ISUZU

KBP190

MY 2010-2012

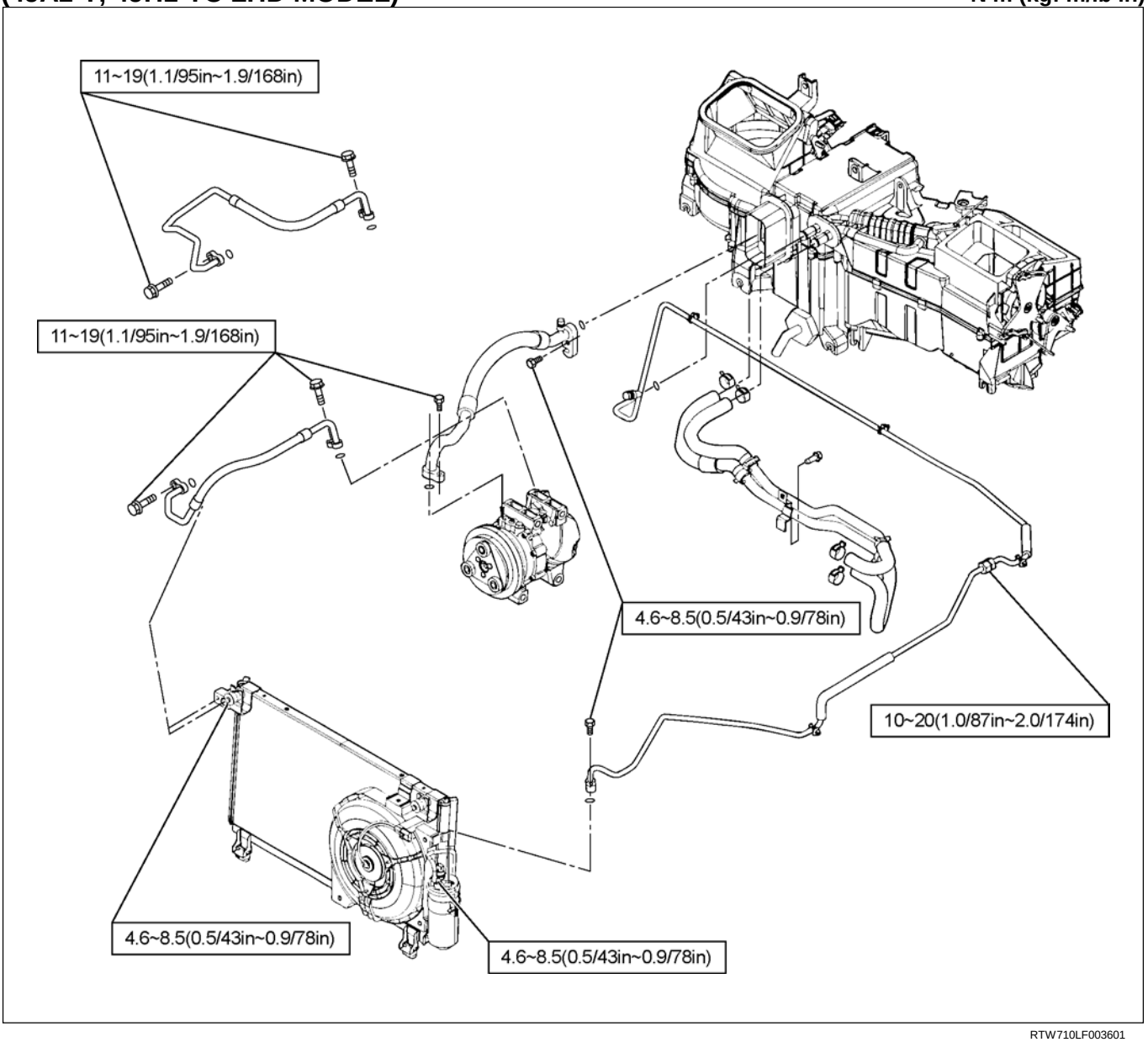
WORKSHOP

REPAIR MANUAL

MAIN INDEX

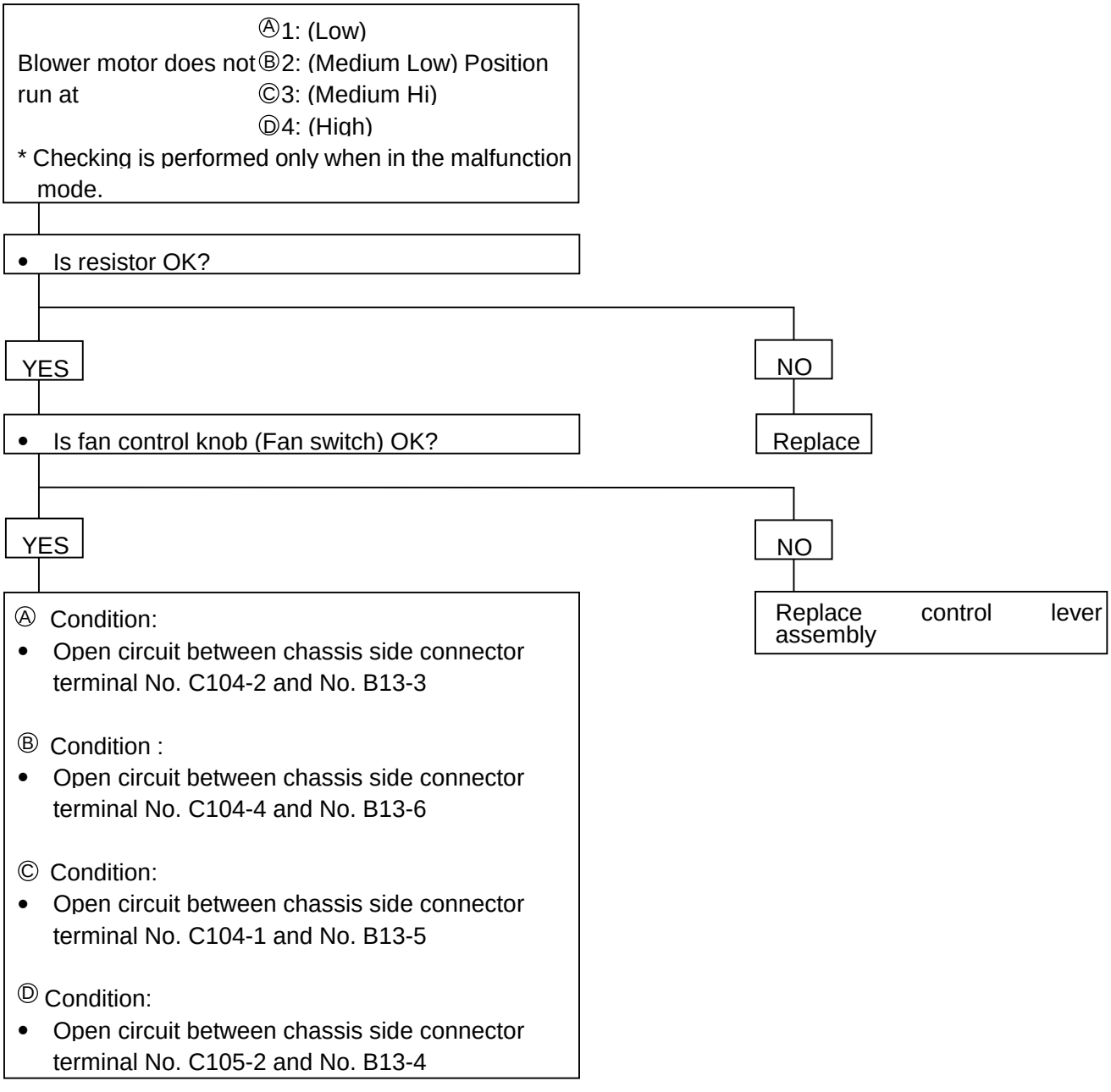
(4JA1-T, 4JH1-TC LHD MODEL)

N·m (kgf·m/lb·in)



RTW710LF003601

BLOWER MOTOR DOES NOT RUN IN CERTAIN POSITION

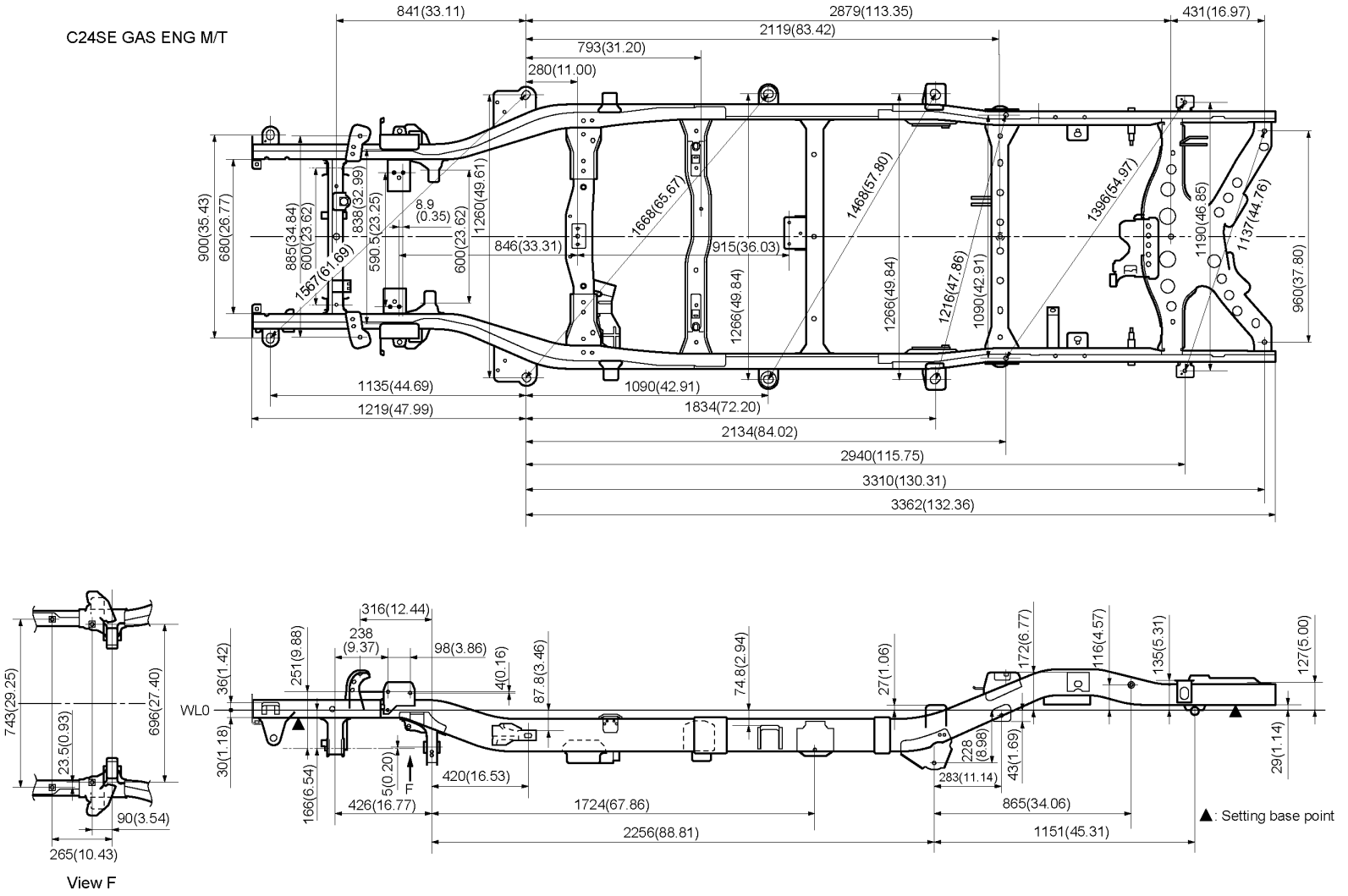


4×2, HIGH RIDE, LWB, CREW CAB MODEL

This illustration is based on the RHD model.

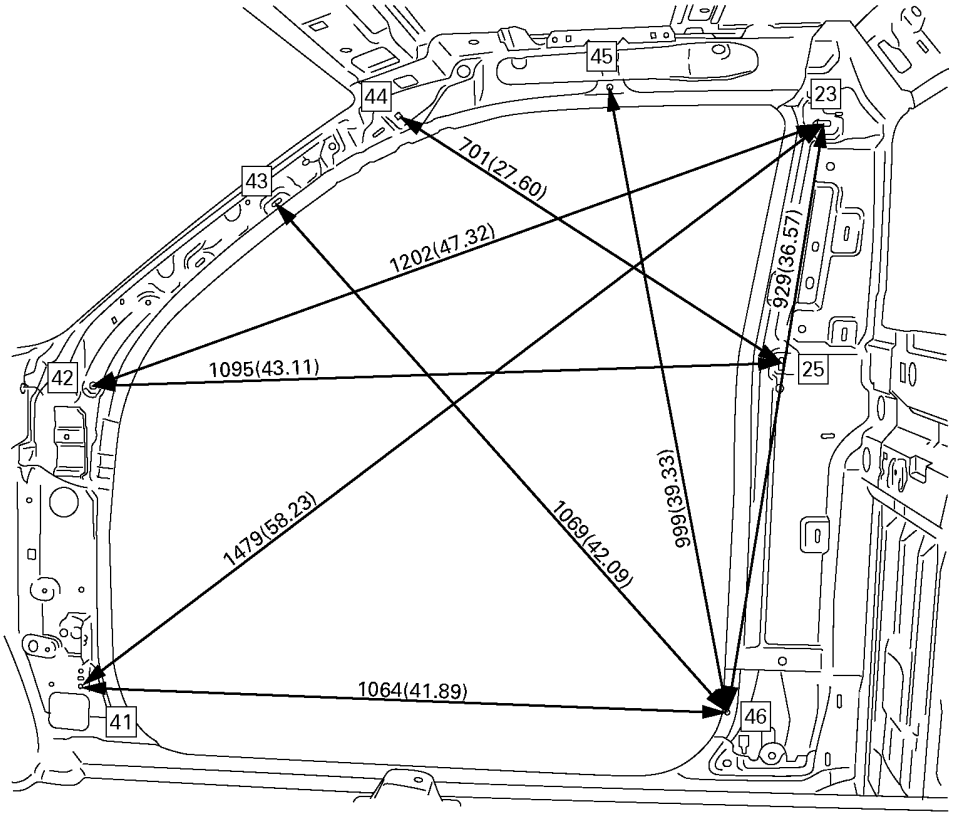
mm(in)

C24SE GAS ENG M/T



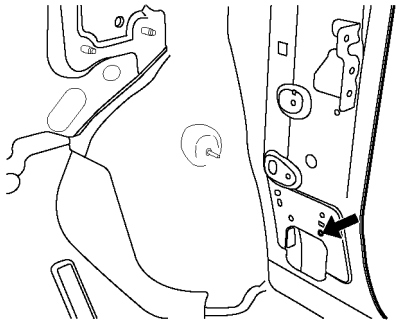
RTW72AXF002101

SIDE BODY SECTION (REGULAR CAB)

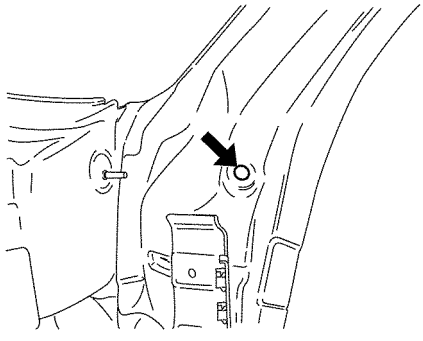


mm (in)

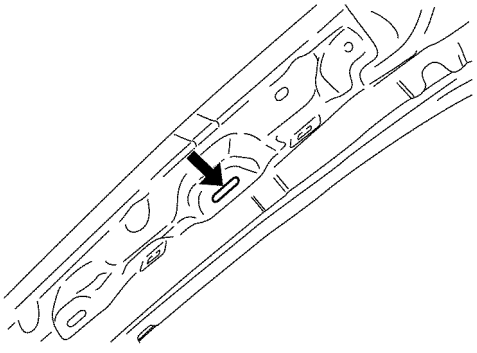
41



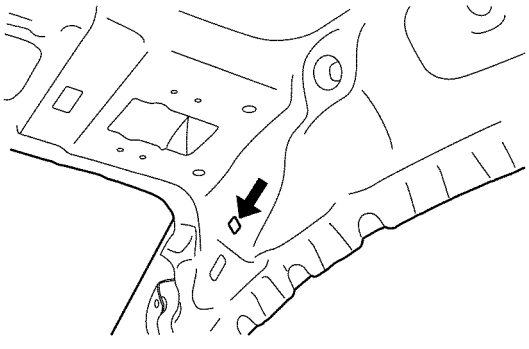
42



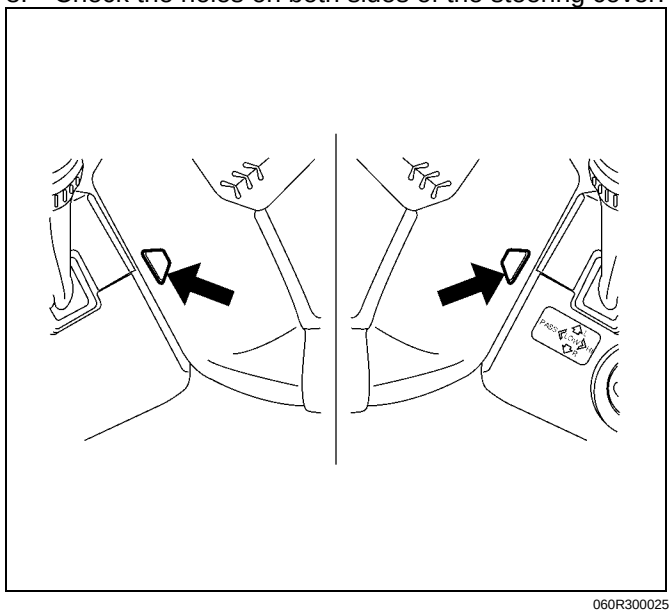
43



44

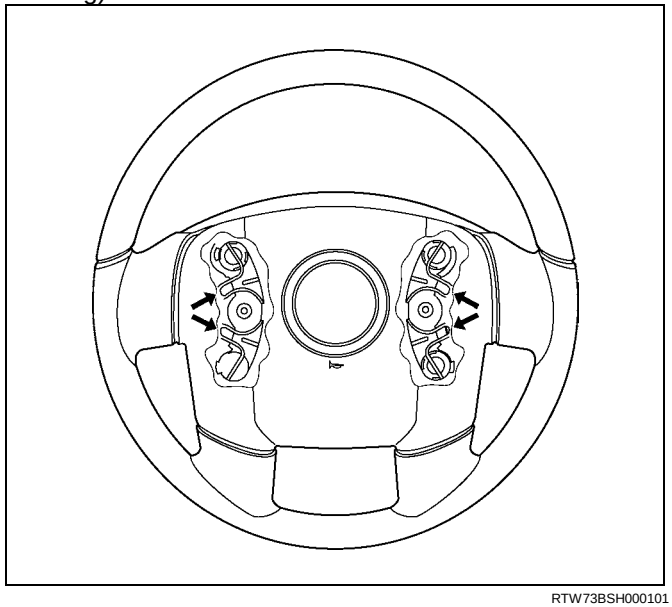


7. Disable the SRS (Refer to "Disabling the SRS" in this section) (with SRS air bag).
8. Check the holes on both sides of the steering cover.



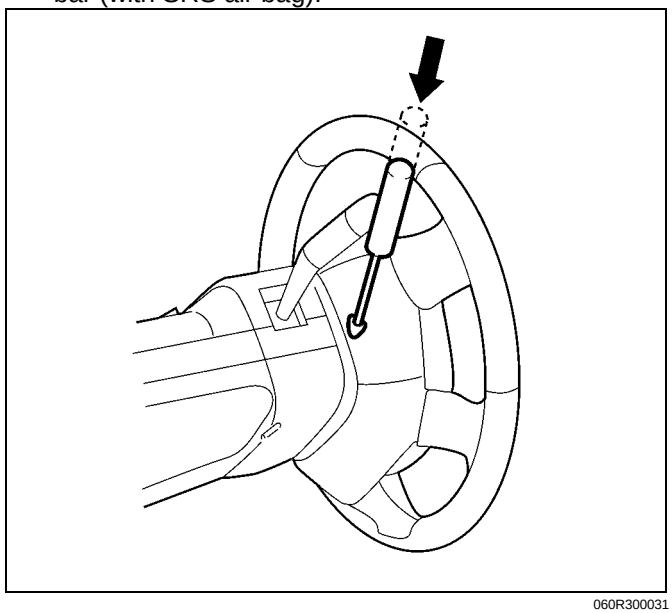
060R300025

9. Check the position of the pins in their holes. Push the pin in the direction of the arrow (with SRS air bag).



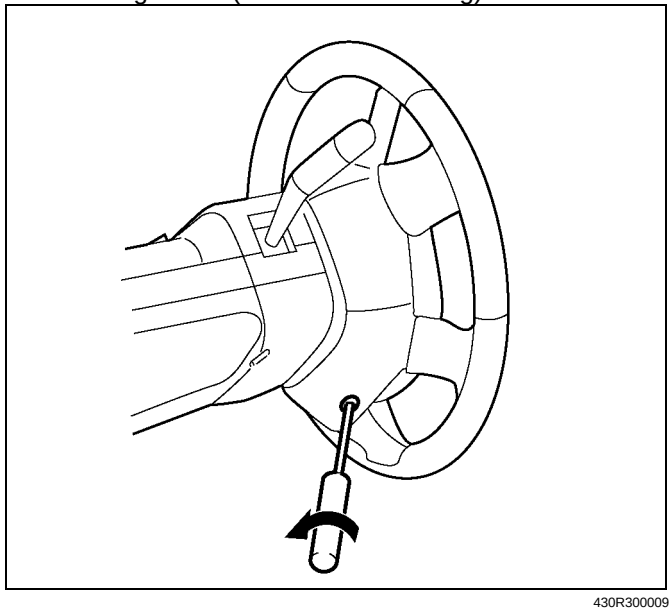
RTW73BSH000101

10. Push the four pins with a ϕ 5~6 mm (0.20~0.24 in) bar (with SRS air bag).



060R300031

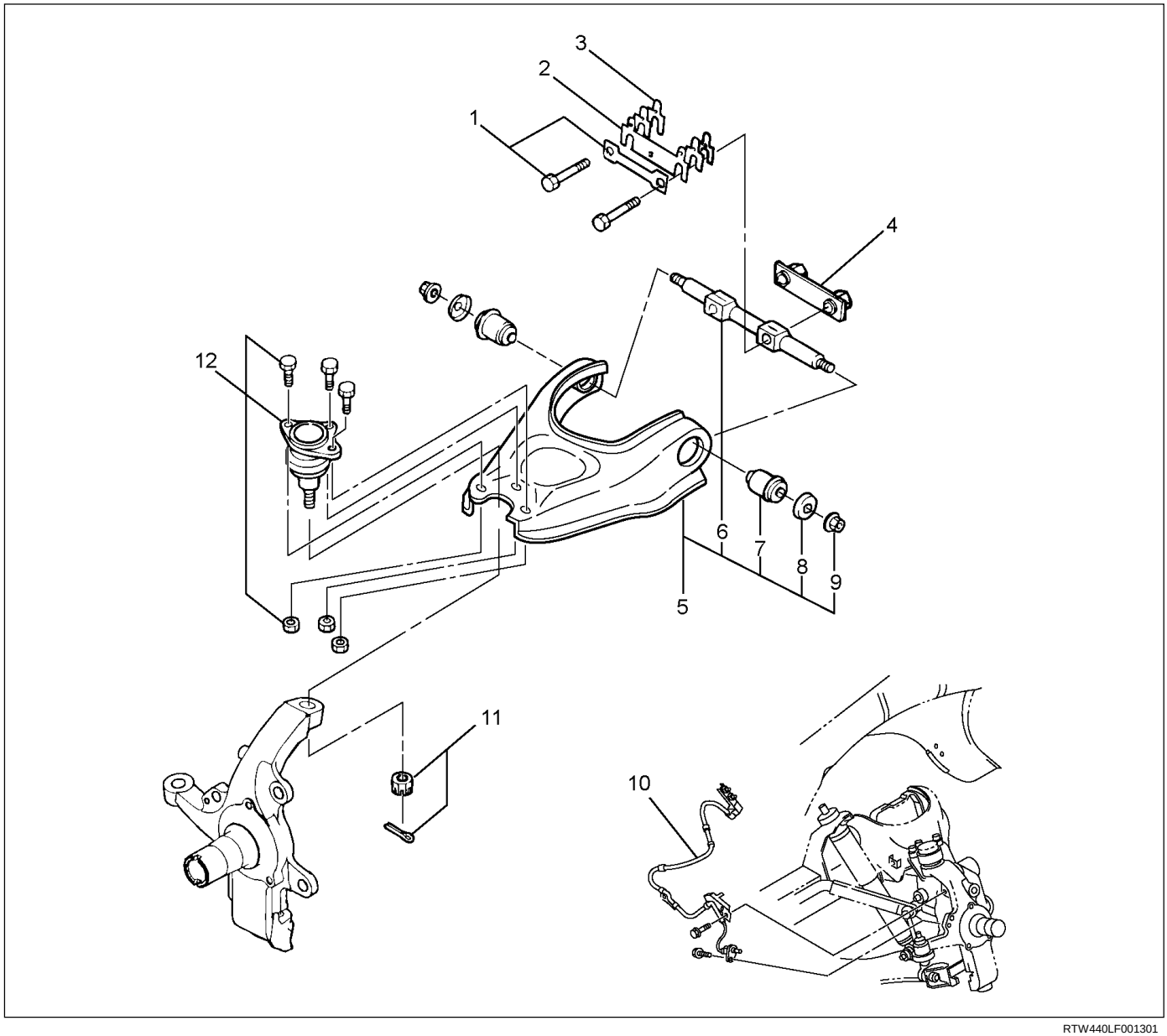
11. Cancel the lock to release the four pins (with SRS air bag).
12. Loosen the horn pad fixing screw at the rear of the steering wheel (without SRS air bag).



430R300009

Upper Control Arm

Upper Control Arm and Associated Parts



RTW440LF001301

Legend

(1) Bolt and Plate
(2) Camber Shims
(3) Caster Shims
(4) Nut Assembly
(5) Upper Control Arm Assembly
(6) Fulcrum Pin
(7) Bushing
(8) Plate
(9) Upper Control Arm Nut
(10) Speed Sensor harness
(11) Nut and Cotter Pin
(12) Upper Ball Joint, Bolt and Nut

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel in this section.
3. Remove the brake caliper and disconnect brake pipe. Refer to Disc Brakes in Brake section.

	4×4 Model				
Engine Model	4JA1-T(L)	4JA1-TC	4JH1-TC		
Transmission Type	5M/T (MUA)		5M/T (MUA)		4A/T
Wheel Base	Long		Long	Extra Long	Long
Front Suspension	—		—	—	—
Rear Axle	ϕ220mm		←	←	←
Type	OBS		←	←	←
Outside Diameter mm	75		68.9	68.9	63.5
(in)	(2.95)		(2.71)	(2.71)	(2.50)
Inside Diameter mm	71.8		64.9	64.9	60.3
(in)	(2.83)		(2.56)	(2.56)	(2.37)
Length 1st(L1) mm	469.5		468.5	616.5	402.5
(in)	(18.48)		(18.44)	(24.27)	(15.85)
2nd(L2) mm	801		801	801	801
(in)	(31.54)		(31.54)	(31.54)	(31.54)
Spline Major mm	29.89		29.89	29.89	29.89
Diameter (in)	(1.18)		(1.18)	(1.18)	(1.18)
Fix Bolt Size	M10		M10	M10	M10

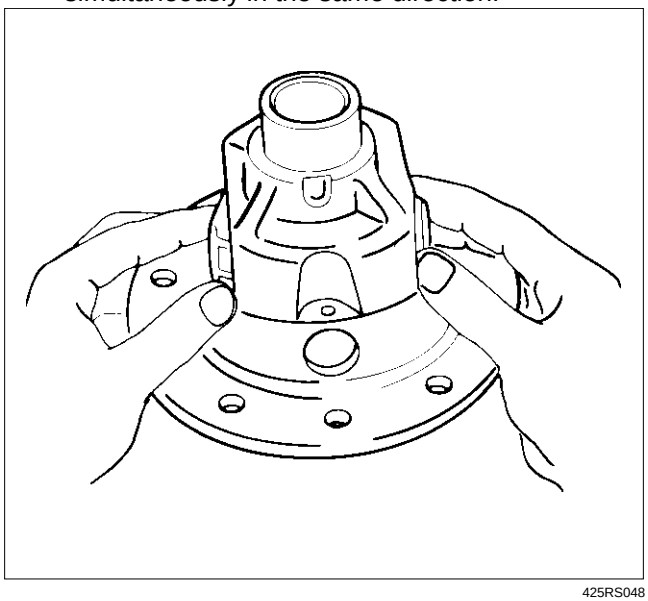
* OBS - Outboard Slip (Spline Engagement To T/M)

	4×4 Model			
Engine Model	C24SE	HFV6		
Transmission Type	5M/T (MUA)	5M/T (AR-5)		4A/T
Wheel Base	Long	Long	Extra Long	Long
Front Suspension	—	—	—	—
Rear Axle	ϕ220mm	←	←	←
Type	OBS	←	←	←
Outside Diameter mm	63.5	68.9	68.9	75
(in)	(2.50)	(2.71)	(2.71)	(2.95)
Inside Diameter mm	60.3	64.9	64.9	71.8
(in)	(2.37)	(2.56)	(2.56)	(2.83)
Length 1st(L1) mm	495.5	476.5	624.5	484.5
(in)	(19.51)	(18.75)	(24.59)	(19.07)
2nd(L2) mm	801	801	801	801
(in)	(31.54)	(31.54)	(31.54)	(31.54)
Spline Major mm	29.89	29.89	29.89	29.89
Diameter (in)	(1.18)	(1.18)	(1.18)	(1.18)
Fix Bolt Size	M10	M10	M10	M10

* OBS - Outboard Slip (Spline Engagement To T/M)

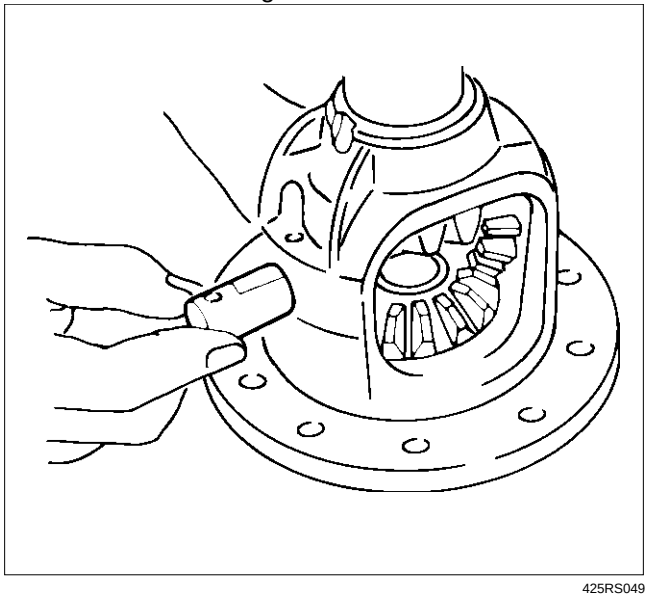
Reassembly

1. Install side gear with thrust washer in differential cage.
2. Install the pinion gear by engaging it with the side gears while turning both pinion gears simultaneously in the same direction.



425RS048

3. Install cross pin.
   - Be sure to install the cross pin so that it is in alignment with the lock pin hole in the differential cage.



425RS049

4. Check the amount of backlash.
   Backlash between the side gear and the pinion gear.

mm (in)

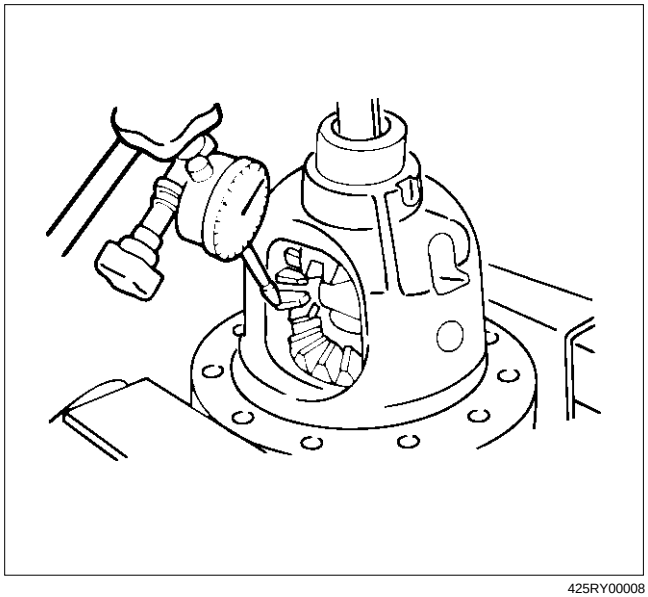
ϕ220mm	0.13-0.18 (0.005-0.007)
ϕ194mm	0.10-0.20 (0.004-0.008)

If the backlash is beyond the limits, adjust with a thrust washer of selected thickness.

Thicknesses of thrust washers available.

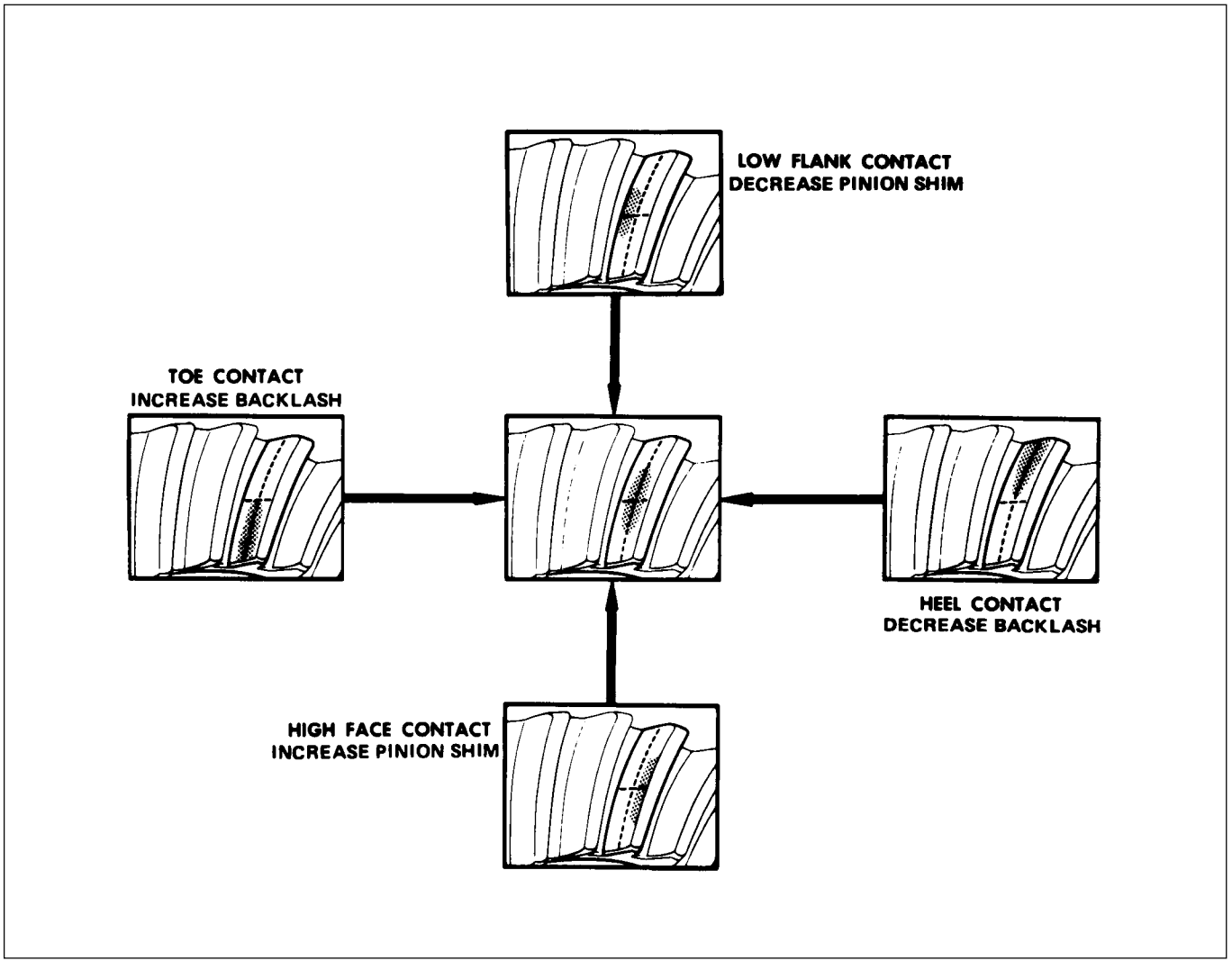
Backlash mm (in)

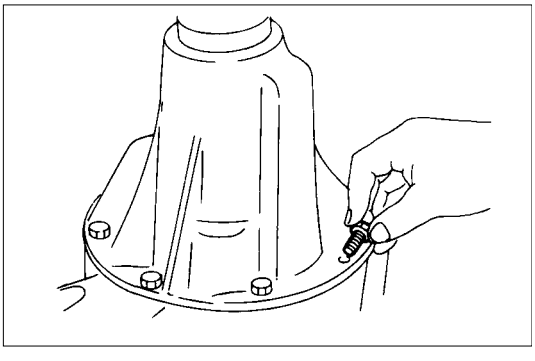
ϕ220 mm	0.80 (0.031)	0.90 (0.035)	1.00 (0.039)	1.10 (0.043)	1.20 (0.047)	1.30 (0.051)
ϕ194 mm	1.00 (0.039)	1.05 (0.041)	1.10 (0.043)			



425RY00008

5. Install lock pin.
   After lock pin installation, stake the case to secure the lock pin.
6. Install ring gear.
   Refer to “Ring gear replacement” on this section.





20. Differential Assembly

(1) Clean the faces of the front axle case and differential carrier.
Apply the recommended liquid gasket or its equivalent to the sealing side of the axle case and the carrier.

(2) Attach the differential case and the carrier assembly to the front axle case and tighten the nuts and bolts. The axle case bolt is used for drainage.

Torque	N·m (kgf·m/lb·ft)
26 (2.7/20)	

(3) Install the axle shaft assemblies as instructed earlier in this section under “Axle Shaft Replacement”.

(4) Fill the axle case with hypoid gear lubricant, to just below the filler hole.

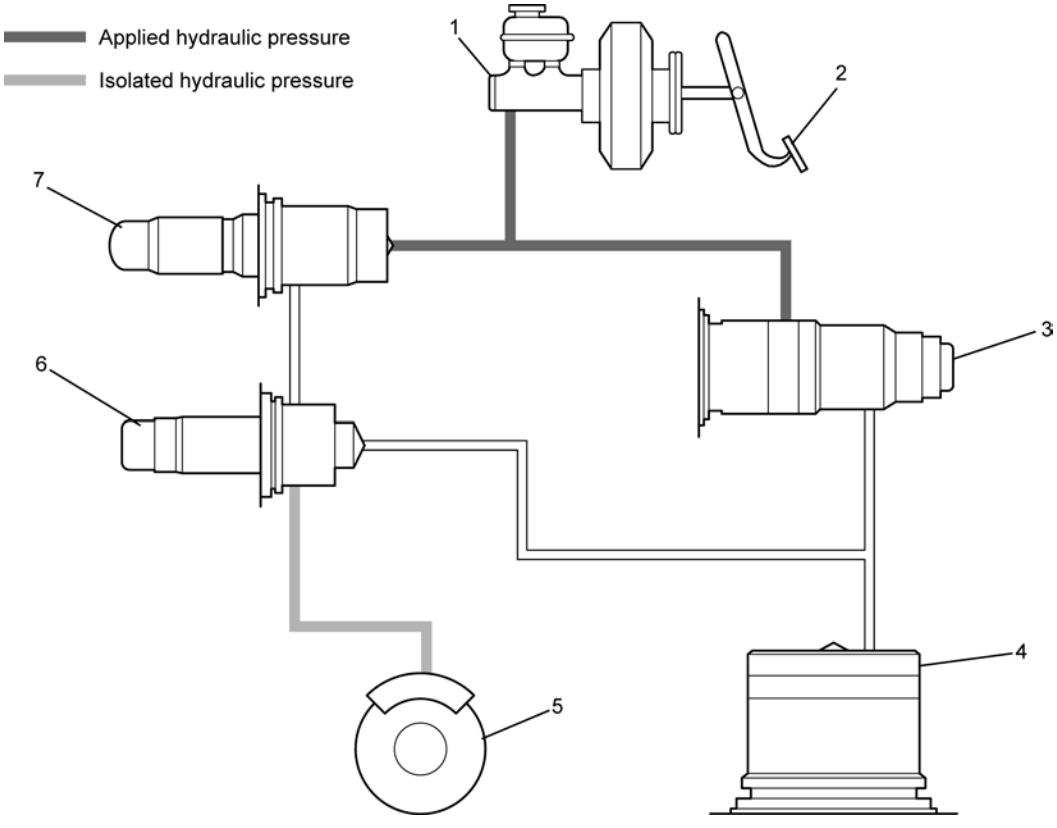
Lubricant capacity	liter (US/UK gal)
1.4 (0.37/0.31)	

Pressure Isolation (Pressure Maintain)

The electronic-hydraulic control unit is activated when the brakes are applied.

If the information from the wheel speed sensors indicates excessive wheel deceleration (imminent lockup), the first step in the anti-lock sequence is to isolate the brake pressure being applied by the brake pedal.

The microprocessor in the Control Unit sends a voltage to the coil to energize and close the outlet valve. This prevents any additional fluid pressure applied by the brake pedal from reaching the wheel. With the outlet valves closed, unnecessary increase in the brake pressure is prevented.

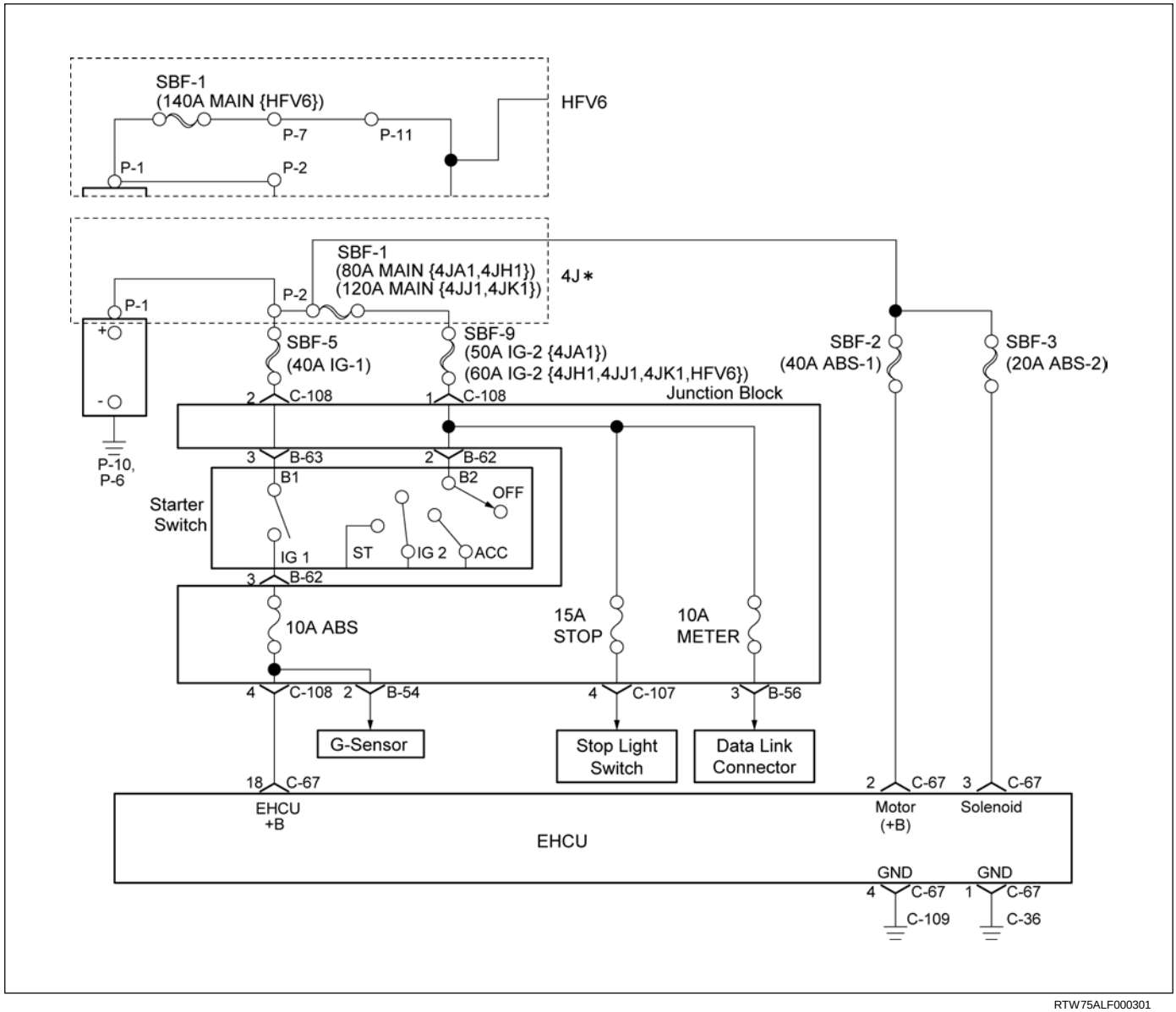


RTW75AMF000301

Legend

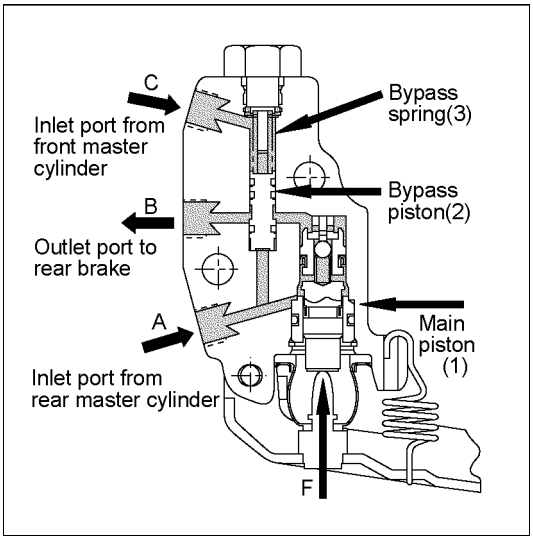
(1) Master Cylinder
(2) Brake Pedal
(3) Motor and Pump
(4) Accumulator
(5) Brake
(6) Outlet Valve
(7) Inlet Valve

DTC C0245 (Flash Code 45) Front Left Hold Solenoid Valve Circuit
DTC C0246 (Flash Code 46) Front Left Release Solenoid Valve Circuit



RTW75ALF000301

Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Ignition “OFF”. 2. Check the EHCU circuit for an open, short to ground, or short to voltage. Also, check the EHCU ignition feed circuit for an open or short to ground and the EHCU ground circuit for an open or short to voltage. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3



RTW35CSH001001

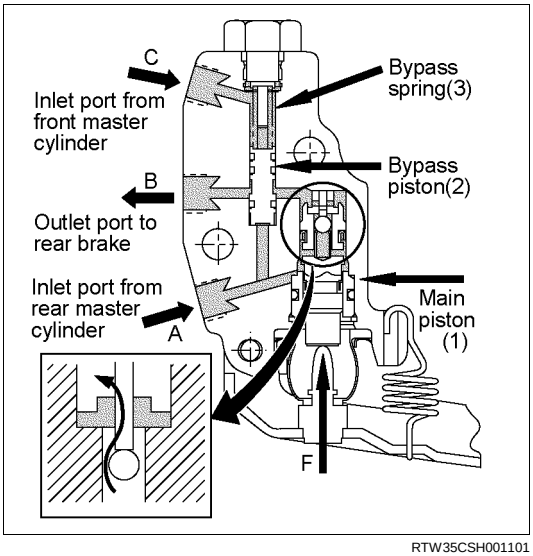
- **Operation**

1) Outline

When the LSPV (Load Sensing Proportioning Valve) detects a change in load weight, the load sensing spring stretches.

Its reaction force is transmitted to the bottom of the load sensing valve to secure an optimum rear wheel cylinder fluid pressure break point in proportion to the actual load weight.

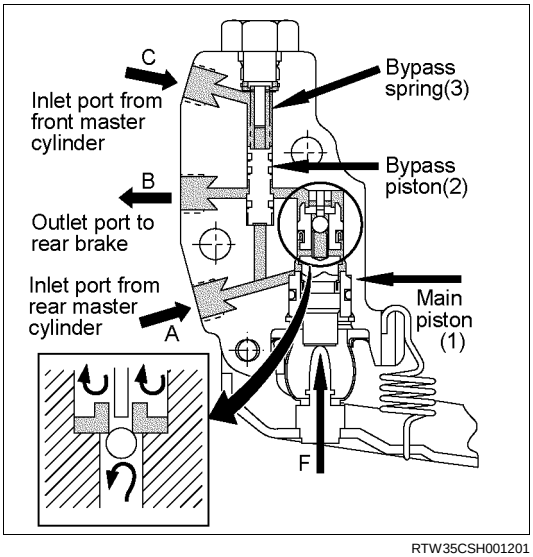
Besides, if the front brake system should fail, the device is designed to prevent the master cylinder fluid pressure from decreasing and to apply it directly to the rear wheel cylinder to obtain a sufficient braking performance.



RTW35CSH001101

2) Bellow cutting point.

The Force (F) keeps the main piston (1) the rest position. The inlet pressure (A) and outlet pressure (B) are the same as well as the inlet pressure (C) from front master cylinder. The bypass piston (2) is kept on rest position by equilibrium of the pressures (A) and (C) and the bypass spring load (3).



RTW35CSH001201

3) Cutting point.

The cutting point is given by relation between force (F), that is the load applied by suspension of the vehicle and the main piston area (1). The cutting point is achieved when the force generated by hydraulic pressure is upper than the force (F) given by the load suspension. The main piston (1) moves from the rest position closing the valve. In this moment the inlet pressure (A) is upper than the outlet pressure (B). The bypass piston (2) continues on the rest position by equilibrium of (A) and (C) pressure.

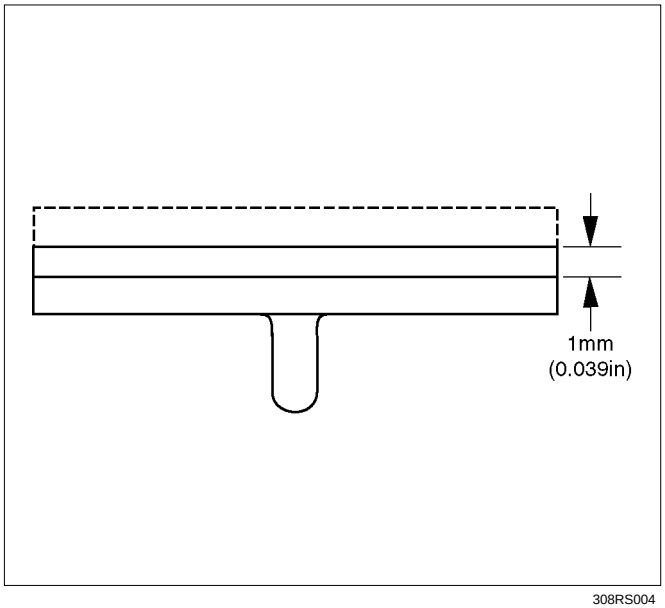
Inspection and Repair

Brake Lining Inspection

Check the shoe assemblies for wear by removing the brake drum.

Replace the shoe assemblies if the lining thickness is less than 1.0 mm (0.039 in).

Minimum limit: 1.0 mm (0.039 in)



308RS004

Parking Brake Adjustment

NOTE: All brakes are self-adjusting. Brakes are adjusted by repeated stepping on the brake pedal. (After stepping on the pedal and releasing it, the rear brake auto-adjuster produces a clicking sound. The same operation should be repeated until the sound disappears.)

Take the following steps after overhauling the rear brake assembly.

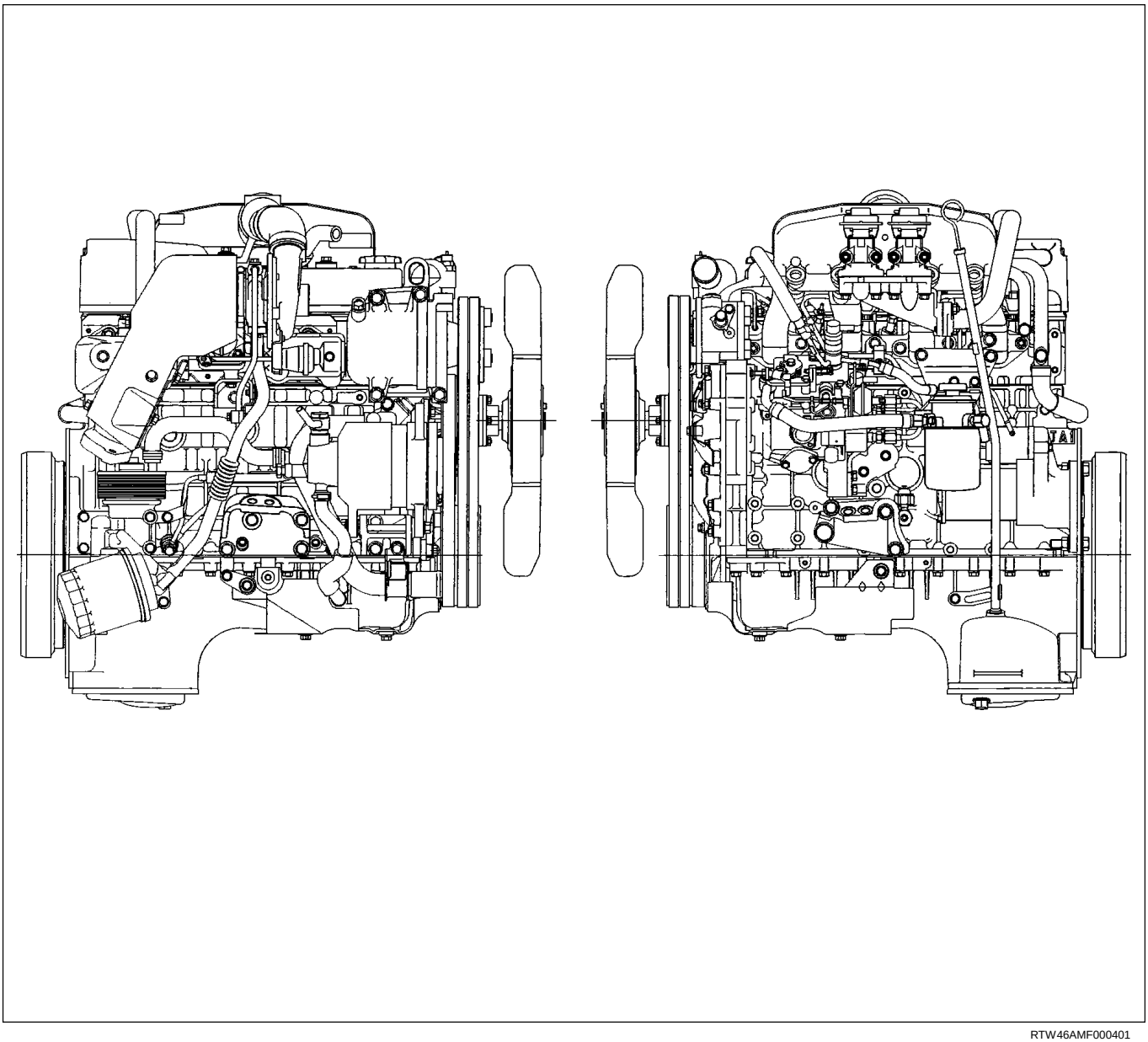
1. Move the parking brake lever to its fully released position.
2. Parking brake cable must be loosened sufficiently. (Loosen the adjust nut.)
3. Repeat stepping on the brake pedal firmly, and releasing it until the clicking sound can no longer be heard.

   If the difference between the brake drum inside diameter and the brake shoes external diameter is adjusted to be 0.4 mm (0.0157 in), the number of times for depressing the brake pedal can be reduced.
4. Remove the drum. Measure the brake drum inside diameter and the brake shoes external diameter.

   Total shoe clearance: 0.4 mm (0.0157 in)

   If incorrect, readjust the brake shoe clearance.
5. Rotate the adjust nut of hand brake lever until all slack disappears from the cable. Set the adjust nut.
6. After the rear brake shoe/drum gap has been adjusted, perform parking brake cable adjustment.
7. Turn the adjusting nut so that the parking brake lever travels 6–9 notches (Bucket Seat) or 8–14 notches (Bench Seat) when pulled up with a force of 294 N (30 kg/66 lb).
8. Make sure there is no brake dragging.

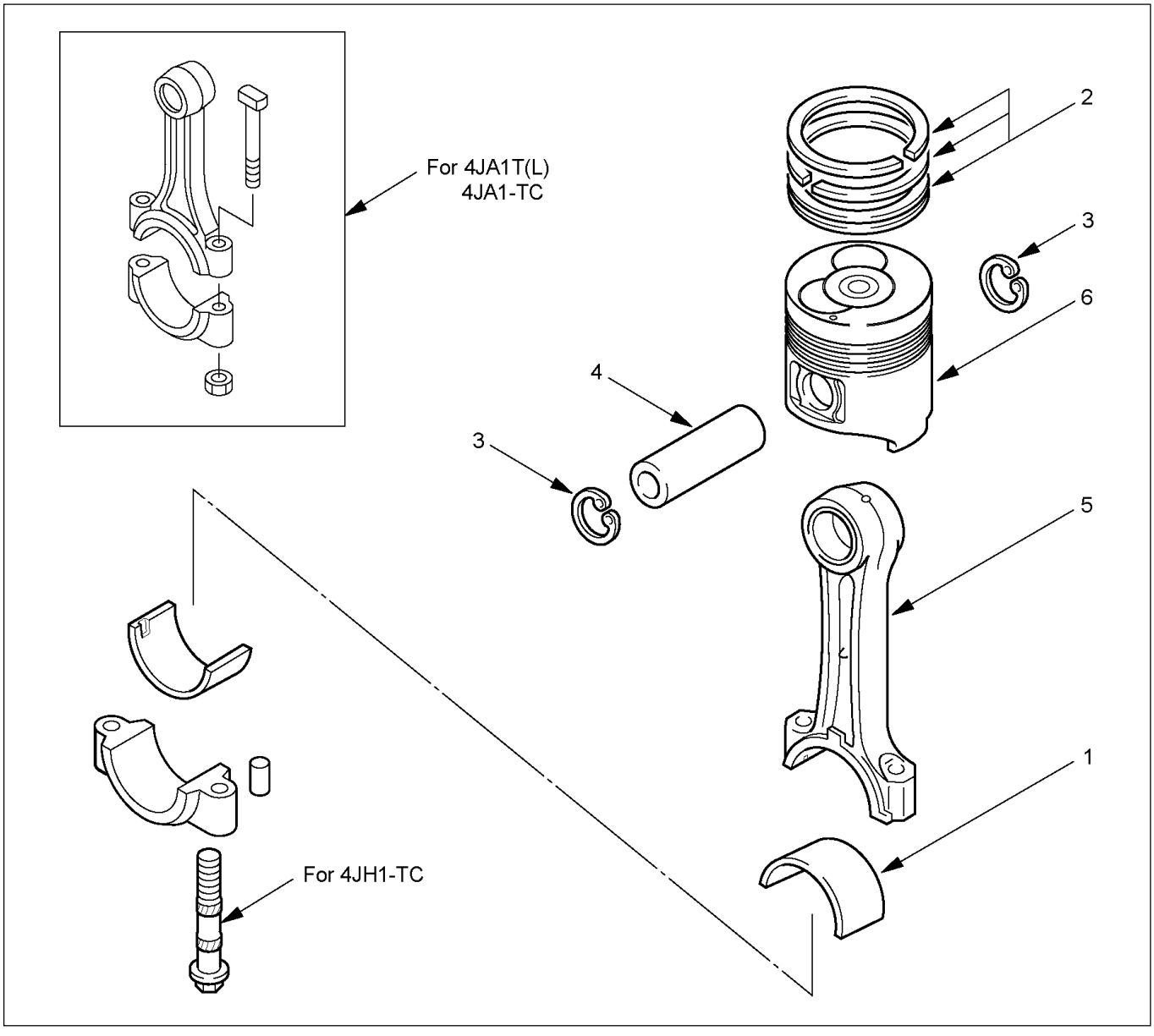
GENERAL DESCRIPTION



RTW46AMF000401

The 4J series automotive diesel engine has special designed combustion chambers in the piston. This design provides superior fuel economy over a wide range of driving conditions.
Auto-thermatic pistons with cast steel struts are used to reduce thermal expansion and resulting engine noise when the engine is cold.
Chrome plated dry type cylinder liners provide the highest durability.
The laminated steel sheet cylinder head gasket is very durable and, to increase the head gasket reliability.
The crankshaft has been tufftrided to provide a longer service life. Because the crankshaft is tufftrided, it cannot be reground.
The 4JA1T(L) engine is equipped with the BOSCH VE-Type distributor injection pump.
The 4JH1TC and 4JA1TC engine is equipped with the BOSCH VP44-Type distributor injection pump.
The engine is turbocharger equipped.

PISTON AND CONNECTING ROD



RTW46ALF000301

Reassembly Steps

1. Piston
2. Connecting rod
3. Piston pin snap ring
4. Piston pin
5. Piston pin snap ring
6. Piston ring
7. Connecting rod bearing

Inspection and Repair

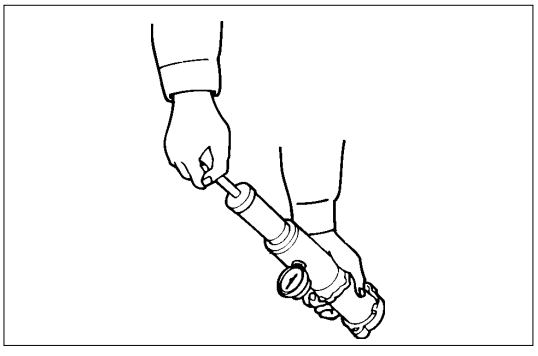
Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Radiator Cap

Measure the valve opening pressure of the pressurizing valve with a radiator filler cap tester.
Replace the cap if the valve opening pressure is outside the standard range.

Valve opening pressure kPa (psi) 93.3 ~ 122.7 (13.5 ~17.8)

Cap tester: 5–8840–0277–0
Adapter: 5–8840–2603–0
Check the condition of the vacuum valve in the center of the valve seat side of the cap. If considerable rust or dirt is found, or if the valve seat cannot be moved by hand, clean or replace the cap.



110RS006

Valve opening vacuum kPa (psi) 1.96 ~ 4.91 (0.28 ~ 0.71)

Radiator Core

1. A bent fin may result in reduced ventilation and overheating may occur. All bent fins must be straightened. Pay close attention to the base of the fin when it is being straightened.
2. Remove all dust, bugs and other foreign material.

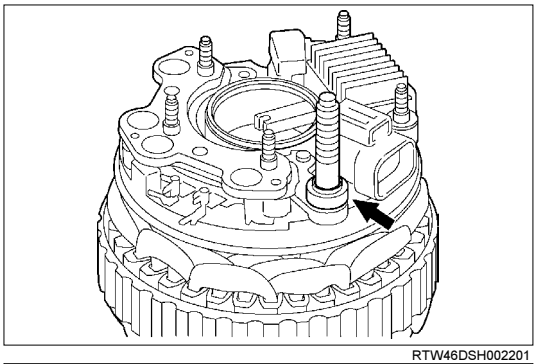
Flushing the Radiator

Thoroughly wash the inside of the radiator and the engine coolant passages with cold water and mild detergent. Remove all signs of scale and rust.

Cooling System Leakage Check

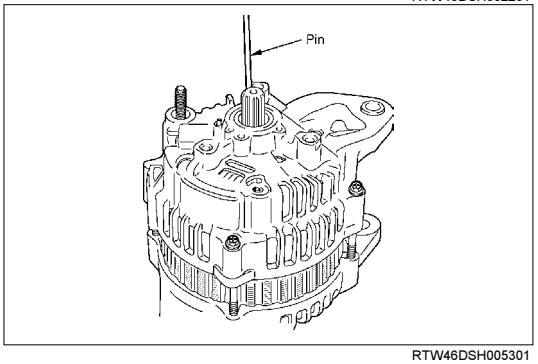
Use a radiator cap tester to force air into the radiator through the filler neck at the specified pressure of 196 kPa (28.5 psi) with a cap tester:

- Leakage from the radiator
- Leakage from the coolant pump
- Leakage from the water hoses



RTW46DSH002201

NOTE: Be sure to attach a cooler to B terminal.



RTW46DSH005301

Insert the pin from the outside of the rear cover. Press the brushes into the brush holder. Complete the assembly procedure.

Remove the pin after completion of the assembly procedure.

Engine Cranks but Does Not Run

Description

The Engine Cranks but Does Not Run diagnostic table is an organized approach to identifying a condition that causes an engine to not start. The diagnostic table directs the service technician to the appropriate system diagnosis. The diagnostic table assumes the following conditions are met:

- The battery is completely charged and terminals are cleaned and tight.
- The engine cranking speed is normal.
- There is adequate fuel in the fuel tank.
- There is no fuel leak in the fuel line.
- There is no air in the fuel line.
- Filters (Air, Fuel) are clean.
- Fuse and slow blow fuse are normal.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Crank the engine for specified amount of time. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the scan tool display any DTCs that failed this ignition?	15 seconds	Go to Diagnostic Trouble Code (DTC) List	Go to Step 3
3	1. Check for normal readings at key up for the following inputs and output: Refer to the scan tool Data List or a known good vehicle to determine normal values. • System Voltage • Engine Coolant Temperature (ECT) • Intake Air Temperature (IAT) • Mass Air Flow (MAF) Sensor • Barometric Pressure • Desired Injection Quantity 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 4

DTC P0243 (Symptom Code 3) (Flash Code 64)

Circuit Description

The engine control module (ECM) controls the turbocharger wastegate valve based on the barometric pressure in order to reduce turbocharger spinning speeds at high altitude area. The ECM controls the turbocharger wastegate valve diaphragm by acting the regulated vacuum pressure via controlling the solenoid valve. The vacuum pressure sensor monitors the regulated vacuum pressure to the turbocharger wastegate valve. The ECM calculates desired vacuum pressure and it compares the calculated desired vacuum pressure to the actual value to determine the solenoid valve position. When the actual vacuum pressure is higher than the desired value, the solenoid valve is closed to decrease the vacuum pressure. An expected vacuum pressure amount should be detected while the engine running. If the ECM detects the actual vacuum pressure amount is higher than desired vacuum pressure amount, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The barometric pressure (BARO) is between 0 hPa and 3500 hPa.
- The intake air temperature (IAT) is between -50°C (-58 °F) and 200°C (392°F).
- The engine coolant temperature (ECT) is between -50°C (-58 °F) and 150°C (302°F)

Condition for Setting the DTC

- The ECM detects that the vacuum pressure is 50 hPa higher than the desired vacuum pressure for 3 seconds. This indicates excessive high vacuum pressure.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misrouted vacuum hoses will cause this DTC to set.

Test Description

The numbers below refer to the step number on the diagnostic table.

4. A skewed vacuum pressure sensor value (shifted to a high pressure) can set this DTC. The Vacuum Pressure on the scan tool should read near doubled barometric pressure (BARO) with the key ON and engine OFF.

5. A skewed BARO sensor value (shifted to a lower pressure) may set this DTC. The BARO on the scan tool should read near surrounding barometric pressure.

DTC P0243 (Symptom Code 3) (Flash Code 64)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0105 (Symptom Code 1, 2, 7 or 9) or P0243 (Symptom Code 4 or 8) set?	—	Go to Applicable DTC	Go to Step 3

DTC P0560 (Symptom Code 2) (Flash Code 35)

Circuit Description

The engine control module (ECM) monitors the system voltage on the ECM main relay load supply voltage terminal to make sure that the voltage stays within the proper range. If the ECM detects an excessively low system voltage, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the battery voltage feed circuit voltage is less than 7 volts.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A charging system problem may set this DTC.

DTC P0560 (Symptom Code 2) (Flash Code 35)
Schematic Reference: Engine Controls Schematics & Starting and Charging Schematics
Connector End View Reference: Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Start the engine and let idle for 30 seconds. 2. Load the electrical system by turning ON the headlights, A/C, etc. 3. Observe the System Voltage parameter with the scan tool. Is the System Voltage parameter more than the specified value?	10 volts	Go to Diagnostic Aids	Go to Step 4
4	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 5	Go to Step 6
5	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for a poor connection and corrosion on the battery voltage feed at the harness connector of the ECM (pin 3 of C-56 connector). 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—

DTC P1650 (Symptom Code A) (Flash Code 44)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.
The ECM monitors CAN operational status by expecting a constant flow of messages from the PCU. If the ECM detects that the PCU receives from the CAN controller rest or Bus Offline, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the PCU receives from the CAN controller reset or Bus Offline.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts the fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

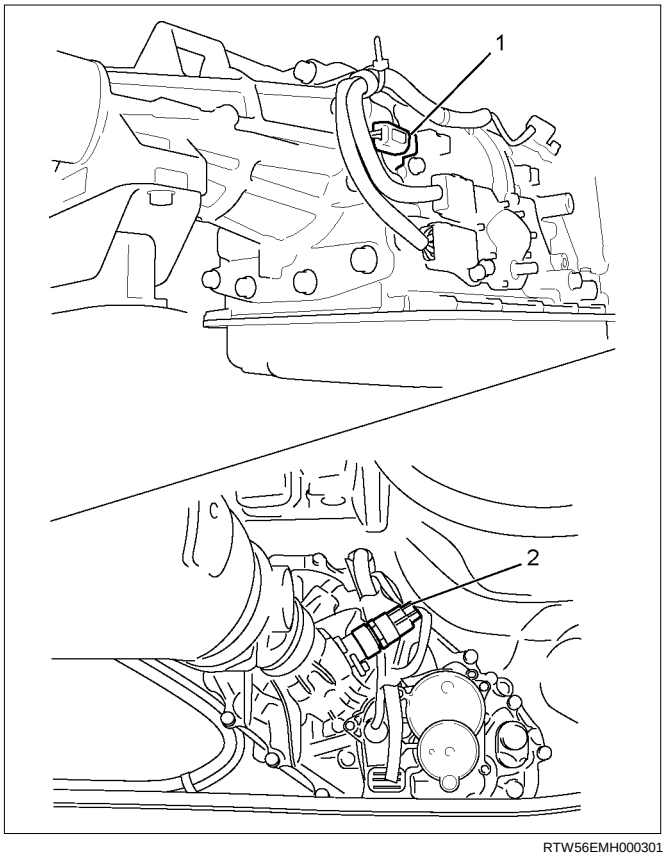
Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1650 (Symptom Code A) (Flash Code 44)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P1651 (Symptom Code A or B) set?	—	Go to Applicable DTC	Go to Step 3
3	Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Connect a DMM across the controller area network (CAN) harness (pins 1 and 2 of E-6 connector). 4. Measure the resistance across the CAN terminals. Is the resistance within the specified value?	110-130 Ω	Go to Step 5	Go to Step 10
5	1. Connect a DMM between the CAN Low signal circuit (pin 1 of E-6 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage within the specified value?	1.5 – 2.5 volts	Go to Step 6	Go to Step 11
6	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a DMM between the CAN High signal circuit (pin 2 of E-6 connector) and a known good ground. Is the DMM voltage within the specified value?	3.0 – 4.0 volts	Go to Step 7	Go to Step 12

Vehide Speed Sensor (VSS)



RTW56EMH000301

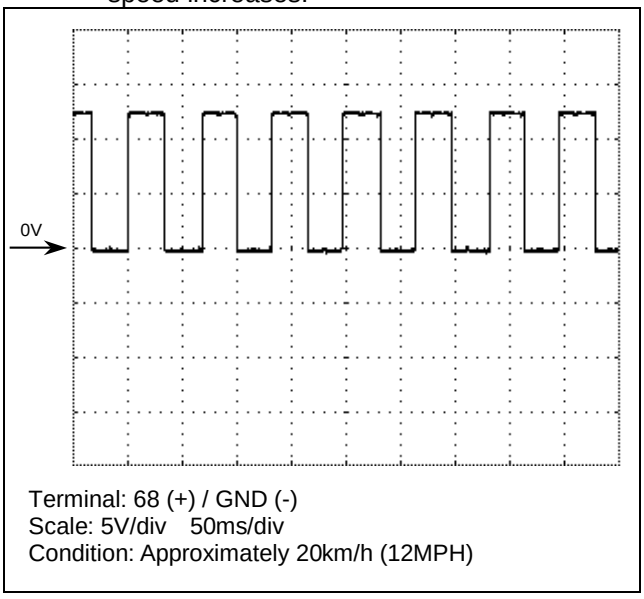
Legend

1. Vehicle Speed Sensor (VSS) 2WD with A/T
2. Vehicle Speed Sensor (VSS) except 2WD with A/T

The vehicle speed sensor (VSS) is used by the engine control module (ECM) and speedometer, which generates a speed signal from the transmission output shaft. The VSS uses a hall effect element. It interacts with the magnetic field created by the rotating magnet and outputs square wave pulse signal. The ECM calculates the vehicle speed by the VSS.

The following waveform aids to diagnose when there is an oscilloscope or equivalent.

- VSS waveform cycle shorten as the vehicle speed increases.

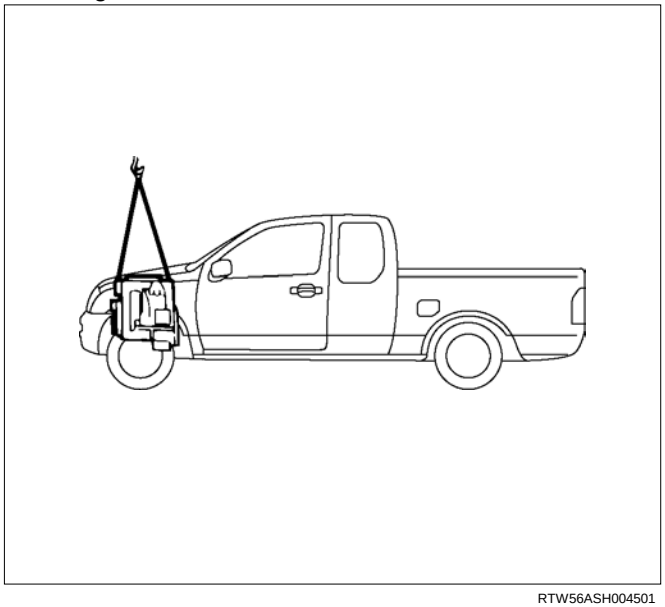


Terminal: 68 (+) / GND (-)
Scale: 5V/div 50ms/div
Condition: Approximately 20km/h (12MPH)

Removal

1. Remove the engine hood.
2. Remove the engine cover.
3. Set the hoist and the engine hanger of the special tool (special tool 5-8840-2823-0).
4. Remove the engine mount.

- Before removing the engine mount, hang the engine with a hoist.
- Remove the bolts of the engine mount.
- Hoist the engine assembly slightly to remove the engine mount.



RTW56ASH004501

Installation

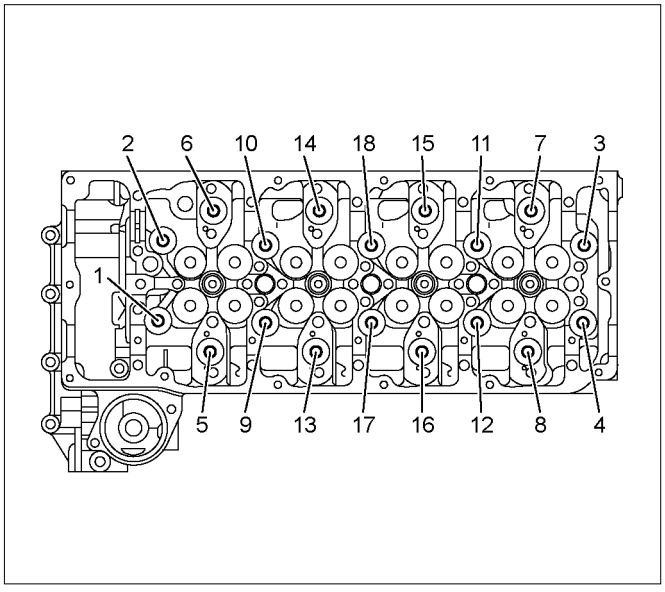
1. Install the engine mount and tighten up with the specified torque.

Tightening torque: 52 N·m (5.3 kg·m / 38 lb ft)

2. Install the engine cover.
3. Install the engine hood.
   - Check if nothing is wrong with the engine mount by starting the engine.

54. Remove the cylinder head assembly.
    - Loosen the cylinder head bolts in the order described in the drawing.
    - Remove the cylinder head gasket.

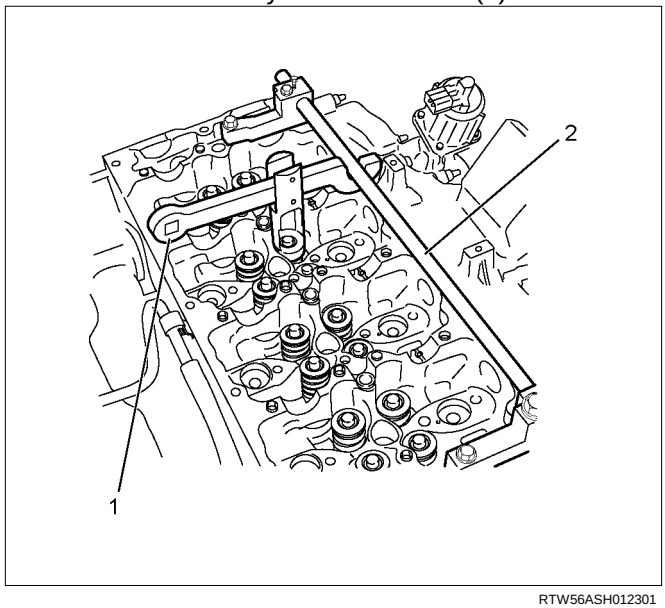
Note:
Replace the head gasket with a new one once it is removed.



RTW56ASH008601

Disassembly

1. Remove the throttle assembly.
    - Refer to procedure for Intake Manifold in this manual.
2. Remove the intake manifold assembly.
    - Refer to procedure for Intake Manifold in this manual.
3. Remove the turbocharger.
    - Refer to “Turbocharger and Exhaust Manifold”.
4. Remove the exhaust manifold assembly.
    - Refer to procedure for Turbocharger and Exhaust Manifold in this manual.
5. Remove the water outlet pipe.
6. Remove the valve stem cap.
   Refer to procedure for valve stem and valve in this manual.
7. Remove the split collar.
    - Use a replacer to compress the valve spring to remove the split collar.
      Special tool
      Valve spring replacer: 5-8840-2818-0 (1)
      Pivot assembly: 5-8840-2819-0 (2)



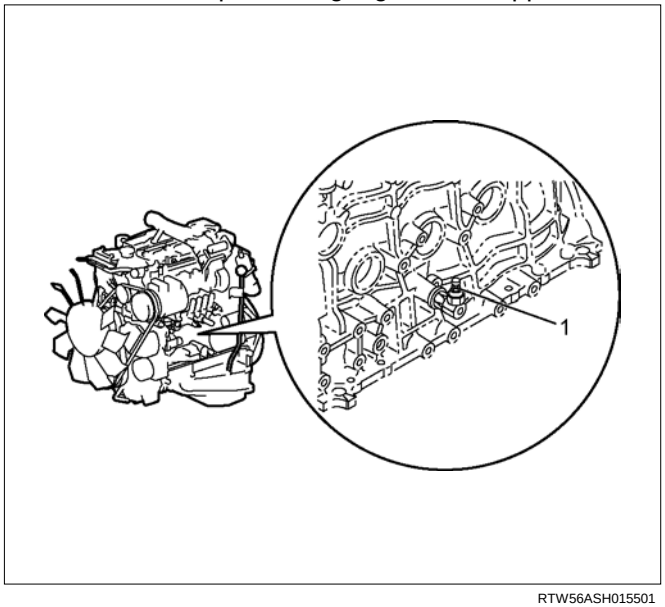
RTW56ASH012301

8. Remove the spring upper seat.
    - Remove the special tool to remove the upper seat.
9. Remove the valve spring.
    - Put the removed valve springs in order by cylinder number.

Functional Check

Oil pressure check

1. Check whether the engine oil is contaminated with dirt, light oil, or water. If contaminated with dirt, light oil, or water (after examining the cause and taking the appropriate measures for light oil or water contamination), replace the oil.
2. Check the engine oil level. The oil level should be between the two holes of the level gauge. If the oil level is insufficient, replenish it.
3. Remove the oil pressure switch on the nipple.
4. Install the oil pressure gauge on the nipple.



RTW56ASH015501

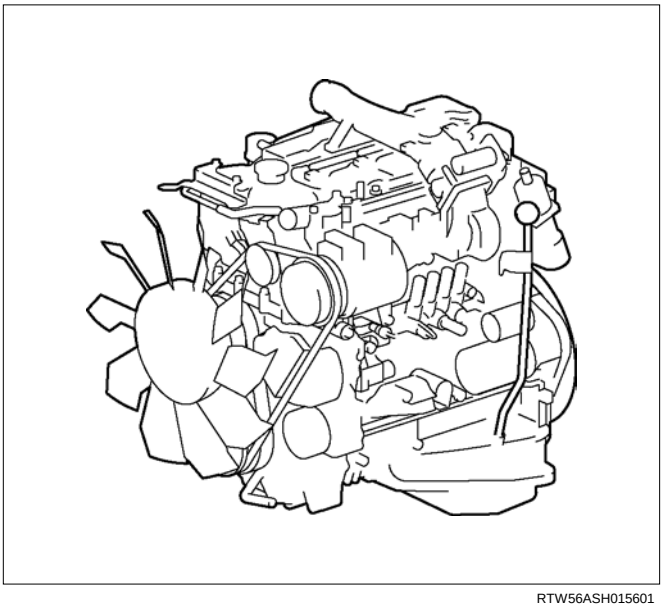
Legend

1. Oil Pressure Switch

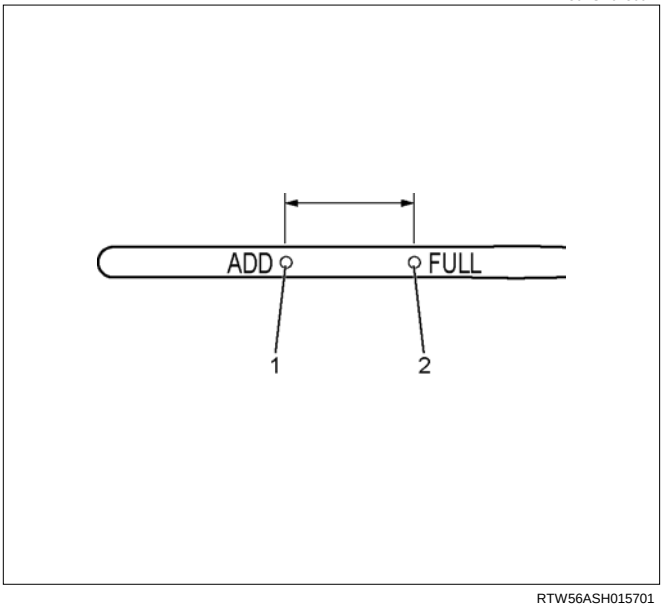
5. Warm the engine.
6. Measure the oil pressure, to check whether it is more than 400 kPa (4 kg/cm^2 / 58 psi) at 3600 rpm.
7. Stop the engine.
8. Remove the oil pressure gauge.
9. Install the oil pressure switch.
10. Start the engine and check for oil leakage.

Engine oil

- Ensure the car is on level ground. Before starting the engine or when 30 minutes or more have elapsed after stopping the engine, check the engine oil volume using the level gauge. The volume is appropriate if the engine oil is between the upper and lower limits of the level gauge. Replenish the engine oil, if level is below the lower limit. Also, check for contamination of the engine oil.



RTW56ASH015601



RTW56ASH015701

Legend

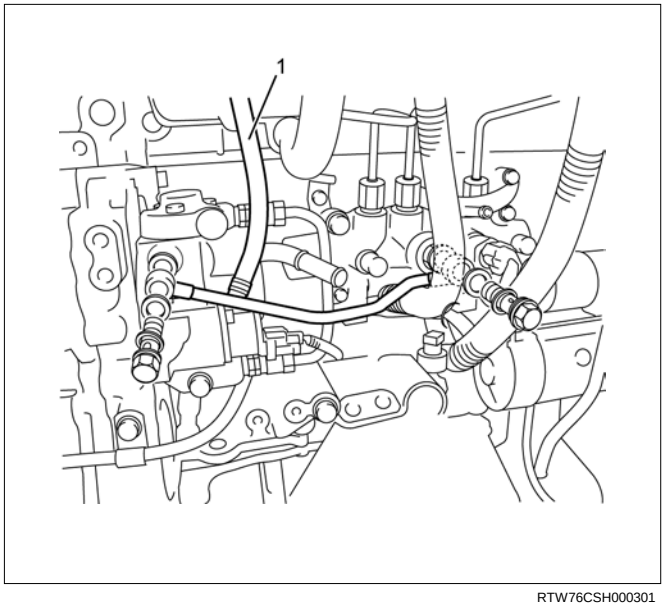
1. Lower Limit
2. Upper Limit

Fuel Pressure Limiter

Removal

1. Remove the leak off pipe and hose (1).

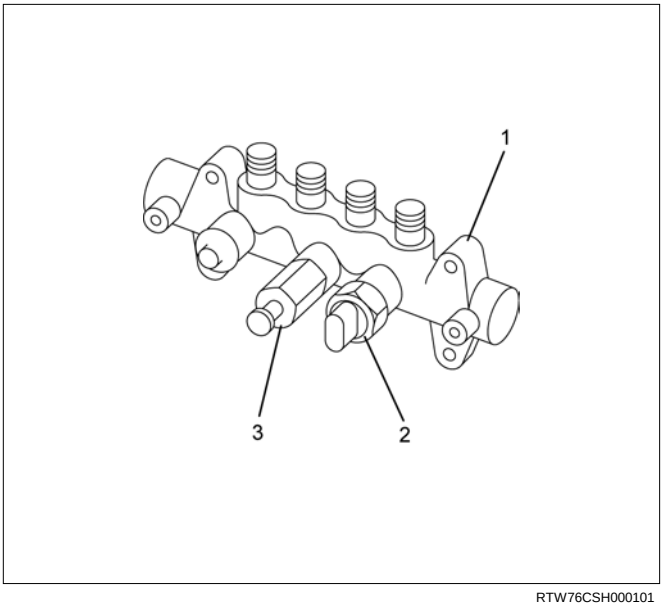
Note: Cover the areas exposed during parts removal to prevent the entry of foreign material into the fuel system.



RTW76CSH000301

2. Remove the fuel pressure limiter.

Note: Cover the areas exposed during part removal to prevent the entry of foreign material into the fuel system.



RTW76CSH000101

Legend

1. Fuel Rail
2. Fuel Rail Pressure Sensor
3. Fuel Pressure Limiter

Installation

1. Install the fuel pressure limiter.

   Tightening torque: 172 N·m (17.5 kg·m/127 lb ft)

2. Install the fuel leak off pipe and hose using the mounting eyebolt using the specified torque.

   Tightening torque: 10 N·m (1.0 kg·m/87 lb in)

Diagnostic Trouble Code (DTC) Type Definitions

Emission Related DTC

Action Taken When the DTC Sets - Type A

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Freeze Frame/ Failure Records.

Action Taken When the DTC Sets - Type B

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the ECM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive driving cycle, the ECM records the operating conditions at the time of failure and stores this information in the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/ DTC - Type A or Type B

- The ECM turns OFF the MIL after 3 consecutive driving cycles when the diagnostic runs and does not fail. (Euro 4 Specification)
- The ECM turns OFF the MIL after 1 driving cycle when the diagnostic runs and does not fail. (Except Euro 4 Specification)
- A current DTC clears when the diagnostic runs and passes after 1 driving cycle.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- Use a scan tool to clear the MIL and the DTC.

Non-Emissions Related DTCs

Action Taken When the DTC Sets - Type C

- The ECM illuminates the Service Vehicle Soon (SVS) lamp when the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Failure Records.

Conditions for Clearing the SVS Lamp/ DTC - Type C

- The ECM turns OFF the SVS lamp after 1 driving cycle when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and passes after 1 driving cycle.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- Use a scan tool to clear the SVS lamp and the DTC.

Action Taken When the DTC Sets - Type D

- The ECM will not illuminate the MIL or SVS lamp.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Failure Records.

Conditions for Clearing the DTC - Type D

- A current DTC clears when the diagnostic runs and passes after 1 driving cycle.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- Use a scan tool to clear the DTC.

Diagnostic Trouble Code (DTC) List

DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Except Euro 4 Specification (High Output)	Except Euro 4 Specification (Standard Output)	
P0016	16	C	A	A	Crankshaft Position - Camshaft Position Correlation
P0045	33	A	A	-	Turbocharger Boost Control Solenoid Circuit
P0087	225	A	A	A	Fuel Rail/ System Pressure Too-Low
P0088	118	A	A	A	Fuel Rail/ System Pressure Too-High (First Stage)
P0088	118	C	A	A	Fuel Rail/ System Pressure Too-High (Second Stage)
P0089	151	A	A	A	Fuel Pressure Regulator Performance
P0091	247	A	A	A	Fuel Pressure Regulator Control Circuit Low
P0092	247	A	A	A	Fuel Pressure Regulator Control Circuit High

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 7
7	Replace the FRP sensor. Refer to FRP Sensor Replacement. Did you complete the replacement?	—	Go to Step 11	—
8	Repair the short to ground between the ECM (pins 50 and 70 of E-90) and the FRP regulator (pin 2 of E-50). Did you compete the repair?	—	Go to Step 11	—
9	1. Check for normal readings at key up for the following sensor inputs: Use the Scan Tool Data List or a known good vehicle to determine nominal values. • Engine Coolant Temperature Sensor • Barometric Pressure (BARO) Sensor • Boost Pressure Sensor • Intake Throttle Position Sensor 2. Repair the circuit(s) or replace the sensor as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
10	1. Other possible causes for the no-start condition: • Engine mechanical timing • Heavily restricted intake or exhaust plugged solid. • Poor engine compression. • Water or gasoline contamination in fuel. 2. Repair as necessary. Did you find and correct the condition?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start and continue to run?	—	Go to Step 12	Go to Step 2
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0192 or P0193 (Flash Code 245)

Circuit Description

The fuel rail pressure (FRP) sensor is installed to the fuel rail and it detects the fuel pressure in the fuel rail, converts the pressure into a voltage signal, and sends the signal to the ECM. The sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- FRP sensor signal circuit

The ECM monitors the FRP sensor signal voltage. Higher fuel rail pressure provides higher signal voltage while lower pressure provides lower signal voltage. The ECM calculates actual fuel rail pressure (fuel pressure) from the voltage signal and uses the result in fuel injection control and other control tasks. If the ECM detects an excessively low or high signal voltage, DTC P0192 or P0193 will set.

Condition for Running the DTC

- DTCs P0652 and P0653 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the FRP sensor signal voltage is less than 0.4 volts. (DTC P0192)
- The ECM detects that the FRP sensor signal voltage is more than 4.75 volts. (DTC P0193)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses a FRP substitution of default value.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference may affect intermittent condition.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0192

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0652 also set?	—	Go to DTC P0652	Go to Step 3
3	Observe the Fuel Rail Pressure (FRP) Sensor parameter with a scan tool. Is the FRP Sensor parameter less than the specified value?	0.4 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the FRP Sensor parameter more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6
5	Connect a DMM between the 5 volts reference circuit (pin 3 of E-48) and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Cruise Main Switch parameter with a scan tool. Dose the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	Go to Step 8	Go to Step 3
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1262 (Flash Code 34)

Circuit Description

The charge up circuit in the ECM steps up the voltage for fuel injectors and is divided into two banks, common 1 and common 2. The common 1 covers fuel injectors in cylinders #1 and #4, and the common 2 covers fuel injectors in cylinders #2 and #3. If the common 2 fuel injector charge up circuit in the ECM is an insufficient charge or an overcharge, this DTC will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is not running.

Condition for Setting the DTC

- The ECM detects that the common 2 fuel injector charge up circuit is an insufficient charge or an overcharge.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P1262

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
3	1. Inspect for an intermittent, for poor tightening and corrosion at the engine ground terminal (E-10). 2. Repair the tightening or clean the corrosion as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Test ground circuit between the ECM (pin 73 of E-90) and the engine ground terminal (E-10) for an intermittently open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	1. Test the battery voltage feed circuit between the ECM (pin 73 of E-90) and the ECM main relay (pin 1 of X-12) for an intermittently open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6

Step	Action	Value(s)	Yes	No
6	**Notice:** If the intake throttle solenoid is commanded OFF, Intake Throttle Position parameter indicates over 100%. Observe the Desired Intake Throttle Position and Intake Throttle Position parameter with a scan tool. Does the Intake Throttle Position parameter follow within the specified value?	±5%	Go to Step 7	Go to Step 10
7	1. Perform the Intake Throttle Solenoid Control with a scan tool several times. 2. Command the Desired Intake Throttle Position Increase and Decrease while observing the Intake Throttle Position. Does the Intake Throttle Position parameter follow within the specified value quick enough?	±5%	System OK	Go to Step 10
8	1. Remove the EGR valve assembly from the engine. 2. Inspect the EGR valve for the following conditions: • Restricted EGR valve by foreign materials • Excessive deposits at valve • Bent valve shaft 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9
9	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the EGR valve (pins 1, 2, 3, 4 and 6 of E-71). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 30, 31, 32, 62 and 63 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
10	1. Remove the intake duct that is connected to the intake throttle valve. 2. Inspect the intake throttle valve for the following conditions: • Restricted intake throttle valve by foreign materials • Excessive deposits at throttle bore • Bent butterfly valve **Notice:** Replace the intake throttle valve is there is any sticking 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11

Fuel Injection System Description

Fuel Injection Quantity Control

This control determines the fuel injection quantity by adding coolant temperature, fuel temperature, intake air temperature, barometric pressure, mass air flow and some switch inputs information corrections to the basic injection quantity is calculated by the ECM based on the engine operating conditions (engine speed, accelerator pedal pressing amount and boost pressure sensor). More fuel rate indicates if the engine load is increased as the accelerator pedal is stepped on at constant engine speed.
Combined with high pressure injection of atomized fuel, this control improves exhaust gas and ensures proper fuel consumption. Compared with conventional mechanical governors, an electronic control system provides higher degree of freedom of fuel injection quantity control, thereby presenting high accelerator response (acceleration feeling and pressing feeling).

Starting Injection Quantity Control

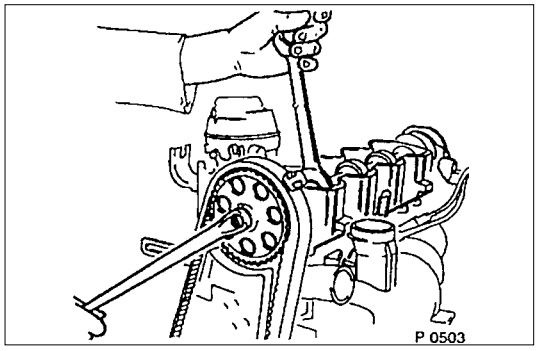
At the engine starting (after the key switch is turned to the START position to start the engine, up to return of key switch to the ON position), optimum fuel injection quantity is controlled based on the information on the engine speed and coolant temperature. At low temperature, the fuel injection quantity increases. When the engine started completely, this boosted quantity mode at the starting is cancelled and normal running mode is restored.

Idle Speed Control

A control is made so as to achieve stable idling speed at all time regardless of engine secular changes or engine condition variations. The ECM sets target idling speed and controls the fuel injection quantity according to the engine conditions (actual engine speed, coolant temperature and engine load) to follow actual engine speed to the target idling speed so as to ensure stable idling speed.

Idle Vibration Control

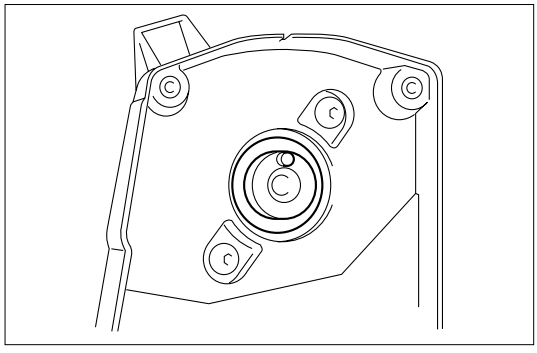
A control is made so as to reduce the engine vibration caused by torque variations between cylinders due to variations in fuel injection quantity of each cylinder or injector performance. The ECM corrects the injection quantity between cylinders based on the revolution signals from the crankshaft position (CKP) sensor. Normal range of correction quantity between cylinders is within ± 5 mm^3.



Seal Ring, Camshaft Housing, Timing Side

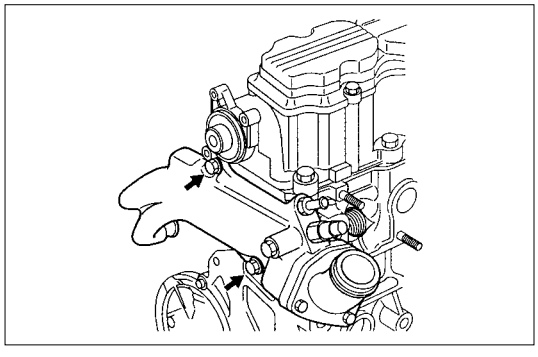
Removal

1. Remove front toothed belt cover toothed belt from camshaft timing gear according to the corresponding operation.
2. Remove camshaft housing cover and camshaft timing gear.
3. Remove sealing ring by making hole in middle of ring, turning in self-tapping screw and edging out.



Installation

1. Install sealing ring by using 5-8840-0451-0 with camshaft sprocket bolt and washer.
2. Install coat seal lips of shaft seal ring slightly.



Seal Ring, Thermostat Housing, Cylinder Head

Removal

1. Open radiator drain tap and collect coolant.
2. Remove toothed belt rear cover and toothed belt according to the corresponding operation.
3. Remove camshaft housing cover.
4. Remove camshaft timing gear by counterholding camshaft with a flat spanner.
5. Remove cable from temperature sensor.
6. Remove upper inner hex bolts of rear toothed belt cover.
7. Turn rear toothed belt cover to one side.
8. Remove thermostat housing.
9. Remove sealing ring from cylinder head.

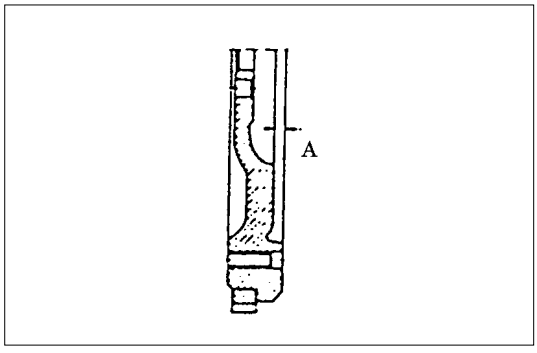
Clean

Sealing surfaces in cylinder head and thermostat housing.

Installation

1. Install sealing ring in recess of cylinder head.

Crankshaft, Cylinder Block (continued)



Flywheel

Starter ring gear	Before fitting, heat ring gear to 180°C - 230°C
Lateral run-out	Permissible lateral run-out of installed starter ring gear to flywheel: 0.5mm
Precision turning	Permissible removal of material in clutch disc lining surface area: 0.3mm In order to achieve the functional relationship again after removal of material, the same removal of material must take place on the fore part of the flywheel (contact for clutch assembly)

Dimension A: 2.1 to 2.2mm

Cylinder block

Top deck flatness	mm	0.05
Cylinder block height	mm	280±0.075

5. During current output tests please make sure that the ammeter is securely connceted into the charge circuit.
6. Some battery powered timing lights can produce high transient voltages when connected or disconnected. Only disconnect or connect timing lights when the engine is switched off.
7. Make sure the warning lamp circuit is functioning normally before commencing tests.
8. Battery isolation switches must only be operated when the engine is stopped.
9. To protect the charging system when using 240 volt chargers it is recommeneded that the battery is disconnected whilst charging.
10. Due to the very low resistance value of the stator winding it may not be possible to obtain accurate readings without special equipment.
11. 12 volts must never be connected to the "L" terminal of the regulator as this will damage the lamp driver circuit.
12. No loads apart from the warning lamp can be connected to the "L" termainal. The "W" terminal is provided for this purpose.

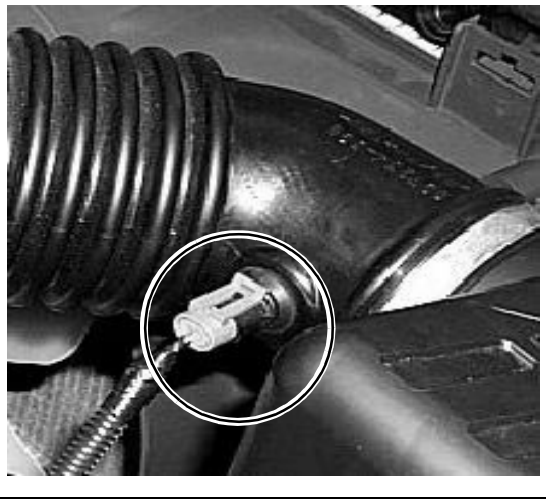
Disassembly

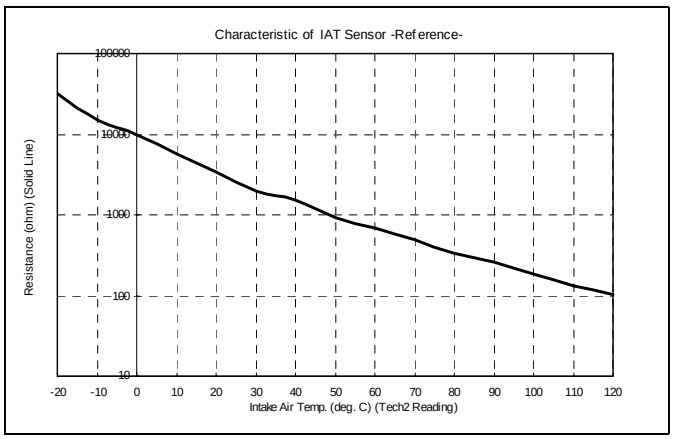
1. Mark the relative positions of the end housings in relation to the stator assembly to aid reassembly. Use a permanent marking pen do not use centre punched as this can cause misalignmnet of the housings.
2. Remove the EP regulator from the slipring end housing by removing the two screws. Tilt the regulator slightly from the plug connection until the regulator clears the housing, then lift clear.
3. Remove the four through bolts.
4. Carefully remove the stator assembly along with the slipring end housing taking care not to put strain on the stator wires.
5. To disconnect the stator from the rectifier assembly, grasp the stator wires close to the wire loop with a pair of long nosed pliers, heat the joint with a soldering iron, when the point becomes plastic apply a slight twisting motion to the wires, then pull upwards to release the wires. Remove the stator.

   This procedure opens the wire loop to release the stator connections easily.
6. To remove the rectifier remove the three retaining screw and the B+ terminal nut and washers.

Note: the B+ bolt and the positive heatsink retaining screw are fitted with mica insulating washers.
These must be discarded and replaced with new washers and heatsink compound.

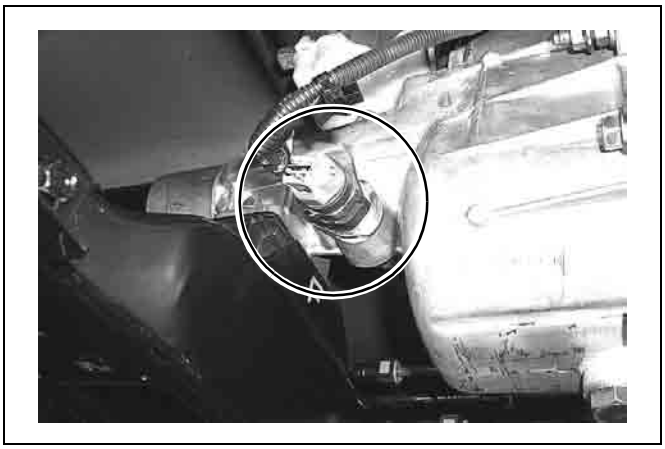
Intake Air Temperature (IAT) Sensor





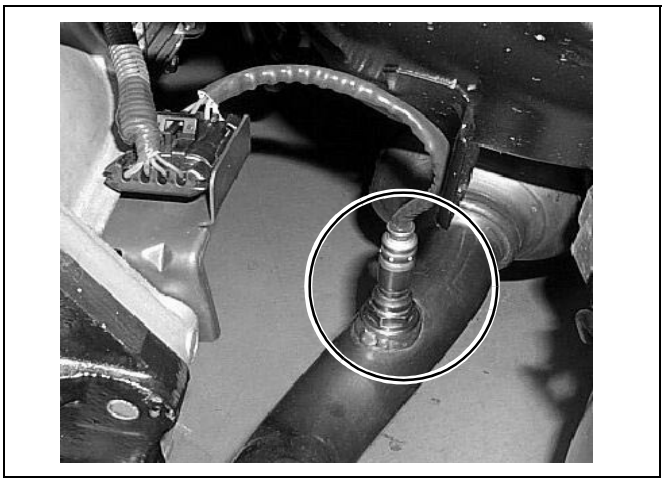
The IAT sensor is a thermistor. A temperature changes the resistance value. And it changes voltage. In other words it measures a temperature value. Low air temperature produces a high resistance.
The ECM supplies 5 volts signal to the IAT sensor through resisters in the ECM and measures the voltage. The signal voltage will be high when the air temperature is cold, and it will be low when the air temperature is hot.

Vehicle Speed Sensor (VSS)



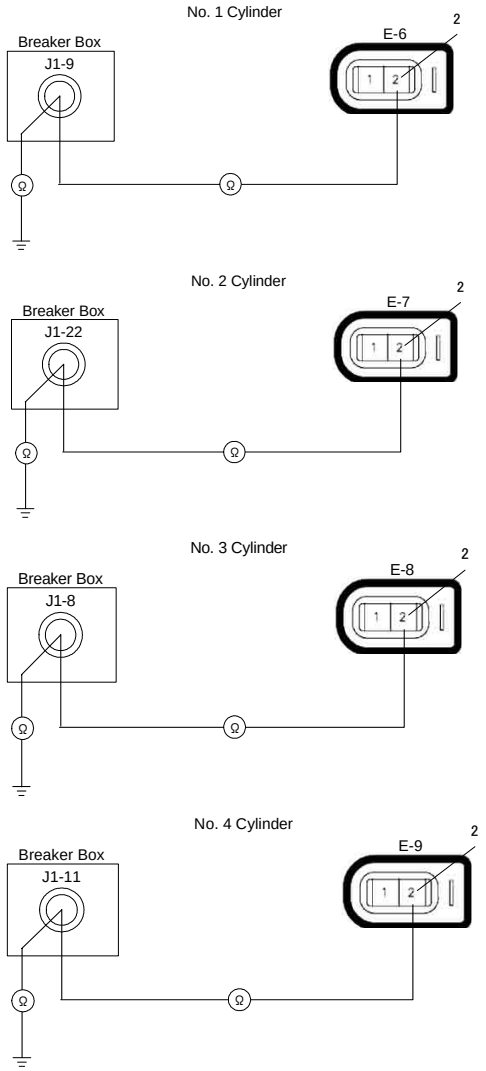
The VSS is a magnet rotated by the transmission output shaft. The VSS uses a hall element. It interacts with the magnetic field treated by the rotating magnet. It outputs pulse signal. The 12 volts operating supply from the meter fuse.

Heated Oxygen (O_2) Sensor



The heated oxygen sensor consists of a 4-wire low temperature activated zirconia oxygen analyzer element with heater for operating temperature of 315°C, and there is one mounted on each exhaust pipe.
A constant 450millivolt is supplied by the ECM between the two supply terminals, and oxygen concentration in the exhaust gas is reported to the ECM as returned signal voltage.
The oxygen present in the exhaust gas reacts with the sensor to produce a voltage output. This voltage should constantly fluctuate from approximately 100mV to 1000mV and the ECM calculates the pulse width commanded for the injectors to produce the proper combustion chamber mixture.
Low oxygen sensor output voltage is a lean mixture which will result in a rich commanded to compensate.
High oxygen sensor output voltage is a rich mixture which result in a lean commanded to compensate.
When the engine is first started the system is in “Open Loop” operation. In “Open Loop”, the ECM ignores the signal from the oxygen sensors. When various conditions (ECT, time from start, engine speed & oxygen sensor output) are met, the system enters “Closed Loop” operation. In “Closed Loop”, the ECM calculates the air fuel ratio based on the signal from the oxygen sensors.
Heated oxygen sensors are used to minimize the amount of time required for closed loop fuel control to begin operation and allow accurate catalyst monitoring.
The oxygen sensor heater greatly decreases the amount of time required for fuel control sensors to become active.
Oxygen sensor heaters are required by catalyst monitor and sensors to maintain a sufficiently high temperature which allows accurate exhaust oxygen content readings further away from the engine.

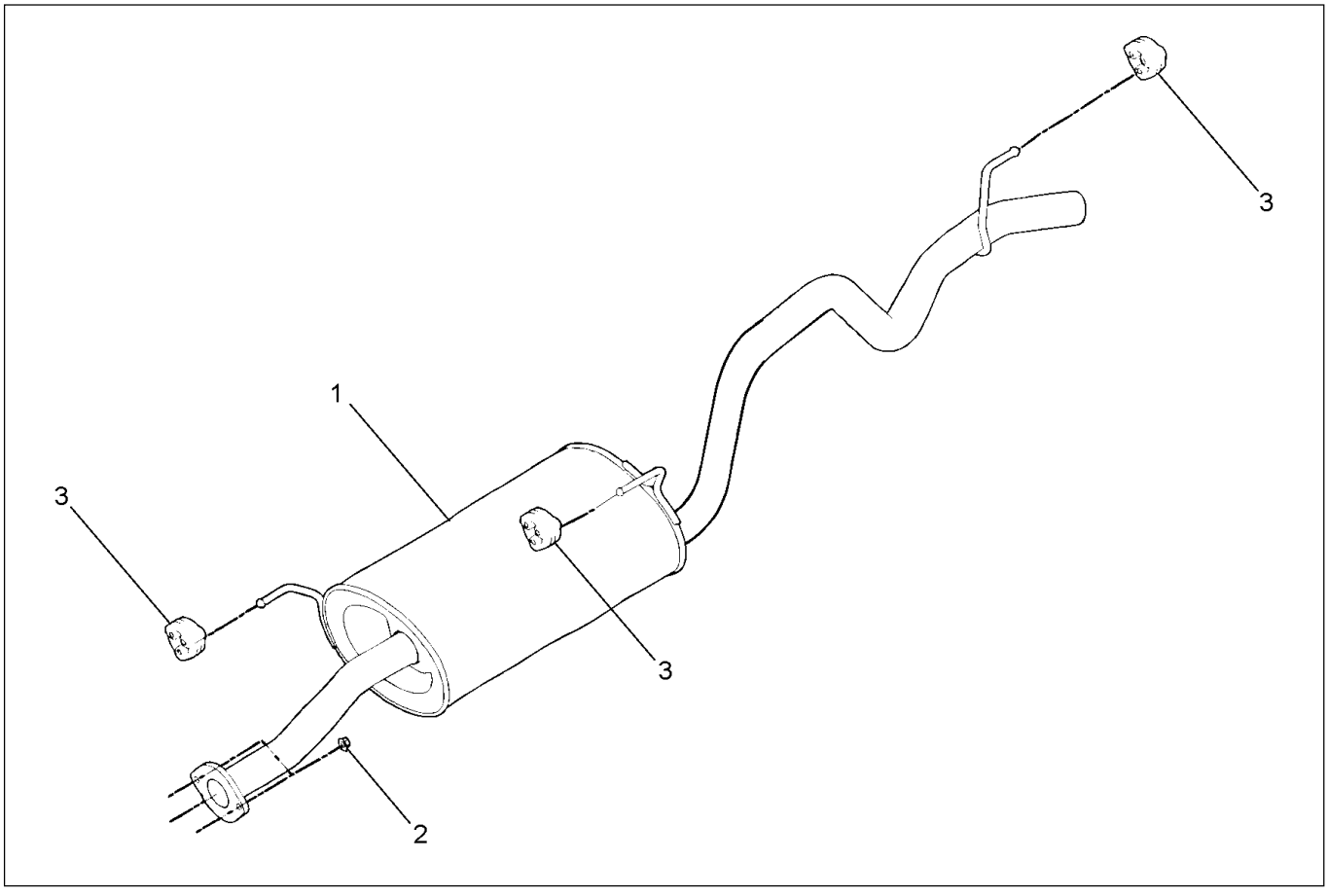
Step	Action	Value(s)	Yes	No
10	Locate and repair the loss of vacuum to the fuel pressure regulator. Is the action complete?	—	Verify repair	—
11	Replace the fuel pressure regulator. Is the action complete?	—	Verify repair	—
12	1. Run the fuel pump with the Scan Tool. 2. After pressure has built up, turn off the pump and clamp the supply hose shut with suitable locking pliers. Does the fuel pressure indicated by the fuel pressure gauge remain constant?	—	Go to *Step 13*	Go to *Step 15*
13	Visually inspect the fuel supply line and repair any leaks. Was a problem found?	—	Verify repair	Go to *Step 14*
14	Remove the fuel tank and inspect for leaky hose or in-tank fuel line. Was a problem found?	—	Verify repair	Go to *Step 8*
15	1. If the pliers are still clamped to the fuel supply hose, remove the locking pliers. 2. With suitable locking pliers, clamp the fuel return line to prevent fuel from returning to the fuel tank. 3. Run the fuel pump with the Scan Tool. 4. After pressure has built up, remove power to the pump. Does the fuel pressure indicated by the fuel pressure gauge remain constant?	—	Go to *Step 11*	Go to *Step 16*
16	Locate and replace any leaking fuel injector(s). Is the action complete?	—	Verify repair	—
17	Is the fuel pressure indicated by the fuel pressure gauge above the specified limit?	376 kPa (55 psi)	Go to *Step 18*	Go to *Step 21*
18	1. Relieve the fuel pressure. Refer to the *Fuel Pressure Relief*. 2. Disconnect the fuel return line from the fuel rail. 3. Attach a length of flexible hose to the fuel rail return outlet passage. 4. Place the open end of the flexible hose into an approved gasoline container. 5. Run the fuel pump with the Scan Tool. 6. Observe the fuel pressure indicated by the fuel pressure gauge with the fuel pump running. Is the fuel pressure within the specified limits?	290-376 kPa (42-55 psi)	Go to *Step 19*	Go to *Step 20*
19	Locate and correct the restriction in the fuel return line. Is the action complete?	—	Verify repair	—
20	Visually and physically inspect the fuel rail outlet passages for a restriction. Was a restriction found?	—	Verify repair	Go to *Step 11*
21	Is the fuel pressure indicated by the fuel pressure gauge above the specified value?	0 kPa (0 psi)	Go to *Step 22*	Go to *Step 23*

Step	Action	Value(s)	Yes	No
9	Using the DVM and check the injector signal circuit for the affected cylinder. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the injector connector for the affected cylinder. 4. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 10*

Step	Action	Value(s)	Yes	No
9	Replace the Tacho meter. Was the problem solved?	—	Verify repair	Go to *Step 10*
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 11*
11	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify repair	—

Exhaust Silencer

Exhaust Silencer and Associated Parts



RTW46FMF000701

Legend

1. Exhaust Silencer
2. Exhaust Silencer Fixing Nuts
3. Rubber

Removal

(2.4L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove the damper rubber and nut (2)(3).
4. Remove exhaust silencer (1).

2.19 Engine Oil Pressure Diagnosis

If the engine oil pressure is below the specified value, inspect the engine and components for the following:

- loose oil filter adaptor bolts,
- faulty oil filter adaptor seals,
- worn or faulty oil pump,
- loose oil pump bolts,
- loose, blocked or damaged oil pump suction pipe,
- faulty oil pump suction pipe seal,
- faulty oil pump pressure relief valve,
- faulty or incorrectly installed oil gallery plugs,
- excessive bearing clearance in one of the following:
- connecting rods big end/s,
- crankshaft main journal/s,
- camshaft/s,
- camshaft sprocket/s, and
- cracked, porous or restricted oil galleries, or broken lash adjuster/s.

2.20 Accessory Drive Belt Diagnosis

Tension Check

NOTE

An accessory drive belt that squeaks when the engine is started or stopped is considered normal and has no effect on drive belt durability.

1 Start the engine and switch off the air-conditioning system. Allow engine to run until normal operating temperature has been reached.

2 Turn the engine off and inspect the markings on the drive belt tensioner to confirm the drive belt tension is within the operating limits.

3 If the markings on the drive belt tensioner were outside the acceptable operating limits, replace the accessory drive belt, refer to 3.5 Accessory Drive Belt.

NOTE

The operating limits for acceptable drive belt tension are when the drive belt tensioner pointer (1) is aligned between the outer edge of the minimum and maximum tension marks (2).

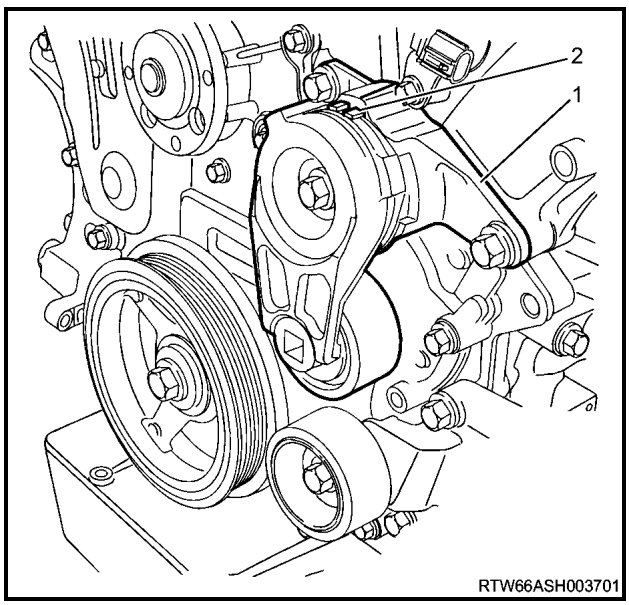


Figure 6A1 – 21

Inspect

Figure 6A1 – 22 illustrates the various stages of belt wear to aid in belt replacement decisions. Condition of the belt ribs is best judged where the belt is bent over one of the larger accessory drive system pulleys.

8 If required, remove the crankshaft sprocket (1) from the crankshaft (2).

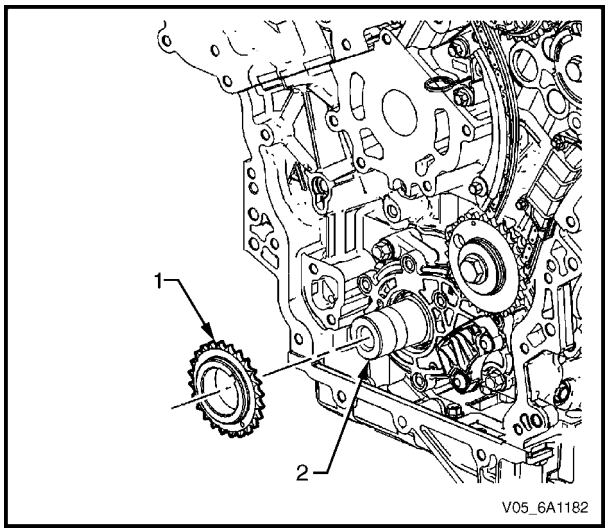


Figure 6A1 – 118

Left-hand Secondary Timing Chain

1 Remove the primary timing chain, refer to Primary Timing Chain in this Section.

2 Remove the two left-hand secondary timing chain tensioner bolts (1) and remove the tensioner (2).

NOTE

Take care when removing the tensioner bolts. The tensioner plunger is subjected to spring tension and may spring apart during tensioner removal.

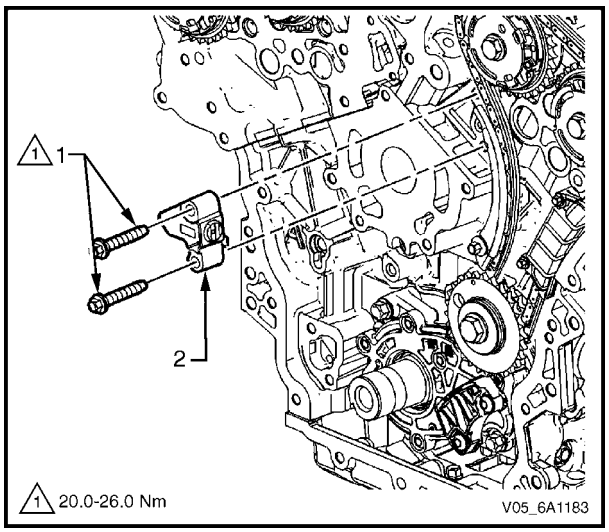


Figure 6A1 – 119

3 Remove the gasket (1) from the tensioner (2) and discard the gasket.

4 Inspect the tensioner mounting surface on the left-hand cylinder head for burrs or any defects that would affect the sealing of a new tensioner gasket.

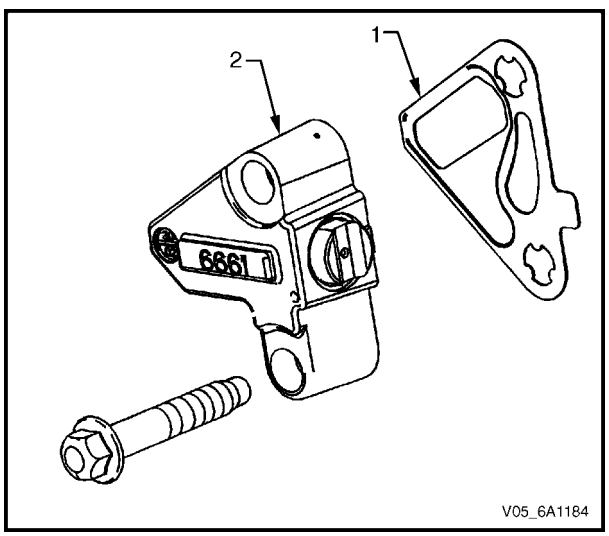


Figure 6A1 – 120

9 Remove and discard the cylinder head gasket (1).

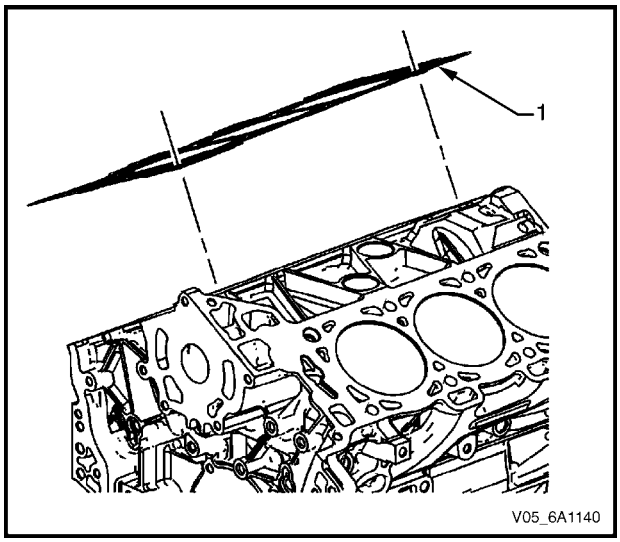


Figure 6A1 – 276

Left-hand Side (Bank 2) Cylinder Head

1 Remove the intake manifold assembly, refer to 3.10 Intake Manifold Assembly – Complete.

2 Remove the exhaust manifold, refer to 3.11 Exhaust Manifold Assembly.

3 Remove the power steering reservoir and pump mounting brackets, refer to 3.8 Power Steering Pump Bracket.

NOTE

Do not disconnect the power steering pipes and/or hoses.

4 Remove the oil filter adapter upper bolt.

NOTE

Do not remove the oil filter adapter.

5 Remove the engine coolant temperature (ECT) sensor, refer to 6C1-3 Engine Management – V6 – Service Operations.

6 Remove engine harness ground terminal attaching bolt from cylinder head, refer to 8A Electrical Body & Chassis.

7 Remove the left-hand bank secondary timing chain, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.

8 Remove the camshaft position actuators, refer to 3.18 Camshaft Sprocket.

9 Remove the front M8 (1) cylinder head attaching bolt, two places.

10 Remove the cylinder head attaching bolt (2), eight places.

11 Remove the cylinder head (3).

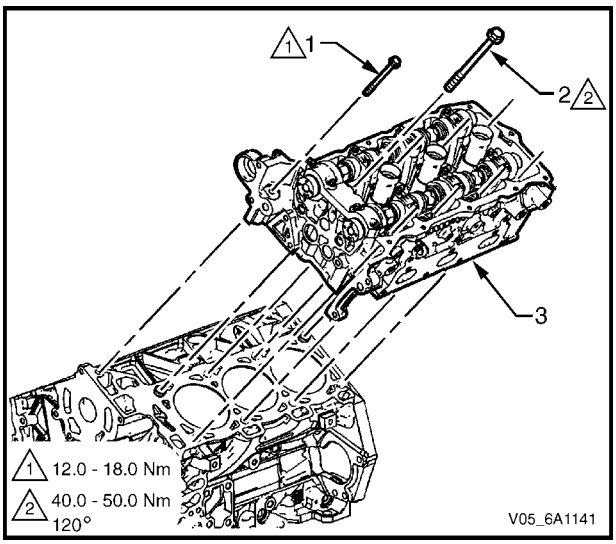


Figure 6A1 – 277

8 Determine the connecting rod bearing clearance by comparing the width of the flattened plastic gauging (1) material at its widest point with the graduation on the gauging material container (2).

9 Compare the measurements with the specifications, refer to 5 Specifications.

10 If the new bearings do not provide the correct crankshaft to connecting rod bearing clearance, inspect the following:

11 Measure the crankshaft connecting rod journals for the correct specified size and ensure the correct new bearings are being installed. If the crankshaft connecting rod journals are incorrectly sized, replace or regrind the crankshaft. Crankshaft machining is permitted and undersized bearings are available.

12 Measure the connecting rod bearing bore diameter to ensure correct size. The connecting rod is not machineable and the connecting rod must be replaced if out of specification.

13 Clean the plastic gauging material from the connecting rod bearing journals using a soft lint-free cloth.

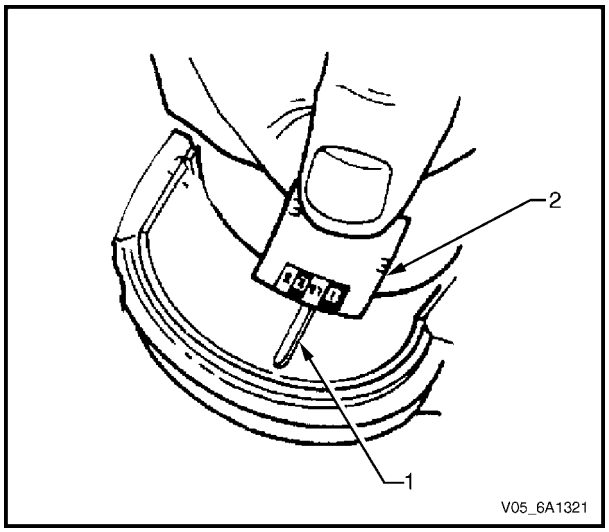


Figure 6A1 – 408

Connecting Rod Final Assembly Procedure

1 Carefully guide the connecting rod away from the crankshaft connecting rod journal slightly to lubricate the crankshaft connecting rod bearing journal.

2 Apply a liberal amount of clean engine oil to the crankshaft connecting rod bearing journal.

3 Guide the connecting rod to the crankshaft connecting rod journal.

4 Install the connecting rod end cap (1) on its original connecting rod and ensure the bearing lock tangs are aligned on the same side of the rod.

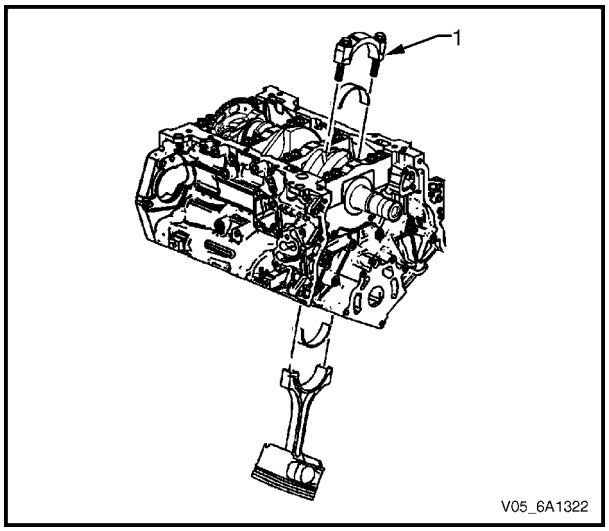


Figure 6A1 – 409

CAUTION

- **Do not lubricate the new connecting rod bolts. The new bolts have a pre-applied graphite lubricant. Applying lubricant to the connecting rod bolts will effect the clamp load when the connecting rod bolts are tightened to the specified torque. Incorrect clamp load can lead to component failure and extensive engine damage.**
- **Do not reuse the old connecting rod bolts.**

5 Install new connecting rod bolts into the connecting rod cap and tighten to the correct torque specification.

■ Connecting rod cap attaching bolt torque specification:

Stage 1	30.0 Nm
Stage 2	Loosen completely
Stage 3	25.0 Nm
Stage 4	110 degrees

Upper Intake Manifold Front

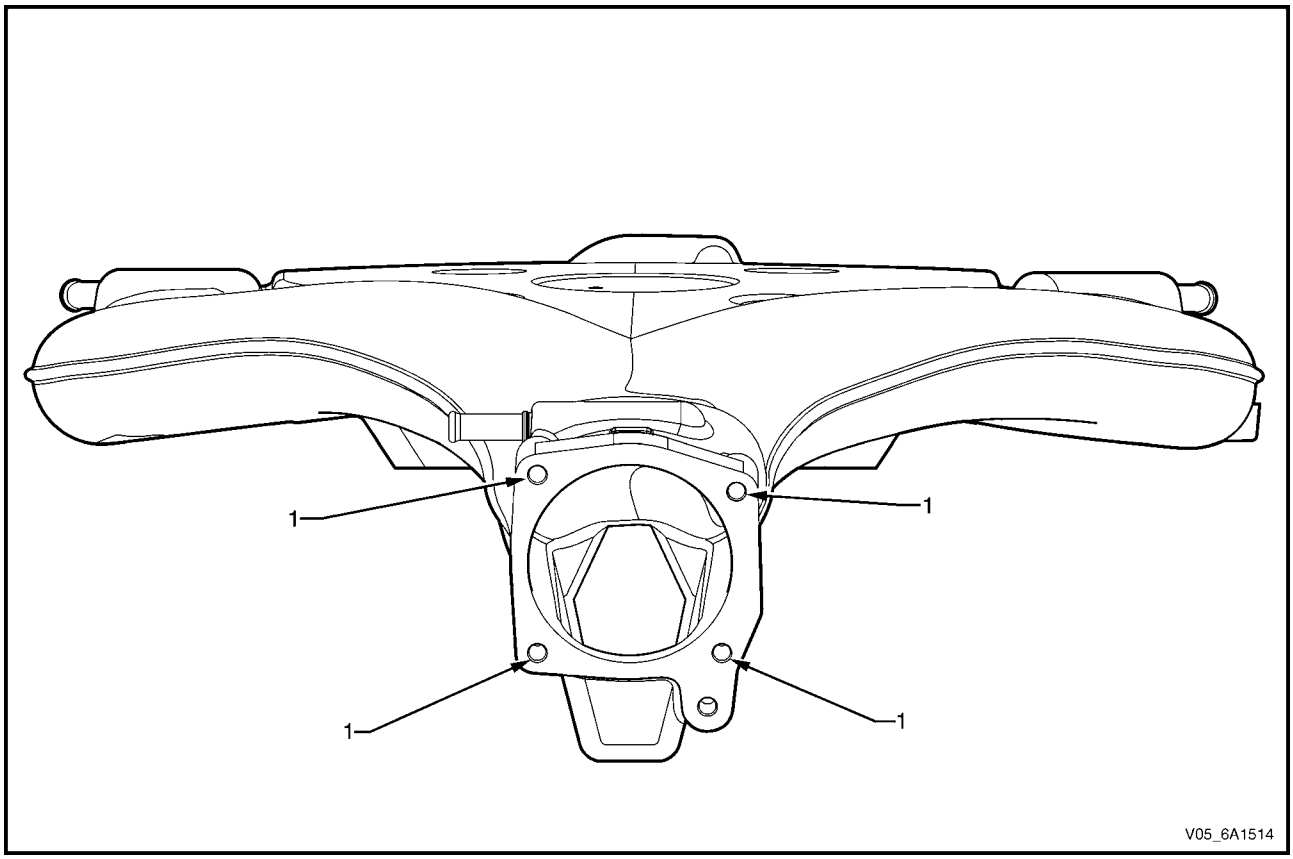


Figure 6A1 – 533

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	Thread Size	Drill	Counter-bore	Tap	Driver	Insert	Drill	Tap
1	M6 x 1.0	201	202	203	204	205	Thru	Thru

2.14 Coolant in Engine Oil

Definition

Foamy or discoloured oil or an engine oil overfill condition may indicate coolant entering the engine crankcase. Low coolant levels, an inoperative engine cooling fan or a faulty thermostat may lead to an over-temperature condition which may result in engine component damage. Contaminated engine oil and oil filters must be replaced.

1 Inspect the oil for excessive foaming or an overfill condition. Oil diluted by coolant may not correctly lubricate the crankshaft bearings, resulting in component damage, refer to 2.10 Lower Engine Noise, Regardless of Engine Speed.

2 Perform a cylinder leakage test, refer to 2.16 Cylinder Leakage Test. During this procedure, excessive air bubbles in the engine coolant may indicate a faulty gasket or damaged component.

3 Perform a cylinder compression test. Two cylinders side-by-side on the cylinder block, with low compression, may indicate a failed cylinder head gasket, refer to 2.15 Engine Compression Test.

Cause	Correction
Faulty cylinder head gasket.	Replace the cylinder head gasket, refer to 3.22 Cylinder Head Assembly.
Warped cylinder head.	Repair or replace the cylinder heads as required, refer to 3.22 Cylinder Head Assembly.
Cracked cylinder liner or block	Repair or replace the cylinder block and components as required, refer to 4.7 Cylinder Block.
Cylinder head, cylinder block or intake manifold porosity.	Repair or replace the cylinder block, cylinder heads or intake manifold components as required, refer to 4.7 Cylinder Block, 3.22 Cylinder Head Assembly or 3.10 Intake Manifold Assembly – Complete.

3.15 Front Cover Assembly

Remove

1 Drain the engine coolant, refer to Section 6B1 Engine Cooling.

2 Remove the water outlet pipe and coolant pump assembly, refer to Section 6B1 Engine Cooling:

3 Remove the camshaft covers, refer to 3.12 Camshaft Cover.

4 Remove the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

5 Disconnect the purge vent hose from the water outlet pipe.

NOTE

Do not disconnect the power steering pipes or drain the power steering fluid.

6 Remove the power steering pump reservoir mounting bracket, refer to 3.8 Power Steering Pump Bracket.

7 Remove the camshaft position sensor, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

NOTE

Do not disconnect the A/C compressor pipes.

8 Remove the bolt (2), 22 places, attaching the front cover assembly (1).

CAUTION

Only use the prise points and a bolt in the jackscrew hole to remove the engine front cover.

9 Loosely install a 10 x 1.5 mm bolt in the jackscrew hole (1).

10 Using the prise points (2) located at the edge of the front cover and the jackscrew, shear the RTV sealant.

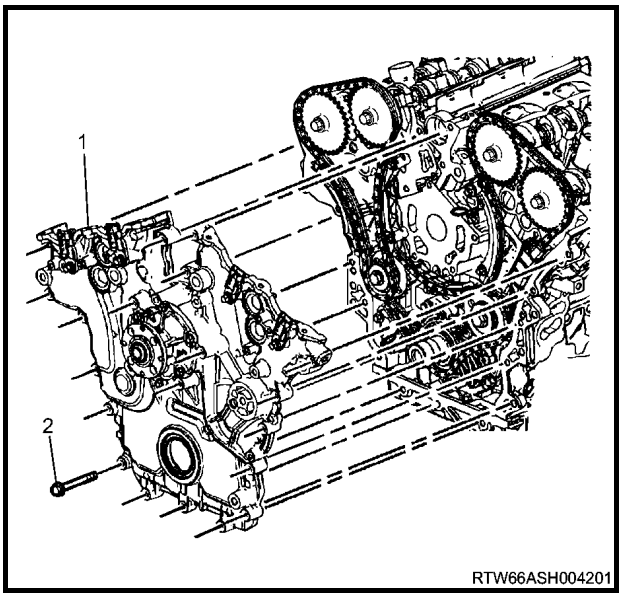


Figure 6A1 – 83

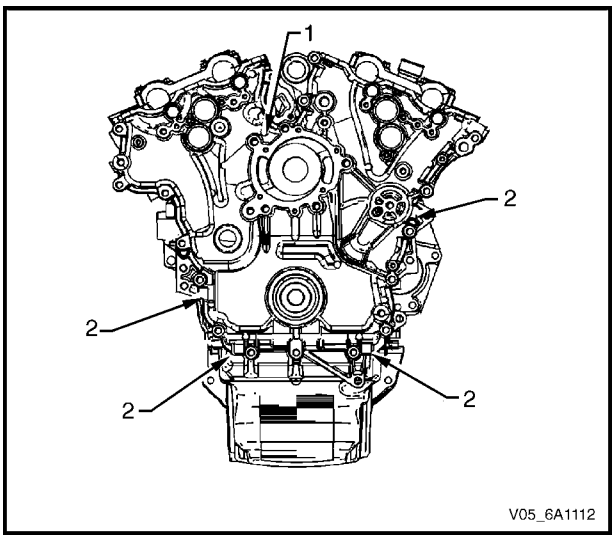


Figure 6A1 – 84

Right-hand Secondary Timing Chain Components – Excluding MY06 Update

1 Install the primary timing chain components, refer to Primary Timing chain Components in this Section.

2 Using Tool No. EN46111 (1), rotate the crankshaft in a clockwise direction until the crankshaft sprocket timing mark (2) is aligned with the indexing mark (3) on the oil pump housing.

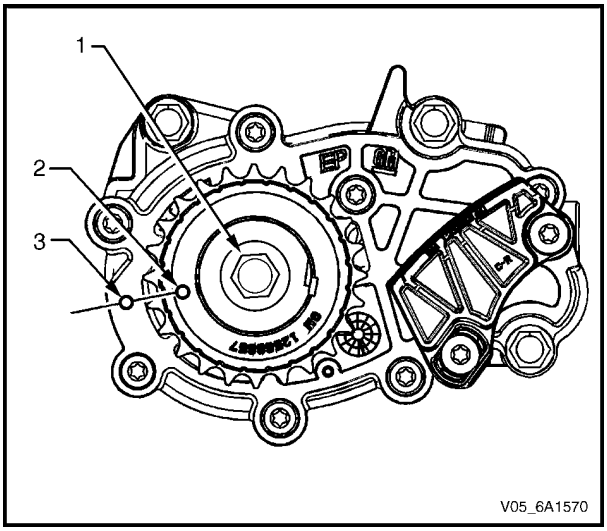


Figure 6A1 – 240

CAUTION

In order to install Tool No. EN 46105 onto the camshafts, rotate the camshafts. There should be no need to rotate the camshaft more than 45 degrees.

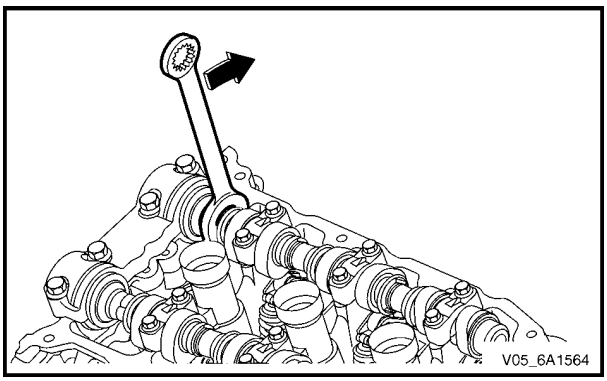


Figure 6A1 – 241

3 Install Tool No. EN 46105–1 (1) onto the rear of the right-hand cylinder head camshafts (2).

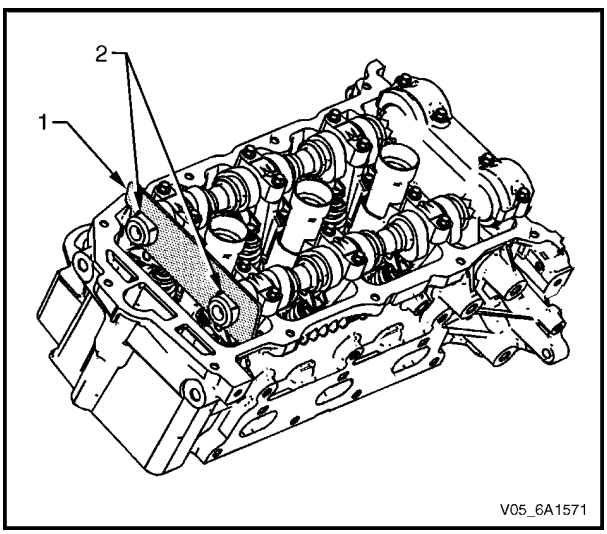


Figure 6A1 – 242

Valve Guide Measurement

1 Measure the valve stem (1) to-guide (2) clearance. Excessive valve stem-to-guide clearance may cause excessive oil consumption and may also cause a valve to break. Insufficient clearance will result in noisy and sticky functioning of the valve and will disturb the engine assembly smoothness.

2 Clamp a dial indicator to the cylinder head at the camshaft cover rail.

3 Locate the dial indicator so the movement of the valve stem from side to side, crossways to the cylinder head, will cause a direct movement of the indicator stem. The dial indicator stem must contact the side of the valve stem just above the valve guide.

4 Drop the valve head about 0.064 mm off the valve seat.

5 Use light pressure when moving the valve stem from side to side to obtain a clearance reading, refer to 5 Specifications.

- If the clearance for the valve is greater than specified and a new standard diameter valve stem will not bring the clearance within specifications, the valve guide may be oversized by 0.075 mm using the valve guide reamer, Tool No. J 42096 or by 0.375 mm using the valve guide reamer, Tool No. EN-46120. Two sizes of oversized valve stems are available for service.
- Valve guide wear at the bottom 10 mm of the valve guide is not significant enough to affect normal operation.
- If over sizing the guide does not bring the clearance within specifications, replace the cylinder head.

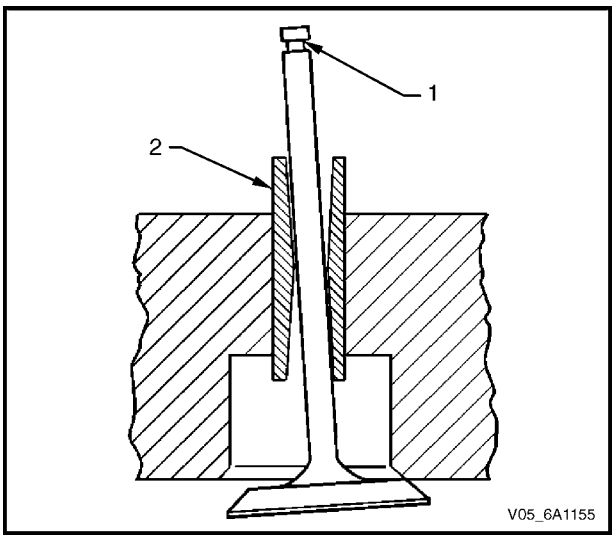


Figure 6A1 – 379

Crankshaft and Main Bearing Visual Inspection

1 Perform the following visual inspections:

- Inspect the crankshaft balancer bolt hole (1) for thread damage.
- Inspect the crankshaft balancer mounting area (2) for damage.
- Inspect the crankshaft sprocket pin hole (3) for damage.
- Inspect the oil pump drive flats (4) for damage.
- Inspect the crankshaft main journals (5) for damage.
- Inspect the crankshaft connecting rod journals (6) for damage.
- Inspect the crankshaft oil passages (7) for obstructions.
- Inspect the crankshaft main bearing thrust wall surfaces (8) for damage.
- Inspect the crankshaft counterweights (9) for damage.
- Inspect the crankshaft reluctor ring teeth (10) for damage.
- Inspect the crankshaft rear main oil seal surface (11) for damage.
- Inspect the crankshaft engine flexplate mounting surface (12) for damage.
- Inspect the crankshaft pilot hole (13) for damage.
- Inspect the crankshaft engine flywheel bolt holes (14) for thread damage.

2 Repair or replace the crankshaft as required.

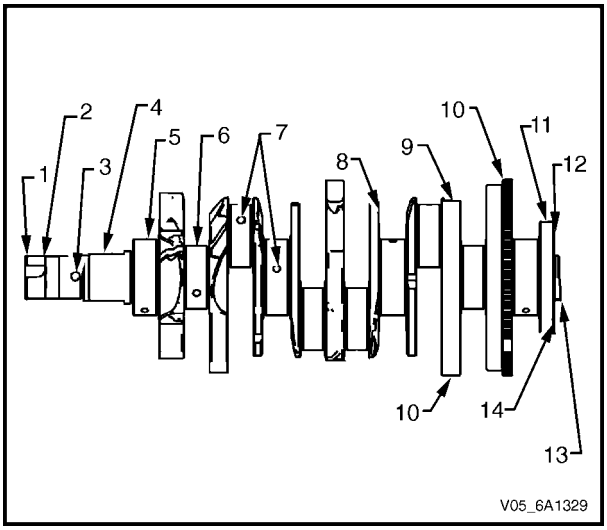


Figure 6A1 – 506

Oil Pan Front

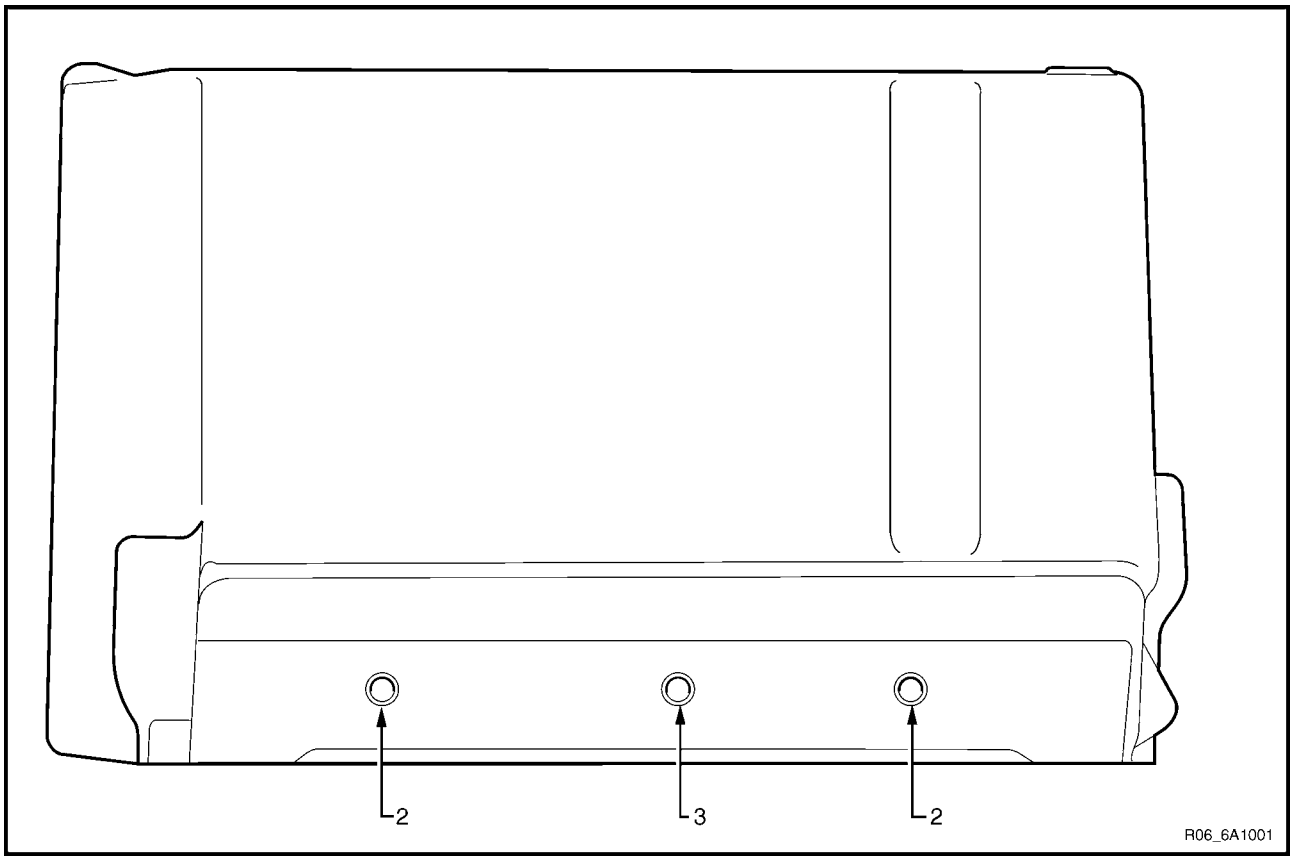


Figure 6A1 – 626

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	Thread Size	Drill	Counter-bore	Tap	Driver	Insert	Drill	Tap
2	M8 x 1.25	206	207	208	209	210	28.5	23.0
3	M8 x 1.25	610	n/a	208	209	620	37.5	32.0

6 Remove the two coolant outlet housing attaching bolts (1), and remove coolant outlet housing (2).

7 Remove and discard coolant outlet housing O-ring (3) and seal (4).

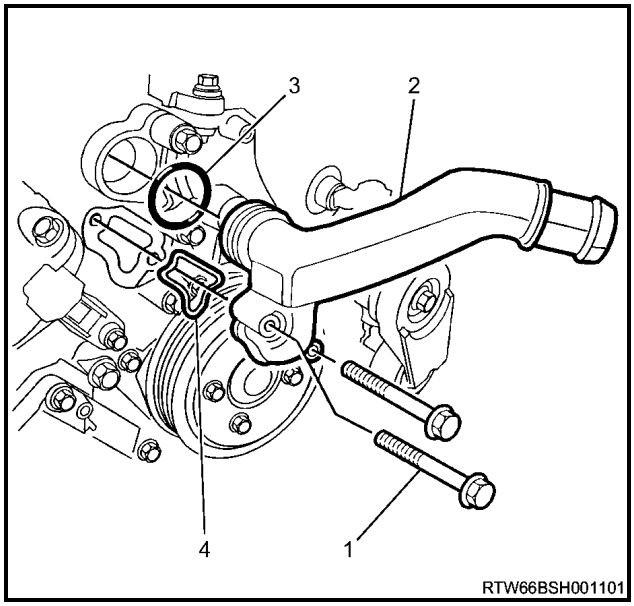


Figure 6B1 – 51

Reinstall

1 Ensure that the coolant outlet housing and front outlet mating surfaces are clean and dry.

2 Install new O-ring and seal to coolant outlet housing.

3 Install coolant outlet housing and attaching bolts. Tighten all bolts to the correct torque specification.

Coolant outlet housing to front outlet bolt torque specification.....10 N.m

WARNING

Always wear protective safety glasses when working with spring type hose clamps. Failure to do so could result in eye injury.

4 Connect the upper radiator hose and clamp to the coolant outlet housing connection.

5 Close the radiator drain tap on the lower RHS of the radiator and remove the piece of rubber tubing to the tap outlet.

6 Reinstall the intake manifold assembly. Refer to 6A1 Engine Mechanical.

7 Refill cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

8 Check for coolant leaks. Refer to 3.7 Pressure Testing in this Section.

9 Reconnect battery ground lead. Refer to 8A – Electrical Body & Chassis.

3.12 Coolant Inlet Pipe

Remove

WARNING

Refer to 3.1 Service Notes in this Section, for important safety items.

1 Allow engine to cool to ambient temperature (less than 50° C), and then remove the coolant filler cap (located at the front left-hand side of the engine).

6 Torque Wrench Specifications

Fuel Tank Mounting Strap Bolts	68.0 Nm
Evaporative Emission Control Canister Mounting Nut	2.0 – 5.0 Nm
Fuel Line Securing Nut	8.0 – 12.0 Nm
Stone Guard Securing Bolt	5.0 – 7.0 Nm

- there is no Current DTC but a History DTC is stored.

Diagnostic Table

Checks	Actions

Preliminary	• Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section.
	• Gather information from the customer regarding the conditions that trigger the intermittent fault such as:
	  • At what engine or ambient temperature range does the fault occur?
	  • Does the fault occur when operating aftermarket electrical equipment inside the vehicle?
	  • Does the fault occur on rough roads or in wet road conditions?
	• If the intermittent fault is a start and then stall condition, check the immobiliser system. Refer to 11A Immobiliser.

Tech 2 Tests	The following are lists of Tech 2 diagnostic tests that may be used to diagnose intermittent faults: • Wriggle test the suspected wiring harness and connectors while observing Tech 2 operating parameters. If Tech 2 read-out fluctuates during this procedure, check the tested wiring harness circuit for a loose connection. • Observe the freeze frame / failure records for the suspected history DTC and then operate the vehicle in the conditions that triggers the intermittent fault while an assistant observes the suspected Tech 2 operating parameter data. • Capture and store data in the snapshot mode when the fault occurs. The stored data may be played back at a slower rate to aid diagnostics. Refer to Tech 2 User Instructions for further information on the Snapshot function. • Compare the engine operating parameters of the engine being diagnosed to the engine operating parameters of a known good engine.

Malfunction Indicator Lamp	The following conditions may cause an intermittent Malfunction Indicator Lamp fault with no DTC listed:
	• Electromagnetic interference (EMI) caused by a faulty relay, ECM controlled solenoid, switch or other external source.
	• Incorrect installation of aftermarket electrical equipment such as the following:
	  • mobile phones,
	  • lights, or
	  • radio equipment.
	• ECM grounds are loose.

The pumping current required to maintain the HO2S 1 signal circuit voltage to about 450 mV is proportional to the level of oxygen concentration in the exhaust gas.

- If the air/fuel mixture in the exhaust is balanced (lambda = 1), the oxygen pumping cell current is zero.
- If the exhaust gas in the HO2S 1 diffusion gap is lean, the ECM applies a positive current to the oxygen pumping cell to discharge oxygen from the diffusion gap.
- If the exhaust gas in the HO2S 1 diffusion gap is rich, the ECM applies a negative current to the oxygen pumping cell to draw oxygen into the diffusion gap.

The ECM monitors and evaluates the oxygen pumping current to determine the level of oxygen concentration in the exhaust.

An HO2S reference circuit DTC sets if the ECM detects the HO2S signal voltage is outside the predetermined range for a specified period.

Conditions for Running the DTC

DTC P0130, P0131, P0132, P0137, P0138, P0140, P0150, P0151 or P0152

Run continuously once the following conditions are met:

- The ignition voltage is 10.0 – 16.0 V.
- The engine is running.

DTC P0135 and P0155

Condition 1

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051, P0052, P0101, P103, P0121, P0122, P0123, P0131, P0132, P0151, P0152, P0221, P0222, P0223, P0335, P0336, P0338, P2237, P2240, P2243, P2247, P2251 and P2254 ran and passed.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is at operating temperature.
- The ECM internal sensing element resistance test is enabled.

Condition 2

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051, P0052, P0101, P103, P0121, P0122, P0123, P0131, P0132, P0151, P0152, P0221, P0222, P0223, P0335, P0336, P0338, P2237, P2240, P2243, P2247, P2251 and P2254 ran and passed.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is at operating temperature.
- The ECM internal sensing element resistance test is enabled.
- The fuel injectors are not disabled.
- If the engine is operating and the ignition is turned off, the engine must be off for at least 5 minutes for this DTC to run.

DTC P0137 and P0157

Run continuously once the following conditions are met:

- DTCs P0117, P0118, P0125 and P0128 ran and passed.
- The engine is operating for longer than two minutes.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is at operating temperature.

- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 Test signal circuit of the EOP sensor. This circuit should display a voltage within the specified range.

5 Measures the integrity of the EOP sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

P0521 to P0523 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0521, P0522 or P0523 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the EOP sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the EOP sensor 5 V reference circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 4	Go to Step 6
4	1 Connect a 3 A fused jumper wire between the EOP sensor 5 V reference circuit and the EOP sensor signal circuit. 2 Switch on the ignition with the engine not running. 3 Using Tech 2, observe the EOP sensor parameter. Does Tech 2 display 780 – 980 kPa?	Go to Step 5	Go to Step 7
5	1 Switch off the ignition. 2 Remove ECM / TCM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the EOP sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 9	Go to Step 8
6	Test the EOP sensor 5 V reference circuit for an open, short to ground or high resistance fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
7	Test EOP sensor signal circuit for short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10

DTC P2196 or P2198 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Allow the engine to reach operating temperature. 2 Operate the vehicle within the parameters specified in Conditions for Running the DTC. 3 Observe the diagnostic trouble code (DTC) information, using Tech 2. Did DTC P2196 or DTC P2198 fail this ignition?	—	Go to Step 4	Go to Step 3
3	1 Observe the Freeze Frame and / or the Failure records data for this DTC. 2 Turn the ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame and / or the Failure records data. Does the DTC fail this ignition cycle?	—	Go to Step 4	Refer to Additional Information in this DTC.
4	Is DTC P0041, P0137, P0138, P0140, P0157, P0158, or P0160 also set?	—	Go to the appropriate DTC Table in this Section	Go to Step 5
5	1 Operate the engine above 1,200 RPM for 30 seconds. 2 Observe the appropriate rear HO2S voltage, using Tech 2. Is the voltage less than the specified value?	1,050 mV	Go to Step 8	Go to Step 6
6	1 Ignition OFF. 2 Disconnect the appropriate rear heated oxygen sensor (HO2S). 3 Ignition ON, engine OFF. 4 Observe the appropriate rear HO2S voltage parameter with Tech 2. Is the voltage within the specified range?	350 – 550 mV	Go to Step 12	Go to Step 7
7	1 Test the appropriate rear HO2S signal circuit for a short to voltage. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
8	1 Shake the related HO2S harnesses for the front sensor between the HO2S harness connector and the engine control module (ECM) while monitoring the appropriate HO2S lambda parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 9

CAUTION

Clean the area around the ECT before removal to avoid debris from entering the engine.

5 Remove the ECT sensor (1).

NOTE

If coolant leaks from the cylinder head as the sensor is removed, screw the sensor back into the cylinder head and drain more coolant from the cooling system.

6 If required, test the ECT sensor, refer to the Test in this Section.

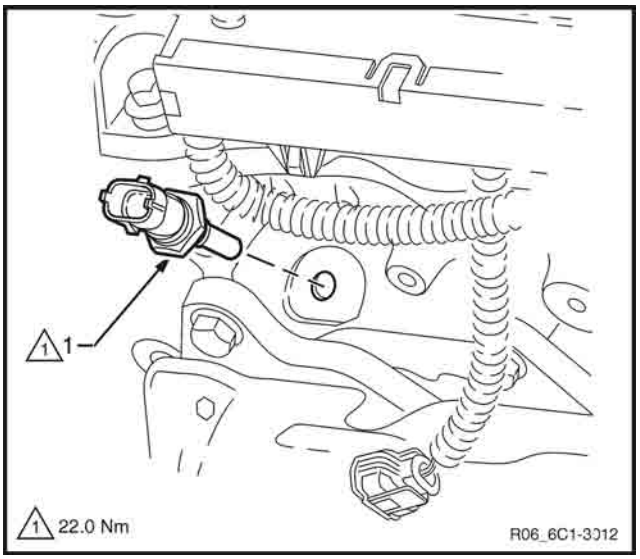


Figure 6C1-3 – 13

Test

CAUTION

To prevent component damage, use connector test adaptor kit J 35616-A.

Resistance Check

1 Suspend the engine coolant temperature (ECT) sensor and a suitable thermometer in a container of 50/50 DEX-COOL® long life coolant or equivalent and water.

NOTE

Neither the ECT sensor or thermometer should rest on the bottom of the container due to an uneven concentration of heat at this point when the container is heated.

2 Connect a digital ohmmeter using connector test adaptor kit J 35616-A to the ECT sensor.

3 Measure the resistance across terminals 1 and 2.

4 Whilst heating the container, observe the resistance values as the temperature increases and compare the temperature / resistance change to the specifications.

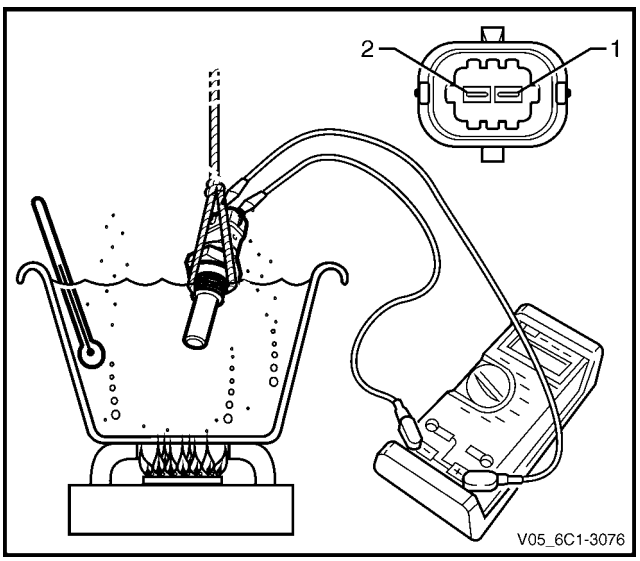


Figure 6C1-3 – 14

8 Connect the positive lead of a multimeter set to measure voltage to the battery negative post.

9 Connect the negative lead of the multimeter to the generator housing.

9 Increase the engine speed to approximately 2500 r.p.m.

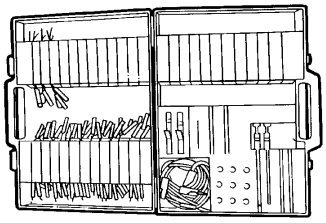
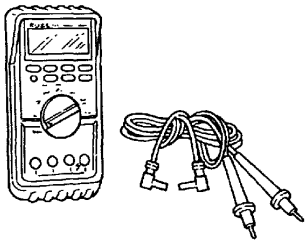
10 Record the voltage reading.

11 Reduce the engine speed to idle.

12 Check the two readings. If the readings exceed 0.3 V, there is a high resistance in the charging circuit.

13 Trace the cause and correct the problem, refer to 8A Electrical Body and Chassis.

7 Special Tools

Tool Number	Illustration	Description	Tool Classification
KM609		**Connector Test Adaptor Kit** Used when carrying out electrical diagnostic circuit checks. Previously released.	Desirable
J39200		**Digital Multimeter** Must have at least 10 MΩ input impedance and be capable of reading frequencies. Previously released.	Available

Conditions for Setting the DTC

The PIM detects the power mode switch is activated for 120 seconds or more.

Action Taken When the DTC Sets

When the DTC sets, there is no warning lamp displayed on the instrument cluster.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

Test Description

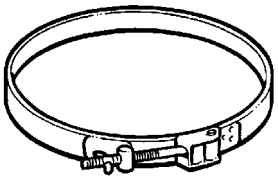
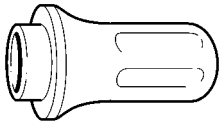
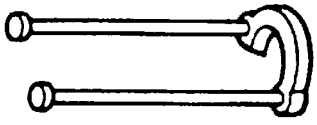
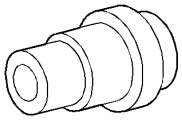
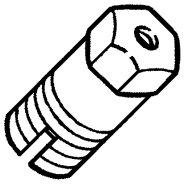
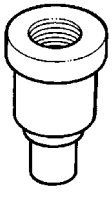
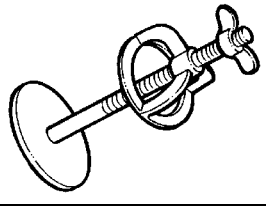
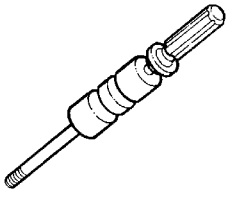
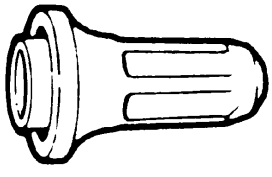
The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the power mode switch using Tech 2.

6 This step tests the power mode switch signal circuit.

DTC B0980 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	Using Tech 2, view the power mode switch status parameter in the PIM data list. Does Tech 2 display **Power**?	Go to Step 4	Go to Step 3
3	1 Switch off the ignition for 10 seconds. 2 Operate the vehicle within the conditions for setting DTC B0980. 3 Using Tech 2, select the DTC display function. Does DTC B0980 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this Section
4	1 Disconnect connector S22 – X1 from the power mode switch. 2 Using Tech 2, view the power mode switch status parameter in the PIM data list. Does Tech 2 display **Power**?	Go to Step 6	Go to Step 5
5	Replace the power mode switch. Refer to 10 Cab. Has the repair been completed?	Go to Step 8	—
6	Test the power mode switch ground signal circuit for a short to ground. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 8	Go to Step 7
7	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 8	—
8	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC B0980 fail this ignition cycle?	Go to Step 2	Go to Step 9

J21368		**Oil Pump Alignment Band** Used to align the two oil pump sections before tightening the securing bolts. Previously released	Unique
J21426		**Rear Seal Installer** Used to install the extension housing oil seal. Previously released	Unique
J21427-01		**Puller Adaptor** Used with J8433 to remove the output speed sensor ring from the main shaft. Previously released	Unique
J21465-2		**Installer** Used with driver J8092 to install the front stator shaft bush. Previously released	Unique
J21465-15		**Remover** Used in conjunction with slide hammer J6125-1B to remove the stator shaft front bushing. Previously released	Unique
J23062-14		**Bush Remover** Used in conjunction with driver handle J8092. Previously released	Unique
J23327-1		**Clutch Spring Compressor** Needed to compress the clutch, before dismantling. Plate J42628 is also required. Previously released	Unique
J23907		**Slide Hammer** Used with J29369-2 to remove the reaction carrier shaft bushes. Previously released	Unique
J25016		**Oil Pump Seal Installer** Used to install the oil pump oil seal. Previously released	Unique

Step	Action	Yes	No
6	1 Disconnect connector C-96 from the TCM. 2 Test circuits speed sensor circuits (between C-96 pin 16 and E-44 pin 2; C-96 pin 41 and E-44 pin 1) for the following conditions: • Short to ground, • Short to battery, • Open circuit, and • Short together. Did you find and correct the condition?	Go to Step 9	Go to Step 8
7	Replace the vehicle speed sensor, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Service. Did you complete the replacement?	Go to Step 9	—
8	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Service. Did you complete the replacement?	Go to Step 9	—
9	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Data Display / Transmission Data.** 4 Operate the vehicle ensuring the transmission output speed drop is less than 500 r.p.m. for 2 seconds and output speed is greater than 500 r.p.m. 5 On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Has DTC P0723 set?	Go to Step 2	Go to Step 10
10	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.17 DTC P0724 – Brake Switch Circuit Low Input (Stuck Off)

DTC Description

This diagnostic procedure supports DTC P0724 Brake Switch Circuit Low Voltage.

Circuit Description

The transmission control module receives a direct input from the stop lamp switch assembly. When the brake pedal is pressed, 12 V is supplied to the TCM through connector C-96 pin 42.

When the TCM detects an open or short to ground on the stop lamp signal circuit during stopping then DTC P0724 sets. DTC P0724 is a type C DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Step	Action	Yes	No
20	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.35 DTC P2769 – Torque Converter Clutch Enable Solenoid Control Circuit Low Voltage

DTC Description

This diagnostic procedure supports DTC P2769 Torque Converter Clutch (TCC) Enable Solenoid Control Circuit Low Voltage.

Circuit Description

The torque converter clutch (TCC) solenoid valve is an electrical device that is used with the torque converter clutch pulse width modulation (TCC PWM) solenoid valve to control TCC apply and release. The TCC solenoid valve attaches to the transmission case assembly extending into the pump cover. The TCC solenoid valve receives voltage through ignition voltage circuit. The transmission control module (TCM) controls the solenoid by providing the ground path on the TCC solenoid valve control circuit. The TCM monitors the throttle position (TP) voltage, the vehicle speed and other inputs to determine when to energize the TCC solenoid valve.

NOTE

The TCC solenoid valve is part of the control valve body wiring harness. To replace the solenoid valve, the control valve body harness must be replaced.

When the TCM detects a continuous open or short to ground in the TCC solenoid valve control circuit, then DTC P2769 sets. DTC P2769 is a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The system voltage is 8 – 18 V.
- The engine speed is 500 r.p.m. for 5 seconds.

Conditions for Setting the DTC

DTC P2769 sets when either of the following conditions occurs for 5 seconds:

- The TCM detects an open in the TCC solenoid valve circuit when the TCC is commanded on.
- The TCM detects a short to ground in the TCC shift solenoid valve circuit when the TCC is commanded on.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits TCC engagement.
- The TCM inhibits 4th gear if in hot mode.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.

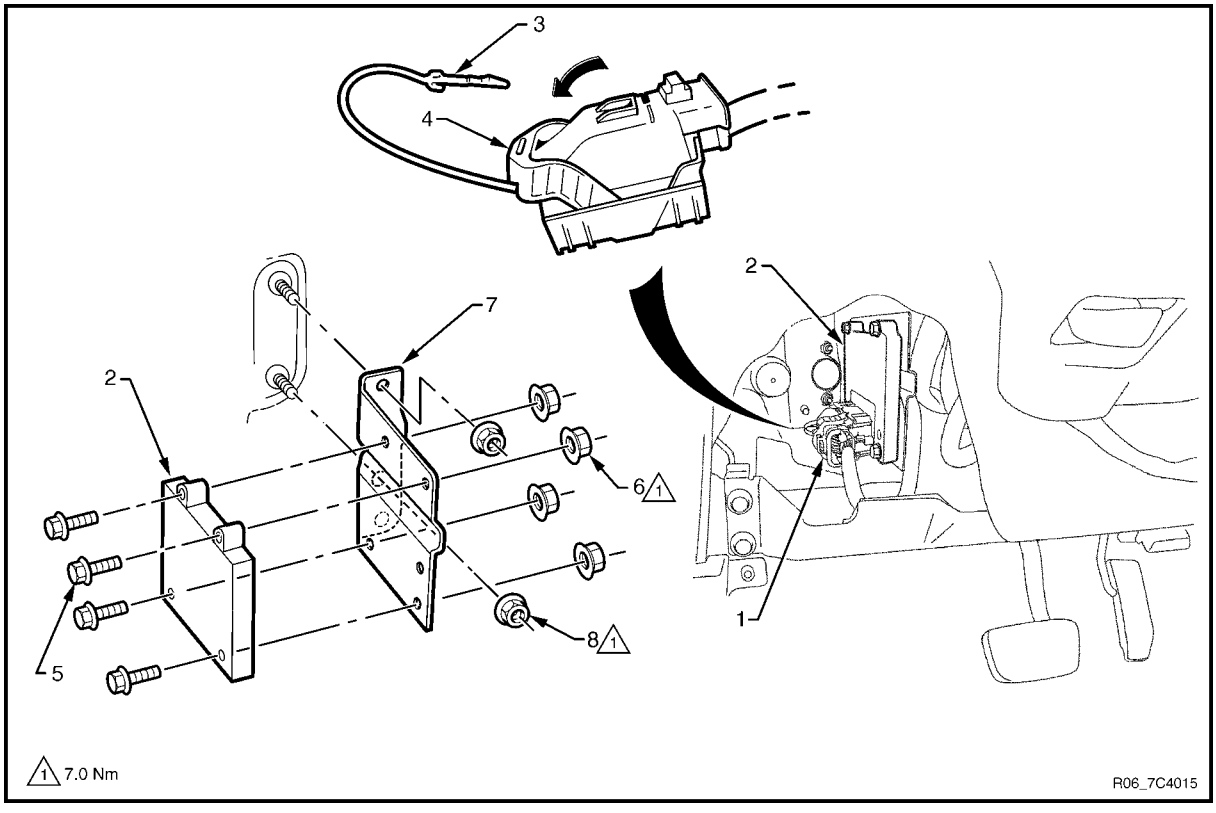


Figure 7C4 – 63

Reinstall

Reinstallation of the transmission control module (TCM) is the reverse of the removal procedure, noting the following:

1 If a new TCM is installed it must be programmed, refer to TCM Programming Procedure in this Section.

2 If required, install the mounting bracket to the firewall and tighten the nuts to the correct torque specification.

TCM bracket attaching nut torque specification .....7.0 Nm

3 Install the TCM onto the bracket and tighten the bolts and nuts to the correct torque specification.

TCM attaching bolt and nut torque specification .....7.0 Nm

4 Lock the connector securely to the TCM by with the locking lever and the securing pin.

5 Using Tech 2, clear any TCM diagnostic trouble code (DTC) that may have set during the removal procedure, refer to 0C Tech 2.

TCM Programming Procedure

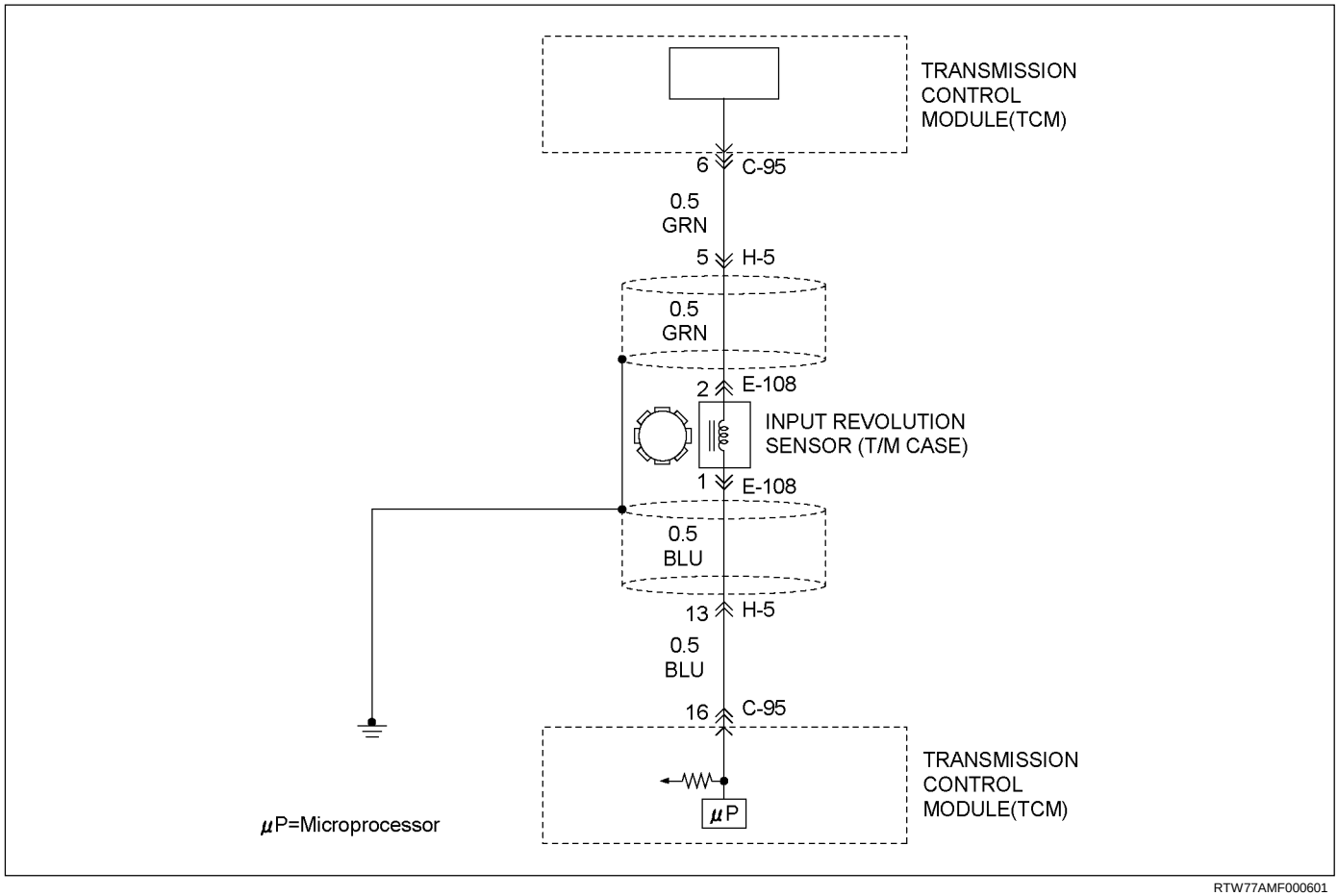
1 The transmission control module (TCM) must be programmed with the correct software/calibration. Ensure the following conditions exist before starting the TCM programming procedure:

- a The battery is fully charged.
- b The Tech 2 cable connection at the data link connector (DLC) is secure.
- c The ignition switch is in the ON position.

2 Program the TCM using the latest software for the vehicle, refer to the following:

- a Current release of TIS for the latest software and
- b 0C Tech 2 for TCM service programming.

DTC P0717 (Flash Code 14)



RTW77AMF000601

Circuit Description

Input revolution information is provided to TCM by the input revolution sensor. This sensor is located in the transmission case.

The input revolution sensor is an electromagnetic pulse pickup type that generates a speed signal according to the revolution of the transmission OD direct clutch drum. As a result, the sensor sends a sine wave signal (AC) to the TCM, which converts this sine wave signal (pulse voltage) to a RPM signal.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution sensor is not detecting failure or not deciding failure.
- The engine revolution is more than 550rpm.

(2) Not emergency mode.

(3) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication Service is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

All of the following conditions are met.

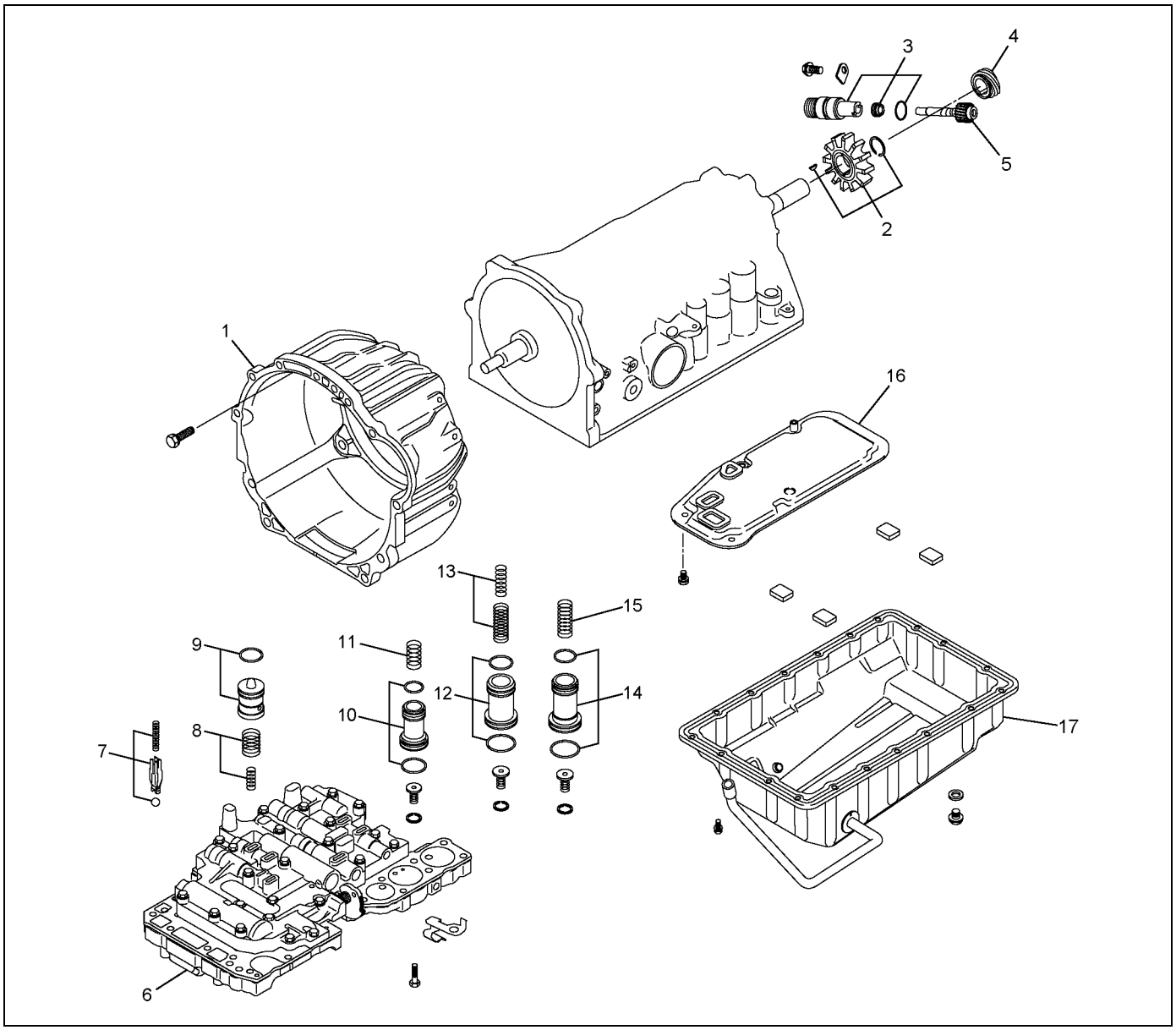
(1) 25 seconds or more passed after changing to the except P/R/N from P/R/N.
If the following condition is met when 25 seconds or more passed after changing, it is considered that 25 seconds or more passed.

- The oil temperature sensor is not detecting failure or not deciding failure, and also oil temperature is more than 20°C (68°F).

Step	Action	Value(s)	YES	NO
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 10*
10	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

Major Components (2)

Major Componets (2) and Associated Parts

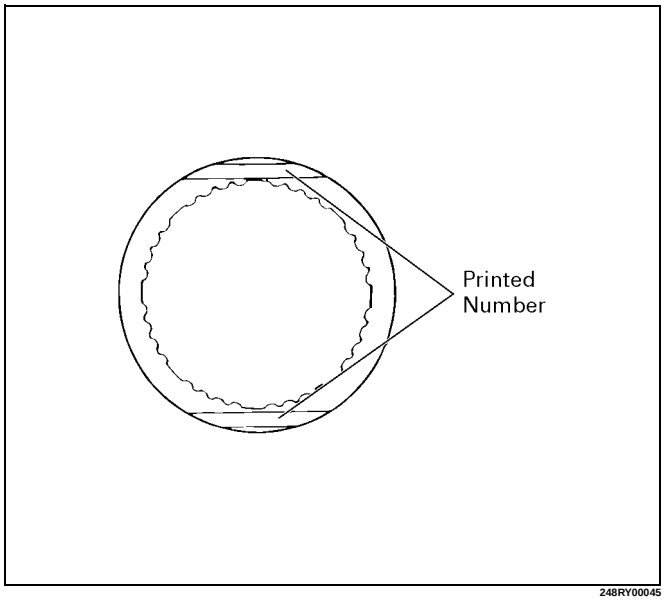


RTW77ALF001701

Legend

(1) Converter housing
(2) Snap ring, rotor, key
(3) Speedometer shaft sleeve
(4) Speedometer drive gear
(5) Speedometer driven gear
(6) Valve body
(7) Check valve, spring, ball
(8) Spring
(9) Accumulator piston (C–0), O-ring
(10) Accumulator piston (B–0), O-ring
(11) Spring
(12) Accumulator piston (C–2), O-ring
(13) Spring
(14) Accumulator piston (B–2), O-ring
(15) Spring
(16) Oil strainer assembly
(17) Oil pan

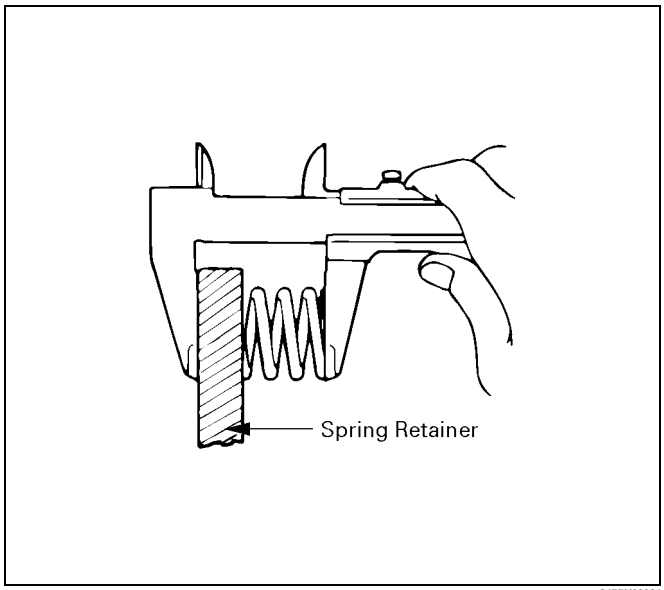
- Before assembling new discs, soak them in ATF for at least fifteen minutes.



248RY00045

4. Check piston return spring.
   Using calipers, measure the free length of the return spring.

Standard length: 19.47mm (0.7665in)

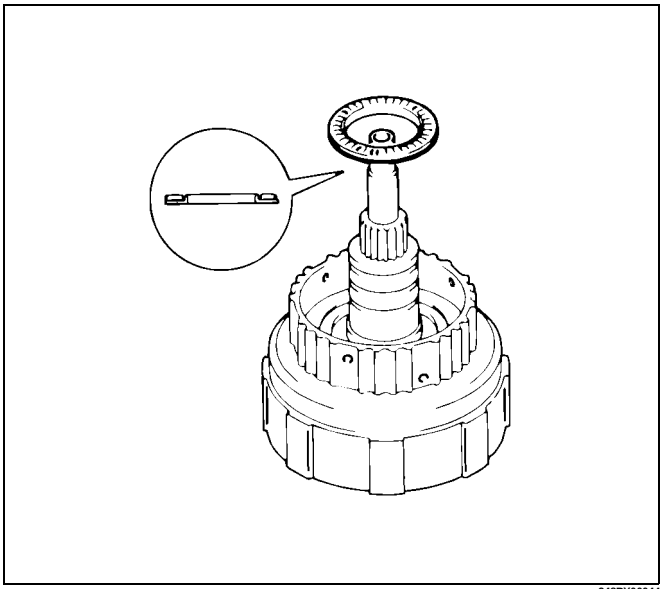


247RY00034

Reassembly

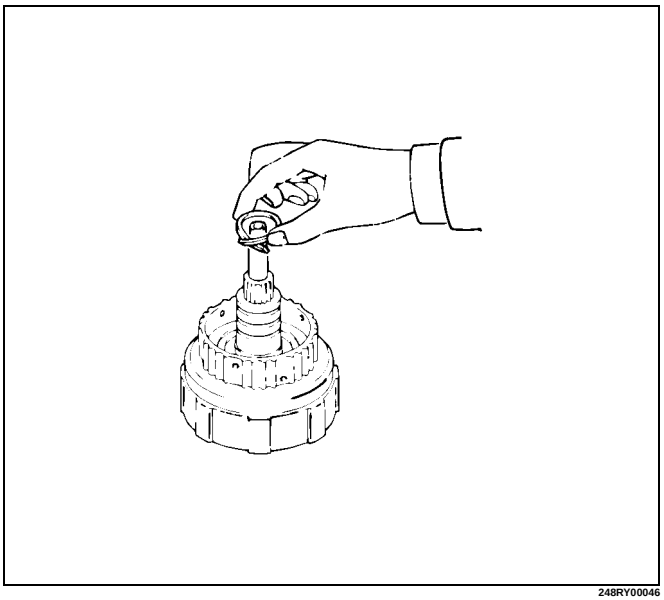
1. Coat the assembled thrust bearing and race with petroleum jelly and install it onto the forward clutch drum, with the race side facing downward.
   Bearing and race (Reference)

Inside diameter	33.7mm (1.327in)
Outside diameter	47.8mm (1.882in)


248RY00044

2. Coat the three oil rings with ATF.
   Contract the oil seal rings as shown, and install three oil seal rings onto the forward clutch drum.

NOTE: Do not spread the ring ends more than necessary.


248RY00046

TURBINE SENSOR

- The turbine sensor is a hall element. It is installed to the front of the transmission case. The turbine sensor converts the rotations of the reverse & high clutch drum fitted with the input shaft by spline to pulse signal and sends the signal to the TCM.
- One turn of the reverse & high clutch drum generates 32-pulse signals, which are sent to the TCM.

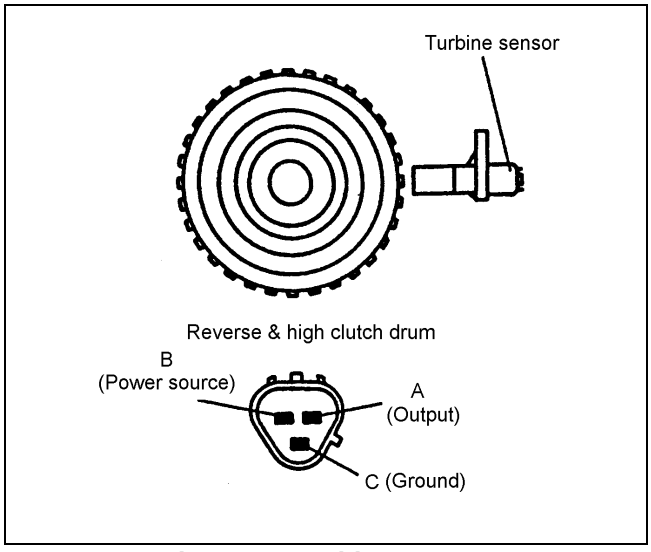


Figure 38. Turbine Sensor

SPEED SENSOR

- The speed sensor is a hall element. It is installed to the rear of the transmission case. The speed sensor converts the rotations of the parking gear, fitted with the output shaft by spline, to a pulse signal and sends the signal to the TCM.
- One turn of the parking gear generates 16-pulse signals, which are sent to the TCM.

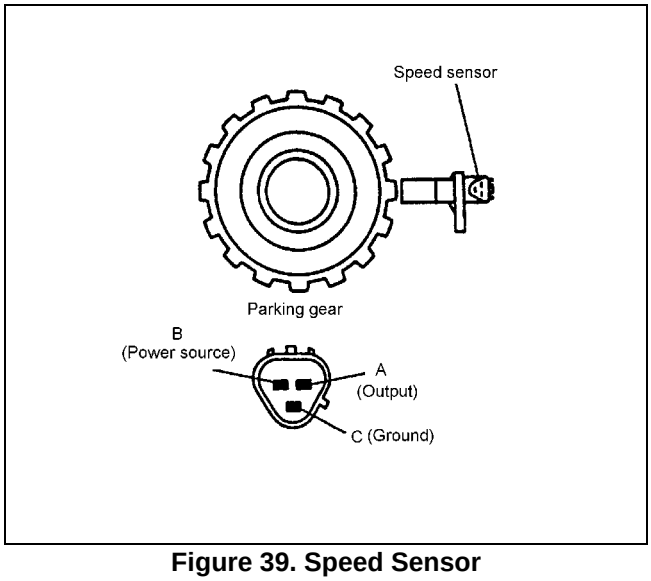


Figure 39. Speed Sensor

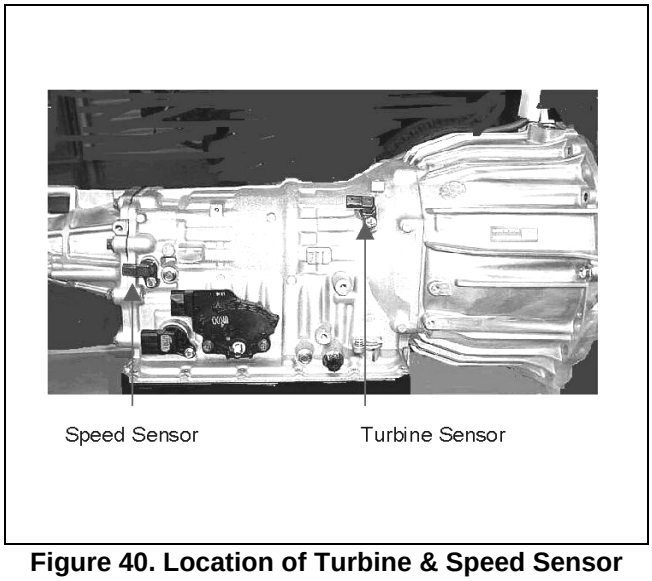


Figure 40. Location of Turbine & Speed Sensor

Step	Action	Value(s)	Yes	No
5	Connect a test lamp between the ignition voltage feed circuit to the TR switch (pin 3 of E-51) and a known good ground. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 6
6	Repair the open circuit or high resistance between the Back Up (15A) fuse and the TR switch (pin 3 of E-51). Check the Back Up (15A) fuse first. Did you complete the repair?	—	Go to Step 16	—
7	Observe the ALL TR Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the TR switch harness connector. • P range: Between 3 and 2 of E-51 • R range: Between 3 and 4 of E-51 • N range: Between 3 and 8 of E-51 • D range: Between 3 and 5 of E-51 • 3 range: Between 3 and 1 of E-51 • 2 range: Between 3 and 9 of E-51 • L range: Between 3 and 6 of E-51 Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 8	Go to Step 9
8	Does the scan tool indicate multiple TR switch ON at Step 7?	—	Go to Step 10	Go to Step 12
9	1. Test the TR switch signal circuit (which ever parameter reading did not ON at Step 7) between the TCM and the TR switch for an open circuit or high resistance. • P range: Between 2 of C-94 and 2 of E-51 • R range: Between 19 of C-95 and 4 of E-51 • N range: Between 10 of C-95 and 8 of E-51 • D range: Between 11 of C-95 and 5 of E-51 • 3 range: Between 17 of C-94 and 1 of E-51 • 2 range: Between 2 of C-95 and 9 of E-51 • L range: Between 21 of C-95 and 6 of E-51 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13

Diagnostic Category		Category No.
Faulty Operation in Stopping	Vehicle moves in P range or parking is not disengaged in other than P range	G1
	Large creeping force	G2
	Small creeping force	G3
	Large noise during idle with vehicle stop	G4
Faulty Lock Up	Judder Occurs at Lock Up	H1
	Large Shock at Lock Up	H2
	Lock Up Point is High or Low	H3
No Lock Up	No Lock Up	I1
Transmission Fluid Leak	Transmission fluid leaks from breather	J1
	Transmission fluid leaks between engine and converter housing	J2
	Transmission fluid leaks between converter housing and transmission case	J3
	Transmission fluid leaks between transmission case and extension housing	J4
	Transmission fluid leaks from oil pan	J5
	Transmission fluid leaks from manual shaft oil seal	J6
	Transmission fluid leaks from oil cooler pipe joint	J7
Others	Transmission overheat	Z1
	Mode lamp (power drive or 3rd start) does not turn On	Z2
	Mode lamp (power drive or 3rd start) does not turn Off	Z3
	A/T oil temperature lamp turns On	Z4
	Selector lever feeling is faulty	Z5
	Poor fuel consumption	Z6
	Shift indicator is faulty	Z7
	Abnormal smell	Z8
	Transmission fluid quantity is low or high	Z9
	Transmission fluid quantity is low or high	Z10
	Abnormal transmission fluid pressure	Z11

Down Slope Mode

Condition for setting the down slope mode shift map;
All of the following conditions are met:

- Brake pedal switch is depressed
- Accelerator pedal is released
- Vehicle speed is more than 60 km/h (36 MPH)
- Increment of vehicle speed is more than 1 km/h (1 MPH) per second
- Selector lever is D or 3 range

Condition for canceling the down slope mode shift map;
Either of the following condition is met:

- Accelerator pedal is depressed
- Selector lever is other than D or 3 range

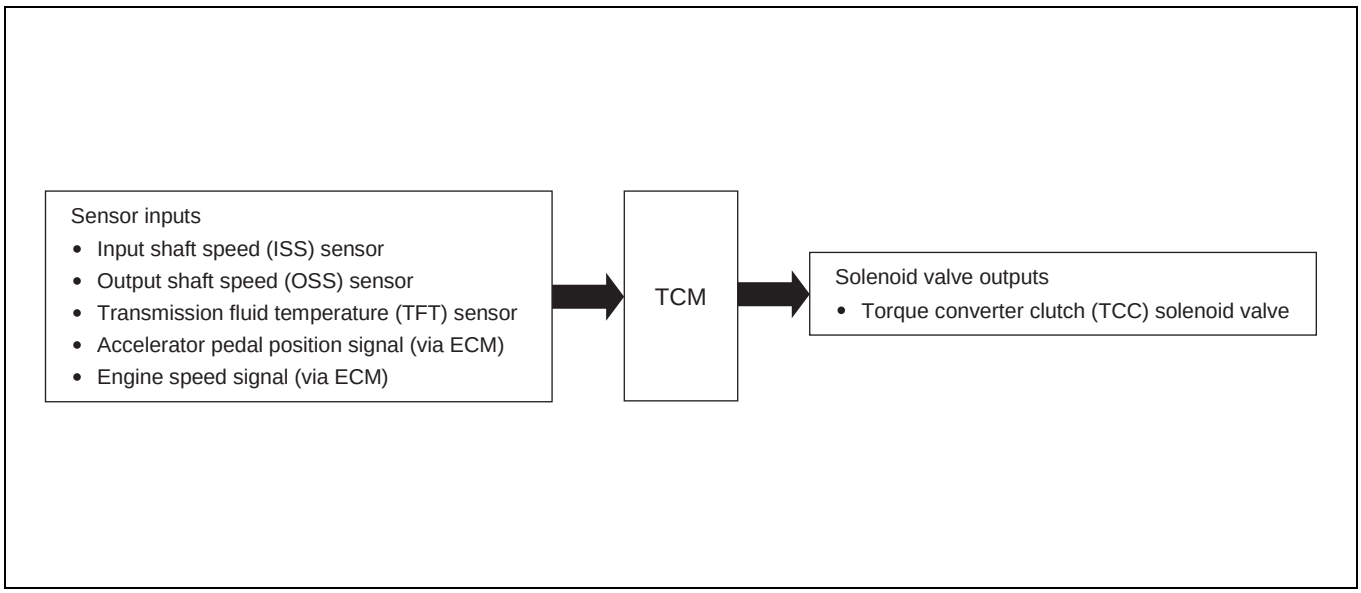
Power Drive Mode

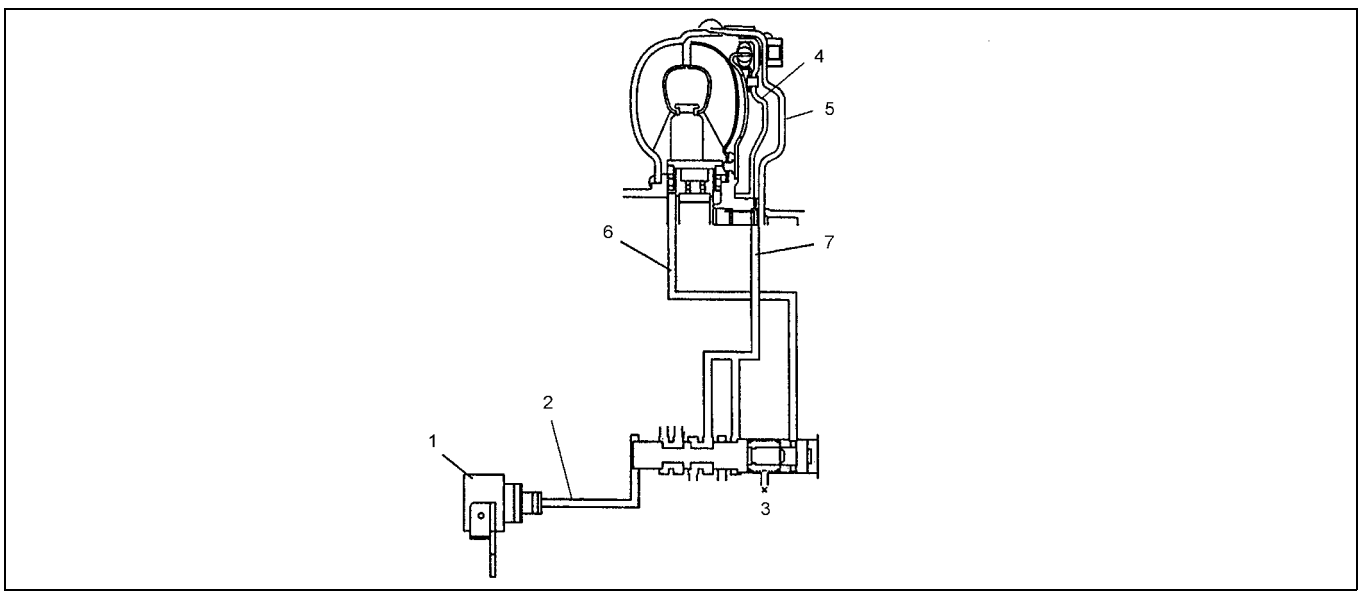
When the power drive switch is ON, the TCM switches shift map to the power drive mode map and performs gearshift control from 1st to 4th to gain more acceleration compared with normal mode.

Up Slope Mode

Up slope reasoning value is calculated from the averaged accelerator pedal angle and the averaged acceleration. Otherwise, up slope reasoning value is calculated from the vehicle speed. The TCM selects a up slope mode when the former is bigger than the latter.

Lock Up Control



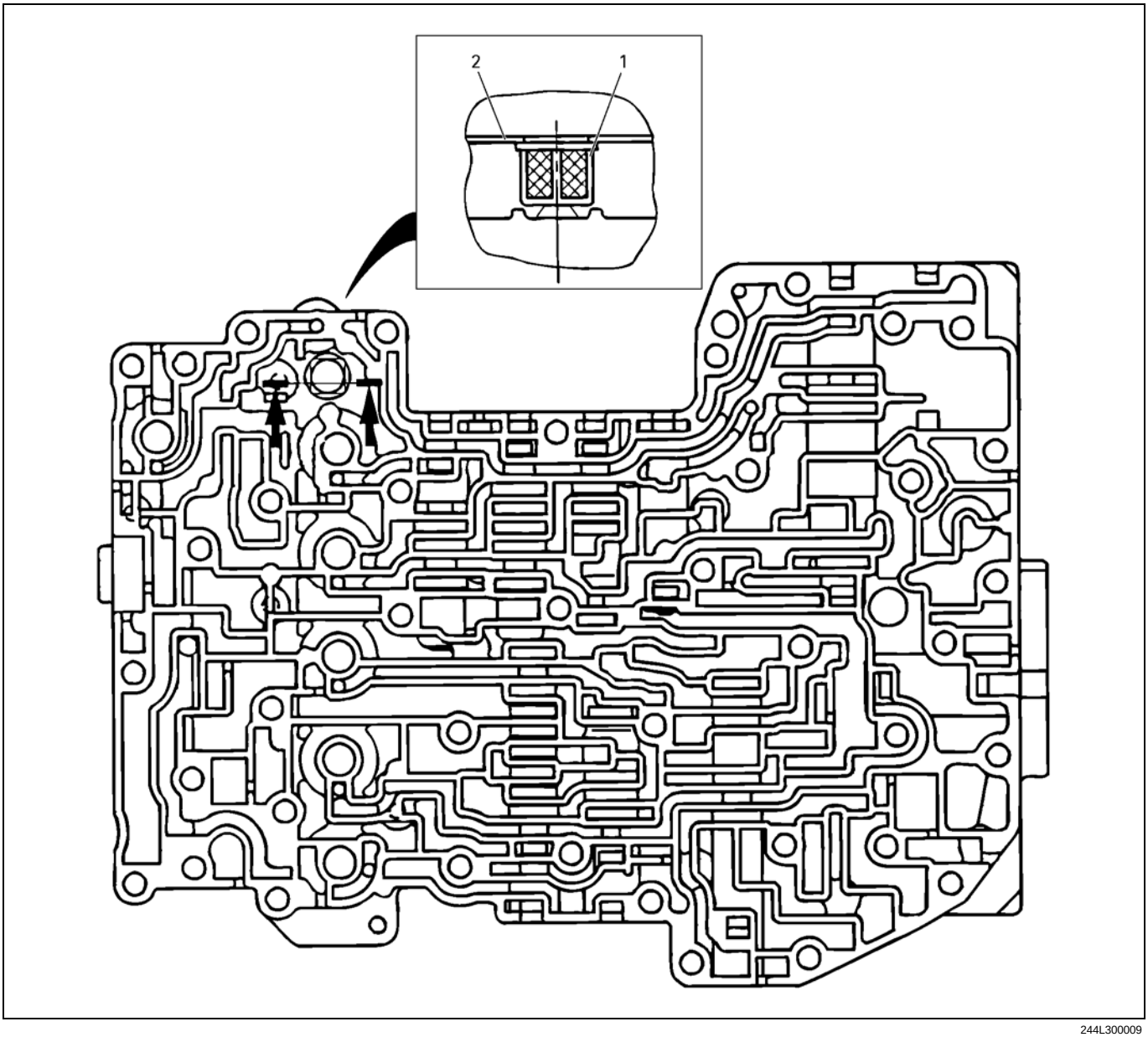


Legend

1. TCC solenoid valve
2. Solenoid fluid pressure
3. Lock up control spool valve
4. Torque converter clutch (TCC)
5. Torque converter front cover
6. TCC engagement fluid pressure
7. TCC disengagement fluid pressure

Disassembly steps

- Remove the oil filter from the control valve lower body.



244L300009

Legend

1. Oil filter
2. Separation plate

- Remove the control valve from the control valve lower body.

NOTE:
Place the control valve where it will not get mixed up with the other parts.

Inspection

Valve

Inspect each of the valves for denting and other damage.

Spring

Inspect each of the springs for wear and fatigue.

SERVICE STANDARD (Cont'd)

	Return spring	Number of coils		4.8	
		Outside diameter	mm (in)	11.2	(0.441)
		Free length	mm (in)	22.3	(0.878)
		Linear diameter	mm (in)	1.1	(0.043)
2-4 brake	Number of drives / driven plates			5/5	
	Drive plate facing thickness	Standard	mm (in)	2.0	(0.079)
		Limit	mm (in)	1.8	(0.071)
	Retaining plate and retaining plate clearance		mm (in)	1.0 – 1.4	(0.039 – 0.055)
	Available 2-4 brake retaining plate thickness		mm (in)	5.4	(0.213)
				5.6	(0.220)
				5.8	(0.228)
				6.0	(0.236)
				6.2	(0.244)
				6.4	(0.252)
	Return spring	Number of coils		10.2	
		Outside diameter	mm (in)	6.9	(0.272)
		Free length	mm (in)	22.5	(0.886)
		Linear diameter	mm (in)	1.1	(0.043)
Output shaft	Seal ring clearance		mm (in)	0.10 – 0.25	(0.0039 – 0.0098)
Total end play	Total end play		mm (in)	0.25 – 0.55	(0.0098 – 0.0217)
	Available oil pump bearing race thickness		mm (in)	1.4	(0.055)
				1.6	(0.063)
				1.8	(0.071)
				2.0	(0.079)
				2.2	(0.087)
				2.4	(0.094)
Torque converter end play			mm (in)	67.0	(2.638)

13. Install the rear propeller shaft.

    Torque: 59 N·m (6.0 kgf·m/43 lb·ft)

14. Install the center bearing on crossemember.

    Torque: 69 N·m (7.0 kgf·m/51 lb·ft)

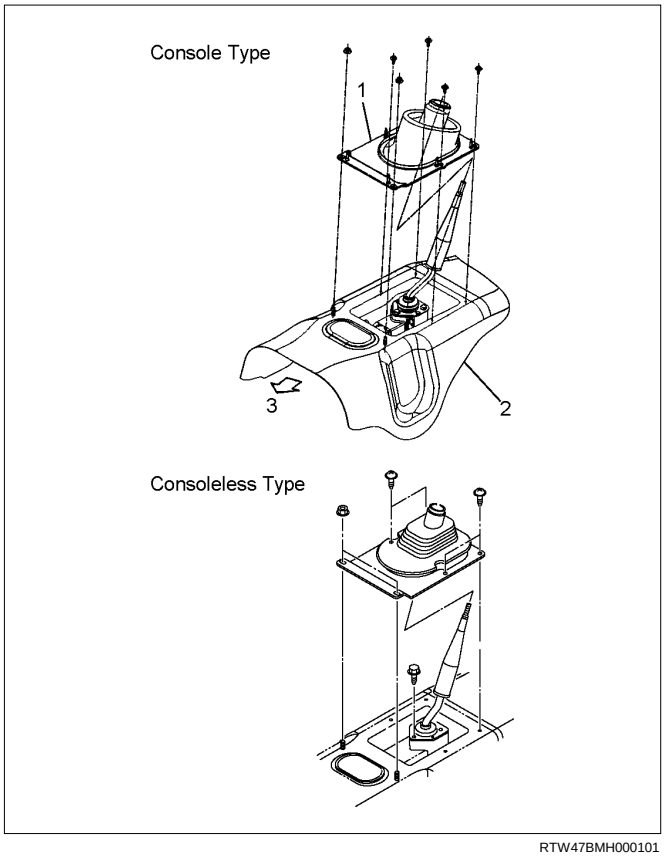
15. Install the gear control lever.

    Torque: 19 N·m (1.9 kgf·m/14 lb·ft)

16. Install the grommet assembly.

    Torque: Screw 1.4 N·m (0.14 kgf·m/12 lb·in)

    Nut 7 N·m (0.7 kgf·m/61 lb·in)



RTW47BMH000101

Legend

(1) Grommet Assembly
(2) Floor Panel
(3) Front

17. Install the front floor console and the rear floor console.
18. Install the gear control lever knob.

    To the female thread portion, apply 3 - 4 drops of adhesive (TB1344 or LOCTITE 222 or equiv.) and tighten the transmission knob.

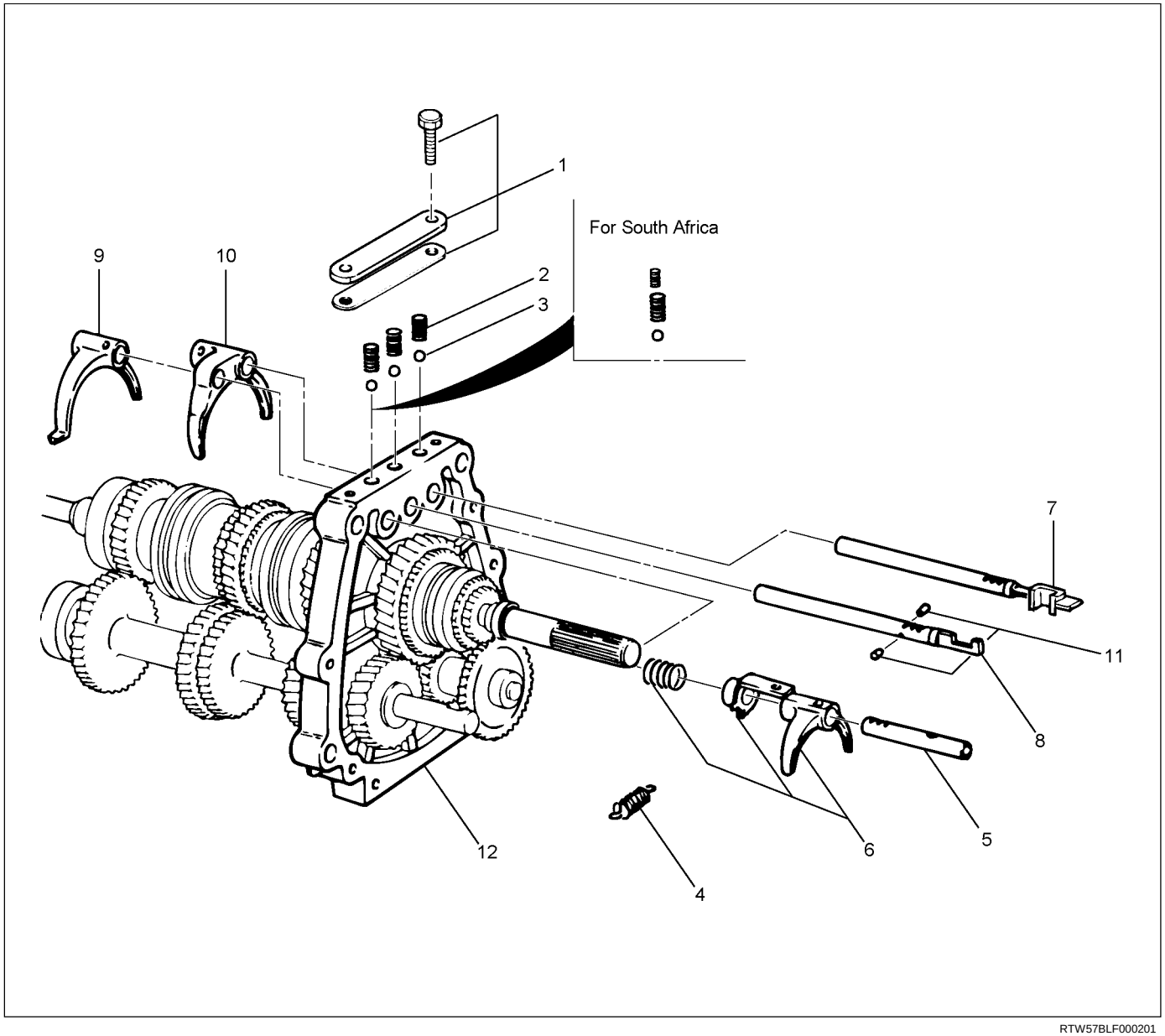
    Torque: 9 N·m (0.9 kgf·m/78 lb·in)

    After tightening to specified torque, rewrench the knob until the direction of the shift pattern is in the due positioned.

19. Connect the battery ground cable.

Intermediate Plate with Gear Assembly, Detent, Shift Arm, Shift Rod, and Interlock Pin

Disassembled View

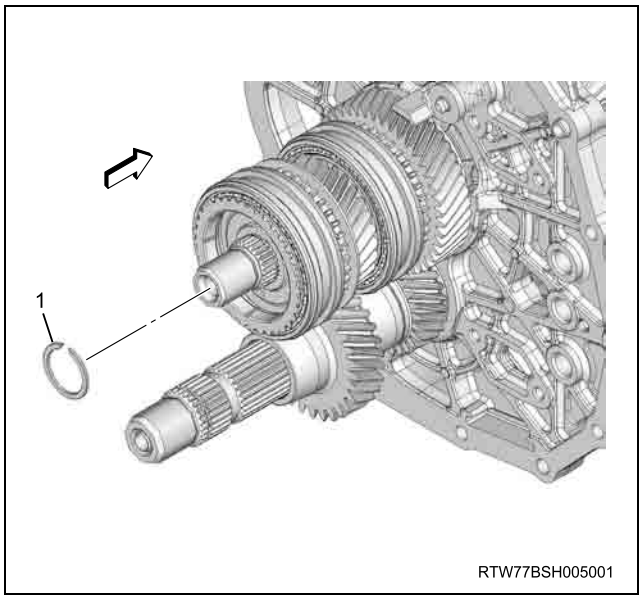


RTW57BLF000201

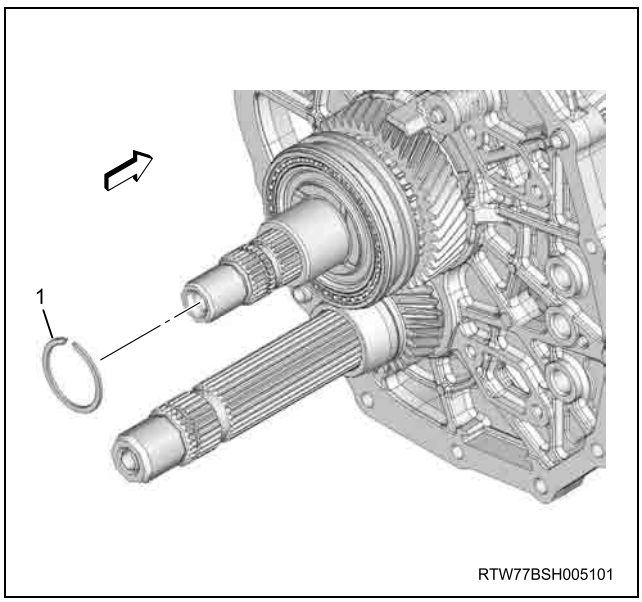
Legend

(1) Detent Spring Plate and Gasket
(2) Detent Spring
(3) Detent Ball
(4) Spring
(5) Rev-5th Shift Rod
(6) Rev-5th Shift Arm and Reverse Inhibitor
(7) 1st-2nd Shift Rod
(8) 3rd-4th Shift Rod
(9) 3rd-4th Shift Arm
(10) 1st-2nd Shift Arm
(11) Interlock Pin
(12) Intermediate Plate and Gear Assembly

47. Remove the 3rd-4th hub snap ring (1).



48. Remove the 3rd-4th synchronizer assembly, 3rd-4th block ring of 3rd input gear side, and 3rd input gear assembly.
49. Remove the 3rd input gear needle bearing.
50. Remove the 3rd counter gear.
51. Remove the counter shaft assembly and 5th counter gear from the intermediate plate.
52. Remove the counter middle roller bearing outer race.
53. Remove the 5th hub snap ring (1).



54. Remove the 5th synchronizer assembly, 5th block ring and 5th input gear assembly.
55. Remove the 5th input gear needle bearing. (2 piece type)
56. Use a pair of snap ring pliers to hold the input middle bearing snap ring open .
    Push the input shaft assembly toward the front of the transmission to remove it.
    The input middle bearing snap ring will come free.

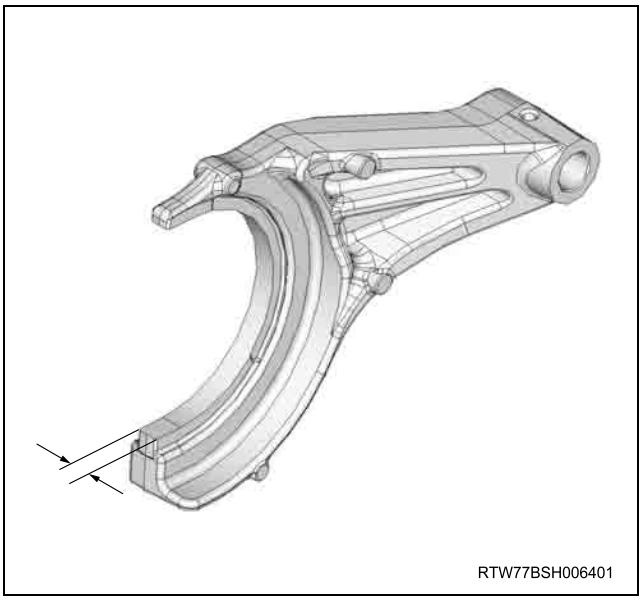
Inspection and Repair

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

Shift Arm Thickness

Use a micrometer to measure the shift arm thickness.
If the measured value exceeds the specified limit, the shift arm must be replaced.

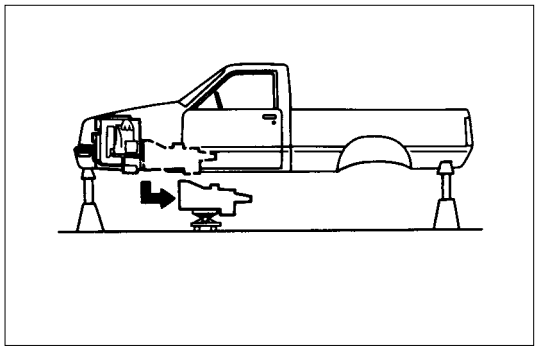
	Standard	Limit
1st - 2nd 3rd - 4th	9.60 - 9.85 mm (0.378 - 0.388 in)	8.85 mm (0.348 in)
5th	9.60 - 9.85 mm (0.378 - 0.388 in)	9.35 mm (0.368 in)
Reverse	7.85 - 8.10 mm (0.309 - 0.319 in)	7.60 mm (0.299 in)



Block Ring and Dog Teeth Clearance

Use a thickness gauge to measure the clearance between the block ring and the dog teeth.
If the measured value exceeds the specified limit, the block ring must be replaced.

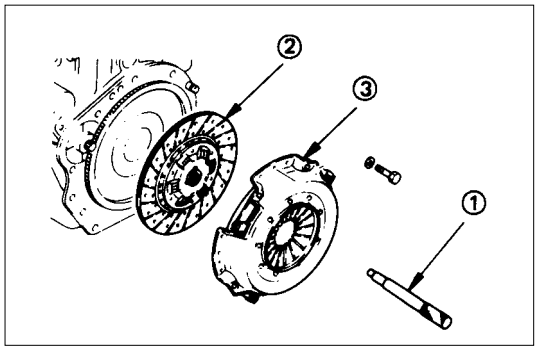
	Standard	Limit
3rd - 4th 5th	1.50 mm (0.059 in)	0.80 mm (0.031 in)



Important Operations - Removal

1. Transmission Assembly

Refer to “MANUAL TRANSMISSION” of section 7B and 7B1 for “REMOVAL AND INSTALLATION” procedure.

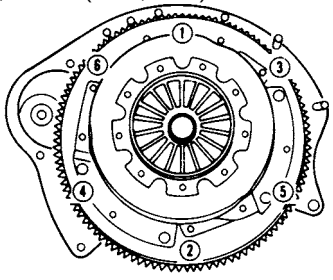


2. Pressure Plate Assembly

3. Driven Plate Assembly

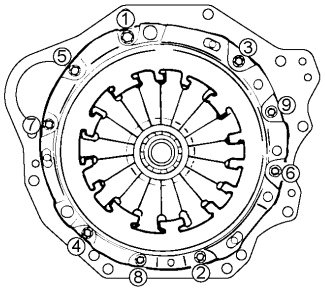
(1) Use the clutch pilot aligner ① to prevent the driven plate assembly ② from falling free.
Clutch Pilot Aligner : 5-8525-3001-0(J-24547)

4J series, C24SE (MSG, MUA)

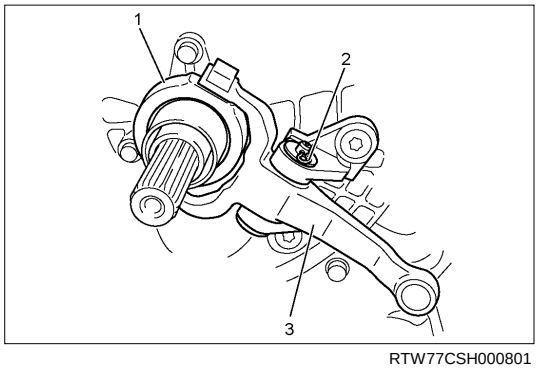


(2) Loosen the clutch cover bolts in the numerical order shown in the illustration.
(3) Remove the pressure plate assembly ③ from the flywheel.
(4) Remove the driven plate from the flywheel.

4JJ1 (High Output) (MUX)



RTW77CSH000601



RTW77CSH000801

4. Shift Fork (MUX)

5. Release Bearing (MUX)

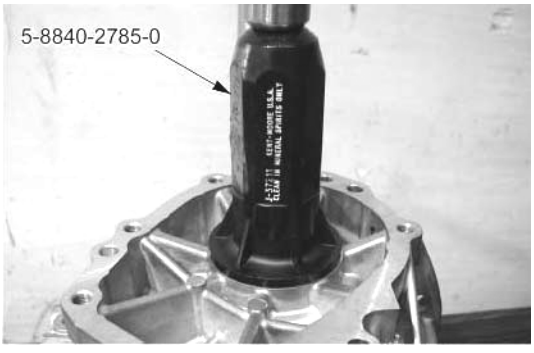
(1) Remove the shift fork snap pin (2).
(2) Remove the shift fork pin and shift fork (3) from the fulcrum bridge.
(3) Remove the release bearing (1) from the transmission case.

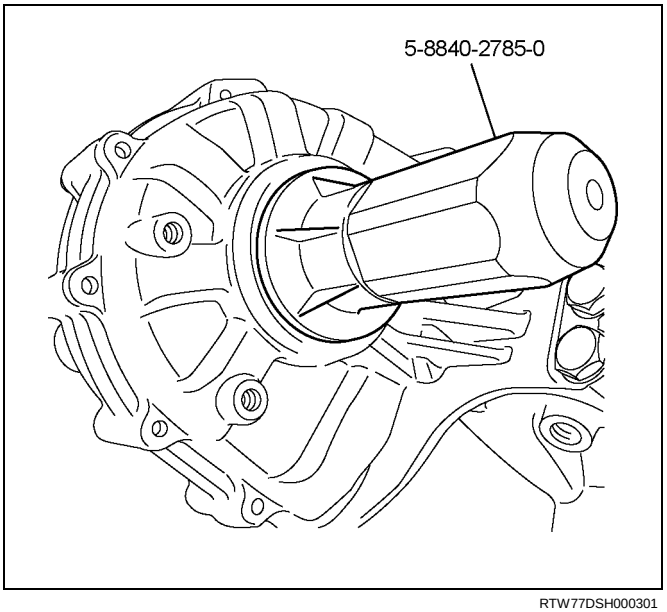
Reassembly

Transfer Reassembly

The rear cover oil seals and the rear output shaft ball bearings cannot be reused. They must be replaced with new ones when the transfer is reassembled.

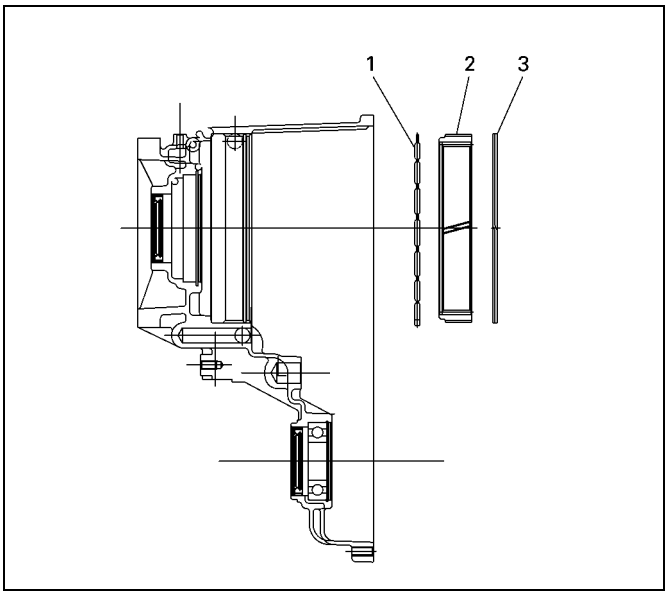
1. Use an oil seal installer (5-8840-2785-0) to press the new input shaft and/or front output shaft oil seals into place (If replacement is required).





RTW77DSH000301

2. Use a press to install the ball bearings to the front output shaft. Be sure that the bearings are fully inserted and then install the snap ring.
3. Install the damper ring and the internal gear to the transfer case. Be sure that the damper ring is between the internal gear and the case.

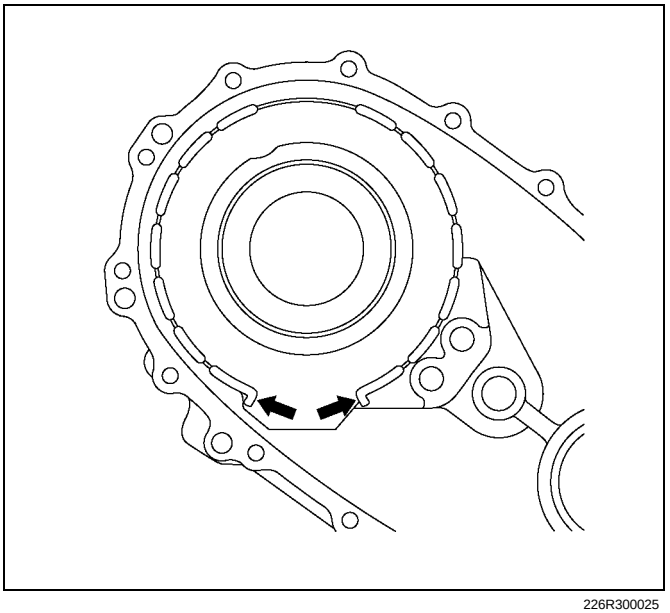


226R300004

Legend

(1) Dumper Ring
(2) Internal Gear
(3) Retaining Ring

Note the direction of the dumper ring installation as figure.



226R300025

3. *Shifting from 4H to 4L*

3-1 When the 4L indicator flashes at 2Hz

When shifting from 4H to 4L, the 4L indicator continues flashing at 2Hz until shifting in the transfer case is completed. The phases of the engaged splines may sometimes deviate preventing completion of shifting. By correcting the deviation of phases, shifting is completed.

Step 3-1:

(In case of AT): Set the select bar of the transmission to the D position.

(In case of MT): Set the lever of the transmission to a position allowing running and engage the clutch gently.

At this time, some rotating force acts on the engaged splines, phase is corrected and the engagement is completed.

3-2 When the 4L indicator flashes at 2Hz for 10 seconds and then keeps ON again (AT vehicle)

This condition occurs when torsional torque has been generated between the transmission and road surface and the transfer standby mechanism cannot absorb it completely.

Step 3-2:

Set the select lever of the transmission to the N position. (Stepping on the brake pedal is effective at this time.)

3-3 When the 4L indicator flashes at a frequency of 4Hz

Shifting from 4H to 4L is restricted.

When the vehicle is running, the transmission lever is at the running range and the engine speed is high (L4: 3000rpm or more V6: 2000rpm), the transfer cannot be shifted from 4H to 4L (restriction on operation).

Restriction on operation (Except 4JA1-T)

The 4H, neutral and 4L shifting mechanism has no synchronization function. Therefore, if relative rotations in the mechanism become excessive, shifting exerts adverse influence on the internal mechanism of the transfer. To avoid such a trouble, vehicle condition is detected to restrict the operation (vehicle speed, engine speed and TM position).

Requirement to restrict the speed: Vehicle should be in stop.

Due to the detection logic, time to wait for start of operation may be required.

A/T: If the vehicle is in stop for a long time at the TM running range (D, 1, 2) before operating the AT, waiting time becomes longer (from 1 second to 3 minutes at the maximum).

M/T: If the vehicle is at stop with the clutch stepped on at the T/M running position (1 – R), the time to wait becomes longer.

Waiting time means the time commencing from when other requirements (engine speed and T/M position) are met to permission of the speed restriction. Operation during the waiting time is not permissible.

The waiting time is 1 second at the minimum and increases up to 5 seconds if the above condition continues for 3 minutes. After that, the waiting time increases up to 3 minutes in 2 minute intervals.

When it is clear that the above condition has continued and reduction of waiting time is required, turn on or off the ignition or start and stop the vehicle several meters.

Requirements for permission of restriction on engine speed: Engine speed should be decreased.

The engine speed of 3000rpm (V6: 2000rpm) or below is advisable.

Requirements for permission of restriction on T/M position restriction:

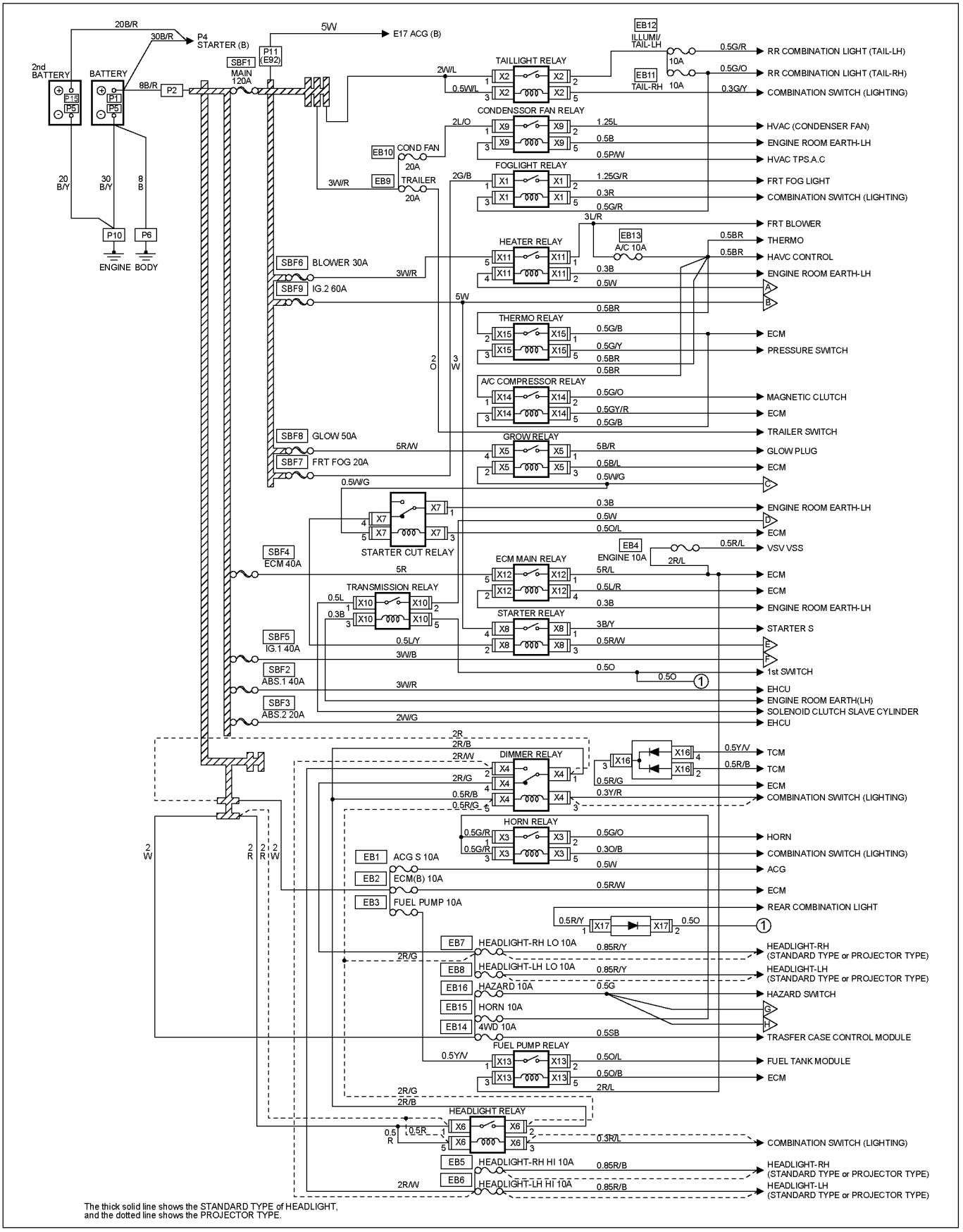
(AT) N range is recommended

(MT) should be at the neutral.

These requirements for permission should all be met before the switch is operated. If the requirements are met after operation, operation is not automatically effected but re-operation is required after permission is given.

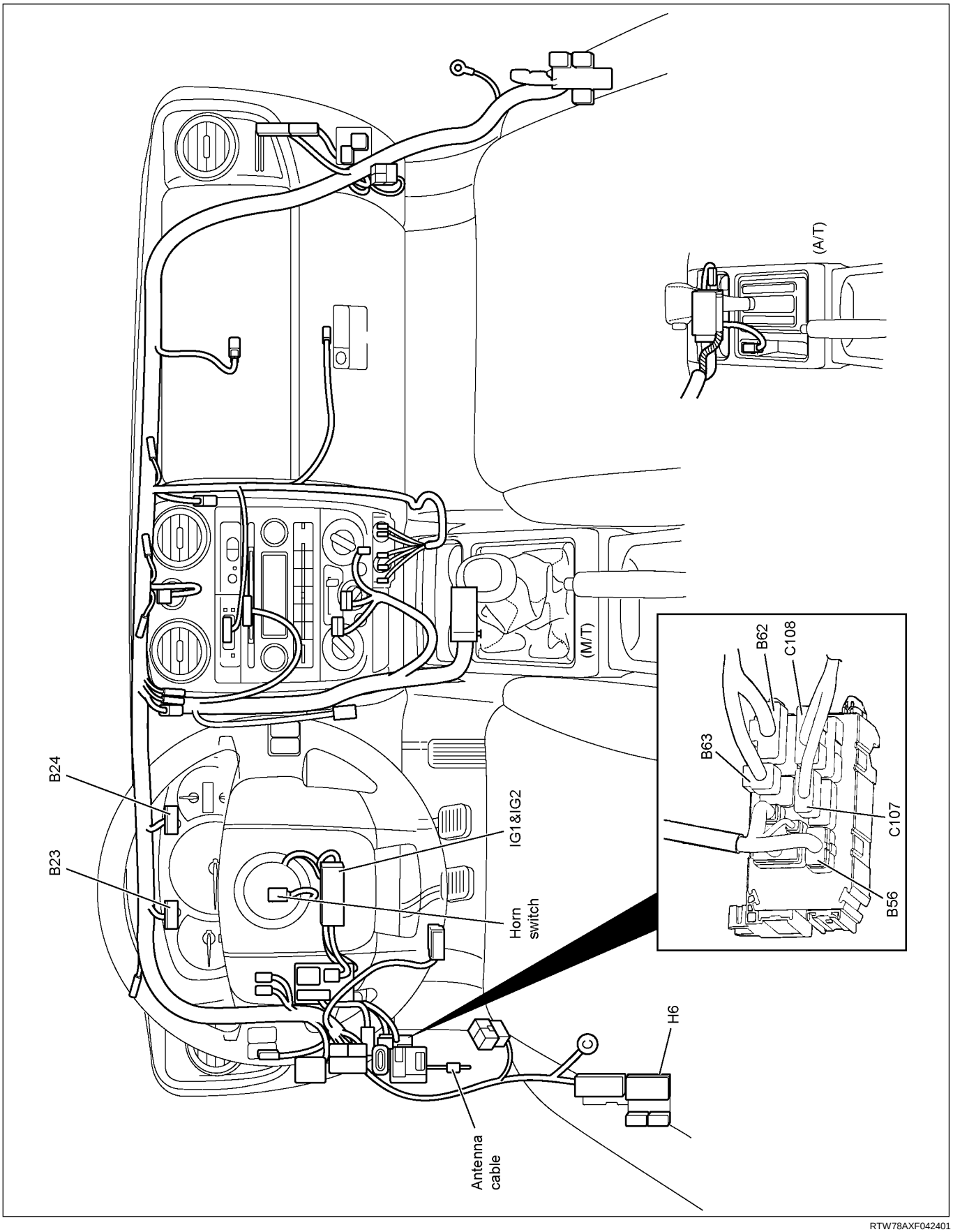
FUSE BLOCK CIRCUIT 4JJ1-TC/4JK1-TC (LHD) G.EXP

Sheet 1/2



RTW78AXF029901

PARTS LOCATION (LHD)



RTW78AXF042401

7. Passing light does not function when dimmer switch is operated

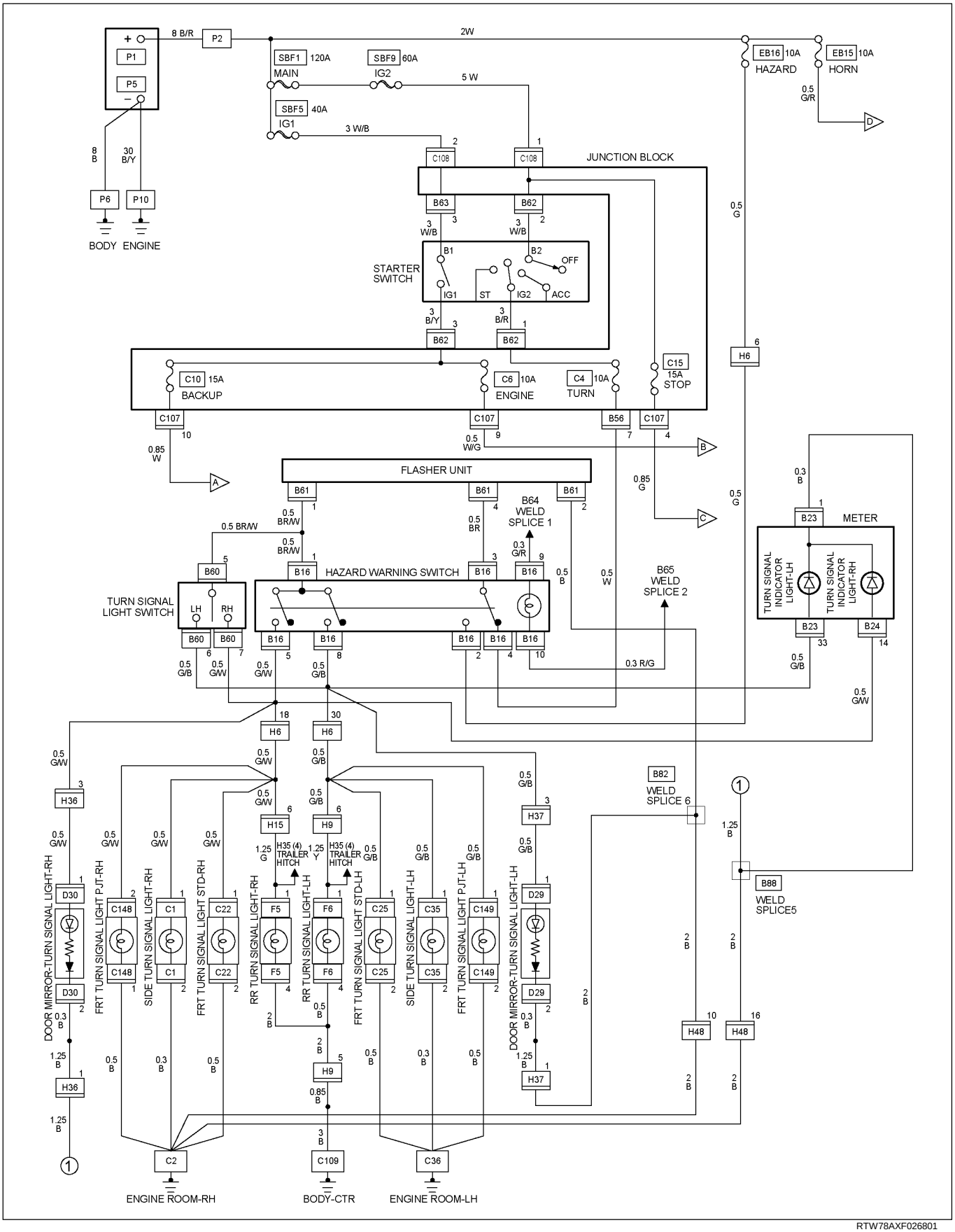
Checkpoint		Trouble Cause	Countermeasure
Dimmer switch	NG	Poor switch point contact	Repair or replace the dimmer switch
OK			
Voltage between 3 B60 - ground (Should be battery voltage present)	NG	Open circuit	Repair open circuit between 3 X6 - 3 B60

8. Headlight beam does not change when dimmer switch is operated

Dimmer switch	NG	Loose beam lever or foreign material in switch	Repair or replace the dimmer switch

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (LHD)

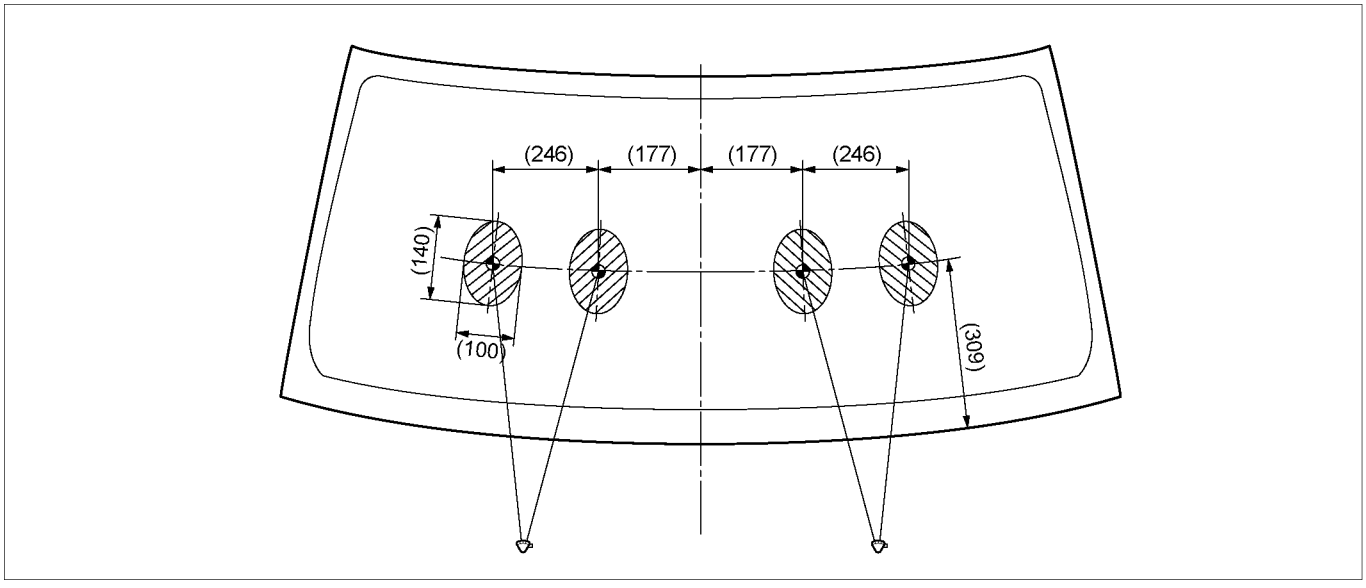
Sheet 1/2



RTW78AXF026801

Windshield Washer Spray

Be sure that the engine hood is completely closed before checking the windshield washer spray adjustment.
Windshield Washer Spray Position: Refer to the illustration.

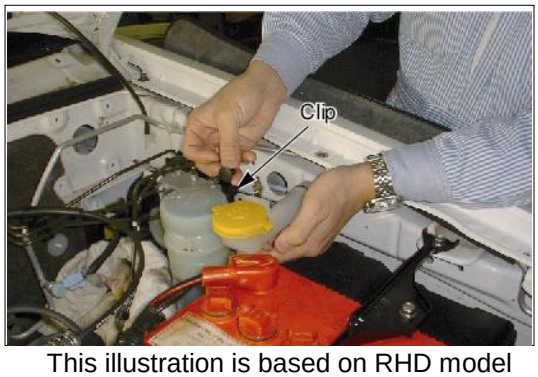


RTW38DSF000201

Connector

Be absolutely sure that the wiper motor connector is securely connected.
This will prevent a poor contact and an open circuit.

Note:
Windshield wiper arm and blade assembly configurations are different for the right-hand and left-hand side of the vehicle.
Be careful not to confuse the right-hand and left-hand side assemblies.



This illustration is based on RHD model

WASHER TANK MOTOR

Removal

1. Remove the head light.
   - Refer to the head light in this manual.
2. Remove the inner liner.
3. Pull out the clip washer filler.
4. Remove the washer tank nuts.

TROUBLESHOOTING

SPEEDOMETER

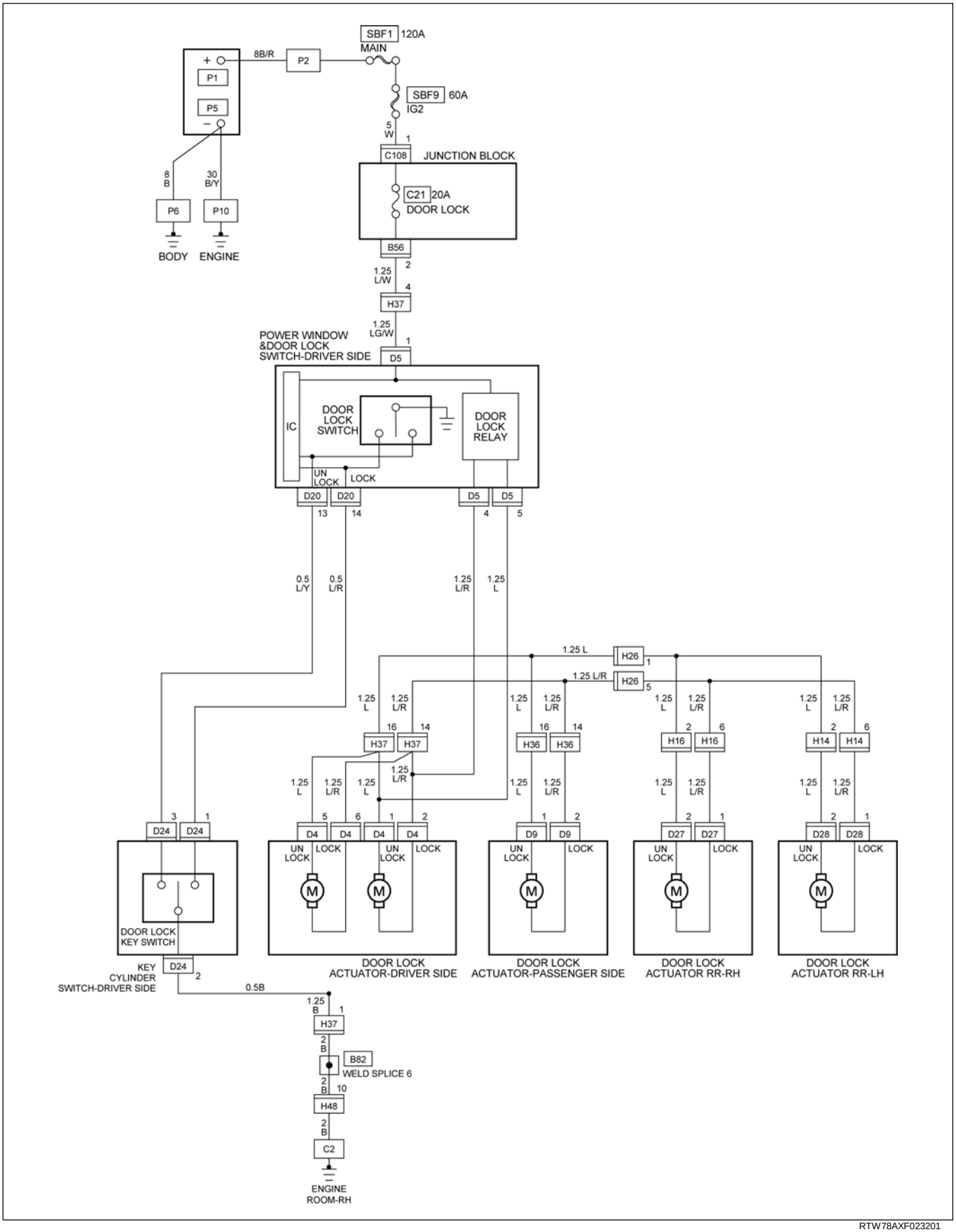
1. Speedometer and odometer do not function

Checkpoint		Trouble Cause	Countermeasure
Check the vehicle speed sensor output (4 pulses/1 rotation)	NG	Vehicle speed sensor malfunction	Replace the vehicle speed sensor
OK			
Continuity between the vehicle speed sensor and the meter, or the fuse C14 (10A) and the ground	NG	Open circuit or poor connector contact	Repair an open circuit in the circuit or a poor connection at the connectors
OK			
Use a meter tester to check the speedometer function	NG	Speedometer malfunction	Replace the case baseboard assy

2. Speedometer pointer fluctuates (May be wide fluctuation)

Check the speed sensor output by using the oscilloscope	NG	Vehicle speed sensor malfunction, or open circuit or poor connector contact	Replace the vehicle speed sensor, or repair an open circuit in the circuit or a connectors
OK			
Use a meter tester to check the speedometer function	NG	Speedometer malfunction	Replace the case baseboard assy

CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP STD TYPE



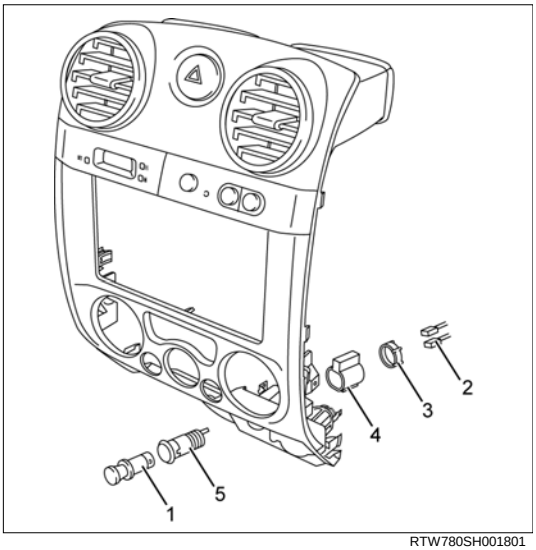
RTW78AXF023201

REMOVAL AND INSTALLATION

AUDIO

Refer to Section 9 “ACCESSORIES” for details.

CIGARETTE LIGHTER



RTW780SH001801

Removal

1. Disconnect the battery ground cable.
2. Remove the center cluster ASM.
3. Remove the lighter ①.
4. Disconnect the connector ②.
5. Loosen the ring nut ③ at the back side.
6. Remove the outer case ④.
7. Remove the lighter holder ⑤ from the bezel.

Installation

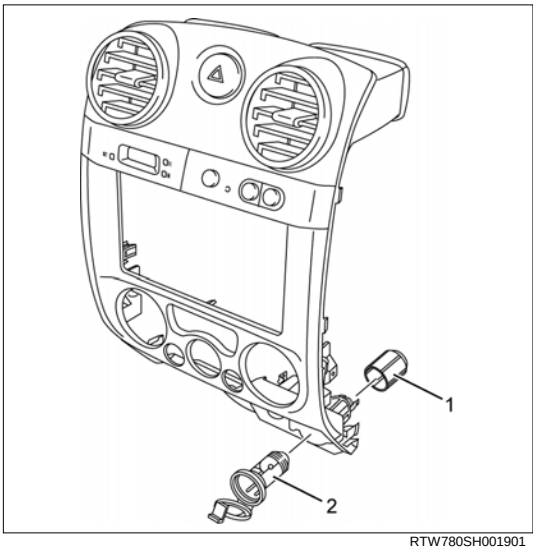
Follow the removal procedure in the reverse order to install the lighter.

Pay close attention to the important points mentioned in the following paragraphs.

Connector

Be absolutely sure that the lighter connector is securely connected.
This will prevent a poor contact and an open circuit.

ACC SOCKET



RTW780SH001901

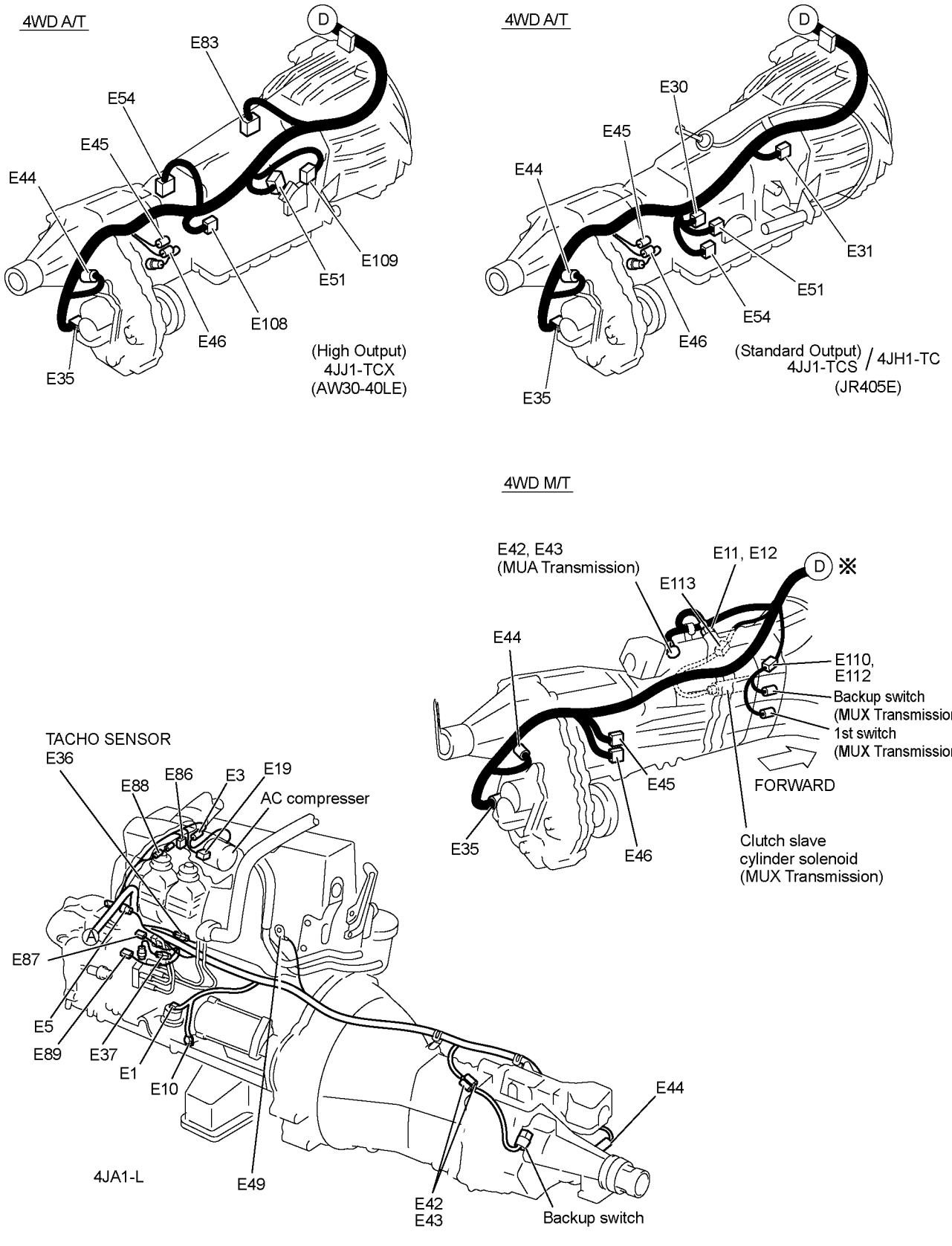
Removal

1. Disconnect the battery ground cable.
2. Remove the center cluster ASM.
3. Disconnect the connector.
4. Remove the holder nut ①.
5. Remove the ACC Socket ②

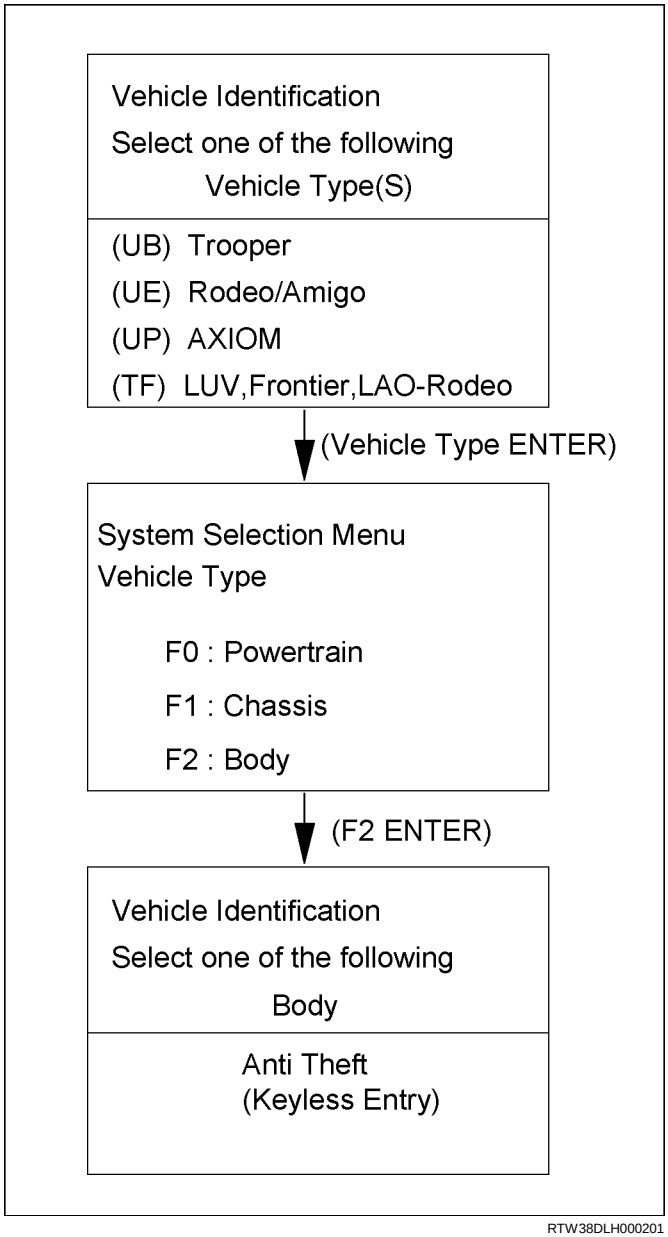
Installation

Follow the removal procedure in the reverse order to install the lighter.

PARTS LOCATION



RTW78AXF035901



RTW38DLH000201

1 General Information

A new cruise control system has been introduced due to changes in the powertrain architecture and components. There is no longer a cruise control module; instead the management has been taken over by the engine control module (ECM).

To the user, the system operates as previously, with all controls from the cruise control switch assembly and the cruise control messages presented by the instrument cluster. For vehicles fitted with the HFV6 engine refer to 1.3 System Operation .

CAUTION

The cruise control system now has an additional fail-safe feature. The brake pedal must be pressed in the ignition cycle for the cruise control to be engaged. The cruise control will not engage until this is done.

1.1 WARNINGS, CAUTIONS and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. GM HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. GM HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING Defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

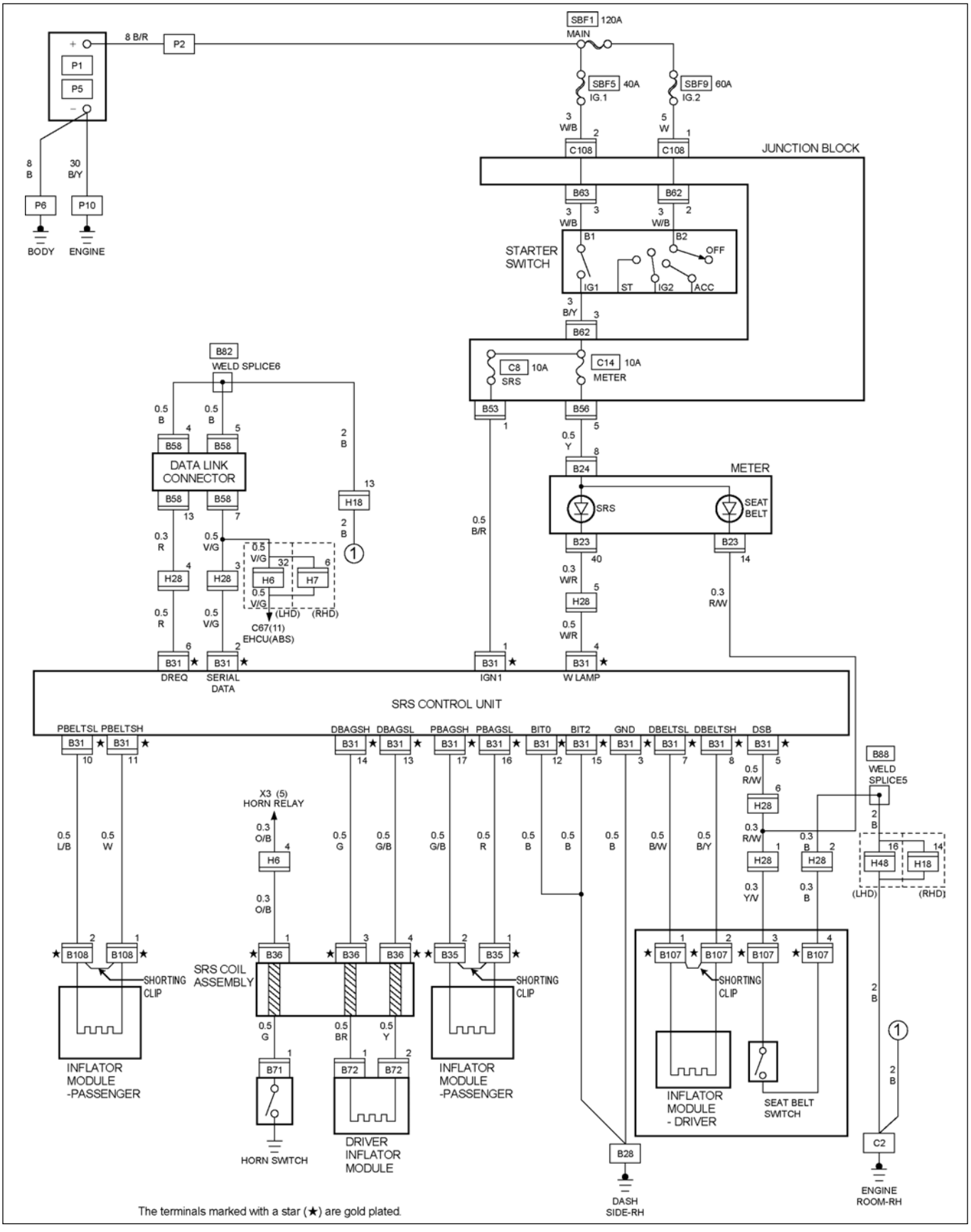
CAUTION Defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

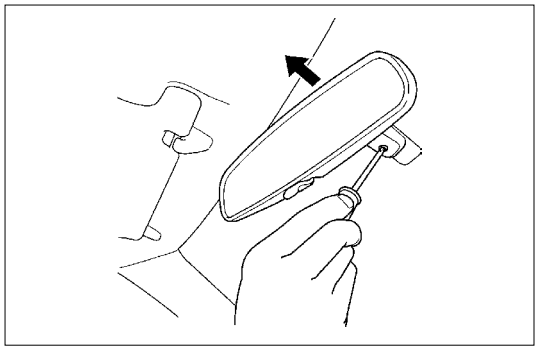
Circuit Diagram

4JJ1-TC, 4JK1-TC (Except South Africa)



RTW78AXF028601

Step	Action	Yes	No
6	1. Ignition switch is at “LOCK”. 2. There has been an increase in the total circuit resistance of the passenger inflator deployment loop. 3. Use the high resolution ohmmeter mode of the DMM while checking the circuits “Passenger Bag High” and “Passenger Bag Low”, and the SRS control unit connector terminal “17” and “16”, to locate the root cause. Was a fault found?	Replace SRS harness. Go to Step 7	Go to Chart A
7	1. Reconnect all components and ensure all components are properly mounted. 2. Clear the diagnostic trouble codes. Is This step finished?	Repeat the “SRS Diagnostic System Check”	—

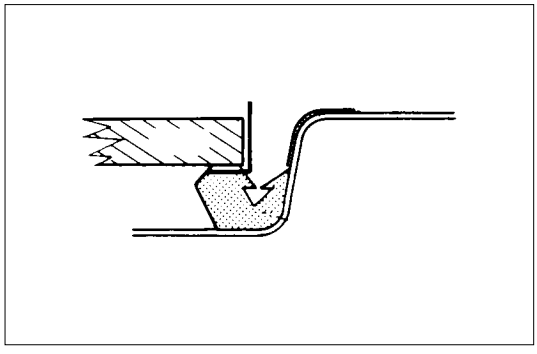


RUW5A0SH002901

Important Operations - Removal

3. Room Mirror

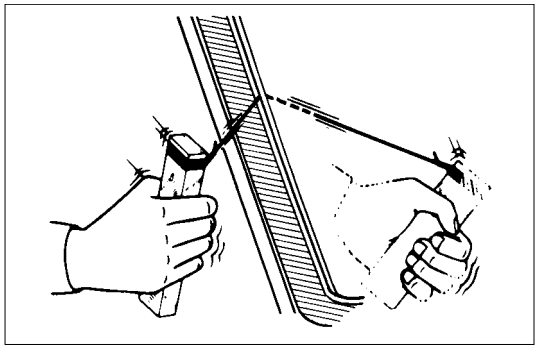
Remove the screw and pull the room mirror to the upper side.



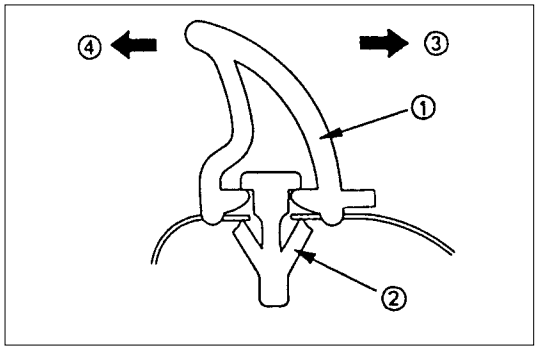
8. Windshield

Remove the windshield, carefully following the steps listed below:

1) Use a knife to cut through part of the adhesive caulking material.
2) Secure one end of a piece of steel piano wire (0.02 inches in diameter) to a piece of wood that can serve as a handle.
3) Use a pair of needle nose pliers to insert the other end of the piano wire through the adhesive caulking material at the edge of the windshield.
4) Secure the other end of the piano wire to another piece of wood.



5) With the aid of an assistant, carefully move the piano wire with a sawing motion to cut through the adhesive caulking material around the entire circumference of the windshield.
6) Lift the windshield from the body.
7) Clean any remaining adhesive caulking material from the area of the body which holds the windshield.
8) Use a soft rag and unleaded gasoline to wipe off any adhesive remaining on the windshield.

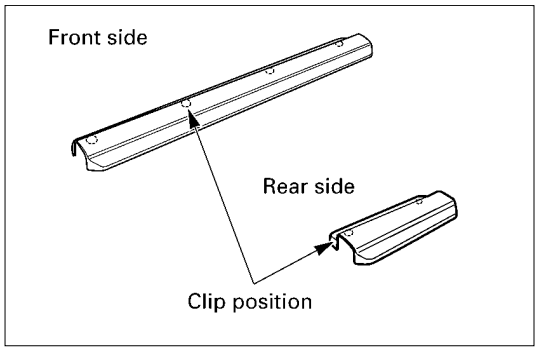


Important Operations - Installation

9. Engine Hood Rear Seal

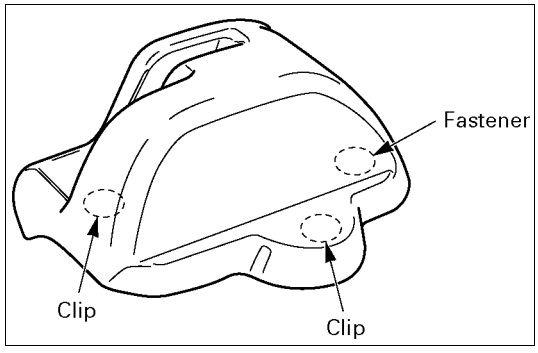
Install the engine hood rear seal as shown in the illustration.

① : Seal
② : Clip
③ : Rear (windshield side)
④ : Front

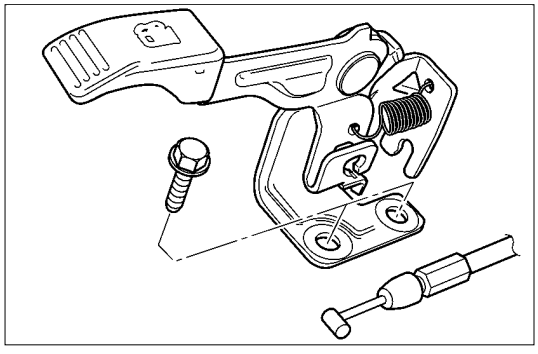


Important Operations - Removal

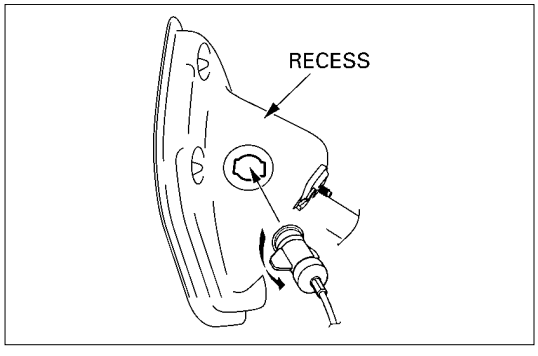
1. **Front Sill Plate**
   - Pull out the 4 clip positions.
2. **Rear Sill Plate**
   - Pull out the 2 clip positions.



4. **Fuel Filler Lid Opener Cover**
   - Pull out the 3 clip positions.



5. **Fuel Filler Lid Opener Lever**
   - Remove the 2 opener fixing bolts and disconnect the cable.



7. **Fuel Filler Lid Cable Assembly**
   - Remove some fixing clips, turn the cable holder on the side of the recess at 90° counterclockwise and remove it from the recess. Pull out the grommet in the direction of the front of the vehicle and remove the cable assembly.

DTC B0010

Description

When the ignition switch is ON, the ICU begins authentication of the transponder key in the steering lock through the antenna coil. Once the ICU transmits a signal, the transponder must send back a specific response signal. If the ICU receives an unknown response signal from the transponder, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ICU receives an unknown response signal from the transponder key.

Action Taken When the DTC Sets

- The engine will not start if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Diagnostic Aids

- Non-programmed transponder key sets this DTC.

Circuit/ System Testing DTC B0010

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC B0009, B0012 or B0013 also set?	—	Go to Applicable DTC	Go to Step 3
3	Inspect all programmed transponder keys while observing the Transponder Key parameter with a scan tool. Is there a transponder key that indicates Invalid when ignition switch is ON?	—	Go to Step 4	Go to Diagnostic Aids
4	Does only specific transponder key indicate Invalid?	—	Go to Step 5	Go to Step 7
5	Program transponder key information into the ICU. Refer to Resetting and Programming Guidelines in this section. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
6	**Important**: Replacement transponder key must be programmed. Replace the transponder key that indicates Invalid at Step 3. Refer to Resetting and Programming Guidelines in this section. Did you complete the replacement?	—	Go to Step 8	—
7	**Important**: Replacement ICU must be programmed. Replace the ICU. Refer to ICU Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9

B0008 WRONG TRANSPONDER KEY

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to Step 3	Refer to *Diagnostic Aids*
3	Check the immobilizer programming functions. • Transponder (Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the immobilizer programming functions. • Transponder (Key). (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0008 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transponder (Key). **IMPORTANT**: The replacement transponder (key) must be programmed the security data by scan tool. Was the action complete?	—	Go to Step 7	—
7	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0008 stored?	—	Go to *Step 8*	Verify repair
8	Replace the immobilizer control unit (ICU). **IMPORTANT**: The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—