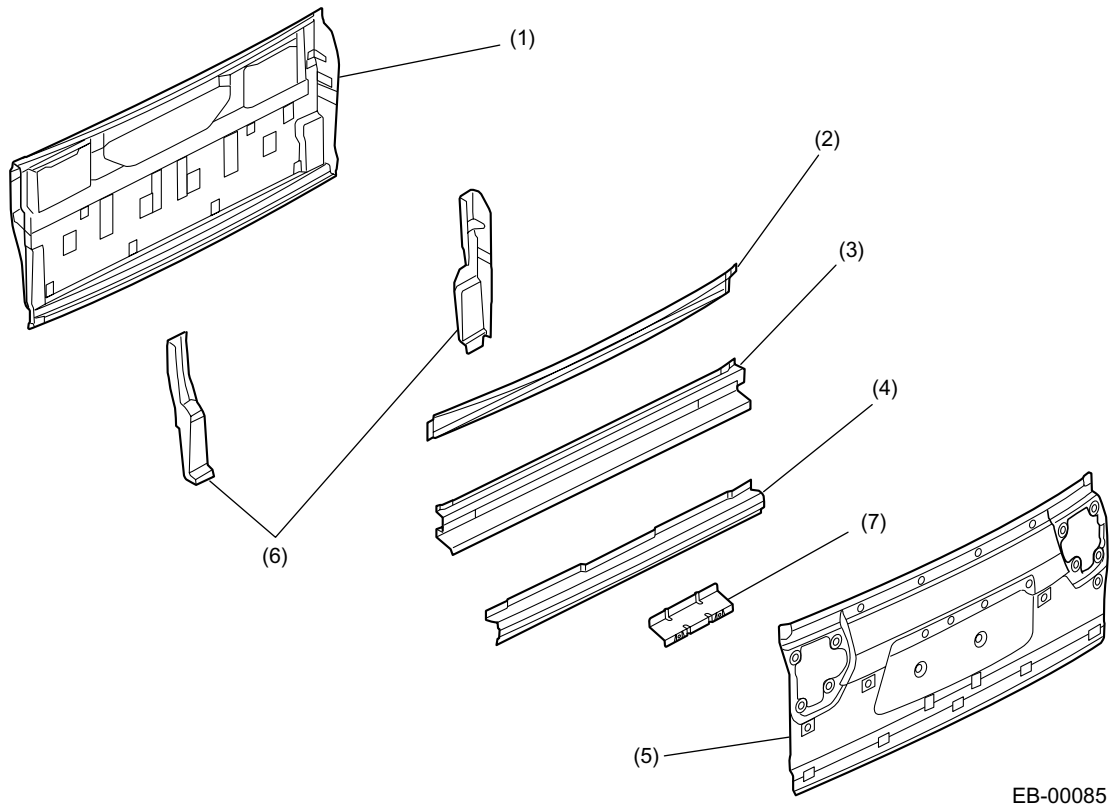
B: TAILGATE

1. CONSTRUCTION

Due to redesigning the vehicle's rear end to a cargo bed configuration, a newly designed tailgate is provided.

The tailgate panel assembly consists of 3 reinforcements, left and right reinforcing side brackets, reinforcement which connects the center reinforcement and outer panel, and front and rear tailgate panels.

The reinforcement assembly inside the tailgate contributes to enhance sturdiness of tailgate panels.

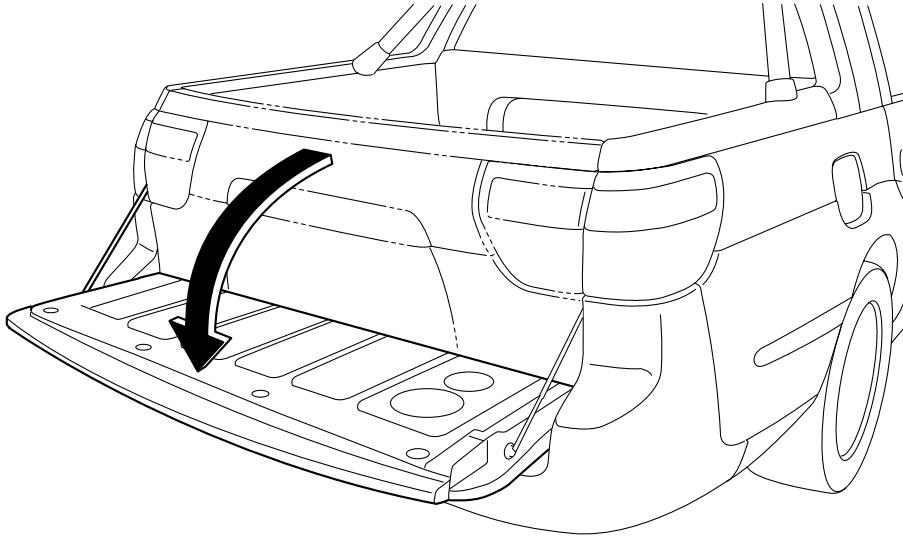


- (1) Tailgate inner panel
- (2) Tail gate upper reinforcement
- (3) Tailgate center reinforcement
- (4) Tailgate lower reinforcement

- (5) Tailgate outer panel
- (6) Tailgate reinforcing side bracket
- (7) Tailgate center outer reinforcement

2. OPERATION

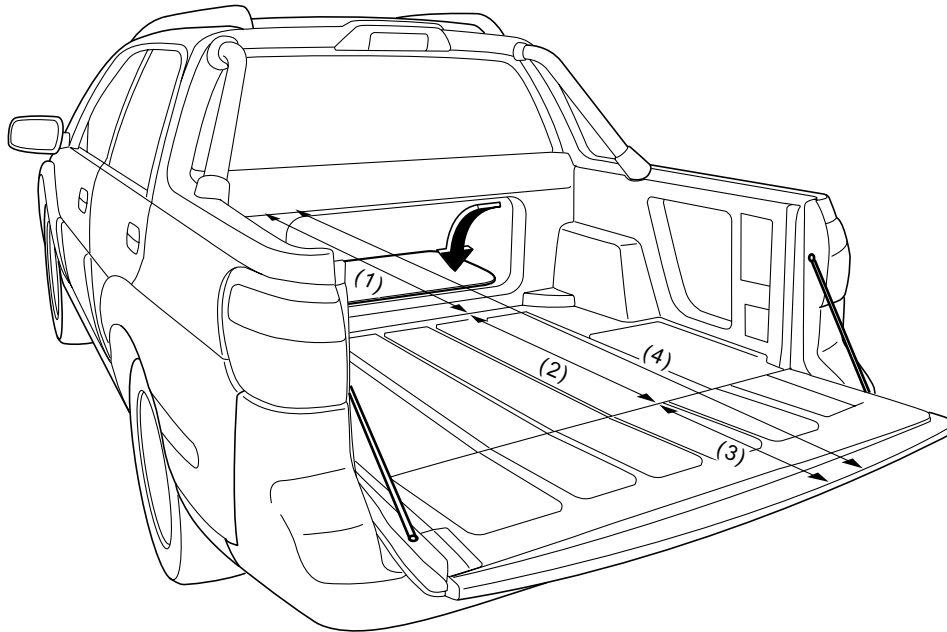
The tailgate will open until it is almost flat with the cargo bed.



EB-00086

3. DIMENSIONS

The depth of the cargo bed is normally 1050 mm (41.3 in), however, it can be extended to 1550 mm (61.0 in) by opening the tailgate. Furthermore, it can be extended to the maximum dimension of 2270 mm (89.4 in) by releasing the switch back.



EB-00087

(1) 720 mm (28.3 in)

(2) 1050 mm (41.3 in)

(3) 500 mm (19.7 in)

(4) Max. 2270 mm (89.4 in)

MEMO

1. Front Suspension

A: GENERAL

The front suspension is a strut-type independent suspension, with cylindrical double-acting, oil-filled dampers and coil springs. The top of each strut assembly is attached to the body through a rubber cushion (strut mount). Used in combination with other rubber cushions, this rubber cushion effectively insulate vibration and shock and thus improves ride comfort. This type also maintains a wide distance between the upper and lower supporting points and makes adjustment of the caster unnecessary.

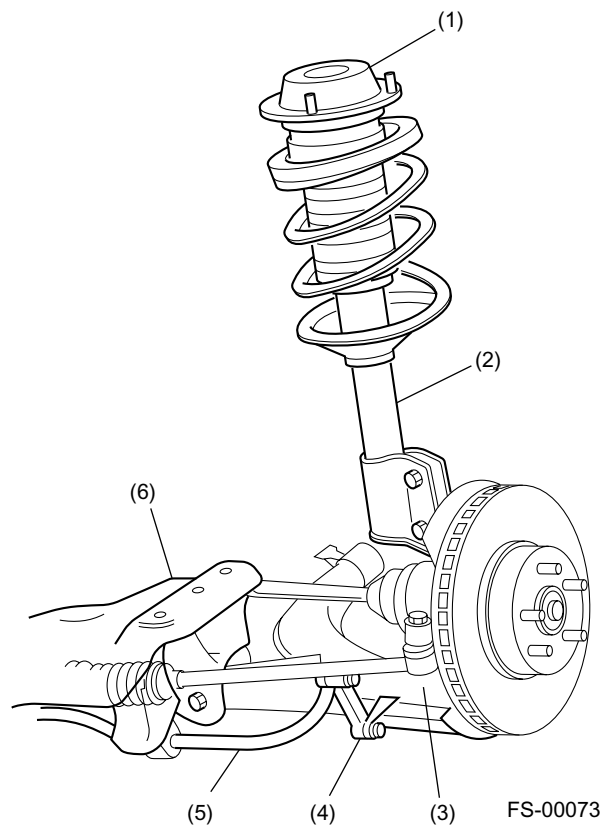
The transverse link is an “L” shaped arm design to increase steering stability and reduce road noise. The transverse link has a maintenance-free ball joint fitted by a castle nut at its outer end. The front of the link’s inner end is fitted to the front cross member through a rubber cushion and the rear of the inner end is bolted to the vehicle body through a fluid-filled bushing.

The front cross member is bolted to the vehicle body.

The stabilizer is attached to the front crossmember through rubber cushions and its right and left ends are connected to the stabilizer links through rubber bushings.

The lower end of the stabilizer link is connected to the transverse link through rubber bushings.

A camber angle adjustment mechanism, which uses eccentric bolts, is provided at the joint of the damper strut and axle housing.



- (1) Strut mount
- (2) Strut
- (3) Transverse link

- (4) Stabilizer link
- (5) Stabilizer
- (6) Front cross member

FRONT SUSPENSION

FRONT SUSPENSION

MEMO

2. Cooling Circuits

The cooling system operates in three different phases depending on the temperature of the engine coolant.

- 1st phase (thermostat closed)

When the engine coolant temperature is below 76°C (169°F), the thermostat remains closed. The coolant flows through the bypass and heater circuits. This permits the engine to warm up quickly.

- 2nd phase (thermostat open)

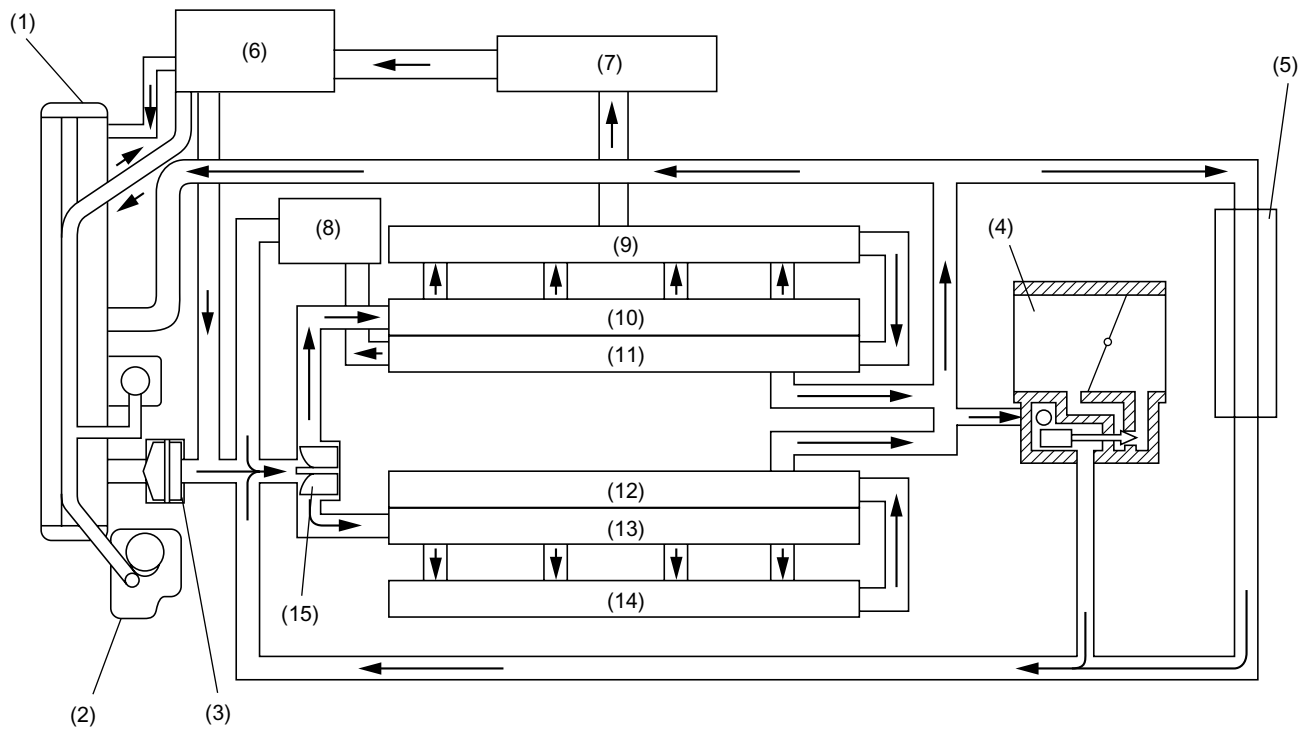
When the engine coolant temperature is above 76 — 80°C (169 — 176°F), the thermostat opens. The coolant flows through the radiator where it is cooled.

- 3rd phase (thermostat open and radiator fan operating)

When the engine coolant temperature sensor sends a signal indicating a temperature above 95°C (203°F) to the ECM, it causes the radiator fan (or fans) to operate. When the engine is stopped after high-speed operation, vapor produced in the turbocharger cooling section flows from the coolant filler tank to the reservoir tank where it condenses back into water. Water is then absorbed by the coolant filler tank as the engine cools down.

COOLING CIRCUITS

COOLING



CO-00287

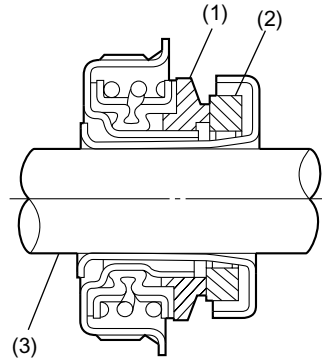
- | | |
|-----------------------------------|-------------------------|
| (1) Radiator | (9) Cylinder head RH |
| (2) Engine coolant reservoir tank | (10) Cylinder jacket RH |
| (3) Thermostat | (11) Cylinder block RH |
| (4) Throttle body | (12) Cylinder block LH |
| (5) Heater core | (13) Cylinder jacket LH |
| (6) Coolant filler tank | (14) Cylinder head LH |
| (7) Turbocharger | (15) Water pump |
| (8) Oil cooler (water cooled) | |

1. General

- The engine cooling system consists of a down-flow radiator which features high heat-dissipation performance, an electric-motor-driven fan, a water pump, a thermostat, and an engine coolant temperature sensor.
- The reservoir tank is made of translucent resin and enables easy confirmation of the coolant level. Also, coolant should be added to the reservoir tank when replenishment is necessary.
- The ECM controls the operation of the radiator main fan and sub fan depending on the signals from the engine coolant temperature sensor, vehicle speed sensor and A/C switch.

4. Mechanical Seal

The mechanical seal has its seat tightly fitted on the water pump shaft. Since it is a hermetic seal forming an integral part of the water pump, the water pump cannot be disassembled.

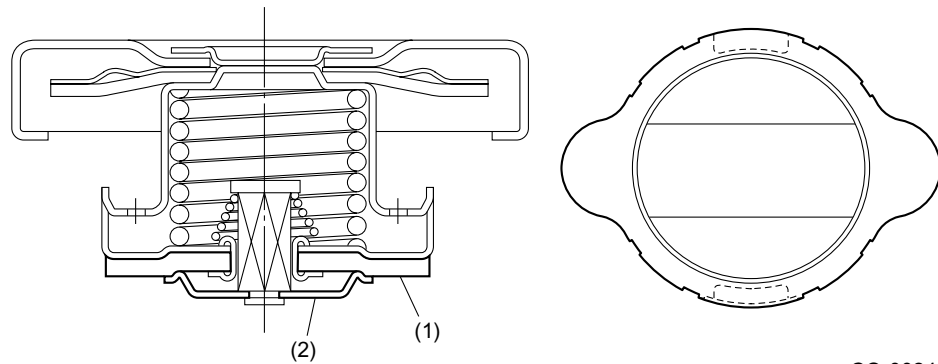


CO-00058

- (1) Carbon seal
- (2) Ceramics seat
- (3) Water pump shaft

7. Radiator Cap

The radiator cap at the coolant filler tank side has a pressure valve and a vacuum valve. When the radiator inner pressure becomes higher than specified, the pressure valve opens to send coolant to the reservoir tank. Also, when the radiator inner pressure becomes lower than the atmospheric pressure during the cooling down phase, the vacuum valve opens to send back coolant from the reservoir tank to the radiator. These functions prevent damage to the radiator components.



CO-00245

- (1) Pressure valve
- (2) Vacuum valve

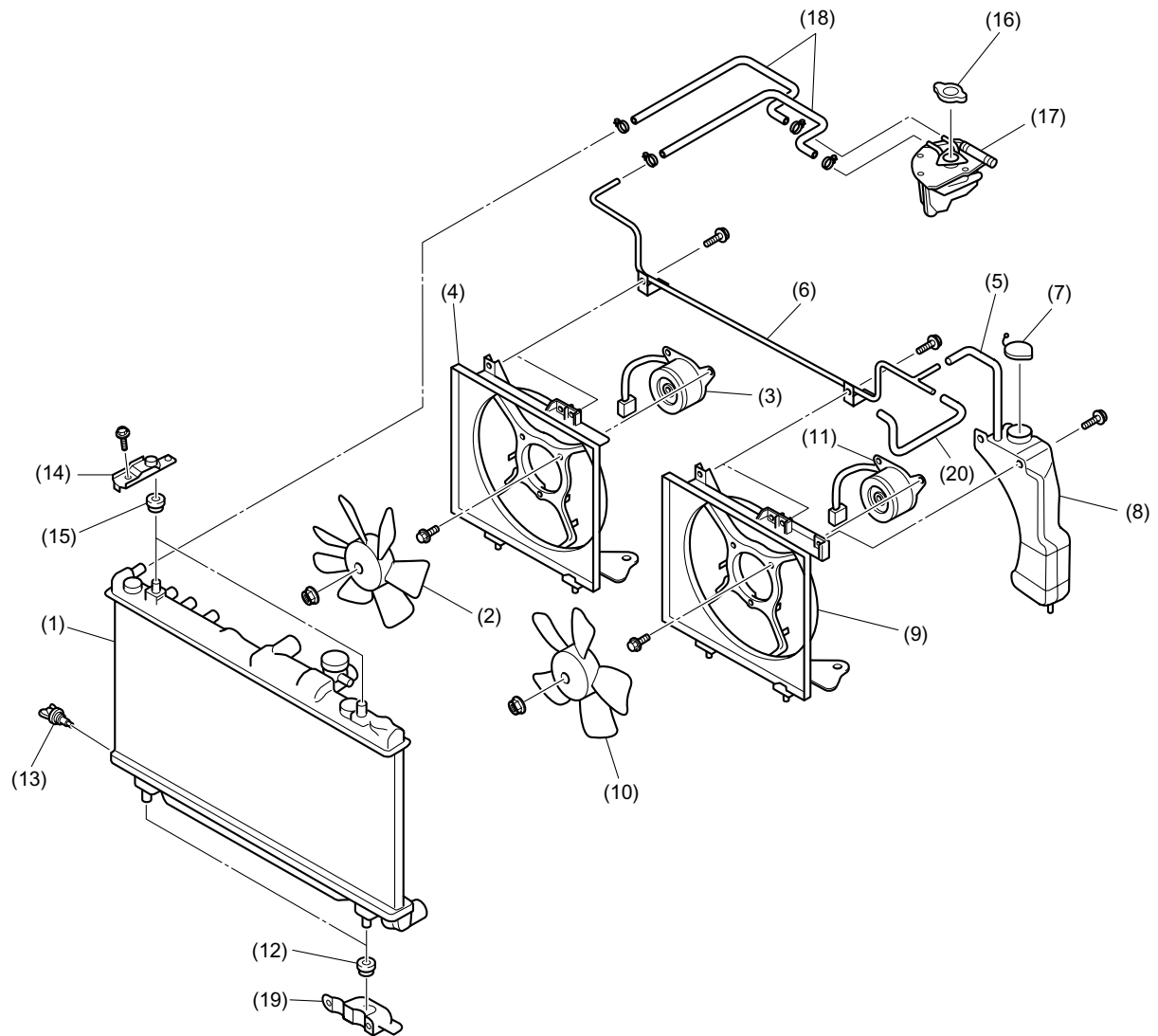
6. Radiator Fan

A: DESCRIPTION

Each radiator fan is made of plastic. It is driven by an electric motor which is retained on a shroud.

RADIATOR FAN

COOLING



CO-00244

- | | |
|---|---|
| (1) Radiator | (12) Lower cushion |
| (2) Radiator sub fan (models with A/C) | (13) Drain plug |
| (3) Radiator sub fan motor (models with A/C) | (14) Upper bracket |
| (4) Radiator sub fan shroud (models with A/C) | (15) Upper cushion |
| (5) Overflow hose (A) | (16) Radiator cap (coolant filler tank cap) |
| (6) Overflow pipe | (17) Coolant filler tank |
| (7) Reservoir tank cap | (18) Coolant hose |
| (8) Reservoir tank | (19) Lower bracket |
| (9) Radiator main fan shroud | (20) Overflow hose (B) |
| (10) Radiator main fan | |
| (11) Radiator main fan motor | |

A/C: Air conditioning system

RADIATOR FAN

COOLING

B: FUNCTION

To reduce fan noise, the electric radiator fan control switches the fan speed to Low or High in accordance with the ECM's decision based on conditions such as engine coolant temperature, vehicle speed, and A/C load signals.

To switch the fan speed to Low or High, the circuit connects two motors in series (Low speed) or parallel (High speed).

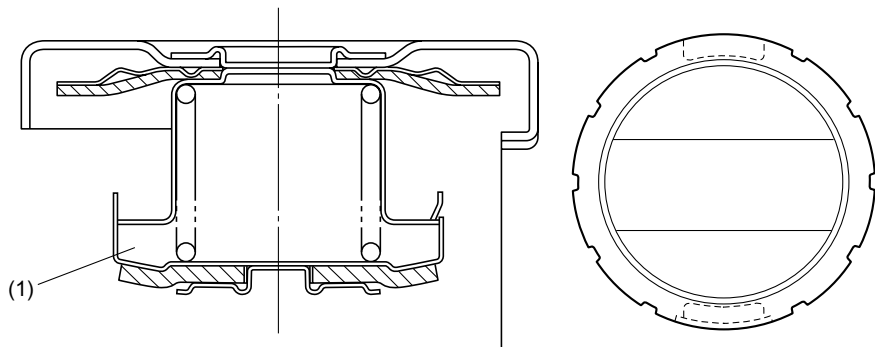
Vehicle speed	A/C compressor load	Engine coolant temperature		
		Below 95°C (203°F)	Between 96 and 99°C (203 and 210°F)	Over 100°C (212°F)
		Operation of radiator fans	Operation of radiator fans	Operation of radiator fans
Below 19 km/h (12 MPH)	OFF	OFF	Low-speed	High-speed
	Low	Low-speed	Low-speed	High-speed
	High	High-speed	High-speed	High-speed
Between 20 and 69 km/h (12 and 43 MPH)	OFF	OFF	Low-speed	High-speed
	Low	High-speed	High-speed	High-speed
	High	High-speed	High-speed	High-speed
Between 70 and 105 km/h (43 and 65 MPH)	OFF	OFF	Low-speed	High-speed
	Low	OFF	Low-speed	High-speed
	High	Low-speed	High-speed	High-speed
Over 106 km/h (66 MPH)	OFF	OFF	OFF	High-speed
	Low	OFF	Low-speed	High-speed
	High	OFF	Low-speed	High-speed

8. Relief Valve Cap

The relief valve cap at the radiator side has a pressure valve. When the radiator inner pressure becomes higher than specified, the pressure valve opens to send coolant to the reservoir tank. This function prevents damage to the radiator components.

CAUTION:

Due to the difference in construction, the relief valve cap cannot be used in place of the radiator cap at the coolant filler tank side. If the relief valve cap is fit on the coolant filler tank, overheating may occur.

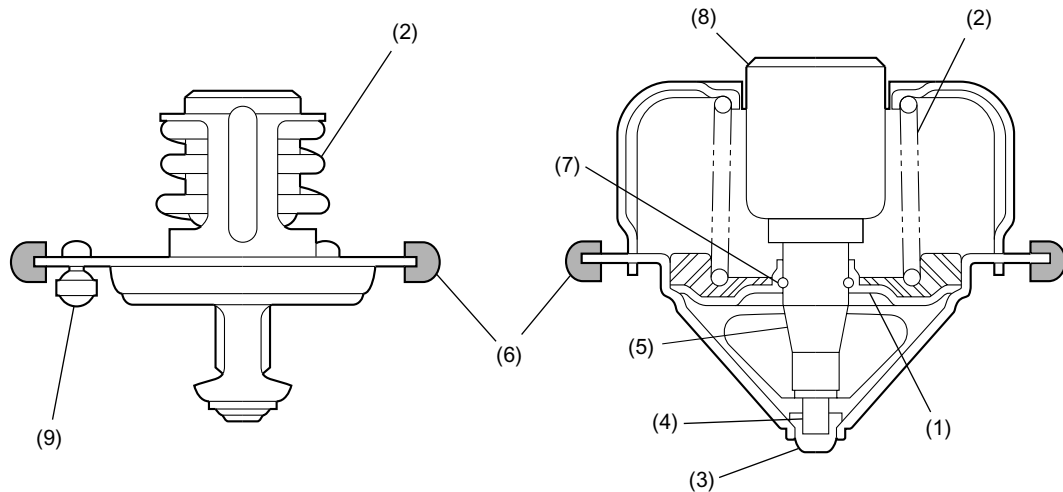


CO-00246

(1) Pressure valve

5. Thermostat

The thermostat has a totally-enclosed wax pellet which expands as the coolant temperature increases. It opens and closes accurately at the preset temperatures and features high durability.

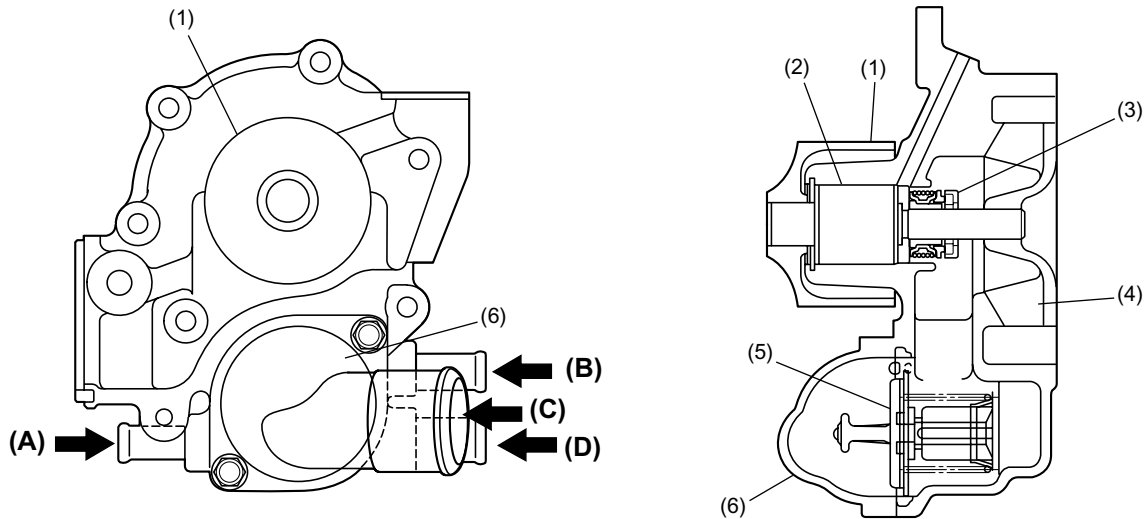


CO-00059

- | | | |
|-------------|--------------------|------------------|
| (1) Valve | (4) Piston | (7) Stop ring |
| (2) Spring | (5) Guide | (8) Wax element |
| (3) Stopper | (6) Rubber packing | (9) Jiggle valve |

3. Water Pump

The water pump is located in the front portion of the left bank cylinder block and is driven by the engine through the timing belt. The thermostat is fitted into the coolant inlet at the bottom of the water pump. When the pump impeller rotates, the coolant is drawn into the pump from the lower pipe (which is connected to the radiator hose) via the thermostat. It then flows along the perimeter of the impeller and then is discharged for circulation through a circuit depending on the coolant temperature.



CO-00068

- (A) From engine oil cooler
- (B) From water tank
- (C) From radiator
- (D) From heater

- (1) Pulley
- (2) Ball and roller bearing
- (3) Mechanical seal
- (4) Impeller
- (5) Thermostat
- (6) Thermostat cover

AIR/FUEL (A/F) CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

5. Air/fuel (A/F) Control System

- The air/fuel (A/F) control system makes a correction to the basic fuel injection duration in accordance with the signals from the front oxygen (A/F) sensor and the rear oxygen sensor so that the stoichiometric ratio is maintained, thus ensuring most effective exhaust gas purification by the three-way catalytic converter. Different basic fuel injection durations are preset for various engine speeds and loads, as well as the amount of intake air.
- This system also has a learning control function which stores the corrected data in relation to the basic fuel injection in the memory map. This allows an appropriate air-fuel ratio correction to be added automatically in quick response to any situation that requires such an effect. Thus, the air-fuel ratio is optimally maintained under various conditions while purifying exhaust gases most effectively, improving driving performance and compensating for changes in sensors' performance over time.

4. Catalytic Converter

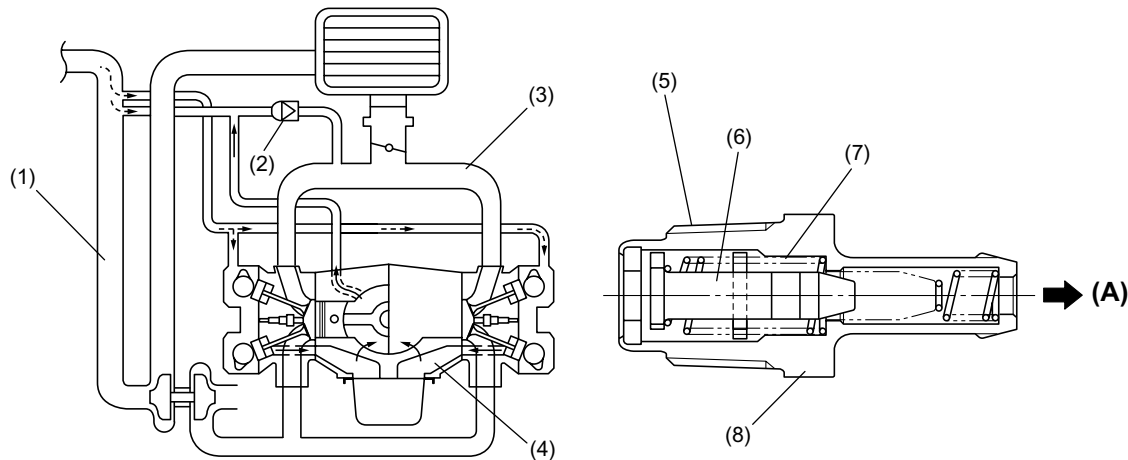
- The basic materials of the three-way catalytic converter are platinum (Pt), rhodium (Rh) and palladium (Pd), and a thin coat of their mixture is applied onto a honeycomb or porous ceramic (carrier). To avoid damaging the catalytic converter, only unleaded gasoline should be used.
- The catalytic converter reduces HC, CO and NO_x in exhaust gases through chemical reactions (oxidation and reduction). These harmful components are reduced most efficiently when their concentrations are in a certain balance. These concentrations vary with the air-fuel ratio. The ideal air-fuel ratio for reduction of these components is the stoichiometric ratio.
- Therefore, the air-fuel ratio needs to be controlled to around the stoichiometric ratio to purify the exhaust gases most efficiently.

CRANKCASE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

3. Crankcase Emission Control System

- The positive crankcase ventilation (PCV) system prevents air pollution which will be caused by blow-by gas being emitted from the crankcase.
The system consists of a sealed oil filler cap, rocker covers with fresh air inlet, connecting hoses, a PCV valve and an air intake duct.
- In a part-throttle condition, the blow-by gas in the crankcase flows into the intake manifold through the connecting hose of crankcase and PCV valve by the strong vacuum created in the intake manifold. Under this condition, fresh air is introduced into the crankcase through the connecting hose of the rocker cover.
- In a wide-open-throttle condition, a part of blow-by gas flows into the air intake duct through the connecting hose and is drawn into the throttle chamber, because under this is condition, the intake manifold vacuum is not strong enough to introduce through the PCV valve all blow-by gases that increase in the amount with engine speed.
- The PCV hose is provided with a leak detection function.



EC-02005

- (1) Intake duct
- (2) PCV valve
- (3) Intake manifold
- (4) Crankcase

- (5) Case
- (6) Valve
- (7) Spring
- (8) PCV valve

(A) To intake manifold

EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

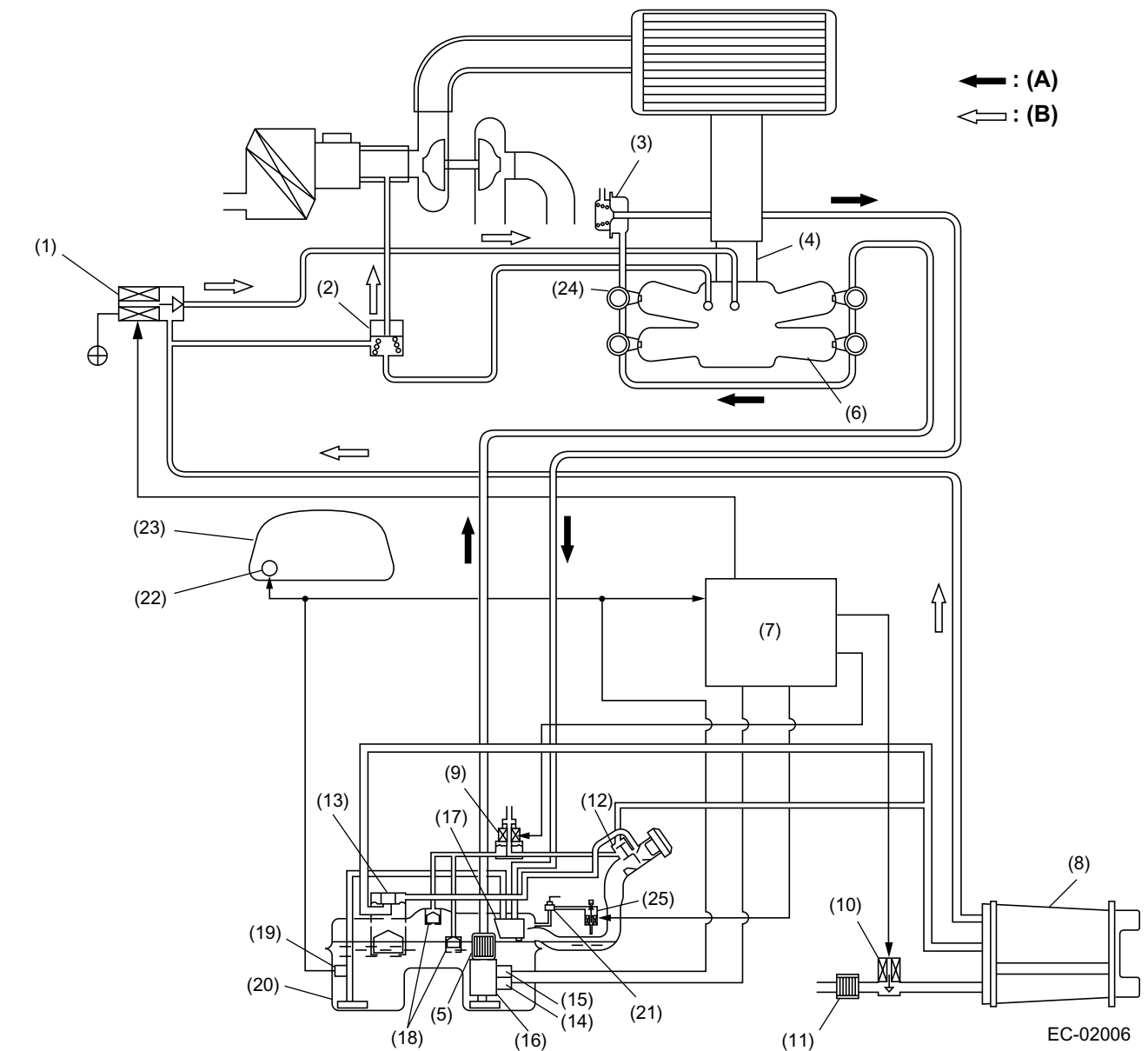
7. Evaporative Emission Control System

A: GENERAL

- The evaporative emission control system prevents fuel vapors from escaping into atmosphere. This system includes a canister, purge control solenoid valve, fuel cut valve, and the lines connecting them.
- Fuel vapors in the fuel tank is introduced into the canister through the evaporation line, and are absorbed by activated carbon in it. The fuel cut valve is also incorporated in the fuel tank line.
- The purge control solenoid valve is controlled optimally by the ECM according to the engine condition.
- The pressure control solenoid valve incorporated in the fuel tank evaporation line regulates the pressure/vacuum in the fuel tank under the control of the ECM which uses the signal from the fuel tank pressure sensor.
- The diagnosis of the evaporative emission control system is performed by turning each solenoid valve ON/OFF to vary the pressure inside the fuel tank and measure this pressure change with the fuel tank pressure sensor in order to check for leaks and proper valve operation.

EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)



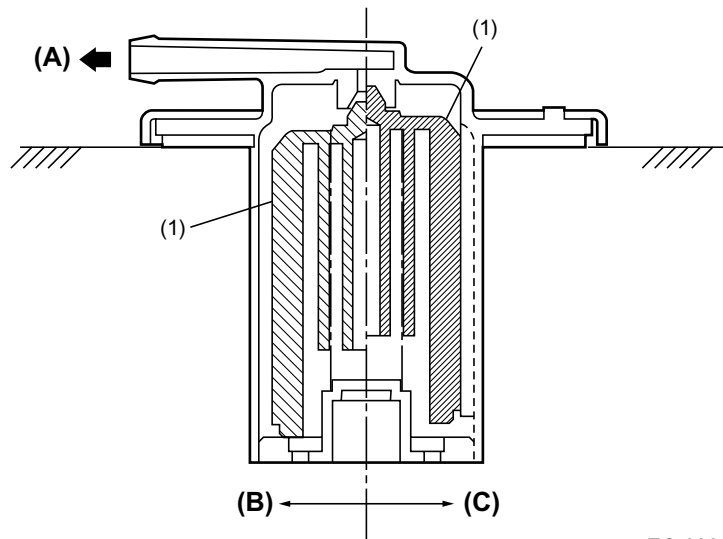
- | | | |
|-------------------------------------|------------------------------|-------------------------------------|
| (1) Purge control solenoid valve | (11) Drain filter | (21) Fuel tank pressure sensor |
| (2) Purge valve | (12) Shut-off valve | (22) Fuel gauge |
| (3) Pressure regulator | (13) Vent valve | (23) Combination meter |
| (4) Throttle valve | (14) Fuel temperature sensor | (24) Fuel injector |
| (5) Fuel filter | (15) Fuel level sensor | (25) Fuel tank sensor control valve |
| (6) Intake manifold | (16) Fuel pump | |
| (7) ECM | (17) Jet pump | (A) Fuel line |
| (8) Canister | (18) Fuel cut valve | (B) Fuel evaporation line |
| (9) Pressure control solenoid valve | (19) Fuel sub level sensor | |
| (10) Drain valve | (20) Fuel tank | |

EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

B: FUEL CUT VALVE

The fuel cut valve is built onto the evaporation pipe of the fuel tank. The rising level of the fuel in the fuel tank causes the float to move up and close the cap hole so that no fuel can enter the evaporation line.



EC-00022

(1) Float

(A) To canister

(B) Valve open

(C) Valve closed

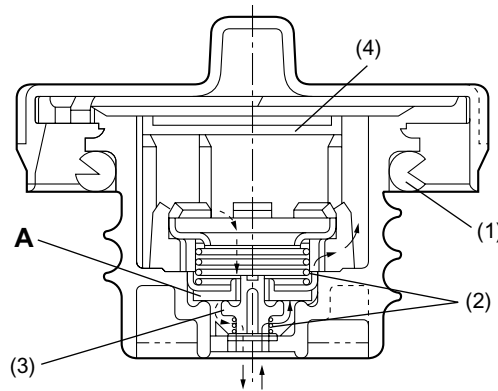
EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

C: FUEL TANK CAP

The fuel tank cap has a relief valve which prevents development of vacuum in the fuel tank in the event of a problem with the fuel vapor line.

When there is no problem with the fuel vapor line, the filler pipe is sealed at the portion (A) and by the seal pressed against the filler pipe end. If vacuum develops in the fuel tank, the atmospheric pressure forces the spring down to open the valve; consequently outside air flows into the fuel tank, thus controlling the inside pressure.



EC-00023

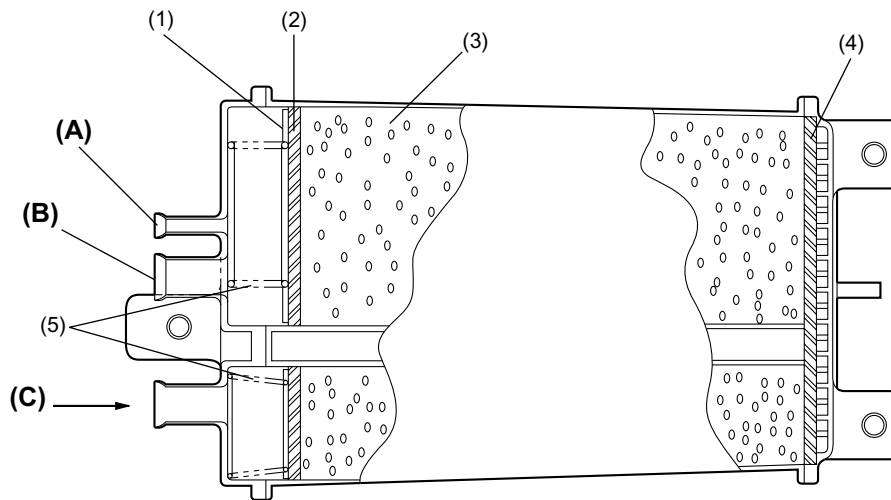
- (1) Seal
- (2) Spring
- (3) Valve
- (4) Filter

EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

D: CANISTER

The charcoal filled in the canister temporarily stores fuel vapors. When the purge control solenoid valve is opened by a signal from the ECM, the external fresh air entering the canister carries the fuel vapors into the collector chamber.



EC-00024

- (1) Grid
- (2) Filter
- (3) Activated charcoal
- (4) Filter
- (5) Spring

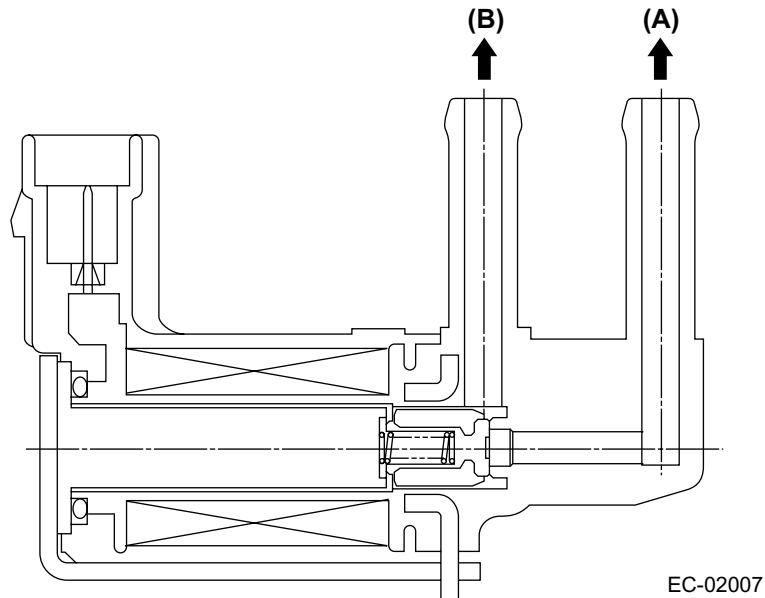
- (A) To purge control solenoid valve
- (B) From fuel tank
- (C) Air

EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

E: PURGE CONTROL SOLENOID VALVE

The purge control solenoid valve is on the evaporation line between the canister and intake manifold. The valve is installed under the intake manifold and lets the evaporative gas absorbed by the canister be drawn into the intake manifold.



- (A) To canister
- (B) To intake manifold

EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

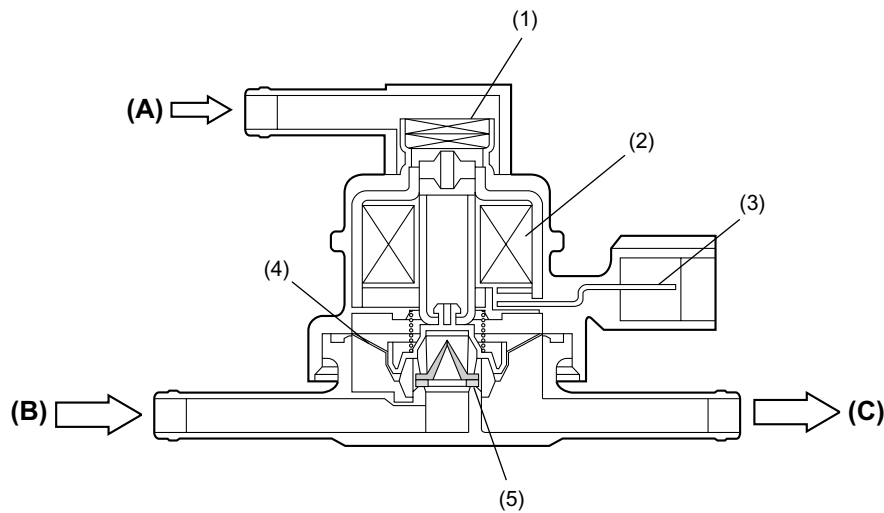
F: PRESSURE CONTROL SOLENOID VALVE

The fuel tank pressure control solenoid valve is located in the evaporation line between the canister and the fuel tank. It adjusts the fuel tank inside pressure under the control of the ECM.

When the tank inside pressure becomes higher than the atmospheric pressure, the valve is opened allowing fuel vapors to be introduced into the canister.

On the other hand, when the tank inside pressure becomes lower than the atmospheric pressure, external air is taken through the drain valve into the canister.

The pressure control solenoid valve can also be electrically closed for diagnosis of the evaporative emission control system.



EC-00026

- (1) Filter
- (2) Coil
- (3) Connector terminal
- (4) Diaphragm
- (5) Valve

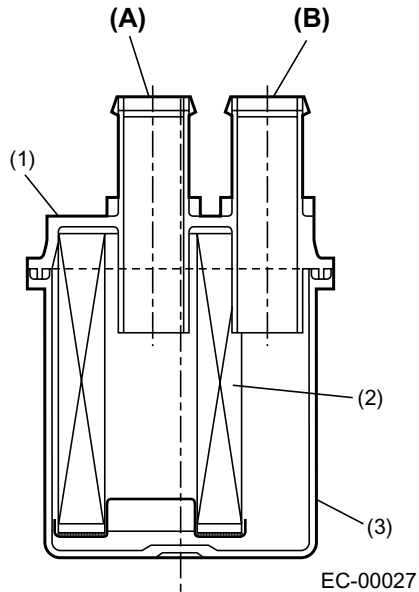
- (A) Atmospheric pressure
- (B) Shut-off valve
- (C) To fuel tank

EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

G: DRAIN FILTER

The drain filter is installed at the air inlet port of the vent control solenoid valve. It cleans the air taken in the canister through the vent control solenoid valve.



- (1) Cap
- (2) Element
- (3) Case

- (A) To drain valve
- (B) To atmosphere

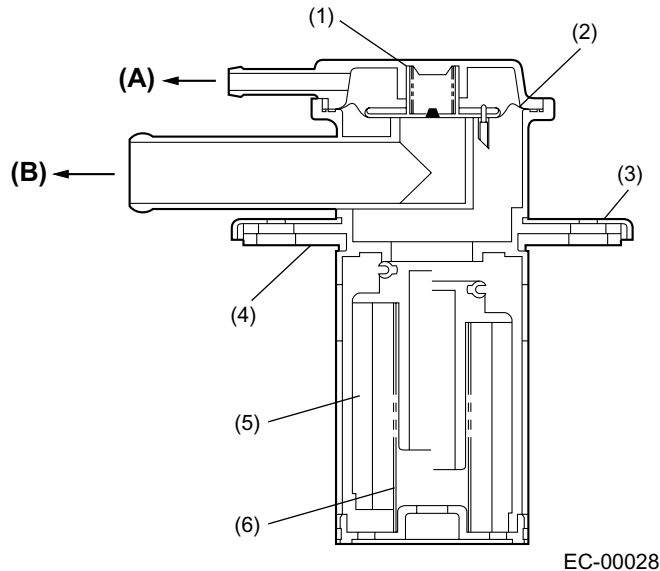
EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

H: VENT VALVE

The vent valve is located in the fuel tank. During filling the fuel tank, fuel vapors are introduced into the canister through the vent valve.

When the fuel vapor pressure becomes higher than the atmospheric pressure and overcomes the spring force which is applied to the back side of the diaphragm, the port toward the canister is opened. The vent valve also contains a float which closes the port toward the canister when the fuel level rises.



- (1) Spring
- (2) Diaphragm
- (3) Plate cover
- (4) Packing
- (5) Float
- (6) Float spring

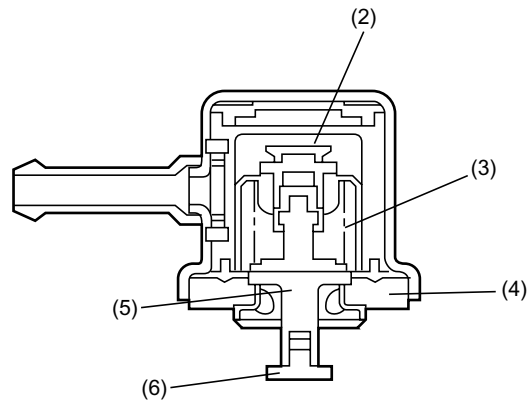
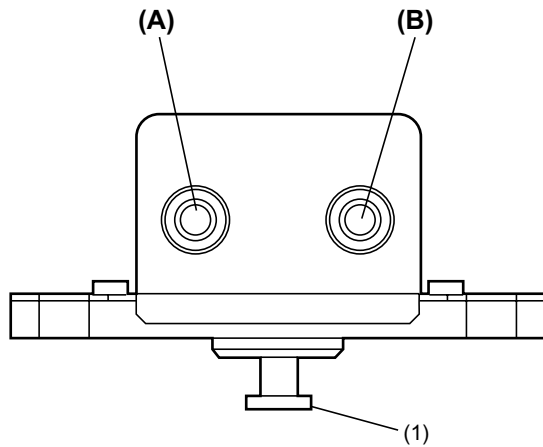
- (A) To filler pipe
- (B) To canister

EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

I: SHUT-OFF VALVE

The shut-off valve is located at the top of the fuel filler pipe. When a filler gun is inserted into the filler pipe, the shut-off valve closes the evaporation line.



EC-00029

- (1) Pin
- (2) Valve
- (3) Spring
- (4) Plate
- (5) Shaft
- (6) Pin

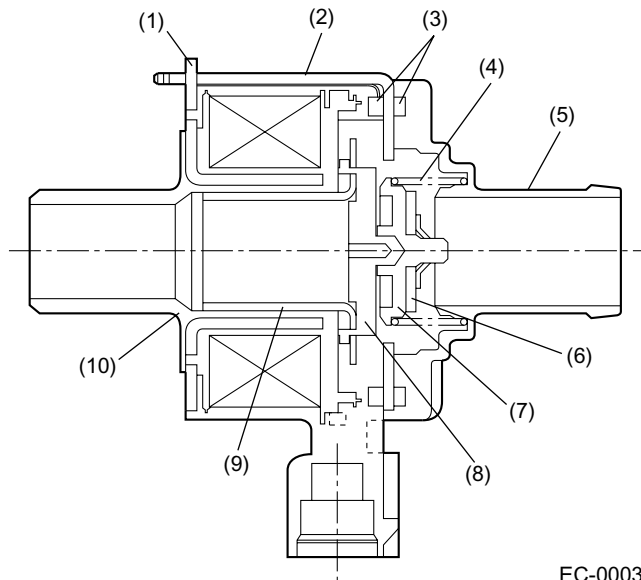
- (A) To canister
- (B) To fuel tank

EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

J: DRAIN VALVE

The drain valve is located on the line connecting the drain filter and canister, just below the drain filter. The drain valve is forcibly closed by a signal from the ECM while the evaporation system diagnosis is being conducted.



- | | |
|--------------------|-----------------|
| (1) Magnetic plate | (6) Valve |
| (2) Yoke | (7) Plate |
| (3) Packing | (8) Retainer |
| (4) Spring | (9) Moving core |
| (5) Valve seat | (10) Bobbin |

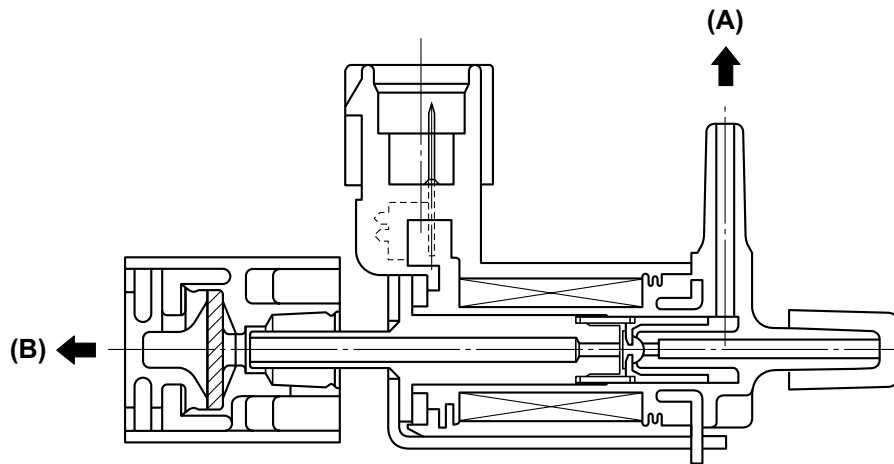
EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

K: FUEL TANK SENSOR CONTROL VALVE

The fuel tank sensor control valve is installed on the top of the fuel tank and its one end is connected to the fuel tank pressure sensor while its other end is open to the atmosphere.

Normally the passage to the fuel tank pressure sensor is open to the atmosphere, however, the passage is closed when the ECM sends a signal to make a diagnosis of the evaporative emission control system.



EC-00214

(A) Fuel tank pressure sensor

(B) Outside air

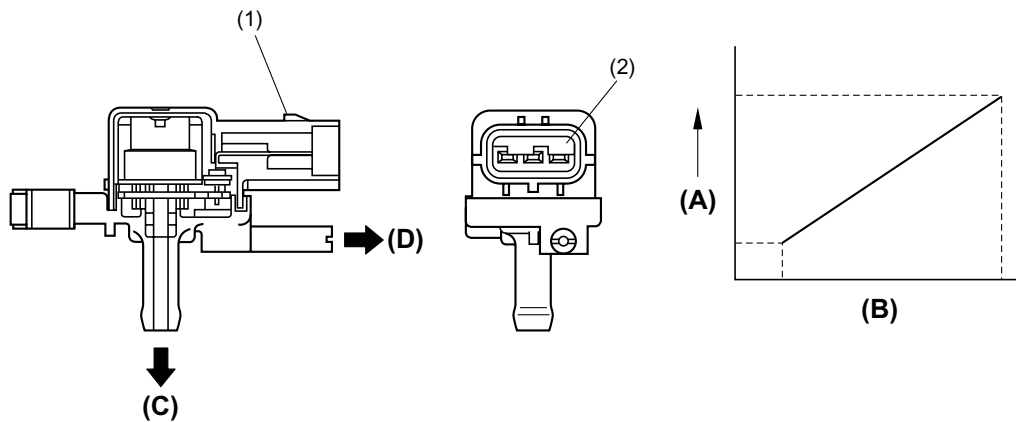
EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

L: FUEL TANK PRESSURE SENSOR

The fuel tank pressure sensor is installed on the top of the fuel tank and measures the pressure in the fuel tank.

The measured pressure is converted into an electrical signal and sent to the ECM for diagnosis of the evaporative emission control system.



EC-00213

- (1) Connector
- (2) Terminal

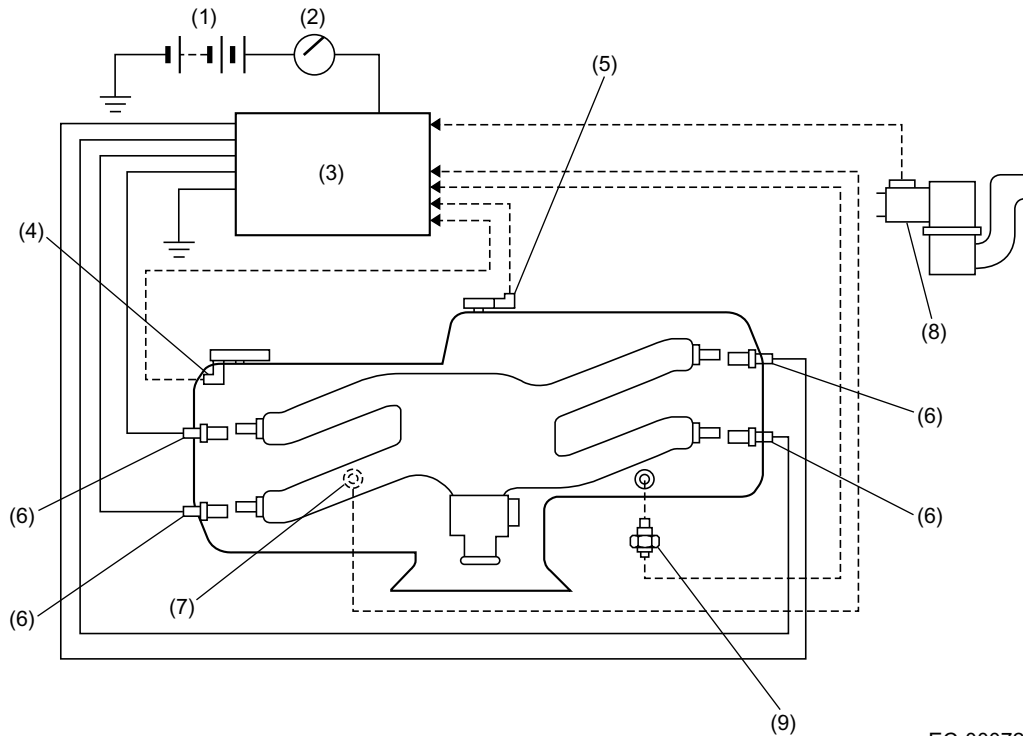
- (A) Output voltage
- (B) Input pressure
- (C) To fuel tank
- (D) To fuel tank sensor control valve

IGNITION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

6. Ignition Control System

- The ignition system is controlled by the ECM.
The ECM monitors the operating condition of the engine using the signals from the sensors and switches shown below and determines the ignition timing most appropriate for each engine operating condition. Then it sends a signal to the igniter, commanding generation of a spark at that timing.
- The ECM uses a preprogrammed map for a “closed-loop” control which provides its ignition timing control with excellent transient characteristics, i.e., highly responsive ignition timing control.



EC-00072

- | | |
|--------------------------------|---|
| (1) Battery | (6) Ignition coil and igniter assembly |
| (2) Ignition switch | (7) Knock sensor |
| (3) ECM | (8) Mass air flow and intake air temperature sensor |
| (4) Camshaft position sensor | (9) Engine coolant temperature sensor |
| (5) Crankshaft position sensor | |

8. On-board Refueling Vapor Rrecovery (ORVR) System

A: GENERAL

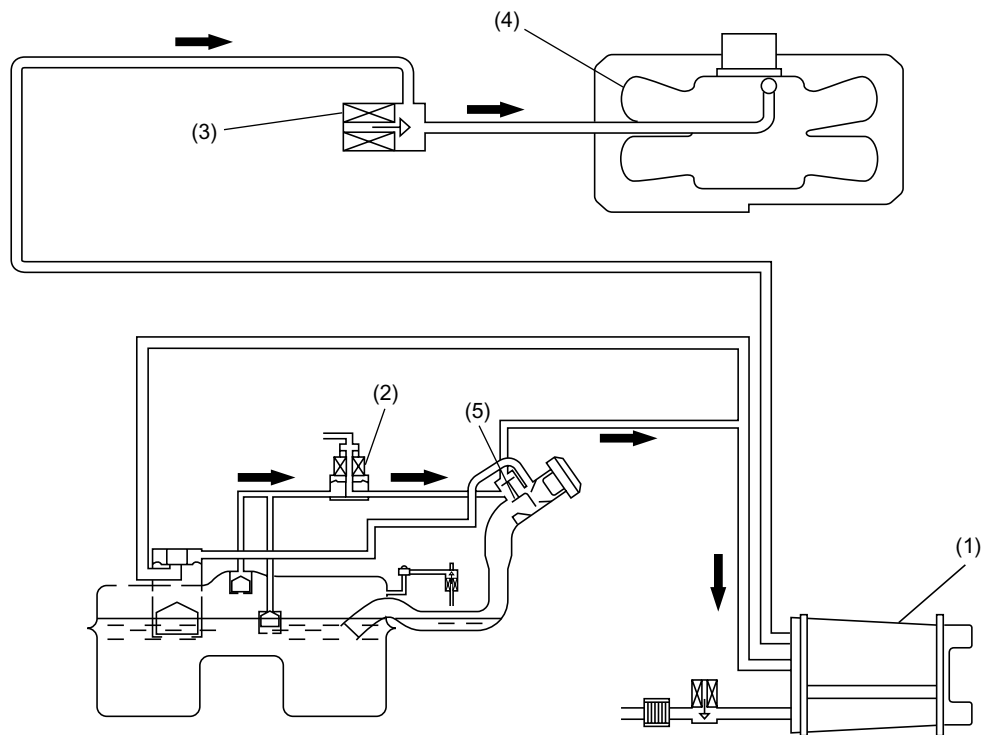
The on-board refueling vapor recovery system allows the fuel vapors in the fuel tank to be introduced directly into the canister through the vent valve when the fuel tank inside pressure increases as a result of refueling.

The diagnosis of the system is performed by monitoring the fuel tank inside pressure data from the fuel tank pressure sensor while forcibly closing the drain valve.

B: OPERATION

- While driving

Since the back side of the diaphragm in the pressure control solenoid valve is open to the atmosphere, the diaphragm is held pressed by the atmospheric pressure in the position where only the external air is introduced into the canister. When the fuel vapor pressure acting on the other side of the diaphragm increases and overcomes the atmospheric pressure, it pushes the diaphragm and opens the port through which the fuel vapors make their way to the canister.



EC-02008

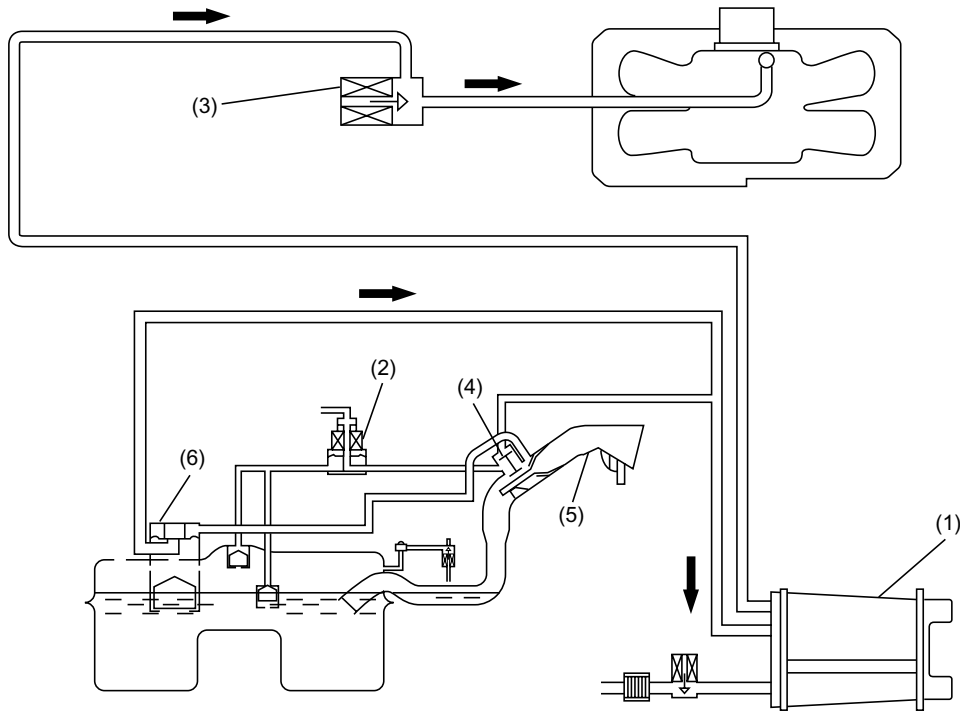
- | | |
|-------------------------------------|--------------------------|
| (1) Canister | (4) Intake manifold |
| (2) Pressure control solenoid valve | (5) Shut-off valve: open |
| (3) Purge control solenoid valve | |

ON-BOARD REFUELING VAPOR RECOVERY (ORVR) SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

- While refueling

As the fuel enters the fuel tank, the tank inside pressure increases. When the inside pressure becomes higher than the atmospheric pressure, the port of the vent valve opens, allowing the fuel vapors to be introduced into the canister through the vent line. The fuel vapors are absorbed by charcoal in the canister, so the air discharged from the drain valve contains no fuel. When a filler gun is inserted, the shut-off valve closes the evaporation line.



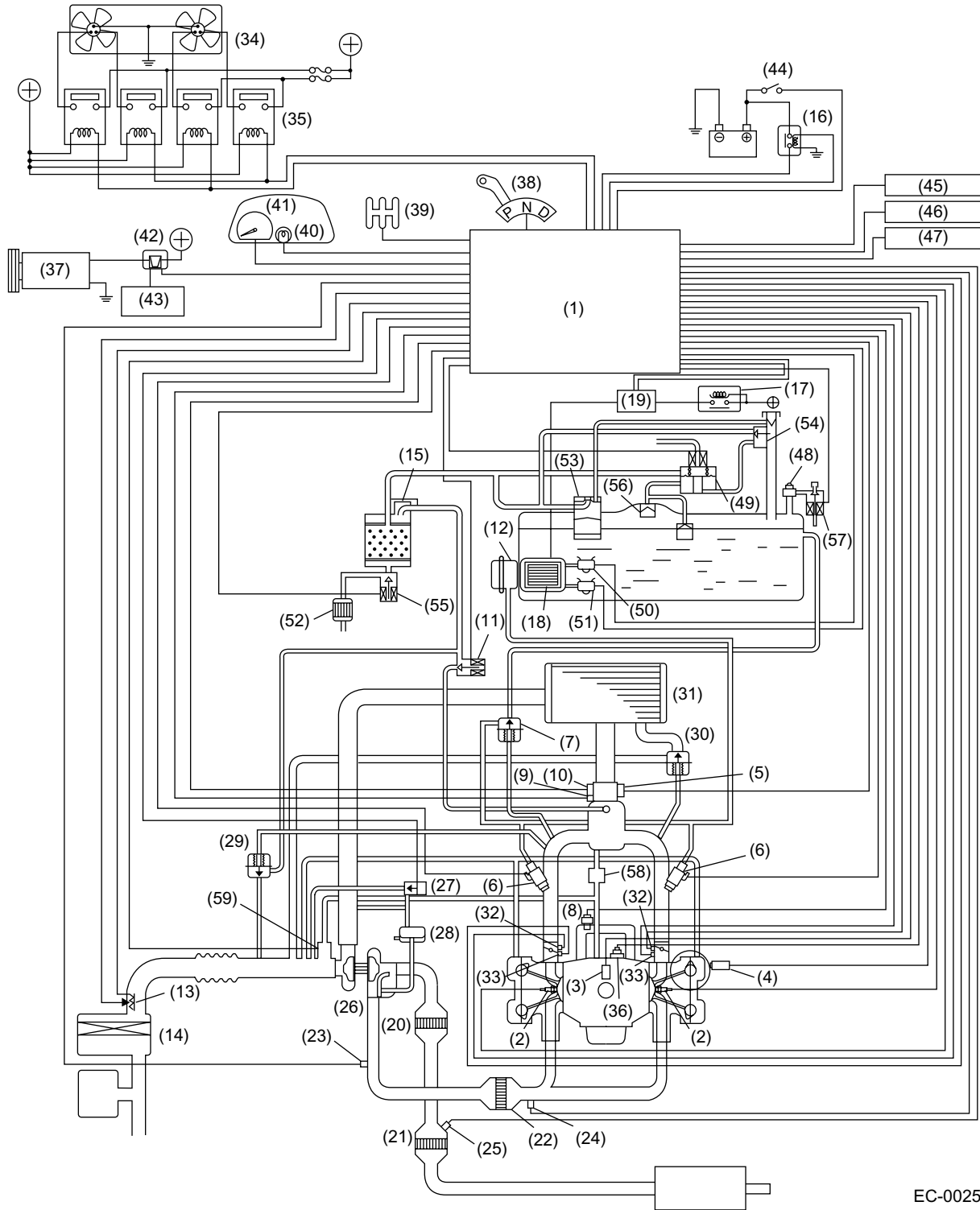
EC-02009

- | | |
|-------------------------------------|----------------------------|
| (1) Canister | (4) Shut-off valve: closed |
| (2) Pressure control solenoid valve | (5) Filler gun |
| (3) Vent valve | |

SCHEMATIC DIAGRAMS

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

2. Schematic Diagrams



EC-00259

SCHEMATIC DIAGRAMS

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

- | | |
|--|---|
| (1) Engine control module (ECM) | (31) Intercooler |
| (2) Ignition coil and igniter assembly | (32) Tumble generator valve position sensor |
| (3) Crankshaft position sensor | (33) Tumble generator valve actuator |
| (4) Camshaft position sensor | (34) Radiator fan |
| (5) Throttle position sensor | (35) Radiator fan relay |
| (6) Fuel injector | (36) Knock sensor |
| (7) Pressure regulator | (37) A/C compressor |
| (8) Engine coolant temperature sensor | (38) Inhibitor switch (AT models) |
| (9) Manifold absolute pressure sensor | (39) Neutral position switch (MT models) |
| (10) Idle air control solenoid valve | (40) Engine malfunction indicator light (MIL) |
| (11) Purge control solenoid valve | (41) Tachometer |
| (12) Fuel pump | (42) A/C relay |
| (13) Mass air flow and intake air temperature sensor | (43) A/C control module |
| (14) Air cleaner element | (44) Ignition switch |
| (15) Canister | (45) Transmission control module (TCM) |
| (16) Main relay | (46) Vehicle speed sensor |
| (17) Fuel pump relay | (47) Data link connector |
| (18) Fuel filter | (48) Fuel tank pressure sensor |
| (19) Fuel pump control unit | (49) Pressure control solenoid valve |
| (20) Front catalytic converter | (50) Fuel temperature sensor |
| (21) Rear catalytic converter | (51) Fuel level sensor |
| (22) Pre-catalytic converter | (52) Drain filter |
| (23) Exhaust temperature sensor | (53) Vent valve |
| (24) Front oxygen (A/F) sensor | (54) Shut-off valve |
| (25) Rear oxygen sensor | (55) Drain valve |
| (26) Turbocharger | (56) Fuel cut valve |
| (27) Wastegate control solenoid valve | (57) Fuel tank sensor control valve |
| (28) Wastegate controller | (58) PCV valve |
| (29) Purge valve | (59) PCV diagnosis connector |
| (30) Air bypass valve | |

SYSTEM OVERVIEW

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

1. System Overview

There are three emission control systems which are as follows:

- Crankcase emission control system
- Exhaust emission control system
 - Catalytic converter
 - Air/fuel (A/F) control system
 - Ignition control system
- Evaporative emission control system
 - On-board refueling vapor recovery (ORVR) system

SYSTEM OVERVIEW

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

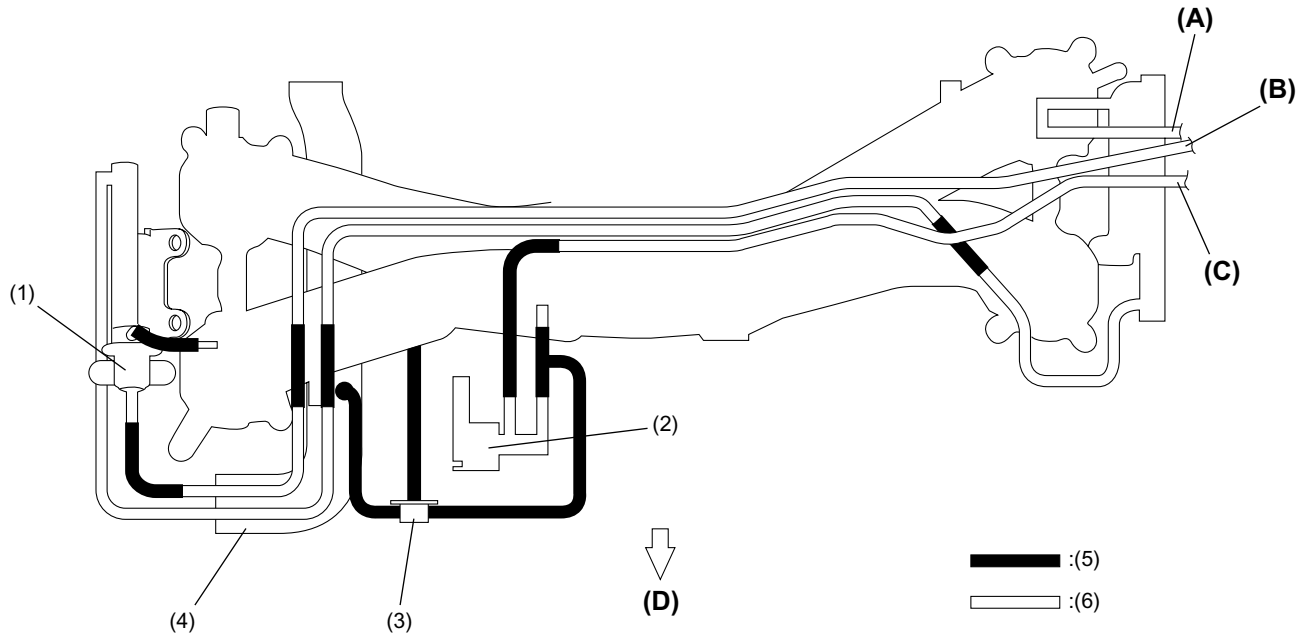
Item			Main components	Function
Crankcase emission control system			Positive crankcase ventilation (PCV) valve	Draws blow-by gas into intake manifold from crankcase and burns it together with air-fuel mixture. Amount of blow-by gas to be drawn in is controlled by intake manifold pressure.
Exhaust emission control system	Catalytic converter	Pre	Catalytic converter	Oxidizes HC and CO contained in exhaust gases as well as reducing NOx.
		Front		
		Rear		
	Air/fuel (A/F) control system		Engine control module (ECM)	Receives input signals from various sensors, compares signals with stored data, and emits a signal for optimal control of air-fuel mixture ratio.
			Front oxygen (A/F) sensor	Detects density of oxygen contained exhaust gases.
			Rear oxygen sensor	Detects density of oxygen contained in exhaust gases.
			Throttle position sensor	Detects throttle opening.
			Manifold absolute pressure sensor	Detects absolute pressure of intake manifold.
			Mass air flow and intake air temperature sensor	Detects amount of intake air.
				Detects intake air temperature at air cleaner case.
	Ignition control system		ECM	Receives various signals, compares signals with basic data stored in memory, and emits a signal for optimal control of ignition timing.
			Crankshaft position sensor	Detects engine speed (revolution).
			Camshaft position sensor	Detects reference signal for combustion cylinder discrimination.
			Engine coolant temperature sensor	Detects coolant temperature.
			Knock sensor	Detects engine knocking.
Evaporative emission control system			Canister	Absorbs evaporative gas which occurs in fuel tank when engine stops, and releases it to combustion chambers for a complete burn when engine is started. This prevents HC from being discharged into atmosphere.
			Purge control solenoid valve	Receives a signal from ECM and controls purge of evaporative gas absorbed by canister.
			Pressure control solenoid valve	Receives a signal from ECM and controls evaporative gas pressure in fuel tank.
ORVR system			Vent valve	Closes the port to the canister when the fuel tank is full of fuel.
			Drain valve	Closes the evaporation line by receiving a signal from ECM to check the evaporation gas leak.

VACUUM CONNECTIONS

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

9. Vacuum Connections

The hose and pipe connections of the intake manifold, throttle body and other related parts are as shown in the illustration.



EC-00212

- (1) Pressure regulator
- (2) Purge control solenoid valve
- (3) Purge valve
- (4) Intake duct
- (5) Hose
- (6) Pipe

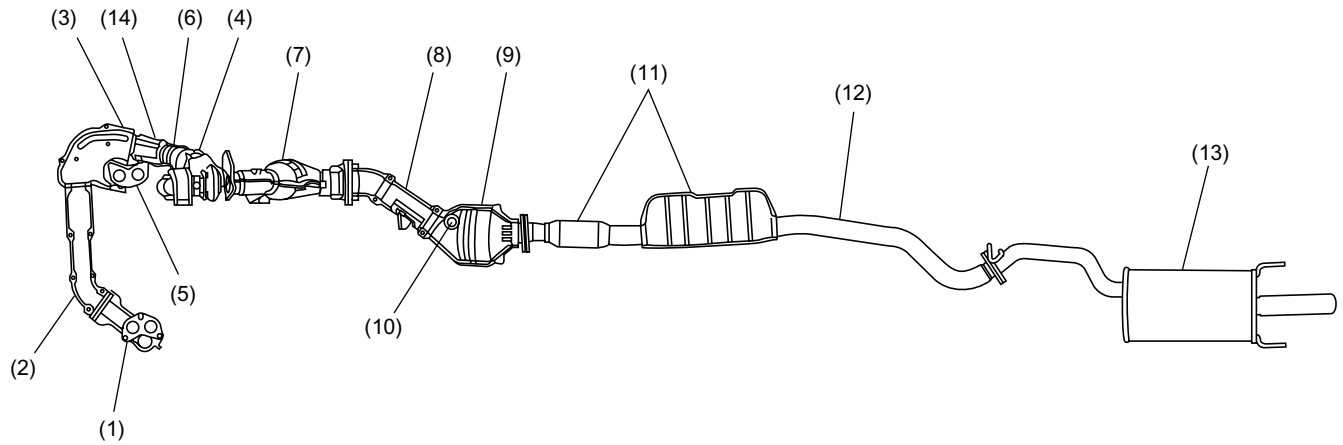
- (A) Delivery pipe
- (B) Return pipe
- (C) Evaporation pipe
- (D) Front of vehicle

VACUUM CONNECTIONS

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

MEMO

2. Construction



EX-00252

- | | |
|--------------------------------|------------------------------|
| (1) Exhaust manifold (LH) | (8) Center exhaust pipe |
| (2) Front joint pipe | (9) Rear catalytic converter |
| (3) Front oxygen (A/F) sensor | (10) Rear oxygen sensor |
| (4) Exhaust temperature sensor | (11) Chamber |
| (5) Exhaust manifold (RH) | (12) Rear exhaust pipe |
| (6) Pre-catalytic converter | (13) Muffler |
| (7) Front catalytic converter | (14) Turbocharger joint pipe |

CONSTRUCTION

EXHAUST

MEMO

1. General

- The exhaust system consists of left and right exhaust manifolds, a front joint pipe, a turbocharger joint pipe, a center exhaust pipe, a rear exhaust pipe and a muffler. The pre catalytic converter is incorporated in the turbocharger joint pipe, the front catalytic converter is incorporated in the center exhaust pipe, and the rear catalytic converter is incorporated in the rear exhaust pipe.
- The exhaust system features an excellent sound suppression design; the rear exhaust pipe has a chamber in addition to a large capacity muffler.

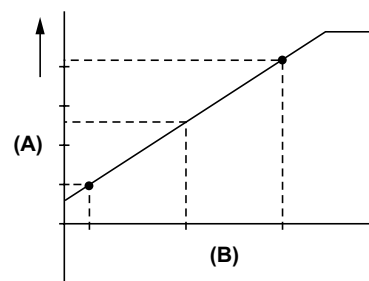
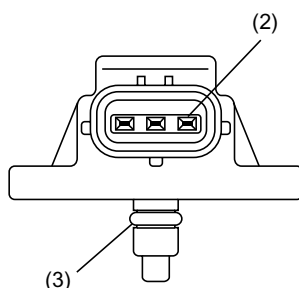
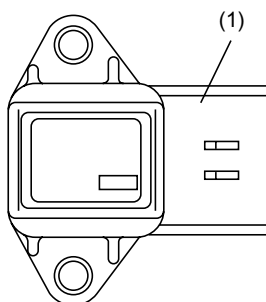
2. Air Line

A: GENERAL

The air filtered by the air cleaner enters the throttle body where it is regulated in the volume by the throttle valve and then enters the intake manifold. It is then distributed to each cylinder where the air is mixed with fuel injected by the injector.

B: MANIFOLD ABSOLUTE PRESSURE SENSOR

The manifold absolute pressure sensor is attached to the top of the throttle body, and continuously sends to the engine control module (ECM) voltage signals that are proportional to intake manifold absolute pressures. The ECM controls the fuel injection and ignition timing based on the intake manifold absolute pressure signals in addition to other signals from many sensors and other control modules.



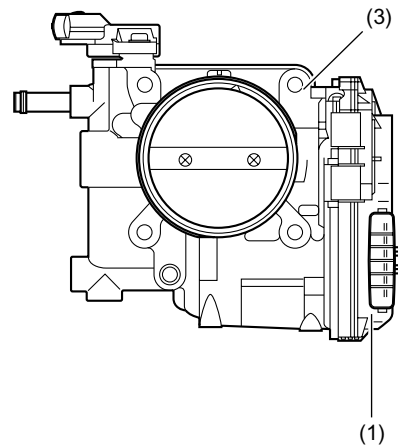
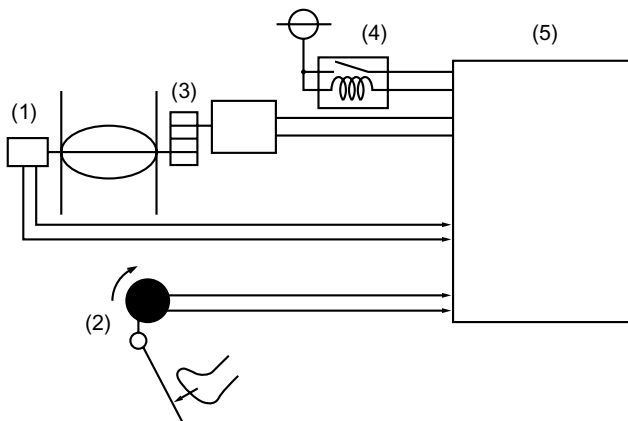
FU-00343

- (1) Connector
- (2) Terminal
- (3) O-ring

- (A) Output voltage
- (B) Absolute pressure

C: ELECTRONIC CONTROL THROTTLE SYSTEM

- The electronic control throttle system consists of an accelerator pedal position sensor mounted on the accelerator pedal, a throttle position sensor and a throttle motor mounted on the throttle body, and the ECM which controls these devices.
- The movement of the accelerator pedal is converted into electrical signals by the accelerator pedal position sensor and sent to the ECM. Based on these signals the ECM controls the throttle motor to open and close the throttle valve.
- Idling control is now performed by the electronic control throttle system in place of the idle air control solenoid valve.



FU-01069

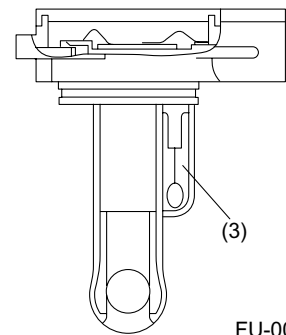
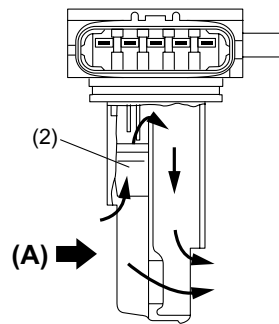
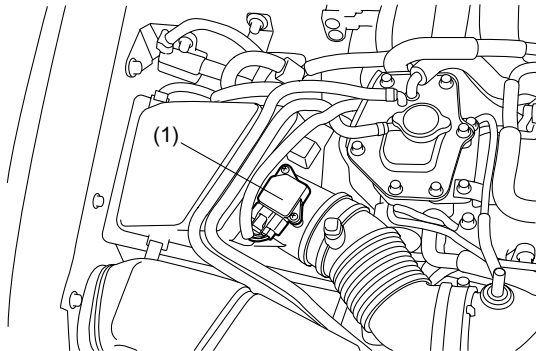
- (1) Throttle position sensor
- (2) Accelerator pedal position sensor
- (3) Electronic control throttle assembly

- (4) Electronic control throttle relay
- (5) ECM

D: MASS AIR FLOW AND INTAKE AIR TEMPERATURE SENSOR

The mass air flow and the intake air temperature sensors are integrated into a single unit. The unit is mounted on the air cleaner case and measures the amount as well as the temperature of the intake air.

The measured amount and temperature are converted into electrical signals and sent to the ECM. The ECM uses these signals to control injection and ignition timing as well as the fuel injection amount.



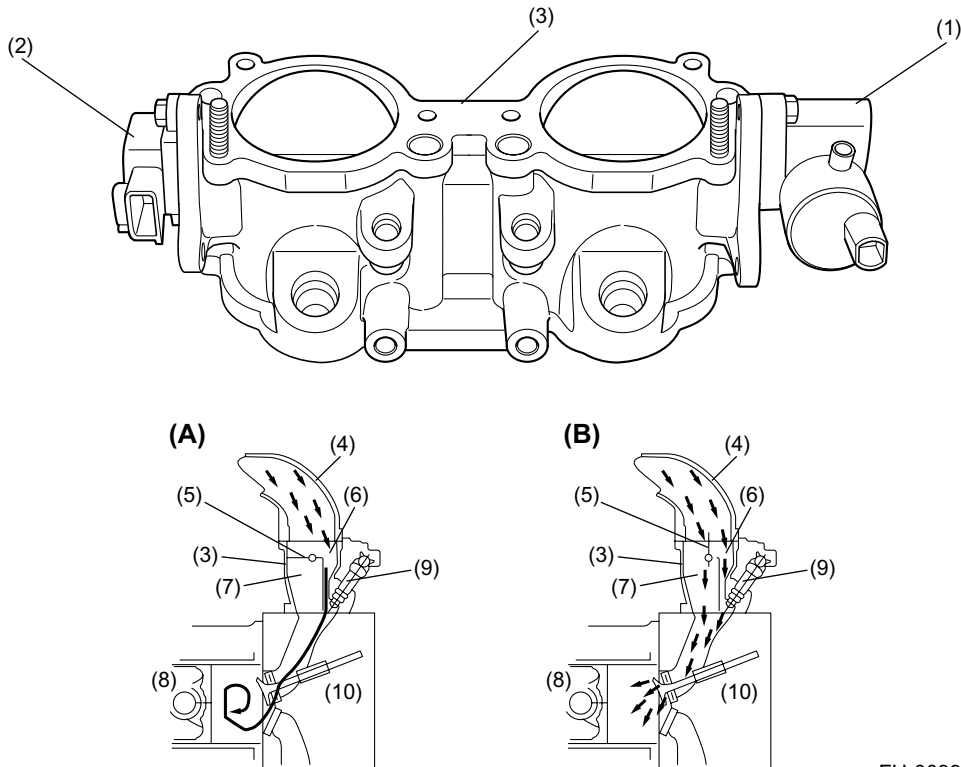
FU-00346

- (1) Mass air flow and intake air temperature sensor
- (2) Mass air flow sensor
- (3) Intake air temperature sensor

(A) Air

E: TUMBLE GENERATOR VALVE

- A tumble generator valve is provided on each engine bank, between the intake manifold and intake air ports. The right bank tumble generator valve has butterfly valves for the #1 and #3 cylinders and the left bank tumble generator valve has those for the #2 and #4 cylinders. The two butterfly valves in each tumble generator valve are fitted on a single shaft that is driven by an actuator.
- The tumble generator valves are controlled by the ECM according to the coolant temperature and the time elapsed after start of the engine. When the engine is started, the butterfly valves are moved to the closing ends. In this state, the intake air flows at very high speeds passing through narrowed passages in the directions determined by the individual intake air ports in the cylinder head. This creates tumbling air motions in the cylinders, which enables lean mixtures to be ignited and thus harmful exhaust emissions to be reduced during engine start. The tumble generator valves are fully open when the engine is operating at an ordinary driving speed, allowing intake air to flow without being changed in direction and velocity.



FU-00998

(A) Activated

(B) Not activated

(1) Actuator

(2) Tumble generator valve position sensor

(3) Tumble generator housing

(4) Intake manifold

(5) Tumble generator valve

(6) Tumble generating air passage

(7) Intake main air passage

(8) Piston

(9) Injector

(10) Cylinder head

5. Control System

A: GENERAL

The ECM receives signals from various sensors, switches, and other control modules. Using these signals, it determines the engine operating conditions and if necessary, emits signals to one or more systems to control them for optimum operation.

Major control items of the ECM are as follow:

- Fuel injection control
- Ignition control
- Idle air control
- Fuel pump control
- Canister purge control*¹
- Radiator fan control*²
- On-board diagnosis function

*1: Canister purge control is described under EC(H4DOTC) section. <Ref. to EC(H4DOTC) section.>

*2: Radiator fan control is described under CO(H4DOTC) section. <Ref. to CO(H4DOTC) section.>

CONTROL SYSTEM

FUEL INJECTION (FUEL SYSTEM)

B: INPUT AND OUTPUT SIGNALS

Signal	Unit	Function
Input signals	Manifold absolute pressure sensor	Detects the amount (measures the absolute pressure) of intake air.
	Mass air flow and intake air temperature sensor	Detects the temperature and amount of intake air.
	Accelerator pedal position sensor	Detects the depressed amount of the accelerator pedal.
	Front oxygen (A/F) sensor	Detects the density of oxygen in exhaust gases at the upstream of the front catalytic converter.
	Front oxygen sensor	Detects the density of oxygen in exhaust gases at the downstream of the front catalytic converter.
	Rear oxygen sensor	Detects the density of oxygen in exhaust gases at the downstream of the rear catalytic converter.
	Exhaust gas temperature sensor	Detects the exhaust gas temperature.
	Tumble generator valve position sensor	Detects the tumble generator valve position.
	Crankshaft position sensor	Detects the crankshaft angular position.
	Camshaft position sensor	Detects the cylinder in which combustion is taking place and also detects advance and retard angles of the intake valves.
	Engine coolant temperature sensor	Detects the engine coolant temperature.
	Knock sensor	Detects engine knocking.
	Vehicle speed sensor	Detects the vehicle speed.
	Ignition switch	Detects operation of the ignition switch.
	Starter switch	Detects the condition of engine cranking.
	Neutral position switch (MT)	Detects that the gear is in neutral.
	Inhibitor switch (AT)	Detects shift positions.
	Heater circuit of front and rear oxygen sensors	Detects abnormality in the heater circuit of the front and rear oxygen sensors.
	Diagnostics of TCM (AT)	Detects the self-diagnostics of TCM.
	Torque control signal (AT)	Controls engine torque.
	A/C switch	Detects ON-OFF operation of the A/C switch.
	Fuel level sensor	Detects the level of the fuel in the fuel tank.
	Fuel temperature sensor	Detects the temperature of the fuel in the fuel tank.
	Fuel tank pressure sensor	Detects the evaporation gas pressure in the fuel tank.
	Small light switch	Detects ON-OFF operation of the small light switch.
	Blower fan switch	Detects ON-OFF operation of the blower fan switch.
	Rear defogger switch	Detects ON-OFF operation of the rear defogger switch.
	Throttle position sensor	Detects the throttle valve position.

CONTROL SYSTEM

FUEL INJECTION (FUEL SYSTEM)

Signal	Unit	Function
Output signals	Fuel injector	Activates an injector.
	Ignition signal	Turns the primary ignition current ON or OFF.
	Fuel pump control unit	Controls the fuel pump.
	A/C control relay	Turns ON or OFF the A/C control relay.
	Radiator fan control relay	Turns ON or OFF the radiator fan control relay.
	Idle air control solenoid valve	Adjusts the amount of air flowing through the bypass line in the throttle body.
	Wastegate control solenoid valve	Controls supercharging pressure
	Tumble generator valve actuator	Operates the tumble generator valve.
	Engine malfunction indicator light (MIL)	Indicates existence of abnormality.
	Purge control solenoid valve	Controls purge of evaporative gas absorbed by the canister.
	Pressure control solenoid valve	Controls evaporation pressure in fuel tank.
	Drain valve	Closes the evaporation line between the fuel tank and canister to detect leakage of evaporation gases.
	Power supply	Controls ON/OFF of the main power supply relay.
	Oil flow control solenoid valve	Controls advance and retard angles of the intake valves.

C: FUEL INJECTION CONTROL

- The ECM receives signals from various sensors and based on them, it determines the amount of fuel injected and the fuel injection timing. It performs the sequential fuel injection control over the entire engine operating range except during start-up of the engine.
- The amount of fuel injected depends upon the length of time the injector stays open. The fuel injection duration is determined according to varying operating condition of the engine. For the purpose of achieving highly responsive and accurate fuel injection duration control, the ECM performs a new feedback control that incorporates a learning feature as detailed later.
- The sequential fuel injection control is performed such that fuel is injected accurately at the time when the maximum air intake efficiency can be achieved for each cylinder (i.e., fuel injection is completed just before the intake valve begins to open).

1. FUEL INJECTION DURATION

Fuel injection duration is basically determined as indicated below:

- While cranking the engine:

The duration defined below is used.

- Duration of fuel injection during engine start-up Determined according to the engine coolant temperature detected by the engine coolant temperature sensor.

- During normal operation:

The duration is determined as follows:

Basic duration of fuel injection $\times$ Correction factors + Voltage correction time

- Basic duration of fuel injection The basic length of time fuel is injected. This is determined by two factors — the amount of intake air detected by the manifold absolute pressure sensor and the engine speed monitored by the crankshaft position sensor.
- Correction factors See the next section.
- Voltage correction time This is added to compensate for the time lag before operation of injector that results from variation in the battery voltage.

2. CORRECTION FACTORS

The following factors are used to correct the basic duration of fuel injection in order to make the air-fuel ratio meet the requirements of varying engine operating conditions:

- Air-fuel ratio feedback factor:

This factor is used to correct the basic duration of fuel injection in relation to the actual engine speed. (See the next section for more details.)

- Start increment factor:

This factor is used to increase the fuel injection duration only while the engine is being cranked to improve its startability.

- Coolant-temperature-dependent increment factor:

This factor is used to increase the fuel injection duration depending on engine coolant temperature signals to facilitate cold starting. The lower the coolant temperature, the greater the increment.

- After-start increment factor:

- This factor is used to increase the fuel injection duration for a certain period immediately after start of the engine to stabilize engine operation.
- The increment depends on the coolant temperature at the start of the engine.

- Wide-open-throttle increment factor:

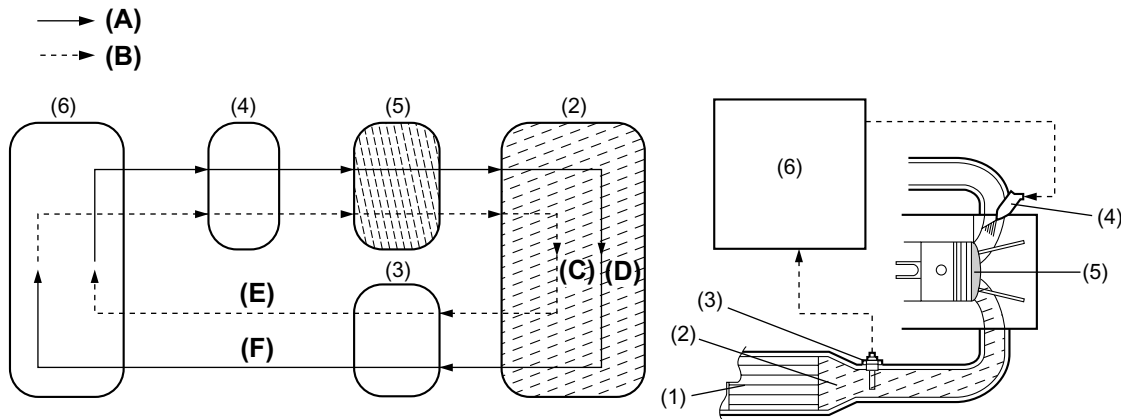
This factor is used to increase the fuel injection duration depending on the relationship between the throttle position sensor signal and manifold absolute pressure sensor signal.

- Acceleration increment factor:

This factor is used to increase the fuel injection duration to compensate for a time lag between air flow measurement and fuel injection control for better engine response to driver's pedal operation during acceleration.

3. AIR-FUEL RATIO FEEDBACK FACTOR

The ECM creates this factor utilizing the front oxygen (A/F) sensor signal. When the signal voltage is high, the air-fuel ratio is richer than the stoichiometric ratio. The ECM then makes the fuel injection duration shorter by modifying the factor. When the voltage is low showing that the mixture is lean, the ECM modifies the factor to make the injection duration longer. In this way, the air-fuel ratio is maintained at a level close to the stoichiometric ratio at which the three-way catalytic converter acts most effectively.



FU-00240

- (1) Front catalytic converter
- (2) Exhaust gases
- (3) Front oxygen (A/F) sensor
- (4) Fuel injector
- (5) Combustion chamber
- (6) ECM

- (A) Injection duration increment signal
- (B) Injection duration decrement signal
- (C) High oxygen density
- (D) Low oxygen density
- (E) Lean signal
- (F) Rich signal

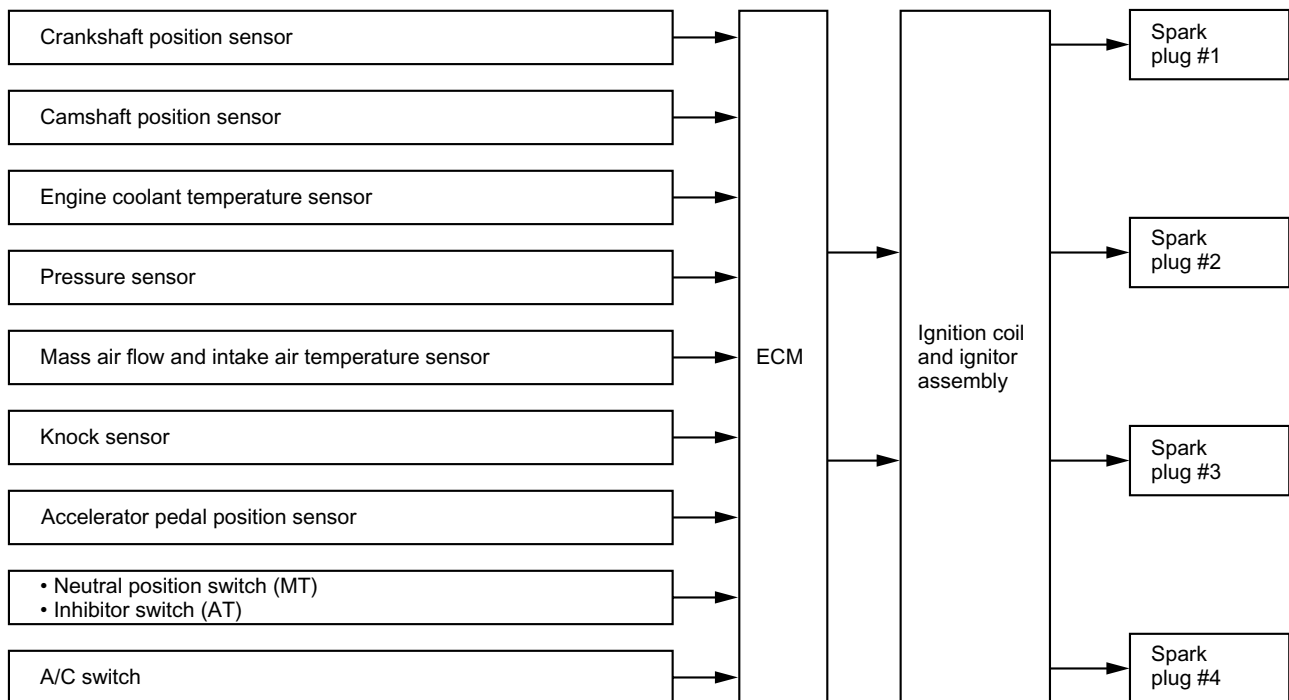
4. LEARNING FEATURE

The air-fuel ratio feedback control includes a learning feature which contributes to more accurate and responsive control.

- In the air-fuel ratio feedback control, the ECM calculates the necessary amount of correction based on data from the oxygen sensor and adds the result to the basic duration (which is stored in the ECMs memory for each condition defined by the engine speed and various loads.)
- Without a learning feature, the ECM carries out the above-mentioned process every time. This means that if the amount of necessary correction is large, the air-fuel ratio feedback control becomes less responsive and less accurate.
- The learning feature enables the ECM to store the amount of correction into memory and add it to the basic fuel injection duration to create a new reference fuel injection duration. Using the reference duration as the basic duration for the injection a few times later, the ECM can reduce the amount of correction and thus make its feedback control more accurate and responsive to changes in the air-fuel ratio due to difference in driving condition and sensor/actuator characteristics that may result from unit-to-unit variation or aging over time.

D: IGNITION CONTROL

- The ECM determines operating condition of the engine based on signals from the manifold absolute pressure sensor, engine coolant temperature sensor, intake air temperature sensor, crankshaft position sensor and other sources. The ECM then selects the ignition timing most appropriate for the condition thus determined from those stored in its memory and outputs at that timing a primary current OFF signal to the igniter to initiate ignition.
- This control uses a quick-to-response learning feature by which the data stored in the ECM memory is processed in comparison with information from various sensors and switches.
- Thus, the ECM can always perform optimum ignition timing taking into account the output, fuel consumption, exhaust gas, and other factors for every engine operating condition.
- Ignition control during start-up
Engine speed fluctuates during start of the engine, so the ECM cannot control the ignition timing. During that period, the ignition timing is fixed at 10° BTDC by using the 10° signal from the crankshaft position sensor.

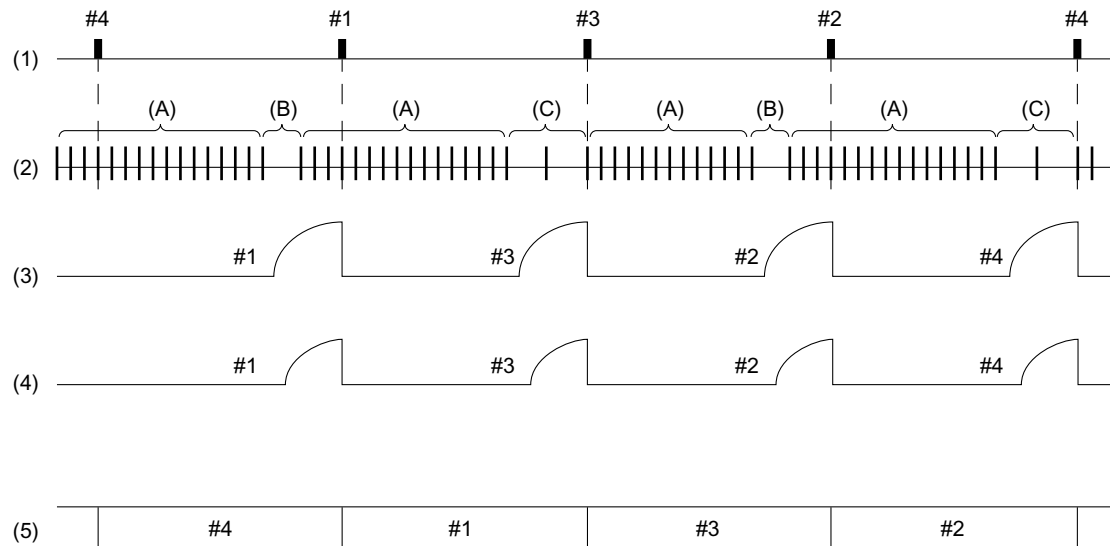


FU-01327

CONTROL SYSTEM

FUEL INJECTION (FUEL SYSTEM)

- The ECM identifies cylinders at TDC and determines ignition timing as follows:
 - Within the range (A), the crank angle signal is input every 10° rotation of the crankshaft.
 - The ECM discriminates a TDC cylinder group from the other by detecting the ranges (B) and (C) where no signals are input.
 - The ECM judges that the No. 1 and No. 2 cylinders are at TDC when it detects the range (B), and that the No. 3 and No. 4 cylinders are at TDC when it detects the range (C).

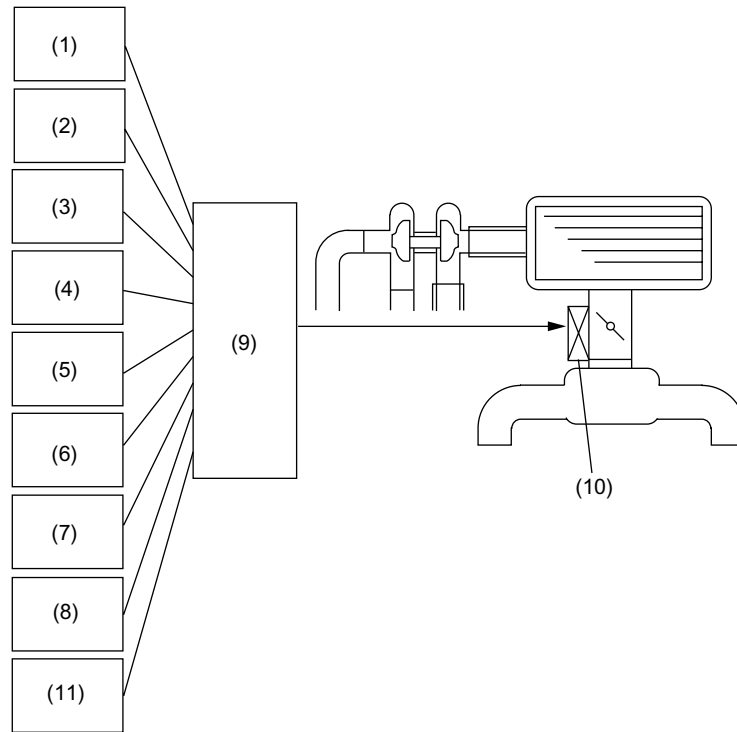


FU-00358

- (1) Cylinder number (TDC)
- (2) Crank angle pulse
- (3) Ignition timing at starting
- (4) Ignition timing at normal condition
- (5) Cylinder at combustion

E: IDLE AIR CONTROL

- The ECM controls the electronic control throttle based on signals from the crankshaft position sensor, engine coolant temperature sensor, mass air flow and intake air temperature sensor, and A/C switch etc. so that the proper idle speed for each engine load is achieved.



FU-02032

- | | |
|---------------------------------------|---|
| (1) Crankshaft position sensor | (7) A/C switch |
| (2) Camshaft position sensor | (8) Neutral position switch (MT) or inhibitor switch (AT) |
| (3) Accelerator pedal position sensor | (9) ECM |
| (4) Engine coolant temperature sensor | (10) Electronic control throttle |
| (5) Vehicle speed sensor | (11) Mass air flow and intake air temperature sensor |
| (6) Ignition switch | |

F: FUEL PUMP CONTROL

Using the signal from the crankshaft position sensor, the ECM controls operation of the fuel pump by turning its relay ON or OFF. To improve safety, the fuel pump is stopped if the engine stalls with the ignition switch ON.

Ignition switch ON	Fuel pump relay	Fuel pump
A certain period of time after ignition switch is turned ON	ON	Operates
While cranking the engine	ON	Operates
While engine is operating	ON	Operates
When engine stops	OFF	Does not operate

3. Fuel System

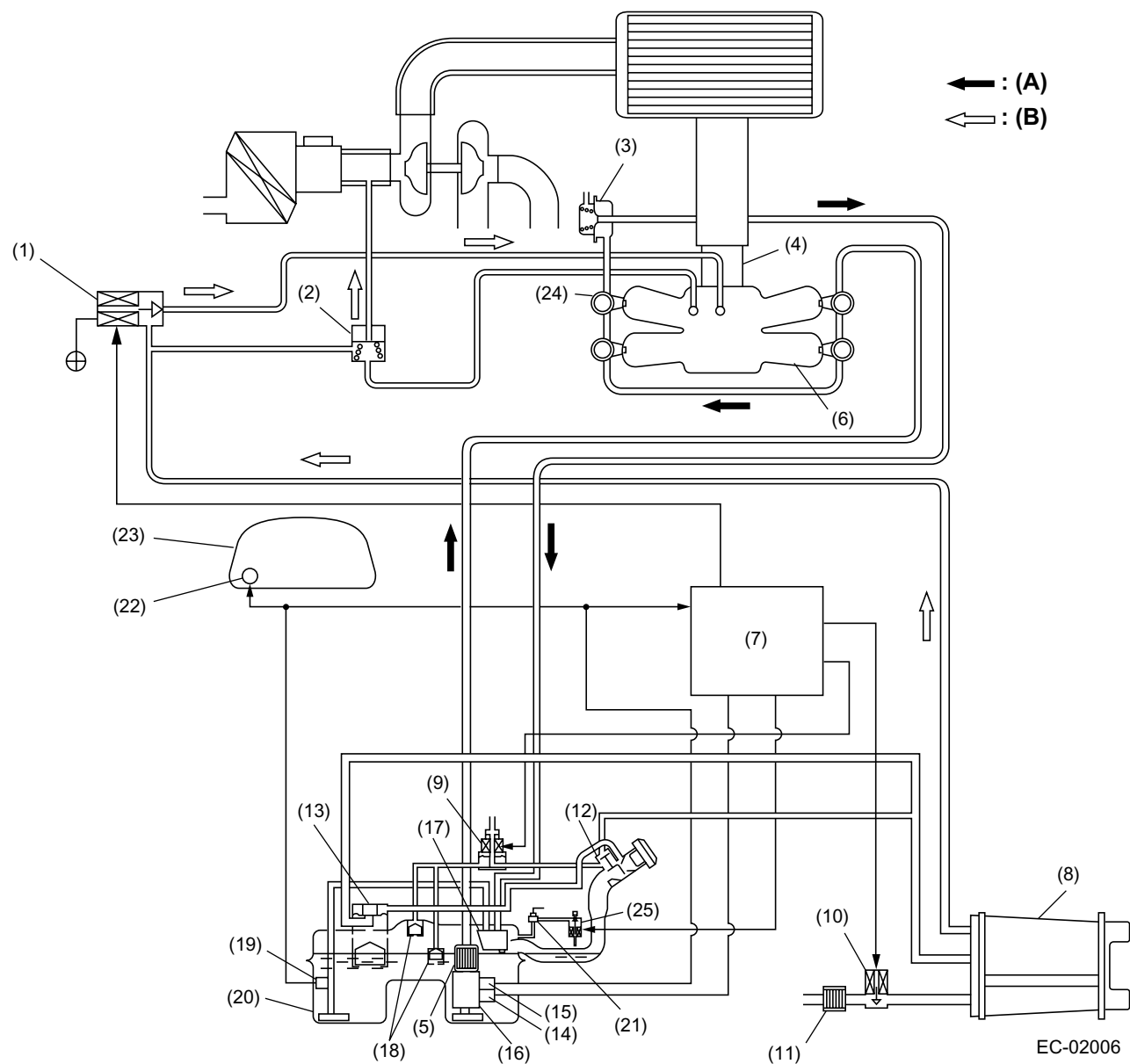
A: GENERAL

- The fuel pressurized by the fuel tank inside pump is delivered to each fuel injector by way of the fuel pipe and fuel filter. Fuel injection pressure is regulated to an optimum level by the pressure regulator.
- Each injector injects fuel into the intake port of the corresponding cylinder where the fuel is mixed with air. The mixture then enters the cylinder.

Fuel injection amount and timing are regulated by the ECM.

FUEL SYSTEM

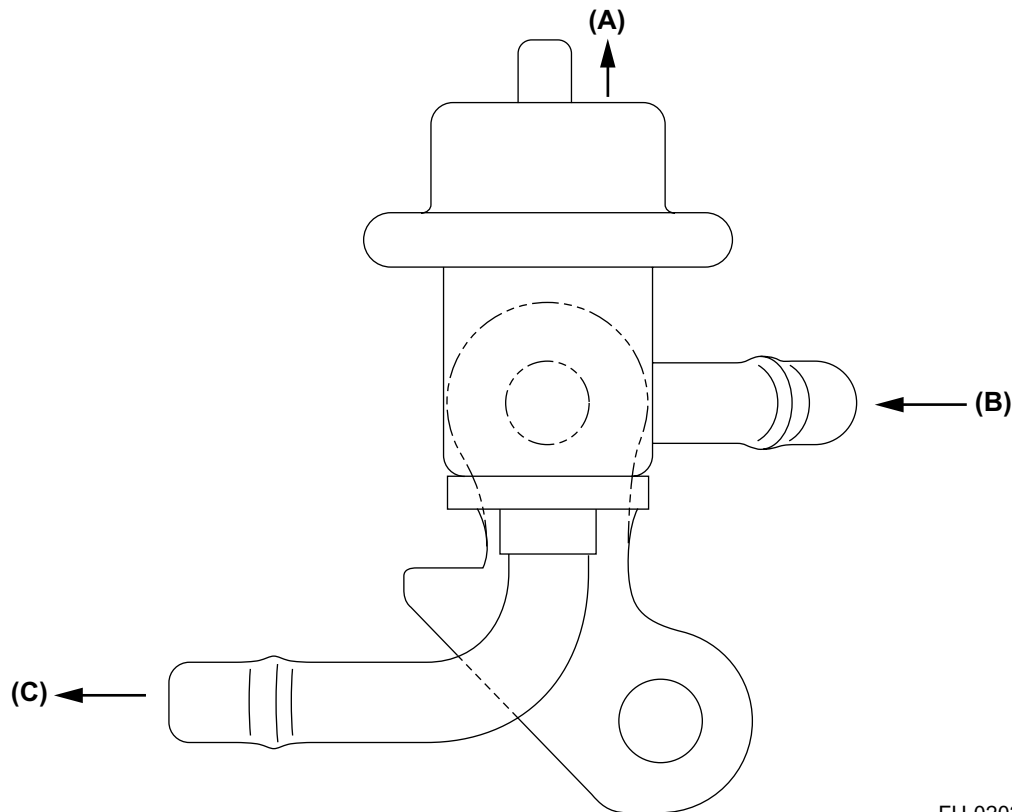
FUEL INJECTION (FUEL SYSTEM)



- | | | |
|-------------------------------------|------------------------------|-------------------------------------|
| (1) Purge control solenoid valve | (10) Drain valve | (19) Fuel sub level sensor |
| (2) Purge valve | (11) Drain filter | (20) Fuel tank |
| (3) Pressure regulator | (12) Shut-off valve | (21) Fuel tank pressure sensor |
| (4) Throttle body | (13) Vent valve | (22) Fuel gauge |
| (5) Fuel filter | (14) Fuel temperature sensor | (23) Combination meter |
| (6) Intake manifold | (15) Fuel level sensor | (24) Fuel injector |
| (7) ECM | (16) Fuel pump | (25) Fuel tank sensor control valve |
| (8) Canister | (17) Jet pump | (A) Fuel line |
| (9) Pressure control solenoid valve | (18) Fuel cut valve | (B) Fuel evaporation line |

B: PRESSURE REGULATOR

The pressure regulator is installed at the injector end of the fuel supply line. It has a fuel chamber and spring chamber separated by a diaphragm. The fuel chamber is connected to the fuel supply line and the spring chamber is connected to the intake manifold. Fuel chamber also has a relief valve connected to the fuel return line through which fuel returns to the fuel tank. When the intake manifold vacuum increases, the diaphragm is pulled and the relief valve opens to decrease the fuel supply line pressure (or fuel injection pressure). When the intake manifold vacuum decreases, the diaphragm is pushed by the spring to increase the fuel supply line pressure. Thus, the difference between the fuel injection pressure and the intake manifold vacuum is kept at a constant level of 294 kPa (3.00 kgf/cm², 43.0 psi) to precisely control the amount of injected fuel.



FU-02031

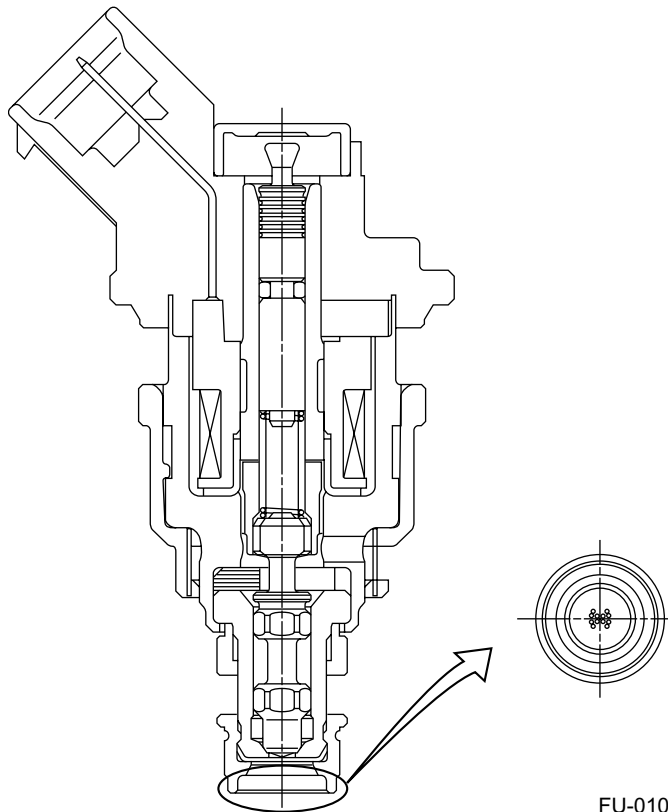
- (A) To intake manifold
- (B) Fuel IN
- (C) Fuel OUT

FUEL SYSTEM

FUEL INJECTION (FUEL SYSTEM)

C: FUEL INJECTOR

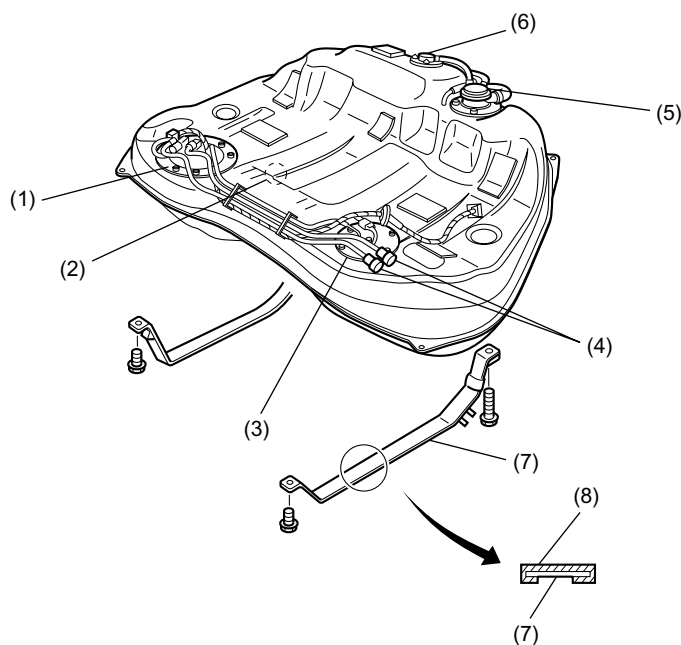
- The MFI system employs side feed type fuel injectors.
- Each injector is installed in the fuel pipe in such a way that the injector is cooled by fuel.
- The features of this type of fuel injector are as follows:
 - 1) High heat resistance
 - 2) Low driving noise
 - 3) Easy to service
- The injector injects fuel according to the valve open signal from the ECM. The needle valve is lifted by the solenoid which is energized on arrival of the valve open signal.
- Since the injector's nozzle hole area, the lift of valve and the fuel pressure are kept constant, the amount of fuel injected is controlled only by varying the duration of the valve open signal from the ECM.
- The multi-hole nozzle makes it possible for the injector to produce fine fuel particles, which enhances the combustion efficiency and output performance of the engine.



D: FUEL TANK

The fuel tank utilizes a two-compartment design to ensure sufficient capacity without interfering with the rear differential. It is provided with a suction jet pump (included in the fuel pump and fuel level sensor assembly) which transfers fuel from one compartment to the other.

Each compartment has an individual fuel level sensor. The fuel tank is located under the rear seat and secured with hold-down bands.



FU-00509

- (1) Fuel pump and fuel level sensor assembly
- (2) Fuel cut valve (sub-compartment)
- (3) Fuel sub level sensor
- (4) Quick connector

- (5) Vent valve
- (6) Fuel cut valve (main compartment)
- (7) Cushion
- (8) Steel

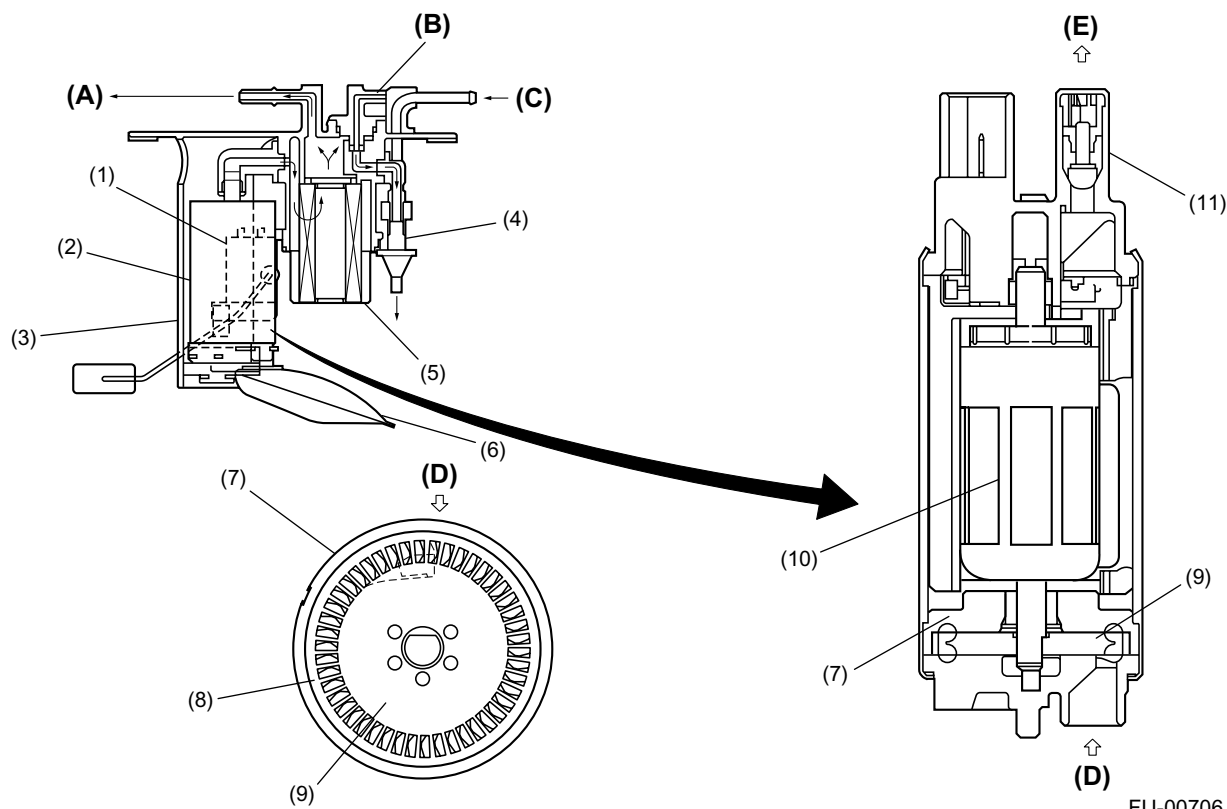
FUEL SYSTEM

FUEL INJECTION (FUEL SYSTEM)

E: FUEL PUMP AND FUEL LEVEL SENSOR ASSEMBLY

1. FUEL PUMP

The fuel pump consists of a motor, impeller, pump casing, pump cover, check valve and filter. It is located in the fuel tank and combined with the fuel level sensor into a single unit. The operation of this impeller type pump is very quiet.



FU-00706

- (1) Fuel level sensor
- (2) Fuel pump
- (3) Pump cover
- (4) Jet pump
- (5) Cartridge filter
- (6) Mesh filter

- (7) Pump casing
- (8) Fuel passage
- (9) Impeller
- (10) Motor armature
- (11) Check valve

- (A) To engine (delivery line)
- (B) From engine (return line)
- (C) From sub tank
- (D) Suction
- (E) Discharge

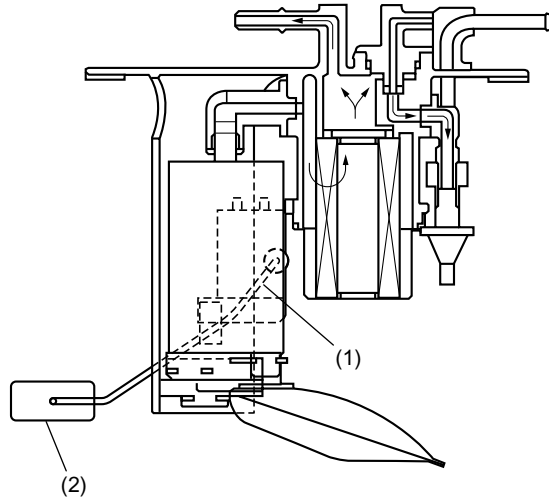
- When the ignition switch is turned ON, fuel pump relay is activated. Then the motor operates to rotate the impeller.
- As the impeller rotates, fuel in a vane groove of the impeller flows along the fuel passage into the next vane groove by centrifugal force. When fuel flows from one groove to the next, a pressure difference occurs due to friction. This creates a pumping effect.
- The fuel pushed up by rotation of the impeller then passes through the clearance between the armature and the magnet of the motor and is discharged through the check valve.
- When the fuel discharge pressure reaches the specified level, the relief valve opens and excess fuel is released into the fuel tank. In this manner, the relief valve prevents an abnormal increase in fuel pressure.
- When the engine and the fuel pump stop, spring force acts on the check valve to close the discharge port, so that the fuel pressure in the fuel delivery line is retained.

FUEL SYSTEM

FUEL INJECTION (FUEL SYSTEM)

2. FUEL LEVEL SENSOR

The fuel level sensor is integrated with the fuel pump which is located in the fuel tank. The sensor outputs an electric resistance signal that varies with movement of its float to indicate the level of the fuel remaining in the tank.

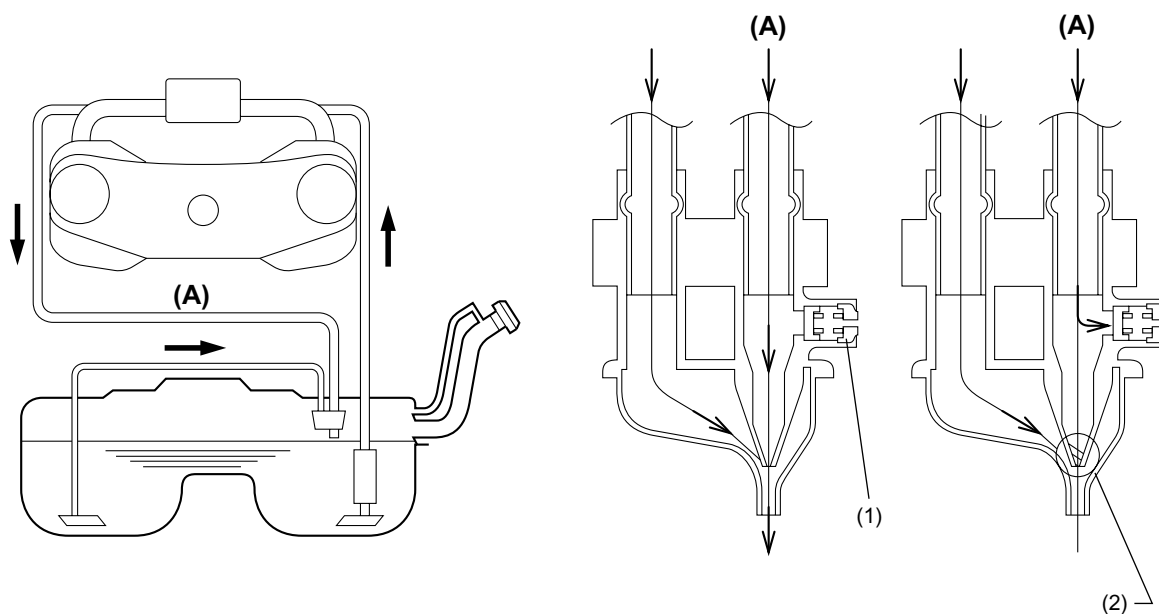


FU-00707

- (1) Fuel level sensor
- (2) Float

3. JET PUMP

- The jet pump utilizes the velocity of fuel returning from the engine to produce vacuum in it.
- Using the pumping effect produced by the vacuum, the jet pump transfers fuel from the sub-compartment to the main compartment of the fuel tank.
- When the return line nozzle is clogged, the fuel sent back through the return line flows back into the fuel tank via the relief valve.



FU-00226

- (1) Relief valve
(2) Nozzle

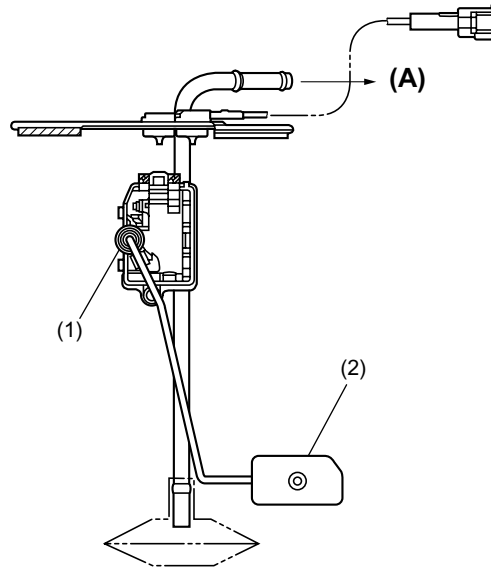
(A) Return line

FUEL SYSTEM

FUEL INJECTION (FUEL SYSTEM)

F: SUB-COMPARTMENT FUEL LEVEL SENSOR

This sensor detects the level of the fuel in the sub-compartment (the compartment in which the fuel pump is not located) and acts as part of the fuel transfer line when the jet pump is in operation to maintain the fuel in both compartments at the same level.



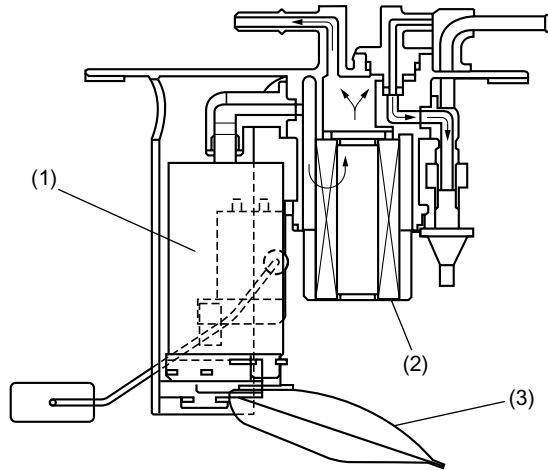
FU-00512

- (1) Fuel level sensor
- (2) Float

(A) To jet pump

G: FUEL FILTER

There are two different types of fuel filters inside fuel tank, forming integral part of the fuel pump. The filter at the inlet of the fuel pump is a mesh type which removes relatively large particles in the fuel before it enters the pump. The filter at the outlet of the pump is a pressure resistant cartridge type whose inside filtering element can remove small particles in the pressurized fuel.



FU-00708

- (1) Fuel pump
- (2) Cartridge filter
- (3) Mesh filter

1. General

- The Multipoint Fuel Injection (MFI) system supplies optimum air-fuel mixture under every engine operating condition through the use of the latest electronic control technology.

This system pressurizes the fuel to a constant pressure and injects it into each intake air port in the cylinder head. The injection quantity of fuel is controlled by an intermittent injection system where an electro-magnetic injection valve or injector opens for a short period that is precisely controlled depending on the quantity of air appropriate for each condition of operation. In actual control, an optimum fuel injection quantity is achieved by varying the duration of an electric pulse applied to the injector. This way of control enables simple, yet highly precise metering of the fuel.

- The engine control module (ECM) that controls the fuel injection system corrects the fuel injection amount depending on the vehicle speed, throttle opening, coolant temperature and other vehicle-operation-related information. The ECM receives the information in the form of electric signals from the corresponding sensors and switches.

The MFI system also has the following features:

- Reduced exhaust emissions
- Reduced fuel consumption
- Increased engine output
- Quick response to accelerator and brake pedal operation
- Superior startability and warm-up performance in cold weather due to corrective controls made according to coolant and intake air temperatures

6. On-board Diagnosis System

A: GENERAL

- The on-board diagnosis system detects and indicates a fault by generating a code corresponding to each fault location. The engine malfunction indicator light on the combination meter indicates occurrence of a fault or abnormality.
- When the engine malfunction indicator light comes on as a result of detection of a fault by the ECM, the corresponding diagnostic trouble code (DTC) and freeze frame engine condition are stored in the ECM.
- On the OBD-II conformable car, it is necessary to connect the SUBARU Select Monitor (SSM) or General Scan Tool (GST) to the data link connector in order to check the DTC.
- The SSM and GST can erase DTCs. This can also read freeze frame data in addition to other pieces of engine data.
- If there is a failure involving sensors which may affect drive control of the vehicle, the fail-safe function ensures minimum level of driveability.

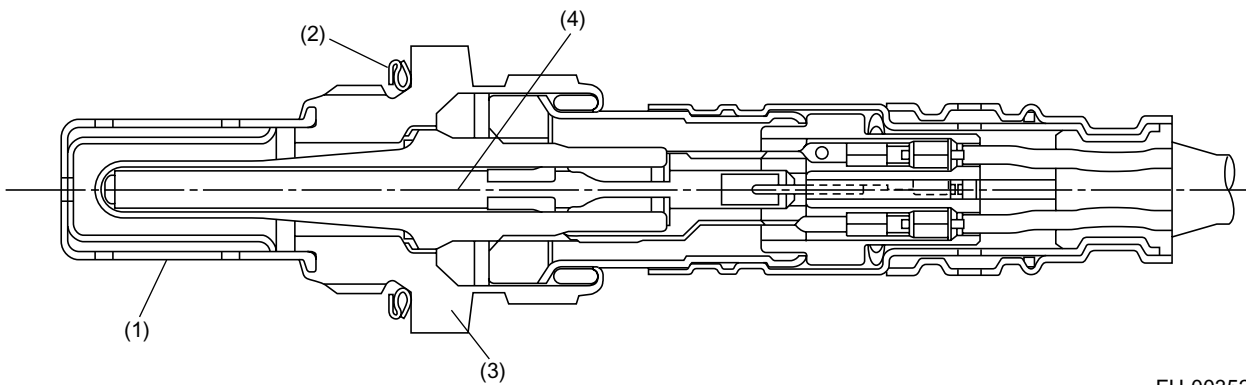
B: FAIL-SAFE FUNCTION

For a sensor or switch which has been judged faulty in the on-board diagnosis, the ECM, if appropriate, generates an associated pseudo signal to keep the vehicle operational. (The control becomes degraded.)

4. Sensors and Switches

A: FRONT OXYGEN (A/F) SENSOR

- The front oxygen sensor uses zirconium oxide (ZrO_2) which is a solid electrolyte, at portions exposed to exhaust gas.
- The zirconium oxide has the property of generating electromotive force when its both sides are exposed to oxygen ions of different concentration and the magnitude of this electromotive force depends on how much the difference is.
The front oxygen (A/F) sensor detects the amount of oxygen in exhaust gases by making use of this property of the zirconium oxide material.
- The zirconium oxide material is formed into a closed end tube and its external surface is exposed to exhaust gases with smaller oxygen ion concentration, whereas its internal surface is exposed to atmospheric air. The external surface has a porous platinum coating. The sensor housing is grounded to the exhaust pipe and the inside is connected to the ECM through the harness to be able to use the current output from the sensor.
- The sensor incorporates a ceramic heater to improve its performance at low temperatures.



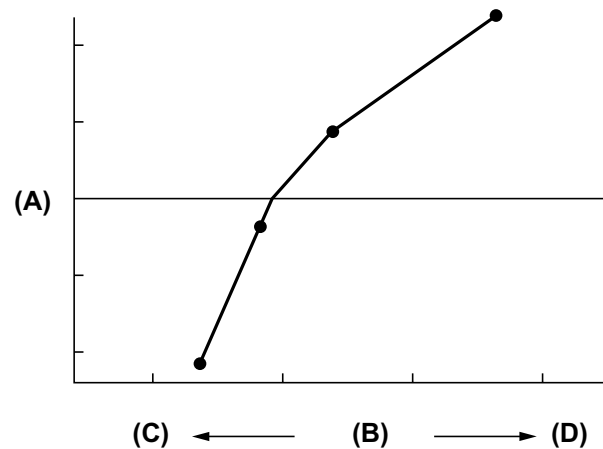
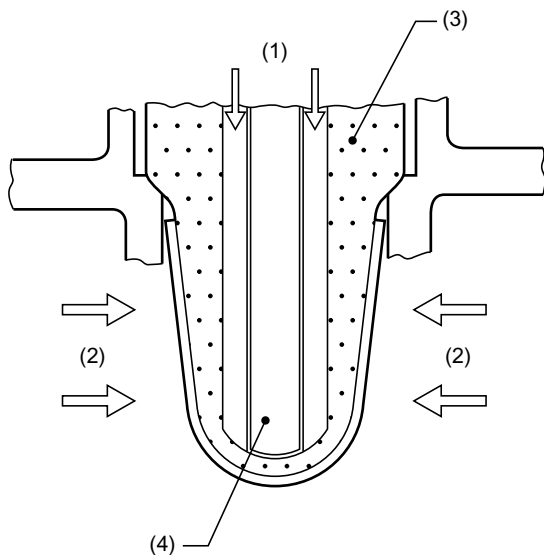
FU-00352

- (1) Protection tube
- (2) Gasket
- (3) Sensor housing
- (4) Ceramic heater

SENSORS AND SWITCHES

FUEL INJECTION (FUEL SYSTEM)

- When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases is almost completely used in the catalytic reaction by the platinum coating on the external surface of the zirconia tube. This results in a very large difference in the oxygen ion concentration between the inside and outside of the tube, and the electromotive force generated is large.
- When a lean air-fuel mixture is burnt in the cylinder, relatively large amount of oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen ion concentration between the tube's internal and external surfaces. The electromotive force in this case is very small.
- The difference in oxygen concentration changes drastically in the vicinity of the stoichiometric air-fuel ratio, and hence the change in the electromotive force is also large. By using this information, the ECM can determine the air-fuel ratio of the supplied mixture easily. The front oxygen (A/F) sensor does not generate much electromotive force when the temperature is low. The output characteristics of the sensor stabilize at a temperature of approximately 700°C (1,292°F).



FU-00230

- (1) Atmospheric air
- (2) Exhaust gases
- (3) ZrO_2
- (4) Ceramic heater

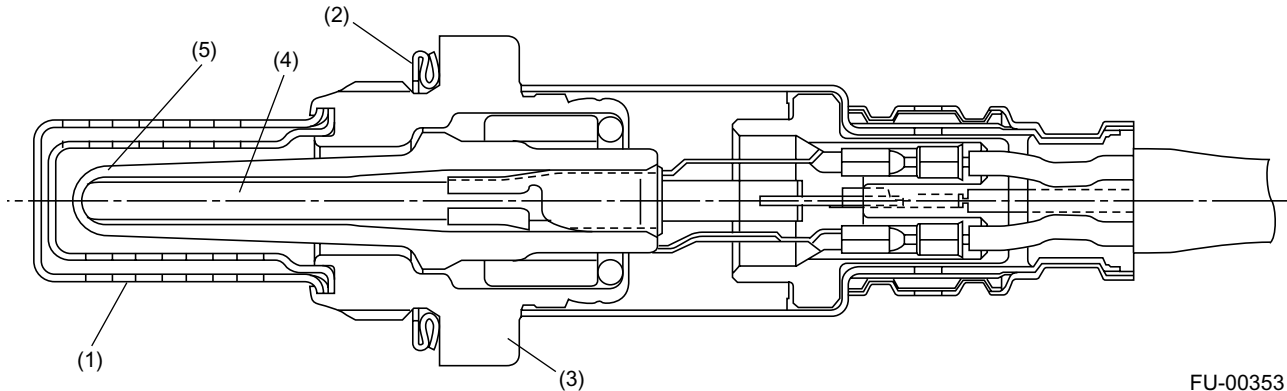
- (A) Electromotive force
- (B) Air/fuel ratio
- (C) Lean
- (D) Rich

SENSORS AND SWITCHES

FUEL INJECTION (FUEL SYSTEM)

B: REAR OXYGEN SENSOR

- The rear oxygen sensor is used to sense oxygen concentration in the exhaust gas. If the air-fuel ratio is leaner than the stoichiometric ratio in the mixture (i.e., excessive amount of air), the exhaust gas contains more oxygen. To the contrary, if the fuel ratio is richer than the stoichiometric ratio, the exhaust gas contains almost no oxygen.
- By detecting the oxygen concentration in the exhaust gas using the oxygen sensor makes it possible to determine whether the air-fuel ratio is leaner or richer than the stoichiometric ratio.
- The rear oxygen sensor has a zirconia tube (ceramic) which generates voltage if there is a difference in oxygen ion concentration between the inside and outside of the tube. Platinum is coated on the inside and outside of the zirconia tube as a catalysis and electrode material. The sensor housing is grounded to the exhaust pipe and the inside is connected to the ECM through the harness.
- A ceramic heater is employed to improve performance at low temperatures.



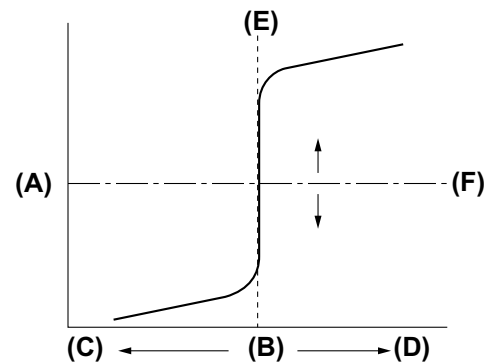
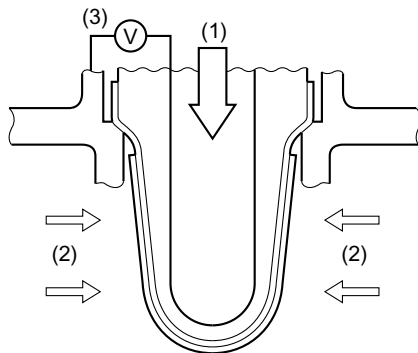
FU-00353

- | | |
|---------------------|--------------------|
| (1) Protection tube | (4) Ceramic heater |
| (2) Gasket | (5) Zirconia tube |
| (3) Sensor housing | |

SENSORS AND SWITCHES

FUEL INJECTION (FUEL SYSTEM)

- When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases is almost completely used in the catalytic reaction by the platinum coating on the external surface of the zirconia tube. This results in a very large difference in the oxygen ion concentration between the inside and outside of the tube, and the electromotive force generated is large.
- When a lean air-fuel mixture is burnt in the cylinder, relatively large amount of oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen ion concentration between the tube's internal and external surfaces. The electromotive force in this case is very small.
- The difference in oxygen concentration changes drastically in the vicinity of the stoichiometric air-fuel ratio, and hence the change in the electromotive force is also large. By using this information, the ECM can determine the air-fuel ratio of the supplied mixture easily. The rear oxygen sensor does not generate much electromotive force when the temperature is low. The output characteristics of the sensor stabilize at a temperature of approximately 300 to 400°C (572 to 752°F).



FU-01010

- (1) Atmospheric air
- (2) Exhaust gases
- (3) Electromotive force

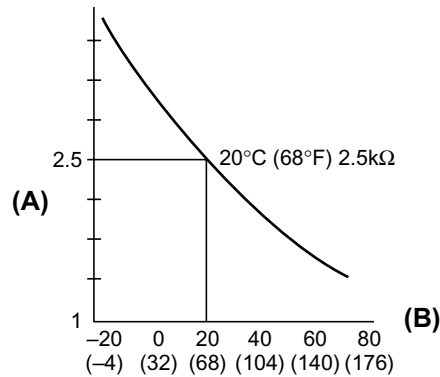
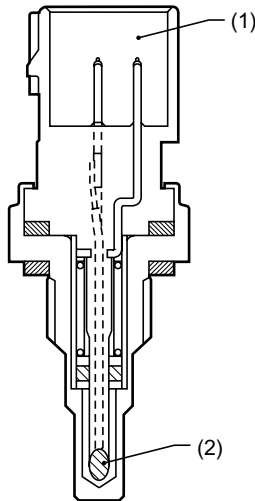
- (A) Electromotive force
- (B) Air/fuel ratio
- (C) Lean
- (D) Rich
- (E) Stoichiometric ratio
- (F) Comparison voltage

SENSORS AND SWITCHES

FUEL INJECTION (FUEL SYSTEM)

C: ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor is located on the engine coolant pipe. The sensor uses a thermistor whose resistance changes inversely with temperature. Resistance signals as engine coolant temperature information are transmitted to the ECM to make fuel injection, ignition timing, purge control solenoid valve and other controls.



FU-00233

- (1) Connector
- (2) Thermistor element

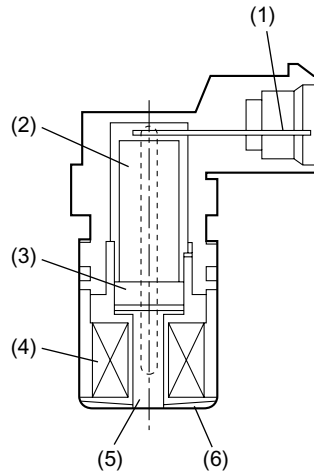
- (A) Resistance (kΩ)
- (B) Temperature °C (°F)

D: EXHAUST GAS TEMPERATURE SENSOR

The exhaust gas temperature sensor is located on the joint pipe and used to monitor the condition of the pre-catalytic converter.

E: CRANKSHAFT POSITION SENSOR

- The crankshaft position sensor is installed on the oil pump which is located in the front center portion of the cylinder block. The sensor generates a pulse when one of the teeth on the perimeter of the crankshaft sprocket (rotating together with the crankshaft) passes in front of it. The ECM determines the crankshaft angular position by counting the number of pulses.
- The crankshaft position sensor is a molded type which consists of a magnet, core, coil, terminals and other components as illustrated below.



FU-00234

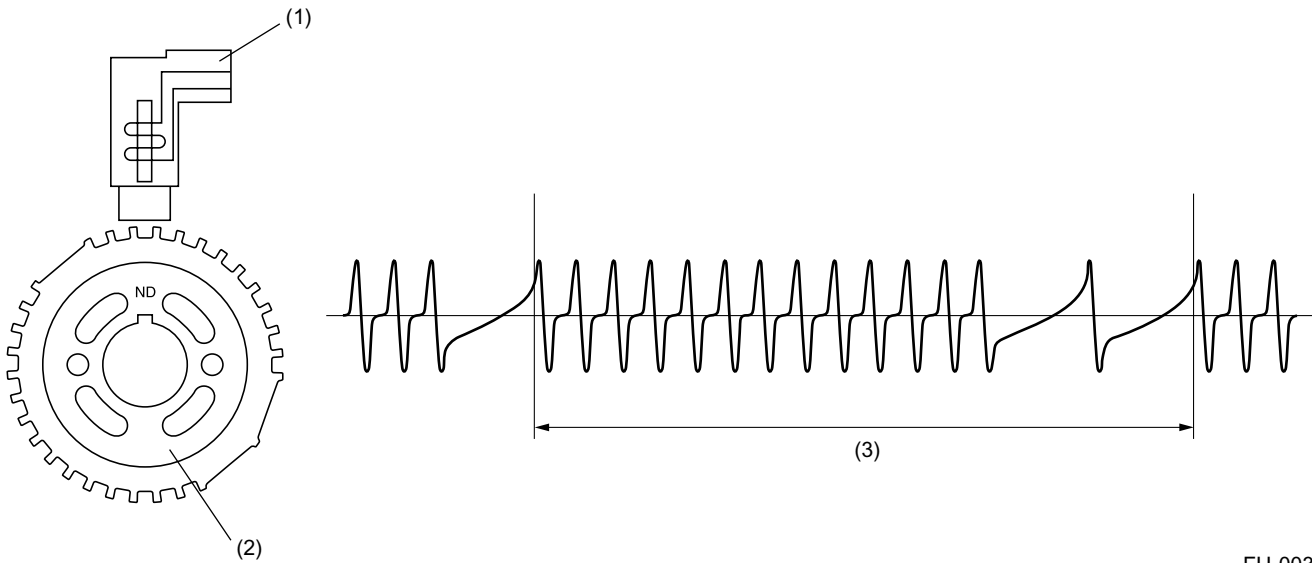
- (1) Terminal
- (2) Yoke core
- (3) Magnet

- (4) Coil
- (5) Core
- (6) Cover

SENSORS AND SWITCHES

FUEL INJECTION (FUEL SYSTEM)

- As the crankshaft rotates, each tooth aligns with the crankshaft position sensor. At that time, the magnetic flux in the sensor's coil changes since the air gap between the sensor pickup and the sprocket changes. This change in magnetic flux induces a voltage pulse in the sensor and the pulse is transmitted to the ECM.

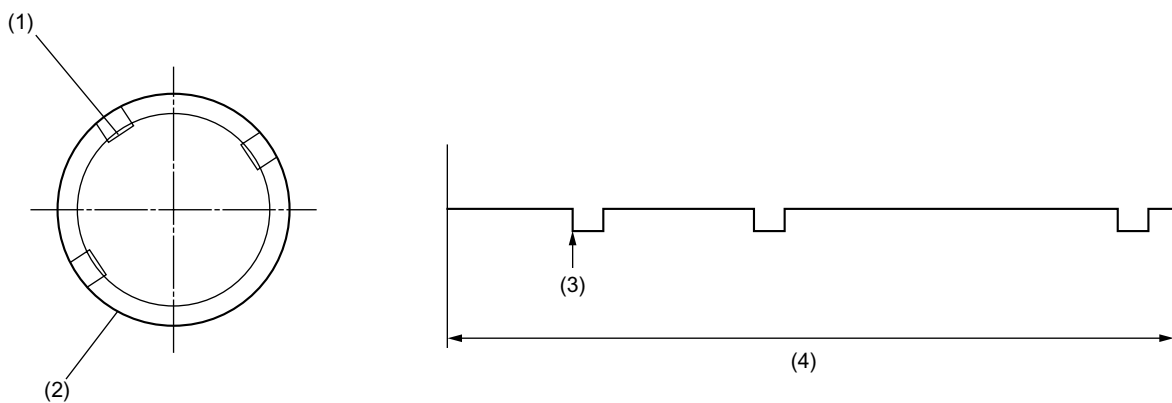


FU-00354

- (1) Crankshaft position sensor
- (2) Crankshaft sprocket
- (3) Crankshaft half rotation

F: CAMSHAFT POSITION SENSOR

- The camshaft position sensor is located on the cylinder head. It detects the combustion cylinder at any given moment.
 - The sensor generates a pulse when one of the slots in the camshaft passes in front of the sensor. The ECM detects the camshaft position by measuring the pulse. Three slots are provided on the camshaft as shown below.
- Three slots are provided on the camshaft as shown below.



FU-01151

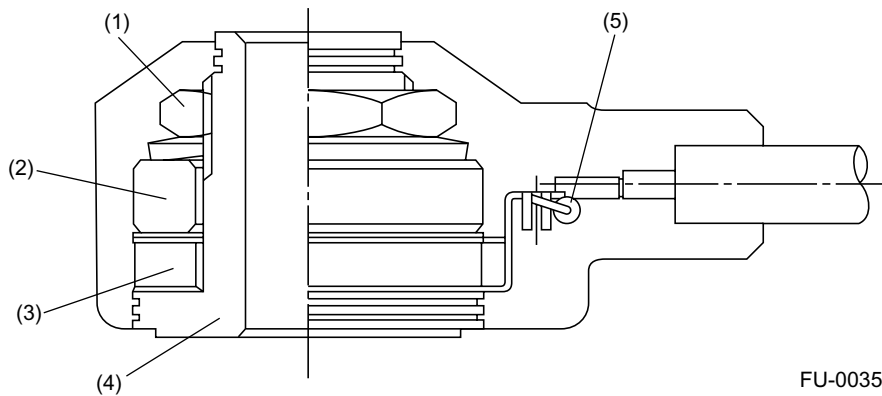
- (1) Slot
- (2) Camshaft
- (3) Detection point
- (4) Camshaft one rotation (crankshaft two rotations)

SENSORS AND SWITCHES

FUEL INJECTION (FUEL SYSTEM)

G: KNOCK SENSOR

- The knock sensor is installed on the cylinder block, and senses knocking that occurs in the engine.
- The sensor is a piezo-electric type which converts vibration resulting from knocking into electric signals.
- In addition to a piezo-electric element, the sensor has a weight and case as its components. If knocking occurs in the engine, the weight in the case moves causing the piezo-electric element to generate a voltage.
- The knock sensor harness is connected to the engine harness.



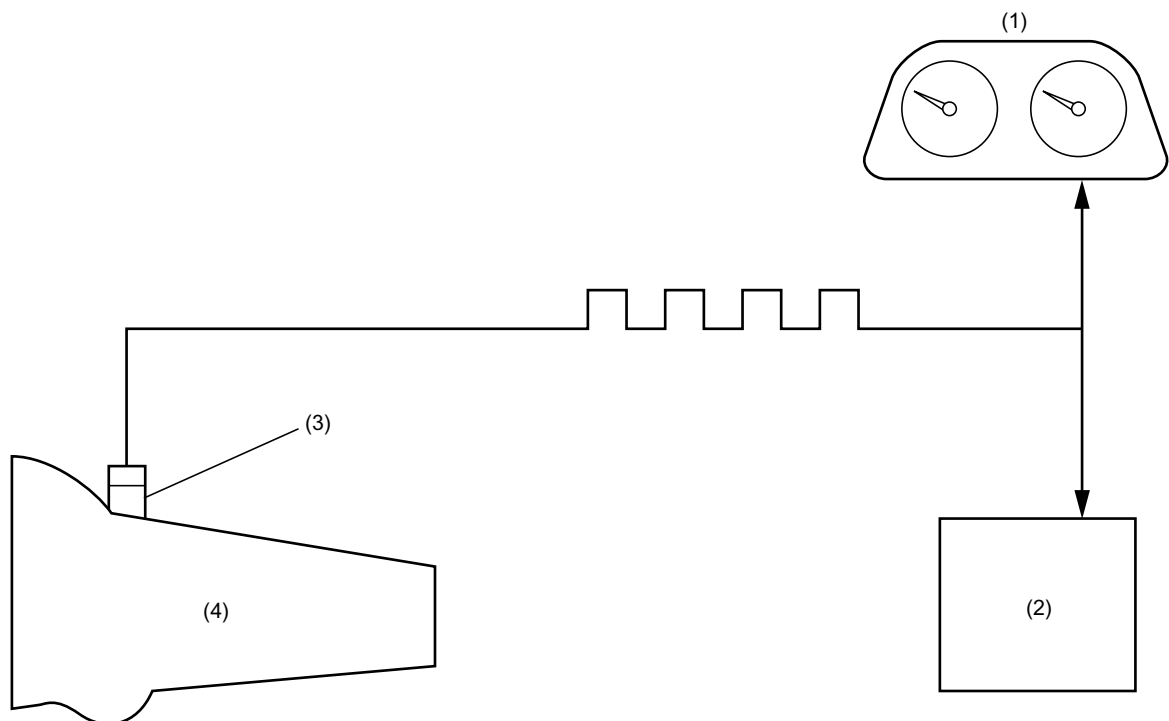
FU-00356

- (1) Nut
- (2) Weight
- (3) Piezo-electric element
- (4) Housing
- (5) Resistance

H: VEHICLE SPEED SENSOR

1. MT MODELS

- The vehicle speed sensor is mounted on the transmission.
- The vehicle speed sensor generates a 4-pulse signal for every rotation of the front differential and send it to the ECM and the combination meter.



FU-00238

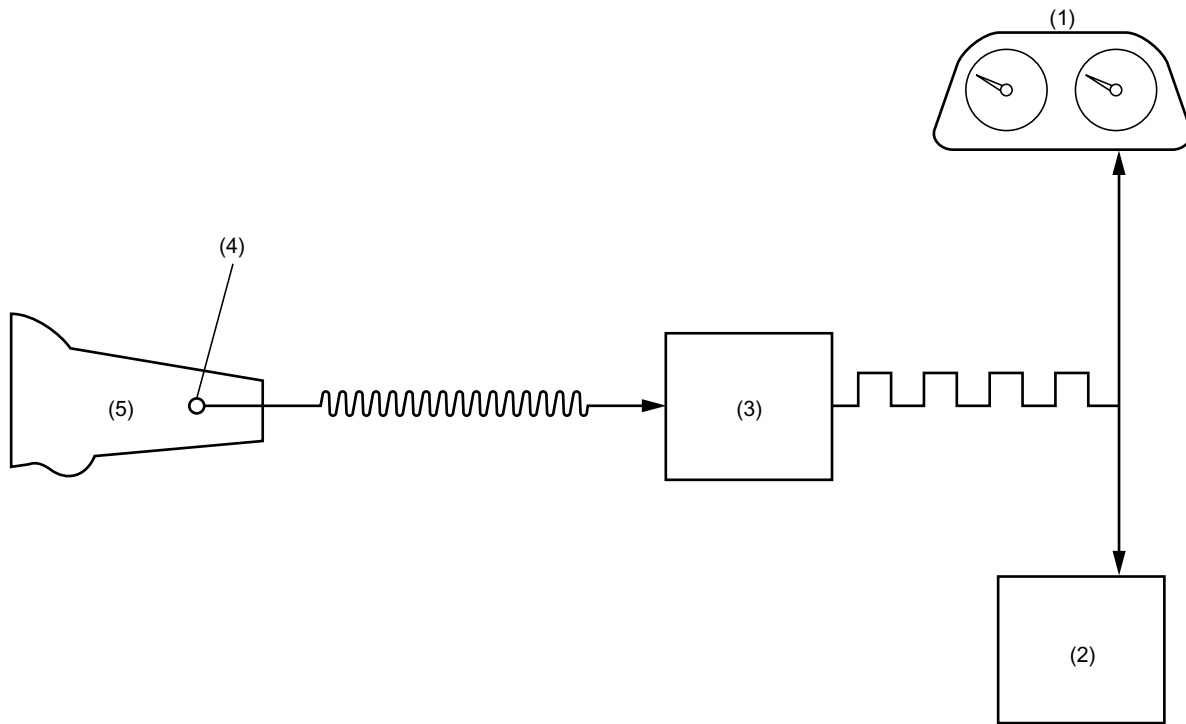
- (1) Combination meter
- (2) ECM
- (3) Vehicle speed sensor
- (4) Transmission

SENSORS AND SWITCHES

FUEL INJECTION (FUEL SYSTEM)

2. AT MODELS

- The vehicle speed sensor is mounted on the transmission.
- The vehicle speed sensor generates a 16-pulse signal for every rotation of the front differential and send it to the transmission control module (TCM). The signal sent to the TCM is converted there into a 4-pulse signal, and then sent to the ECM and the combination meter.



FU-00239

- (1) Combination meter
- (2) ECM
- (3) TCM
- (4) Vehicle speed sensor
- (5) Transmission

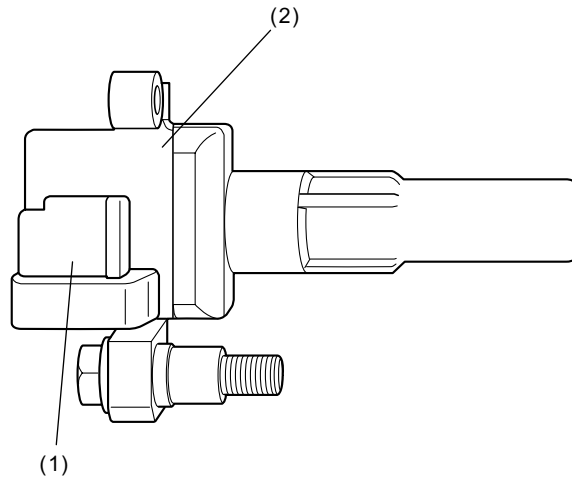
IGNITION COIL

IGNITION

1. Ignition Coil

The engine uses a direct ignition system with one ignition coil mounted for each cylinder.

The secondary terminal of the ignition coil is in contact with the spark plug terminal. Since no spark plug cable is used, secondary voltage drop, leaks, or other problems that are inherent in a system using spark plug cables do not occur. The result is high performance and high reliability.



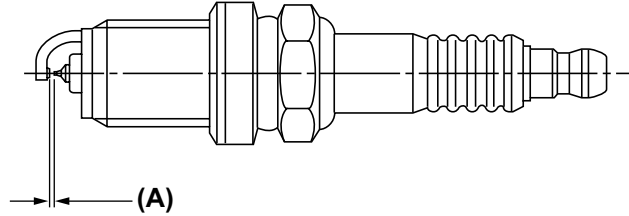
IG-00040

(1) Connector

(2) Ignition coil

2. Spark Plug

The spark plug has an iridium tipped electrode. The thread diameter is 14 mm (0.551 in) and the gap is controlled to a value between 0.7 and 0.8 mm (0.028 and 0.031 in).



IG-00041

(A) Gap: 0.7 — 0.8 mm (0.028 — 0.031 in)

SPARK PLUG

IGNITION

MEMO

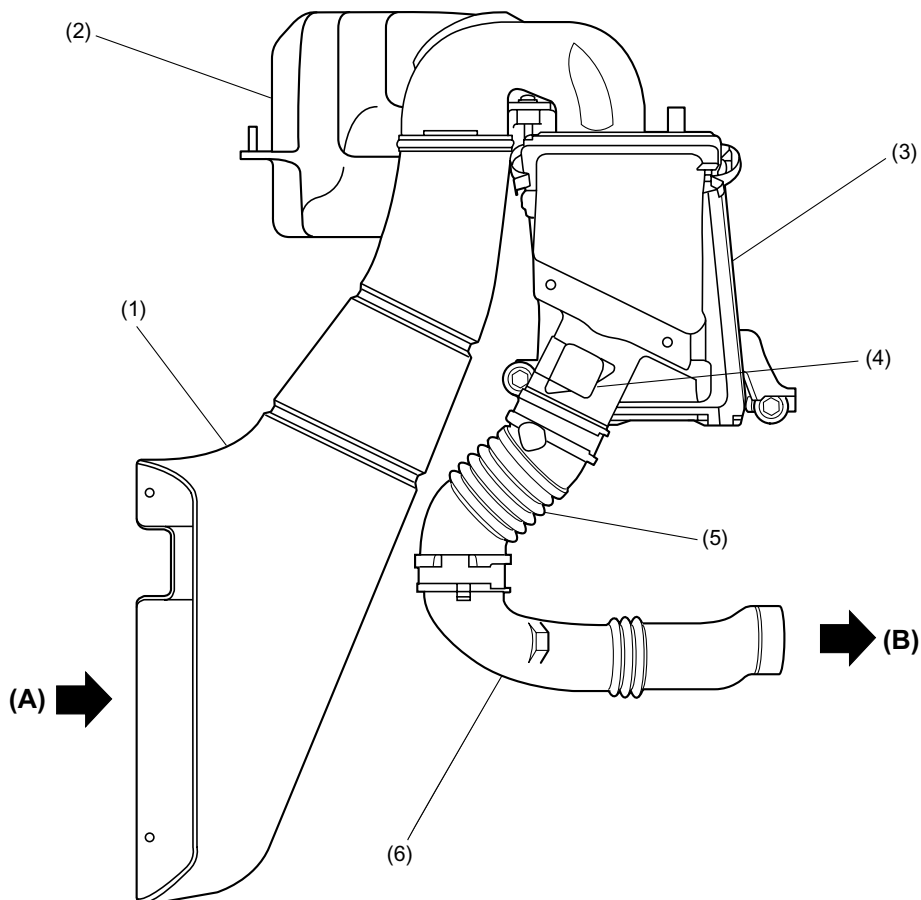
INTAKE SYSTEM

INTAKE (INDUCTION)

1. Intake System

A: GENERAL

The intake system consists of an air intake duct, a resonator chamber, and an air cleaner element housed in its case. The resonator, located upstream of the air cleaner case, effectively reduces the intake noise level.



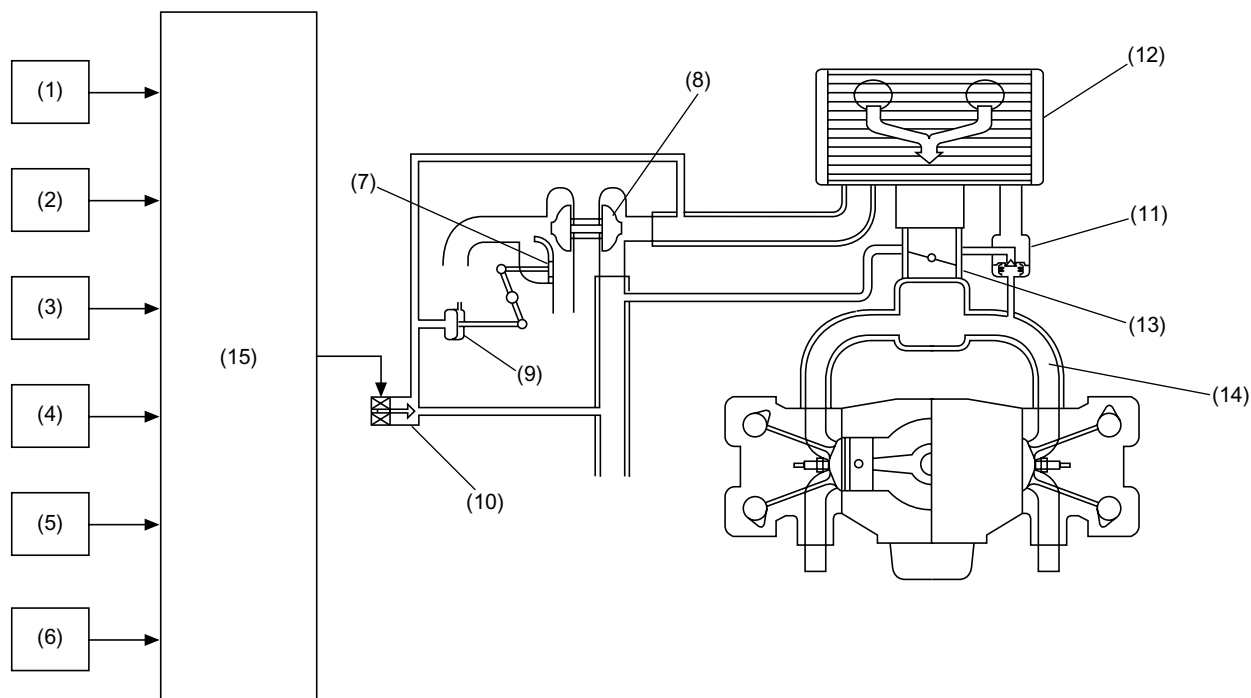
IN-00184

- | | |
|---|---------------------|
| (1) Air intake duct | (A) Outside air |
| (2) Resonator chamber | (B) To turbocharger |
| (3) Air cleaner case | |
| (4) Mass air flow and intake air temperature sensor | |
| (5) Air intake boot | |
| (6) Intake duct | |

2. Turbocharger System

A: GENERAL

- The turbocharger system consists of a water-cooled turbocharger, air-cooled intercooler, wastegate control solenoid valve, etc.
- The turbine wheel, rotated by exhaust gas pressure, rotates the intake air side compressor impeller.
- As a result, the compressor impeller compresses the intake air before it is delivered to the intake manifold.
- This turbocharger system controls the supercharging pressure according to changes in the atmospheric pressure. Even at a high altitude, therefore, the system offers stable performance without being affected by variations in atmospheric pressure.



IN-00046

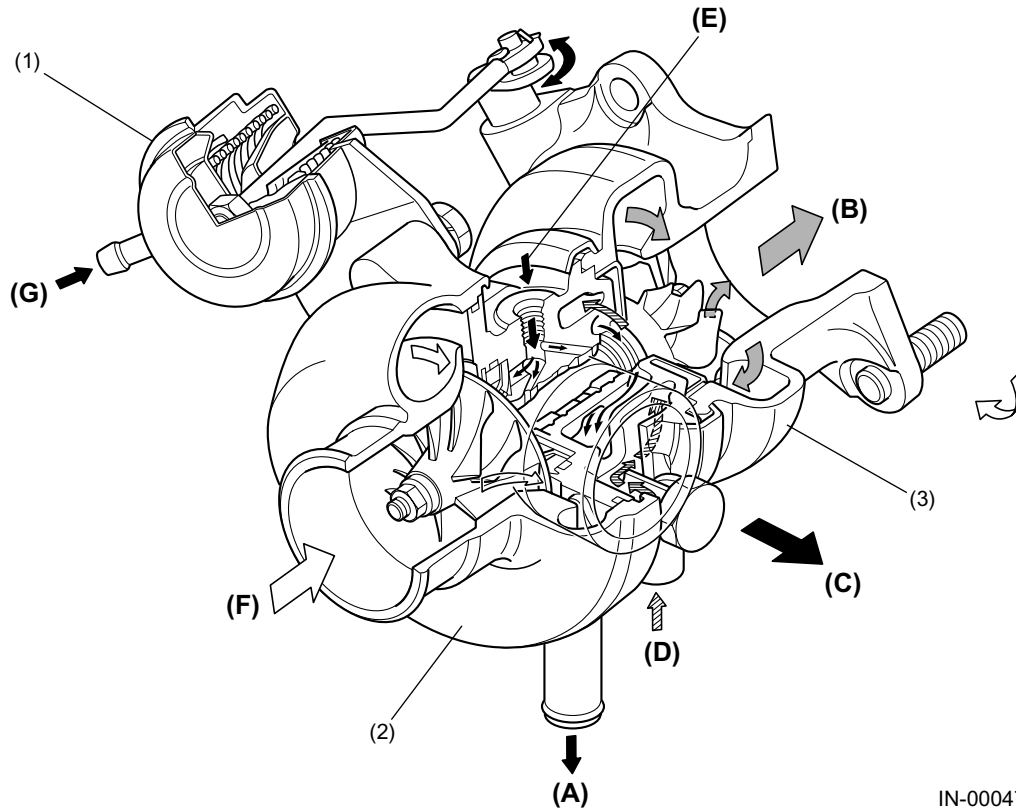
- | | |
|---|---------------------------------------|
| (1) Pressure sensor | (9) Wastegate controller |
| (2) Crankshaft position sensor | (10) Wastegate control solenoid valve |
| (3) Camshaft position sensor | (11) Air bypass valve |
| (4) Throttle position sensor | (12) Intercooler |
| (5) Engine coolant temperature sensor | (13) Throttle body |
| (6) Mass air flow and intake air temperature sensor | (14) Intake manifold |
| (7) Wastegate valve | (15) ECU |
| (8) Turbocharger unit | |

TURBOCHARGER SYSTEM

INTAKE (INDUCTION)

B: TURBOCHARGER UNIT

The turbocharger is water-cooled. It utilizes a wastegate valve to adjust its supercharging pressure to an optimum level. The turbine is housed in a lightweight, thin-wall, heat-resistant casting. The compressor housing is made of thin-wall, aluminum alloy casting. The shaft for turbine and compressor is supported by a full-floating metal bearing system.



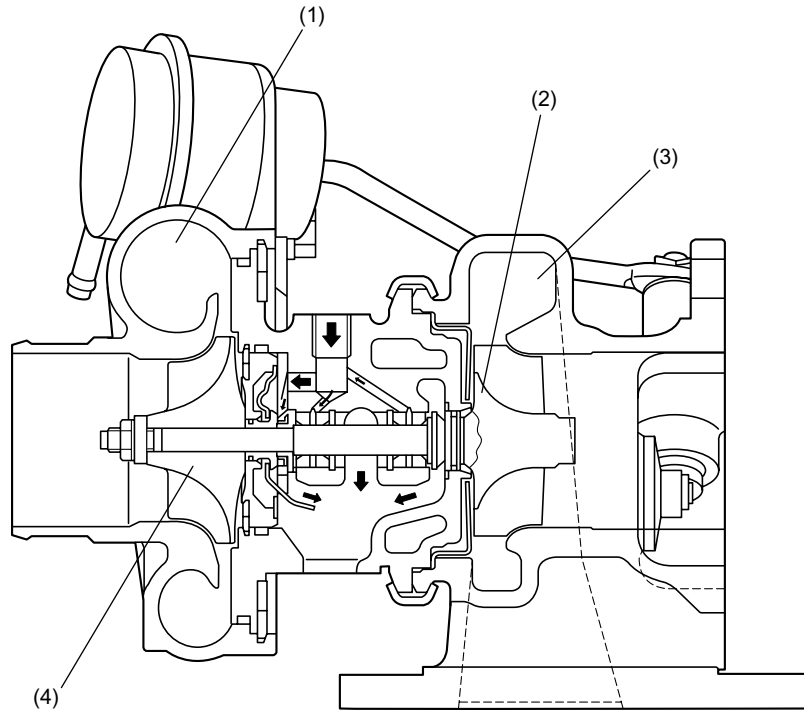
IN-00047

- | | | |
|--------------------------|----------------------------|--|
| (1) Wastegate controller | (A) Lubricating oil outlet | (E) Lubricating oil inlet |
| (2) Compressor housing | (B) Exhaust gas outlet | (F) Air inlet |
| (3) Turbine housing | (C) Air outlet port | (G) Wastegate valve operation pressure |
| | (D) Coolant inlet | |

C: LUBRICATION OF TURBOCHARGER

The turbocharger is lubricated by engine oil branched out from the oil pump. To cope with very high speed of the turbocharger turbine and the compressor shaft which may reach a maximum of several hundred thousands of rpm, full-floating type bearings are used which can form adequate oil films on their inside and outside during running.

Further the oil supplied to the turbocharger also plays a role of cooling the turbine so that heat from exhaust gas does not transmitted to the bearings.



IN-00048

(1) Compressor housing

(2) Turbine wheel

(3) Turbine housing

(4) Compressor impeller

D: COOLING OF TURBOCHARGER

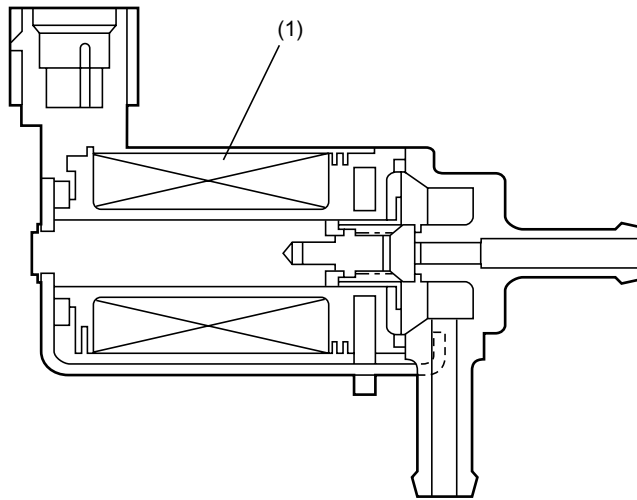
The turbocharger unit is cooled by engine coolant, which enhances the reliability and durability of the unit. The engine coolant from the coolant drain hose located under the cylinder head is led by a pipe to the coolant passage provided in the turbocharger bearing housing. After cooling the bearing housing, the engine coolant is led into the coolant filler tank through a pipe.

TURBOCHARGER SYSTEM

INTAKE (INDUCTION)

E: WASTEGATE CONTROL SOLENOID VALVE

The wastegate control solenoid valve switches the intake air pressure passages to the wastegate controller in response to signals from the ECM. When the solenoid valve is closed, the intake air pressure downstream of the turbocharger unit (supercharged air pressure) is applied to the wastegate controller. When the solenoid valve is opened, the intake air pressure upstream of the turbocharger unit (air pressure not supercharged) is applied to the wastegate controller.



IN-00055

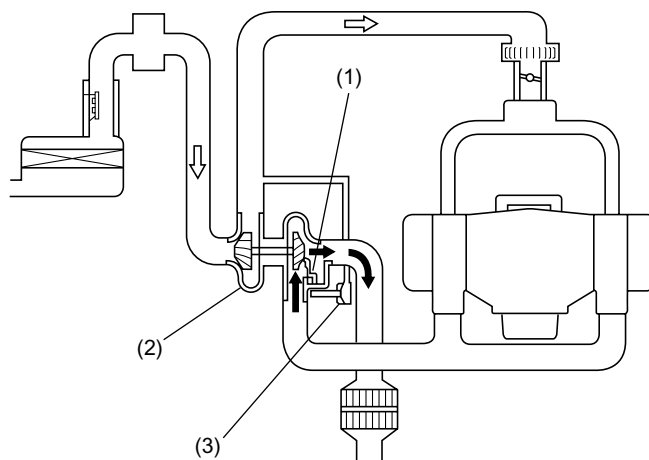
(1) Coil

F: REGULATION OF SUPERCHARGING PRESSURE

1. BASIC FUNCTION OF THE WASTEGATE VALVE

When the engine speed increases as the throttle valve opens, the amount of exhaust gas increases. This increases the speed of the turbine (approx. 20,000 to 150,000 rpm), the supercharging pressure and the engine output.

If the resultant supercharging pressure is extremely high, however, it may cause knocking and an excessively high thermal load on such engine components as pistons. In the worst case, the engine may be damaged or broken. To prevent this, the wastegate valve and its controller are provided. By sensing the supercharging pressure, the wastegate valve controller controls the operation of the wastegate valve to maintain the supercharging pressure below a predetermined level.



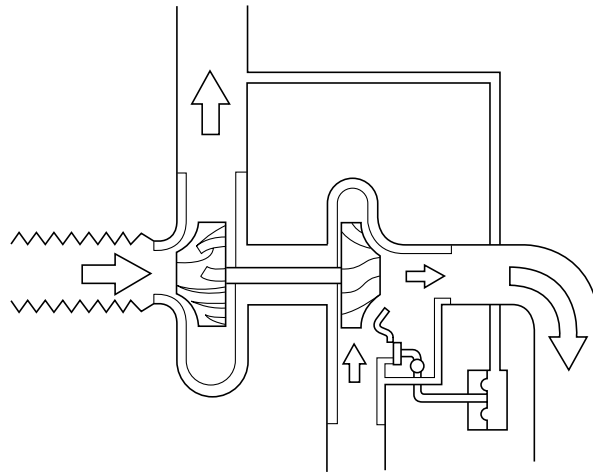
IN-00049

- (1) Wastegate valve
- (2) Turbocharger
- (3) Wastegate valve controller

TURBOCHARGER SYSTEM

INTAKE (INDUCTION)

While the supercharging pressure is lower than the predetermined level, the wastegate valve is closed so that entire exhaust gas is directed to the turbine.



IN-00050

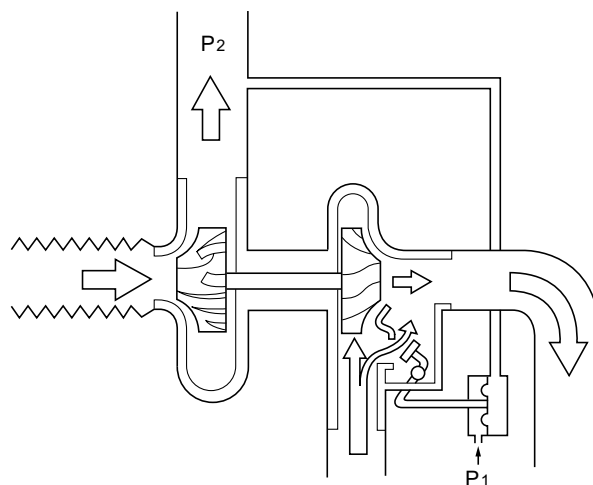
When the supercharging pressure reaches the predetermined level, the wastegate controller lets the supercharging pressure press the diaphragm. This causes the wastegate valve to open through a linkage. With the wastegate valve open, part of the exhaust gas is allowed to flow into the exhaust gas pipe that bypasses the passage to the turbine.

This decreases the exhaust gas pressure that rotates the turbine and keeps the supercharging pressure constant.

- It means $P_2 - P_1 = \text{constant}$.

P_1 : Atmospheric pressure

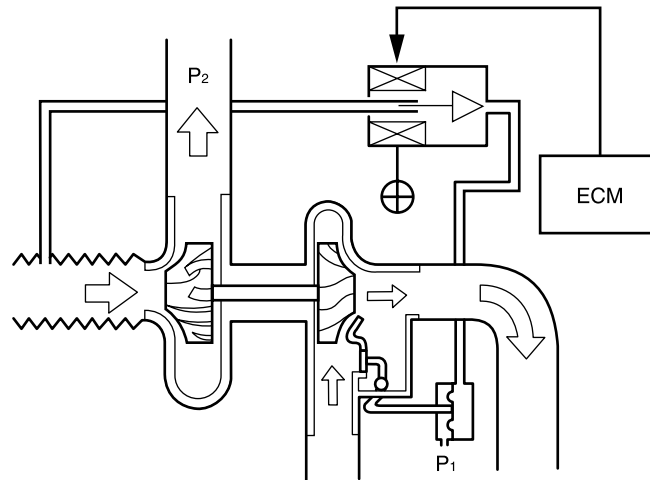
P_2 : Supercharging pressure



IN-00051

2. CONCEPT OF THE WASTEGATE VALVE CONTROL

At high altitudes, the atmospheric pressure (P_1) is low, so that the supercharging pressure (P_2) is also low in a conventional system. The wastegate solenoid valve operates in such a way that a constant supercharging pressure (P_2) is maintained by acting in response to change in the atmospheric pressure.



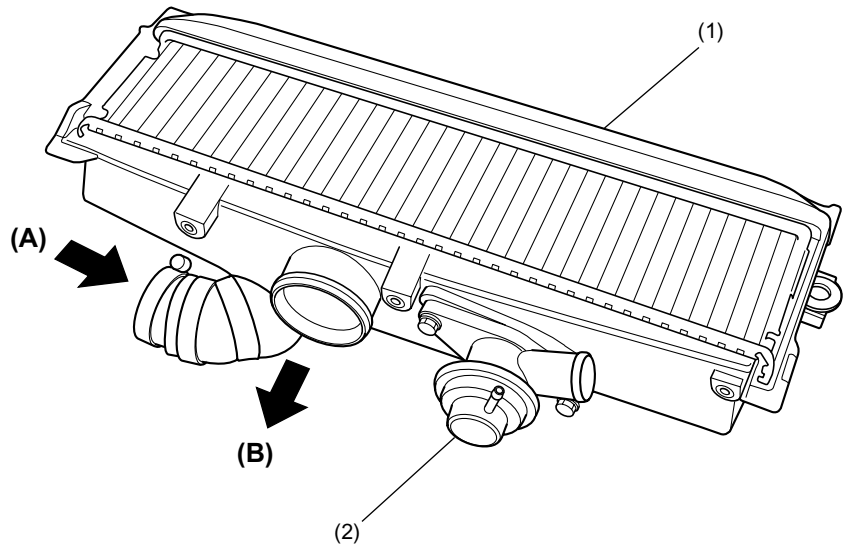
IN-00052

TURBOCHARGER SYSTEM

INTAKE (INDUCTION)

G: INTERCOOLER

- Since the intake air having passed through the turbocharger unit is heated to a very high temperature, the air itself is expanded, resulting in a lower supercharging efficiency. The intercooler is provided just before the throttle body to cool down the intake air and improve the boosting efficiency.
- The intercooler is an air cooled type. The air delivered from the air intake duct provided at the engine hood flows through the core and cools the intake air passing through the intercooler.



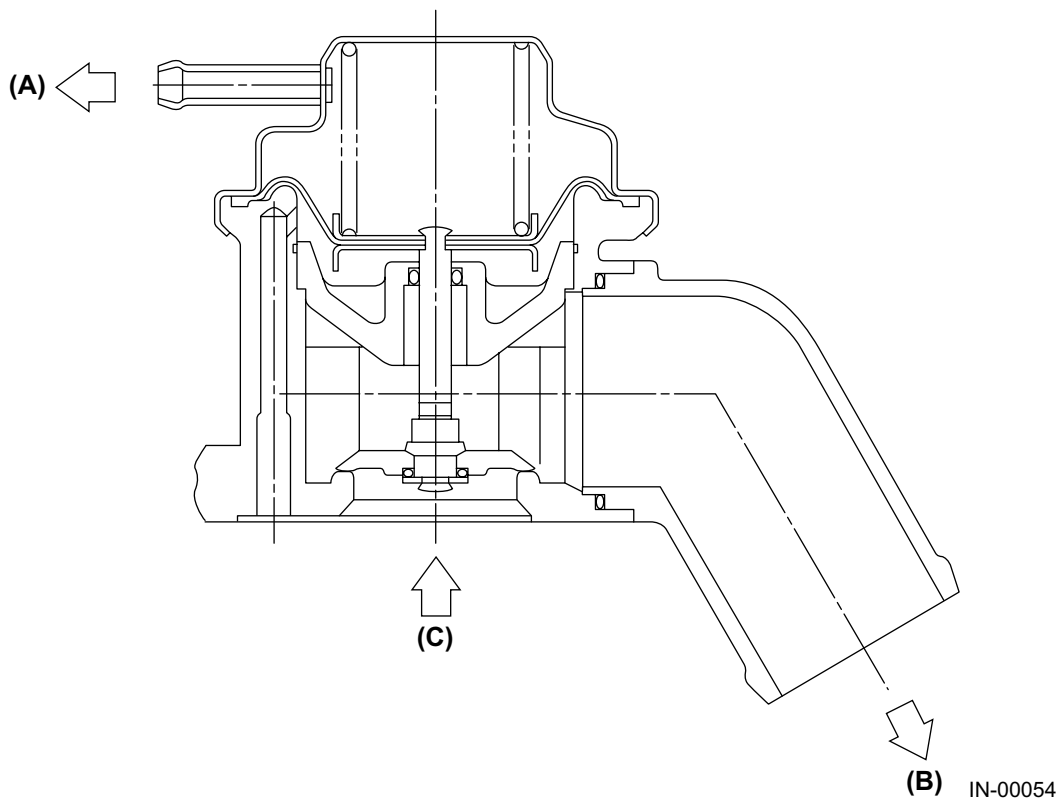
IN-00247

- (1) Intercooler
- (2) Air bypass valve

- (A) From turbocharger
- (B) To throttle body

H: AIR BYPASS VALVE

When a throttle valve is suddenly closed, low air suction noise may occur due to a sudden rise of the air pressure in the passage between the turbocharger and throttle body. To prevent this, an air bypass valve and air passage are provided. The air bypass valve, actuated by the vacuum created by a sudden closure of the throttle valve, allows the suction air to bypass the turbocharger and flow directly upstream, thus lowering the pressure in the air passage.



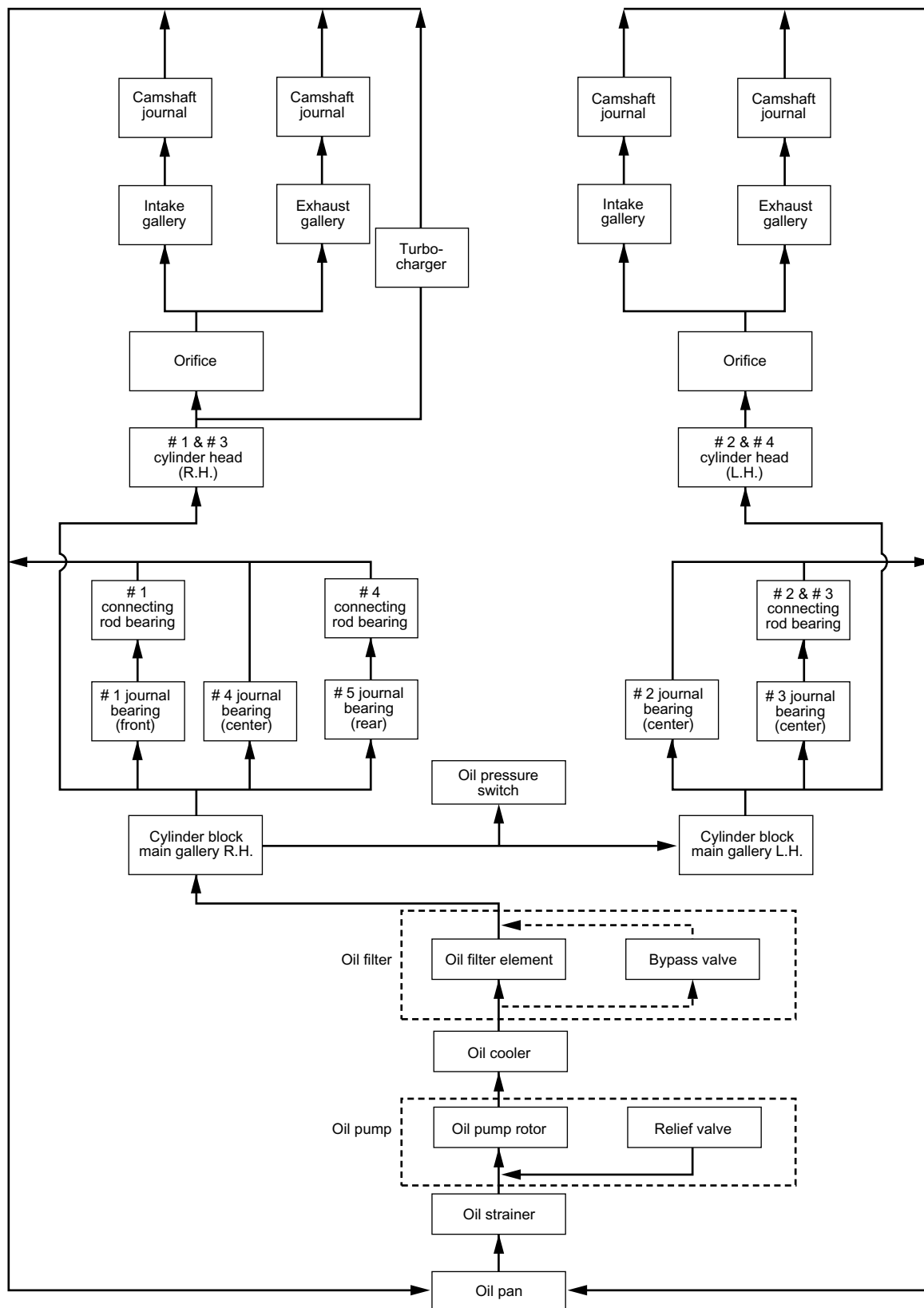
- (A) To intake manifold
- (B) To turbocharger inlet duct
- (C) From intercooler

TURBOCHARGER SYSTEM

INTAKE (INDUCTION)

MEMO

2. Engine Oil Flow



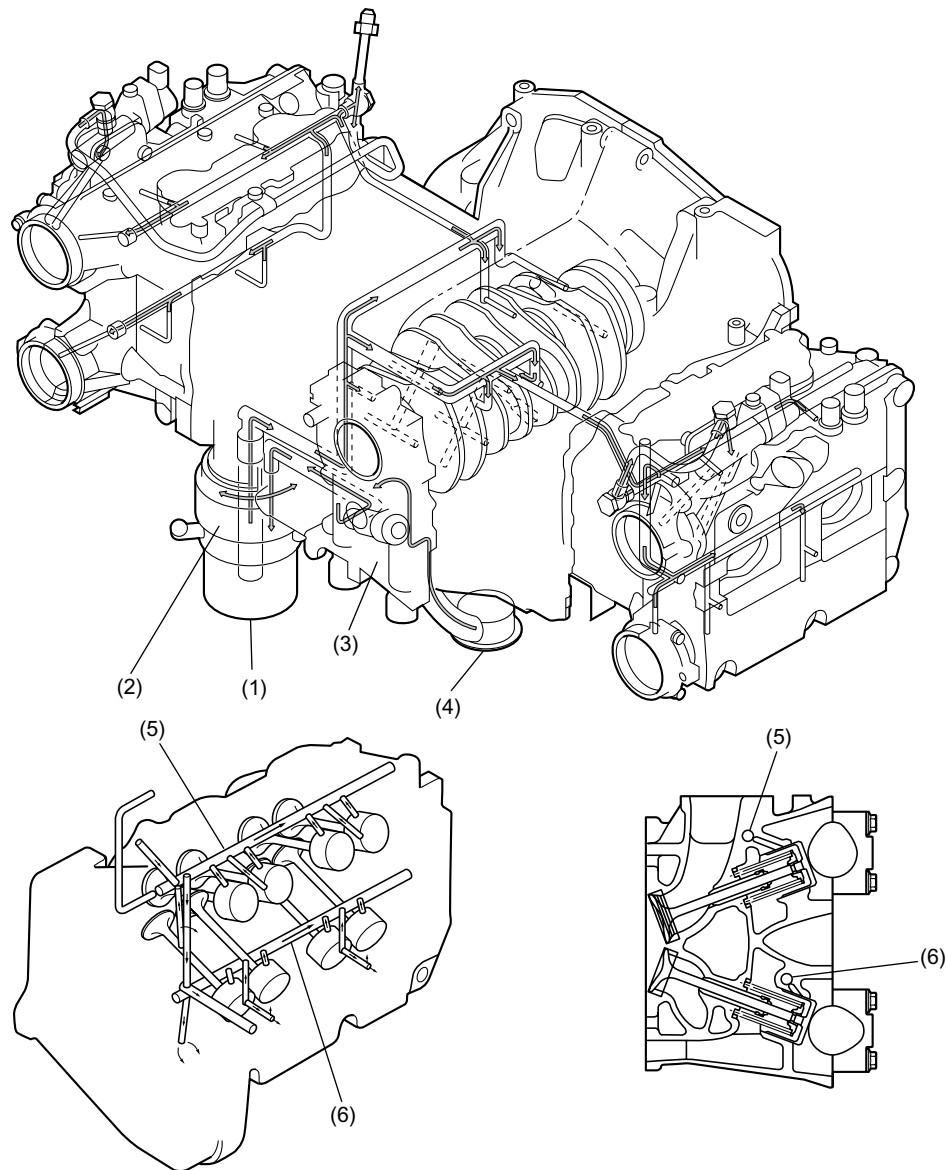
LU-00068

1. General

- The lubrication system force-circulates engine oil throughout the engine using an oil pump. The oil pressure is regulated by the relief valve*¹ built into the oil pump.
- The oil pump is a thin, large-diameter trochoid rotor type which can accommodate the engine's high output. The pump is directly driven by the crankshaft.
- The engine oil is cleaned by a full-flow, paper element type oil filter. The filter has a bypass valve*² which allows the engine oil to flow bypassing the filter if it is clogged.
- The inside of the oil pan is fitted with a baffle plate which reduces changes in the oil level due to movement of the vehicle, thus ensuring uninterrupted suction of oil.
- The engine oil discharged from the oil pump is delivered to the journal bearings, connecting rod bearings, and other parts requiring lubrication and cooling via the vertical passage in the right bank of the cylinder block, the oil filter, and the oil galleries in the right and left banks of the cylinder block.
- The engine oil is also distributed to each cylinder head valve mechanism at a proper flow rate achieved by metering by the orifice provided in each oil gallery.
- An oil cooler is installed to keep the engine oil in an optimum temperature range and prevent degradation of lubrication performance.

*1: Relief valve opening pressure: 588 kPa (6.0 kgf/cm², 85 psi)

*2: Bypass valve opening pressure: 157 kPa (1.6 kgf/cm², 23 psi)



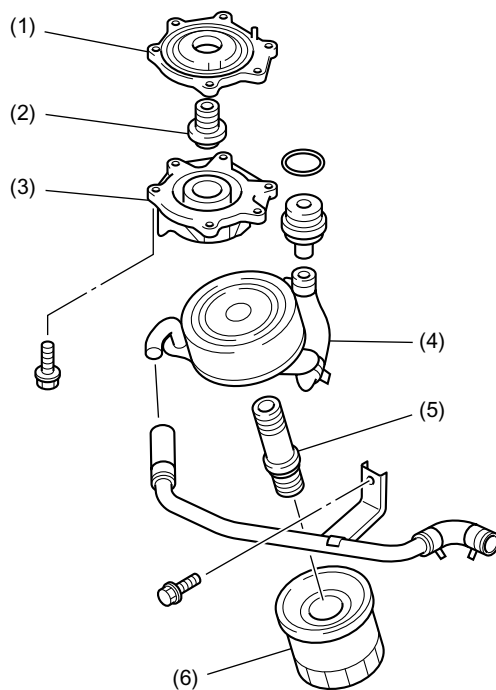
LU-00212

- (1) Oil filter
- (2) Oil cooler (water cooled)
- (3) Oil pump

- (4) Oil strainer
- (5) Intake gallery
- (6) Exhaust gallery

7. Oil Cooler

The oil cooler used in turbo models is of a water cooled type. It serves to maintain engine oil in proper temperature range and so prevent degradation of lubricating oil performance.



LU-00240

- (1) Oil cooler
- (2) Water pipe
- (3) Connector

- (4) Oil filter
- (5) Oil cooler connector
- (6) Oil filter

OIL COOLER

LUBRICATION

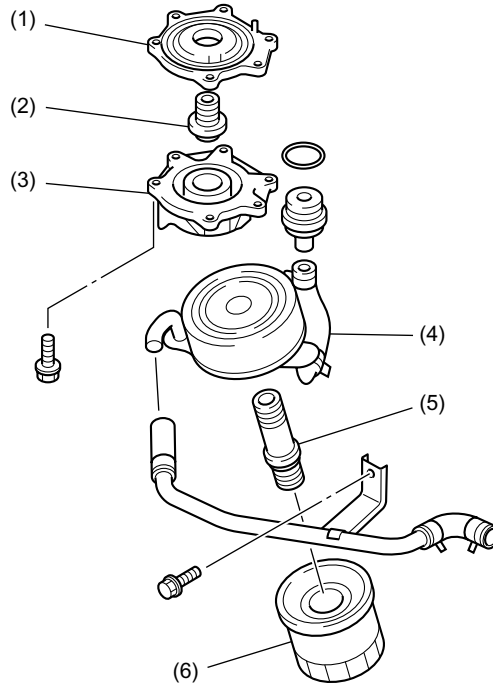
MEMO

OIL FILTER

LUBRICATION

4. Oil Filter

The oil filter is a full-flow filtering, cartridge type that utilizes a paper element. It also has a built-in bypass valve. The filter element has a special pleated design to increase the effective filtering area.

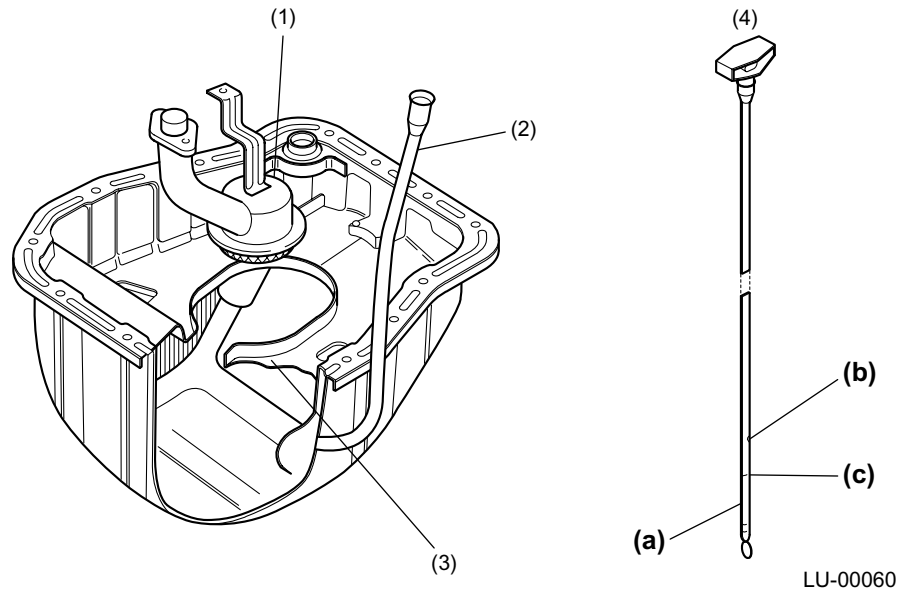


LU-00240

- (1) Oil seal
- (2) Filter body
- (3) Bypass valve
- (4) Pleated element

5. Oil Pan and Oil Strainer

- The oil pan is attached to the cylinder block using liquid gasket for sealing. The oil strainer is a metal net type and removes large foreign particles from the engine oil. It is located in the middle of the oil pan. The pipe from the strainer is connected to the suction port of the oil pump in the left bank of the cylinder block.
- There is a baffle plate in the oil pan, near the bottom of the cylinder block. It stabilizes the oil level and reinforces the oil pan.



- (1) Oil strainer
- (2) Level gauge guide
- (3) Baffle plate
- (4) Oil level gauge

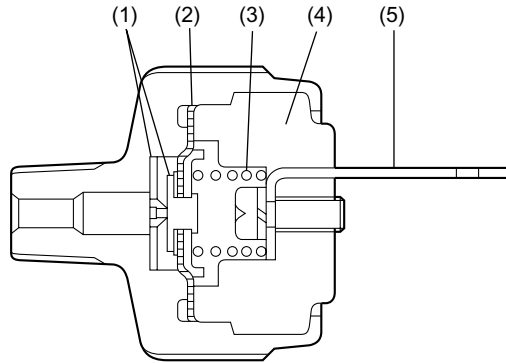
- (a) LOW level
- (b) FULL level (engine HOT condition)
- (c) FULL level (engine cold condition)

OIL PRESSURE SWITCH

LUBRICATION

6. Oil Pressure Switch

The oil pressure switch is located in the front upper portion of the right cylinder block bank. The purpose of this switch is to monitor the operation of the oil pump as well as the lubricating oil pressure when the engine is running.



LU-00061

- | | |
|---------------|--------------------|
| (1) Contact | (4) Molded portion |
| (2) Diaphragm | (5) Terminal |
| (3) Spring | |

1) When oil pressure does not build up (immediately after ignition switch is turned ON):

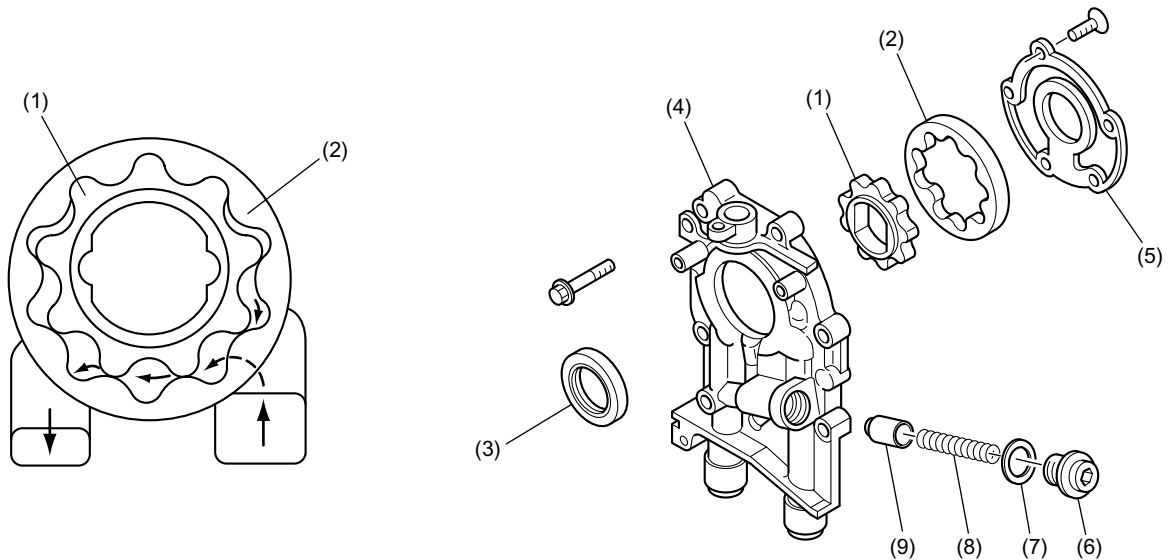
The diaphragm is pushed toward the cylinder block by the spring force (a force equivalent to the specified oil pressure). This closes the contact points, causing the oil pressure warning light in the combination meter to illuminate.

2) When oil pressure reaches the specified value (after engine starts):

After reaching the specified value of 14.7 kPa (0.15 kgf/cm², 2.1 psi), the oil pressure pushes the diaphragm overcoming the spring force. This opens the contact points and the oil pressure warning light goes out.

3. Oil Pump

- The oil pump is a trochoid rotor type consisting of an inner rotor and outer rotor assembled with each other in a pump body. When the inner rotor is driven by the crankshaft, the outer rotor is rotated, changing the space between it and the inner rotor. The change in the space occurs because of the difference in the number of teeth between the rotors.
- Engine oil is carried from the inlet port to the discharge port. As the pump rotates, the space carrying the oil becomes smaller, thus the oil is pressurized and discharged from the outlet port.
- A relief valve is built in the oil pump at its discharge side. When the oil pressure becomes 588 kPa (6.0 kgf/cm², 85 psi) or higher, the relief valve regulates the pressure by sending excessive oil back to the inlet side.



LU-00058

- (1) Inner rotor
- (2) Outer rotor
- (3) Oil seal
- (4) Oil pump case
- (5) Oil pump cover

- (6) Plug
- (7) Gasket
- (8) Relief valve spring
- (9) Relief valve

AUTOMATIC BELT TENSION ADJUSTER

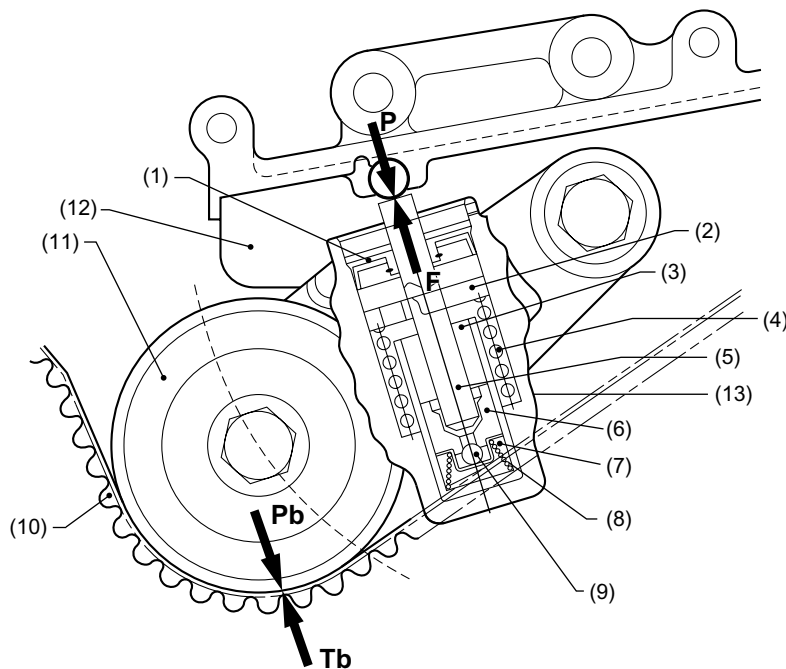
MECHANICAL

3. Automatic Belt Tension Adjuster

The automatic belt tension adjuster consists of a tensioner unit and a bracket. It maintains the timing belt tension automatically at a specified level to enable the belt to transmit power correctly, reduce operating noise and increase the life of the belt.

The cylinder of the tensioner unit incorporates an adjuster rod, wear ring, plunger spring, return spring, check ball and silicone oil.

The automatic belt tension adjuster gives tension to the belt by a levering action which is produced by the push force of the tensioner unit's adjuster rod. It operates in the process detailed below.



ME-00314

- | | |
|---------------------------|--------------------------|
| (1) Oil seal | (8) Plunger spring |
| (2) Wear ring | (9) Check ball |
| (3) Oil reservoir chamber | (10) Timing belt |
| (4) Return spring | (11) Belt tension pulley |
| (5) Adjuster rod | (12) Tensioner bracket |
| (6) Plunger | (13) Cylinder |
| (7) Oil pressure chamber | |

- Timing belt tensioning action

When the belt becomes slack, the adjuster rod is pushed upward by the return spring. The oil in the reservoir chamber, which is pressurized by the plunger spring to a certain level, pushes open the check ball and flows into the oil pressure chamber to keep the pressure constant.

The thrust force F resulting from extension of the adjuster rod applies a counterclockwise torque to the tensioner bracket, which causes the belt tension pulley at its end to turn in the same direction. This applies tensioning pressure P_b to the timing belt.

- Timing belt tension balancing action

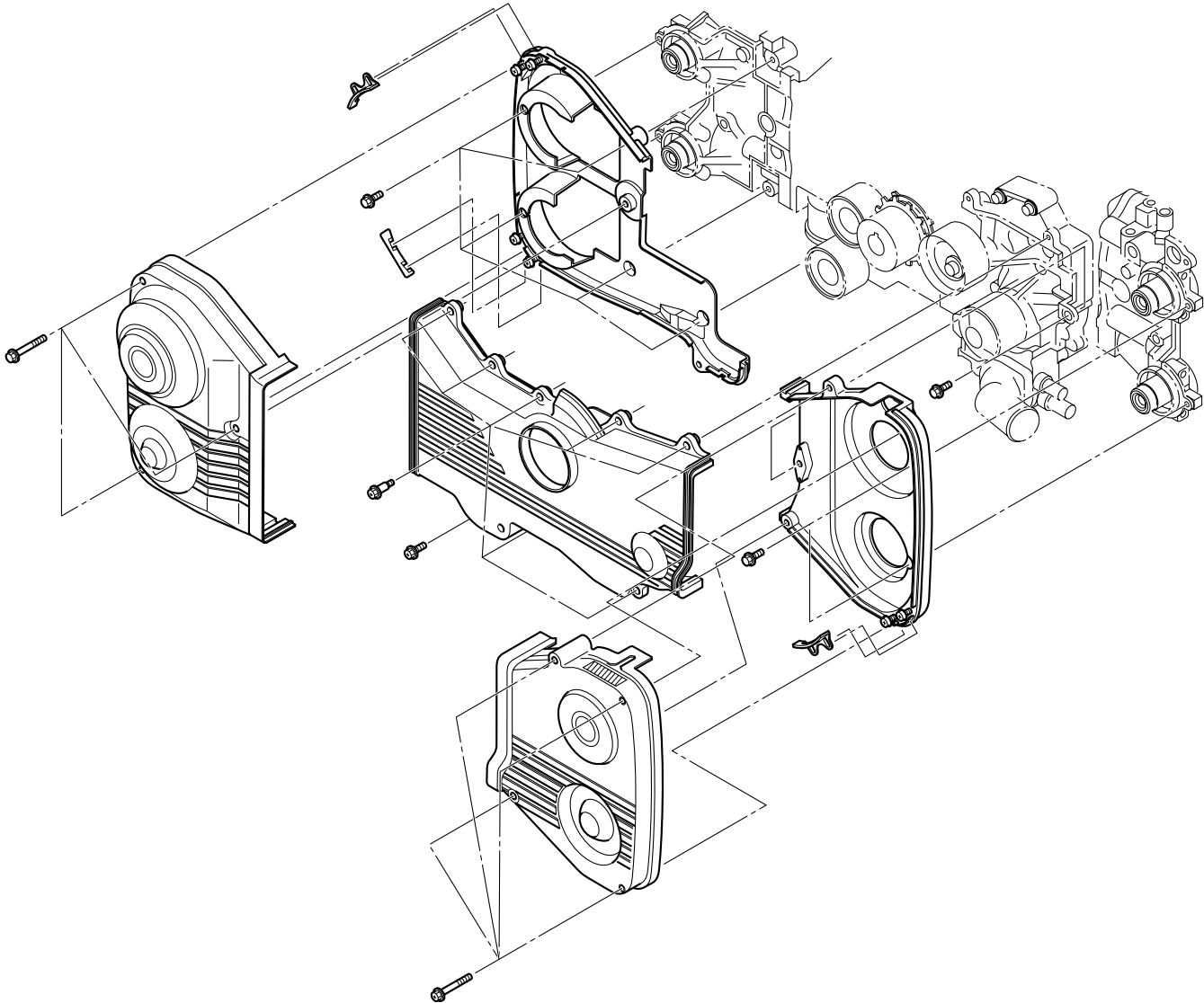
When the belt tension pulley is pushed against the timing belt with pressure P_b , reaction force T_b of the timing belt generates the reaction force P at the point on which the adjuster rod force is acting. This force P pushes the adjuster rod until it balances with the sum of the thrust force F and the pressure of the oil in the oil pressure chamber. Therefore, the timing belt tension is kept constant.

- Over-tension correction action

If the tension of the timing belt increases excessively, the force P becomes larger than the thrust force F and silicone oil is returned from the oil pressure chamber to the reservoir chamber little by little until the force P balances again with the thrust force F . Thus the timing belt tension is maintained at the specified level at all times.

4. Belt Cover

- The belt cover is made of lightweight, heat resistant synthetic resin molding. It constitutes a totally enclosed housing with its cylinder block mating edges sealed with rubber gaskets. This effectively protects the inside components from dust and liquid.
- Rubber seals used between the cylinder block and the belt cover effectively reduces transmission of noise and vibration.
- The front belt cover has a line mark for ignition-timing checking.



ME-00792

5. Camshaft

The DOHC engine uses four camshafts in all; intake and exhaust camshafts on each of the right and left banks.

The camshafts are of a composite material type using sintered steel for cam lobes and carbon steel for pipe part.

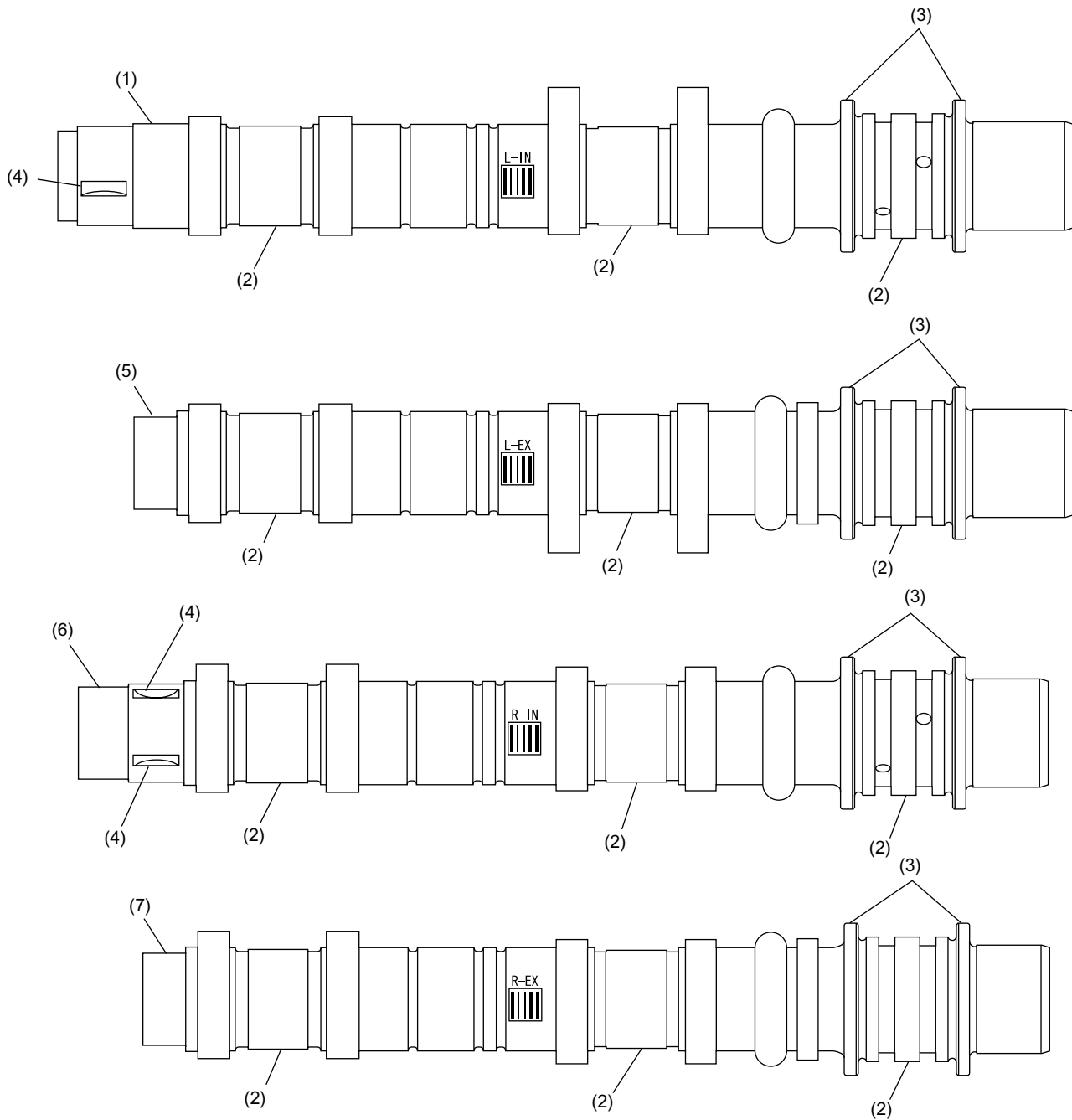
The sintered steel cams are very high in the resistance to wear, which enables the cam lift to be increased. In addition, use of the sintered steel cams contributes to reduction in weight.

Each camshaft is supported at its three journals and held in position by three camshaft caps. Each camshaft has a flange which fits in the corresponding groove in the cylinder head to receive thrust forces generated in the camshaft.

Each intake camshaft has slots (notches) at the rear end for the variable valve timing position sensor.

CAMSHAFT

MECHANICAL

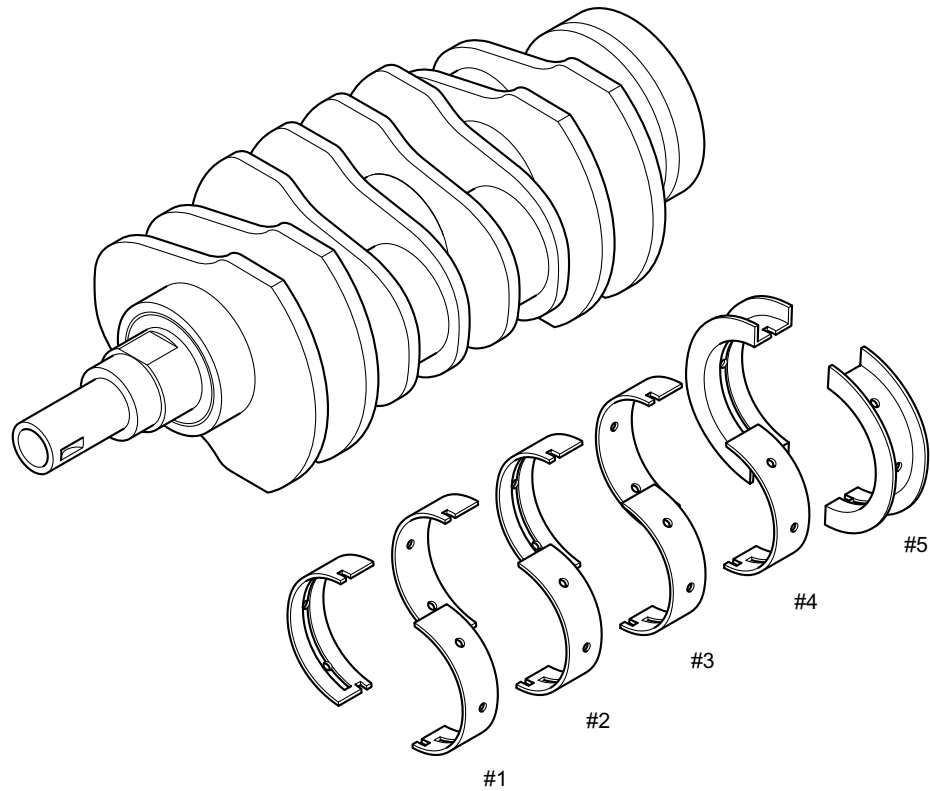


ME-00790

- | | |
|--|-------------------------|
| (1) Intake camshaft LH | (5) Exhaust camshaft LH |
| (2) Journal | (6) Intake camshaft RH |
| (3) Flange | (7) Exhaust camshaft RH |
| (4) Slot (notch) for variable timing position sensor | |

8. Crankshaft

The crankshaft is supported in the cylinder block by five bearings. Each corner formed by a journal or pin and a web is finished by fillet-rolling method which increases strength of that area. The five crankshaft bearings are made of aluminum alloy and the No. 5 bearing is provided with a flanged metal to support thrust forces.



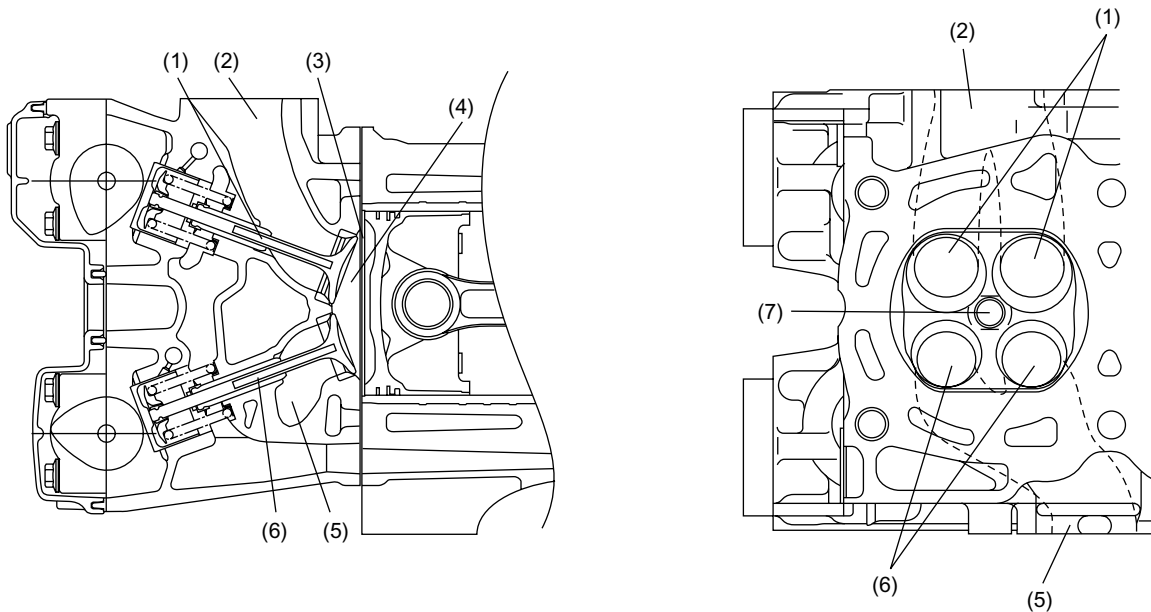
ME-00319

7. Cylinder Block

- With the 2.5 L turbo engine that generates increased torque outputs, the cylinder block uses a semi-closed deck design which can hold the cylinder liners with higher rigidity.
- The cylinder liners are made of cast iron. They are dry type which means their outer surfaces are entirely in contact with the cylinder block.
- The cylinder block supports the crankshaft at its five journals. The journal supporting portions are designed such that sufficient stiffness and quiet operation are ensured.
- Sintered material is fit in the casting at the #5 journal to achieve further quietness.
- The oil pump is located in the front center of the cylinder block and the water pump is located at the front of the left-cylinder bank. At the rear of the right-cylinder bank is an oil separator which removes oil mist contained in blow-by gas.

6. Cylinder Head

- The cylinder head is made of cast aluminum.
- Each combustion chamber in the cylinder head is a compact, pentroof design. The spark plug is located at the center of the combustion chamber, which contributes to creation of a wide “squish area” for increased combustion efficiency.
- The two intake and two exhaust valves are arranged on opposite sides for a cross-flow feature.
- The cylinder head gasket is a metallic gasket consisting of three layers of the stainless steel sheets. The gasket is highly resistant to heat and maintains high level of sealing performance for a long period.

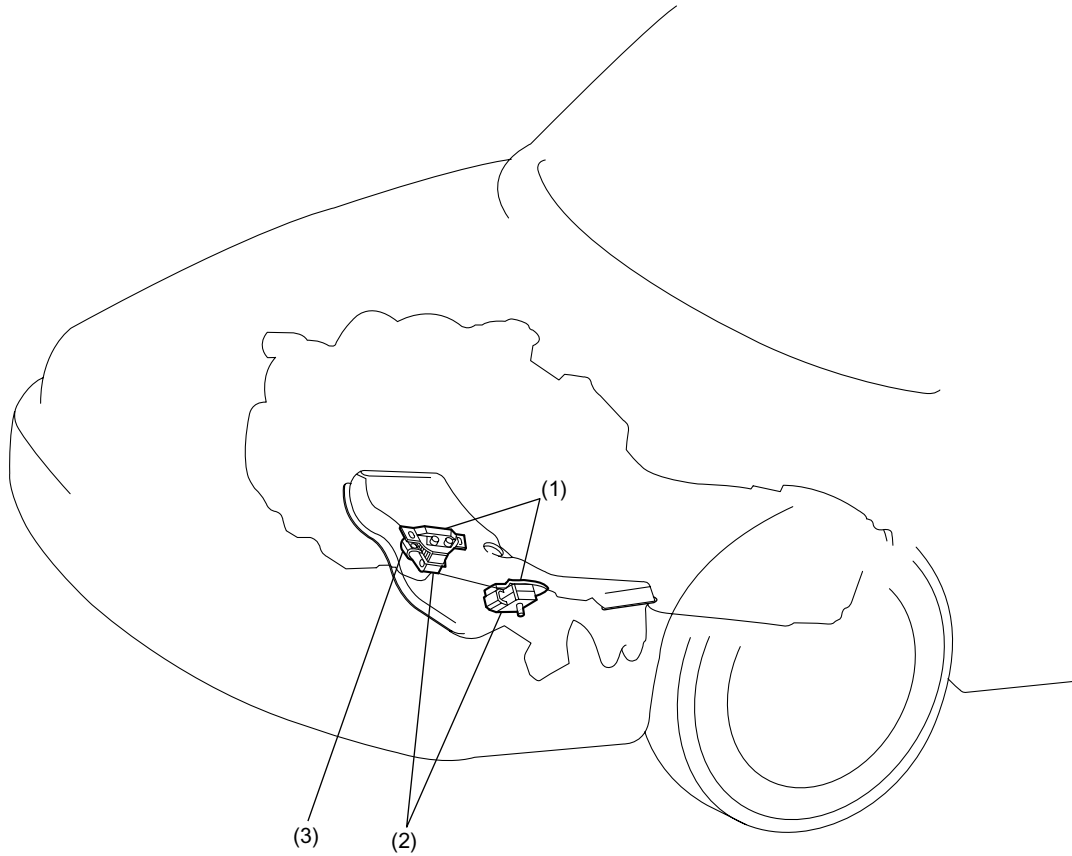


ME-00793

- (1) Intake valve (hollow type)
- (2) Intake port
- (3) Squish area
- (4) Combustion chamber

- (5) Exhaust port
- (6) Exhaust valve (sodium-filled)
- (7) Spark plug

12.Engine Mounting



ME-00797

- (1) Bracket
- (2) Cushion rubber
- (3) Heat shield cover (RH side only)

ENGINE MOUNTING

MECHANICAL

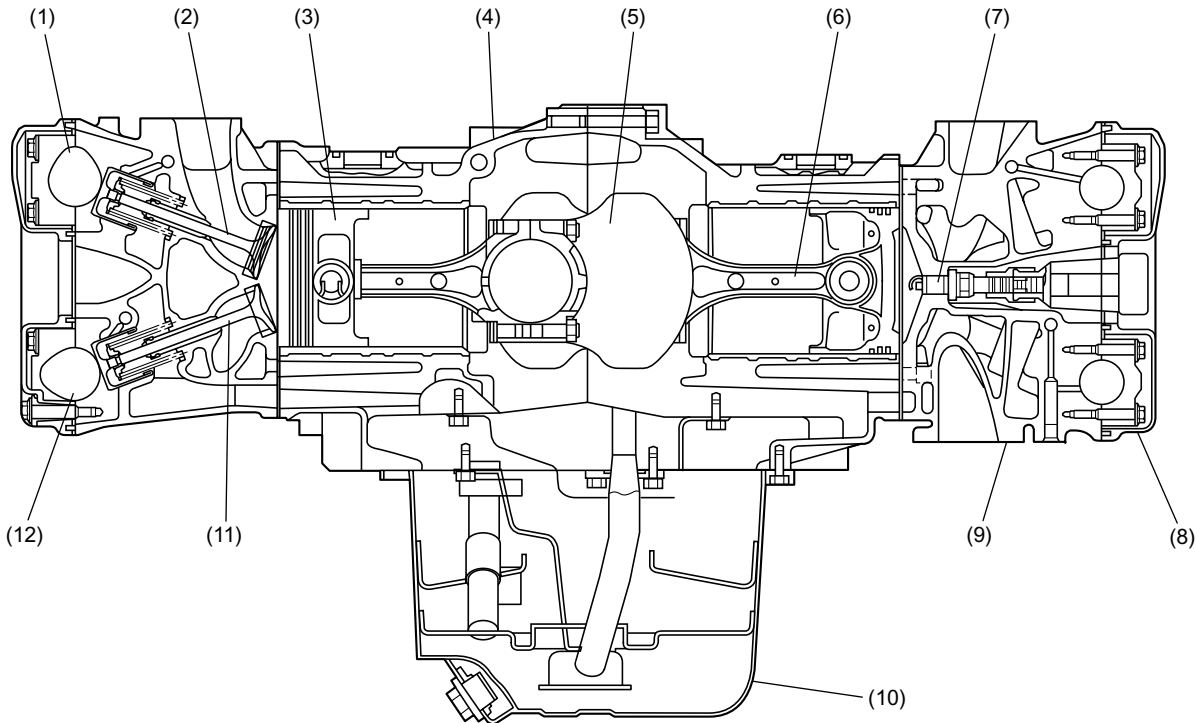
MEMO

1. General

The engine used in this vehicle is of a horizontally opposed, four-cylinder design. This four-stroke-cycle, water-cooled, DOHC turbocharged engine uses a total of 16 valves and its main components are made of aluminum alloy. It is fueled by a multiple fuel injection system.

The engine's major structural and functional features are as follows:

- The cylinder head forms pentroof combustion chambers, each having a spark plug located at its center and two each of intake and exhaust valves (four valves per cylinder). The intake and exhaust ports are located in a cross-flow arrangement.
- A single timing belt drives four camshafts on the left and right banks and the engine coolant pump on the left bank. Belt tension is automatically adjusted by a belt tension adjuster, eliminating need for a manual adjustment.
- The crankshaft is supported by five bearings with high rigidity and strength.
- The cylinder block is made of cast aluminum and fitted with cast iron cylinder liners.

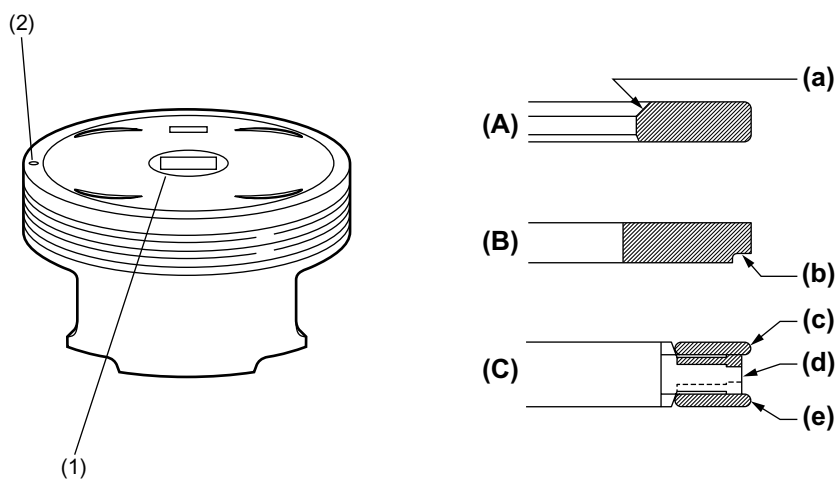


ME-00761

- | | | |
|---------------------|------------------------|-----------------------|
| (1) Intake camshaft | (5) Crankshaft | (9) Cylinder head |
| (2) Intake valve | (6) Connecting rod | (10) Oil pan |
| (3) Piston | (7) Spark plug | (11) Exhaust valve |
| (4) Cylinder block | (8) Valve rocker cover | (12) Exhaust camshaft |

9. Piston

- The pistons are of a slipper skirt design for reduced weight and friction. The oil control ring groove utilizes a thermal design.
- The piston pin is offset either downward (Nos. 1 and 3 pistons) or upward (Nos. 2 and 4 pistons).
- The piston head has recesses to prevent interference with the intake and exhaust valves. It also has engraved marks to identify the piston size and the direction of installation. All the pistons are common in their design.
- Three piston rings are used for each piston — two compression rings and one oil control ring. The top piston ring has inner bevels and the second piston ring has a cut on the bottom outside to reduce oil consumption.



ME-00791

- (1) Identification mark
(2) Location mark (engine front side)

- (A) Top ring
(B) Second ring
(C) Oil ring

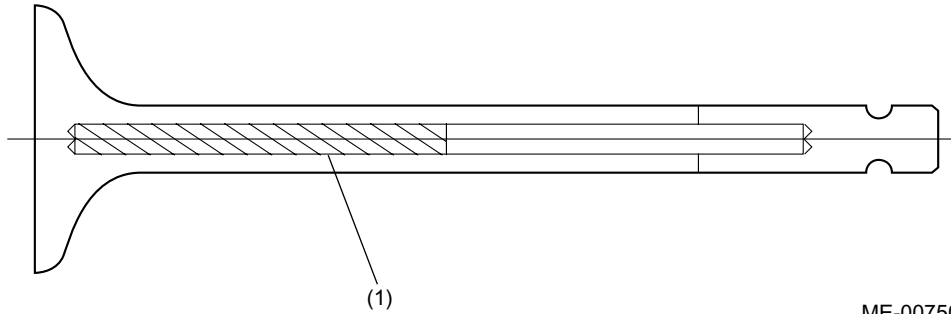
- (a) Inner-bevel
(b) Cut
(c) Upper rail
(d) Spacer
(e) Lower rail

SODIUM-FILLED EXHAUST VALVES

MECHANICAL

11.Sodium-filled Exhaust Valves

Each exhaust valve contains pure sodium in its hollow stem. Sodium has high thermal conductivity. The entrapped sodium will liquefy at high temperatures and move inside the stem as the valve is operated. Thus the sodium will effectively transfer heat from the valve head to the valve stem, contributing to cooling down the valve head faster.

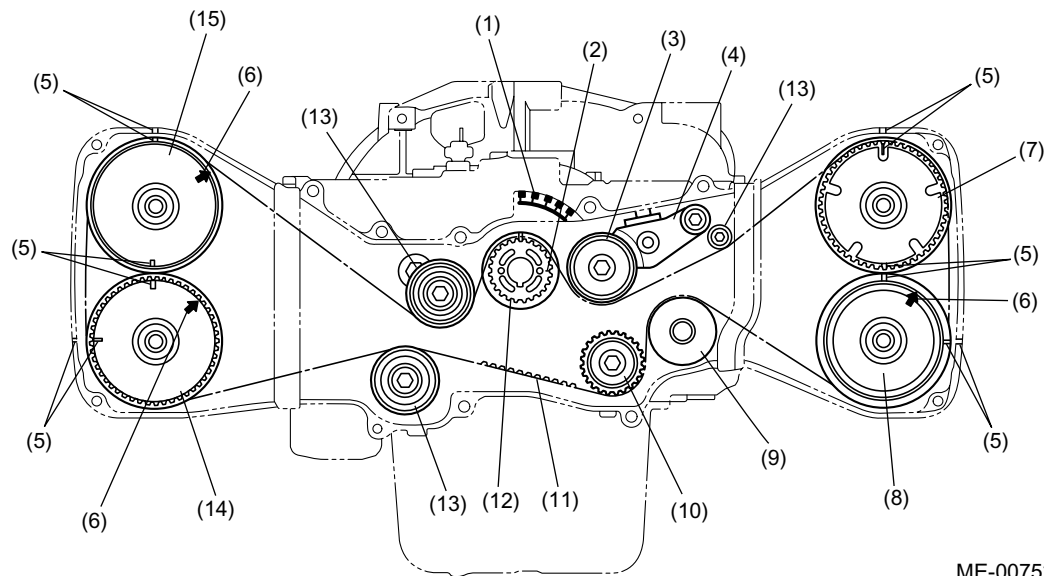


ME-00750

(1) Pure sodium

2. Timing Belt

- A single timing belt drives four camshafts (intake and exhaust camshafts on each bank). The belt also drives the water pump by its non-toothed side.
- The timing belt teeth have a specially designed round profile which contributes to quiet operation. The timing belt is made of strong and inflexible core cords, wear-resistant canvas and heat-resistant rubber material.
- A hydraulic automatic belt tension adjuster always keeps the belt taut to the specified tension. Any manual belt tension adjustment is unnecessary.



ME-00752

- | | |
|---|-----------------------------------|
| (1) Timing indicator (for timing mark of crankshaft pulley) | (9) Water pump pulley |
| (2) *Piston position mark | (10) Idler No. 2 |
| (3) Belt tension pulley | (11) Timing belt |
| (4) Automatic belt tension adjuster assembly | (12) Crankshaft sprocket |
| (5) Alignment mark | (13) Idler |
| (6) **Piston position mark | (14) Exhaust camshaft sprocket RH |
| (7) Intake camshaft sprocket LH | (15) Intake camshaft sprocket RH |
| (8) Exhaust camshaft sprocket LH | |

NOTE:

*: The #1 piston is set at the top dead center (TDC) when the piston-position mark on the crankshaft sprocket is aligned with the mark on cylinder block.

**: The #1 piston is set at TDC on the compression stroke when the piston-position mark on the camshaft sprocket is facing directly upward.

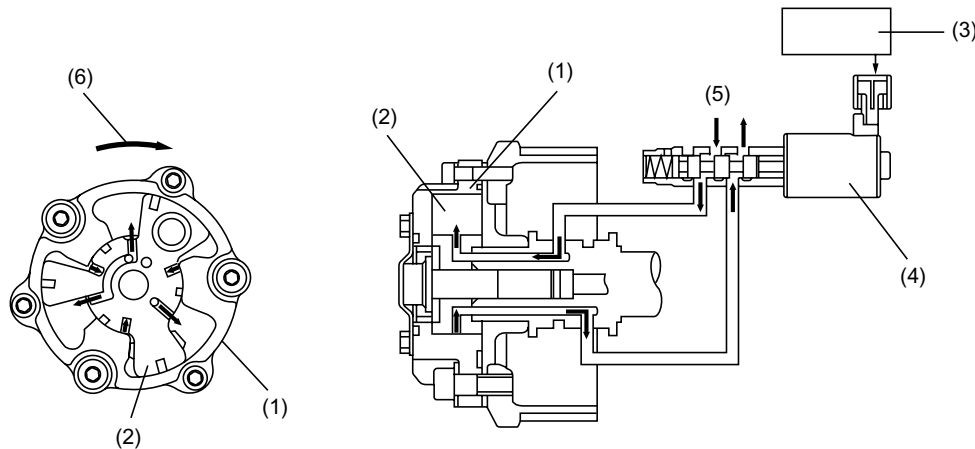
10. Variable Valve Timing System

This engine has a variable valve timing system, which adjusts the opening and closing timings of the intake valves optimally by continuously changing the phase angle of the camshaft sprocket relative to the camshaft.

- The ECM determines the optimal cam angle relative to the crank angle by making reference to the engine speed, vehicle speed, throttle opening and other relevant parameters.
- Under the control of the ECM, the oil flow control solenoid valve moves its spool to switch the hydraulic passage to/from the advance and retard chambers that are formed in the camshaft sprocket to change continuously the phase angle between the camshaft sprocket and camshaft.

A: PHASE ANGLE ADVANCES

In response to an advance signal from the ECM, the oil flow control solenoid valve moves its spool such that hydraulic pressure is applied to the advance chamber in the camshaft sprocket. The sprocket is then turned in the direction in which its phase angle advances relative to the camshaft.



ME-00747

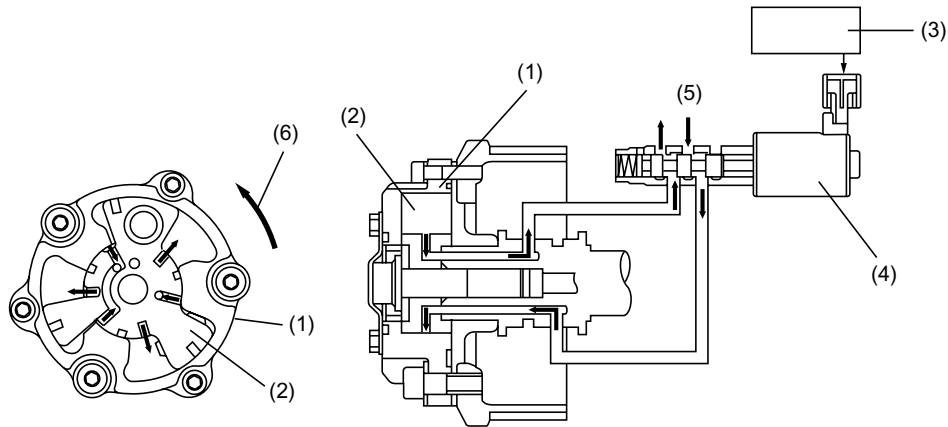
- (1) Variable valve timing controller (attached to camshaft sprocket)
- (2) Vane (attached to intake camshaft)
- (3) ECM
- (4) Oil flow control solenoid valve
- (5) Oil pressure
- (6) Turns in advance direction

VARIABLE VALVE TIMING SYSTEM

MECHANICAL

B: PHASE ANGLE RETARDS

In response to a retard signal from the ECM, the oil flow control solenoid valve moves its spool such that hydraulic pressure is applied to the retard chamber in the camshaft sprocket. The sprocket is then turned in the direction in which its phase angle retards relative to the camshaft.

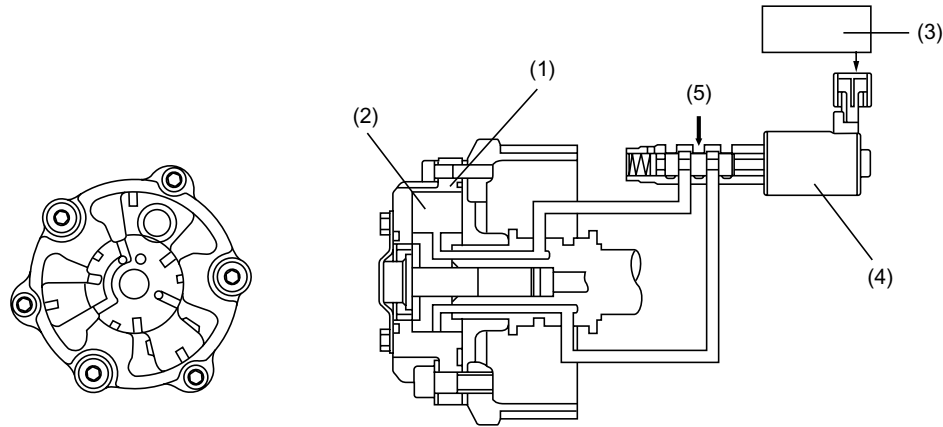


ME-00748

- (1) Variable valve timing controller (attached to camshaft sprocket)
- (2) Vane (attached to intake camshaft)
- (3) ECM
- (4) Oil flow control solenoid valve
- (5) Oil pressure
- (6) Turns in retard direction

C: A CERTAIN PHASE ANGLE IS RETAINED

When the ECM issues a signal to keep the phase angle unchanged, the oil flow control solenoid valve moves its spool to the position at which the hydraulic pressures to/from both the chambers are blocked. The pressures in the chambers are thus maintained, so the phase angle does not change and the intake valves' opening and closing timings also remain unchanged.



ME-00749

- (1) Variable valve timing controller (attached to camshaft sprocket)
- (2) Vane (attached to intake camshaft)
- (3) ECM
- (4) Oil flow control solenoid valve
- (5) Oil pressure

1. General

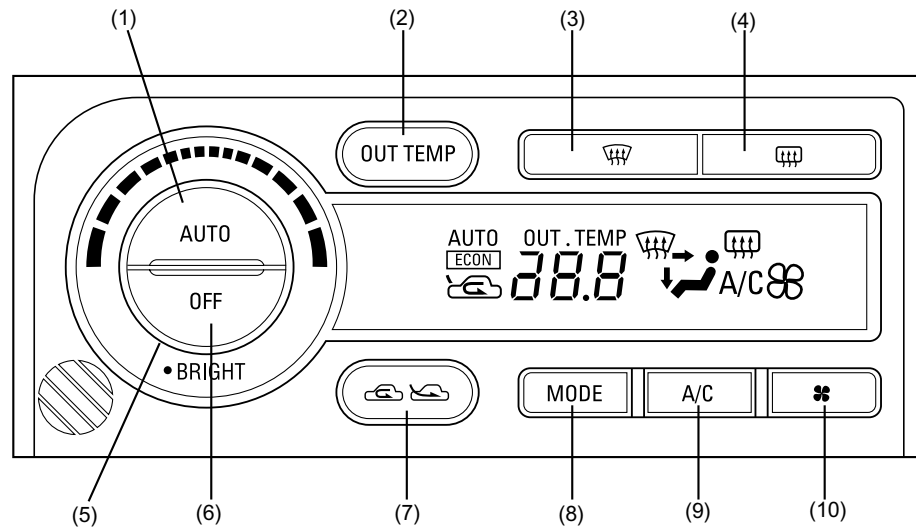
Specifications for DOHC turbo models are the same as those for SOHC models. <Ref. to SC(H4SO) section.>

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

17. Automatic Air Conditioning

A: SWITCH FUNCTIONS



AC-00292

- | | |
|--|--------------------------|
| (1) AUTO switch | (6) OFF/BRIGHT switch |
| (2) Ambient temperature display switch | (7) FRESH/RECIRC switch |
| (3) Defroster switch | (8) Mode selector switch |
| (4) Rear defogger switch | (9) A/C switch |
| (5) Temperature set switch | (10) Blower fan switch |

NOTE:

The beeper for button operation confirmation has been discontinued.

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

1. OPERATION OF AUTO CONTROL

- **AUTO switch:** When this switch is pressed (ON), the air outlet selection, blower fan speed, air temperature, fresh/recirculation switching, and compressor operation are automatically controlled. When the AUTO switch is pressed second time, the compressor operates in the ECON mode. In the ECON mode, the ECM controls compressor operation based on inputs from the intake air temperature sensor. Compressor operating time in the ECON mode is shorter than in the AUTO mode.

- **Temperature set switch:** A desired cabin temperature can be set in 0.5°C (0.9°F) increments.

- **OFF/BRIGHT switch:** When this switch is pressed, the blower fan and compressor stop and all the indicators go out.

Setting the light switch to the  or  position causes the illuminating icons on the display panel to dim. When traveling with the lights on in gloomy daylight or in twilight, press the OFF switch for 1 second or longer if you feel it is too hard to identify the icons clearly. The brightness comes back to normal.

2. MANUAL OPERATION

- **A/C switch:** The air-conditioner turns on when this switch is pressed first and turns off when it is pressed second time.

- **Blower fan switch:** Fan speed changes in the order of Lo, M1, M2 and Hi, every time it is pressed.

- **Ambient temperature display switch:** When this switch is pressed momentarily, the ambient temperature is indicated on the display for 5 seconds. When this switch is depressed for more than 1 seconds, the ambient temperature is continuously indicated.

- **Defroster switch:** Air is directed to the windshield for defrosting when this switch is pressed.

- **Rear defogger switch:** Pressing this switch causes the rear defogger to operate for 15 minutes.

- **FRESH/RECIRC switch:** Every time this switch is pressed, switching takes place between fresh air introduction and inside air recirculation alternately.

- **Mode selector switch:** Pressing this switch changes the outlets to which the air is directed in the order shown below.



AC-00293

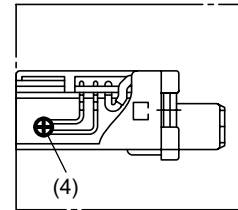
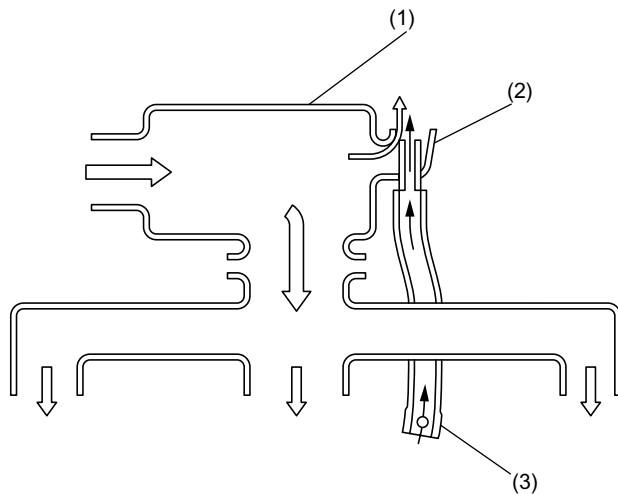
AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

B: CABIN TEMPERATURE SENSOR

The cabin temperature sensor sends signals to the ECM.

This sensor consists of an aspirator and a thermistor, the resistance of which changes in inverse proportion to the temperature. The aspirator uses the vacuum created by the heater unit to direct cabin air to the thermistor. (The cabin temperature sensor, therefore, functions only while the blower fan is in operation.)



AC-00294

- (1) Heater unit
- (2) Aspirator
- (3) Cabin temperature sensor
- (4) Thermistor

AUTOMATIC AIR CONDITIONING

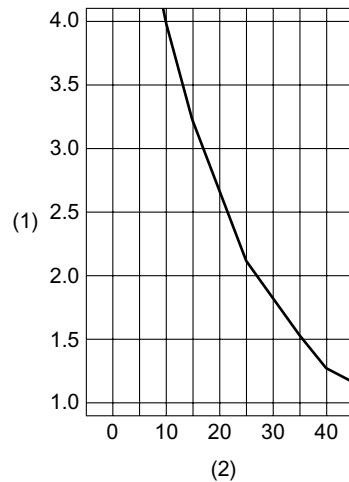
HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

C: AMBIENT TEMPERATURE SENSOR

This sensor uses a thermistor to detect the ambient temperature and sends signals the ECM.

The thermistor can detect only an average temperature of the outside air but cannot respond to sharp changes in the temperature because its exterior is made of a plastic to increase the thermal capacity.

The ambient temperature sensor is located on the radiator stay behind the front grille for efficient exposure to the outside air.



AC-00295

(1) Resistance (kΩ)

(2) Temperature (°C)

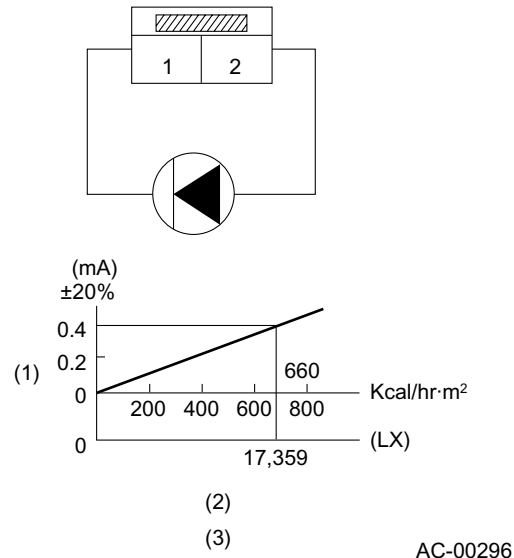
AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

D: SUN-LOAD SENSOR

A photodiode is used in the sun-load sensor. The photodiode detects changes in the sunbeam intensity and converts the results into current signals to send to the ECM.

The sun-load sensor is built into the front defroster grille.



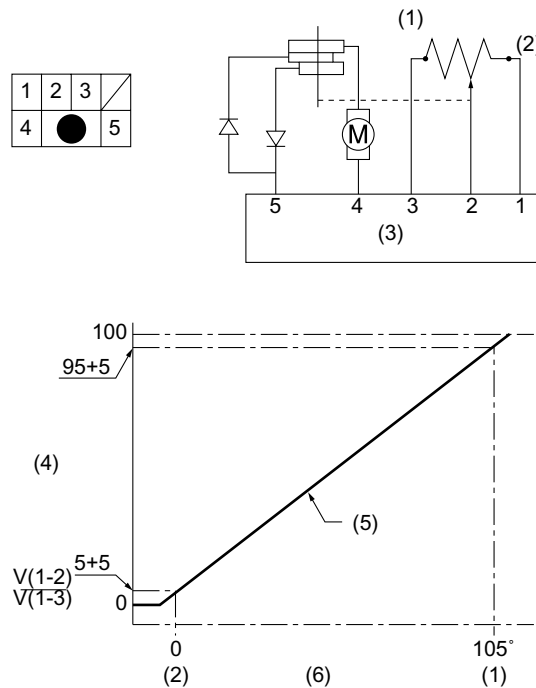
AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

E: AIR MIX SERVO MOTOR

According to signals from the ECM, the servo motor forming integral part of the air mix damper rotates in one or the other direction to change the opening of the damper via a link.

The motor has a built-in potentiometer which detects the opening of the air mix damper and sends the result to the ECM.



AC-00297

- (1) Full HOT
- (2) Full COOL
- (3) ECM

- (4) Outlet voltage ratio (%)
- (5) Reference line
- (6) Rotating angle (°)

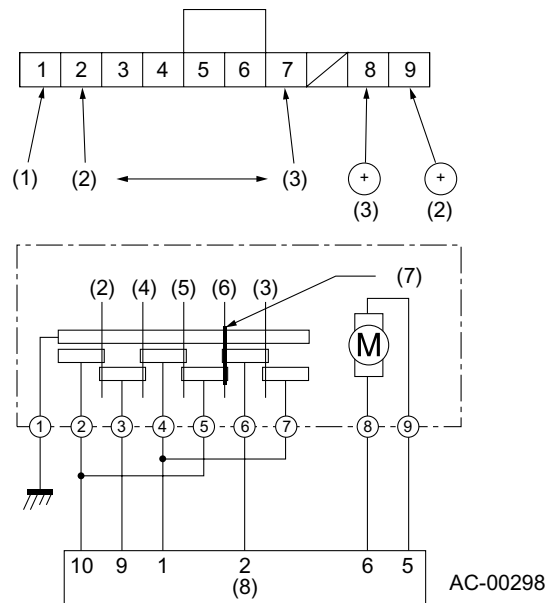
AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

F: AIR OUTLET SWITCHING SERVO MOTORS

According to signals from the ECM, the servo motor incorporated into each air outlet switching damper rotates in one or the other direction to open or close the damper via a link to control the air from the corresponding outlet(s).

Each motor has a built-in potentiometer which detects the position of its damper and send the result to the ECM.



- (1) Ground
- (2) VENT
- (3) DEF
- (4) BILEVEL

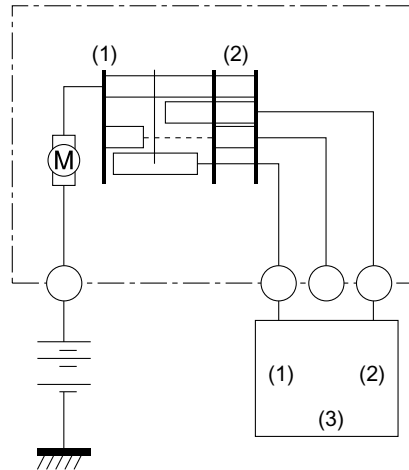
- (5) HEAT
- (6) DEF/HEAT
- (7) Brush
- (8) ECM

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

G: FRESH/RECIRC SWITCHING SERVO MOTOR

According to signals from the ECM, the servo motor incorporated into the FRESH/RECIRC switching damper rotates in one or the other direction to perform switching between the fresh air introduction and inside air recirculation modes via a link.



AC-00299

- (1) FRESH
- (2) Inside air recirculation
- (3) ECM

H: BLOWER SPEED CONTROL POWER TRANSISTOR

The base voltage of the power transistor changes according to blower drive signals from the ECM. The blower speed changes stepless in accordance with the change in the power transistor's base voltage.

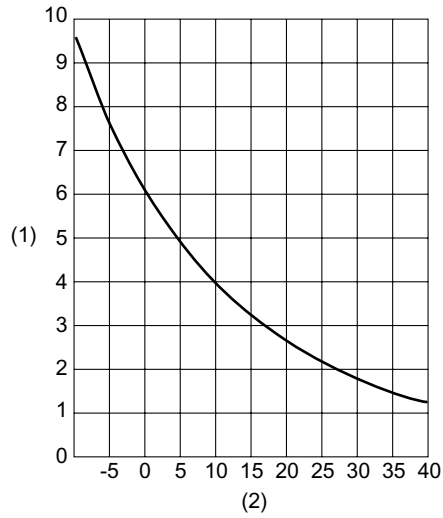
Should an over-current occur, the thermal fuse connected to the circuit (rated to blow at 144°C or 291°F) cuts off the current to the blower.

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

I: EVAPORATOR SENSOR

The evaporator sensor detects the temperature at the evaporator outlet and sends the result to the ECM.



AC-00300

- (1) Resistance (kΩ)
- (2) Temperature (°C)

AUTOMATIC AIR CONDITIONING

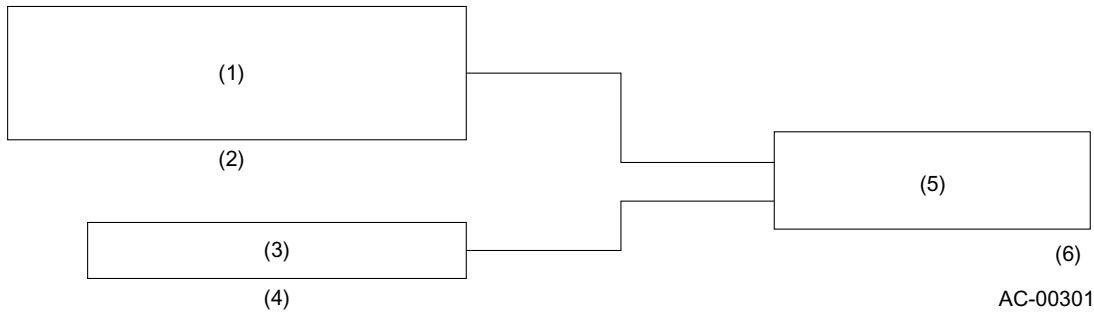
HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

J: CONTROL SYSTEM

1. CALCULATION OF REQUIRED BLOW-OUT AIR TEMPERATURE (TAO)

1) Required blow-out air temperature (TAO)

Upon reception of temperature set switch signals in addition to cabin temperature, ambient temperature and sun-load sensor signals, the ECM calculates the TAO first and then, based on the calculated temperature, it determines the outlets from which the air is to be blown out.



- (1) Cabin temperature (cabin temperature sensor)
Ambient temperature (ambient temperature sensor)
Intensity of sunload (sun-load sensor)
Intake air temperature (intake sensor)
- (2) (Sensor transmitted data)
- (3) Temperature setting (18.0 — 32.0°C (64.4 — 89.6°F))
- (4) (Driver input data)
- (5) Determination of air temperature and outlets
- (6) (TAO)

2) Calculation of required TAO

- When the set temperature is 18.0°C (64.4°F), the TAO is fixed at the MAX COOL.
- When the set temperature is 32.0°C (89.6°F), the TAO is fixed at the MAX HOT.
- When the set temperature is 18.5°C to 31.5°C (65.3°F to 88.7°F), an optimum TAO is calculated based on the set temperature, as well as the cabin temperature, ambient temperature and sunload data at that time.

2. TEMPERATURE CONTROL

The temperature control is made based on the drivers inputs from the temperature set switch and the data from various temperature sensors; the ECM determines the TAO using these data and operates the air mix motor so that the TAO can be attained.

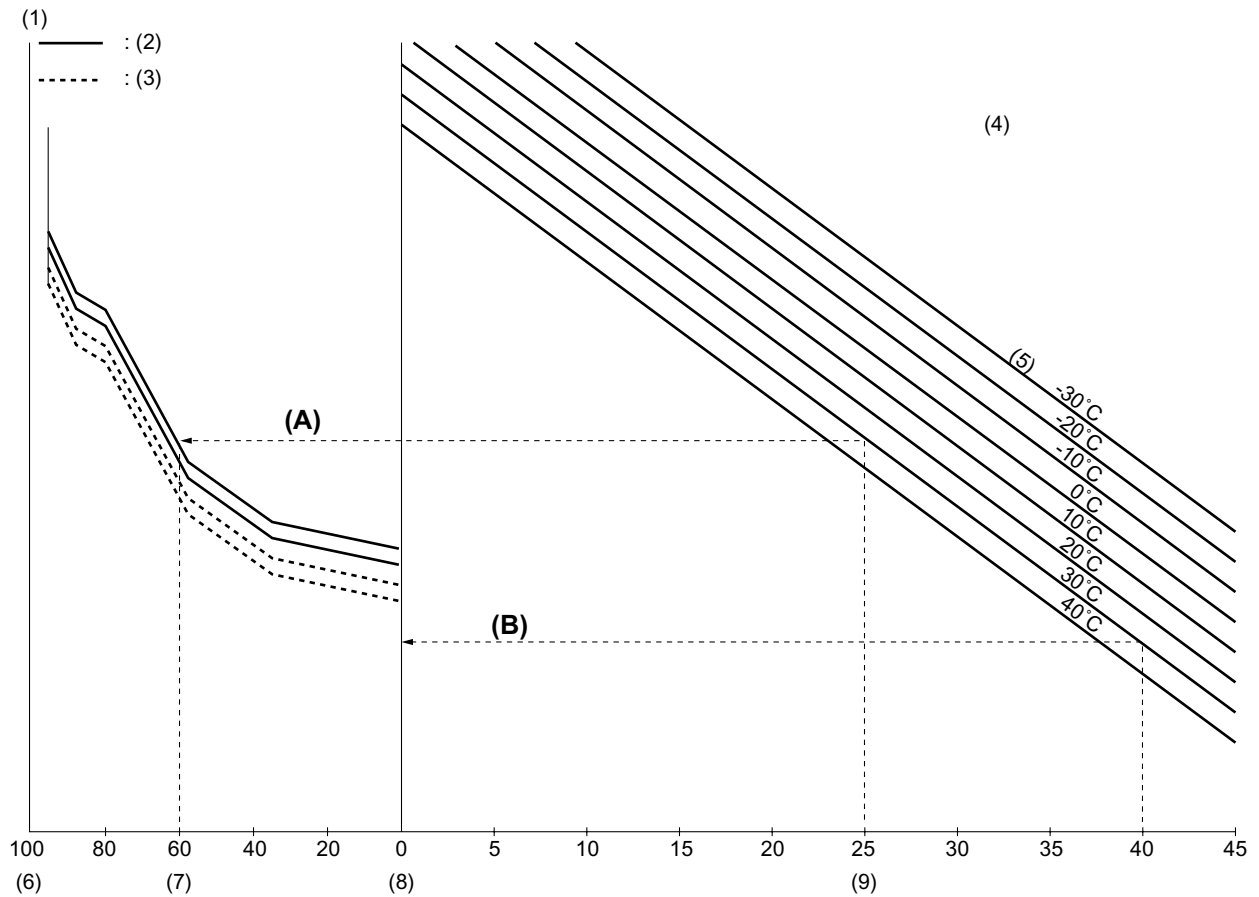
The ECM compares the air mix damper opening it has received from the air mix damper potentiometer with the target opening it has calculated and, if necessary, operates the motor to move the damper to the HOT or COOL side and hold the damper in an appropriate position.

The target damper opening is corrected using the sunlight intensity data.

The air mix damper is moved fully to the HOT side and held there when the temperature set switch is placed at the FULL HOT position (32°C, 89.6°F), while it is moved fully to the COOL side and held there when the switch is placed at the FULL COOL position (18°C, 64.4°F).

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)



AC-00302

(1) Measurement condition: intake air temperature 0°C (32°F)

(2) When exposed to sunbeam

(3) When not exposed to sunbeam

(4) Measurement condition: Temperature setting 25°C (77°F)

(5) Ambient temperature

(6) Full HOT

(7) Air mix damper opening (%)

(8) Full COOL

(9) Cabin temperature (°C)

(A) If the vehicle is exposed to sunbeam, the air mix damper opening is set to 60% when the cabin temperature is 25°C (77°F) and the ambient temperature is 30°C (86°F).

(B) When the cabin temperature is 40°C (104°F) and the ambient temperature is 30°C (86°F) the air mix damper opening is set at 0% (MAX COOL position).

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

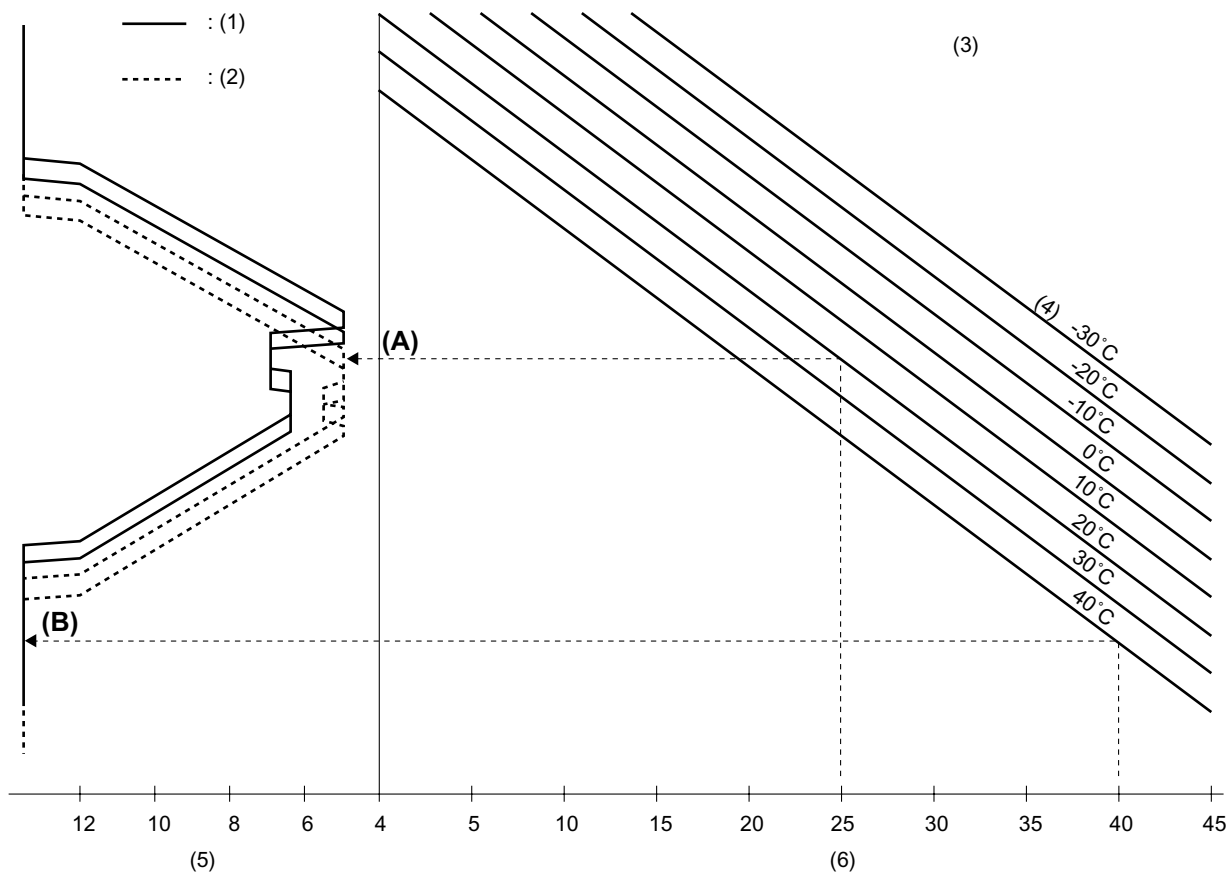
3. AIR FLOW CONTROL

• Normal air flow control

When the air conditioning system is in the automatic control mode, the air flow is determined based on the TAO calculated by the ECM. The blower fan speed is controlled accordingly.

In the automatic control mode, the minimum air flow is different between DEF mode and the other modes. For the minimum air flow in BILEVEL, HEAT and DEF/HEAT modes, a voltage of 5.5 V is applied to the blower motor, while for the DEF mode a voltage of 9.0 V is applied.

The minimum air flow is corrected by the sunbeam intensity if the VENT or BILEVEL mode is selected.



AC-00303

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

- (1) When exposed to sunbeam
- (2) When not exposed to sunbeam
- (3) Measurement condition: Temperature setting 25°C (77°F)
- (4) Ambient temperature
- (5) Voltage applied to blower motor (V)
- (6) Cabin temperature (°C)
- (A) If the vehicle is exposed to sunbeam, a voltage of approx. 5 V is supplied to the blower fan motor when the cabin temperature is 25°C (77°F) and the ambient temperature is 40°C (104°F).
- (B) When the cabin temperature is 40°C (104°F) and the ambient temperature is 40°C (104°F), system (battery) voltage is supplied to the blower motor.

- Blower fan starting speed control

When the blower motor is turned ON in the automatic control mode, the fan speed is initially low and then gradually increases (applied voltage increases by 1V every second until an appropriate voltage is reached) to prevent air from blowing out in a gust.

- Blower fan control at low coolant temperatures

Even when the blower motor is automatically turned ON, the blower fan is kept stopped or allowed to rotate at the minimum speed for a maximum of 150 seconds depending on the cabin temperature and the ambient temperature, if the engine coolant temperature is below 49°C (120.2°F) with the air outlets for the VENT or DEF mode selected.

After the conditions for prohibiting blower fan operation or limiting its speed are removed, the voltage applied to the blower motor is increased gradually (by 0.34 V per minute) such that a large amount of cold air does not blow out toward the leg area.

Once the coolant temperature exceeds 49°C (120.2°F), the normal blower fan control is performed including the starting speed control.

- Blower fan stop control with compressor ON

The blower fan is stopped for 3 seconds if the compressor is turned ON with the intake sensor-detected temperature is higher than 35°C (95°F).

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

4. AIR INLET CONTROL SYSTEM

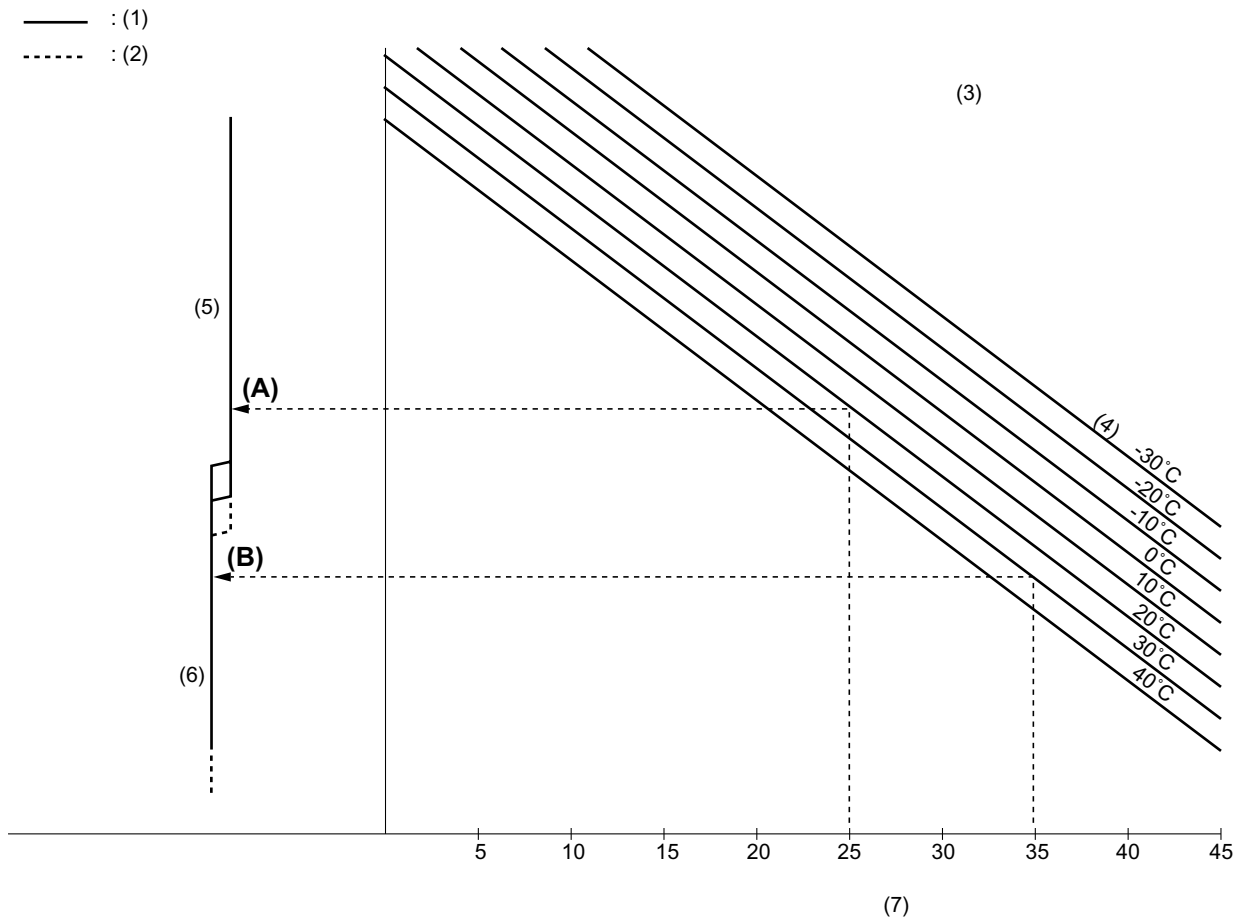
The air inlet control system determines whether the air inlet damper is to be opened depending on the TAO calculated by the ECM, thus selecting either inside air recirculation or fresh air introduction.

The damper is generally opened for fresh air introduction when the compressor is turned OFF.

It is also opened generally when the DEF position is selected.

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)



AC-00304

- (1) When exposed to sunbeam
- (2) When not exposed to sunbeam
- (3) Measurement condition: Temperature setting 25°C (77°F)
- (4) Ambient temperature
- (5) FRESH
- (6) Inside air recirculation
- (7) Cabin temperature (°C)
- (A) When the cabin temperature is 25°C (77°F) and the ambient temperature is 20°C (68°F) the air inlet damper is open and set at fresh air introduction position).
- (B) When the cabin temperature is 35°C (95°F) and the ambient temperature is 30°C (86°F) the air inlet damper is closed and set at cabin air recirculation position).

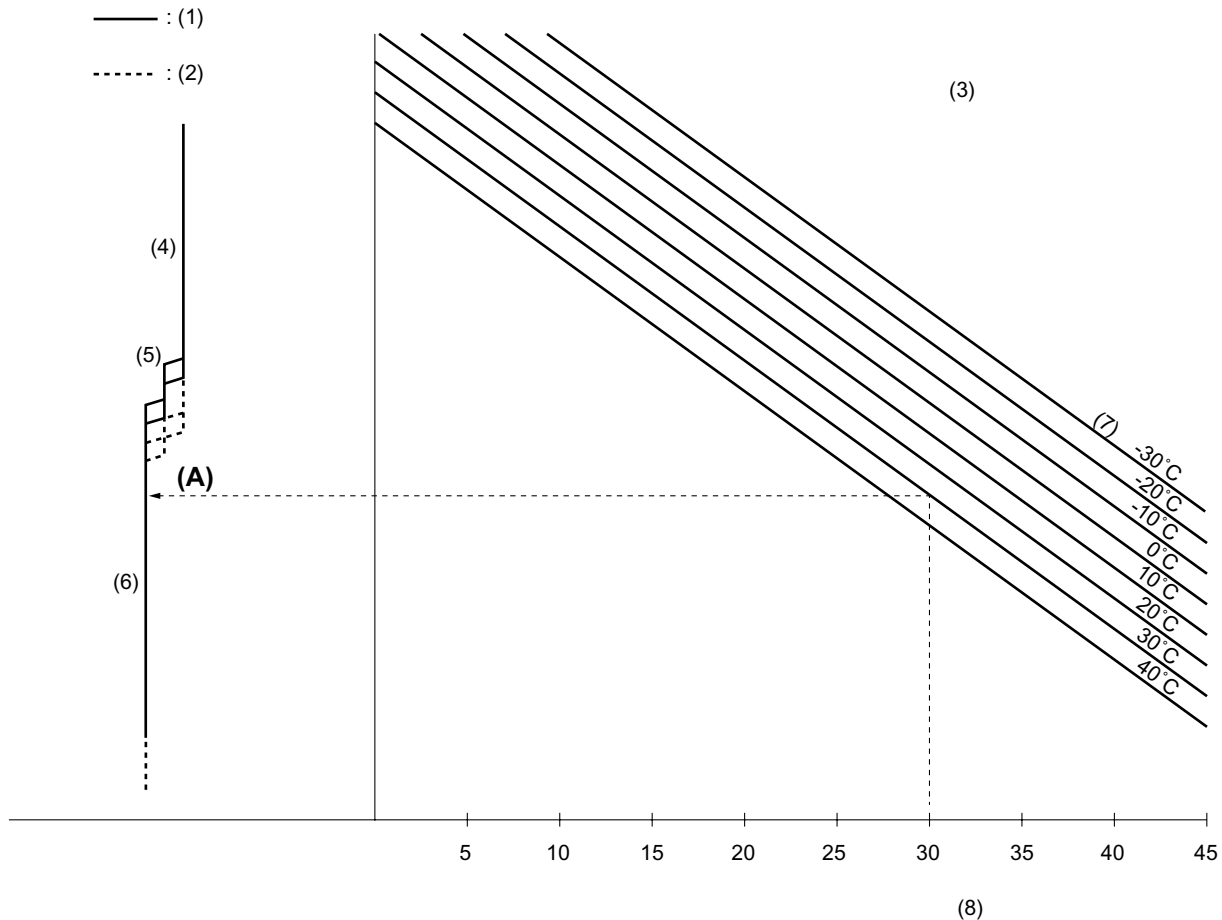
AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

5. AIR OUTLET CONTROL SYSTEM

The air outlet control system automatically selects the most appropriate air outlet combination depending on the ECM-calculated TAO by activating servo-motors for the VENT, BILEVEL or HEAT modes.

When the OFF switch is pressed position, the air outlet control system is held in the HEAT mode.



AC-00305

- (1) When exposed to sunbeam
- (2) When not exposed to sunbeam
- (3) Measurement condition: Temperature setting 25°C (77°F)
- (4) HEAT, DEF/HEAT
- (5) BILEVEL
- (6) VENT
- (7) Ambient temperature
- (8) Cabin temperature (°C)

(A) When the cabin temperature is 30°C (86°F) and the ambient temperature is 30°C (86°F), air outlets for the VENT mode is selected.

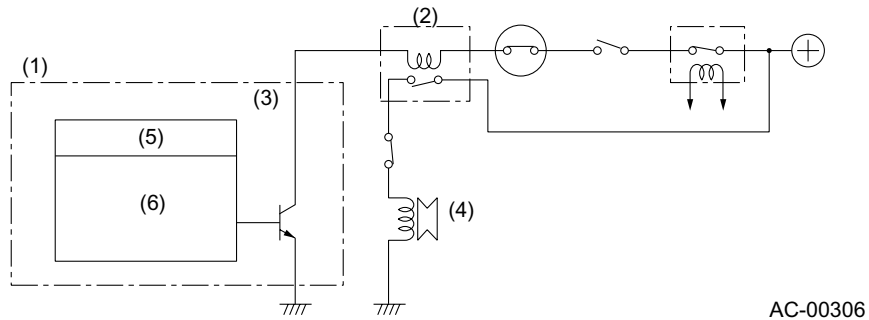
AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

6. COMPRESSOR CONTROL SYSTEM

In the automatic air-conditioning mode, the A/C relay is activated or deactivated depending on the TAO (required blow-out air temperature), TAM (ambient temperature) and T INT (suction air temperature) to operate or stop the compressor.

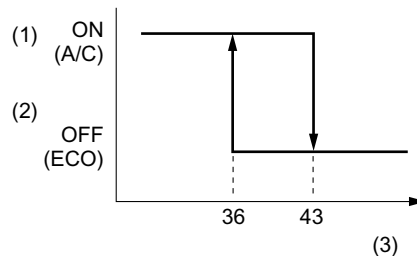
The compressor operation circuit supplies current to the magnet clutch as the ECM activates the A/C relay by connecting its coil to the ground.



- (1) ECM
- (2) A/C relay
- (3) MCR

- (4) Magnet clutch
- (5) Compressor control
- (6) Control by TAO and TAM

● Control by TAO and TAM

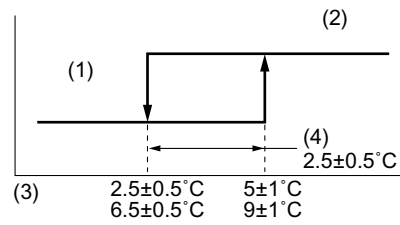


- (1) MCR
- (2) Operation
- (3) TAO - TAM

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

- Control by T INT



AC-00308

- (1) Compressor OFF
- (2) Compressor ON
- (3) A/C
ECON
- (4) DEF

HEATER SYSTEM

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

1. Heater System

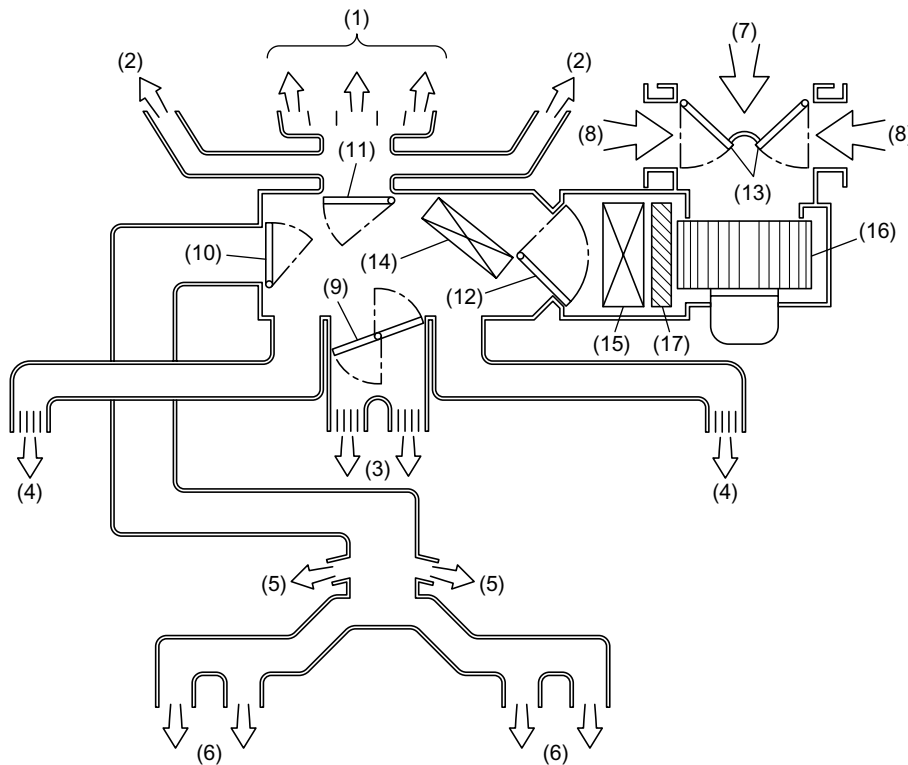
The heater control unit is located in the middle portion of the instrument panel.

The heater unit has mode doors and an air mix door. The intake unit has intake doors and a blower motor. The heater unit and the intake unit are regulated by their control units.

Fresh outside air is introduced into the cabin through the center and side ventilators when the blower fan is operated.

All models are equipped with front side window defrosters.

An optional filter is provided in front of the evaporator inlet.



AC-00262

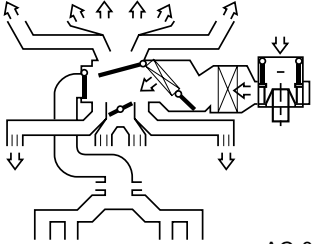
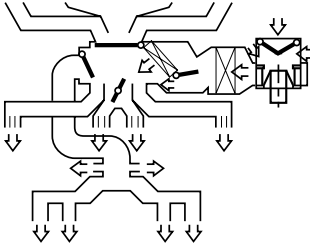
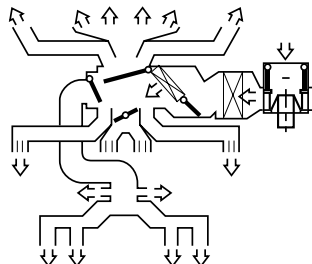
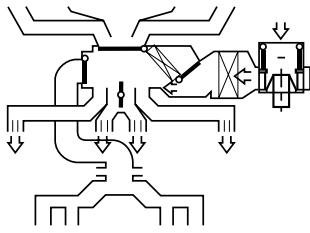
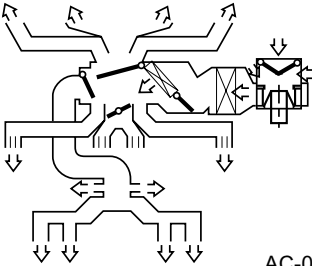
- | | | |
|------------------------------|----------------------|-----------------------------------|
| (1) Front defroster outlet | (7) Outside air | (13) Intake door |
| (2) Side defroster outlet | (8) Recirculated air | (14) Heater core |
| (3) Center ventilator outlet | (9) Ventilator door | (15) Evaporator (models with A/C) |
| (4) Side ventilator outlet | (10) Heater door | (16) Blower fan |
| (5) Front heater outlet | (11) Defroster door | (17) Filter (option) |
| (6) Rear heater outlet | (12) Air mix door | A/C: Air conditioning |

MODE SELECTOR SWITCH AND AIR FLOW

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

3. Mode Selector Switch and Air Flow

A: AIR FLOW

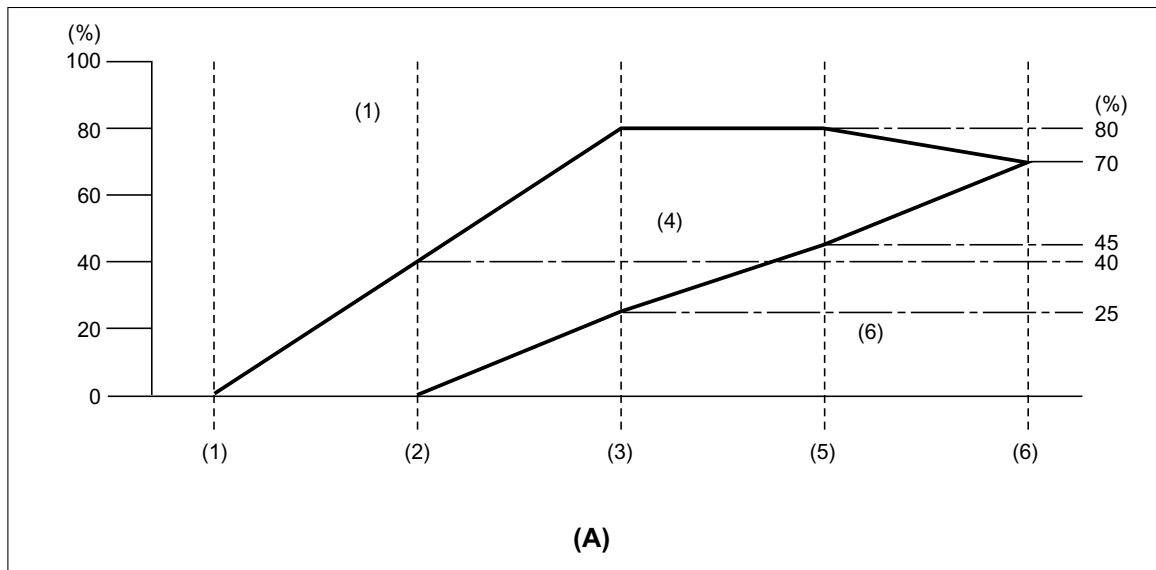
Mode selector switch position	Air flow	Mode selector switch position	Air flow
DEF	 AC-00326	BILEVEL	 AC-00329
DEF/HEAT	 AC-00327	VENT	 AC-00330
HEAT	 AC-00328		

MODE SELECTOR SWITCH AND AIR FLOW

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

B: AIR DISTRIBUTION RATIO

The following diagram shows air distribution for each position of the mode selector switch.



AC-00265

- (1) VENT
- (2) BILEVEL
- (3) HEAT

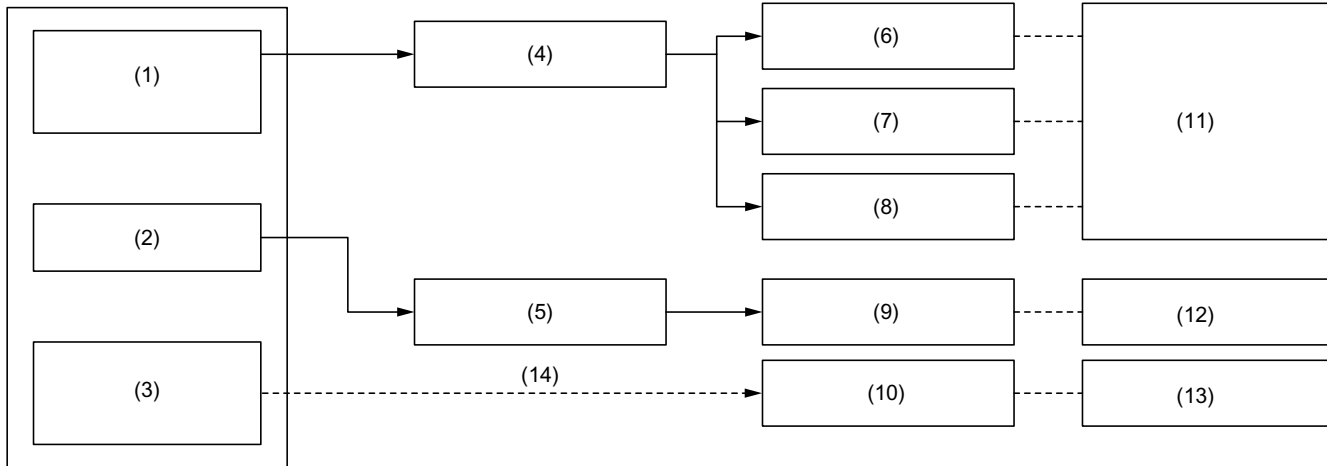
- (4) FOOT
- (5) DEF/HEAT
- (6) DEF

(A) Mode selector switch position

MODE SELECTOR SWITCH AND AIR FLOW

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

C: SYSTEM CONTROL FLOW



AC-00266

(1) Mode selector switch

(2) RECIRC switch

(3) Temperature control switch

(4) Mode door motor

(5) Intake door motor

(6) Ventilator door

(7) Heater door

(8) Defroster door

(9) Intake door

(10) Air mix door

(11) Air outlets

(12) Fresh air introduction or inside air recirculation

(13) Outlet air temperature

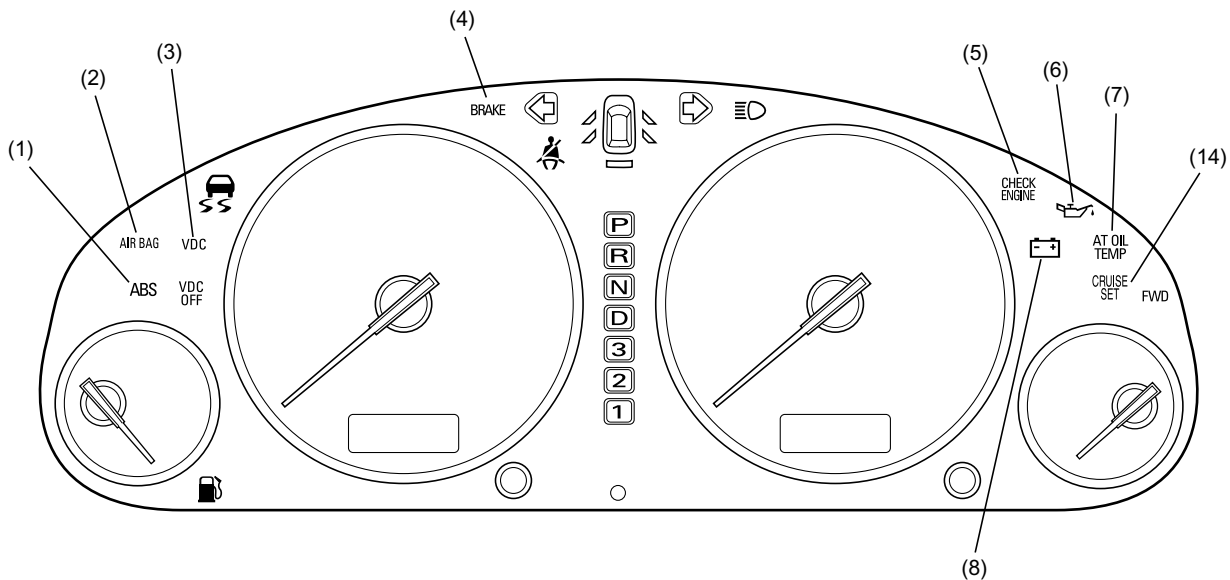
(14) (Cable)

COMBINATION METER

INSTRUMENTATION/DRIVER INFO

1. Combination Meter

A: WARNING AND INDICATOR LIGHTS



IDI00117

- (1) ABS warning light
This warning light illuminates if a fault occurs in any electrical component of the ABS (Anti-lock Brake System).
- (2) AIR BAG system warning light
This warning light illuminates if a fault occurs in the airbag system.
- (3) VDC warning light
This light illuminates when a fault occurs in any electrical component of the VDC (Vehicle Dynamics Control).
- (4) Brake fluid level warning / parking brake indicator light
This light illuminates if the fluid level in the brake reservoir tank lowers below the specified level and/or when the parking brake is applied.
- (5) CHECK ENGINE indicator light
This light illuminates if a fault occurs in the MFI (Multiple point Fuel Injection) system.
- (6) Oil pressure warning light
This light illuminates when the engine oil pressure decreases below 14.7 kPa (0.15 kgf/cm², 2.1 psi).
- (7) AT OIL TEMP warning light
This warning light illuminates when the ATF temperature exceeds 150°C (302°F); it blinks when a fault occurs in the AT control system.
- (8) Charge indicator light
This light illuminates if a fault occurs in the charging system while the engine is running.

COMBINATION METER

INSTRUMENTATION/DRIVER INFO

When everything is normal, the warning and indicator lights should be ON or OFF as shown below according to ignition switch positions.

Warning/Indicator light	Ignition switch position			
	LOCK/ACC	ON	ST	While engine is running
(1) ABS	OFF	*1	*1	*1
(2) AIR BAG	OFF	*2	*2	*2
(3) VDC	OFF	ON	ON	OFF
(4) Brake fluid level / parking brake	OFF	ON	ON	*3
(5) CHECK ENGINE	OFF	ON	ON	OFF
(6) Oil pressure	OFF	ON	ON	OFF
(7) AT OIL TEMP	OFF	ON	ON	OFF
(8) Charge	OFF	ON	ON	OFF

*1: This light stays ON for about 2 seconds, and then goes out.

*2: This light stays ON for about 6 seconds, and then goes out.

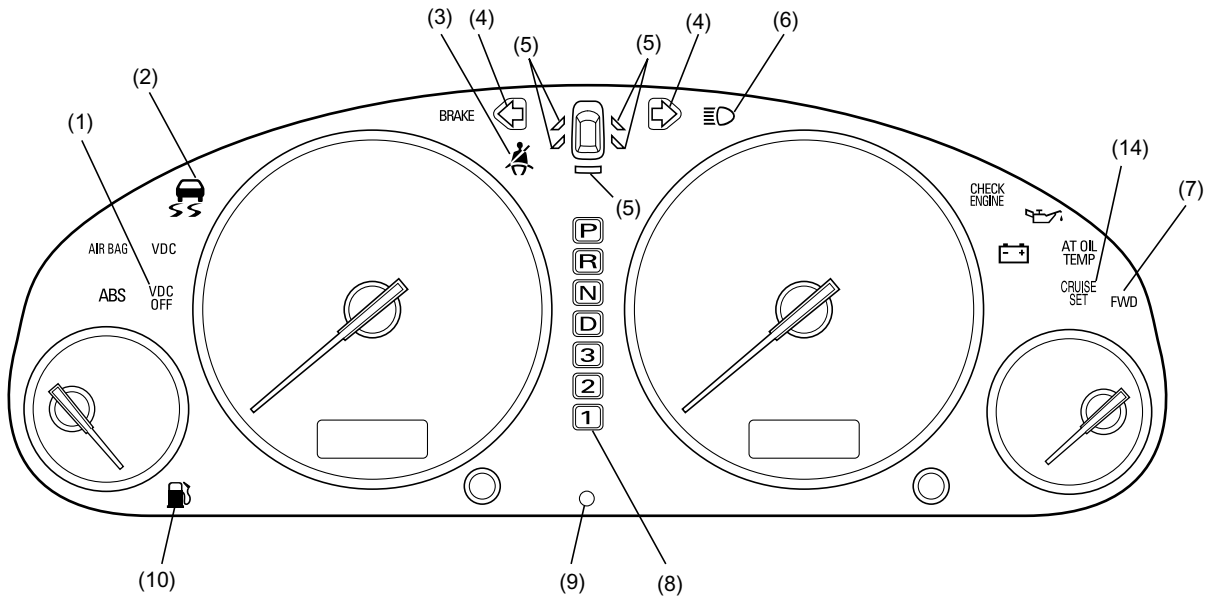
*3: This light comes ON when the parking brake is applied.

COMBINATION METER

INSTRUMENTATION/DRIVER INFO

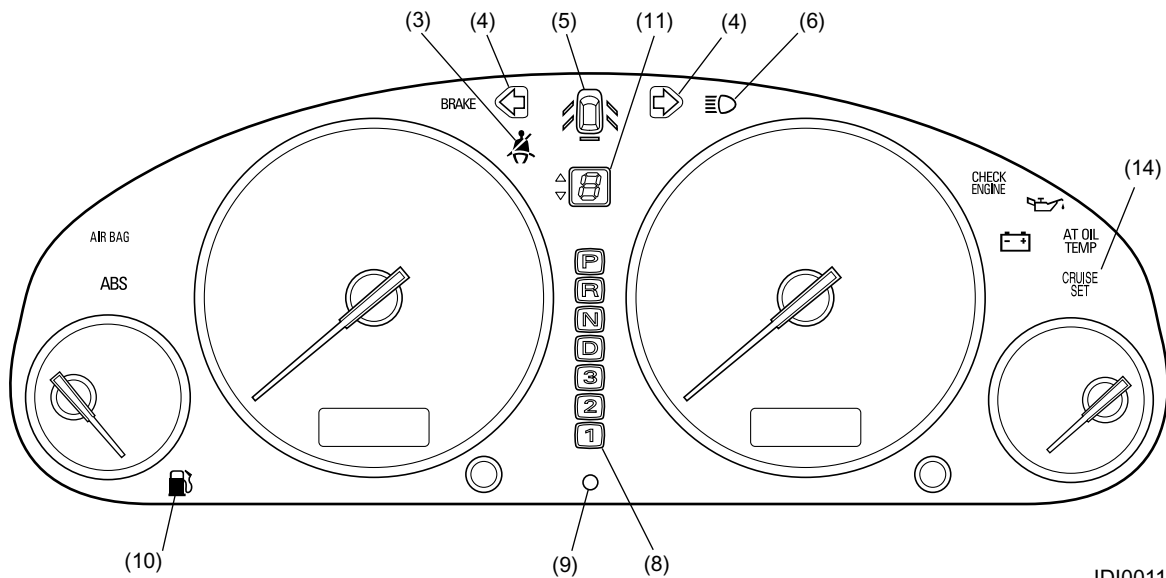
B: TELLTALE (GRAPHIC MONITOR)

Vehicles without sports shift



IDI00118

Vehicles with sports shift

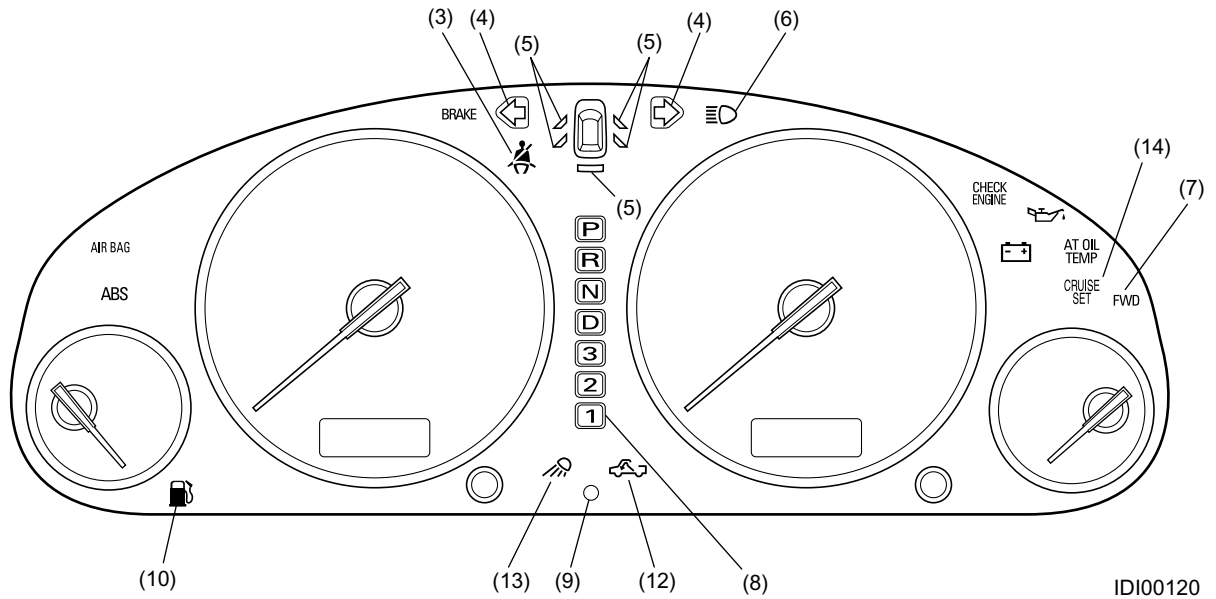


IDI00119

COMBINATION METER

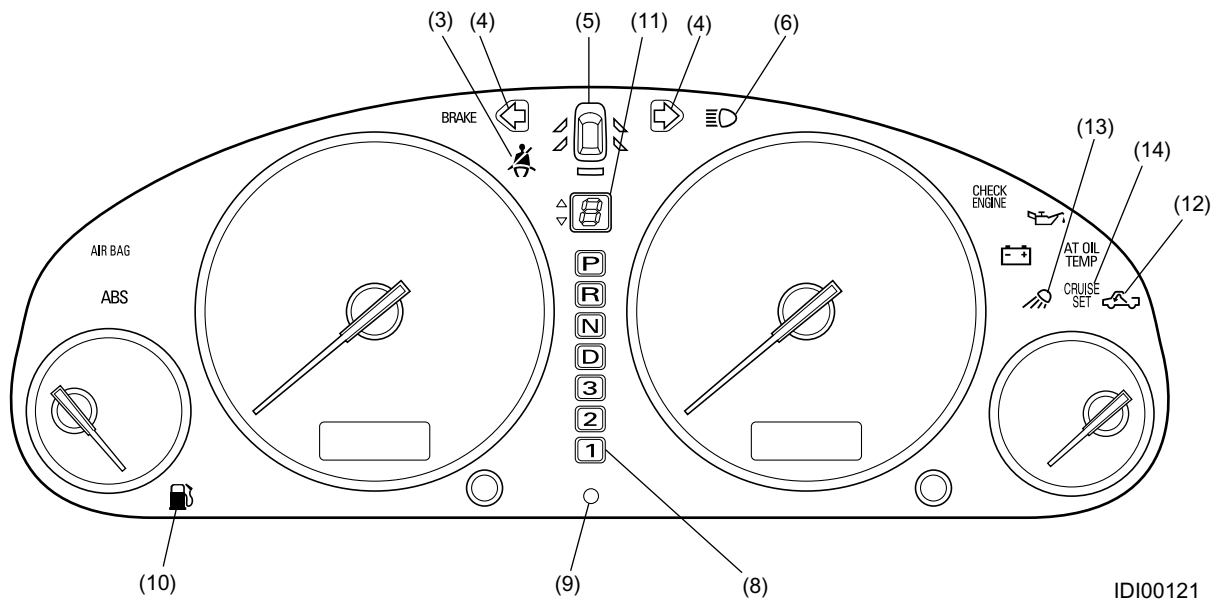
INSTRUMENTATION/DRIVER INFO

Pickup vehicles (non-turbo and turbo MT models)



ID100120

Pickup vehicles (turbo AT models)



ID100121

COMBINATION METER

INSTRUMENTATION/DRIVER INFO

- (1) VDC OFF indicator light
This light illuminates when the VDC or TCS is deactivated.
- (2) VDC operation indicator light
This light flashes when the VDC system is operating. It also illuminates when the TCS is operating.
- (3) Seat belt warning light
This light stays illuminated for about 6 seconds after the ignition switch has been turned ON.
- (4) Turn signal indicator light
This light blinks in unison with the corresponding turn signal lights when the turn signal switch or hazard warning switch is operated.
- (5) Door open warning light
This warning light illuminates when one or more doors and/or rear gate are not completely closed.
- (6) Headlight beam indicator light
This light illuminates when the headlights are in the high-beam position.
- (7) FWD indicator light
This indicator illuminates when the drive mode is changed from AWD to FWD (with the fuse installed in the FWD switch).
- (8) AT selector lever position indicator
The light corresponding to the present AT select lever position illuminates when the ignition switch is in any position other than ACC and LOCK.
- (9) Security indicator light
This light illuminates when the security system is armed.
- (10) Low fuel warning light
This light illuminates when the quantity of the fuel remaining in the tank has decreased to 10 ℓ (2.6 US gal, 2.2 Imp gal) or less.
- (11) Sports shift indicator
This indicator indicates the current gear position when the AT selector lever is moved from the automatic mode (D range) to the sports shift mode and causes the D range light to turn off.
- (12) Switch back gate indicator light
This light illuminates when the switch back gate is opened while the ignition switch is in the ON position. Also, this light blinks for 20 seconds and then turns off when the switch back gate is opened while the ignition switch is in the OFF position.
- (13) Cargo light indicator light
This light illuminates when the cargo light switch is turned ON.
- (14) CRUISE SET indicator
This indicator illuminates when the cruise control main switch is turned ON and the SET/COAST switch on the command switch is turned ON.

COMBINATION METER

INSTRUMENTATION/DRIVER INFO

When everything is normal, the telltales should be ON, OFF or in other states as shown below according to ignition switch position.

Telltale light		Ignition switch position			
		LOCK/ACC	ON	ST	While engine is running
(1) VDC OFF		OFF	ON	ON	*1
(2) VDC operation		OFF	*2	ON	OFF
(3) Seat belt		OFF	*3	*3	*3
(4) Turn signal		*4	Blink	Blink	Blink
(5) Door or rear gate open	• Open	ON	ON	ON	ON
	• Closed	OFF	OFF	OFF	OFF
(6) Headlight beam	• High beam	OFF	ON	ON	ON
	• Low beam	OFF	OFF	OFF	OFF
(7) FWD	• FWD	OFF	ON	ON	ON
	• AWD	OFF	OFF	OFF	OFF
(8) AT selector lever position		OFF	ON	ON	ON
(9) Security		*5	OFF	OFF	OFF
(10) Low fuel level		OFF	*6	*6	*6
(11) Sports shift indicator		OFF	OFF	OFF	*7
(12) Switch back gate		*8	*8	*8	*8
(13) Cargo light		*9	*9	*9	*9

*1: This light stays ON for about 4 seconds, and then goes out.

*2: This light stays ON for about 2 seconds, and then goes out.

*3: This light stays illuminated for about 6 seconds after the ignition switch has been turned ON.

*4: This light blinks when the hazard warning switch is turned ON.

*5: This light illuminates when the security system is armed.

*6: This light illuminates when the quantity of the fuel remaining in the tank has decreased to 10 ℓ (2.6 US gal, 2.2 Imp gal) or less.

*7: This light indicates the current gear position when the AT selector lever is moved from the D range to the sport shift mode.

*8: This light illuminates when the switch back gate is opened while the ignition switch is ON, and blinks for 20 second and then goes OFF when the switch back gate opened while the ignition switch is OFF.

*9: This light illuminates when the cargo light switch is turned ON.

C: SPEEDOMETER

1. DESCRIPTION

- The speedometer system is an electrical type that uses electric signals from the speed sensor in the MT model or the transmission control module (TCM) in the AT model.
- The vehicle speed sensor is installed on the manual transmission.
- Since the system does not use mechanical components such as rotating cable, there are no opportunities of occurring such problems as meter needle vibration and cable disconnection. Also, it does not constitute any means of mechanical noise transmission.

2. OPERATION

MT models: The vehicle speed sensor sends vehicle speed signals (4 pulses per rotation of speed sensor's driven shaft) to the speedometer drive circuit in the speedometer.

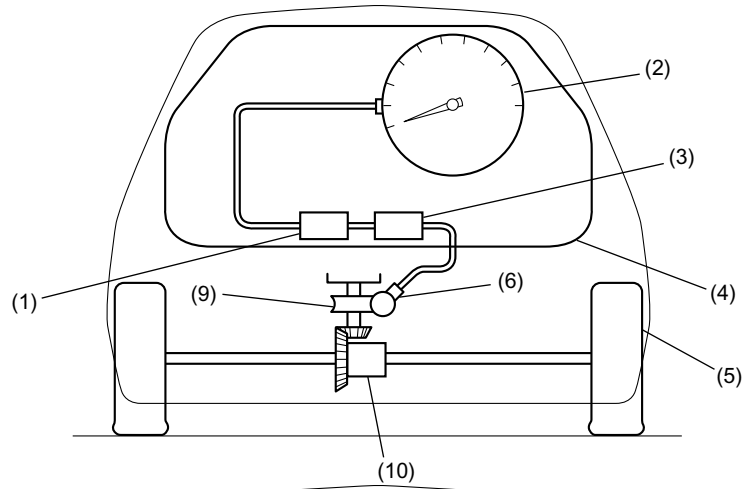
AT models: The TCM sends vehicle speed signals to the speedometer drive circuit in the speedometer.

NOTE:

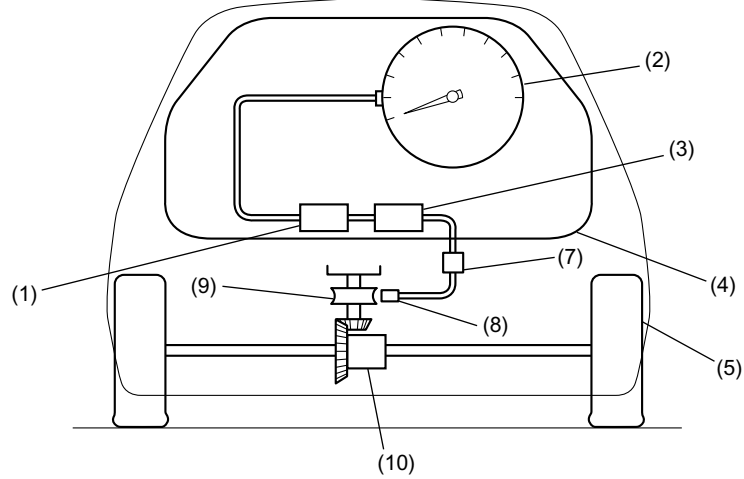
Signals from the speed sensor or TCM are also used by the engine control module, automatic transmission control module, etc.

3. SYSTEM DIAGRAM

(A)



(B)



IDI00040

(A) MT models

(B) AT models

(1) Speedometer movement

(2) Speedometer

(3) Speedometer drive circuit

(4) Combination meter

(5) Front wheel

(6) Speed sensor

(7) TCM

(8) Electromagnetic pick-up

(9) Gear for the speed sensor

(10) Differentials

COMBINATION METER

INSTRUMENTATION/DRIVER INFO

4. SPECIFICATIONS

Speedometer	Type	Electric pulse type
	Indication	Needle points to 60 km/h (37.3 MPH) when 2,548 pulses are input per minute.

D: ODOMETER/TRIP METER

1. DESCRIPTION

- The odometer and trip meter readings appear on a liquid crystal display (LCD).

2. OPERATION

MT models: The vehicle speed sensor sends vehicle speed signals (4 pulses per rotation of speed sensors driven shaft) to the odometer/trip meter drive circuit in the speedometer.

AT models: The TCM sends vehicle speed signals to the odometer/trip meter drive circuit in the speedometer.

3. SPECIFICATIONS

Odometer	Type	Pulse count type
	Display	LCD/6 digits; 0 to 999,999 km (miles).
	Indication	Counts up 1 km per 2,548 pulses (1 mile per 4,104 pulses). (Count down is impossible.)
Trip meter	Type	Pulse count type
	Display	LCD/4 digits; 0 to 999.9 and 1000 to 9999 km (miles).
	Indication	Counts up 1 km per 2,548 pulses (1 mile per 4,104 pulses). (To change the trip meter from A to B or B to A, push the knob momentarily. To return the trip meter to zero indication, keep the knob pushed for more than 1 second.)

E: VEHICLE SPEED SENSOR

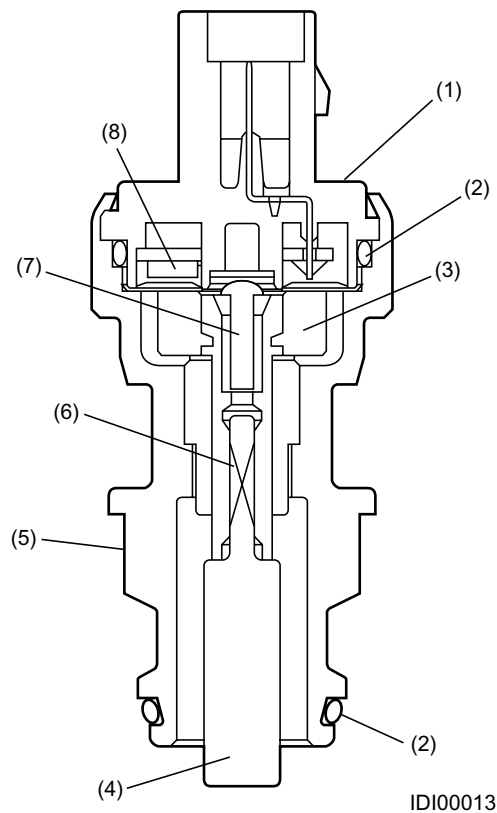
The vehicle speed sensor uses a Hall IC pick-up to generate speed signals. (MT models)

This sensor is installed on the transmission case and detects rotating speed of the transmission output gear.

The sensor generates 4 pulses per rotation of the speed sensor driven shaft and send them to the speedometer.

1. CONSTRUCTION

The speed sensor mainly consists of a Hall IC, magnet ring, driven shaft and spring.



- (1) Upper case
- (2) O-ring
- (3) Magnet ring

- (4) Driven key
- (5) Lower case
- (6) Driven shaft

- (7) Rivet
- (8) Hall IC

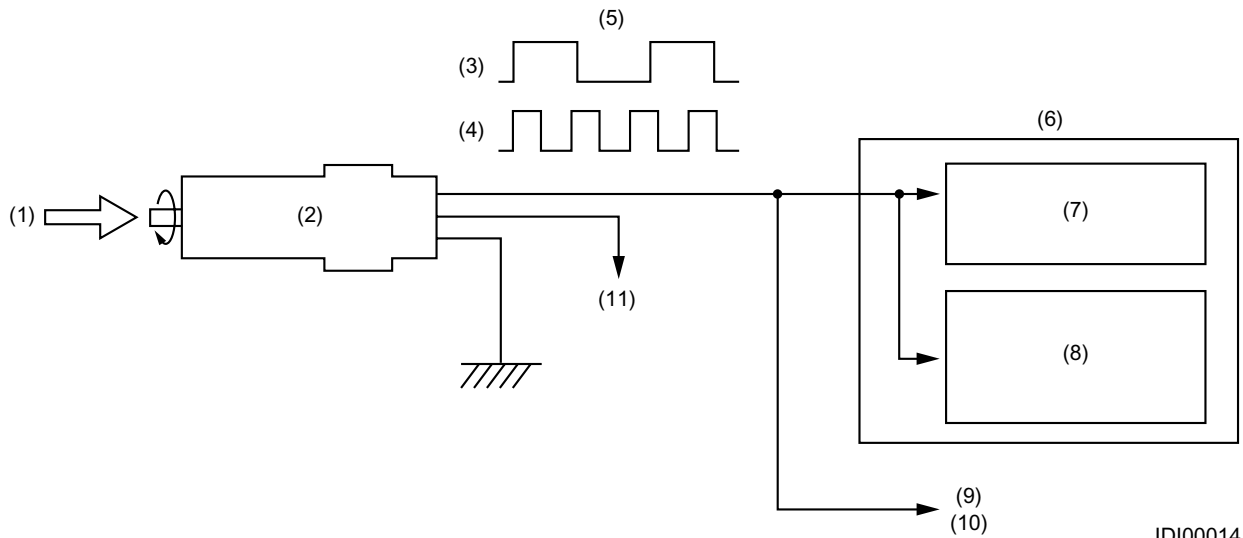
COMBINATION METER

2. OPERATION

As the driven key rotates, the magnet turns causing the magnetic field of the Hall IC to change.

The Hall IC generates a signal that corresponds to a change in the magnetic field.

One turn of the driven key in the speed sensor sends 4 pulses to the combination meter, engine control module and cruise control module.



IDI00014

- (1) Revolution of transmission output gear
- (2) Vehicle speed sensor
- (3) Low-speed
- (4) High-speed
- (5) Signal (4 pulses per revolution)
- (6) Combination meter

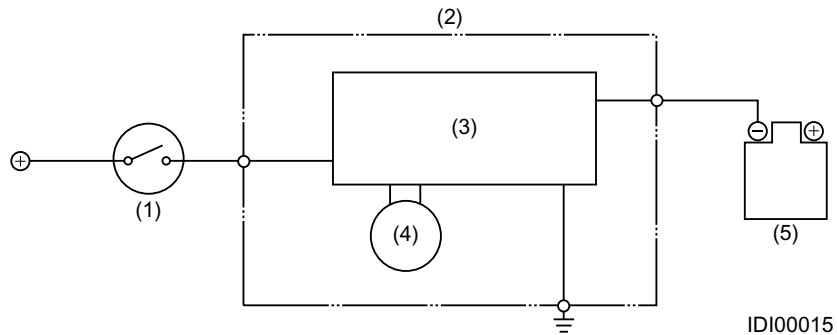
- (7) Speedometer drive circuit
- (8) Odometer and trip meter drive circuit
- (9) Engine control module
- (10) Cruise control module
- (11) Ignition switch

F: TACHOMETER

The tachometer drive circuit is connected to the engine speed sensing circuit in the engine control module.

When the engine speed increases or decreases, the voltage of the circuit also increases or decreases, changing the magnetic force of the tachometer drive coil.

The tachometer needle then moves in accordance with change in the engine speed.



(1) Ignition switch

(2) Combination meter

(3) Tachometer drive circuit

(4) Tachometer

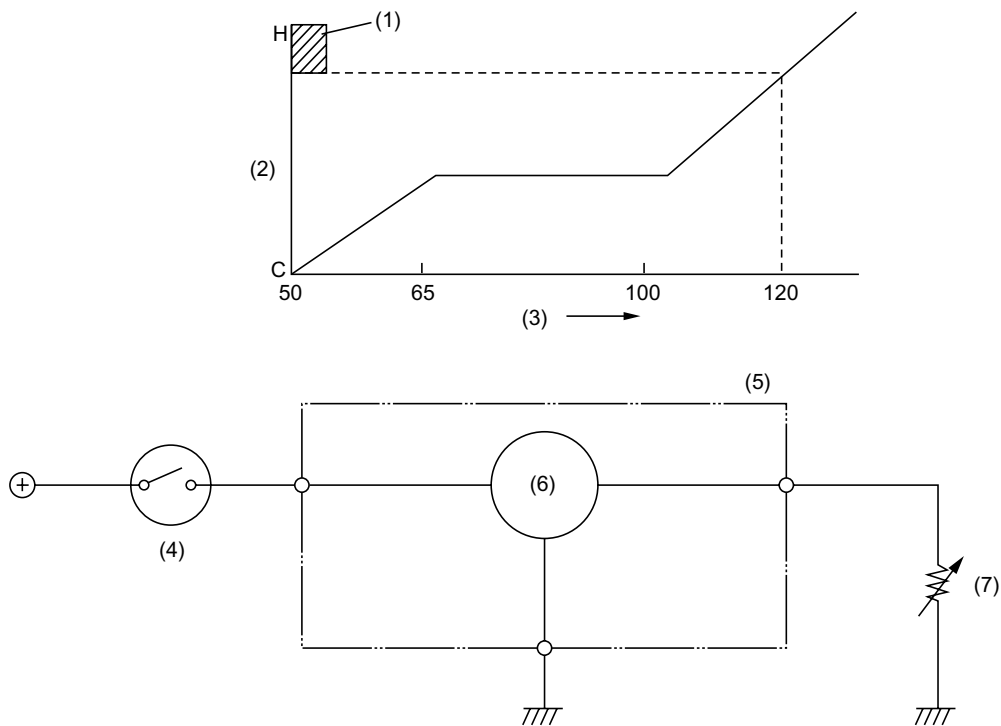
(5) ECU

COMBINATION METER

INSTRUMENTATION/DRIVER INFO

G: WATER TEMPERATURE GAUGE

- The water temperature gauge is a cross-coil type.
- The water temperature signal is sent from the thermo gauge located on the engine.
- The resistance of the thermo gauge changes according to the engine coolant temperature. Therefore, the current sent to the water temperature gauge also changes according to the engine coolant temperature. As the change in current causes the magnetic force of the coil to change, the gauge needle moves according to the engine coolant temperature.
- When the coolant is at a normal operating temperature of approx. 70 to 100°C (158 to 212°F), the gauge needle stays in the middle of the indication range as shown below.

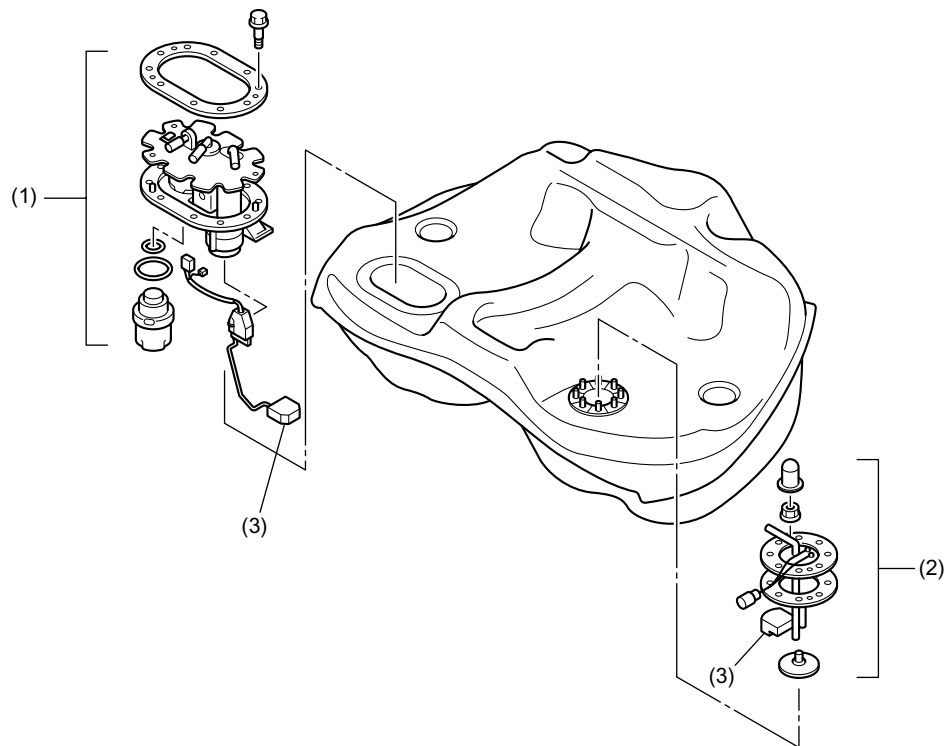


IDI00016

- | | |
|----------------------|---------------------------------------|
| (1) Red zone | (5) Combination meter |
| (2) Indication | (6) Water temperature gauge |
| (3) Temperature (°C) | (7) Engine coolant temperature sensor |
| (4) Ignition switch | |

H: FUEL GAUGE**1. GENERAL**

- The fuel gauge unit consists of a float and a potentiometer whose resistance varies depending on movement of the float. It is located inside the fuel tank and forms an integral part of the fuel pump. The fuel gauge indicates the fuel level in the tank even when the ignition switch is in the LOCK position.
- All models are equipped with two fuel level sensors. These sensors are installed in the fuel tank, one on the right side and the other on the left side. Two sensors are necessary because the fuel tank is divided into main and sub tank compartments.



IDI00041

- (1) Main fuel level sensor
- (2) Sub fuel level sensor
- (3) Float

COMBINATION METER

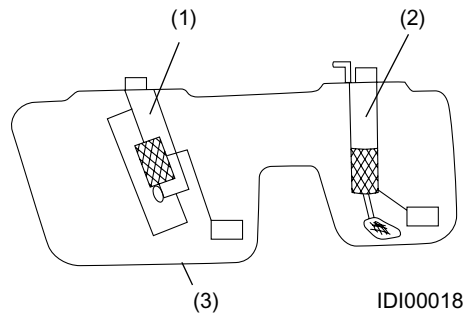
INSTRUMENTATION/DRIVER INFO

2. OPERATION

The low fuel warning light operates as follows:

The combination meter CPU continually monitors the resistance signal from the fuel level sensor. It turns on the low fuel warning light in the combination meter if a resistance value corresponding to the critical fuel level (approx. 76 Ω) is detected successively for about 10 minutes or the period spent for driving a distance of 10 km.

This monitoring time has been decided to avoid false operation of the warning light which may happen when a large part of remaining fuel is collected temporarily in the sub tank compartment.

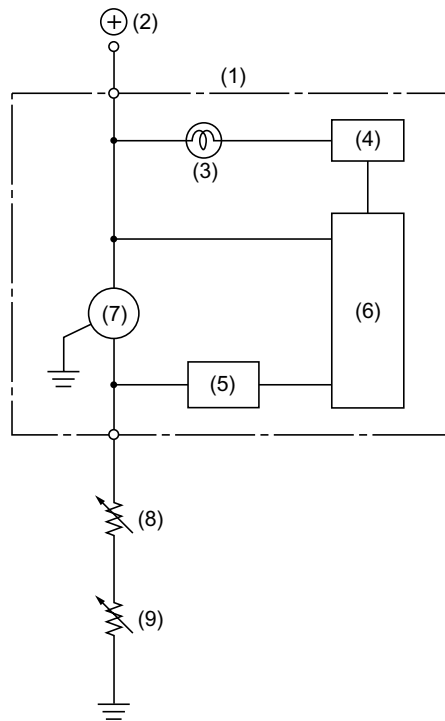


- (1) Main fuel level sensor
- (2) Sub fuel level sensor
- (3) Fuel tank

3. SPECIFICATIONS

	Fuel level	Resistance
Main fuel level sensor	Full	0.5 — 2.5 Ω
	1/2	18.5 — 22.5 Ω
	Empty	52.5 — 54.5 Ω
Sub fuel level sensor	Full	0.5 — 2.5 Ω
	1/2	23.6 — 27.6 Ω
	Empty	39.5 — 41.5 Ω

4. SCHEMATIC DRAWINGS



IDI00042

- (1) Combination meter
- (2) Ignition switch
- (3) Low fuel warning light
- (4) Driver circuit
- (5) Interface

- (6) CUSTOM CPU
- (7) Fuel gauge
- (8) Sub fuel level sensor
- (9) Main fuel level sensor

OUTSIDE AIR TEMPERATURE DISPLAY

INSTRUMENTATION/DRIVER INFO

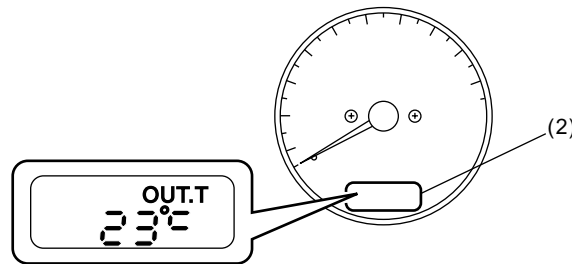
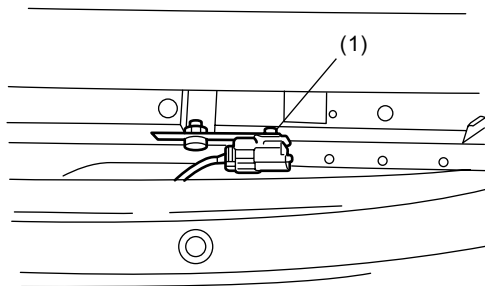
2. Outside Air Temperature Display

A: CONSTRUCTION

The outside air temperature display system consists of an ambient sensor (1), the CUSTOM CPU and a liquid crystal display installed in the combination meter. The ambient sensor detects the outside air temperature using the built-in thermistor which varies its resistance according to change in ambient temperature, and sends signals to the CUSTOM CPU.

As soon as the ignition switch is turned ON, the CUSTOM CPU compares the temperature data sent from the ambient sensor with the one that was stored in its memory when the ignition switch was turned OFF last time and it causes the lower of the temperatures to be displayed. However, if 60 minutes or more time has passed between the last turning OFF and the next turning ON of the ignition switch, the temperature that is displayed is a sensor-provided temperature.

When the vehicle is running slowly, the heat released from the engine compartment raises the temperature of the air around the ambient sensor and this affects the temperature data the sensor sends to the CUSTOM CPU. The CPU then makes a special control using the vehicle speed data, i.e., when the vehicle is running at a speed slower than 10 km/h, the CPU uses the temperature that was detected during the most recent vehicle movement at a speed exceeding 10 km/h rather than a temperature currently being provided by the ambient sensor.



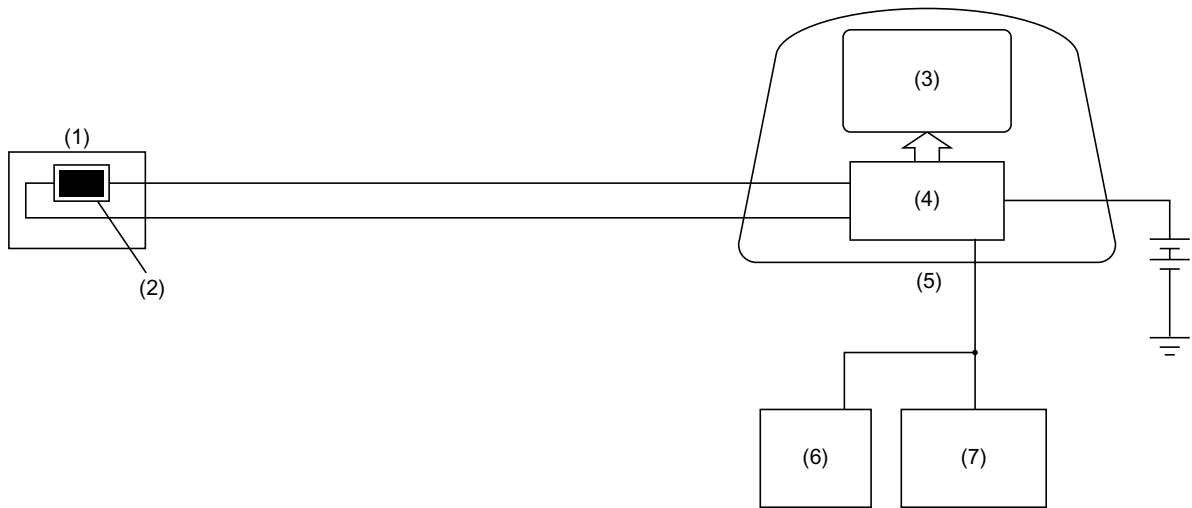
IDI00043

- (1) Ambient sensor
- (2) Outside air temperature display

OUTSIDE AIR TEMPERATURE DISPLAY

INSTRUMENTATION/DRIVER INFO

B: SCHEMATIC DRAWINGS



IDI00021

- (1) Ambient sensor
- (2) Thermistor
- (3) Outside air temperature display
- (4) CUSTOM CPU

- (5) Combination meter
- (6) Vehicle speed sensor (MT)
- (7) Transmission control module (AT)

OUTSIDE AIR TEMPERATURE DISPLAY

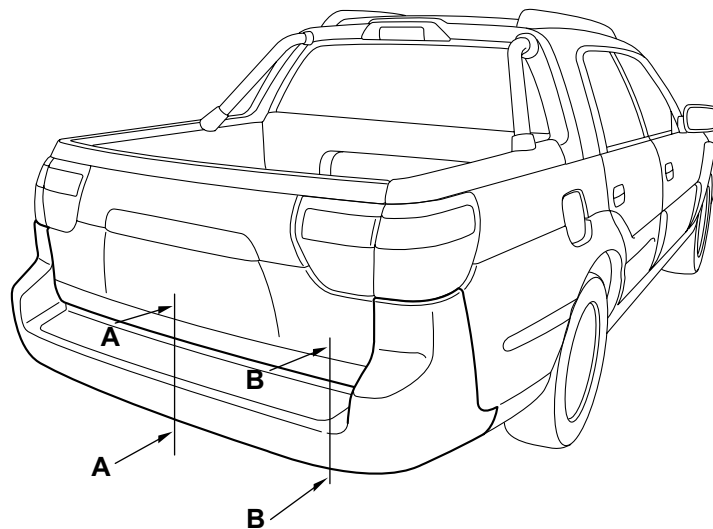
INSTRUMENTATION/DRIVER INFO

MEMO

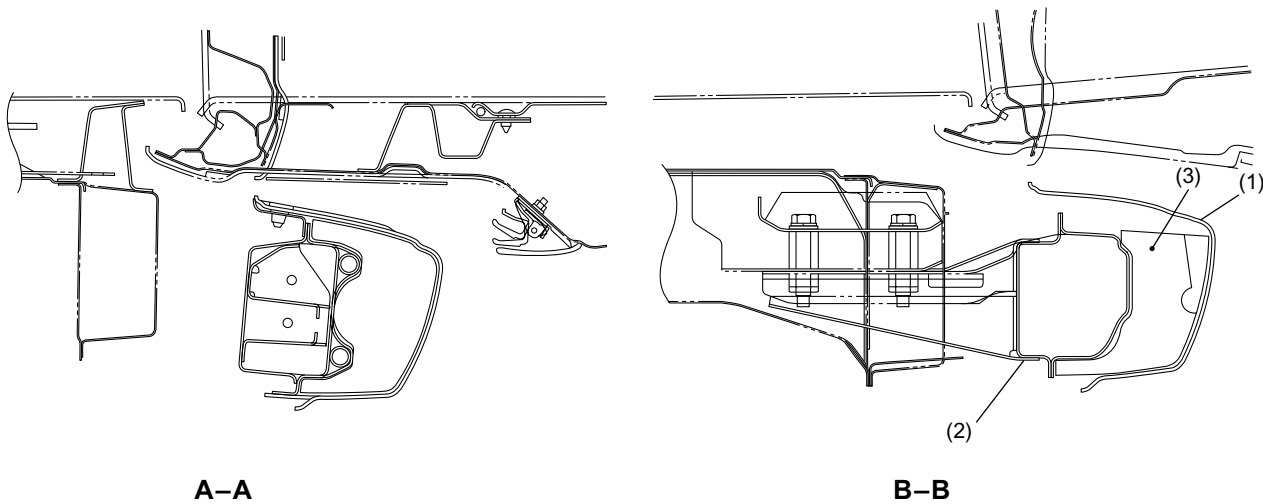
3. Baja

A: REAR BUMPER

- Due to redesigning of the vehicle's rear end, the rear bumper's contour has become unique to the pickup.
- The new bumper beam assembly is designed specially for the pickup.



EI-00273



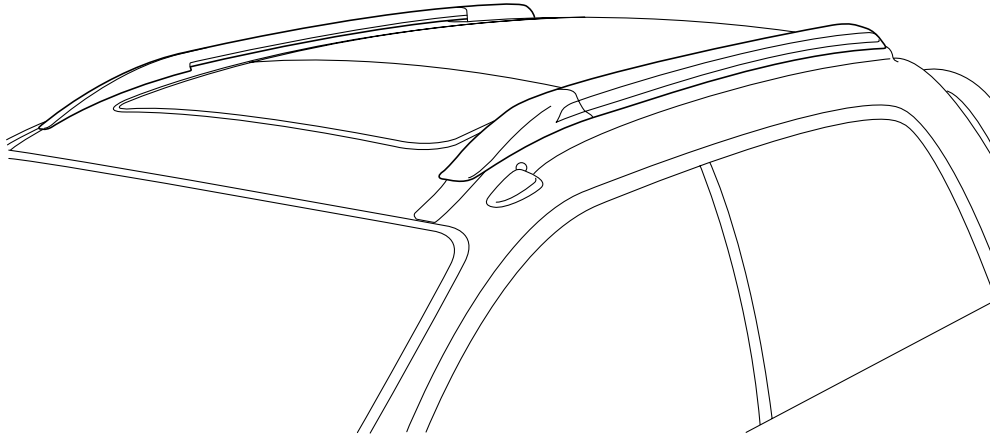
EI-00274

- (1) Bumper face
- (2) Bumper beam

- (3) E/A foam

B: ROOF RAILS

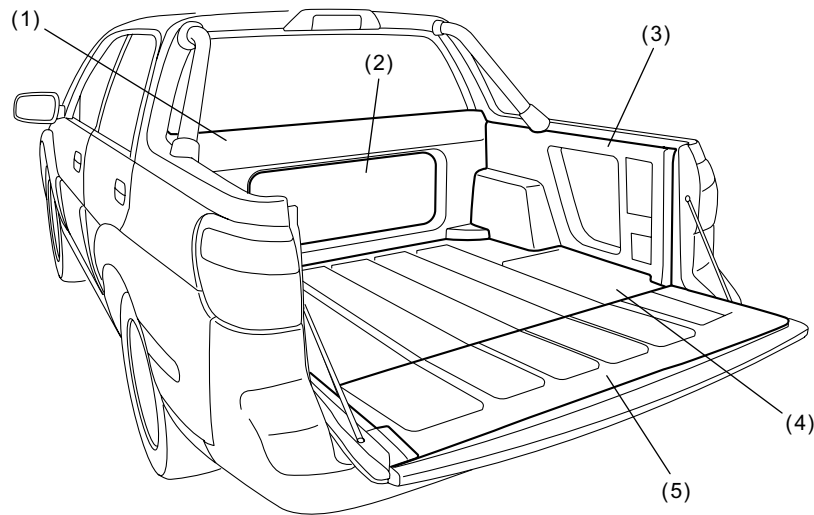
The aluminum roof rails are mounted directly on the roof and are designed specially for the pickup.



EI-00275

C: CARGO BED**1. BED TRAY**

- The bed tray area is covered with a plastic resin (PP) tray to prevent damages to the body.
- Projection of the wheel houses into the cargo bed area is minimized to achieve a floor area as wide as possible.



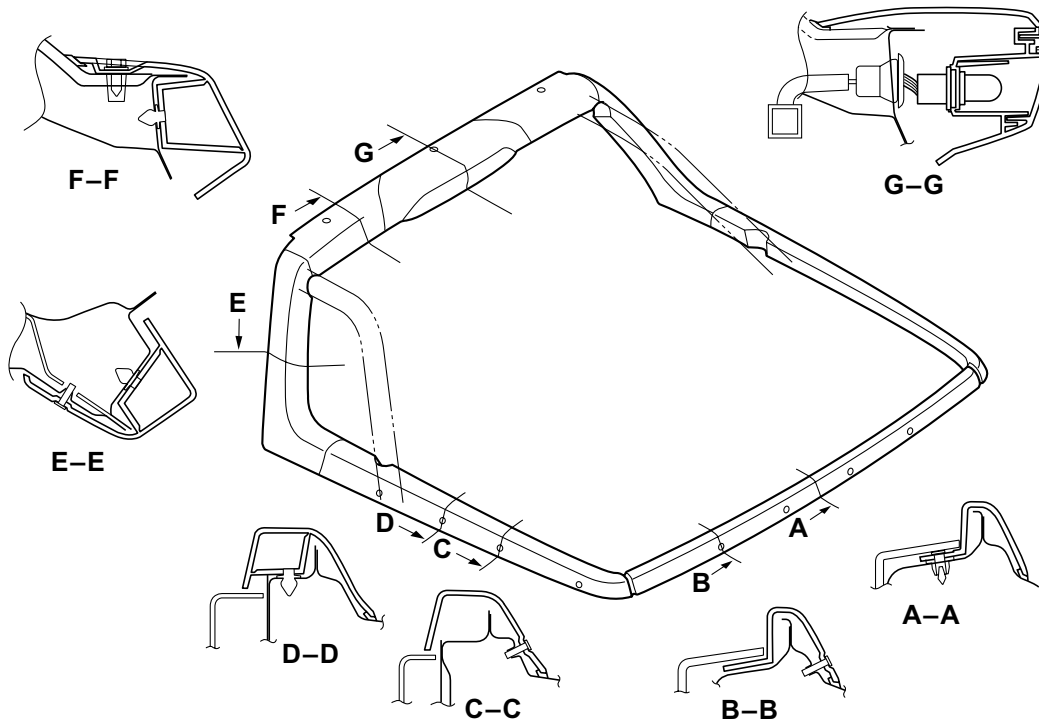
EI-00276

- (1) Back panel tray
- (2) Switch back tray
- (3) Side tray

- (4) Floor tray
- (5) Tailgate tray

2. MOLDING

The cargo bed's edges are covered with plastic resin (PC/PBT) to prevent damage to the body.

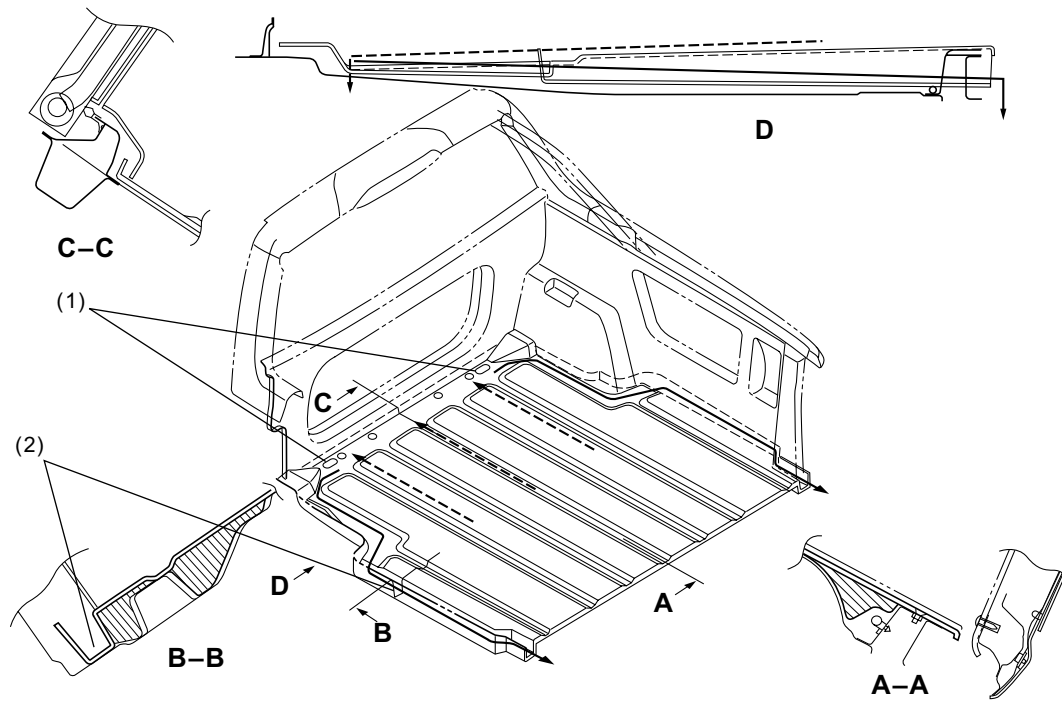


EI-00277

3. DRAIN HOLES

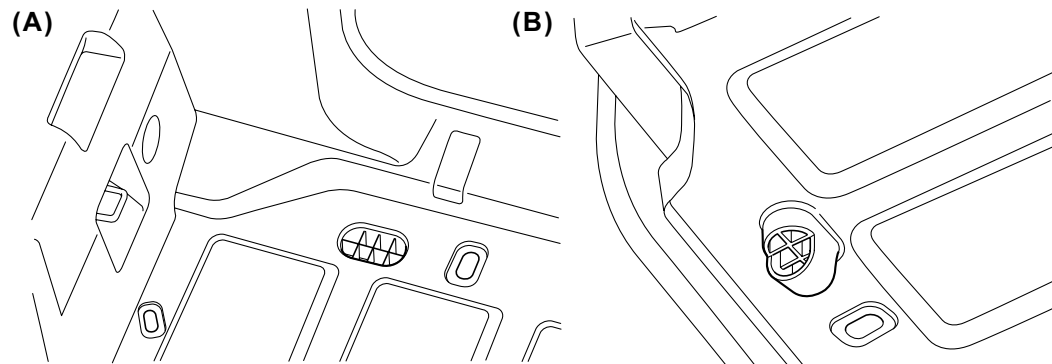
The floor tray is designed as follows to prevent accumulation of rain, etc.

- The floor tray is slanted toward the front of the vehicle. This slant allows rain etc. to run toward the front of the floor tray.
- There are 2 drain holes provided at the front end of the floor tray. Water flowing toward the front of the vehicle is drained through the drain holes.
- The excessive water that couldn't be drained through the drain holes will flow along the drain guide to the rear of the vehicle and get drained there.



EI-00278

- (1) Drain hole
- (2) Drain guide

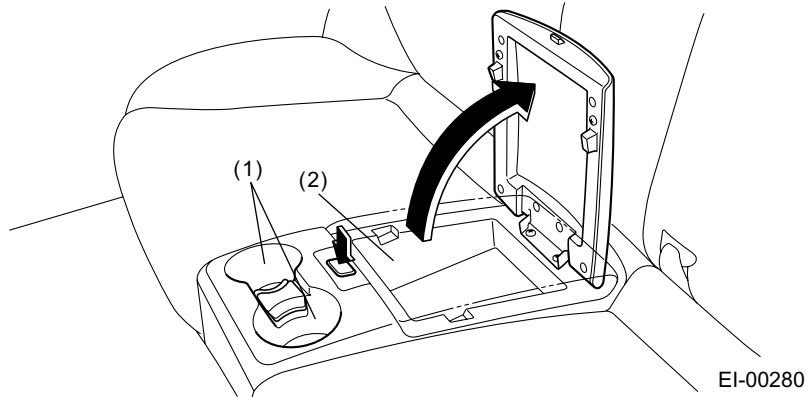


EI-00279

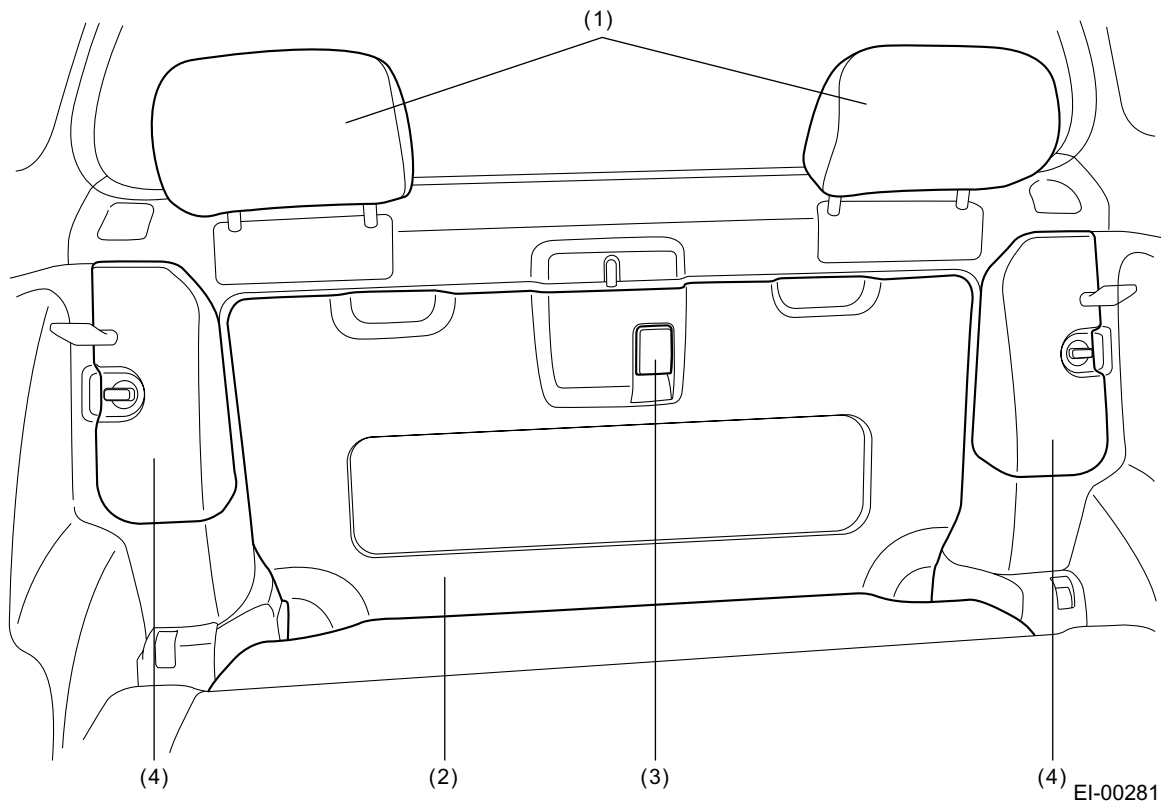
- (A) Drain hole upper view
- (B) Drain hole lower view

D: REAR SEAT CONSOLE BOX

Cup holders and a console box are provided at the center of the rear seat cushion for rear seat occupants.



- (1) Cup holders
- (2) Storage box

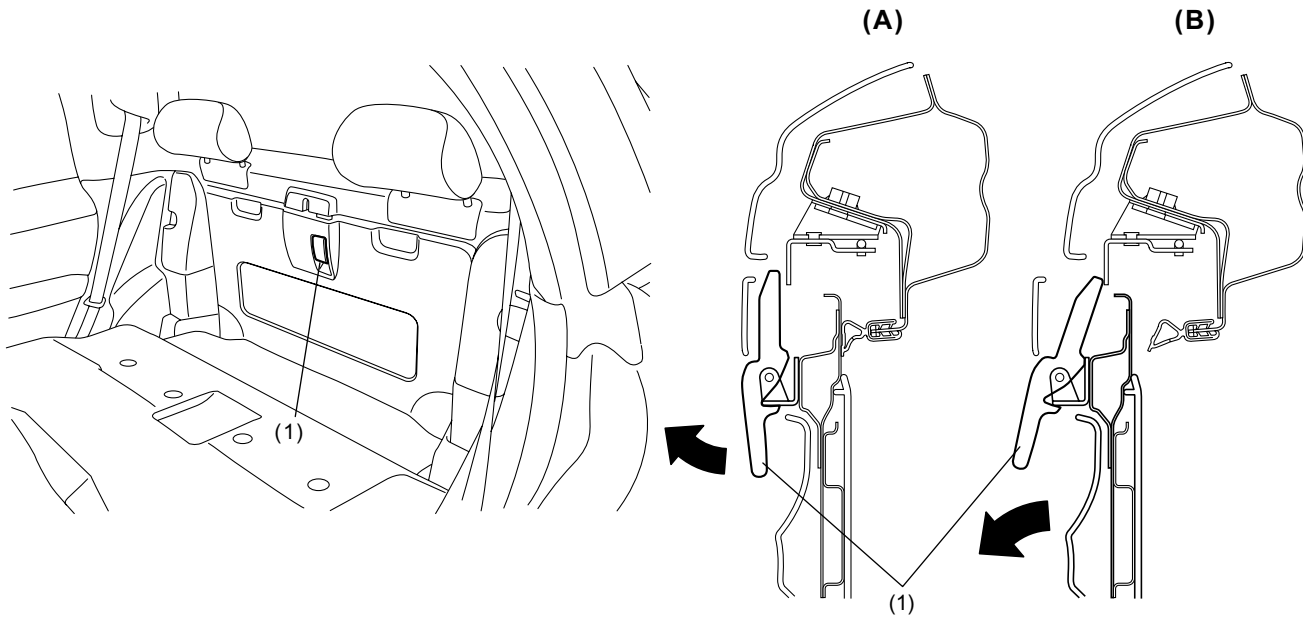
E: REAR BULKHEAD PANEL

- (1) Rear seat head rest
- (2) Switch back

- (3) Switch back release lever
- (4) C pillar lower pocket

1. SWITCH BACK GATE

- The switch back gate can be opened by pulling the switch back release lever.



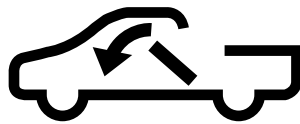
EI-00282

(A) Closed

(B) Open

(1) Switch back release lever

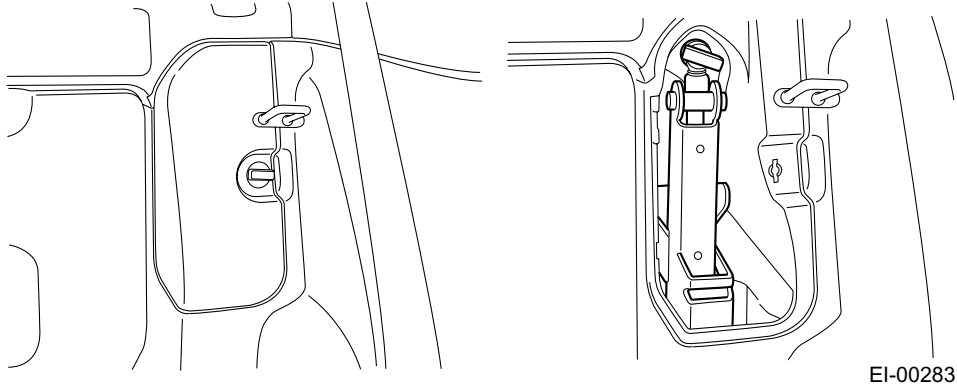
- When the switch back gate is open, an indicator light in the combination meter illuminates.



ID100045

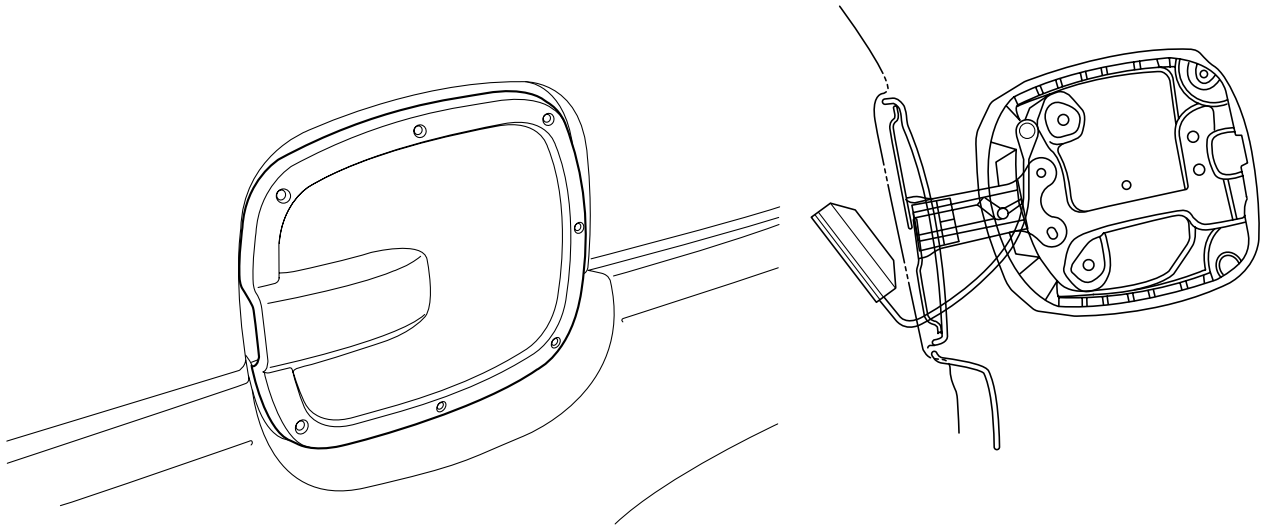
2. C PILLAR LOWER POCKET

Storage pockets are provided adjacent to both sides of the switch back gate which is located at the rear of the rear seat. The jack and standard tools are stored in the driver's side pocket.

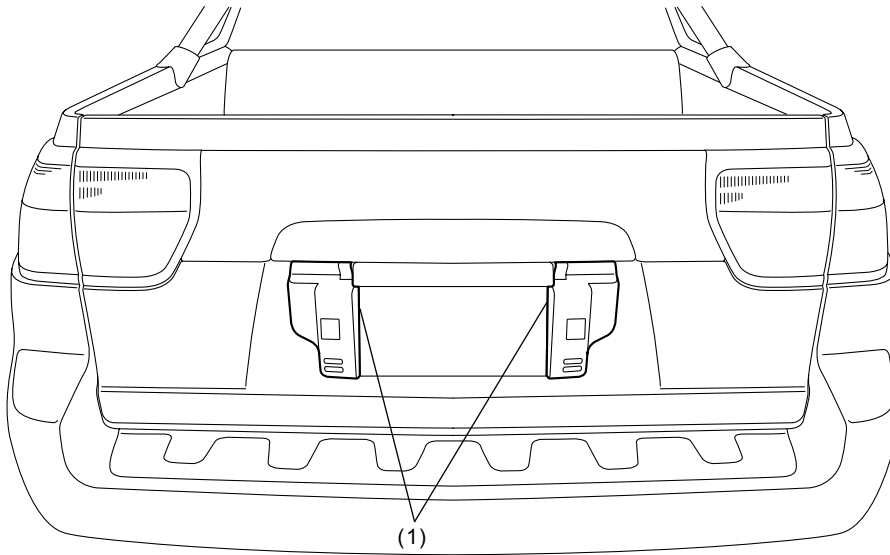


F: FUEL FLAP

Due to redesigning of the vehicle's rear end, an ABS fuel lid designed specially for pickup trucks is used.



G: LICENSE PLATE BRACKET



EI-00394

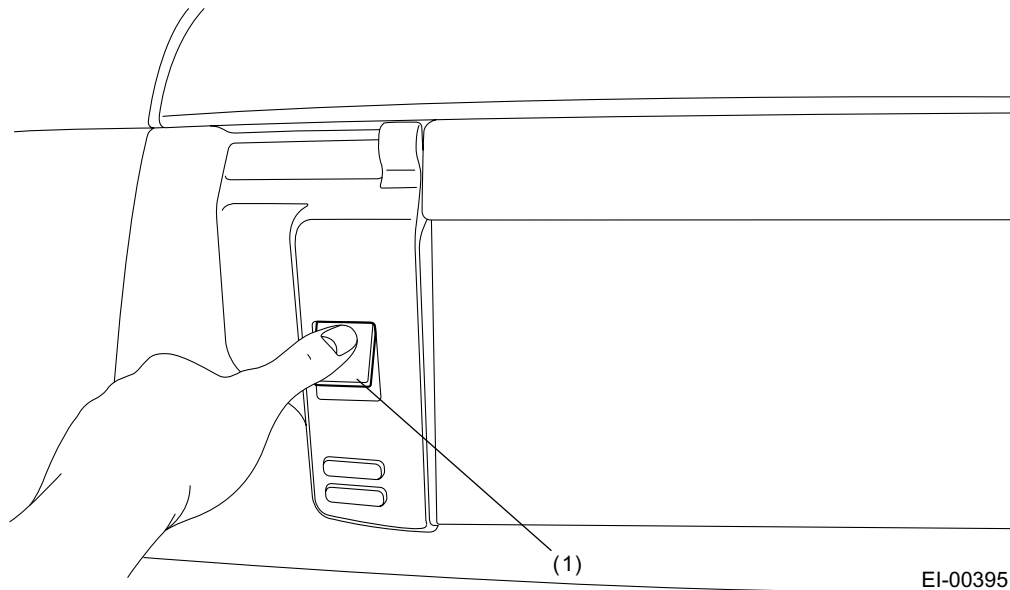
(1) License plate light

To keep the license plate visible even when the tailgate is regularly kept open with the accessory extender, a movable license plate bracket is provided.

The license plate bracket is equipped with a license plate light.

Operation

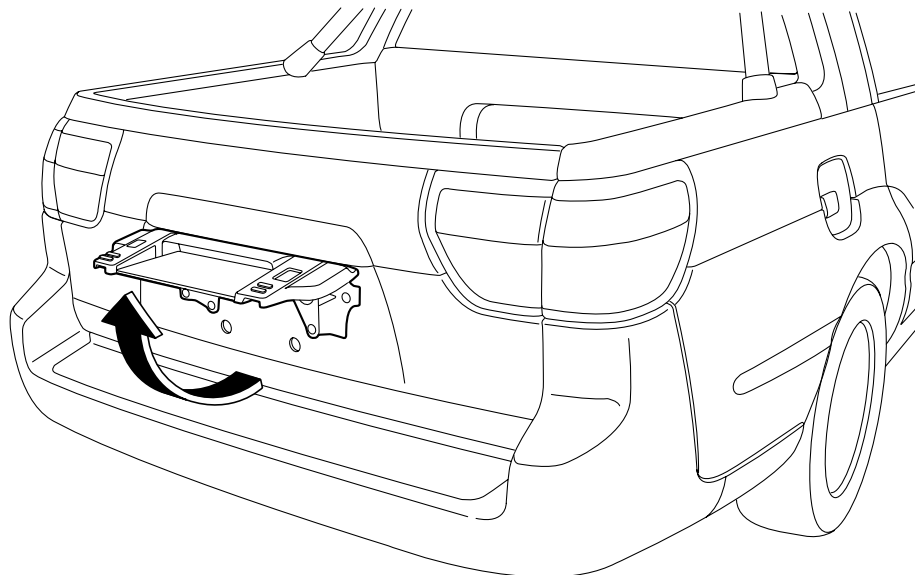
Push the buttons on each side of the license plate to release locks.



EI-00395

(1) Release button

Raise the license plate.

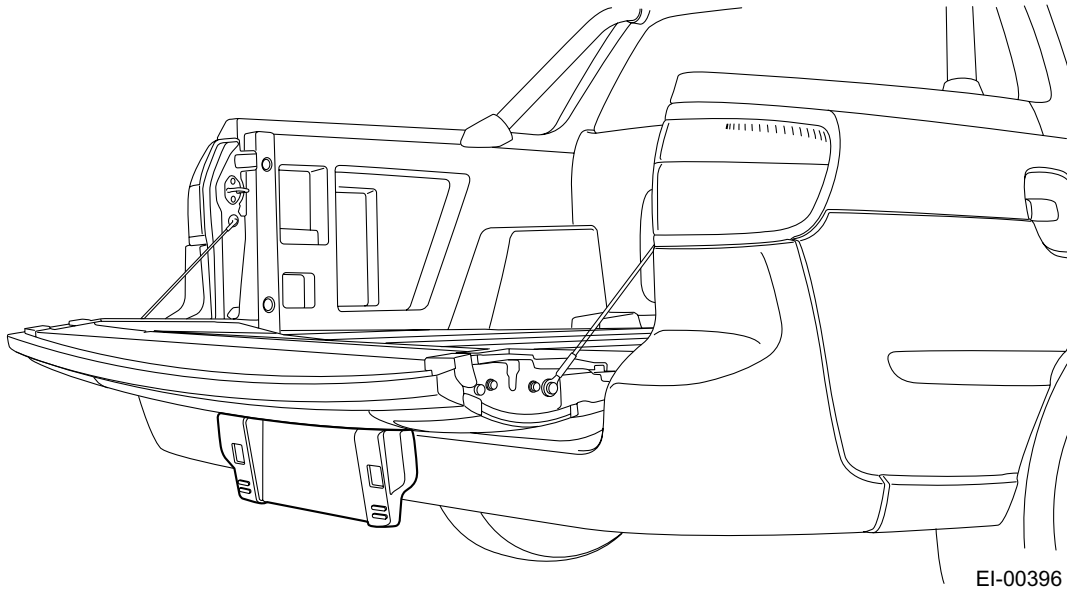


EI-00397

BAJA

EXTERIOR/INTERIOR TRIM

Open the tailgate.



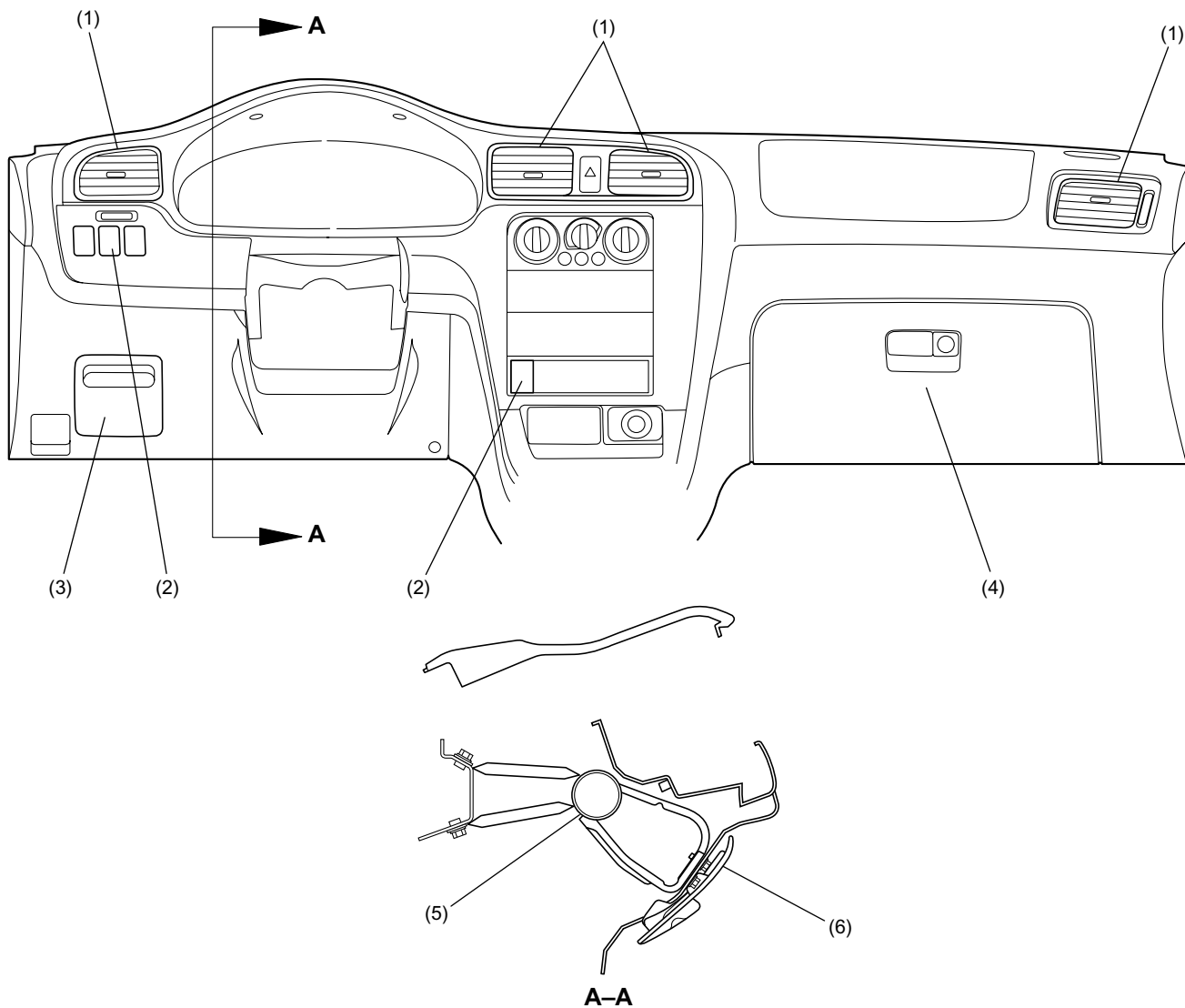
EI-00396

INSTRUMENT PANEL

EXTERIOR/INTERIOR TRIM

1. Instrument Panel

- The glove compartment has a lockable lid.
- A coin tray is provided.
- The vent grills are barrel type.
- The dashboard lower cover is fitted with a knee cover.
- The steering support beam connecting the left and right pillars is located behind the instrument panel. The instrument panel is mounted on the support beam.



EI-00736

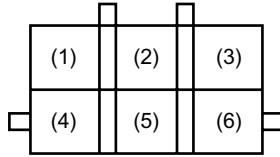
- (1) Barrel type vent grill
- (2) Optional accessory switches
- (3) Coin tray

- (4) Glove box
- (5) Steering support beam
- (6) Knee pad

2. Trailer Lights Connector

A: DESCRIPTION

The lights of a trailer (e.g., camping car) can be supplied with power through this connector.



EI-00232

(1) Battery +B

(2) Right turn signal

(3) Stop light

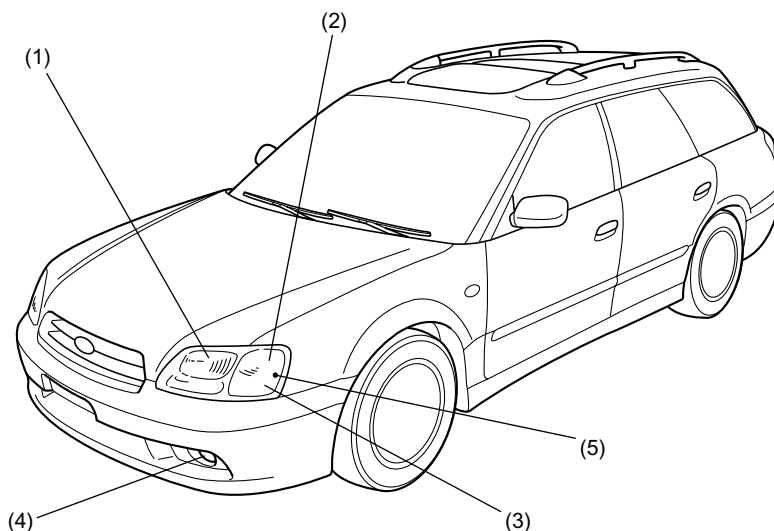
(4) Left turn signal

(5) Tail light

(6) Ground

1. Front

A: GENERAL



LI-00069

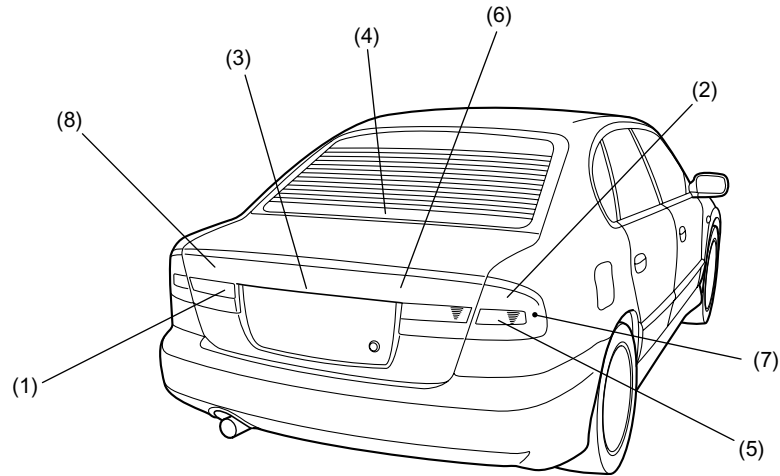
- | | |
|--|---------------------------------|
| (1) Headlight | (4) Front fog light |
| (2) Turn signal/hazard warning light | (5) Front side reflex reflector |
| (3) Clearance/parking/front side marker/turn signal/hazard warning light | |

- The headlight is either a two bulb type or four bulb type and each type has a multiple aspect reflector. The reflector controls the distribution of the light and no lens cutting is done on the shield for all models.
- The front turn signal/hazard warning light, clearance/parking light, front side marker light, and front side reflex reflector are incorporated into the headlight.
- The sedan and wagon models have projector type front fog lights, and the OUTBACKs have large sized multiple aspect reflector type front fog lights.
- A keyless answerback feature is added to the hazard warning lights. When the keyless entry system is operated, the hazard warning lights will flash.

2. Rear

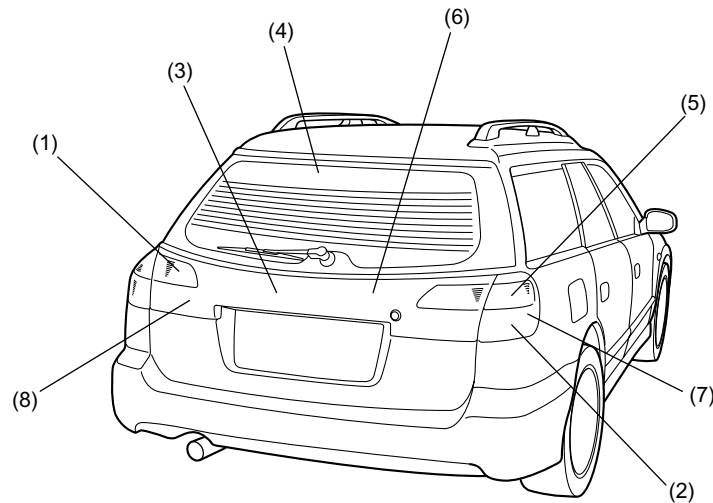
A: GENERAL

Sedan models



LI-00318

Wagon models



LI-00319

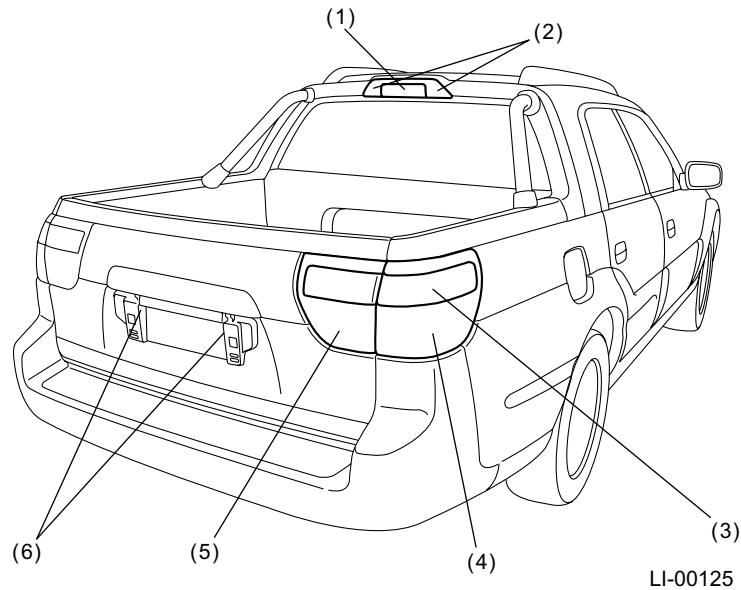
- | | |
|--|--------------------------------------|
| (1) Backup light | (5) Turn signal/hazard warning light |
| (2) Stop/tail/parking/rear side marker light | (6) Rear finisher light |
| (3) License plate light | (7) Rear combination light |
| (4) High mount stop light | (8) Stop/tail/parking light |

REAR

LIGHTING SYSTEM

- The rear turn signal/hazard warning light, stop/tail/parking light, and the backup light are incorporated into the rear combination light and rear finisher light. The side marker light and rear reflex reflector are also incorporated into the rear combination light.
- The high mount stop light is installed to the bottom inside of the rear window on sedans, and to the top inside of the rear gate on wagons.

B: BAJA



(1) High mount stop light

(2) Cargo light

(3) Backup light

(4) Stop/turn signal/tail light

(5) Tail light

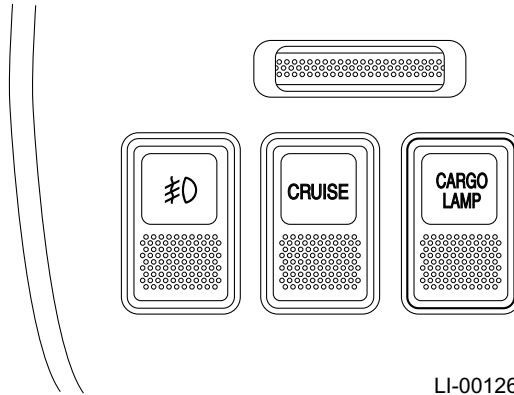
(6) License plate light

- The backup light and stop/turn signal/tail light are built into the rear combination light. The turn signal light is also used as the stop light.
- The rear finisher light contains a tail light.
- The license plate bracket is equipped with a license plate light.
- The cargo bed upper molding is equipped with a high mount stop light and a cargo light.

REAR

LIGHTING SYSTEM

- The cargo light switch is located at the left side of the driver's seat. When the cargo light is ON, an indicator light in the combination meter illuminates.



IDI00047

3. Center Differential

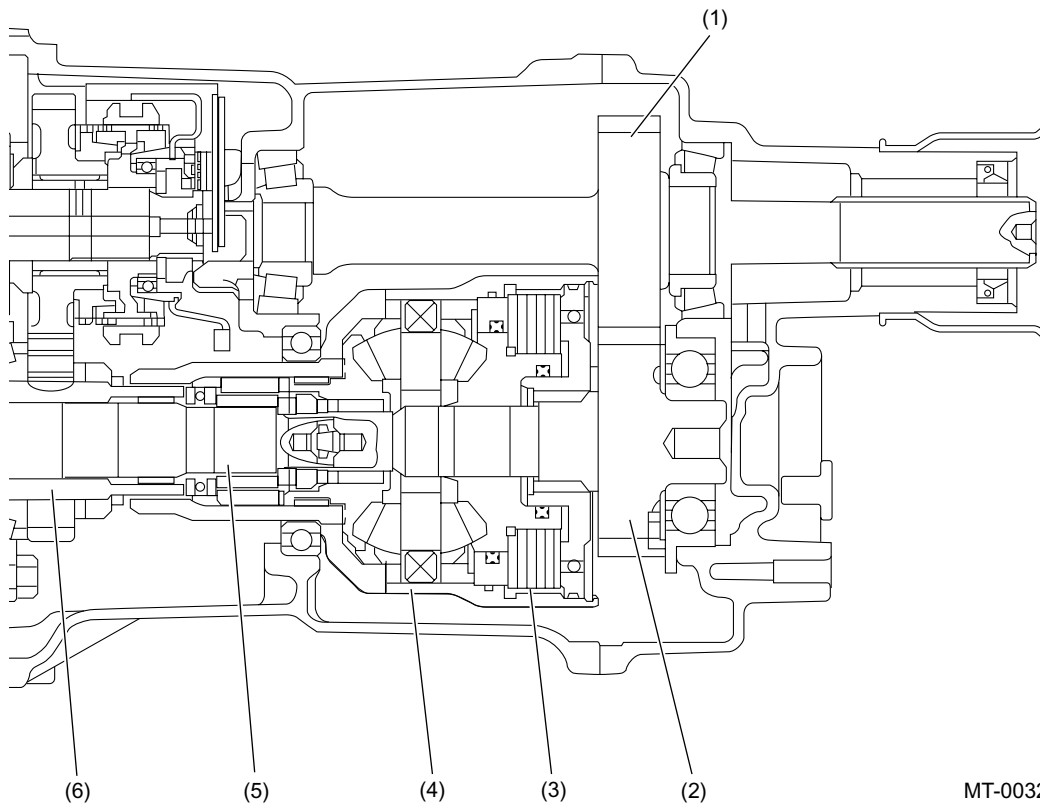
A: CONSTRUCTION

The center differential consists of a set of bevel gears and a viscous coupling.

The center differential has the following two functions: distributing the engine torque to the front and rear wheel drive shafts and absorbing the difference in rotating speed between the front and rear wheels.

The engine torque enters the center differential case from the transmission's driven shaft. The engine torque is then distributed through the bevel gear set directly to the drive pinion shaft and via the transfer drive and driven gears to the rear drive shaft.

The viscous coupling limits the differential action of the bevel gear set when either front or rear wheels spin so that adequate torques are transmitted to the front and rear wheels and proper traction is obtained.



MT-00327

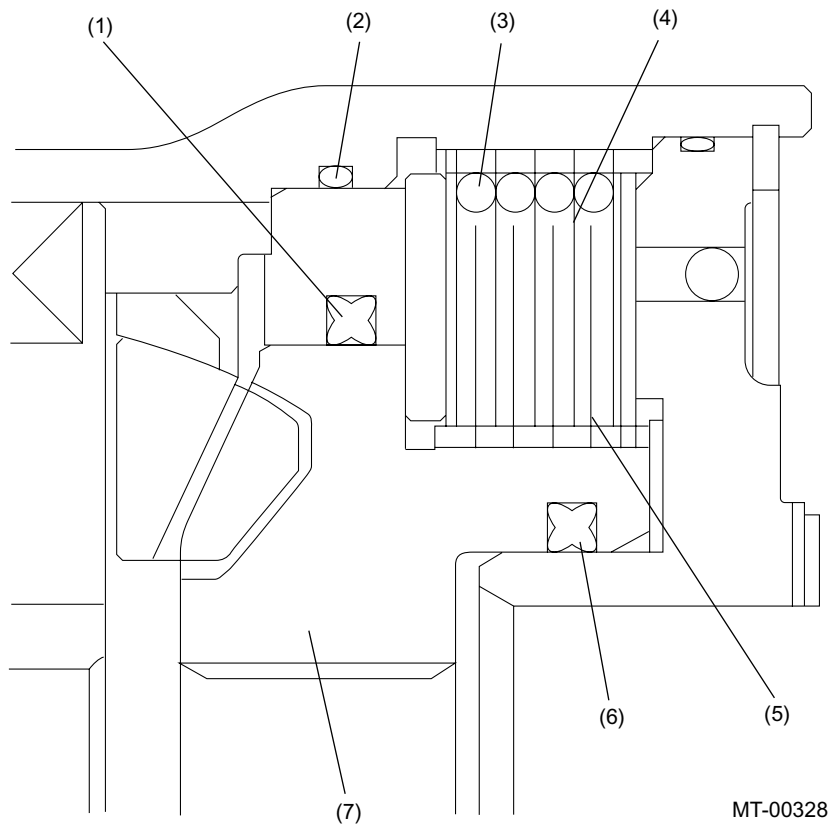
- | | |
|--------------------------|---|
| (1) Transfer driven gear | (4) Center differential (with viscous coupling) |
| (2) Transfer drive gear | (5) Drive pinion shaft |
| (3) Viscous coupling | (6) Driven shaft |

CENTER DIFFERENTIAL

MANUAL TRANSMISSION AND DIFFERENTIAL

B: MECHANISM OF VISCOUS COUPLING

The viscous coupling consists of a number of alternately arranged inner and outer plates and air-and-silicone oil mixture filled into a sealed space that is formed by the center differential case and the rear side gear of the differential gear set. The inner plates have their inner perimeters splined to the side gear and the outer plates have their outer perimeters splined to the center differential case. The outer plates are held apart by spacer rings. There are no spacer rings between the inner rings, so the inner plates are movable slightly in axial directions. X-section rings are used to prevent leakage of silicone oil which would otherwise occur if the oil is heat expanded and pressurized due to large difference in front and rear axle speeds.



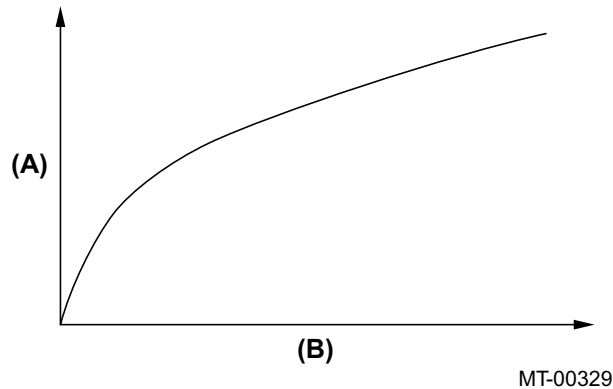
MT-00328

- | | |
|--------------------|----------------------|
| (1) X-section ring | (5) Inner plate |
| (2) O-ring | (6) X-section ring |
| (3) Spacer ring | (7) Side gear (rear) |
| (4) Outer plate | |

1. TORQUE CHARACTERISTICS

When a speed difference occurs between the center differential case and the rear side gear, a viscosity shearing force is generated in the silicone oil placed between the outer and inner plates. The torque is then transmitted by the silicone oil between the center differential case and the rear side gear.

The greater the speed difference, the greater the viscosity shearing force generated in the silicone oil. The relationship between the torque transmission and the speed difference is shown in the figure below. As can be seen from the figure, the smaller the speed difference, the smaller the torque transmission and the differential action.



(A) Driving torque

(B) Speed difference

2. HUMP PHENOMENON

Silicone oil is heated and expanded as differential action continues. This causes the pressure of air inside the viscous coupling to increase and the pressure of oil between plates to decrease. As a result, the inner and outer plates are pushed together. This direct plate-to-plate contact causes a non-viscous operation to occur. This phenomenon is called “hump”.

The hump eliminates the rotating speed difference between the center differential case and the rear side gear (or locks the differential), so soon after it has occurred, the internal pressure and temperature drop. The viscous coupling then returns to the normal viscosity shearing torque transmitting operation. (The hump phenomenon does not occur under normal operating conditions.)

CENTER DIFFERENTIAL

MANUAL TRANSMISSION AND DIFFERENTIAL

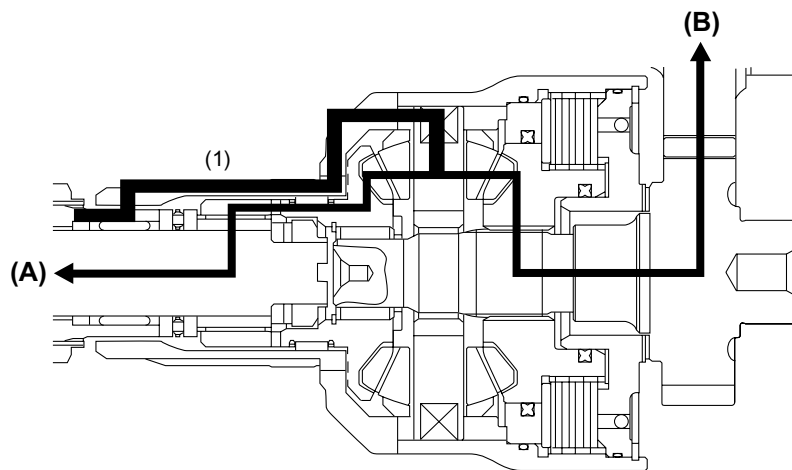
C: FUNCTION

When there is no speed difference between the front and rear wheels, the center differential delivers the engine torque to the front and rear wheels at a ratio of 50:50.

When a rotating speed difference occurs between the front and rear wheels, the center differential operates to absorb it in a controlled way by the function of the viscous coupling.

1. DURING NORMAL DRIVING

During straight-line driving on a flat road at a constant speed, all the four wheels rotate at the same speed. The center differential delivers engine torque evenly to the front and rear wheels. The viscous coupling does not generate viscosity shearing torque because there is no relative movements between the inner and outer plates.



MT-00330

(1) Engine torque

(A) To front differential

(B) To rear differential

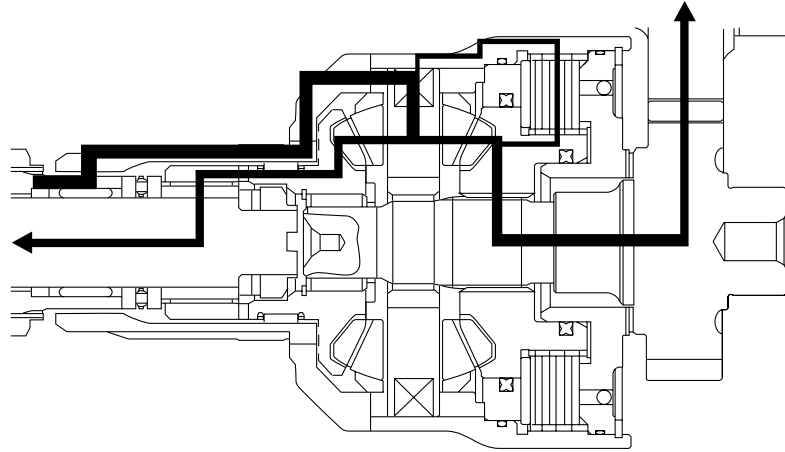
CENTER DIFFERENTIAL

MANUAL TRANSMISSION AND DIFFERENTIAL

2. DURING TURNS AT LOW SPEEDS

During turns at low speeds, rotating speed difference occurs between the front and rear wheels, as well as between the left and right wheels. More particularly, the front wheels rotate faster than the rear wheels. The center differential then acts to absorb the speed difference to enable smooth driving.

Although the speed difference is small under this condition, operation of the viscous coupling causes more torque to be transmitted to the rear than to the front.

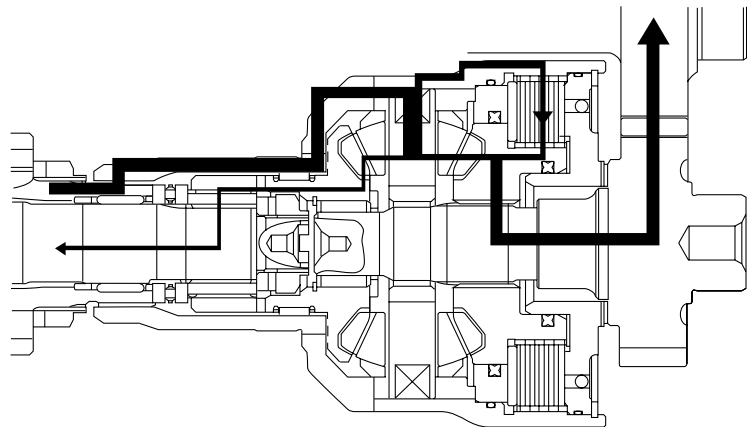


MT-00331

3. DRIVING ON ROUGH OR SLIPPERY ROADS

- When front wheels are on a slippery surface

When the front wheels begin to spin, the resulting speed difference between the front and rear drive shafts causes the viscous coupling to generate significant amount of viscosity shearing torque. As a result, the torque distributed to the rear wheels becomes much larger than that distributed to the spinning front wheels. The traction and driving stability are thus ensured on a rough or slippery road.



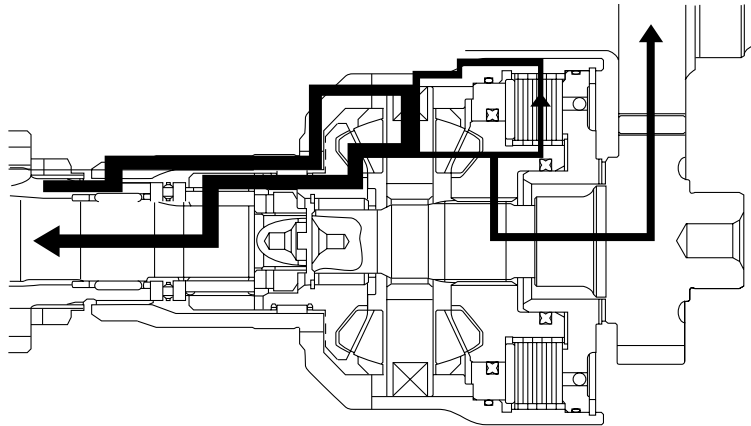
MT-00332

CENTER DIFFERENTIAL

MANUAL TRANSMISSION AND DIFFERENTIAL

- When rear wheels are on a slippery surface

When the vehicle is accelerated quickly from a standing start with the rear wheels on a slippery surface, the distribution of the vehicle weight on the front and rear wheels changes and the rear wheels start spinning. Due to the resulting speed difference between the front and rear drive shafts, the viscous coupling generates a significant amount of viscosity shearing torque, now in the direction opposite to that generated when the front wheels are on a slippery surface. As a result, the torque distributed to the front wheels becomes much larger than that distributed to the rear wheels.



MT-00367

1. General

The manual transmission is of a full-time all-wheel-drive design integrating a transmission assembly, front differential, and transfer gear assembly with center differential into a single unit. The transmission creates five forward speeds and one reverse using the corresponding gears all provided with inertia lock-key type synchronizers.

The transmission and front differential are housed in an aluminum case which is split into right and left halves and constitutes also a clutch housing. Located at the rear and joined each other are the transfer case and extension case which house the transfer gears and center differential as well as part of the transmission assembly.

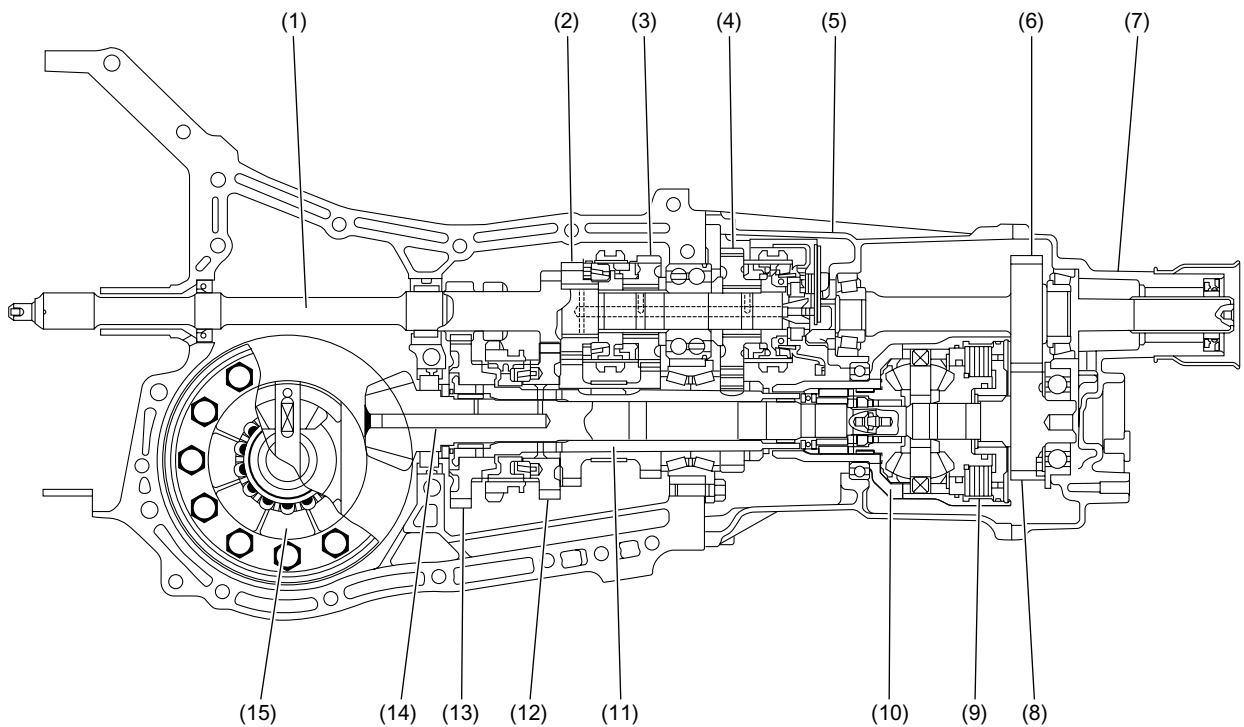
The major features of the transmission are as follows:

- The forward speed gears are helical gears featuring high tooth face strength, large tooth contact areas, and quiet operation.
- Reversing rotation is achieved by making a slidable reverse idler gear engage with both the reverse drive gear on the main shaft and the reverse driven gear integral with the 1st-2nd synchronizer hub on the drive pinion shaft.

The center differential compensates for the difference in front and rear axle speeds. It consists of a bevel gear set and a viscous coupling located at its rear end which are housed in a single case. The center differential, together with a pair of transfer gears, transmits the power from the transmission to the drive pinion shaft (front wheel drive shaft) and the rear drive shaft. The viscous coupling functions as a differential-action-limiting element.

GENERAL

MANUAL TRANSMISSION AND DIFFERENTIAL



MT-00320

- | | | |
|--------------------------|-----------------------------------|----------------------------------|
| (1) Main shaft | (7) Extension case | (13) 1st driven gear |
| (2) 3rd drive gear | (8) Transfer drive gear | (14) Drive pinion shaft |
| (3) 4th drive gear | (9) Viscous coupling | (15) Front differential assembly |
| (4) 5th drive gear | (10) Center differential assembly | |
| (5) Transfer Case | (11) Driven shaft (countershaft) | |
| (6) Transfer driven gear | (12) 2nd driven gear | |

REVERSE CHECK MECHANISM

MANUAL TRANSMISSION AND DIFFERENTIAL

2. Reverse Check Mechanism

Located in the transfer case, the reverse check mechanism prevents a direct 5th-to-reverse shift by using a selector arm and cam combination which allows the gear to be shifted into the reverse only after it has been returned once to neutral.

A: CONSTRUCTION

The construction of the reverse check mechanism is as shown in the drawing on the opposing page.

The reverse check sleeve is bolted to the transfer case and houses the mechanism main components.

The reverse accent shaft is slidable inside the reverse check sleeve and its smaller-diameter end is fitted with the reverse check cam. The cam can rotate and move axially on the shaft but its leftward movement is restricted by a step formed on the sleeve inner wall.

The reverse accent shaft has hollows in both ends. In the left end hollow are the 1st return spring and its cap and in the right end hollow is the reverse return spring which pushes the shaft leftward.

Around the check cam is the reverse check spring whose left end applies simultaneous leftward and rotational forces to the cam.

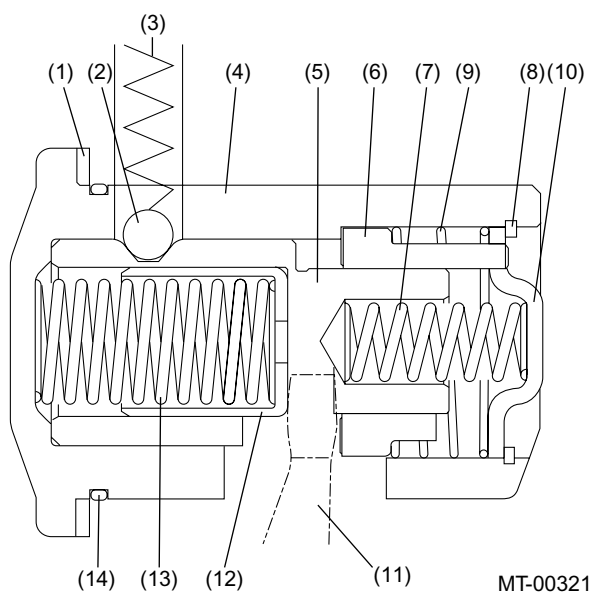
Both the reverse check spring and reverse return spring are retained at their right ends by the reverse check plate which is held in place by the snap ring.

The reverse accent shaft has a V-groove in which the detent ball is pressed by the reverse accent spring fitted through the hole in the reverse check sleeve.

The reverse check sleeve and reverse accent shaft have a slot and a notch at their bottoms, respectively, and the selector arm is inserted in the notch through the slot.

REVERSE CHECK MECHANISM

MANUAL TRANSMISSION AND DIFFERENTIAL



MT-00321

- | | | |
|---------------------------|---------------------------|------------------------|
| (1) Select adjust shim | (6) Reverse check cam | (11) Selector arm |
| (2) Detent ball | (7) Reverse return spring | (12) Spring cap |
| (3) Reverse accent spring | (8) Snap ring | (13) 1st return spring |
| (4) Reverse check sleeve | (9) Reverse check spring | (14) O-ring |
| (5) Reverse accent shaft | (10) Reverse check plate | |

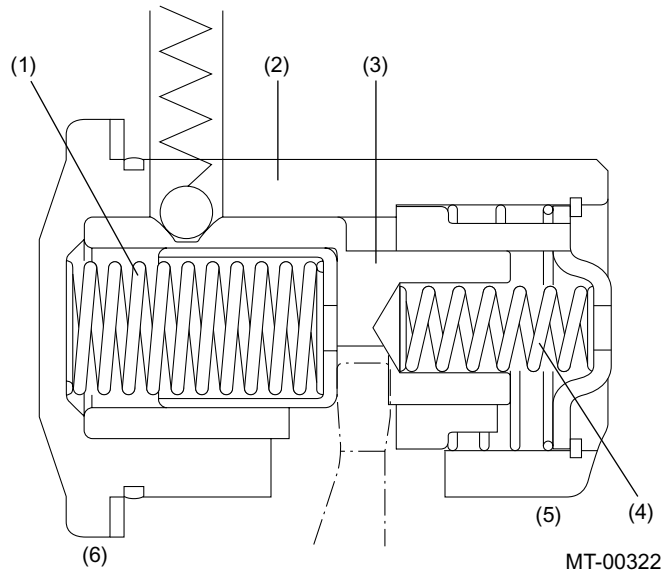
REVERSE CHECK MECHANISM

MANUAL TRANSMISSION AND DIFFERENTIAL

B: OPERATION

The drawing below shows the state of the reverse check mechanism when the selector arm is in the neutral position. The 1st and 2nd gears will be selected if the selector arm is moved leftward from this point to a stop and then turned in either way. A rightward movement of the arm to a stop will enable selection of the 5th and reverse gears. In the neutral position, the selector arm receives a rightward force (force toward the 5th and reverse gear side) from the 1st return spring and a leftward force (force toward the 1st and 2nd gear side) from the reverse return spring to stay in that position.

The following explanation describes how the selector arm and reverse check mechanism operate when the driver selects the 5th gear and then selects the reverse gear.



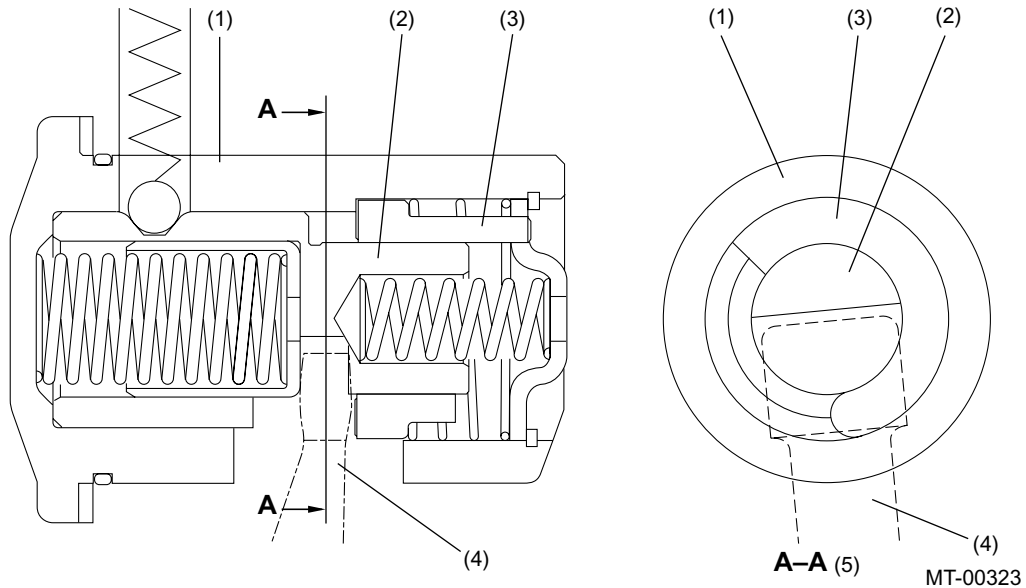
- | | | |
|--------------------------|---------------------------|-------------------------------|
| (1) 1st return spring | (3) Reverse accent shaft | (5) 5th and reverse gear side |
| (2) Reverse check sleeve | (4) Reverse return spring | (6) 1st and 2nd gear side |

REVERSE CHECK MECHANISM

MANUAL TRANSMISSION AND DIFFERENTIAL

1. WHEN SELECTOR ARM IS MOVED TOWARD 5TH AND REVERSE GEAR SIDE

The selector arm moves rightward while pushing both the reverse accent shaft and reverse check cam simultaneously.



- (1) Reverse check sleeve
- (2) Reverse accent shaft

- (3) Reverse check cam
- (4) Selector arm

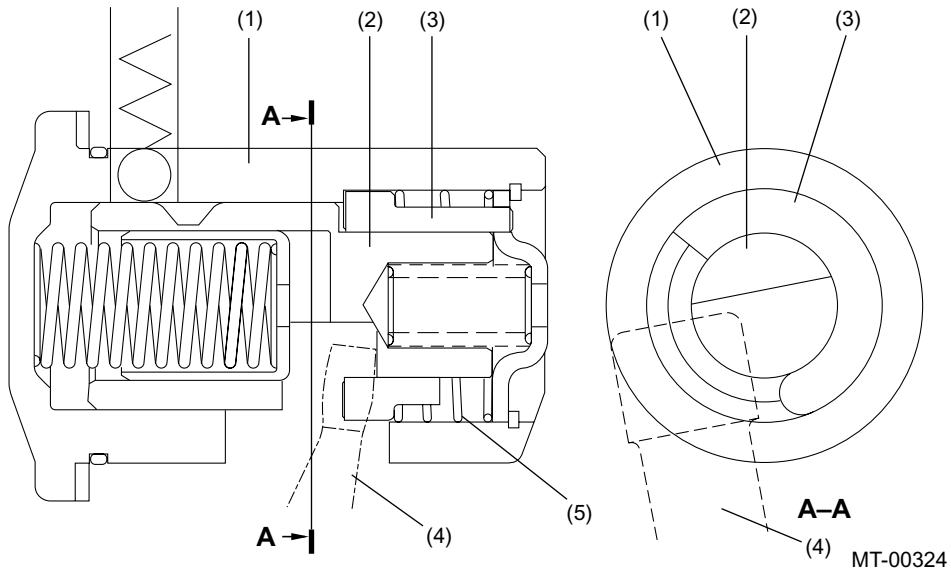
- (5) Neutral position

REVERSE CHECK MECHANISM

MANUAL TRANSMISSION AND DIFFERENTIAL

2. WHEN SHIFT IS MADE TO 5TH GEAR

The selector arm is turned toward the 5th gear selection direction. When the arm clears the edge of the reverse check cam as it turns, the cam becomes free of the selector arm pressure and returns to its original position by the force of the reverse check spring.



(1) Reverse check sleeve

(2) Reverse accent shaft

(3) Reverse check cam

(4) Selector arm

(5) Reverse check spring

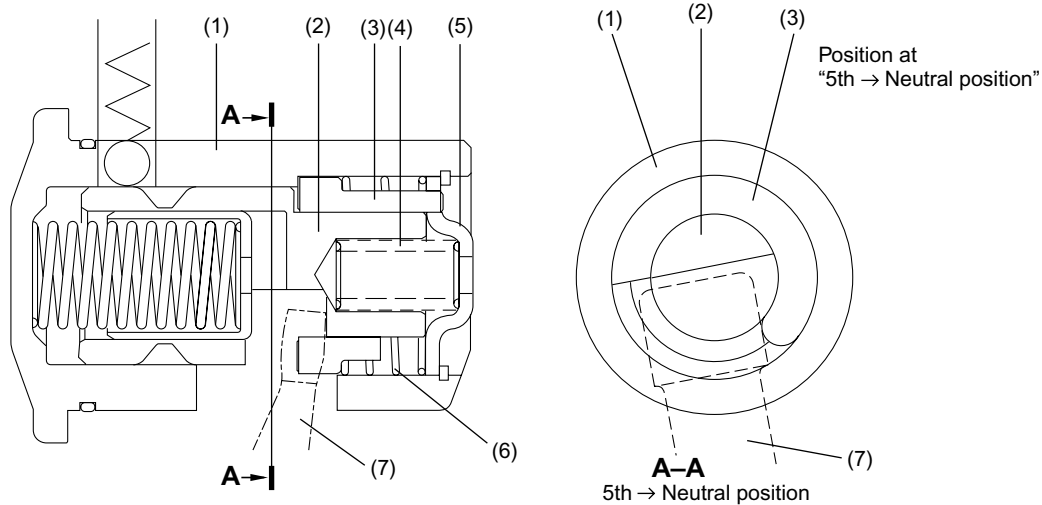
REVERSE CHECK MECHANISM

MANUAL TRANSMISSION AND DIFFERENTIAL

3. WHEN A SHIFT FROM 5TH TO REVERSE IS ATTEMPTED

The selector arm turns toward the reverse gear while pushing the reverse accent shaft rightward and the reverse check cam counterclockwise (as viewed in the direction of arrows A).

The reverse check cam, however, stops to rotate at a point where its stopper hits against the reverse check plate (this point corresponds to the neutral position in terms of the angle) and prevents the selector arm from moving toward the reverse gear selection direction. The selector arm is then axially pushed to the neutral position by the reverse accent shaft which is given a leftward force by the reverse return spring.



MT-00325

- (1) Reverse check sleeve
- (2) Reverse accent shaft
- (3) Reverse check cam
- (4) Reverse return spring

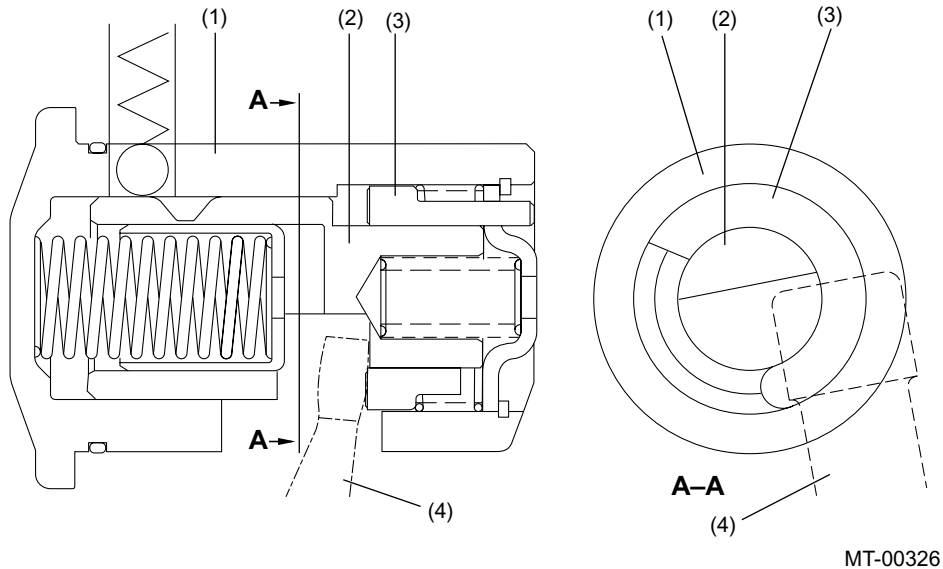
- (5) Reverse check plate
- (6) Snap ring
- (7) Selector arm

REVERSE CHECK MECHANISM

MANUAL TRANSMISSION AND DIFFERENTIAL

4. WHEN A SHIFT TO REVERSE IS MADE AFTER RETURN OF SELECTOR ARM TO NEUTRAL

As the ends of the reverse accent shaft and the reverse check cam are on the same plane, the selector arm now can turn toward the reverse gear selection direction after pushing leftward both the shaft and cam simultaneously.



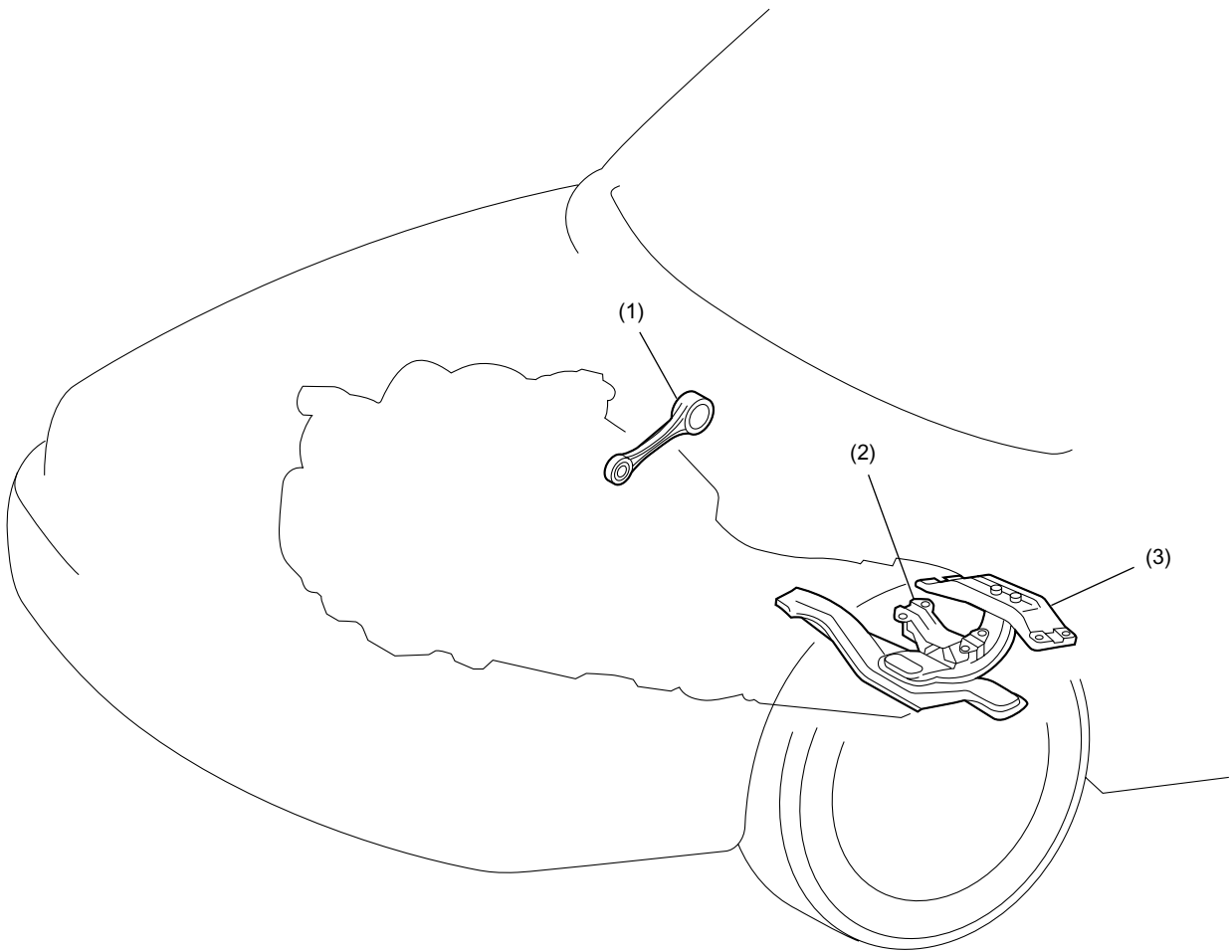
- (1) Reverse check sleeve
- (2) Reverse accent shaft

- (3) Reverse check cam
- (4) Selector arm

4. Transmission Mounting

A: GENERAL

The transmission mounting consists of a pitching stopper, cushion rubber, and a cross member. In addition to support the transmission, these components absorb noise and vibration caused by the transmission.



MT-00334

(1) Pitching stopper

(2) Cushion rubber

(3) Cross member

TRANSMISSION MOUNTING

MANUAL TRANSMISSION AND DIFFERENTIAL

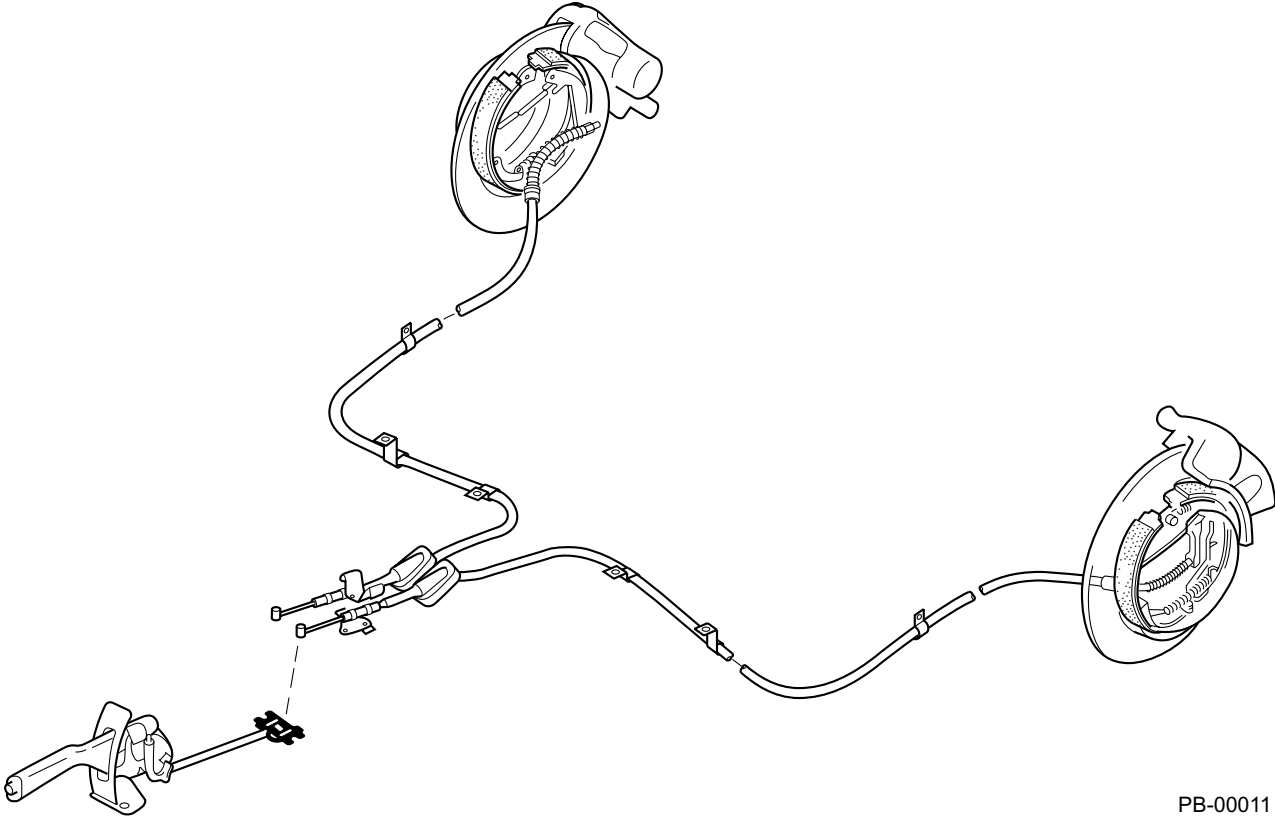
MEMO

PARKING BRAKE

PARKING BRAKE

1. Parking Brake

The parking brake uses a drum housed in the disc rotor of each rear disc brake. The shoes are mechanically controlled through linkage and cables.



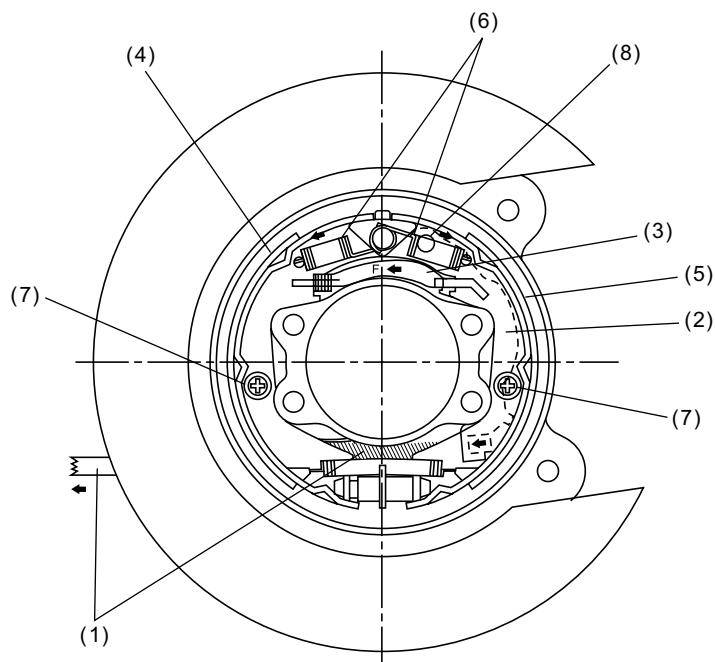
PB-00011

A: OPERATION

1. ENGAGING

When the parking brake lever is pulled, the shoe actuating lever to which the end of the parking brake cable is connected turns the strut in direction "F" around point "P".

The strut then presses the brake shoes A and B against the drum. These brake shoes utilize a floating design and are movably supported by hold-down pins. The force applied to brake shoe A and the reaction force "F" applied to the brake shoe B via point "P" press them against the brake drum.



PB-00030

- (1) Parking brake cable
- (2) Lever
- (3) Strut
- (4) Brake shoe A

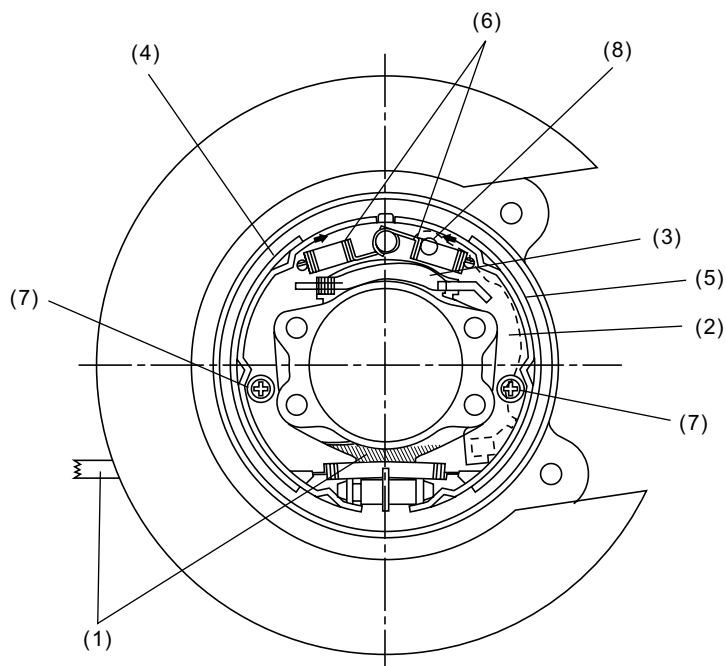
- (5) Brake shoe B
- (6) Shoe return spring
- (7) Shoe hold down pin
- (8) Point "P"

PARKING BRAKE

PARKING BRAKE

2. RELEASING

When the parking brake lever is returned to the release position and the parking brake cables are slackened, the brake shoes A and B are moved back to their original positions by the tension of return springs, so that the parking brake is released.



PB-00031

- (1) Parking brake cable
- (2) Lever
- (3) Strut
- (4) Brake shoe A

- (5) Brake shoe B
- (6) Shoe return spring
- (7) Shoe hold down pin
- (8) Point "P"

2. Power Steering System

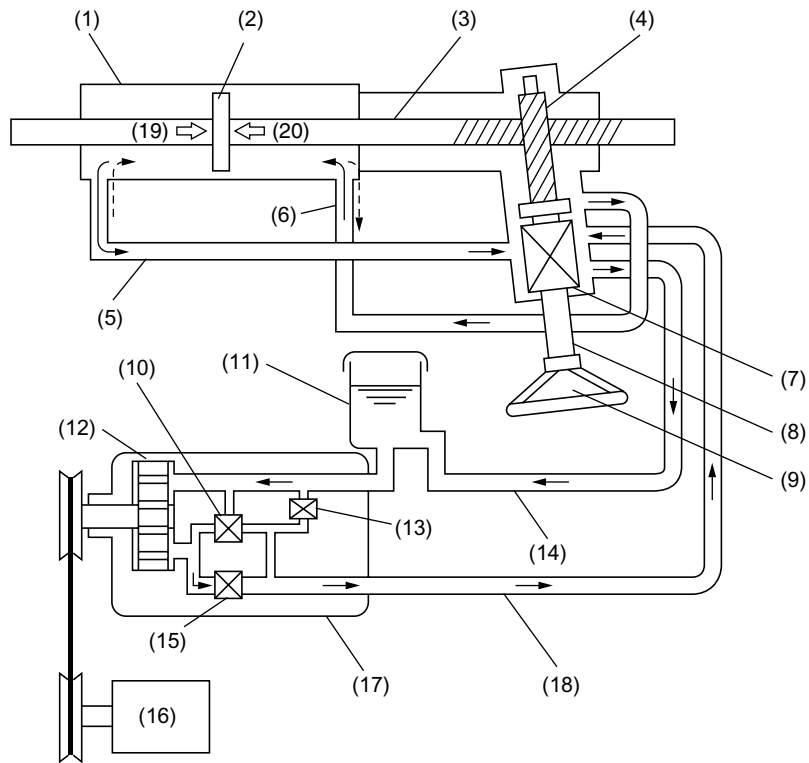
A: HYDRAULIC SYSTEM

- The fluid pump is directly driven by the engine through a belt.
- When the steering wheel is not being turned, the pressure-sensitive valve in the pump opens to drain the fluid into the fluid reservoir tank.
- The fluid pressure is maintained almost constant regardless of change in the engine speed by the function of the flow control valve. The pressure-regulated fluid is delivered to the control valve via hose A.
- When the steering wheel is turned, the rotary control valve connected to the pinion shaft opens the hydraulic circuit corresponding to the direction in which the steering wheel is turned. The fluid then flows into chamber A or B via pipe A or B.
- The fluid pressure in chamber A or B acts on the rack piston in the same direction as that in which the rack shaft is moved by rotation of the steering wheel. This helps reduce the effort required of the driver to operate the steering wheel.
- Movement of the rack piston causes the fluid in the other chamber to return to the reservoir tank via pipe A or B, control valve, and hose B.
 - As the steering shaft is connected to the pinion shaft mechanically via the rotary control valve, the steering system can be operated as a manual system even if the hydraulic system becomes inoperative.
 - To control the maximum fluid pressure, a relief valve is built into the fluid pump to prevent build-up of an excessive fluid pressure.

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

2.5 L model

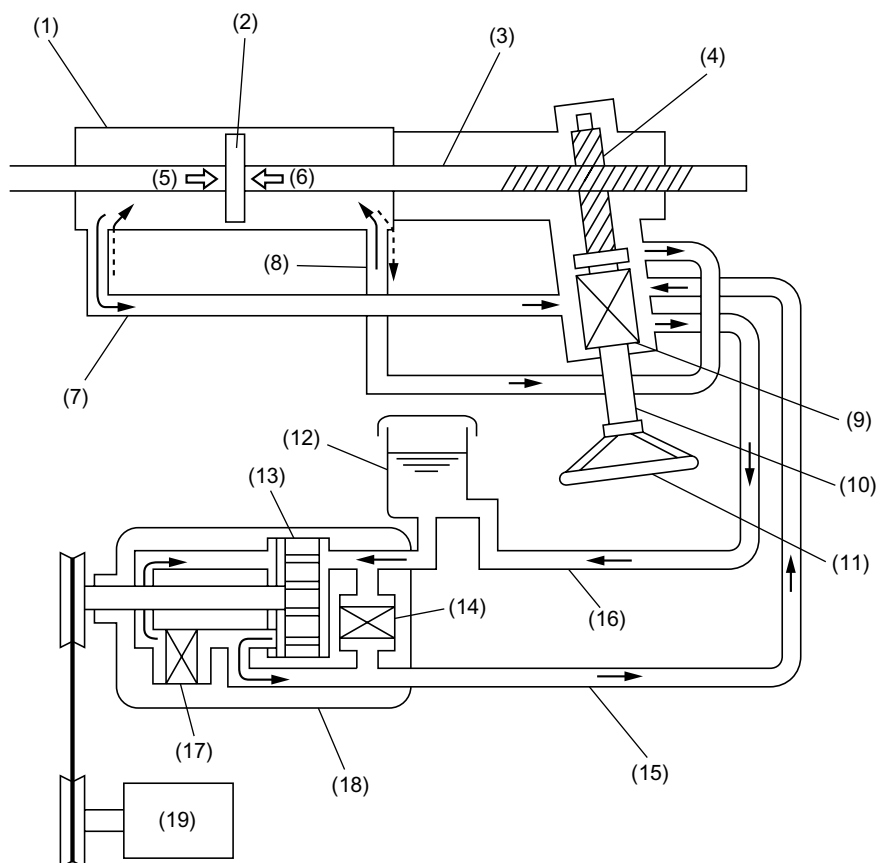


- | | | |
|--------------------------|-------------------------------|-------------------------|
| (1) Power cylinder | (8) Steering shaft | (15) Flow control valve |
| (2) Rack piston | (9) Steering wheel | (16) Engine |
| (3) Rack shaft | (10) Pressure-sensitive valve | (17) Fluid pump |
| (4) Pinion shaft | (11) Tank | (18) Hose A |
| (5) Pipe A | (12) Vane pump | (19) Chamber A |
| (6) Pipe B | (13) Relief valve | (20) Chamber B |
| (7) Rotary control valve | (14) Hose B | |

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

3.0 L model



PS-00009

- | | |
|--------------------------|-------------------------|
| (1) Power cylinder | (11) Steering wheel |
| (2) Rack piston | (12) Tank |
| (3) Rack shaft | (13) Vane pump |
| (4) Pinion shaft | (14) Relief valve |
| (5) Chamber A | (15) Hose A |
| (6) Chamber B | (16) Hose B |
| (7) Pipe A | (17) Pump control valve |
| (8) Pipe B | (18) Fluid pump |
| (9) Rotary control valve | (19) Engine |
| (10) Steering shaft | |

POWER STEERING SYSTEM

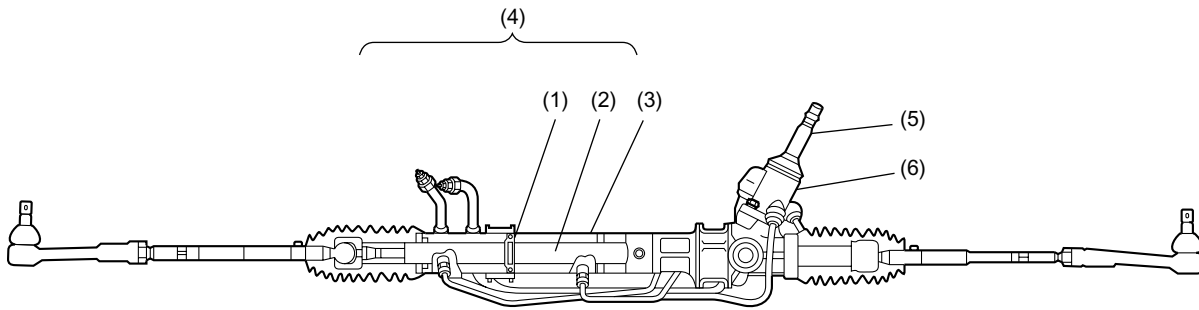
POWER ASSISTED SYSTEM (POWER STEERING)

B: GEARBOX ASSEMBLY

1. POWER CYLINDER

The gearbox integrates the control valve and power cylinder into a single unit. The rack shaft serves as a power cylinder piston. The rotary control valve is located around the pinion shaft.

The rotary control valve and power cylinder are connected to each other by two pipes through which hydraulic fluid flows.



PS-00483

- | | |
|----------------|--------------------|
| (1) Piston | (4) Power cylinder |
| (2) Rack shaft | (5) Pinion shaft |
| (3) Cylinder | (6) Control valve |

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

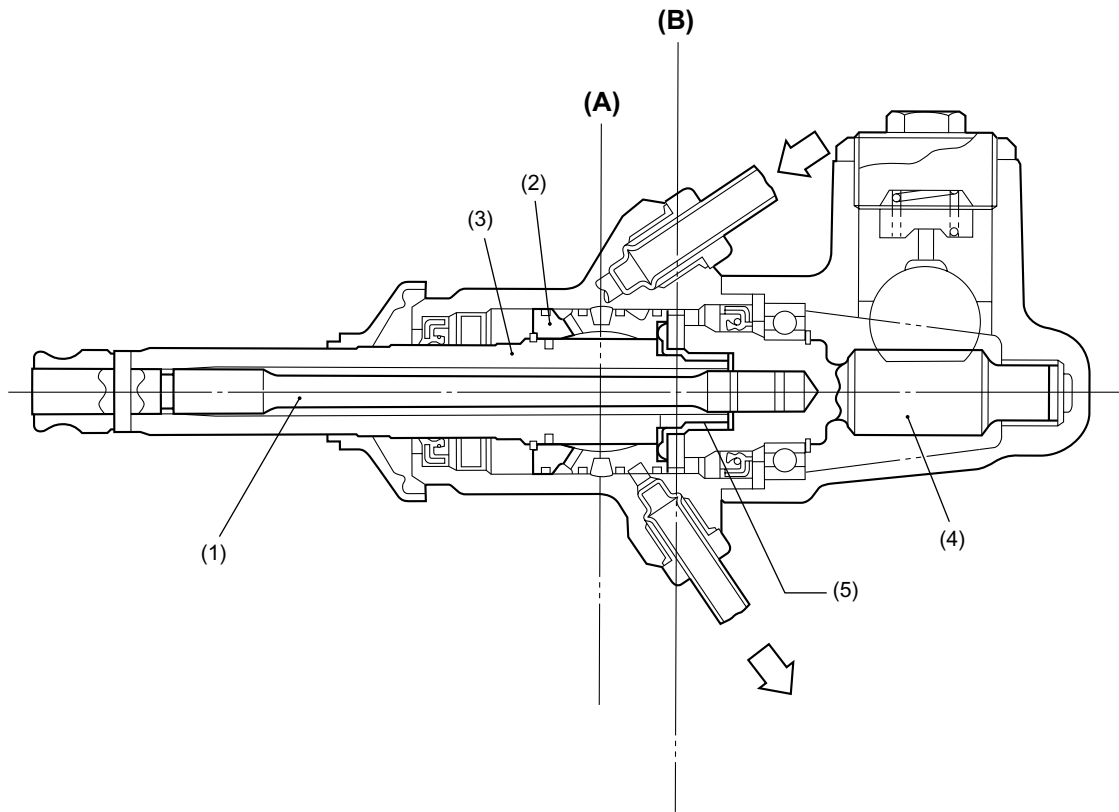
2. ROTARY CONTROL VALVE

The rotary control valve consists of a rotor (which rotates together with the steering shaft), a pinion (which is connected to the rotor and torsion bar), and a sleeve (which rotates together with the pinion). The rotor and sleeve have grooves C and D, respectively, which form fluid passages V_1 through V_4 .

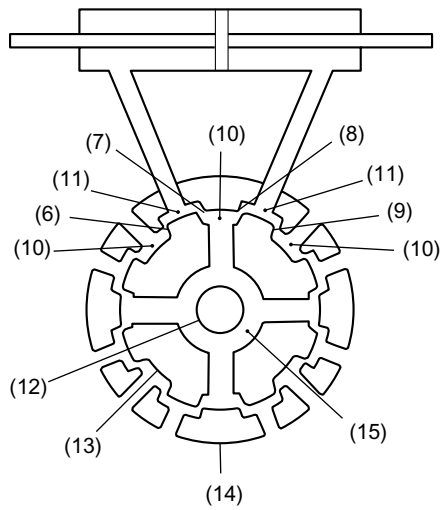
The pinion is in mesh with the rotor with adequate clearance, which enable the rack to be moved manually by rotating the steering shaft (fail-safe feature).

POWER STEERING SYSTEM

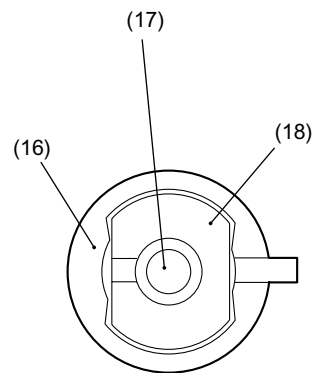
POWER ASSISTED SYSTEM (POWER STEERING)



(A)



(B)



PS-00250

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

- | | |
|--|---|
| (1) Torsion bar | (12) Torsion bar |
| (2) Sleeve | (13) Rotor |
| (3) Rotor | (14) Sleeve |
| (4) Pinion | (15) Fluid return line (to reservoir tank) |
| (5) Pinion-to-rotor engagement (fail-safe feature) | (16) Pinion |
| (6) Fluid passage V_1 | (17) Torsion bar |
| (7) Fluid passage V_2 | (18) Rotor |
| (8) Fluid passage V_3 | |
| (9) Fluid passage V_4 | (A) Cross-sectional view A (fluid passage switching circuit) |
| (10) Groove C | (B) Cross-sectional view B (pinion-to-rotor engagement) |
| (11) Groove D | |

POWER STEERING SYSTEM

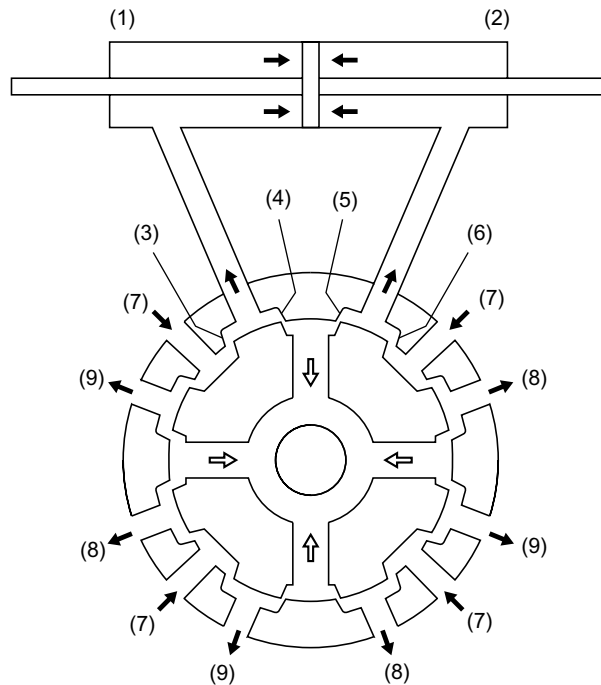
POWER ASSISTED SYSTEM (POWER STEERING)

- Principle of operation

When the torsion bar is twisted by a rotational force applied to the steering wheel, the relative position between the rotor and sleeve changes. This changes the cross-sectional area of fluid passages V_1 , V_2 , V_3 and V_4 . The fluid passages are thus switched and the fluid pressure is controlled in accordance with the operation of the steering wheel.

- When no steering force is applied:

The rotor and sleeve are held at the neutral position. Fluid passages V_1 , V_2 and V_3 , which are formed by grooves C and D are open equally. Under this condition, the fluid from the pump returns to the reservoir tank so that neither fluid pressure builds up nor the rack piston moves in the power cylinder.



PS-00012

- (1) Chamber A
- (2) Chamber B
- (3) V_1

- (4) V_2
- (5) V_3
- (6) V_4

- (7) From fluid pump
- (8) To A
- (9) To B

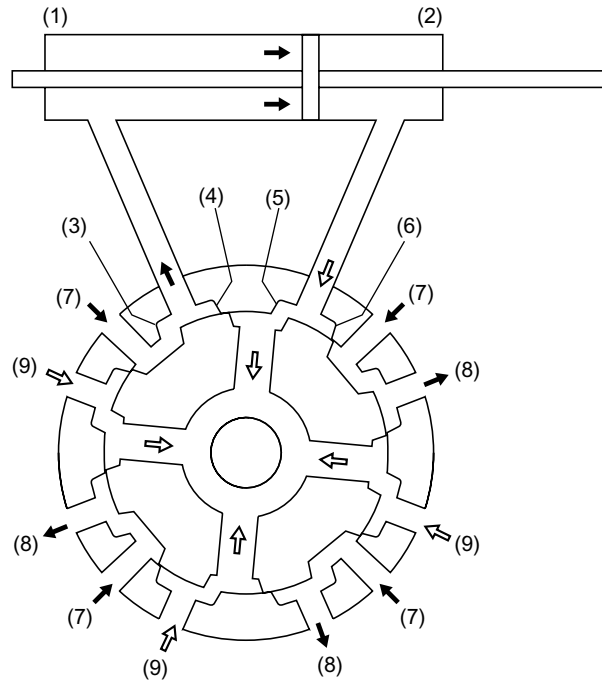
POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

- When steering force is applied:

When the steering wheel is turned to the right, for example, fluid passages V_1 and V_3 are opened while fluid passages V_2 and V_4 are nearly closed.

At this point, the fluid pressure in chamber A of the power cylinder increases depending on the degree of closure of fluid passages V_2 and V_4 so that the rack piston moves to the right. The fluid in chamber B, on the other hand, is drained through fluid passage V_3 into the reservoir tank.



PS-00013

- (1) Chamber A
- (2) Chamber B
- (3) V_1

- (4) V_2
- (5) V_3
- (6) V_4

- (7) From fluid pump
- (8) To A
- (9) From B

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

C: FLUID PUMP AND RESERVOIR TANK

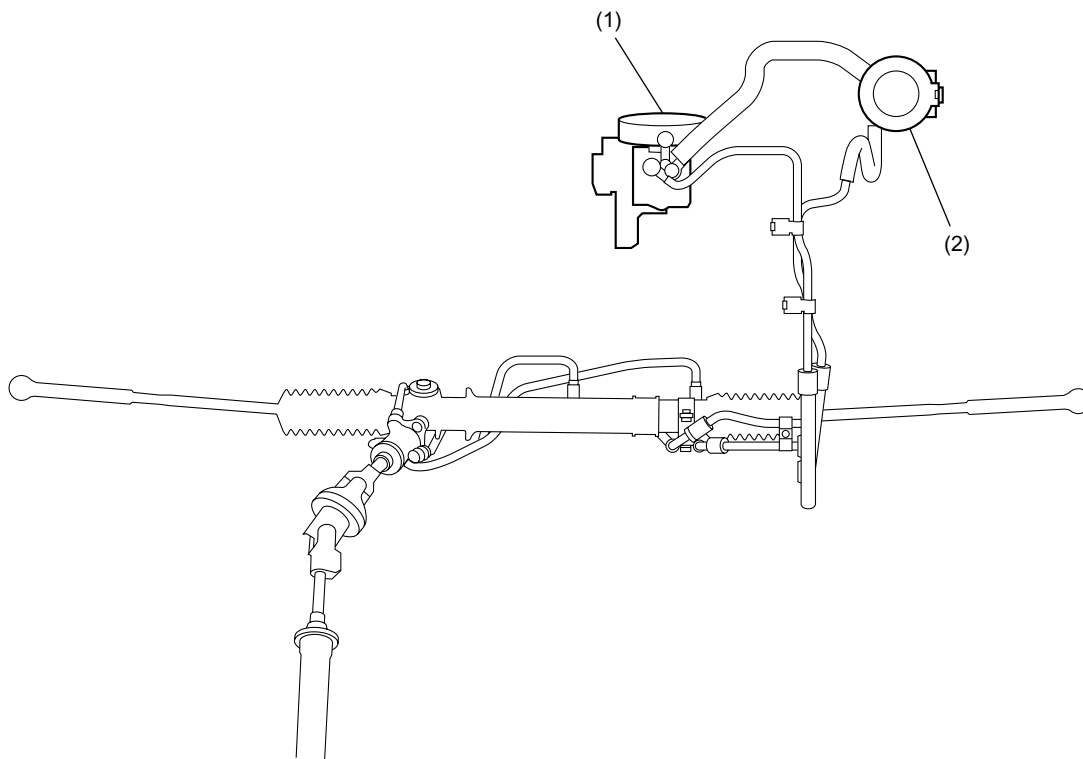
1. 2.5 L MODEL

The fluid pump is a vane type driven by the engine via belt.

The reservoir tank is mounted on the vehicle body.

The fluid pump incorporates the flow control valve, pressure-sensitive valve, and relief valve, each performing the following functions:

- The flow control valve regulates the flow rate of discharged fluid to a constant level irrespective of the engine speed.
- The pressure-sensitive valve returns the fluid to the reservoir tank when there is no steering input.
- The relief valve protects the system from an excessively high pressure which may occur, for example, when the steering wheel is turned all the way.

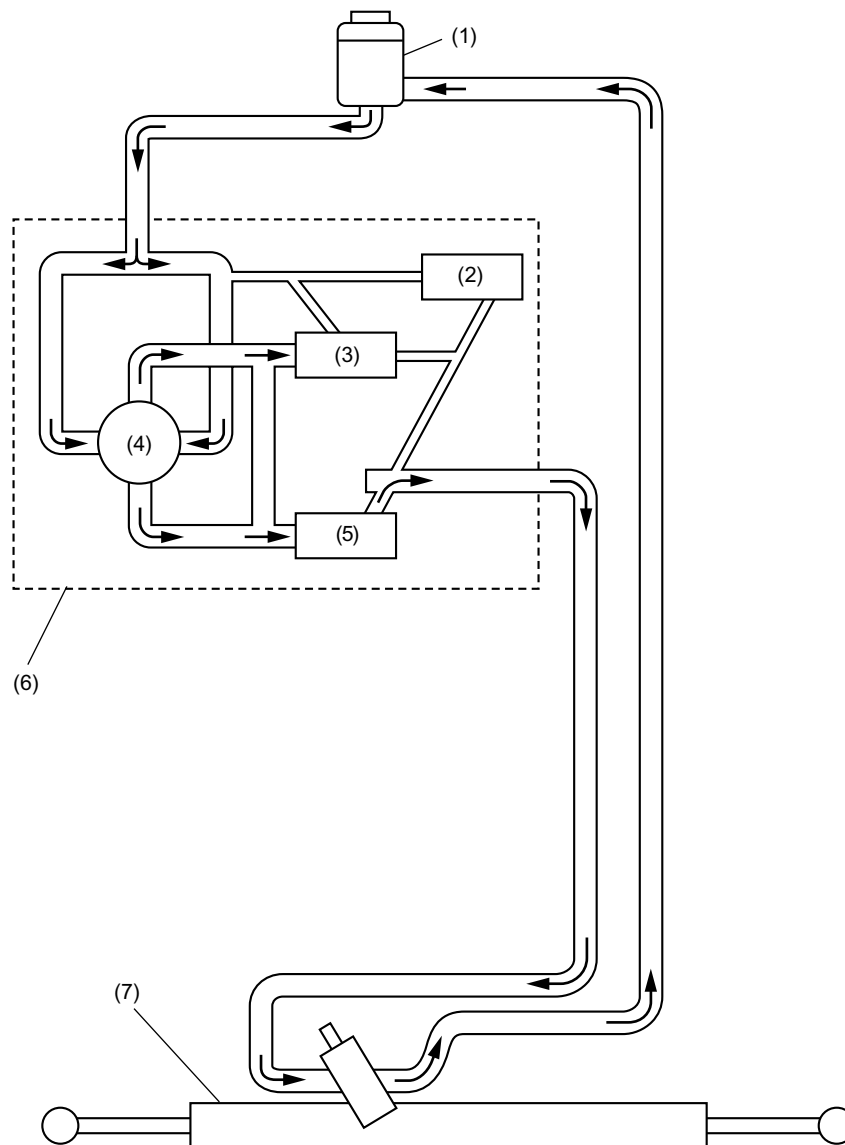


PS-00251

- (1) Fluid pump
(2) Reservoir tank

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)



PS-00252

- (1) Reservoir tank
- (2) Relief valve
- (3) Pressure-sensitive valve
- (4) Vane pump

- (5) Flow control valve
- (6) Fluid pump
- (7) Steering gearbox

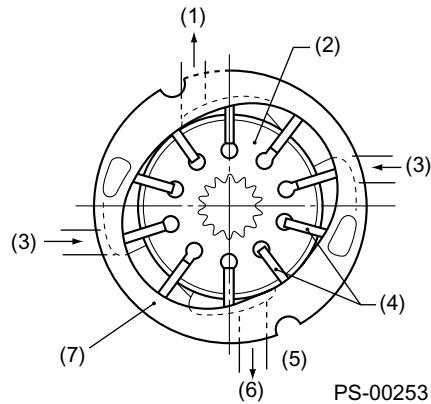
POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

• Vane pump

The vane pump consists of a rotor, a cam ring, and 10 vanes.

When the rotor rotates, the vane movably fitted in each slot of the rotor is radially moved out by centrifugal force and pressed against the inside wall of the cam ring. Since the inside of the cam ring is oval-shaped, the fluid from the suction port is confined and pressurized in the chamber formed between two adjacent vanes as the rotor rotates and is delivered through the discharge port. The pressurized fluid circulates through the hydraulic circuit.



- (1) Discharge
- (2) Rotor
- (3) Suction
- (4) Vane

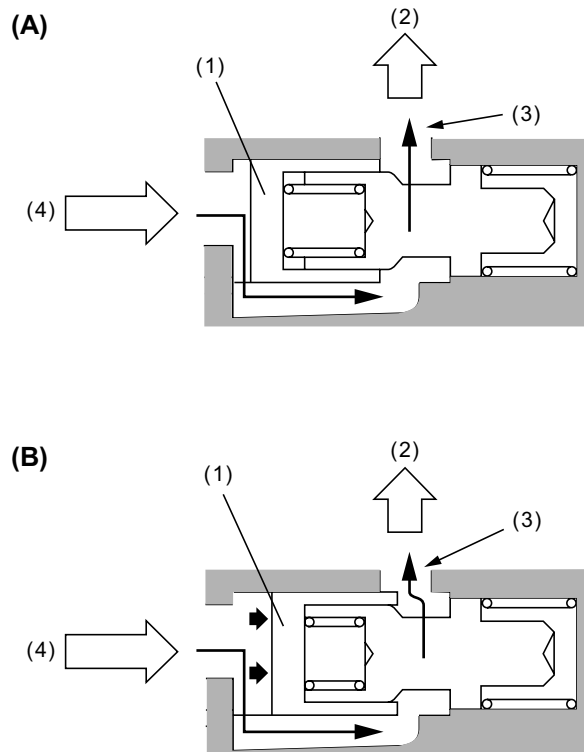
- (5) Vane pump
- (6) Discharge
- (7) Cam ring

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

● Flow control valve

The flow control valve consists of a sub-spool which is pushed to the right when the fluid pressure rises as the engine speed increases (and consequently, the pump discharge rate becomes higher). When the sub-spool is shifted to the right, the variable orifice is narrowed, thus the discharge rate is reduced.



PS-00254

- (A) Engine speed low
- (B) Engine speed high

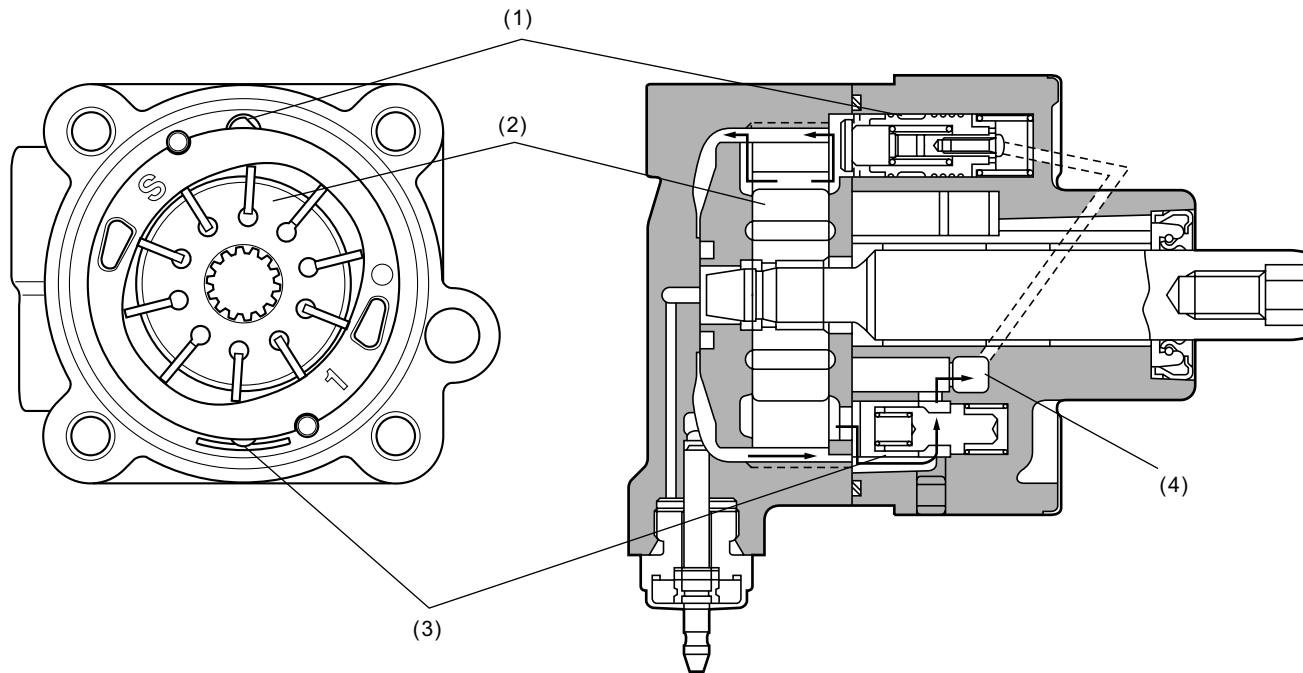
- (1) Sub-spool
- (2) To steering gearbox
- (3) Variable orifice
- (4) From vane pump

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

● Pressure-sensitive valve

The pressure-sensitive valve's left end is exposed to the fluid pump discharge-pressure and its right end to the flow control valve outlet pressure (the pressure of the fluid being directed to the steering gearbox).



PS-00255

- (1) Pressure-sensitive valve
- (2) Fluid pump

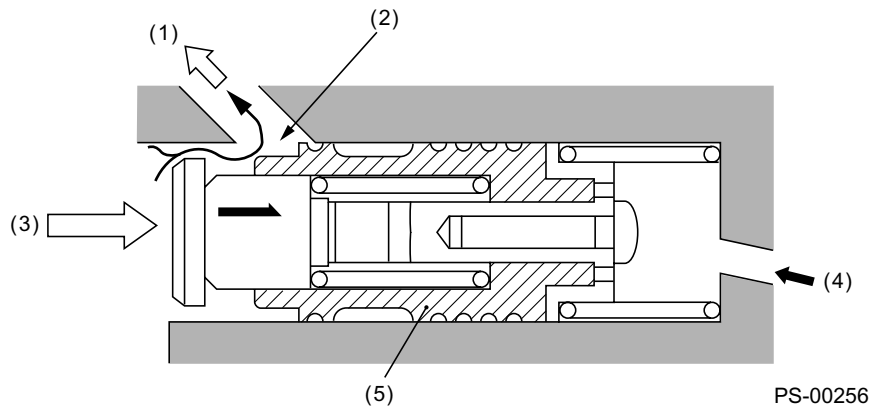
- (3) Flow control valve
- (4) To steering gearbox

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

- When the steering wheel is not being turned, the fluid that has passed through the flow control valve is directed to the steering gearbox but it is returned to the reservoir tank without entering the rotary control valve's passages in the gearbox. Therefore, the pressure acting on the valve's right end does not increase.

On the other hand, the pressure acting on the left end of valve is the fluid pump-discharge pressure which is higher than the pressure acting on the right end. This causes the pressure-sensitive valve's spool assembly to move to the right. As a result, the drain port which was closed by the outer spool is now opened. The pump discharged fluid then flows to the reservoir tank and the pressure inside the pump is reduced.



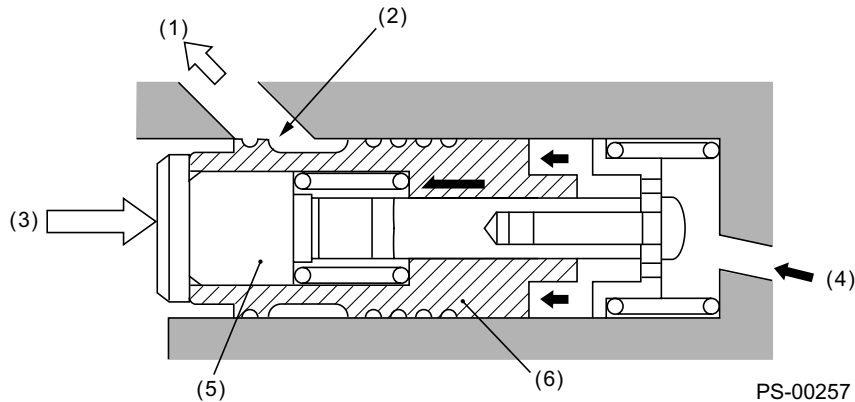
- | | |
|------------------------------------|---|
| (1) To reservoir tank | (4) Fluid pressure after passing through flow control valve (low) |
| (2) Drain port open | (5) Outer spool |
| (3) Pressure from vane pump (high) | |

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

- When the steering wheel is turned in either direction, the pressure of the fluid that has passed through the flow control valve and directed into the steering gearbox increases as it enters the power cylinder and acts on the rack piston.

The inner spool of the pressure-sensitive valve is kept pressed to the right by the pump-discharge pressure acting on its left end. On the other hand, the fluid pressure acting on the right end of the valve is also high. So, the outer spool is moved to the left, closing the drain port. As a result, the pump internal pressure increases so that the fluid with a high pressure necessary for power assistance is supplied to the gearbox.



- | | |
|-----------------------------|--|
| (1) To reservoir tank | (4) Fluid pressure after passing through flow control valve (increase) |
| (2) Drain port closed | (5) Inner spool |
| (3) Pressure from vane pump | (6) Outer spool |

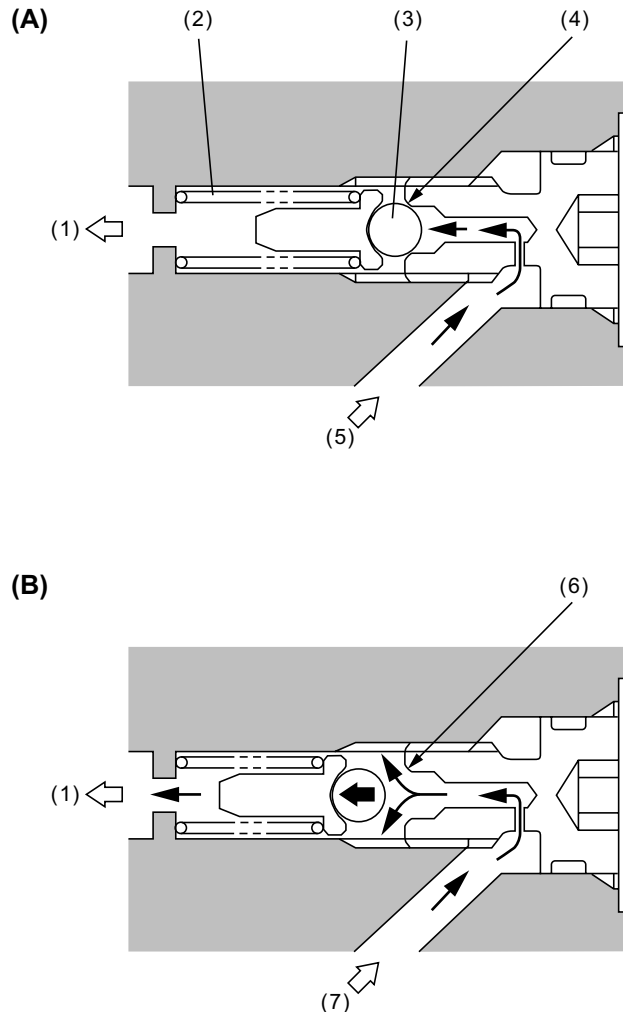
POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

● Relief valve

The relief valve consists of a check ball and a spring. The check ball is exposed to the fluid pressure that is regulated by the flow control valve (branched from the line to the steering gearbox).

If the pressure acting on the check ball is increased abnormally due to, for example, rotation of the steering wheel to a stop and overcomes the spring tension, the ball is pushed to the left, allowing the fluid to be drained into the reservoir tank. Therefore, the pressure to the steering gearbox is prevented from becoming excessively high.



PS-00258

(A) Relief valve not in operation

(B) Relief valve in operation

(1) To reservoir tank

(2) Spring

(3) Check ball

(4) Valve closed

(5) Fluid pressure after passing through flow control valve (low)

(6) Valve open

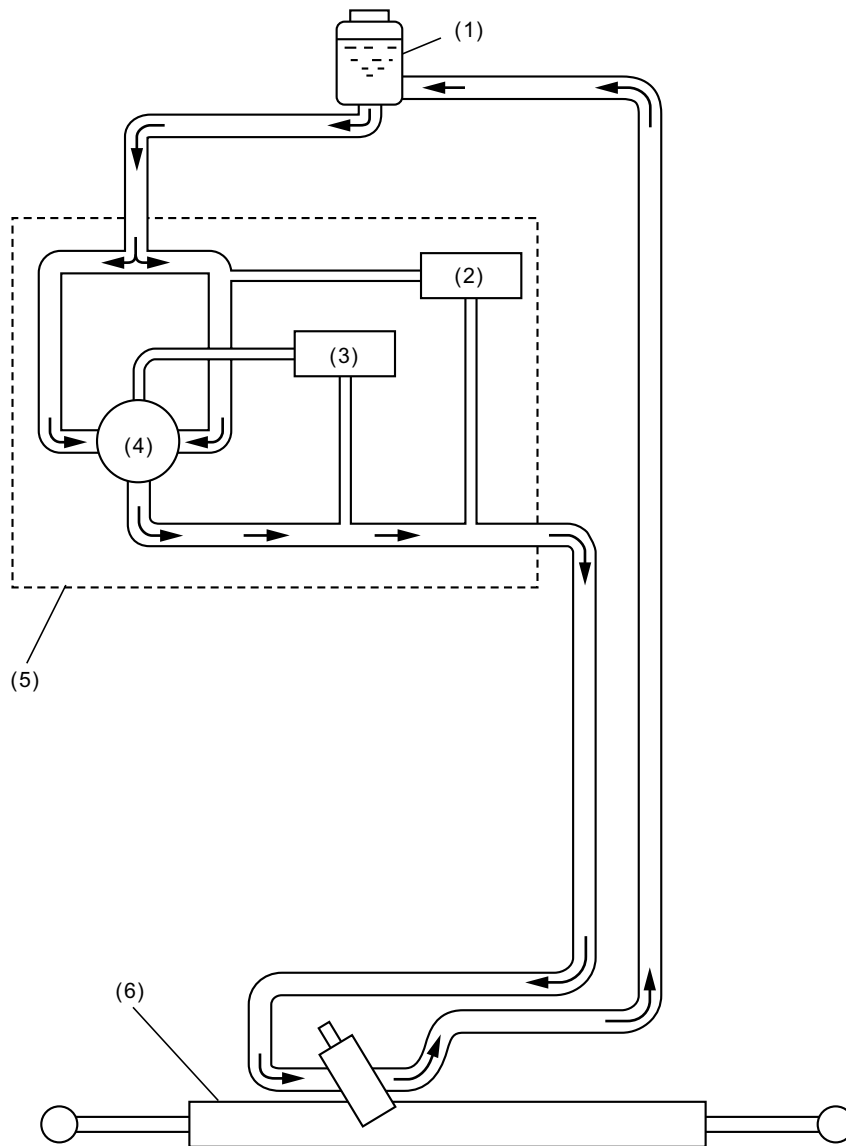
(7) Fluid pressure after passing through flow control valve (higher than preset level)

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

2. 3.0 L MODEL

- The reservoir tank is mounted on the vehicle body.
- The fluid pump is belt-driven by the engine. The fluid flow is controlled according to the engine speed so that an adequate steering resistance is given during high-speed operation. The fluid pump is a variable capacity type vane pump whose delivery rate per rotation decreases as the engine speed increases. The pump is integral with a pump control valve and relief valve.



PS-00259

- (1) Reservoir tank
- (2) Relief valve
- (3) Pump control valve

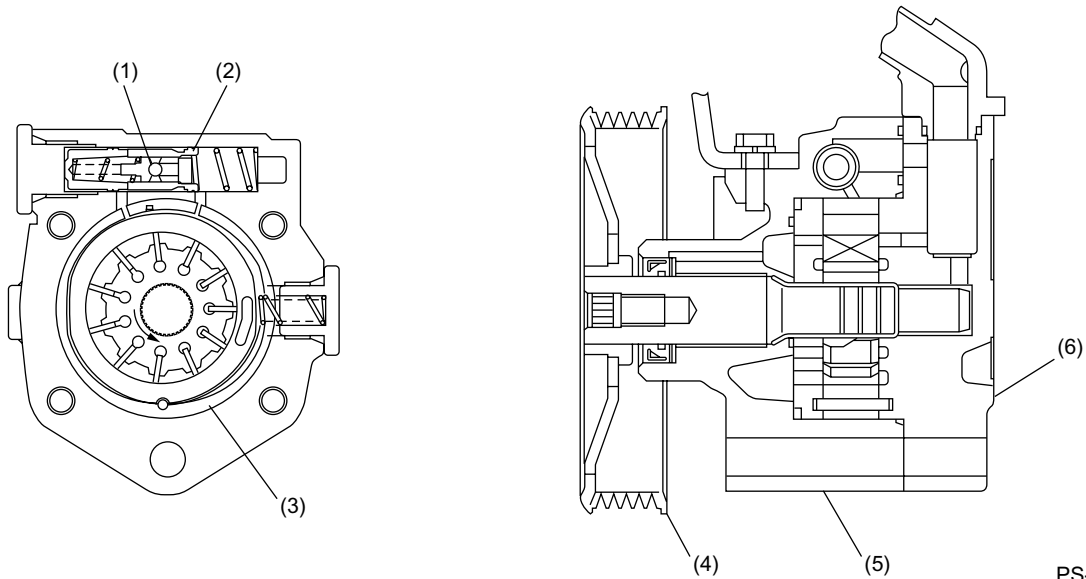
- (4) Vane pump
- (5) Fluid pump assembly
- (6) Steering gearbox

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

- The oil pump is driven by the engine and its flow is controlled in accordance with the engine speed to maintain an adequate steering effort at high speeds.

Also, to improve fuel efficiency and limit temperature rise of the system, a variable displacement vane pump whose output flow per rotation is controlled in accordance with the engine speed is used, and a control valve and a relief valve are built in the pump.



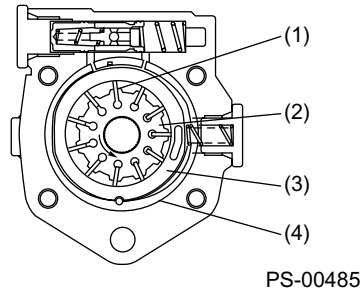
PS-00484

- (1) Relief valve
- (2) Control valve
- (3) Vane pump
- (4) Pulley
- (5) Front body
- (6) Rear body

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

- The vane pump consists of a rotor, cam ring, adapter, and eleven vanes. When the rotor rotates, the vane in each slot of the rotor is moved out by centrifugal force in radial directions and pressed against the cam ring. The tip of the vanes slide along the inner wall of the cam ring and the oil that has entered the chamber formed by the rotor, cam ring and vanes is discharged continuously.



- (1) Vane
- (2) Rotor
- (3) Cam ring
- (4) Adapter

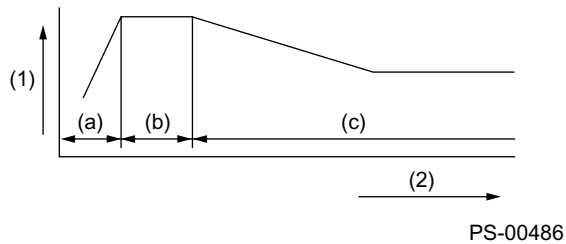
POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

- Flow control

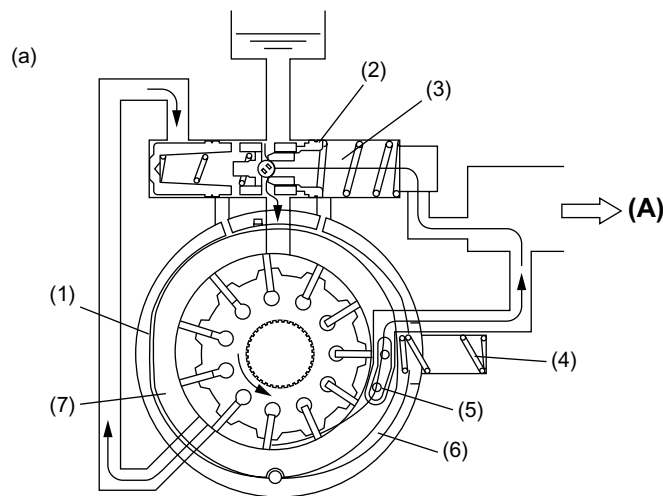
Consists of a control valve, orifice, adapter and cam ring, and regulates the amount of oil supplied to the gearbox by changing the eccentricity of the cam ring to control the discharge rate per rotation.

1) In phase (a), the pressure difference is small between both sides of the orifice, and the control valve is pressed to the set position by the control valve spring. Tank pressure is led to pressure chamber A. Pressure after the orifice is led to pressure chamber B. The cam spring is pressed to the set position by the differential pressure between pressure chambers A and B ($A < B$) and the force of the cam spring itself, and maximum discharge rate is achieved.



(1) Discharge flow

(2) Pump speed



PS-00487

(1) Pressure chamber A

(2) Control valve

(3) Control valve spring

(4) Cam spring

(5) Orifice

(6) Pressure chamber B

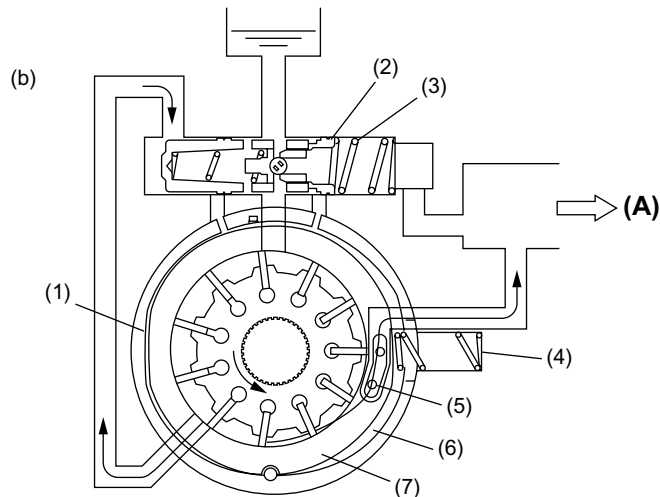
(7) Cam ring

(A) To P/S

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

2) In phase (b), the pressure difference between both sides of the orifice increases, and the control valve moves against the valve spring force. Pressure before the orifice is led to pressure chamber A, and the cam ring moves against the cam spring force by the differential pressure between pressure chambers A and B (= differential pressure across the orifice). When the cam spring moves, the delivery rate per rotation decreases and will not increase even when the engine speed increases.



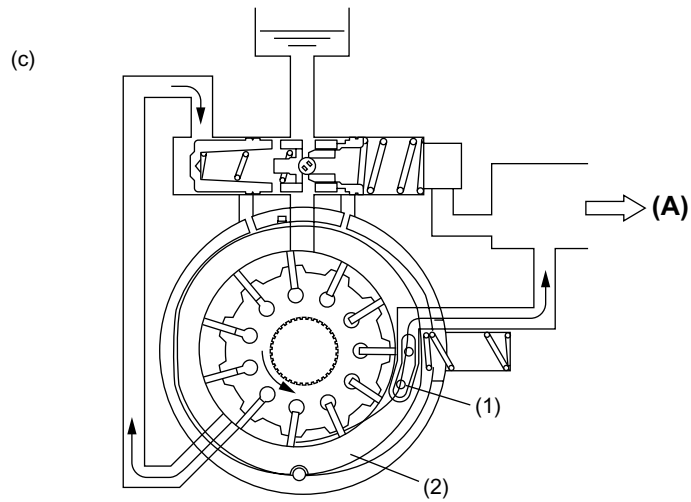
PS-00488

- | | |
|--------------------------|------------------------|
| (1) Pressure chamber A | (5) Orifice |
| (2) Control valve | (6) Pressure chamber B |
| (3) Control valve spring | (7) Cam ring |
| (4) Cam spring | (A) To P/S |

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

3) In phase (c), the cam spring moves further due to the effect of the orifice, and the flow is controlled as shown in the previous figure.



PS-00489

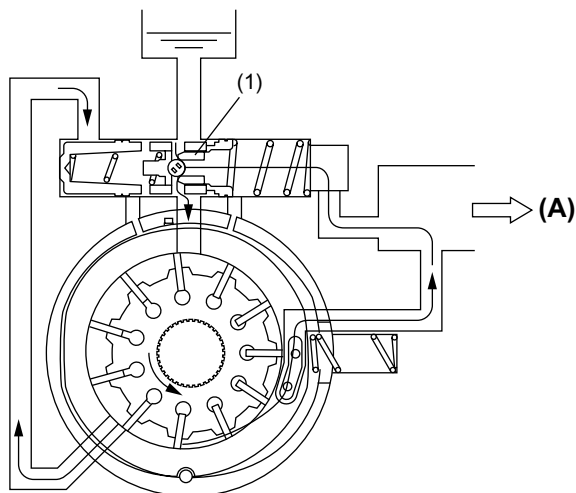
(1) Orifice

(2) Cam ring

(A) To P/S

4) Relief valve operation

When the discharge pressure exceeds the specified value, the relief valve opens to release the discharged oil to the low pressure side and limit the maximum pressure.



PS-00490

(1) Relief valve

(A) To P/S

POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)

MEMO

1. Power Window

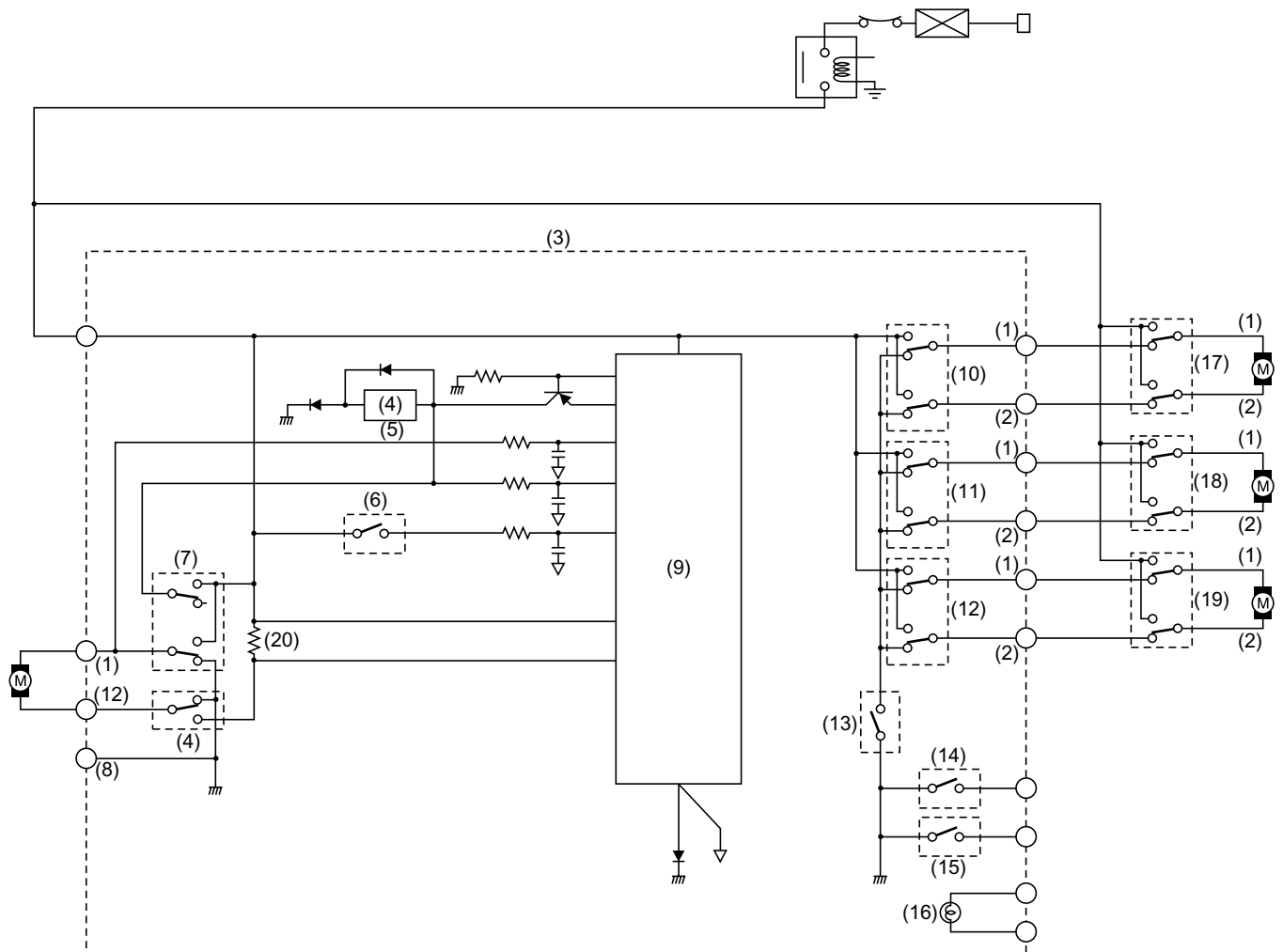
A: CONSTRUCTION

- The power window system consists of regulator motors and switches for individual doors, relays and a circuit breaker unit.
- Each door window opens/closes by pushing down/pulling up the switch.
- Only the driver's door window switch has a 2-stage mechanism:
 - When the switch is pushed lightly and held in the pushed position, the window continues to lower until the switch is released.
 - When the switch is pushed down fully, the window lowers to the end position automatically.

NOTE:

For safety, the power window system is designed to operate only when the ignition switch is in the ON position.

B: SCHEMATIC DRAWINGS



GW-00141

- | | |
|-------------------------------|------------------------------------|
| (1) Raise | (11) Rear left |
| (2) Lower | (12) Rear right |
| (3) Power window main switch | (13) Power window lock |
| (4) Lowering relay | (14) Unlock |
| (5) Relay 1 | (15) Lock |
| (6) Automatic lowering switch | (16) Lamp 1 |
| (7) Switch 1 | (17) Passenger's switch |
| (8) Ground | (18) Rear left passenger's switch |
| (9) Automatic circuit | (19) Rear right passenger's switch |
| (10) Passenger's seat | (20) Current detection resistor |

POWER WINDOW

GLASS/WINDOWS/MIRRORS

MEMO

PICKUP

SPECIFICATIONS

3. Pickup

A: DIMENSIONS

Model				AWD		
				Non-turbo model		Turbo model
Overall length				mm (in)	4,910 (193.3)	
Overall width				mm (in)	1,780 (70.1)	
Overall height				mm (in)	1,577 (62.1)	1,590 (62.6)
Compartment	Leg room	Front Max.	mm (in)	1,101 (43.3)		
		Rear Min.	mm (in)	851 (33.50)		
	Head room	Front	mm (in)	973 (38.31)		
		Rear	mm (in)	947 (37.28)		
	Shoulder room	Front	mm (in)	1,368 (53.9)		
		Rear	mm (in)	1,362 (53.6)		
Wheelbase				mm (in)	2,650 (104.3)	
Tread		Front	mm (in)	1,465 (57.7)		
		Rear	mm (in)	1,465 (57.7)		
Minimum road clearance		M.L.V.W.	mm (in)	173 (6.81)	163 (6.42)	
		C.W.	mm (in)	213 (8.39)		

B: ENGINE

Model		2.5 L	Turbo 2.5 L
Engine type		Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine	
Valve arrangement		Overhead camshaft type	DOHC
Bore × stroke		99.5 × 79.0 (3.917 × 3.110)	
Displacement		2,457 (149.9)	
Compression ratio		10.0	8.2±0.2
Firing order		1 — 3 — 2 — 4	
Idle speed at Park/Neutral position		MT: 650 AT: 700	MT: 700±100 AT: 700±100
Maximum output		123 (165)/5,600	157 (210)/5600
Maximum torque		226 (23.0, 166)/3,600	319 (32.5, 235)/3600

C: ELECTRICAL

Model		2.5 L	Turbo 2.5 L
Ignition timing at idling speed		MT: 10°±8°/650, AT: 15°±8°/700	MT: 13°±10°/700, AT: 17°±10°/700
Spark plug	Type and manufacturer	CHAMPION: RC10YC4 (Standard) NGK: BKR5E-11 NGK: BKR6E-11	NGK: ILFR6B
Generator		12 V — 90 A	
Battery	Reserve capacity	min	90 (MT), 110 (AT)
	Cold cranking amperes	amp.	430 (MT), 490 (AT)

D: TRANSMISSION

Model			2.5 L non-turbo		2.5 L turbo	
Transmission type			5MT	4AT	5MT	4AT
Clutch type			DSPD	TCC	DSPD	TCC
Gear ratio		1st	3.454	3.027	3.454	2.785
		2nd	2.062	1.619	1.947	1.545
		3rd	1.448	1.000	1.366	1.000
		4th	1.088	0.694	0.972	0.694
		5th	0.871	—	0.738	—
		Reverse	3.333	2.272	3.333	2.272
Reduction gear (front drive)	1st reduction	Type of gear	—	Helical	—	Helical
		Gear ratio	—	1.000	—	1.000
	Final reduction	Type of gear	Hypoid		Hypoid	
		Gear ratio	4.111	4.444	4.444	4.444
Reduction gear (rear drive)	Transfer reduction	Type of gear	Helical	—	Helical	—
		Gear ratio	1.000	—	1.000	—
	Final reduction	Type of gear	Hypoid		Hypoid	
		Gear ratio	4.111	4.444	4.444	4.444

5MT: 5-forward speeds with synchromesh and 1-reverse — with center differential and viscous coupling

4AT: Electronically controlled fully-automatic, 4-forward speeds and 1-reverse — with hydraulically controlled transfer clutch

DSPD: Dry single plate diaphragm

TCC: Torque converter clutch

E: STEERING

Type	Rack and pinion	
Turns, lock to lock	3.4	
Minimum turning circle	m (ft)	Wall to wall: 12.0 (39.4), curb to curb: 11.2 (36.7)

F: SUSPENSION

Front	Macpherson strut type, independent, coil spring
Rear	Multi-link type, independent, coil spring

G: BRAKE

Model	With ABS
Service brake system	Dual circuit hydraulic with vacuum suspended power unit
Front	Ventilated disc brake
Rear	Disc brake
Parking brake	Mechanical on rear brakes

PICKUP

SPECIFICATIONS

H: TIRE

Model	16-inch wheel	
Size	P215/60R16*1	P225/60R16 97H
Type	Steel belted radial, tubeless	

*1: Recommended winter (snow) tire size.

I: CAPACITY

Model		AWD		AWD turbo	
		5MT	4AT	5MT	4AT
Fuel tank	ℓ (US gal, Imp gal)	64 (16.9, 14.1)			
Engine oil (replacement)	ℓ (US qt, Imp qt)	Approx. 4.0 (4.2, 3.5)			
Transmission gear oil	ℓ (US qt, Imp qt)	3.5 (3.7, 3.1)	—	3.5 (3.7, 3.1)	—
Automatic transmission fluid	ℓ (US qt, Imp qt)	—	9.3 – 9.6 (9.8 – 10.1, 8.2 – 8.4)	—	9.3 – 9.6 (9.8 – 10.1, 8.2 – 8.4)
AT differential gear oil	ℓ (US qt, Imp qt)	—	1.1 – 1.3 (1.2 – 1.4, 1.0 – 1.1)	—	1.1 – 1.3 (1.2 – 1.4, 1.0 – 1.1)
AWD rear differential gear oil	ℓ (US qt, Imp qt)	0.8 (0.8, 0.7)			
Power steering fluid	ℓ (US qt, Imp qt)	0.7 (0.7, 0.6)			
Engine coolant	ℓ (US qt, Imp qt)	6.8 (7.2, 6.0)	6.7 (7.1, 5.9)	7.7 (8.1, 6.8)	7.6 (8.0, 6.7)

J: WEIGHT

1. U.S. SPEC. VEHICLE

Model			AWD		AWD-S		AWD-B		
			5MT	4AT	5MT	4AT	5MT non-turbo	5MT turbo	4AT turbo
Curb weight (C.W.)	Front	kg (lb)	844 (1,860)	873 (1,925)	839 (1,850)	869 (1,915)	889 (1,960)	894 (1,970)	914 (2,015)
	Rear	kg (lb)	744 (1,640)	744 (1,640)	739 (1,630)	739 (1,630)	748 (1,650)	755 (1,665)	748 (1,650)
	Total	kg (lb)	1,588 (3,500)	1,617 (3,565)	1,579 (3,480)	1,608 (3,545)	1,637 (3,610)	1,649 (3,635)	1,662 (3,665)
Gross vehicle weight (G.V.W.)	Front	kg (lb)	1,002 (2,210)						
	Rear	kg (lb)	1,063 (2,345)						
	Total	kg (lb)	2,066 (4,555)						

2. CANADA SPEC. VEHICLE

Model			AWD		AWD-S		AWD-B		
			5MT	4AT	5MT	4AT	5MT non-turbo	5MT turbo	4AT turbo
Curb weight (C.W.)	Front	kg (lb)	844 (1,860)	873 (1,925)	839 (1,850)	869 (1,915)	889 (1,960)	894 (1,970)	914 (2,015)
	Rear	kg (lb)	744 (1,640)	744 (1,640)	739 (1,630)	739 (1,630)	748 (1,650)	755 (1,665)	748 (1,650)
	Total	kg (lb)	1,588 (3,500)	1,617 (3,565)	1,579 (3,480)	1,608 (3,545)	1,637 (3,610)	1,649 (3,635)	1,662 (3,665)
Gross vehicle weight (G.V.W.)	Front	kg (lb)	1,002 (2,210)						
	Rear	kg (lb)	1,063 (2,345)						
	Total	kg (lb)	2,066 (4,555)						

PICKUP

SPECIFICATIONS

MEMO

2. AWD Transfer System

Regarding the construction and operation of the AWD transfer system, refer to the “4AT” section.<Ref. to 4AT section.>

AWD TRANSFER SYSTEM

TRANSFER CASE

MEMO

CENTER DIFFERENTIAL

TRANSFER CASE

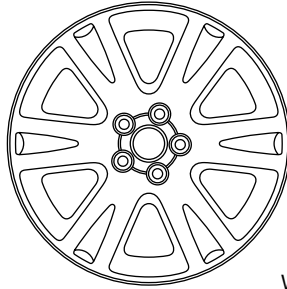
1. Center Differential

Regarding the construction and operation of the center differential, refer to the “5MT” section. <Ref. to 5MT section, Center Differential.>

1. General

The wheel is for OBK-H6, SUS-H6 and BAJA turbo.

The wheel has a center cap designed exclusively for the type.



WT-00048