SECTION 0B

GENERAL INFORMATION

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MAINTENANCE AND REPAIR

MAINTENANCE AND LUBRICATION

NORMAL VEHICLE USE

The maintenance instructions contained in the maintenance schedule are based on the assumption that the vehicle will be used for the following reasons:

- To carry passengers and cargo within the limitation of the tire inflation prassure. Refer to “Tire and Wheel” in section 2E.
- To be driven on reasonable road surfaces and within legal operating limits.

EXPLANATION OF SCHEDULED MAINTENANCE SERVICES

The services listed in the maintenance schedule are further explained below. When the following maintenance services are performed, make sure all the parts are replaced and all the necessary repairs are done before driving the vehicle. Always use the proper fluid and lubricants.

Engine Oil and Oil Filter Change

Always use above the API SH grade or recommended engine oil.

Engine Oil Viscosity

Engine oil viscosity (thickness) has an effect on fuel economy and cold weather operation. Lower viscosity engine oils can provide better fuel economy and cold weather performance; however, higher temperature weather conditions require higher viscosity engine oils for satisfactory lubrication. Using oils of any viscosity other than those viscosities recommended could result in engine damage.

Cooling System Service

Drain, flush and refill the system with new coolant. Refer to “Recommended Fluids And Lubricants” in this section.

Air Cleaner Element Replacement

Clean the air cleaner element every.

- Gasoline Engine : 15,000 km (10,000 miles)
- Diesel Engine : 10,000 km (6,000 miles)

Replace the air cleaner element every.

- Gasoline Engine : 60,000 km (36,000 miles)
- Diesel Engine : 30,000 km (18,000 miles)

Replace the air cleaner more often under dusty conditions.

Fuel Filter Replacement

Replace the engine fuel filter every.

- Gasoline Engine : 60,000 km (36,000 miles)
- Diesel Engine : 45,000 km (24,000 miles)

Spark Plug Replacement

Replace spark plugs with same type.

- Type : BOSCH : F8DC4
  BERU : 14F-8DU4
  Champion : C11YCC
- Gap : 0.8 ± 0.1 mm

Spark Plug Wire Replacement

Clean wires and inspect them for burns, cracks or other damage. Check the wire boot fit at the Distributor and at the spark plugs. Replace the wires as needed.

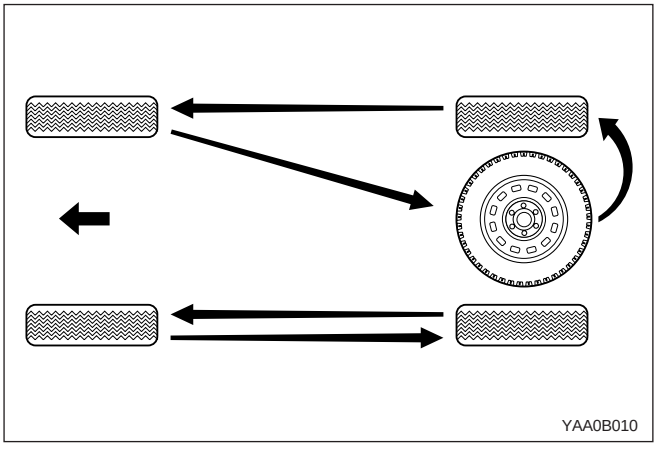
Brake System Service

Check the disc brake pads or the drum brake linings. Check the pad and the lining thickness carefully.

Tire and Wheel Inspection and Rotation

Check the tires for abnormal wear or damage. To equalize wear and obtain maximum tire life, rotate the tires. If irregular or premature wear exists, check the wheel alignment and check for damaged wheels. While the tires and wheels are removed, inspect the brakes.

Tire Rotation (Left-hand Drive Type)



OWNER INSPECTIONS AND SERVICES

WHILE OPERATING THE VEHICLE

Horn Operation

Blow the horn occasionally to make sure it works. Check all the button locations.

Brake System Operation

Be alert for abnormal sounds, increased brake pedal travel or repeated puling to one side when braking. Also, if the brake warning light goes on, or flashes, something may be wrong with part of the brake system.

Exhaust System Operation

Be alert to any changes in the sound of the system or the smell of the fumes. These are signs that the system may be leaking or overheating. Have the system inspected and repaired immediately.

Tires, Wheels and Alignment Operation

Be alert to any vibration of the steering wheel or the seats at normal highway speeds. This may mean a wheel needs to be balanced. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or a wheel alignment.

Steering System Operation

Be alert to changes in the steering action. An inspection is needed when the steering wheel is hard to turn or has too much free play, or is unusual sounds are noticed when turning or parking.

Headlamp Aim

Take note of the light pattern occasionally. Adjust the headlights if the beams seem improperly aimed.

AT EACH FUEL FILL

A fluid loss in any (except windshield washer) system may indicate a problem. Have the system inspected and repaired immediately.

Engine Oil Level

Check the oil level and add oil if necessary. The best time to check the engine oil level is when the oil is warm.

1. After stopping the engine, wait a few minutes for the oil to drain back to the oil pan.
2. Pull out the oil level indicator (dip stick).
3. Wipe it clean, and push the oil level indicator back down all the way.
4. Pull out the oil level indicator and look at the oil level on it.
5. Add oil, if needed, to keep the oil level above the lower mark. Avoid overfilling the engine, since this may cause engine damage.
6. Push the indicator all the way back down into the engine after taking the reading.

If you check the oil level when the oil is cold, do not run the engine first. The cold oil will not drain back to the pan fast enough to give a true oil level reading.

Engine Coolant Level and Condition

Check the coolant level in the coolant reservoir tank and add coolant if necessary. Inspect the coolant. Replace dirty or rusty coolant.

Windshield Washer Fluid Level

Check the washer fluid level in the reservoir. Add fluid if necessary.

AT LEAST TWICE A MONTH

Tire And Wheel Inspection and Pressure Check

Check the tire for abnormal wear or damage. Also check for damaged wheels. Check the tire pressure when the tires are cold (check the spare also, unless it is a stow-away).

Maintain the recommended pressures. Refer to “Tire and Wheel” is in section 0B.

AT LEAST MONTHLY

Lamp Operation

Check the operation of the license plate lamp, the headlamps (including the high beams), the parking lamps, the fog lamps, the taillamp, the brake lamps, the turn signals, the backup lamps and the hazard warning flasher.

Fluid Leak Check

Periodically inspect the surface beneath the vehicle for water, oil, fuel or other fluids, after the vehicle has been parked for a while. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, find the cause and correct it at once.

AT LEAST TWICE A YEAR

Power Steering System Reservoir Level

Check the power steering fluid level. Keep the power steering fluid at the proper level. Refer to Section 6A, Power Steering System.

Brake Master Cylinder Reservoir Level

Check the fluid and keep it at the proper level. A low fluid level can indicate worn disc brake pads which may need to be serviced. Check the breather hole in the reservoir cover to be free from dirt and check for an open pas-sage.

Weather-Strip Lubrication

Apply a thin film silicone grease using a clean cloth.

EACH TIME THE OIL IS CHANGED

Brake System Inspection

This inspection should be done when the wheels are removed for rotation. Inspect the lines and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Inspect the disc brake pads for wear. Inspect the rotors for surface condition. Inspect other brake parts, the parking brake, etc., at the same time. Inspect the brakes more often if habit or conditions result in frequent braking.

Steering, Suspension and Front Drive Axle Boot And Seal Inspection

Inspect the front and rear suspension and the steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect the power steering line and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Clean and inspect the drive axle boot and seals for damage, tears or leakage. Replace the seals if necessary.

Exhaust System Inspection

Inspect the complete system (including the catalytic converter if equipped). Inspect the body near the exhaust system. Look for broken, damaged, missing, or out-of-position parts as well as open seams, holes, loose connections, or other conditions which could cause heat buildup in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment.

Throttle Linkage Inspection

Inspect the throttle linkage for interference or binding, damaged, or missing parts. Lubricate all linkage joints and throttle cable joints, the intermediate throttle shaft bearing, the return spring at throttle valve assembly, and the accelerator pedal sliding face with suitable grease. Check the throttle cable for free movements.

Engine Drive Belts

Inspect all belts for cracks, fraying, wear and proper tension. Adjust or replace the belts as needed.

Hood Latch Operation

When opening the hood, note the operation of the secondary latch. It should keep the hood from opening all the way when the primary latch is released. The hood must close firmly.

AT LEAST ANNUALLY

Lap and Shoulder Belts Condition and Operation

Inspect the belt system including: the webbing, the buckles, the latch plates, the retractor, the guide loops and the anchors.

Movable Head Restraint Operation

On vehicles with movable head restraints, the restraints must stay in the desired position.

Spare Tire and Jack Storage

Be alert to rattles in the rear of the vehicle. The spare tire, all the jacking equipment, and the tools must be securely stowed at all times. Oil the jack ratchet or the screw mechanism after each use.

Key Lock Service

Lubricate the key lock cylinder.

Body Lubrication Service

Lubricate all the body door hinges including the hood, the fuel door, the rear compartment hinges and the latches, the glove box and the console doors, and any folding seat hardware.

Underbody Flushing

Flushing the underbody will remove any corrosive materials used for ice and snow removal and dust control. At least every spring clean the underbody. First, loosen the sediment packed in closed areas of the vehicle. Then flush the underbody with plain water.

Engine Cooling System

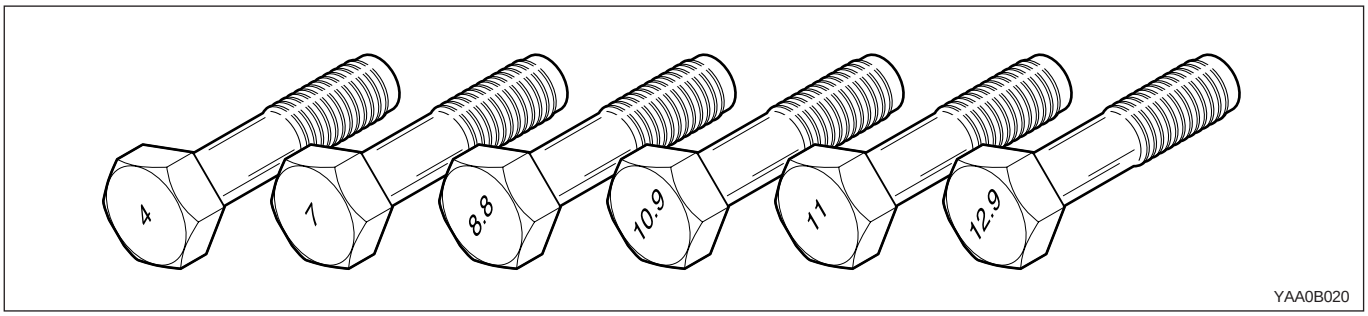
Inspect the coolant and freeze protection fluid. If the fluid is dirty or rusty, drain, flush and refill the engine cooling system with new coolant. Keep the coolant at the proper mixture in order to ensure proper freeze protection, corrosion protection and engine operating temperature. Inspect the hoses. Replace the cracked, swollen, or deteriorated hoses. Tighten the clamps.

Clean the outside of the radiator and the air conditioning condenser. Wash the filler cap and the neck. Pressure test the cooling system and the cap in order to help en-sure proper operation.

STANDARD BOLTS SPECIFICATIONS

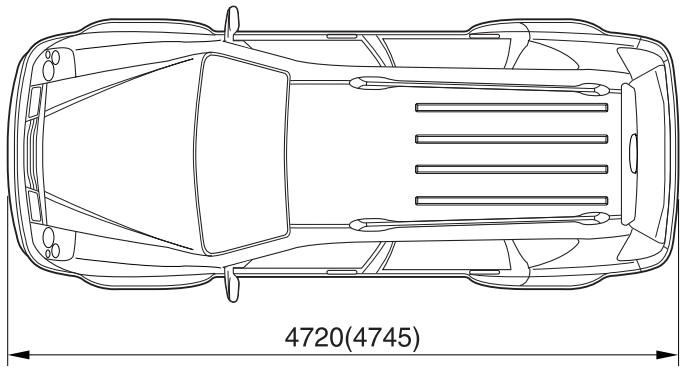
Bolt*	Torque (N•m / lb-in)					
	Standard			Limit		
	4T	7T	9T	4T	7T	9T
M3 × 0.5	0.5 N•m (4.5 lb-in)	0.9 N•m (8 lb-in)	1.3 N•m (12 lb-in)	0.7 N•m (6.3 lb-in)	1.2 N•m (11 lb-in)	17 N•m (15 lb-in)
M4 × 0.7	1.2 N•m (11 lb-in)	2.0 N•m (18 lb-in)	3.0 N•m (27 lb-in)	1.6 N•m (14 lb-in)	2.6 N•m (23 lb-in)	4.0 N•m (36 lb-in)
M5 × 0.8	2.4 N•m (22 lb-in)	4.0 N•m (36 lb-in)	5.6 N•m (50 lb-in)	3.1 N•m (28 lb-in)	5.2 N•m (47 lb-in)	7.6 N•m (68 lb-in)
M6 × 1.0	4.0 N•m (36 lb-in)	6.7 N•m (60 lb-in)	9.7 N•m (87 lb-in)	5.4 N•m (49 lb-in)	9.0 N•m (81 lb-in)	12.7 N•m (114 lb-in)
M8 × 1.25	8.6 N•m (77 lb-in)	15.7 N•m (12 lb-in)	22.5 N•m (17 lb-in)	12.7 N•m (9 lb-in)	20.6 N•m (15.2 lb-in)	30.4 N•m (22 lb-in)
M10 × 1.25	18.6 N•m (14 lb-in)	32.3 N•m (24 lb-in)	46.0 N•m (34 lb-in)	25.5 N•m (19 lb-in)	42.1 N•m (31 lb-in)	60.8 N•m (31 lb-in)
M10 × 1.5	18.6 N•m (14 lb-in)	30.4 N•m (22 lb-in)	44.1 N•m (33 lb-in)	24.5 N•m (18 lb-in)	41.2 N•m (30 lb-in)	58.8 N•m (44 lb-in)
M12 × 1.25	34.3 N•m (25lb-in)	56.8 N•m (42 lb-in)	82.3 N•m (61 lb-in)	45.0 N•m (33 lb-in)	75.5 N•m (56 lb-in)	107.8 N•m (80 lb-in)
M12 × 1.75	32.3 N•m (24 lb-in)	53.9 N•m (40 lb-in)	77.4 N•m (57 lb-in)	43.1 N•m (32 lb-in)	71.5 N•m (53 lb-in)	98.0 N•m (73 lb-in)
M14 × 1.5	54.0 N•m (40 lb-in)	89.2 N•m (66 lb-in)	127.4 N•m (94 lb-in)	71.6 N•m (53 lb-in)	117.6 N•m (87 lb-in)	166.6 N•m (123 lb-in)
M16 × 1.5	81.3 N•m (60 lb-in)	107.8 N•m (80 lb-in)	196.0 N•m (145 lb-in)	107.8 N•m (80 lb-in)	186.2 N•m (138 lb-in)	264.6 N•m (196 lb-in)
M18 × 1.5	117.6 N•m (87 lb-in)	196.0 N•m (145 lb-in)	284.2 N•m (210 lb-in)	156.8 N•m (116 lb-in)	264.6 N•m (196 lb-in)	372.4 N•m (276 lb-in)
M20 × 1.5	166.6N•m (123 lb-in)	274.4 N•m (203 lb-in)	392.0 N•m (290 lb-in)	215.6 N•m (160 lb-in)	362.6 N•m (268 lb-in)	519.4 N•m (384 lb-in)
M22 × 0.5	225.4N•m (167 lb-in)	372.4 N•m (276 lb-in)	529.2 N•m (392 lb-in)	294.0 N•m (218 lb-in)	490.0 N•m (362 lb-in)	705.6 N•m (522 lb-in)
M24 × 1.5	284.2 N•m (210 lb-in)	480.2 N•m (355 lb-in)	686.0 N•m (508 lb-in)	382.2 N•m (283 lb-in)	637.0 N•m (471 lb-in)	921.2 N•m (682 lb-in)
M24 × 2.0	274.4 N•m (203 lb-in)	460.6 N•m (341 lb-in)	666.4 N•m (493 lb-in)	372.4 N•m (276 lb-in)	617.4 N•m (457 lb-in)	891.8 N•m (660 lb-in)

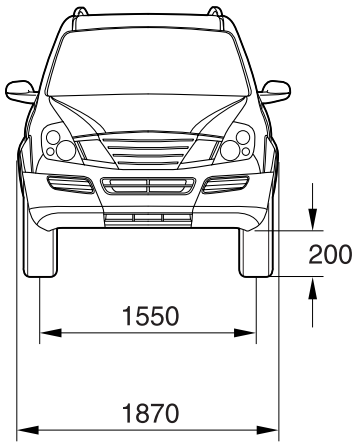
*Diameter X pitch in millimeters

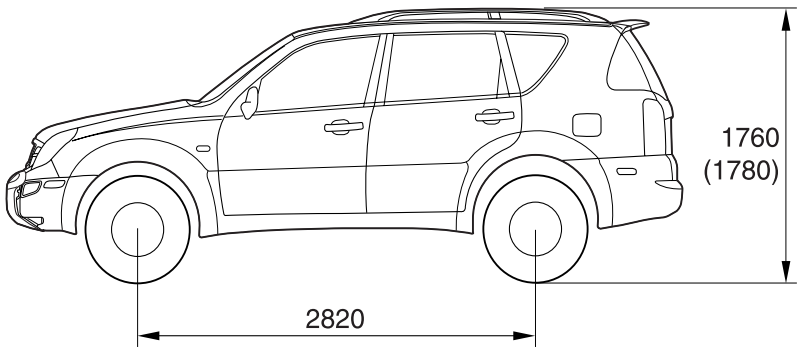


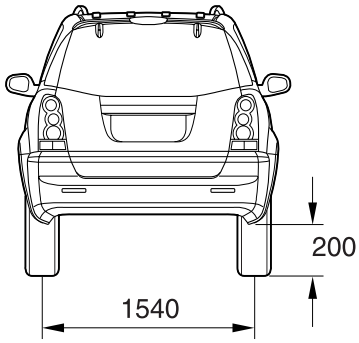
BASIC SPECIFICATION

DIMENSION









* ( ): Gasoline engine equipped vehicle

YAA0B030

SPECIFICATIONS

Systems	Items		Diesel	Gasoline G32D (G23D)
General	Overall length (mm)		4,270	4,745
	Overall width (mm)		1,870	←
	Overall height (mm)		1,760	1,780
	Gross vehicle weight (kg)		AT : 2405, MT : 2365	2415
	Curb weight (kg)		AT : 1950, MT : 1910	-
	Min. turning radius (m)		5.6	←
	Ground clearance (mm)		200	←
	Fuel		Diesel	Gasoline
	Fuel tank capacity		80 L	←
Engine	Model		OM662LA	M162 (M161)
	No. of cyl./Compression ratio		5 / 22 : 1	6 / 10 : 1
	Total displacement		2,874 cc	3,199 cc
	Camshaft arrangement		SOHC	DOHC
	Max. power		120 ps / 4,000 rpm	220 ps / 6,000 rpm
	Max. torque		25.5 kg.m / 2,400 rpm	31.9 kg.m / 3,000 rpm
	Injection timing		BTDC 18° ± 1.0°	BTDC 8°
	Idle speed		770 ± 50 rpm	770 ± 50 rpm
	Cooling system		Water-cooled/forced circulation	←
	Coolant capacity		10.5 L ~ 11 L	11.3 L ~ 11.5 L
	Lubrication		Gear pump, forced circulation	←
	Max. oil capacity		8.9 L	9.8 L
	Turbo charger and cooling type		Turbo charger, air-cooled	-
Manual transmission	Type		Remote control, floor change type	←
	Gear ratio	1st	3.969	←
		2nd	2.341	←
		3rd	1.457	←
		4th	1.000	←
		5th	0.851	←
		Rev.	3.705	←
Automatic transmission	Model		Electronic	←
	Type		Floor change type	←
	Gear ratio	1st	2.742	←
		2nd	1.508	←
		3rd	1.000	←
		4th	0.708	←
		Rev.	2.429	←

SPECIFICATIONS (Cont'd)

Systems	Items		Diesel	Gasoline G32D (G23D)
Transfercase	Model		Part-time	Full-time (Part-Time)
	Type		Planetary gear type	←
	Gear ratio	High	1.000 : 1	←
		Low	2.483 : 1	←
Clutch	Type		Hydraulic [A/T: Torque converter]	Torque converter
	Disc type		Dry single diaphragm type [A/T: 3 elements 1 stage 2 phases]	3 elements 1 stage 2 phases
Power steering	Type		Rack and pinion	←
	Steering angle	Inner	36°17′	←
		Outer	32°40′	←
Front axle	Drive shaft type		Ball joint type	←
	Axle housing type		Build-up type	←
Rear axle	Drive shaft type		Semi-floating type	←
	Axle housing type		Build-up type	←
Brake	Master cylinder type		Tandem type	←
	Booster type		Vacuum booster	←
	Type	Front	Disc	←
		Rear	Drum (Disc)	Disc (Drum)
Suspension	Parking brake		Cable type (internal expansion)	←
	Front		Wishbone + Coil spring	←
	Rear		5-link + Coil spring	←
Air conditioner	Refrigerant		R134a	←
	Compressor type		Vane type	←
Electrical	Battery type/Capacity (V-AH)		MF / 12 - 90	MF / 112 - 75
	Starter capacity (V-kW)		12 - 2.2	12 - 1.8
	Alternator capacity (V-A)		12 - 75 (12 - 90)	12 - 115

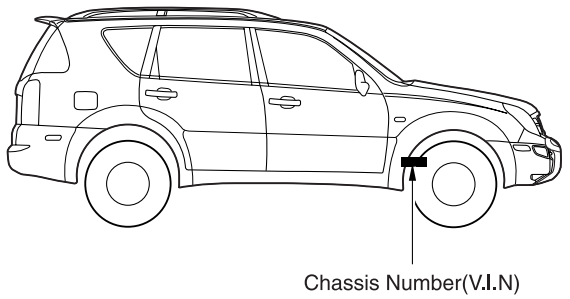
RECOMMENDED FLUIDS AND LUBRICANTS

Usage		Specification	Service interval	Capacity (L)
Engine Oil	D29ST	Approved by MB Sheet 229.1 or 229.3 Viscosity: See MB Sheet 224.1	Initial change: 1,000 km, Change every 10,000 km or 12 months (But, every 5,000 km or 6 months under severe conditions)	6.0 ~ 8.0
	G32D	Approved by MB Sheet 229.1 or 229.3 Viscosity: See MB Sheet 224.1	Initial change: max. 1,000 km, Change every 15,000 km or 12 months (But, every 7,500 km or 6 months under severe conditions)	7.0 ~ 9.0
	G23D			5.5 ~ 7.5
Automatic Transmission Fluid*		CASTROL TQ95	Inspect every 30,000 km or 12 months (But, change every 60,000 km under severe conditions)	Approx. 9.5 L
Manual Transmission Fluid		(ATF DEXRON II or III)	Initially change at 12,000 km, and Inspect every 50,000 km	Approx. 3.4 L
Clutch Fluid (For Manual Transmission)		(DOT 4)	Inspect frequently, Change every 40,000 km or 2 years	As required
Transfer Case Fluid	Part-time	ATF DEXRON® II, III, ATF S-2, S-3, S-4, TOTAL FLUID ATX	Inspect every 10,000 ~ 15,000 km Change every 60,000 km	1.2 L
	Full-time	ATF DEXRON® II,III, ATF S-2, S-3, S-4, TOTAL FLUID ATX	Inspect every 10,000 ~ 15,000 km Change every 60,000 km	1.4 L
Brake Fluid		DOT4	Change every 40,000 km or 2 years (Inspect frequently)	As required
Front and Rear Axle Fluid	Front Axle	API GL-5 or SAE 80W/90	Inspect frequently Change every 38,000 km	1.4 L
	Rear Axle	API GL-5 or SAE 80W/90	Inspect frequently Change every 38,000 km	1.9 L
Power Steering Fluid		(ATF DEXRON II)	Check and replenish as necessary.	Approx. 1.1 L
Coolant	D29ST	Change every 3 years. And, inspect and replenish as necessary.		10.5~11.0 L
	G23D			10.0~10.5 L
	G32D			11.0~11.5 L
Air Cleaner	Diesel	Clean every 10,000 km, Replace every 30,000 km		
	Gasoline	Clean every 15,000 km, Replace every 60,000 km		
Fuel filter	Diesel	Replace every 45,000 km		
	Gasoline	Replace every 60,000 km		

VEHICLE IDENTIFICATION NUMBER SYSTEM

VEHICLE IDENTIFICATION NUMBER (VIN)

Vehicle Identification Number (VIN) is on the right front axle upper frame.



YAA0B040

*** K P T G 0 B 1 9 S 1 P 000000**

12~17. Production Serial Number
: 000001- 999999

11. Plant Code
P : PyongTaek Plant

10. Model Year
2 : 2002
3 : 2003

9. Check Digit
S : All area except North America

8. Engine Type
6 : 2295cc, In-line 4Cylinder, Gasoline (E23)
9 : 3199cc, In-line 6Cylinder, Gasoline (E32)
D : 2874cc, In-line 5Cylinder, Diesel (662LA)

7. Restraint System
1 : 3-Point Seat Belts, 2 : 2-Point Seat Belts

6. Trim Level
A : Standard, B : Deluxe, C : Super Deluxe

5. Body Type
0 : 5-Door
1 : 4-Door
2 : 3-Door

4. Line Models
G : Rexton (LHD)
H : Rexton (RHD)

3. Vehicle Type
T : Passengr Cars, A : Truck

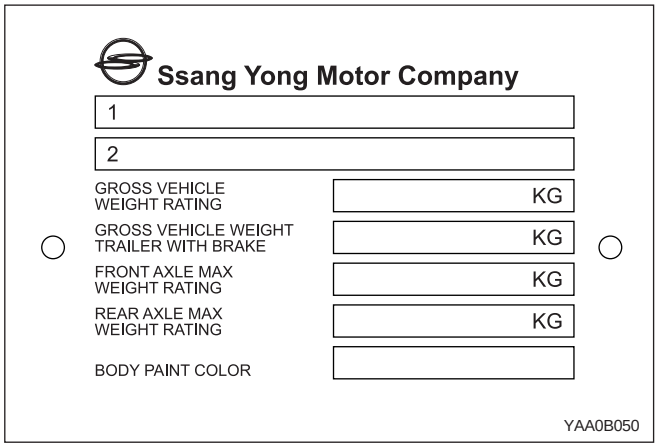
2. Maker Identification : P

1. Nation : K

*. Symbol according to No.

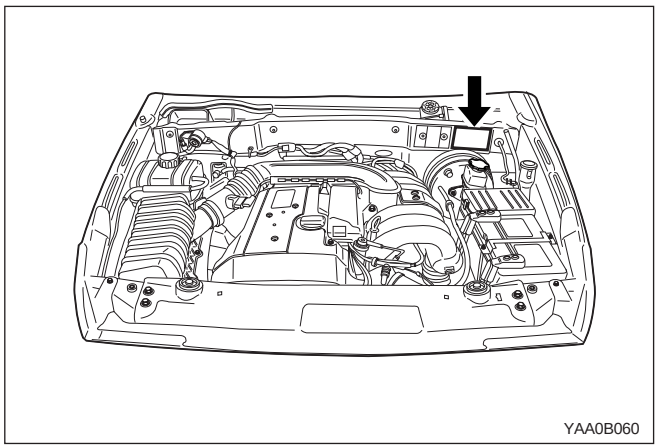
MANUFACTURER'S PLATE

1 Type Approval No.
2 Vehicle Identification No.

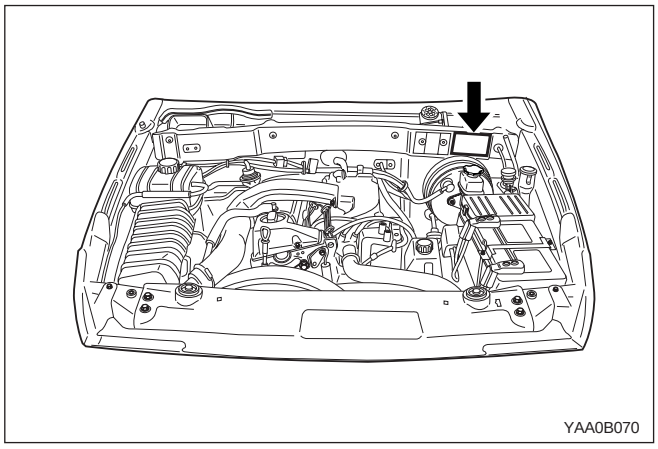


Manufacturer's Plate Location

Gasoline Engine

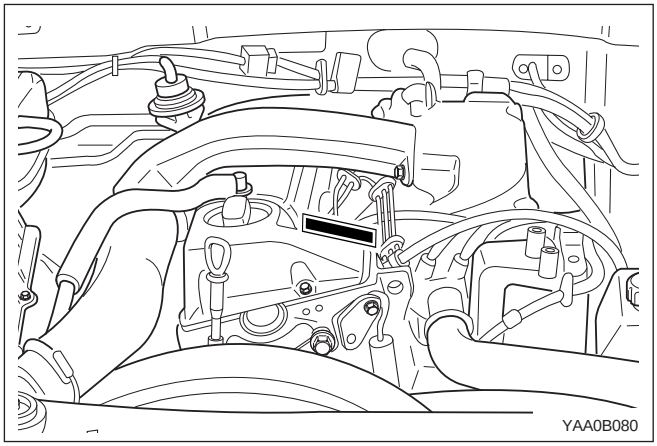


Diesel Engine

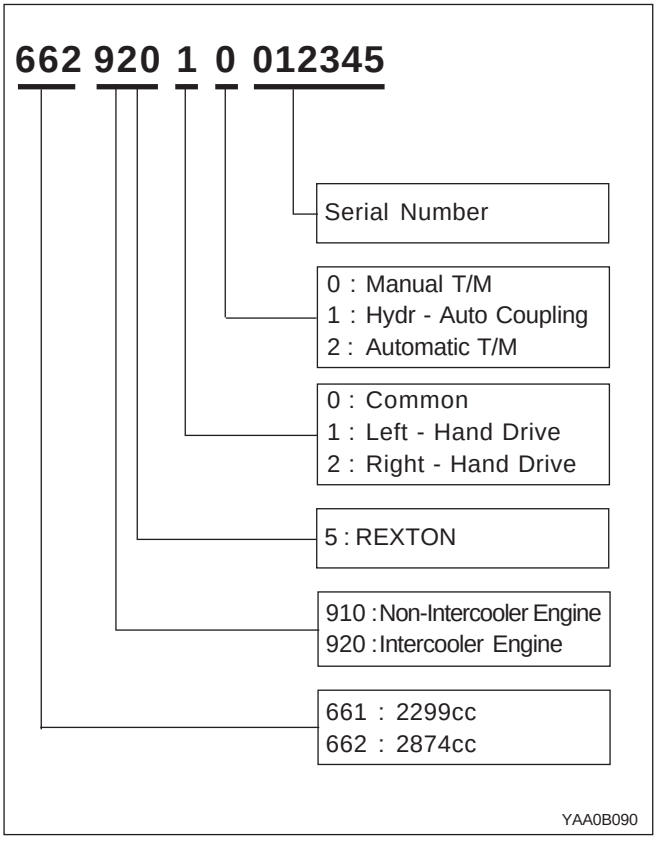


ENGINE NUMBER

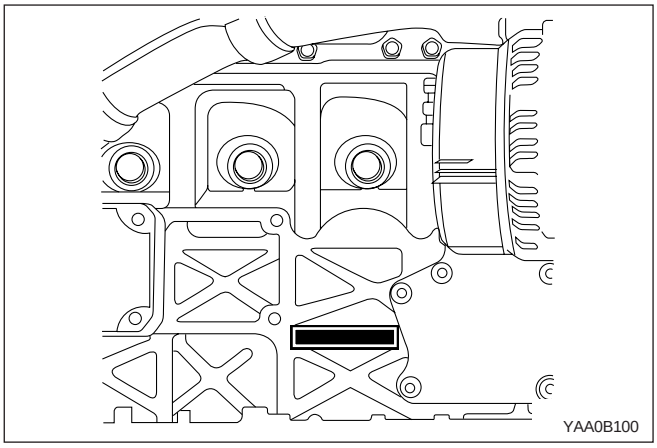
Diesel Engine



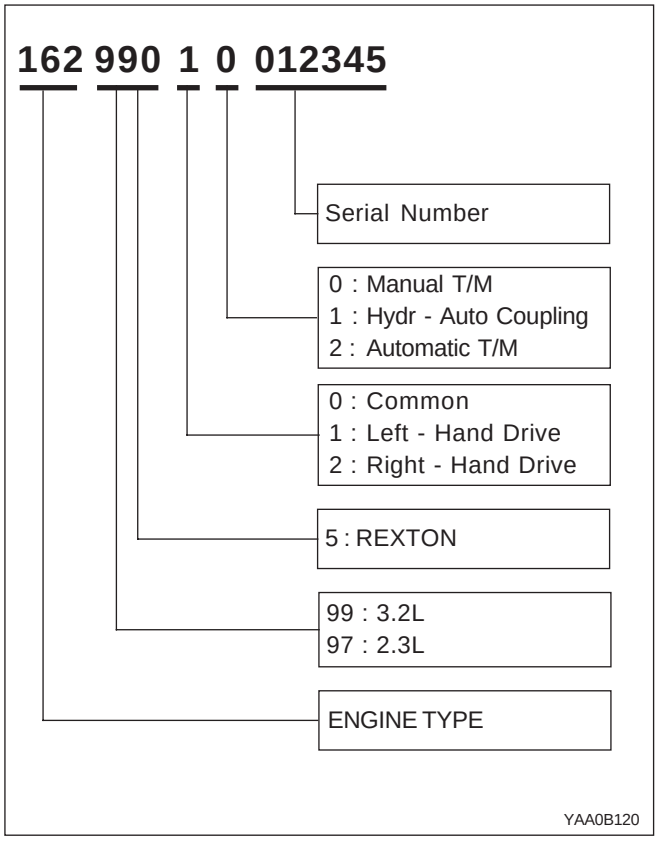
The engine number is stamped on the cylinder block in front of injection pump.



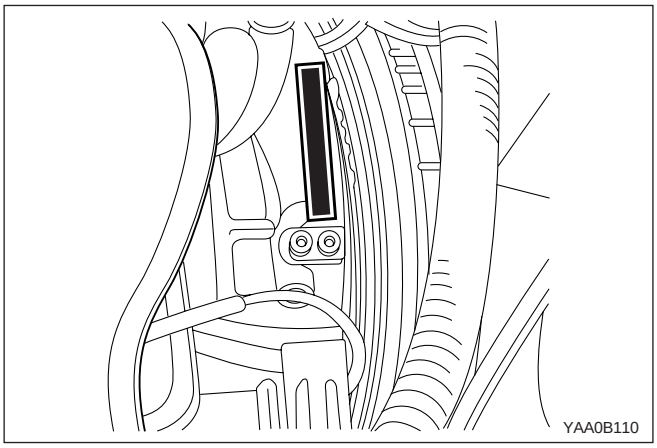
Gasolind Engine (3.2L DOHC)



- The engine number is stamped on the lower rear side of the alternator.



Gasolind Engine (2.3L DOHC)



- The engine number is stamped on the upper rear left-hand side of the cylinder block.

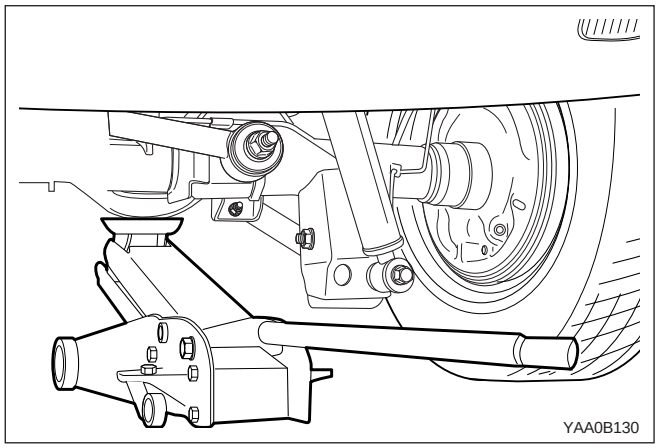
VEHICLE LIFTING PROCEDURES

To raise the vehicle, place the lifting equipment only at the points indicated. Failure to use these precise positions may result in permanent vehicle body deformation.

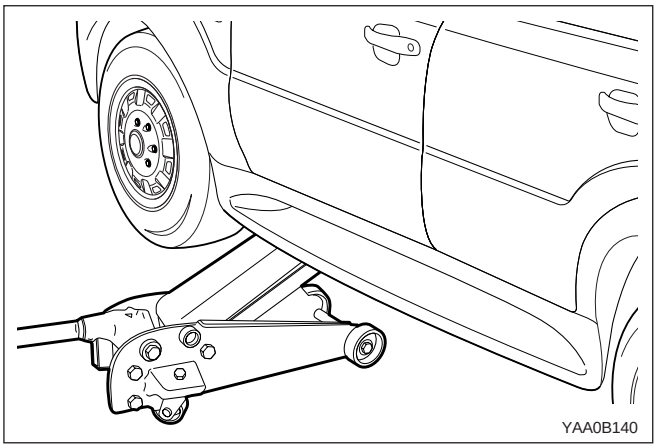
Many dealer service facilities and service stations are equipped with automative hoists that bear upon some parts of the frame in order to lift the vehicle. If any other hoist method is used, take special care to avoid damaging the fuel tank, the filter neck, the exhaust system, or the underbody.

Using Floor Jack

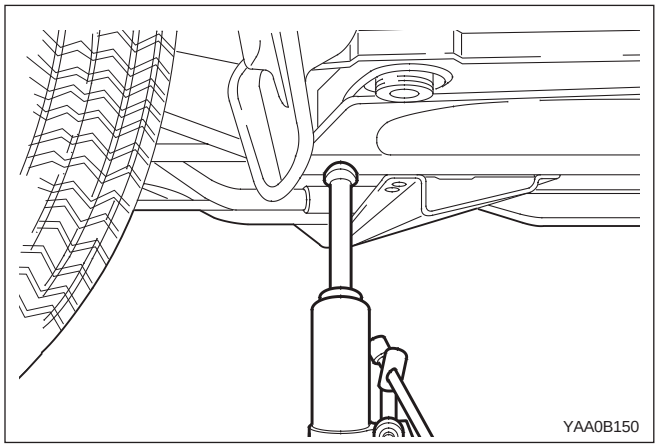
Front Side



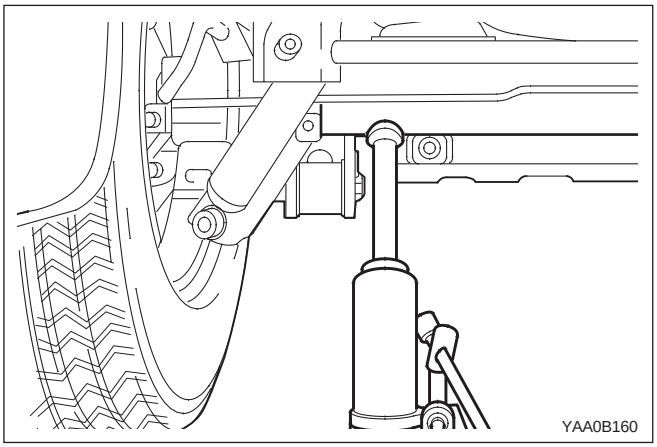
Rear Side



Using Jack



Rearward of Front Tire



Forward of Rear Tire

SECTION 1

ENGINE

SECTION 1A

ENGINE GENERAL INFORMATION

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DESCRIPTION AND OPERATION

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousanths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of enigne oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when they were removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

ON-ENGINE SERVICE

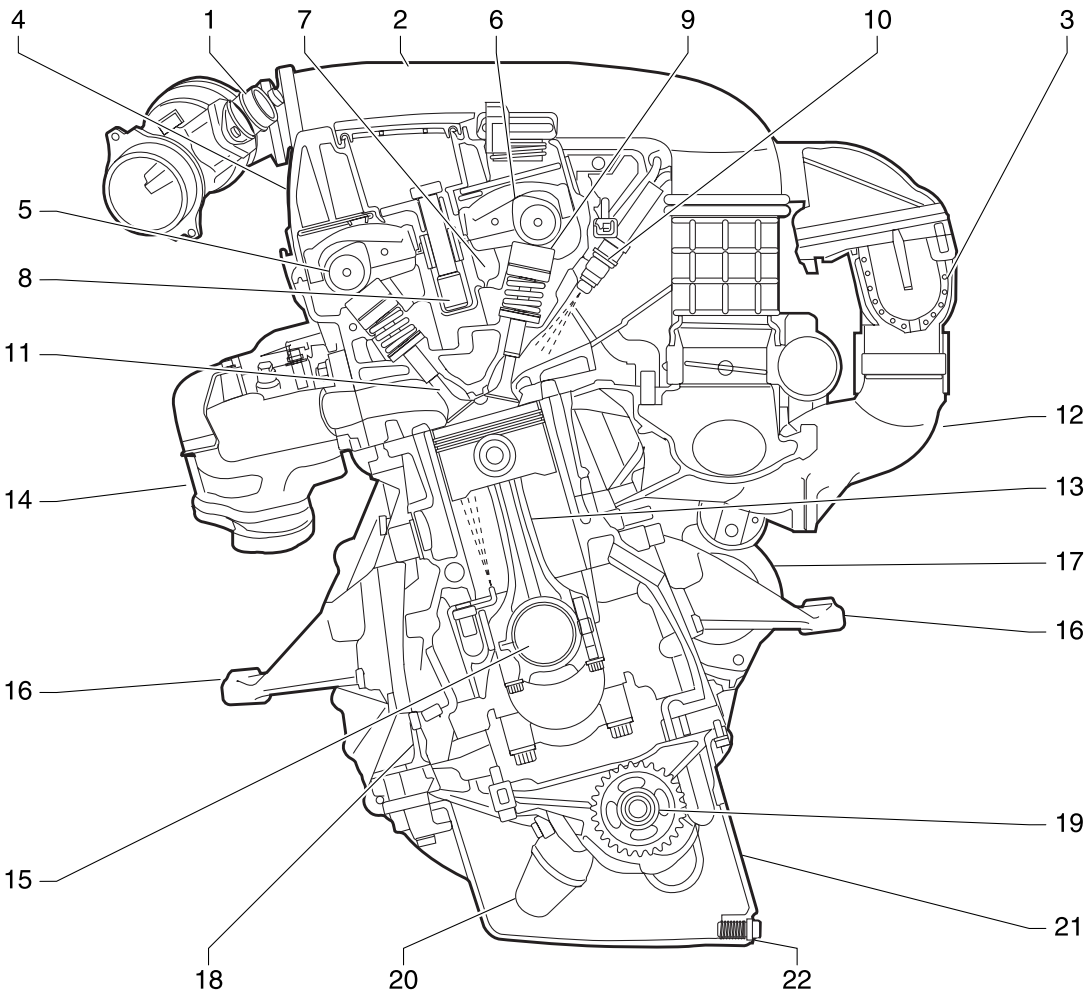
Caution: Disconnect the negative battery cable before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

Notice: Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

COMPONENT LOCATOR

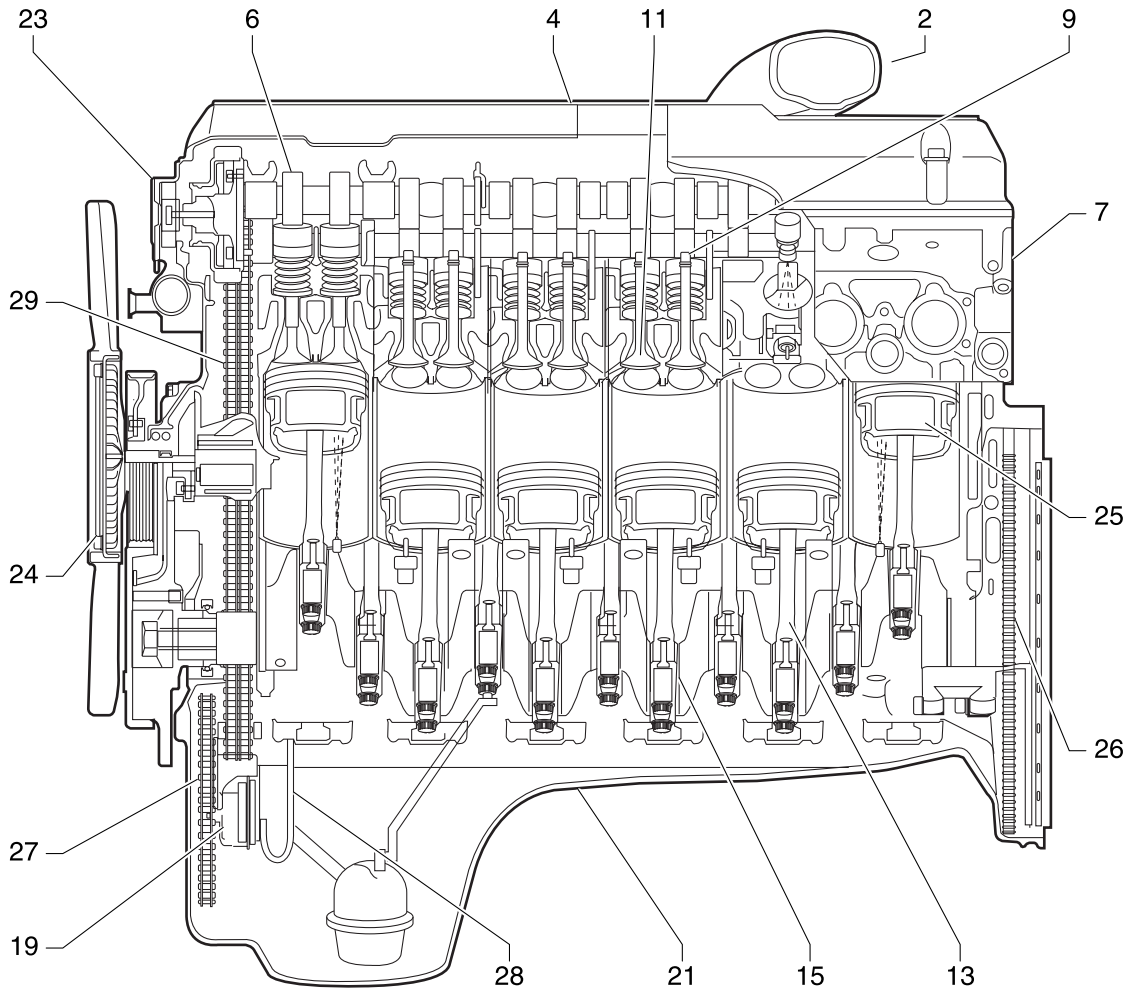
M162 ENGINE

Front View



1 HFM Sensor
2 Intake Air Duct
3 Resonance Flap
4 Cylinder Head Cover
5 Exhaust Camshaft
6 Intake Camshaft
7 Cylinder Head
8 Spark Plug Connector
9 Valve Tappet
10 Injector
11 Exhaust Valve
12 Intake Manifold
13 Connecting Rod
14 Exhaust Manifold
15 Crankshaft
16 Engine Mounting Bracket
17 Starter
18 Crankcase
19 Oil Pump Sprocket
20 Oil Strainer
21 Oil Pan
22 Drain Plug

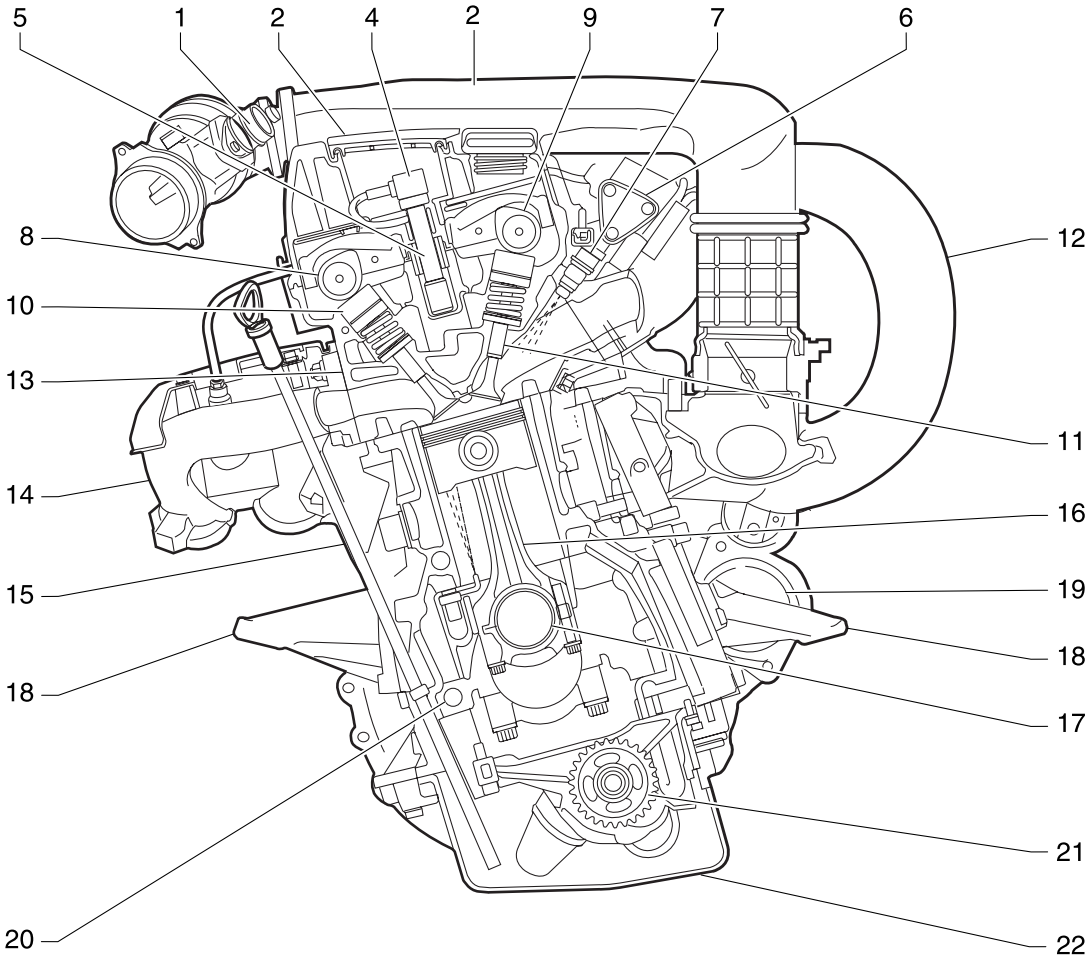
Side View



23 Camshaft Adjuster
24 Cooling Fan and Viscous Clutch
25 Piston
26 Flywheel of Drive Plate
27 Oil Pump Drive Chain
28 Oil Return Pipe
29 Timing Chain
30 Oil Pump

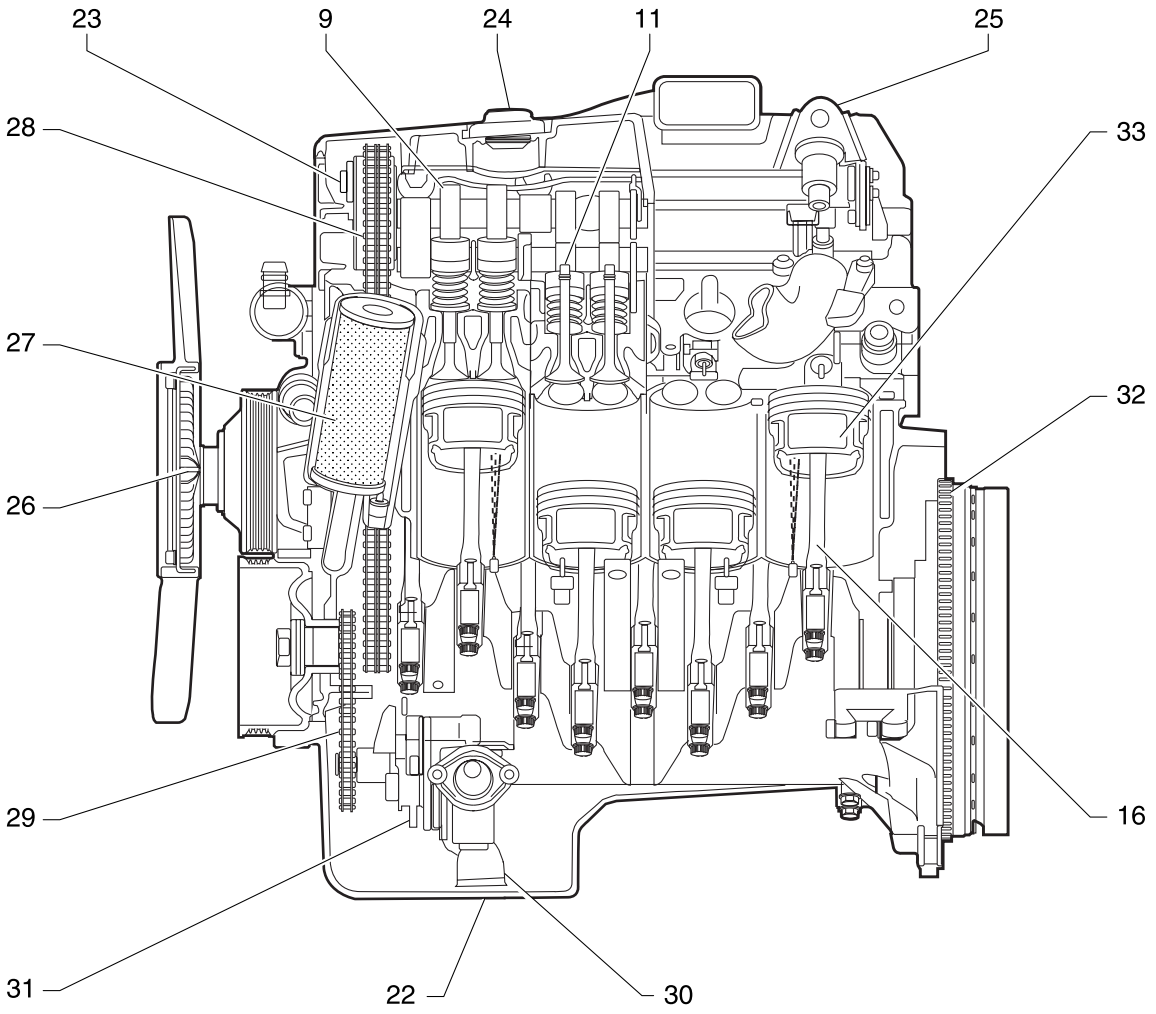
M161 ENGINE

Front View



1 HFM Sensor
2 Intake Air Duct
3 Cylinder Head Cover
4 Ignition Coil
5 Spark Plug Connector
6 Fuel Distributor
7 Injector
8 Exhaust Camshaft
9 Intake Camshaft
10 Valve Tappet
11 Intake Valve
12 Intake Manifold
13 Cylinder Head
14 Exhaust Manifold
15 Dipstick Guide Tube and Gauge
16 Connecting Rod
17 Crankshaft
18 Engine Mounting Bracket
19 Starter
20 Crankcase
21 Oil Pump Sprocket
22 Oil Pan

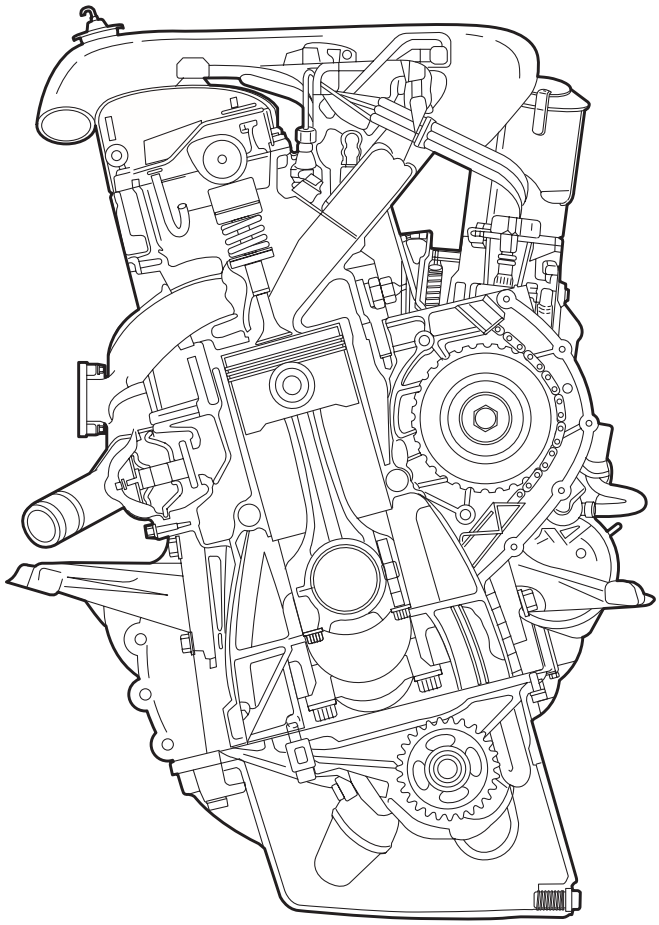
Side View



23 Camshaft Adjuster
24 Oil Filler Cap
25 Engine Hanger Bracket
26 Cooling Fan and Viscous Clutch
27 Oil Filter
28 Timing Chain
29 Oil Pump Drive Chain
30 Oil Strainer
31 Oil Pump
32 Ring Gear and Flywheel of Drive Plate
33 Piston

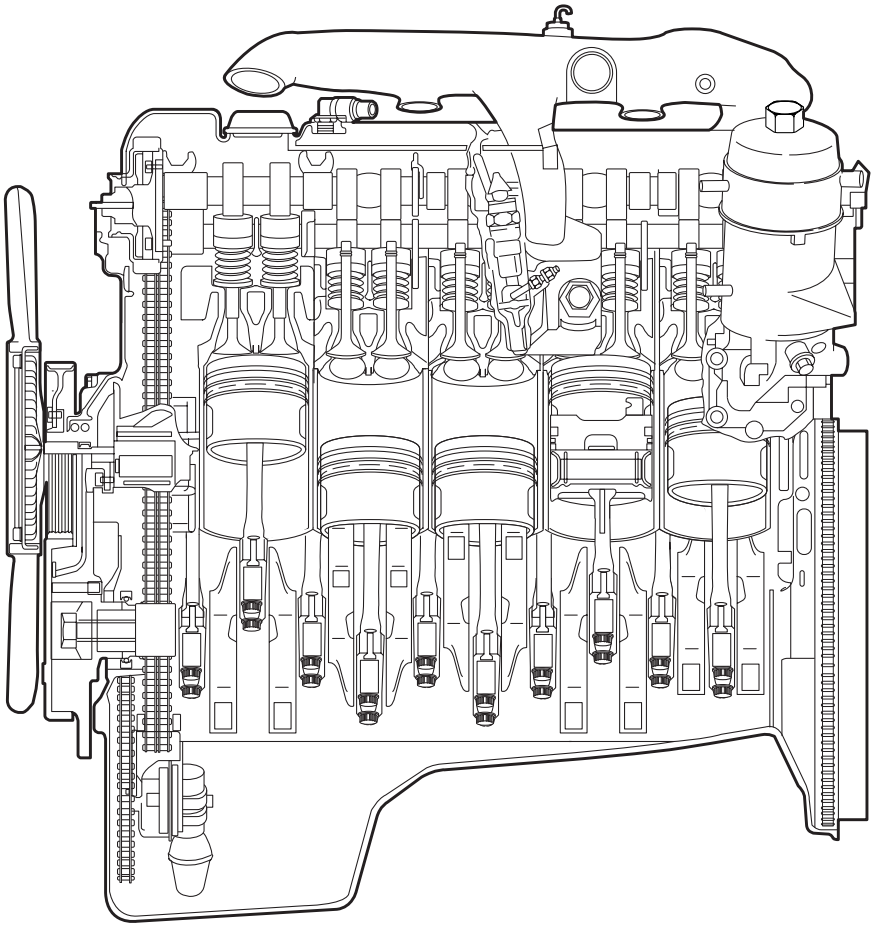
DIESEL ENGINE

Front View



YAD1A050

Side View



YAD1A060

DIAGNOSTIC INFORMATION AND PROCEDURE

OIL LEAK DIAGNOSIS

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedures may help you in locating and repairing most leaks.

Finding the Leak

1. Identify the fluid. Determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. Identify where the fluid is leaking from.
   - 2.1 After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper.
   - 2.2 Wait a few minutes.
   - 2.3 You should be able to find the approximate location of the leak by the drippings on the paper.
3. Visually check around the suspected component. Check around all the gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
4. If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent.
   - 4.1 Clean the area well.
   - 4.2 Dry the area.
   - 4.3 Operate the vehicle for several miles at normal operating temperature and varying speeds.
   - 4.4 After operating the vehicle, visually check the suspected component.
   - 4.5 If you still cannot locate the leak, try using the powder or black light and dye method.

Powder Method

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditoins.
4. Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

Black Light and Dye Method

A dye and light kit is available for finding leaks, Refer to the manufacturer's directions when using the kit.

1. Pour the specified amount of dye into the engine oil fill tube.
2. Operate the vehicle normal operating conditions as directed in the kit.
3. Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

Repairing the Leak

Once the origin of the leak has been pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check for the following conditions and correct them as they may cause a leak.

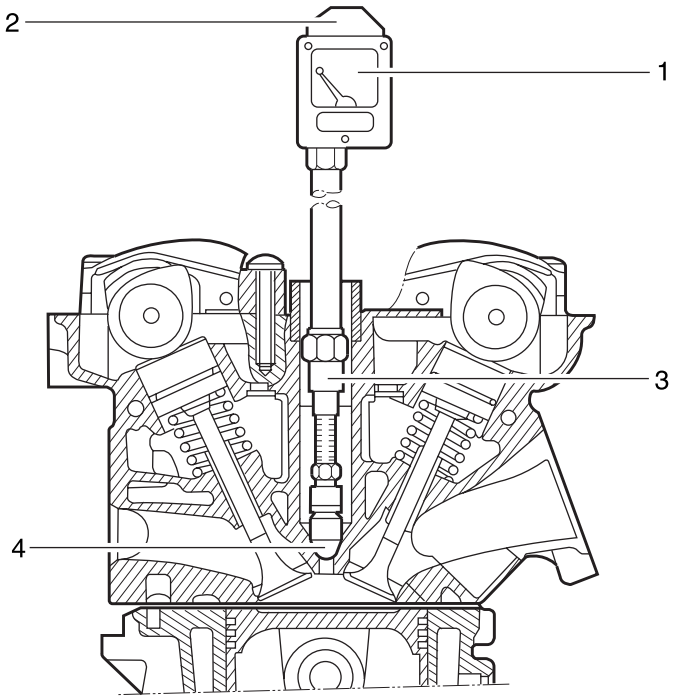
Gaskets

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The fasteners are tightened improperly or the threads are dirty or damaged.
- The flanges or the sealing surface is warped.
- There are scratches, burrs or other damage to the sealing surface.
- The gasket is damaged or worn.
- There is cracking or porosity of the component.
- An improper seal was used (where applicable).

Seals

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The seal bore is damaged (scratched, burred or nicked).
- The seal is damaged or worn.
- Improper installation is evident.
- There are cracks in the components.
- The shaft surface is scratched, nicked or damaged.
- A loose or worn bearing is causing excess seal wear.

COMPRESSION PRESSURE TEST (GASOLINE ENGINE)



YAD1A070

1 Compression Pressure Tester
2 Diagram Sheet
3 Adaptor
4 Sealing Cone

Standard Service Data

Application	M162 Engine	M161 Engine
Compression Ratio	10 : 1	10.4 : 1
Normal Engine Temperature	80 °C (176 °F)	←
Normal Compression Pressure	Min. 10 bar, Max. 14 bar	Min. 11 bar, Max. 15 bar
Permissible Pressure Difference Between Individual Cylinders	Max. 1.5 bar	←

Tools Required

001 589 76 21 00 Compression Pressure Tester

119 589 01 09 00 Spark Plug Wrench

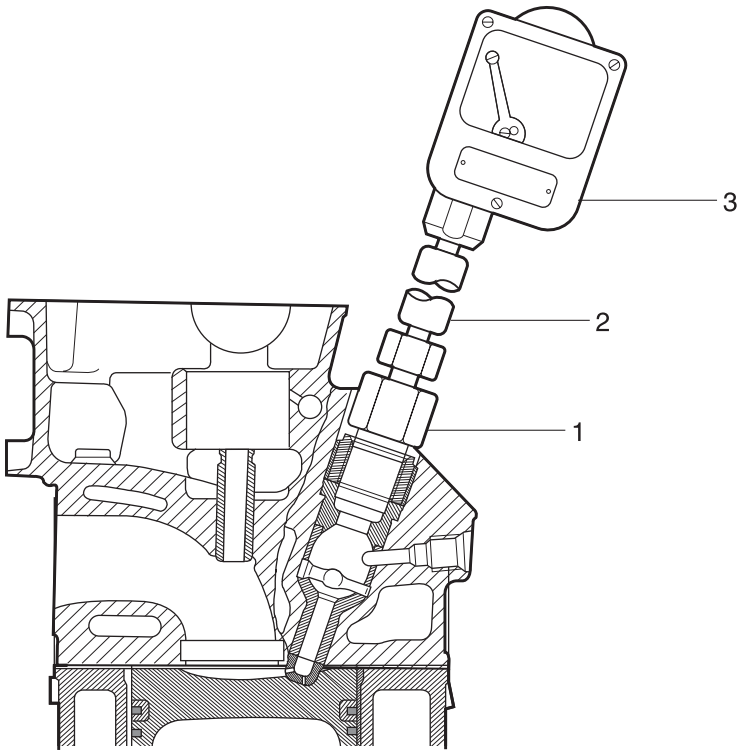
Measuring Procedure

1. Warm the engine up to normal operating temperature.
2. Remove the spark plugs using the spark plug wrench 119 589 01 09 00.
3. Place the diagram sheet to compression pressure tester 001 589 76 21 00.
4. Connect the adaptor to compression pressure tester 001 589 76 21 00 and install it into the spark plug hole.
5. Crank the engine approx. eight revolutions by using the start motor.
6. Compare the measurements of compression pressure tester 001 589 76 21 00 with the specifications.
7. Measure the compression pressure of the other cylinders in the same way.
8. If measured value is not within the specifications, perform the cylinder pressure leakage test.

Notice:

- Discharge the combustion residues in the cylinders before testing the compression pressure.
- Apply the parking brake before cranking the engine.

COMPRESSION PRESSURE TEST (DIESEL ENGINE)

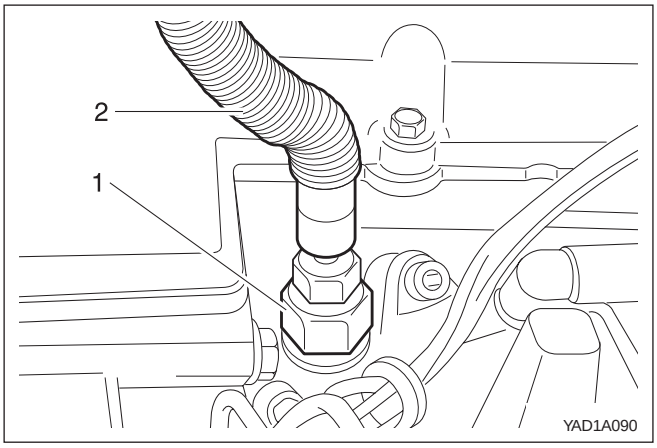


YAD1A080

1 Test Adaptor
2 Flexible Connector
3 Compression Pressure Tester

Standard Service Data

Compression Ratio	22 : 1
Normal Engine Temperature	80 °C (176 °F)
Normal Compression Pressure	28bar
Minimum Compression Pressure	Approx.18bar
Permissible Pressure Difference Between Individual Cylinders	Max. 3bar



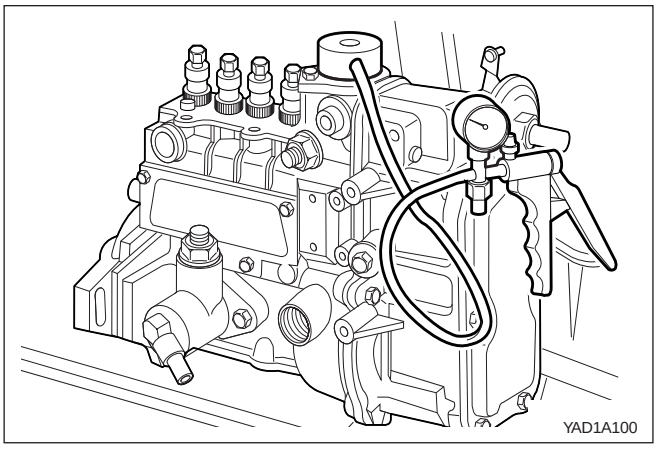
Tools Required

001 589 76 21 00 Compression Pressure Tester
001 589 73 21 00 Hand Vacuum Pump
601 589 65 09 00 Socket

Measuring Procedure

Notice: Ensure that no gear is engaged and that the vehicle is protected from rolling.

1. Run the engine to be the coolant temperature 80 °C (176 °F).
2. Remove the fuel injection nozzle.
3. Install the test adapter (1) and connect the flexible connector (2) to the compression pressure tester 001 589 76 21 00.



4. Disconnect the vacuum line from the stop unit and connect the hand vacuum pump 001 589 73 21 00 to the stop unit.
5. Pump the hand vacuum pump 001 589 73 21 00 and make the fuel injection pump in stop position.

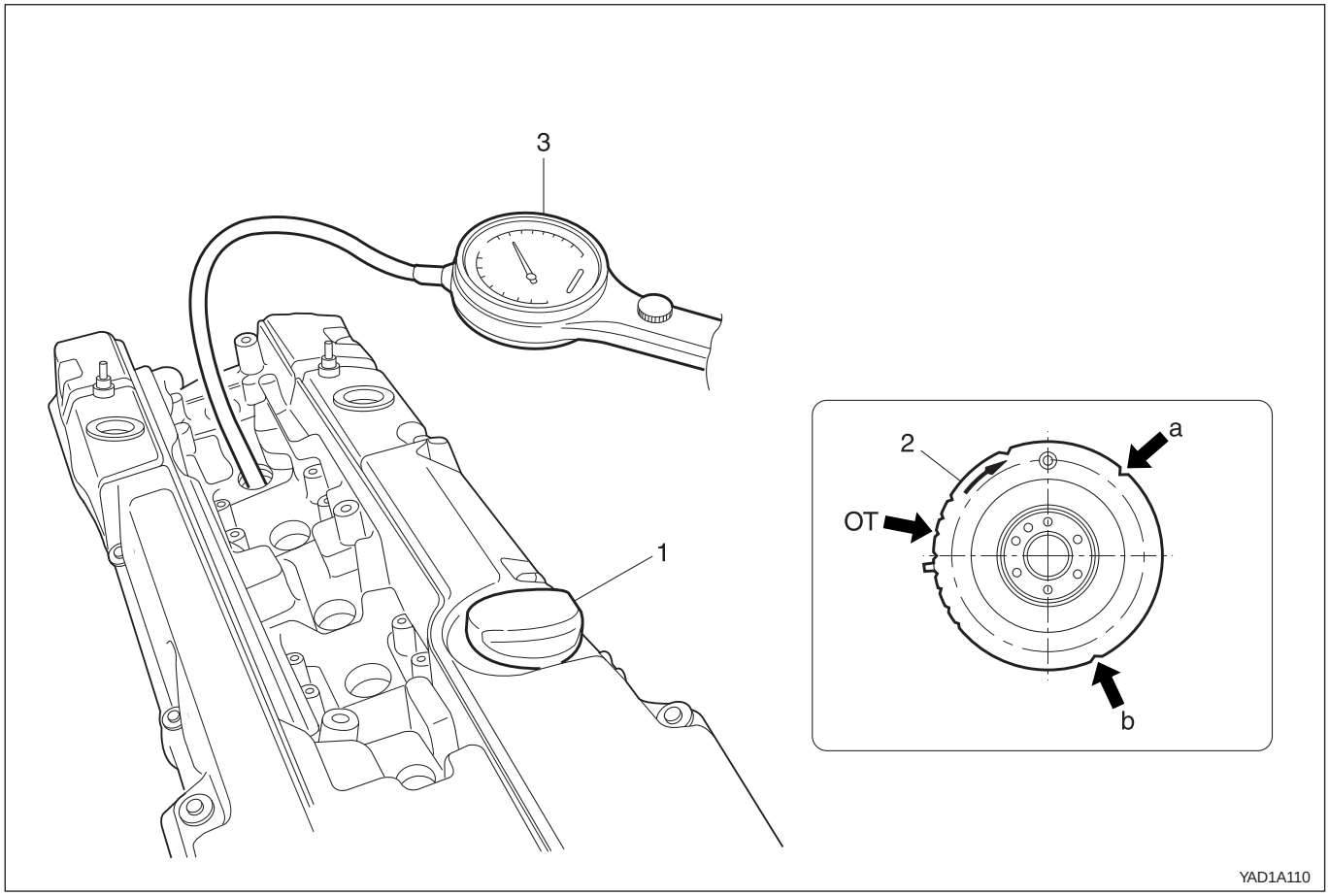
Operating Pressure	Approx. 500bar

6. Using a starter motor, crank the engine 8 revolutions.
7. Measure the remaining cylinder compression pressure in the same manner and compare it with service data.

   Notice: If out of standard, do cylinder pressure leakage test.

8. Remove the compression pressure tester 001 589 76 21 00.
9. Install the fuel injection nozzle.

CYLINDER PRESSURE LEAKAGE TEST (GASOLINE ENGINE)



1 Engine Oil Filler Cap
2 Vibration Damper
3 Cylinder Pressure Leakage Tester with Connecting Hose

Permissible Pressure Leakage

At Whole Engine	Max. 25 %
At Valve and Cylinder Head Gasket	Max. 10 %
At Piston and Piston Ring	Max. 20 %

Cylinder Number By Mark On Vibration Damper At TDC

TDC Mark (M162 Engine)	**OT (TDC)**	**a (120 °)**	**b (240 °)**
Cylinder Number	1, 6	2, 5	3, 4
TDC Mark (M161 Engine)	**OT (TDC)**		**UT (BDC 180 °)**
Cylinder Number	1, 4		2, 3

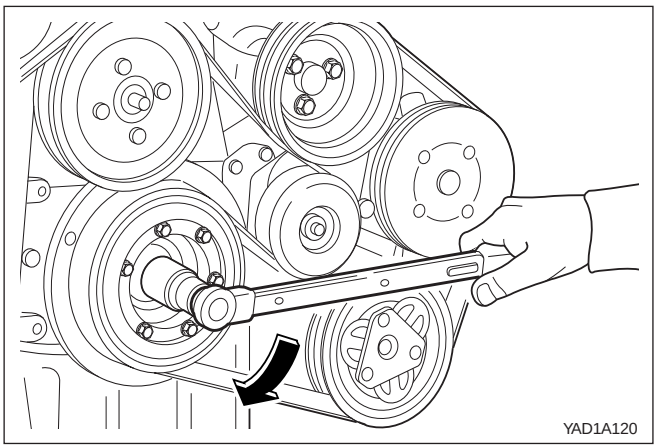
Universal Tool

Cylinder Pressure Leakage Tester	Bosch, EFAW 210A Sun, CLT 228

Leakage Test

1. Warm the engine up to normal operating temperature.
2. Disconnect the negative battery cable.
3. Remove the spark plugs.
4. Check the coolant level by opening the coolant reservoir cap and replenish if insufficient.
5. Open the engine oil filler cap.
6. Connect the tester to air pressure line and adjust the scale of tester.
7. Install the connecting hose to spark plug hole.

M162 Engine



8. Position the piston of No.1 cylinder at TDC by rotating the crankshaft.
9. Connect the connecting hose to tester and measure the leakage volume after blowing up 5 bar of compressed air.

   Notice: Measure the leakage volume in the completely opening condition of throttle valve by pulling the acceleration cable.

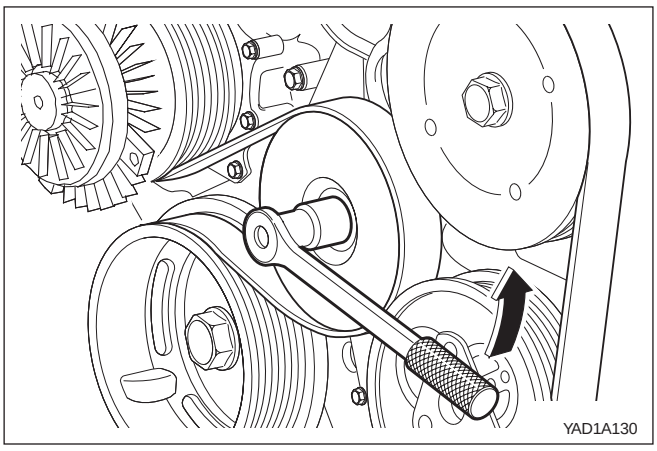
10. Perform the pressure test according to the firing order.

    Notice:

    Firing Order

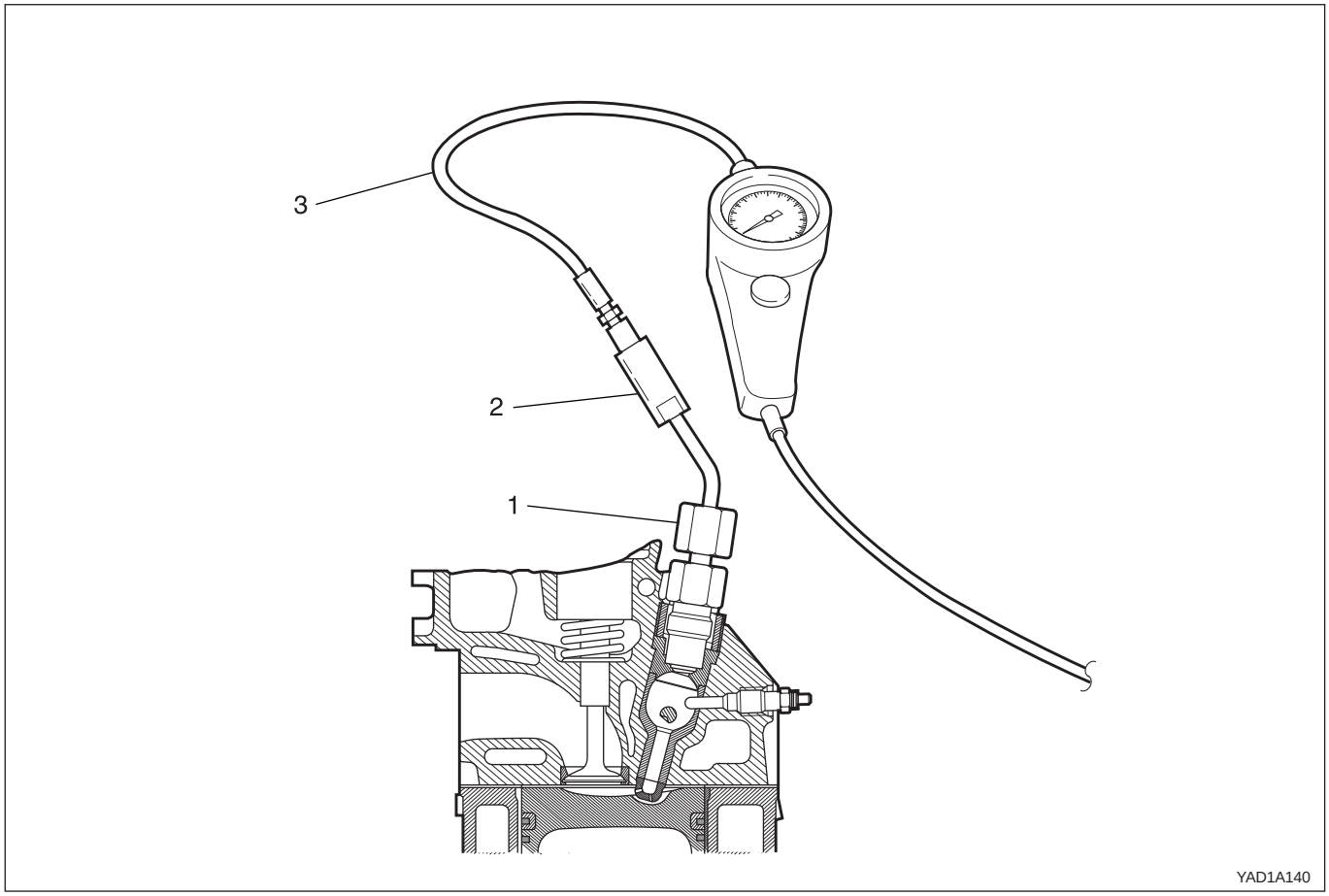
    - M162 Engine: 1 - 5 - 3 - 6 - 2 - 4
    - M161 Engine: 1 - 3 - 4 - 2

M161 Engine



11. Compare the leakage pressure with the specifications.

CYLINDER PRESSURE LEAKAGE TEST (DIESEL ENGINE)



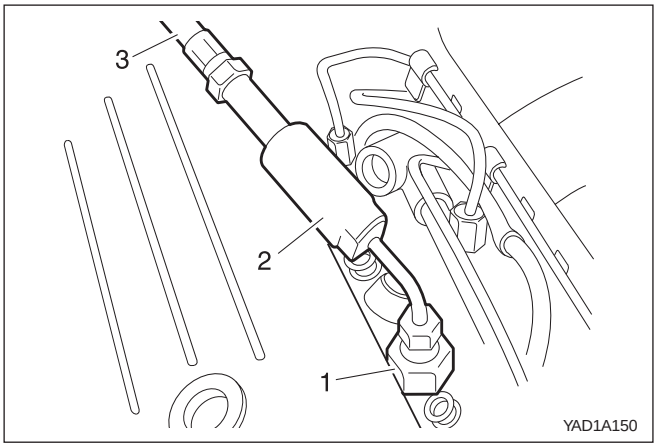
1 Connector
2 Connection Piece
3 Connection Hose

Permissible Pressure Leakage (Engine at Normal Operating Temperature of 80°C)

At Whole Engine	Max. 25 %
At Valve and Cylinder Head Gasket	Max. 10 %
At Piston and Piston Ring	Max. 20 %

Universal Tools

Cylinder Pressure Leakage Tester	Bosch, EFAW 210 A or Sun CLT 228
Connection Piece	Bosch order no. 1 687 010 016



Leakage Test

1. Run the engine to be the coolant temperature 80 °C (176 °F).
2. Remove the fuel injection nozzle.
3. Open the coolant reservoir.
4. Check the coolant level and replenish if necessary.
5. Open the oil filler cap.
6. Remove the air cleaner cover and element.
7. Position the piston at TDC.
8. Install the connector (1) and connection piece (2).
9. Calibrate the tester and connect the connection hose (3)
10. Pressurize with compressed air and compare the pressure changes with permissible pressure leakage.
11. If permissible pressure leakage is out of standard, check followings :
    - Intake and exhaust lines.
    - Sounds in oil filler area.
    - Air bubbles in radiator coolant.
12. Do pressure leakage test for the remaining cylinders according to the firing order.
    - firing order: 1-2-4-5-3
13. Remove the tester.
14. Close the coolant reservoir cap and oil filler cap.
15. Install the air cleaner element and cover.
16. Install the fuel injection nozzle.

GENERAL DIAGNOSIS

Condition		Probable Cause	Correction
Hard Starting (With normal cranking)	Malfunction of Ignition System	• Faulty fuse.	• Replace the fuse.
		• Faulty spark plug.	• Clean, adjust the plug gap or replace.
		• Electric leakage at the high tension cable.	• Replace the cable.
		• Poor connection of the high tension cable or lead wires.	• Replace the cable or wires.
		• Improper ignition timing.	• Adjust the ignition timing.
		• Faulty ignition coil.	• Replace the ignition coil.
	Malfunction of Fuel System	• Lock of fuel in the fuel tank.	• Feed the fuel.
		• Dirty or clogged fuel filter.	• Replace the filter.
		• Clogged fuel pipe.	• Clean the fuel pipe.
		• Malfunction of the fuel pump.	• Replace the fuel pump.
		• Malfunction of the fuel injector.	• Replace the injector.
		• The foreign material in the fuel tank.	• Clean the fuel tank.
	Decline of Compression Pressure	• Poor tightening spark plug.	• Tighten to the specified torque. Compression
		• Cracked cylinder head gasket.	• Replace the gasket.
		• Inadequate the valve clearance.	• Adjust the clearance.
		• Leakage of the valve clearance.	• Repair the valve.
		• Interference of the valve stem.	• Replace the valve or the valve guide.
		• Low elasticity or damage of the valve spring.	• Replace the valve spring.
		• Abnormal interference of pistons and cylinders.	• Replace the piston ring.
		• Excessive wear of pistons, rings, or cylinders.	• Replace the ring or the piston and boring or replace the cylinder.
	Others	• Broken timing belt.	• Replace the belt.
		• Loosening, damage or leakage of the vacuum hose.	• Connect the hose correctly or replace it.
		• Leakage of intake system.	• Replace intake system.
Lack of Engine Power	Decline of Compression Pressure	• Refer to above in this page.	• Refer to above in this page.
	Malfunction of Ignition System	• Improper ignition timing.	• Adjust the ignition timing.
		• Faulty spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.

General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Lack of Engine Power	Malfunction of Fuel System	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
	Others	• Clogged exhaust system.	• Check and repair the system.
		• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
		• Dragging brakes.	• Repair or replace the brakes.
Rough Engine Idling	Decline of Compression Pressure	• Refer to "Page 1A-10".	• Refer to "Page 1A-10".
	Malfunction of Fuel System	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
		• Malfunction of the fuel pressure regulator.	• Replace the regulator.
	Malfunction of Ignition System	• Malfunction of the spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
		• Poor ignition timing.	• Adjust the ignition timing.
		• Malfunction of the ignition coil.	• Replace the ignition coil.
	Others	• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
		• Poor connection or damage or leakage of the vacuum hose.	• Connect the hose correctly or replace it.
Engine Hesitate (Upon pressing accelerating pedal, the engine makes delayed response This situation is remarkable when cruising or starting.)	Decline of Compression Pressure	• Refer to "Page 1A-10".	• Refer to "Page 1A-10".
	Malfunction of Ignition System	• Poor ignition timing.	• Adjust the ignition timing.
		• Poor spark plug or Poor adjustment of the plug gap.	• Replace the plug or adjust the gap.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
	Others	• Malfunction of the air cleaner system.	• Clean or replace the air cleaner system.
		• Leak of the intake manifold gasket.	• Replace the gasket.

General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Engine Surging (Engine power makes fluctuation in a fixed speed and speed changes without operating the accelerating pedal.)	Decline of Compression Pressure	• Refer to "Page 1A-10".	• Refer to "Page 1A-10".
	Malfunction of Fuel System	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
		• Malfunction of the fuel pressure regulator.	• Replace the fuel pressure regulator.
	Malfunction of Ignition System	• Malfunction of the spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
		• Poor ignition timing.	• Adjust the ignition timing.
	Others	• Leak of the intake manifold gasket.	• Clean or replace the gasket.
		• Leakage of the vacuum hose.	• Connect the hose correctly or replace it.
Excessive Detonation (According to the opening range of Malfunction of metallic is made with abnormal explosion)	Overtheated Engine	• Refer to "Overheat" in this page.	• Refer to "Overheat" in this page.
	Malfunction of Fuel System	• Abnormal spark plug.	• Replace the spark plug.
		• Poor ignition timing.	• Adjust the ignition timing
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
	Malfunction of Ignition System	• Clogged or contaminated fuel filter and fuel pipe.	• Clean or replace the fuel filter and the fuel pipe.
	Others	• Leak of the intake manifold gasket.	• Replace the gasket.
		• Excessive carbon deposit due to abnormal combustion.	• Remove the carbon.
Overheat	Malfunction of Cooling System	• Lack of coolant.	• Refill coolant.
		• Malfunction of the thermostat.	• Replace the thermostat.
		• Malfunction of the cooling fan.	• Check or replace the cooling fan.
		• Poor water pump performance.	• Replace the pump.
		• Clogged or leaky radiator.	• Clean, repair or replace the radiator.
	Malfunction of Lubrication System	• Poor engine oil.	• Replace engine oil with the specified one.
		• Blocking oil filter or strainer.	• Clean or repair the oil filter or the strainer.
		• Lack of engine oil.	• Refill oil.
		• Poor oil pump performance.	• Replace or repair the pump.
	Other	• Leakage of oil	• Repair.
		• Damaged cylinder head gasket.	• Replace the gasket.

General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Poor Fuel Consumption	Decline of Compression Pressure	• Refer to "Page 1A-10".	• Refer to "Page 1A-10".
	Malfunction of Fuel System	• Leakage of the fuel tank or the fuel pipe.	• Repair or replace the fuel tank or the fuel pipe
	Malfunction of Ignition System	• Improper ignition timing.	• Adjust the ignition timing.
		• Abnormal spark plug (Excessive carbon deposit, inadequate gap, burnt electrode).	• Replace the plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable normally or replace it.
	Malfunction of Cooling System	• Malfunction of the thermostat.	• Repair the thermostat.
	Others	• Improperly installed valve.	• Repair or replace the valve.
		• Low pressure of tires.	• Adjust the pressure of tires.
Excessive Consumption of Engine Oil	Leakage of Engine Oil	• Loosened oil drain plug.	• Tighten the plug.
		• Loosened oil pan bolt.	• Tighten the bolt. Engine Oil
		• Loosened oil filter.	• Tighten the filter.
		• Loosened oil pressure switch.	• Tighten the switch.
		• Leakage of camshaft front oil seal.	• Replace the seal.
		• Leakage of crankshaft front oil seal.	• Replace the seal.
		• Leakage at the cylinder head cover gasket.	• Replace the gasket.
		• Damage of the cylinder head gasket.	• Replace the gasket.
	Oil Mixing in Combustion Chamber	• Stuck piston ring.	• Remove carbon and replace the ring.
		• Worn piston or cylinder.	• Replace the piston or the cylinder.
		• Worn piston ring or ring groove.	• Replace the piston or ring.
		• Inadequate position of the piston ring cutting part.	• Adjust the position.
		• Abrasion or damage of the valve system.	• Replace the valve system.
Low Oil Pressure	Malfunction of Lubrication System	• Inadequate oil viscosity.	• Replace with the specified one.
		• Loosening of the oil pressure switch.	• Tighten the switch.
		• Lack of engine oil.	• Refill oil.
		• Blocking oil strainer.	• Clean the strainer.
		• Lowered function of the oil pump.	• Replace the pump.
		• Abrasion or damage of the oil pump relief valve.	• Replace the valve.

General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Engine Noise	Valve Noise	• Inadequate valve clearance	• Adjust the valve clearance.
		• Abrasion of valve stem or guide.	• Replace the valve stem or the guide.
		• Weak valve spring.	• Replace the spring.
	Piston, Ring, Cylinder Noise	• Abrasion of the piston, the ring or the cylinder.	• Boring the cylinder or replace the piston, the ring or the cylinder.
	Connecting Rod Noise	• Abrasion of the connecting rod bearing.	• Replace the bearing.
		• Loosened the connecting rod nut.	• Tighten to the specified torque
	Crankshaft Noise	• Abrasion of the crankshaft bearing.	• Replace the bearing.
		• Abrasion of the crankshaft journal.	• Grind or replace the crankshaft journal.
		• Loosened bearing cap bolt.	• Tighten to the specified torque.
		• Excessive clearance of the crankshaft thrust bearing.	• Adjust or replace.
		• Low oil pressure.	• Refer to "Page 1A-21" in this section.

SPECIFICATIONS

ENGINE SPECIFICATIONS

Application			M162 Engine	M161 Engine	Diesel Engine
Engine Model			M162.990	M161.970	Four-Stroke Diesel
Displacement (CC)			3199	2295	2874
Cylinder (Bore x Stroke) (mm)			89.9 x 84.0	90.9 x 88.4	89 x 92.4
Fuel Injection / Ignition System			MSE 3.63D	MSE 3.53D	PES 5 M55 C320 RS 168
Compression Ratio			10 : 1	10.4 : 1	22 : 1
Number of Cylinders			6	4	5
Camshaft Valve Arrangement			DOHC	DOHC	SOHC
Camshaft Drive Type			Chain-Driven	←	←
Max. Output (ps/rpm)			220 / 6000	149 / 5500	120 / 4000
Max. Torque (kg•m/rpm)			31.6 / 3900	22.4 / 4000	25.5 / 4000
Firing Order			1 - 5 - 3 - 6 - 2 - 4	1 - 3 - 4 - 2	1 - 2 - 4 - 5 - 3
Ignition Type			Distributorless Double Ignition	←	-
Ignition Timing			BTDC 8°	BTDC 6° ± 2°	BTDC 18° ± 10°
Valve Timing	Intake	Open/ Close	ATDC 11° / ABDC 34°	ATDC 13.15° / ABDC 13.57°	ATDC 11.33° / ABDC 17°
	Exhaust	Open/ Close	BBDC 31° / BTDC 14°	BBDC 16.58° / BTDC 17.05°	BBDC 28° / BTDC 15.25°
Valve Clearance Adjustment			Automatic Control	←	←
Idle Speed (rpm)			700 ± 50	750 ± 50	720 - 820
Fuel Injection Pressure (kg/cm²)			3 - 4	3.2 - 4.2	138 - 146
Oil Capacity (liter)			8.2	7.5	8.0 - 9.5
Lubrication Type			Forced by Gear Pump	←	←
Oil Filter Type			Full Flow with Paper Filter	←	Combined Full-Flow and Partial Flow Filter
Fuel			Unleaded Gasoline	←	Diesel

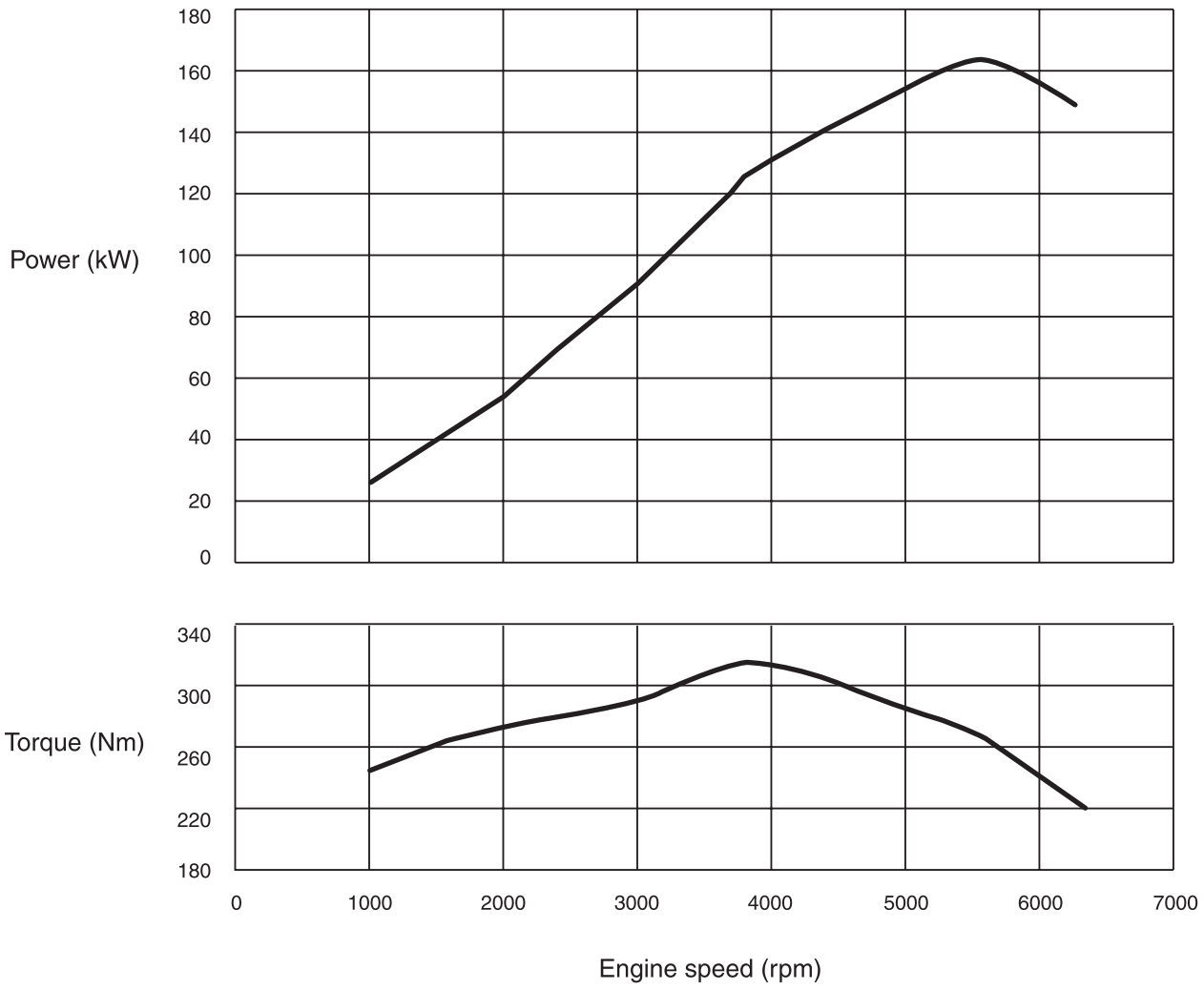
MSE : Engine Control Module

3.63D : 6 Cylinder Version

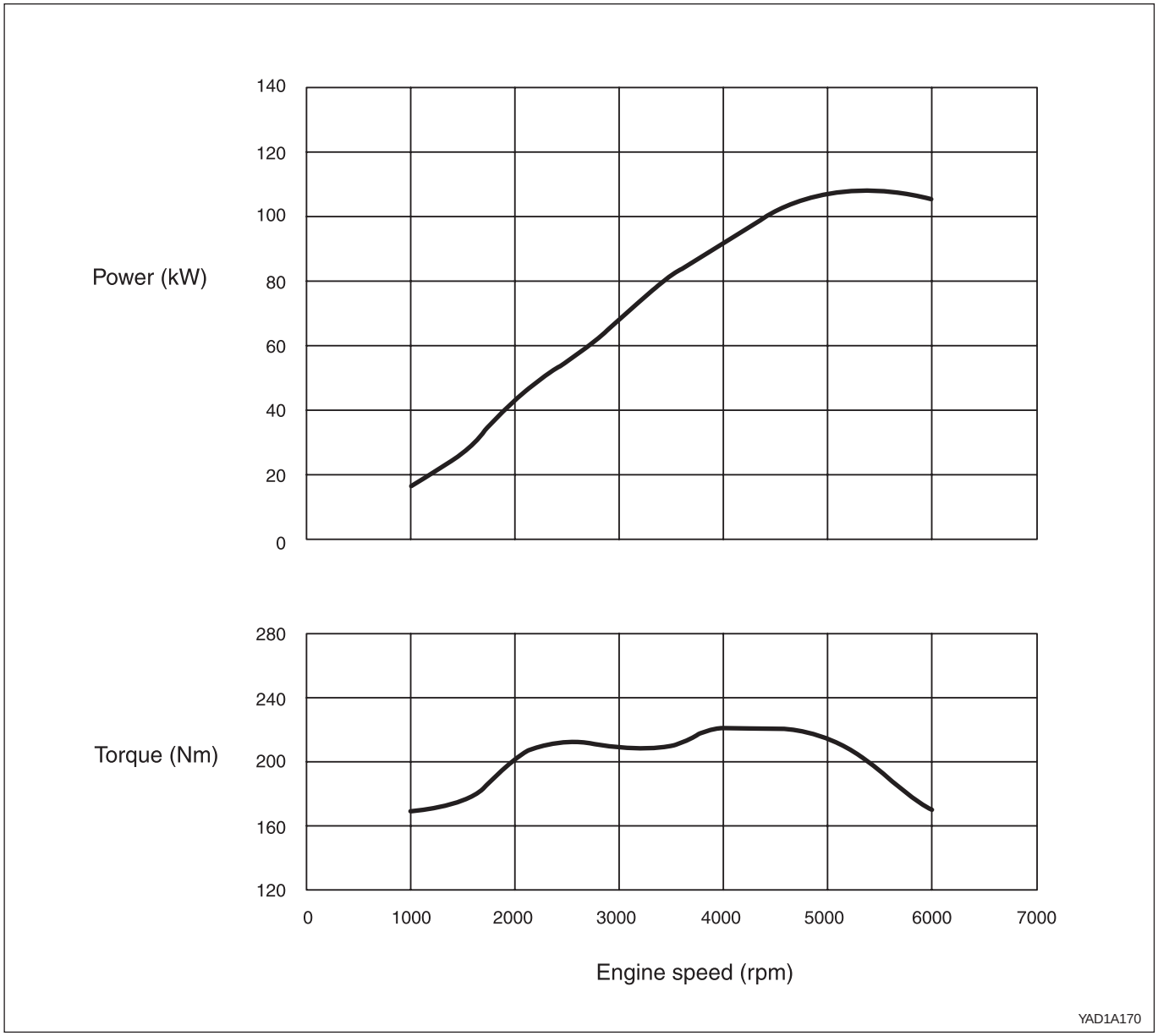
3.53D : 4 Cylinder Version

PERFORMANCE CURVE

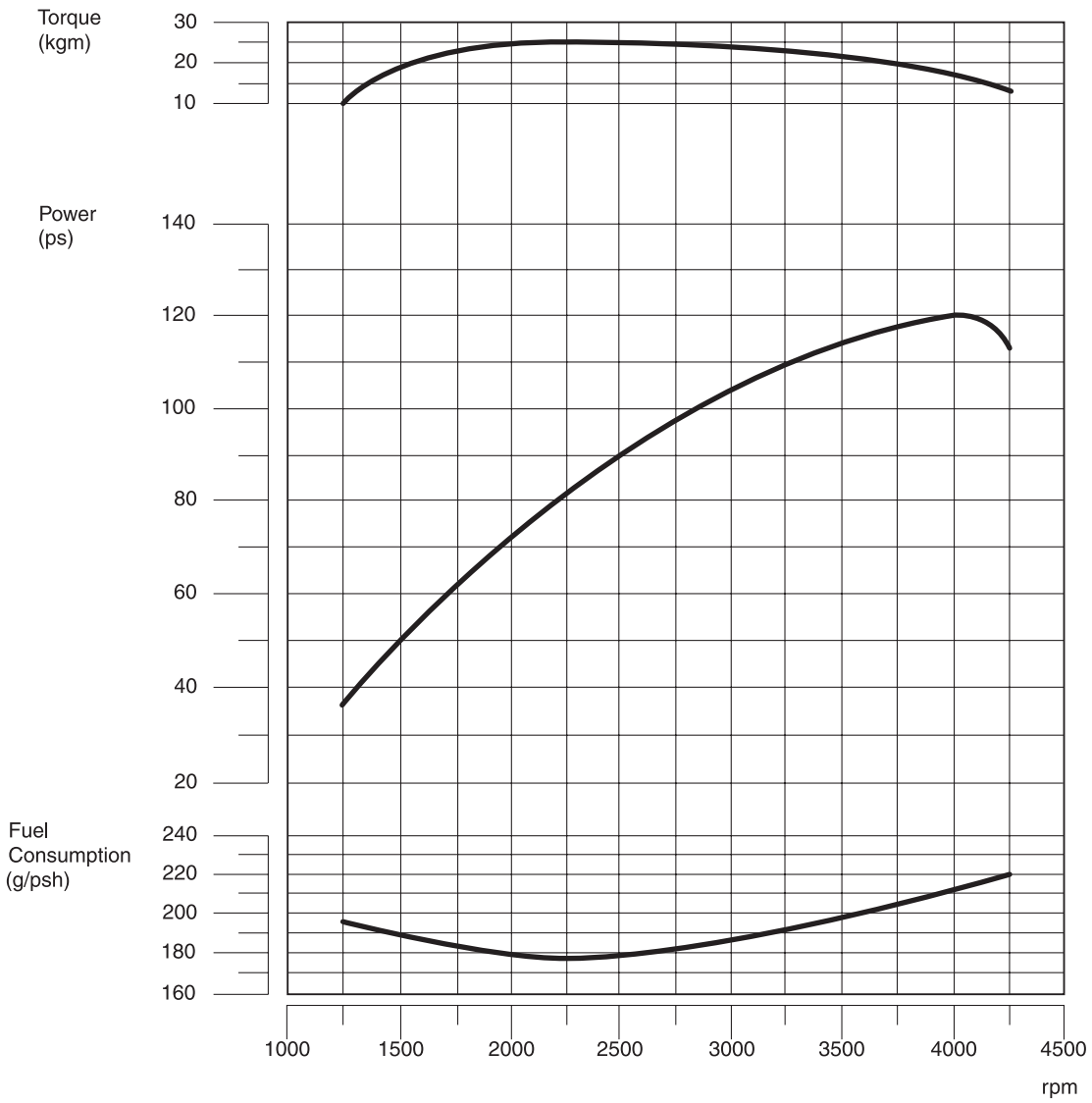
M162 Engine



M161 Engine

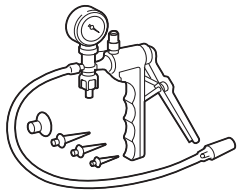
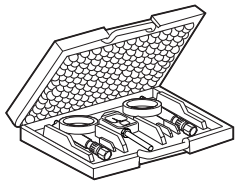
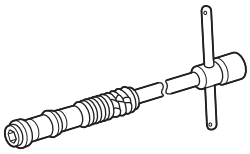
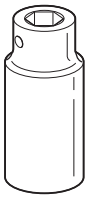

Power (kW)
140
120
100
80
60
40
20
0
Torque (Nm)
280
240
200
160
120
0
1000
2000
3000
4000
5000
6000
7000
Engine speed (rpm)
YAD1A170

Diesel Engine



SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD1A190	**001 589 73 21 00 Hand Vacuum Pump**
 YAD1A210	**001 589 76 21 00 Compression Pressure Tester**
 YAD1A220	**120 589 02 09 00 Spark PlugWrench**
 YAD1A200	**610 589 65 09 00 Socket**

SECTION 1B1

M162 ENGINE MECHANICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

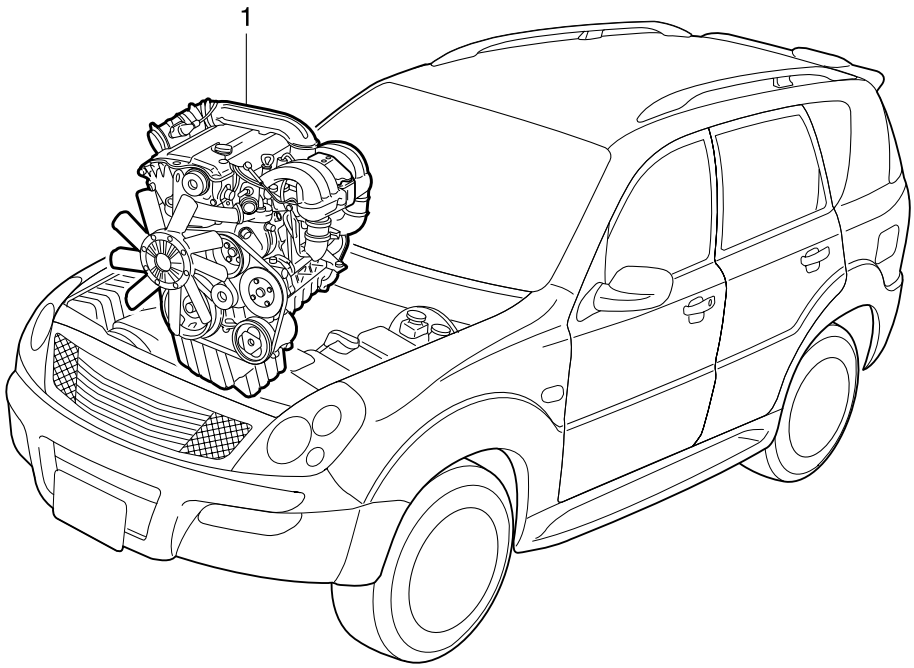
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REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE

ENGINE ASSEMBLY

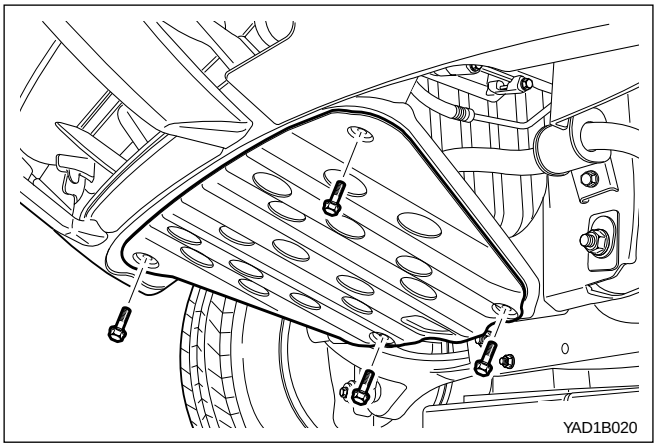


YAD1B010

1 Engine Assembly

Tools Required

000 589 10 99 01 Torque Wrench
000 589 40 37 00 Hose Clamp
112 589 00 72 00 Oil Extractor

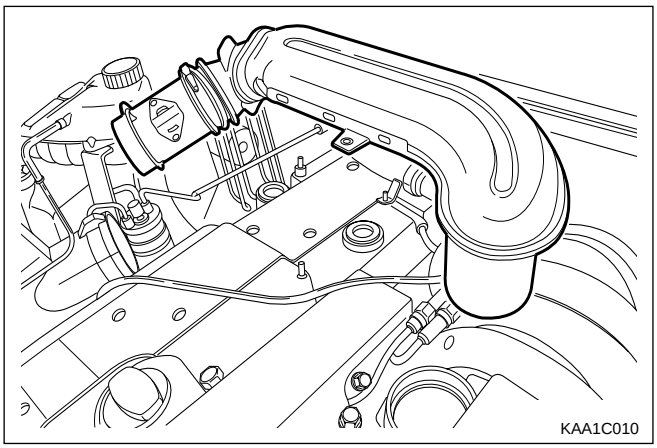


Removal & Installation Procedure

1. Disconnect the negative terminal of battery.
2. Remove the hood.
3. Remove the under cover.

Installation Notice

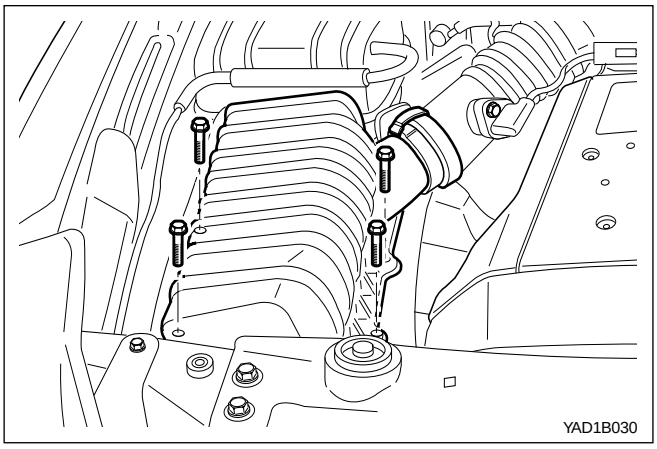
Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)



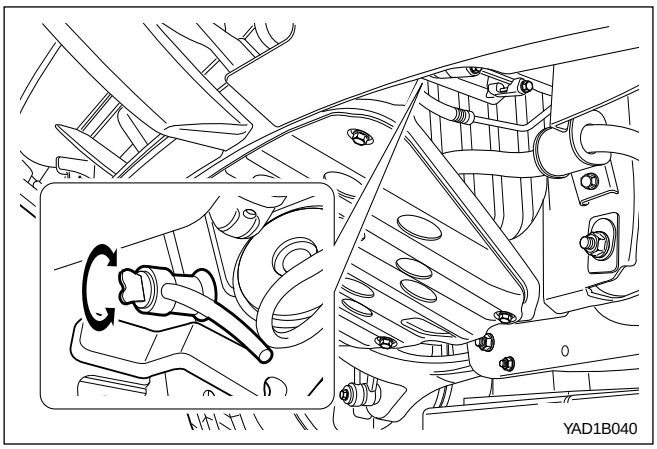
4. Disconnect the Hot Film Air Mass (HFM) sensor connector.
5. Disconnect the HFM sensor from the air filter housing.
6. Remove the intake air duct mounting nuts.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

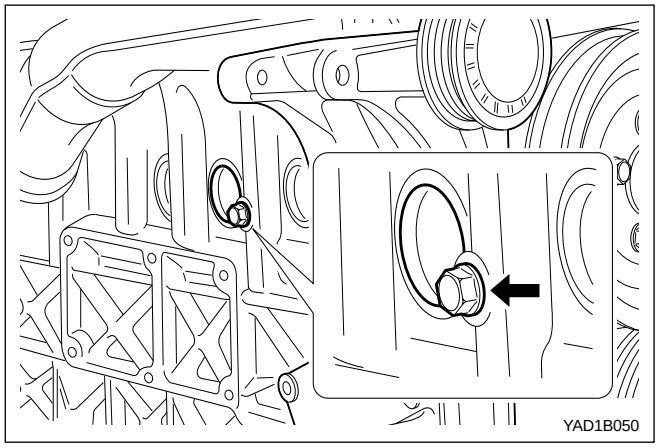


7. Remove the air cleaner cover. Remove the mounting bolts and air cleaner housing and element assembly.



8. Loosen the radiator drain cock and drain the coolant.

   Notice: Open the coolant reservoir cap.

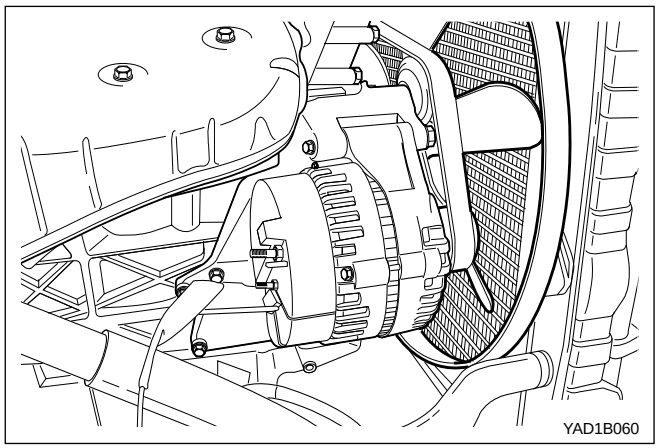


9. Loosen the cylinder block drain plug and then drain the coolant completely.

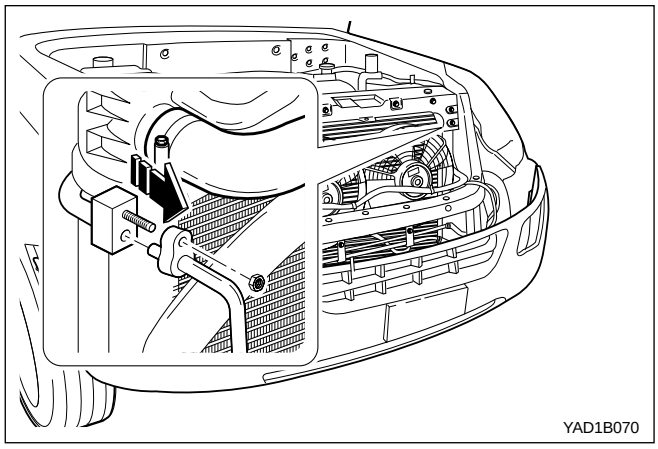
Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

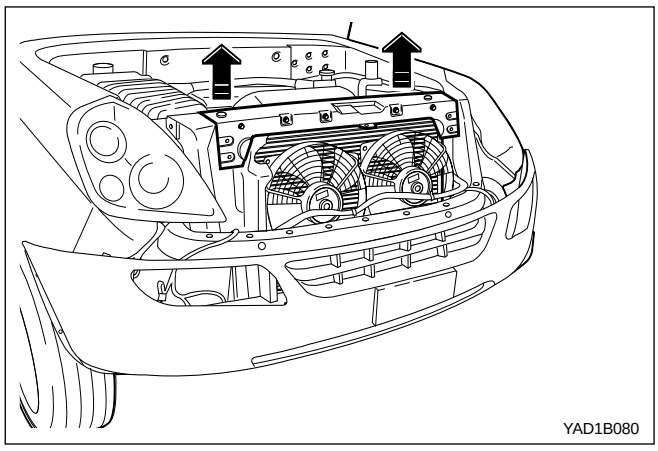
Replace the seal before installation of the drain plug.



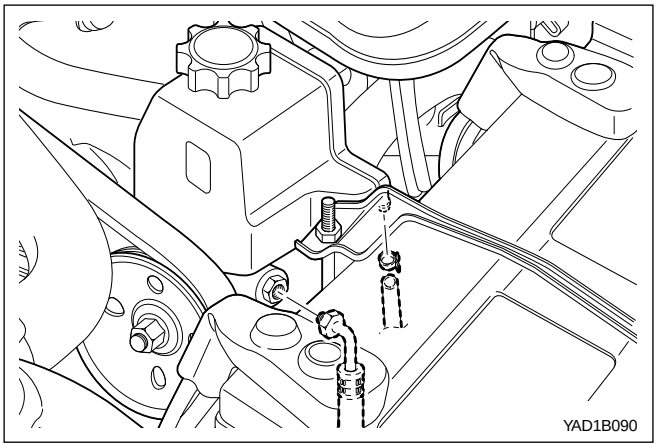
10. Remove the cooling fan shroud. Refer to *Section 1D, Engine Cooling.*



11. Disconnect the each hose from radiator.



12. Remove the upper mounting bolts of radiator and then remove the radiator.

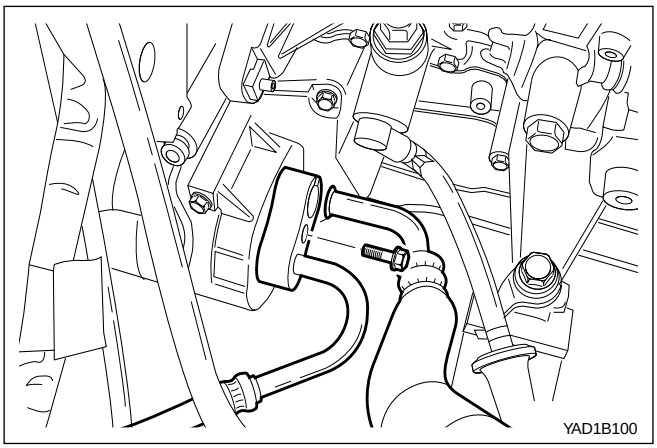


13. Remove the hydraulic pipe of power steering.

Installation Notice

Tightening Torque	40 - 50 N•m (30 - 37 lb-ft)

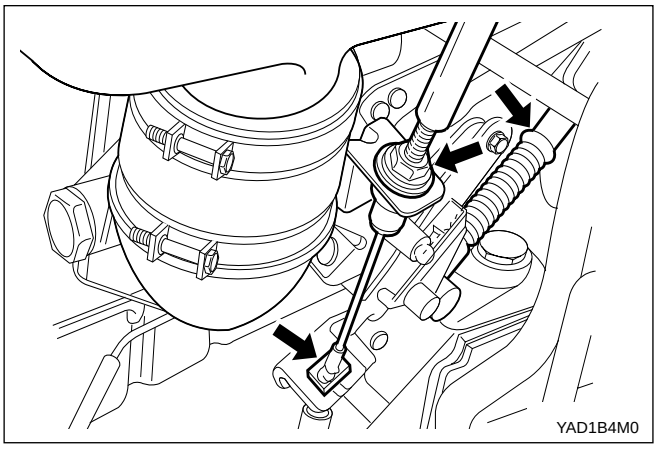
Completely drain the oil.



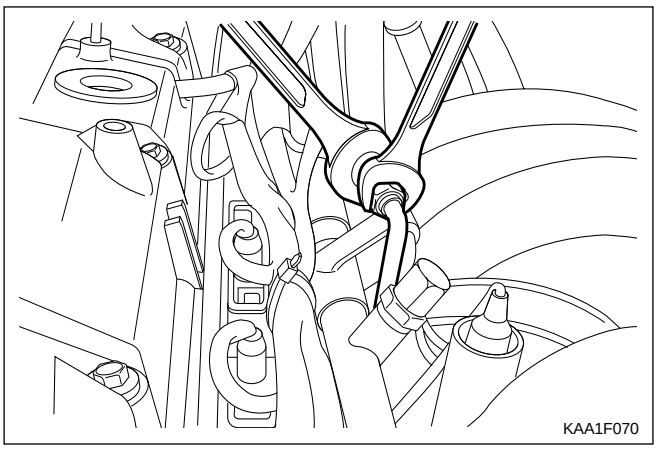
14. Discharge the refrigerant from A/C system, and disconnect the discharge pipe and suction pipe from the compressor. Refer to *Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.*

Installation Notice

Tightening Torque	20 - 30 N•m (15 - 22 lb-ft)



15. Remove the acceleration control cable and automatic transmission pressure cable.

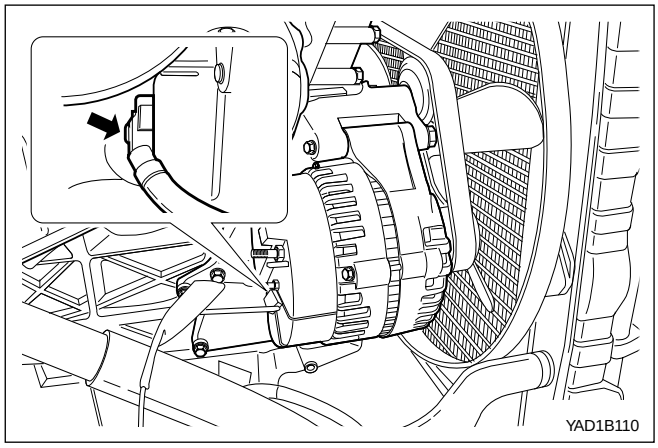


16. Remove the fuel feed and return line.

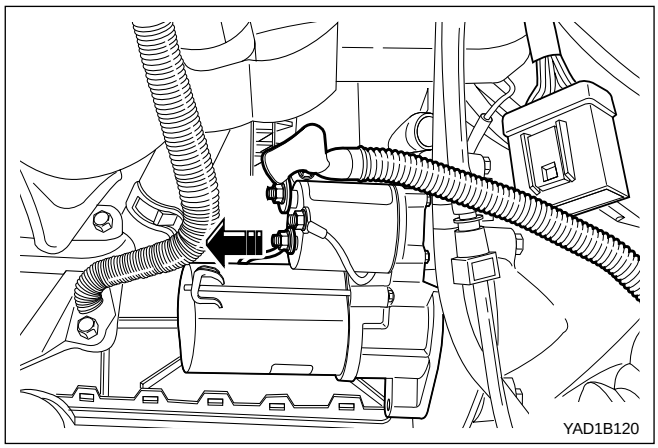
Installation Notice

Tightening Torque	21 - 25 N•m (15 - 18 lb-ft)

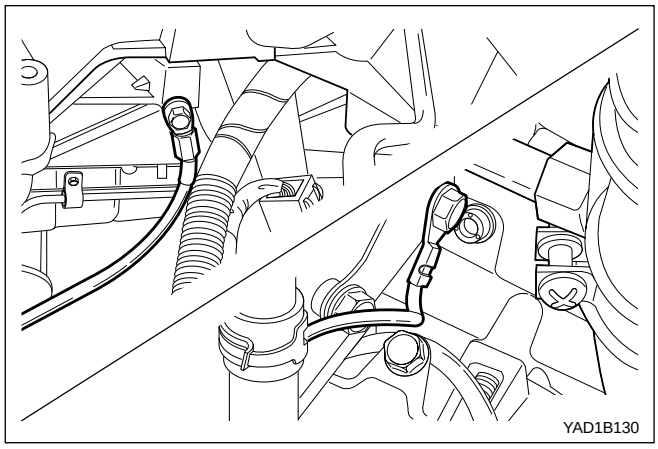
Before removing the fuel lines, release the pressure in the fuel system.



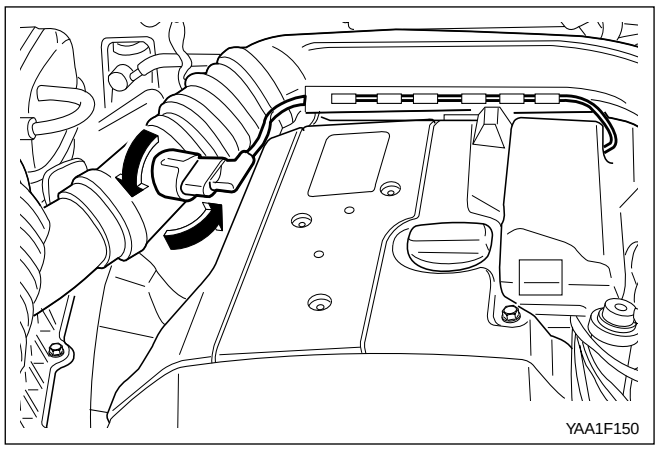
17. Disconnect the terminals from the generator.



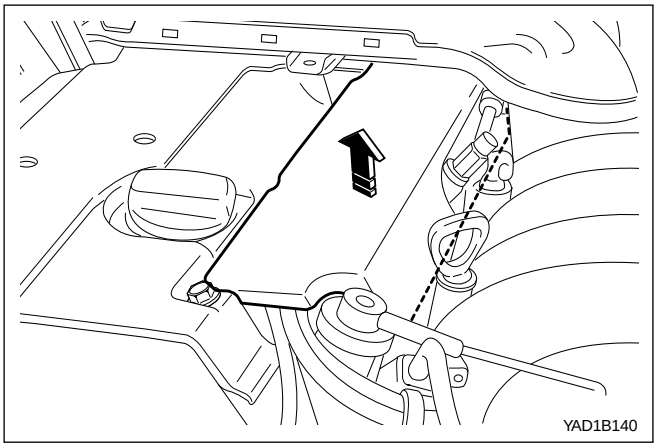
18. Disconnect the terminal from starter motor and remove the starter motor.
19. Disconnect the engine main harness ground.



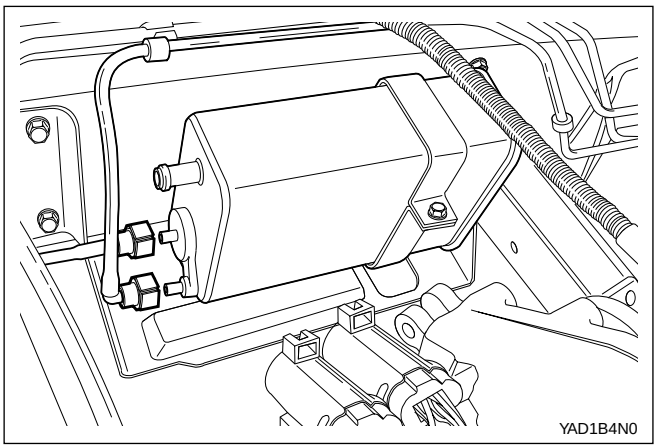
20. Disconnect the engine ground wire.



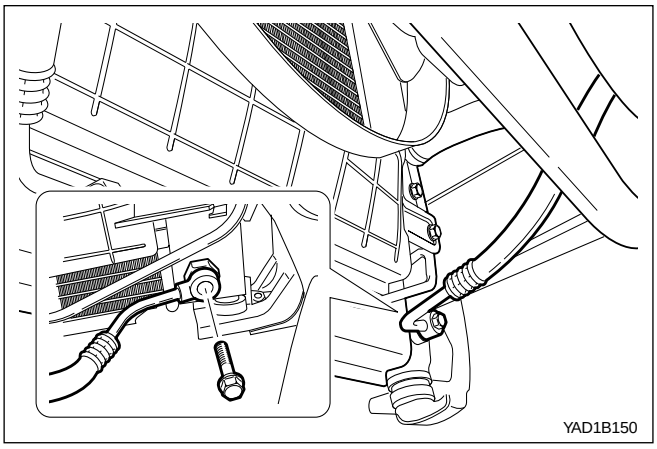
21. Disconnect following sensors connector.
    - Coolant temperature sensor.
    - 2 knock sensors.
    - Camshaft and crankshaft sensors.



22. After removing the ignition coil cover, disconnect the ignition coil connector.
23. Remove the harness cover and disconnect the 6 injection valve connectors. Disconnect the main harness.



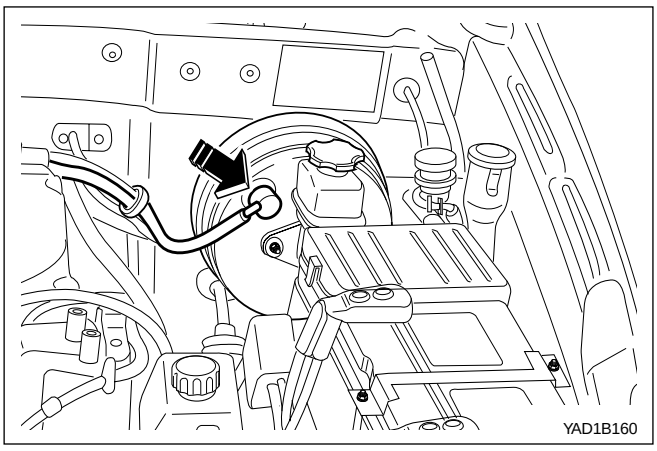
24. Separate the hose toward engine from canister purge solenoid valve.



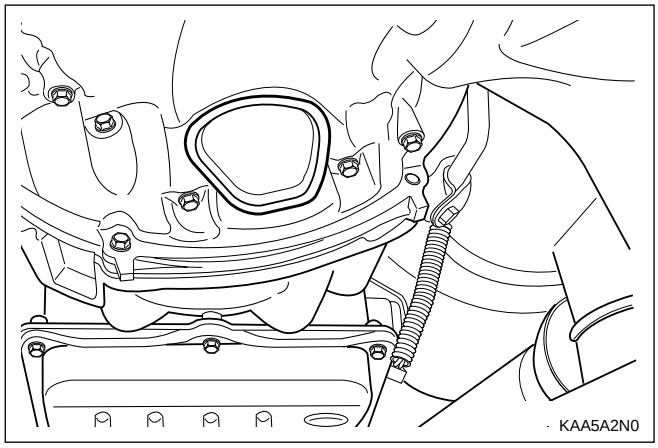
25. Remove the automatic transmission oil cooler line.

Installation Notice

Tightening Torque	25 - 35 N•m (18 - 26 lb-ft)



26. Separate the vacuum hose for brake booster.
27. Separate the other vacuum hoses.

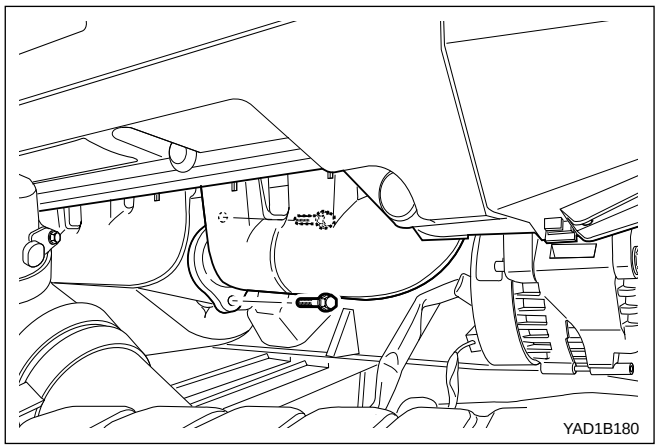


28. Remove the service hole cover in the engine block.
29. Put the alignment mark for installation, and remove the six mounting bolts for torque converter from drive plate through the service hole by rotating the engine and remove the torque converter.

Installation Notice

Tightening Torque	42 N•m (31 lb-ft)

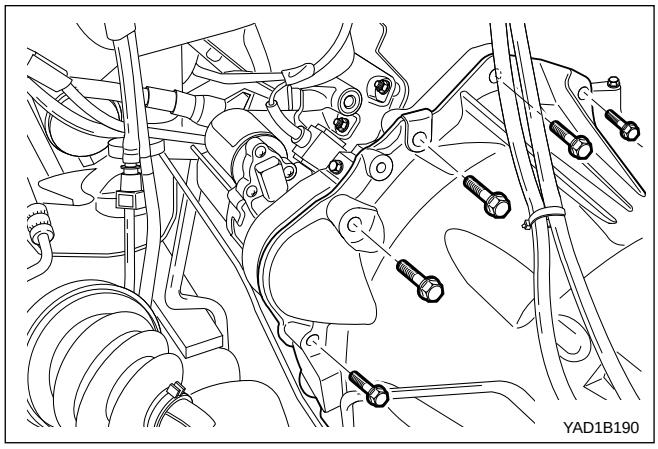
- Screw the six bolts mounting the torque converter through the service hole by using a mirror and rotating the engine.



30. Remove the exhaust manifold and exhaust pipe.

Installation Notice

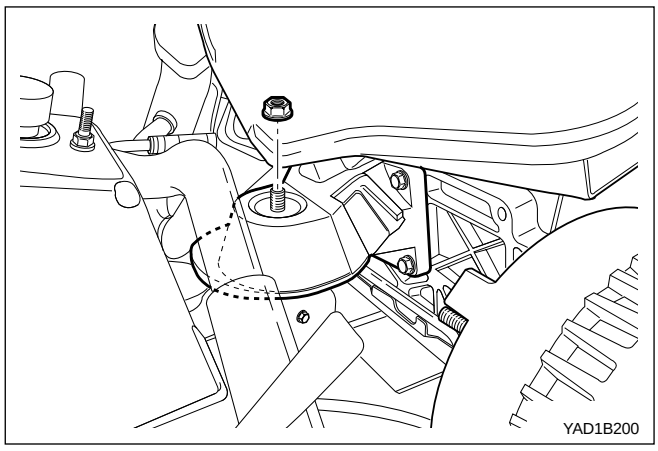
Tightening Torque	30 N•m (22 lb-ft)



31. Remove the transmission mounting bolts and separate the transmission from the engine.

Installation Notice

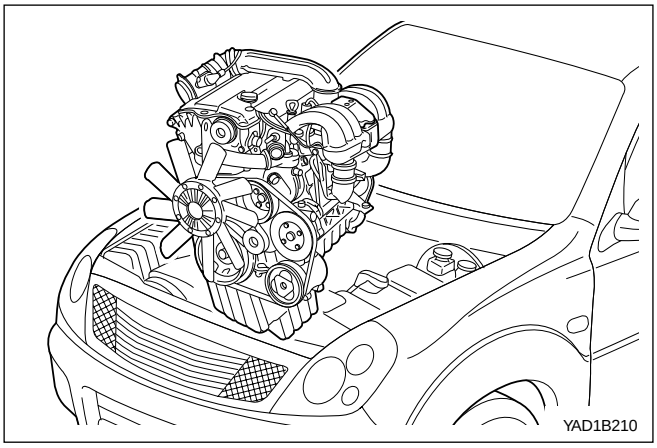
Tightening Torque	54 - 68 N•m (40 - 50 lb-ft)



32. Install a chain to the bracket of engine, by using a hoist or crane.
33. Remove the engine mounting bracket nuts.

Installation Notice

Tightening Torque	Upper : 70 N•m (52 lb-ft)
	Lower : 38 N•m (28 lb-ft)

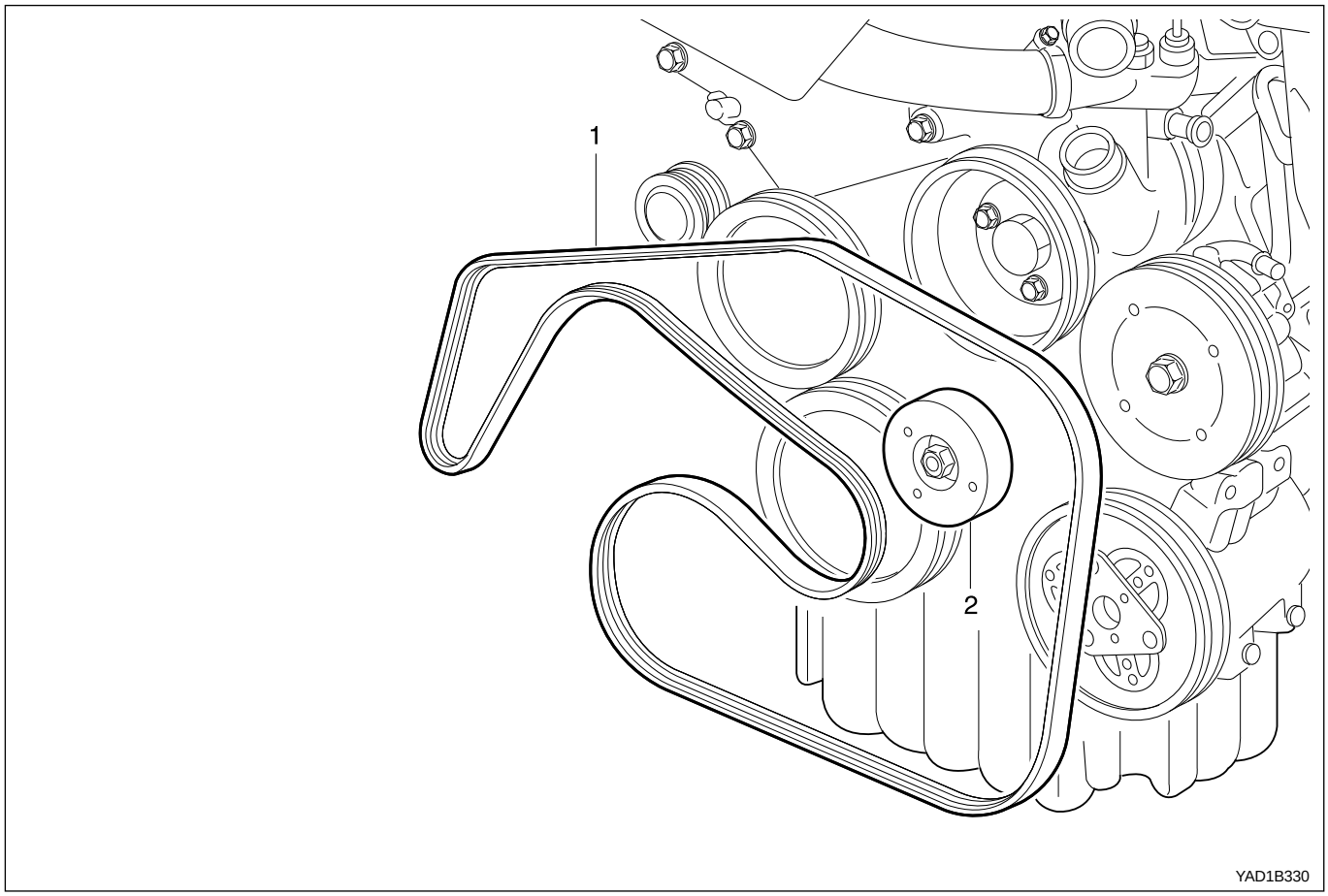


34. Carefully separate the engine assembly from the vehicle.
35. Installation should follow the removal procedure in the reverse order.

POLY V-BELT AND TENSIONING DEVICE

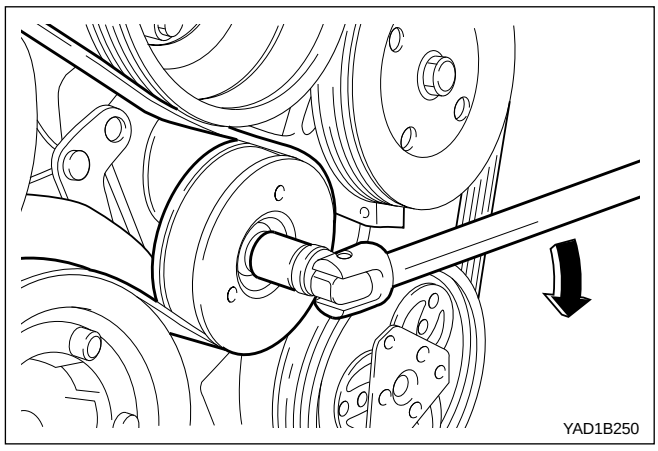
POLY V - BELT

Preceding Work : Removal of cooling fan



1 Poly V-belt

2 Belt Tensioning Pulley



Removal & Installation Procedure

1. Release the belt tension by turning the belt tensioning pulley nut clockwise.

   Installation Notice

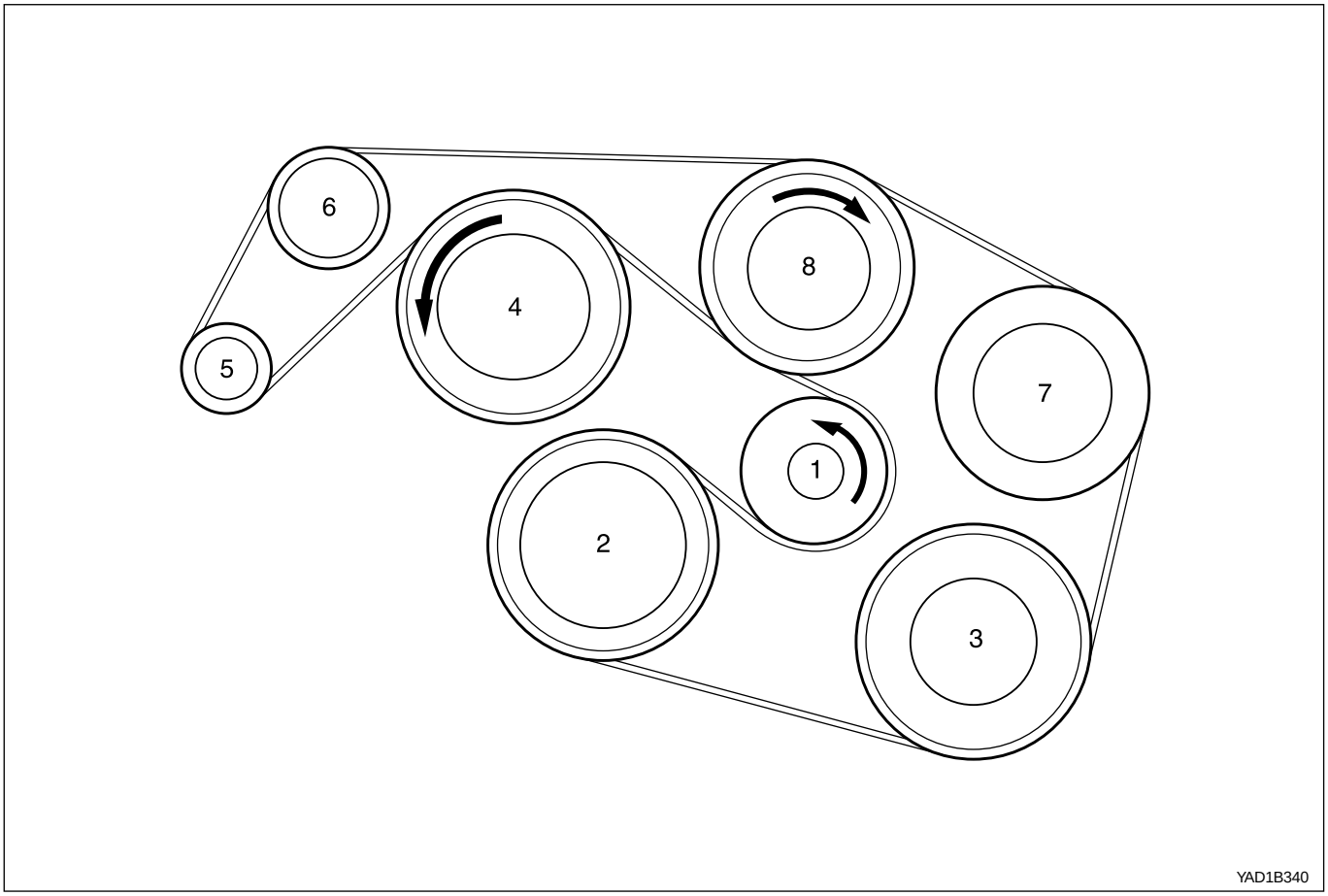
Tightening Torque	40.5 - 49.5 N•m (29.9 - 36.5 lb-ft)

2. Remove the poly v-belt.

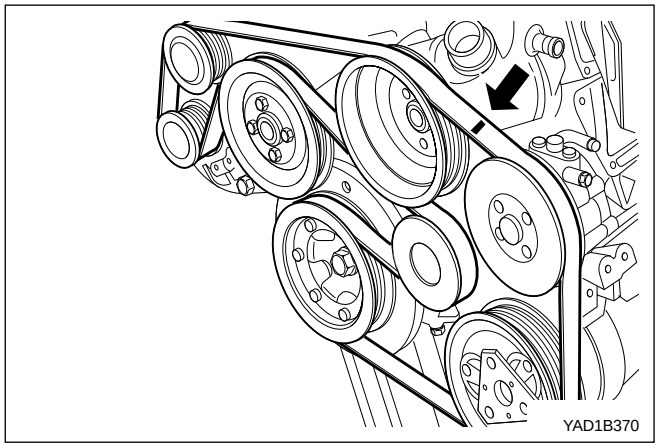
   Notice: Check the belt for damage and tensioning pulley bearing point for wear and replace them if necessary.

3. Install the belt by turning the nut of tensioning pulley clockwise.

Poly V-Belt Arrangement



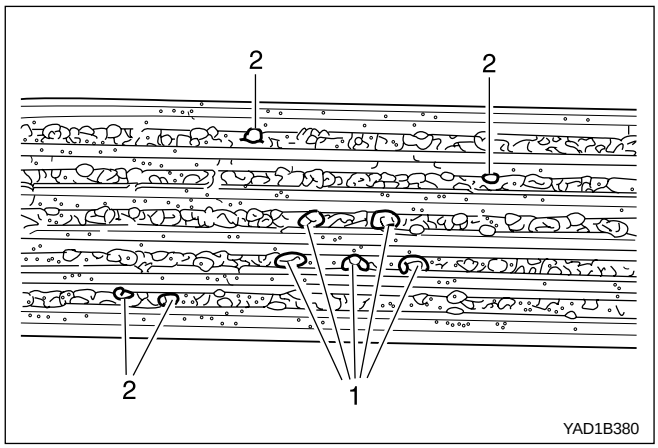
1 Belt Tensioning Pulley
2 Crankshaft Belt Pulley
3 A/C Compressor Pulley
4 Cooling Fan Pulley
5 Generator Pulley
6 Idler
7 Power Steering Pump Pulley
8 Cooling Fan and Water Pump Pulley


YAD1B370

POLY V - BELT INSPECTION

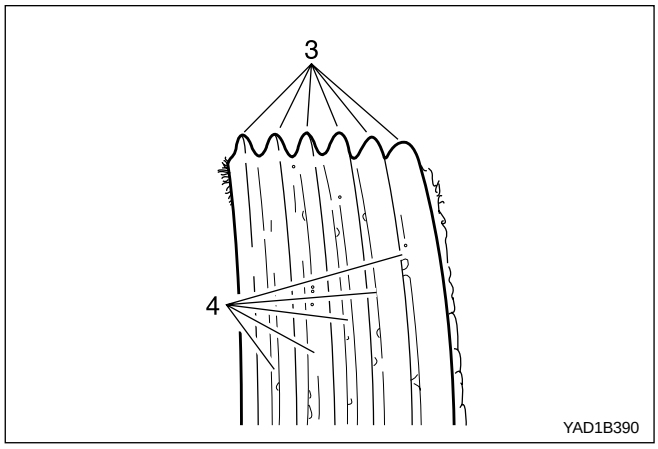
- Make marks on the belt with chalk.
- Rotate the engine and check the belt for damage.

Notice: If one of the following types of damages is found, replace the belt.



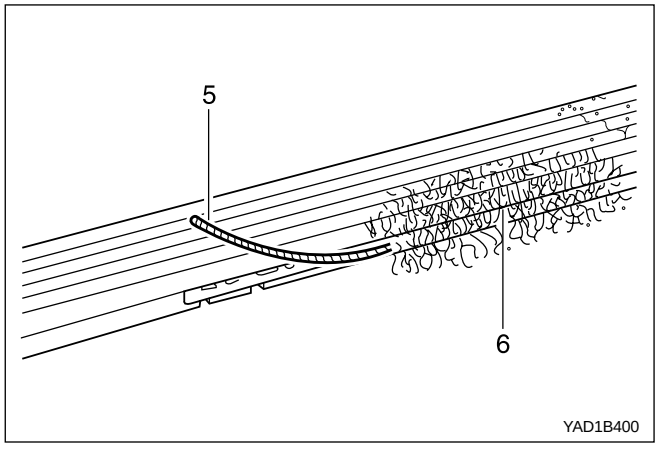
YAD1B380

1. Rubber lumps in the base of rib.
2. Dirt or grit ingrained.



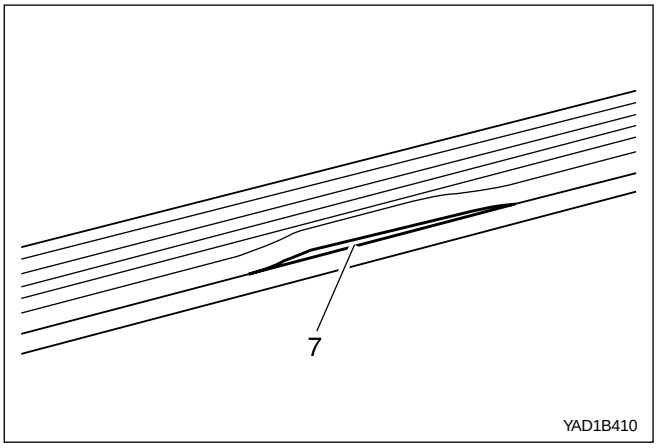
YAD1B390

3. Pointed rib.
4. Belt cord visible in the base of rib.

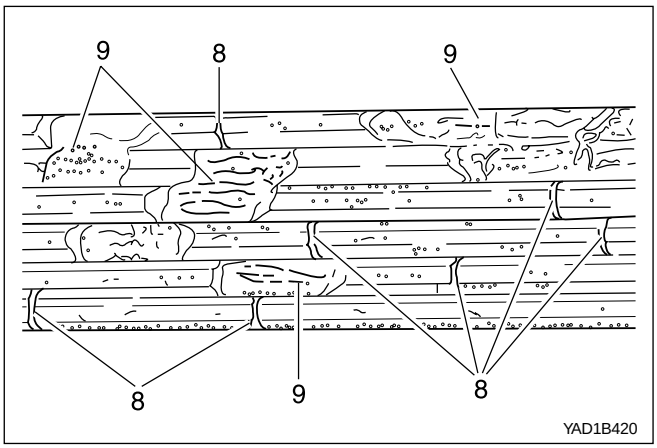


YAD1B400

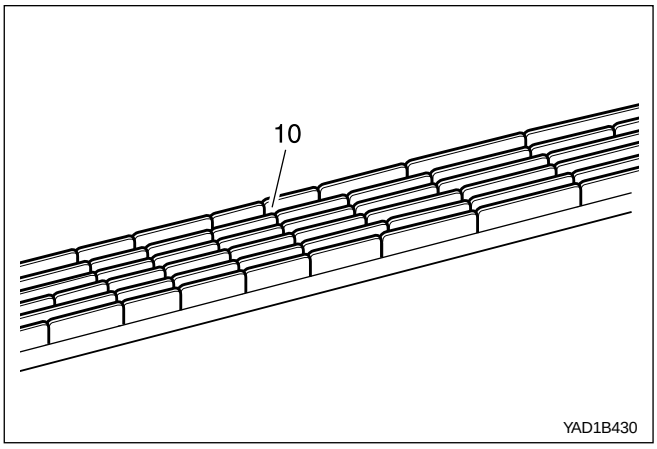
5. Cord torn out at the side.
6. Outer cords frayed.



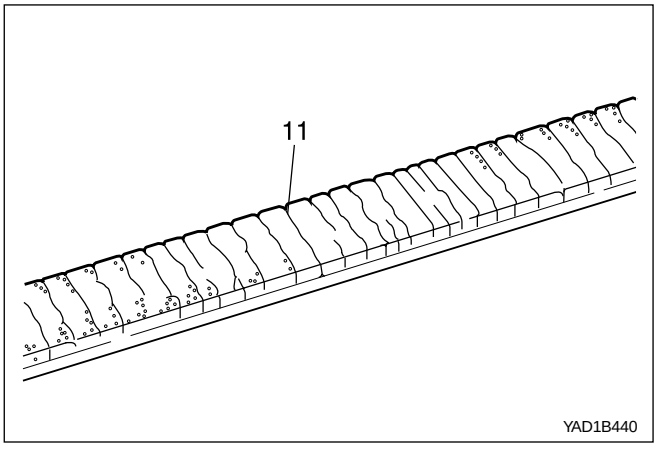
7. Rib detached from the base of belt.



8. Splits across the rib.
9. Sections of rib torn out.



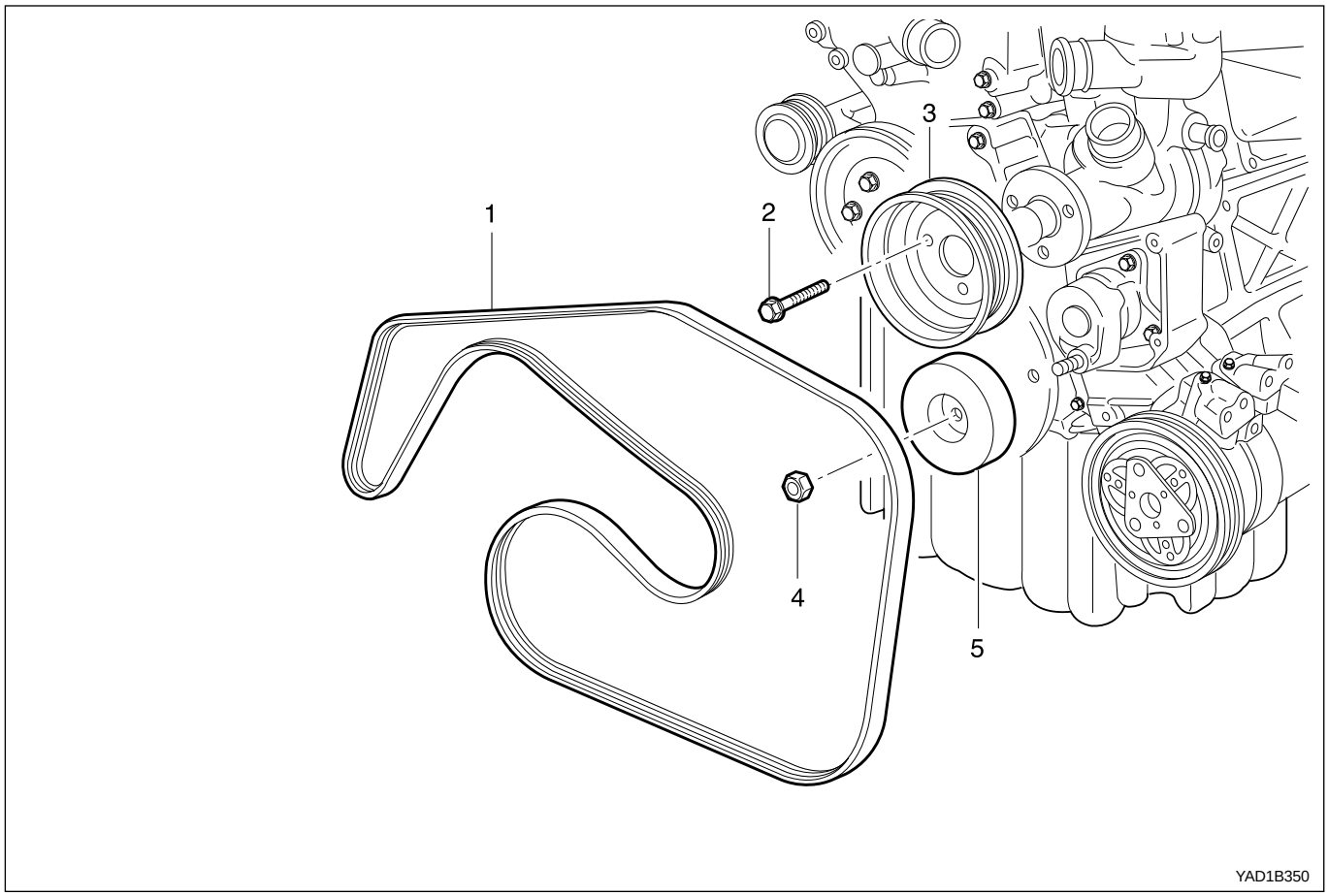
10. Splits across several ribs.



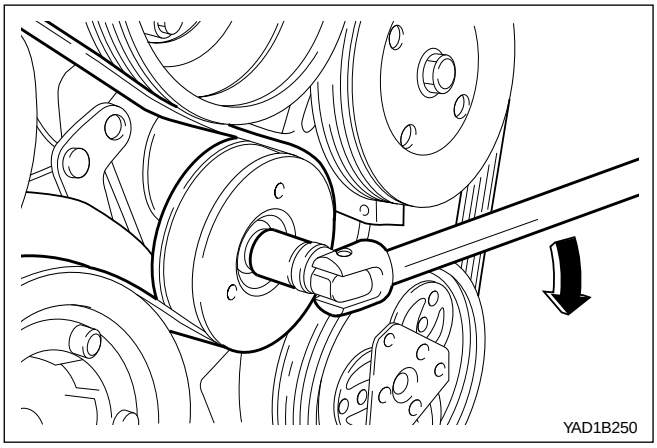
11. Splits across the back of the belt.

TENSIONING DEVICE

Preceding Work : Removal of poly v-belt



1 Belt (L = 2245)
2 Bolt Combi (M8 x 14, 3 pieces) + Washer
..... 22.5-27.5 N•m (16.6-20.3 lb-ft)
3 Water Pump Pulley
4 Nut
5 Belt Tensioning Pulley

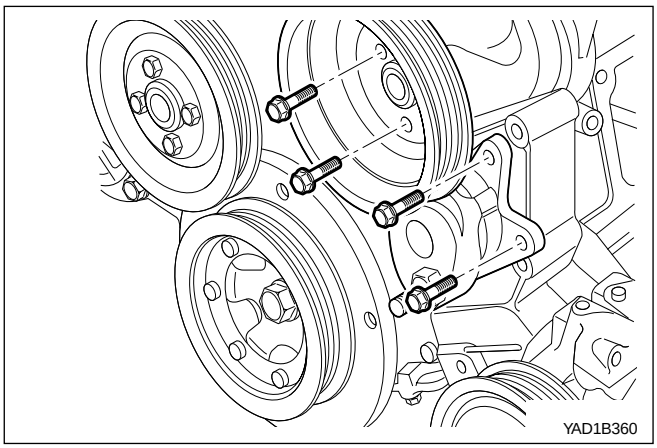

YAD1B250

Removal & Installation Procedure

1. Remove the poly v-belt.
2. Remove the tensioning pulley by turning its mounting nut counter clockwise as shown in figure.

Installation Notice

Tightening Torque	40.5 - 49.5 N•m (29.9 - 36.5 lb-ft)


YAD1B360

3. Remove the bolts and remove the water pump pulley.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

4. Remove the mounting bolts(M8 x 30, 3 pieces) at the tensioning device, and remove the tensioning device.

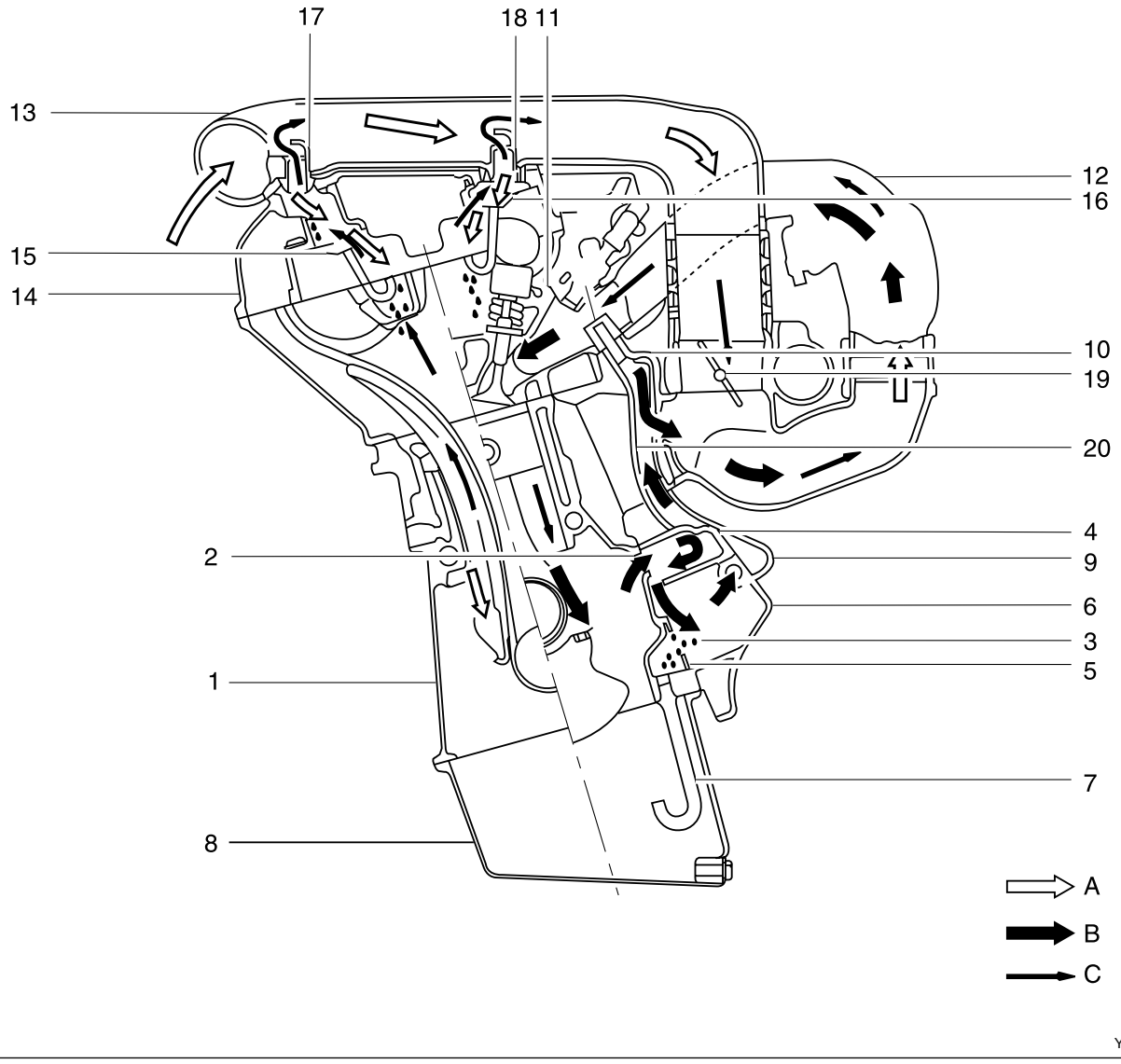
Installation Notice

Tightening Torque	26 - 32 N•m (19 - 24 lb-ft)

5. Installation should follow the removal procedure in the reverse order.

CRANK CASE AND CYLINDER HEAD

CRANKCASE VENTILATION SYSTEM



1 Crankcase
2 Air Admission Port in Crankcase
3 Oil Drain Port
4 Filter
5 Gasket
6 A/C Bracket
7 Oil Drain Pipe
8 Oil Pan
9 Air Admission Line
10 Vent Line
11 Restriction Hole (Diameter = 2 mm)
12 Intake Manifold
13 Intake Air Duct (Cross Pipe)
14 Cylinder Head Cover
15 Oil Separator
16 Oil Separator
17 Air Admission and Vent Connection
18 Air Admission and Vent Connection
19 Throttle Valve
20 Vent Line

A Fresh Air
B Blowby Gas in Partial Load
C Blowby Gas in Full Load

Operation at Idling and Mid-Load

- It show that the throttle valve (19) is closed or very partially opened and the vacuum pressure in intake manifold is high.

  The blowby gas in the crankcase in partial load flows into the intake manifold through the vent line (20) after passing the air conditioner bracket (6) and the filter (4). The air reentered into the intake manifold will be dilluted on the flow through the restriction hole (11) in the vent line (10).

  The circulated engine oil is separated at the air conditioner bracket (6) and then returns into the oil pan through the drain pipe (7).

  The vacuum pressure generated at the crankcase sucks fresh air from intake air line(13) through the air admission and vent connection (17, 18).

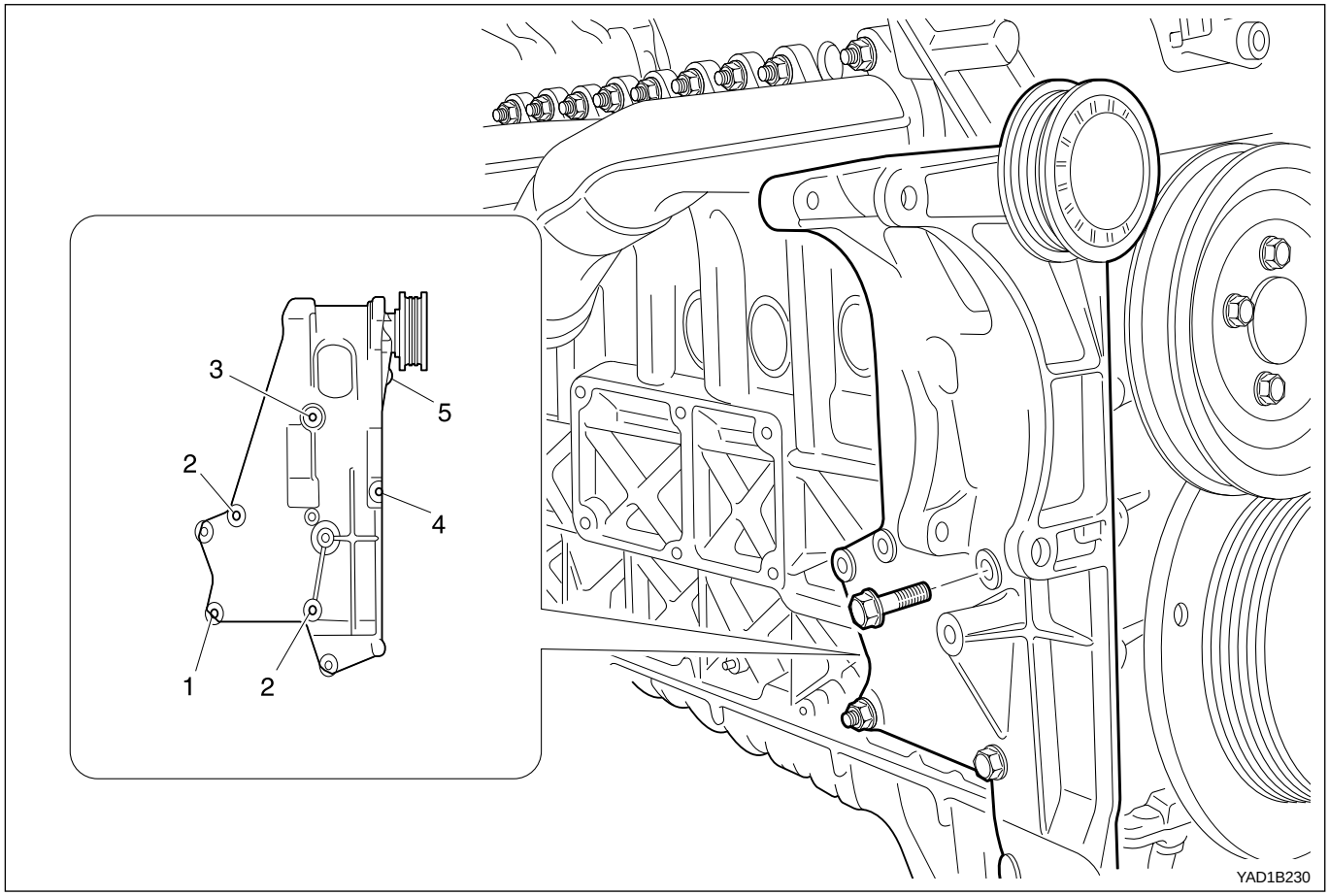
  The fresh air prevents engine oil from being contaminated and the air admission and vent connection (17, 18) is designed to control the rapid pressure changes in intake air line (13).

Operation at Full-Load

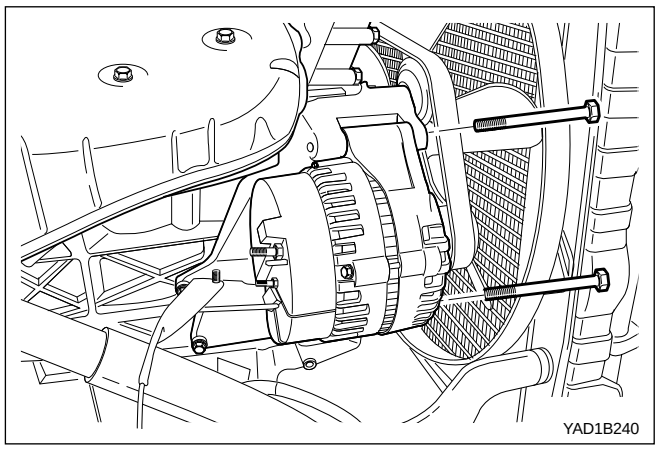
- The throttle valve (19) is fully opened.

  All the blowby gases flow into the intake air duct (13) after passing through the oil separator (15,16) of the cylinder head cover (14) when fully loaded. This dilluted air will be supplied to the combustion chamber through the intake manifold (12).

GENERATOR



1 Nut (M8) .....22.5-27.5 N•m (16.5-20.5 lb-ft)
2 Bolt (M8 x 30, 3 pieces)
.....22.5-27.5 N•m (16.5-20.5 lb-ft)
3 Bolt (M8 x 40, 1 piece)
.....22.5-27.5 N•m (16.5-20.5 lb-ft)
4 Bolt (M8 x 70, 1 piece)
.....22.5-27.5 N•m (16.5-20.5 lb-ft)
5 Bolt (M8 x 75, 1 piece)
.....22.5-27.5 N•m (16.5-20.5 lb-ft)



Removal & Installation Procedure

1. Remove the drive belt.
2. Remove the generator.
3. Unscrew the generator carrier bolts and remove the carrier.

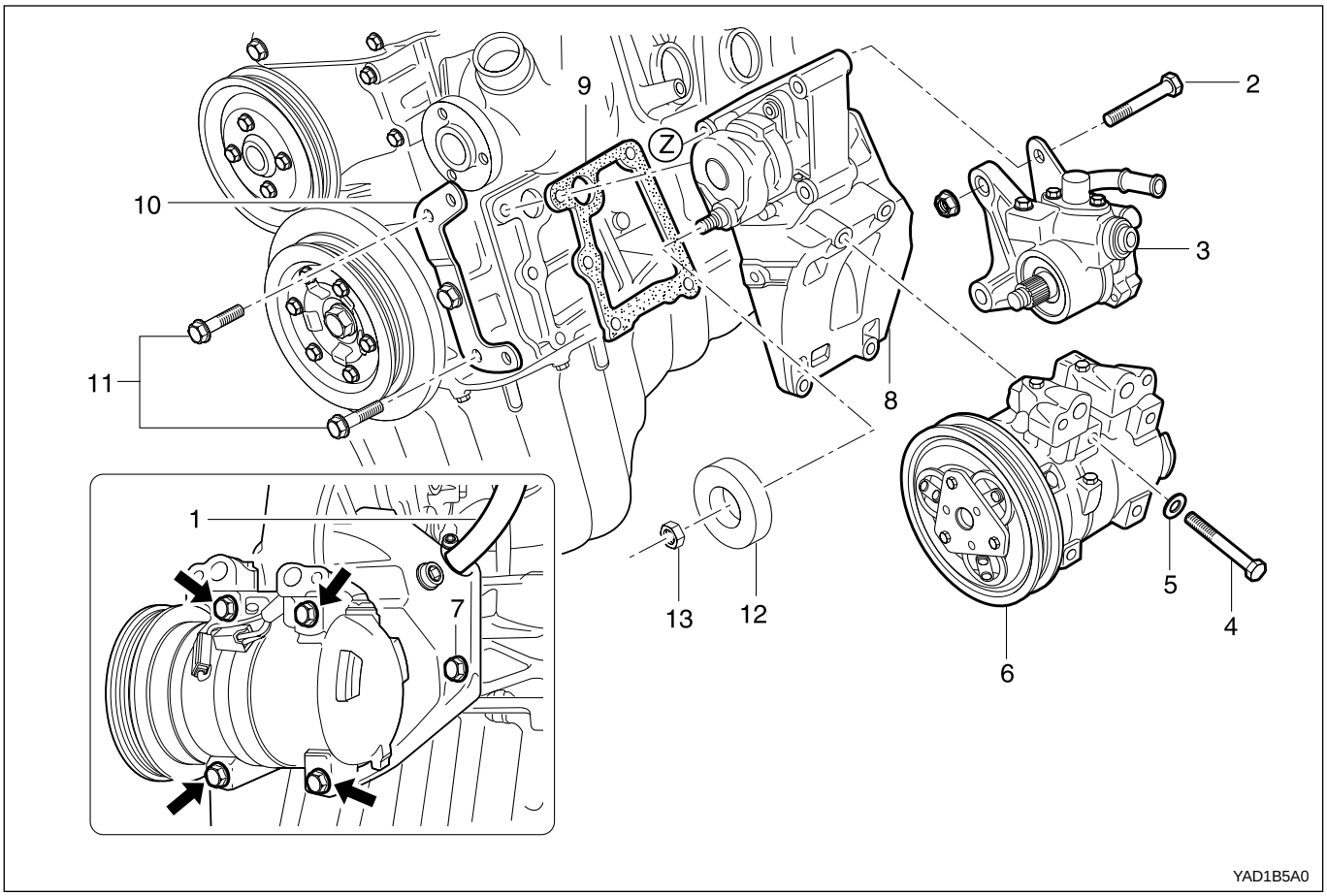
Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

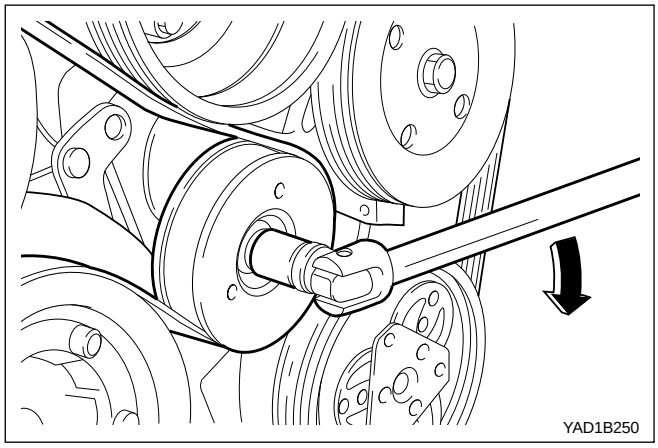
4. Installation should follow the removal procedure in the reverse order.

POWER STEERING PUMP AND A/C BRACKET

Preceding Work : Removal of cooling fan and shroud



1 Vent Hose
2 Bolt (M8 x 91, 2 pieces)
..... 22.5-27.5 N•m (16.5-20.5 lb-ft)
3 Power Steering Pump
4 Bolt (M8 x 105, 4 pieces)
..... 22.5-27.5 N•m (16.5-20.5 lb-ft)
5 Washer
6 A/C Compressor
7 Bolt (M8 x 40, 3 pieces, M8 x 95, 2 pieces)
..... 22.5-27.5 N•m (16.5-20.5 lb-ft)
8 A/C Bracket
9 Gasket..... Replace
10 Bracket
11 Bolt (M8 x 22, 2 pieces)
..... 22.5-27.5 N•m (16.5-20.5 lb-ft)
12 Tensioning Pulley
13 Nut ..... 40.5-49.5 N•m (29.9-36.5 lb-ft)


YAD1B250

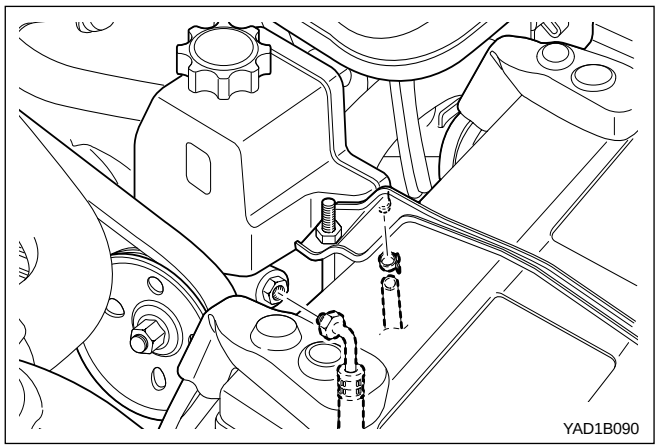
Removal & Installation Procedure

1. Remove the belt tensioning pulley.

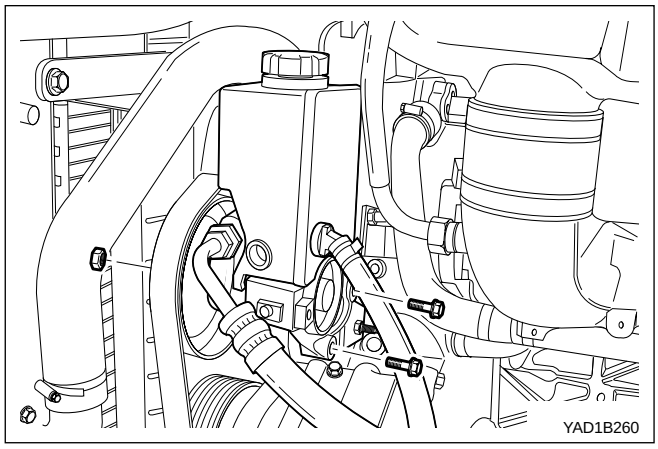
   Installation Notice

Tightening Torque	40.5 - 49.5 N•m (29.9 - 36.5 lb-ft)

   Pull the tensioning pulley clockwise as shown in the figure.


YAD1B090

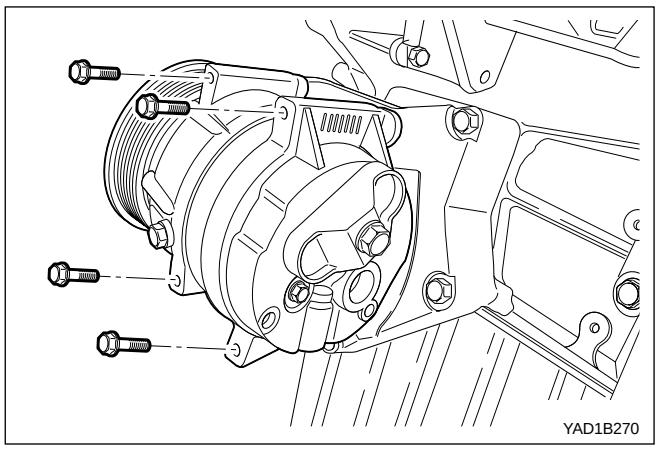
2. Disconnect the hydraulic pipe of the power steering pump and drain the oil.


YAD1B260

3. Unscrew the bolts and remove the steering pump.

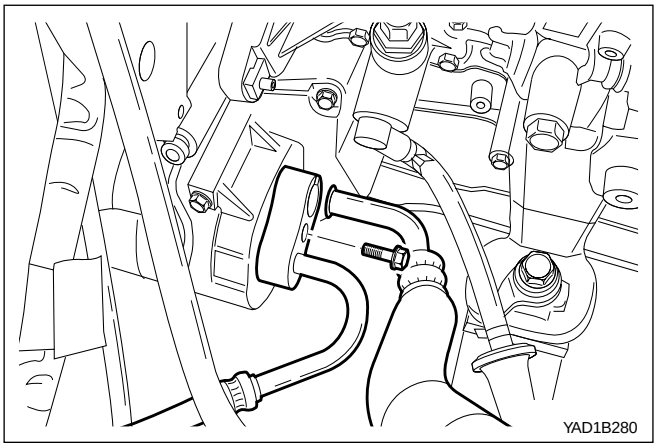
   Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)


YAD1B270

4. Remove the compressor after disconnecting the wiring connector and refrigerant pipe of A/C compressor.

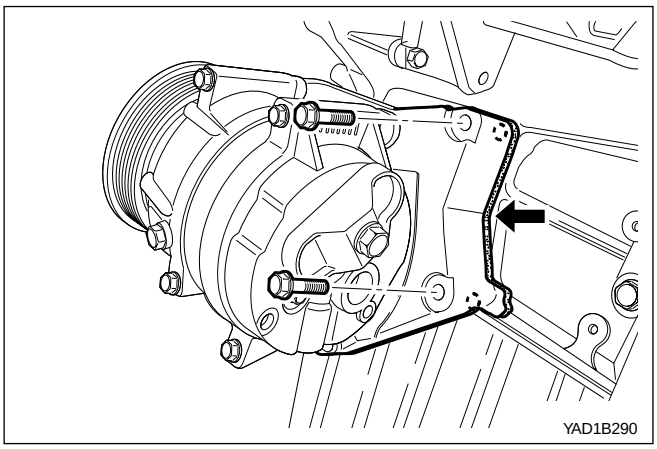
   Notice: Discharge all the refrigerant before removing the pipes.



5. Disconnect the vent hose from the A/C bracket.

Installation Notice

Tightening Torque	20 - 30 N•m (15 - 22 lb-ft)



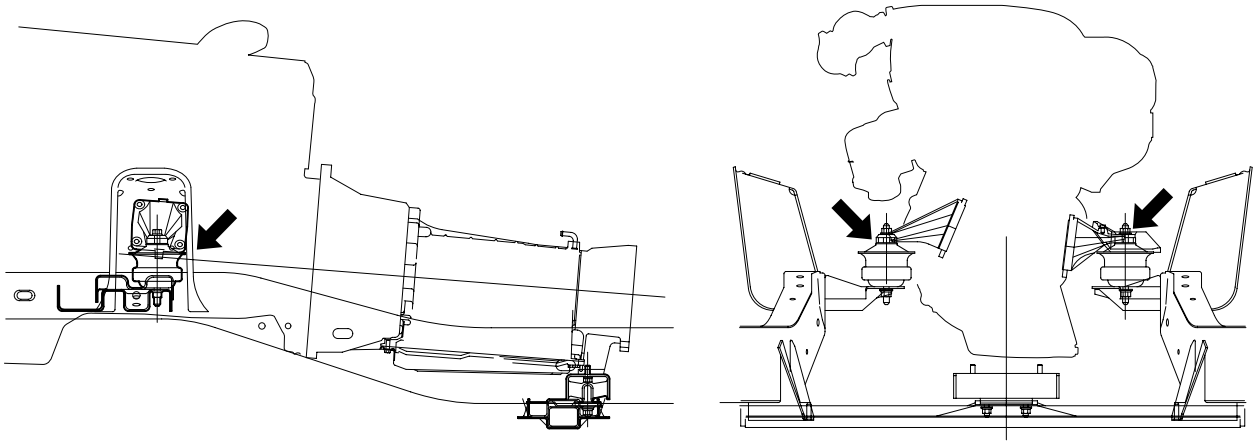
6. Unscrew all the mounting bolts and remove the A/C bracket and the gasket.

Installation Notice

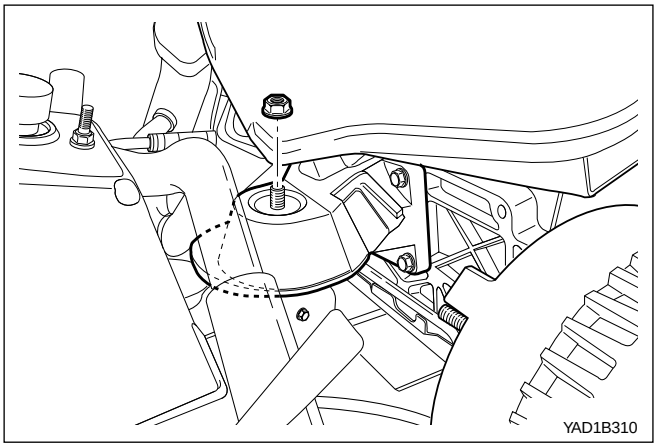
TighteningTorque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

7. Clean the sealing surface.
8. Replace the gasket with new one.
9. Installation should follow the removal procedure in the reverse order.
10. Check the oil leakage by operating the engine after installation.

ENGINE MOUNT



YAD1B300

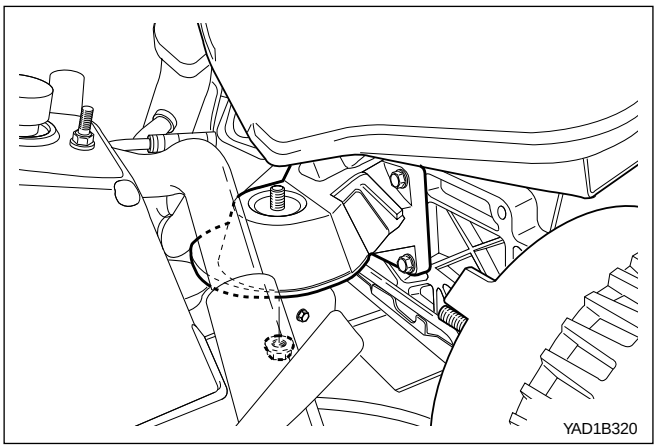


Removal and Installation Procedure

1. Unscrew the upper engine mounting nut.

   Installation Notice

Tightening Torque	70 N•m (52 lb-ft)



2. Unscrew the lower engine mounting nut.

   Installation Notice

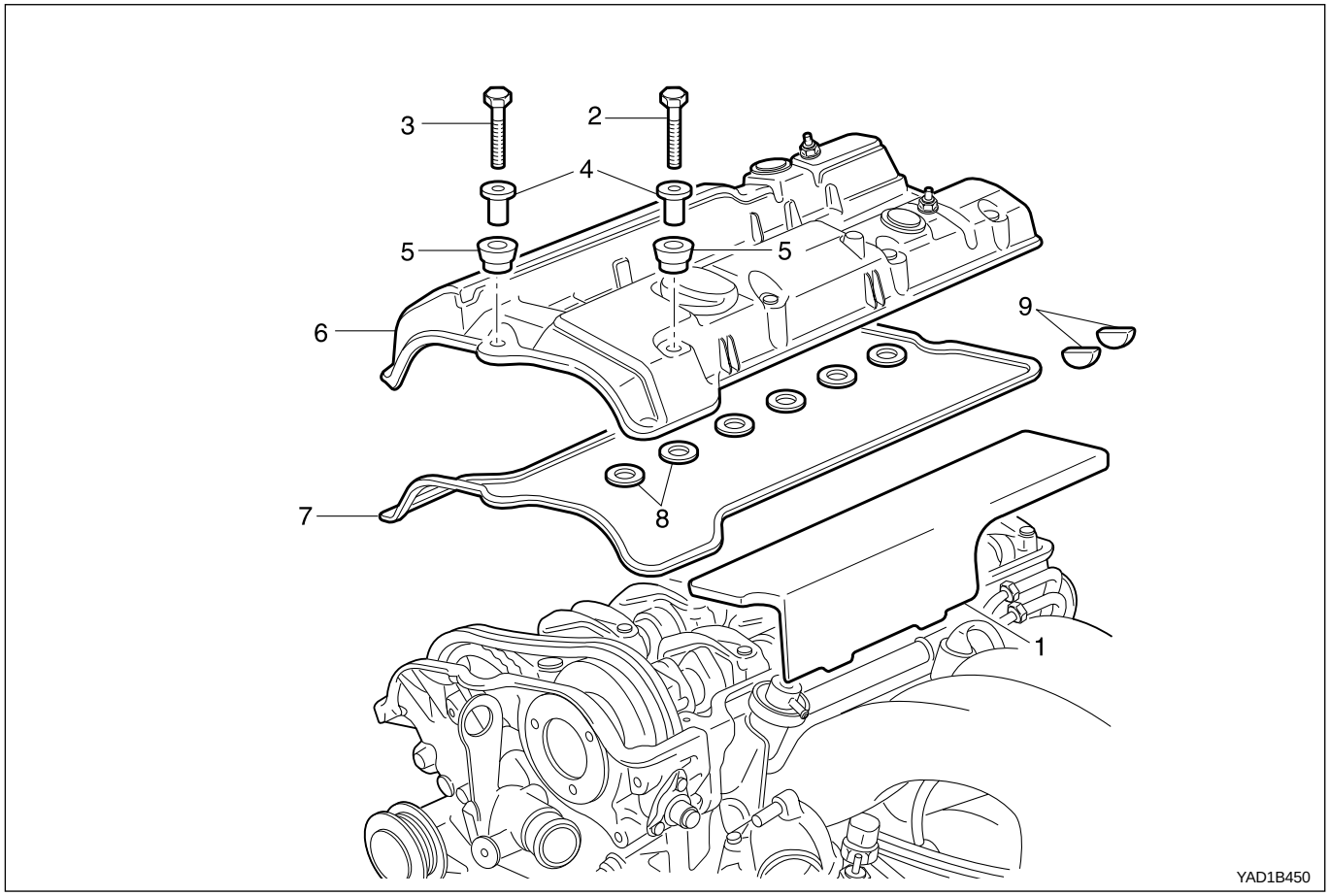
Tightening Torque	38 N•m (28 lb-ft)

3. Remove the hydraulic engine mounting insulator.

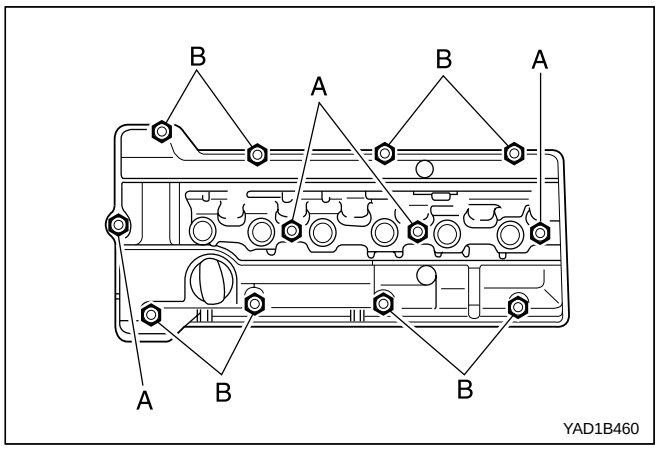
   Notice: If the insulator is spotted with oil, replace the hydraulic insulator asseambly.

4. Installation should follow the removal procedure in the reverse order.

CYLINDER HEAD COVER

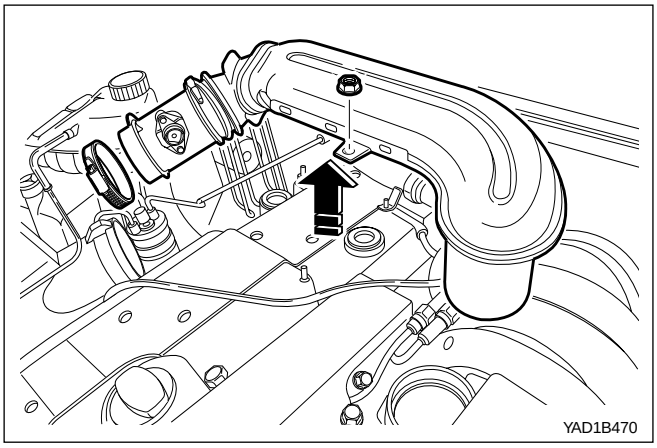


1 Ignition Cable Dust Cover
2 Bolt (M6 x 65, 8 pieces)
..... 9-11 N•m (80-97 lb-in)
3 Bolt (M6 x 50, 4 pieces)
..... 9-11 N•m (80-97 lb-in)
4 Spacer Sleeve
5 Thrust Piece
6 Cylinder Head Cover
7 Gasket..... Replace
8 Spart Plug Hole Seal ..... Replace
9 Camshaft Seal ..... Replace



Composition of The Cylinder Head Cover Bolts

A. M6 x 50, 4 Pieces - Bolts + Washers
B. M6 x 65, 8 Pieces - Bolts + Washers

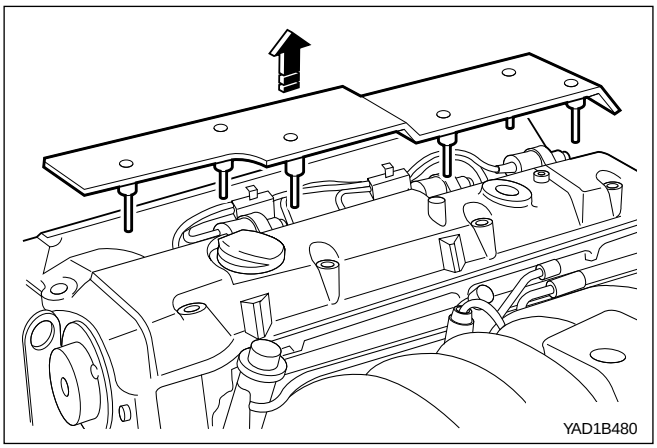


Removal & Installation Procedure

1. Remove the intake air duct.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

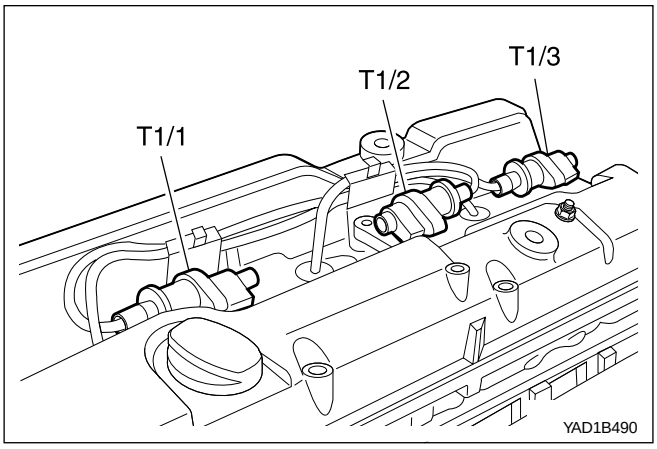


2. Remove the spark plug cover.

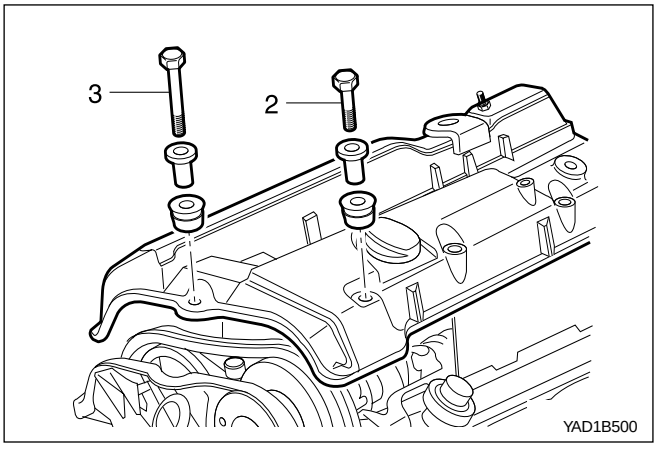
Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

Unscrew the seven (M6 x 60) bolts and remove the spark plug cover.



3. Remove the spark plug connector and ignition cable.



4. Unscrew all the bolts (2,3) and remove the head cover and the gasket.

Installation Notice

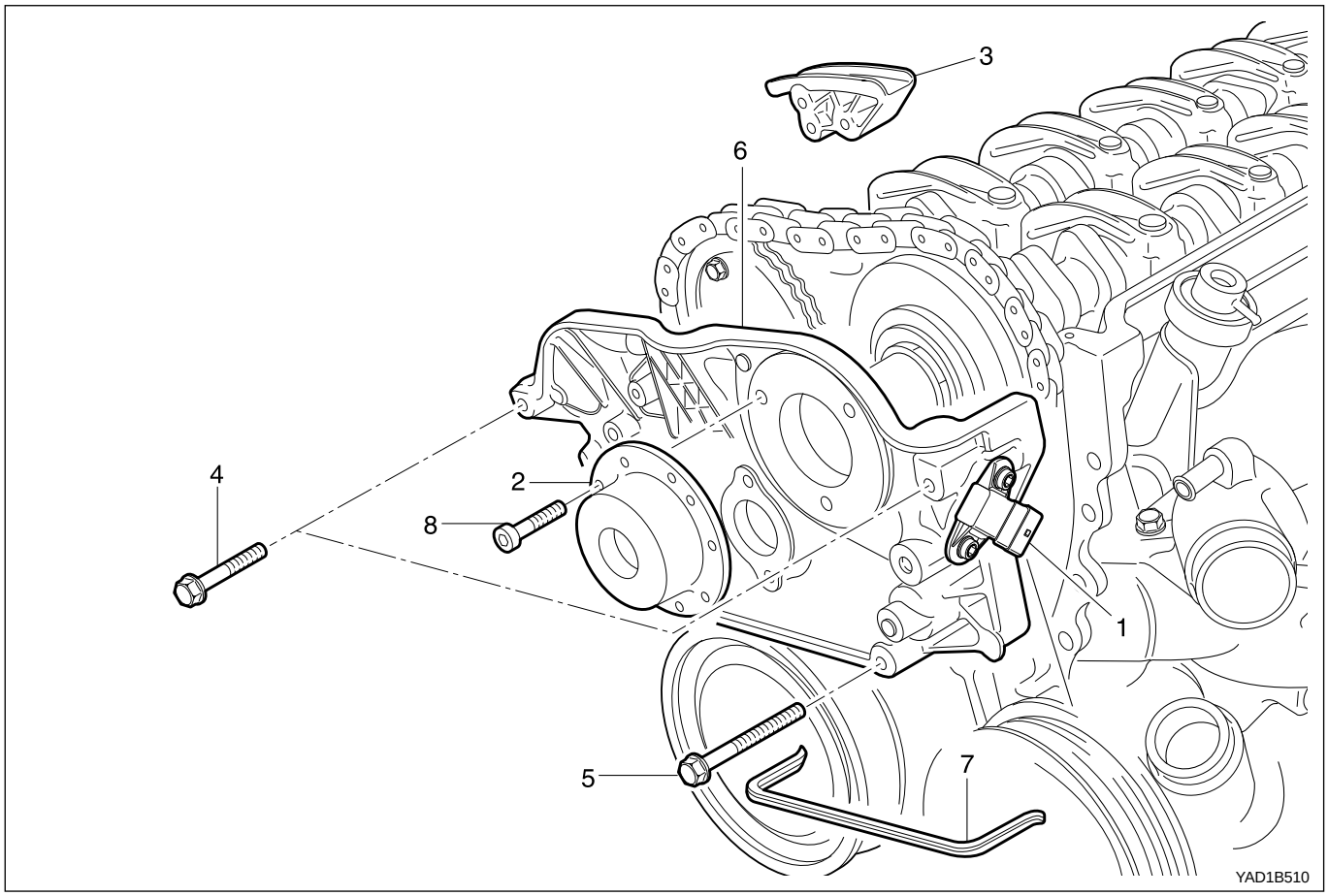
Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

Replace the gasket with a new one if necessary.

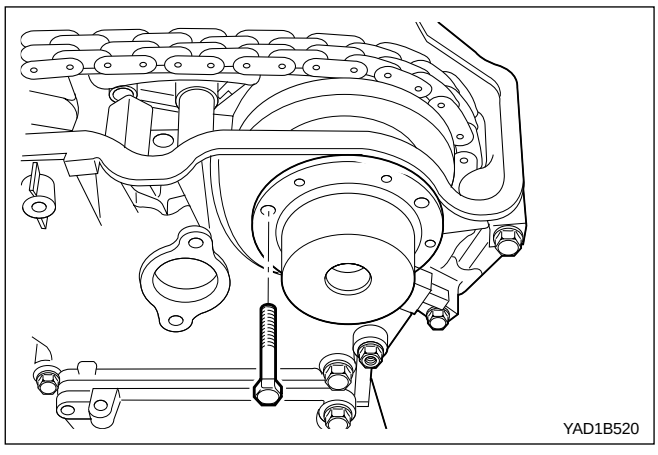
5. Installation should follow the removal procedure in the reverse order.
6. Check for oil leaks by operating the engine.

CYLINDER HEAD FRONT COVER

Preceding Work : Removal of cylinder head cover
Removal of coolant connection fitting



1 Camshaft Position Sensor
2 Camshaft Actuator
3 Upper Guide Rail
4 Bolt (M6 x 60, 3 pieces)
..... 22.5-27.5 N•m (16.6-20.3 lb-ft)
5 Bolt (M8 x 80, 3 pieces)
..... 22.5-27.5 N•m (16.6-20.3 lb-ft)
6 Front Cover
7 Rubber Gasket ..... Replace
8 Bolt (M6 x 16, 3 pieces)
..... 9-11 N•m (80-97 lb-in)

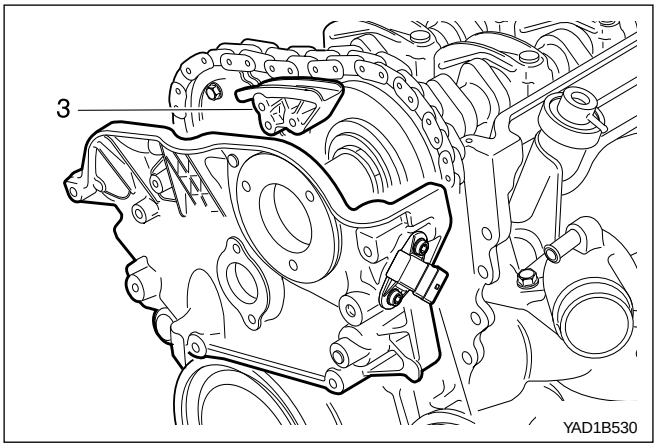


Removal & Installation Procedure

1. Remove the camshaft actuator.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)



2. Remove the cylinder head front cover (6).

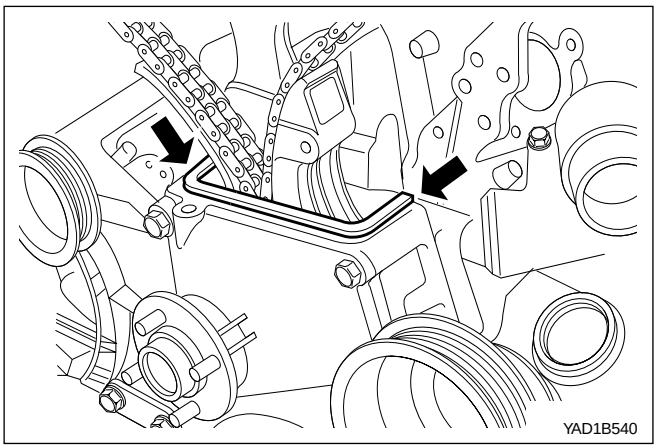
Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

Apply the sealant at the mating surface of the cylinder head and the front cover.

3. Remove the upper guide rail pin and the guide rail (3).

Notice: Install it while the chain tensioner is loose.



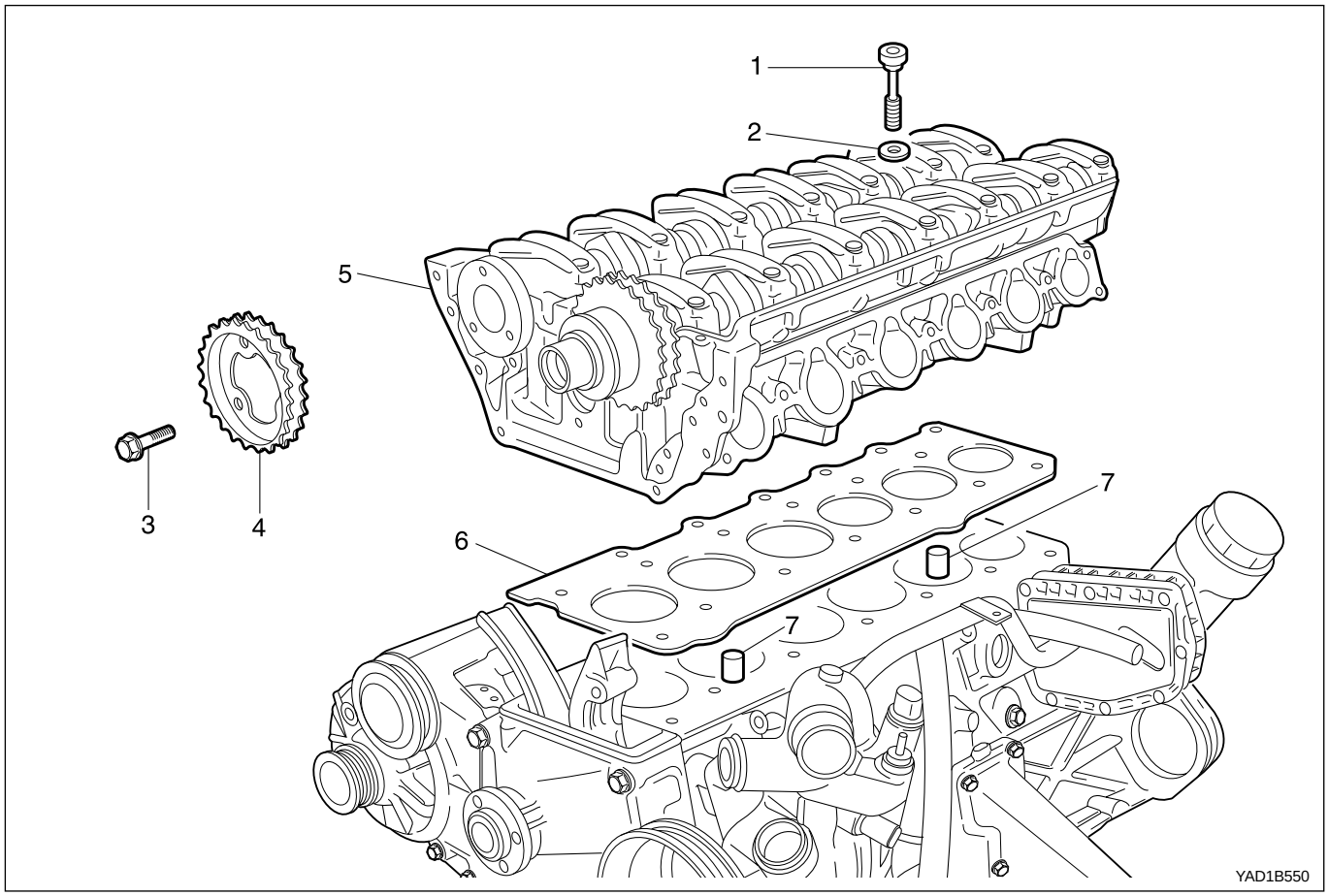
4. Remove the gasket (arrow).

Notice: Replace the gasket with new one and apply the sealant.

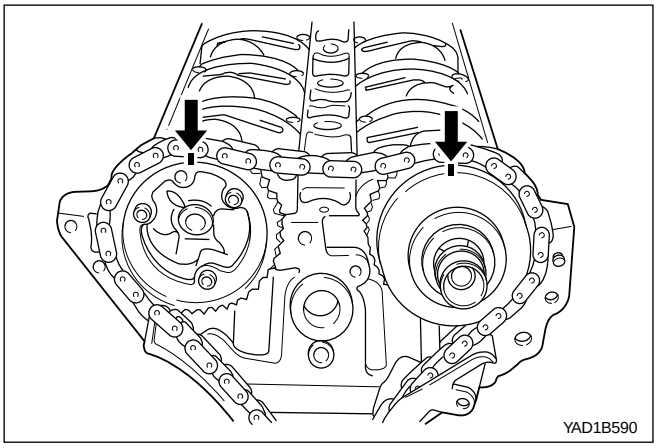
5. Installation should follow the removal procedure in the reverse order.

CYLINDER HEAD

Preceding Work : Removal of cylinder head cover
Removal of cylinder head front cover
Removal of upper intake manifold



1 Cylinder Head Bolt (14 pieces)
..... 1st step 55 N•m (141 lb-ft)
2nd step 90°
3rd step 90°
2 Washers (14 pieces)
3 Flange Bolts (3 pieces)
..... 1st step 18-22 N•m (13-16 lb-ft)
2nd step 90°±5°
4 Exhaust Camshaft Sprocket
5 Cylinder Head
6 Gasket..... Replace
7 Dowel Sleeve


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Tools Required

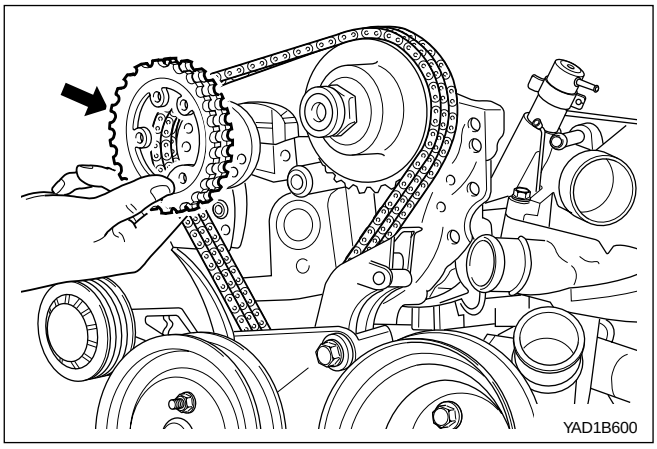
116 589 01 34 00	Threaded Pin
116 589 20 33 00	Sliding Hammer
617 589 00 10 00	Allen Wrench Socket

Removal & Installation Procedure

1. Rotate the crankshaft so that the piston of number 1 cylinder is at TDC.

   Notice: Rotate the crankshaft in the normal engine direction.

2. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
3. Drain the coolant from the crankcase.

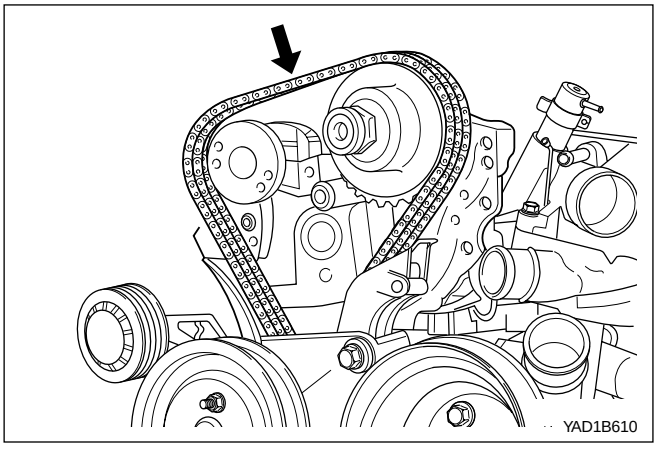

YAD1B600

4. Remove the three flange bolts in the exhaust camshaft sprocket.

   Installation Notice

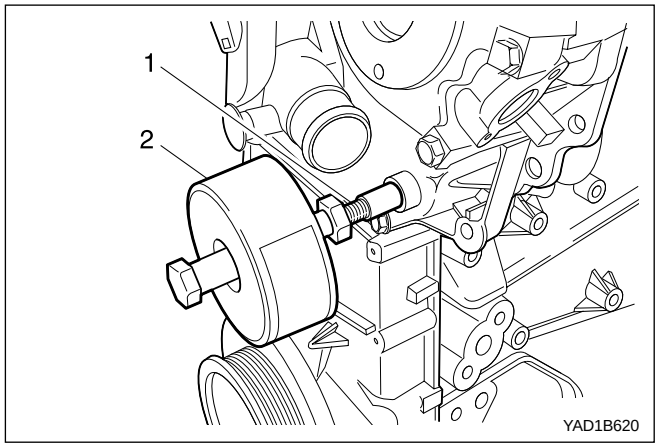
Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 90° ± 5°

   Do not reuse the removed bolts.

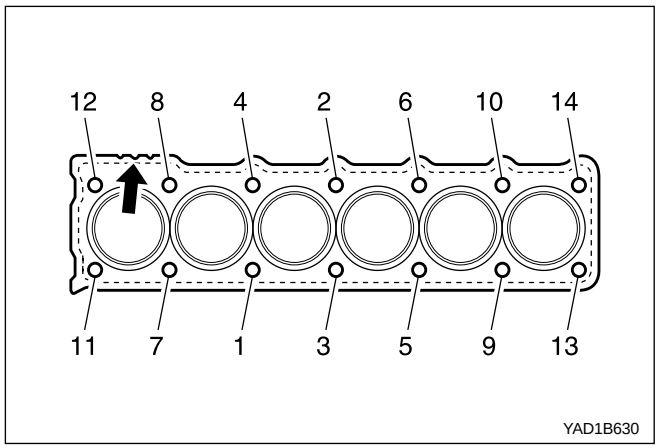

YAD1B610

5. Separate the chain from the camshaft sprockrt.

   Notice: Be careful not to drop the chain into the timing case.



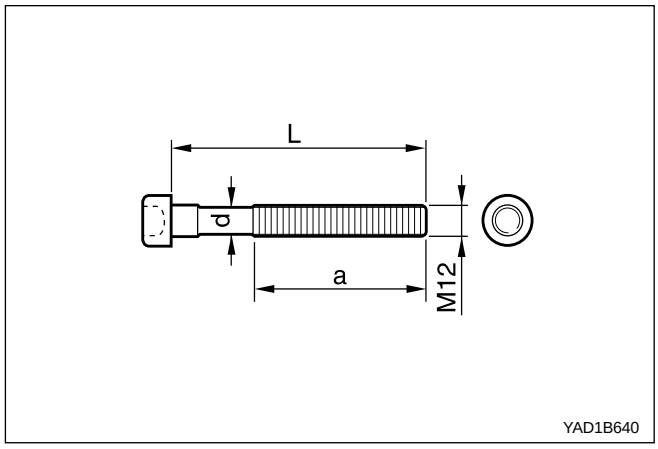
6. Remove the guide rail fixing pin from the cylinder head using the threaded pin 116 589 01 34 00 (1) and sliding hammer 116 589 20 33 00 (2).



7. Remove the cylinder head bolts in numerical order using allen wrench socket 617 589 00 10 00.

Installation Notice

Tightening Torque	1st step: 55 N•m (41 lb-ft)
	2nd step : 90°
	3rd step : 90°



8. Check the length of the cylinder head bolt.

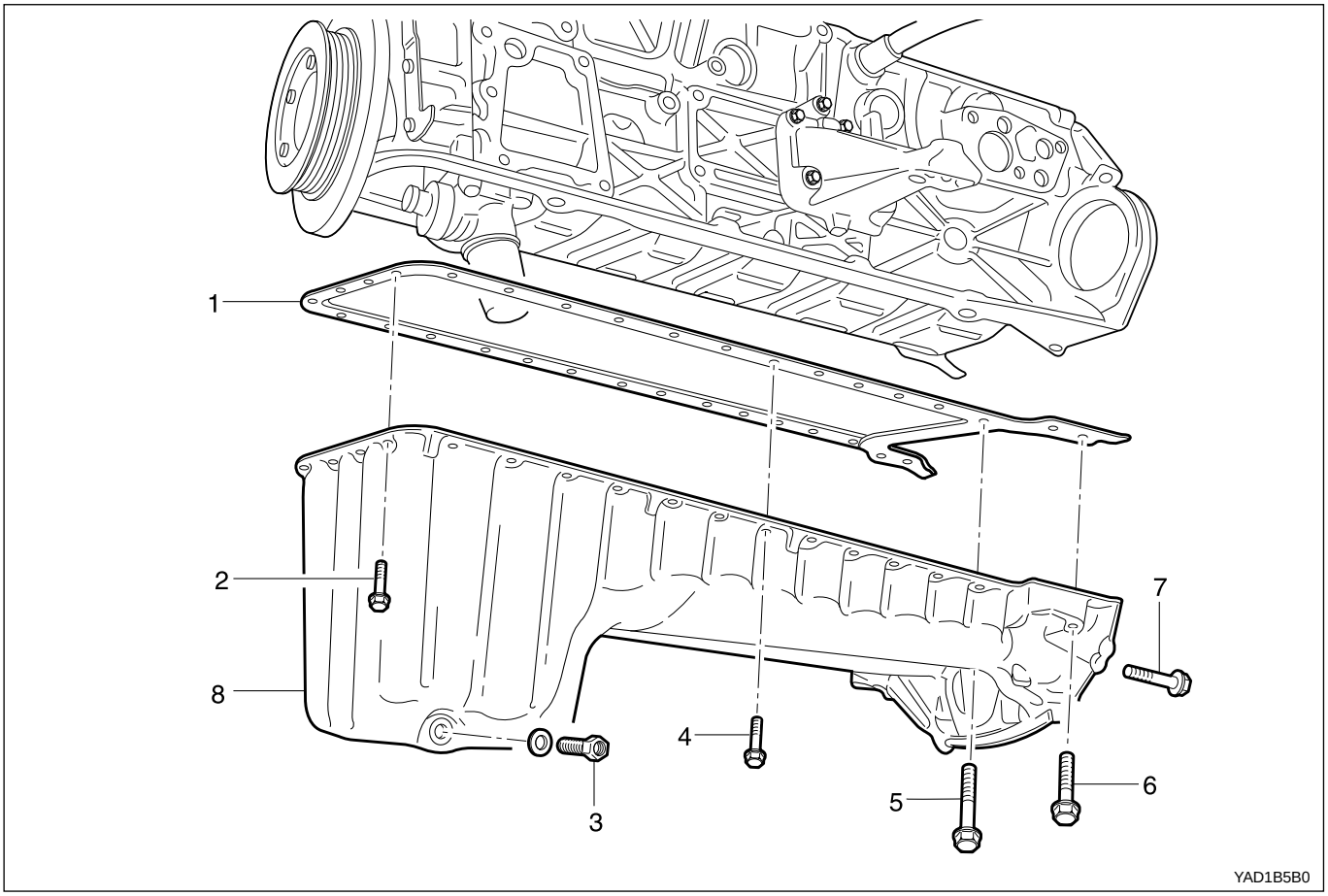
Installation Notice

Length (L)	New 160 ± 0.8 mm
	Max. 162 ± 0.7 mm

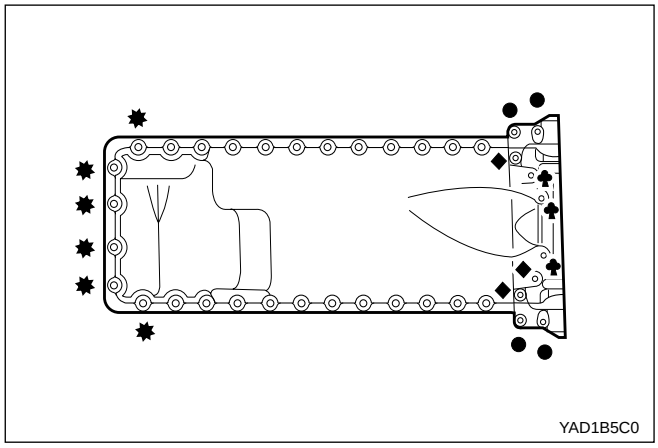
- Replace the bolt if the measured length exceed the max. length.
- Apply the oil to the thread surface of bolt.

9. Carefully remove the cylinder head and check the mating surface.
10. Installation should follow the removal procedure in the reverse order.

OIL PAN



1 Gasket..... Replace
2 Bolt (M6 x 22, 6 pieces)
..... 9-11 N•m (80-97 lb-in)
3 Drain Plug ..... 22.5-27.5 N•m (16.6-20.3 lb-ft)
4 Bolt (M6 x 20, 22 pieces)
..... 9-11 N•m (80-97 lb-in)
5 Bolt (M6 x 85, 3 pieces)
..... 9-11 N•m (80-97 lb-in)
6 Bolt (M8 x 40, 4 pieces)
..... 22.5-27.5 N•m (16.6-20.3 lb-ft)
7 Bolt (M10) ..... 40 N•m (30 lb-ft)
8 Oil Pan



● M8 X 40, 4 pieces
♣ M6 X 85, 3 pieces
◆ M6 X 35, 3 pieces
✸ M6 X 22, 6 pieces
Others M6 X 20, 28 pieces

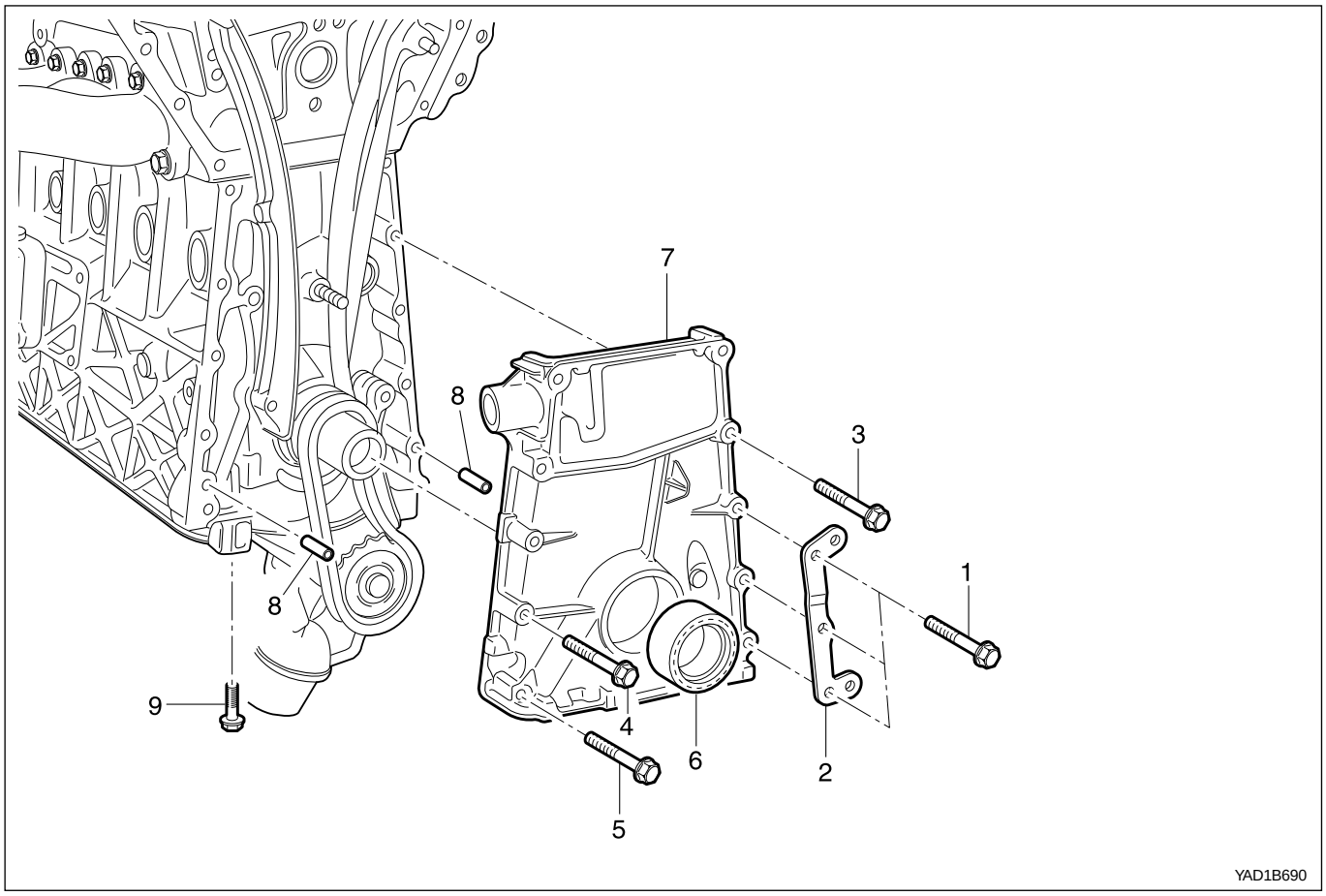
Removal & Installation Procedure

1. Remove the drain plug and drain the oil completely.
2. Unscrew the bolts and remove the oil pan and gasket.

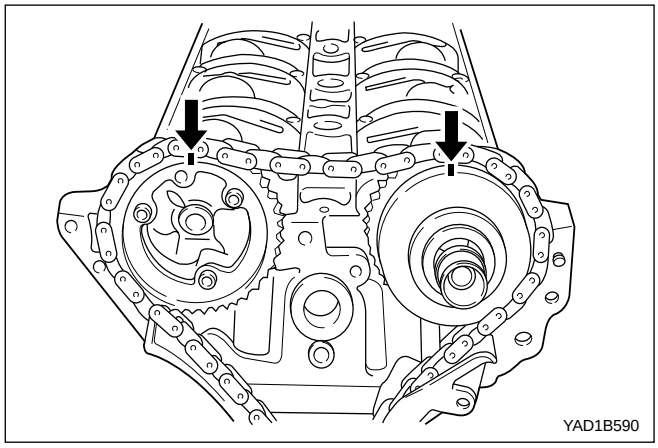
   Notice: Arrange the bolts according to each size.
3. Clean the inside of oil pan and sealing surface, then apply the sealant.
4. Replace the gasket with new one.
5. Install the oil pan with gasket, and tighten each bolt in specified torque.
6. Check for oil leaks while running the engine.

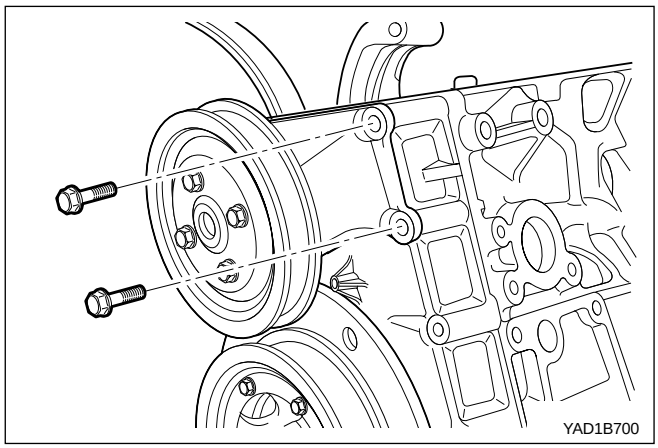
TIMING GEAR CASE COVER

Preceding Work : Removal of cylinder head front cover
Removal of generator bracket
Removal of tensioning device
Removal of belt pulley and vibration damper



1 Bolt (M8 x 60, 3 pieces)
..... 22.5-27.5 N•m (16.6-20.3 lb-ft)
2 A/C Bracket
3 Bolt (M8 x 65, 3 pieces)
..... 22.5-27.5 N•m (16.6-20.3 lb-ft)
4 Bolt (M8 x 40, 1 piece)
..... 22.5-27.5 N•m (16.6-20.3 lb-ft)
5 Bolt (M8 x 60, 1 piece)
..... 22.5-27.5 N•m (16.6-20.3 lb-ft)
6 Seal
7 Timing Gear Case Cover
8 Roll Pin
9 Bolt (M6 x 22, 6 pieces)
..... 9-11 N•m (80-97 lb-in)


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Removal & Installation Procedure

1. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
2. Unscrew the A/C bracket bolts (1) and remove the bracket.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

3. Remove the cooling fan and the viscous clutch. Unscrew the three bolts from the cooling fan bracket and remove the bracket.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

4. Remove the timing gear case cover after unscrewing the bolts (3) and (4) from the timing gear case cover and the bolt (9) from the oil pan.

   Notice: Be careful not to damage the oil pan gasket.

Installation Notice

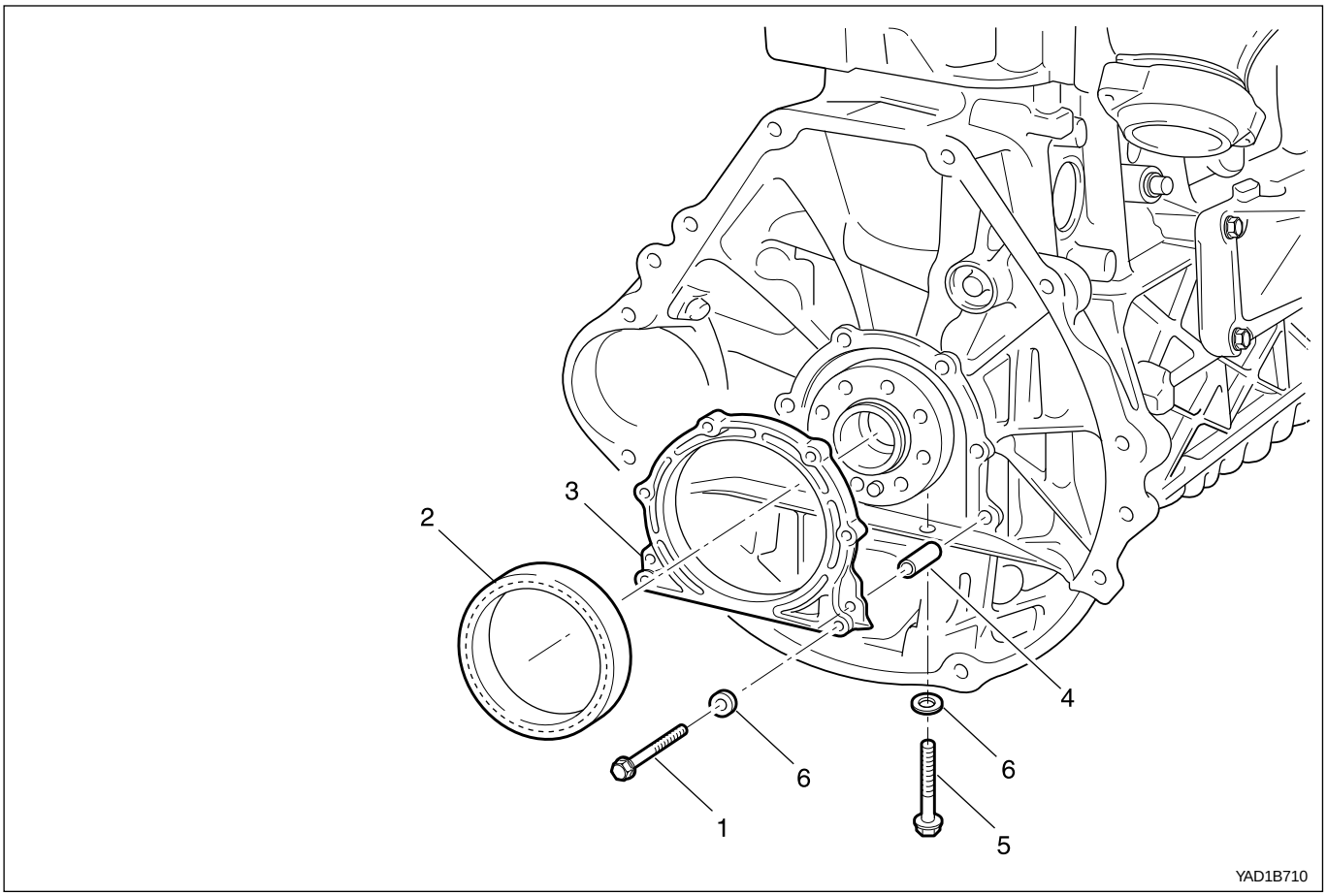
Tightening Torque	Bolt (3, 4) : 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
	Bolt (9) : 9 - 11 N•m (80 - 97 lb-in)

- Apply the sealant after cleaning the timing gear case cover surface.
- Be careful not to stain the oil chamber of chain tensioner with the sealant.

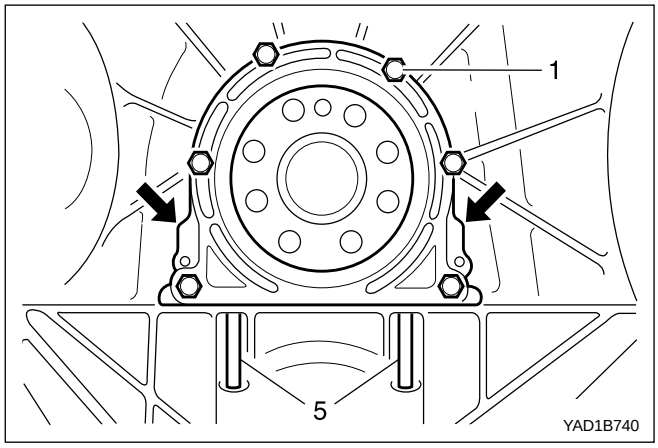
5. Installation should follow the removal procedure in the reverse order.
6. Warm up the engine and check for oil leaks.

CRANKSHAFT SEALING REAR COVER

Preceding Work : Removal of the automatic transmission drive plate



1 Bolt (M6 x 20, 6 pieces)
.....9-11 N•m (80-97 lb-in)
2 Radial Shaft Seal
3 Rear Cover
4 Sleeve
5 Bolt (M6 x 85, 2 pieces)
.....9-11 N•m (80-97 lb-in)
6 Washer



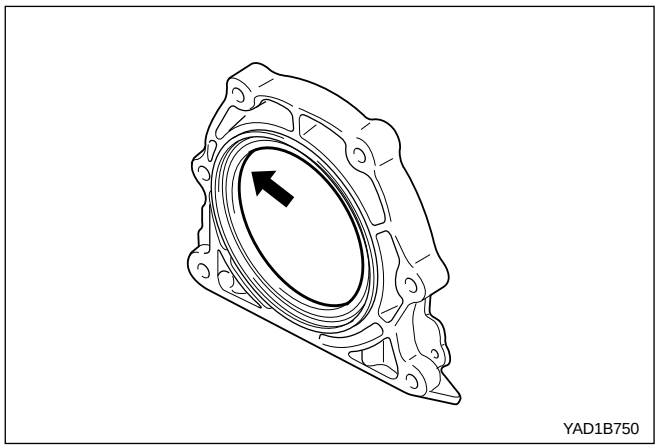
Tools Required

601 589 03 43 00 Crankshaft Rear Seal Installer

Removal & Installation Procedure

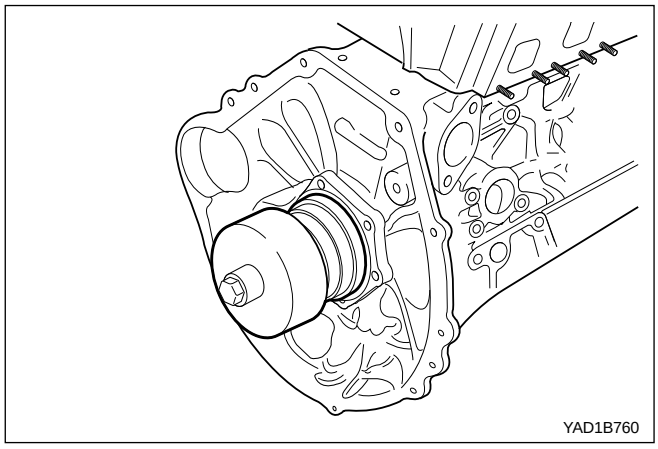
1. Unscrew the bolts (1) and (5) and remove the closing cover by pulling the rear cover lug (arrows).

   Notice: Be careful not to damage the oil pan gasket.

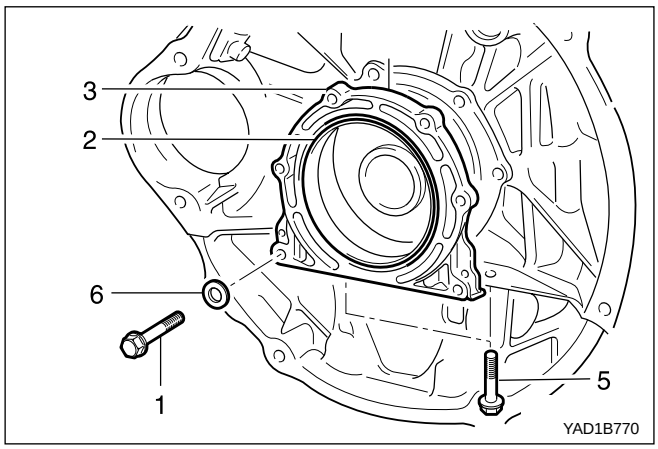


2. Clean the sealing surface of the crankcase and the rear sealing cover.
3. Check the radial shaft seal and replace it if necessary.
4. Apply the Loctite 573 to the rear cover sealing surface.
5. Apply the engine oil to the dust lip of the radial shaft seal.

   Notice: Do not use the grease.



6. Install the crankshaft rear radial seal and the crankshaft sealing rear cover, using crankshaft rear seal installer 601 589 03 43 00.



7. Install the crankshaft sealing rear cover mounting bolts and remove the crankshaft rear seal installer 601 589 03 43 00.

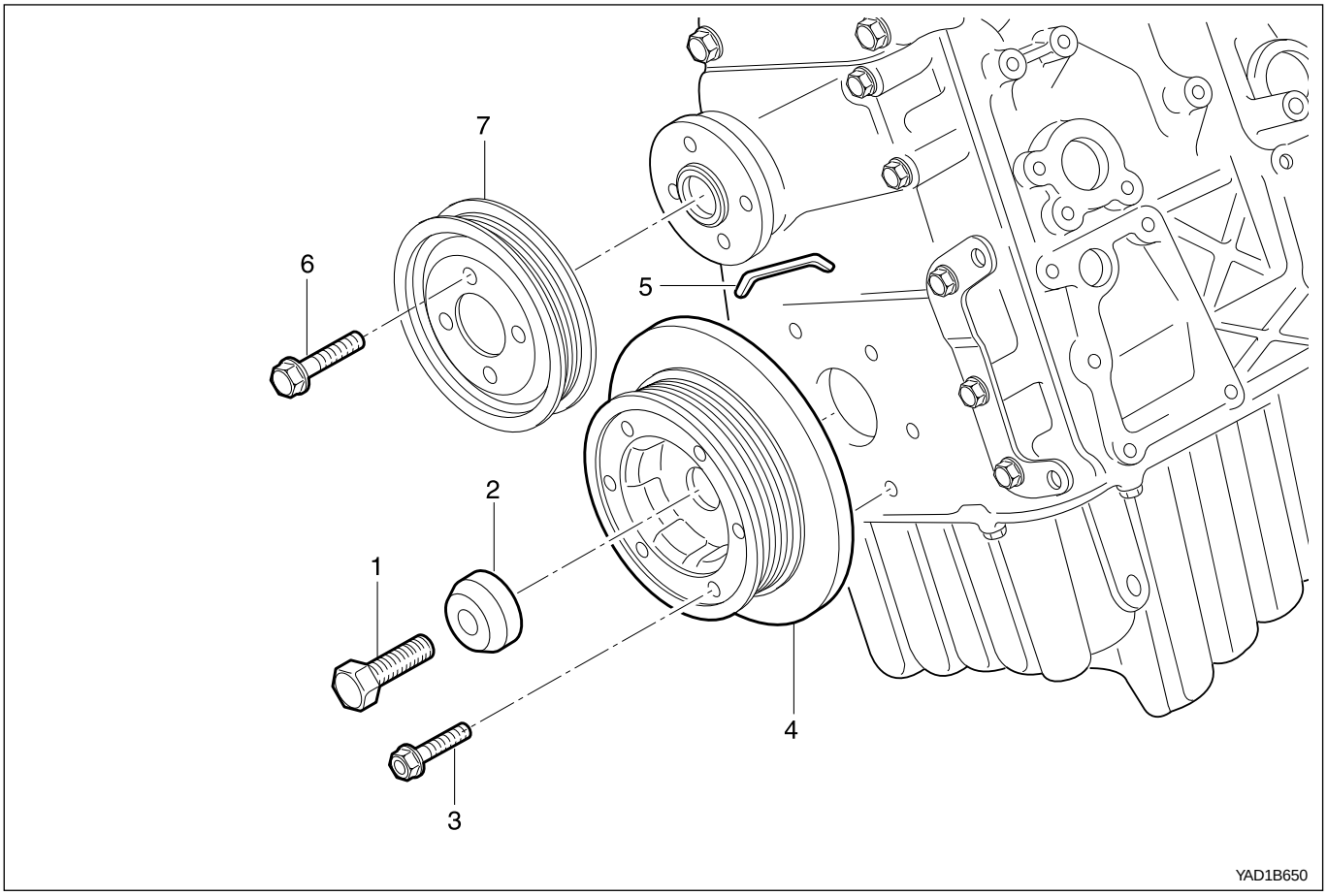
Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

CRANKSHAFT ASSEMBLY

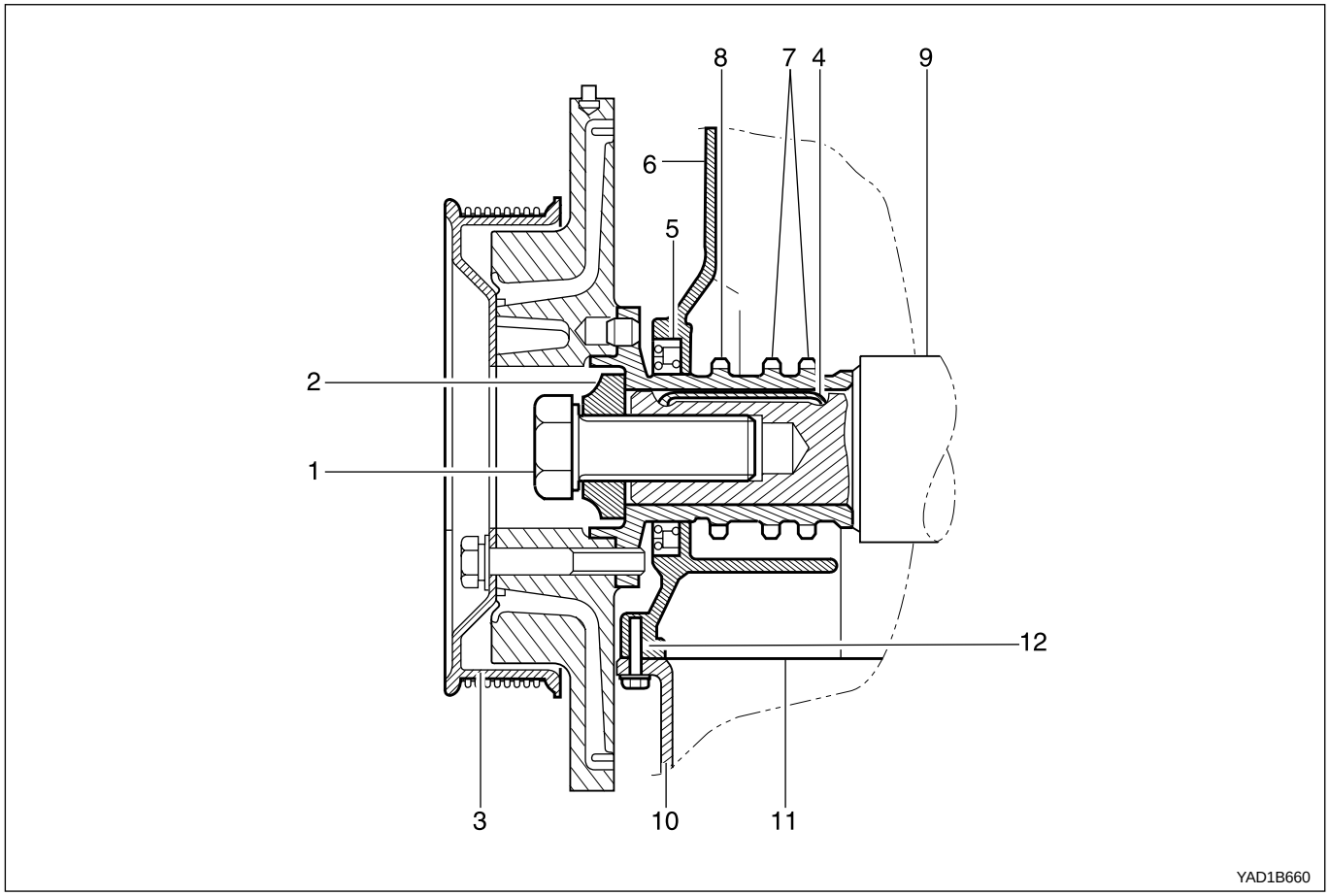
BELT PULLEY AND VIBRATION DAMPER

Preceding Work : Removal of cooling fan and viscous clutch
Removal of fan shroud
Removal of drive belt



1 Center Bolt (M18 x 50)
..... 1st step 180- 220 N•m (133-162 lb-ft)
..... 2nd step 90°+10°
2 Vibration Damper Disk
3 Bolt (M6 x 20, 6 pieces)
..... 7.7-9.5 N•m (68.1-84.1 lb-in)
4 Vibration Damper Assembly
5 Woodruff Key
6 Bolt (M6 x 12, 4 pieces)
..... 9-11 N•m (80-97 lb-in)
7 Cooling Fan Pulley

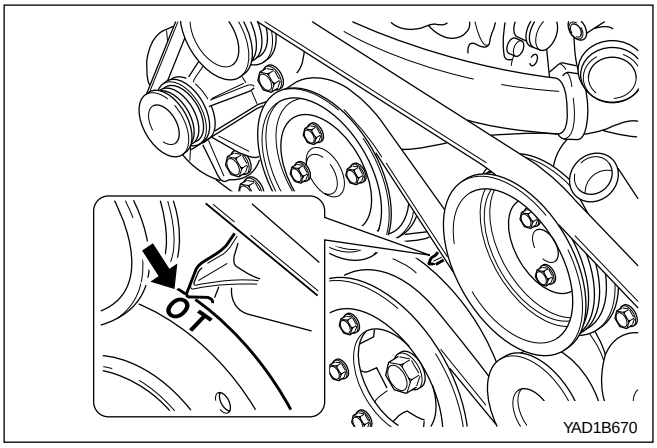
Components



1 Center Bolt (M18 x 50)
2 Vibration Damper Disk
3 Vibration Damper and Pulley Assembly
4 Woodruff Key
5 Crankshaft Front Seal
6 Timing Gear Case Cover
7 Crankshaft Sprocket (Camshaft Driven)
8 Crankshaft Sprocket (Oil Pump Driven)
9 Crankshaft
10 Oil Pan
11 Oil Pan Gasket
12 Oil Pan Mounting Bolt (M6 x 22)

Service Data Standard

Permissble Deviation of The Vibration Damper	Radial Runout	0.6 mm
	Axial Runout	0.6 mm

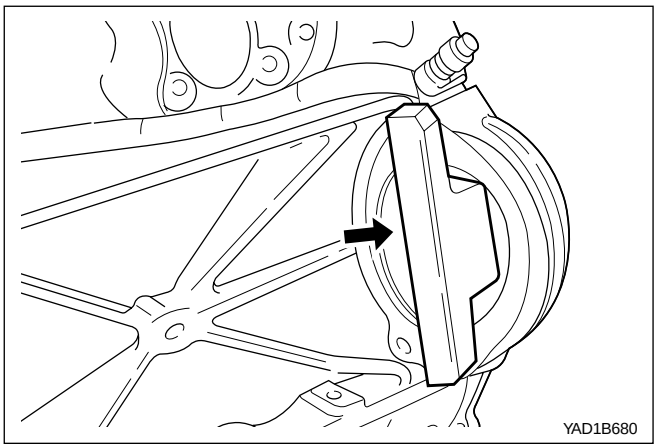


Tools Required

602 589 00 40 00 Engine Lock

Removal & Installation Procedure

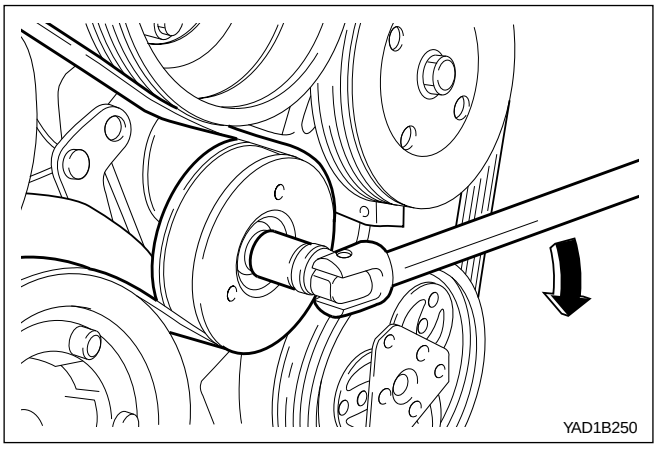
1. Adjust the piston of number 1 cylinder to the TDC.



2. Remove the start motor and install the engine lock 602 589 00 40 00 to the flywheel ring gear.
3. Remove the vibration damper center bolt.

Installation Notice

Tightening Torque	1st step: 180 - 220 N•m (133 - 162 lb-ft)
	2nd step: 90° + 10°

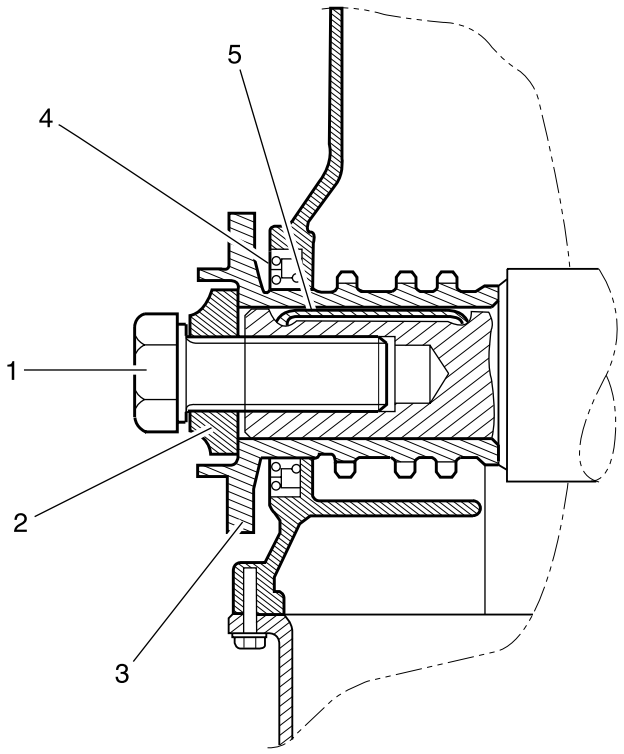


4. Remove the vibration damper assembly using the puller.
5. Installation should follow the removal procedure in the reverse order.

Notice: If possible, don't separate the vibration damper and the pulley.

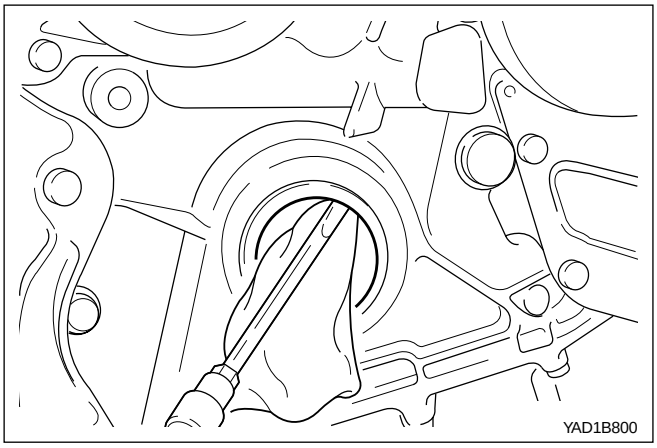
CRANKSHAFT FRONT RADIAL SEAL

Preceding Work : Removal of belt pulley and vibration damper



YAD1B780

1 Center Bolt (M18 x 50)
..... 1st step 180- 220 N•m (133-162 lb-ft)
2nd step 90°+10°
2 Center Bolt Washer
3 Sleeve (Special Tool)
4 Crankshaft Front Seal
5 Key



Tools Required

601 589 03 14 00 Crankshaft Front Seal Installer

Replacement Procedure

1. Remove the radial seal with a screw driver.

   Notice: Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.

2. Coat the radial sealing lip with engine oil.
3. Using the crankshaft front seal installer 601 589 03 14 00, assemble the radial seal.
4. Align the sleeve groove and the woodruff key and tighten the center bolt until the center bolt and the damper disk stop in the movement.

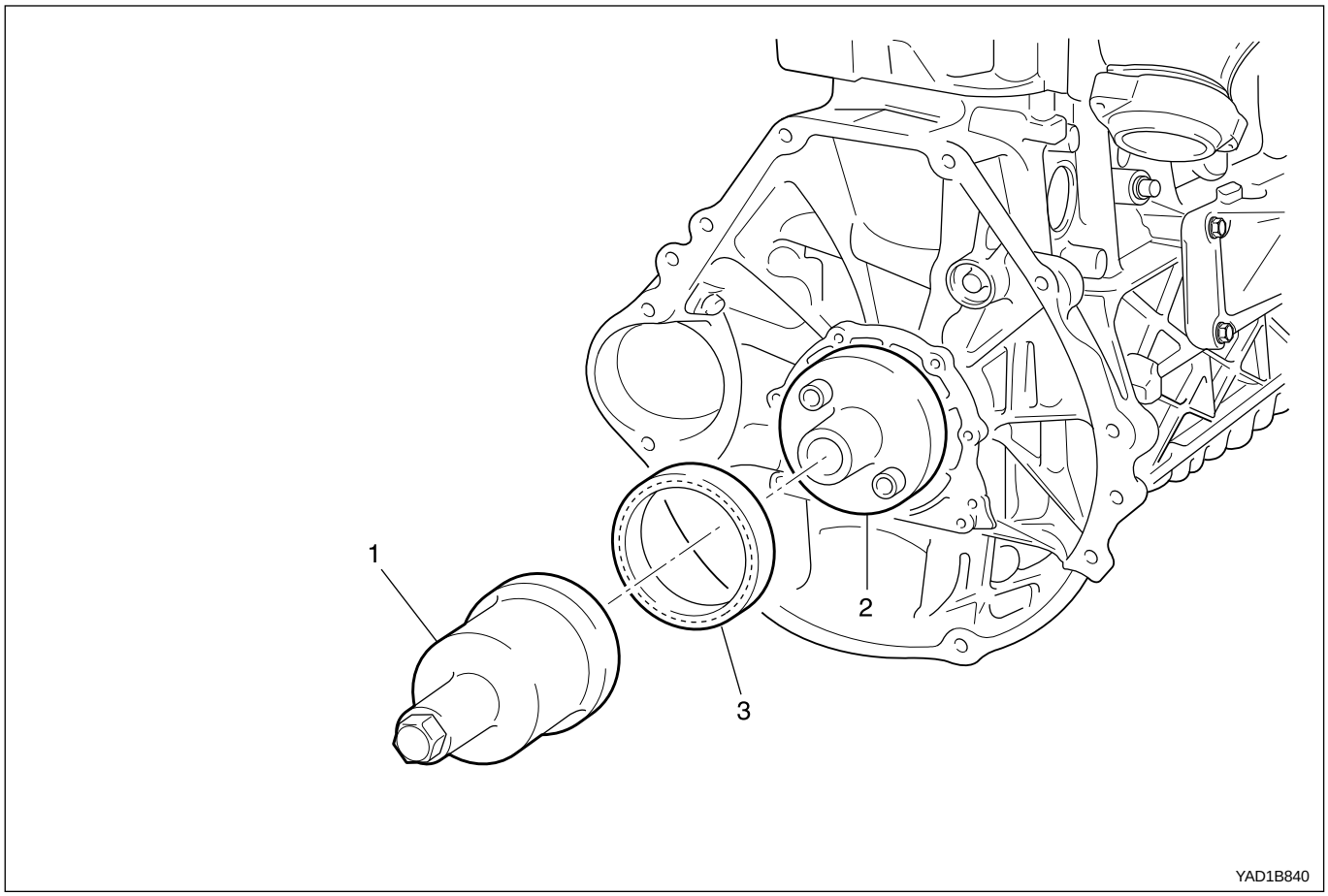
   Installation Notice

Tightening Torque	1st step: 180 - 220 N•m (133 - 162 lb-ft)
	2nd step: 90° + 10°

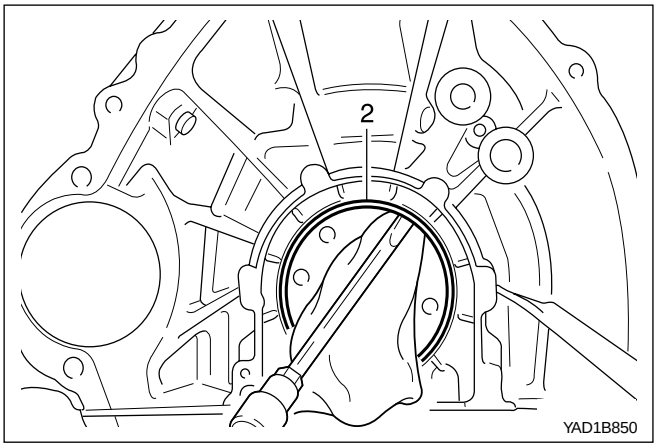
5. Remove the crankshaft front seal installer 601 589 03 14 00, and install the belt pulley and the vibration damper.
6. Check for leaks while operating the engine.

CRANKSHAFT REAR RADIAL SEAL

Preceding Work : Removal of flywheel or drive plate



1 Special Tool
2 Special Tool
3 Crankshaft Rear Seal



Tools Required

601 589 03 43 00 Crankshaft Rear Seal Installer

Replacement Proceudre

1. Remove the radial seal with a screw driver.

   Notice: Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.

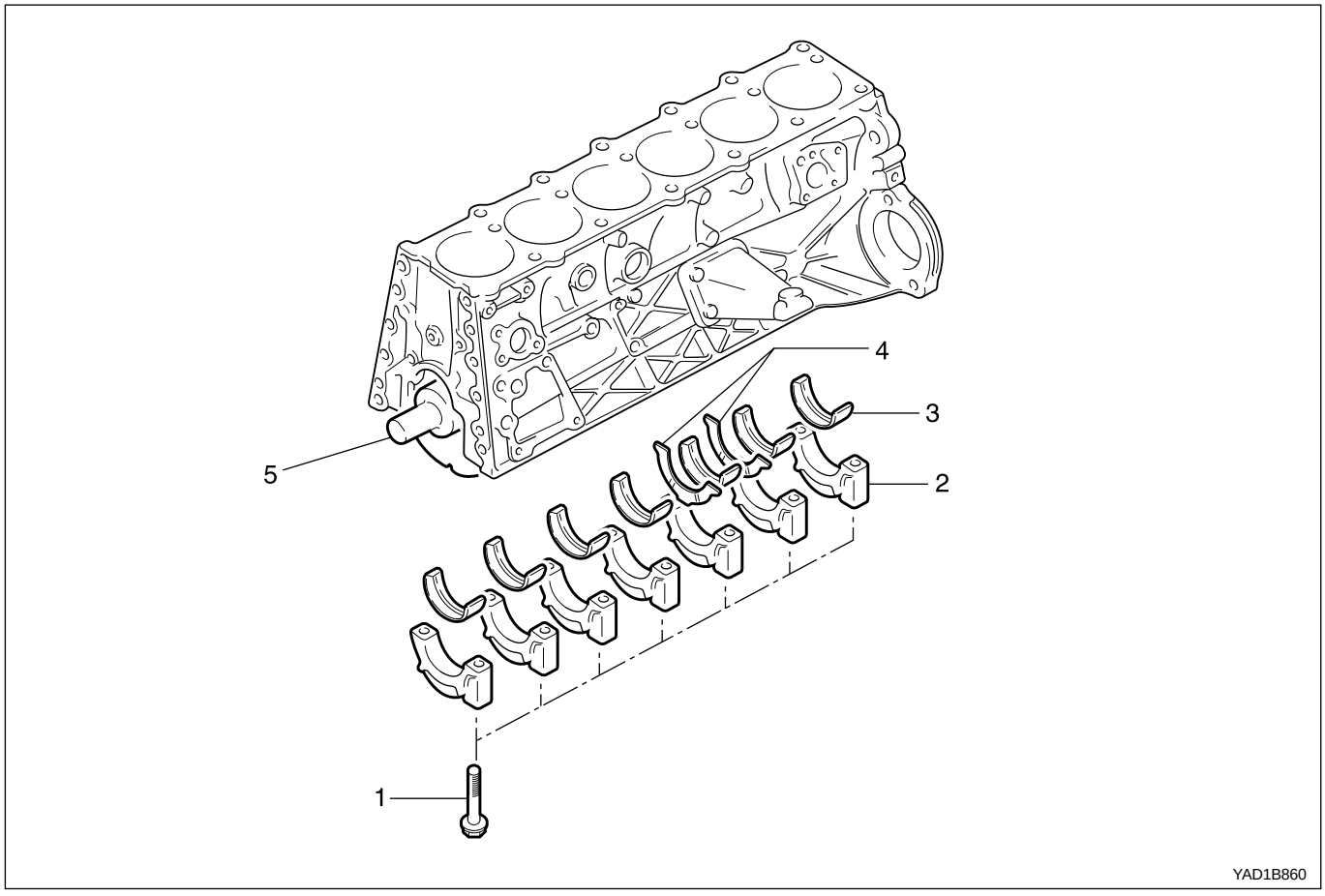
2. Install the crankshaft rear seal installer 601 589 03 43 00 (2) to the crankshaft.
3. Apply the engine oil on the crankshaft rear seal installer 601 589 03 43 00 (2).

   Notice: Do not use the grease.

4. Install the radial seal on the inner parts assembler.
5. Press in the crankshaft rear seal installer 601 589 03 43 00 (1) until the radial seal is stopped.
6. Check for leaks while operating the engine.

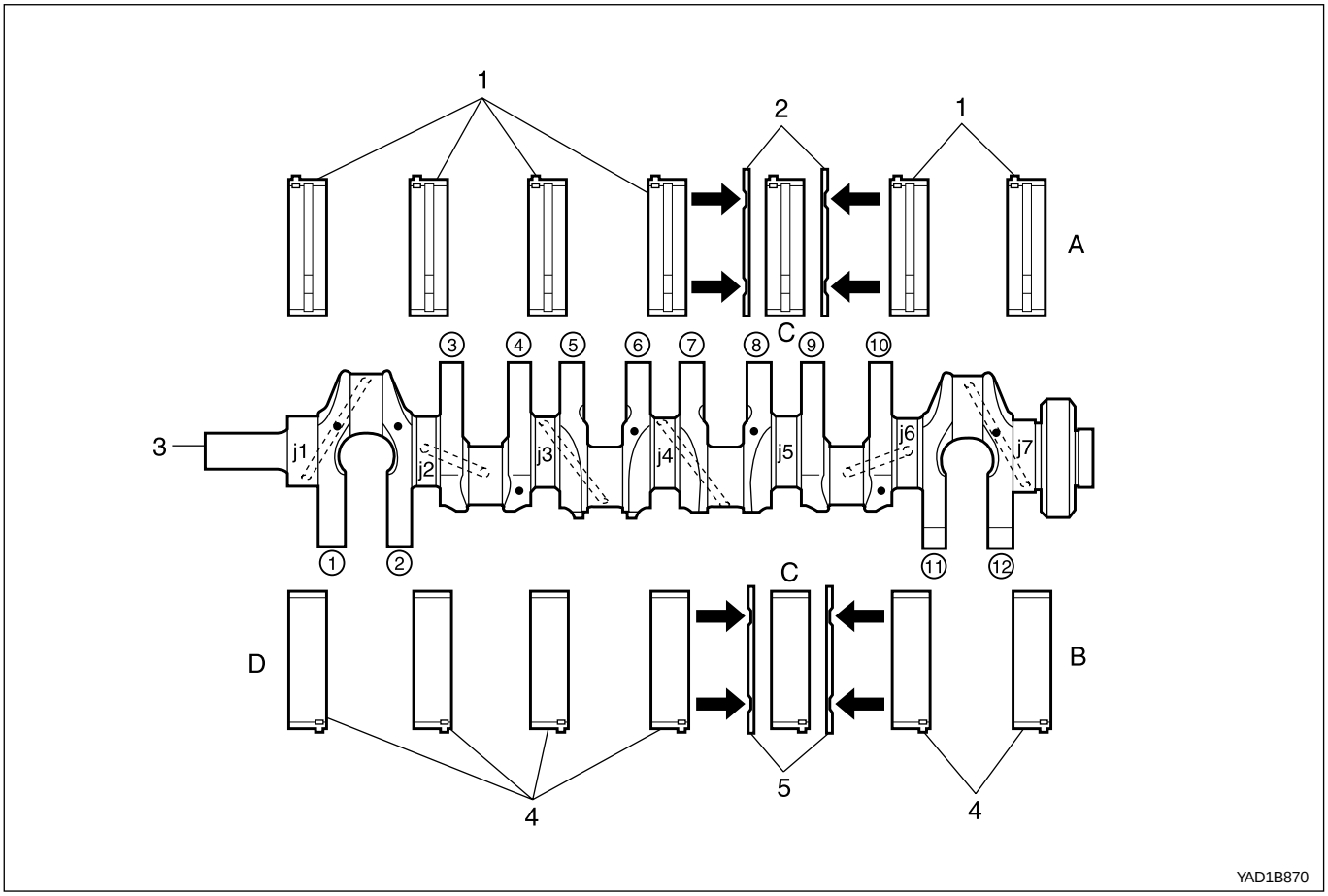
CRANKSHAFT

Preceding Work : Removal of engine assembly
Removal of timing gear case cover
Removal of cylinder head
Removal of crankshaft sealing rear cover
Removal of oil pan
Removal of oil pump
Removal of baffle plate



1 Crankshaft Bearing Cap Bolt
(M8 x 55, 14 pieces)
..... 1st step 50- 60 N•m (37-44 lb-ft)
2nd step 90°+5°
2 Crankshaft Bearing Cap
3 Crankshaft Lower Main Bearing
4 Crankshaft Lower Thrust Bearing
5 Crankshaft

Arrangement of the Thrust Bearing and the Main Bearing



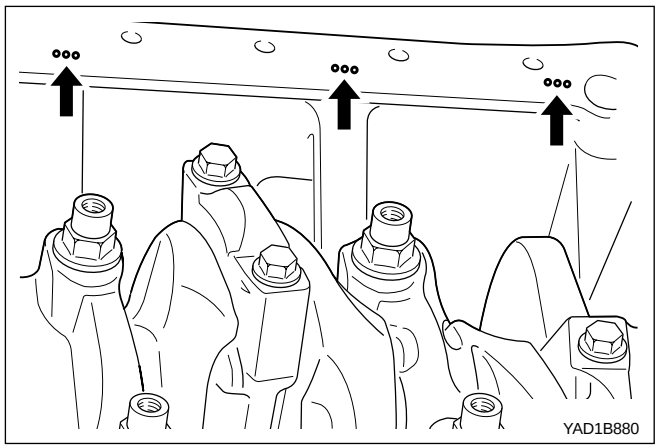
1 Upper Main Bearing
2 Upper Thrust Bearing
3 Crankshaft
4 Lower Main Bearing
5 Lower Thrust Bearing

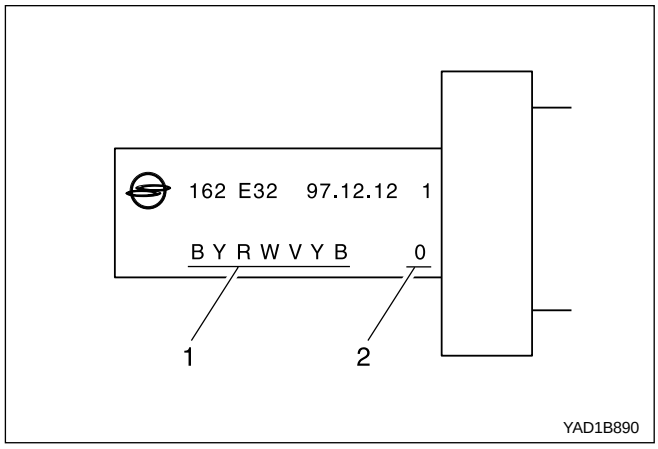
A Crankcase Side
B Bearing Cap Side (Oil Pan Side)
C Axial Fit Bearing (Number 5 Bearing Point)
D Radial Bearing

① - ⑫ Weight Balance/Color Marking Point
j1 - j7 Journal Main Bearing #1 - #7
● Color Dot Marking

The color dot marking are put on the ①, ②, ④, ⑥, ⑧, ⑩, ⑫ and it indicates the diameter of crankshaft journal by color as below.

Color Dot Marking	Crankshaft Journal Diameter (mm)
Blue	57.960 - 57.965
Yellow	57.955 - 57.960
Red	57.950 - 57.955
White	57.945 - 57.950
Violet	57.940 - 57.945





Selection of Crankshaft Main Bearing

1. Crankcase Side

   There are seven punching marks on the mating surface to oil pan. This mark is correspondent to the bearing distinguished by color. Select the relevant bearing according to the punching mark when repaired.

Punching Mark	Bearing Color Selected
●	Blue
●●	Yellow
●●●	Red

2. Crankshaft Bearing Cap Side

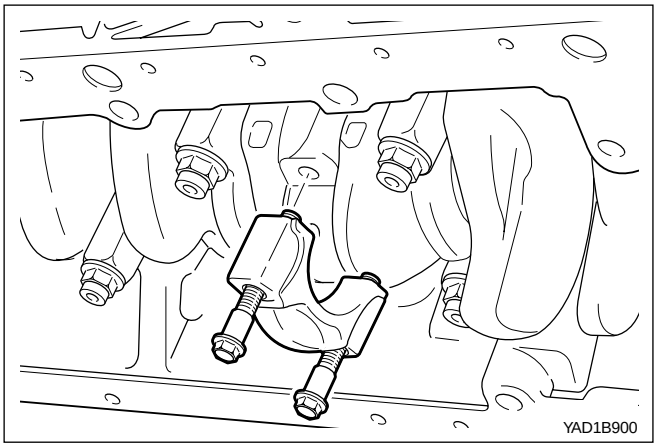
   Select the crankshaft main bearing according to the marking letter on the crankshaft main journal when repaired.

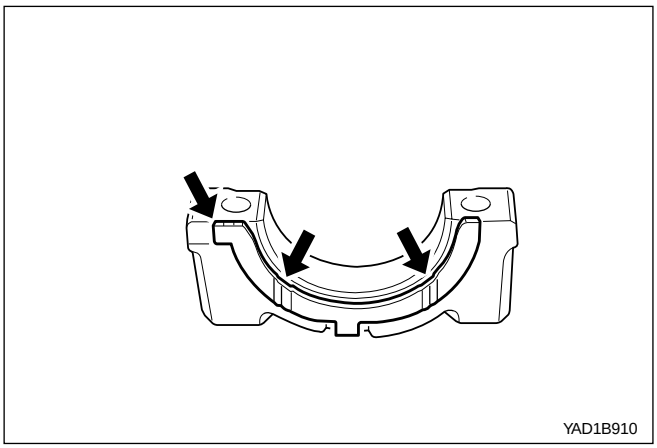
Marking Letter	Bearing Color Selected
B	Blue
Y	Yellow
R	Red
W	White
V	Violet

Service Data

Unit : mm

Crankshaft Standard and Repair Size	Crankshaft Bearing Journal Diameter	Thrust Washer Thickness	Crankshaft Journal Width at fit bearing	Connecting Rod Bearing Journal Diameter	Connecting Rod Bearing Journal Width
Standard size	57.950 - 57.965	2.15 or 2.20	24.50 - 24.533	47.94 - 47.96	27.958 - 28.042
1st repair size	57.700 - 57.715	2.25 or 2.35 or 2.40	-	47.75	-
2nd repair size	57.450 - 57.465			47.50	
3rd repair size	57.200 - 57.215			47.25	
4th repair size	56.950 - 56.965			47.00	


YAD1B900


YAD1B910

Part No. : 601 030 00 62 2.15 mm
Part No. : 601 030 01 62 2.20 mm
Part No. : 601 030 02 62 2.25 mm
Part No. : 601 030 03 62 2.30 mm
Part No. : 601 030 04 62 2.40 mm

Removal & Installation Procedure

1. Unscrew the connecting rod bearing cap bolt and remove the bearing cap.

   Installation Notice

Tightening Torque	1st step: 40 + 5 N•m (30 + 3.7 lb-ft)
	2nd step: 90° + 10°

   - Make sure that the upper and lower bearing shells do not change each other.
   - Coat the bearing shell with engine oil.
   - Install the bearing cap according to the consecutive number.

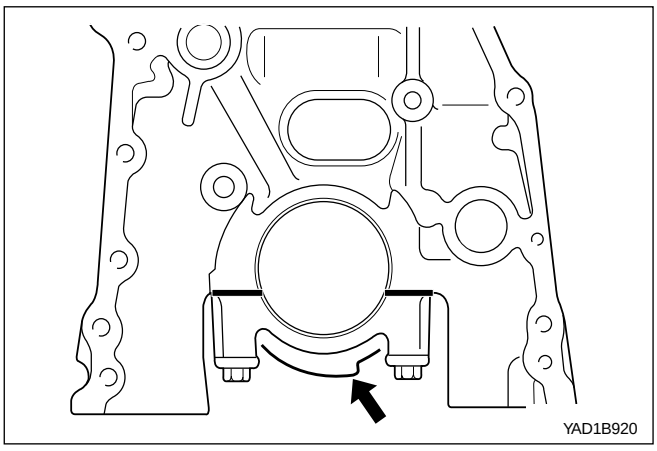
2. Unscrew the crankshaft bearing cap bolts and separate the upper and lower bearing shells and thrust washers.

   Installation Notice

Tightening Torque	1st step: 50 - 60 N•m (37 - 44 lb-ft)
	2nd step: 90°

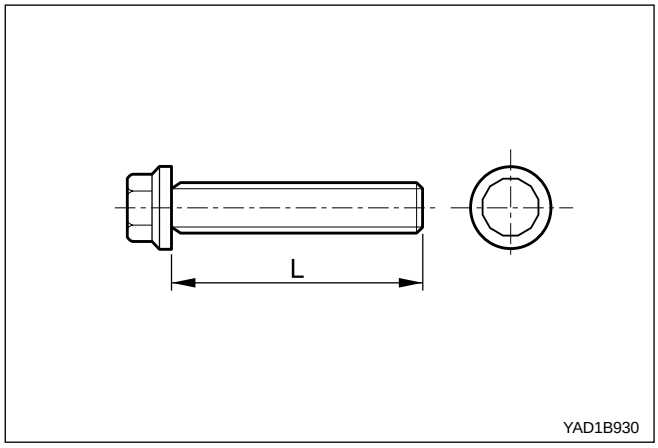
   - Remove the bearing cap from front (pulley side) to rear.
   - Make sure that the upper and lower bearing shells do not change each other and coat with engine oil.
   - The oil grooves (arrows) in the thrust washers must face outward and insert the thrust bearing into the bearing cap.
   - There are five kinds of thrust washers by thickness. Select the proper washer when repaired.

3. Remove the crankshaft.
4. Installation should follow the removal procedure in the reverse order.
5. After completion of the installation, check for the rotating condition of the crankshaft.


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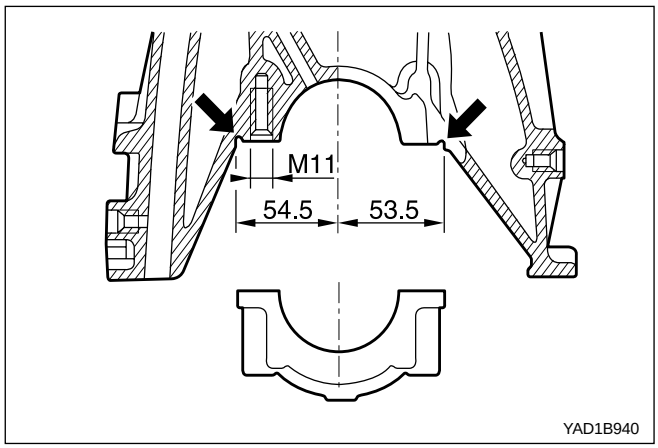
Notice:

- Make sure the crankshaft bearing cap properly seated in place in the crankcase side. When perfectly installed, the projected part (arrow) locates in the left side (intake manifold side).
- Assemble so that the projected part of the cap and crankcase face the same direction.

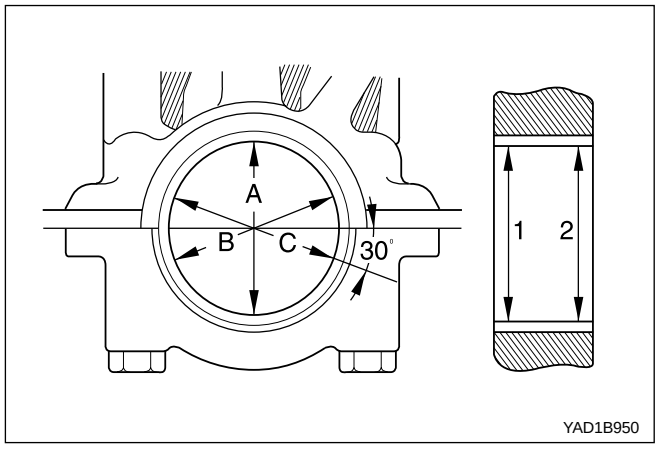


Inspection

1. If the length 'L' of the crankshaft bearing cap bolt exceeds 63.8 mm, replace it.



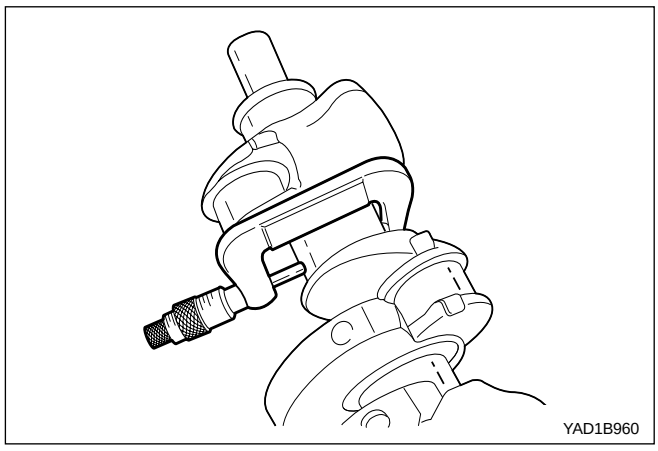
2. Make sure the crankshaft bearing cap is properly seated on the cylinder block (arrows).



3. Measure and record the inner diameter of the crankshaft bearing.

Notice:

- Measure at 2 points (1, 2).
- Measure 'A','B'and 'C' as shown. If average value of 'B' and 'C'is less than value 'A', then the average value of 'B' and 'C' is actual average value. If average value of 'B' and 'C' is more than value 'A', then the value 'A' is actual average value.



4. Measure and record the diameter of the crankshaft bearing journal.

Notice:

- Record the mean value when measured at 3 points (A, B, C).
- Measure the inner diameter of bearing and the diameter of journal and if it is out of the standard data, replace the bearing shell.

Service Data Standard (Crankshaft Main Bearing Gap)

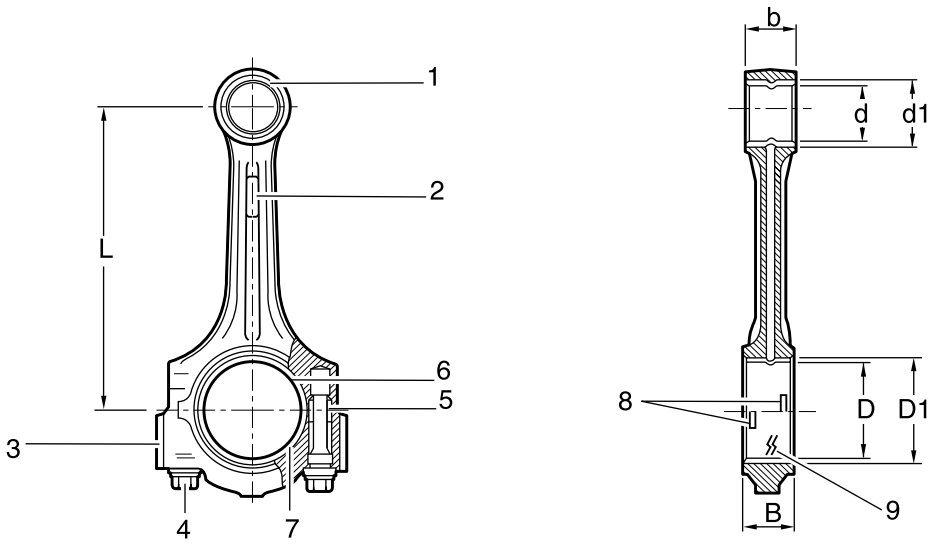
Item	Measuring Position	Gap (mm)
Main Bearing Journal (NO. 1, 5, 7)	Radial	Static condition :0.015 - 0.039 Dynamic condition: 0.031 - 0.051 (Consider the expansion 0.011 - 0.016)
	Axial	0.010 - 0.254
Main Bearing Journal (NO. 3, 4, 6)	Radial	Static condition :0.011 - 0.039 Dynamic condition: 0.031 - 0.051 (Consider the expansion 0.015 - 0.022)
	Axial	0.010 - 0.254

(Connecting Rod Bearing Gap)

Item	Measuring Position	Gap (mm)
Connecting Rod Bearing	Radial	0.030 - 0.050

CONNECTING ROD

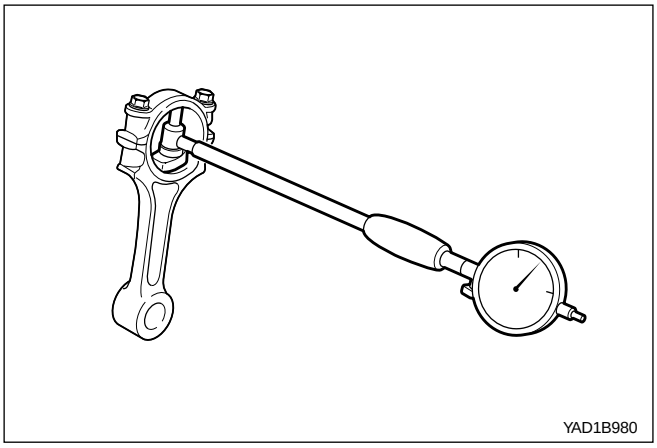
Preceding Work : Removal of piston



1 Connecting Rod Bushing
2 Oil Gallery
3 Balance Weight
4 Connecting Rod Bolt (M9 x 52, 12 pieces)
..... 1st step 40+5 N•m (30+3.7 lb-ft)
2nd step 90°+10°
5 Fit Sleeve
6 Upper Connecting Rod Bearing
7 Lower Connecting Rod Bearing
8 BearingShell Lug
9 Marking [Indication(//) or Numbers]

Service Data Standard

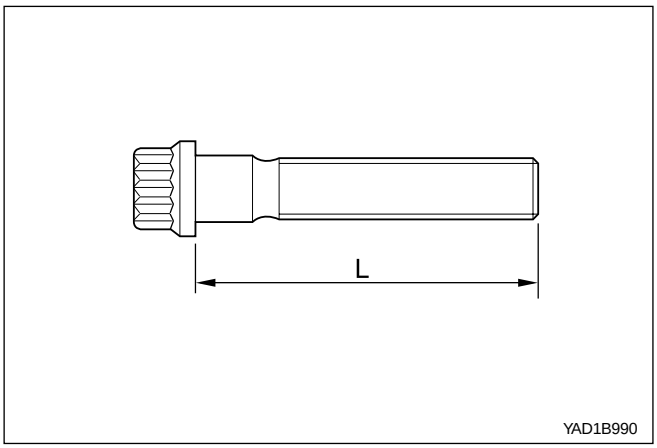
Distance (L) from The Connecting Rod Bearing Bore Center to The Bushing Bore Center	145 ± 0.05 mm
Width of The Connecting Rod (B) at Bearing Bore	21.940 - 22.000 mm
Width of The Connecting Rod (b) at Bushing Bore	21.940 - 22.000 mm
Basic Bore at The Bearing Shell (D1)	51.600 - 51.614 mm
Basic Bore at The Bushing (d1)	24.500 - 24.571 mm
Bushing Inner Diameter (d)	22.007 - 22.013 mm
Clearance Between The Piston Pin and The Bushing	0.007 - 0.018 mm
Peak-to-valley Height of Connecting Rod Bushing on Inside	0.005 mm
Permissible Twist of Connecting Rod Bearing Bore to Connecting Rod Bushing Bore	0.15 mm
Permissible Deviation of Axial Paralleism of Connecting Rod Bearing Bore to Connecting Rod Bushing Core	0.07 mm
Permissible Deviation of Connecting Rod Bearing Bore from Concentricity	0.01 mm
Permissible Difference of Each Connecting Rod in Weight	0.4 g


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Inspection

1. Measure the basic bore of the connecting rod bearing.

   Notice: If the basic bore exceeds the value of 51.614 mm, replace the bearing or check the connecting rod.

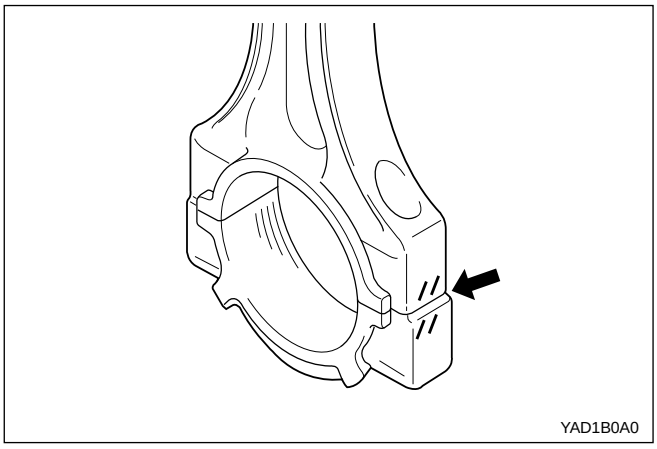


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2. Check connecting rod bolts.

Length When New (L)	51.7 - 52 mm
Max. Length (L)	52.9 mm
Tightening Torque	1st step: 40 + 5 N•m (30 + 3.7 lb-ft)
	2nd step: 90°+10°

   Notice: If the length exceeds max. length, replace it.


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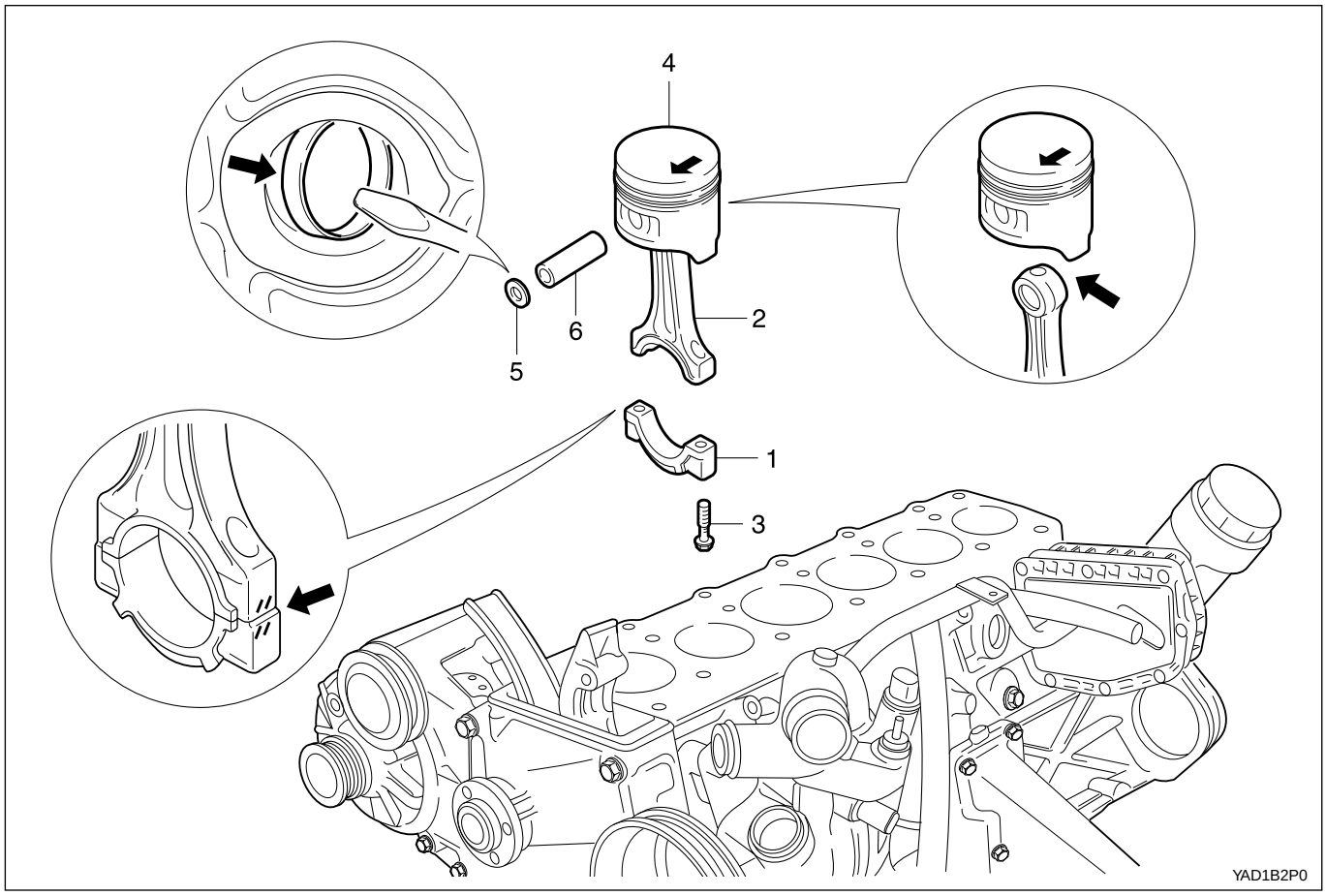
3. Check the assembly mark(indication//or number: arrow) of the connecting rods and the bearing cap when installing.

   Notice:

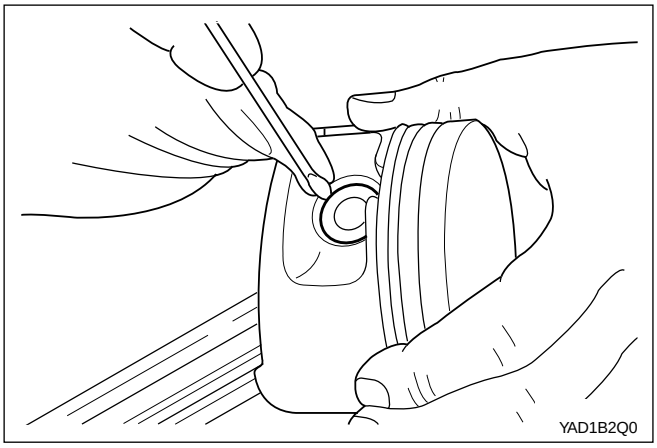
   - Make sure it doesn't exceed over 4g with other connecting rods when replacing the connecting rods.
   - Check if the connecting rod and the bearing cap are accurately seated on the groove when replacing the bearing.

PISTON

Preceding Work : Removal of engine
Removal of cylinder head
Removal of oil pan
Removal of oil pump
Removal of baffle plate



1 Connecting Rod Bearing Cap
2 Connecting Rod
3 Connecting Rod Bearing Cap Bolt
(M9 x 52, 12 pieces)
..... 1st step 40+5 N•m (30+3.7 lb-ft)
2nd step 90°+10°
4 Piston
5 Snap Ring
6 Piston Pin



Removal Procedure

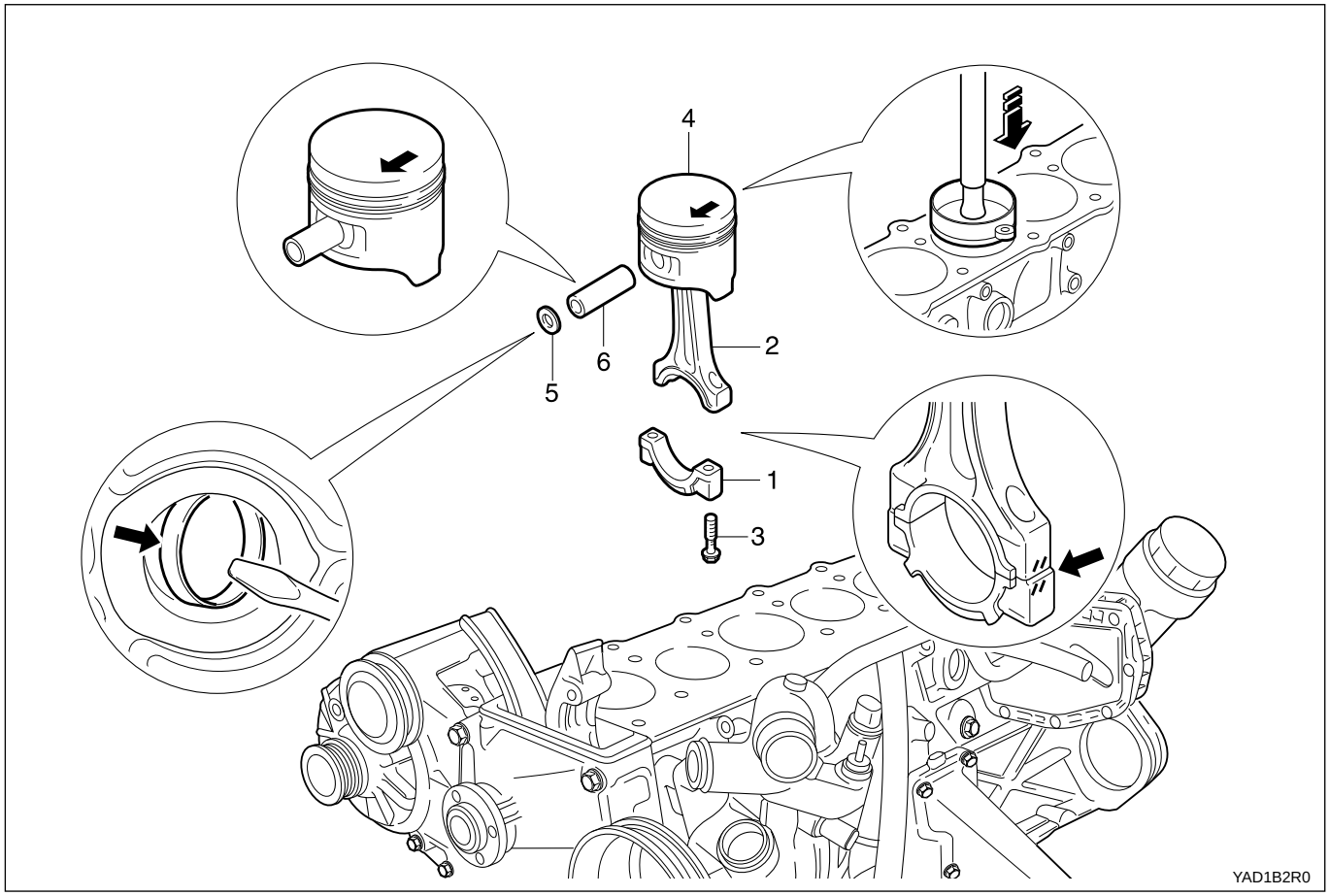
1. Unscrew the connecting rod bearing cap bolt (3) and remove the cap.
2. Remove the connecting rod and the piston upward.

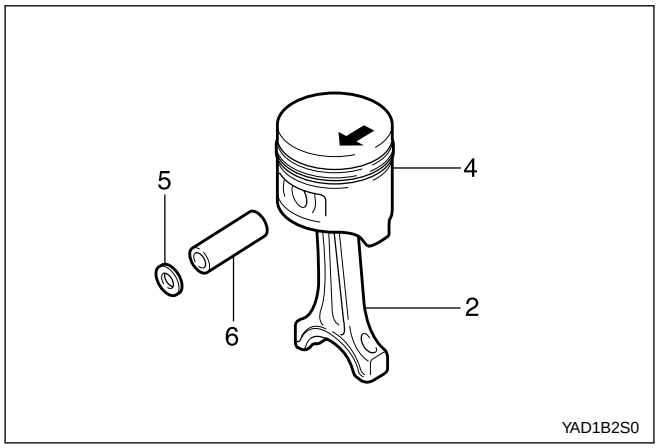
   Notice: Make sure that the bearing cap and shell are not changed each other.

3. Remove the snap ring (5) and pull out the piston pin (6).

   Notice: Remove the snap ring using a clean cloth as shown in the right picture so that the piston, piston ring, and the snap ring don't get damaged.

Installation Procedure





1. Check the piston ring gap and apply the engine oil to the piston pin and the connecting rod bushing.
2. Connect the piston and the connecting rod by pressing in the piston pin (6) and install the snap ring to the groove.
3. Clean the cylinder bore, connecting rod bearing journal, connecting rod bearing shell and the piston and coat them with engine oil.
4. Install the piston ring.
5. Install the piston so that the arrow on the piston head faces to the forward of the vehicle.
6. After aligning the connecting rod and the bearing cap mark (// or a number), tighten the bolts.

Installation Notice

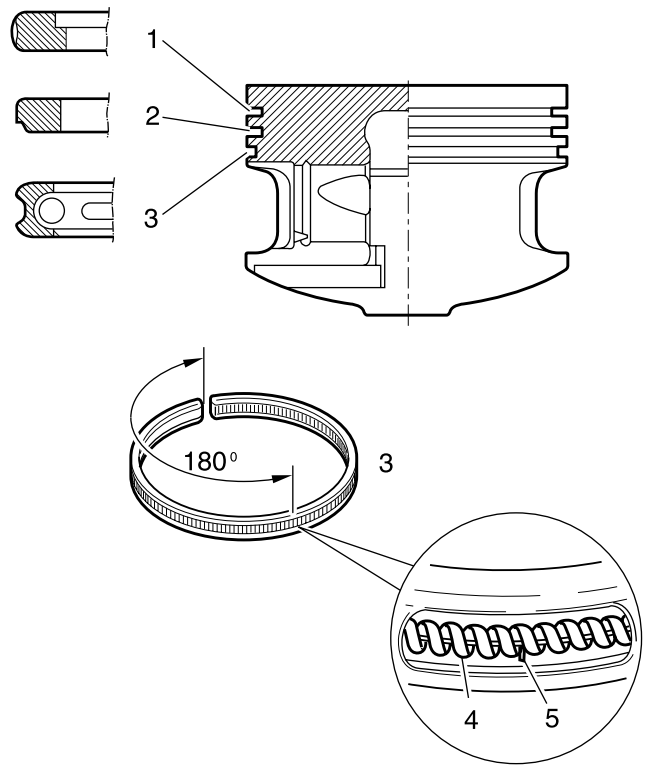
Tightening Torque	1st step: 40 + 5 N•m (30 + 3.7 lb-ft)
	2nd step: 90° + 10°

Apply the engine oil to the bearing cap upper and lower bearing shells.

7. Check if the crankshaft rotates without any trouble by rotating it.

PISTON RING

Preceding Work : Removal of piston



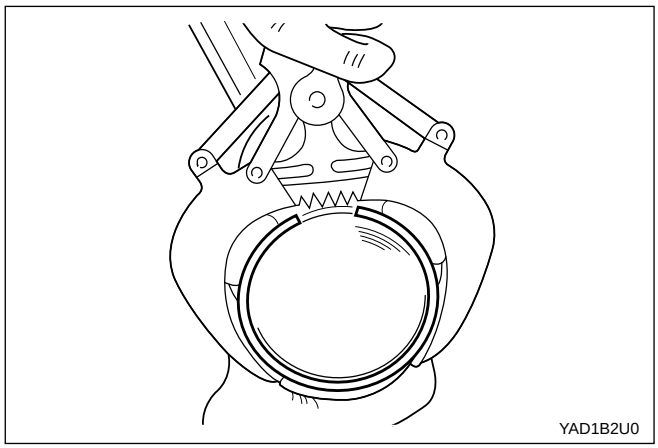
1 Piston Compression Ring
2 Piston Compression Ring
3 Piston Oil Ring
4 Coil Spring and Control Ring
5 Hook Spring

Replacement Procedure

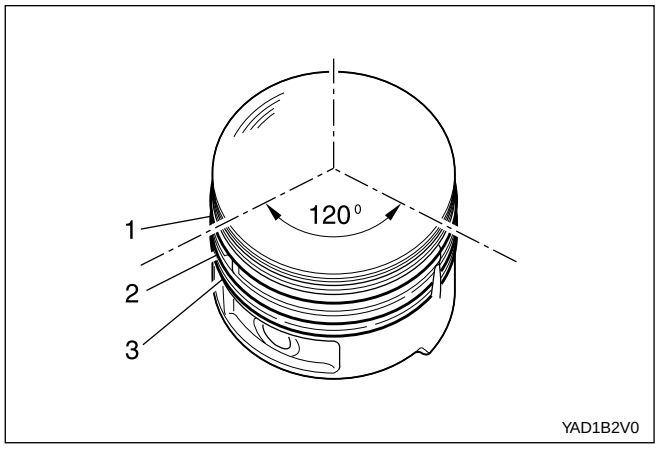
1. Measure the piston ring's gap.

End Gap of The Piston Ring	Groove 1 0.20 - 0.40 mm
	Groove 2 0.20 - 0.40 mm
	Groove 3 0.20 - 0.45 mm
Gap Between The Piston and The Piston Ring	Groove 1 0.015 - 0.050 mm
	Groove 2 0.020 - 0.040 mm
	Groove 3 0.010 - 0.045 mm

Notice: If out of specification, replace the piston ring.


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2. Remove the piston ring with a pliers.

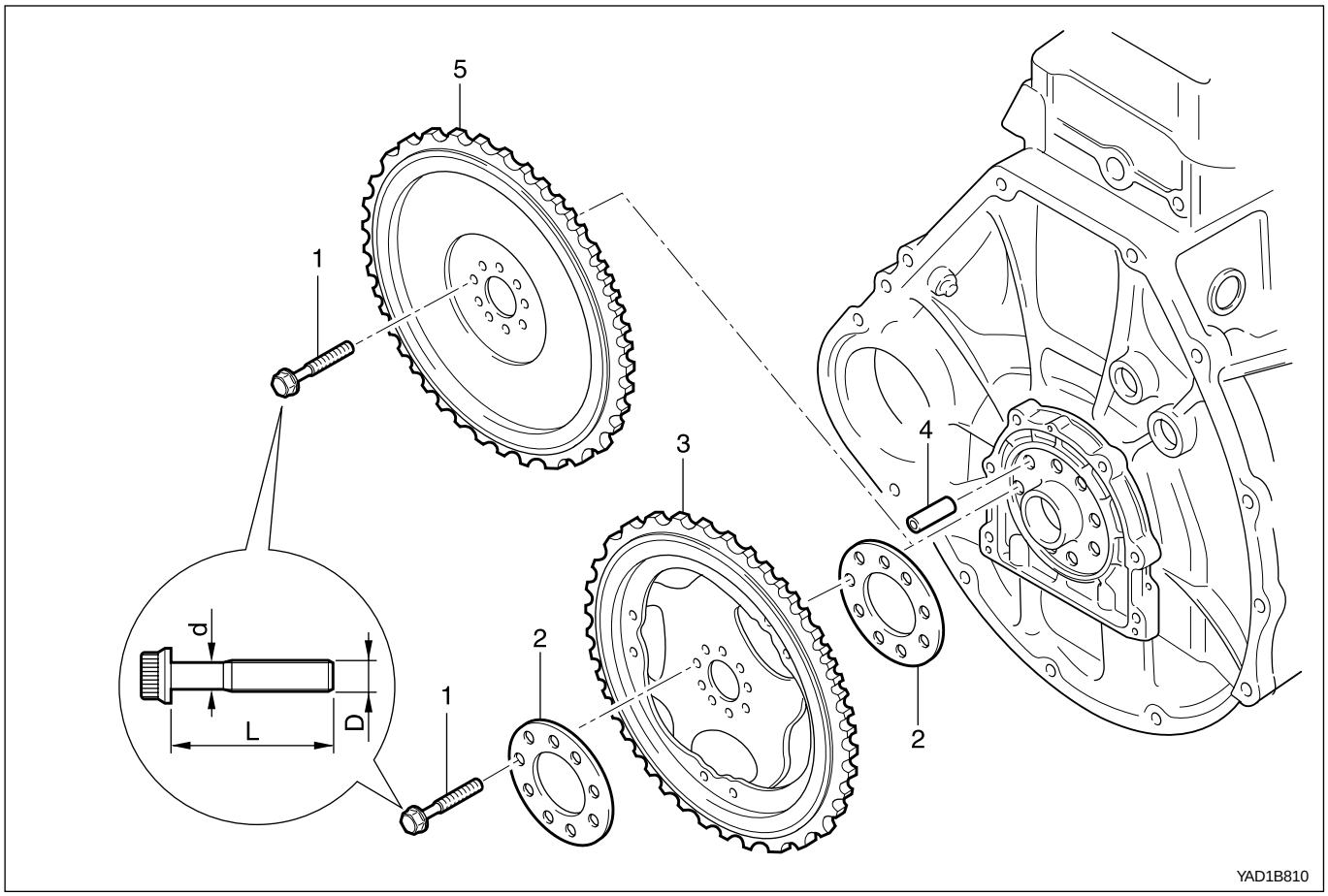


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3. For installation, position the piston ring to be the 'TOP' mark on the piston ring upward and arrange the piston ring ends to be 120° apart.
4. Adjust the hook spring joint in the oil ring 180° away from the ring end.

FLYWHEEL / DRIVEN PLATE

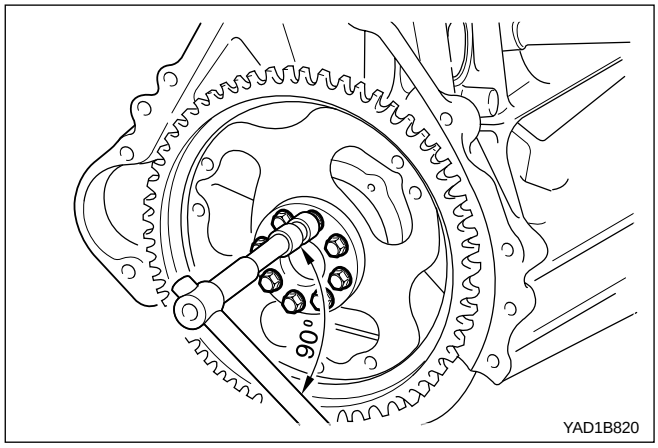
Preceding Work : Removal of manual or automatic transmission



1 Flywheel Mounting Bolt (M10 x 22, 8 pieces)
..... 1st step 45+5 N•m (33+3.7 lb-ft)
2nd step 90°+10°
2 Plate
3 Driven Plate (A/T)
4 Dowel Pin
5 Flywheel (M/T)

Service Data Standard (Stretch Bolt)

Nominal Size	D	-	M x 1.5
Stretch Side Diameter	d	When New	8.5 - 0.2 mm
		Min. Diameter	8.0 mm
Bolt Length	L	When New	21.8 - 22.2 mm
Tightening Torque	1st step 45 + 5 N•m (33 + 3.7 lb-ft), 2nd step 90° + 10°		



Removal & Installation Procedure

1. Unscrew the flywheel mounting bolt.

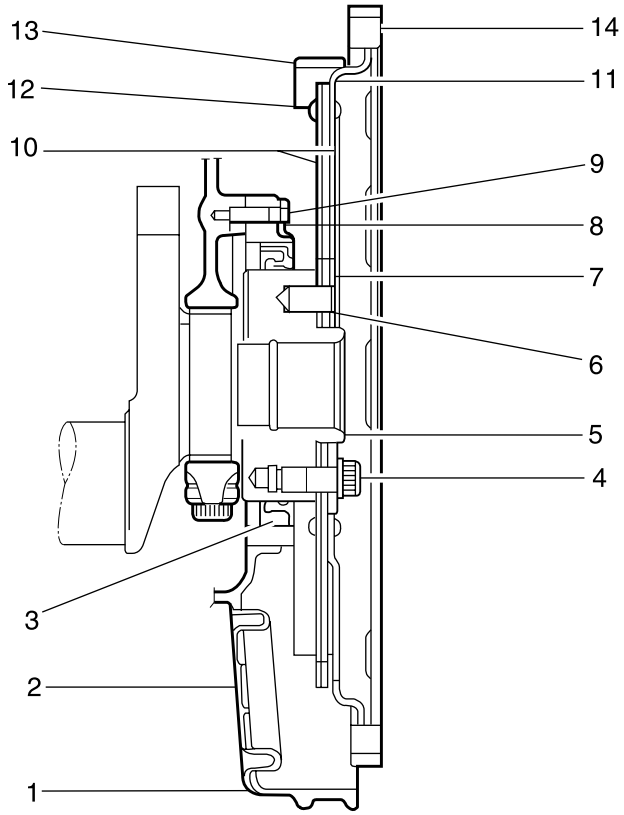
   Installation Notice

Tightening Torque	1st step: 40 + 5 N•m (30 + 3.7 lb-ft)
	2nd step: 90° + 10°

   - Replace the bolt when the stretch side diameter (d) of the flywheel mounting bolt is less than 8.0 mm.
   - For the stretch bolt tightening, keep the socket wrench and Tommy-bar to be 90° and tighten as specified.

2. Remove the flywheel for manual transmission vehicles, or the driven plate (3), and plate (2) for automatic transmission vehicle.
3. Installation should follow the removal procedure in the reverse order.

Sectional View

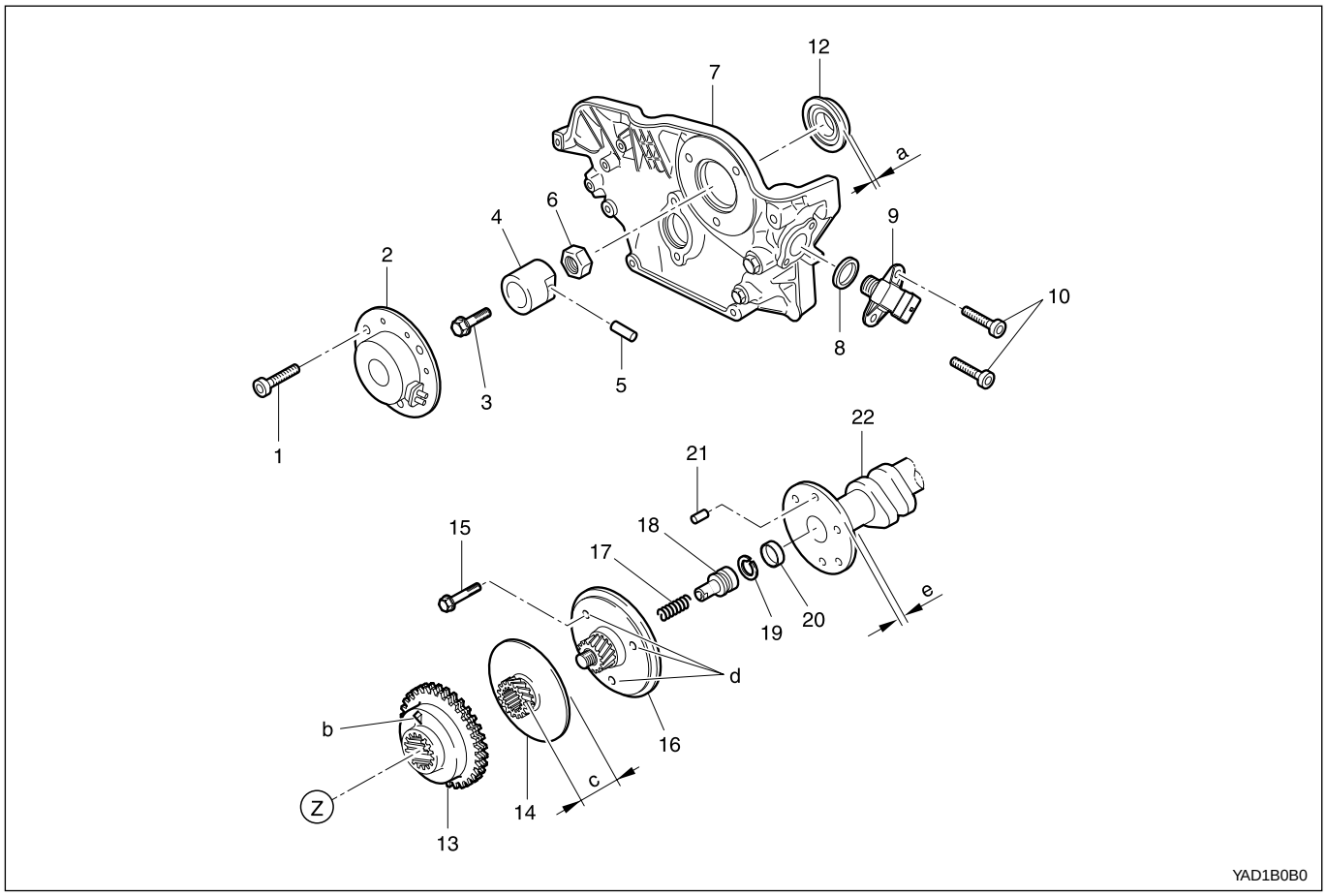


1 Oil Pan
2 Cover
3 Crankshaft Front Seal
4 Flywheel Mounting Bolt
5 Crankshaft
6 Dowel Pin
7 Washer (thickness = 3.5 mm)
8 Washer
9 Bolt
10 Front Drive Plate
11 Rear Drive Plate
12 Rivet
13 Segment
14 Ring Gear

TIMING DEVICE AND VALVE

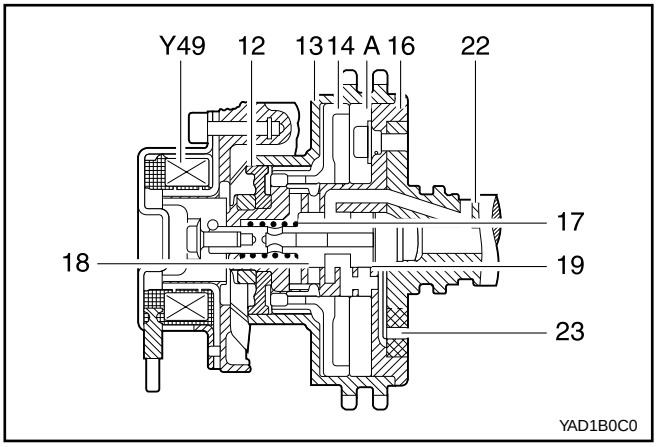
CAMSHAFT ADJUSTER

Preceding Work : Removal of cylinder head cover
Removal of cylinder head front cover



1 Bolt (M6 x 16, 3 pieces) ..... 9-11 N•m (80-97 lb-in)
2 Camshaft Actuator (2 Pin Connector)
3 Bolt ..... 35 N•m (26 lb-ft)
4 Armature
5 Roll Pin
6 Nut (M20 x 1.5) ..... 60-70 N•m (44-52 lb-ft)
7 Front Cover
8 Seal
9 Camshaft Position Sensor
10 Bolt (M6 x 16, 2 pieces) .....9-11 N•m (80-97 lb-in)
11 -
12 Seal Cover
13 Camshaft Sprocket and Position Indicator (b)
14 Adjuster Piston
15 Flange Bolt (M7 x 13, 3 pieces) .....1st step 18-22 N•m (13-16 lb-ft)
2nd step 90° ± 5°
16 Flange Shaft
17 Compression Spring
18 Control Piston
19 Circlip
20 Oil Gallery
21 Pin
22 Intake Camshaft

"Retarded" Position



12 Seal Cover
13 Camshaft Sprocket
14 Adjust Piston (Stops Towards The Front)
16 Flange Shaft
17 Compression Spring
18 Control Piston (Stops Towards The Rear)
19 Circlip
22 Intake Camshaft
23 Oil Outlet Drilling

A Working Chamber (Oil Pressure)
Y49 Electromagnetic Actuator (Not Functioning)

Functions

When the engine is running, the camshaft rotates the intake camshaft hydrauically/mechanically relative to the camshaft sprocket by 34° crankangle to the 'advanced' position and back to the 'retarded' position.

The camshaft adjuster is actuated electromechanically by the ECU. The positioning time of approx. 1 second is dependent on the engine oil pressure at the camshaft adjuster and on the oil viscosity and oil temperature, respectively. The position indicator (b) on the camshaft sprocket (13) provides the camshaft rotational speed to the position sensor (9) as an input parameter for the engine ignition control unit.

1. Ignition suitch OFF ('retarded')

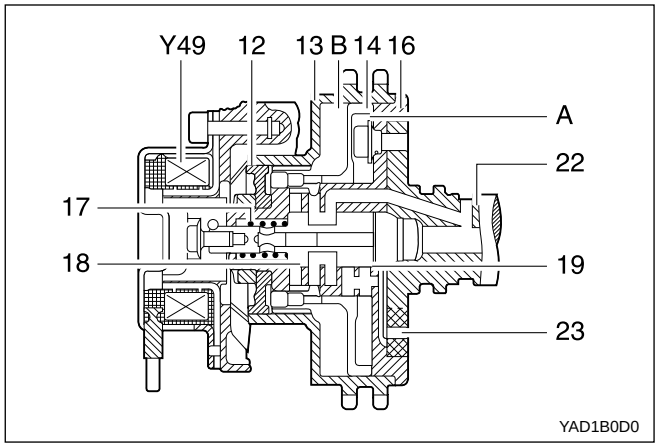
   The compression spring (17) pushes the control piston (18) against the circlip (19). The engine oil pressure in the camshaft is eliminated.

2. From 0 to 1000 - 2000 rpm ('retarded')

   The torque of the internally helically toothed camshaft sprocket (13) acting in the direction of rotation of the engine pushes the externally helically toothed positioning piston(14) against the cover(12) as a result of the screw action. Consequently, the likewise internally helically toothed positioning piston (14) holds the externally helically toothed flanged shaft (16) together with the bolted-on camshaft (22) in the 'retarded position'. The compressing spring (17) pushes the control piston(18) against the circlip (19). The engine oil flows through 2 oblique drillings in the camshaft flange and in the flanged shaft (16) in to the working chamber (A) and holds the positioning piston (14) additionally in the 'retarded' position with the available engine oil pressure.

   Leak oil flows off over control and positioning piston surface, through the control piston drilling and 2 drillings (23) in the camshaft flange.

“Advanced” Position



12 Seal Cover
13 Camshaft Sprocket
14 Adjust Piston (Stops Towards The Front)
16 Flange Shaft
17 Compression Spring
18 Control Piston (Stops Towards The Rear)
19 Circlip
22 Intake Camshaft
23 Oil Outlet Drilling

A Working Chamber (Oil Pressure)
Y49 Electromagnetic Actuator (Not Functioning)

3. From 1000 - 2000 to 4000 rpm (‘advanced’)

The control piston (18) is pulled forward as far as the stop in the flanged shaft (16) by the actuator (Y49) against the force of the compression spring (17).

The control piston (18) closes the oil feed to the working chamber ‘A’ and at the same time allows oil to flow to the working chamber ‘B’ through 2 drillings each in the flanged shaft (16) and adjusting piston (14). The engine oil pressure moves the adjusting piston (14) as for as the stop on the flanged shaft (16). As a result of the axial movement of the flanged shaft (16) is turned into the ‘advanced’ position. The turning action is achieved as a result of the effect of the helical teeth on the camshaft sprocket (13), positioning piston (14) and flanged shaft (16). The engine oil in working chamber ‘A’ flows off, assisted by the pushing action of the adjusting piston (14), over the flanged shaft (16) and through 2 drillings (23) in the camshaft flange.

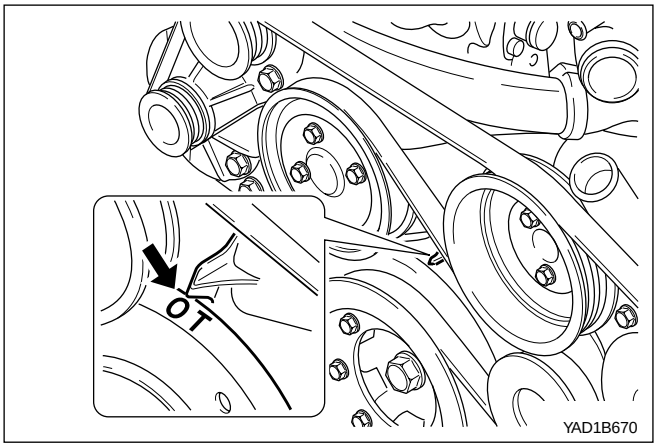
4. From 4000 rpm (‘retarded’)

The electromagnetic actuator (Y49) is not actuated and allows the control piston to move. The compression spring (17) pushes the control piston (18) against the circlip (19). The oil feed to the working chamber ‘B’ is closed off and oil is able to flow to working chamber ‘A’ along 2 drillings in the flanged shaft (16). As a result of the engine oil pressure, the control piston (18) is moved as far as the cover (12).

This axial movement of the adjusting piston (14) rotates the camshaft (22) bolted to the flanged shaft (16) in to the ‘retarded’ position.

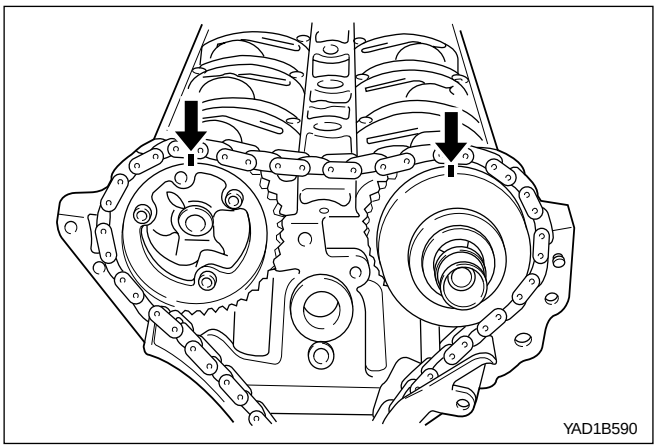
The rotational movement is a result of the screw effect of the helical teeth on the camshaft sprocket (13), positioning piston (14) and flanged shaft (16). The engine oil in the working chamber (B) flows off, assisted by the pushing action of the adjusting piston (14), through 2 drillings each in the adjusting piston (14), flanged shaft (16) and control piston (18) through the control piston (18) and 2 drillings in the camshaft flange (23).

Leak oil flows off over the control and adjusting piston surfaces through the control piston drilling and 2 drillings in the camshaft flange (23).

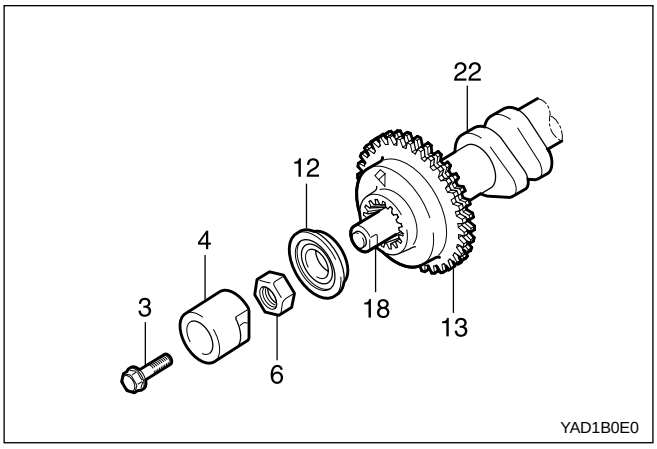


Removal & Installation Procedure

1. Turn the crankshaft to the direction of engine rotation and position the no.1 cylinder piston at TDC which the camshaft is positioned at OT.



2. Remove the cylinder head front cover. Refer to “Cylinder Head Front Cover” in this section.
3. Paint the alignment marks (arrows) on the intake and exhaust camshaft sprocket and the timing chain.



3 Bolt
4 Amarture
6 Nut (M20 x 1.5)
12 Seal Cover
13 Camshaft Sprocket
18 Control Piston
22 Intake Camshaft

4. Unscrew the bolt (3) from the armature (4) and remove the armature.

Installation Notice

Tightening Torque	35 N•m (26 lb-ft)

5. Unscrew the nut (6) and remove the ring and seal cover (11).

Installation Notice

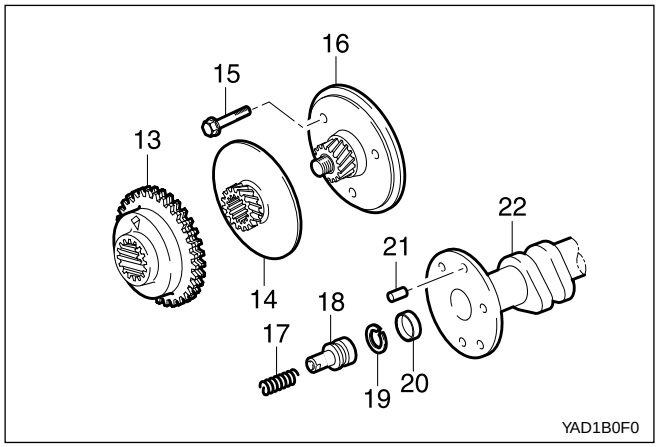
Tightening Torque	60 - 70 N•m (44 - 52 lb-ft)

6. Unscrew the sprocket bolt from the exhaust camshaft and remove the sprocket.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 90° ± 5°

The sprocket bolt is designed to be used only once, so always replace with new one.



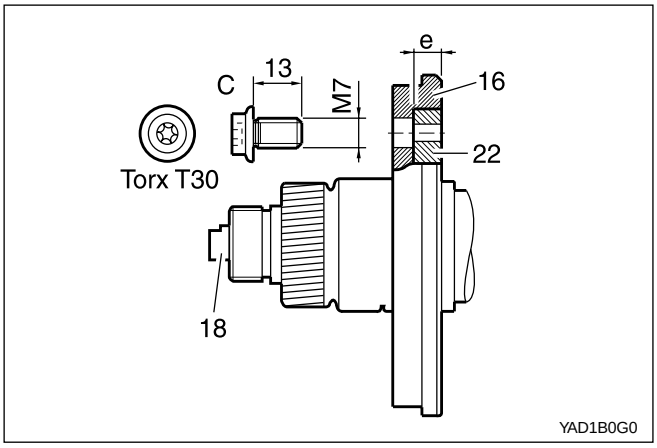
7. Remove the camshaft sprocket (13) and adjust piston (14), and remove the flange shaft (16) from the intake camshaft (22) after removing the bolt (15).

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 90° ± 5°

The sprocket bolt is designed to be used only once, so always replace with new one.

8. Installation should follow the removal procedure in the reverse order.
9. Adjust the camshaft timing.



C M7 x 13 Collar Bolt Torx-T30
e 6.8 mm
16 Flange Shaft
18 Control Piston
22 Intake Camshaft

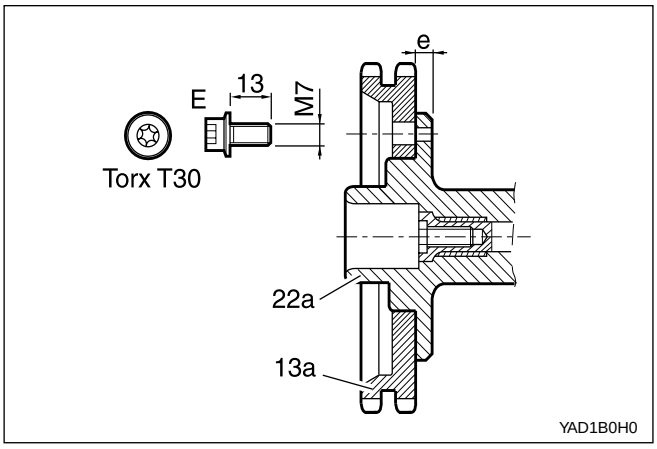
CAMSHAFT SPROCKET BOLT

Intake Flange Shaft Bolt

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 90° ± 5°

The sprocket bolts are designed to be used only once, so always replace with new one.



E M7 x 13 Collar Bolt Torx-T30
e 6.8 mm
13a Camshaft Sprocket
22a Exhaust Camshaft

Exhaust Camshaft Sprocket Bolt

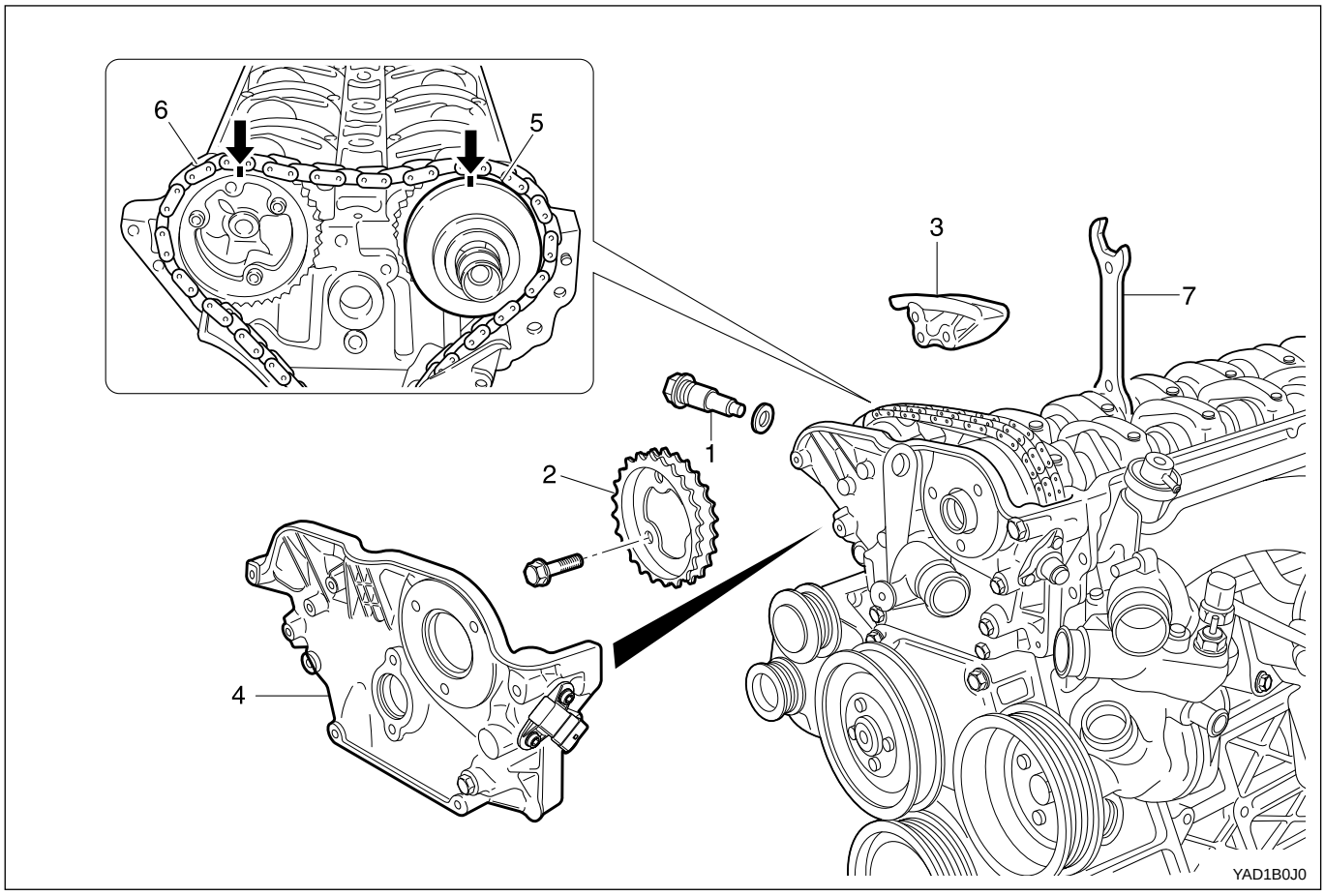
Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 90° ± 5°

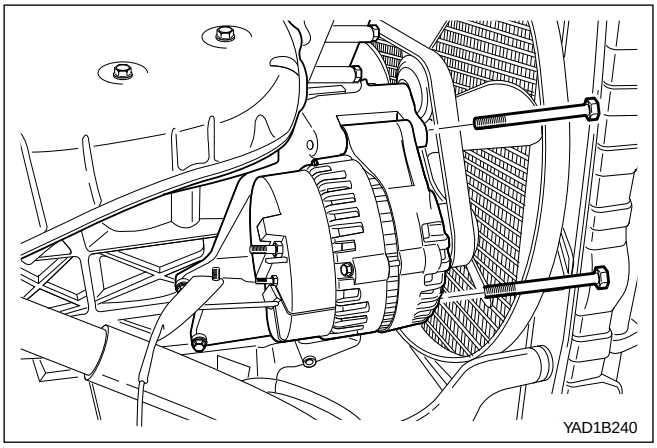
The sprocket bolts are designed to be used only once, so always replace with new one.

CAMSHAFT

Preceding Work : Removal of cylinder head cover
Removal of cylinder head front cover
Removal of coolant connection fitting



1 Chain Tensioner Assembly
..... 72-88 N•m (53-65 lb-ft)
2 Exhaust Camshaft Sprocket
3 Upper Guide Rail
4 Cylinder Head Front Cover
5 Intake Camshaft Sprocket
6 Chain
7 Wrench

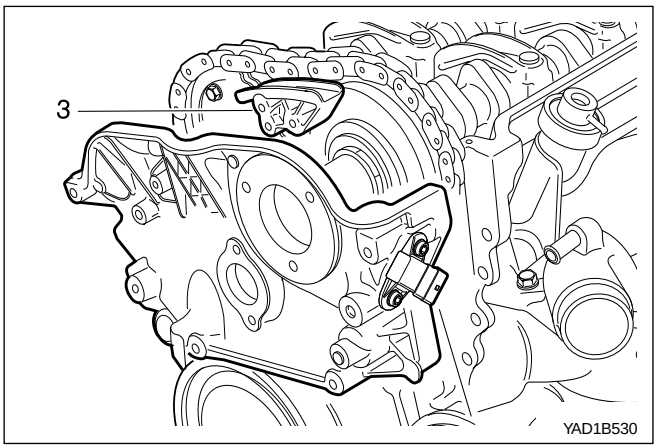


Tools Required

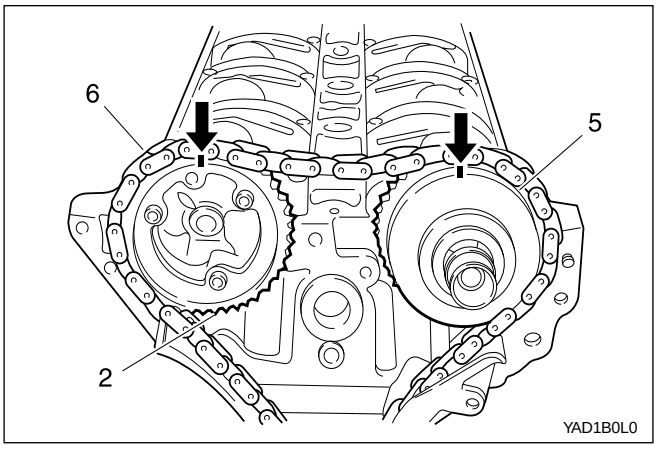
DW 110-120 Holding Pin

Removal Procedure

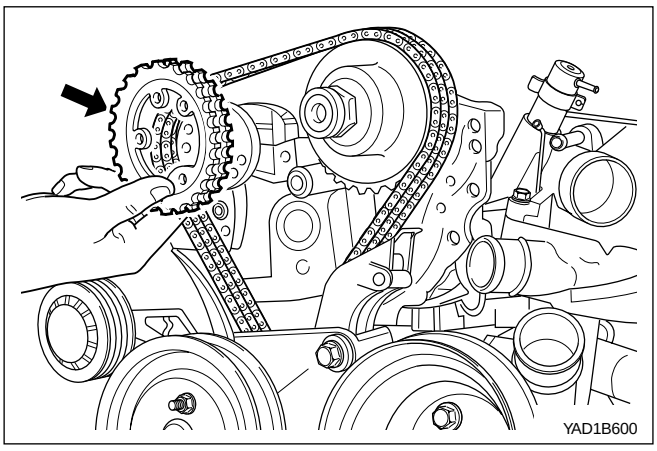
1. Turn the crankshaft and position the No. 1 cylinder piston at BTDC 30°.
2. Remove the generator.
3. Remove the chain tensioner. Refer to “Chain Tensioner” in this section.



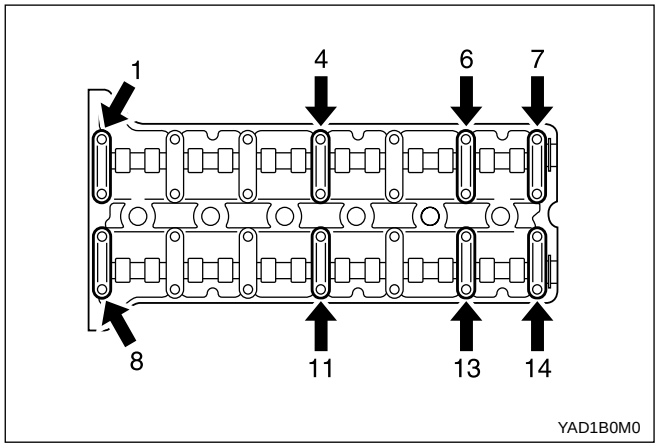
4. Remove the cylinder head front cover and the upper guide rail.



5. Put the alignment marks (arrows) on the camshaft sprocket (2, 5) and the timing chain (6).



6. Unscrew the exhaust camshaft sprocket bolt and remove the sprocket.
7. Separate the chain from the intake camshaft sprocket and put the chain not to be dropped into timing case.



8. Unscrew the intake side bolts (8, 11, 13, 14) and the exhaust side bolts (1, 4, 6, 7).
9. Loosen the remaining bolts and unscrew the intake and exhaust side camshaft bearing cap bolts.

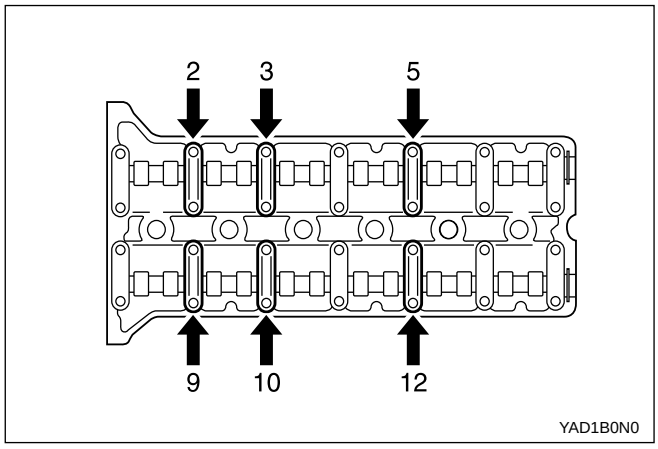
   Notice: Number the camshaft bearing cap bolts when removing them, so that they don't get mixed up.

10. Remove the intake and exhaust camshafts.

Installation Procedure

1. Turn the crankshaft and position the No. 1 cylinder piston at BTDC 30°.

   Notice: Turn the crankshaft in the direction of engine rotation.

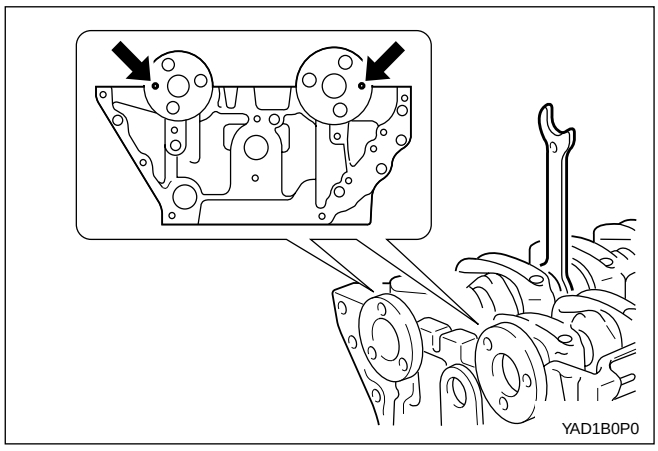


2. Install the exhaust camshaft bearing caps (2, 3, 5) and the intake camshaft bearing caps (9, 10, 12). Tighten the bolts with specified torque and install the remaining bearing caps.

   Installation Notice

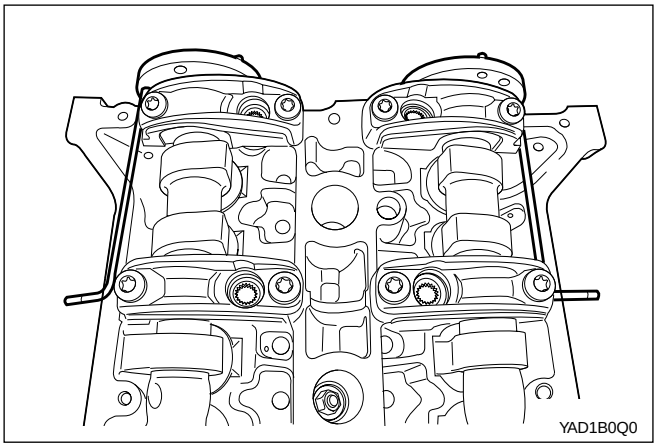
Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

   Install the bearing caps according to the numbers on the bearing caps.

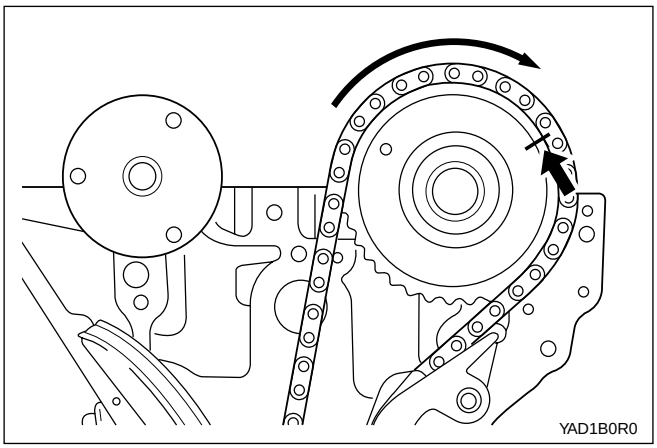


3. Turn the camshaft using the wrench so that the intake camshaft adjustment hole lines up with the cylinder head upper side (3 o'clock direction at the intake, 9 o'clock direction at the exhaust).

   Notice: Turn the crankshaft and adjust it to OT so that No. 1 cylinder's piston would be at TDC.



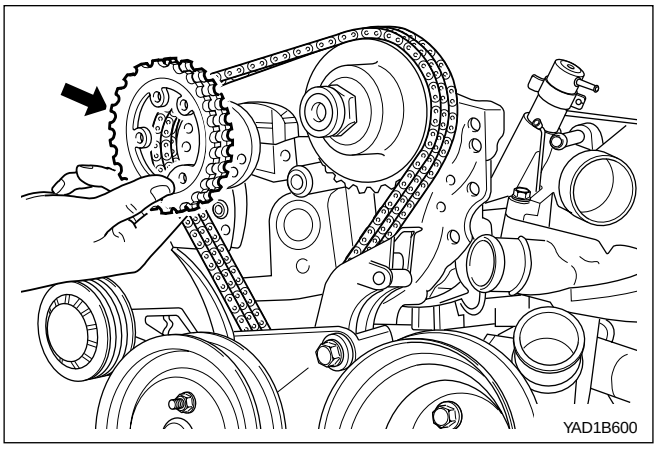
4. Align the holes on intake and exhaust camshaft to the hole on cylinder head. Insert the holding pin DW 110-120 into the holes.



5. Turn the intake camshaft adjuster to the direction of camshaft rotation by hard until it stops and then install the chain.

Notice:

- Make sure that the camshaft sprocket and timing chain are aligned with marks.
- Intake camshaft adjuster should be in retarded position.

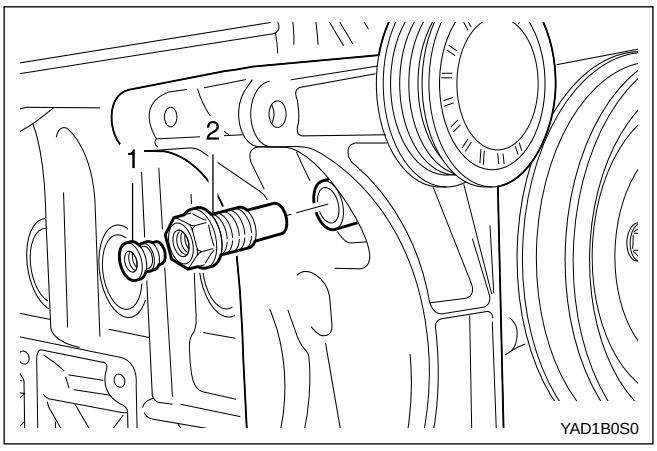


6. Install the chain on the exhaust sprocket and tighten the sprocket bolts.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 90° ± 5°

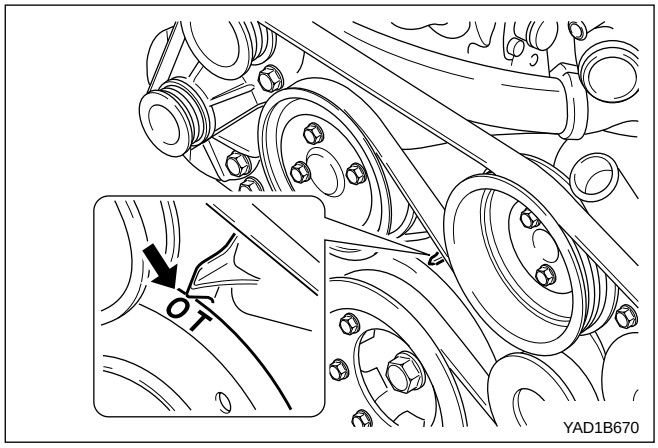
- Make sure that the camshaft sprocket and timing chain are aligned with marks.
- Replace the sprocket bolt with new one.



7. Install the chain tensioner screw plug (1) and chain tensioner assembly (2) and tighten it as specified.

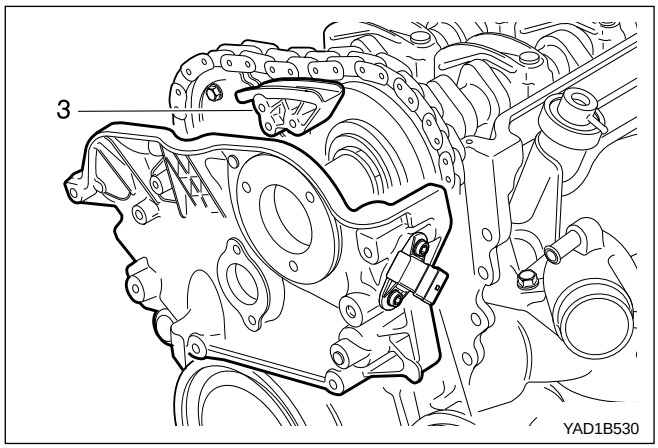
Installation Notice

Tightening Torque	(1) : 40 N•m (30 lb-ft)
	(2) : 72 - 88 N•m (53 - 65 lb-ft)



8. Rotate the crankshaft 2 revolutions and check followings:
   - TDC of no. 1 cylinder : OT
   - Alignment between camshaft adjustment hole and cylinder head surface.
   - Alignments between timing chain and sprocket marks.

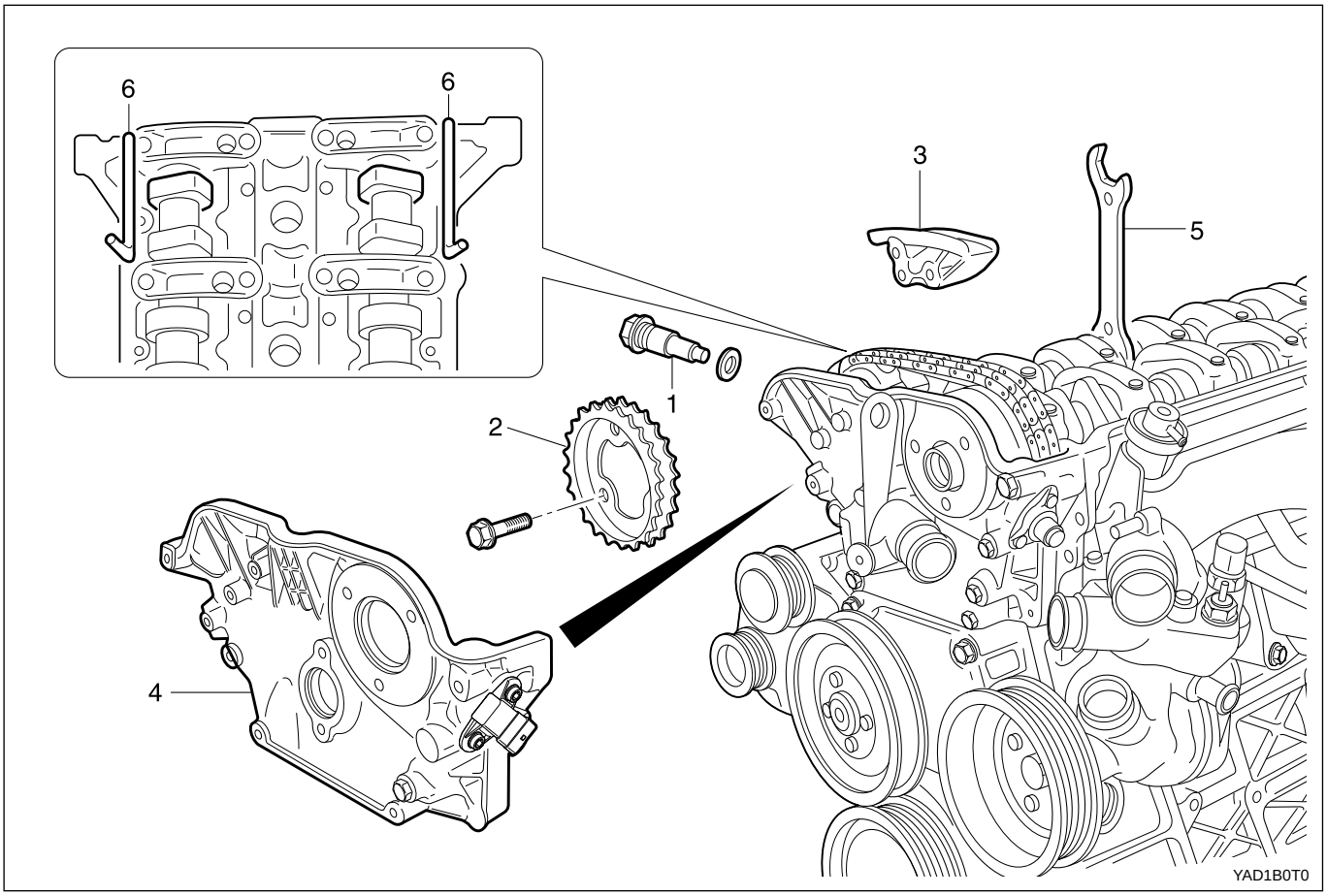
   Notice:
   - Turn the crankshaft in the direction of engine rotation.
   - Read just if not aligned.



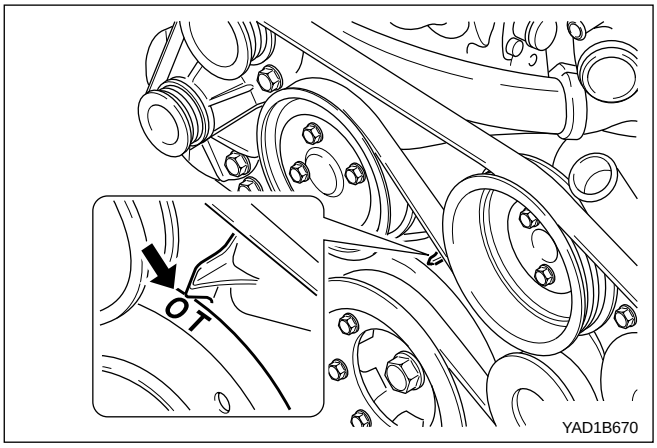
9. Install the upper guide rail and cylinder head front cover.
10. Install the generator.

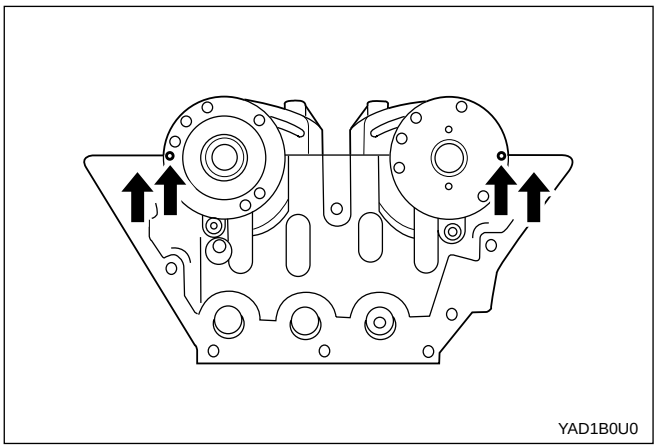
CAMSHAFT TIMING POSITION

Preceding Work : Removal of cylinder head cover
Removal of cylinder head front cover



1 Chain Tensioner Assembly
2 Exhaust Camshaft Sprocket
3 Upper Guide Rail
4 Cylinder Head Front Cover
5 Wrench
6 Holding Pin DW 110-120





Tools Required

DW 110-120 Holding Pin

Inspection

1. Position the No.1 cylinder piston to TDC (OT) by turning the crankshaft.

   Notice: When the OT mark on vibration damper is aligned with timing gear case cover, the intake and exhaust cam of cylinder will make the slope to the center and will face up. In this way, the adjustment hole of the intake and exhaust camshaft will match in line with the cylinder head upper end, at 3 o'clock, and 9 o'clock direction each other.

2. Check the timing as below procedure;
   - Check if the camshaft adjustment hole is positioned to 3 o'clock direction at the intake side and to 9 o'clock direction at the exhaust side, respectively and align with the cylinder head mating surface.
   - At this condition, check if the OT mark on vibration damper aligns with the marker on the timing gear case.

Adjustment Procedure

1. Position the No.1 cylinder to BTDC 30° .
2. Remove the chain tensioner.
3. Remove the exhaust camshaft sprocket.
4. Align the intake and exhaust camshaft flange hole with the cylinder head upper surface.
   - Intake Side : 3 o'clock direction
   - Exhaust Side : 9 o'clock direction
5. Align the holes on intake and exhaust camshaft to the hole on cylinder head. Insert the holding pin DW 110-120 into the hole.
6. Secure the intake and exhaust camshaft.
7. Position the piston of No.1 cylinder at TDC (OT) by turning the crankshaft.
8. Turn the camshaft adjuster of the intake camshaft to the left as much as possible (cam adjuster 'retarded' position).
9. Install the chain to the intake camshaft sprocket.

   Notice: Timing chain must be placed on the guide rail in gear case cover.

10. Install the chain to the exhaust camshaft sprocket and install it to the camshaft.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 90° ± 5°

The sprocket bolt is designed to be used only once, so replace with new one.

11. Install the chain tensioner.

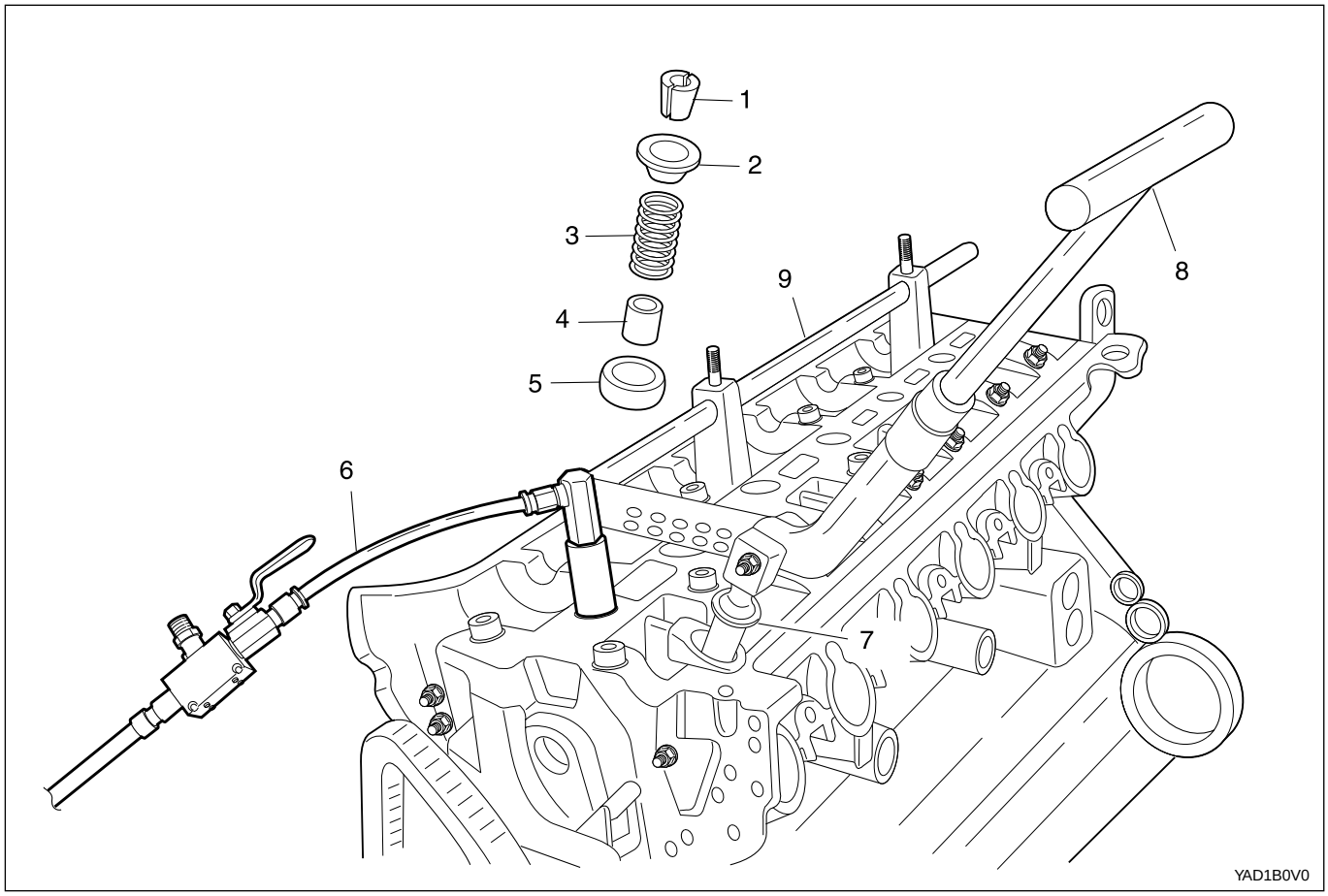
Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

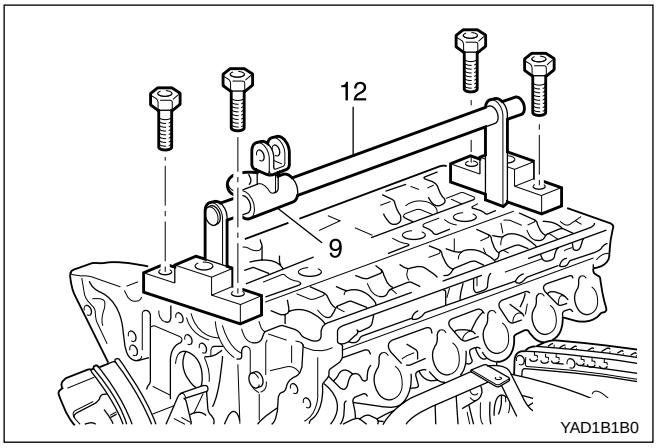
12. Check the camshaft timing.

VALVE SPRING

Preceding Work : Removal of camshaft
Removal of spark plug



1	Valve Cotter	6	Connecting Hose DW 110-090
2	Upper Retainer	7	Thrust Piece 111 589 25 63 00
3	Valve Spring ..... Check, Replace if necessary	8	Lever Pusher 111 589 18 61 00
4	Valve Stem Seal	9	Supporting Bar 111 589 01 59 00
5	Lower Retainer		



Tools Required

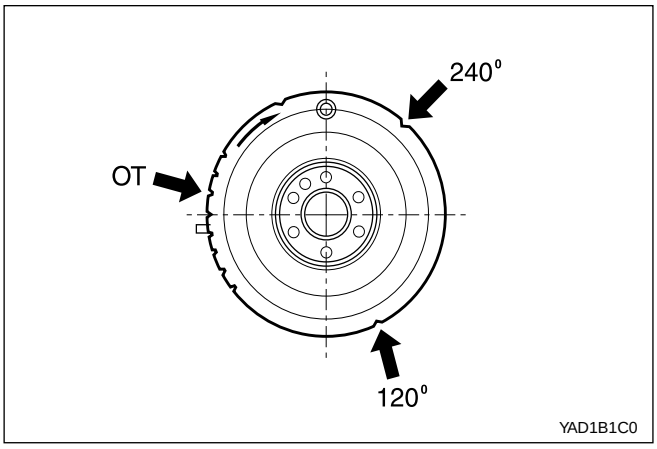
111 589 01 59 00	Supporting Bar
111 589 18 61 00	Lever Pusher
111 589 25 63 00	Thrust Piece
602 589 00 40 00	Engine Lock
DW 110-090	Connecting Hose
DW 110-100	Valve Tappet Remover

Removal & Installation Procedure

1. Place the supporting bar 111 589 01 59 00 (12) at the camshaft bearing cap and tighten them with the bearing cap bolt.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

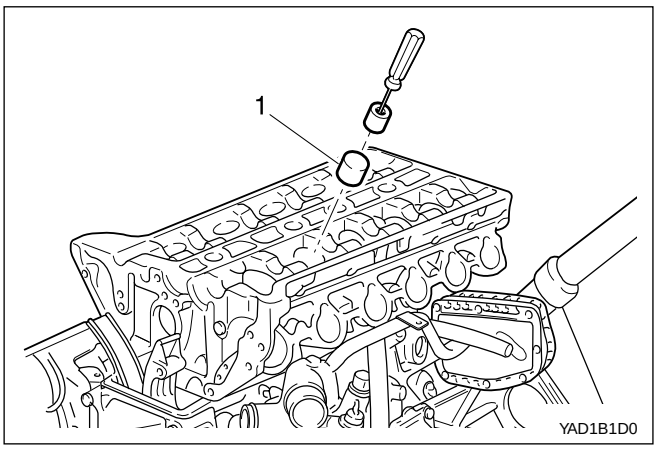


2. Turn the crankshaft to position the each cylinder piston at TDC.

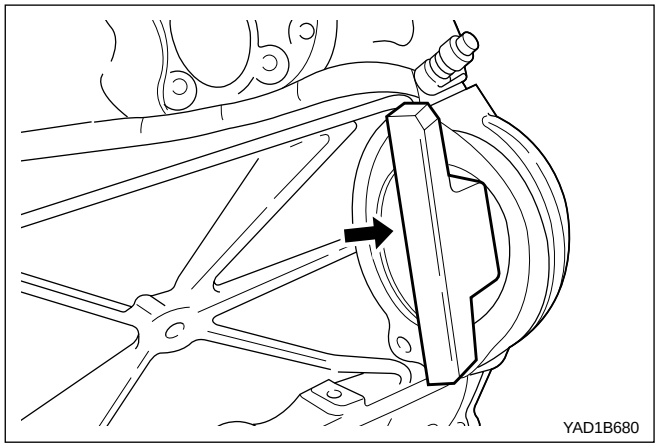
Mark on The Vibration Damper	Cylinder
OT	1, 6
120°	2, 5
240°	3, 4

Notice:

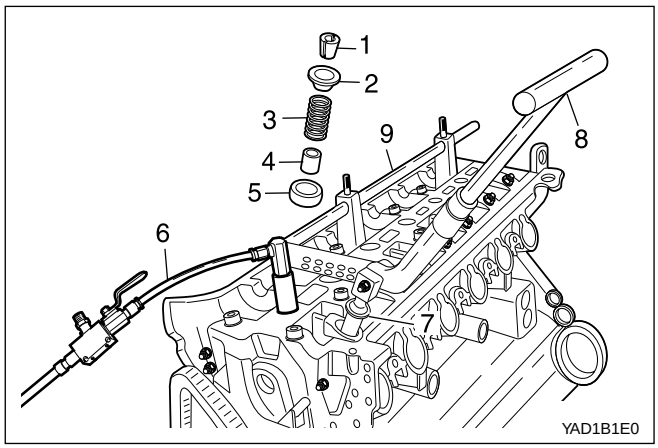
- Remove the valve spring only at TDC.
- Always rotate the crankshaft by holding the chain to prevent from timing chain damage and tangling, and for smooth rotation.



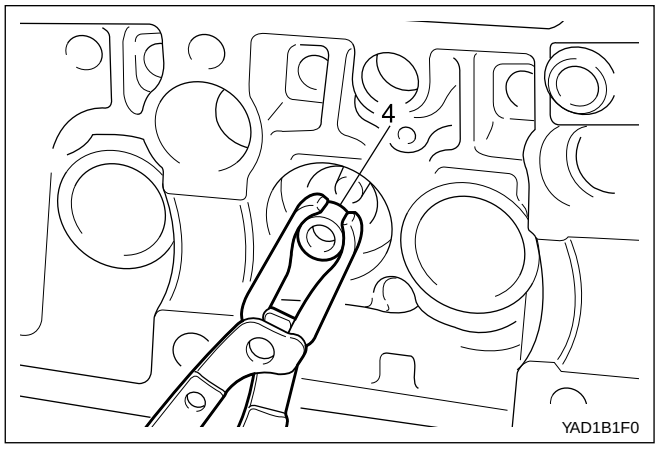
3. Remove the valve tappet (1) using the valve tappet remover DW 110-100.
4. Install the connecting hose DW 110-090 to the spark plug hole.



5. Install the engine lock to the ring gear to prevent the crankshaft from rotating.
6. Blow up with compressed air.



7. Install the lever pusher 111 589 18 61 00 (8) and the thrust piece 111 589 25 63 00 (7).
8. Mount the thrust piece 111 589 25 03 00 (7) vertically to the valve spring retainer (2).
9. Press the valve spring (3) by using the lever pusher 111 589 18 61 00 (8).
10. Remove the valve cotter (1) using the pincette.
11. Remove the upper retainer (2) and the valve spring (3).



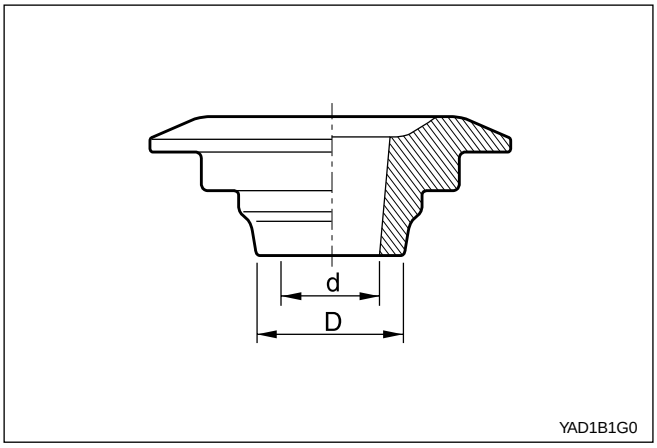
12. Remove the valve stem seal (4).

    Notice: Check the valve stem seal for damage and replace if necessary.

13. Remove the lower retainer (5).

    Notice: Check the retainer for damages and replace with a new one if necessary.

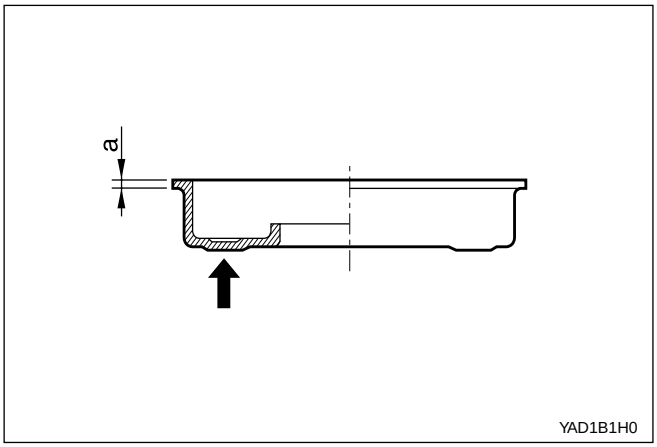
14. Installation should follow the removal procedure in the reverse order.



Test (Upper and Lower Valve Tappet and Valve Cotter)

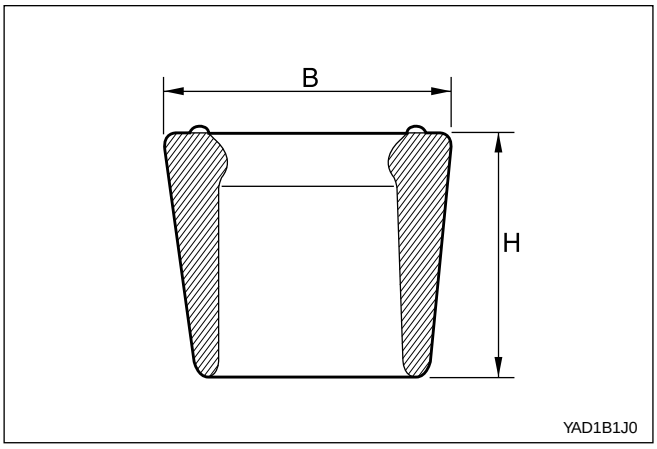
- Upper Valve Spring Retainer

Size (mm)	(d)	8.5
	(D)	12.3



- Lower Valve Spring Retainer

Thickness (mm)	(a)	0.8 - 1.0

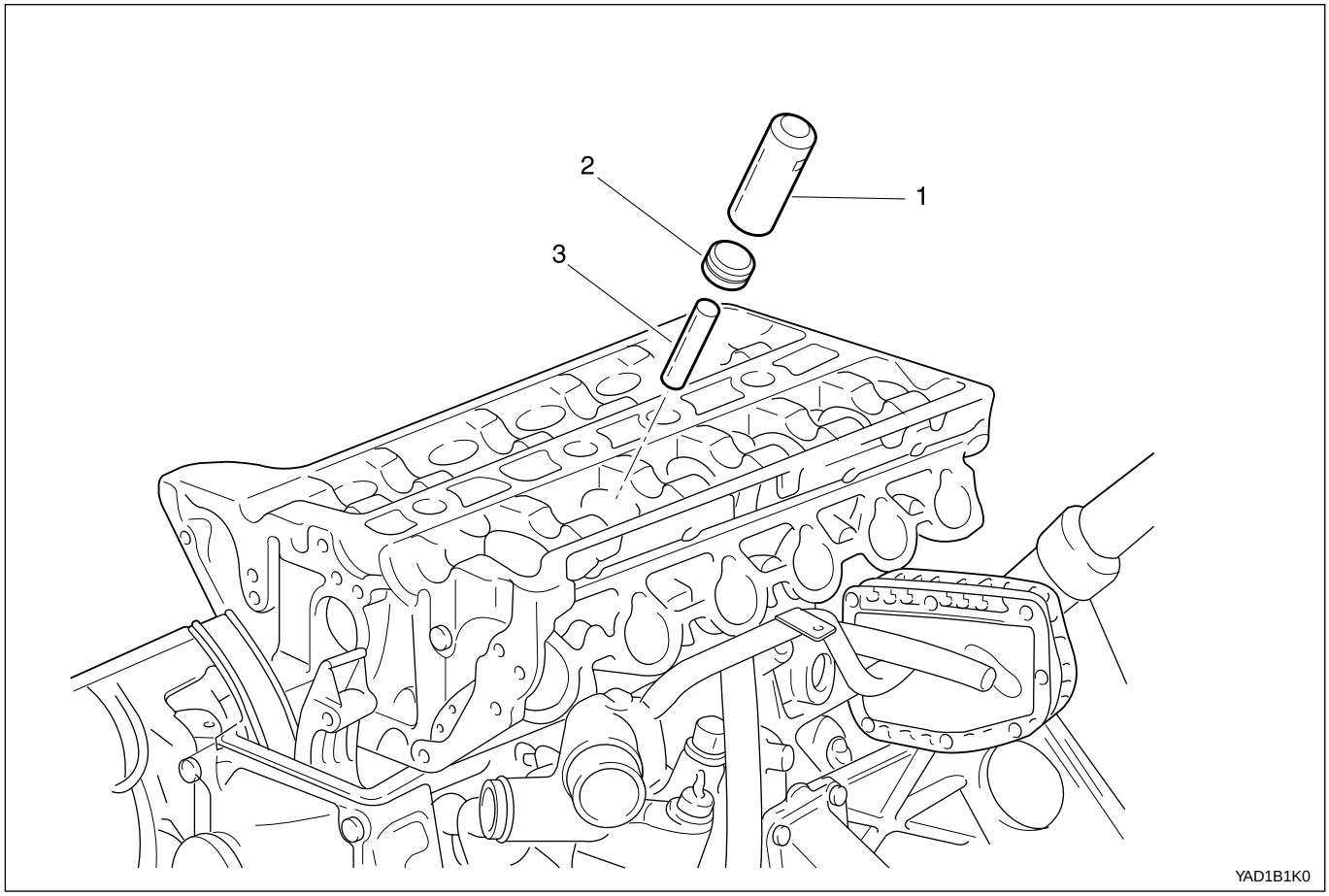


- Valve Cotter

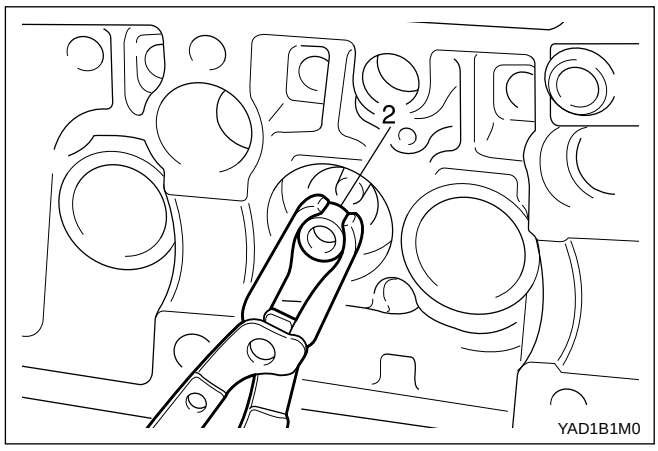
Size (mm)	(B)	9.0
	(H)	9.2 - 9.8

VALVE STEM SEAL

Preceding Work : Removal of valve spring



1 Drift 119 589 00 43 00
2 Valve Stem Seal
3 Protective Sleeve



Tools Required

119 589 00 43 00 Drift

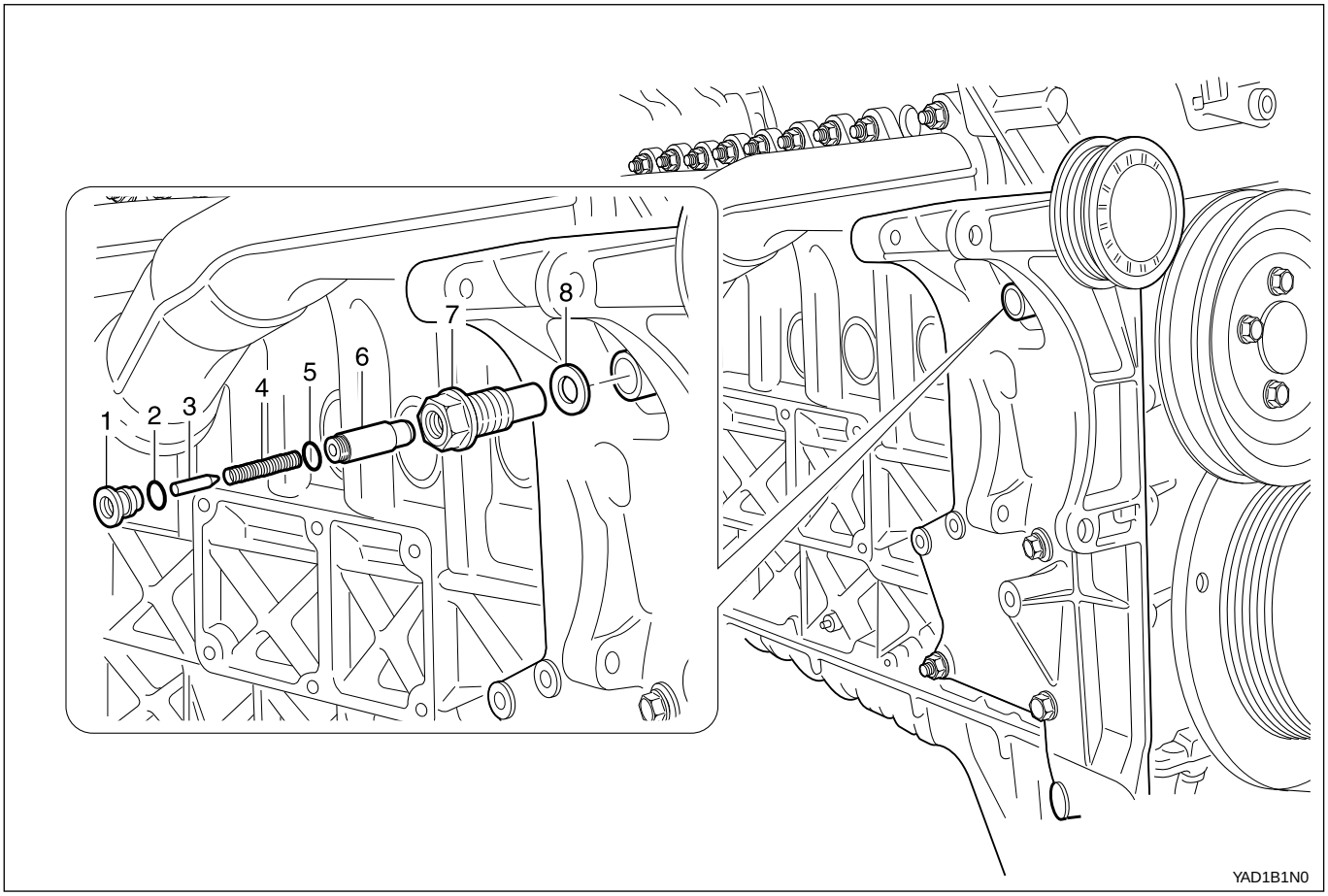
Replacement Procedure

1. Remove the valve stem seal (2) using the pliers.

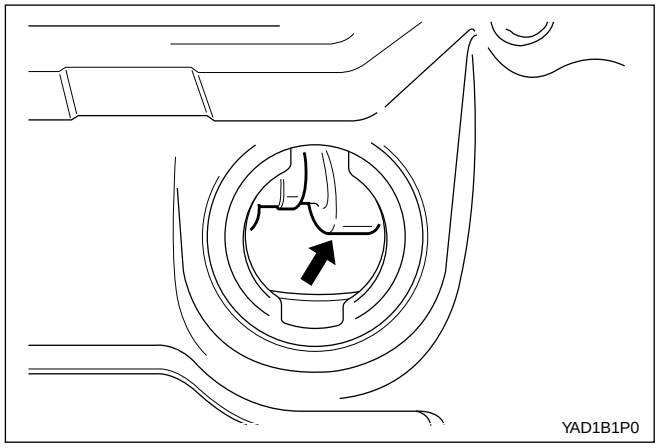
   Notice: Check the valve stem seal for damage and replace if necessary.

2. Coat the valve stem seal with oil and assemble it with the protective sleeve.
3. Insert the valve stem seal by pressing it with the drift 119 589 00 43 00.

CHAIN TENSIONER



1 Screw Plug ..... 40 N•m (30 lb-ft)
2 Seal
3 Filler Pin
4 Compression Spring
5 Snap Ring
6 Thrust Pin
7 Chain Tensioner Housing
..... 72-88 N•m (53-65 lb-ft)
8 Seal


YAD1B1P0

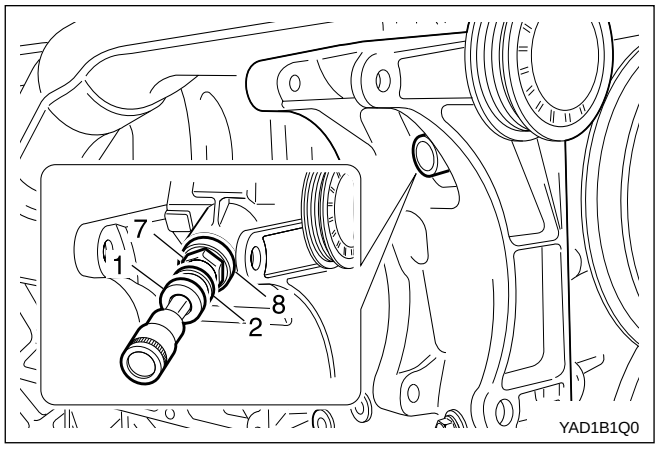
Removal Procedure

1. Position the No.1 cylinder to TDC (OT).

   Notice: Remove the oil filler cap at adjustment position, and check whether the intake camshaft cam's lobe (arrow) stays in the upper side.

2. Cover the generator with a clean cloth.
3. Release the tension by unscrewing the screw plug once.

   Notice: In case that the tension is reduced by unscrewing the screw plug, reinstall after completely removing the chain tensioner. If the chain tensioner is tightened again without completely reducing its tension, then the detent spring doesn't return to the original position and the tension gets exceeded.

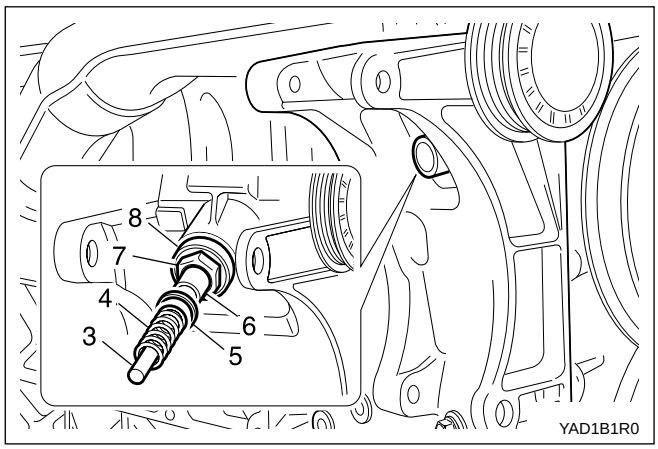


YAD1B1Q0

4. Carefully unscrew the screw plug (1), and remove the seal (2).

   Notice:

   - For the removal of screw plug, be careful that it can be jumped out due to the force of compression spring.
   - Remove the screw plug only when the seal and compression spring are damaged.



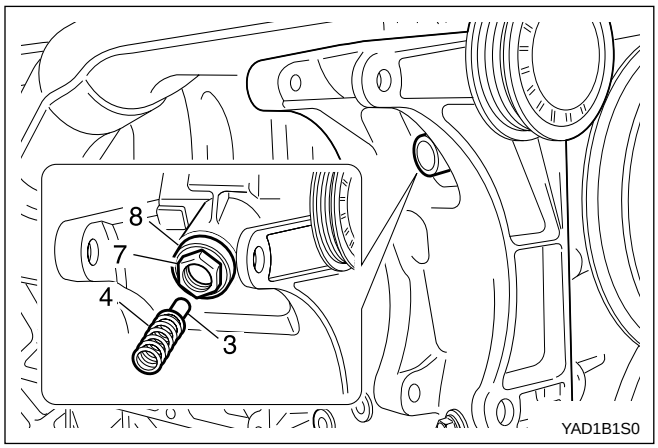
YAD1B1R0

5. Carefully remove the filler pin (3), compression spring (4), snap ring (5), and the thrust pin (6).
6. Remove the chain tensioner housing (7) and the seal (8).

Installation Procedure

1. Connect the thrust pin (6) and the snap ring (5) to the chain tensioner housing (7).

   Notice: When connecting the thrust pin, push in the thrust pin far enough so that it doesn't protrude at the chain tensioner housing.

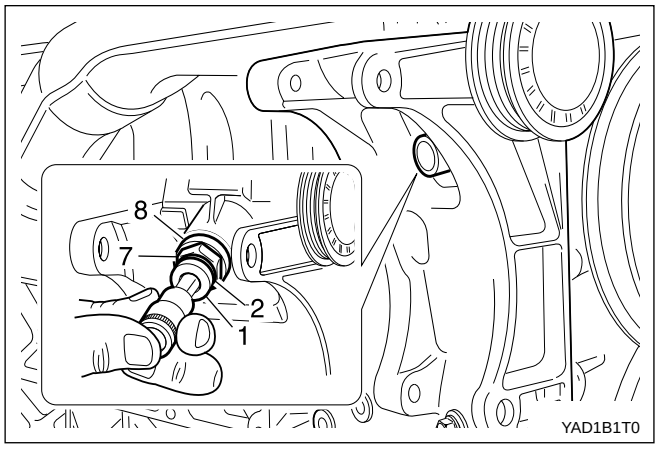


2. Install the chain tensioner housing (7), thrust pin (6), snap ring (5), and the seal (8).

   Installation Notice

Tightening Torque	72 - 88 N•m (53 - 65 lb-ft)

3. Insert the compression spring (4) with the filler pin (3) into chain tensioner housing.



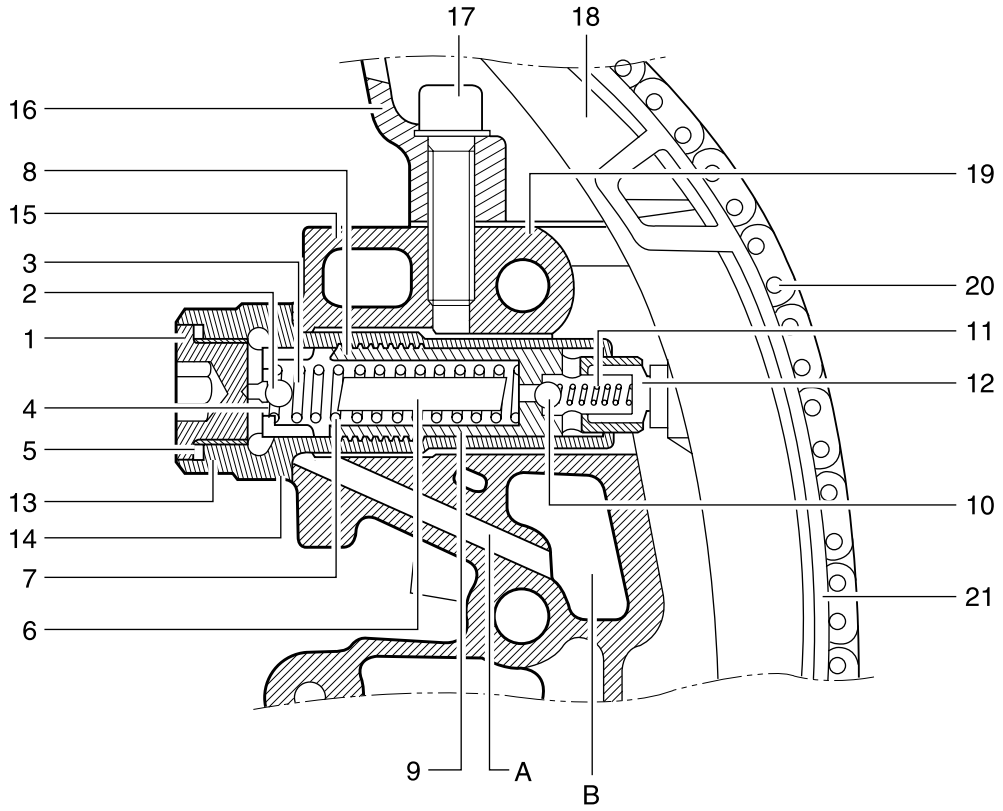
4. Lightly apply the grease to the seal (2) and install the screw plug (1).

   Installation Notice

Tightening Torque	40 N•m (30 lb-ft)

5. Check for leaks by operating the engine.

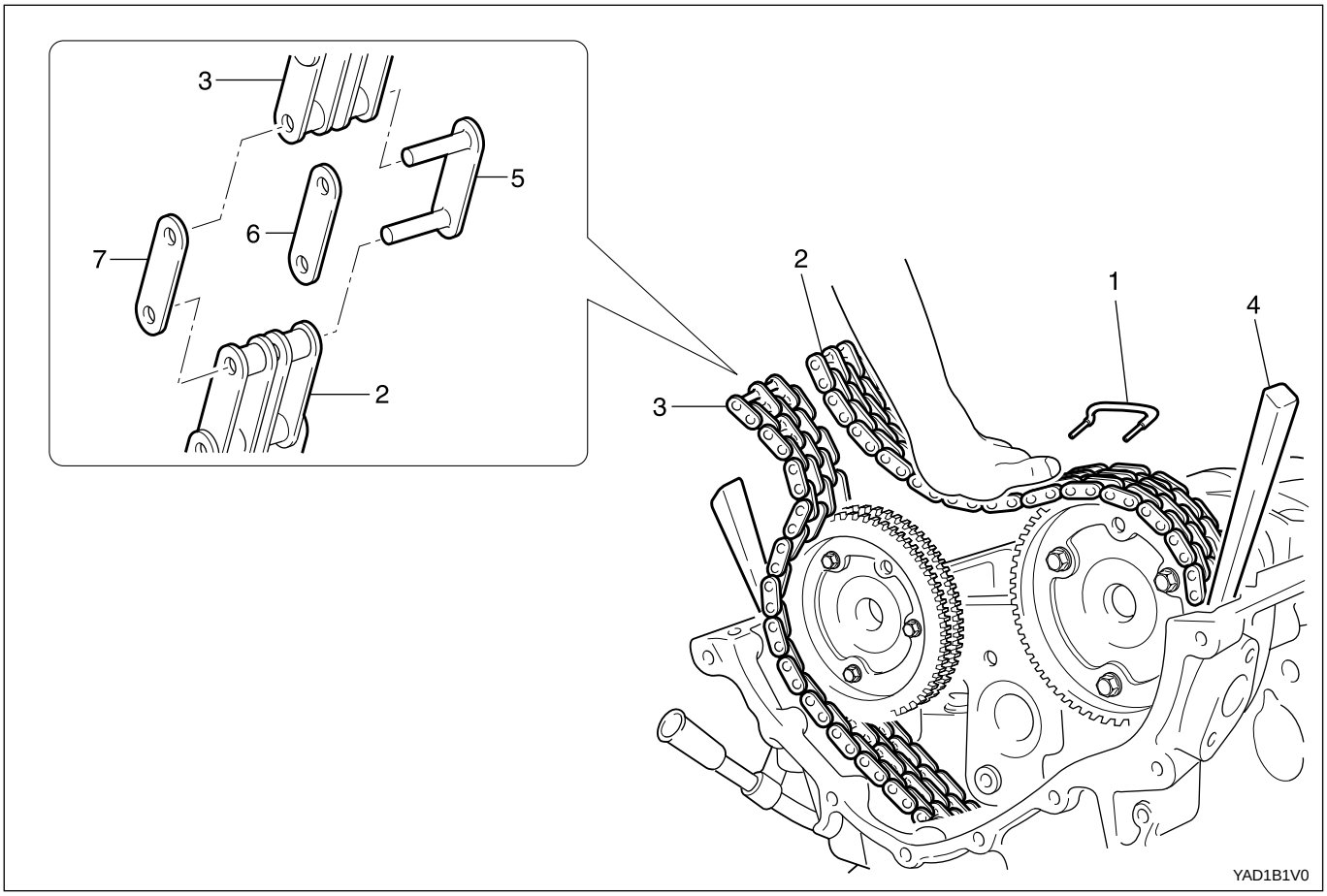
Sectional View



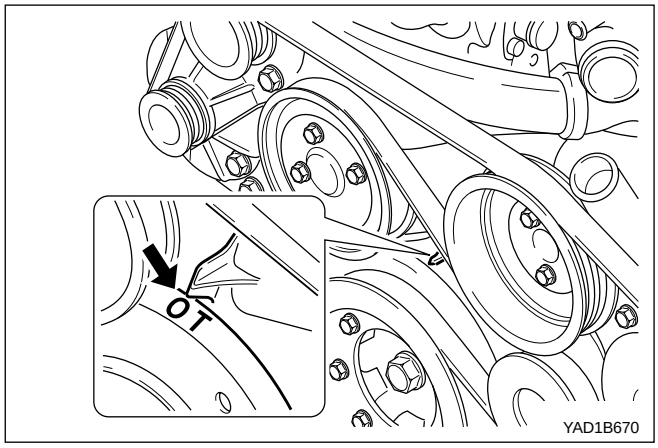
1 Screw Plug
2 Ball (Nonreturn Valve)
3 Compression Spring
4 Ball Guide
5 Seal (Aluminum)
6 Filler Pin
7 Compression Spring
8 Snap Ring
9 Thrust Pin
10 Ball (Nonreturn Valve)
11 Compression Spring
12 Thrust Piece
13 Chain Tensioner Housing
14 Seal
15 Timing Gear Case Cover
16 Cylinder Head
17 Bolt / Washer
18 Tensioning Rail
19 Cylinder Head Gasket
20 Timing Chain
21 Tensioning Rail Base (Sliding Surface)
A Oil Supply Hole
B Chain Tensioner Oil Storage Hole

TIMING CHAIN

Preceding Work : Removal of cylinder head cover
Removal of spark plug



1 Pin
2 New Timing Chain
3 Timing Chain (Used)
4 Wedge
5 Link
6 Center Plate
7 Outer Plate

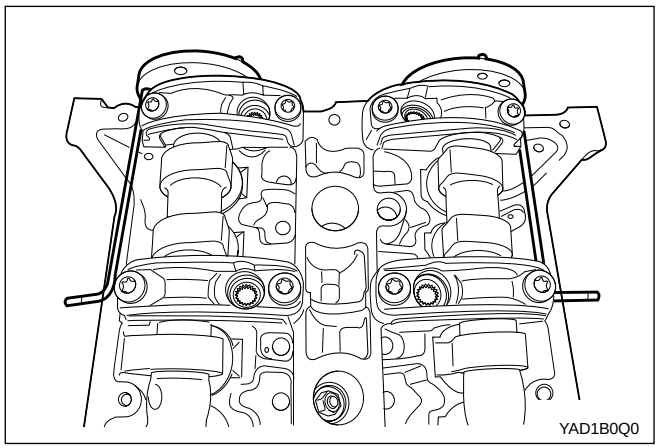


Tools Required

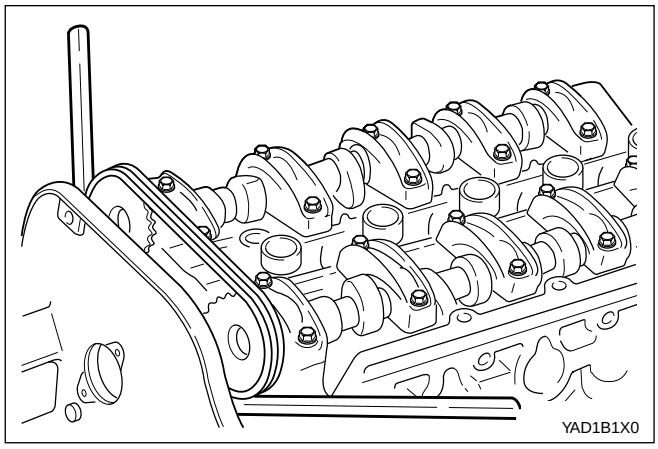
000 589 58 43 00	Chain Assembly
DW 110-120	Holding Pin

Replacement Procedure

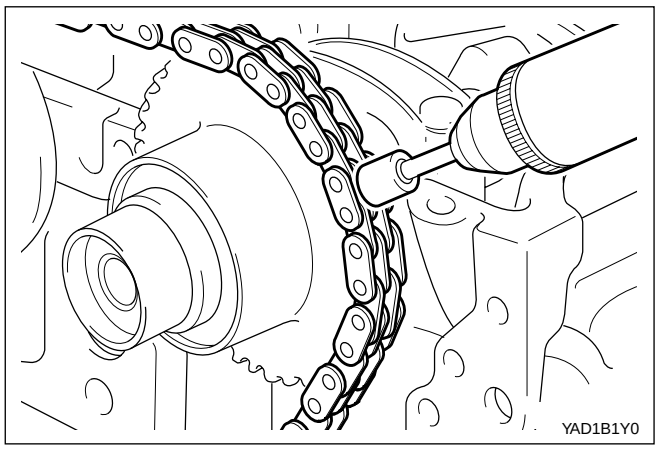
1. Position the No.1 cylinder to TDC (OT).



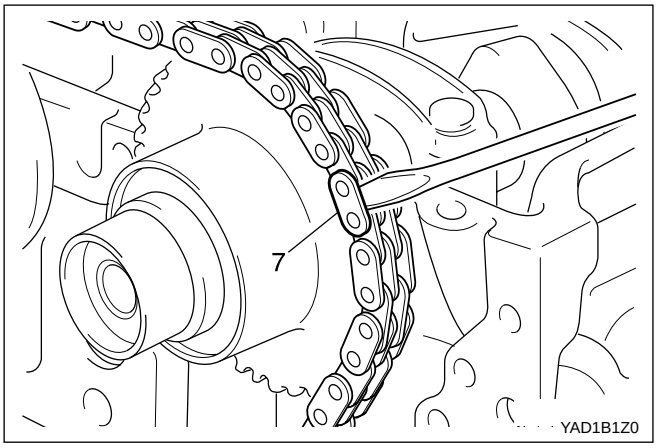
2. Insert the holding pin DW 110-120 to the intake and exhaust camshaft flange not to rotate camshaft.
3. Remove the chain tensioner.



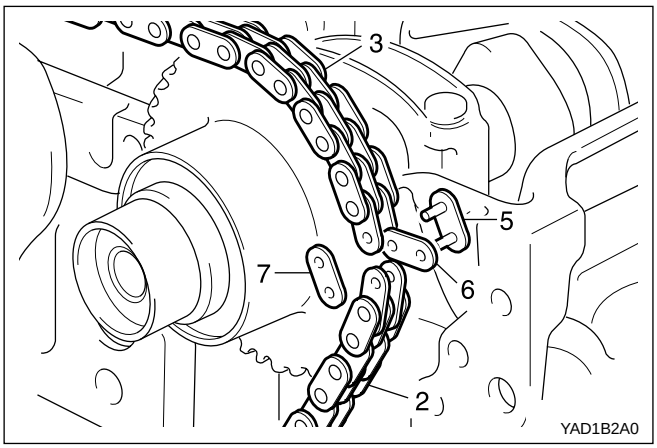
4. Mount the wedges to both sides of the camshaft sprocket as shown in the figure.



5. Cover the chain housing with a clean cloth, and grind off the timing chain pin from the intake camshaft sprocket with the grinder.

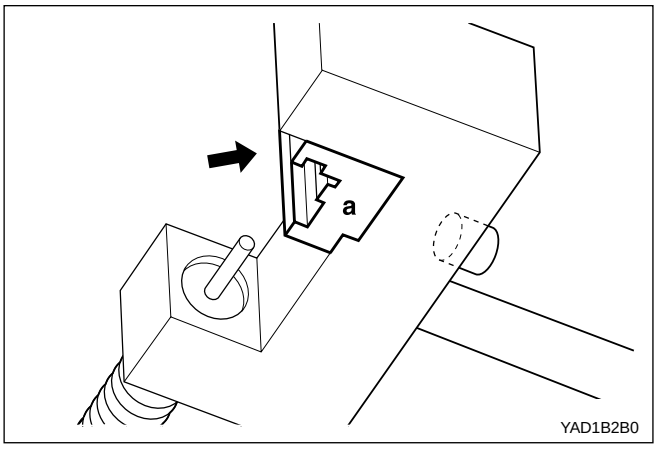


6. Remove the outer plate (7) with the screw driver and remove the link.

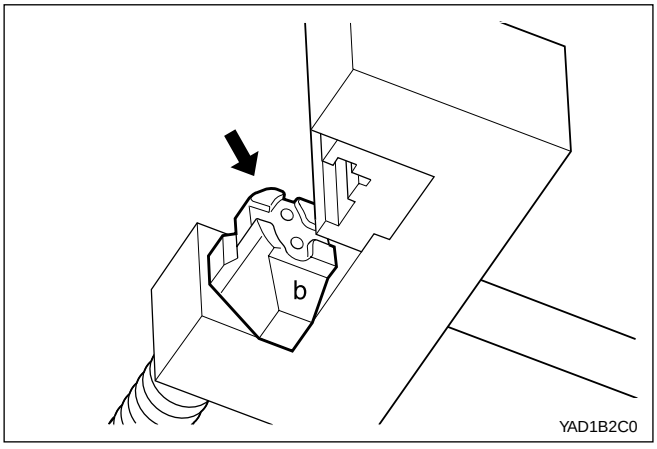


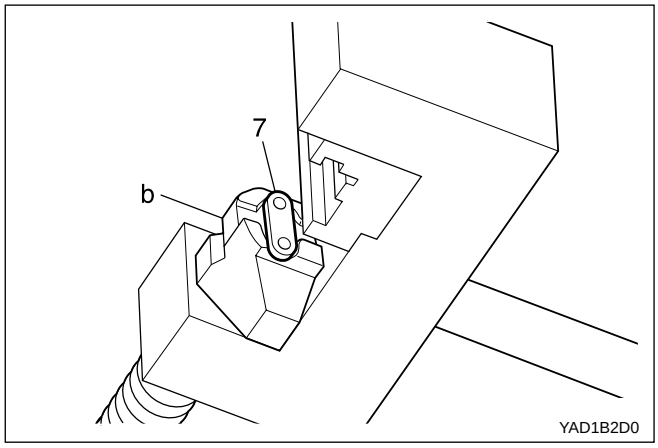
7. Connect the new timing chain (2) to the used timing chain (3) with the link (5), center plate (6, thickness 1.6 mm), and the outer plate (7).
8. Rotate the crankshaft in the direction if engine revolution by pressing the new timing chain against the exhaust camshaft sprocket to prevent it to be tangled.

   Notice: Be sure to remove the wedge before cranking the engine.
9. Take out the used timing chain out from the chain housing.
10. Connect both separators of the new timing chain with the link (5) and the center plate (6).

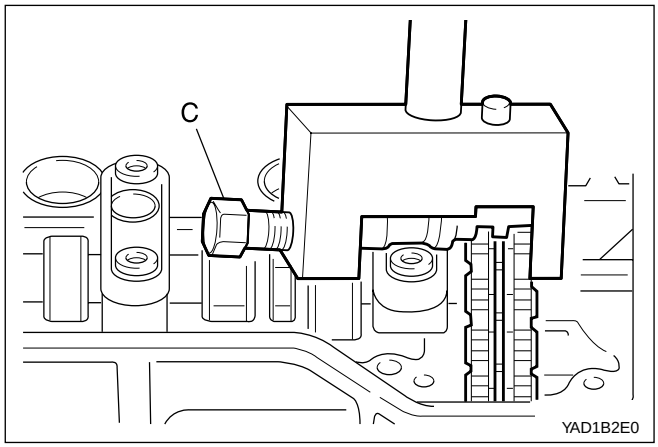


11. Install the jaw (a) and the thrust piece (b) to the assembly tool as shown in the figures.

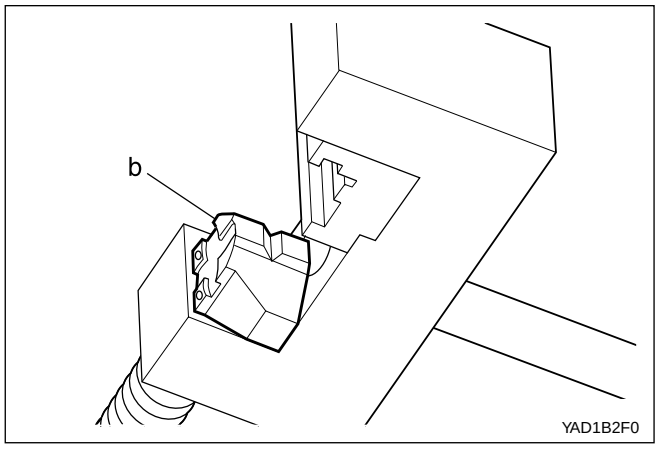




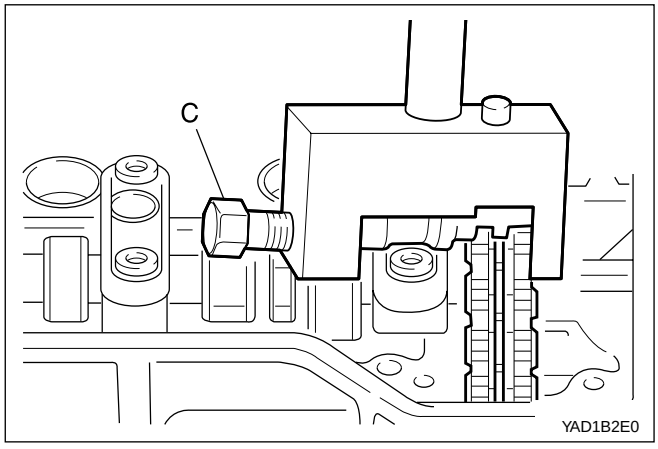
12. Place the outer plate (7, thickness 1.2 mm) inside the thrust piece (b).



13. Install the chain assembly 000 589 58 43 00 above the link and tighten the spindle (c) until a block is felt.
14. Place the chain assembly 000 589 58 43 00.

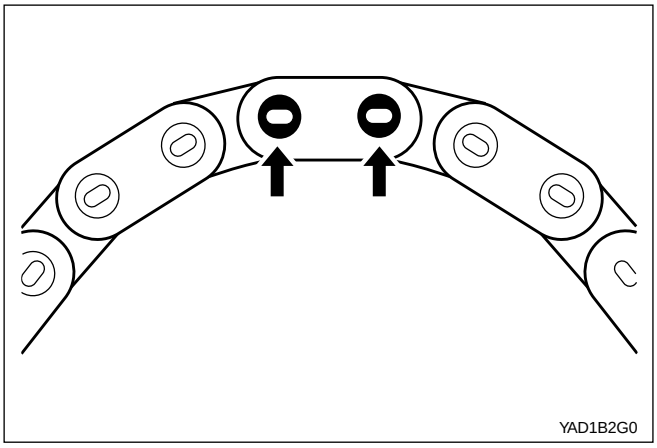


15. Replace the thrust piece (b) as shown in the figure.



16. Install the chain assembly 000 589 58 43 00 to the link pin and tighten the spindle (c).

Tightening Torque	30 N•m (22 lb-ft)



17. Rivet the link pin.
    Check the condition and it again if necessary.
18. Install the chain tensioner.

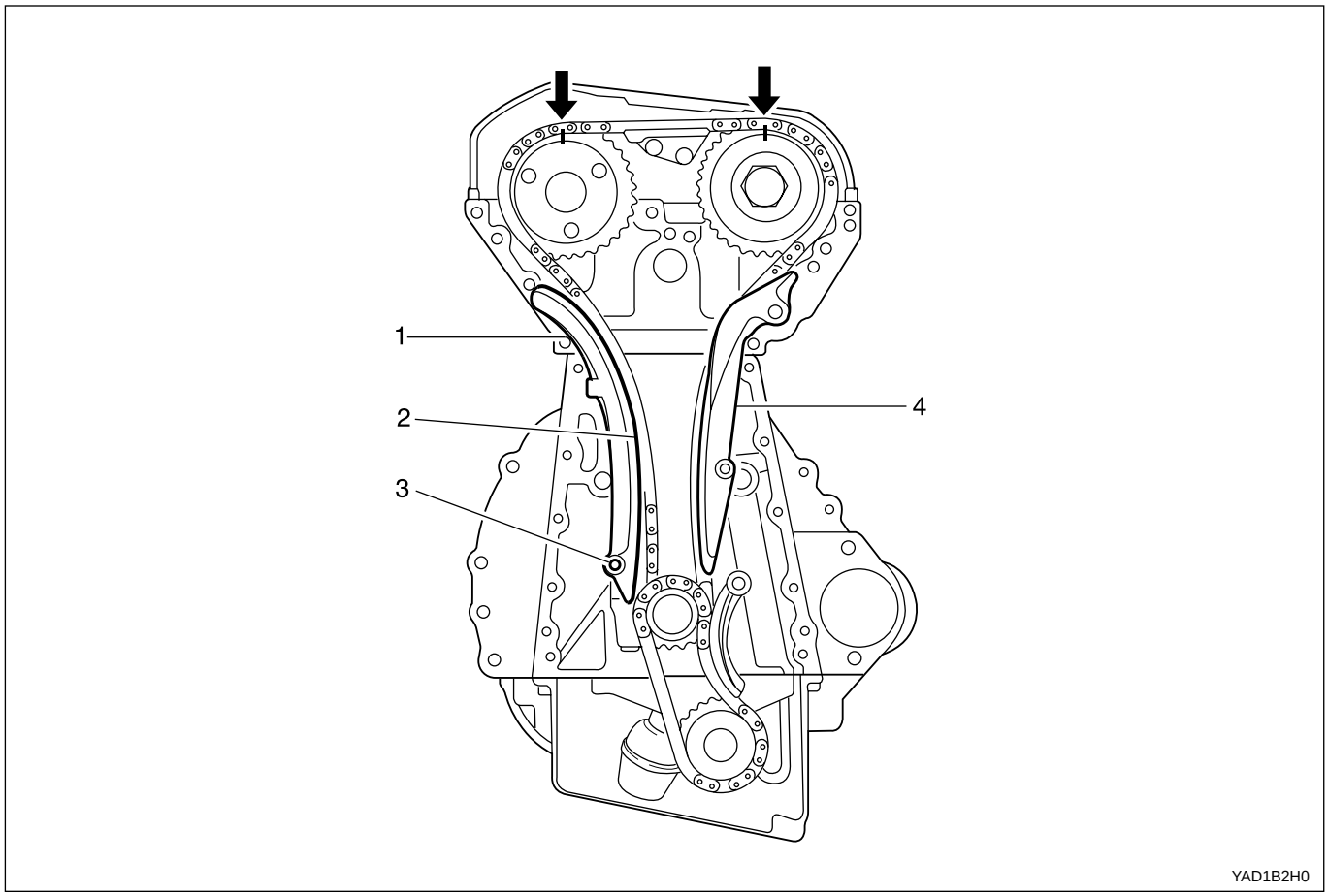
Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

19. Check the camshaft timing position.

TENSIONING RAIL

Preceding Work : Removal of timing gear case cover



1 Tensioning Rail
2 Plastic Guide
3 Tensioning Rail Pin
4 Guide Rail

Removal & Installation Procedure

1. Put the assembly mark at the camshaft sprocket and the timing chain with the paint (arrow).
2. Remove the exhaust camshaft sprocket.
3. Remove the tensioning rail (1) from the tensioning rail pin (3).

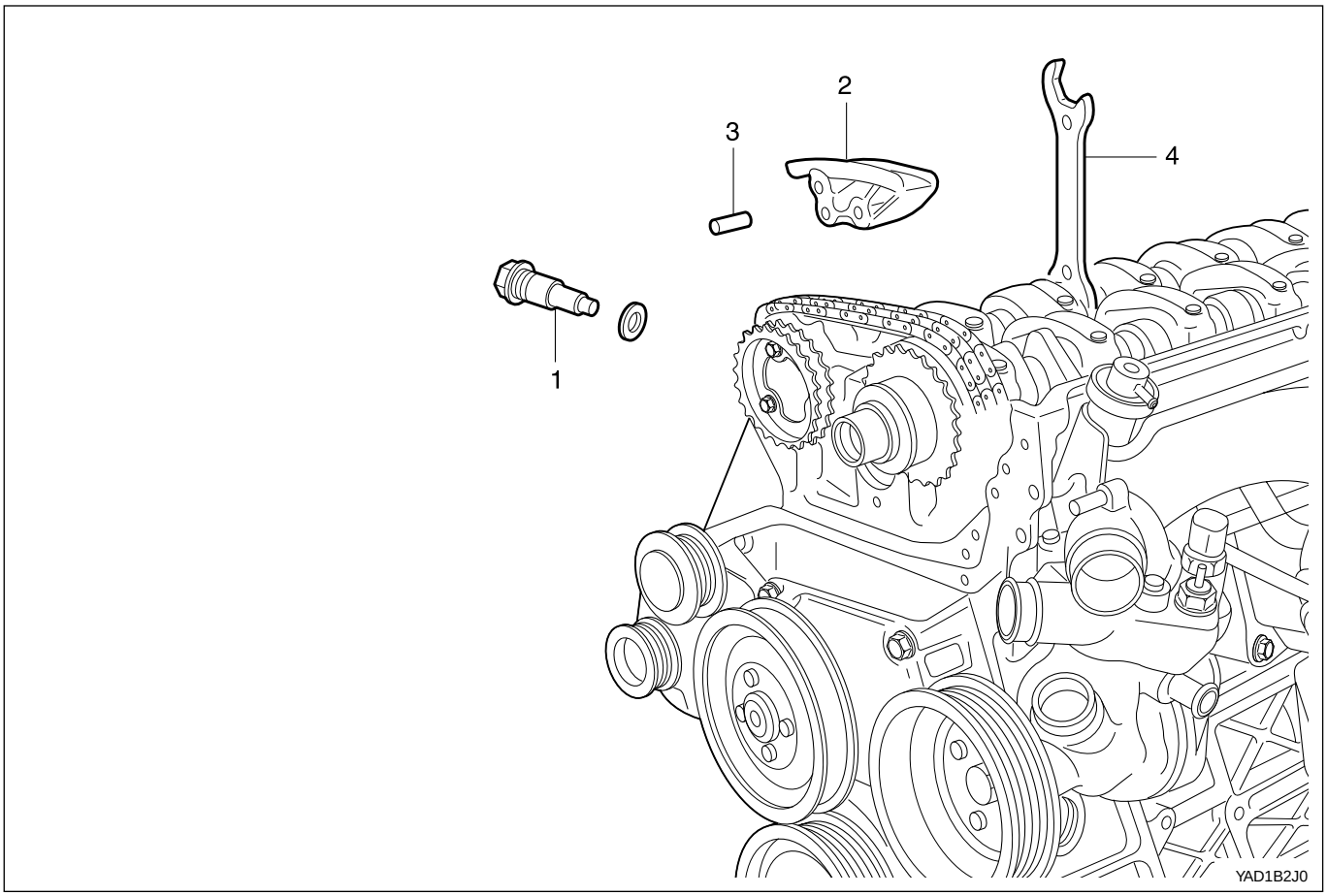
   Notice:

   - Replace the plastic guide (2) if it is damaged.
   - For installation, exactly align the plastic guide (2) with the tensioning rail (1).

4. Installation should follow the removal procedure in the reverse order.
5. Check the camshaft timing position.

CYLINDER HEAD GUIDE RAIL

Preceding Work : Removal of cylinder head cover



1 Chain Tensioner
2 Upper Guide Rail
3 Upper Guide Rail Pin
4 Wrench (Special Tool)

Removal & Installation Procedure

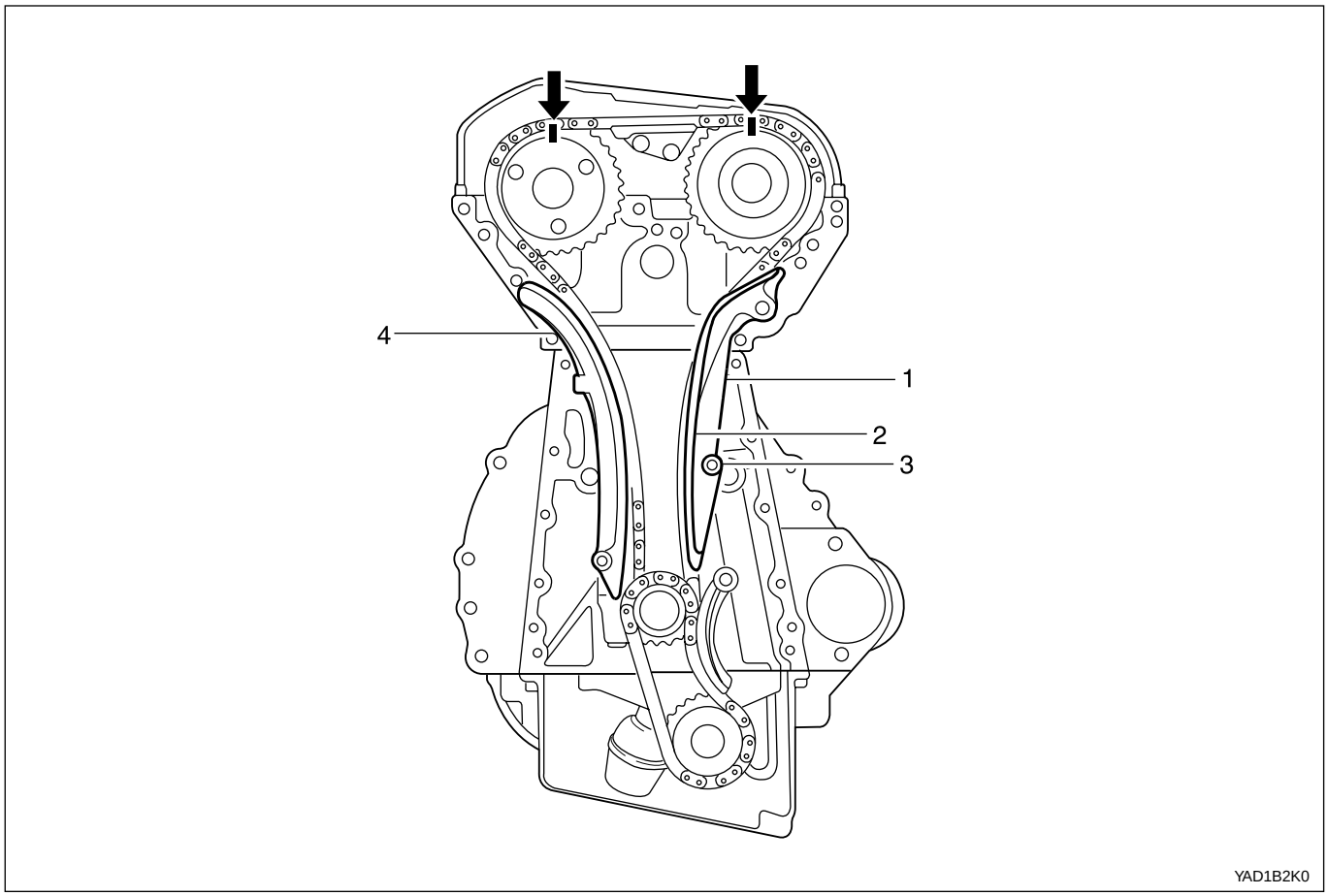
1. Remove the chain tensioner (1).
2. Turn the exhaust camshaft to the camshaft rotating direction using the wrench (4) and loosen the timing chain at upper guide rail (2).
3. Pull out the upper guide rail pin from the guide rail (2).
4. Turn the exhaust camshaft to the opposite direction of rotation using the wrench.
5. Check for damages at the upper sliding rail and replace it if necessary. Install the upper guide rail pin.
6. Install the chain tensioner.

Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

CRANKCASE GUIDE RAIL

Preceding Work : Removal of timing gear case cover



1 Guide Rail
2 Plastic Guide
3 Guide Rail Pin
4 Tensioning Rail

Removal & Installation Procedure

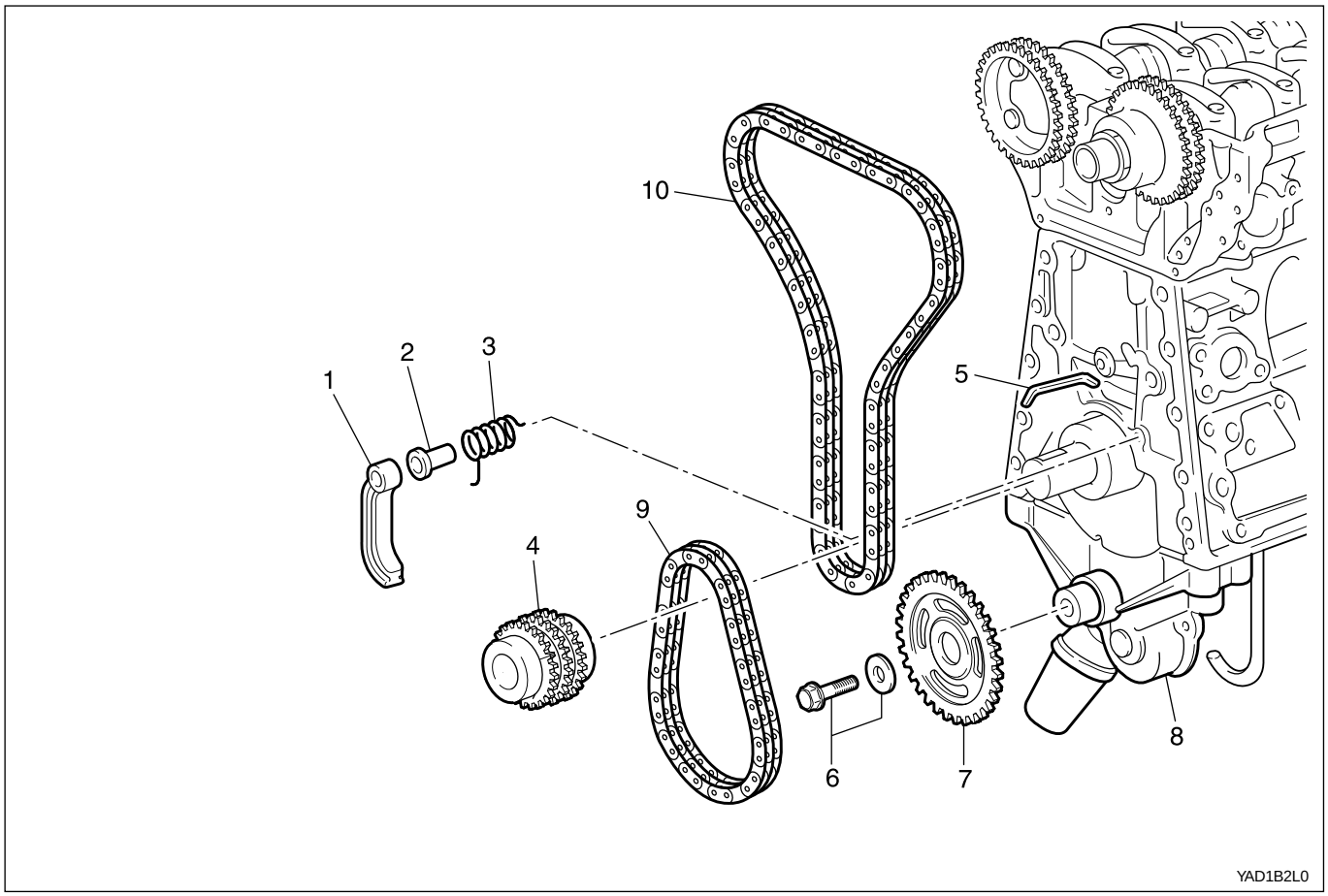
1. Put the assembly mark at the camshaft sprocket and the timing chain with the paint (arrow).
2. Remove the exhaust camshaft sprocket.
3. Remove the guide rail (1) from the guide rail pin (3).

   Notice:

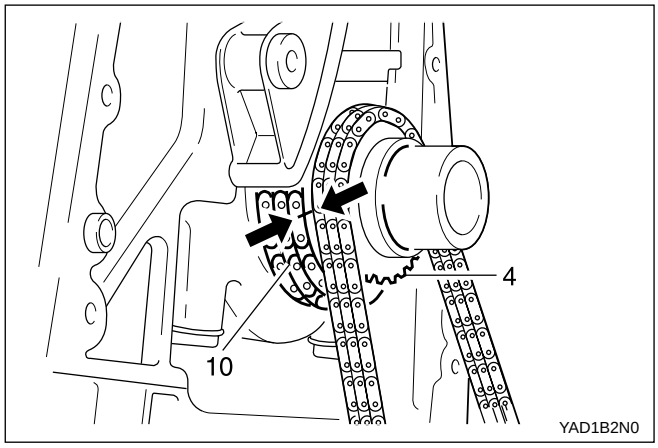
   - Replace the plastic guide (2) if damaged.
   - Connect the plastic guide (2) and the guide rail (1) by aligning them accurately when installing.
4. Installation should follow the removal procedure in the reverse order.
5. Check the camshaft timing position.

CRANKSHAFT SPROCKET

Preceding Work : Removal of oil pan
Removal of tensioning rail
Removal of crankcase guide rail



1 Oil Pump Chain Tensioner
2 Oil Pump Chain Bushing
3 Oil Pump Chain Spring
4 Crankshaft Sprocket
5 Key
6 Bolt (M8 x 20, 1 piece) / Washer
..... 29-35 N•m (21-26 lb-ft)
7 Oil Pump Sprocket
8 Oil Pump
9 Oil Pump Roller Chain
10 Timing Chain



Tools Required

615 589 01 33 00 Crankshaft Sprocker Puller

Removal & Installation Procedure

1. Put the assembly mark at the crankshaft sprocket (4) and the timing chain (10) with the paint (arrow).

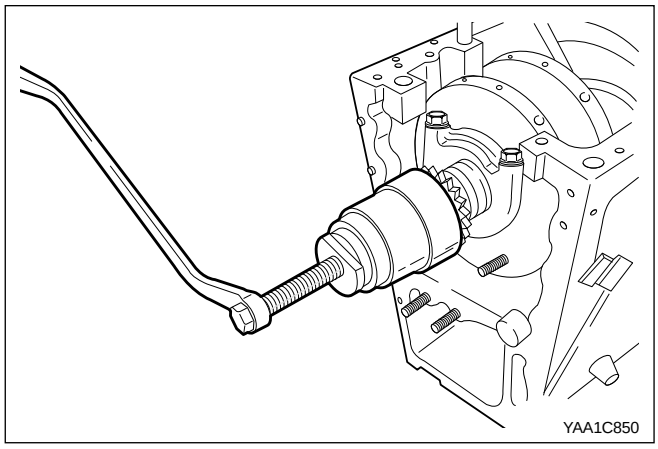
   Notice: Align the assembly marks on cranshaft sprocket and timing chain. Also, align the assembly marks on camshaft sprocket and timing chain when installing.

2. Unscrew the bolt (6) and remove the oil pump sprocket (7) from the oil pump.

   Installation Notice

Tightening Torque	29 - 35 N•m (21 - 26 lb-ft)

3. Remove the oil pump roller chain (9).
4. Remove the oil pump chain tensioner (1), oil pump chain bushing (2), and the oil pump chain spring (3).



5. Remove the crankshaft sprocket (4) using the crankshaft sprocket puller 615 589 01 33 00.

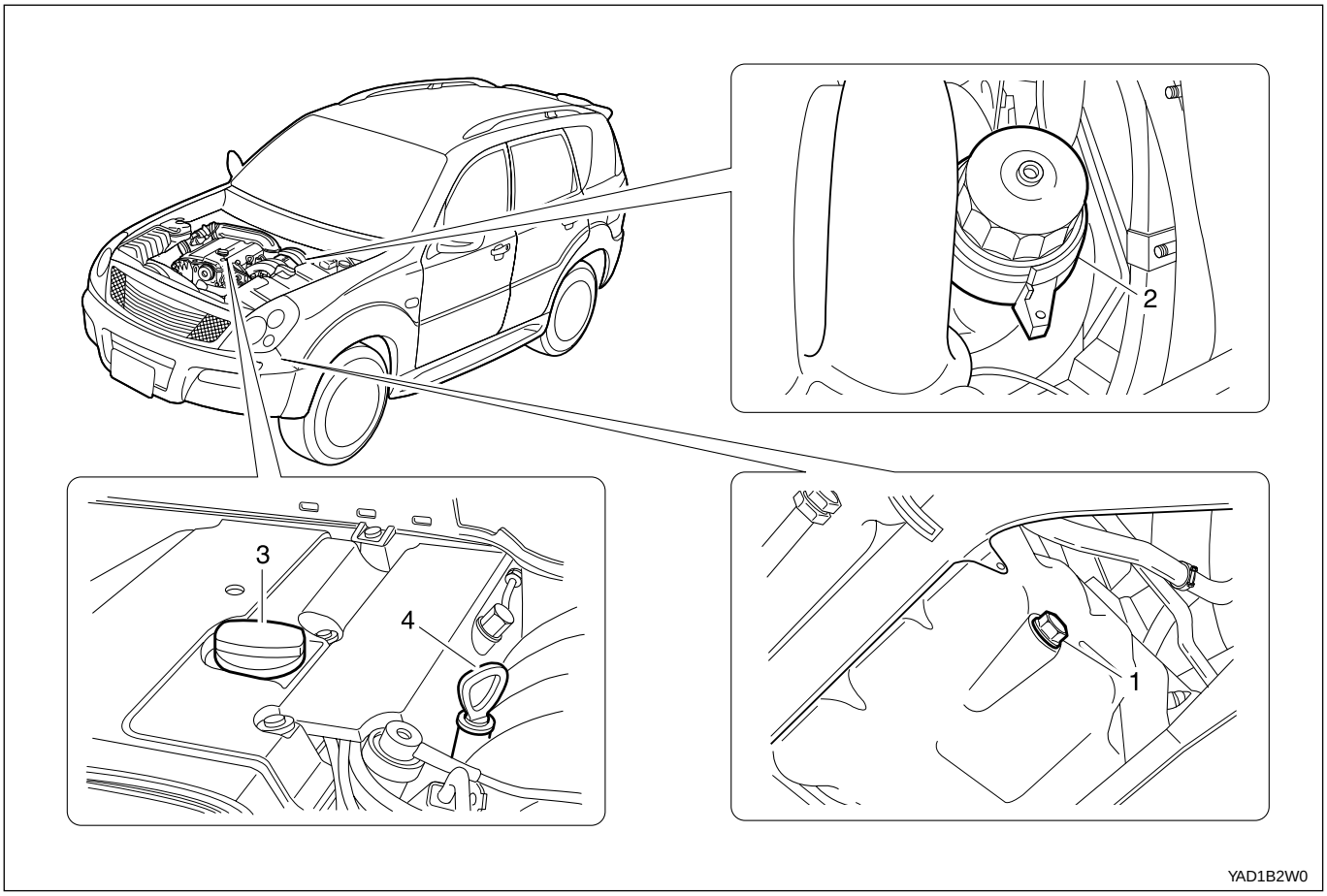
   Notice:

   - Make sure not to lose the crankshaft pulley key (5) when removing.
   - Install the crankshaft sprocket (4) after warming it up.

6. Installation should follow the removal procedure in the reverse order.

LUBRICATION SYSTEM

ENGINE OIL SPECIFICATION

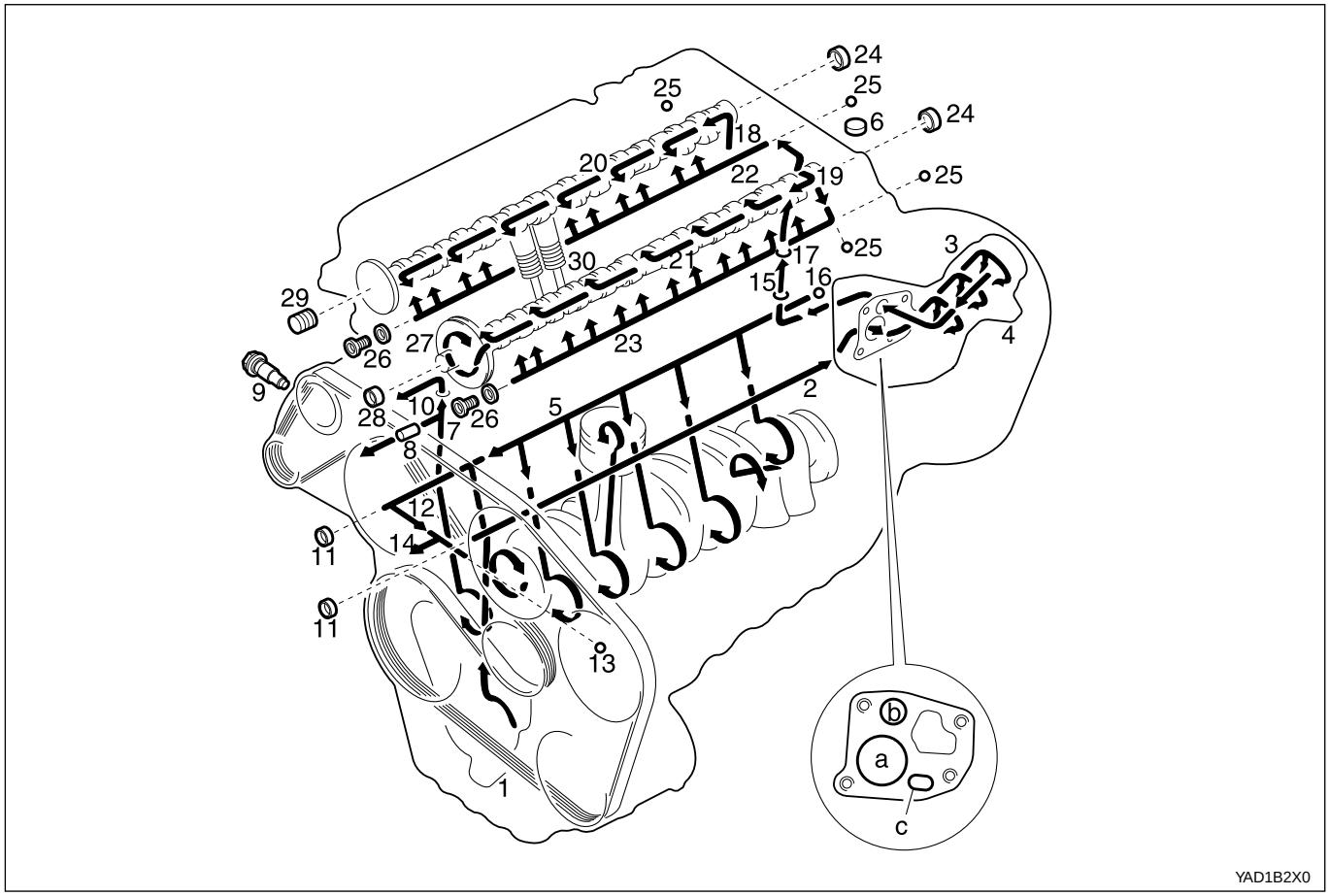


1 Drain Plug ..... 25 N•m (18 lb-ft)
2 Oil Filter
3 Engine Oil Filler Cap
4 Dipstick Gauge

Specifications

Application	Descrition
Capacity	Min : 6.7 L, Max : 8.2 L
Quality	• API SH or above grade
	• ACEA : A2 or A3
	• Approved oil by MB Sheet 229.1
Viscosity	• Approved oil by MB Sheet 224.1
Replacemant	• Initial at 1000-1500 km, Replace every 15000 km

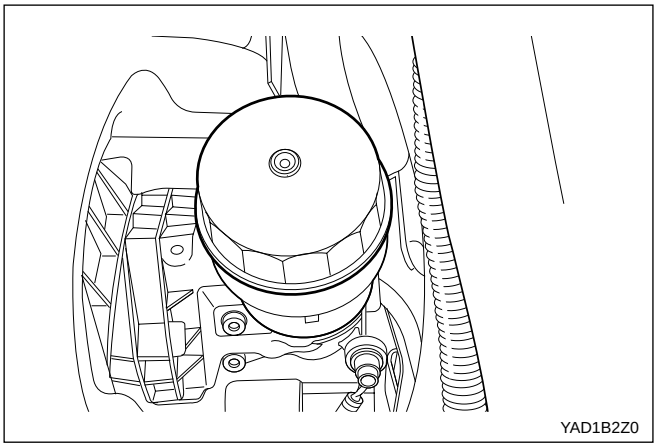
OIL CIRCULATION



YAD1B2X0

1 Oil Pump
2 Oil Gallery (to oil filter)
3 Oil Filter
4 Oil Pressure Switch
5 Main Oil Gallery
6 Cylinder Head Closing Cover
7 Oil Gallery (At Chain Tensioner)
8 Oil Non-return Valve
9 Chain Tensioner
10 Vent (Chain Tensioner)
11 Front Closing Cover (ϕ 17 mm)
12 Oil Gallery (Perpendicular to The Shaft)
13 Ball (ϕ 6 mm)
14 Oil Spray Nozzle (Timing Chain)
15 Oil Gallery (At Cylinder Head)
16 Ball (ϕ 15mm)
17 Oil Restriction Inner (ϕ 4mm)
18 Oil Supply (To Exhaust Camshaft)
19 Oil Supply (To Intake Camshaft)
20 Oil Supply (To Exhaust Camshaft Bearing)
21 Oil Supply (To Intake Camshaft Bearing)
22 Oil Gallery (Oil Supply to Exhaust Valve Tappet)
23 Oil Gallery (Oil Supply to Intake Valve Tappet)
24 Camshaft Closing Cover
25 Ball (ϕ 8 mm)
26 Screw Plug
27 Camshaft Adjuster
28 Front Closing Cover (Intake Camshaft)
29 Front Treaded Bushing (Exhaust Camshaft)
30 Valve tappet

a Oil Gallery (From Oil Pump to Oil Filter)
b Main Oil Gallery
c Oil Return Line (Oil Returns to the Oil Pan when Replacing the Filter Element)


YAD1B2Z0

ENGINE OIL AND OIL FILTER ELEMENT

Tools Required

103 589 02 09 00 Oil Filter Remover

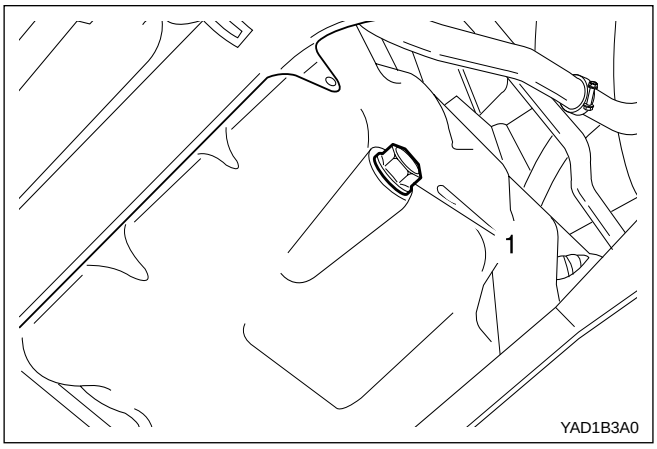
Replacement Procedure

1. Install the oil filter remover 103 589 02 09 00 on the oil filter cover.

   Notice: Make the screw cover removable by tightening the bolt at the side of the oil filter remover 103 589 02 09 00.

2. Install the wrench to the upper bolt in the oil filter remover 103 589 02 09 00 and remove the oil cover by turning it.
3. Remove the oil filter element.

   Notice: Work with a cloth under the vehicle when removing the oil filter element to not drain the oil.



YAD1B3A0

4. Remove the drain plug (1) and drain the engine oil.

   Notice: Leave the oil filler cap open to ease the engine oil discharge.

5. Tighten the engine oil drain plug after cleaning it.

   Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

   Replace the seal washer with new one.

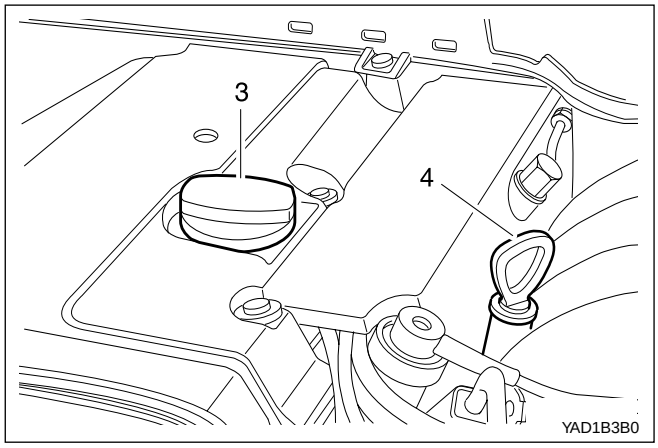
6. Replace the O-ring in the oil filter cover with new one.

   Notice: Apply the engine oil to the O-ring.

7. Insert new oil filter element into the oil filter housing.
8. Temporarily tighten the oil filter cover. Install the oil filter remover 103 589 02 09 00, and then completely tighten it.

   Installation Notice

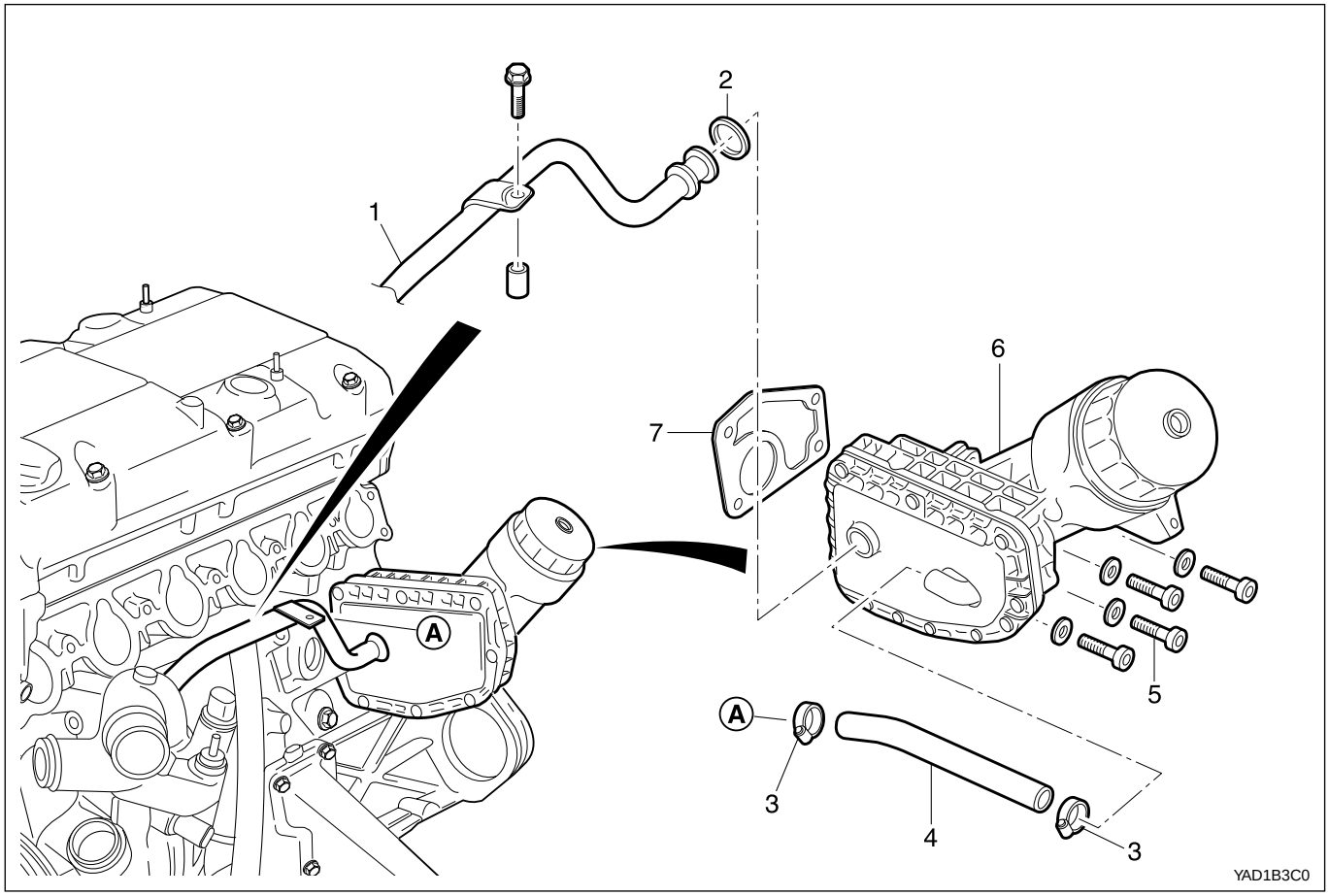
Tightening Torque	25 N•m (18 lb-ft)



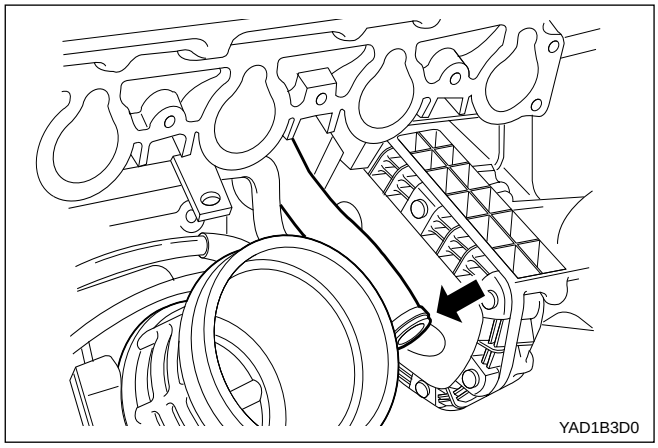
9. Fill up engine oil through the engine oil filler opening (3).
10. Check for oil leaks at normal engine temperature after starting the engine.
11. Stop the engine and wait 5 minutes.
    Check the oil level and fill up as specified if necessary.

OIL FILTER

Preceding Work : Removal of starter motor
Removal of upper intake manifold



1 Coolant Line
2 O-ring ..... Replace
3 Clip
4 Hose
5 Bolt..... 22.5-27.5 N•m (16.6-20.3 lb-ft)
6 Oil Filter
7 Gasket ..... Replace



Removal & Installation Procedure

1. Drain the coolant from the crankcase.
2. Remove the each coolant line and hose.
3. Remove the oil filter bolt and then remove the oil filter.

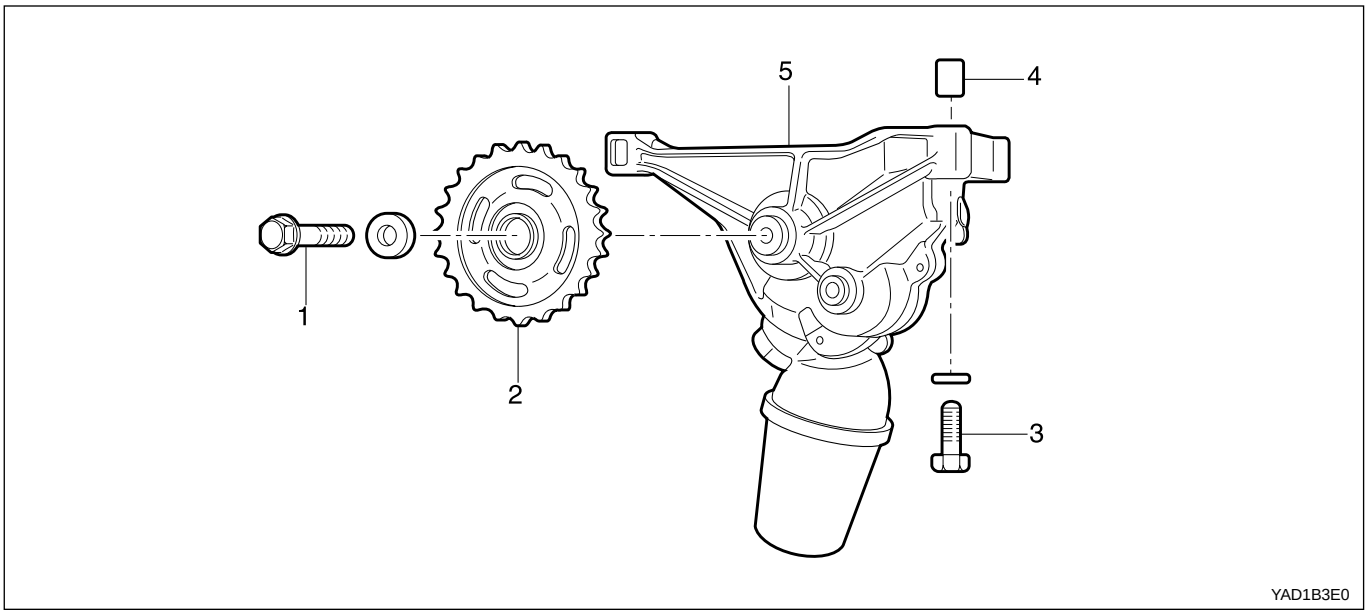
   Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

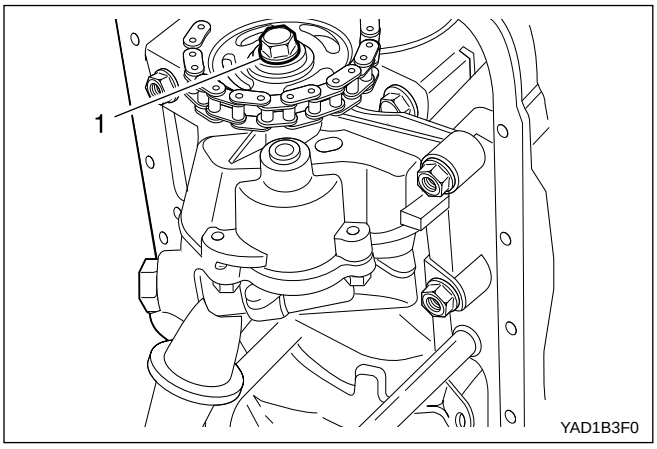
   Replace the oil filter gasket.
4. Installation should follow the removal procedure in the reverse order.
5. Check engine oil level.
6. Run the engine at idle and check the engine for leaks.

OIL PUMP

Preceding Work : Removal of oil pan



1 Bolt (M8 x 20, 1 piece)
..... 29-35 N•m (21-26 lb-ft)
2 Sprocket (Oil Pump Drive)
3 Bolt (M8 x 35, 3 pieces)
..... 22.5-27.5 N•m(16.6-20.3 lb-ft)
4 Spring Pin
5 Oil Pump



Removal & Installation Procedure

1. Remove the bolt (1) from the oil pump drive sprocket (2) and separate the gear and the oil pump drive chain.

   Installation Notice

Tightening Torque	29 - 35 N•m (21 - 26 lb-ft)

2. Unscrew the oil pump mounting bolts (3).

   Installation Notice

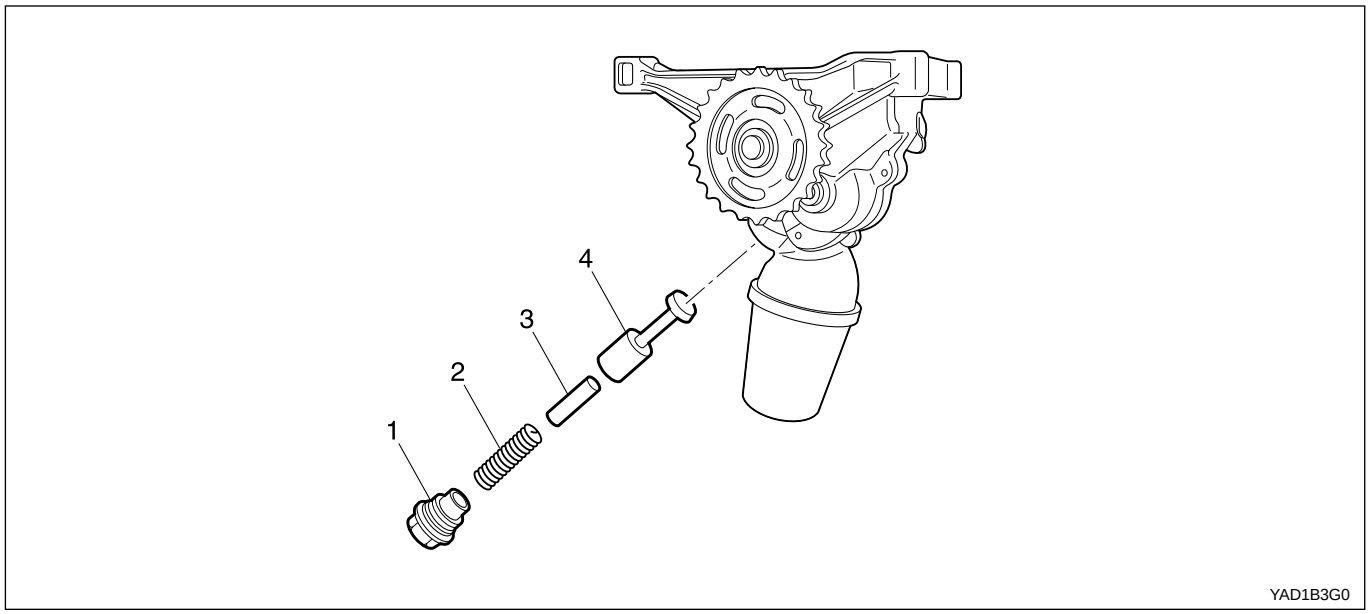
Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

   Tighten the baffle plate and the oil pump with the two bolts in right side first, and then tighten the other bolt.

3. Remove the oil pump and oil strainer assembly.
4. Replace the strainer in oil pump if necessary.
5. Installation should follow the removal procedure in the reverse order.

OIL PRESSURE RELIEF VALVE

Preceding Work : Removal of oil pan



1 Screw Plug ..... 50 N•m (37 lb-ft)
2 Compression Spring
3 Guide Pin
4 Piston

Removal & Installation Procedure

1. Remove the screw plug (1).

   Installation Notice

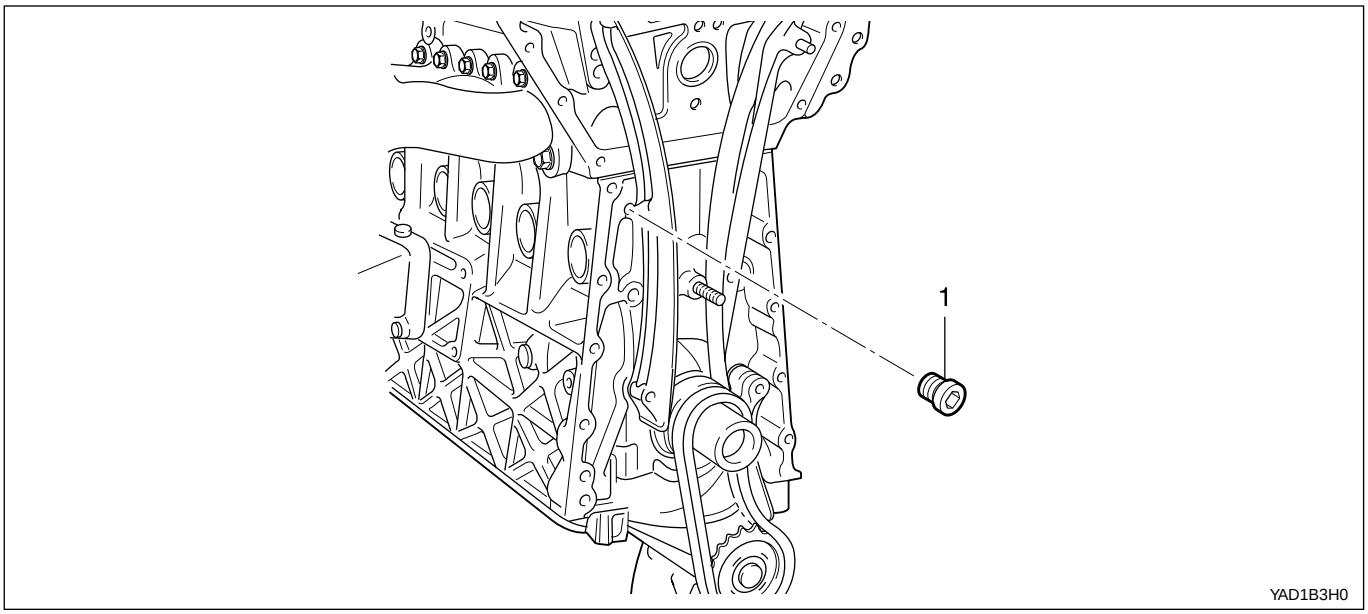
Tightening Torque	50 N•m (37 lb-ft)

2. Remove the spring (2), guide pin (3) and the piston (4).
3. Installation should follow the removal procedure in the reverse order.

   Notice: Don't use the seal for the screw plug.

OIL NON-RETURN VALVE

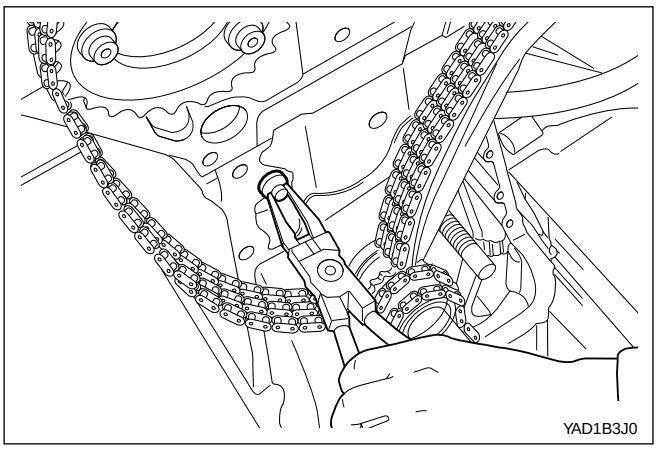
Preceding Work : Removal of timing gear case cover



1 Oil Non-return Valve

Functions

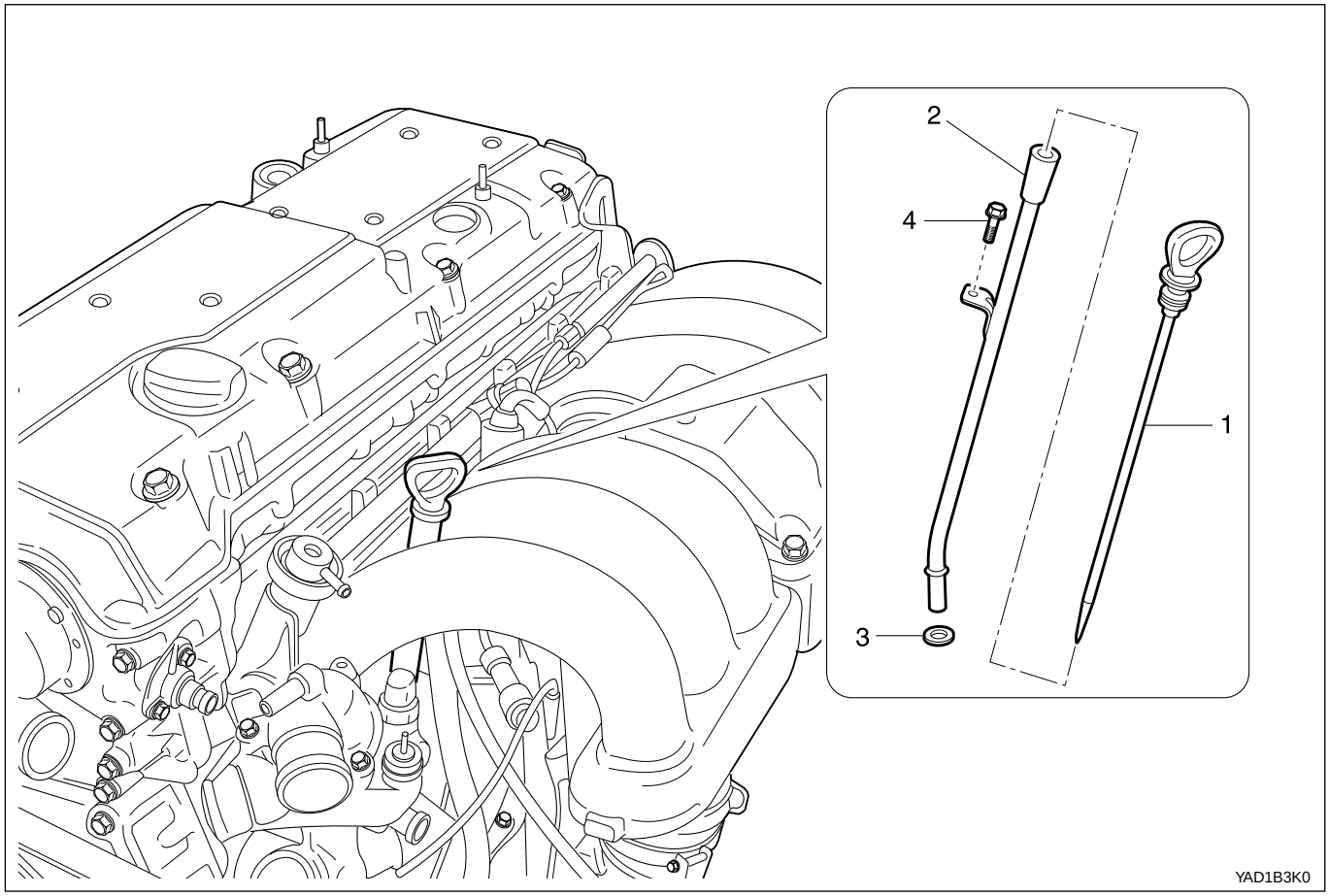
The non-return valve prevents the oil in the chain tensioner from drying up. In other words, it stops oil-returning in order to prevent the oil in the chain tensioner from getting dry. As a result, the chain tensioner can be activated with oil in itself.



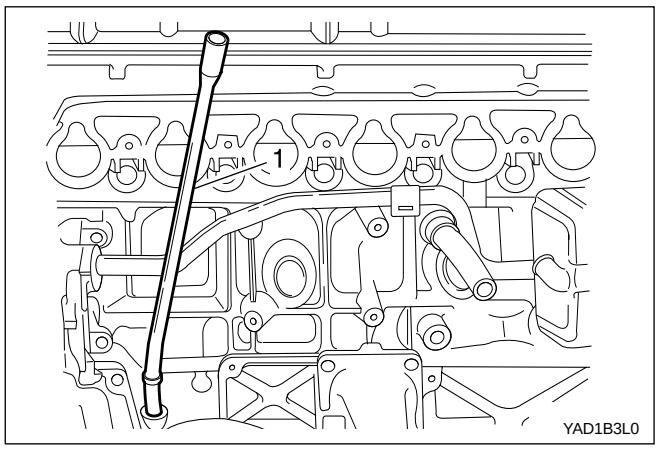
Replacement Procedure

1. Remove the non-return valve using a pliers.
2. Insert new non-return valve with hand.

OIL DIPSTICK GUIDE TUBE



1 Oil Dipstick Level Gauge
2 Oil Dipstick Guide Tube
3 O-ring
4 Bolt (M6 x 12, 1 piece) ....9-11 N•m (80-97 lb-in)



Removal & Installation Procedure

1. Pull out the oil dipstick level gauge (1).
2. Remove the bolt (4) in the upper intake manifold and remove the oil dipstick guide tube.

Installation Notice

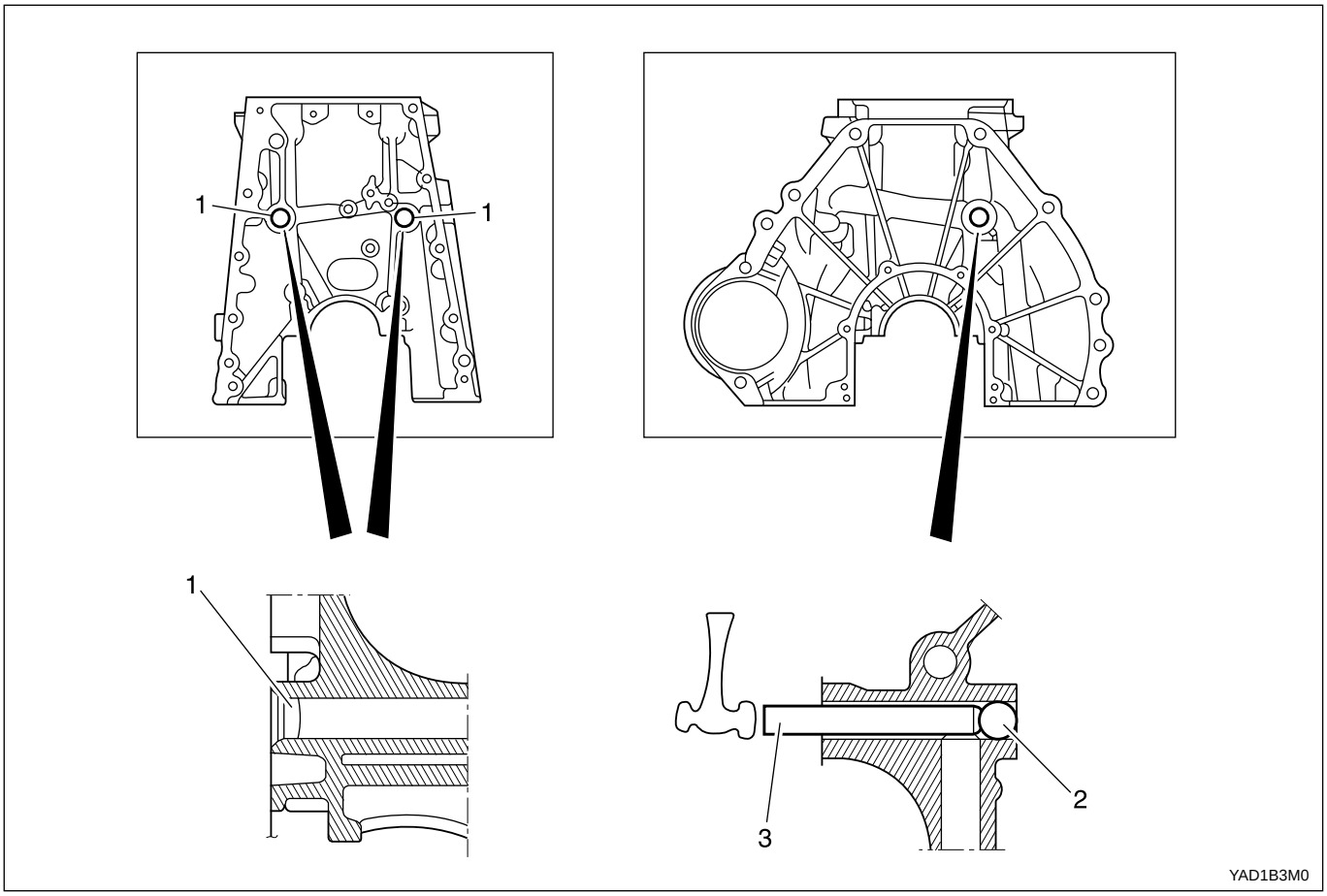
Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

3. Install new O-ring to the dipstick guide tube.
4. Installation should follow the removal procedure in the reverse order.
5. Check for leaks by starting the engine.

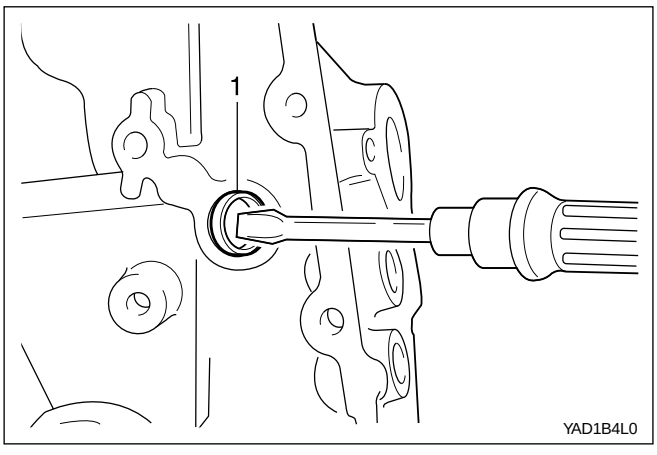
UNIT REPAIR

OIL GALLERY IN CRANKCASE

Preceding Work : Removal of crankshaft
Removal of oil spray nozzle

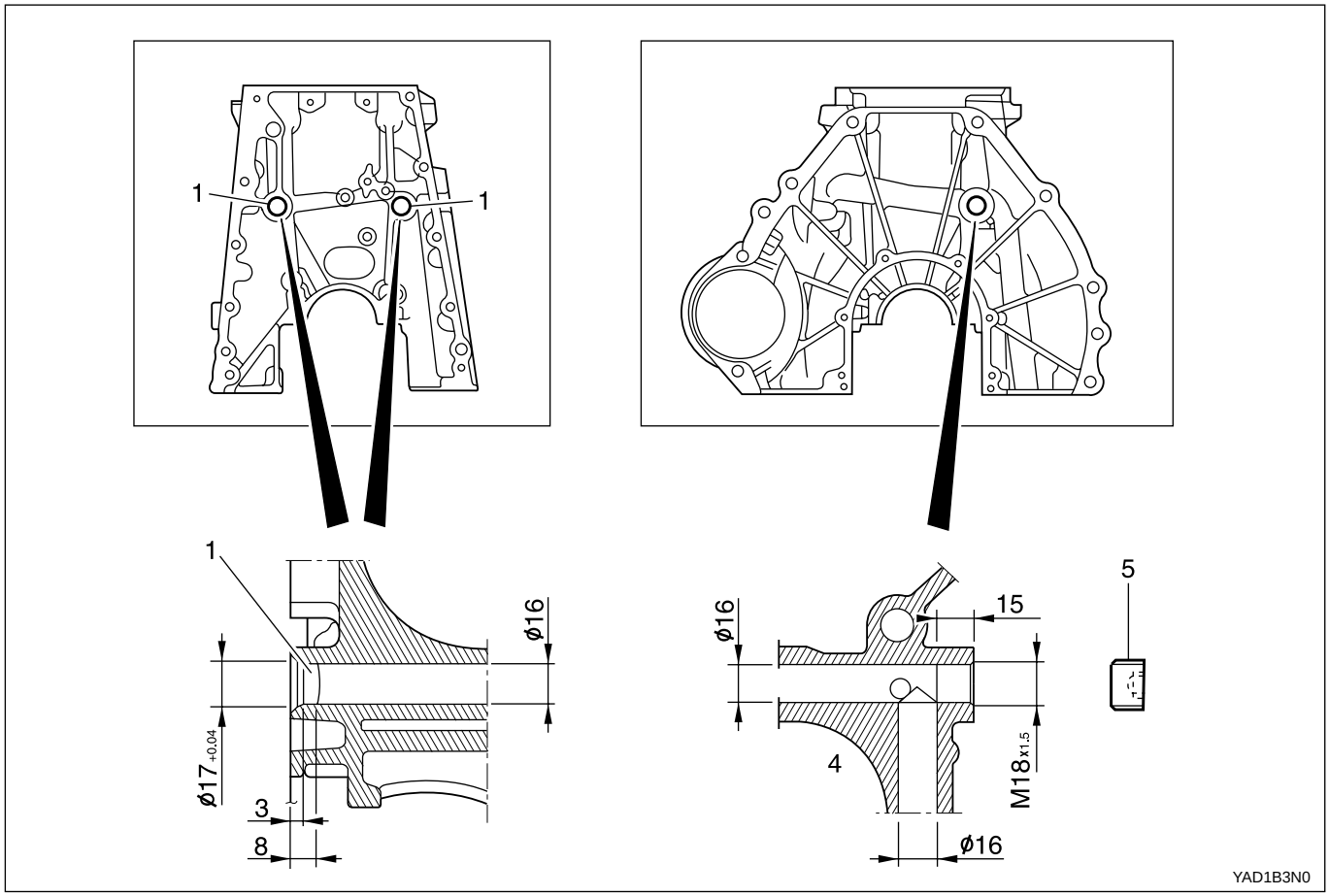


1 Plug
2 Steel Ball
3 Round Bar ..... ϕ 11 x 750 mm



Cleaning Procedure

1. Remove the plug (1) with a screwdriver.
2. Using a round bar (3) and hammer, remove the steel ball (2).
3. Using the compressed air, blow into the oil galleries and clean it off.



1 Plug ..... Replace
2 -
3 -
4 Main Oil Gallery
5 Screw Plug

Tools Required

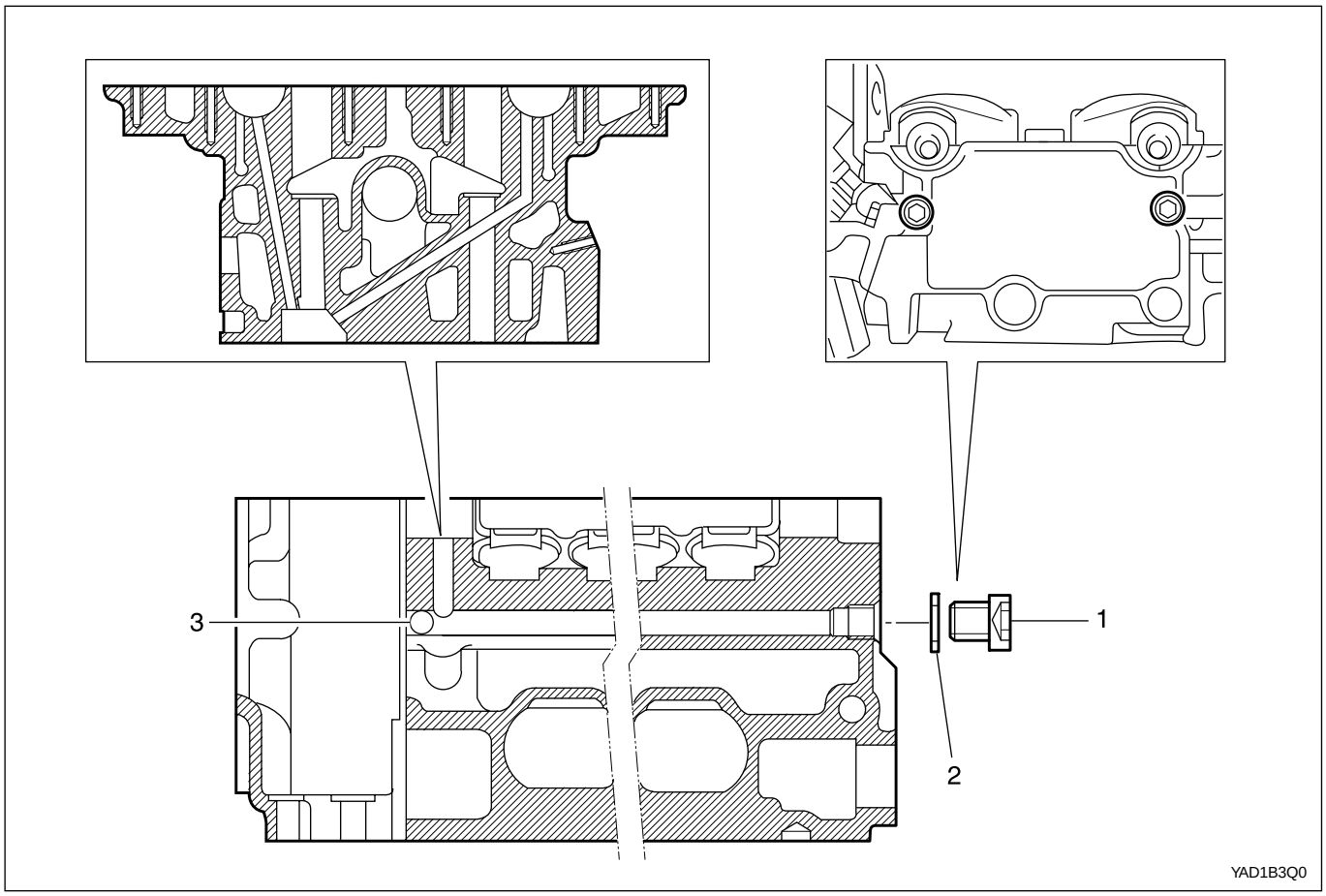
102 589 12 15 00 Drift

Sealing Procedure

1. Enlarge the end of main oil gallery (4) to be diameter of 16mm, depth of 15mm.
2. Using an M16 x 1.5 thread (tap), make the thread at the end of main oil gallery (4).
3. Throughly clean the oil gallery with compressed air and tighten the screw plug (M16 x 1.5) after applying sealing bond on it.
4. Apply Loctite 270 on new plug and tighten to the hole until the drift 102 589 12 15 00 is stopped after inserting new plug into the drift.

OIL GALLERY IN CYLINDER HEAD

Preceding Work : Removal of cylinder head
Removal of camshaft
Removal of tappet



1 Screw Plug ..... 15 N•m (11 lb-ft)
2 Seal
3 Steel Ball (ϕ8mm)

Cleaning Procedure

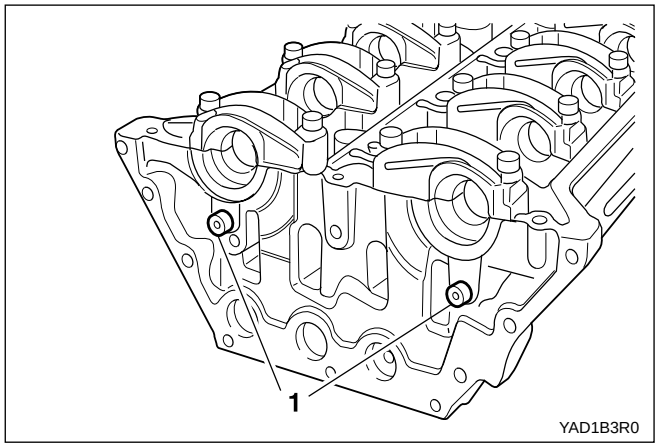
1. Remove the screw plug (1) and the seal (2).

   Installation Notice

Tightening Torque	15 N•m (11 lb-ft)

   Replace the seal with new one.

2. Clean the oil gallery using the compressed air.

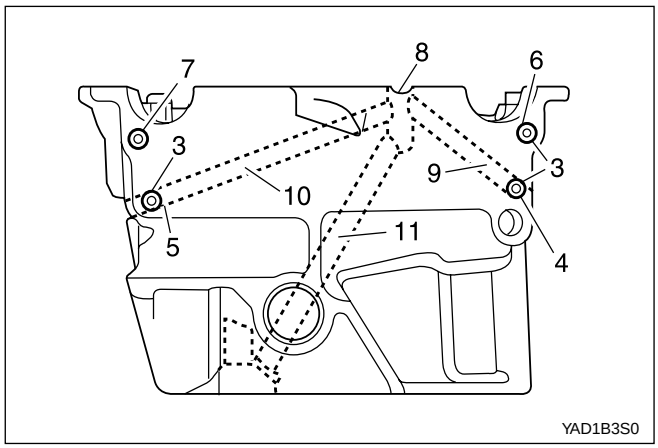


Sealing Procedure

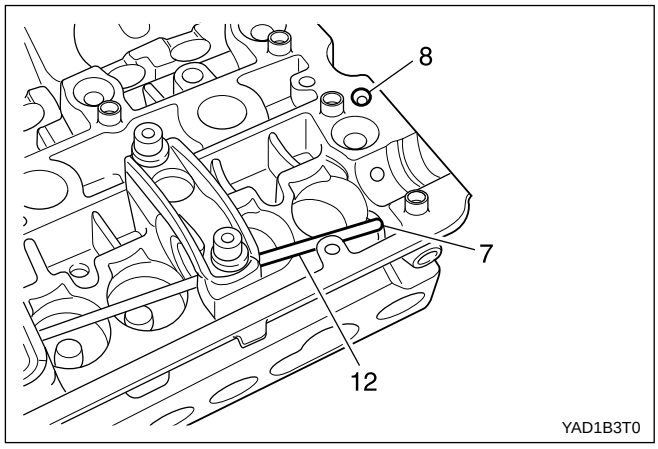
1. Remove the screw plug (1) and the seal.

Installation Notice

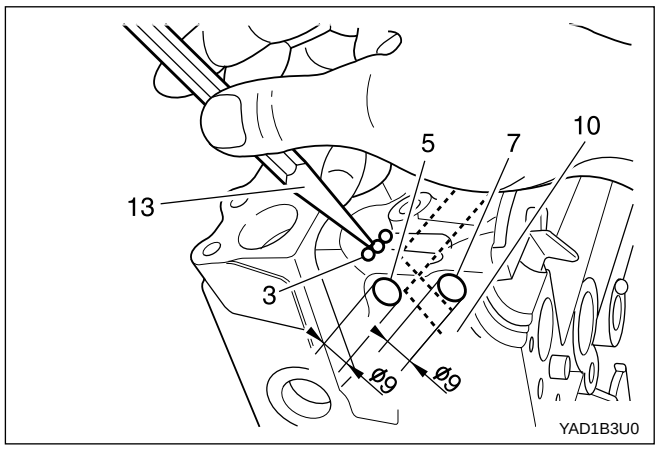
Tightening Torque	15 N•m (11 lb-ft)



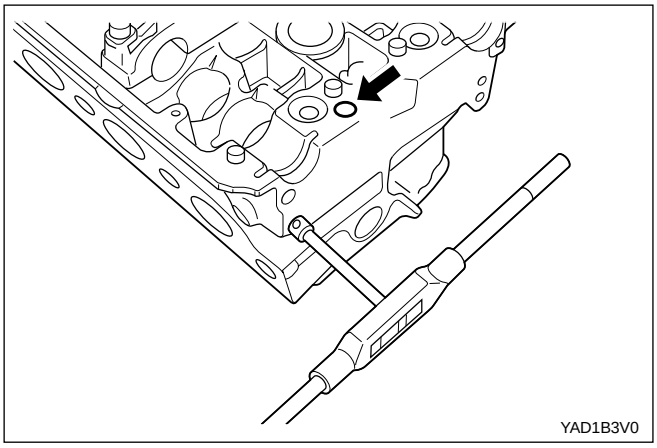
2. Remove the steel ball from the oil gallery (4), (5), (6) and (7) using the round bar (12, ϕ6 x 700 mm).



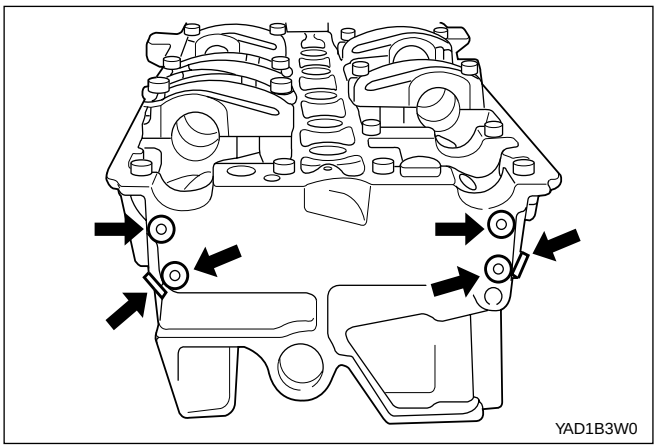
3. Remove the plug (8) using the screw driver.



4. Enlarge the oil gallery at the rear of the cylinder head to be diameter 9mm, depth 8mm.
5. Tap in the steel ball (3) from the side to the oil gallery using the punch (13).
6. Pull out the steel ball (3) using the round bar (12).
7. Enlarge the oil gallery to be diameter 9mm, depth 8 mm.



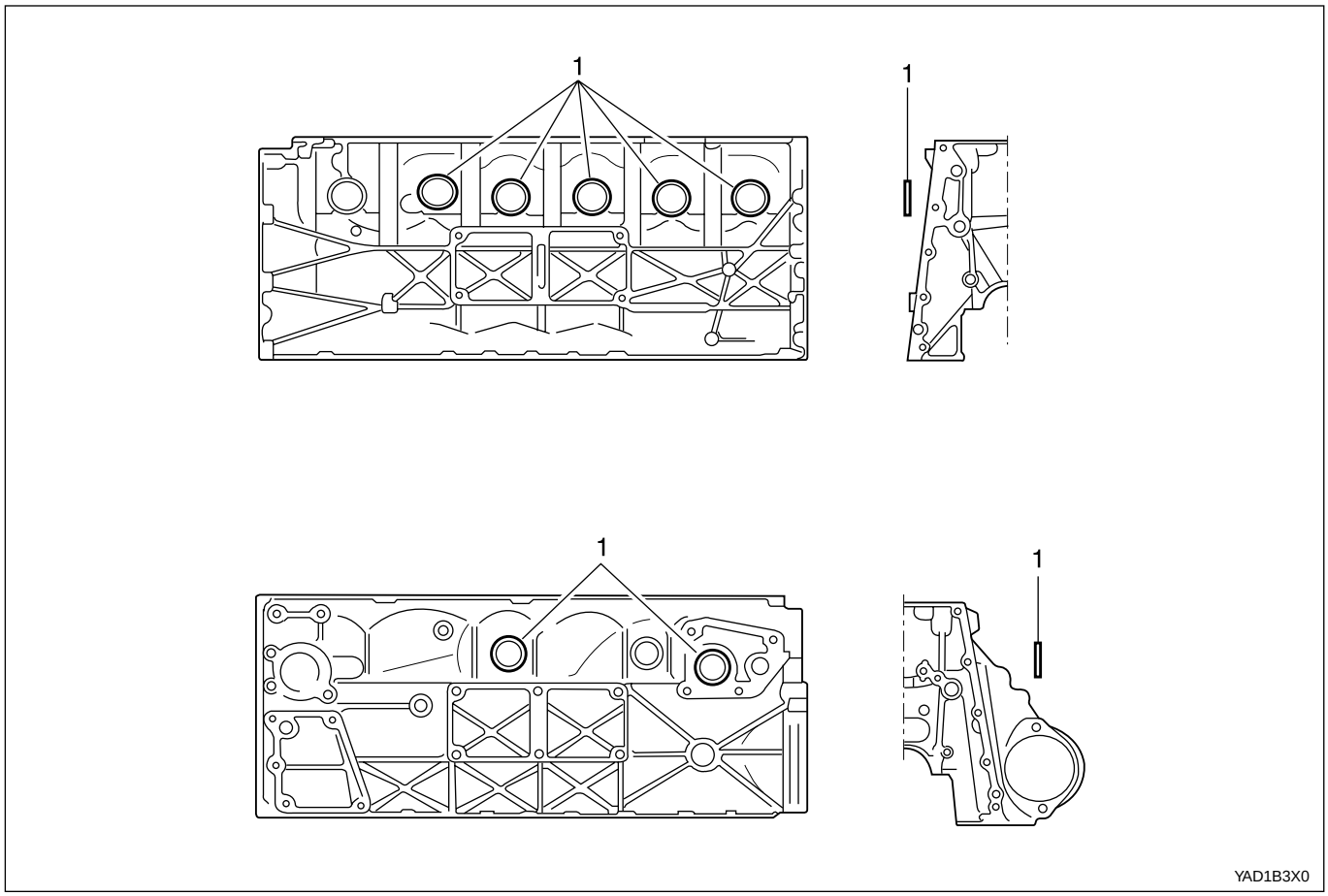
8. Make a screw hole at the oil gallery using M10 x 1 thread.
9. All the oil gallery should be cleaned with the compressed air.
10. Apply the Loctite 270 to new plug and press in using a suitable drift (arrow).



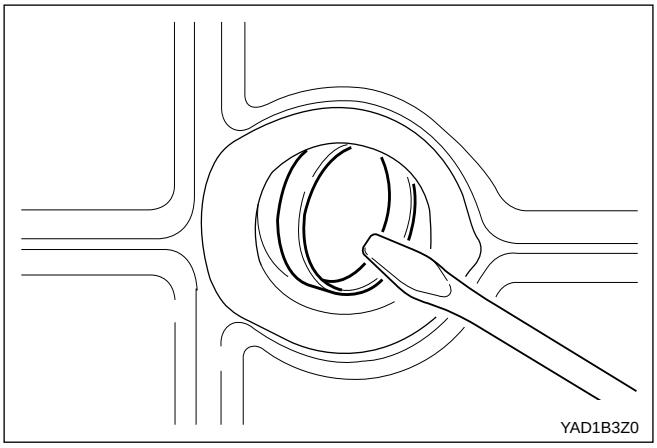
11. Tighten the screw plug with the seal (arrow).

CORE PLUGS IN CRANKCASE

Preceding Work : Draining of the coolant



1 Core Plug ..... Replace

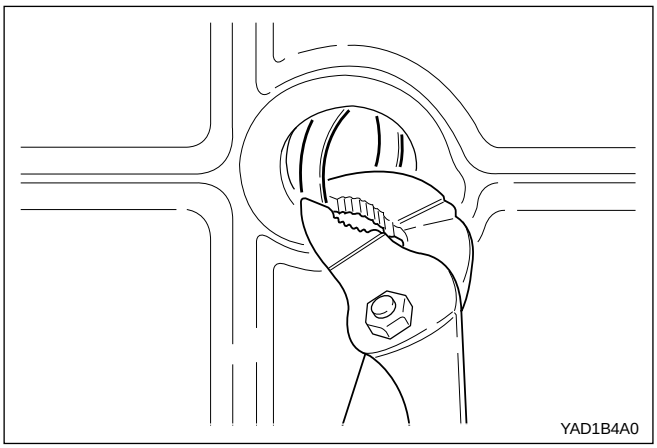

YAD1B3Z0

Tools Required

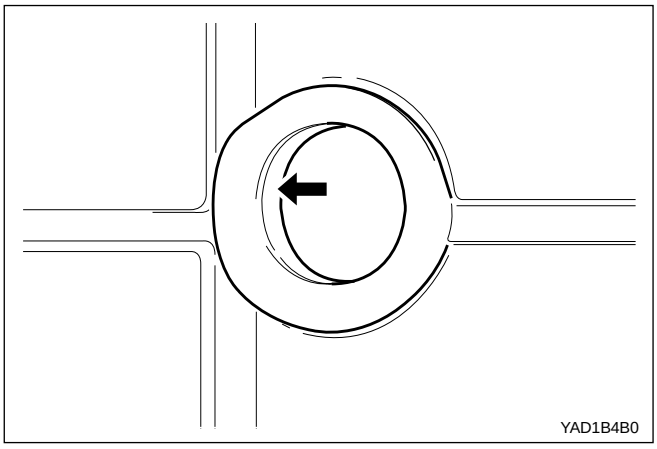
102 589 00 15 00 Drift

Replacement Procedure

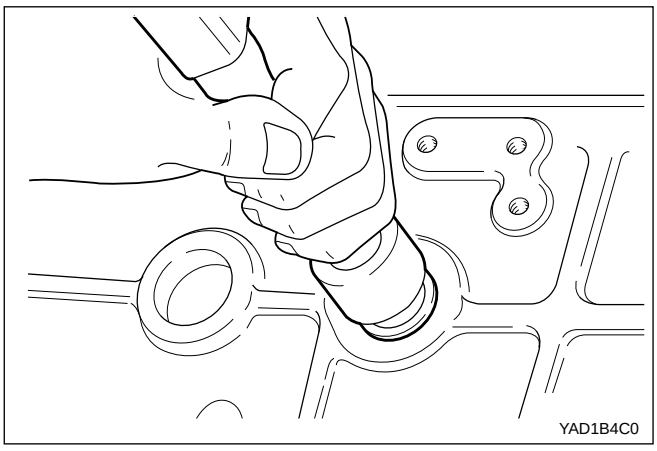
1. Remove the intake and exhaust manifolds.
2. Pull back the core plug until the end of one side comes out using the screw driver.


YAD1B4A0

3. Pull out the plug carefully using a pliers.


YAD1B4B0

4. Clean the sealing surface and apply Loctite 241.

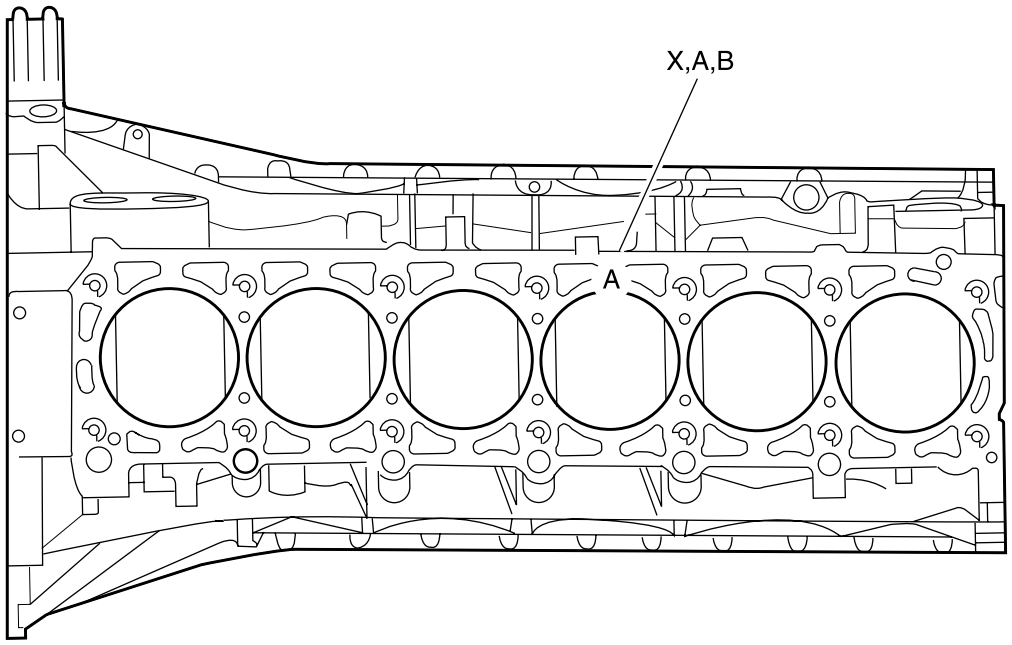

YAD1B4C0

5. Press in new plug using a drift 102 589 00 15 00.

   Notice: Wait for about 45 minutes before filling the coolant so that the Loctite hardens.

6. Warm up the engine and check the coolant for leaks.

CYLINDER BORE



YAD1B4D0

Group Code Letter and Cylinder Bore Size

Group Code Letter of Cylinder	Piston Type to be Used	Cylinder Bore Size (mm)
A	A or X	ϕ89.900 - ϕ90.906
X	A, X or B	ϕ89.906 - ϕ89.912
B	X or B	ϕ89.912 - ϕ89.918
X + 5	X + 5	ϕ89.950 - ϕ89.968
X + 10	X + 10	ϕ90.000 - ϕ90.018

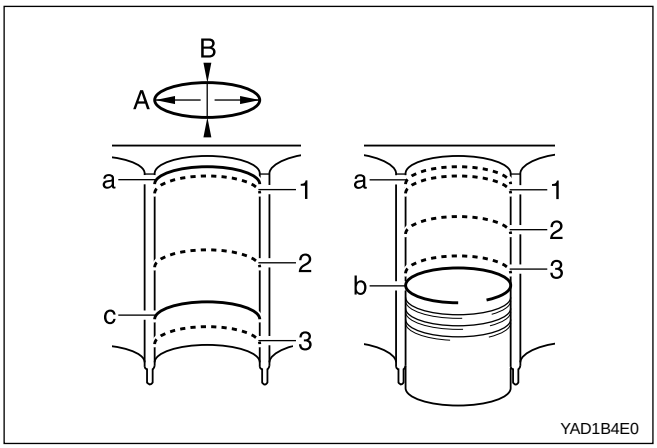
Repair Size

Type	Group Code Letter[1)]	Cylinder Bore Size (mm)
Standard Size ϕ89.9	A	ϕ89.900 - ϕ90.906
	X	ϕ89.906 - ϕ89.912
	B	ϕ89.912 - ϕ89.918
1st Repair Size (Standard Size + 0.25)	A	ϕ90.150 - ϕ90.156
	X	ϕ89.156 - ϕ90.162
	B	ϕ90.162 - ϕ90.168
2nd Repair Size (Standard Size + 0.5)	A	ϕ90.400 - ϕ90.406
	X	ϕ90.406 - ϕ90.412
	B	ϕ90.412 - ϕ90.418

1) The group code letters are carved on the surface of the piston crown and in the mating surface of the crankcase.

Service Data Standard

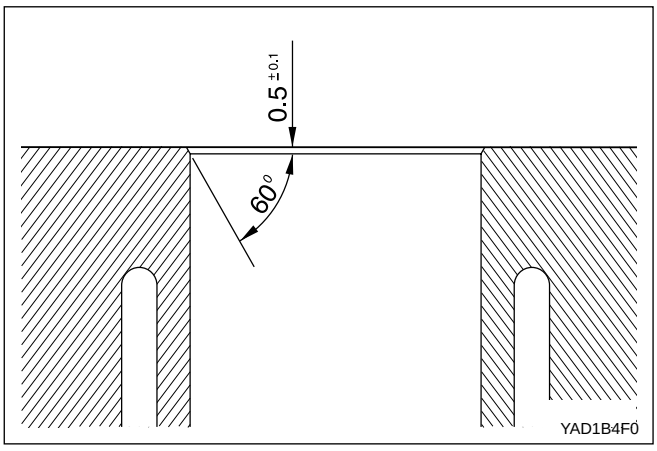
Wear Limit in Longitudinal and Transverse Direction		0.1 mm
Permissible Deviation of Cylinder Out-of-round	When new	0.007 mm
	Wear limit	0.05 mm
Permissible Deviation of Rectangular Cylinder Height (Except Chamfered Area)		0.05 mm
Basic Peak-to-valley Height After Final Honing and Brushing		0.003 - 0.006 mm
Chamfer Angle		60°
Honing Angle		50° ± 10°



1,2,3. Measuring Points
A. Axial Direction
B. Transverse Direction
a. Location of the No.1 Piston Ring at TDC
b. Location of the Piston BDC
c. Location of the Oil Ring at BDC

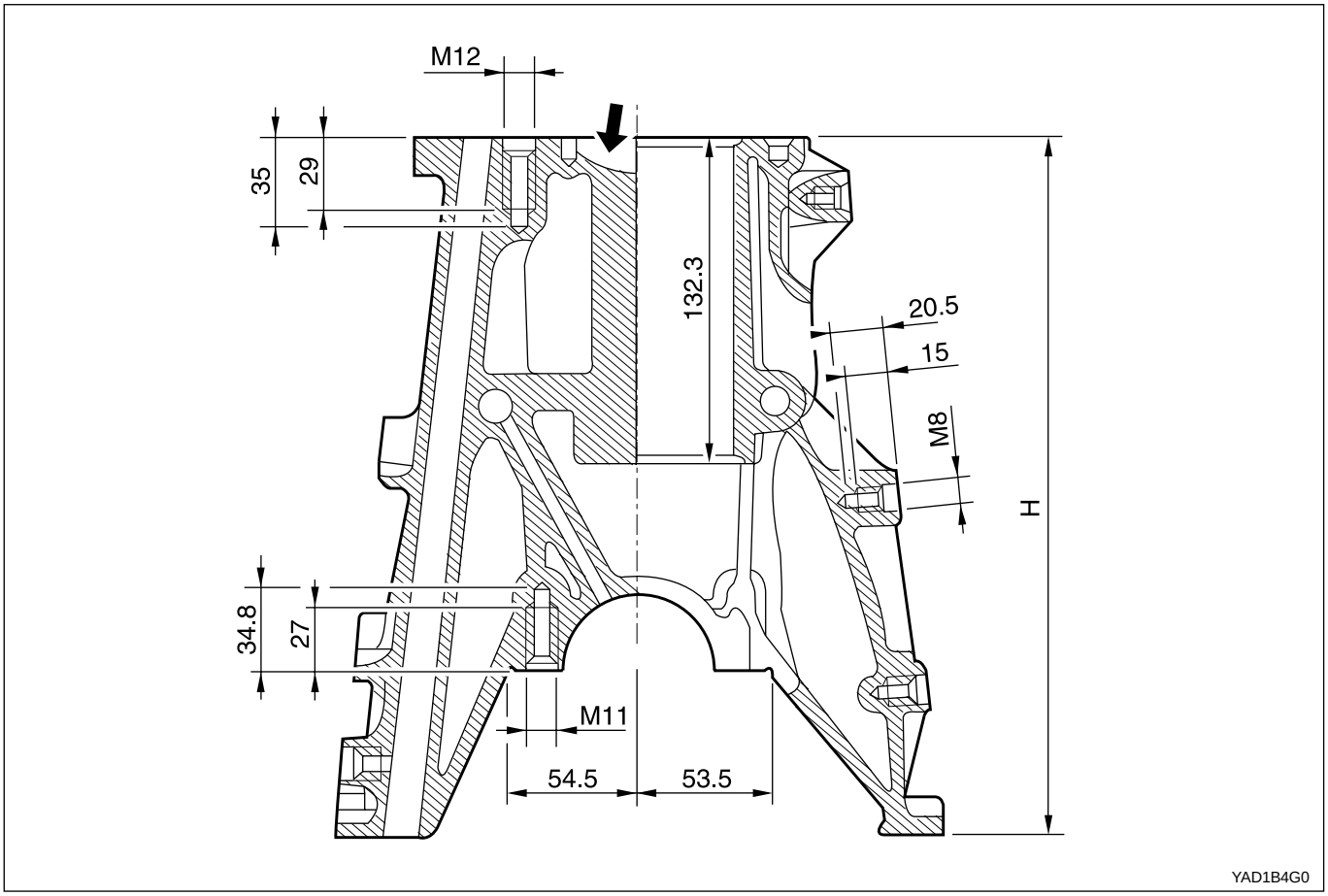
Measurement of Cylinder Bore

1. Clean the cylinder wall.
2. Using a internal diameter gauge, measure the bore size in axial and transverse direction at three points (1, 2, 3).



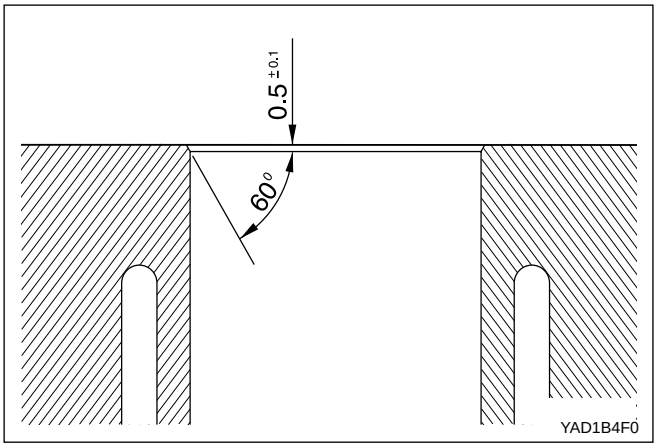
Chamfer Angle

CRANKCASE MATING SURFACE



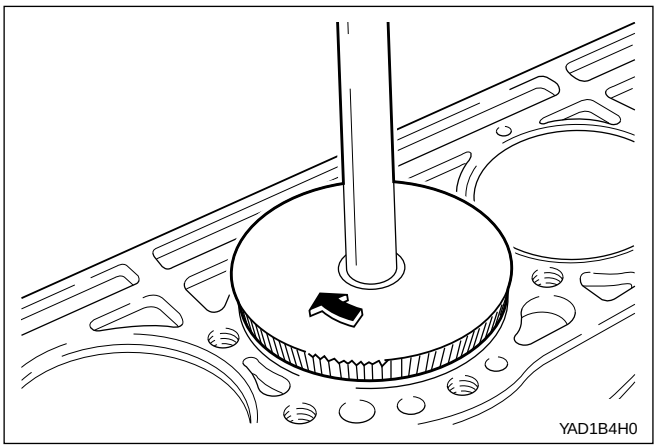
Service Data Standard

Height of The Crankcase “H” (When new)		282.25 - 282.35 mm
Minimum Height After Milling		281.95 mm
Flatness	Crankcase Upper Mating Surface	0.03 mm
	Crankcase Lower Mating Surface	0.04 mm
Permissible Deviation of Parallelism of The Upper to Lower Mating Surface	Axial Direction	0.1 mm
	Transverse Direction	0.05 mm
Peak-to-valley Height	Crankcase Upper Mating Surface	0.005 - 0.020 mm
	Crankcase Lower Mating Surface	0.025 mm



Chamfering Procedure

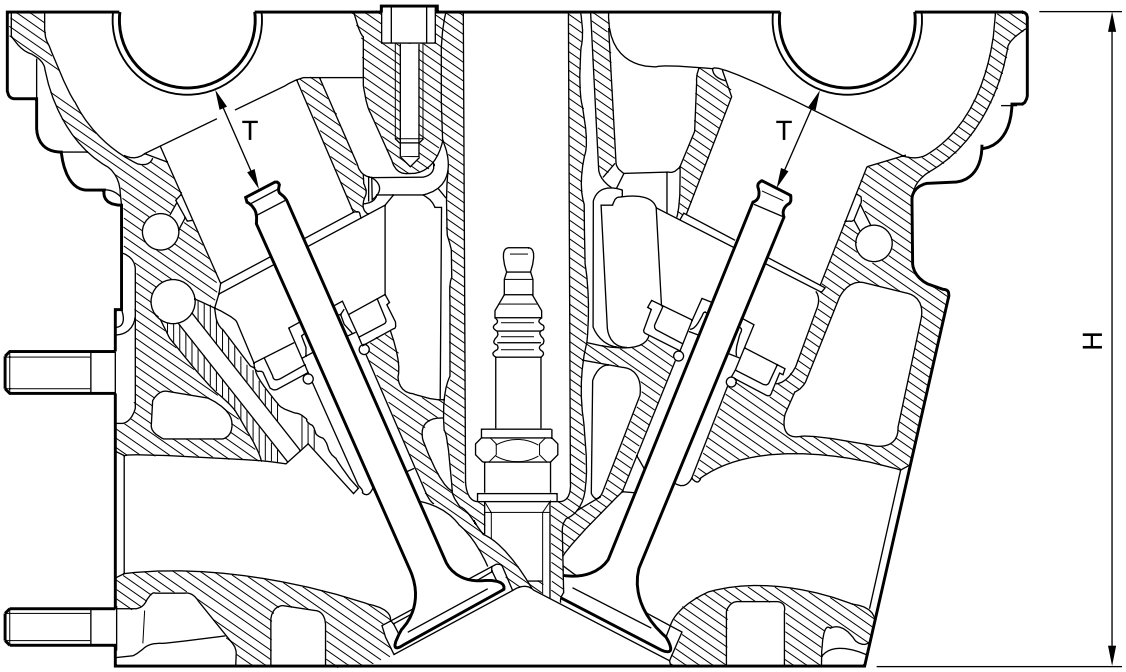
1. Chamfer angle : 60°



2. Polish the lower chamfered area evenly with a grinder after finishing the chamfering with a suitable tool (e.g., hand milling cutter).

CYLINDER HEAD MATING SURFACE

Preceding Work : Removal of valves



YAD1B4J0

Service Data Standard

Overall Height of Cylinder Head			135.9 - 136.0 mm
Minimum Height After Machining			135.5 mm
Flatness	Axial Direction		0.08 mm
	Transverse Direction		0.0 mm
Distance 'T' (Between Camshaft Bearing and Valve Stem)	Standard Size	Intake	24.21 - 24.75 mm
		Exhaust	22.21 - 22.75 mm
	Repair Size	Intake	23.96 - 24.51 mm
		Exhaust	21.96 - 22.51 mm

Notice: Do not exceed 0.4mm for the milling of the mating surface of crankcase and cylinder head.

Measurement of Mating Surface

1. Measure the height (H) of the cylinder head (refer to *Service data standard*).
2. Check the mating surface of the cylinder head.
3. Mill the sharp edge of the combustion chamber.
4. Re-measure the height (H) of the cylinder head.
5. Seal the intake and exhaust valves.
6. Measure the dimension (T) between the camshaft bearing and the valve system (refer to *Service data standard*).
7. Mill the cylinder head valve seat (refer to *Service data standard*).

Universal Tool

Surface Grinding Machine	Sceledum, Type RTY Roaro Schio/Italy

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

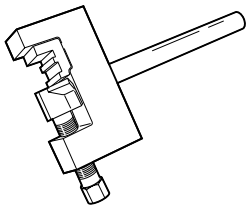
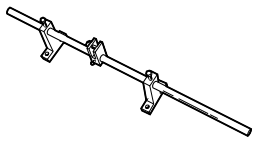
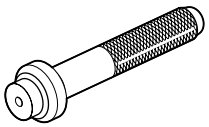
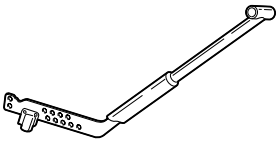
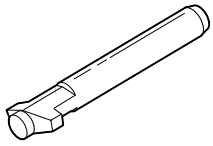
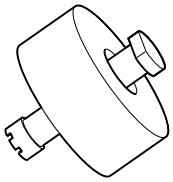
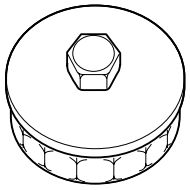
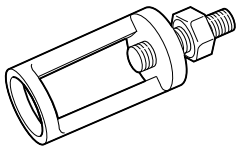
Application		N•m	Lb-Ft	Lb-In
A/C Bracket Bolt		22.5 - 27.5	16.6 - 20.3	-
Armature Bolt in Camshaft Actuator		35	26	-
Belt Tensioning Pulley Nut		40.5 - 49.5	29.9 - 36.5	-
Camshaft Actuator Bolt		9 - 11	-	80 - 97
Camshaft Adjuster Mounting Nut		60 - 70	44 - 52	-
Camshaft Bearing Cap Bolt		22.5 - 27.5	16.6 - 20.3	-
Chain Tensioner Assembly		72 - 88	53 - 65	-
Chain Tensioner Screw Plug		40	30	-
Connecting Rod Bearing Cap Bolt		40 + 5 90° + 10°	30 + 3.7 90° + 10°	-
Cooling Fan Bracket Bolt		22.5 - 27.5	16.6 - 20.3	-
Crankshaft Bearing Cap Bolt		50 - 60 90° + 5°	37 - 44 90° + 5°	-
Crankshaft Sealing Rear Cover Mounting Bolt		9 - 11	-	80 - 97
Cylinder Block Drain Plug		30	22	-
Cylinder Head Bolt		55 + 90° + 90°	41 + 90° + 90°	-
Cylinder Head Cover Bolt		9 - 11	-	80 - 97
Cylinder Head Front Cover Bolt		22.5 - 27.5	16.6 - 20.3	-
Engine Mounting Bracket Nut		70	52	-
Exhaust Camshaft Sprocker Bolt		18 - 22 90° ± 5°	13 - 16 90° ± 5°	-
Exhaust Manifold and Pipe		30	22	-
Flywheel Mounting Bolt		45 + 5 90° + 10°	33 + 3.7 90° + 10°	-
Fuel Feed and Return Hose to Fuel Rail		21 - 25	15 - 18	-
Generator Carrier Bolt		25	18	-
Intake Air Duct Nut		9 - 11	-	80 - 97
Intake Flange Shaft Bolt		18 - 22 90° ± 5°	13 - 16 90° ± 5°	-
Lower Engine Mounting Nut		38	28	-
Oil Dipstick Guide Tube Bolt		9 - 11	-	80 - 97
Oil Drain Plug		22.5 - 27.5	16.6 - 20.3	-
Oil Filter Bolt		22.5 - 27.5	16.6 - 20.3	-
Oil Filter Cover		25	18	-
Oil Gallery Screw Plug in Cylinder Head		15	11	-
Oil Pan Bolt	M10	40	30	-
	M8	22.5 - 27.5	16.6 - 20.3	-
	M6	9 - 11	-	80 -97

FASTENER TIGHTENING SPECIFICATIONS (Cont'd)

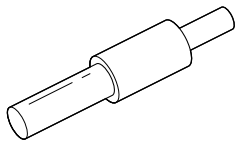
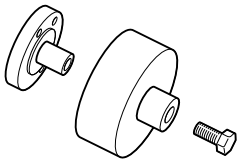
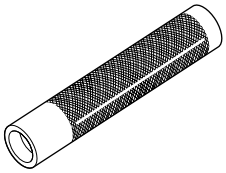
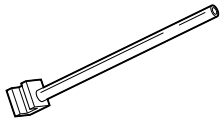
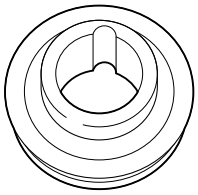
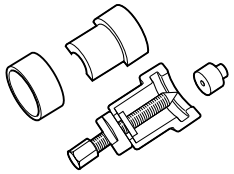
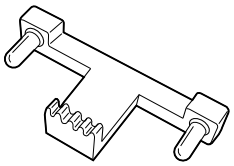
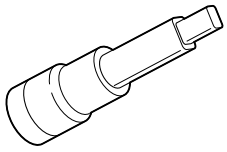
Application		N•m	Lb-Ft	Lb-In
Oil Pressure Relief Valve Screw Plug		50	37	-
Oil Pump Drive Sprocket Bolt		29 - 35	21 - 26	-
Oil Pump Mounting Bolt		22.5 - 27.5	16.6 - 20.3	-
Oil Pump Sprocket Bolt		29 - 35	21 - 26	-
Spark Plug Cover Bolt		9 - 11	-	80 - 97
Steering Pump Bolt		22.5 - 27.5	16.6 - 20.3	-
Tensioning Device Bolt		26 - 32	19 - 24	-
Timing Gear Case Cover Bolt	M8	22.5 - 27.5	16.6 - 20.3	-
	M6	9 - 11	-	80 - 97
Torque Converter Mounting Bolt		42	31	-
Transmission Mounting Nut		54 - 68	40 - 50	-
Under Cover		28 - 47	21 - 35	-
Upper Engine Mounting Nut		70	52	-
Vibration Damper Center Bolt		180 - 220 90° + 10°	133 - 162 90° + 10°	-
Water Pump Pulley Bolt		22.5 - 27.5	16.6 - 20.3	-

SPECIAL TOOLS AND EQUIPMENT

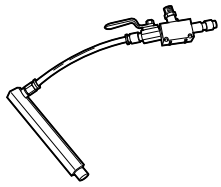
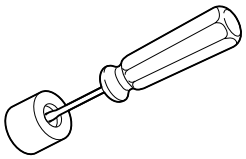
SPECIAL TOOLS TABLE

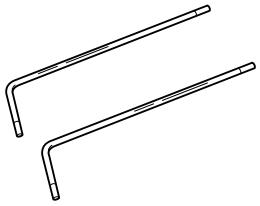
 YAD1B1W0	**000 589 58 43 00** **Chain Assembly**
 YAD1B0W0	**111 589 01 59 00** **Supporting Bar**
 YAD1B3Y0	**102 589 00 15 00** **Drift**
 YAD1B0X0	**111 589 18 61 00** **Lever Pusher**
 YAD1B3P0	**102 589 12 15 00** **Drift**
 YAD1B580	**111 589 20 33 00** **Sliding Hammer**
 YAD1B2Y0	**103 589 02 09 00** **Oil Filter Remover**
 YAD1B0Y0	**111 589 25 63 00** **Thrust Piece**

SPECIAL TOOLS TABLE (Cont'd)

 YAD1B570	**116 589 01 34 00** **Threaded Pin**	 YAD1B730	**601 589 03 43 00** **Crankshaft Rear Seal Installer**
 YAD1B1L0	**119 589 00 43 00** **Drift**	 YAD1B4K0	**603 589 00 40 00** **Fan Clutch Holder**
 YAD1B790	**601 589 03 14 00** **Crankshaft Front Seal Installer**	 YAD1B2M0	**615 589 01 33 00** **Crankshaft Sprocket Puller**
 YAD1B720	**602 589 00 40 00** **Engine Lock**	 YAD1B560	**617 589 00 10 00** **AllenWrench Socket**

SPECIAL TOOLS TABLE (Cont'd)

 YAD1B0Z0	**DW110-090** **Connecting Hose**
 YAD1B1A0	**DW110-100** **Valve Tappet Remover**

 YAD1B0K0	**DW110-120** **Holding Pin**

SECTION 1B2

M161 ENGINE MECHANICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless other-wise noted.

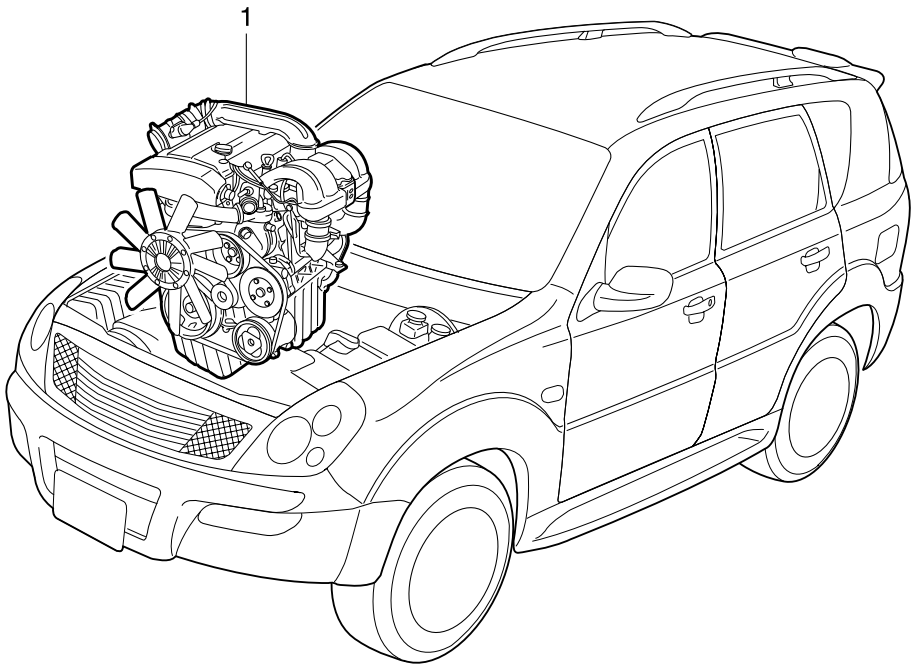
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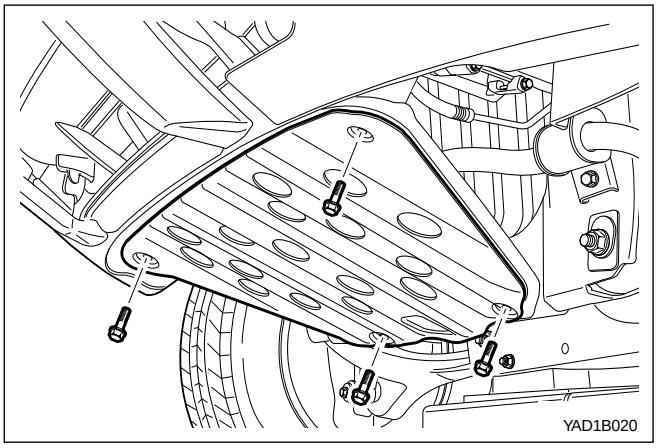
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

ENGINE ASSEMBLY



YAD1B4S0

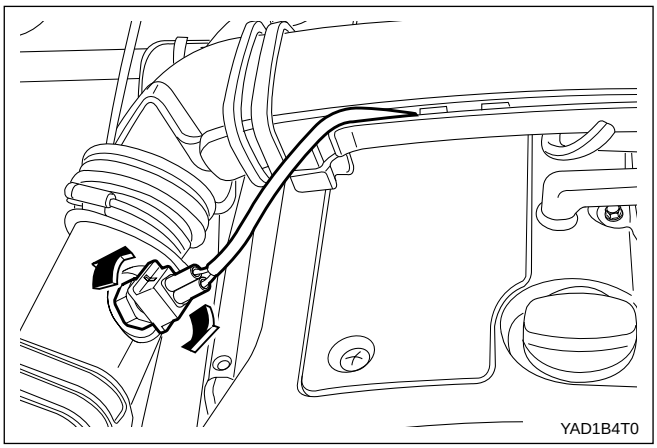


Removal & Installation Procedure

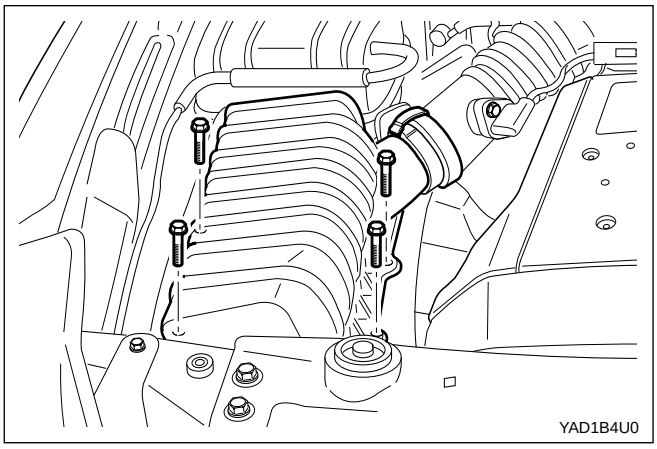
1. Disconnect the negative terminal of battery.
2. Remove the hood.
3. Remove the under cover.

Installation Notice

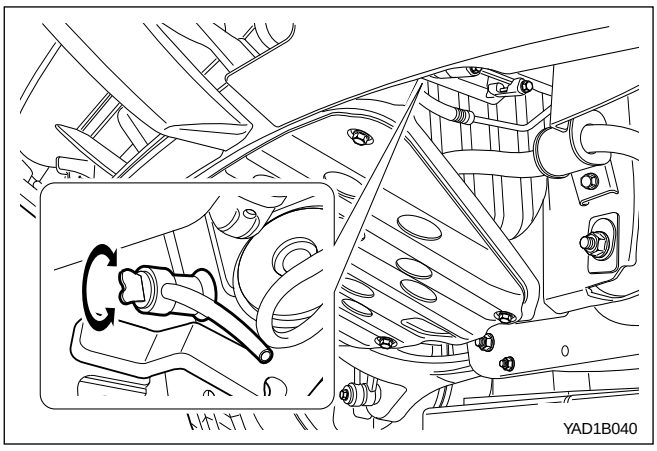
Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)



4. Disconnect the coupling of HFM sensor and remove the air cleaner cross pipe.

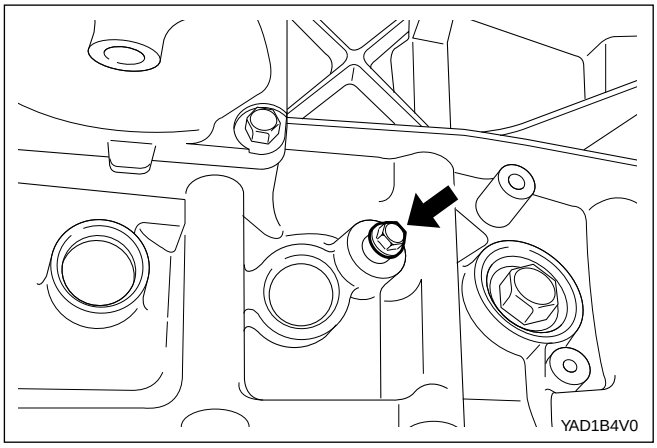


5. Remove the air cleaner cover. Remove the mounting bolts and air cleaner housing and element assembly.



6. Loosen the radiator drain cock and drain the coolant.

   Notice: Open the coolant reservoir cap.

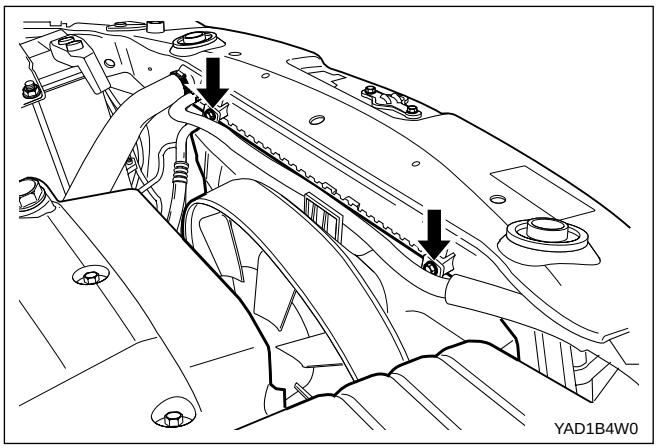


7. Loosen the cylinder block drain plug and then drain the coolant completely.

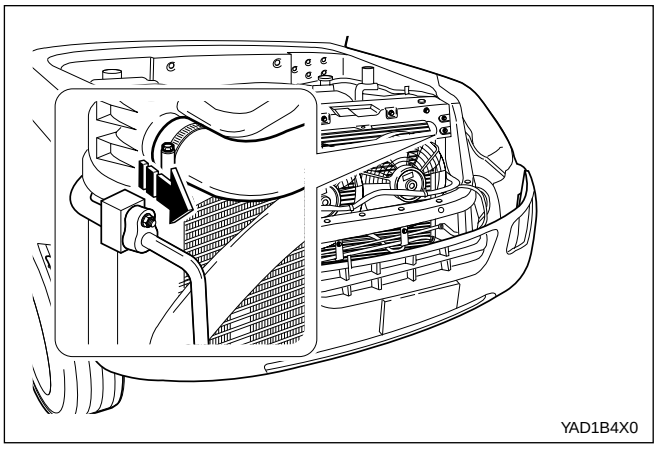
Installation Notice

Tightening Torque	5 N•m (26 lb-ft)

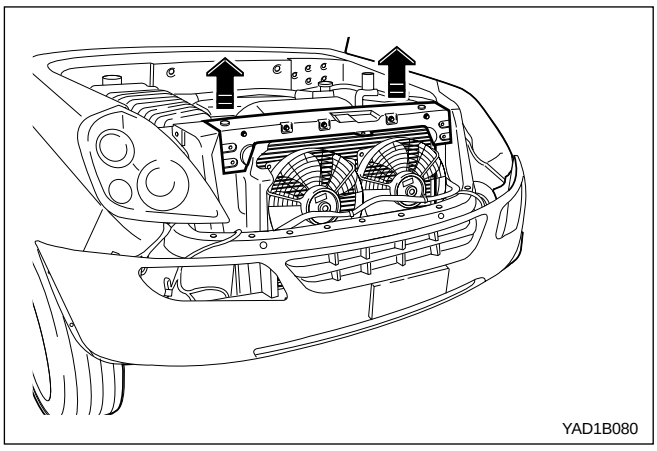
Notice: Replace the seal before installation of the drain plug.



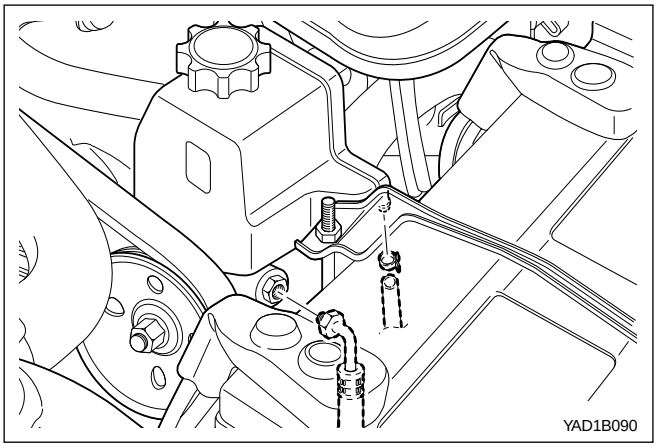
8. Remove the cooling fan shroud. Refer to *Section 1D2, Engine Cooling.*



9. Disconnect the each hose from radiator.

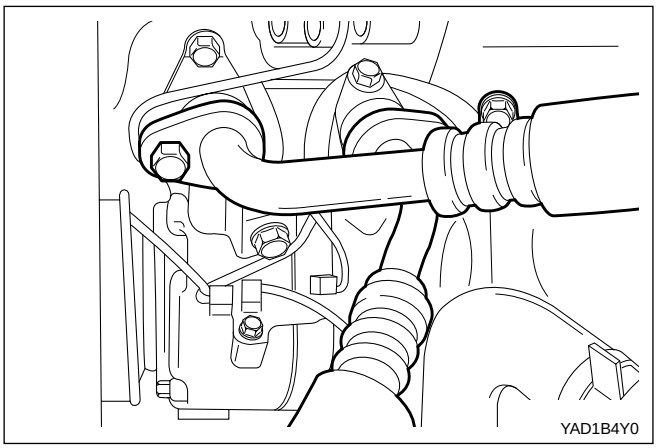


10. Remove the upper mounting bolts of radiator and then remove the radiator.

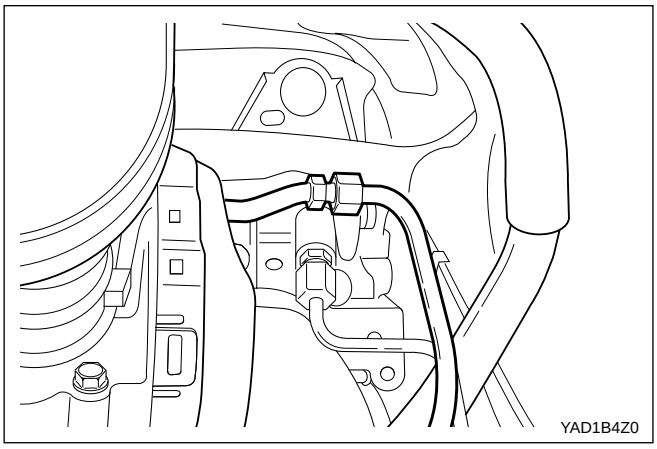


11. Remove the hydraulic pipe of power steering.

    Notice: Completely drain the oil.



12. Discharge the refrigerant from A/C system, and disconnect the discharge pipe and suction pipe from the compressor.

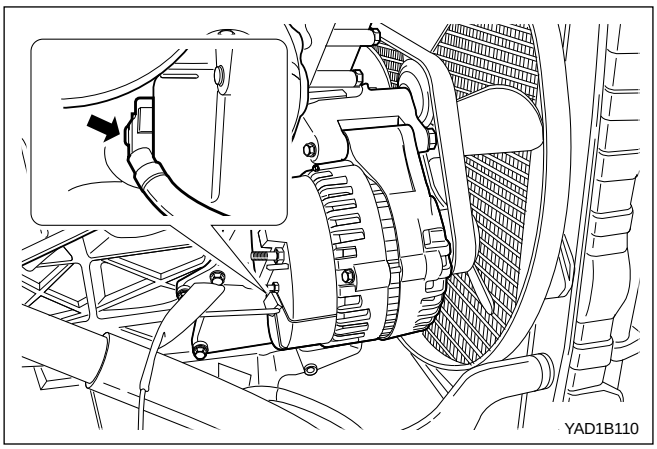


13. Remove the fuel feed and return line.

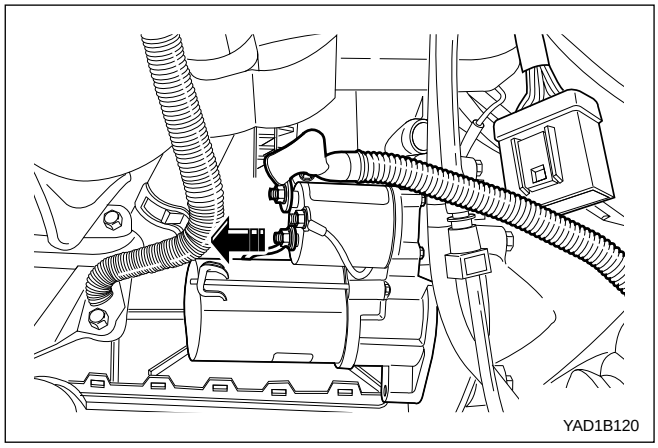
    Notice: Before removing the fuel lines, release the pressure in the fuel system.

    Installation Notice

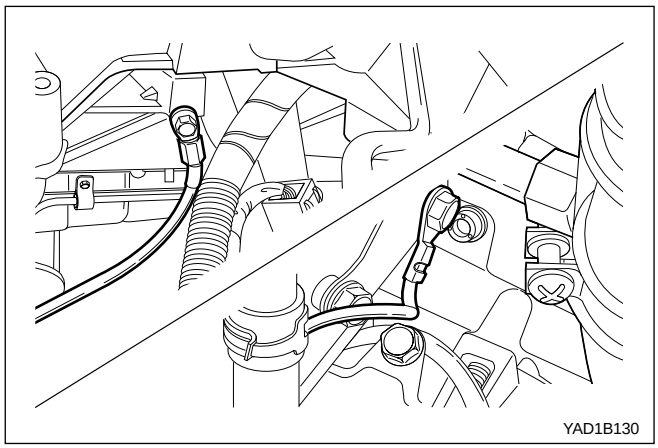
Tightening Torque	21 - 25 N•m (15 - 18 lb-ft)



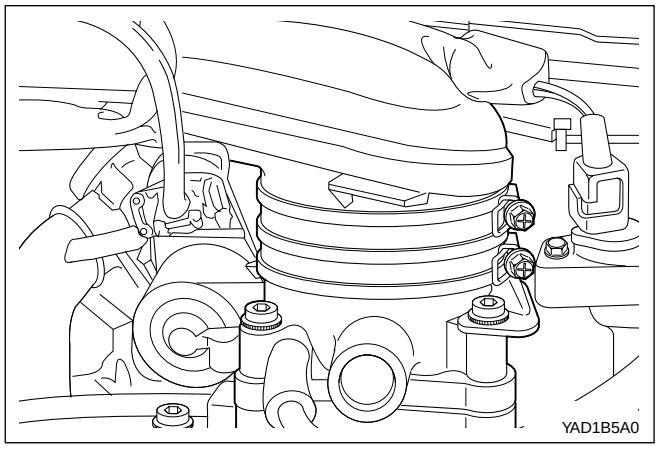
14. Disconnect the terminals from the generator.


YAD1B120

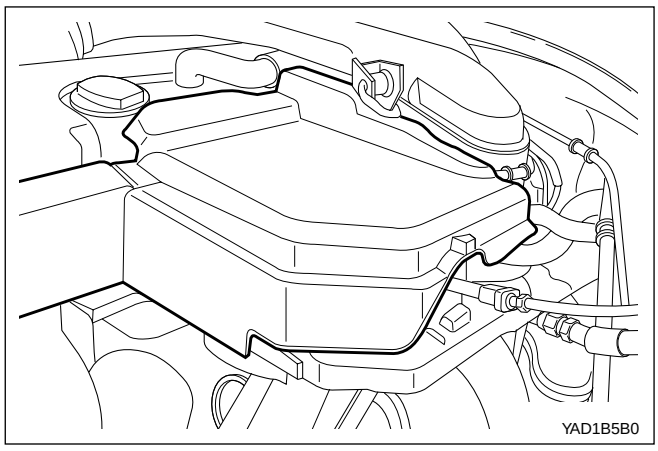
15. Disconnect the terminals from starter motor and remove the starter motor.
16. Disconnect the engine main harness ground.


YAD1B130

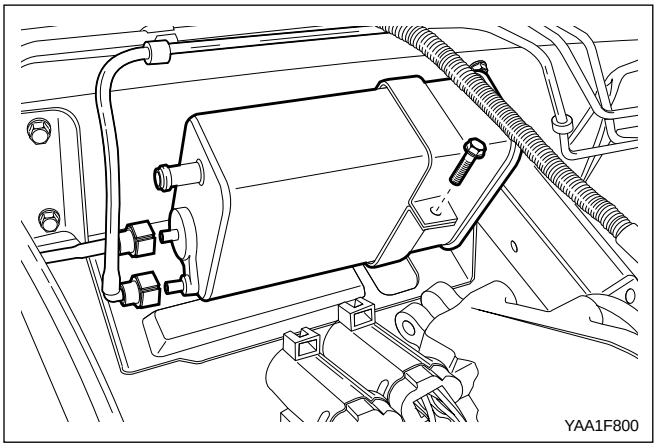
17. Disconnect the engine ground wire.


YAD1B5A0

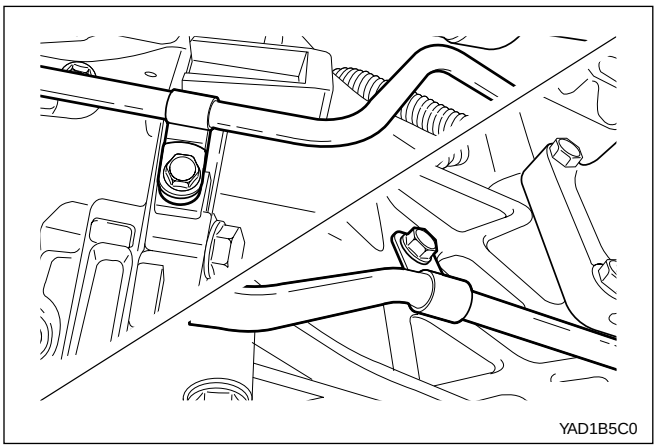
18. Disconnect following sensors connector.
    - HFM sensor.
    - Coolant temperature sensor.
    - Knock sensor.
    - Camshaft and crankshaft sensors.


YAD1B5B0

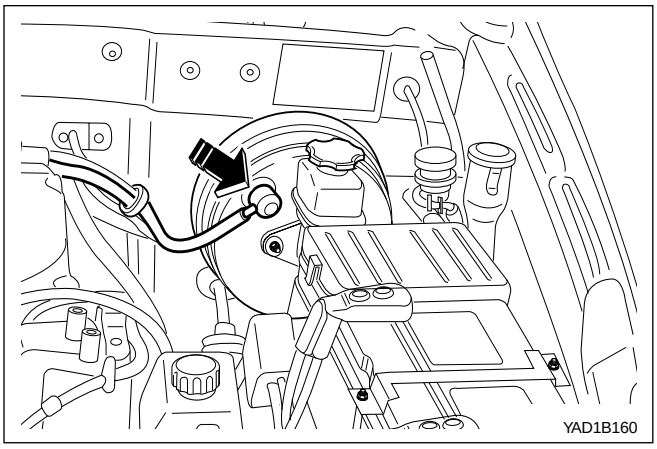
19. After removing the ignition coil cover, disconnect the ignition coil connector.
20. Remove the harness cover and disconnect the 4 injection valve connectors. Disconnect the main harness.



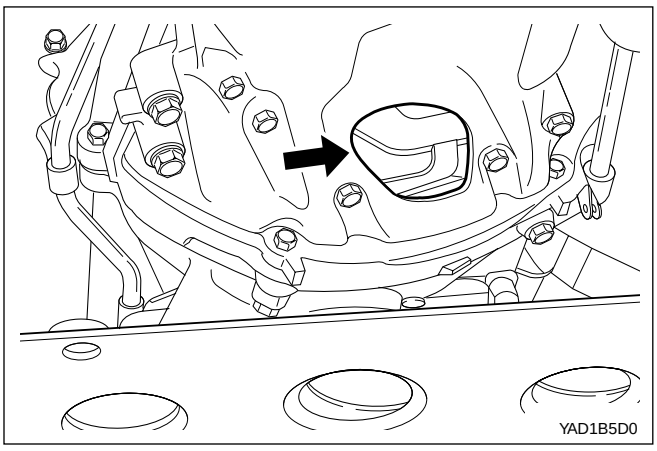
21. Separate the hose toward engine from canister purge solenoid valve and canister. Refer to *Section 1F2, Engine Control.*



22. Remove the automatic transmission oil cooler line retaining bolts from the automatic transmission side and oil pan side.
23. Remove the automatic transmission oil cooler line retaining bolts from engine side and oil pan side.



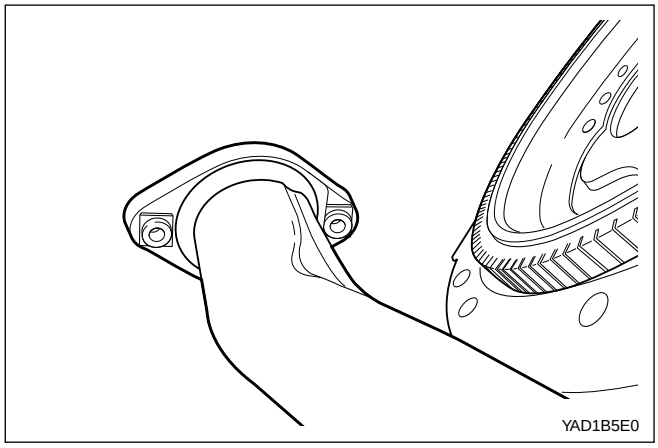
24. Separate the vacuum hose for brake booster.
25. Separate the other vacuum hoses.



26. By rotating the crankshaft from the front of engine, remove the 6 torque converter mounting bolts from the engine ring gear plate.

Installation Notice

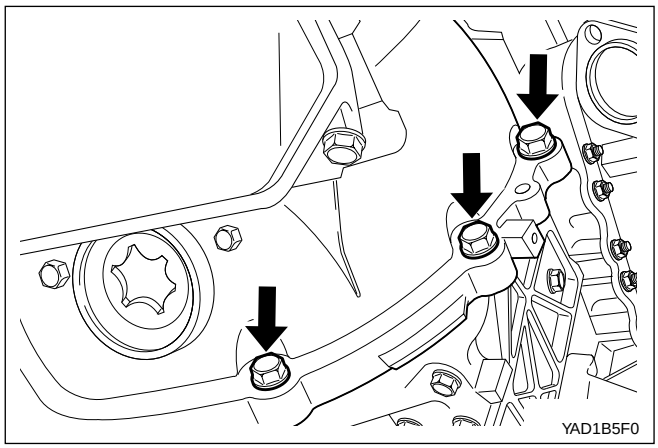
Tightening Torque	42 N•m (31 lb-ft)



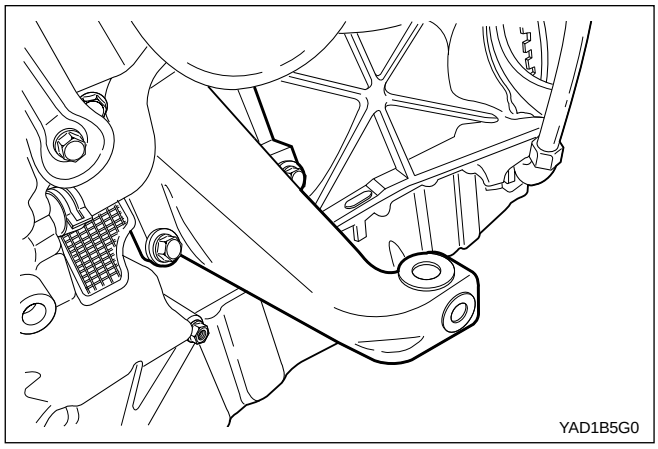
27. Remove the exhaust manifold and exhaust pipe.

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)



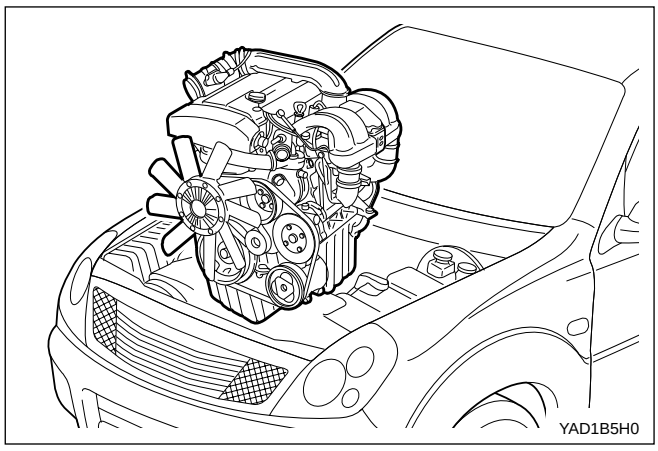
28. Remove the transmission. Refer to Section 5A, Automatic Transmission.



29. Install a chain to the bracket of engine, by using a hoist or crane.
30. Remove the engine mount nuts.

Installation Notice

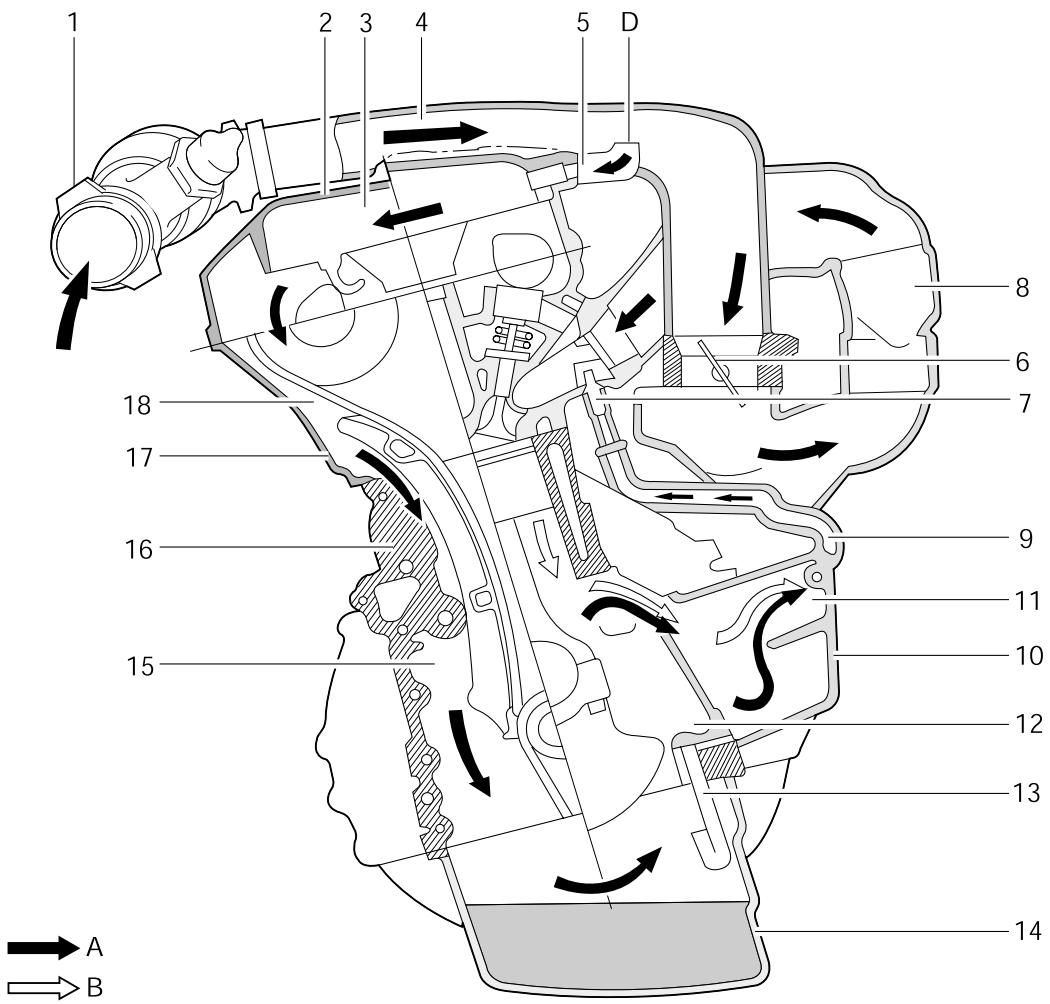
Tightening Torque	70 N•m (52 lb-ft)



31. Carefully separate the engine assembly from the vehicle.
32. Installation should follow the removal procedure in the reverse order.

CRANKCASE VENTILATION SYSTEM

Operation at Idling and Mid- Load



1 HFM Sensor
2 Cylinder Head Cover
3 Oil Spearation Chamber (Full-Load or Over Mid-Load)
4 Intake Air Duct (Cross Pipe)
5 Vent Line (Full-Load or Over Mid-Load)
6 Throttle Valve
7 Restrictor, Diameter 1.1mm (Mid-Load at Idling)
8 Intake Manifold
9 Vent Line (Mid-Load at Idling)
10 Air Conditioner Bracket
11 Oil Separation Chamber (Mid-Load at Idling)
12 Crank Chamber
13 Oil Return Pipe
14 Oil Pan
15 Timing Gear Case Cover
16 Crankcase
17 Chain Housing

A Fresh Air
B Blow-By Gas
D Vent Connection

Operation at Idling and Mid- Load

- The throttle valve (6) is closed or very partially opened, and the vacuum pressure in intake manifold is high.

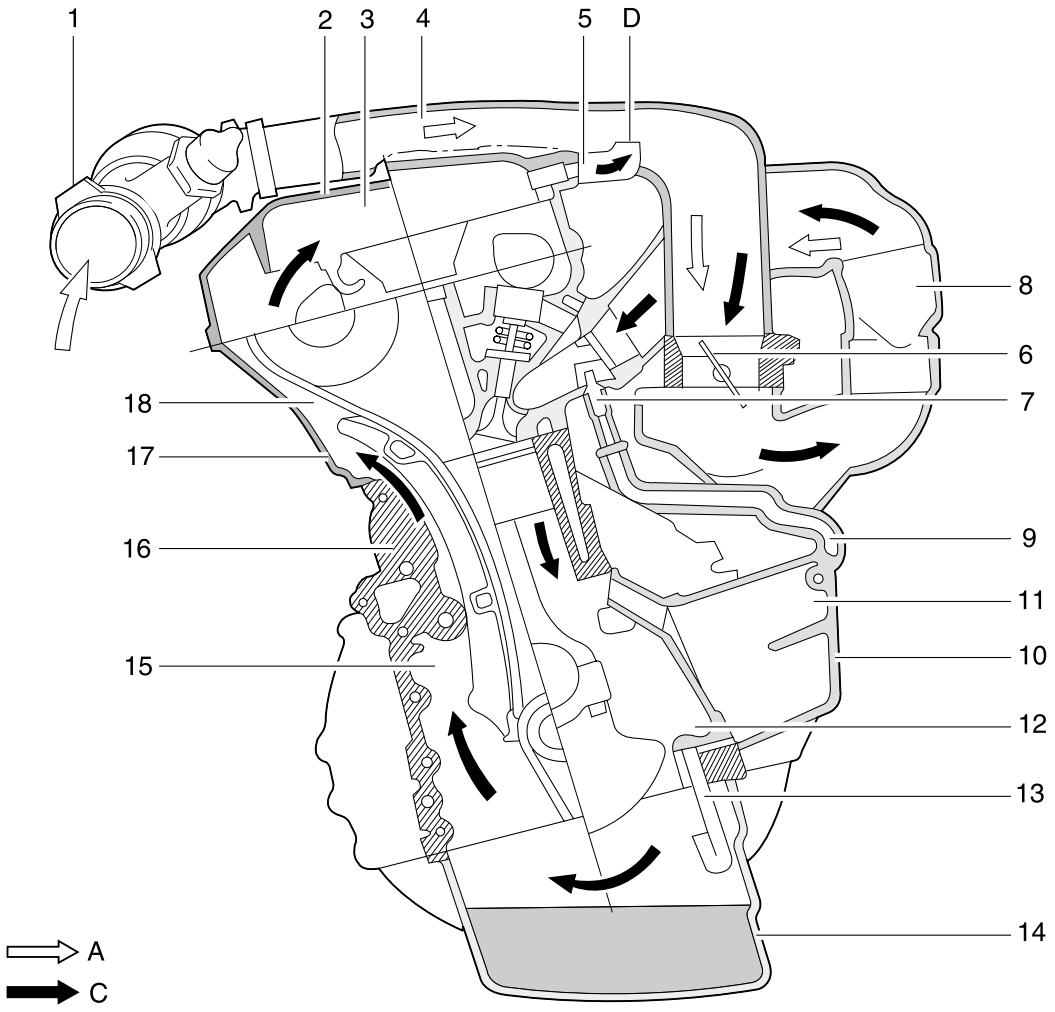
  The blow-by gas and the fresh air that is additionally supplied through the vent connection (D) in the crank-case in partial load gets supplied to the combustion chamber from the crank chamber (12) through the oil separation chamber (11), air-conditioner bracket (10), vent line (9), and restrictor (7) mounted to the cylinder head.

  The circulated engine oil returns to the oil pan through the oil return pipe (13) at the bottom of oil separation chamber (11).

  The fresh air gets supplied to the crank chamber (12) through the HFM sensor (1), intake air duct (4), vent line (5), oil separation chamber (3), chain housing (17), and the timing gear case cover (15).

  The additional supply of the fresh air is needed to prevent from forming the residues of the engine oil.

Operation When Full- Load at Partial Load



1 HFM Sensor
2 Cylinder Head Cover
3 Oil Spearation Chamber (Full-Load or Over Mid-Load)
4 Intake Air Duct (Cross Pipe)
5 Vent Line (Full-Load or Over Mid-Load)
6 Throttle Valve
7 Restrictor, Diameter 1.1mm (Mid-Load at Idling)
8 Intake Manifold
9 Vent Line (Mid-Load at Idling)
10 Air Conditioner Bracket
11 Oil Separation Chamber (Mid-Load at Idling)
12 Crank Chamber
13 Oil Return Pipe
14 Oil Pan
15 Timing Gear Case Cover
16 Crankcase
17 Chain Housing

A Fresh Air
C Blow-By Gas
D Vent Connection

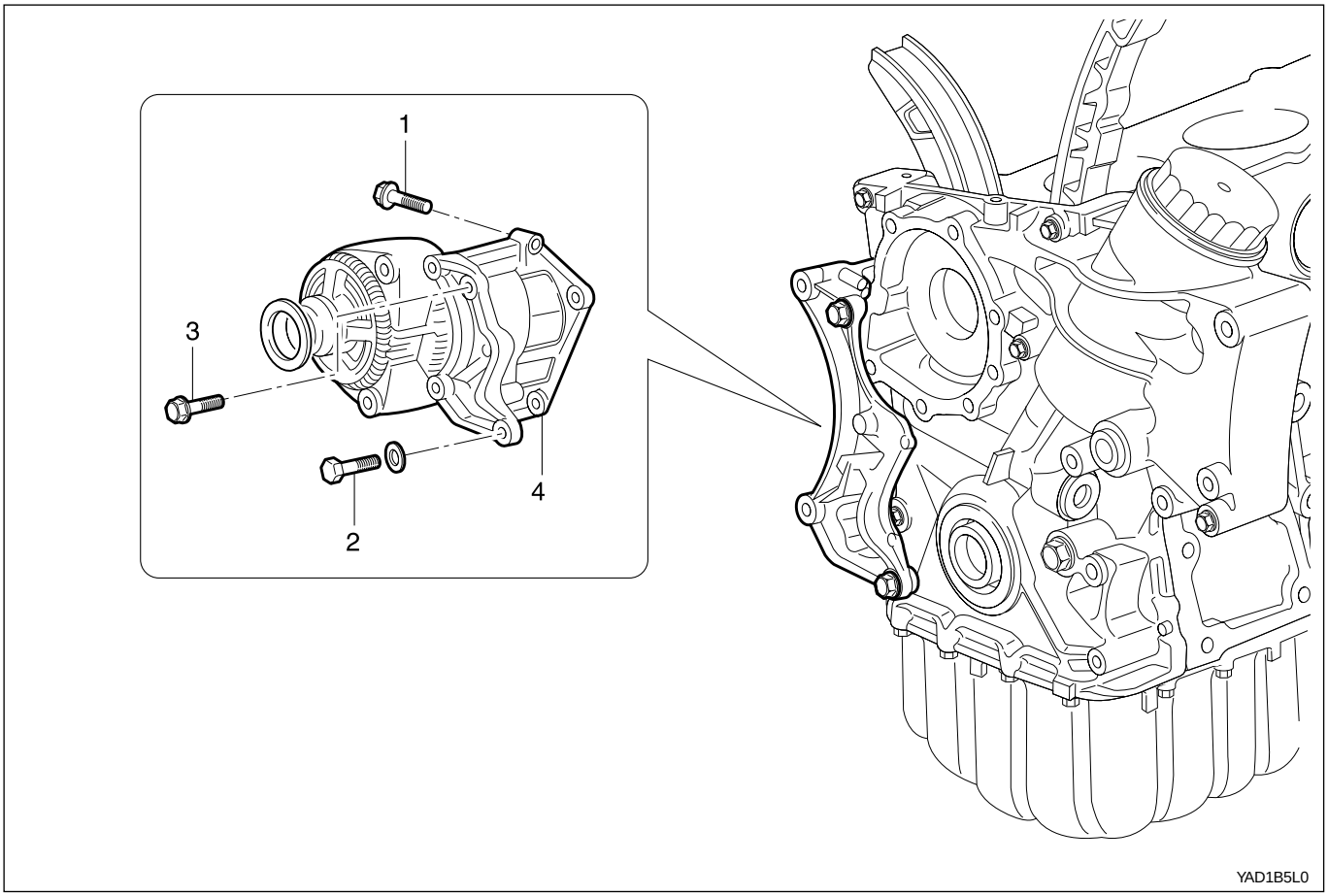
Operation When Full- Load at Partial Load

- The throttle valve (6) is partially opened or fully opened.

  The air flows very rapidly through the vent line (5) s connection (D) and the intake air duct when full load at partial load.

  Consequently, most of the low-by gases are supplied to the combustion chamber through the timing gear case cover (15), chain housing (17), oil separation chamber (3), vent line (5), throttle valve (6), and intake manifold (8).

GENERATOR



1 Bolt (M8 X 40, 3 pieces)
..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
2 Bolt (M8 X 70, 2 pieces)
..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
3 Bolt (M8 X 85, 1 piece)
..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
4 Generator Bracket

Removal & Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the drive belt.
3. Remove the generator.
4. Unscrew the generator carrier bolts and remove the carrier.

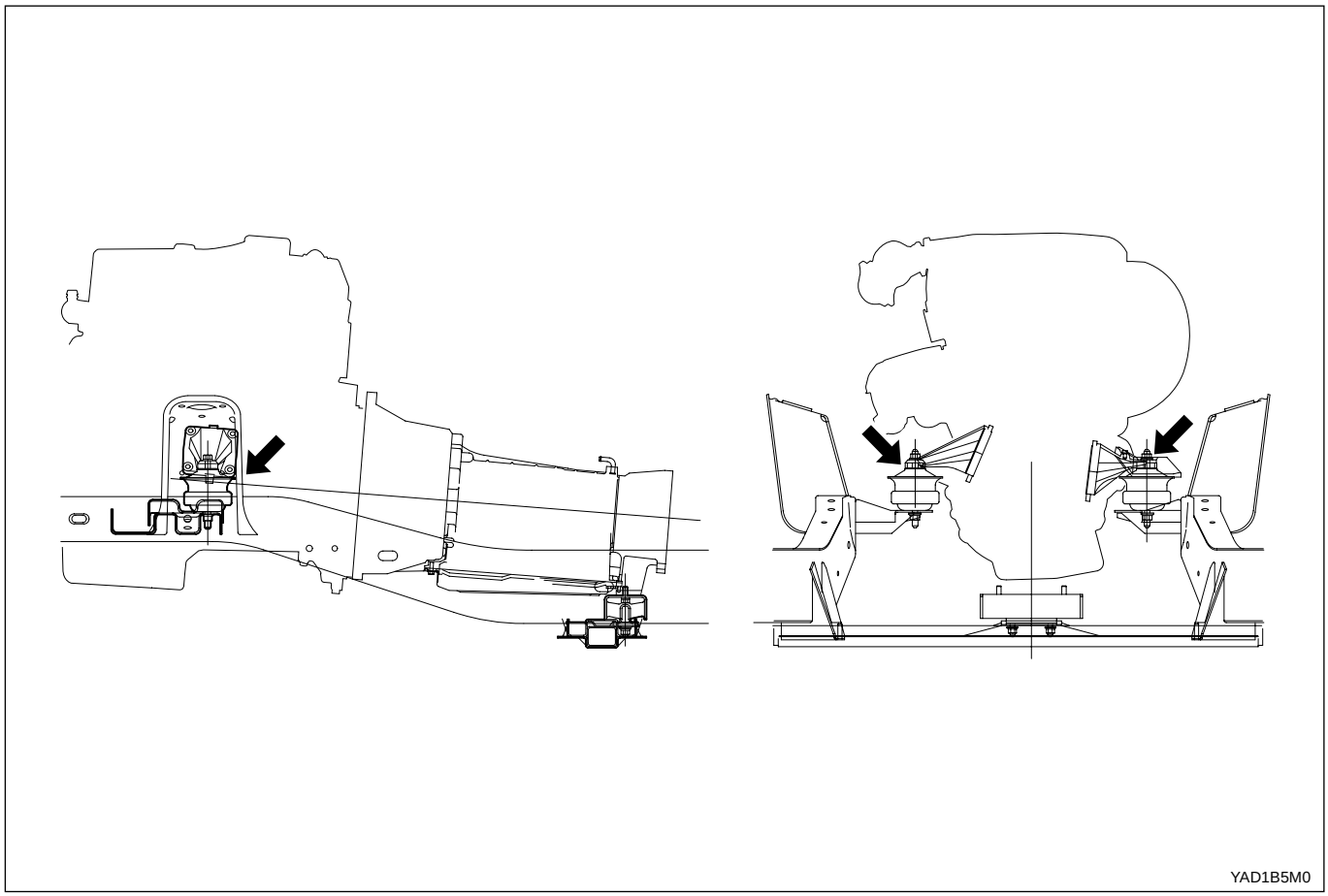
Installation Notice

Tightening Torque	70 N•m (52 lb-ft)

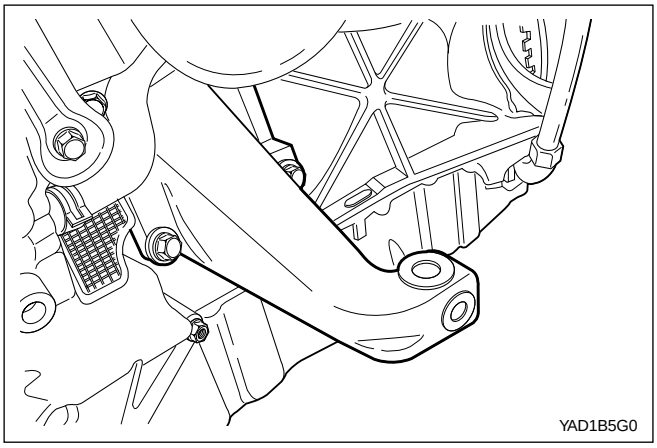
Notice: Apply 3 Nm of torque when mounting the bolt (1) ; apply 25 Nm of torque when mounting the bolts (2), and (3) ; and then tighten the bolt (1) with 25 Nm of torque.

5. Installation should follow the removal procedure in the reverse order.

ENGINE MOUNT



YAD1B5M0

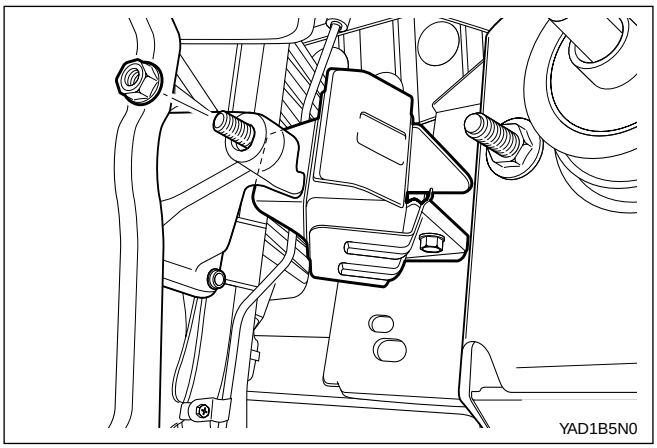

YAD1B5G0

Removal & Installation Procedure

1. Unscrew the upper engine mount nuts and remove the engine.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)


YAD1B5N0

2. Unscrew the lower nuts.

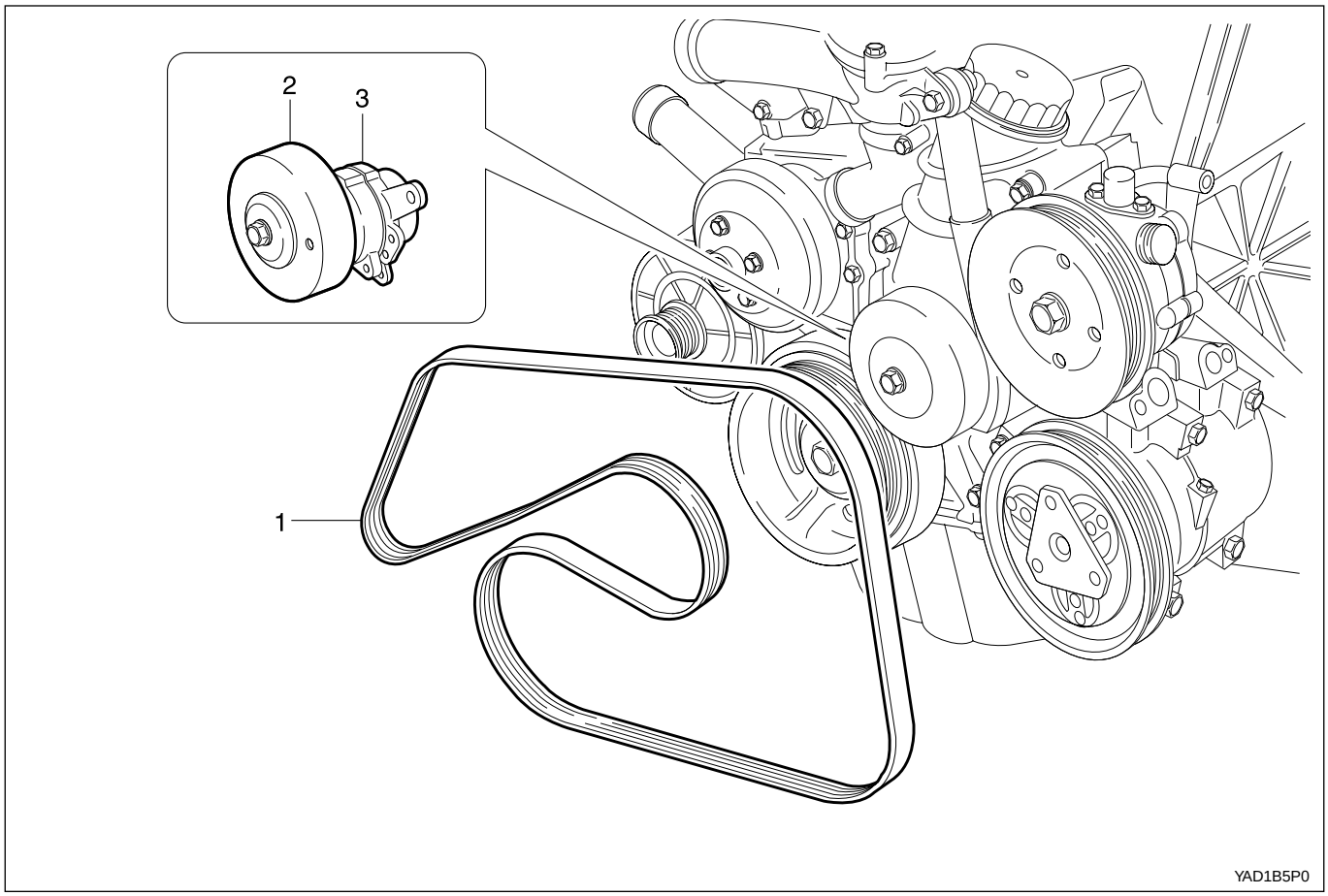
Installation Notice

Tightening Torque	38 N•m (28 lb-ft)

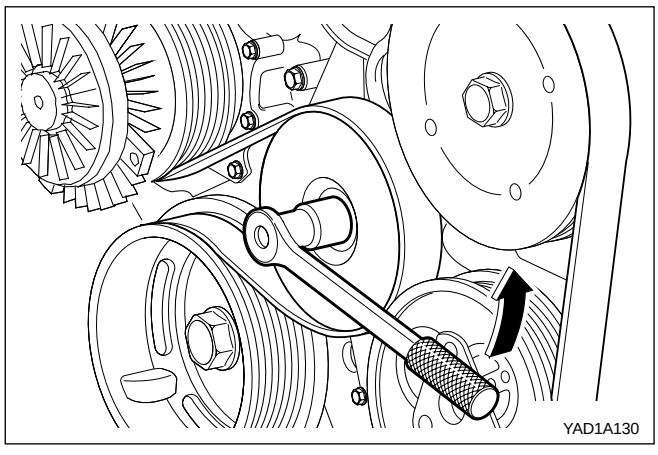
3. Remove the hydraulic engine mounting insulator.
4. Installation should follow the removal procedure in the reverse order.

POLY V - BELT

Preceding Work: Removal of cooling fan



1 Poly V-Belt (2,155 mm)
2 Belt Tensioning Pulley
3 Belt Tensioner



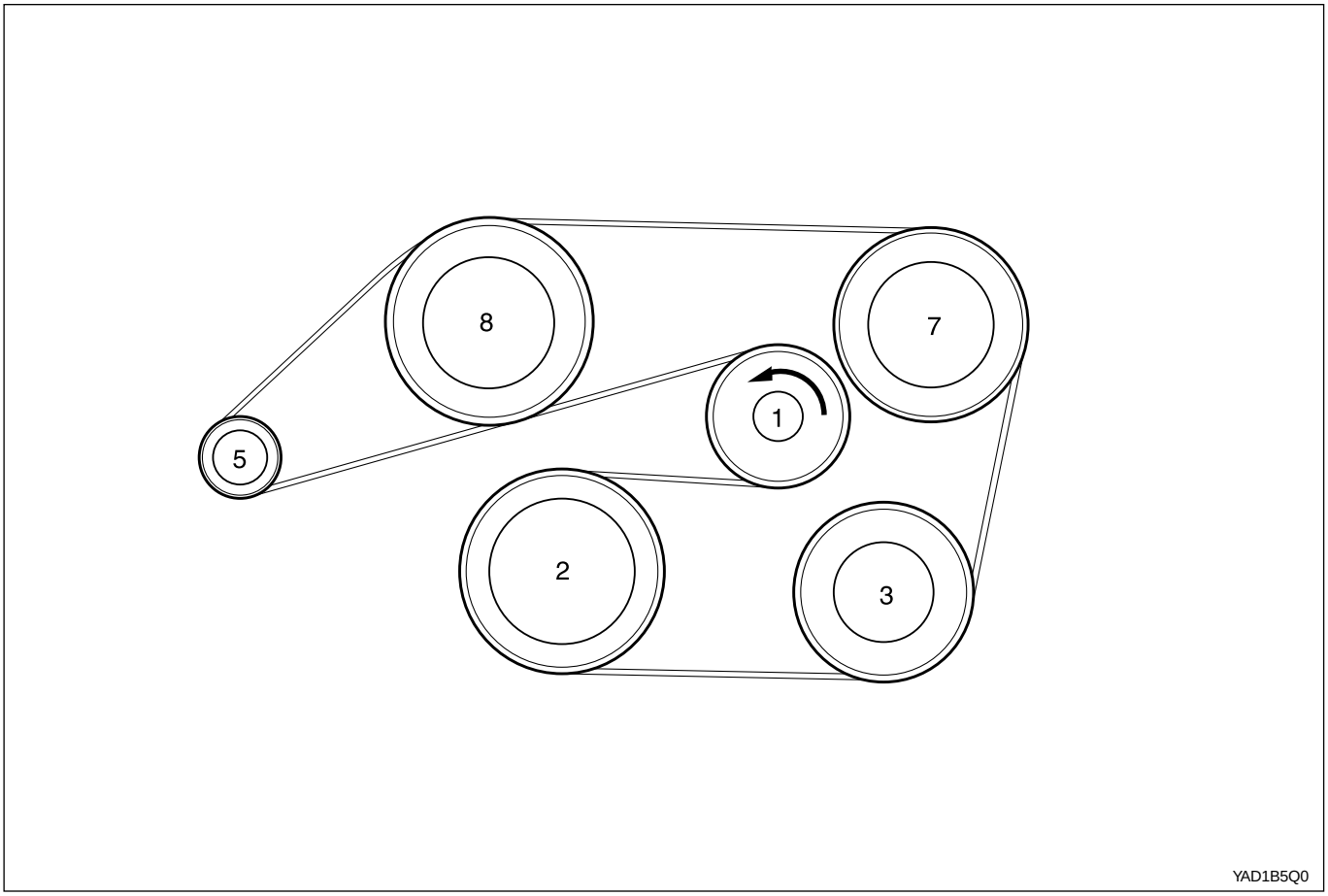
Removal & Installation Procedure

1. Release the belt tension by turning the stud on the cap with 12 sided wrench or spanner counterclock-wise.
2. Remove the poly v-belt.

   Notice: Check the belt for damage and tensioning pulley bearing point for wear and replace them if necessary.

3. Install the belt after prying the tensioning pulley.

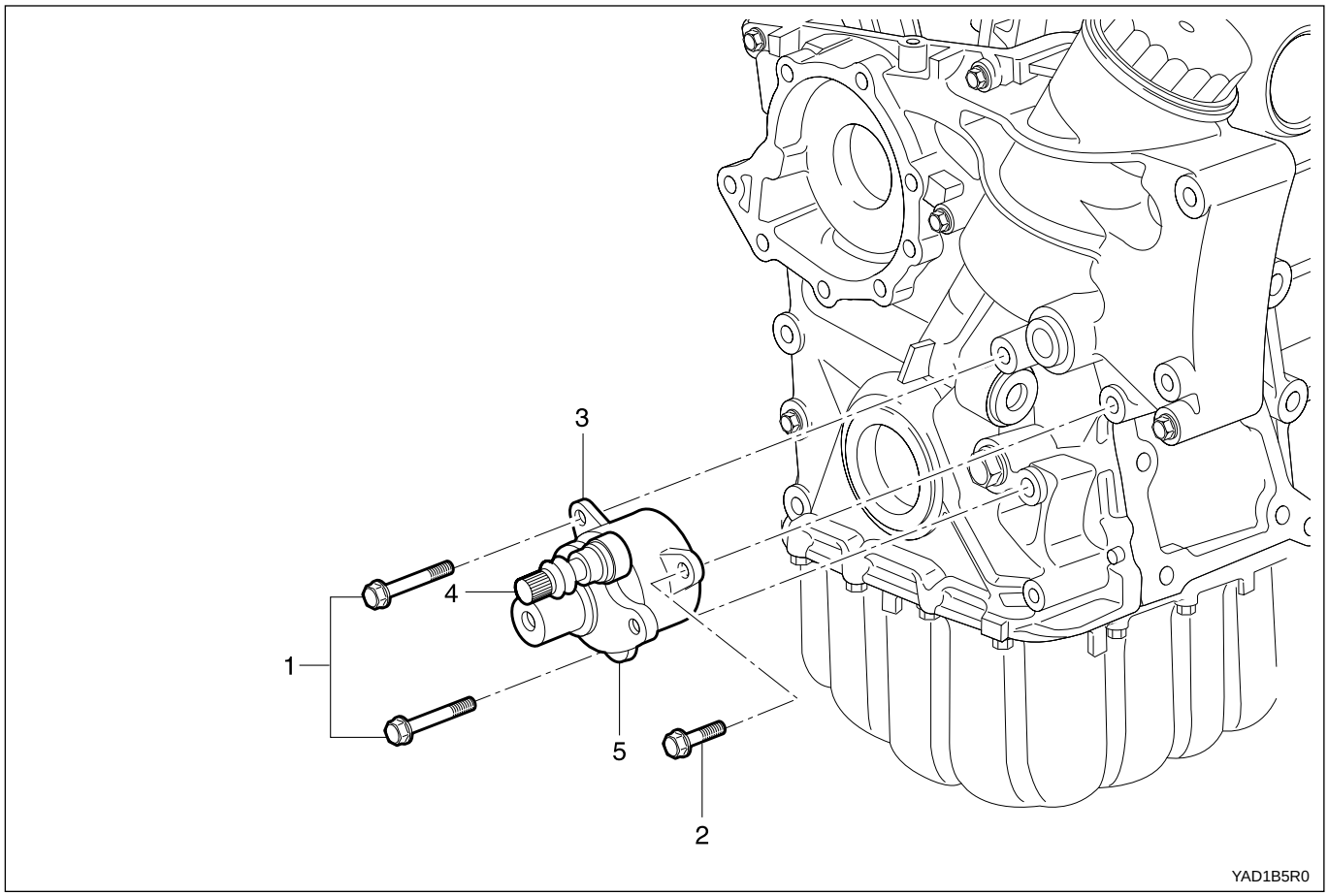
Poly V - Belt Arrangement



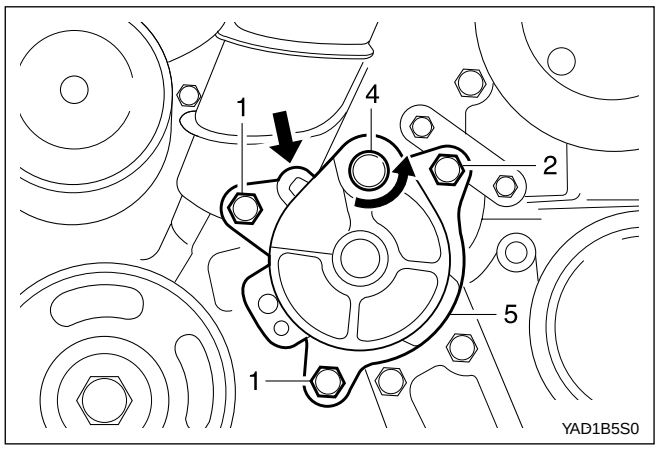
1 Belt Tensioning Pulley
2 Crankshaft Belt Pulley
3 A/C Compressor Pulley
5 Generator Pulley
7 Power Steering Pump Pulley
8 Water Pump Pulley

TENSIONING DEVICE

Preceding Work: Removal of tensioning device shock absorber



1 Bolt (M8 x 75, 2 pieces) +
Washer ..... 22.5 - 27.5 N•m (16.6 - 0.3 lb-ft)
2 Bolt (M8 x 25, 1 pieces) +
Washer ..... 22.5 - 27.5 N•m (16.6 - 0.3 lb-ft)
3 Tensioning Device
4 Stud bolt
5 Tensioning Arm



Removal & Installation Procedure

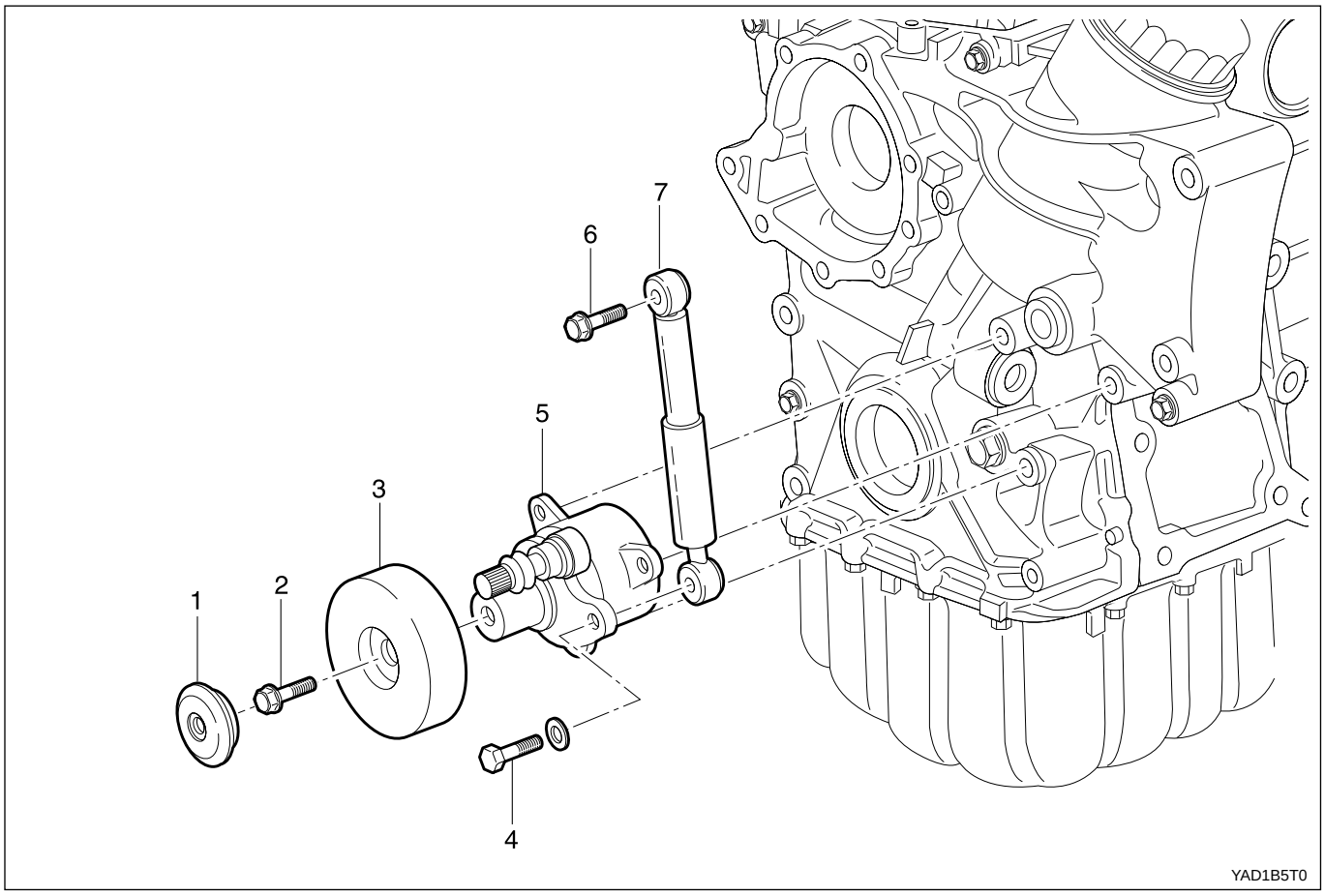
1. Turn the stud bolt to counterclockwise.
2. Insert the pin (111 589 01 15 00) into the hole in tensioning arm.
3. Unscrew the bolts (1, 2) and remove the tensioning device.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

4. Installation should follow the removal procedure in the reverse order.

TENSIONING DEVICE SHOCK ABSORBER



1 End Cover
2 Bolt..... 40.5 - 9.5 N•m (29.9 - 6.5 lb-ft)
3 Tensioning Pulley
4 Bolt (M8 X 25) + Washer
..... 22.5 - 7.5 N•m (16.6 - 0.3 lb-ft)
5 Tensioning Device
6 Bolt (M8 X 35) + Washer
..... 22.5 - 7.5 N•m (16.6 - 0.3 lb-ft)
7 Shock Absorber

Removal & Installation Procedure

1. Remove the end cover (1).
2. Remove the bolt (2) and remove the tensioning pulley (3).

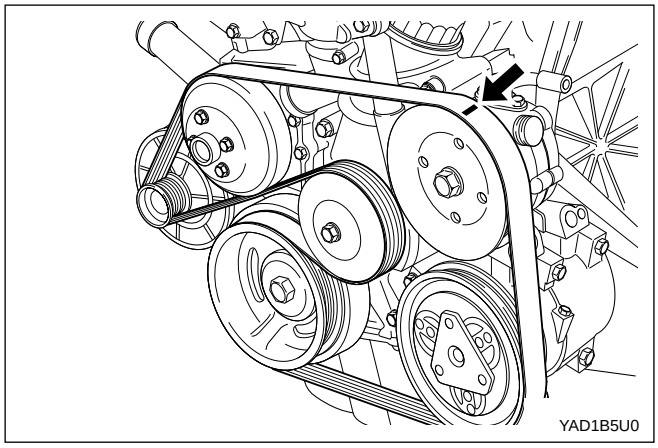
Installation Notice

Tightening Torque	40.5 - 49.5 N•m (29.9 - 36.5 lb-ft)

3. Unscrew the bolts (4,6) and remove the shock absorber (7).

Installation Notice

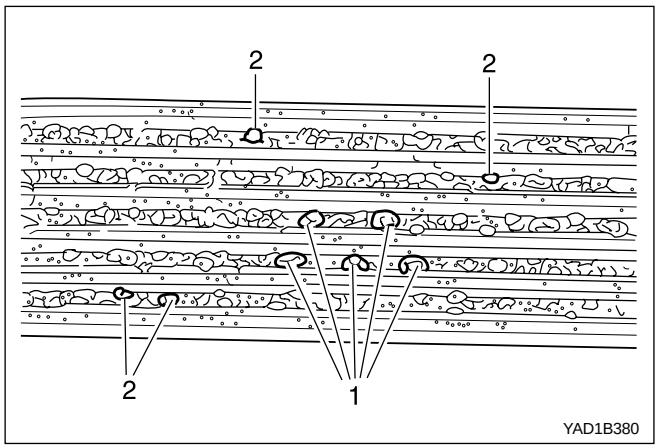
Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)


YAD1B5U0

POLY V - BELT INSPECTION

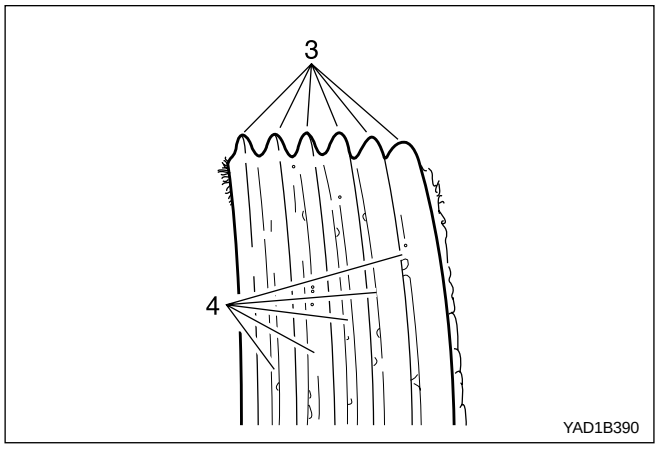
- Make marks on the belt with chalk.
- Rotate the engine and check the belt for damage.

  Notice: If one of the following types of damages is found, replace the belt.



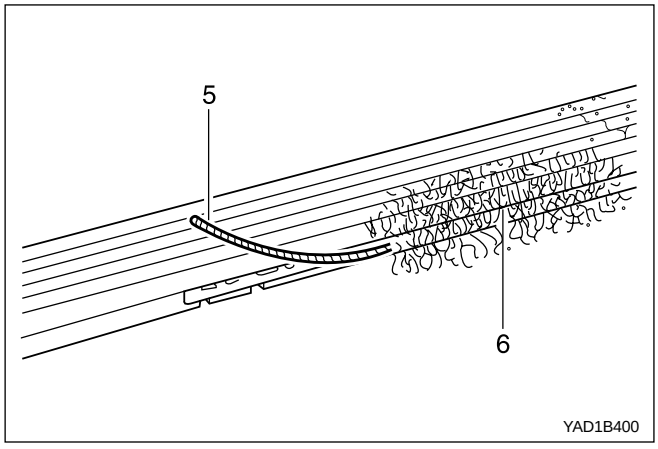
YAD1B380

1. Rubber lumps in the base of rib.
2. Dirt or grit ingrained.



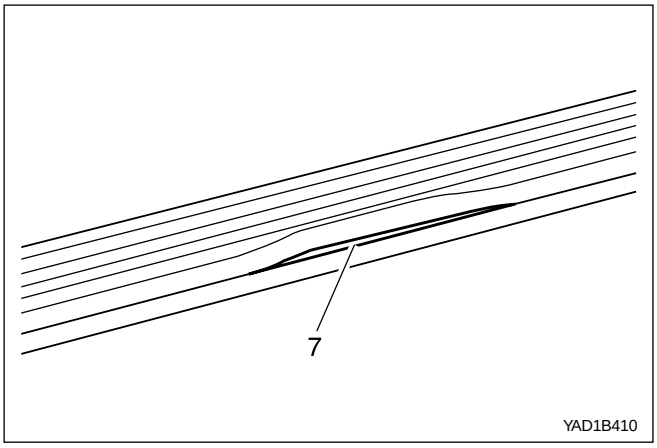
YAD1B390

3. Pointed rib.
4. Belt cord visible in the base of rib.

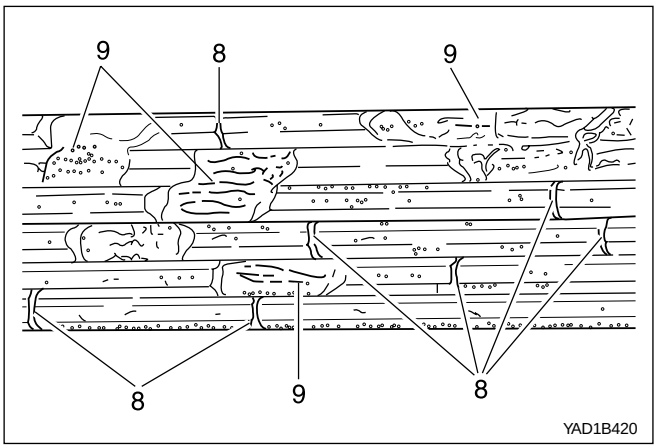


YAD1B400

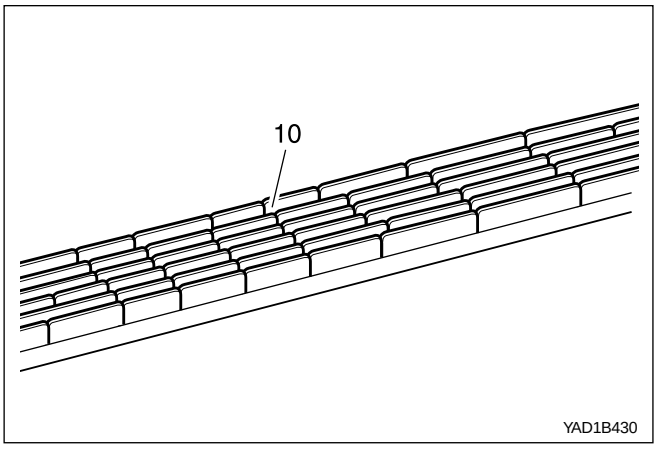
5. Cord torn out at the side.
6. Outer cords frayed.



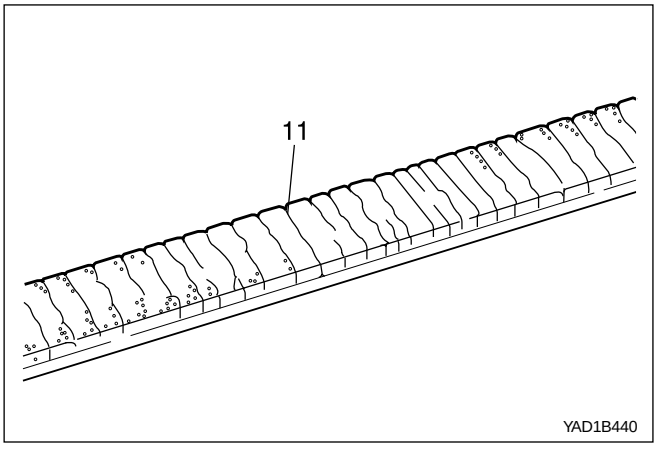
7. Rib detached from the base of belt.



8. Splits across the rib.
9. Sections of rib torn out.

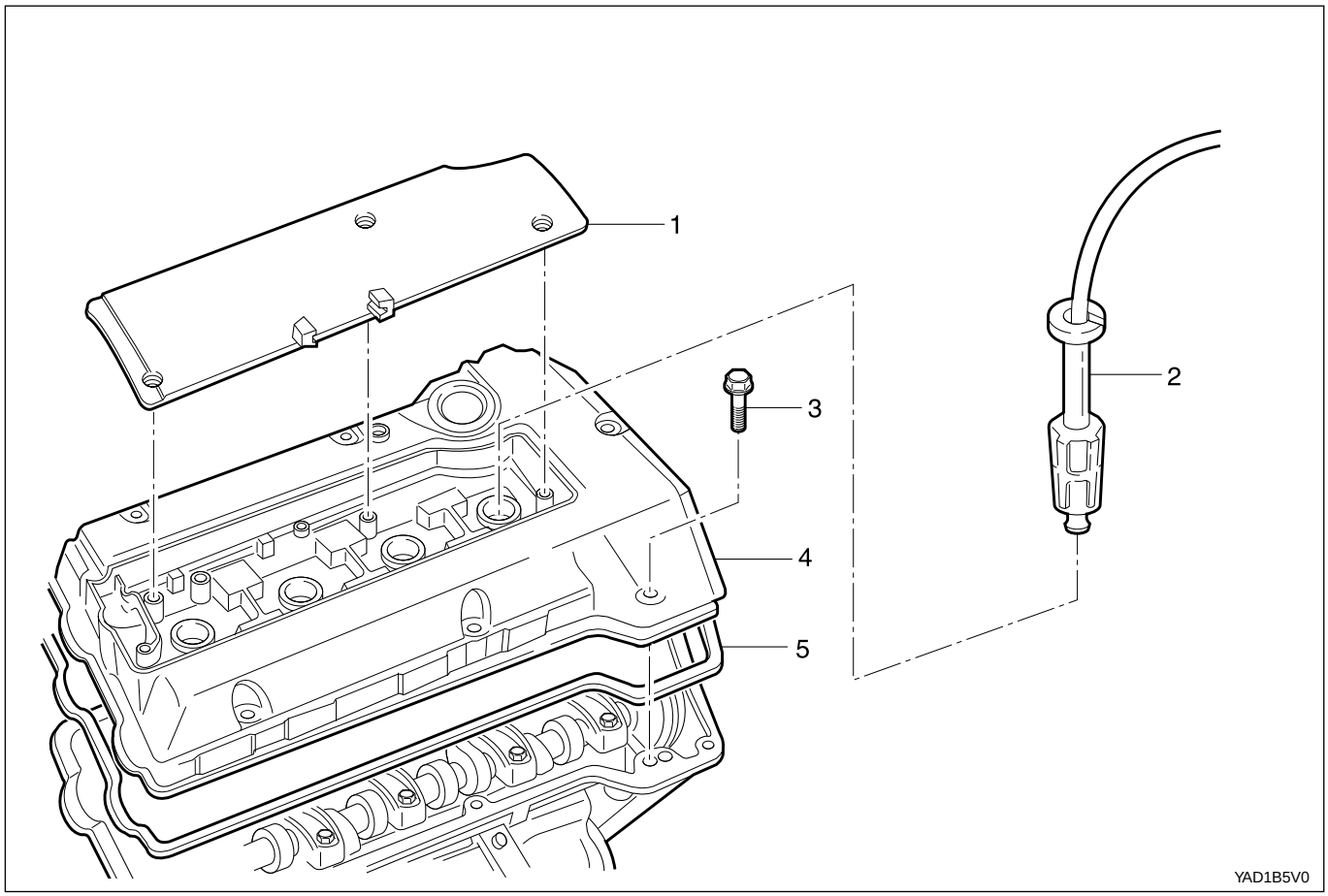


10. Splits across several ribs.

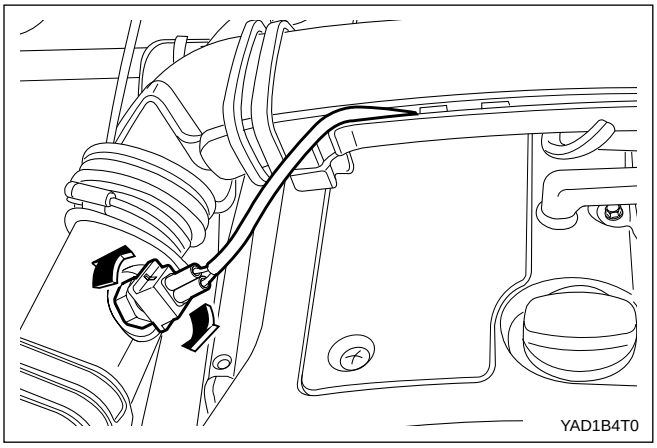


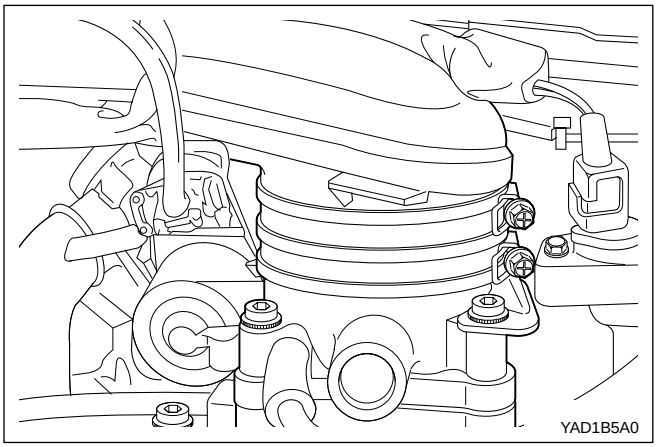
11. Splits across the back of the belt.

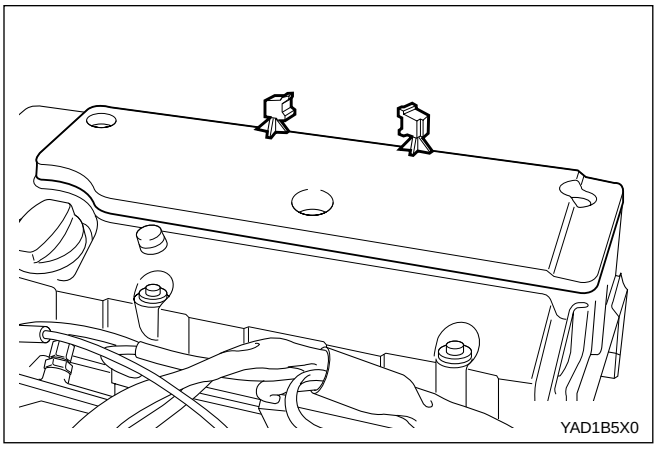
CYLINDER HEAD COVER

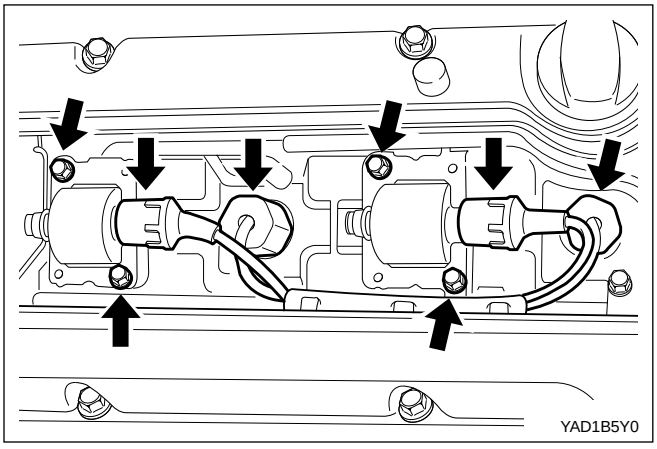


1 Spark Plug Cover
2 Spark Plug Connector
3 Bolt (M6 X 45 : 4 pieces, M6 X 60 : 6 pieces)
..... 9 - 11 N•m (80 - 97 lb-in)
4 Cylinder Head Cover
5 Gasket..... Replace









Removal & Installation Procedure

1. Remove the intake air duct.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

2. Remove the spark plug cover.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

Notice: Release 3 screws from the spark plug cover and remove the cover for M161 Engine coil.

3. Remove the spark plug connector and ignition cable.
4. Unscrew the bolts (3) and remove the head cover and the gasket.

Installation Notice

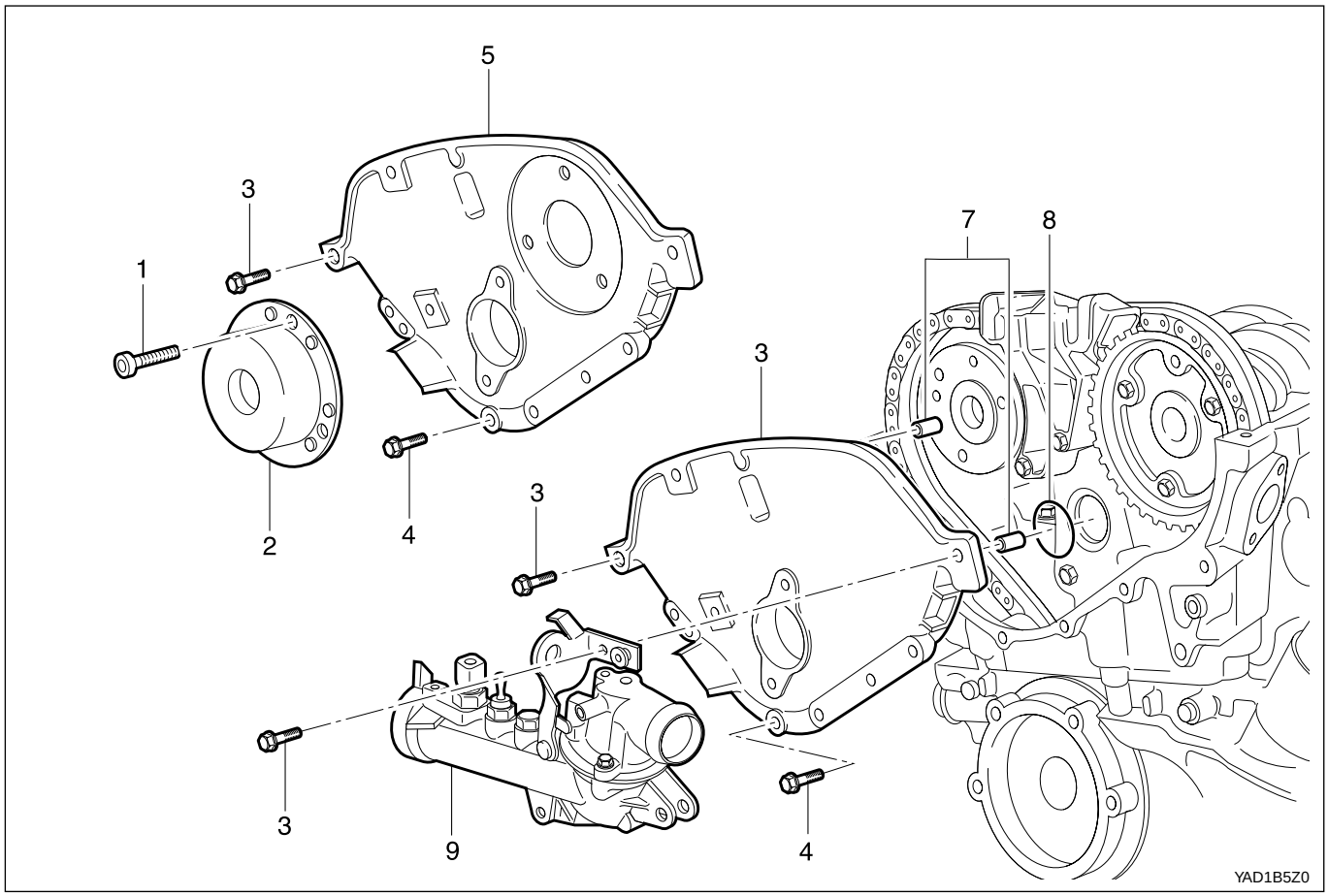
Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

Notice: Replace the gasket with a new one if necessary.

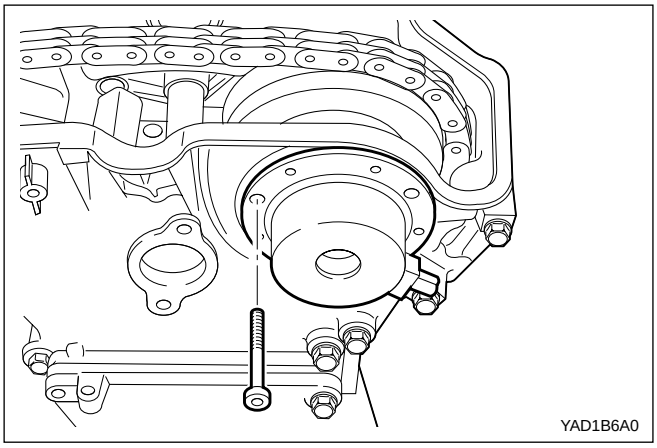
5. Installation should follow the removal procedure in the reverse order.
6. Check for oil leaks by operating the engine.

CYLINDER HEAD FRONT COVER

Preceding Work: Removal of cylinder head cover
Removal of thermostat housing assembly
Removal of engine hanger bracket



1 Bolt (M6 X 16, 3 pieces)
..... 9 - 11 N•m (80 - 97 lb-in)
2 Camshaft Adjuster
3 Bolt (M8 X 35, 2 pieces)
..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
4 Bolt (M6 X 22, 6 pieces)
..... 9 - 11 N•m (80 - 97 lb-in)
5 Front Cover (E23 : M161.973)
6 Front Cover (E20 : M161.943)
7 Sleeve
8 O-Ring ..... Replace
9 Thermostat Housing.

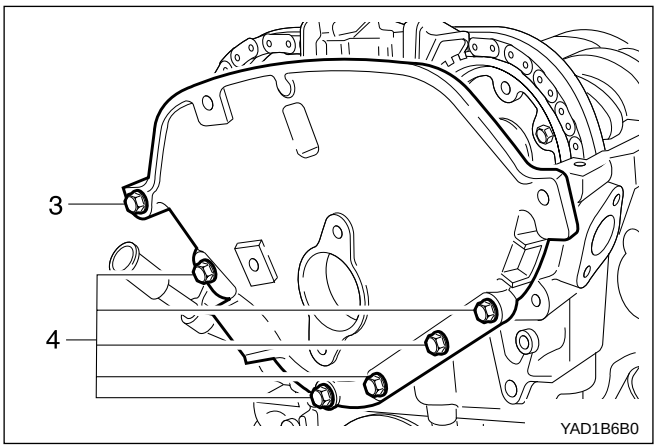


Removal & Installation Procedure

1. Disconnect the camshaft adjuster connector and remove the camshaft adjuster (E23 engine only).

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)



2. Remove the cylinder head front cover.

Installation Notice

Tightening Torque (3)	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
Tightening Torque (4)	9 - 11 N•m (80 - 97 lb-in)

Apply the sealant at the mating surface of the cylinder head and the front cover.

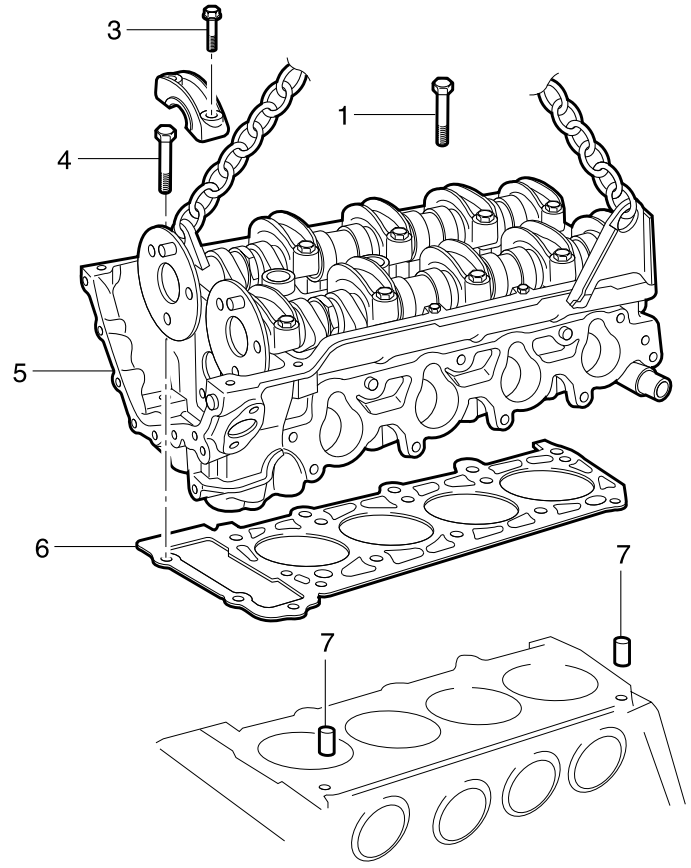
3. Remove the O-Ring.

Notice: Replace the O-ring with new one and apply the sealant.

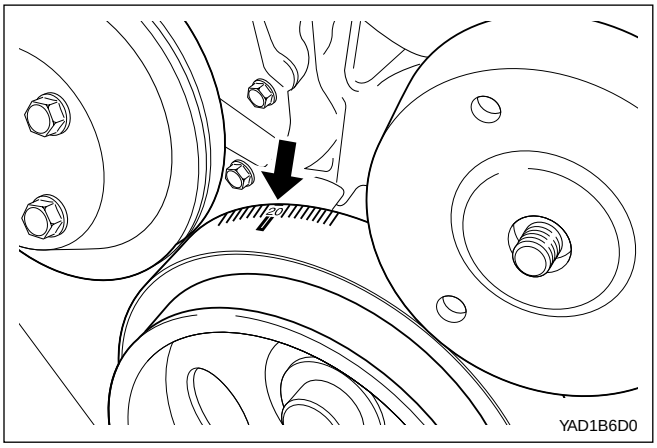
4. Installation should follow the removal procedure in the reverse order.

CYLINDER HEAD

Preceding Work: Removal of cylinder head cover
Removal of cylinder head front cover
Removal of intake manifold
Removal of cylinder head lower line (intake manifold side)



1 Cylinder Head Bolt (M12 X 100, 10 pieces)
..... 1ststep 55 N•m (41 lb-ft)
2nd step 90 ° rotation added
3rd step 90 ° rotation added
3 Bolt (M8 X 35, 4 pieces)
..... 22.5 - 27.5 N•m (16.6 - 0.3 lb-ft)
4 Camshaft Bearing cap
5 Cylinder Head
6 Gasket ..... Replace
7 Dowel Sleeve ..... Note

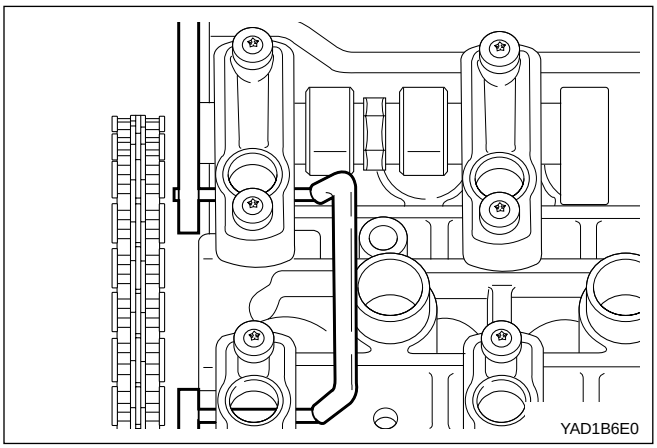


Tools Required

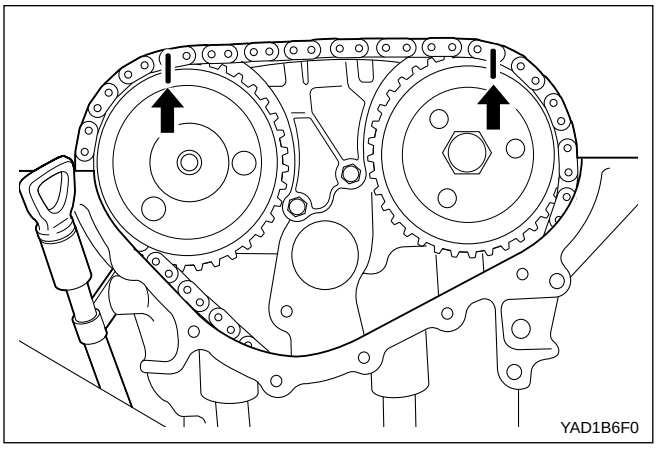
617 589 00 10 00 Allen Wrench Socket
116 589 20 33 00 Sliding Hammer
116 589 01 34 00 Threaded Pin
111 589 03 15 00 Holding Pin

Removal & Installation Procedure

1. Rotate the crankshaft so that the piston of number 1 cylinder is at ATDC 20.



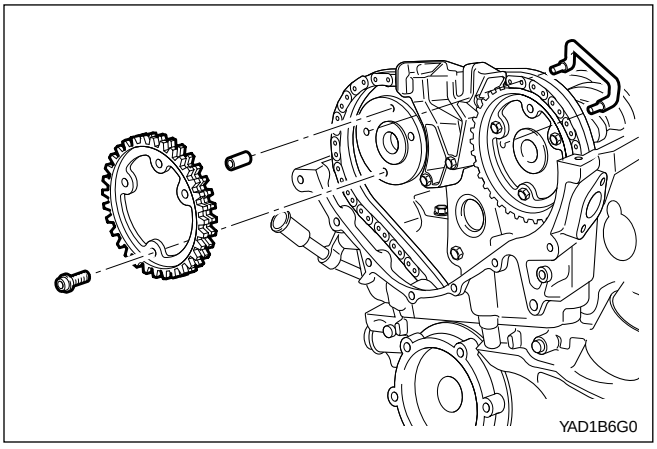
2. Put the holding pin 111 589 03 15 00 into the camshaft bearing cap (number 1, 6).



3. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
4. Remove the chain tensioner.

Installation Notice

Tightening Torque	72 - 88 N•m (53 - 65 lb-ft)

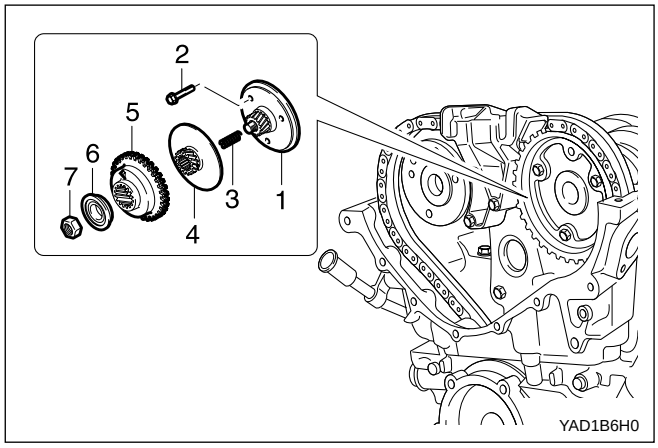


5. Remove the exhaust camshaft sprocket.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The flange bolt is designed to be used only once, so always replace with new one.



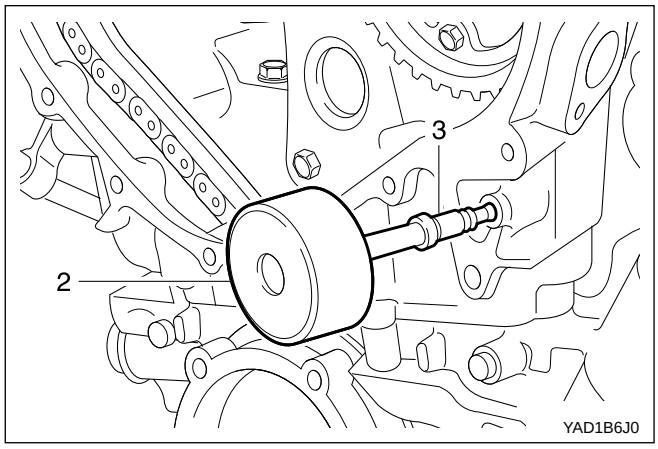
6. Remove the intake camshaft sprocket (E20 engine).
7. Remove the camshaft adjuster (E23, M161.970 engine).

Installation Notice (Flange Bolt)

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

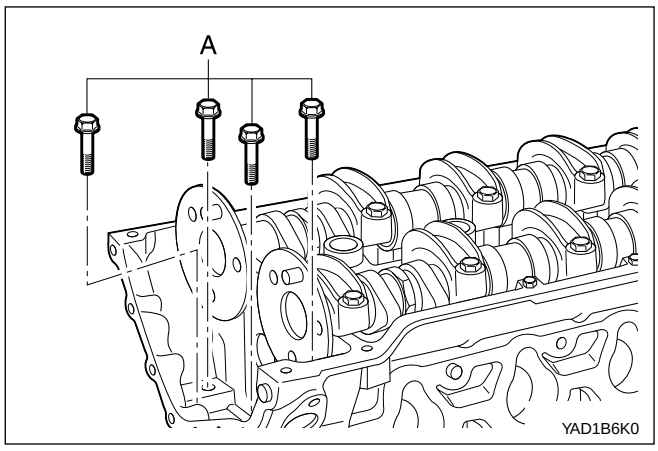
Notice: The flange bolt is designed to be used only once, so always replace with new one.

1 Flange Shaft
2 Flange Bolt
3 Compression Spring
4 Adjust Piston
5 Camshaft Sprocket
6 Seal Cover
7 Nut



8. Remove the guide rail pin using the sliding hammer 116 589 20 33 00 (02) and the threaded pin 116 589 01 34 00 (03).

Notice: Apply the sealant on guide rail pin when installation.

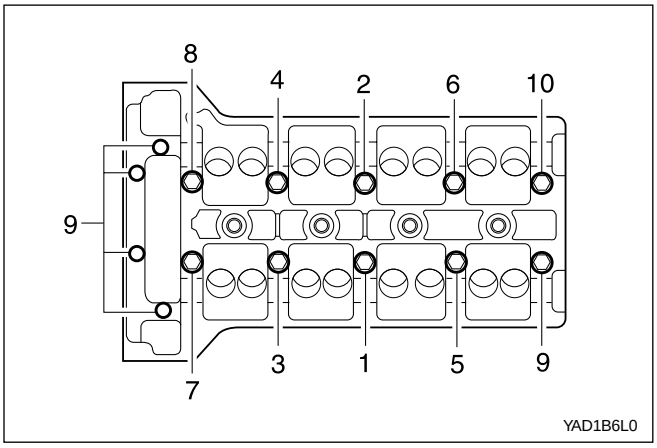


9. Unscrew the bolts (A).

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

Bolt (A) : (M8 X 35, 4 pieces)



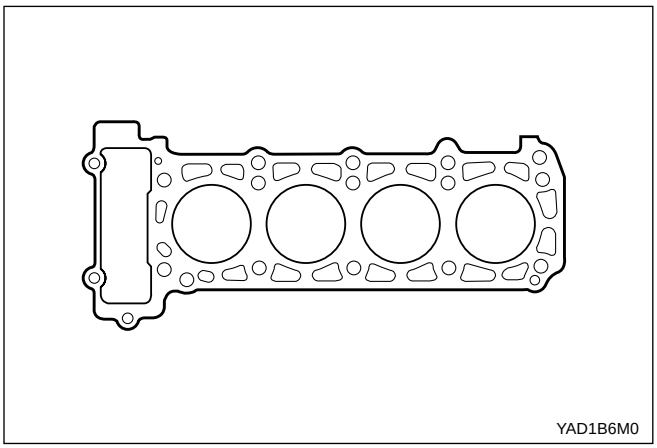
10. Remove the cylinder head bolts in the reverse order of the numerics (No.10 → No.1) using allen wrench socket 617 589 00 10 00.

Installation Notice

Tighten the bolts as numerical order with specified torque (No.1 → No.10).

Tightening Torque	1st step: 55 N•m(41 lb-ft)
	2nd step: +90°
	3rd step: +90°

Notice: Operate during engine cooling.

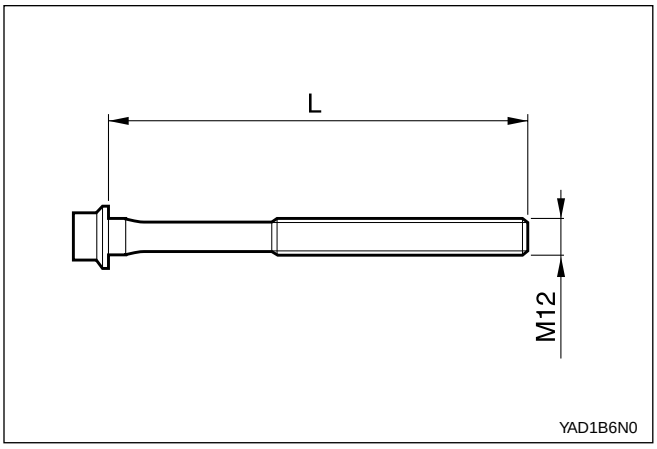


11. Remove the No. 1 bearing cap of the exhaust camshaft.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

12. Carefully remove the cylinder head.
13. Check the cylinder head mating surface and clean the crankcase head bolt mounting hole.
14. Replace the cylinder head gasket with new one.



15. Check the length of the cylinder head bolt.

Installation Notice

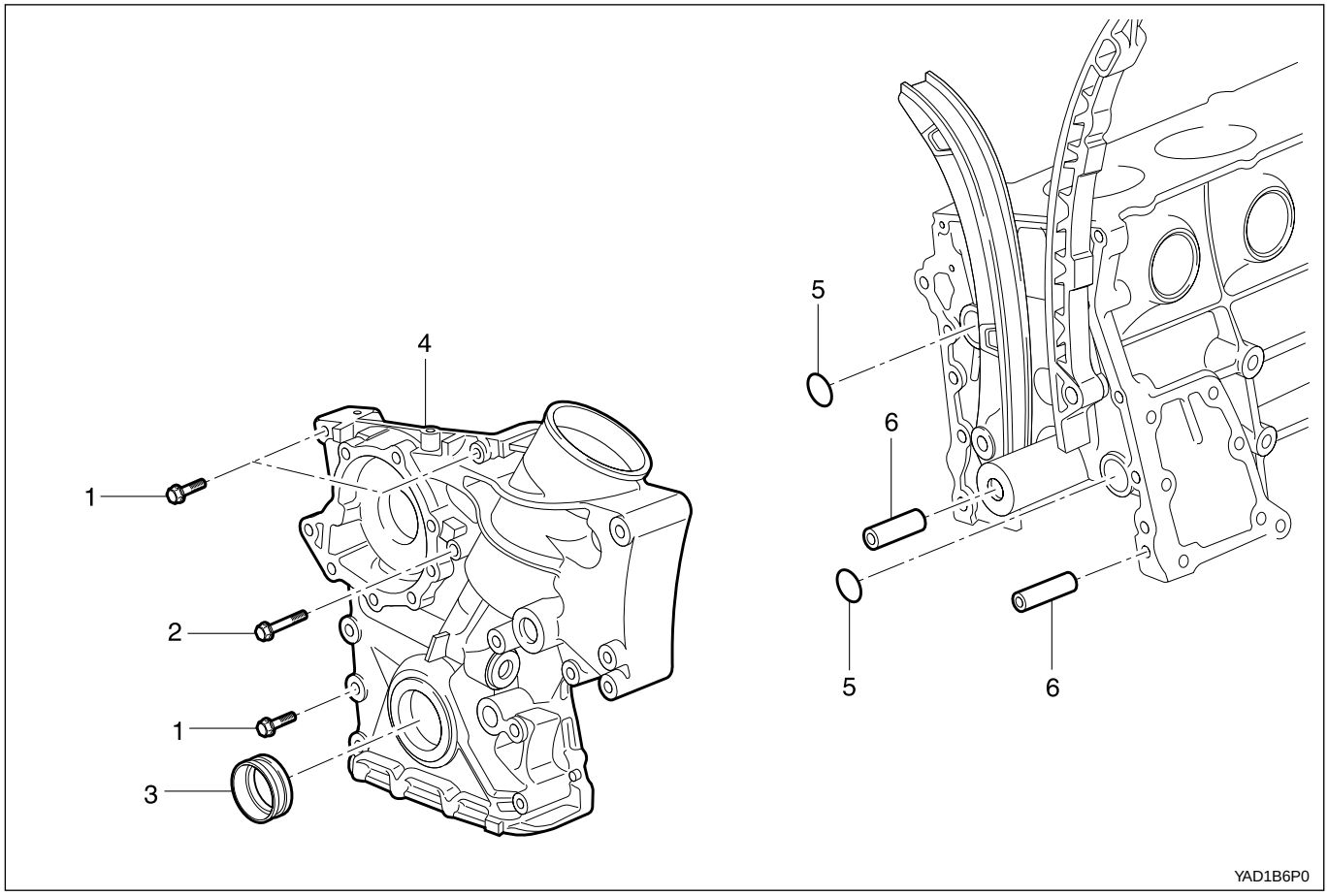
Length (L)	When New 100 mm
	Max. Length 105 mm

Notice: Replace the bolt if the measured length exceed the max. length.

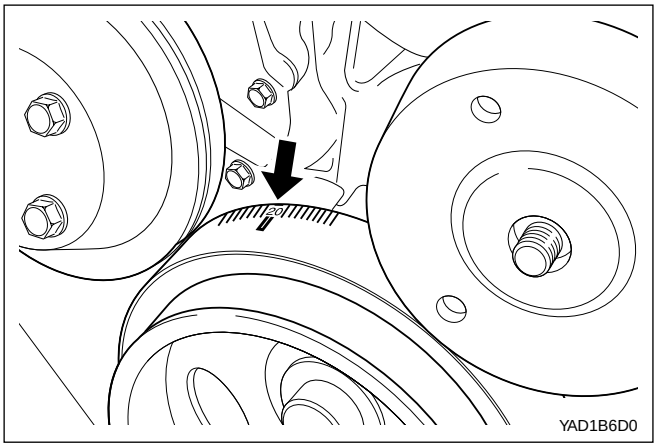
16. Installation should follow the removal procedure in the reverse order.

TIMING GEAR CASE COVER

Preceding Work: Removal of viscous clutch
Removal of cylinder head front cover
Removal of tensioning device
Removal of water pump
Removal of oil filter element
Removal of oil pan
Removal of generator bracket



1 Bolt (M8 X 60, 3 pieces)
..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
2 Bolt (M8 X 75, 1 piece)
..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
3 Seal
4 Timing Gear Case Cover
5 O-Ring
6 Sleeve.



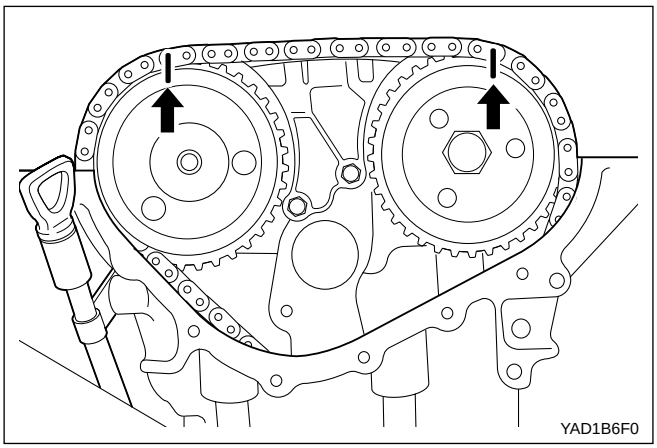
Tools Required

116 589 20 33 00 Sliding Hammer

116 589 01 34 00 Threaded Pin

Removal & Installation Procedure

1. Remove the power steering belt pulley and A/C compressor bracket.
2. Remove the oil line from power steering pump.
3. Rotate the crankshaft so that the piston of number, cylinder is at ATDC 20 °.



4. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
5. Remove the chain tensioner.

Installation Notice

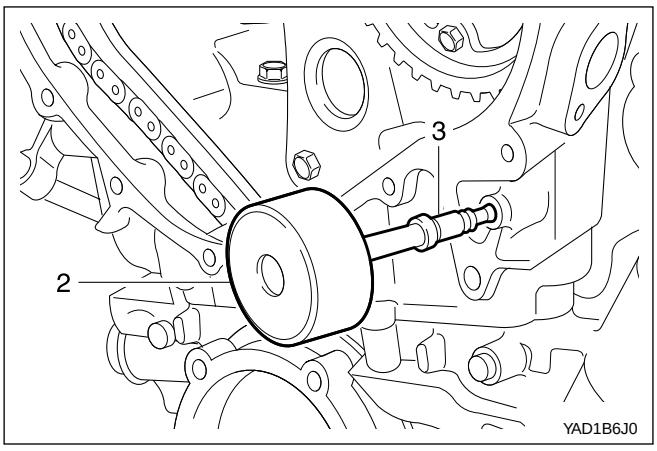
Tightening Torque	72 - 88 N•m (53 - 65 lb-ft)

6. Remove the intake and exhaust camshaft sprocket (remove the camshaft adjuster assembly in E23 engine).

Installation Notice

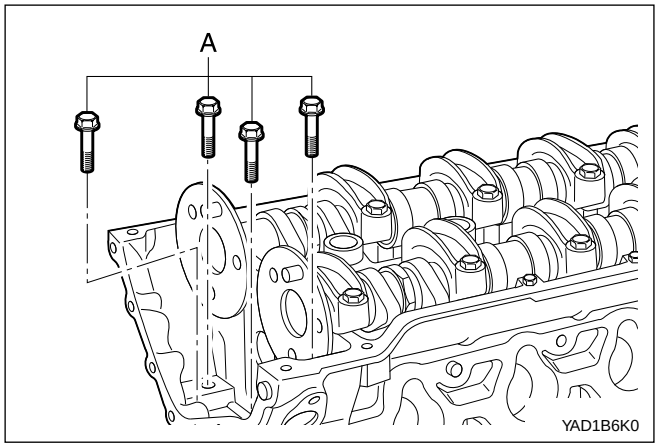
Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The flange bolt is designed to be used only once, so always replace with new one.



7. Remove the guide rail pin using the sliding hammer 116 589 20 33 00 (02) and the threaded pin 116 589 01 34 00 (03).

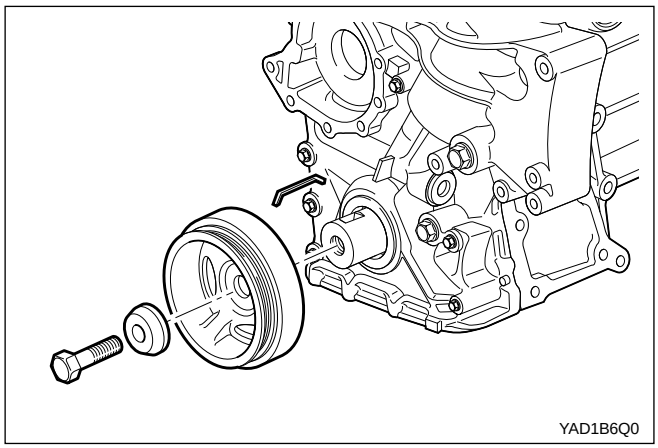
Notice: Apply the sealant on guide rail pin when installation.



8. Unscrew the bolts (A).

Installation Notice

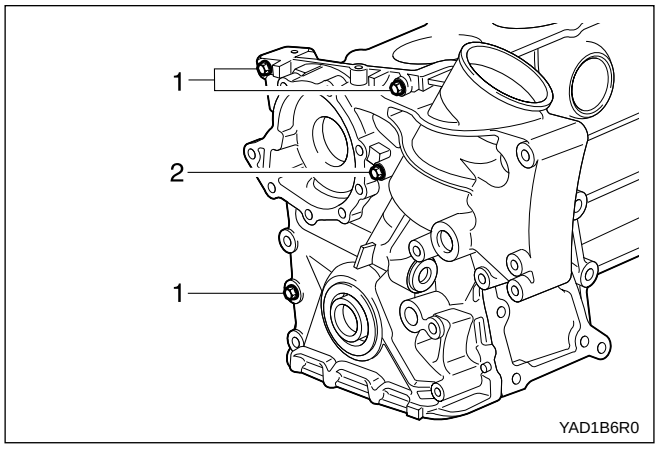
Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)



9. Remove the belt pulley and vibration damper.

Installation Notice (Center Bolt)

Tightening Torque	1st step:	200 + 20 N•m (148 +15 lb-ft)
	2nd step:	90° ± 10°



10. Unscrew the bolts (1, 2) on timing gear case cover and remove the timing gear case cover.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

Notice: Be careful not to damage the cylinder head gas-ket.

11. Remove the radial shaft seal.

Notice: Installation note replace the seal with new one.

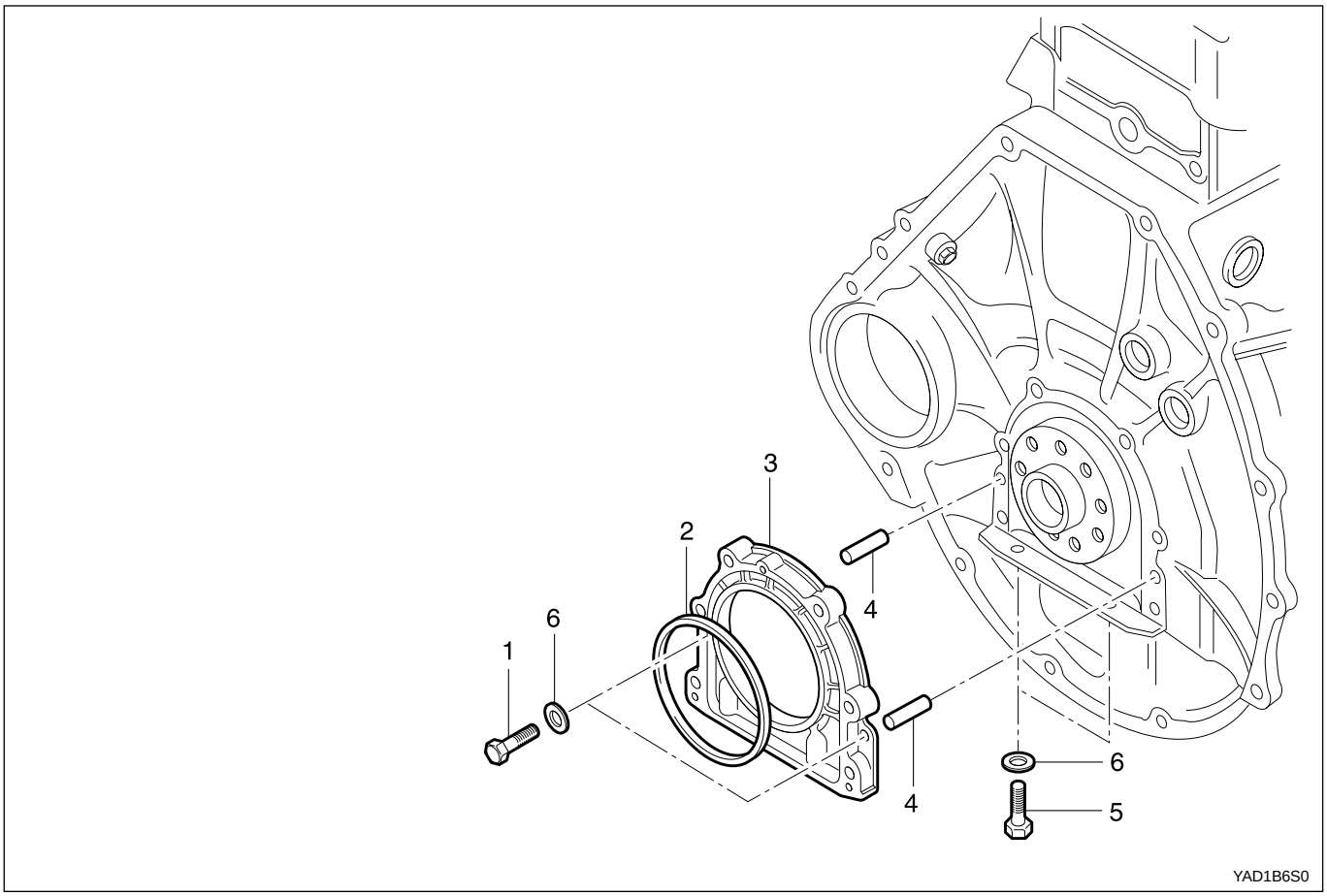
12. Clean the timing gear case cover and crankcase sealing surface.
13. Replace the O-ring with new one and apply the sealant on the sealing surface.

Notice: Be careful not to stain the oil chamber of chain tensioner with the sealant.

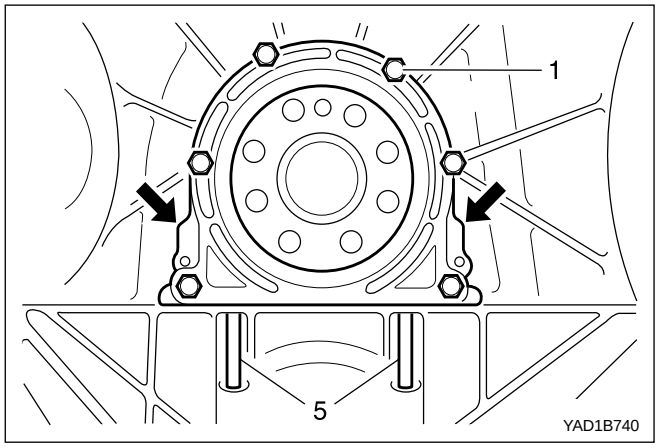
14. Installation should follow the removal precedure in the reverse order.
15. Warm up the engine and check for oil leaks.

CRANKSHAFT SEALING REAR COVER

Preceding Work: Removal of the automatic transmission drive plate or flywheel



1 Bolt (M6 x 20, 6 pieces)
..... 9 - 11 N•m (80 - 97 lb-in)
2 Radial Shaft Seal
3 Rear Cover
4 Sleeve
5 Bolt (M6 x 85, 2 pieces)
..... 9 - 11 N•m (80 - 97 lb-in)
6 Washer



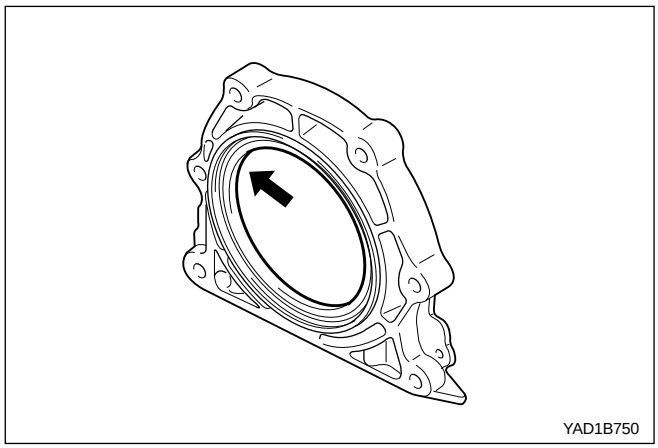
Tools Required

601 589 03 43 00 Crankshaft Rear Seal Installer

Removal & Installation Procedure

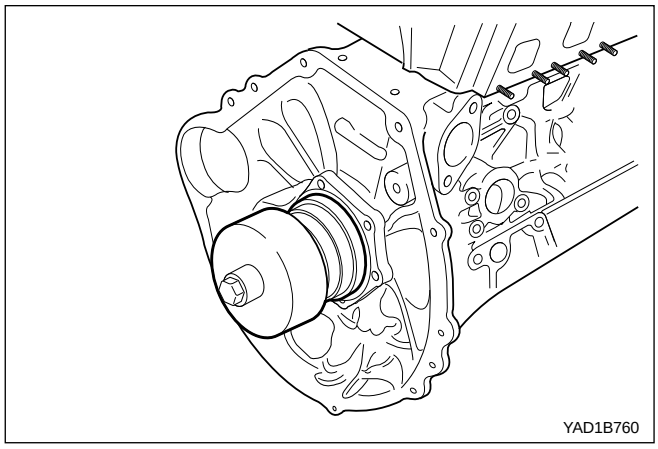
1. Unscrew the bolts (1) and (5) and remove the closing cover by pulling the rear cover lug (arrows).

   Notice: Be careful not to damage the oil pan gasket.

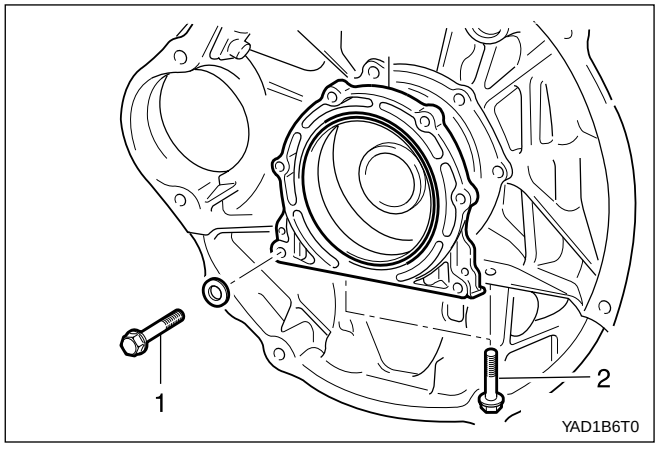


2. Clean the sealing surface of the crankcase and the rear sealing cover.
3. Check the radial shaft seal and replace it if necessary.
4. Apply the Loctite 573 to the rear cover sealing surface.
5. Apply the engine oil to the dust lip of the radial shaft seal.

   Notice: Do not use the grease.



6. Install the crankshaft rear radial seal and the crankshaft sealing rear cover, using crankshaft rear seal installer 601 589 03 43 00.



7. Install the crankshaft sealing rear cover mounting bolts and remove the crankshaft rear seal installer 601 589 03 43 00.

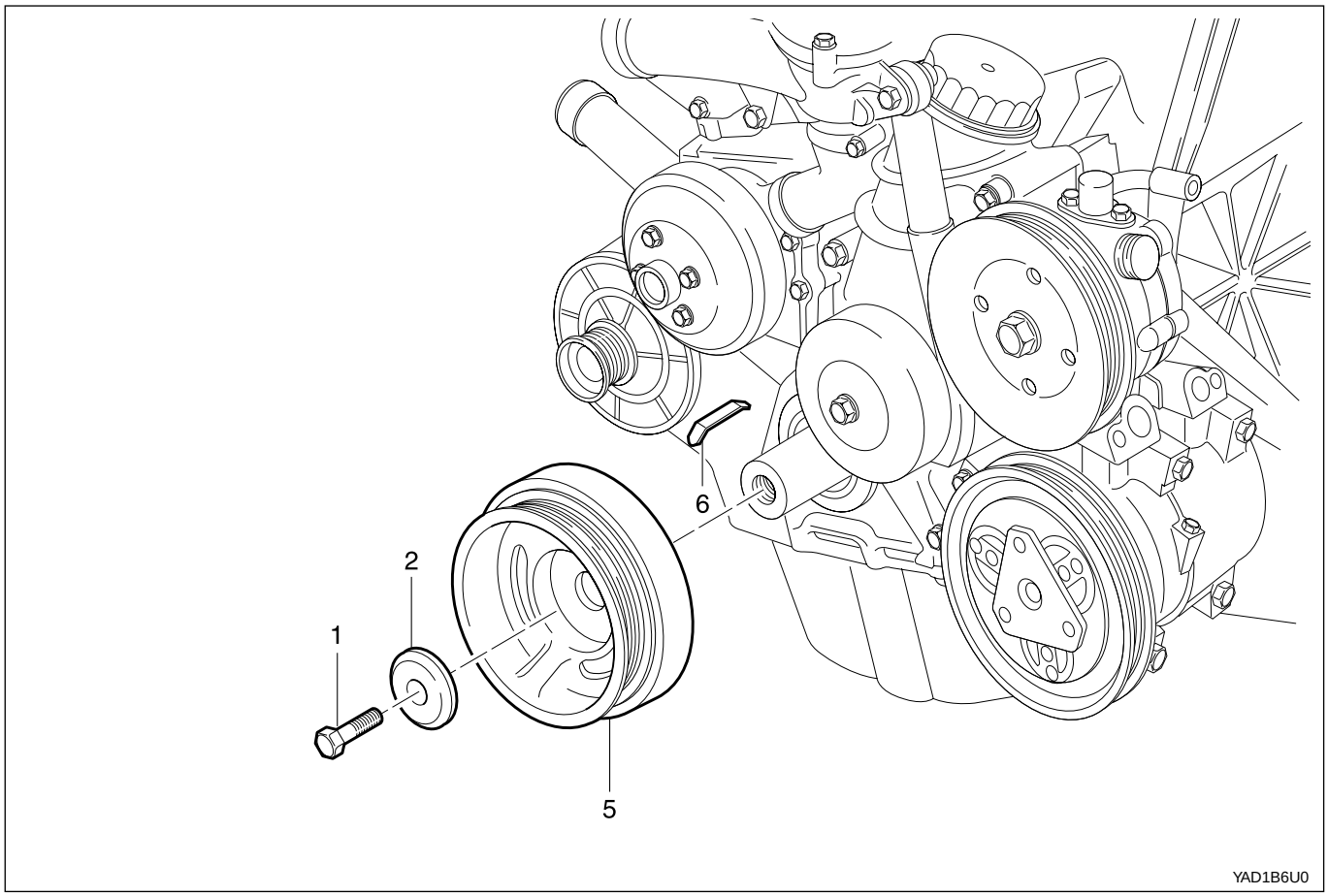
   Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

8. Installation should follow the removal procedure in the reverse order.

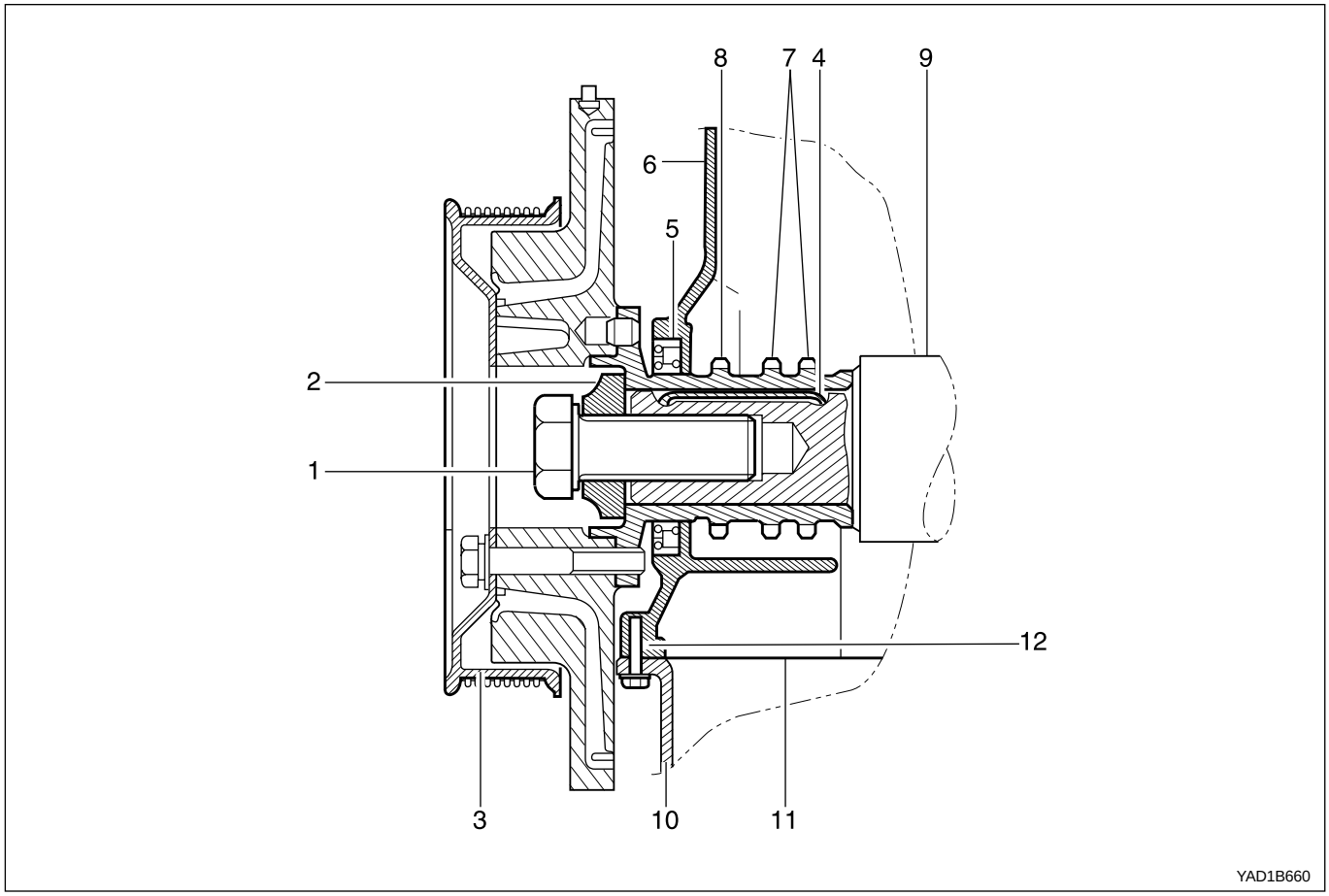
BELT PULLEY AND VIBRATION DAMPER

Preceding Work: Removal of cooling fan and viscous clutch
Removal of fan shroud
Removal of drive belt



1 Vibration Damper Center
..... 1st step 200+20 N•m (148 + 15 lb-ft)
2nd step 90 °+ 10 °rotation added
2 Vibration Damper Disk
5 Vibration Damper Assembly
6 Key

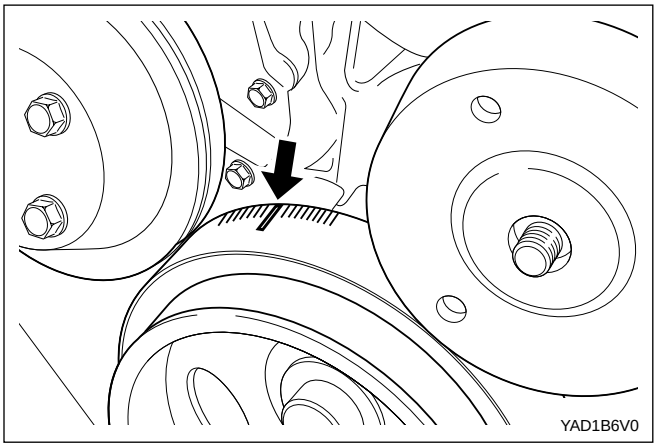
Components



1 Center Bolt (M18 x 50)
2 Center Bolt Washer
3 Vibration Damper and Pulley Assembly
4 Key
5 Crankshaft Front Seal
6 Timing Gear Case Cover
7 Crankshaft Sprocket (Camshaft Driven)
8 Crankshaft Sprocket (Oil Pump Driven)
9 Crankshaft
10 Oil Pan
11 Oil Pan Gasket
12 Oil Pan Mounting Bolt (M6 x 22)

Service Data Standard

Permissble Deviation of The Vibration Damper	Radial Runout	0.6 mm
	Axial Ruout	0.6 mm

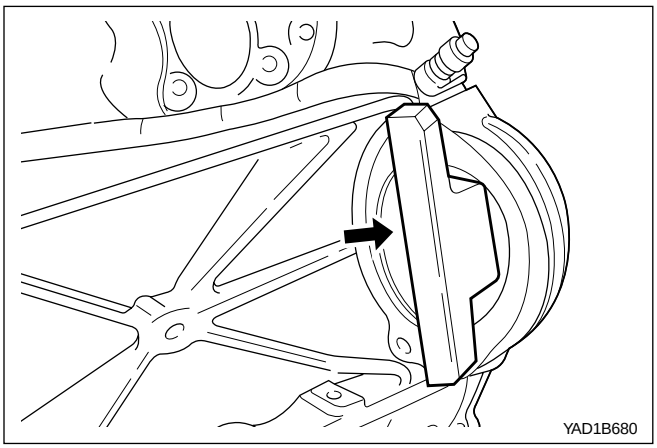


Tools Required

602 589 00 40 00 Engine Lock

Removal & Installation Procedure

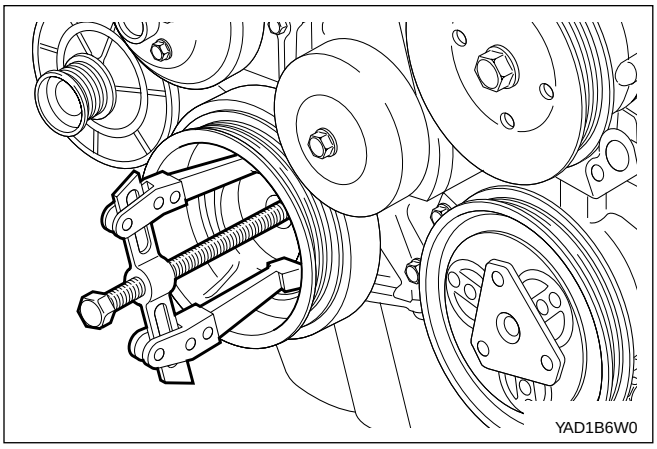
1. Adjust the piston of number 1 cylinder to the TDC.



2. Remove the start motor and install the engine lock 602 589 00 40 00 to the flywheel ring gear.
3. Remove the vibration damper center bolt.

Installation Notice

Tightening Torque	1st step: 200 + 20 N•m (148 + 15 lb-ft)
	2nd step: 90° + 10°

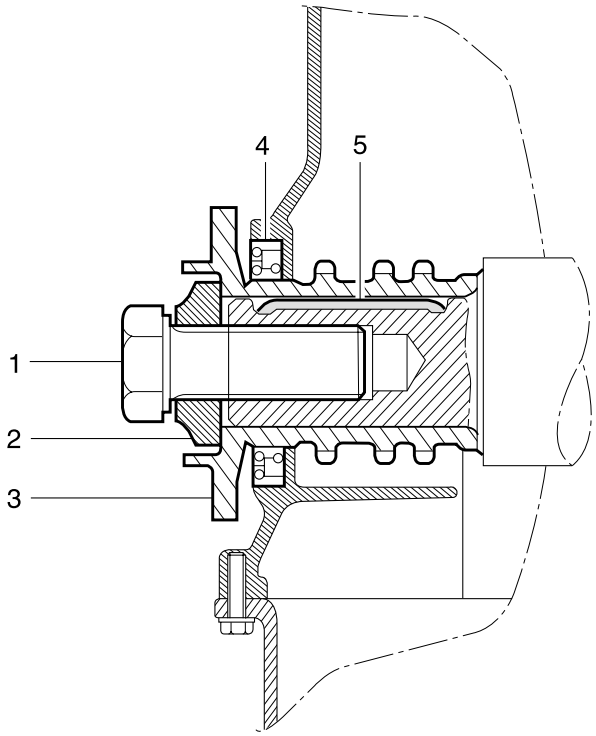


4. Remove the vibration damper assembly using the puller.
5. Installation should follow the removal procedure in the reverse order.

Notice: If possible, don't separate the vibration damper and the pulley.

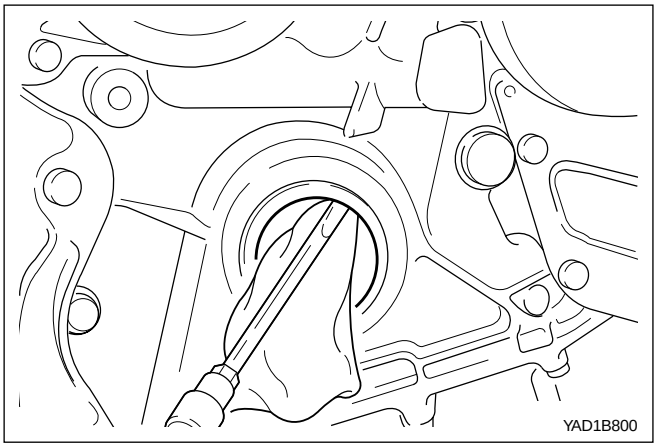
CRANKSHAFT FRONT RADIAL SEAL

Preceding Work: Removal of belt pulley and vibration damper



YAD1B6X0

1 Center Bolt (M18 x 50)
..... 1st step 200 + 20 45 N•m (148 +15 lb-ft)
2nd step 90 ° + 10 °
2 Center Bolt Washer
3 Crankshaft Front Seal Installer
4 Crankshaft Front Seal
5 Key



Tools Required

601 589 03 14 00 Crankshaft Front Seal Installer

Replacement Procedure

1. Remove the radial seal with a screw driver.

   Notice: Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.

2. Coat the radial sealing lip with engine oil.
3. Using the crankshaft front seal installer 601 589 03 14 00, assemble the radial seal.
4. Align the sleeve groove and the woodruff key and tighten the center bolt until the center bolt and the damper disk stop in the movement.

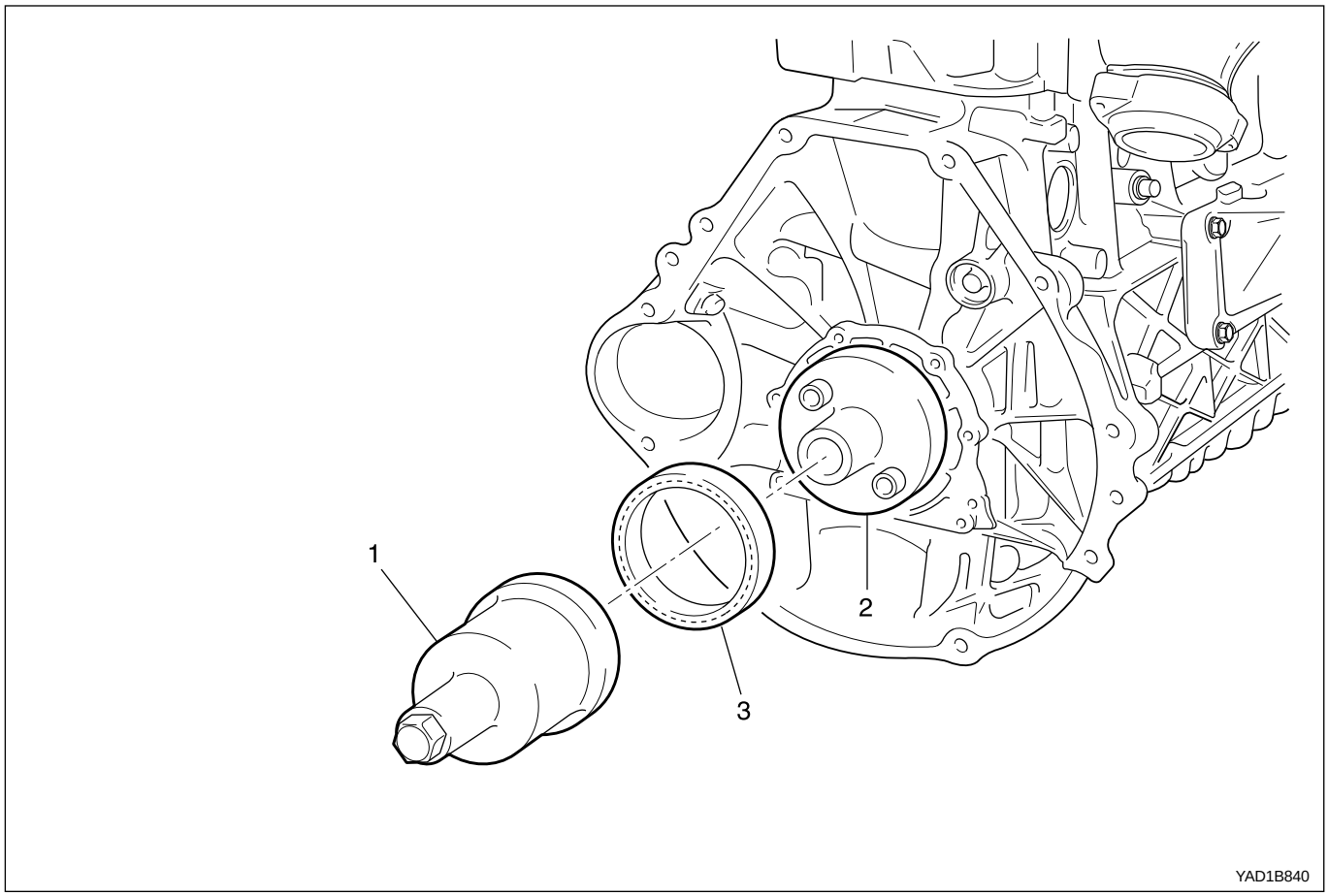
   Installation Notice

Tightening Torque	1st step: 200 + 20 N•m (148 + 15 lb-ft)
	2nd step: 90° ± 10°

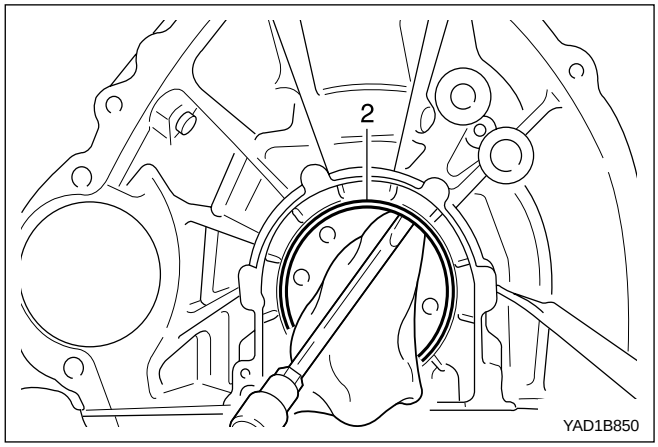
5. Remove the crankshaft front seal installer 601 589 03 14 00, and install the belt pulley and the vibration damper.
6. Check for leaks while operating the engine.

CRANKSHAFT REAR RADIAL SEAL

Preceding Work: Removal of flywheel or drive plate



1 Special Tool
2 Special Tool
3 Crankshaft Rear Seal



Tools Required

601 589 03 43 00 Crankshaft Rear Seal Installer

Replacement Procedure

1. Remove the radial seal with a screw driver.

   Notice: Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.

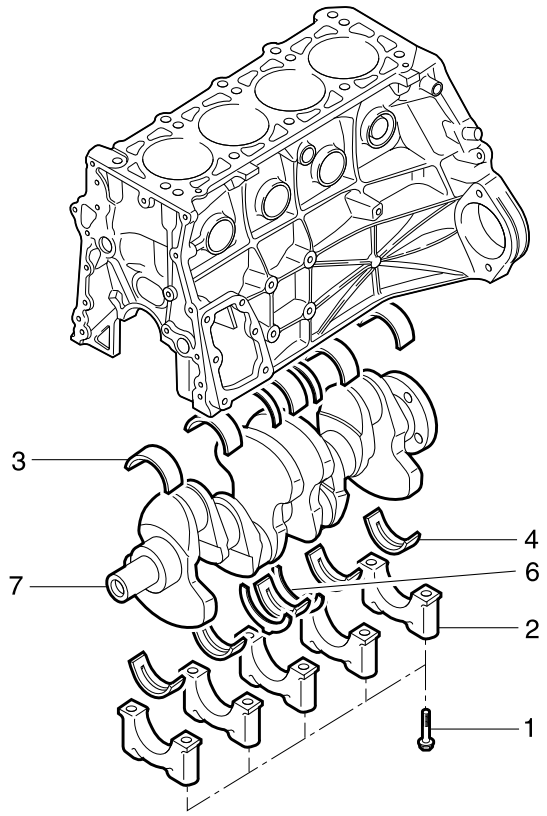
2. Install the special tool (2) to the crankshaft.
3. Apply the engine oil on the special tool (2).

   Notice: Do not use the grease.

4. Install the radial seal on the inner parts assembler.
5. Press in the special tool (1) until the radial seal is stopped.
6. Check for leaks while operating the engine..

CRANKSHAFT

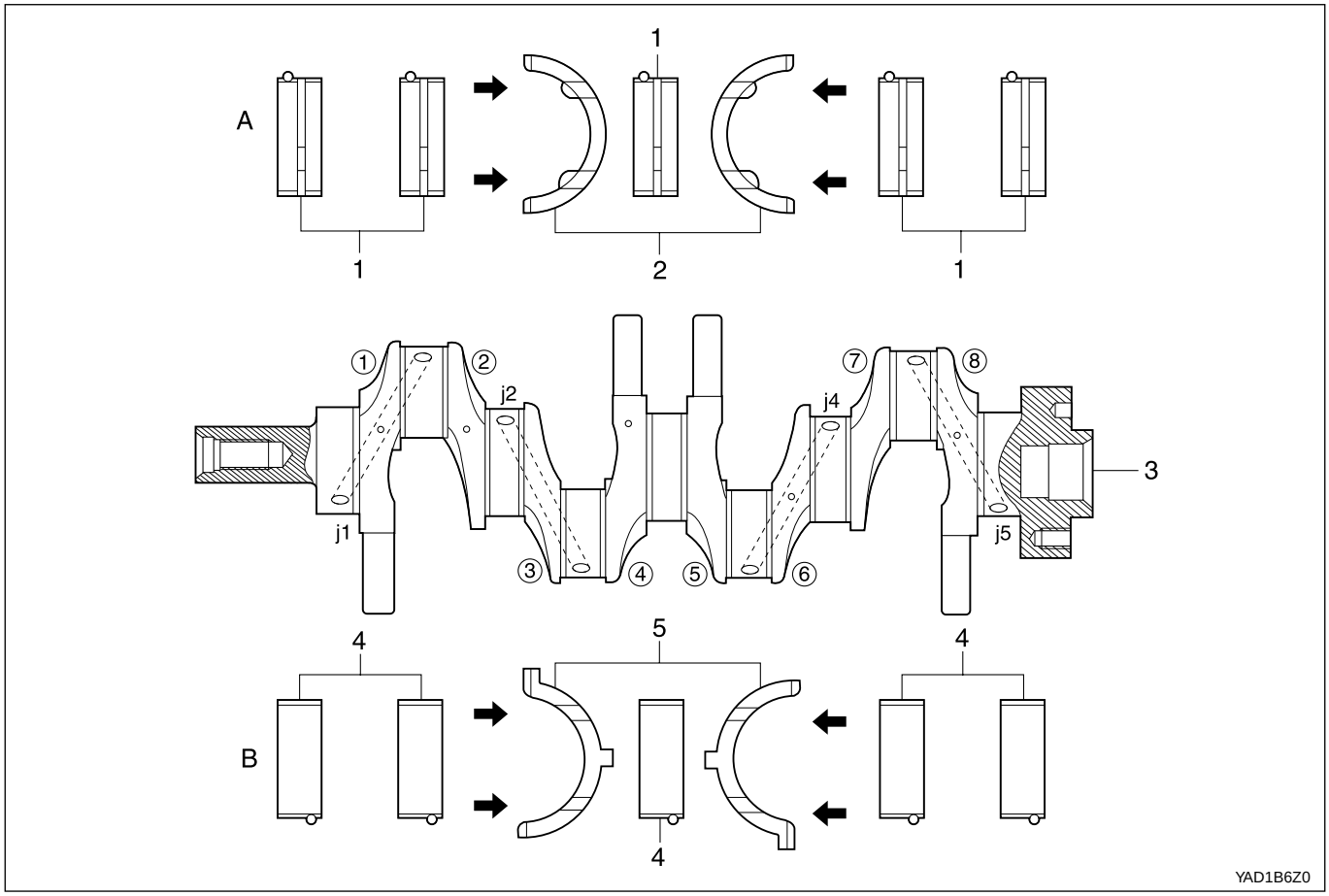
Preceding Work: Removal of engine
Removal of cylinder head
Removal of timing gear case cover
Removal of crankcase sealing rear cover
Removal of oil pan
Removal of baffle plate
Removal of oil pump



YAD1B6Y0

1 Bearing Cap Bolt (M8 X 55 - 10 pieces)
..... 1ststep 55 N•m (41 lb-ft)
2nd step 90 °rotation added
2 Bearing Cap
3 Upper Main Bearing
4 Lower Main Bearing
5 Upper Thrust Bearing
6 Lower Thrust Bearing
8 Crankshaft.

Arrangement of the Thrust Bearing and the Main Bearing



1 Upper Main Bearing
2 Upper Thrust Bearing
3 Crankshaft
4 Lower Main Bearing
5 Lower Thrust Bearing

A Crankcase Side
B Bearing Cap Side (Oil Pan Side)

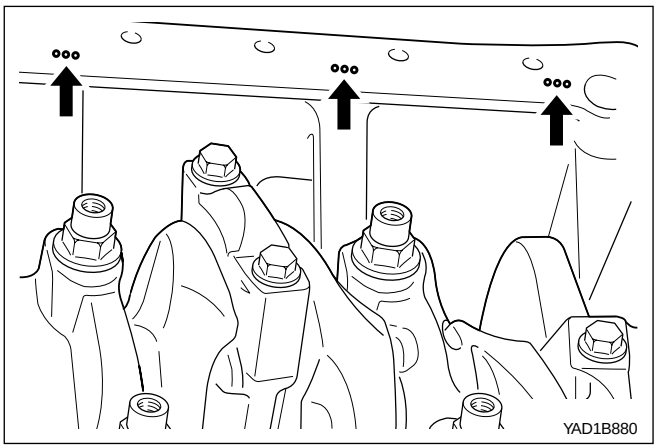
(1) - (8) Weight Balance/Color Marking Point

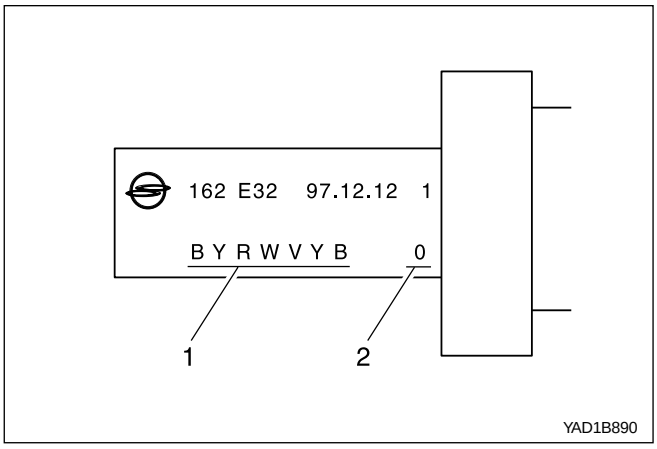
j1 - j5 Journal Main Bearing #1 - #5

- Color Dot Marking

The color dot marking are put on the (1), (2), (4), (6), (8), and it indicates the diameter of crankshaft journal by color as below.

Color Dot Marking	Crankshaft Journal Diameter (mm)
Blue	57.960 - 57.965
Yellow	57.955 - 57.960
Red	57.950 - 57.955
White	57.945 - 57.950
Violet	57.940 - 57.945





Selection of Crankshaft Main Bearing

1. Crankcase Side

   There are seven punching marks on the mating surface to oil pan. This mark is correspondent to the bearing distinguished by color. Select the relevant bearing according to the punching mark when repaired.

Purching Mark	Bearing Color Selected
B	Blue
Y	Yellow
R	Red

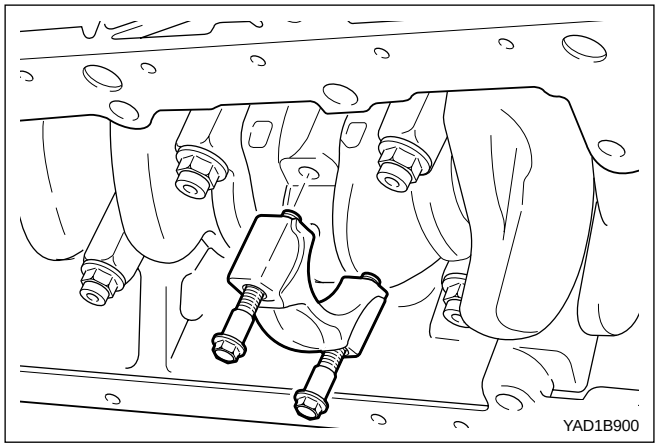
2. Crankshaft Bearing Cap Side

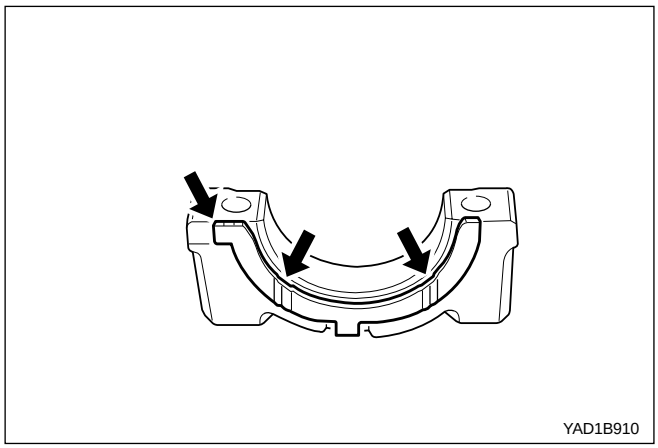
   Select the crankshaft main bearing according to the marking letter on the crank shaft main journal when repaired.

Marking Letter	Bearing Color Selected
B	Blue
Y	Yellow
R	Red
W	White
V	Violet

Service Data

Crankshaft Standard and Repair Size	Crankshaft Bearing Journal Diameter	Crankshaft Bearing Diameter	Crankshaft Journal Width at fit bearing	Connecting Rod Bearing Journal Diameter	Connecting Rod Bearing Journal Width
Standard size	57.940 - 57.965	58	24.50 - 24.533	47.935 - 47.965	27.958 - 28.042
1st repair size	57.705 - 57.715	-	-	47.700 - 47.715	-
2nd repair size	57.450 - 57.465			47.450 - 47.465	
3rd repair size	57.205 - 57.215			47.200 - 4.215	
4th repair size	56.955 - 56.965			46.950 - 46.965	


YAD1B900


YAD1B910

Part No. : 601 030 00 62 2.15 mm
Part No. : 601 030 01 62 2.20 mm
Part No. : 601 030 02 62 2.25 mm
Part No. : 601 030 03 62 2.30 mm
Part No. : 601 030 04 62 2.40 mm

Removal & Installation Procedure

1. Unscrew the connecting rod bearing cap bolt and remove the bearing cap.

   Installation Notice

Tightening Torque	40 N•m (30 lb-ft) + 90°

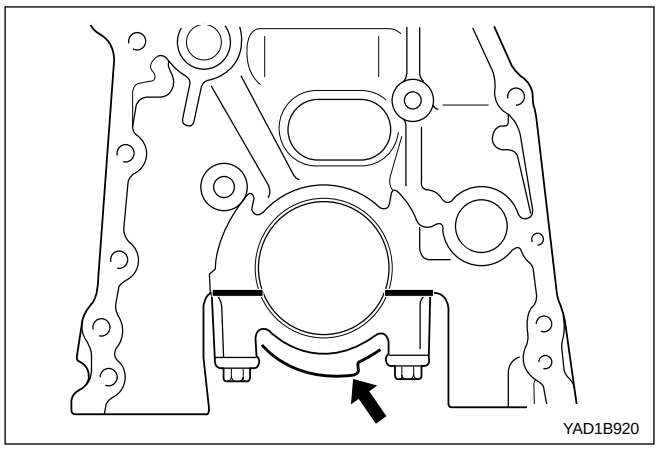
   - Make sure that the upper and lower bearing shells do not change each other.
   - Coat the bearing shell with engine oil.
   - Install the bearing cap according to the consecutive number.

2. Unscrew the crankshaft bearing cap bolts and separate the upper and lower bearing shells and thrust washers.

   Installation Notice

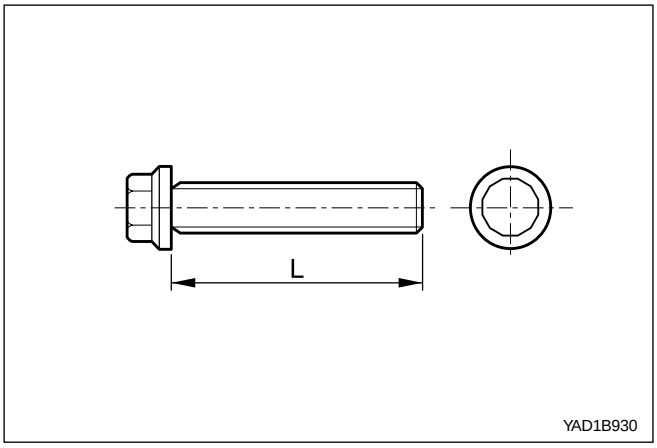
Tightening Torque	55 N•m (41 lb-ft)+ 90°

   - Remove the bearing cap from front (pulley side) to rear.
   - Make sure that the upper and lower bearing shells do not change each other and coat with engine oil.
   - The oil grooves (arrows) in the thrust washers must face outward and insert the thrust bearing into the bearing cap.
   - There are five kinds of thrust washers by thickness. Select the proper washer when repaired.
3. Remove the crankshaft.
4. Installation should follow the removal procedure in the reverse order.
5. After completion of the installation, check for the rotating condition of the crankshaft.


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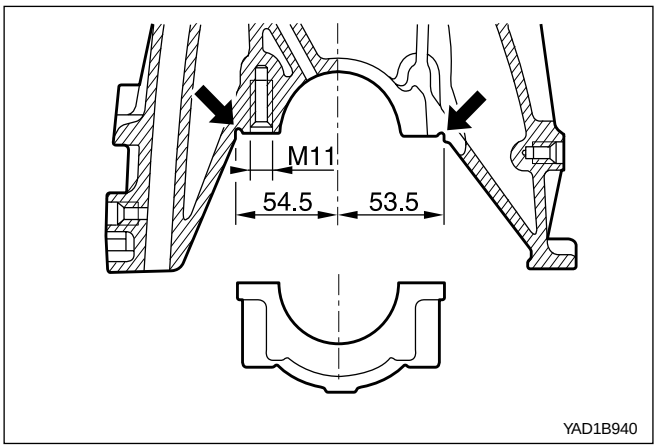
Notice:

- Make sure the crankshaft bearing cap properly seated in place in the crankcase side. When perfectly installed, the projected part (arrow) locates in the left side (intake manifold side).
- Assemble so that the projected part of the cap and crankcase face the same direction.

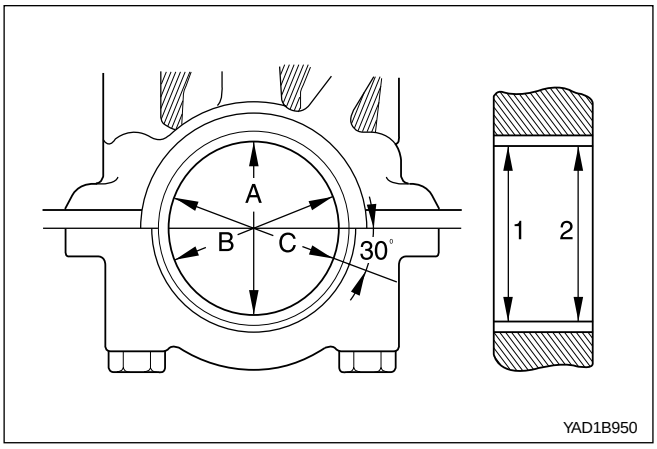


Inspection

1. If the length 'L' of the crankshaft bearing cap bolt exceeds 63.8 mm, replace it.



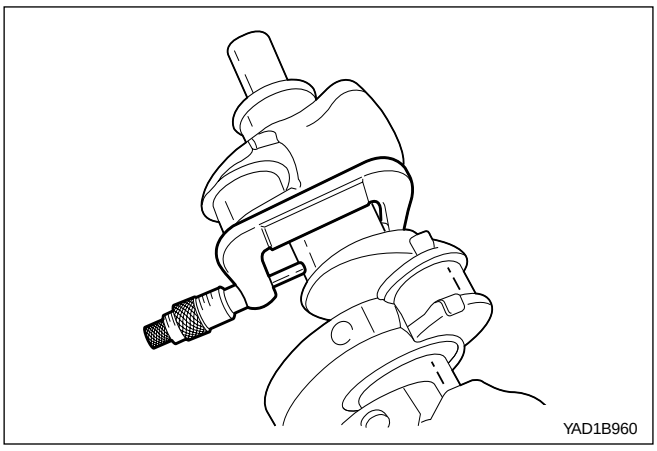
2. Make sure the crankshaft bearing cap is properly seated on the cylinder block (arrows).



3. Measure and record the inner diameter of the crankshaft bearing.

   Notice:

   - Measure at 2 points (1, 2).
   - Measure 'A', 'B' and 'C' as shown. If average value of 'B' and 'C' is less than value 'A', then the average value of 'B' and 'C' is actual average value. If average value of 'B' and 'C' is more than value 'A' is actual average value.



4. Measure and record the diameter of the crankshaft bearing journal.

   Notice:

   - Record the mean value when measured at 3 points (A,B,C).
   - Measure the inner diameter of bearing and the diameter of journal and if it is out of the standard data, replace the bearing shell.

Service Data Standard (Crankshaft Main Bearing Gap)

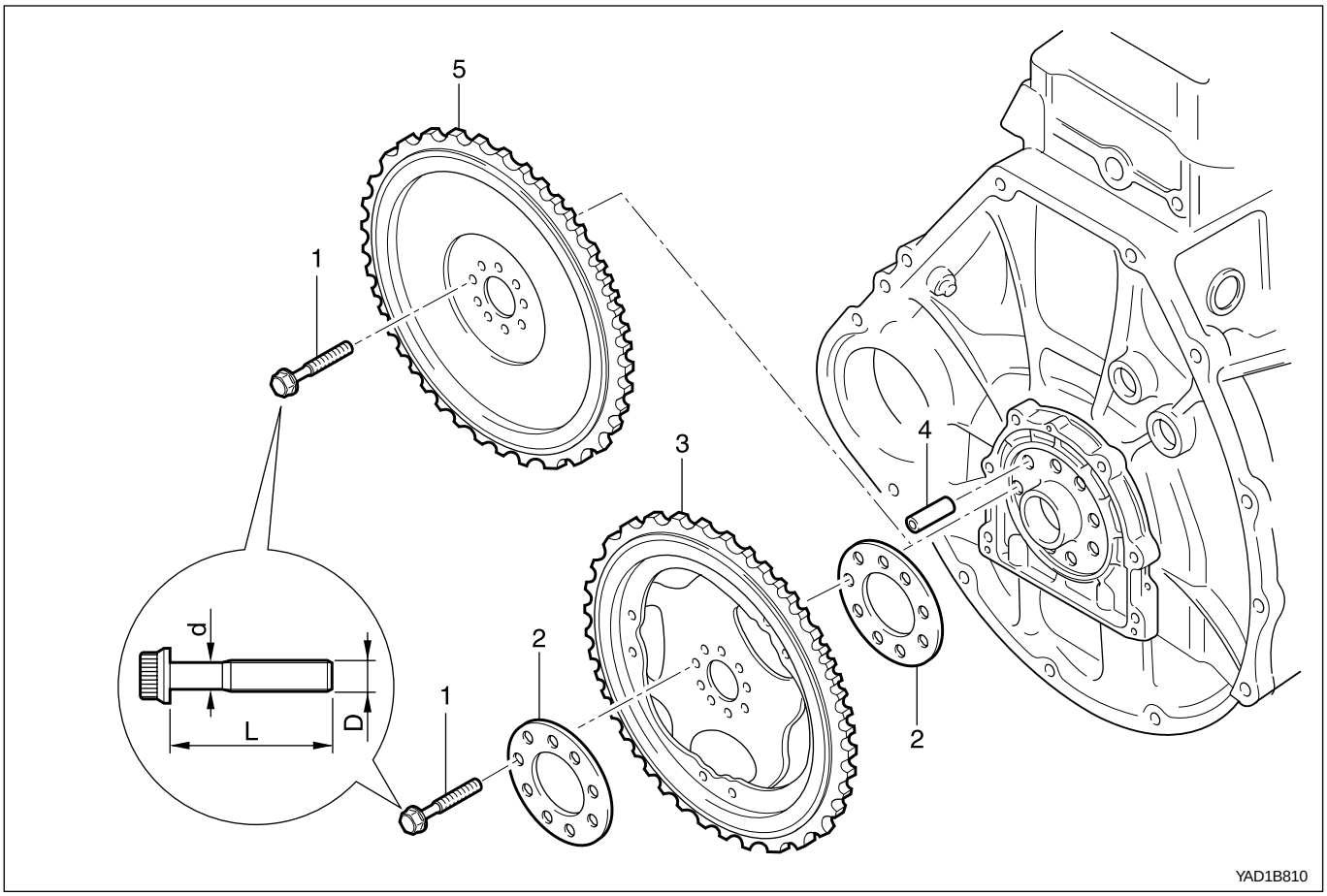
Item	Measuring Position	Gap (mm)
Main Bearing Journal (NO.1,5,7)	Radial	Static condition : 0.015 - 0.039 Dynamic condition : 0.031 - 0.051 (Consider the expansion 0.011 - 0.016)
	Axial	0.010 - 0254

(Connecting Rod Bearing Gap)

Item	Item	Gap (mm)
Connection Rod Bearing	Radial	0.020 - 0.065

FLYWHEEL / DRIVEN PLATE

Preceding Work: Removal of manual or automatic transmission



1 Flywheel Mounting Bolt (M10 x 22, 8 pieces)
..... 1st step 45 + 5 N•m (33 + 3.7 lb-ft)
2nd step 90 ° + 10 °
2 Plate
3 Driven Plate (A/T)
4 Dowel Pin
5 Flywheel (M/T)

Service Data Standard (Stretch Bolt)

Normal Size	D	-	M x 15
Stretch Side Diameter	d	When New	8.5 - 0.2 mm
		Min. Diameter	8.0 mm
Bolt Length	L	When New	21.8 - 22.2 mm
Tightening Torque	1st step 45 + 5 N•m (33 + 37 lb-ft), 2nd step 90° + 10°		

Removal & Installation Procedure

1. Unscrew the flywheel mounting bolt.

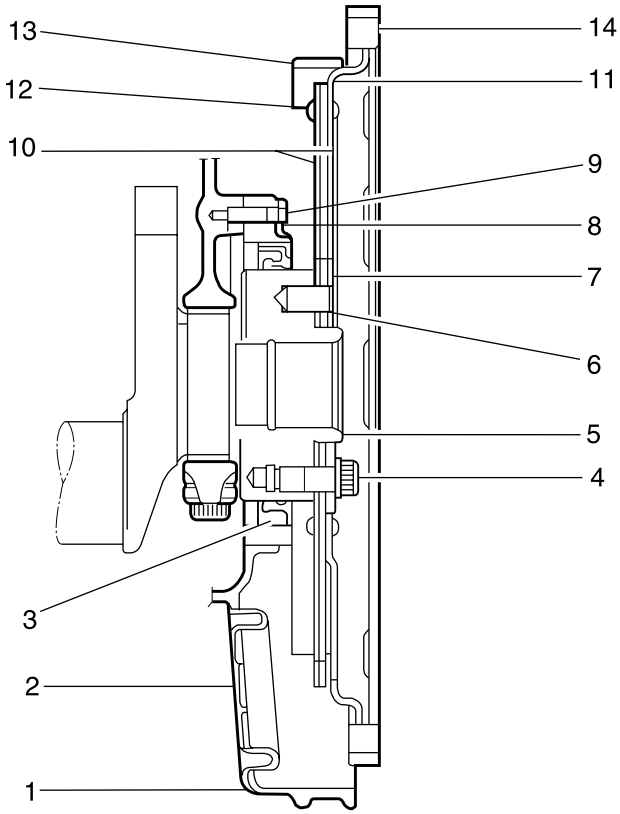
   Installation Notice

Tightening Torque	1st step: 45 + 5 N•m (33 + 3.7 lb-ft)
	2nd step: 90° ± 10°

   - Replace the bolt when the stretch side diameter (d) of the flywheel mounting bolt is less than 8.0mm.
   - For the flywheel mounting bolt tightening, keep the socket wrench and Tommy-bar to be 90° and tighten as specified.

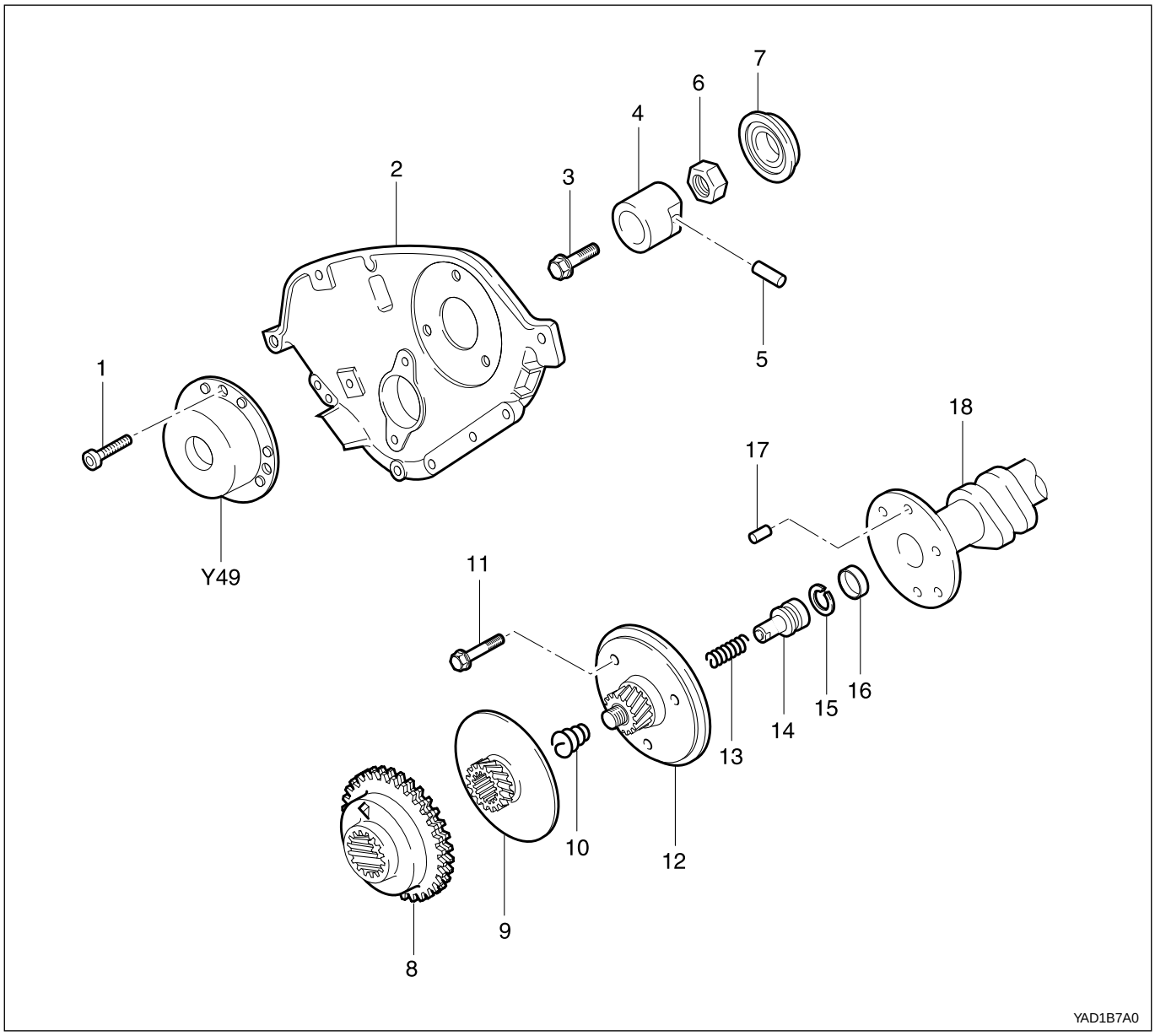
2. Remove the flywheel for manual transmission vehicles, or the driven plate (3), and plate (2) for Auto transmission vehicle.
3. Installation should follow the removal procedure in the reverse order.

Sectional View

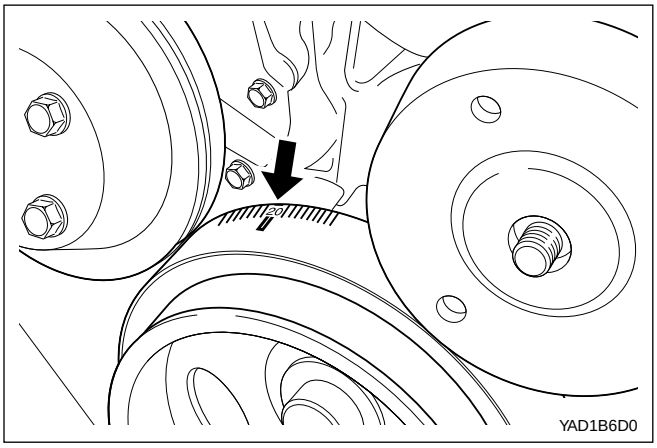


1 OilPan
2 Cover
3 Radial Seal
4 Bolt
5 Crankshaft
6 Dowel Pin
7 Washer (Thickness : 3.5 mm)
8 Washer
9 Bolt
10 Front Drive Plate
11 Rear Drive Plate
12 Rivet
13 Segment
14 Ring Gear

CAMSHAFT ADJUSTER



1 Bolt (M6 X 16, 3 pieces)
..... 9 - 11 N•m (80 - 97 lb-in)
2 Cylinder Head Front Cover
3 Bolt ..... 35 N•m (26 lb-ft)
4 Armature
5 RollPin
6 Nut (M20 X 1.5) ..... 60 - 70 N•m (44 - 52 lb-ft)
7 Seal Cover
8 Camshaft Sprocket
9 Adjust Piston
10 Conical Spring
11 Flange Bolt (M7 X 13, 3 pieces)
..... 1stStep 18 - 22 N•m (13 - 16 lb-ft)
2nd Step 60 ° ± 5 ° Rotation Added
12 Flange Shaft
13 Compression Spring
14 Control Piston
15 Circlip
16 Oil Gallery
17 Straight Pin
18 Intake Camshaft
Y49 Magnetic Actuator (2 - Pin Connector)

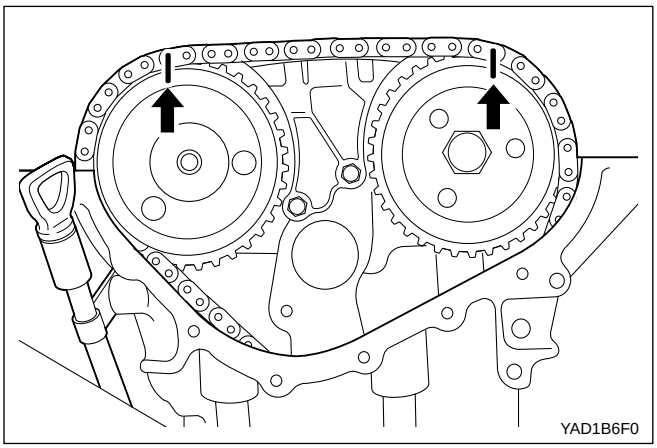


Removal & Installation Procedure

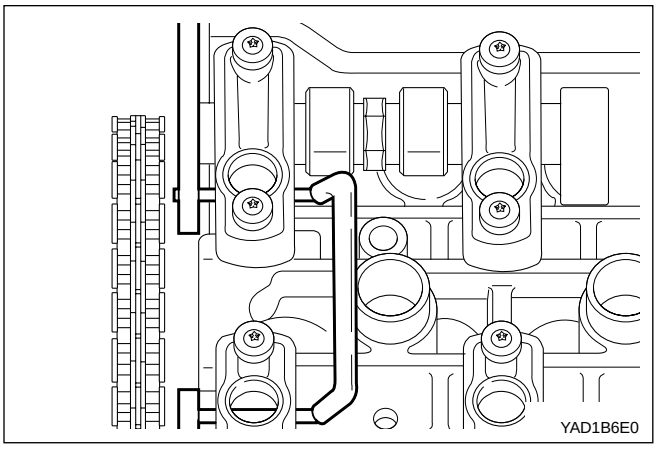
1. Turn the crankshaft and position the no.1 cylinder piston at ATDC 20 ° .

   Notice: Turn the crankshaft in the direction of engine rotation.

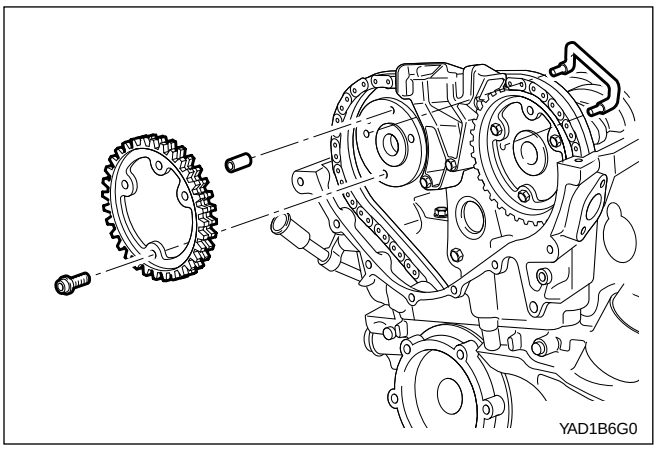
2. Remove the cylinder head front cover.



3. Put the alignment marks (arrows) on the camshaft sprocket and the timing chain.



4. Insert the holding pin 111 589 03 15 00 into the no.1 and no.6 bearing cap hole on camshaft to secure intake and exhaust camshaft.
5. Remove the chain tensioner.

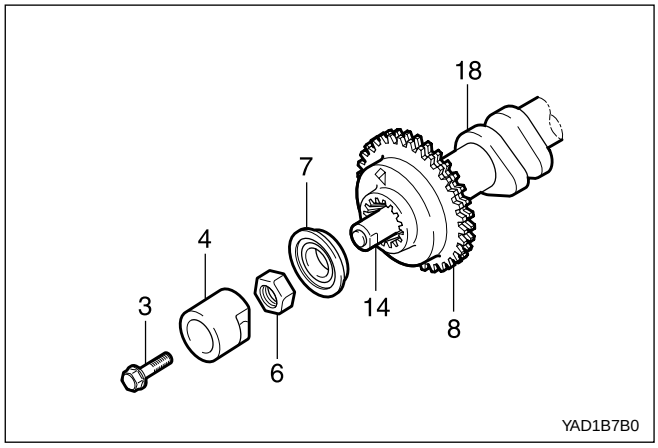


6. Unscrew the exhaust sprocket bolt and remove the exhaust camshaft sprocket.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step:60° ± 5°

Notice: The flange bolt is designed to be used only once, so always replace with new one.



7. Unscrew the bolt (3) from the armature (4) and re ove the roll pin, and remove the armature.

Installation Notice

Tightening Torque	35 N•m (26 lb-ft)

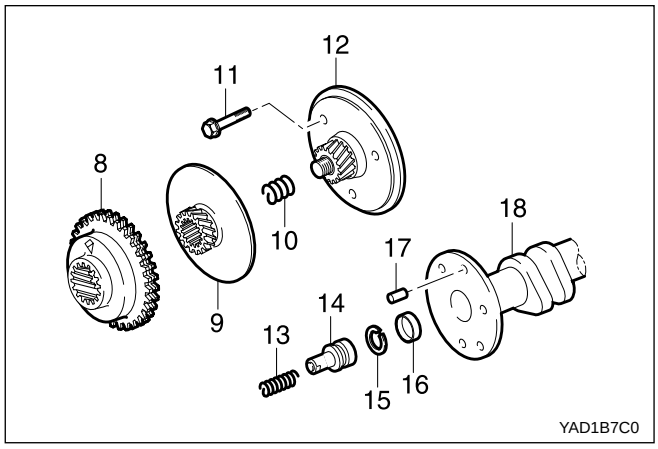
8. Unscrew the nut (6) and remove the seal cover (7).

Installation Notice

Tightening Torque	60 - 70 N•m (44 - 52 lb-ft)

Notice: Put the locking slot of nut toward armarture.

9. Take off the timing chain from intake camshaft sprocket.



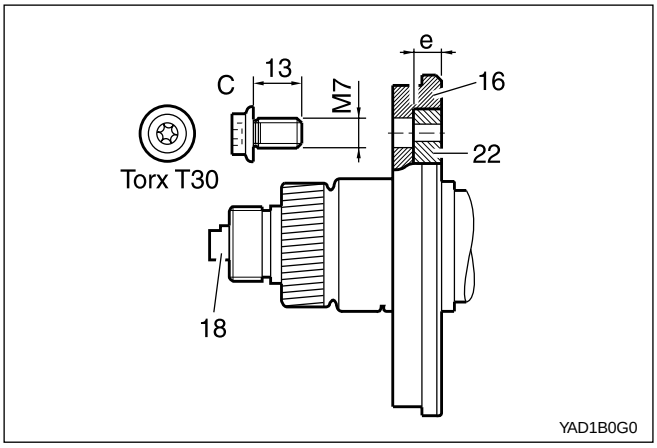
10. Remove the adjuster piston (9) and conical spring (10) from intake camshaft sprocket.
11. Unscrew the bolt (11) and remove the flange shaft.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The flange bolt is designed to be used only once, so always replace with new one.

12. Installation should follow the removal procedure in the reverse order.
13. Check and adjust the camshaft timing.



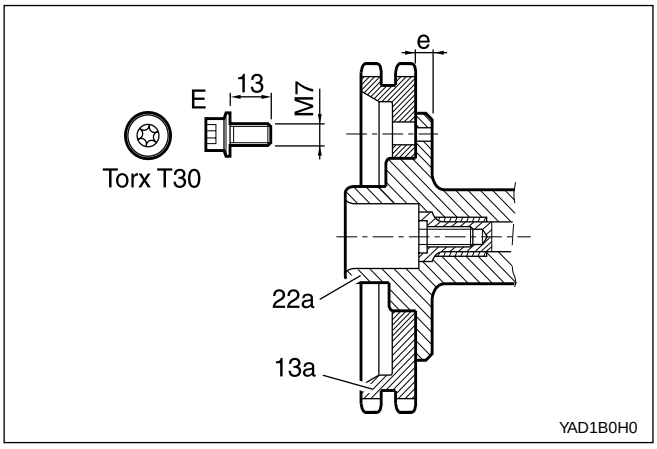
CAMSHAFT SPROCKET BOLT

Intake Flange Shaft Bolt

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The sprocket bolts are designed to be used only once, so always replace with new one.

C. M7 x 13 Collar Bolt Torx-T30
e. 6.8 mm
16. Flange Shaft
18. Control Piston
22. Intake Camshaft



Exhaust Camshaft Sprocket Bolt

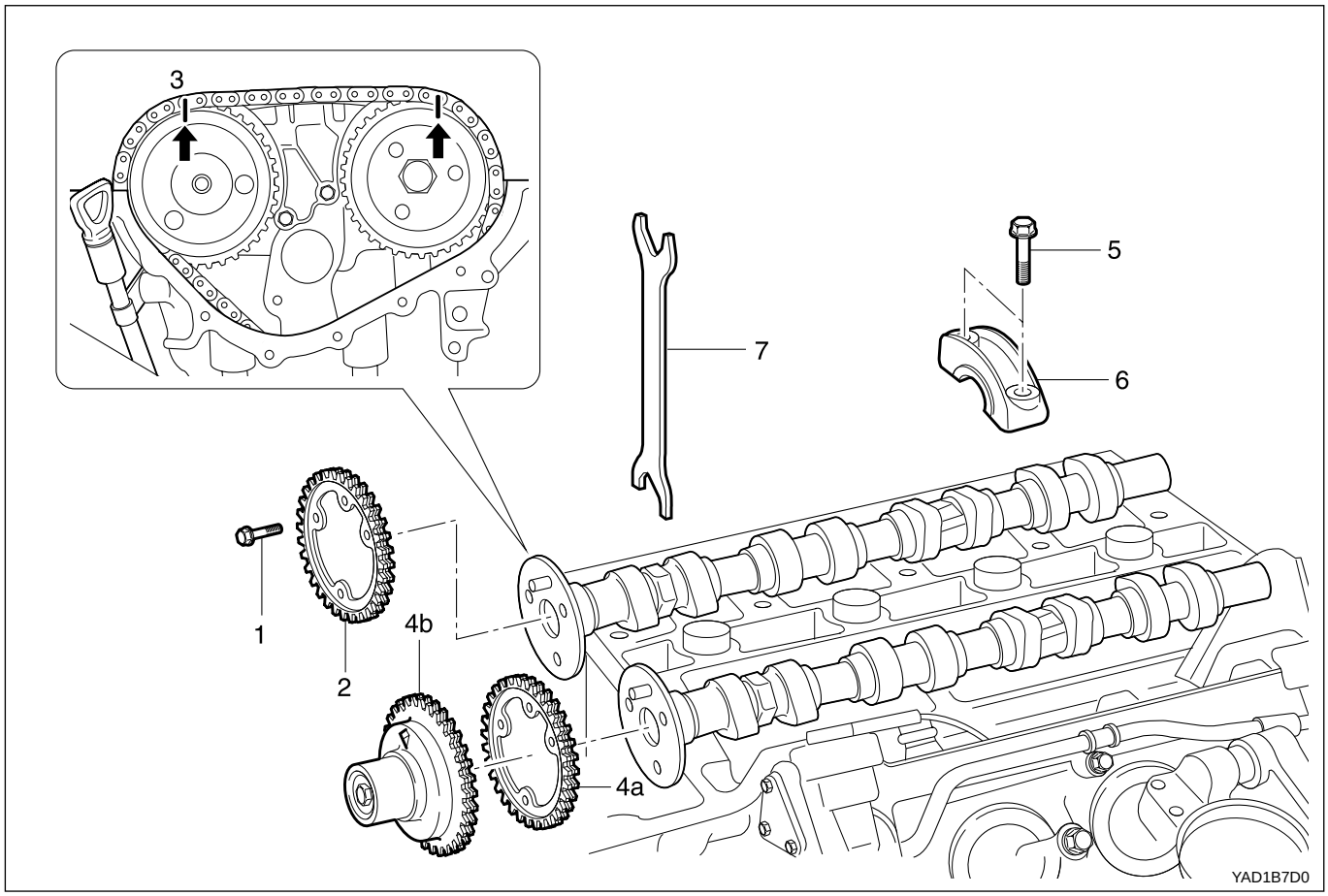
Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The sprocket bolts are designed to be used only once, so always replace with new one.

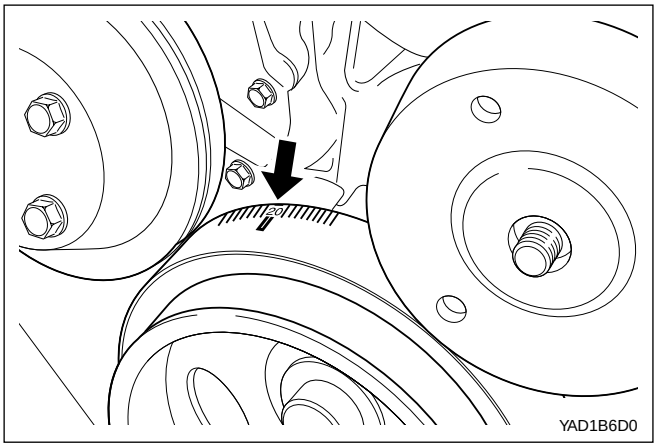
E. M7 x 13 Collar Bolt Torx-T30
e. 6.8 mm
13a. Camshaft Sprocket
22a. Exhaust Camshaft

CAMSHAFT

Preceding Work: Removal of cylinder head cover
Removal of camshaft adjust actuator and cylinder head front cover

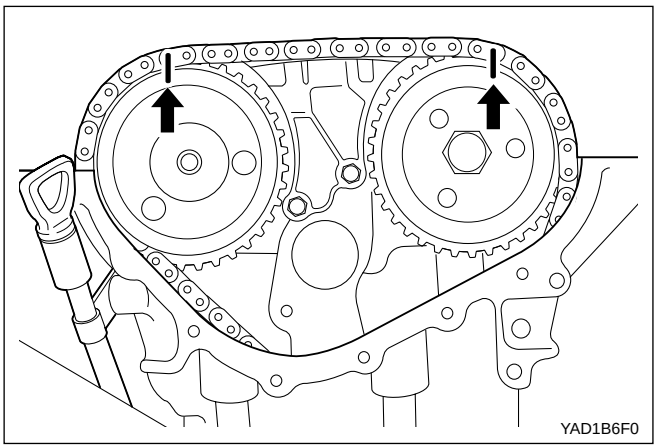


1 Bolt (M7 X 13, 3 pieces)
..... 1st Step 18 - 22 NSm (13 - 16 lb-ft)
2nd Step 60 ° ± 5 ° Rotation Added
2 Exhaust Camshaft Sprocket
3 Timing Chain
4a Intake Camshaft Spocket (E20)
4b Camshaft Adjuster and Camshaft Sprocket (E23)
5 Bearing Cap Bolt (20 pieces)
..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
6 Camshaft Bearing Cap
7 Wrench



Removal & Installation Procedure

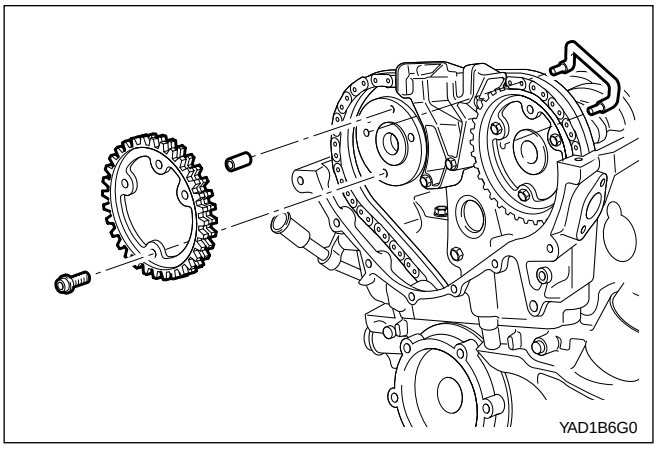
1. Turn the crankshaft and position the no.1 cylinder piston at ATDC 20 ° .



2. Put the alignment marks (arrows) on the camshaft sprocket and the timing chain.
3. Remove the chain tensioner.

Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)



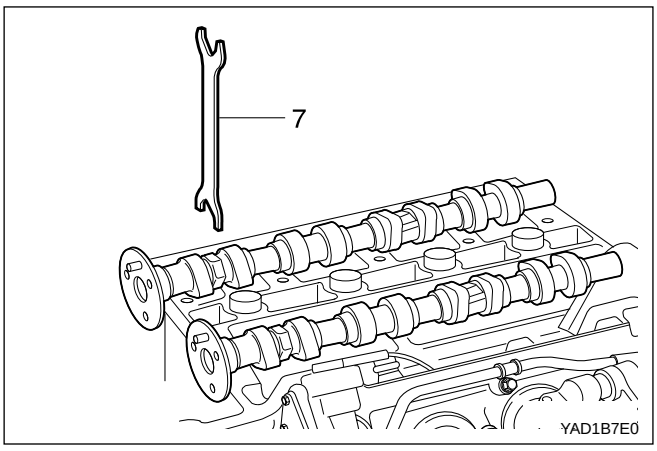
4. Remove the exhaust camshaft sprocket.

Installation Notice

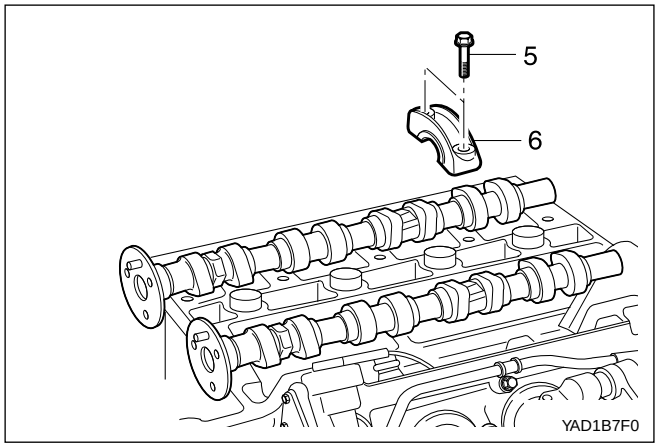
Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The sprocket bolt is designed to be used only once, so always replace with new one.

5. Take off the timing chain from intake camshaft sprocket, and secure it not to fall down into the timing gear case.



6. Using the wrench (7), turn the camshaft until there is no resistence in camshaft bearing area.



7. Remove the bearing cap, and remove the intake and the exhaust camshaft.

   Installation Notice

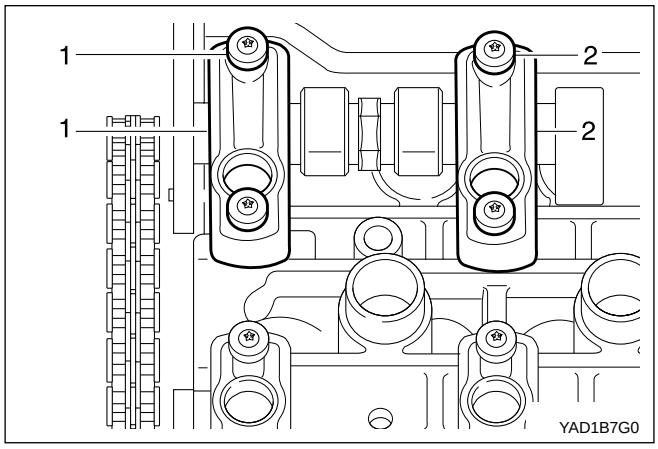
Tightening Torque	60 - 70 N•m (44 - 52 lb-ft)

   Notice: Check the numbers on the bearing cap not to be mixed up.

8. Apply the engine oil on the valve tappet and camshaft bearing.
9. Installation should follow the removal procedure in the reverse order.

   Notice:

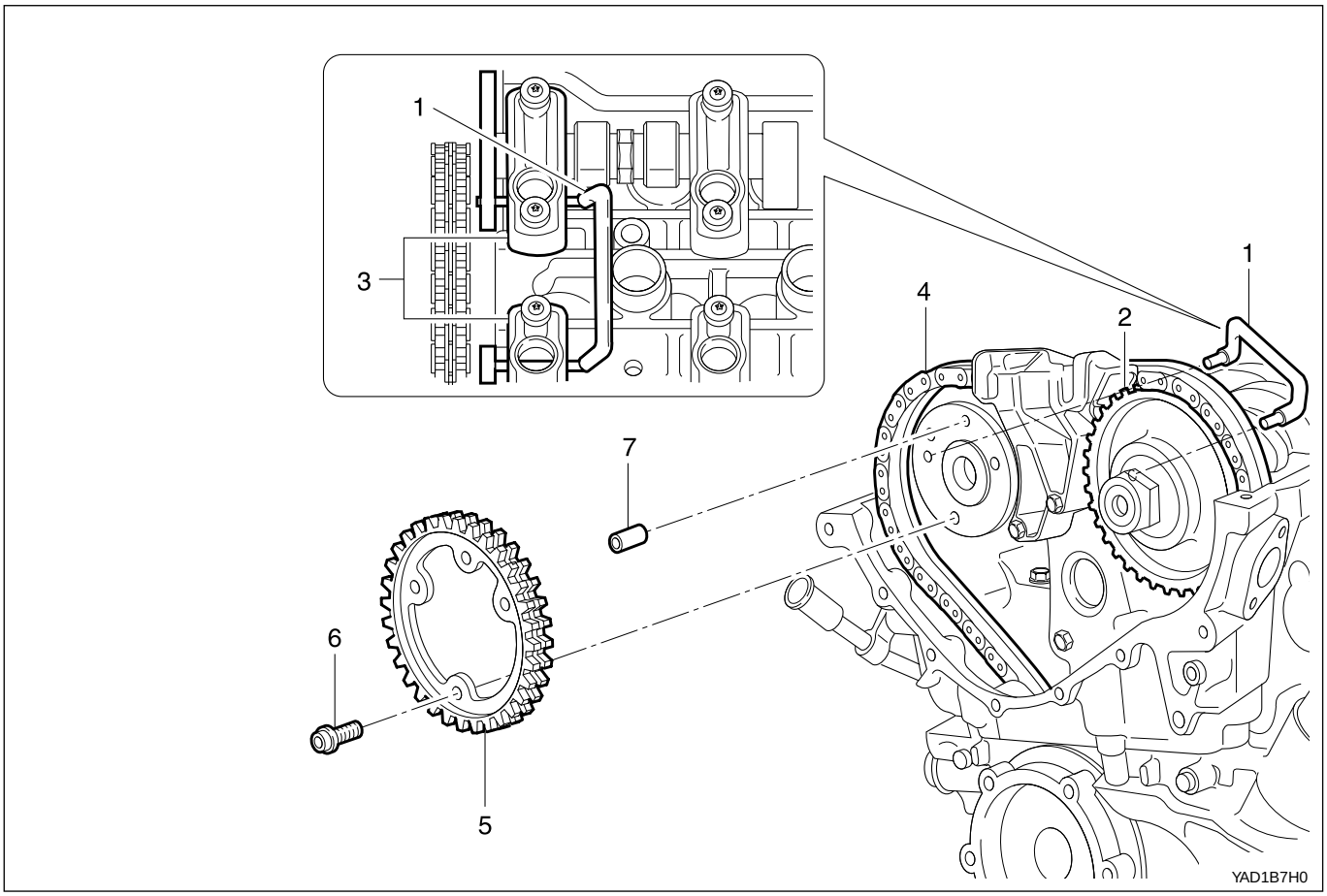
   - Base circle of cam should cantact with the valve tappet.
   - Install the camshaft bearing caps according to the numbers on the cylinder head cast and bearing cap.



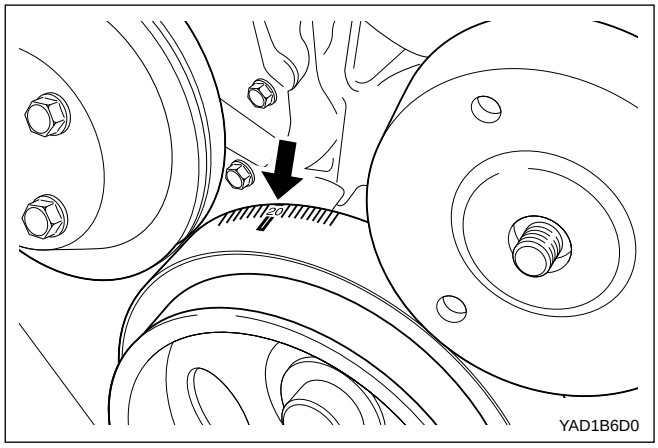
10. Check the camshaft timing position.

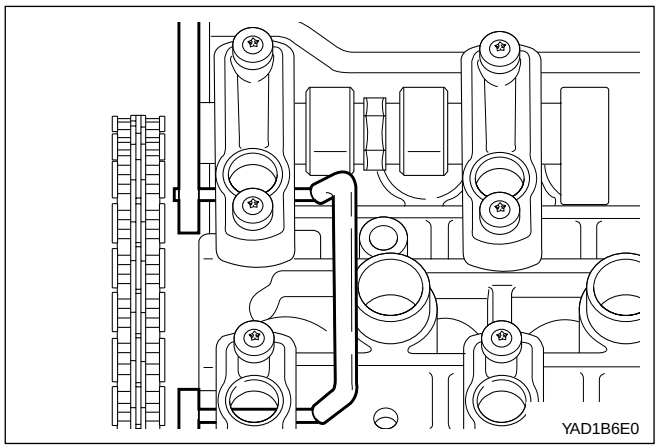
CAMSHAFT TIMING POSITION

Preceding Work: Removal of cylinder head cover
Removal of cylinder head front cover



1 Holding Pin 111 589 03 15 00
2 Intake Camshaft Sprocket
3 Camshaft Bearing Cap
4 Timing Chain
5 Exhaust Camshaft Sprocket
6 Bolt (M7 X 13, 3 pieces)
..... 1ststep 18 - 22 NSm (13 - 16 lb-ft)
2nd step 60 ° ± 5 ° rotation added
7 StratePin





Tools Required

111 589 03 15 00 Holding Pin

Inspection Procedure

1. Position the NO.1 cylinder piston to ATDC 20 ° by turning the crankshaft.

   Notice: When the ATDC 20 °mark on vibration damper is aligned with timing gear case cover, the intake and ex-haust cam of cylinder will make the slope to the center and will face up. In this way, the insert hole in NO.1 and NO.4 camshaft bearing cap will match in line with the flange hole for camshaft sprocket.

2. Check the timing as below procedure;
   - Check if the holding pin 111 589 03 15 00 can be inserted into the NO.1 and NO.4 bearing cap hole.
   - At this condition, check if the ATDC 20 °mark on vibration damper aligns with the marker on the timing gear case.

Adjustment Procedure

1. Position the NO.1 cylinder to ATDC 20 °.
2. Remove the chain tensioner.
3. Remove the exhaust camshaft sprocket.
4. Adjust the timing position with inserting the holding pin 111 589 03 15 00 into the NO.1 and NO.4 camshaft bearing cap hole and flange hole while rotating the camshaft by using wrench.
5. Install the chain to the intake camshaft sprocket.
6. Install the chain to the exhaust camshaft sprocket and tighten the bolt.

   Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 90° ± 5°

   The sprocket bolt is designed to be used only once, so replace with new one.

7. Install the chain tensioner.

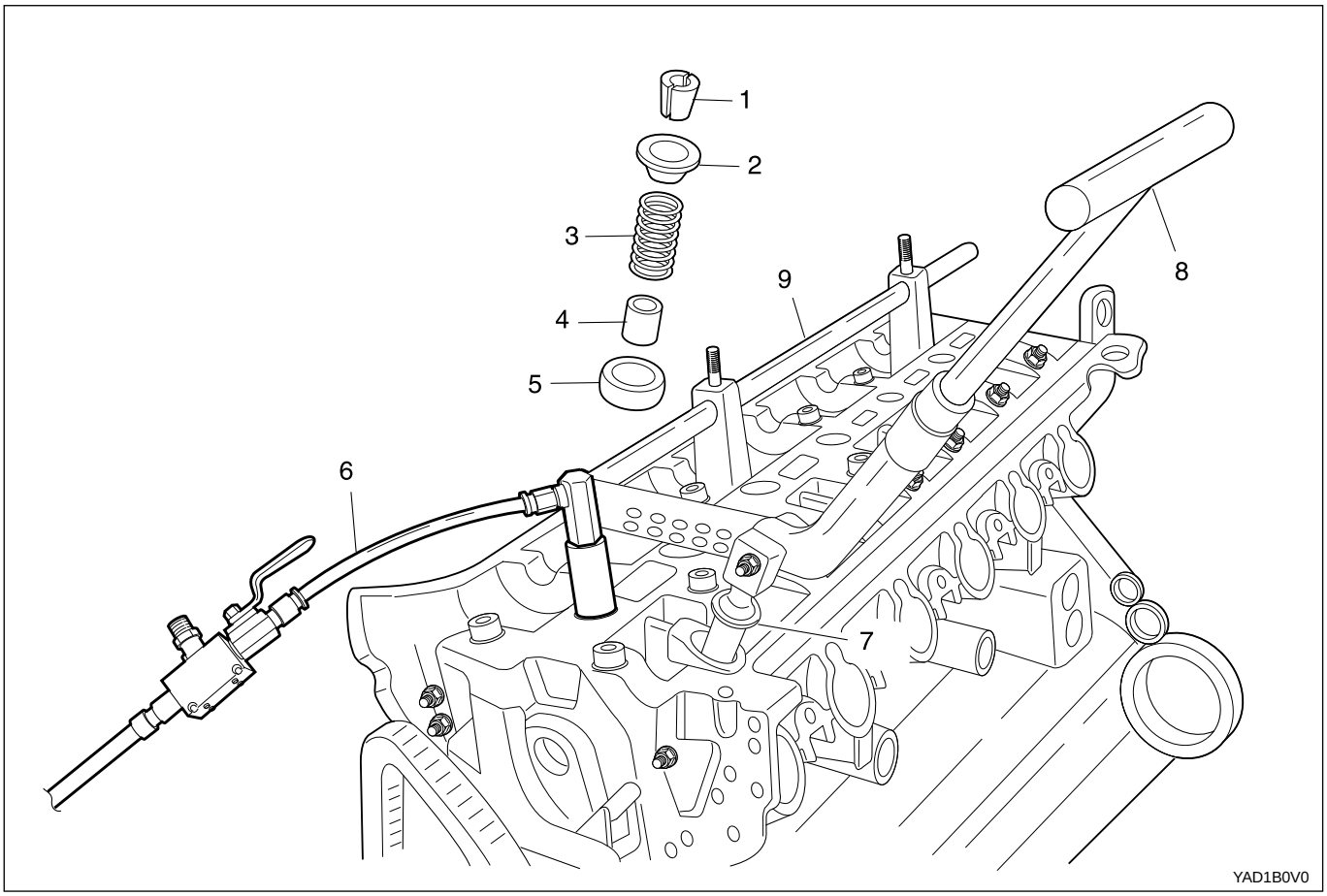
   Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

8. Check the camshaft timing.

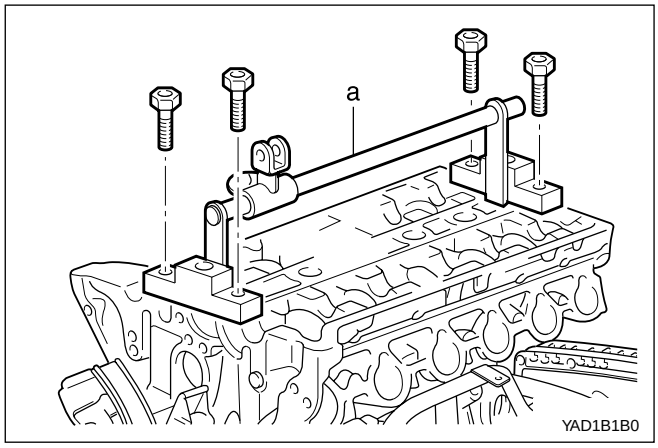
VALVE SPRING

Preceding Work: Removal of camshaft
Removal of spark plug



1 Valve Cotter
2 Valve Spring Retainer
3 Valve Spring
4 Valve Stem Seal
5 Lower Retainer

a Lever Pusher 111 589 18 61 00
b Thrust Piece 111 589 25 63 00
c Connecting Hose DW 110 - 090
d Supporting Bar 111 589 01 59 00



Tools Required

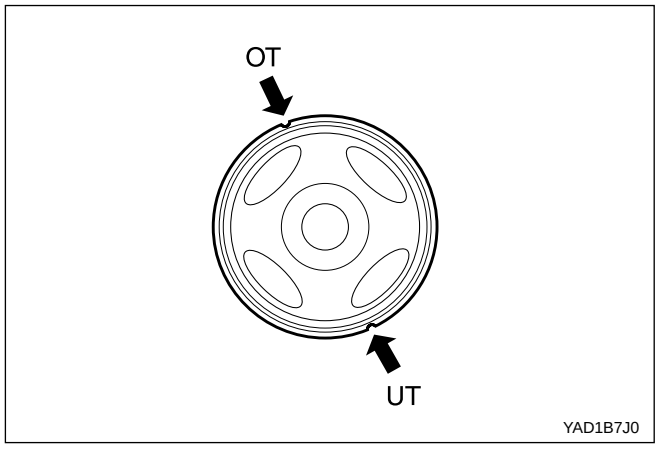
111 589 01 59 00	Supporting Bar
111 589 18 61 00	Lever Pusher
111 589 25 63 00	Thrust Piece
602 589 00 40 00	Engine Lock
DW110 - 090	Connecting Hose
DW110 - 100	Valve Tappet Remover

Removal & Installation Procedure

1. Place the supporting bar 111 589 01 59 00 (a) at the camshaft bearing cap and tighten them with the bearing cap bolt.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

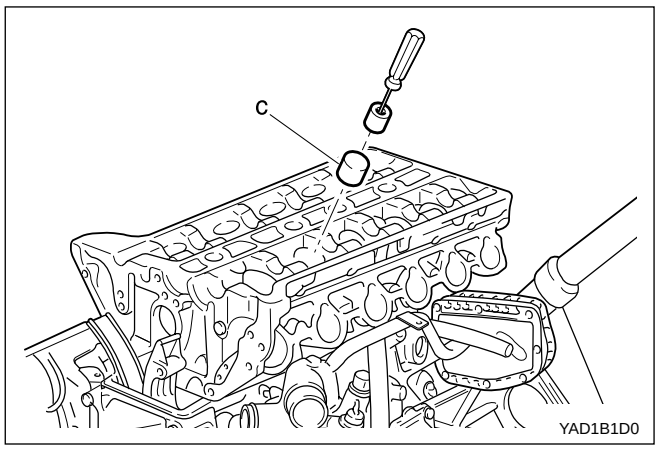


2. Turn the crankshaft to position the each cylinder piston at TDC.

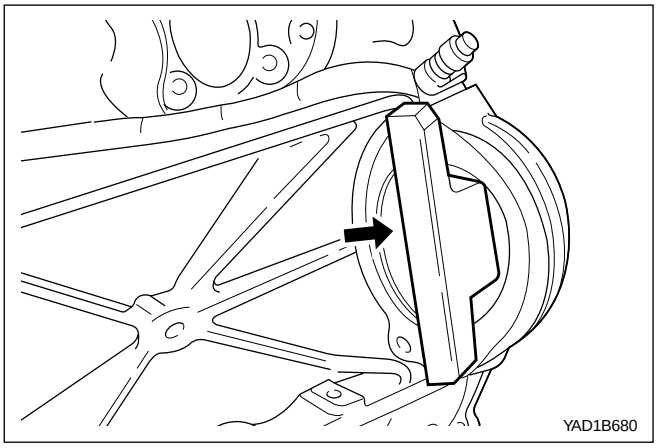
Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 90° ± 5°

Notice:

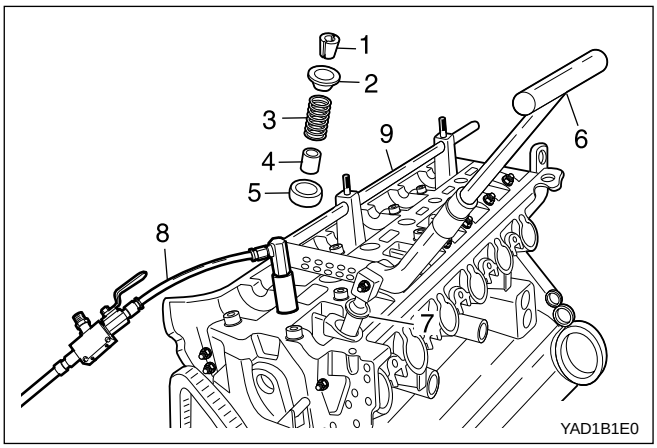
- Remove the valve spring only at TDC.
- Always rotate the crankshaft by holding the chain to prevent from timing chain damage and tangling, and for smooth rotation.



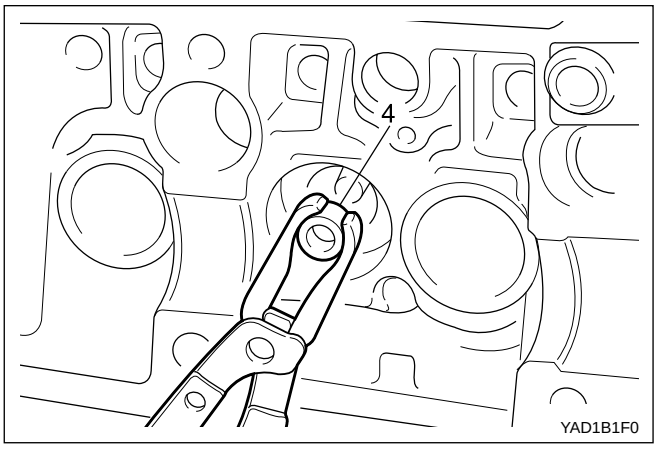
3. Remove the valve tappet using the valve tappet remover DW110 - 100.
4. Install the connecting hose DW110 - 090 (c) to the spark plug hole.



5. Install the engine lock 602 589 00 40 00 to the ring gear to prevent the crankshaft from rotating.
6. Blow up with compressed air.



7. Install the supporting bar 111 589 01 59 00 (d) and the lever pusher 111 589 18 61 00 (a).
8. Mount the thrust piece 111 589 25 63 00 (b) vertically to the valve spring retainer (2).
9. Press the valve spring (3) by using the lever pusher 111589 18 61 00 (a).
10. Remove the valve cotter (1) using the pincette.
11. Remove the upper retainer (2) and the valve spring (3).



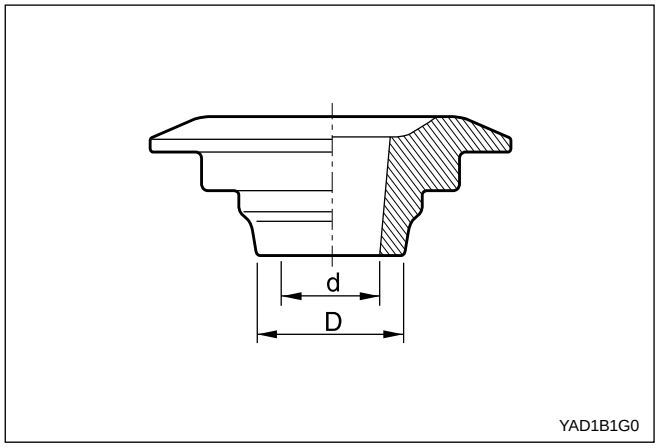
12. Remove the valve stem seal (4) and replace if necessary.

    Notice: Check the valve stem seal for damage and replace if necessary.

13. Remove the lower retainer (5).

    Notice: Check the retainer for damages and replace with a new one if necessary.

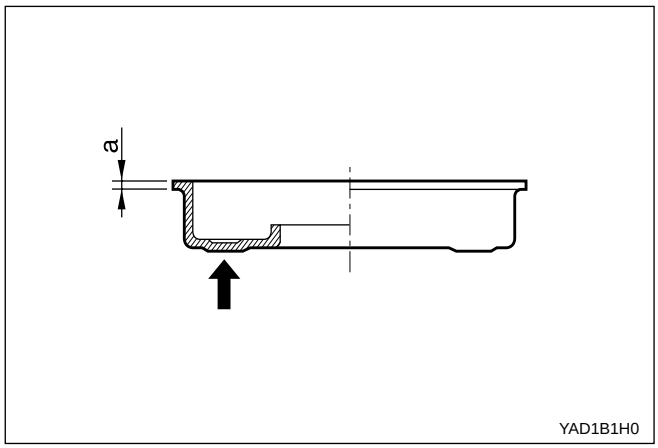
14. Installation should follow the removal procedure in the reverse order.



Test (Upper and Lower Valve Tappet and Valve Cotter)

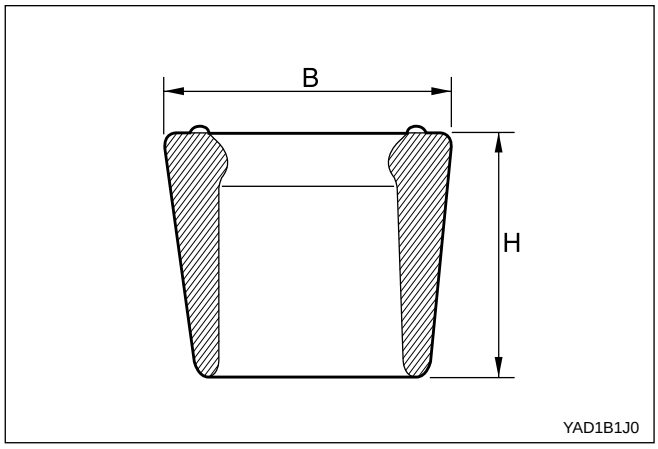
- Upper Valve Spring Retainer

Size (mm)	(d)	8.5
	(D)	12.3



- Lower Valve Spring Retainer

Size (mm)	(a)	0.8 - 1.0

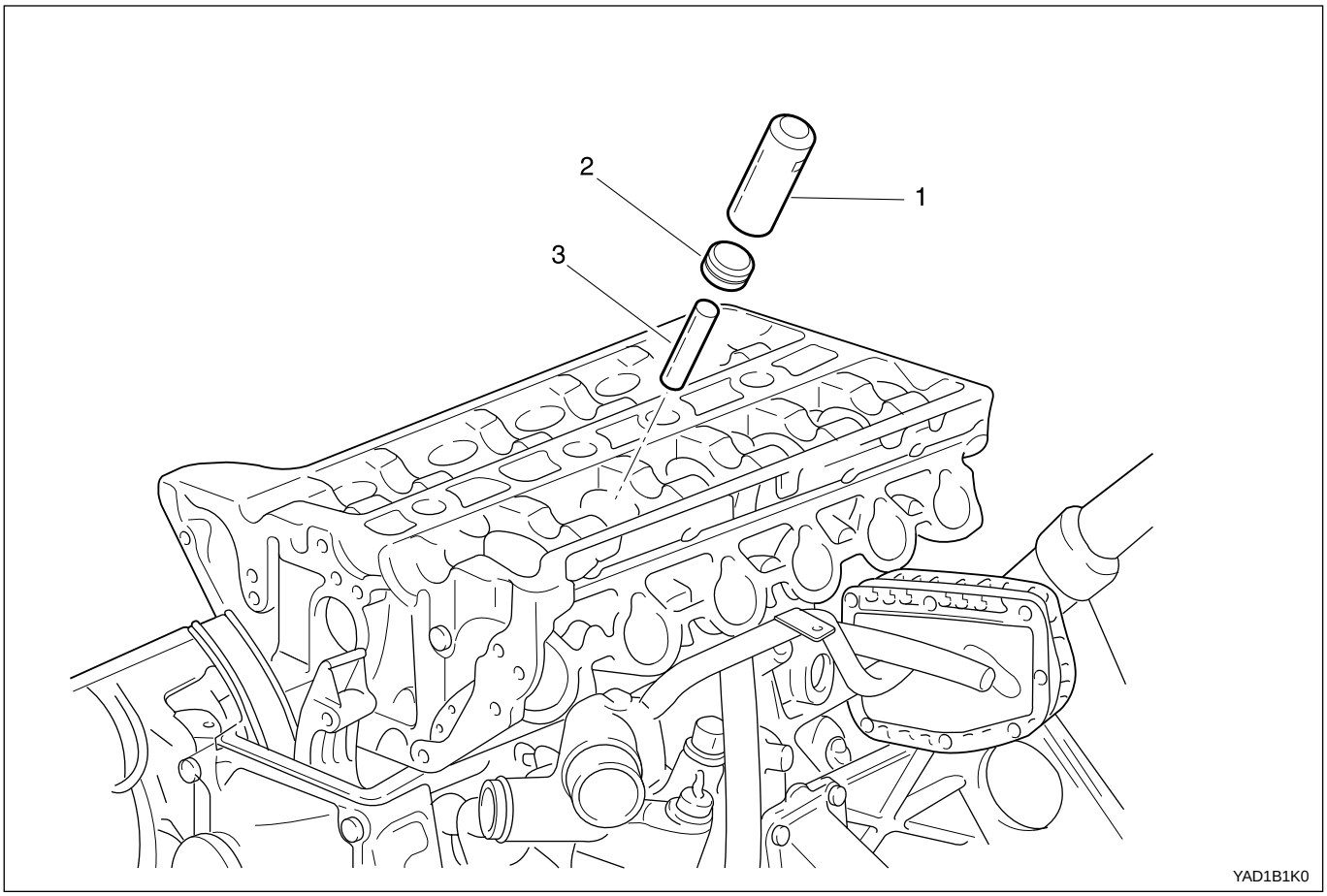


- Valve Cotter

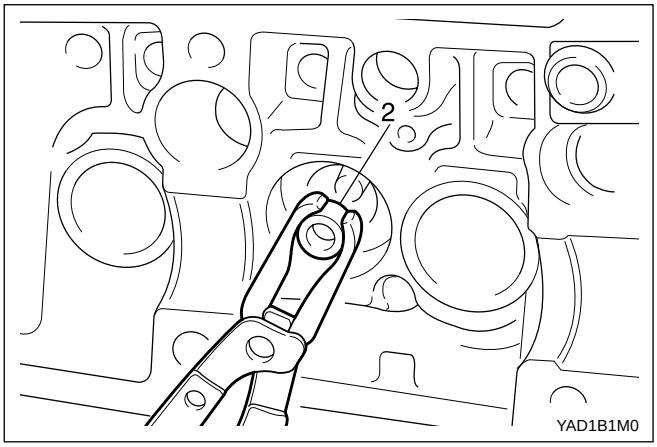
Size (mm)	(B)	9.0
	(H)	9.2 - 9.8

VALVE STEM SEAL

Preceding Work: Removal of valve spring



1 Drift 119 589 00 43 00
2 Valve Stem Seal
3 Protective Sleeve



Tools Required

119 589 00 43 00 Drift

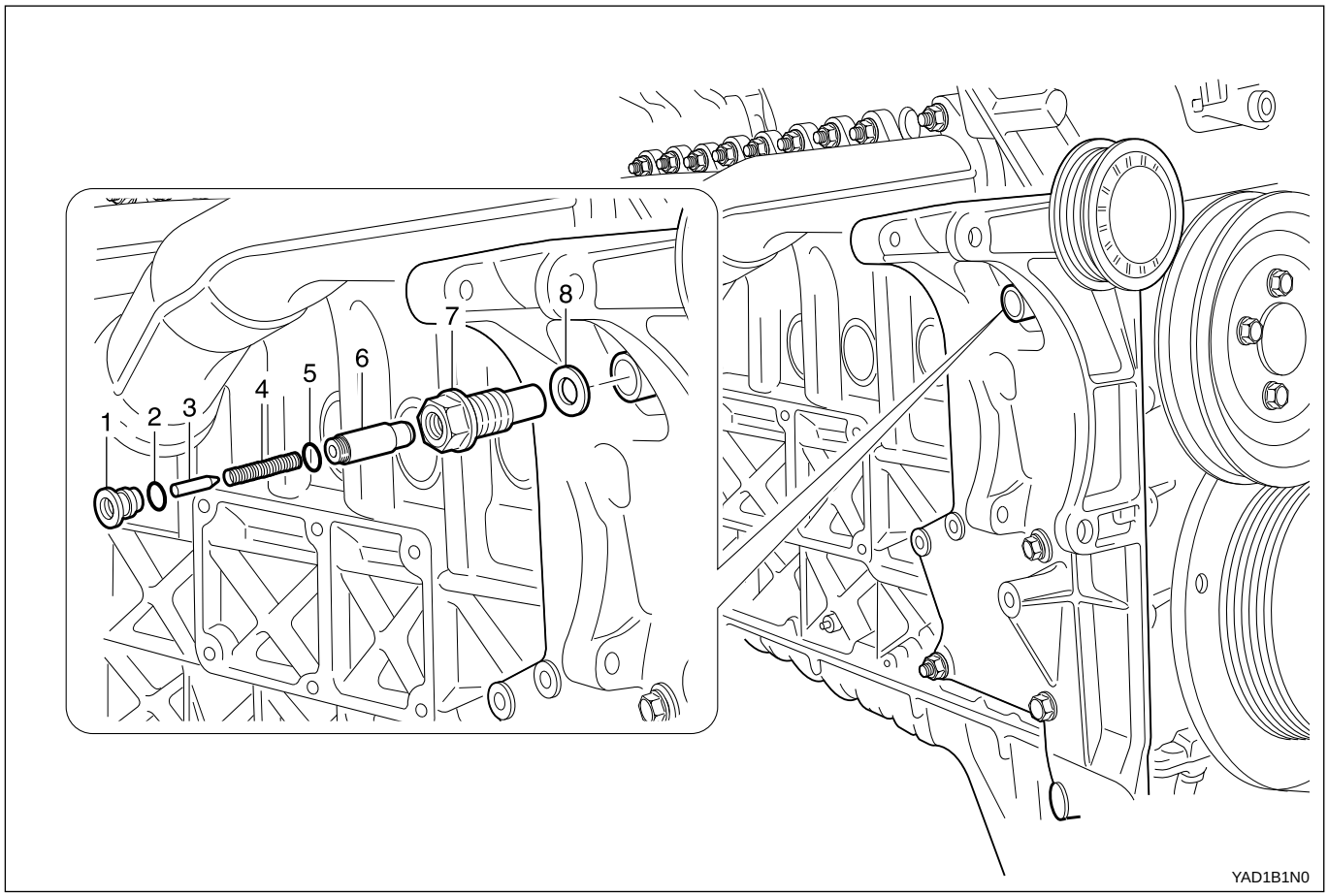
Replacement Procedure

1. Remove the valve stem seal (2) using the pliers.

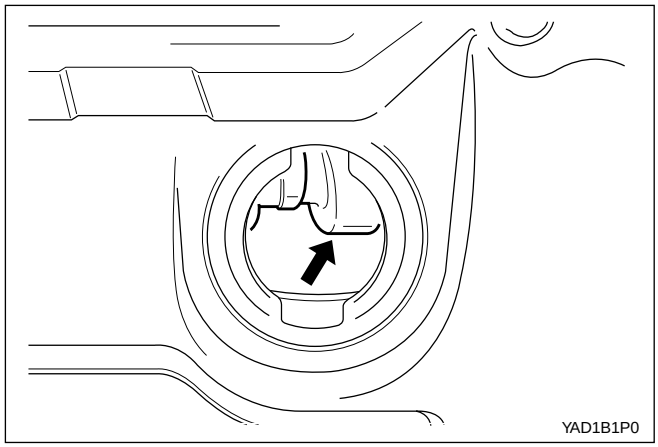
   Notice: Check the valve stem seal for damage and replace if necessary.

2. Coat the valve stem seal with oil and assemble it with the protective sleeve.
3. Insert the valve stem seal by pressing it with the drift 119 589 00 43 00.

CHAIN TENSIONER



1 Screw Plug ..... 40 N•m (30 lb-ft)
2 Seal
3 Filler Pin
4 Compression Spring
5 Snap Ring
6 Thrust Pin
7 Chain Tensioner Housing
..... 72 - 88 N•m (53 - 65 lb-ft)
8 Seal



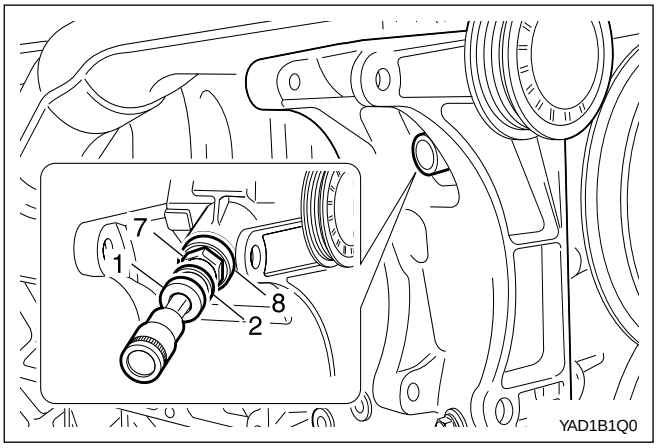
Removal Procedure

1. Position the number 1 cylinder to ATDC 20 ° .

   Notice: Remove the oil filler cap at adjustment position, and check whether the intake camshaft cam's lobe (arrow) stays in the upper side.

2. Cover the generator with a clean cloth.
3. Release the tension by unscrewing the screw plug once.

   Notice: In case that the tension is reduced by unscrewing the screw plug, reinstall after completely removing the chain tensioner. If the chain tensioner is tightened again without completely reducing its tension, then the snap ring doesn't return to the original position and the tension gets exceeded.

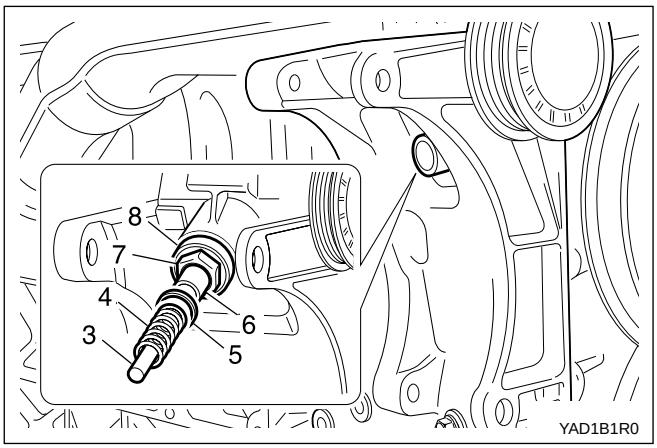


4. Carefully unscrew the screw plug (1), and remove the seal (2).

   Notice:

   - For the removal of screw plug, be careful that it can be jumped out due to the force of compression spring.
   - Remove the screw plug only when the seal and compression spring are damaged.

5. Carefully remove the filler pin (3), compression spring (4), snap ring (5), and the thrust pin (6).

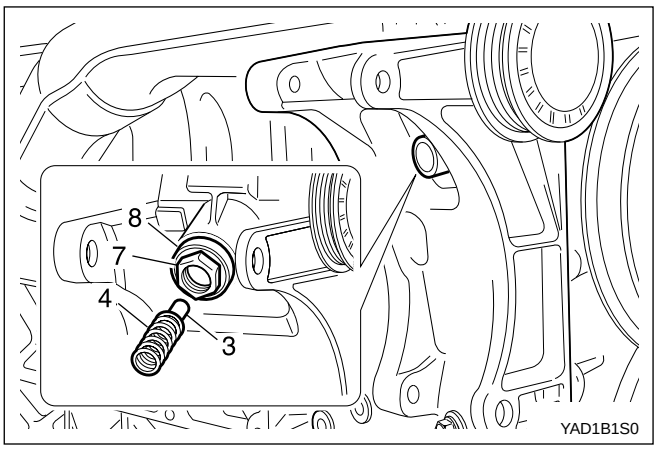


6. Remove the chain tensioner housing (7) and the seal (8).

Installation Procedure

1. Connect the thrust pin (6) and the snap ring (5) to the chain tensioner housing (7).

   Notice: When connecting the thrust pin, push in the thrust pin far enough so that it doesn't protrude at the chain tensioner housing.

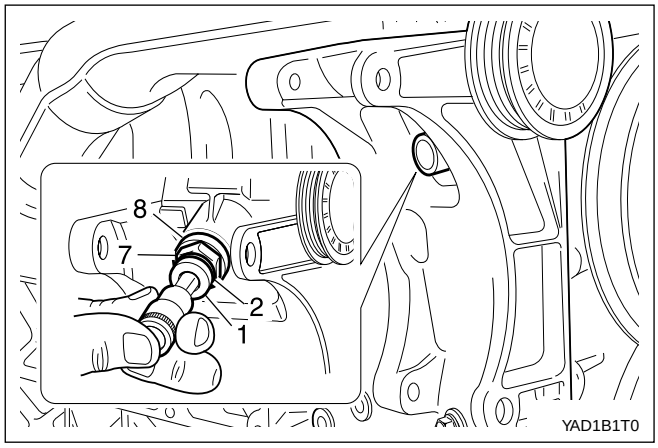


2. Install the chain tensioner housing (7), thrust pin (6), snap ring (5), and the seal (8).

   Installation Notice

Tightening Torque	72 - 88 N•m (53 - 65 lb-ft)

3. Insert the compression spring (4) with the filler pin (3) into chain tensioner housing.



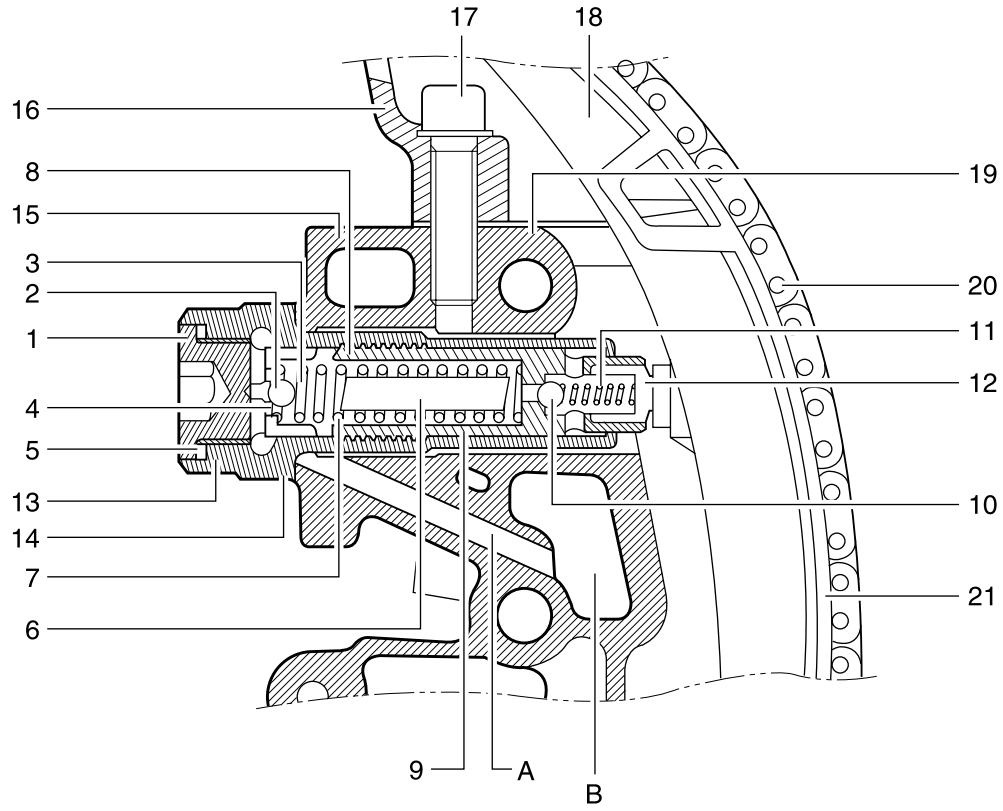
4. Lightly apply the grease to the seal (2) and install the screw plug (1).

   Installation Notice

Tightening Torque	40 N•m (30 lb-ft)

5. Check for leaks by operating the engine.

Sectional View

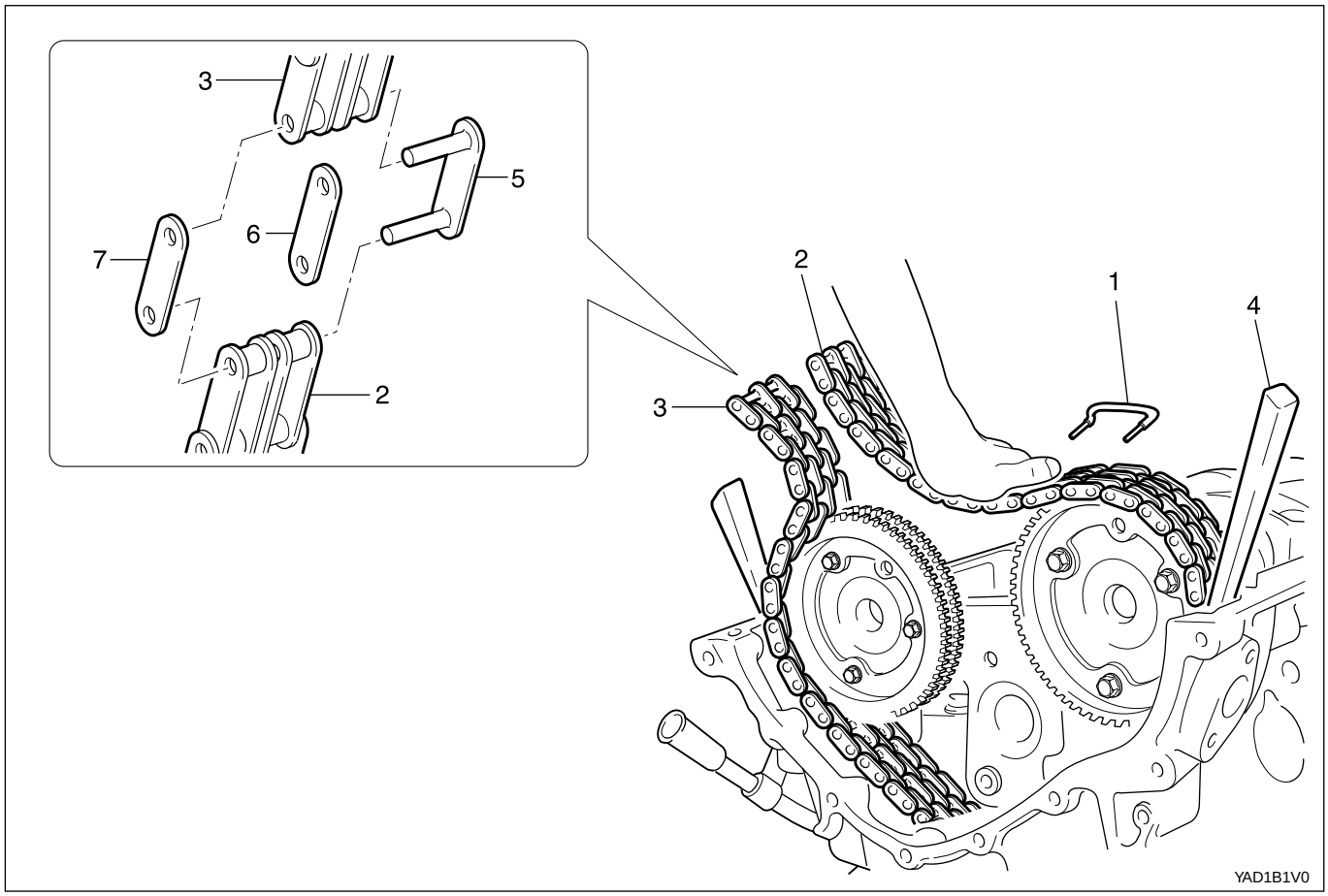


1 Screw Plug
2 Ball (Nonreturn Valve)
3 Compression Spring
4 Ball Guide
5 Seal (Aluminum)
6 Filler Pin
7 Compression Spring
8 Snap Ring
9 Thrust Pin
10 Ball (Nonreturn Valve)
11 Compression Spring
12 Thrust Piece
13 Chain Tensioner Housing
14 Seal
15 Timing Gear Case Cover
16 Cylinder Head
17 Bolt / Washer
18 Tensioning Rail
19 Cylinder Head Gasket
20 Timing Chain
21 Tensioning Rail Base (Sliding Surface)

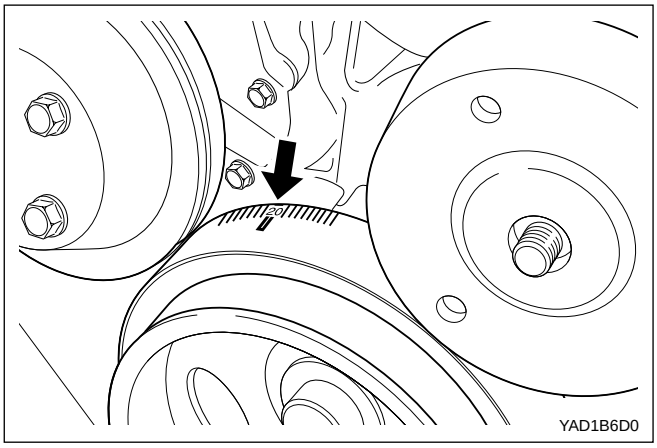
A Oil Supply Hole
B Chain Tensioner Oil Storage Hole

TIMING CHAIN

Preceding Work: Removal of cylinder head cover
Removal of spark plug



1 Pin
2 New Timing Chain
3 Timing Chain (Used)
4 Wedge
5 Link
6 Center Plate
7 Outer Plate



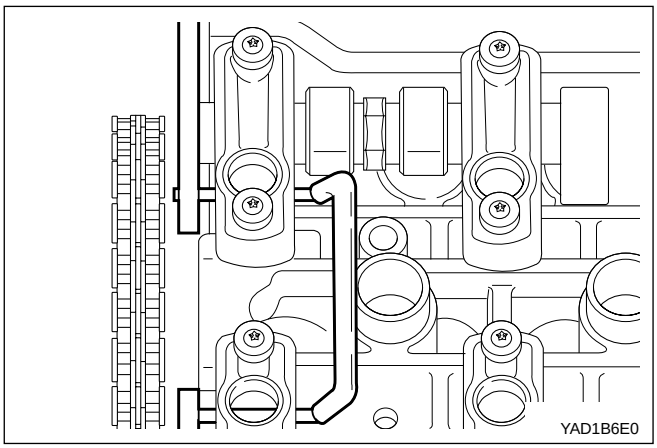
Tools Required

000 589 58 43 00 Chain Assembly

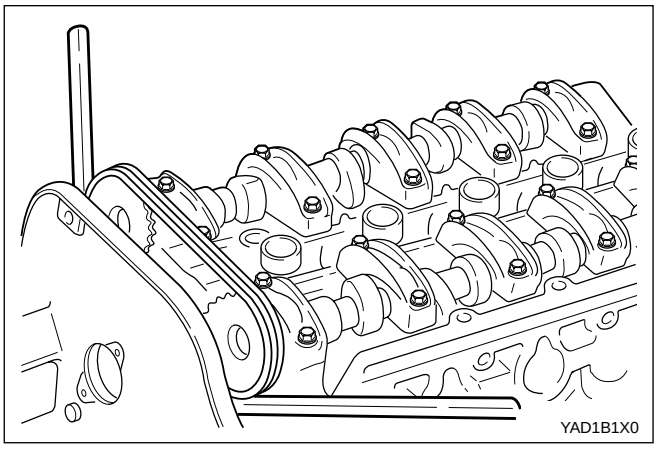
111 589 03 15 00 Holding Pin

Replacement Procedure

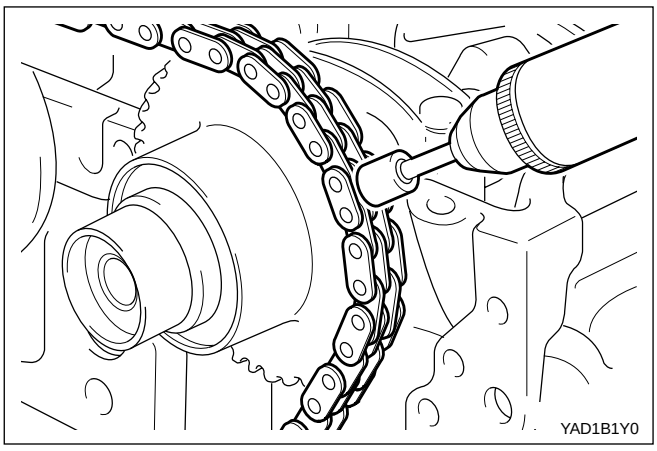
1. Position the NO.1 cylinder to ATDC 20 ° .



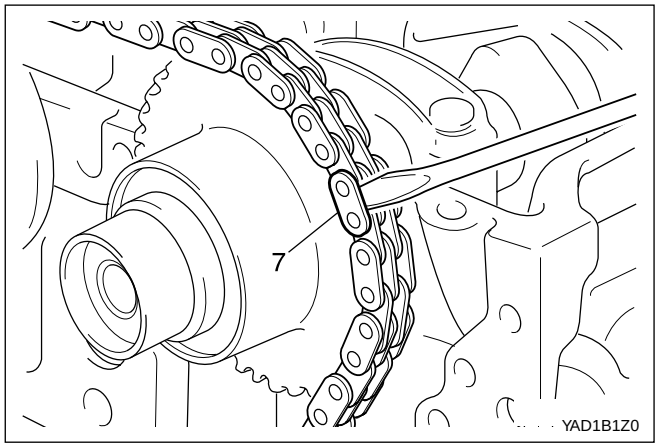
2. Insert the holding pin 111 589 03 15 00 to the intake and exhaust camshaft flange not to rotate camshaft.
3. Remove the chain tensioner.



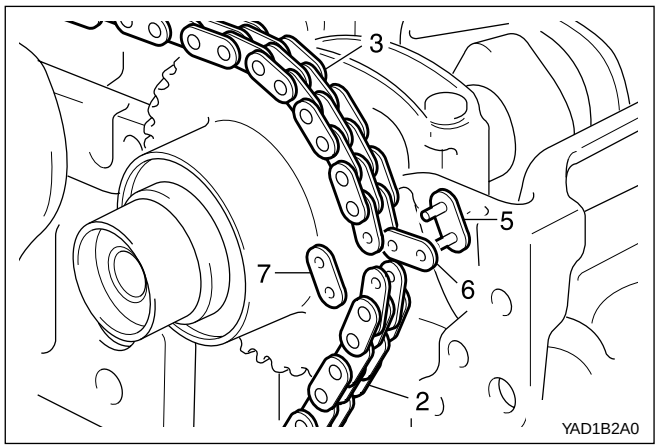
4. Mount the wedges to both sides of the camshaft sprocket as shown in the figure.



5. Cover the chain housing with a clean cloth, and grind off the timing chain pin from the intake camshaft sprocket with the grinder.



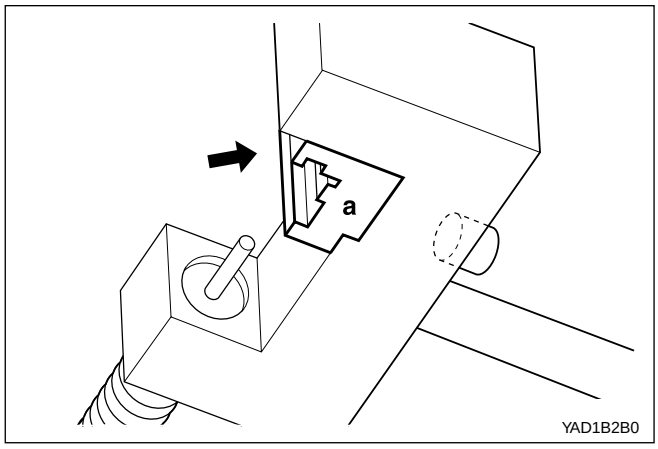
6. Remove the outer plate (7) with the screw driver and remove the link (5).

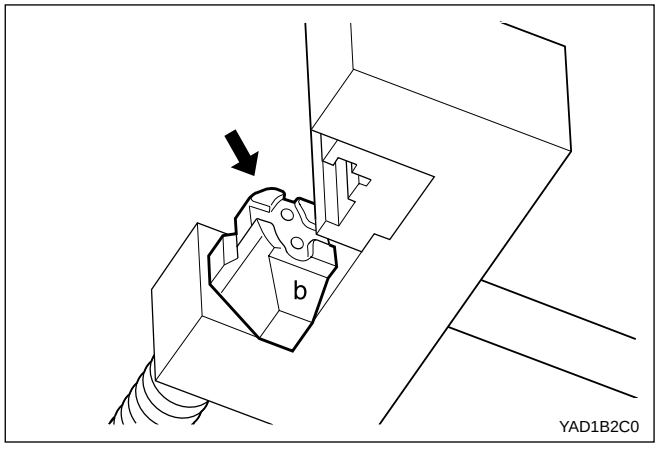


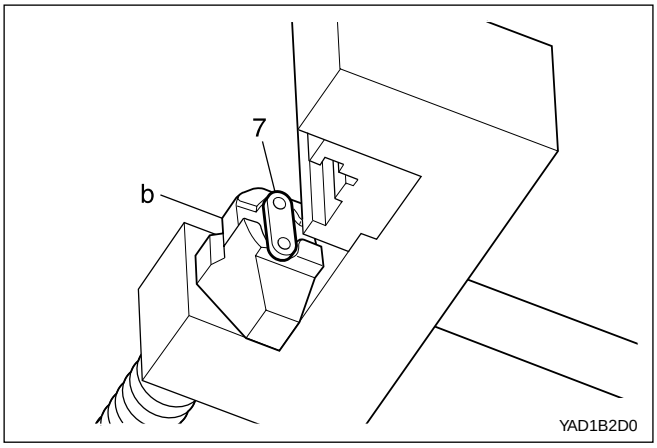
7. Connect the new timing chain (2) to the used timing chain (3) with the link (5), center plate (6, thickness 1.6 mm), and the outer plate (7).
8. Rotate the crankshaft in the direction if engine revolution by pressing the new timing chain against the exhaust camshaft sprocket to prevent it to be tangled.

   Notice: Be sure to remove the wedge before cranking the engine.

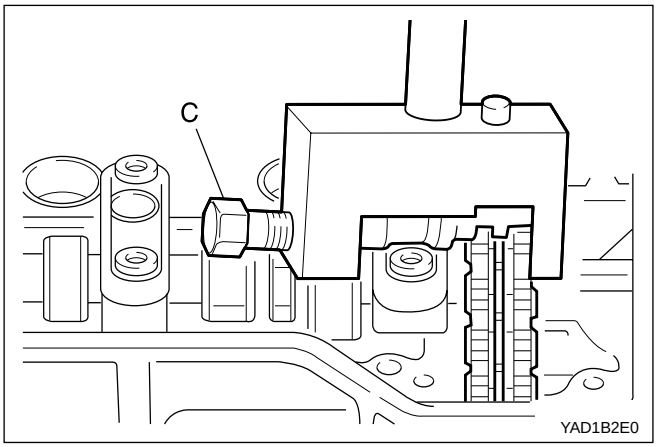
9. Take out the used timing chain out from the chain housing.
10. Connect both separators of the new timing chain with the link (5) and the center plate (6).
11. Install the jaw (a) and the thrust piece (b) to the assembly tool as shown in the figures.



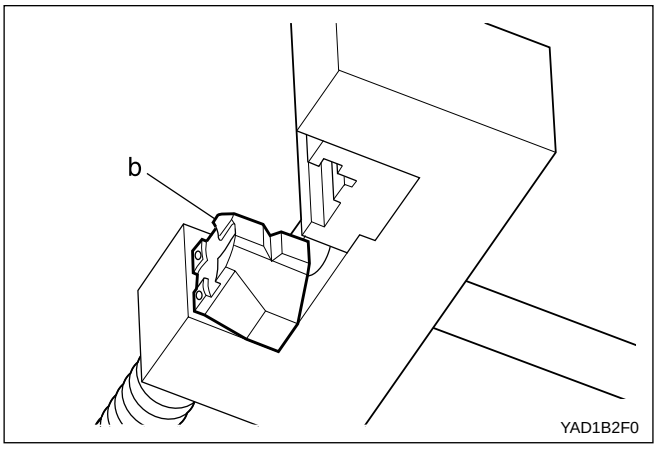




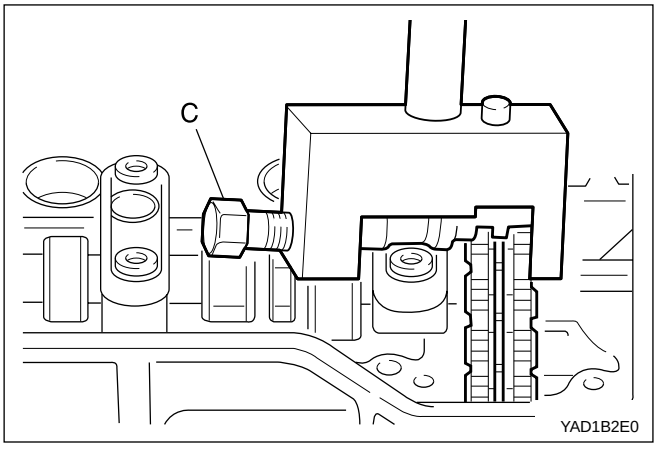
12. Place the outer plate (7, thickness 1.2 mm) inside the thrust piece (b).



13. Install the chain assembly 000 589 58 43 00 above the link and tighten the spindle (c) until a block is felt.
14. Place the chain assembly 000 589 58 43 00.



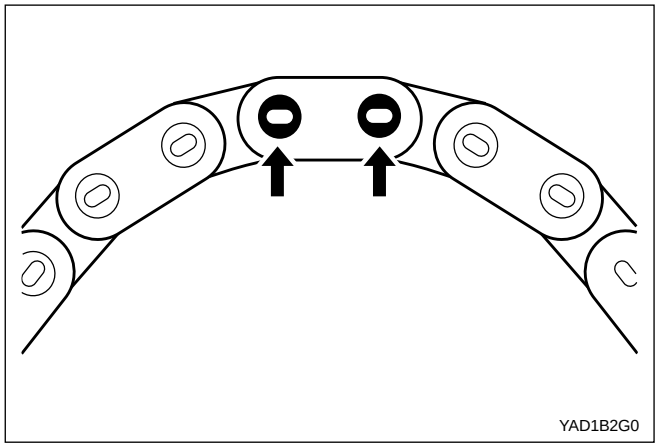
15. Replace the thrust piece (b) as shown in the figure.



16. Install the chain assembly 000 589 58 43 00 to the link pin and tighten the spindle (c).

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)


YAD1B2G0

17. Rivet the link pin.
    Check the condition and it again if necessary.
18. Install the chain tensioner.

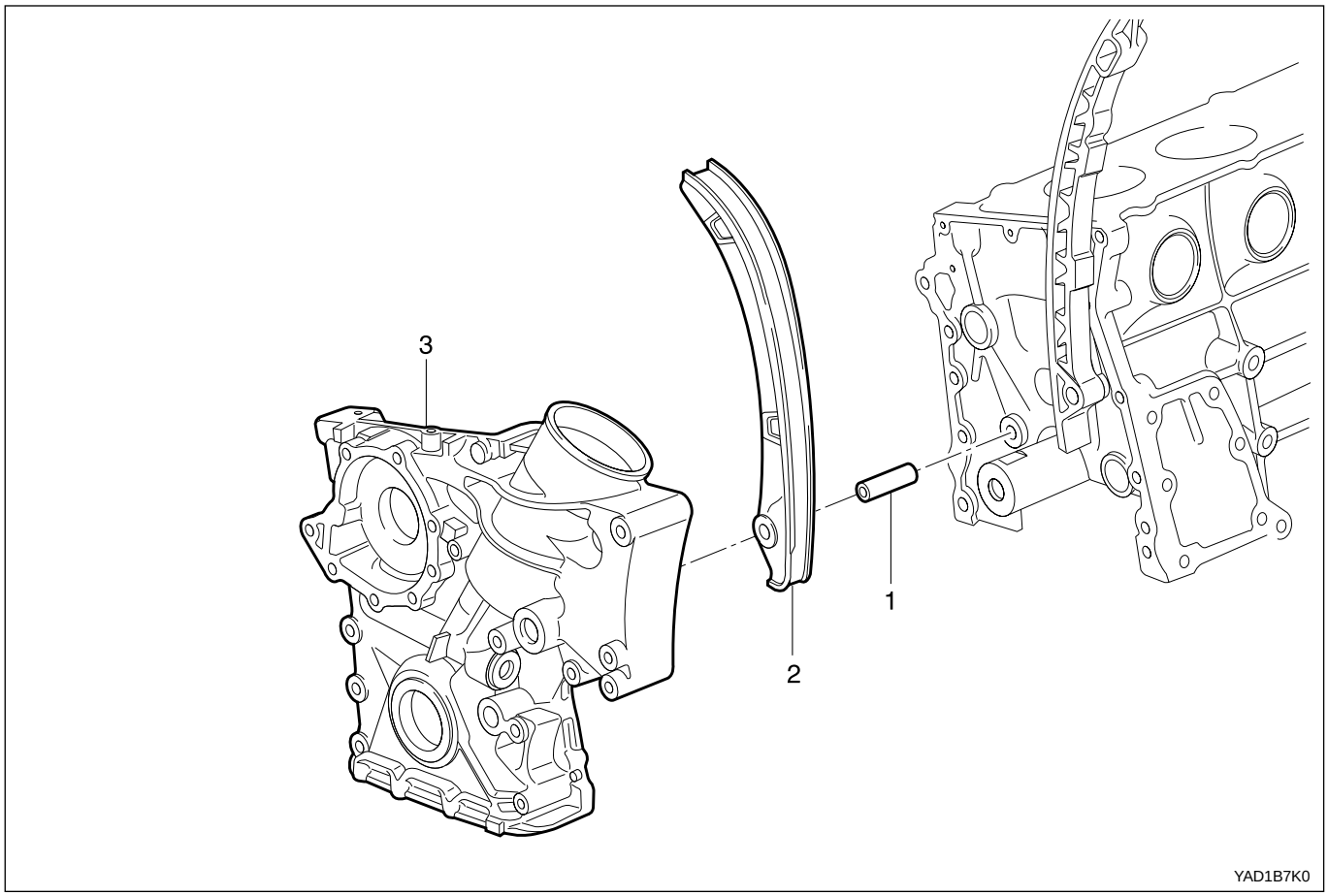
Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

19. Check the camshaft timing position.

TENSIONING RAIL

Preceding Work: Removal of cylinder head



1 Sliding Rail Pin
2 Sliding Rail
3 Timing Gear Case Cover

Removal & Installation Procedure

1. Remove the timing gear case cover (3).

   Notice: Be careful not to damage the gasket.

2. Remove the sliding rail (1) from the sliding rail pin (2).

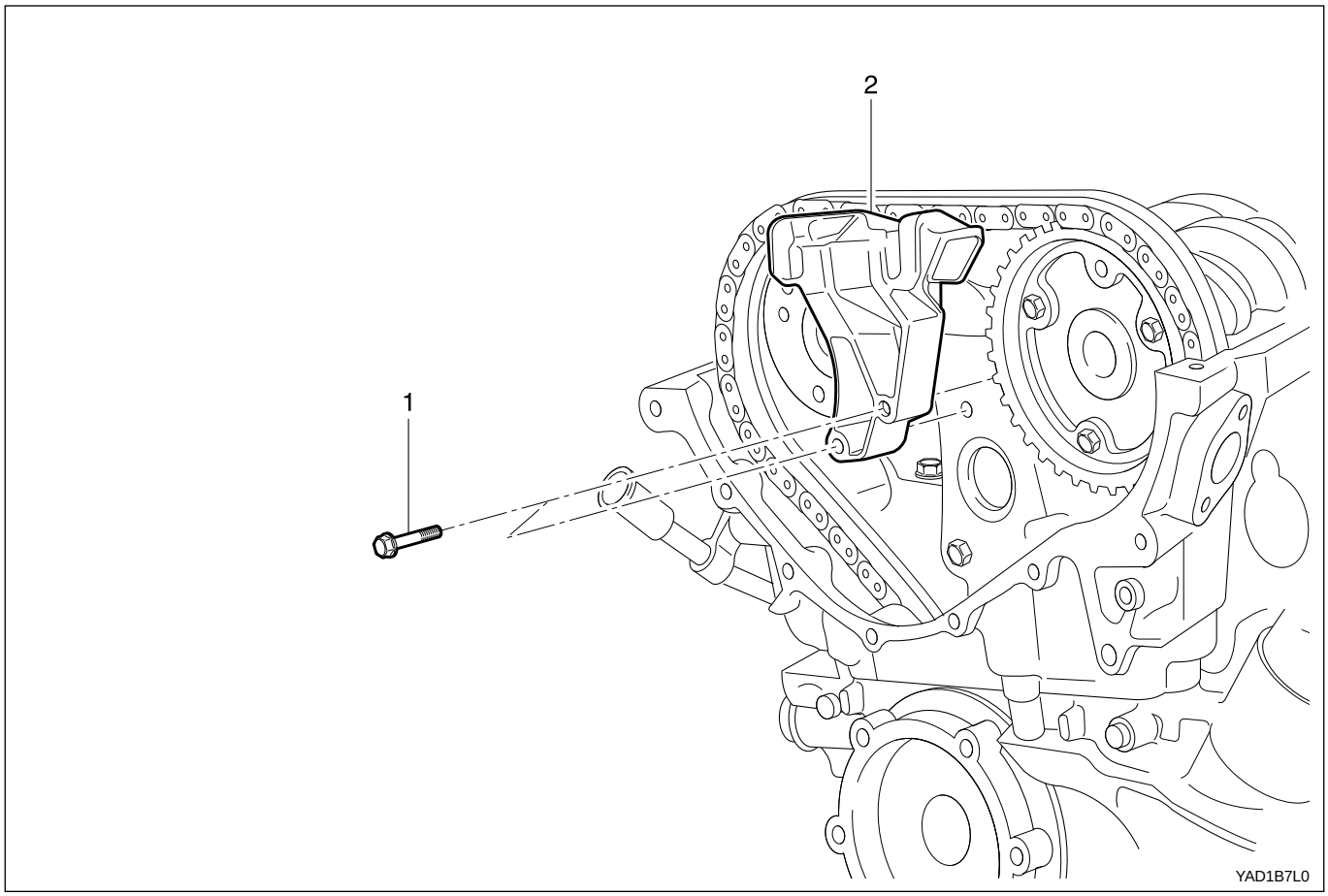
   Notice:

   - Replace the plastic guide (2) if it is damaged.
   - For installation, exactly align the plastic guide (2) with the sliding rail (1).

3. Installation should follow the removal procedure in the reverse order.

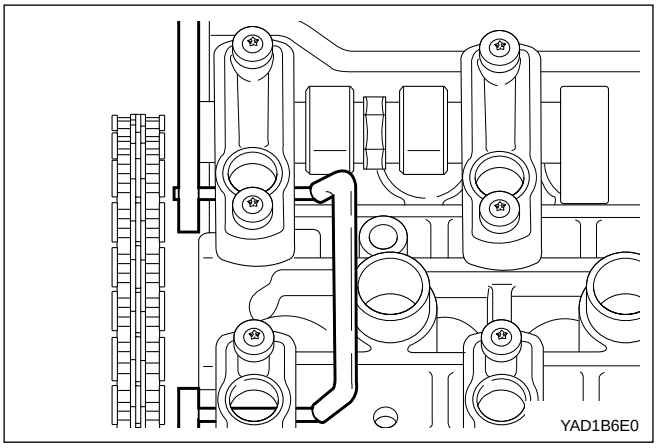
CYLINDER HEAD GUIDE RAIL

Preceding Work: Removal of cylinder head front cover



1 Bolt (M6 X 45, 2 pieces) ..... 9 - 11 N•m (80 - 97 lb-in)

2 Guide Rail



Tools Required

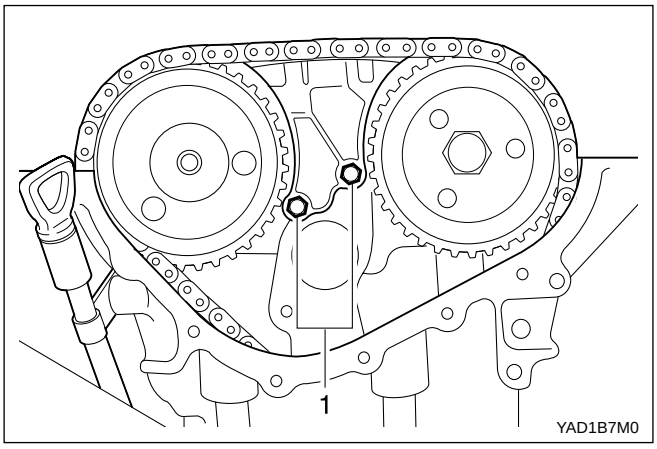
111 589 03 15 00 Holding Pin

Removal & Installation Procedure

1. Position the number 1 cylinder to ATDC 20 ° guide rail.
2. Install the holding pin 111 589 03 15 00 into the no.1 and no.6 bearing cap hole.
3. Remove the chain tensioner.

Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)



4. Unscrew the bolt (1) and remove the guide rail.

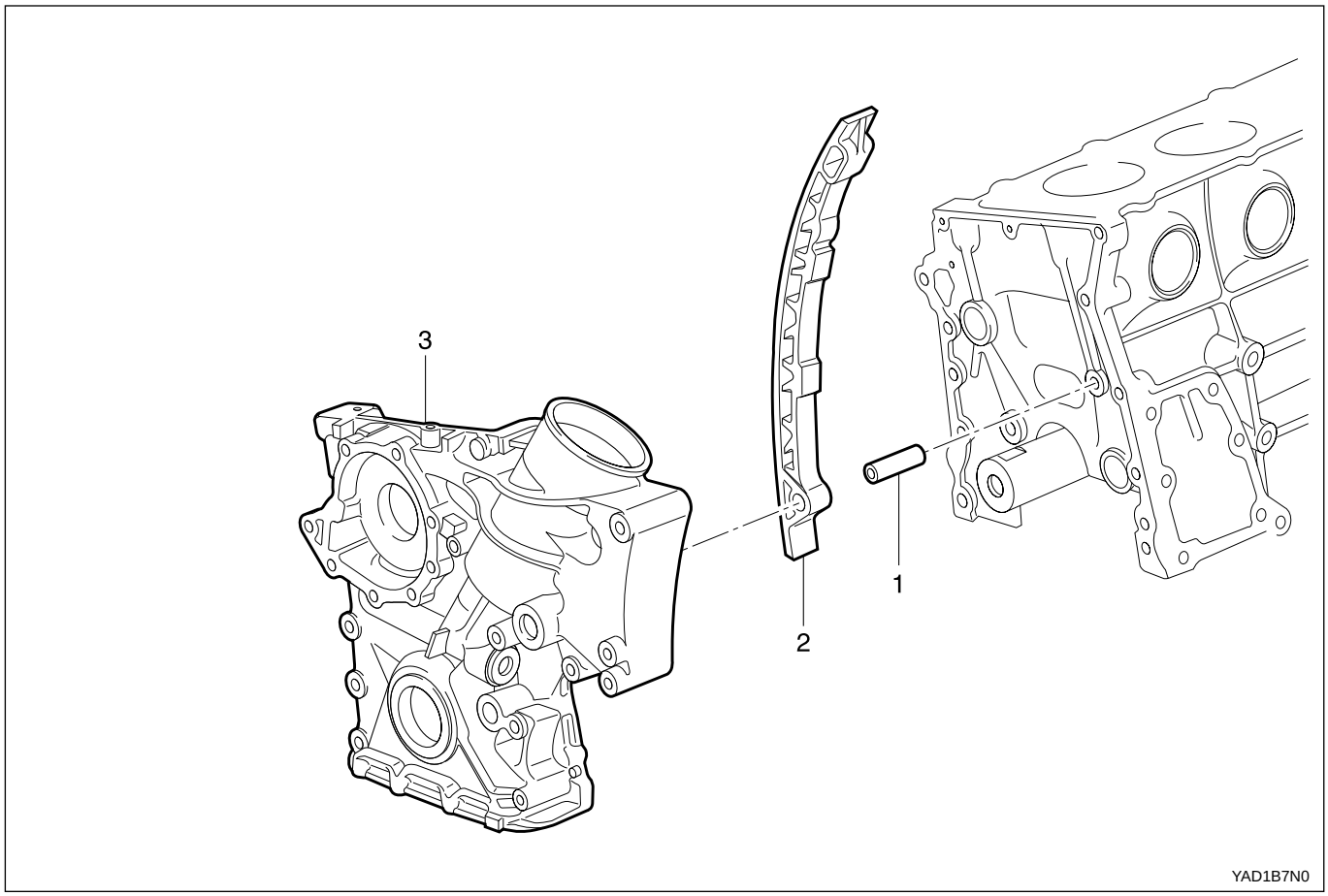
Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

5. Installation should follow the removal procedure in the reverse order.

CRANKCASE GUIDE RAIL

Preceding Work: Removal of timing gear case cover



1 Guide Rail Pin
2 Guide Rail
3 Timing Gear Case Cover

Removal & Installation Procedure

1. Remove the timing gear case cover (3).

   Notice: Be careful not to damage the gasket when removing / installing the timing gear case cover.

2. Remove the guide rail (2) from the guide rail pin (1).

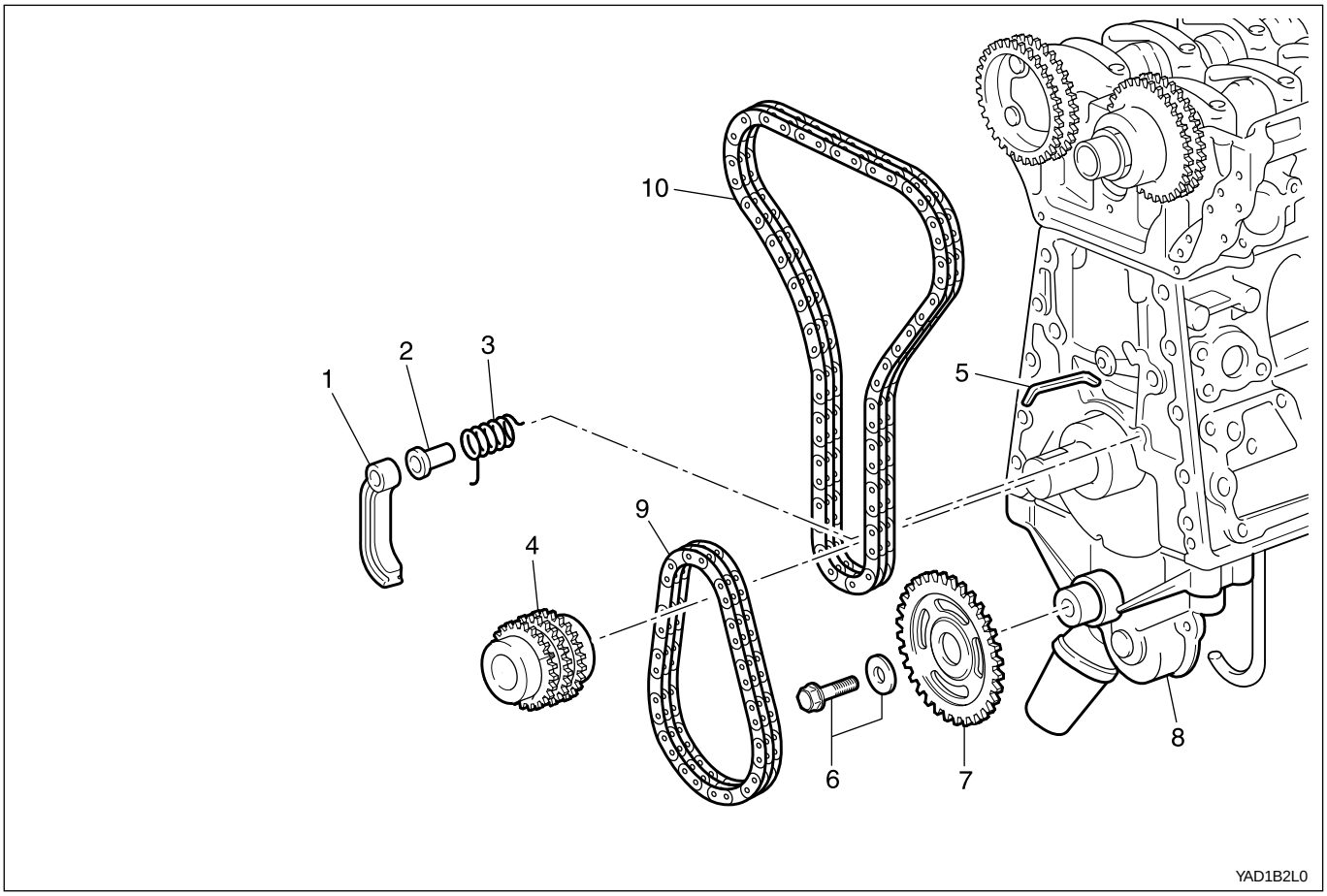
   Notice:

   - Replace the plastic guide (2) if damaged.
   - Connect the plastic guide (2) and the guide rail (1) by aligning them accurately when installing.

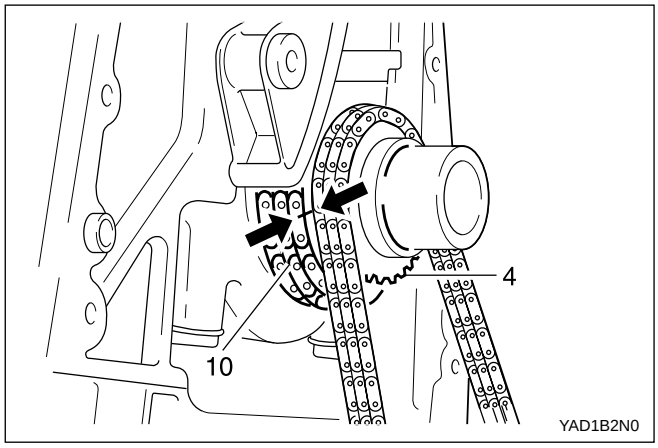
3. Installation should follow the removal procedure in the reverse order.

CRANKSHAFT SPROCKET

Preceding Work: Removal of oil pan
Removal of tensioning rail
Removal of crank case guide rail



1 Oil Pump Chain Tensioner
2 Oil Pump Chain Bushing
3 Oil Pump Chain Spring
4 Crankshaft Sprocket
5 Key
6 Bolt (M8 x 20, 1 piece) / Washer
..... 29 - 35 N•m (21 - 26 lb-ft)
7 Oil Pump Sprocket
8 Oil Pump
9 Oil Pump Roller Chain
10 Timing Chain



Tools Required

615 589 01 33 00 Crankshaft Sprocket Puller

Removal & Installation Procedure

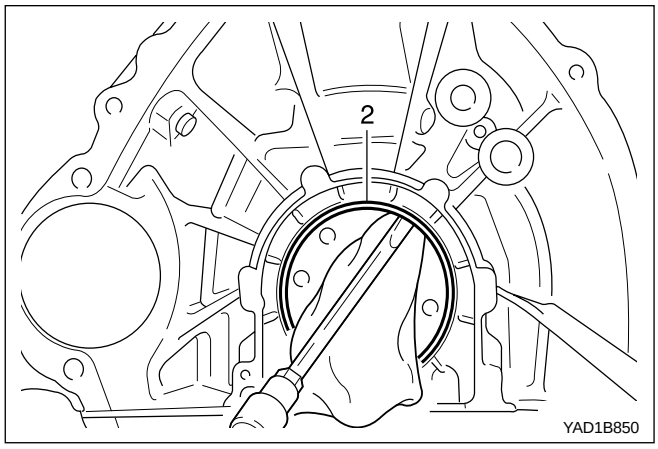
1. Put the assembly mark at the crankshaft sprocket (4) and the timing chain (10) with the paint (arrow).

   Notice: Align the assembly marks on crankshaft sprocket and timing chain. Also, align the assembly marks on camshaft sprocket and timing chain when installing.

2. Unscrew the bolt (6) and remove the oil pump sprocket (7) from the oil pump.

   Installation Notice

Tightening Torque	29 - 35 N•m (21 - 26 lb-ft)



3. Remove the oil pump roller chain (9).
4. Remove the oil pump chain tensioner (1), oil pump chain bushing (3), and the oil pump chain spring (2).
5. Remove the crankshaft sprocket (4) using crankshaft sprocketpuller 615 589 01 33 00.

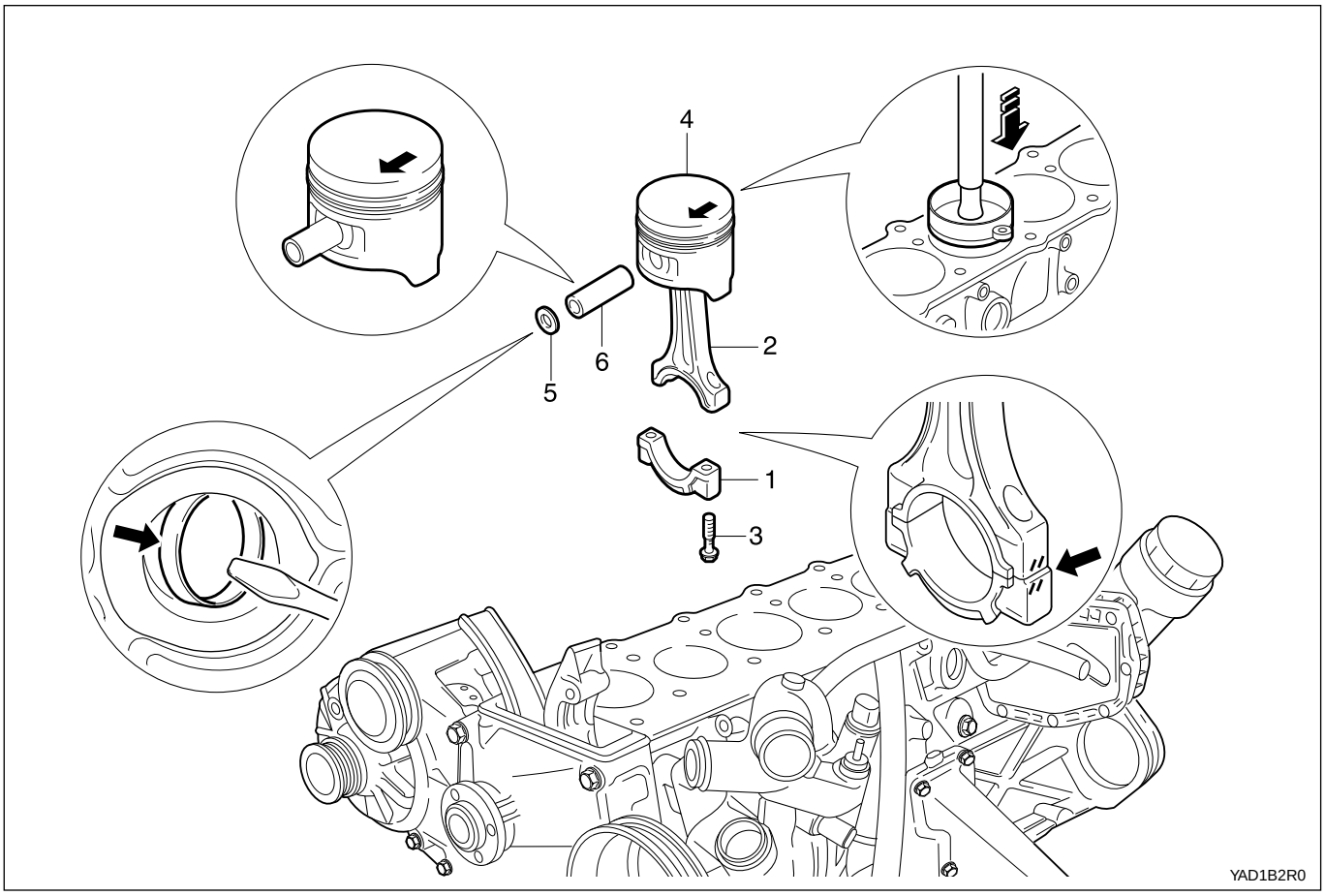
   Notice:

   - Make sure not to lose the crankshaft pulley key (5) when removing.
   - Install the crankshaft sprocket (4) after warming it up.

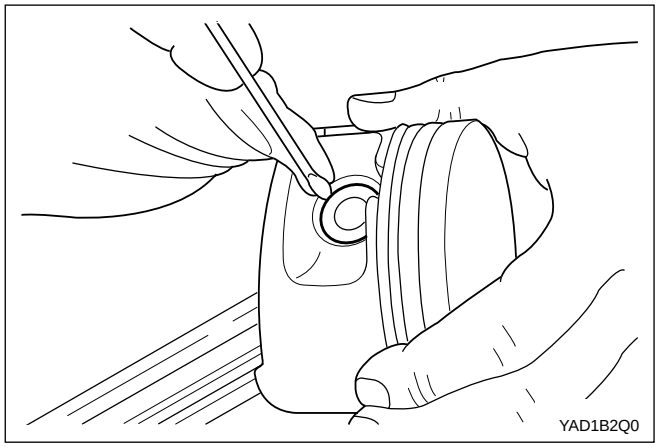
6. Installation should follow the removal procedure in the reverse order.

PISTON

Preceding Work: Removal of engine
Removal of cylinder head
Removal of oil pan
Removal of oil pump
Removal of baffle plate



1 Connecting Rod Bearing Cap
2 Connecting Rod
3 Connecting Rod Bolt (M9 x 52, 8 pieces)
..... 1st step 40 N•m (30 lb-ft)
2nd step 90 °
4 Piston
5 Snap Ring
6 Piston Pin



Removal Procedure

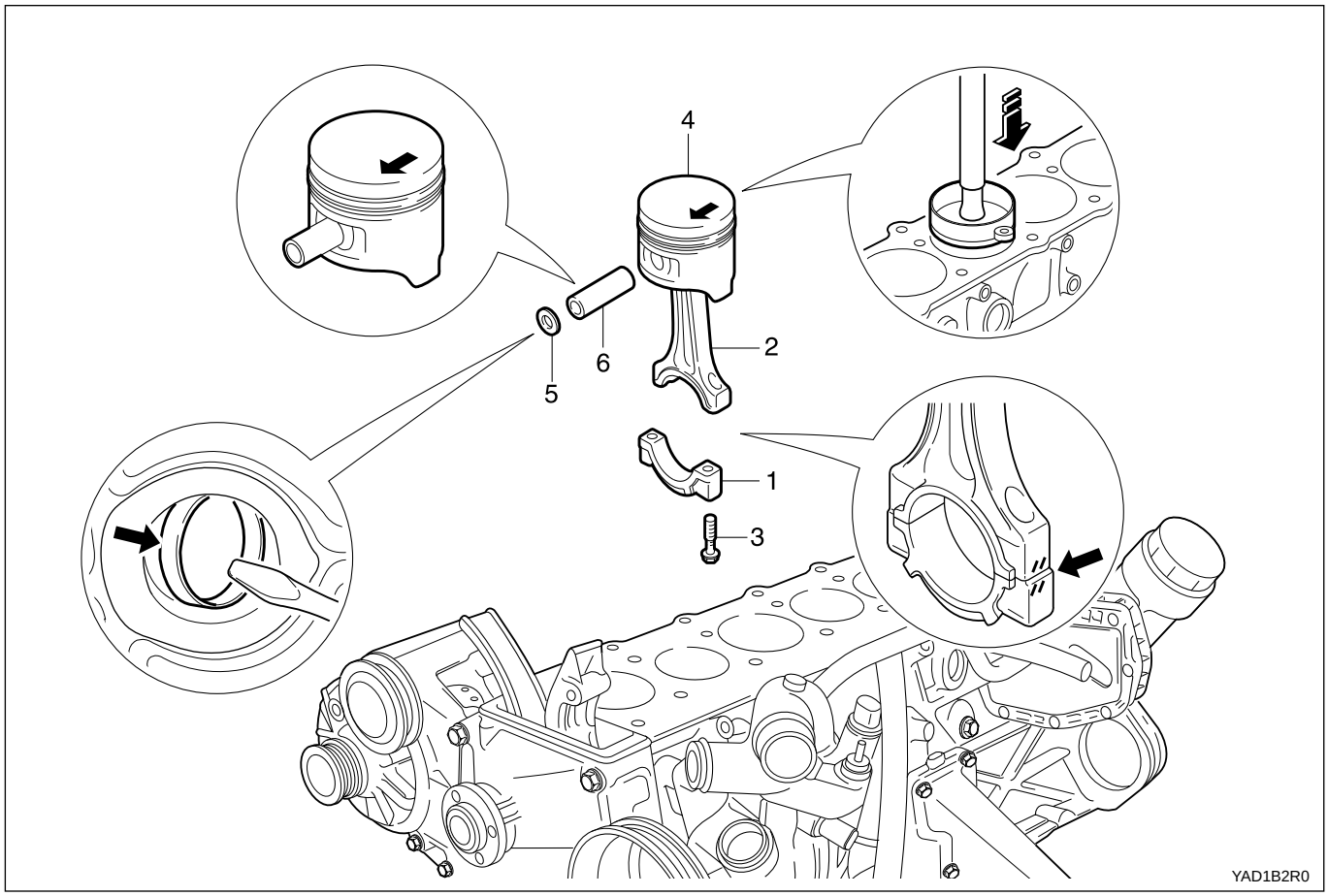
1. Unscrew the connecting rod bolt (3) and remove the cap.
2. Remove the connecting rod and the piston upward.

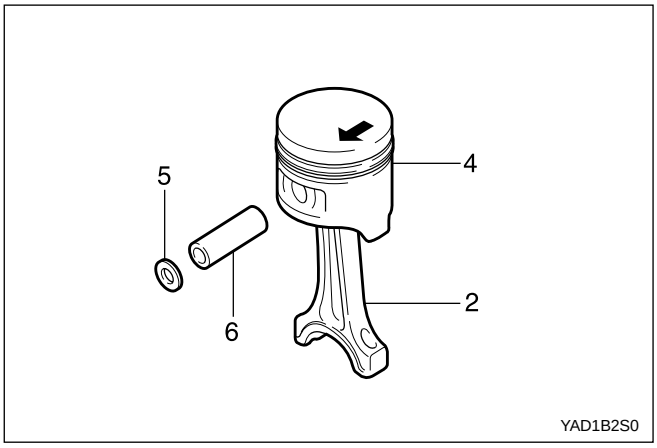
   Notice: Make sure that the bearing cap and shell are not changed each other.

3. Removethe snapring (5)and pulloutthepiston pin (6).

   Notice: Remove the snap ring using a clean cloth as shown in the right picture so that the piston, piston ring, and the snap ring don't get damaged.

Installation Procedure





1. Check the piston ring gap and apply the engine oil to the piston pin and the connecting rod bushing.
2. Connect the piston and the connecting rod by pressing in the piston pin (6) and install the snap ring to the groove.
3. Clean the cylinder bore, connecting rod bearing journal, connecting rod bearing shell and the piston and coat them with engine oil.
4. Install the piston ring.
5. Install the piston so that the arrow on the piston head faces to the forward of the vehicle.
6. After aligning the connecting rod and the bearing cap mark (// or a number), tighten the bolts.

Installation Notice

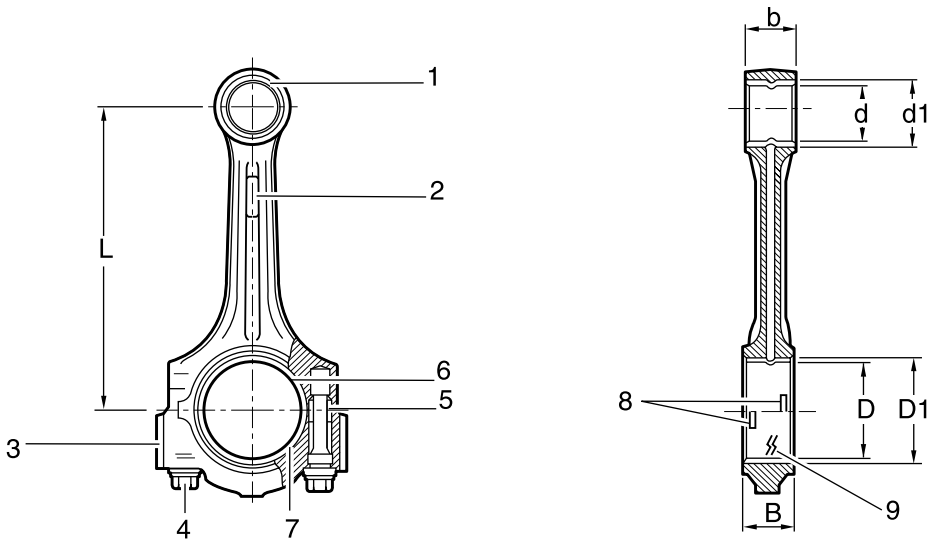
Tightening Torque	1st step : 40 N•m (30 lb-ft)
	2nd step : 90 °

Apply the engine oil to the bearing cap upper and lower bearing shells.

7. Check if the crankshaft rotates without any trouble by rotating it.

CONNECTING ROD

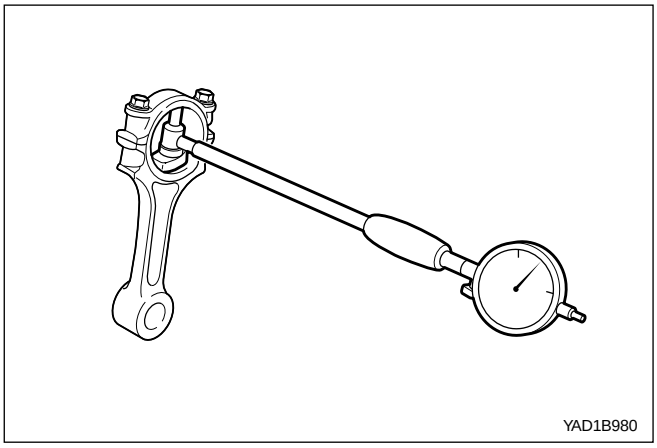
Preceding Work: Removal of piston



1 Connecting Rod Bushing
2 Oil Gallery
3 Balance Weight
4 Connecting Rod Bearing Cap Bolt (M9 x 52, 8 pieces)
..... 1ststep 40 N•m (30 lb-ft)
2nd step 90 °
5 Fit Sleeve
6 Upper Connecting Rod Bearing
7 Lower Connecting Rod Bearing
8 Bearing Shell Lug
9 Marking [Indication (//) or Numbers]

Service Data Standard

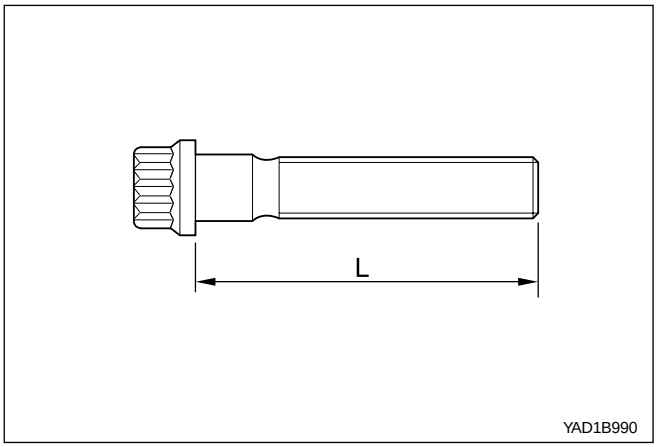
Distance (L) from The Connecting Rod Bearing to Bushing Bore Center	149 ±0.05 mm
Width of The Connecting Rod (B) at Bearing Bore	21.940 - 22.000 mm
Width of The Connecting Rod (b) at Bushing Bore	21.940 - 22.000 mm
Basic Bore at The Bearing Shell (D1)	51.600 - 51.614 mm
Basic Bore at The Bushing (d1)	24.500 - 24.521 mm
Bushing Inner Diameter (d)	22.007 - 22.013 mm
Clearance Between The Piston Pin and The Bushing	0.007 - 0.018 mm
Peak-to-valley Height of Connecting Rod Bushing on Inside	0.005 mm
Permissible Wwist of Connecting Rod Bearing Bore to Connecting Rod Bushing Bore	0.1/100 mm
Permissible Deviation of Axial Paralleism of Connecting Rod Bearing Bore to Connecting Rod Bushing Bore	0.045/100 mm
Permissible Deviation of Axial Paralleism of Connecting Rod Bearing Bore from Concentricity	0.01 mm
Permissible Difference of Each Connecting Rod in Weight	0.4 g


YAD1B980

Inspection

1. Measure the basic bore of the connecting rod bearing.

   Notice: If the basic bore exceeds the value of 51.614 mm, replace the bearing or check the connecting rod.

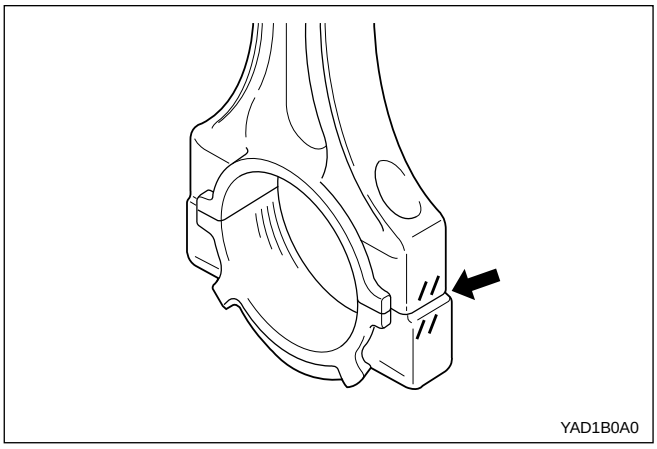


YAD1B990

2. Check connecting rod bolts.

Length When New (L)	51.7 - 52 mm
Max. Length (L)	52.9 mm
Tightening Torque	1st step : 40 N•m (30 lb-ft)
	2nd step : 90°

   Notice: If the length exceeds max. length, replace it.


YAD1B0A0

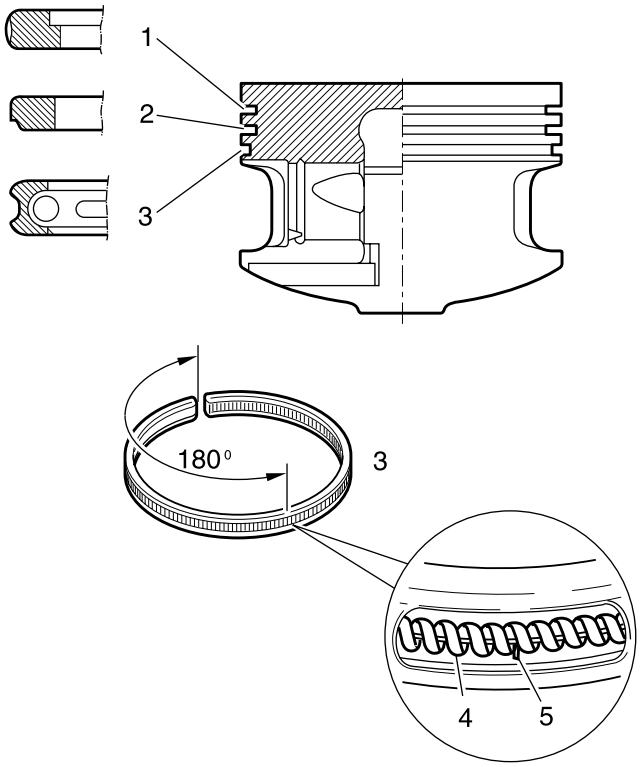
3. Check the assembly mark (indication//or number:arrow) of the connecting rods and the bearing cap when installing.

   Notice:

   - Make sure it doesn't exceed over 4g with other connecting rods when replacing the connecting rods.
   - Check if the connecting rod and the bearing cap are accurately seated on the groove when replacing the bearing.

PISTON RING

Preceding Work: Removal of piston



YAD1B2T0

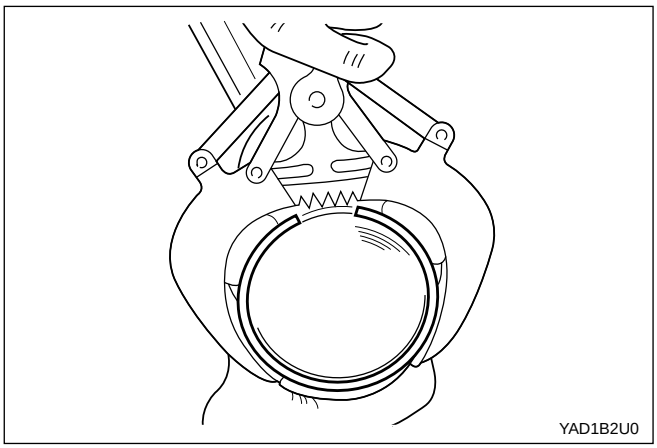
1 Piston Compression Ring (Top Ring)
2 Piston Compression Ring (2nd Ring)
3 Piston Oil Ring
4 -
5 Spacer
6 SideRail

Replacement Procedure

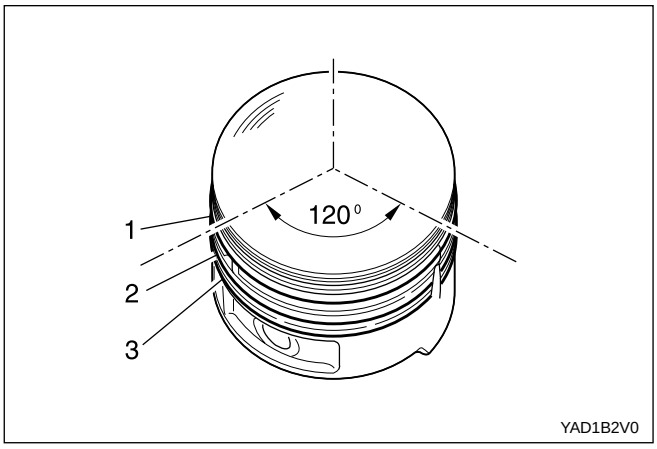
1. Measure the piston ring's gap.

End Gap of the Piston Ring	Groove 1 0.20 - 0.40 mm
	Groove 2 0.20 - 0.40 mm
	Groove 3 0.20 - 0.45 mm
Gap Between the Piston and the Piston Ring	Groove 1 0.028 - 0.060 mm
	Groove 2 0.010 - 0.045 mm
	Groove 3 0.010 - 0.045 mm

Notice: If out of specification, replace the piston ring.


YAD1B2U0

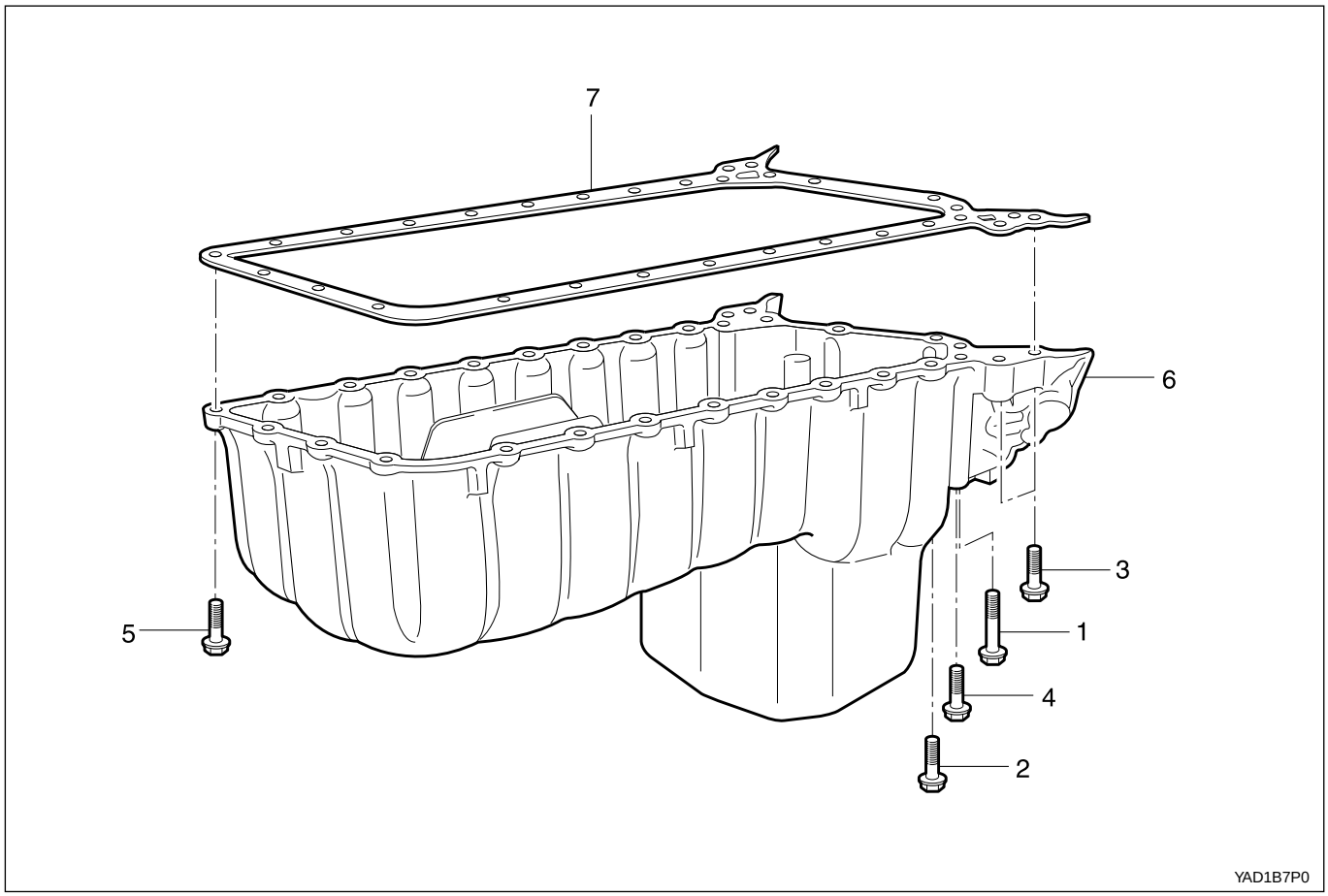
2. Remove the piston ring with a pliers.



YAD1B2V0

3. For installation, position the piston ring to be the 'TOP' mark on the piston ring upward and arrange the piston ring ends to be 120 ° part.
4. Adjust the hook spring joint in the oil ring 180 ° way from the ring end.

OIL PAN



1 Bolt
2 Bolt
3 Bolt
4 Bolt
5 Bolt
6 OilPan
7 Gasket

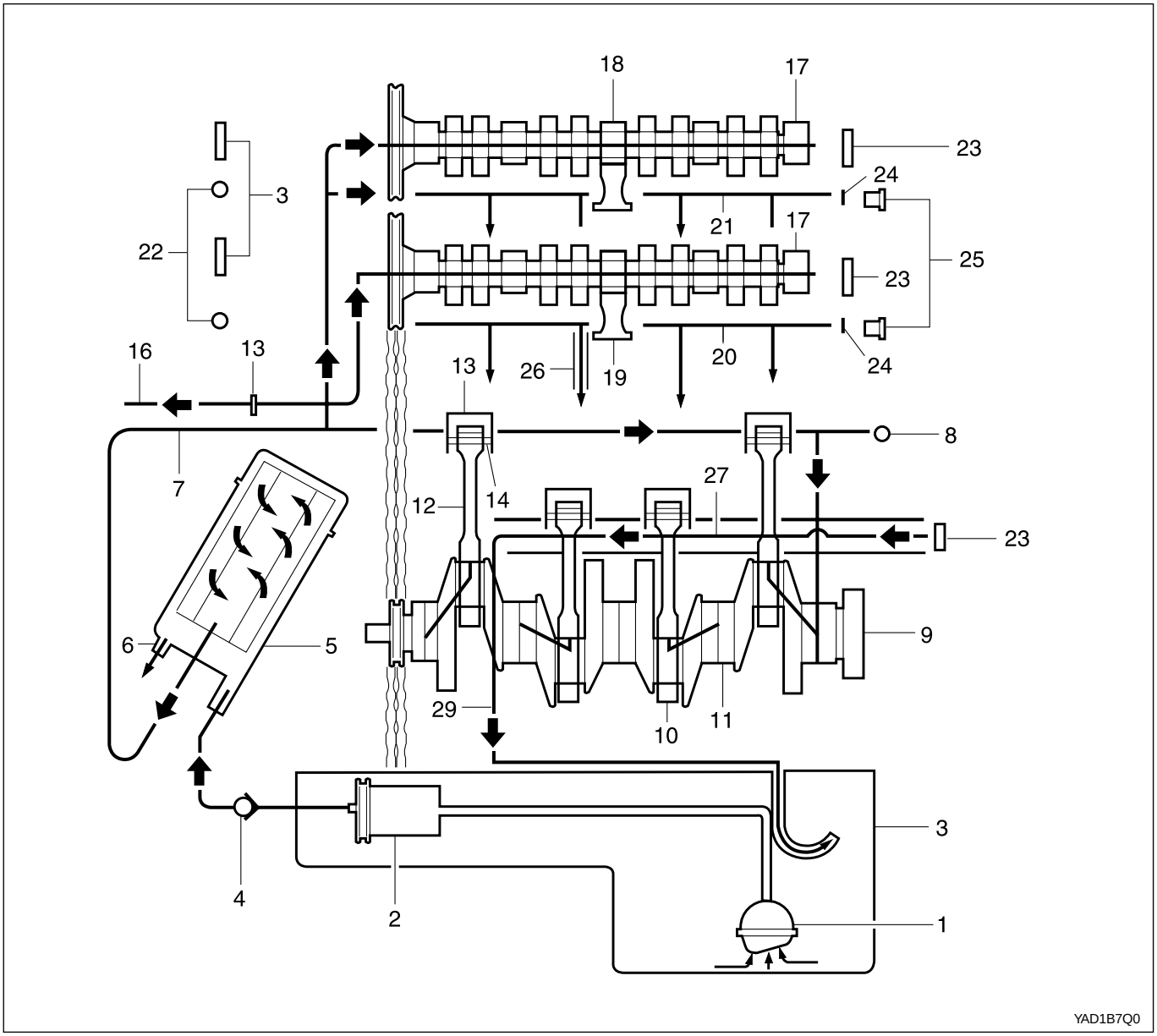
Removal & Installation Procedure

1. Remove the drain plug and drain the oil completely.
2. Unscrew the bolts and remove the oil pan and gasket.

   Notice: Arrange the bolts according to each size.

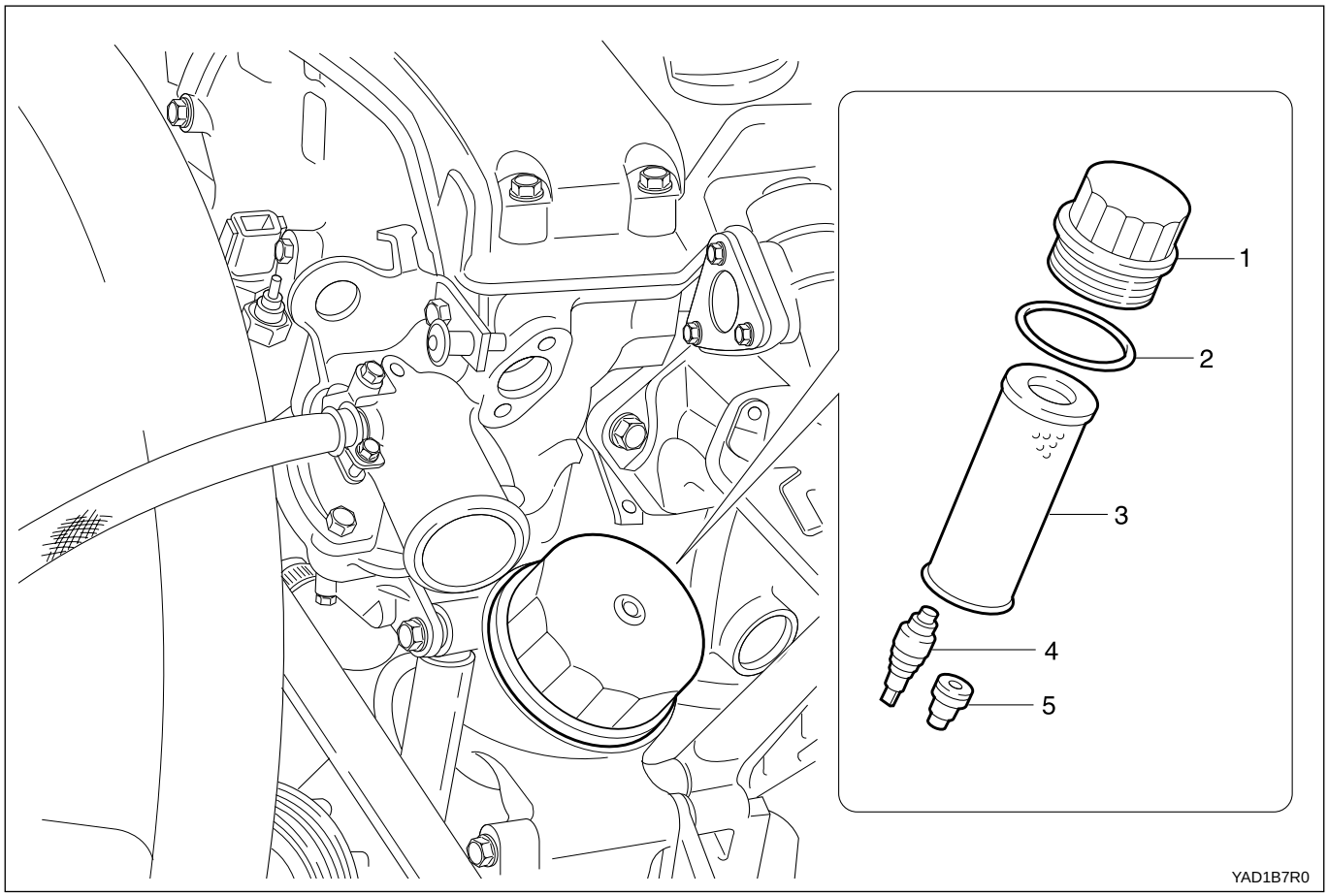
3. Clean the inside of oil pan and sealing surface, then apply the sealant.
4. Replace the gasket with new one.
5. Install the oil pan with gasket, and tighten each bolt in specified torque.
6. Check for oil leaks while running the engine.

Oil Circulation

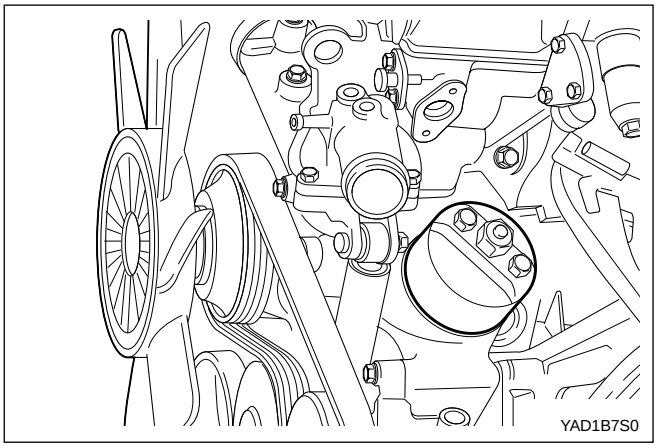


1 Oil Strainer
2 Oil Pump
3 Oil Pan
4 Oil Non-Return Valve
5 Oil Filter
6 Oil Filter Bypass Valve
7 Main Oil Gallery
8 Closing Ball (ϕ 15 mm)
9 Crankshaft
10 Connecting Rod Bearing
11 Crankshaft Bearing
12 Connecting Rod
13 Piston
14 Oil Spray (Piston Crown Area)
15 Non-Return Valve (Crankcase)
16 Oil Supply (To Chain Tensioner)
17 Camshaft
18 Cam Bearing
19 Valve
20 Oil Gallery (Supply Oil to Intake Tappet)
21 Oil Gallery (Supply Oil to Exhaust Tappet)
22 Ball (ϕ 8 mm)
23 Camshaft Plug
24 Seal
25 Screw Plug
26 Oil Return Gallery (Cylinder Head and Crankcase)
27 Oil Return Gallery (Crankcase)
28 End Cover (ϕ 20 mm)
29 Oil Return Pipe

ENGINE OIL AND OIL FILTER ELEMENT



1 Oil Filter Cover 25 N•m (18 lb-ft)
2 O-Ring Replace
3 Oil Filter Element
4 Oil Drain Plug
5 Oil Filter Bypass Valve



Tools Required

103 589 02 09 00 Oil Filter Remover

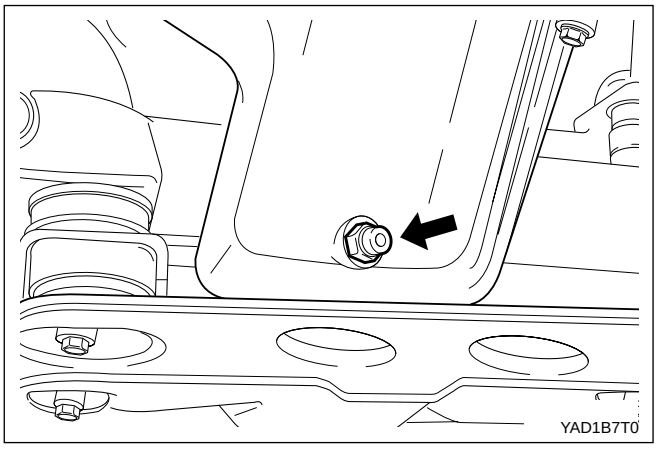
Replacement Procedure

1. Install the oil filter remover 103 589 02 09 00 on the oil filter cover.

   Notice: Make the screw cover removable by tightening the bolt at the side of the oil filter remover 103 589 02 09 00.

2. Install the wrench to the upper bolt in the oil filter remover 103 589 02 09 00 and remove the oil cover by turning it.
3. Remove the oil filter element.

   Notice: Work with a cloth under the vehicle when removing the oil filter element to not drain the oil.



4. Remove the drain plug and drain the engine oil.

   Notice: Leave the oil filler cap open to ease the engine oil discharge.

5. Tighten the engine oil drain plug after cleaning it.

   Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

   Replace the seal washer with new one.

6. Replace the O-ring in the oil filter cover with new one.

   Notice: Apply the engine oil to the O-ring.

7. Insert new oil filter element into the oil filter housing.
8. Temporarily tighten the oil filter cover. Install the Oil filter remover 103 589 02 09 00, and then completely tighten it.

   Installation Notice

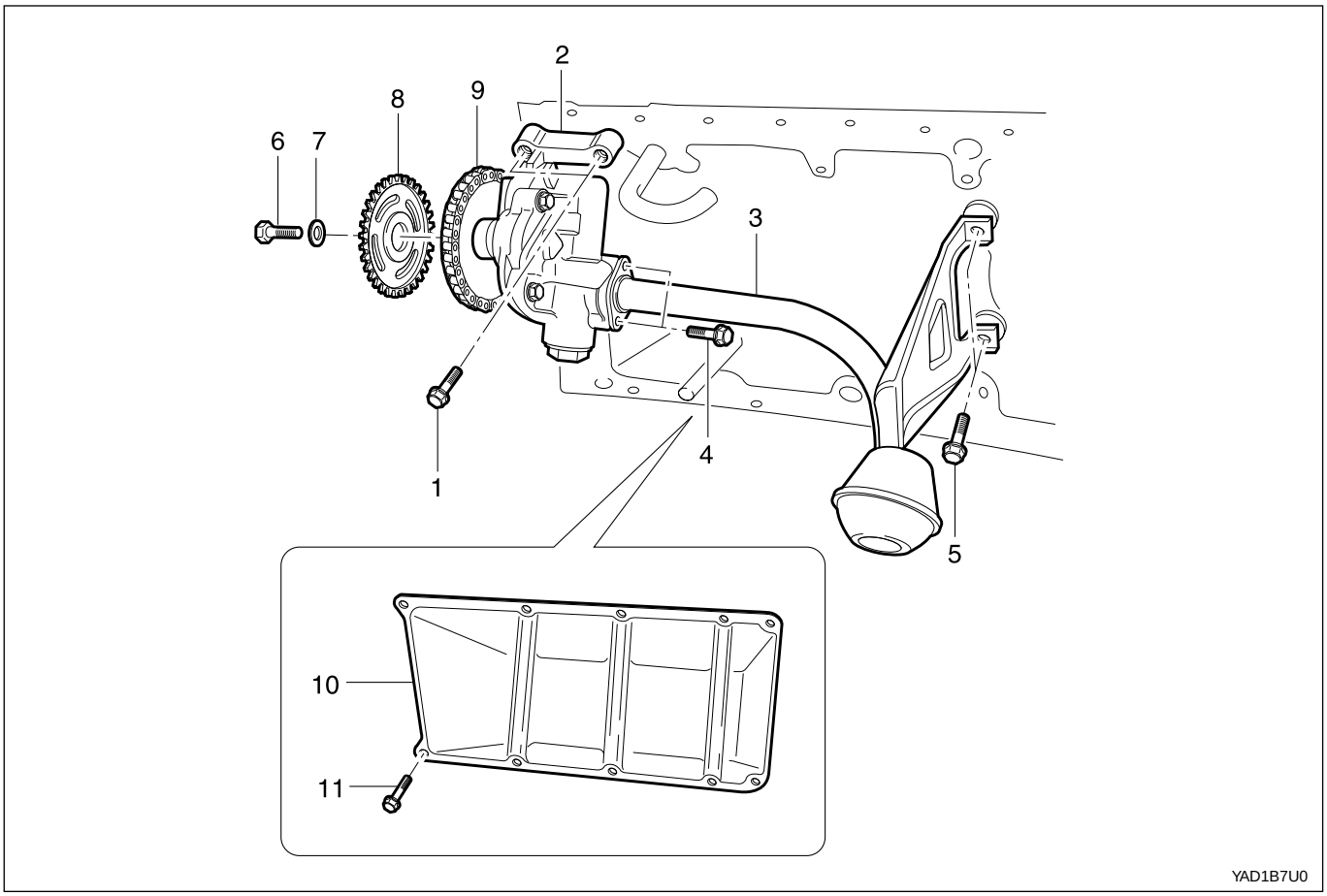
Tightening Torque	25 N•m (18 lb-ft)

9. Fill up engine oil through the engine oil filler opening (3).
10. Check for oil leaks at normal engine temperature after starting the engine.
11. Stop the engine and wait 5 minutes.

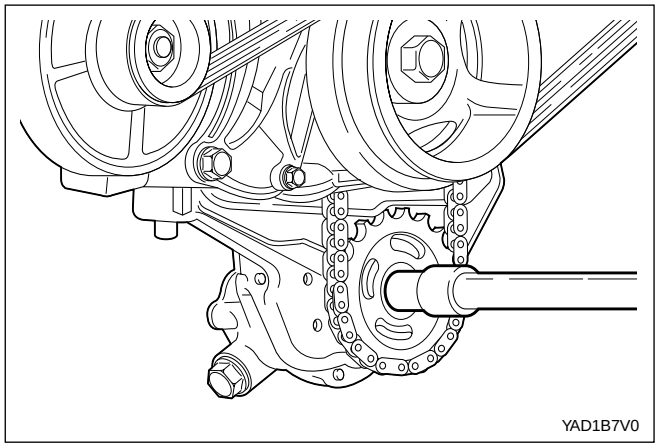
    Check the oil level and fill up as specified if necessary.

OIL PUMP

Preceding Work: Removal of oil pan



1 Bolt (M8 X 35, 3 piece)
..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
2 OilPump
3 Oil Strainer Assembly
4 Bolt (M6 X 20, 2 pieces)
..... 9 - 11 N•m (80 - 97 lb-in)
(In E23 Engine, These Bolts are Combined with Baffle Plate)
5 Bolt (M6 X 12, 2 pieces)
..... 9 - 11 N•m (80 - 97 lb-in)
6 Bolt (M8 X 20, 1 pieces)
..... 29 - 35 N•m (21 - 26 lb-ft)
7 Washer
8 Sprocket (Oil Pump Drive)
9 Chain (Oil Pump Drive)
10 Plate-Baffle
11 Bolt (M6 X 12, 6 pieces)
..... 9 - 11 N•m (80 - 97 lb-in)
(E23 Engine Only : Baffle Plate Mounting Bolt)


YAD1B7V0

Removal & Installation Procedure

1. Unscrew the bolt (6) from the oil pump drive sprocket and separate the oil pump drive chain.

Installation Notice

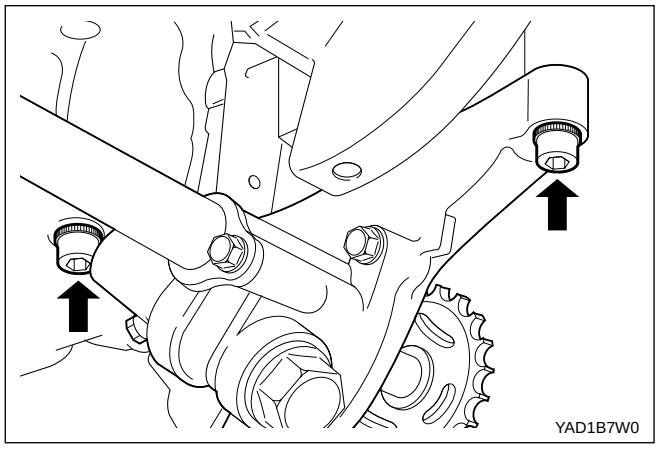
Tightening Torque	25 - 39 N•m (21 - 26 lb-ft)

2. Unscrew the bolts (4,5) and remove the oil strainer assembly (3).

Installation Notice

Tightening Torque	Bolt (4):	9 - 11 N•m (80 - 97 lb-ft)
	Bolt (5):	9 - 11 N•m (80 - 97 lb-ft)

Insert the steel gasket into the oil pump and bolt (4) mounting surface.


YAD1B7W0

3. Unscrew the six bolts (11) and remove the baffle plate.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)

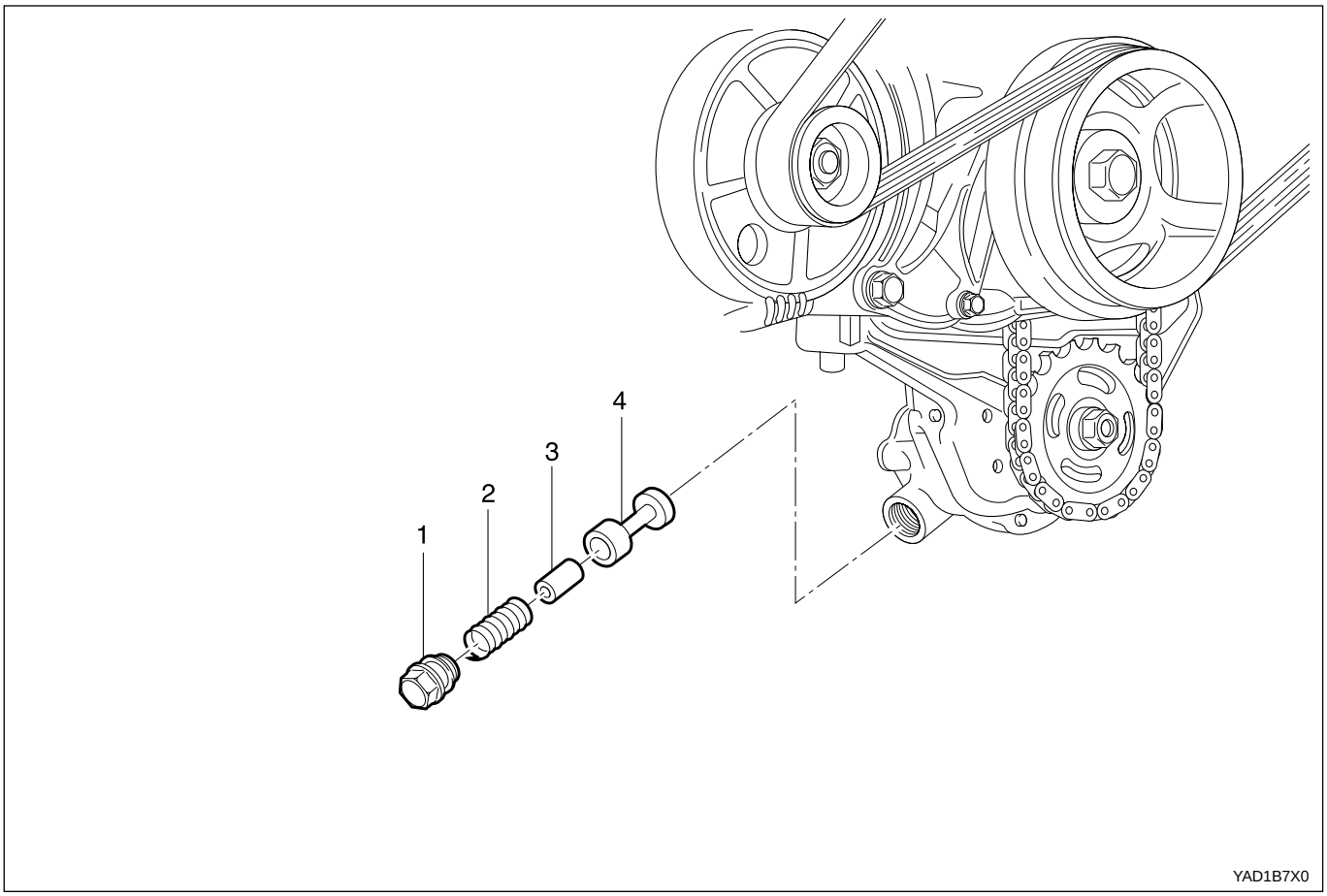
4. Unscrew the three bolt (1) and remove the oil pump.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

OIL PRESSURE RELIEF VALVE

Preceding Work: Removal of oil pan



1 Screw Plug ..... 50 N•m (37 lb-ft)
2 Compression Spring
3 Guide Pin
4 Piston

Removal & Installation Procedure

1. Remove the screw plug (1).

   Installation Notice

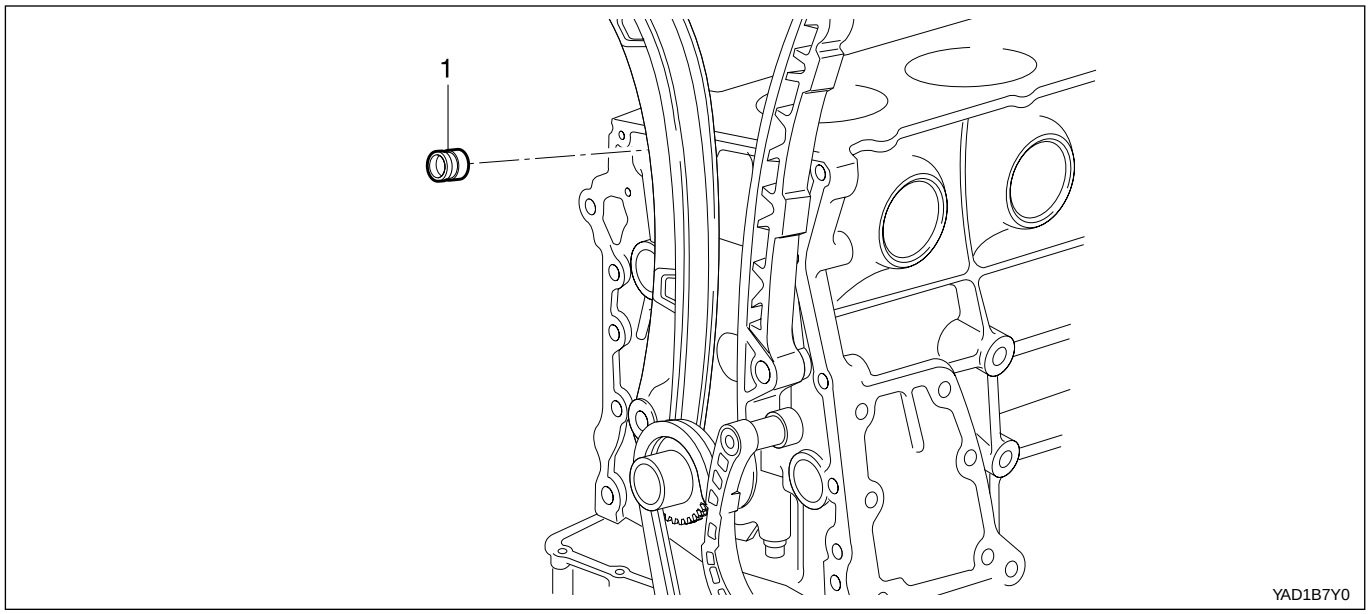
Tightening Torque	50 N•m (37 lb-ft)

2. Remove the spring (2), guide pin (3) and the piston (4).
3. Installation should follow the removal procedure in the reverse order.

   Notice: Don't use the seal for the screw plug.

OIL NON-RETURN VALVE

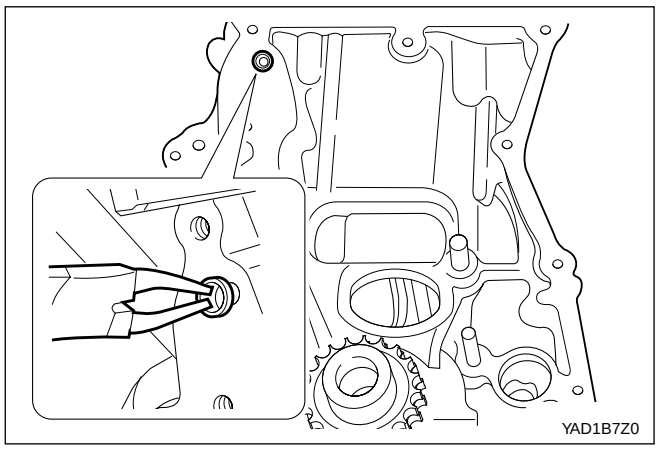
Preceding Work: Removal of timing gear case cover



1 Oil Non-return Valve

Functions

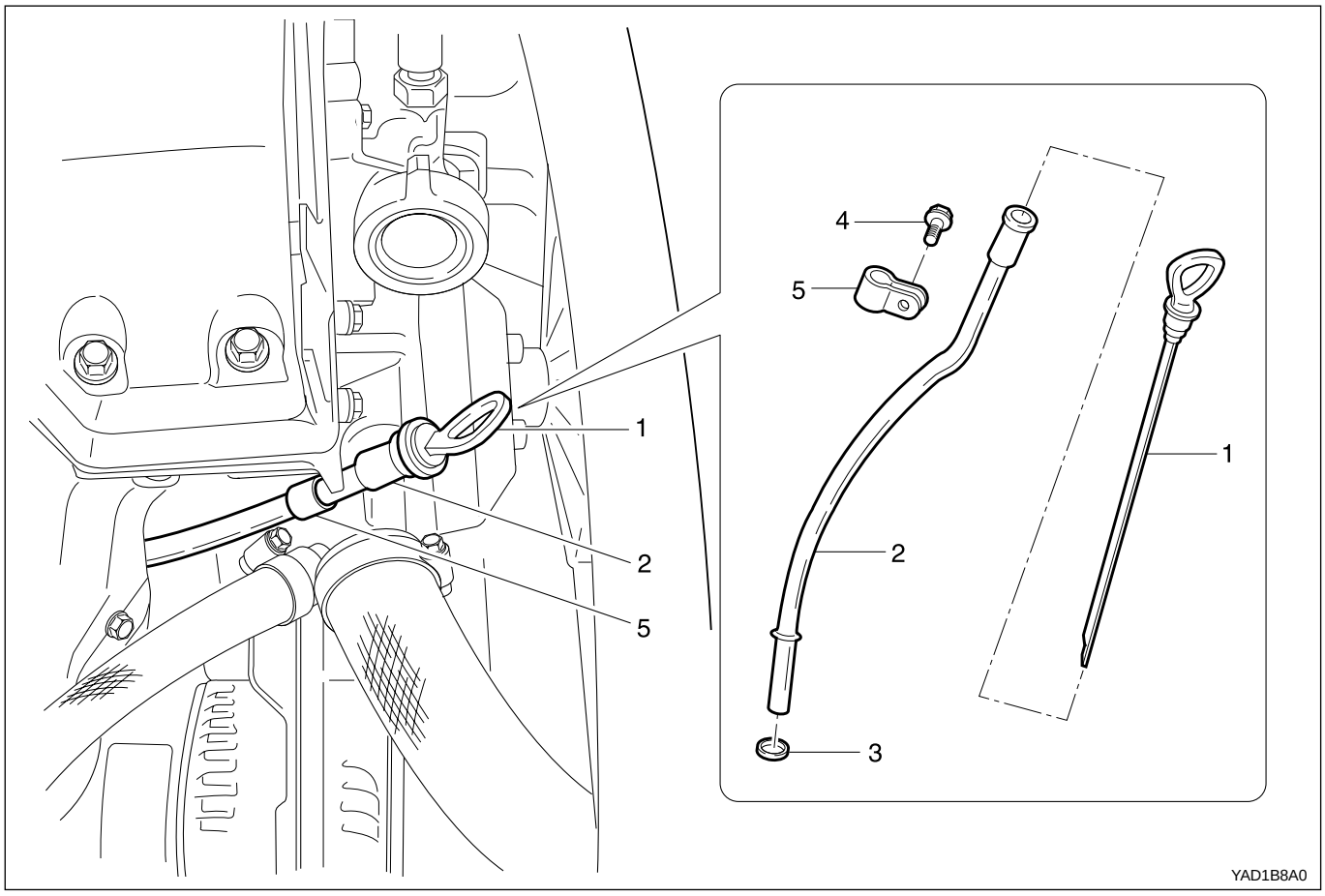
The non-return valve prevents the oil in the chain tensioner from drying up. In other words, it stops oil-returning in order to prevent the oil in the chain tensioner from getting dry. As a result, the chain tensioner can be activated with oil in itself.



Replacement Procedure

1. Remove the non-return valve using a pliers.
2. Insert new non-return valve with hand.

OIL DIPSTICK GUIDE TUBE



1 Oil Dipstick Level Gauge
2 Oil Dipstick Guide Tube
3 O-Ring
4 Bolt (M6 X 16, 1 piece)
..... 9 - 11 N•m (80 - 97 lb-in)
5 Clamp

Removal & Installation Procedure

1. Pull out the oil dipstick level gauge (1).
2. Unscrew the bolt (4) and remove the oil dipstick guide tube (2).

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

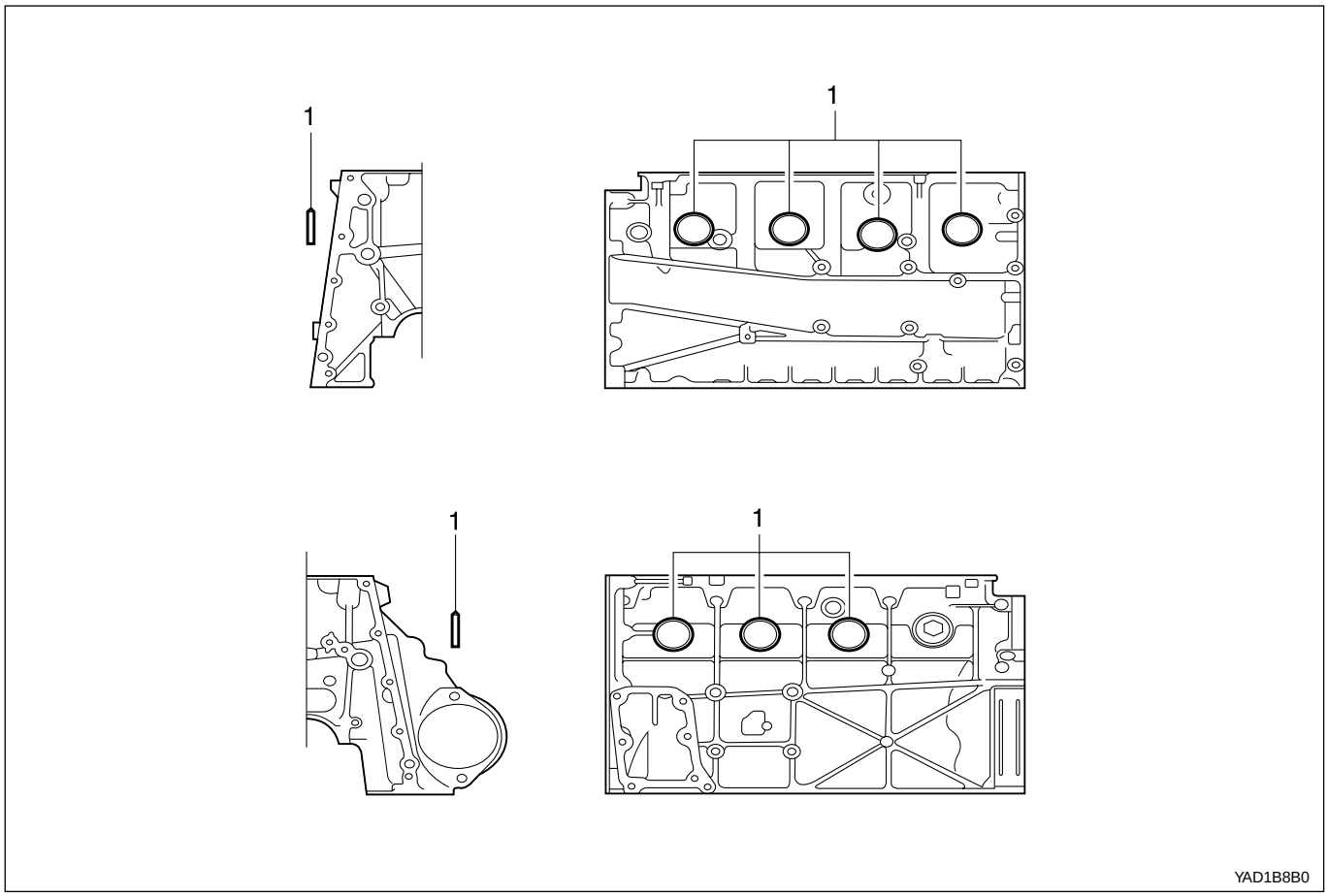
It is very hard to remove the oil dipstick guide tube without special tool. If it is not necessary, do not remove the guide tube.

3. Installation should follow the removal procedure in the reverse order.
4. Check for leaks by starting the engine.

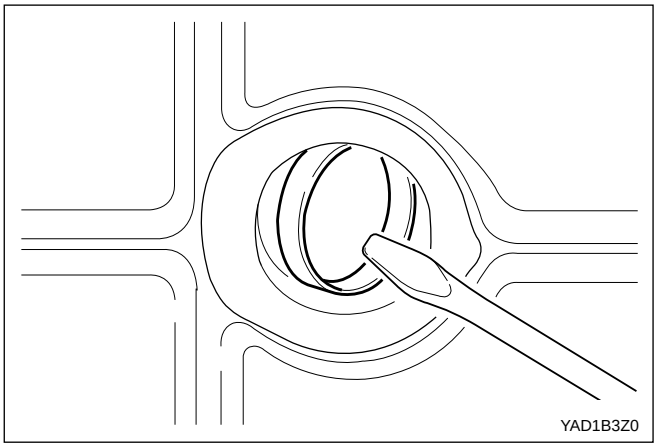
UNIT REPAIR

CORE PLUGS IN CRANKCASE

Preceding Work: Draining of the coolant



1 Core Plug ..... Replace

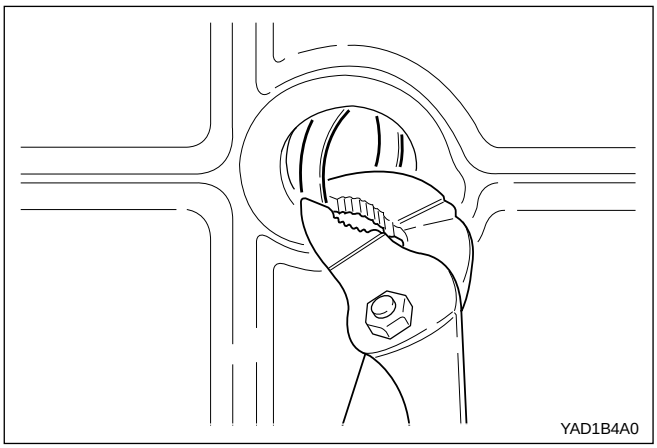

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Tools Required

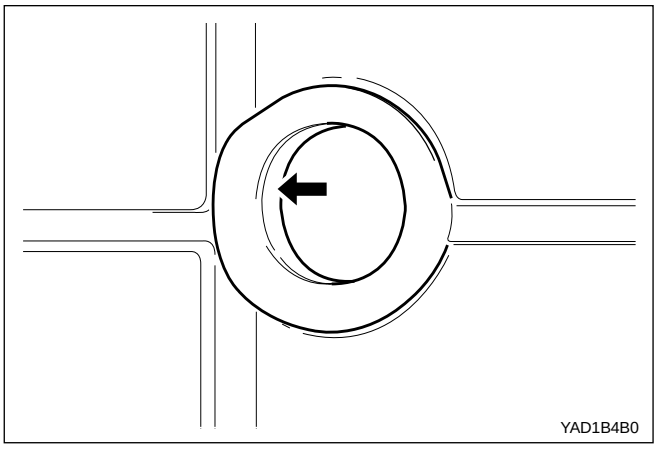
102 589 00 15 00 Drift

Replacement Procedure

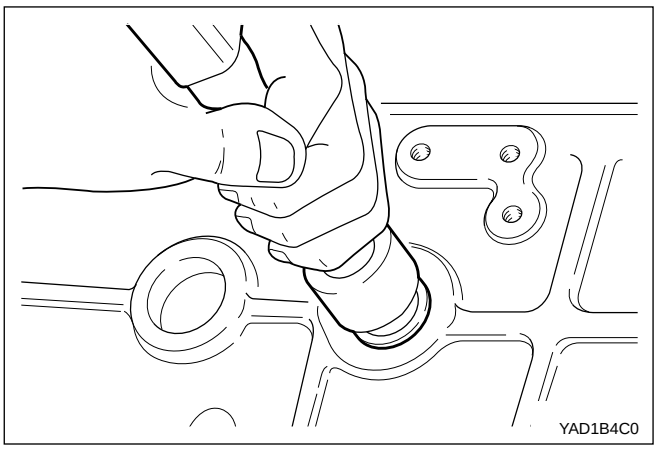
1. Remove the intake and exhaust manifolds.
2. Pull back the core plug until the end of one side comes out using the screw driver.


YAD1B4A0

3. Pull out the plug carefully using a pliers.


YAD1B4B0

4. Clean the sealing surface and apply Loctite 241.

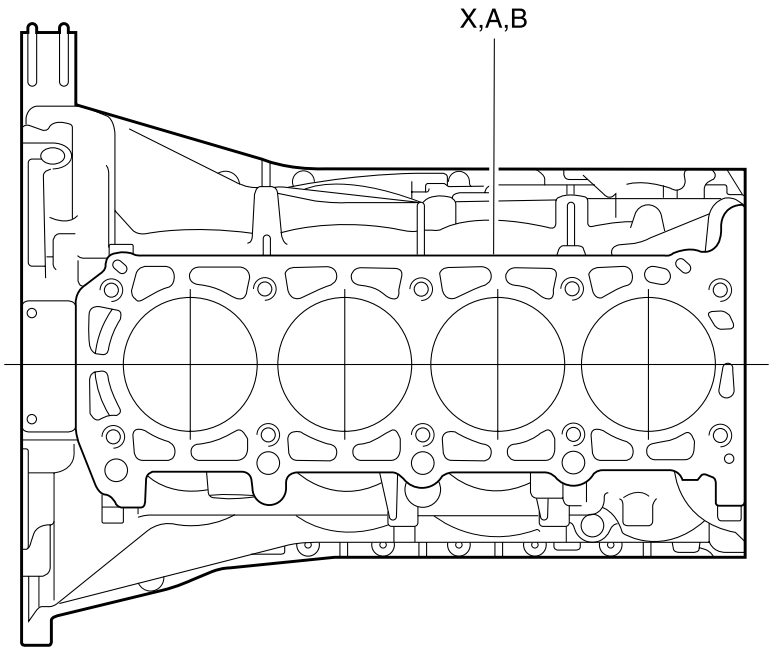

YAD1B4C0

5. Press in new plug using a drift.

   Notice: Wait for about 45 minutes before filling the coolant so that the Loctite 241 hardens.

6. Warm up the engine and check the coolant for leaks.

CYLINDER BORE



YAD1B8C0

Group Code Letter and Cylinder Bore Size

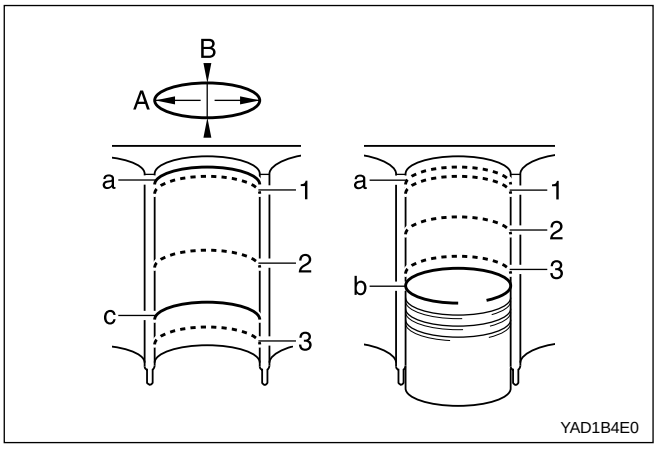
Engine	Group Code Letter of Cylinder	Piston Type to be Used	Cylinder Bore Size (mm)
E23	A	A or X	ϕ 90.906 - ϕ 90.912
	X	A, X or B	ϕ 90.906 - ϕ 90.912
	B	X or B	ϕ 90.912 - ϕ 90.918
	X + 5	X + 5	ϕ 90.950 - ϕ 90.968
	X + 10	X + 10	ϕ 91.000 - ϕ 91.018

Group Code Letter Cylinder	Group Code Letter 1)	Cylinder Bore Size (mm)
Standard Size ∅ 90.9	A	ϕ89.900 - ϕ89.906
	X	ϕ89.906 - ϕ89.912
	B	ϕ89.912 - ϕ89.918
1st Repair Size (Standard Size + 0.25)	A	ϕ90.150 - ϕ90.156
	X	ϕ89.156 - ϕ90.162
	B	ϕ90.162 - ϕ90.168
2nd Repair Size (Standard Size + 0.5)	A	ϕ90.400 - ϕ90.406
	X	ϕ90.406 - ϕ90.412
	B	ϕ90.412 - ϕ90.418

1) The group code letters are carved on the surface of the piston crown and in the mating surface of the crankcase.

Service Data Standard

Wear Limit in Longitudinal and Transverse Direction		0.1 mm
Permissible Deviation of Cylinder Out-of-round	When new	0.007 mm
	Wear limit	0.05 mm
Permissible Deviation of Rectangular Cylinder Height (Except Chamfered Area)		0.05 mm
Basic Peak-to-valley Height After Final Honing and Brushing		0.003 - 0.006 mm
Chamfer Angle		75 °
Honing Angle		50 ° ± 10 °



Measurement of Cylinder Bore

1. Clean the cylinder wall.
2. Using a internal diameter gauge, measure the bore size in axial and transverse direction at three points (1,2,3).

1, 2, 3 Measuring Points

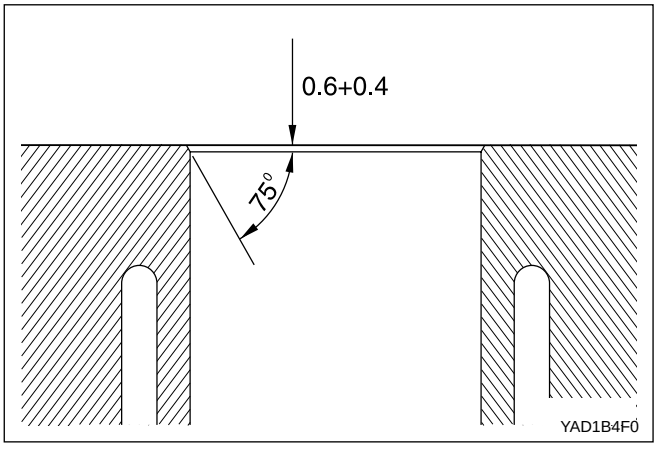
A. Axial Direction

B. Transverse Direction

a. Location of the No.1 Piston Ring at TDC

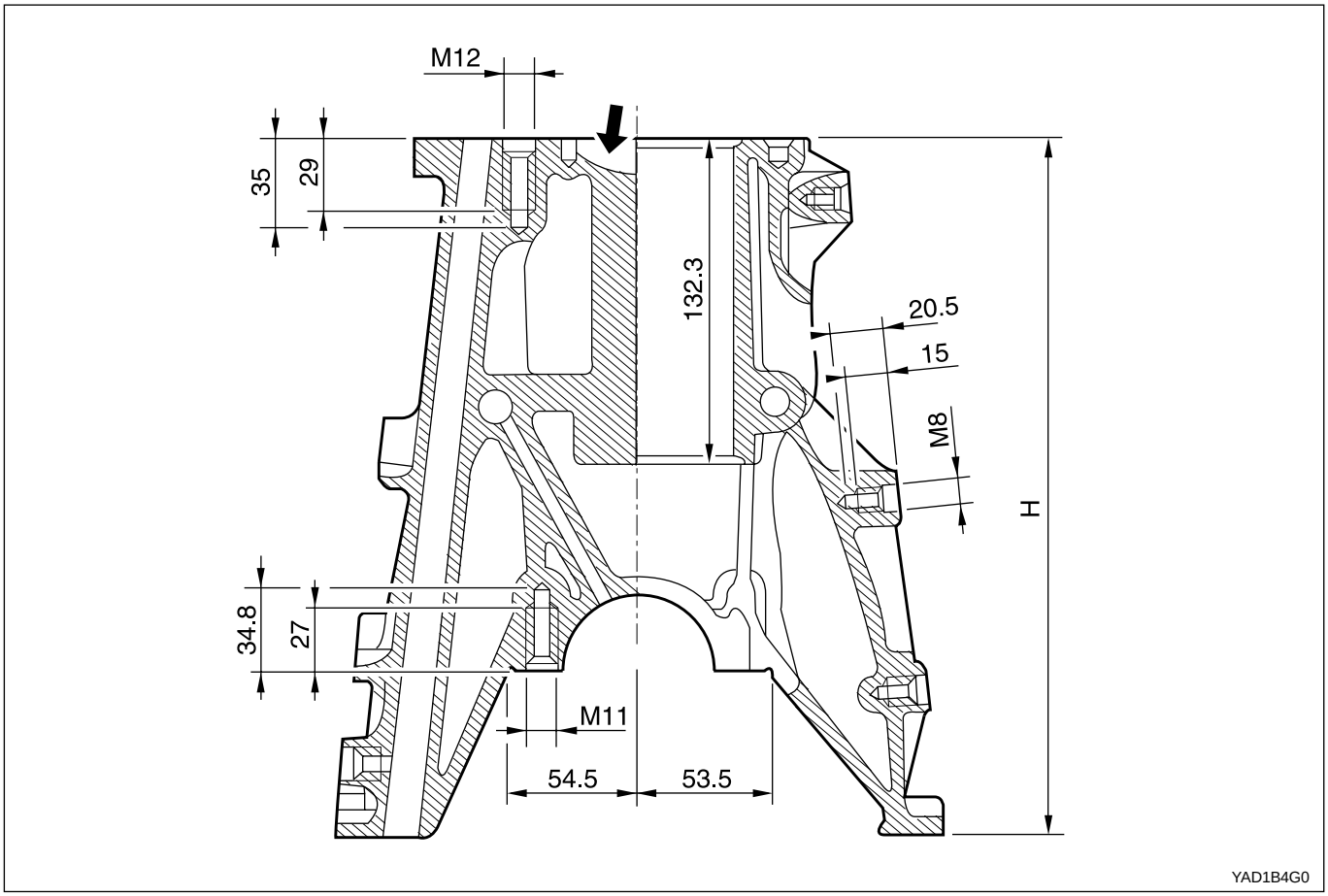
b. Location of the Piston BDC

c. Location of the Oil Ring at BDC



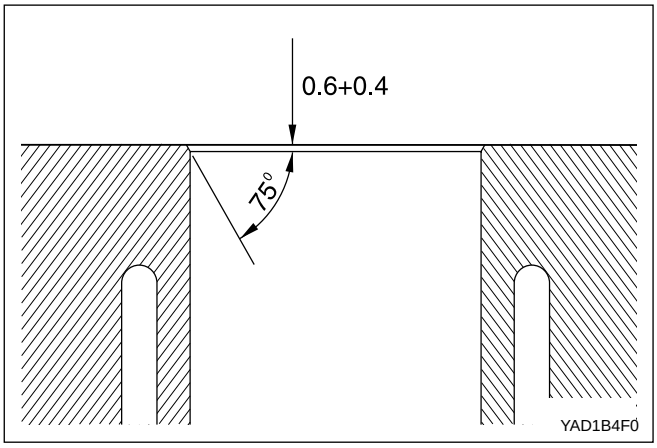
Chamfer Angle

CRANKCASE MATING SURFACE



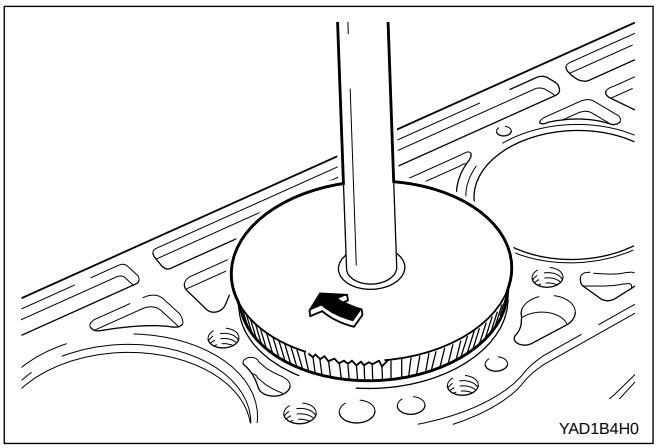
Service Data Standard

Height of The Crankcase 'H' (When new)		289.35 - 289.45 mm
Minimum Height After Milling		289.05 mm
Flatness	Crankcase Upper Mating Surface	0.03 mm
	Crankcase Lower Mating Surface	0.04 mm
Permissible Deviation of Parallelismof The Upper to Lower Mating Surface	Axial Direction	0.1 mm
	Transverse Direction	0.05 mm
Peak-to-valley Height	Crankcase Upper Mating Surface	0.012 - 0.009 mm
	Crankcase Lower Mating Surface	0.025 - 0.020 mm



Chamfering Procedure

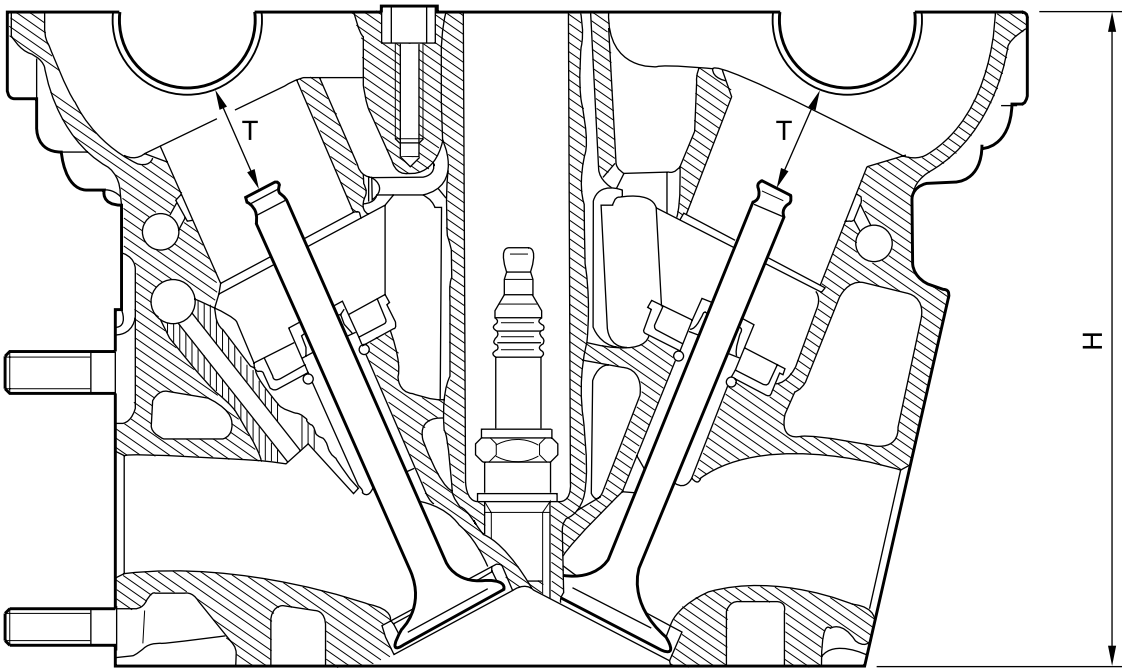
1. Chamfer angle : 75 °



2. Polish the lower chamfered area evenly with a grinder after finishing the chamfering with a suitable tool (e.g., hand milling cutter).

CYLINDER HEAD MATING SURFACE

Preceding Work: Removal of valves



YAD1B4J0

Service Data Standard

Overall Height of Cylinder Head			135.9 - 136.0 mm
Minimum Height After Machining			135.5 mm
Flatness	Axial Direction		0.08 mm
	Transverse Direction		0.0 mm
Distance 'T' (Between Camshaft Bearing and Valve Stem)	Standard Size	Intake	24.21 - 24.75 mm
		Exhaust	22.21 - 22.75 mm
	Repair Size	Intake	23.96 - 24.51 mm
		Exhaust	21.96 - 22.51 mm

Notice: Do not exceed 0.4 mm for the milling of the mating surface of crankcase and cylinder head.

Measurement of Mating Surfac

1. Measure the height (H) of the cylinder head (refer to Service data standard).
2. Check the mating surface of the cylinder head.
3. Mill the sharp edge of the combustion chamber.
4. Re-measure the height (H) of the cylinder head.
5. Seal the intake and exhaust valves.
6. Measure the dimension (T) between the camshaft bearing and the valve system *(refer to Service data standard).*
7. Mill the cylinder head valve seat *(refer to Service data standard).*

Universal Tool

Surface Grinding Machine	Sceledum, Type RTY Roaro Schio / Italy

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

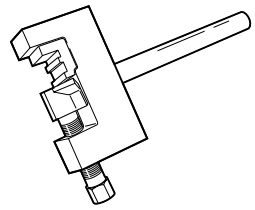
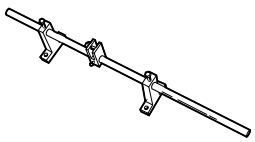
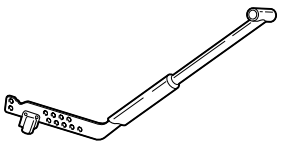
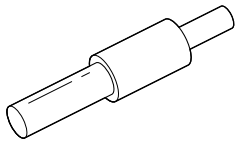
Application		N•m	Lb-Ft	Lb-In
Fuel Feed and Return Line		21 - 25	15 - 18	-
Exhaust Manifold and Pipe		30	22	-
Engine Mounting Nuts		70	52	-
Generator Carrier Bolts		25	18	-
Tensioning Pulley Bolt		40.5 - 49.5	29.9 - 36.5	-
Steering Pump Bolts		22.5 - 27.5	16.6 - 20.3	-
A/C Braket Bolts		22.5 - 27.5	16.6 - 20.3	-
Intake Air Duct Mounting Nuts		9 - 11	-	80 - 97
Spark Plug Cover Bolts		9 - 11	-	80 - 97
Cylinder Head Cover Bolts		9 - 11	-	80 - 97
Magnetic Assembly Bolt		9 - 11	-	80 - 97
Cylinder Head Front Cover Bolts	M8	22.5 - 27.5	16.6 - 20.3	-
	M6	9 - 11	-	80 - 97
Cylinder Head Bolts		55 +90° +90°	41 +90° +90°	- - 80 - 97
Timing Gear Case Cover Bolts		22.5 - 27.5	16.6 - 20.3	-
Crankshaft Sealing Rear Cover Mounting Bolts		9 - 11	-	-
Vibration Damper Center Bolts		200 + 20 +90° + 10°	148 + 15 +90° + 10°	- -
Flywheel Mounting Bolt		40 +90°	30 +90°	- -
Amarture Bolt in Flywheel		45 + 5	33 + 3.7	-
Camshaft Adjuster Flange Bolts		+90° + 10° 35	+90° + 10° 26	- -
Intake Flange Shaft Bolts		18 - 22 60° ± 5°	13 - 16 60° ± 5°	- -
Exhaust Camshaft Sprocket Bolts		18 - 22 60° ± 5°	13 - 16 60° ± 5°	- -
Intake Flange Shaft Bolts		18 - 22	13 - 16	-
Exhaust Camshaft Sprocket Bolts		60° ± 5°	60° ± 5°	-
Camshaft Bearing Cap Bolts		22.5 - 27.5	16.6 - 20.3	-
Chain Tensioner Screw Plug		40	30	-
Chain Tension Assembly		72 - 88	53 - 65	-
Oil Pump Sprocket Bolt		29 - 35	21 - 26	-
Tensioning Device Bolts		26 - 32	19 - 24	-
Water Pump Pulley		22.5 - 27.5	16.6 - 20.3	-
Upper Intake Manifold Bolt		22.5 - 27.5	16.6 - 20.3	-
Lower Intake Mainfold Bolt		22.5 - 27.5	16.6 - 20.3	-
Flange Bolt to Exhaust Mainfold		30	22	-

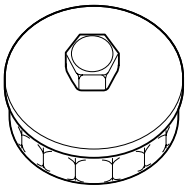
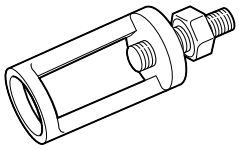
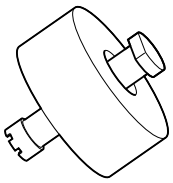
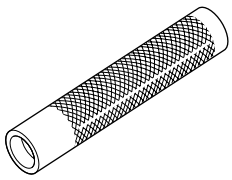
FASTENER TIGHTENING SPECIFICATIONS (Cont'd)

Application	N•m	Lb-Ft	Lb-In
Exhaust Mainfold Nut to Stud Bolt	26 - 34	19 - 25	-
Oil Drain Plug	25	18	-
Oil Filter Cover	25	18	-
Oil Filter Bolt	22.5 - 27.5	16.6 - 20.3	-
Oil Pump Drive Sprocket Bolt	29 - 35	21 - 26	-
Oil Pump Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Oil Strainer Bracket Bolt	9 - 11	-	80 - 97
Oil Pressure Relief Valve Screw Plug	50	37	-
Oil Dipstick Guide Tube Bolt	9 - 11	-	80 - 97
Oil Gallery Screw Plug	15	11	-
Shock Absorber Bolts	22.5 - 27.5	16.6 - 20.3	-
Crankshaft Bearing Cap Bolts	55/+90°	41/+90°	-
Torque Converter Mounting Bracket Bolts	42	31	-

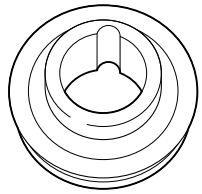
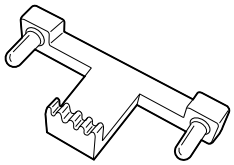
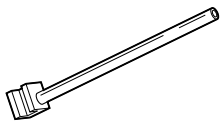
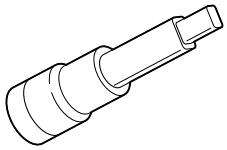
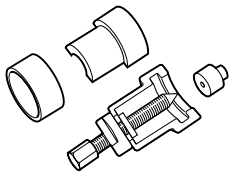
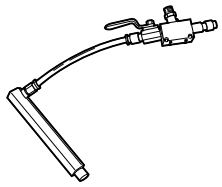
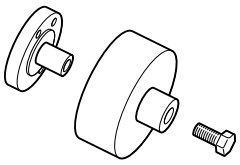
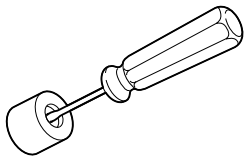
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

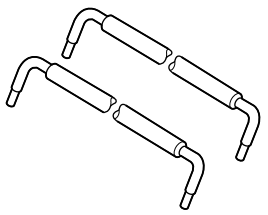
 YAD1B1W0	**000 589 58 43 00** **Chain Assembly**
 YAD1B0W0	**111 589 01 59 00** **Supporting Bar**
 YAD1B0X0	**111 589 18 61 00** **Lever Pusher**
 YAD1B570	**116 589 01 34 00** **Threaded Pin**

 YAD1B2Y0	**103 589 02 09 00** **Oil Filter Remover**
 YAD1B0Y0	**111 589 25 63 00** **Thrust Piece**
 YAD1B580	**116 589 20 33 00** **Sliding Hammer**
 YAD1B1L0	**119 589 00 43 00** **Drift**

Special Tools Table (Cont'd)

 YAD1B790	**601 589 03 14 00 Crankshaft Front Seal Installer**	 YAD1B720	**602 589 00 40 00 Engine Lock**
 YAD1B4K0	**603 589 00 40 00 Fan Clutch Holder**	 YAD1B560	**617 589 00 10 00 Allen Wrench Socket**
 YAD1B2M0	**615 589 01 33 00 Crankshaft Sprocket Puller**	 YAD1B0Z0	**DW110 - 090 Connecting Hose**
 YAD1B730	**601 589 03 43 00 Crankshaft Rear Seal Installer**	 YAD1B1A0	**DW110 - 100 Valve Tappet Remover**

Special Tools Table (Cont'd)

 YAD1B4R0	**111 589 03 15 00** **Holding Pin**

SECTION 1B3

DIESEL ENGINE MECHANICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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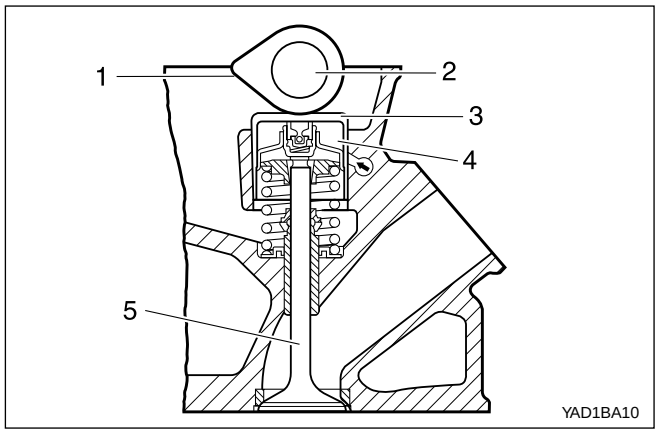
DESCRIPTION AND OPERATION

VALVE DEVICE

Operation

The diesel engines have valves with bucket tappets and automatic valve clearance adjustment. This eliminates the need to re-set the valve clearance.

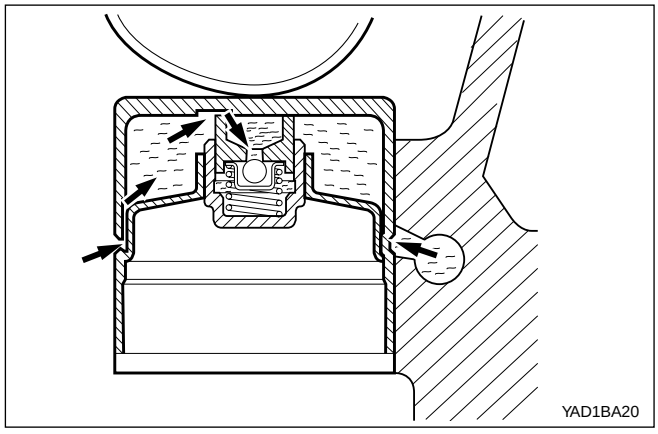
The compact design of the valve timing gear from the cam through the bucket tappet to the valve contributes to weight savings, to low drag power and also to increased rigidity. Oil is supplide to the bucket tappets through oil bores in the cylinder head.



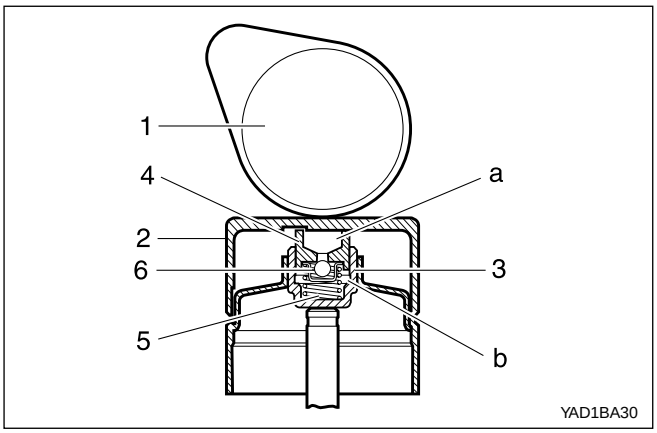
1 Cam
2 Camshaft
3 Tappet
4 Oil
5 Valve

The maintenance-free hydraulic valve clearance adjusting elements automatically compensates the valve clearance resulting from thermal expansion and wear.

This produces a quiet-running valve train.



Function



1 Cam
2 Tappet
3 Guide Sleeve
4 Thrust Piece
5 Pressure Spring
6 Ball Valve
a Supply Chamber
b Working Chamber

The hydraulic valve clearance adjusting elements are installed in the bucket tappets and operate the valves directly through the thrust pins and guide sleeves.

When the engine is running and a load is applied on the element by cam tip, the element cam go down fully. The oil displaced from the working chamber flows via the annular gap (clearance between guide sleeve and thrust pin) to the supply chamber.

As soon as the cam lobe rotates upwards from the tappet (2), the load on the guide sleeve (3) is relieved.

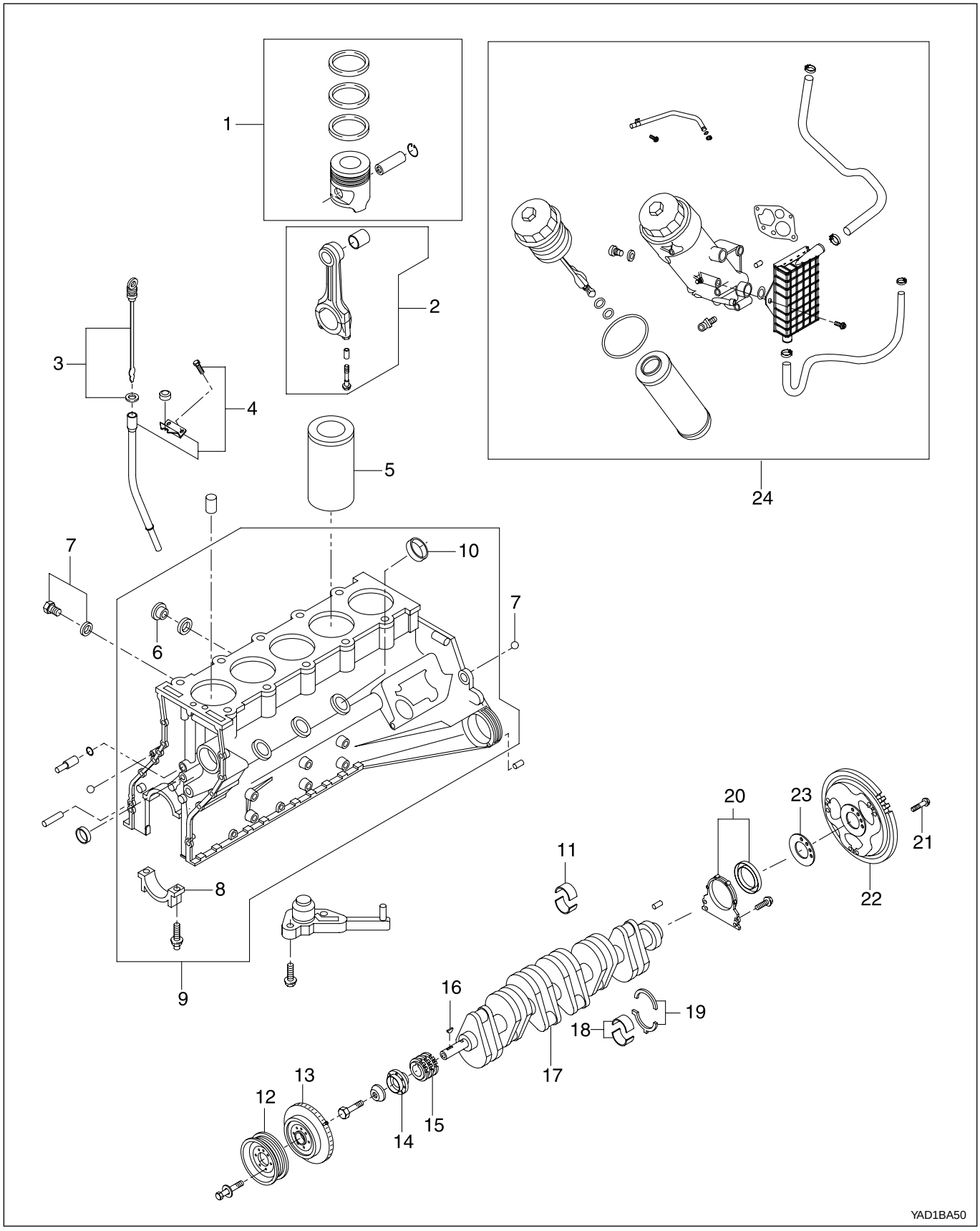
The spring (5) pushes the thrust pin (4) up until the tappet is resting against the cam (1). The vacuum produced in the working chamber (b) as a result of the upward movement of the guide sleeve opens the ball valve (6) and oil flows out of the supply chamber (a) into the working chamber (b).

The ball valve closes when the cam presses against the tappet and thus applies pressure on the thrust pin.

The oil in the working chamber acts as a “hydraulic rigid connection” when the engine is running and the relevant valve is opened. The oil required for this purpose is supplied to the elements along a longitudinal passage in the cylinder head. From here, the oil flows through a bore to the relevant adjustment element.

The oil to the supply chamber flows via the groove provided in the base of the tappet.

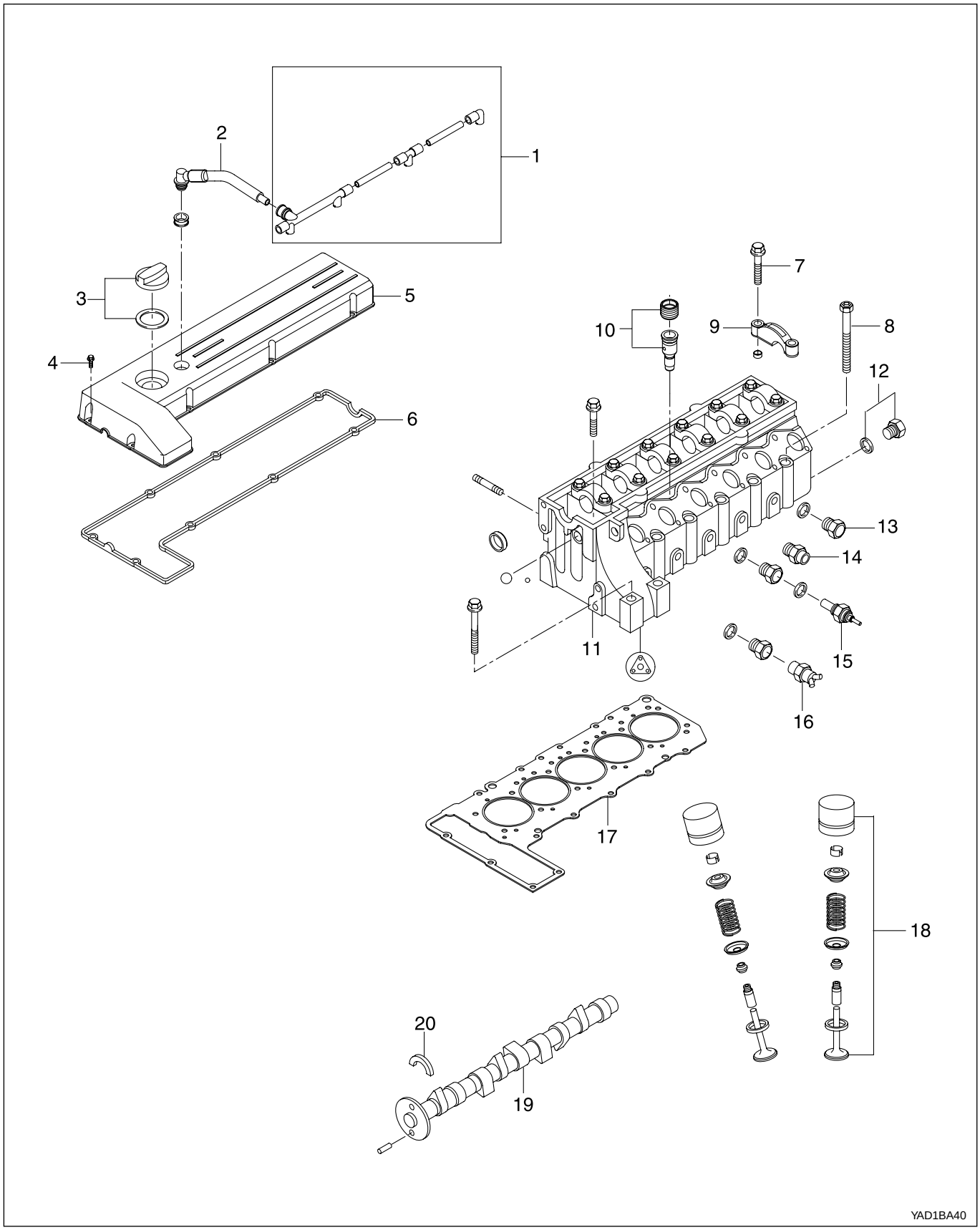
CYLINDER BLOCK



1 Piston & Piston Ring Assembly
2 Connection Rod Assembly
3 Oil Dipstick Gauge
4 Oil Dipstick Gauge Bracket
5 Cylinder Liner
6 Plug
7 Screw & Seal Ring
8 Crankshaft Bearing Cap
9 Cylinder Block
10 Plug
11 Crankshaft Journal Bearing
12 Crankshaft Pulley
13 Vibration Damper
14 Hub
15 Crankshaft Sprocket
16 Key
17 Crankshaft
18 Crankshaft Journal Bearing
19 Crankshaft Thrust Bearing
20 Crankshaft Sealing Cover
21 Bolt
22 Flywheel
23 Plate
24 Oil Pump Assembly

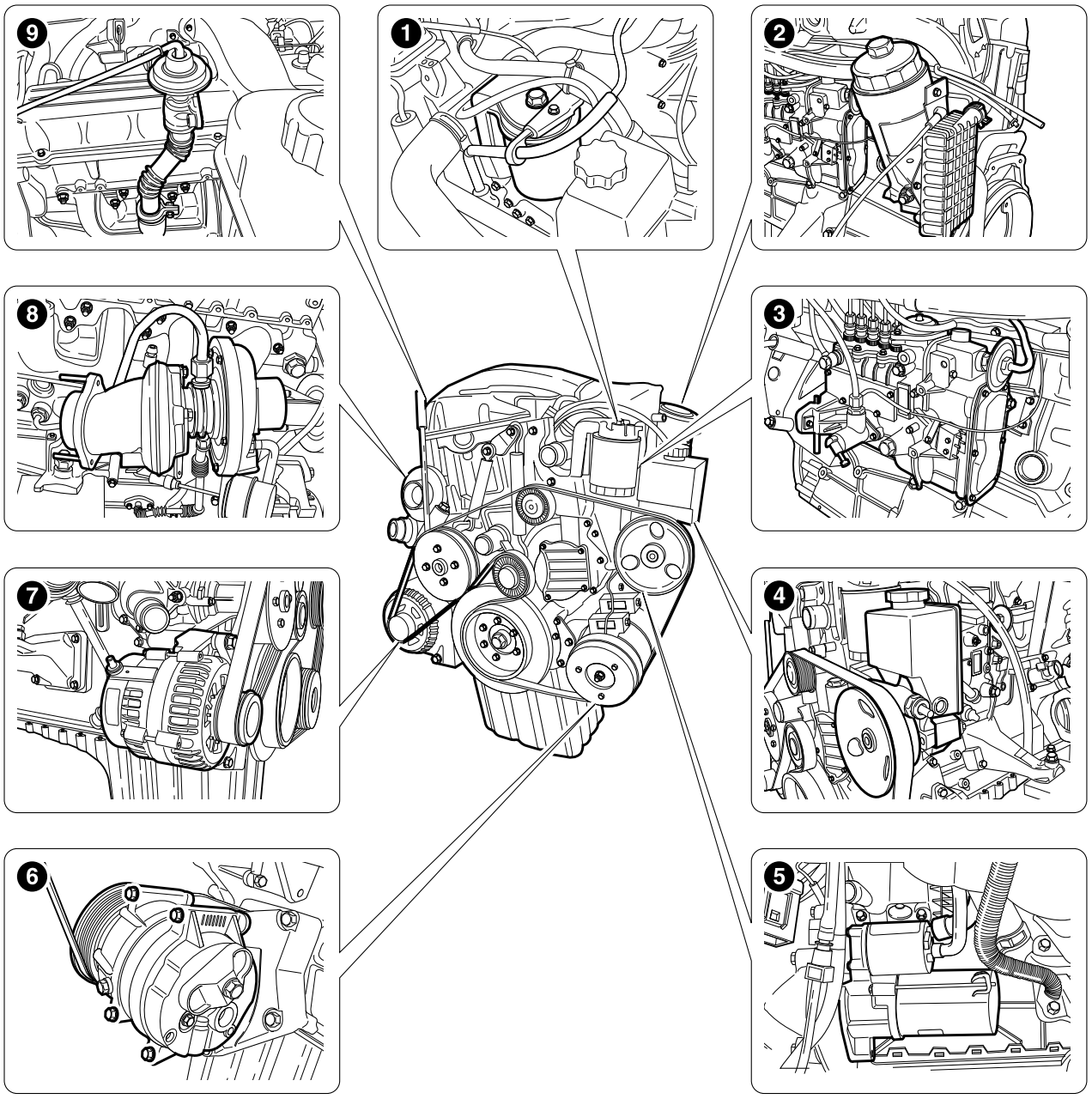
COMPONENT LOCATOR

CYLINDER HEAD



1 Blow By Gas Return Hose
2 Blow By Gas Return Pipe
3 Oil Filler Cap
4 Bolt
5 Cylinder Head Cover
6 Cylinder Head Cover Gasket
7 Camshaft Cap Bolt
8 Cylinder Head Bolt
9 Camshaft Bearing Cap
10 Pre Chamber Assembly
11 Cylinder Head
12 Plug
13 Plug
14 Connector
15 Engine Coolant Temperature Sensor
16 Thermo Valve
17 Cylinder Head Gasket
18 Valve Assembly
19 Camshaft
20 Camshaft Adjust Key

ENGINE COMPONENT

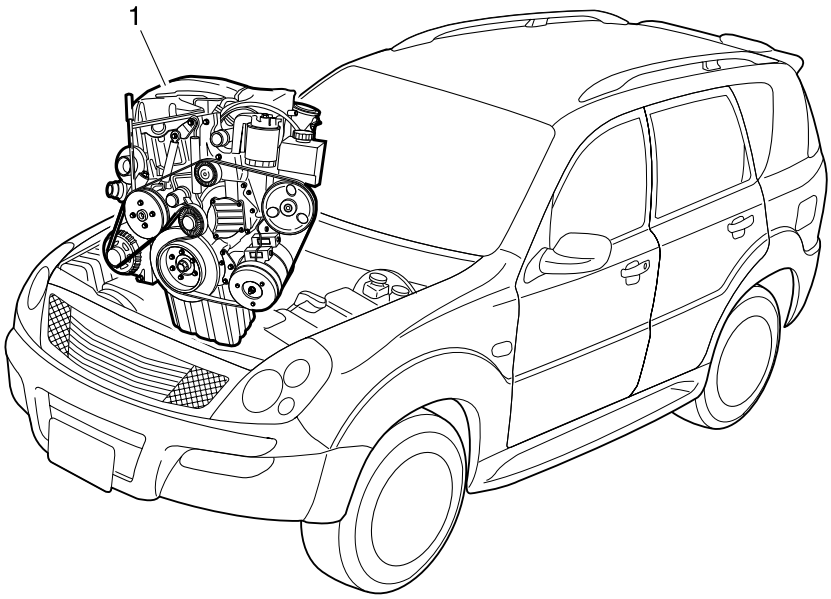


1 Fuel Filter Assembly
2 Oil Filter Assembly
3 Injection Pump Assembly
4 Power Steering Pump Assembly
5 Starter Assembly
6 A/C Compressor Assembly
7 Generator Assembly
8 Turbo Charger Assembly
9 EGR Valve Assembly

REPAIR INSTRUCTIONS

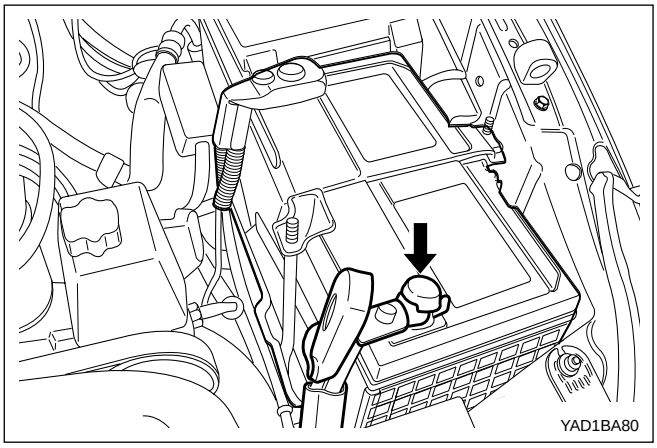
ON-VEHICLE SERVICE

ENGINE ASSEMBLY



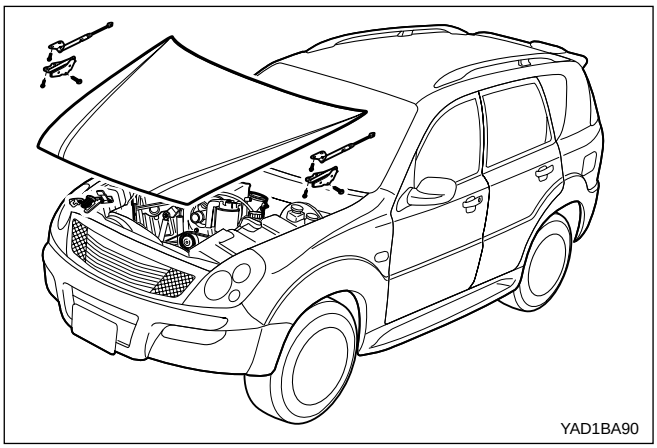
YAD1BA70

1. Engine Assembly

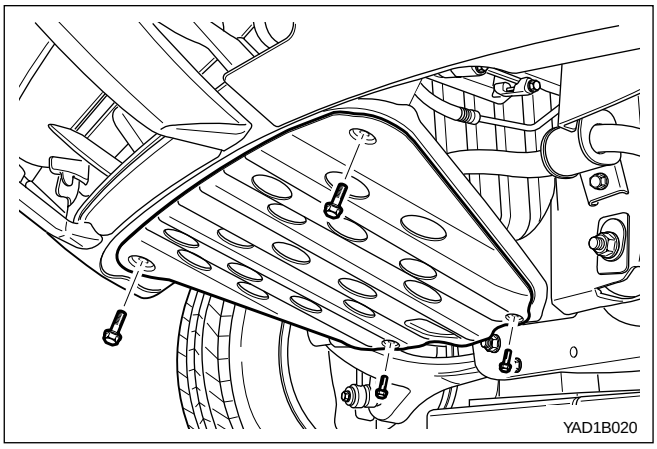


Removal Procedure

1. Disconnect the negative battery cable.



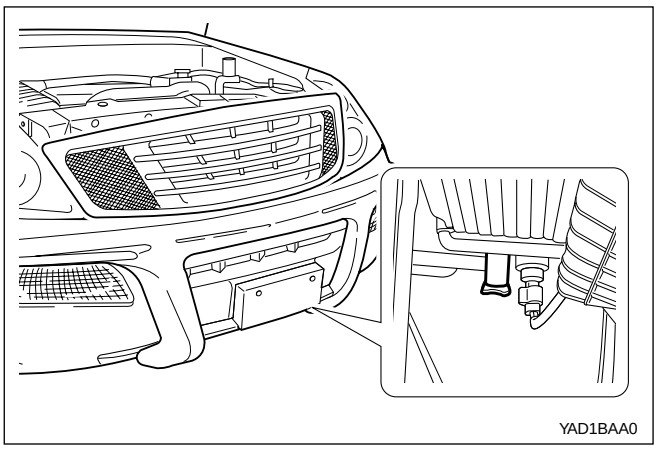
2. Remove the hood.



3. Remove the skid plate.

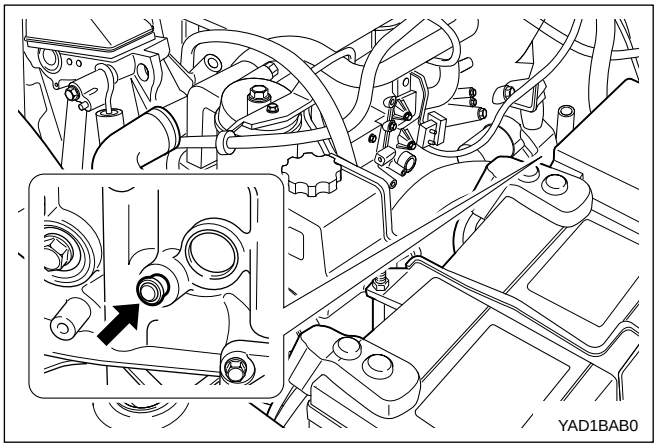
Installation Notice

Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)



4. Remove the radiator drain cock and drain the coolant.

Notice: Open the coolant reservoir tank cap.

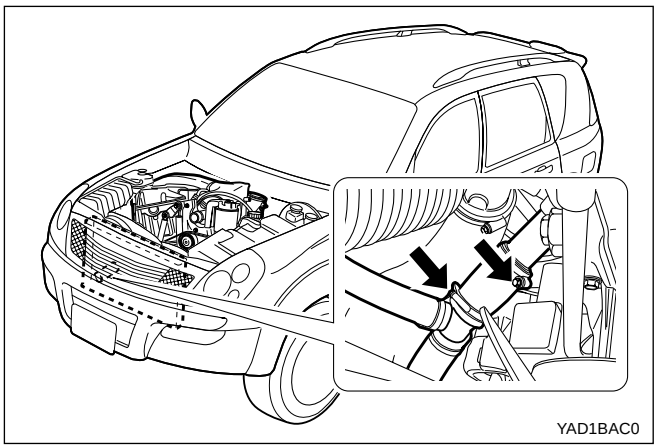


5. Remove the drain plug and seal from the cylinder block and drain the coolant completely.

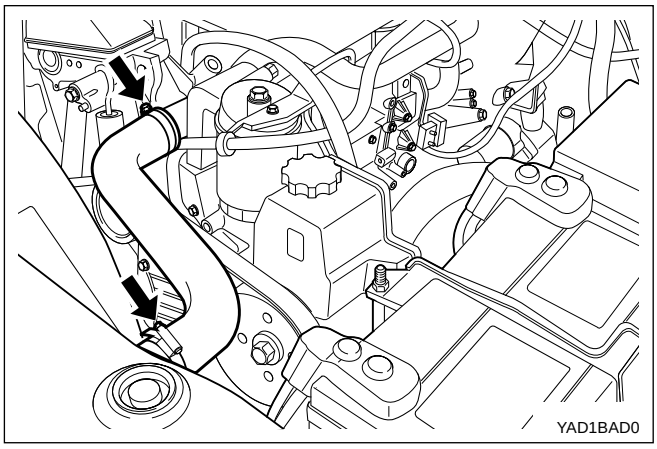
Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

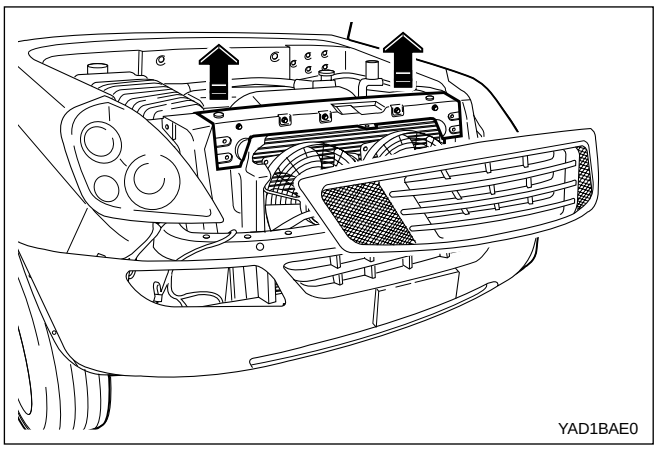
After draining, replace the seal and reinstall the drain plug.



6. Disconnect the lower coolant hose from the radiator.



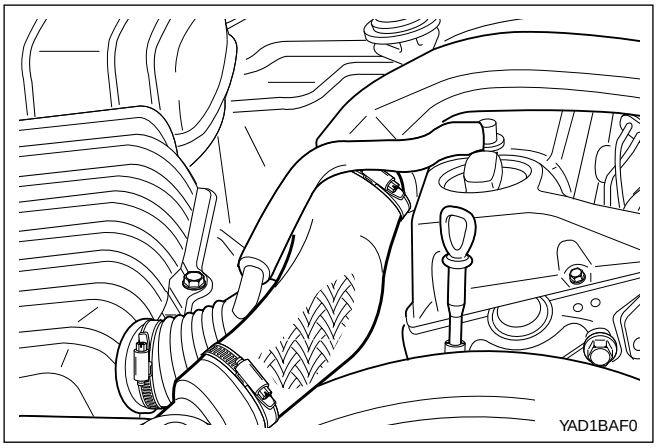
7. Disconnect the upper coolant hose from the radiator.



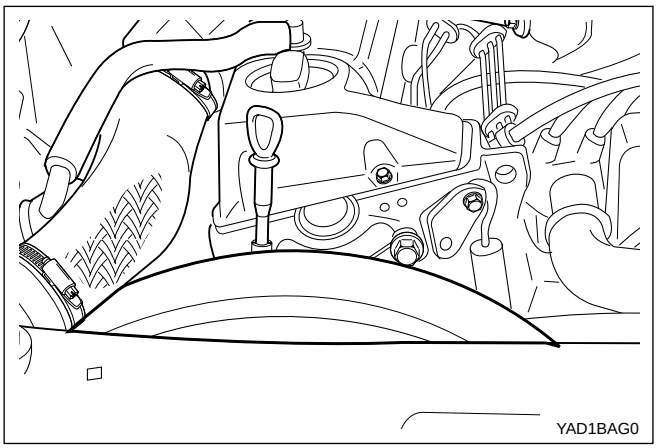
8. Remove the radiator grille mounting screws and radiator grille.
9. Remove the front end upper member mounting blots and front end upper.

Installation Notice

Tightening Torque	30 - 40 N•m (22 - 30 lb-ft)



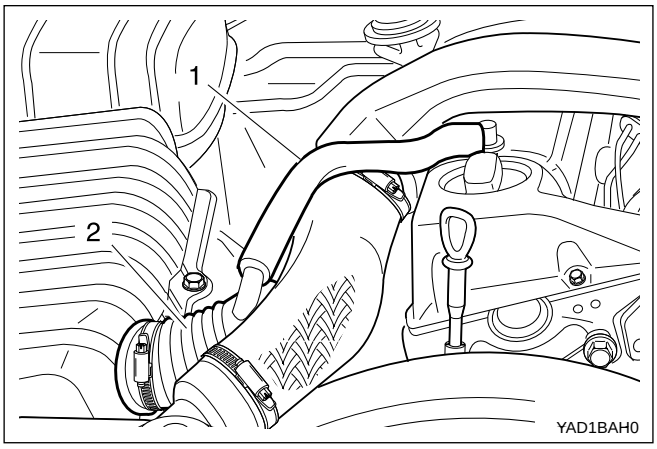
10. Remove the hoses (air intake to intercooler, intercooler to intake duct).



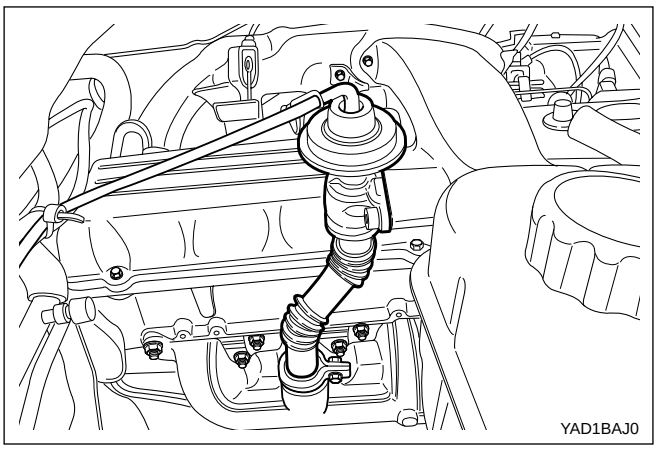
11. Loosen the cooling fan shroud bolts and remove the cooling fan shroud.

Installation Notice

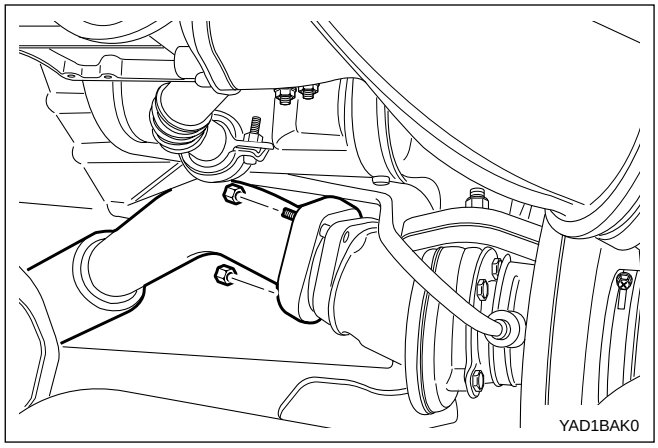
Tightening Torque	3 - 7 N•m (27 - 62 lb-in)



12. Remove the air cleaner to turbo charger hose(2) with blow by hose(1).



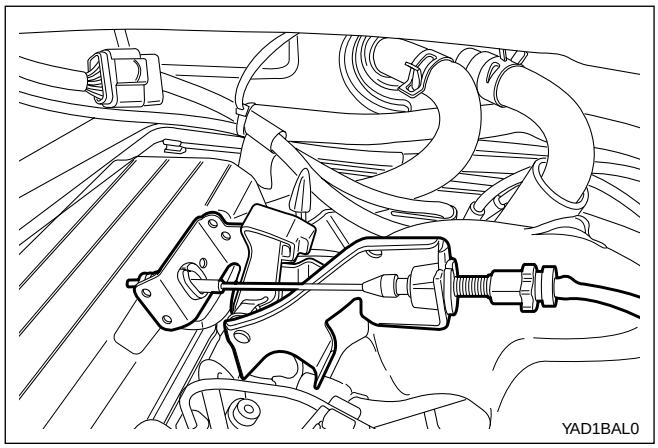
13. Disconnect the exhaust gas recirculation (EGR) valve hose and necessary hoses and pipes.



14. Remove the turbo charge to exhaust pipe bolts and separate the exhaust pipe flange from the turbo charger.

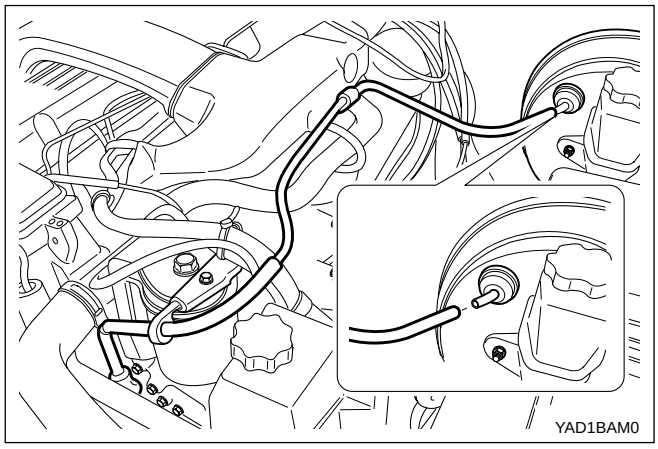
Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

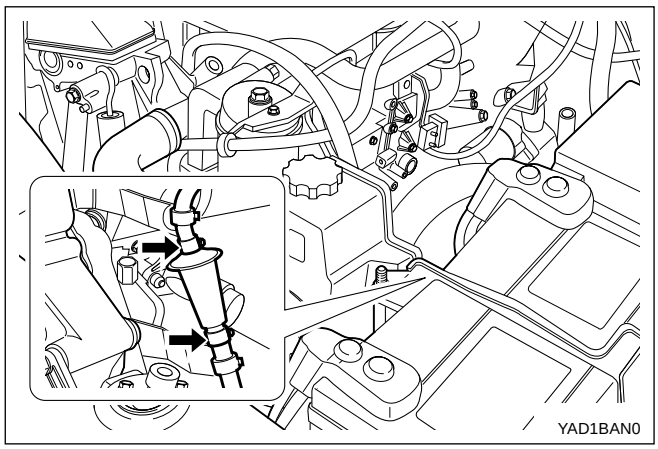


15. Disconnect the accelerator cable from the control linkage.

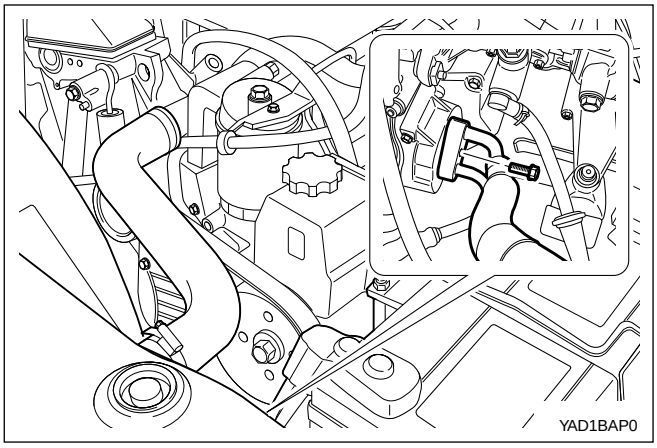
Notice: After installation of accelerator cable, check the engine idling and operation condition.



16. Disconnect the brake booster hose from vacuum pump.

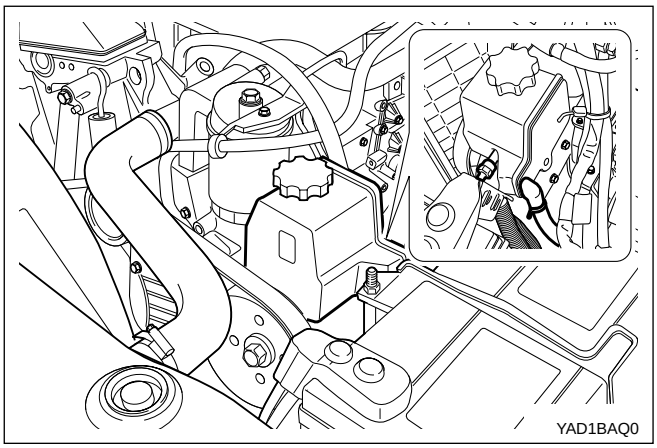


17. Disconnect the fuel feed line with prefilter from the feed pump on injection pump.



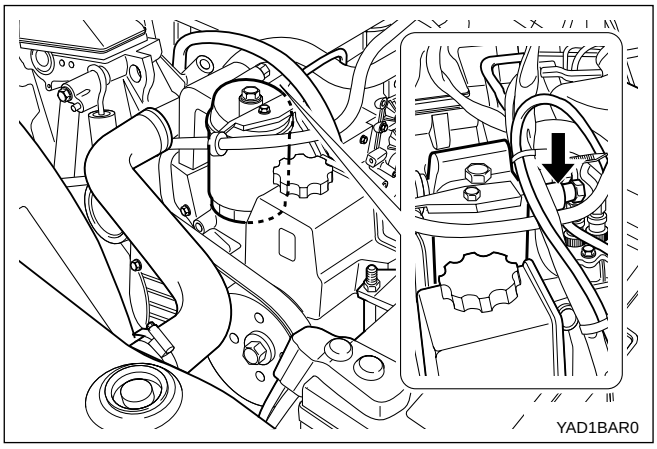
18. Remove the A/C compressor IN/OUT pipes.

    Notice: Evacuate the refrigerant before removal.

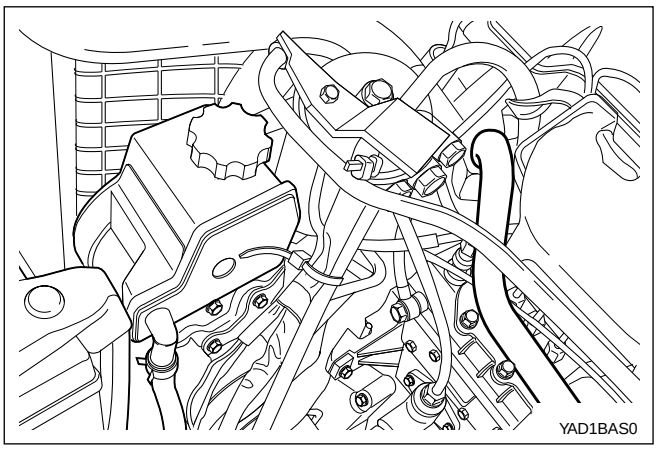


19. Remove the power steering pump lines.

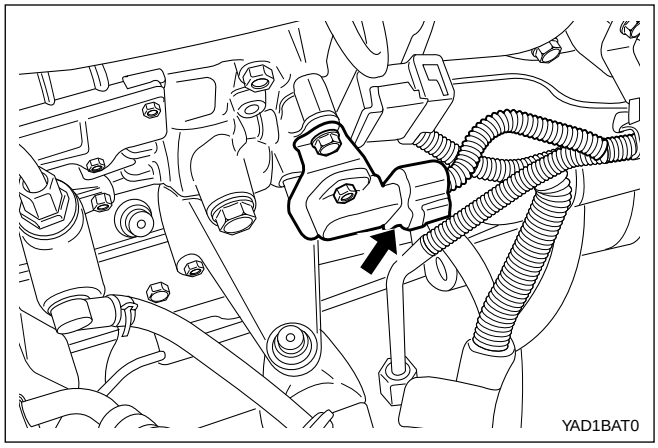
    Notice: Completely drain the fluid.



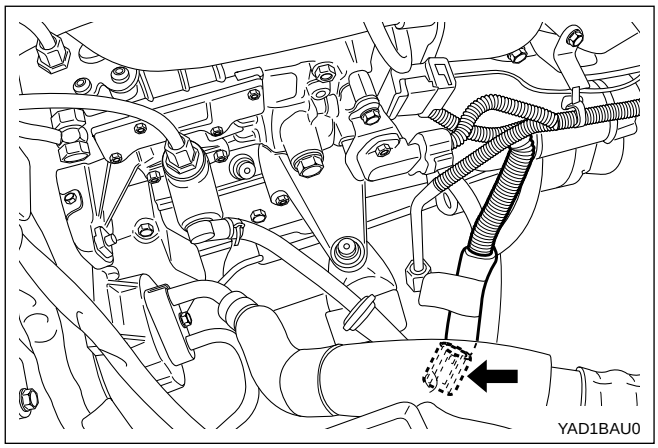
20. Remove the fuel lines from the fuel filter and cover the filter with plug.



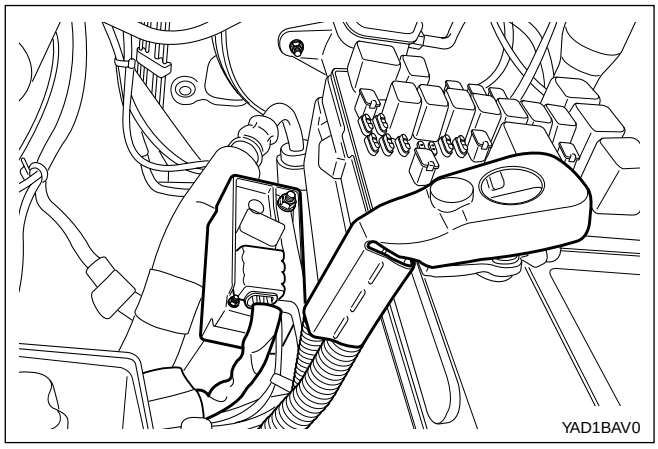
21. Disconnect the coolant hose from the water inlet.



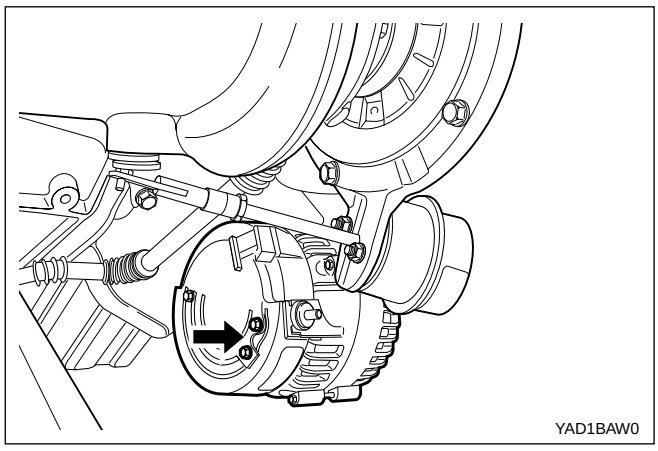
22. Disconnect the injection timing relay connector from injection pump.



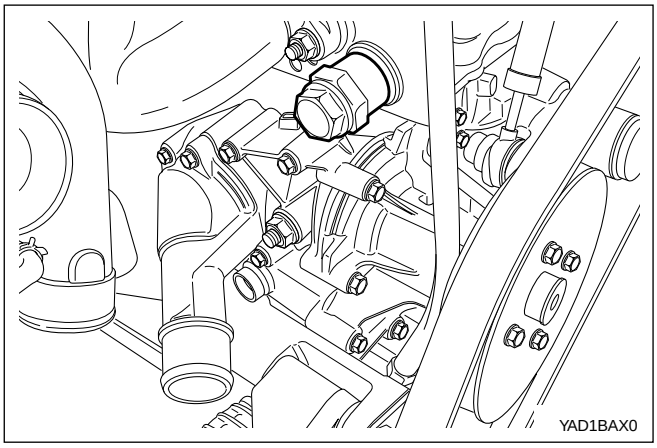
23. Disconnect the starter motor wires and necessary connectors.



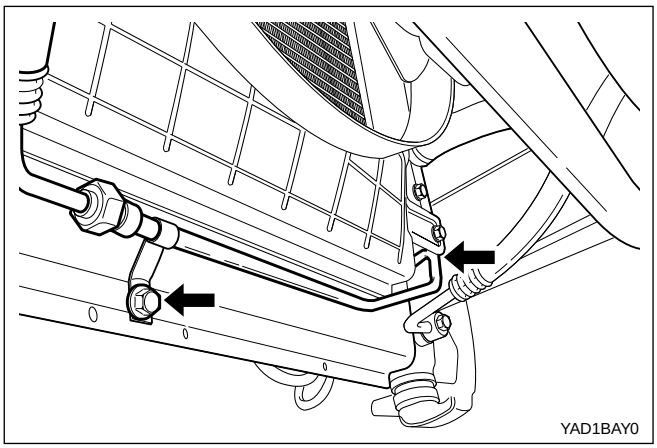
24. Disconnect the preheating time relay cable and glow plug cable.



25. Disconnect the ground cable.
26. Disconnect the generator wires.



27. Disconnect the engine coolant temperature sensor connector.

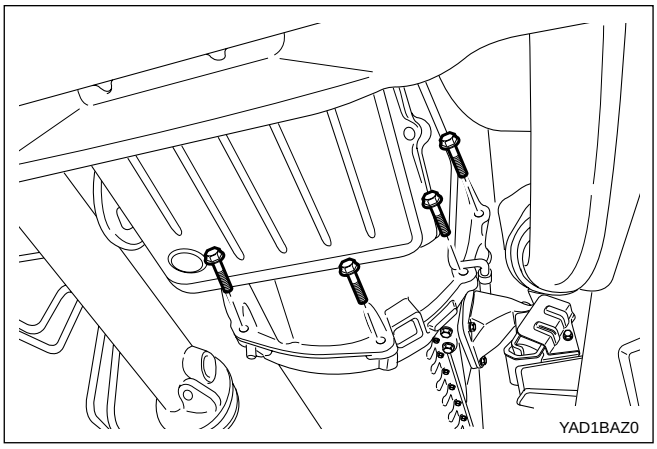


28. Remove the automatic transmission oil cooler lines.

Installation Notice

Tightening Torque	25 - 35 N•m (18 - 26 lb-ft)

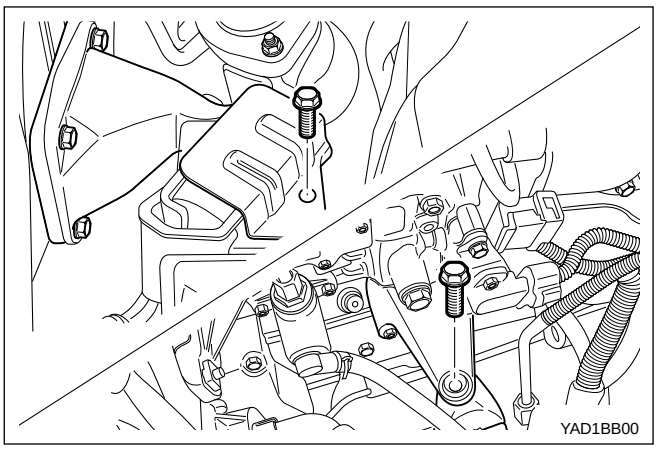
Use the new washer before installation of oil cooler lines.



29. Remove the transmission mounting bolts and separate the transmission from the engine.

Installation Notice

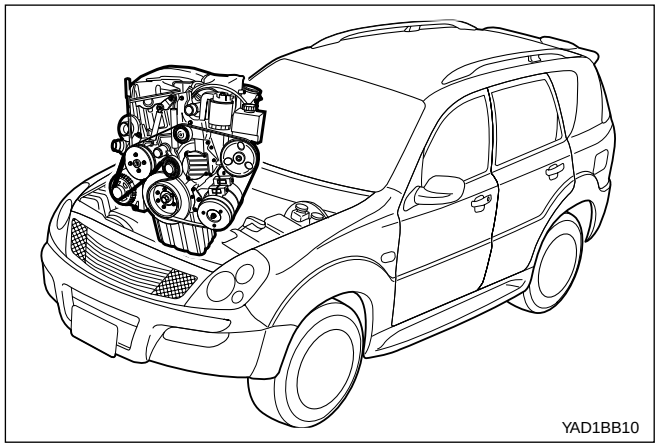
Tightening Torque	54 - 68 N•m (40 - 50 lb-ft)



30. Remove the engine mounting bracket bolts.

Installation Notice

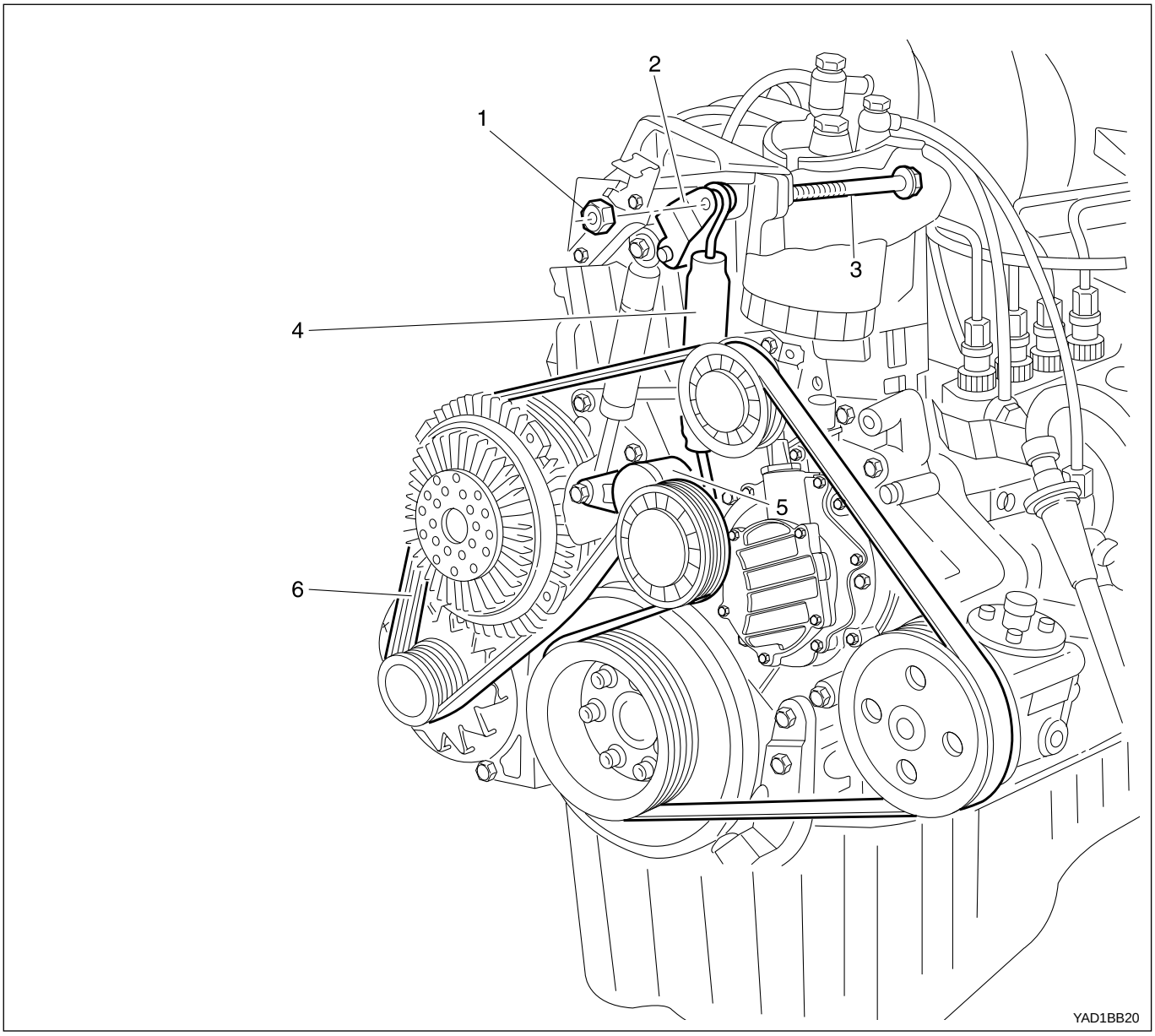
Tightening Torque	50 - 75 N•m (37 - 55 lb-ft)


YAD1BB10

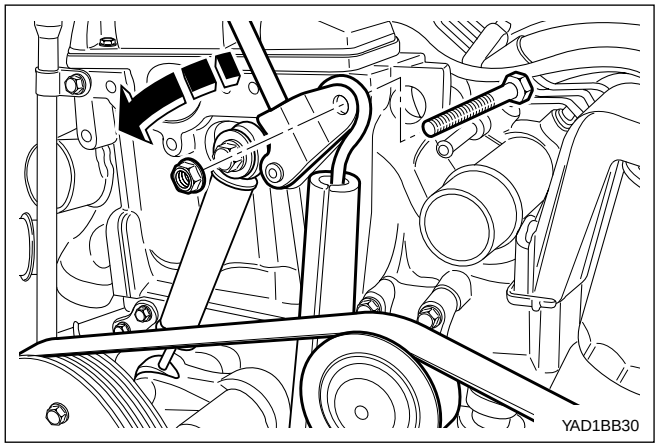
31. Remove the engine assembly from the vehicle by using a hoistor crane.
32. Installation should follow the removal procedure in the reverse order.

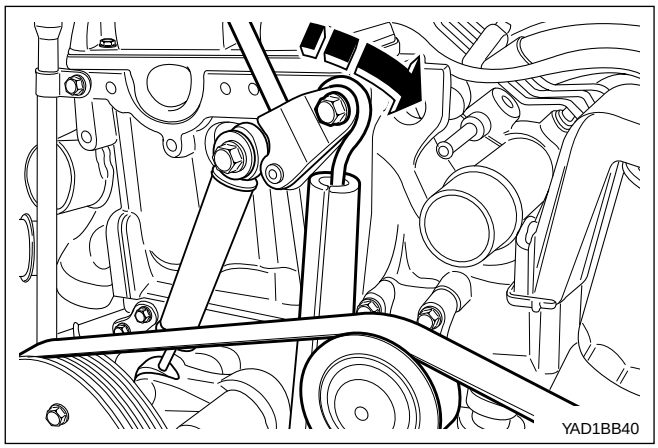
POLY V-BELT AND TENSIONING DEVICE

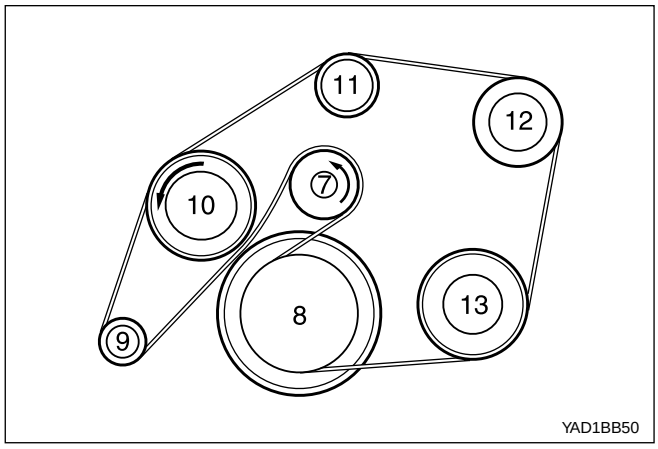
POLY V-BELT



1 Nut ..... 21 N•m (15 lb-ft)
2 Tensioning Lever
3 Bolt
4 Spring
5 Tensioning Lever
6 Poly V-Belt







7 Tensioning Pulley
8 Crankshaft
9 Generator
10 Water Pump
11 Guide Pulley
12 Power Steering Pump
13 A/C Compressor

Removal & Installation Procedure

1. Remove the tensioning lever nut (1).

   Installation Notice

Tightening Torque	21 N•m (15 lb-ft)

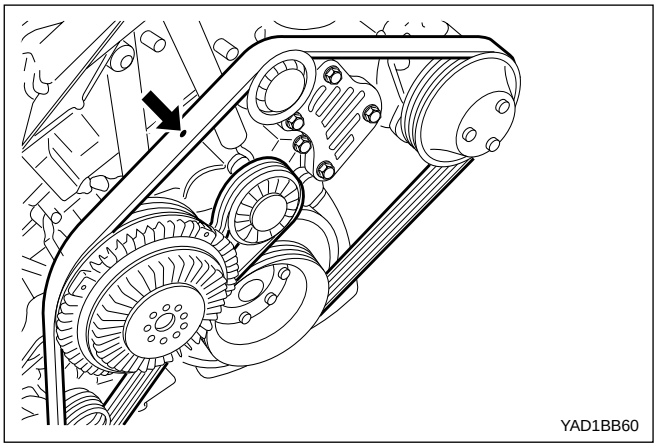
2. Push the tensioning lever in direction of arrow with a rod (ϕ 12, 180 mm) and pull out the bolt to the rear.

3. Push back the tensioning lever (arrow direction) to release the spring tension and remove the belt.

4. Install the poly V-belt beginning at the tensioning pulley (7).

Length of Belt

Length (L)	With Air Conditioner	2,100 mm
	Without Air Conditioner	2,040 mm

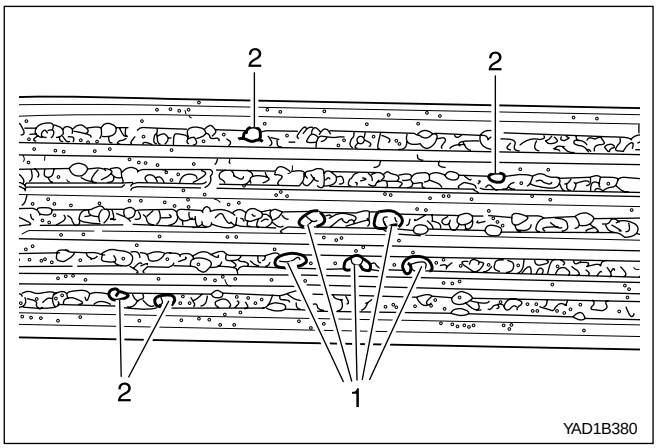

YAD1BB60

Poly V-Belt Inspection

Inspection Procedure

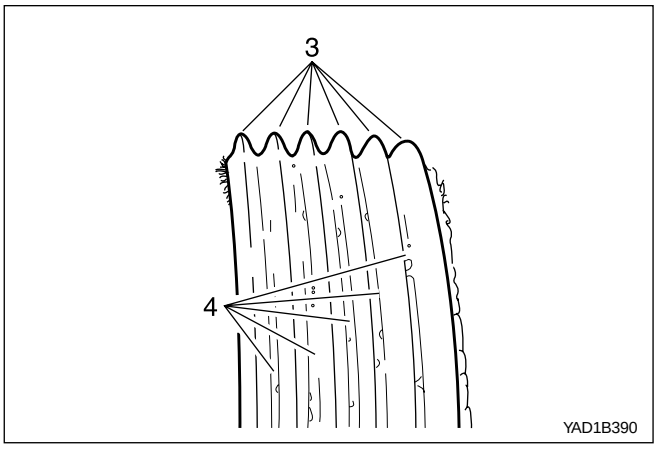
- Mark poly V-belt at a clearly visible point with chalk.
- Rotate the engine and check the belt.

  Notice: If one of the following types of damage is found, replace the belt.



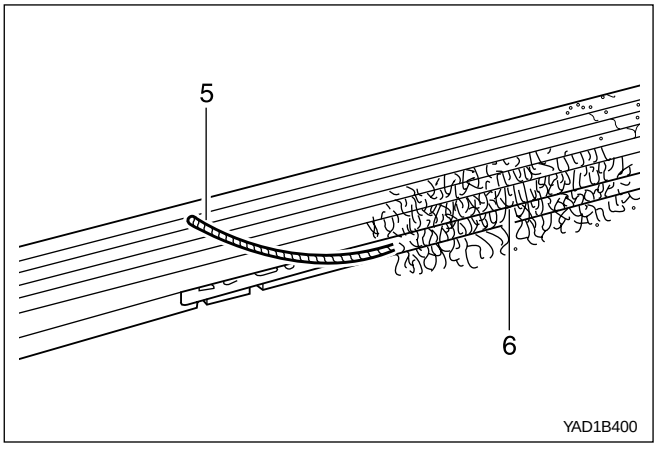
YAD1B380

1. Rubber lumps in the base of rips.
2. Dirt or grit ingrained.



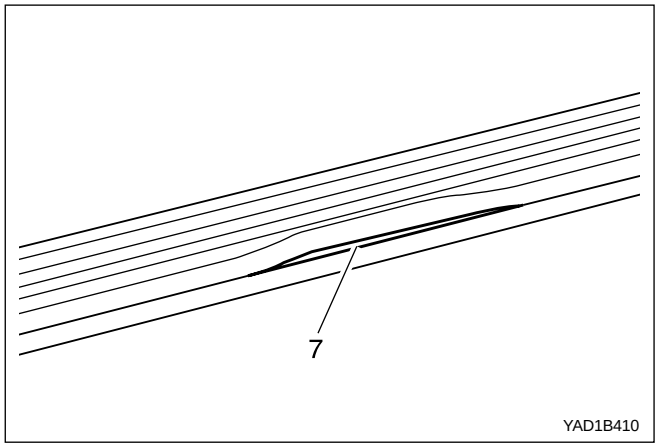
YAD1B390

3. Pointed rips.
4. Belt cord visible in the base of rips.

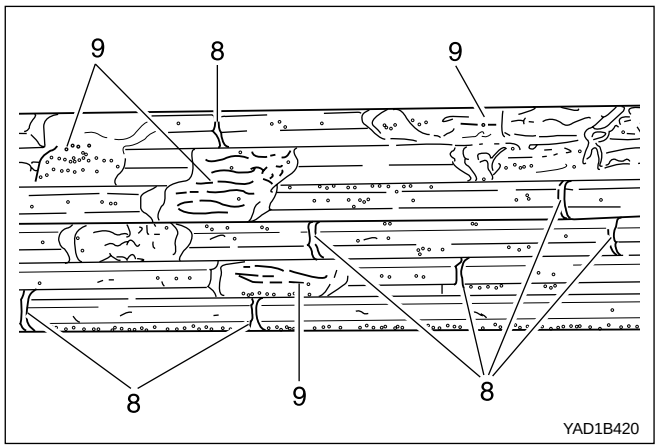


YAD1B400

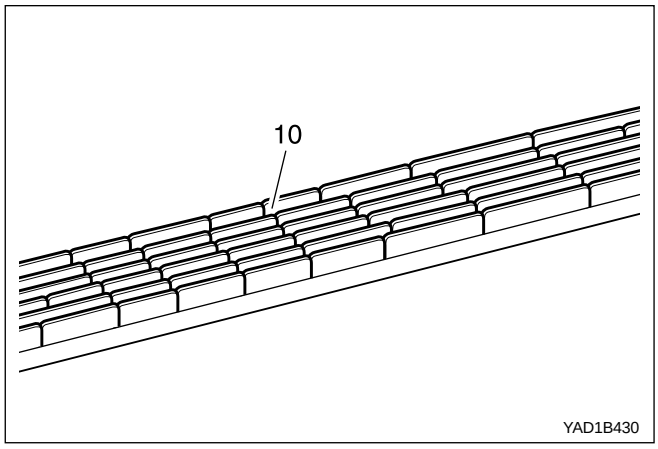
5. Cord torn out at the side.
6. Outer cords frayed.



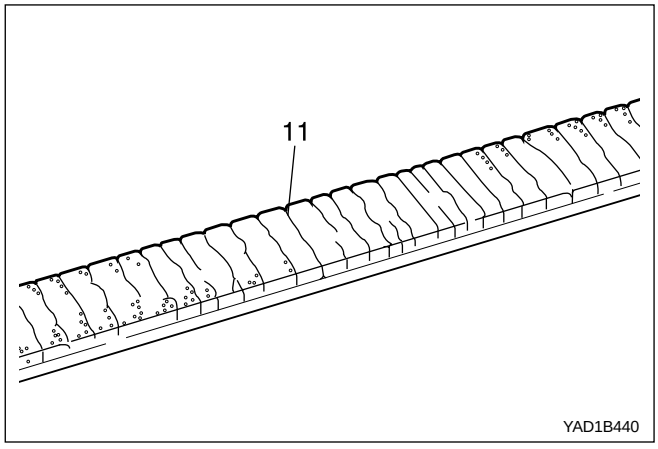
7. Belt detached from the base of rip.



8. Splits across the rips.
9. Sections of rip torn out.



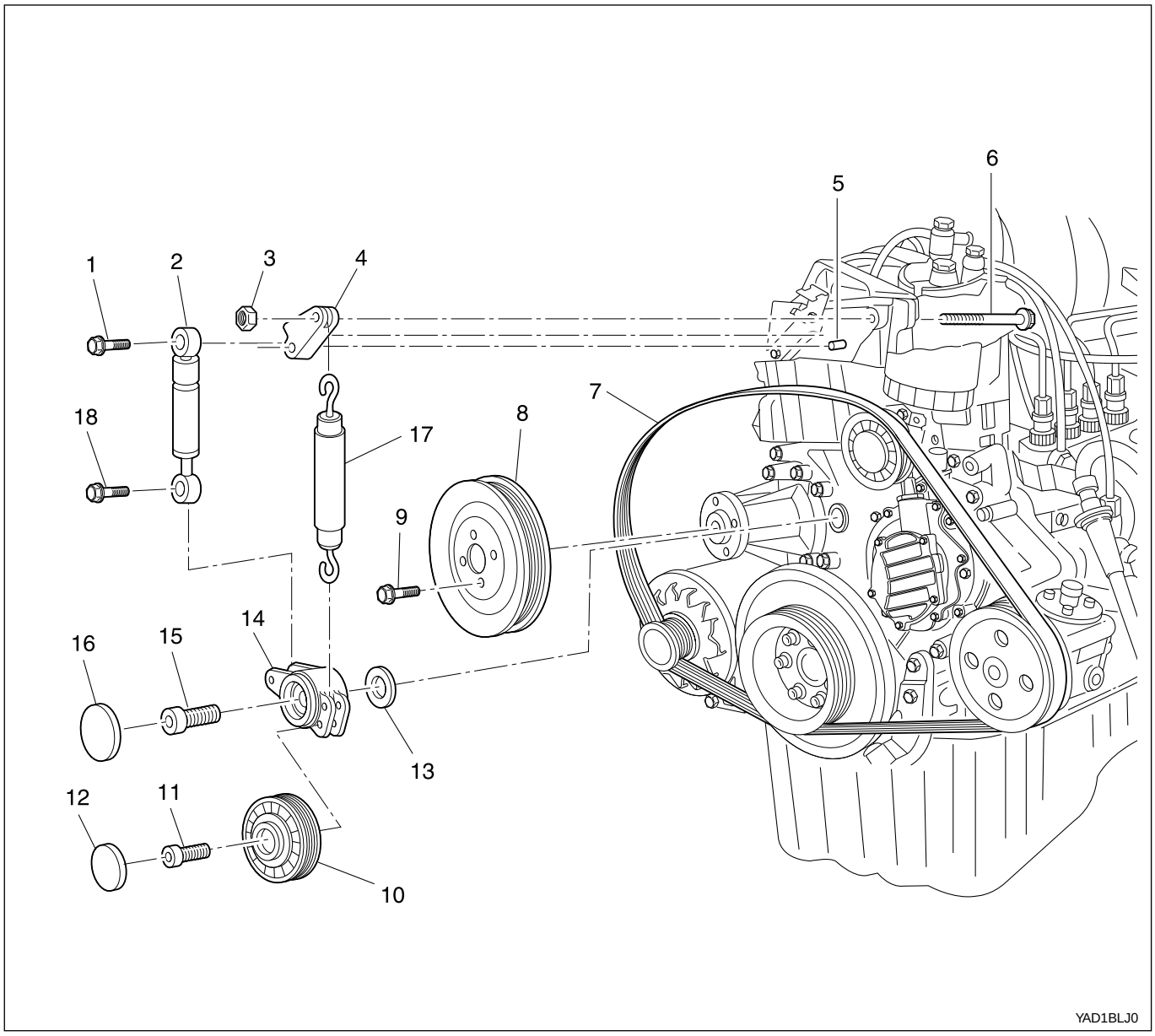
10. Splits across several rips.



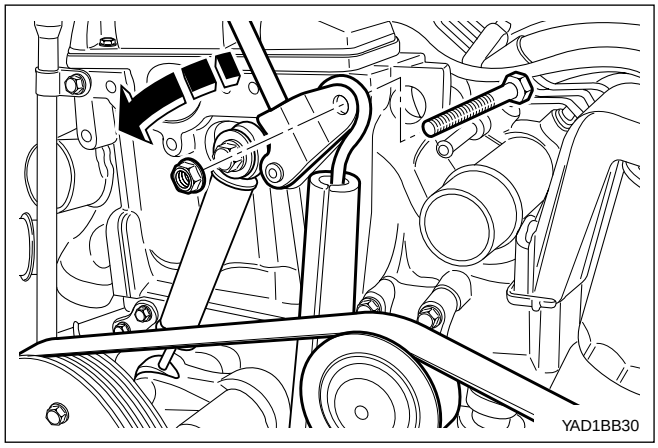
11. Splits across the back.

TENSIONING DEVICE

Preceding Work: Removal of cooling fan



1 Bolt ..... 21 N•m (15 lb-ft)
2 Damper
3 Nut ..... 21 N•m (15 lb-ft)
4 Tensioning Lever
5 Guide Rail Pin
6 Bolt
7 Poly V-Belt
8 Belt Pulley
9 Bolt ..... 10 N•m (89 lb-in)
10 Tensioning Pulley
11 Socket Bolt ..... 29 N•m (21 lb-ft)
12 Closing Cover
13 Washer
14 Tensioning Lever
15 Fit Bolt ..... 100 N•m (74 lb-ft)
16 Closing Cover
17 Spring
18 Bolt ..... 20 N•m (15 lb-ft)



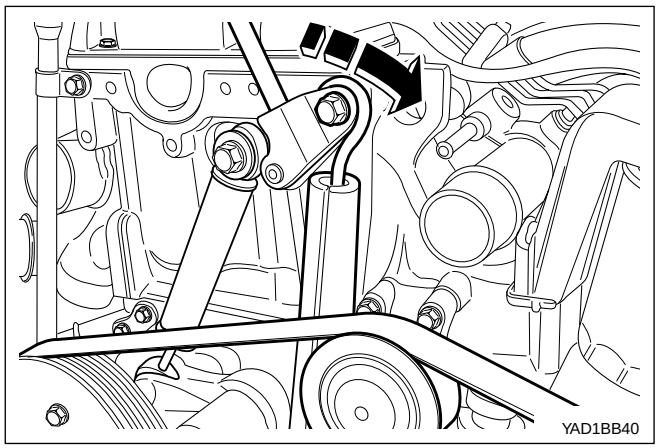
Removal & Installation Procedure

1. Remove the tensioning lever nut.

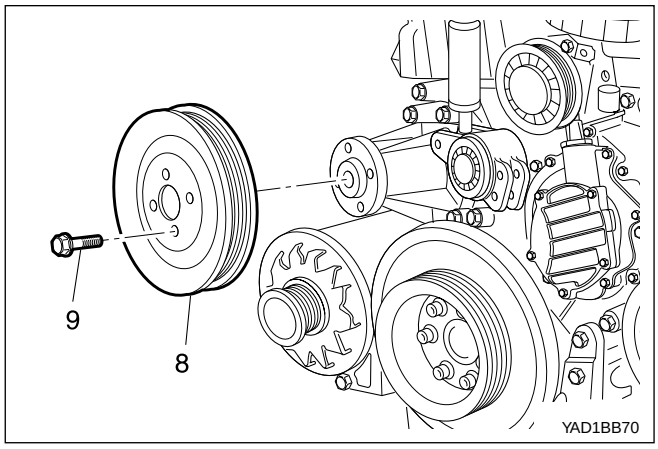
   Installation Notice

Tightening Torque	21 N•m (15 lb-ft)

2. Push the tensioning lever in direction of arrow with a rod (ϕ 12, 180 mm) and push out the bolt to the rear.



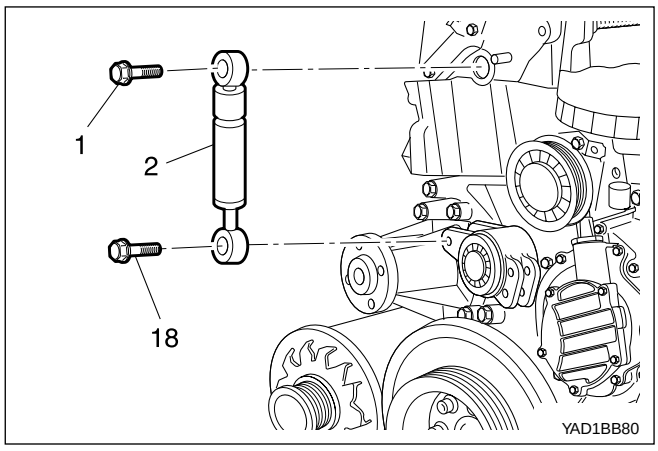
3. Push back the tensioning lever to release the spring tension and remove the belt.



4. Remove the bolt (9) and then remove the belt pulley (8).

   Installation Notice

Tightening Torque	10 N•m (89 lb-in)

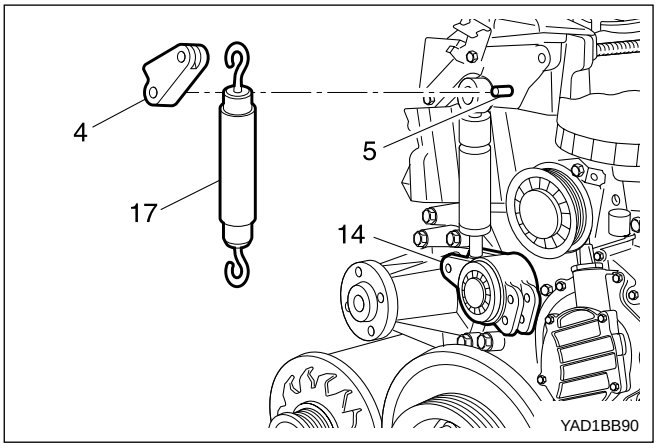


5. Remove the bolt (1, 18) and take off the damper (2).

   Installation Notice

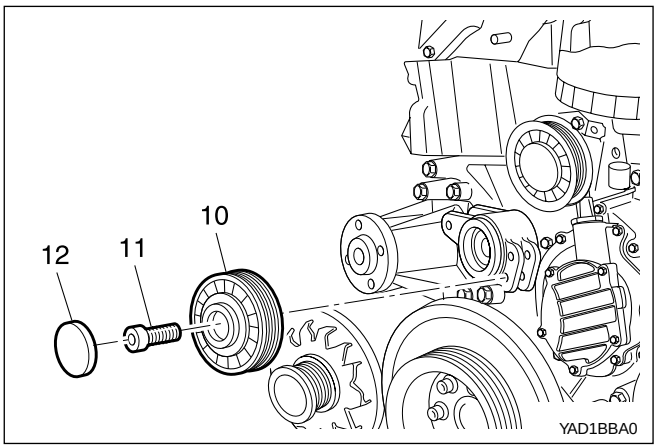
Tightening Torque	bolt (1) : 21 N•m (15 lb-ft)
	bolt (18): 20 N•m (15 lb-ft)

Pay attention to installation position of the damper.



6. Pull off the tensioning lever (4) from guide rail pin.
7. Remove the spring (17).

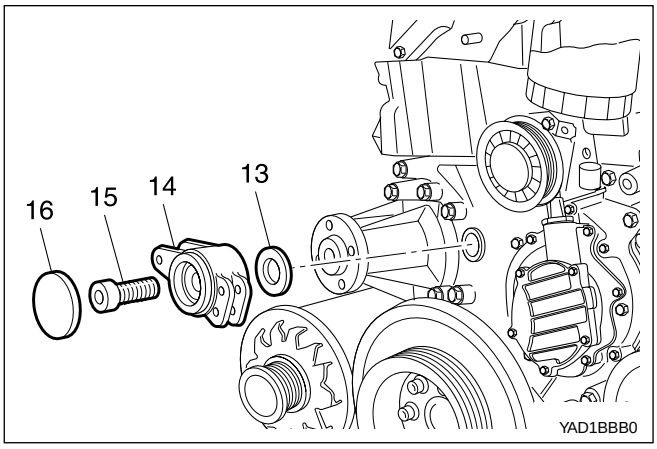
   Notice: Insert spring (17) with color coding (blue/violet) facing up.



8. Pry off the closing cover (12) and remove the socket bolt (11) and then remove the tensioning pulley (10).

   Installation Notice

Tightening Torque	29 N•m (21 lb-ft)



9. Pry off the closing cover (16) and remove the fit bolt (15).

   Installation Notice

Tightening Torque	100 N•m (74 lb-ft)

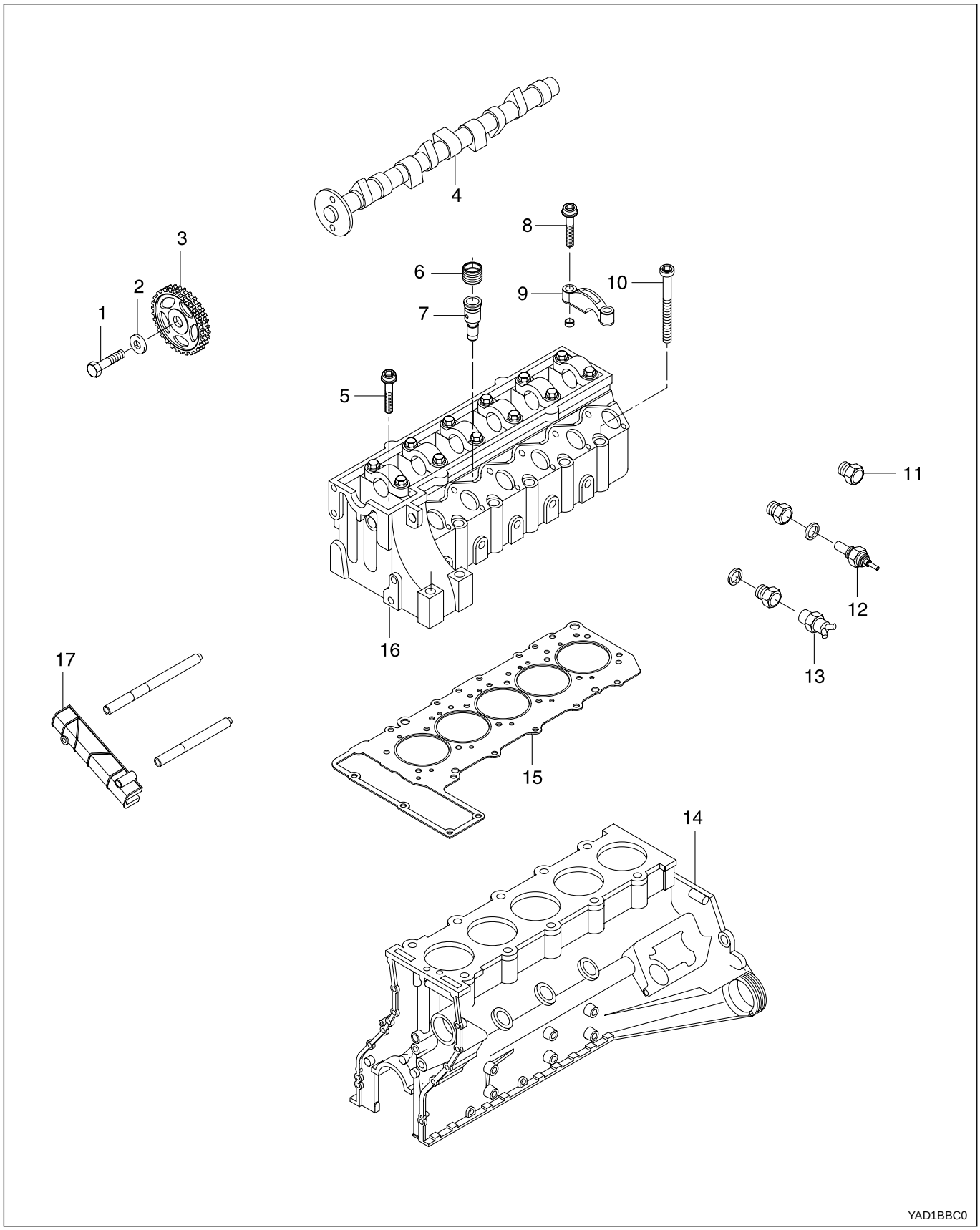
   Apply loctite on thread of fit bolt.

10. Remove the tensioning lever (14) and washer (13).
11. Clean thread in the timing case cover and fit bolt.

12. Installation should follow the removal procedure in the reverse order.

CRANKCASE AND CYLINDER HEAD

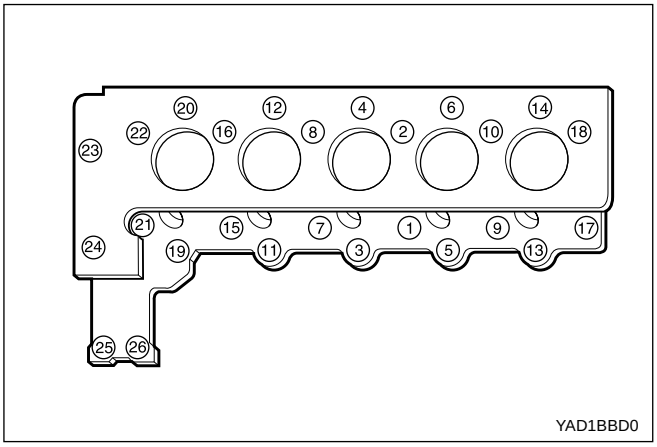
CYLINDER HEAD



1 Bolt..... 25 N•m (18 lb-ft)+90°
2 Washer
3 Camshaft Drive Sproket ..... Relace
4 Camshaft
5 Bolt..... 10 N•m (89 lb-in)
6 Threaded Ring ..... 130 N•m (96 lb-ft)
7 Prechamber
8 Bolt..... 25 N•m (18 lb-ft)
9 Camshaft Bearing Cap
10 Cylinder Head Bolt ..... See Table
11 Plug
12 Engine Coolant Temperature
13 Thermo Valve Sensor
14 Cylinder Block
15 Gasket..... Replace
16 Cylinder Head
17 Sliding Rail

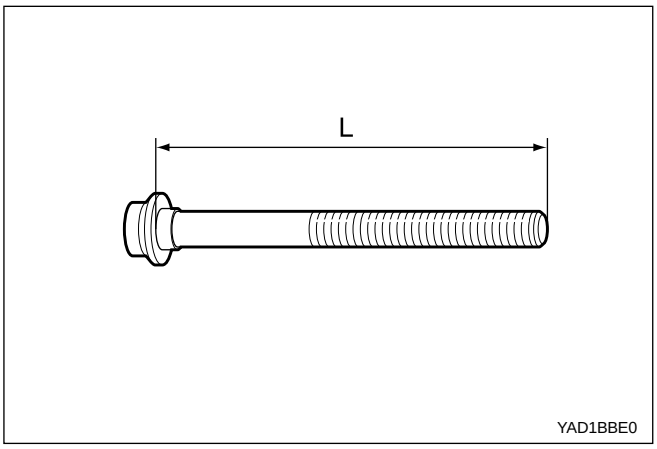
Cylinder Head Bolt Tightening Torque

Cylinder Head Bolts (12-sided socket head) (Engine cold)	1st Step	10 N•m (89 lb-in)
	2nd Step	35 N•m (26 lb-ft)
	3rd Step	180°
M8 Cylinder Head Bolts		25 N•m (18 lb-ft)



YAD1BBD0

Tightening Sequence for Cylinder Head Bolts



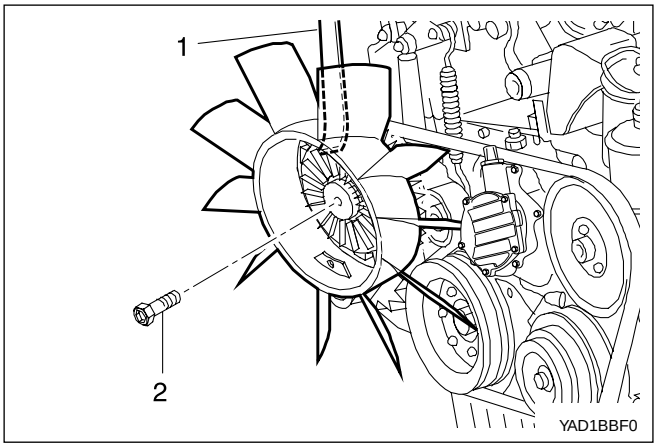
YAD1BBE0

Notice: The cylinder head may only be removed when the engine has cooled down. The cylinder head is removed together with the exhaust manifold. As the cylinder head bolts undergo a permanent tightening. They require to be replaced if they exceed the maximum lengthes indicated in the table.

Thread Dia.	Length(L) When New	Max. Length(L)
M10	80 mm	82 mm
M10	102 mm	104 mm
M10	115 mm	117 mm

The twelve-sided socket head bolts are tightened with each stages of torque and torque angle.

It is not necessary to retighten the cylinder head bolts at the 1000~1500 km inspection or after 1000~1500 km of repairs.

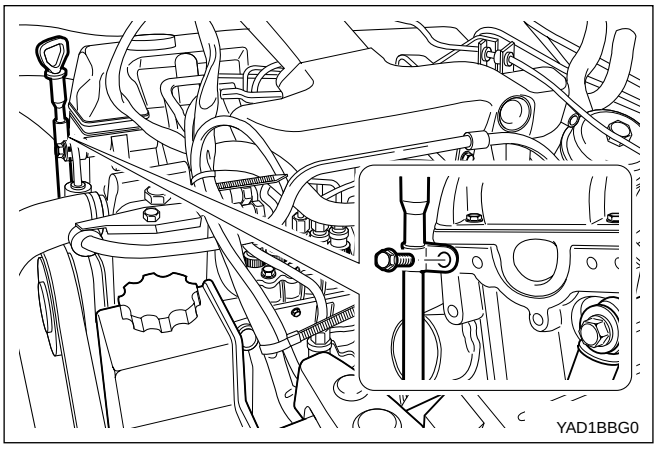


Tools Required

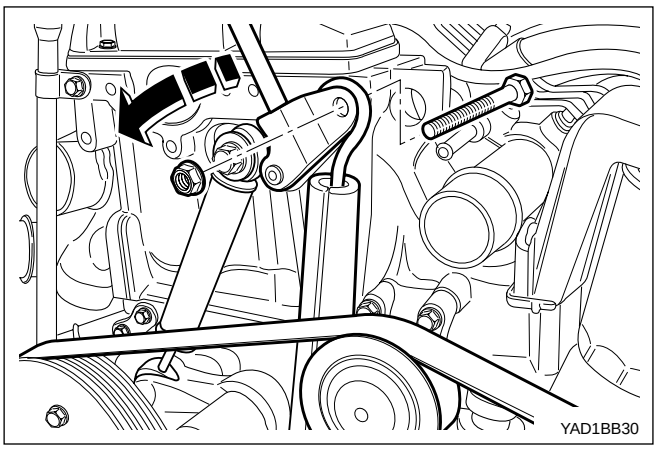
116 589 02 34 00	Threaded Pin
116 589 03 07 00	T Type Socket Wrench
116 589 20 33 00	Sliding Hammer
602 589 00 40 00	Engine Lock
603 589 00 40 00	Counter Holder

Removal Procedure

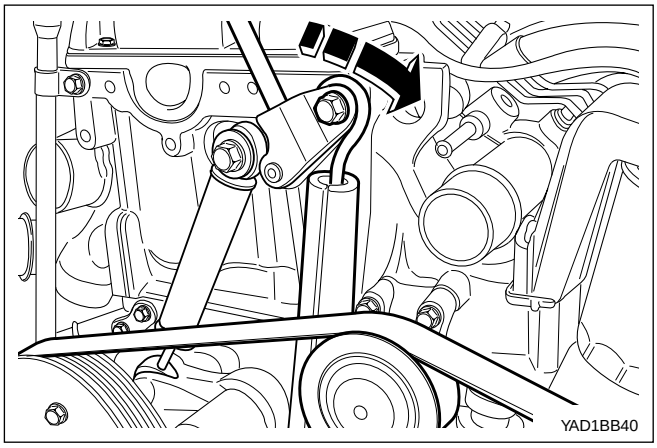
1. Completely drain the coolant from the radiator and cylinder block.
2. Remove the cooling fan shroud.
3. Hold the fan with counter holder 603 589 00 40 00 and remove the bolt and then remove the cooling fan.



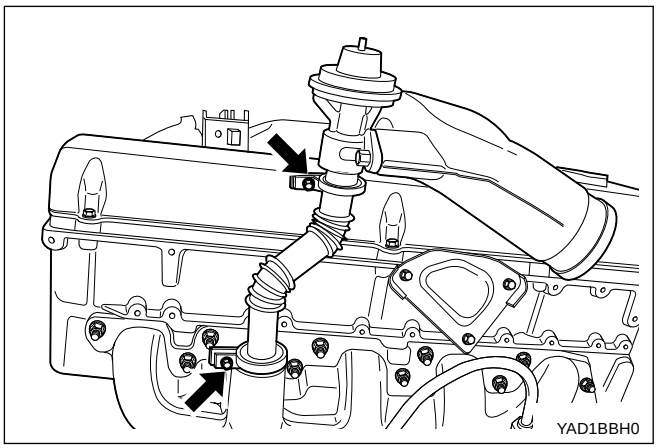
4. Remove the bracket oil dipstick tube.



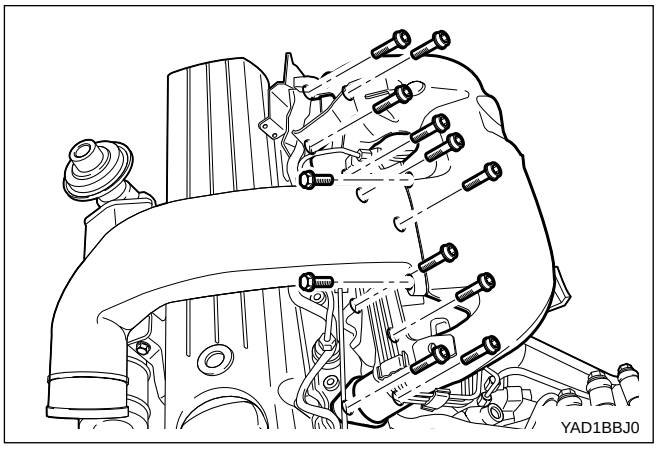
5. Remove the tensioning lever nut.
6. Remove the nut on the tensioning lever and insert the rod(ϕ 18, 180 mm). By pushing the rod to the arrow direction, pull back the bolt.



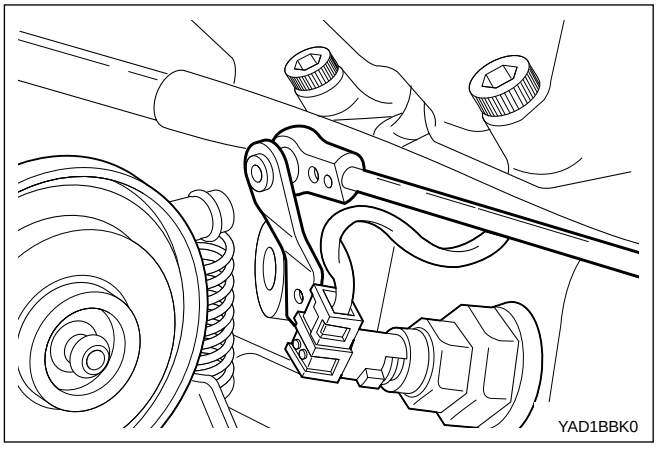
7. Push the tensioning lever to the opposite direction to release the spring tension and remove the poly V-belt.



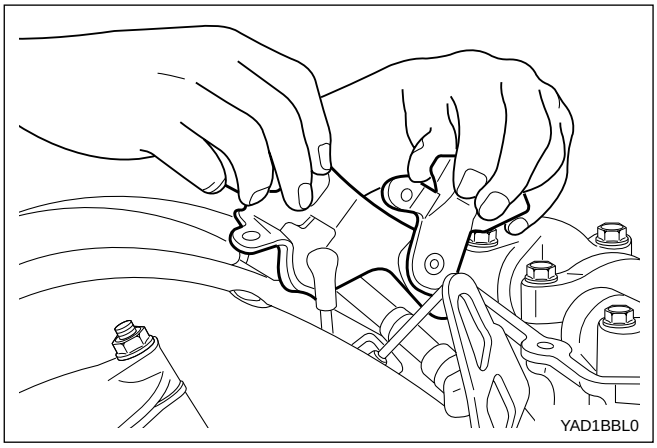
8. Unscrew the EGR pipe mounting bolts onto the exhaust manifold.
9. Remove the duct bracket from the cylinder head.



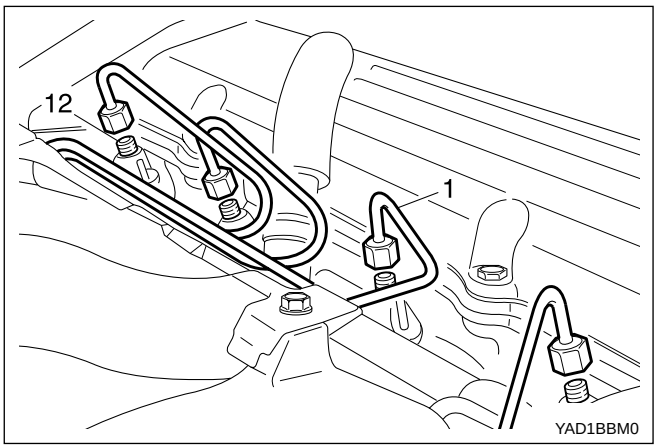
10. Unscrew the intake duct mounting bolts onto the intake manifold.



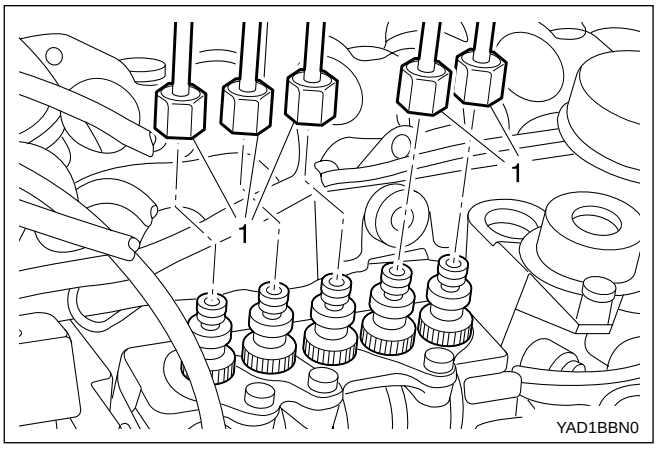
11. Separate the connecting rod from the control lever.



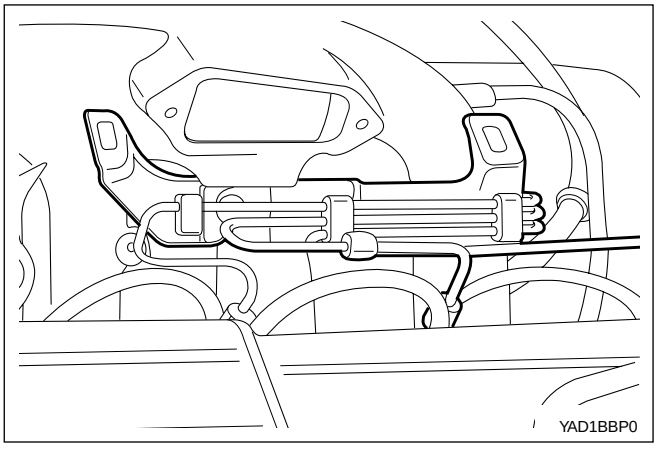
12. Pull out the accelerator control linkage.



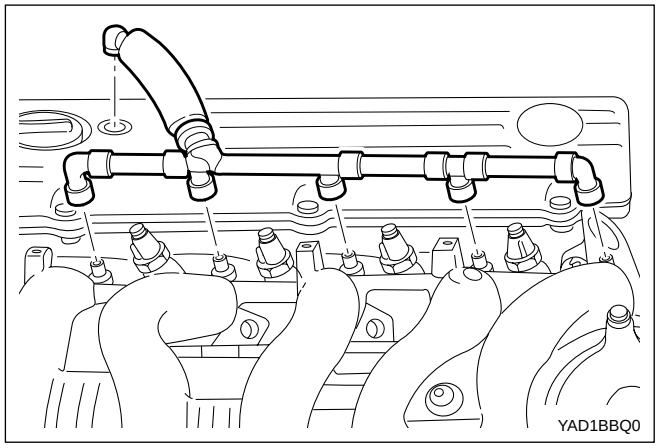
13. Remove the fuel injection line (1) from the fuel injection nozzle (12).



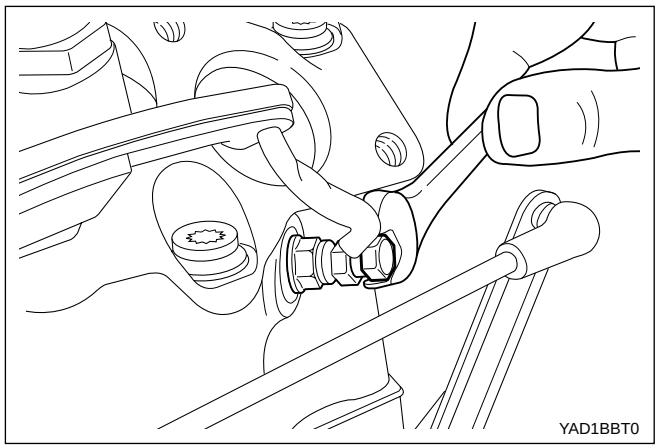
14. Remove the fuel injection line from the fuel injection pump.



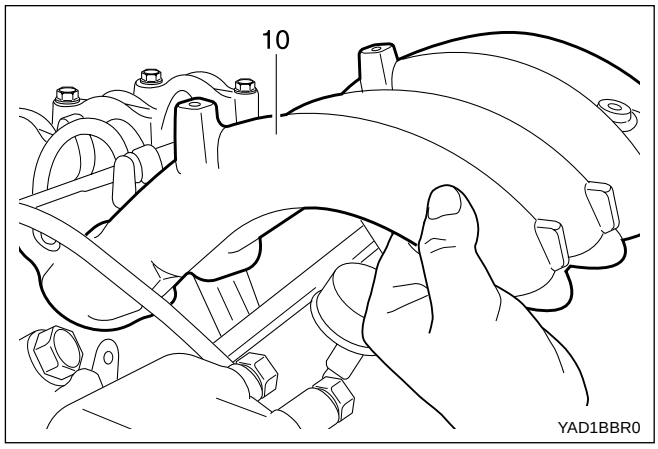
15. Remove the bracket mounting bolts and then remove the fuel injection line (1).



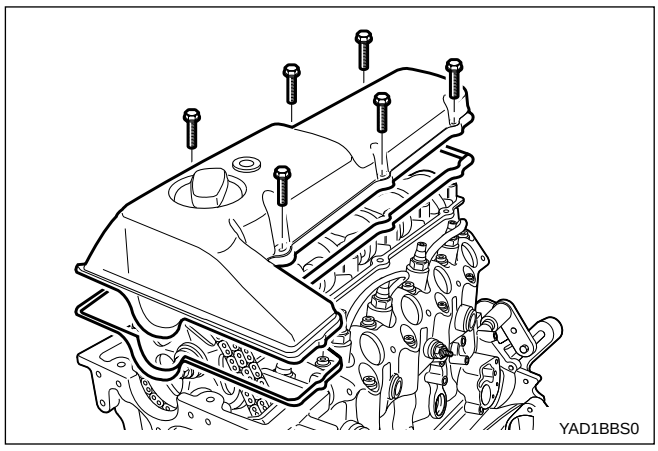
16. Disconnect the blow by hose from the cylinder head cover.



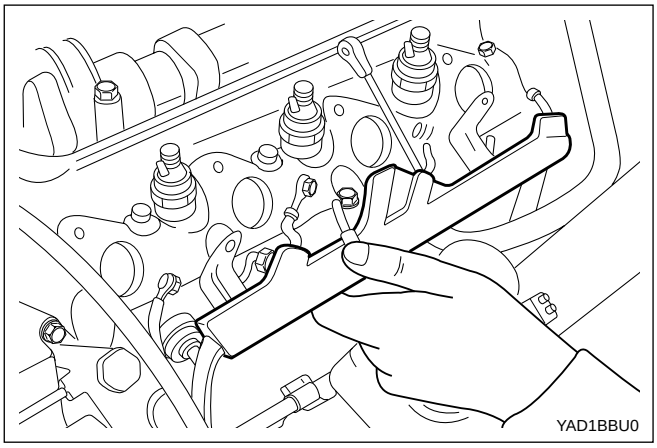
17. Disconnect the glow plug cables.



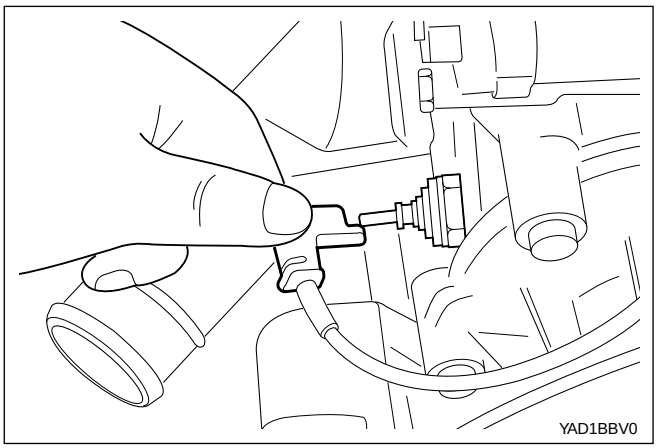
18. Remove the intake manifold (10) and gasket.



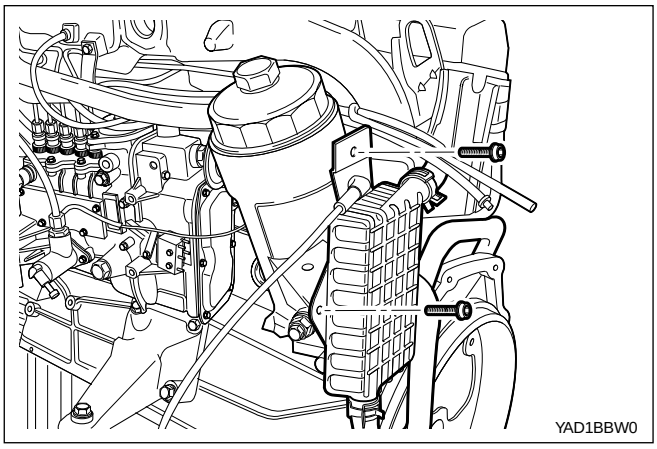
19. Remove the cylinder head cover and gasket.



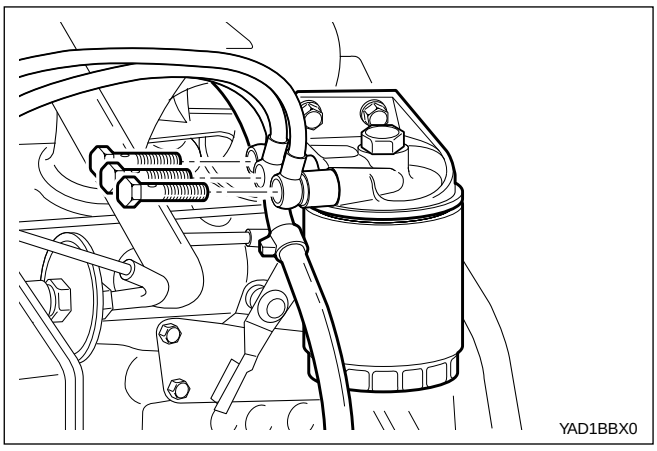
20. Remove the cable channel.



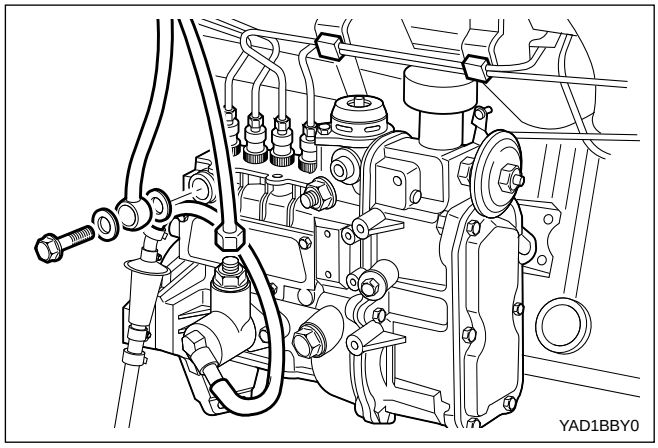
21. Disconnect the cables from the glow plug sensor and engine coolant temperature sensor.



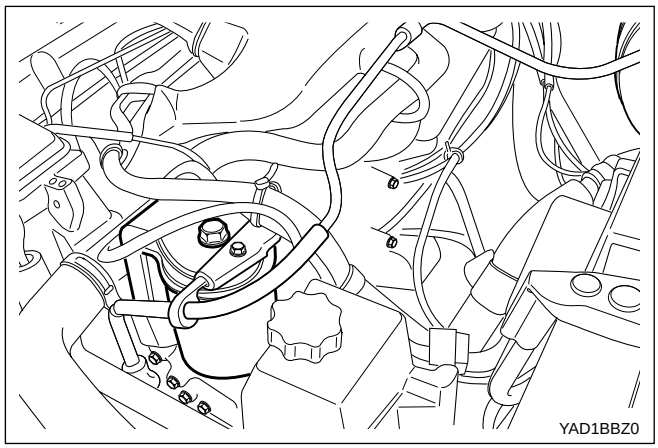
22. Remove the heater pipe bracket from the oil filter.
23. Pry off the clamp and push the heater feed pipe forward and then pull out the pipe.



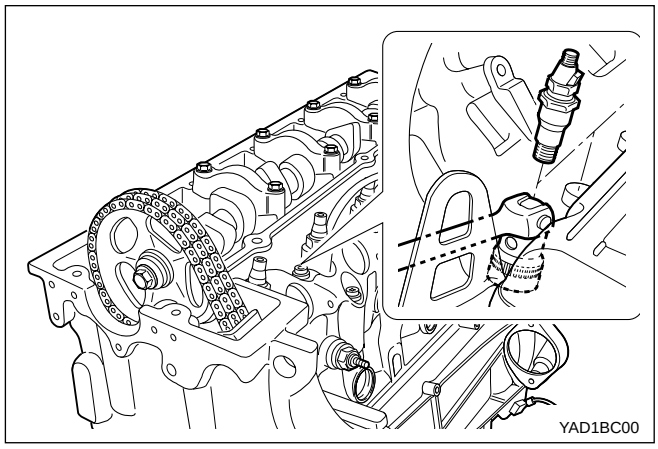
24. Disconnect the fuel lines from the fuel filter.



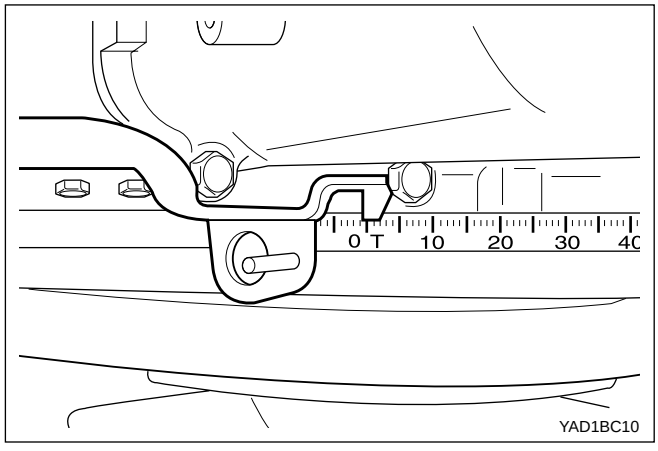
25. Disconnect the fuel lines from the injection pump.



26. Remove the fuel filter.

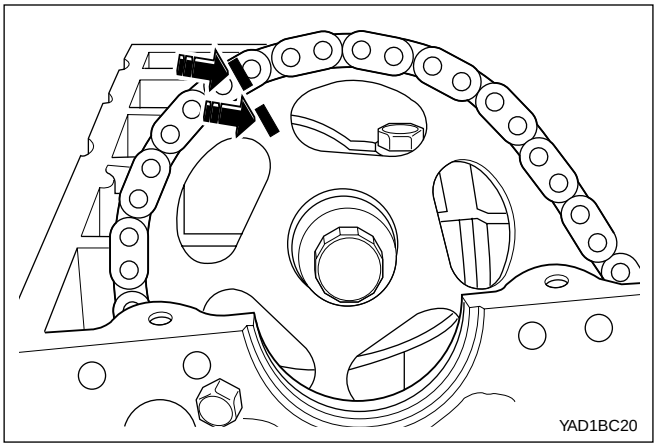


27. Remove the fuel injection nozzle and nozzle washer.

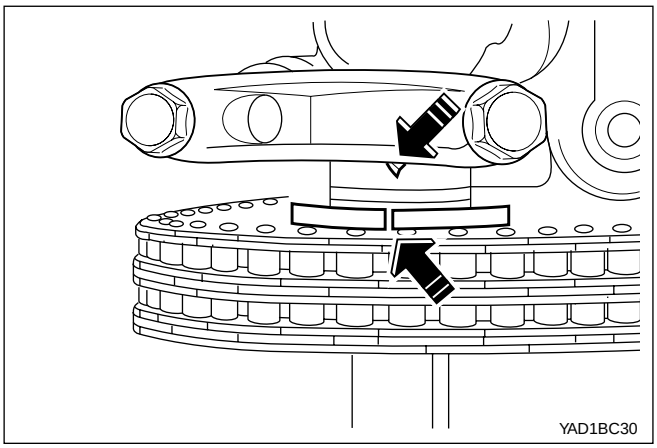


28. Rotate the crankshaft and set the no.1 cylinder at TDC.

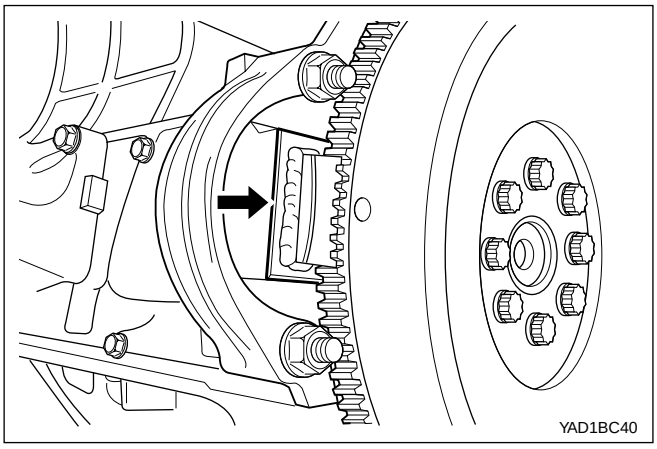
    Notice: Do not rotate the crankshaft to the opposite direction of engine revolution.



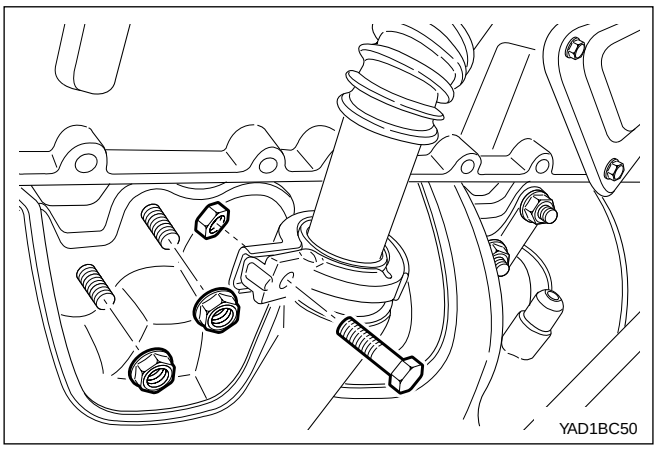
29. Place alignment marks on the camshaft gear and timing chain.



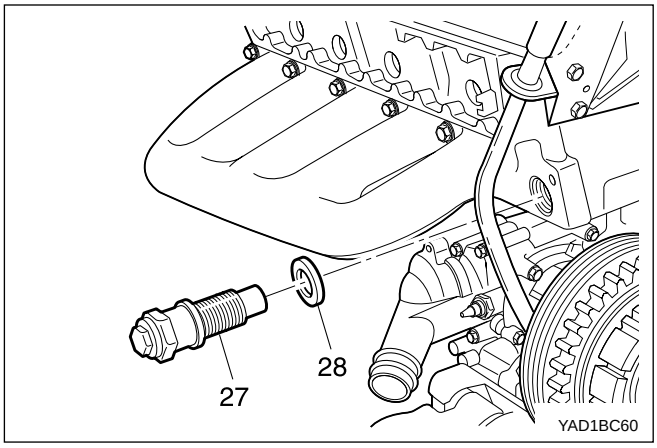
30. Ensure that the camshaft and the bearing cap marking are aligned.



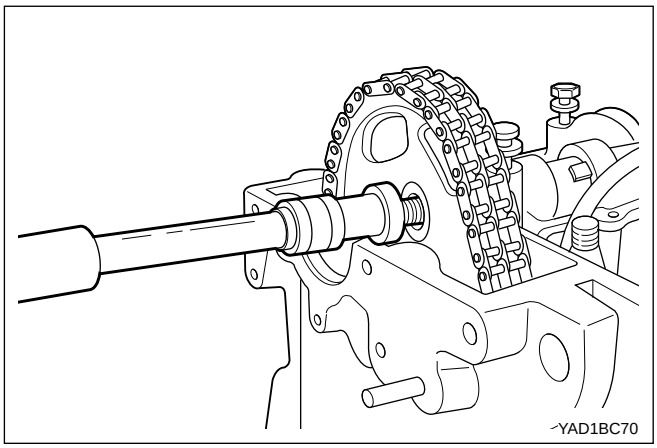
31. Remove the starter motor and install the engine lock 602 589 00 40 00 onto the flywheel ring gear.



32. Remove the exhaust manifold and exhaust pipe.



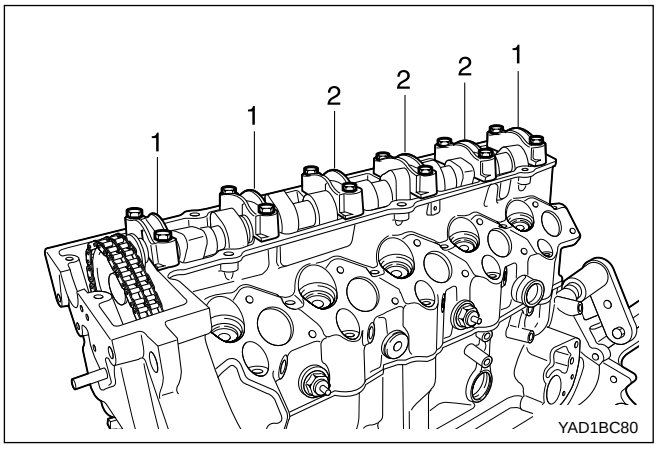
33. Remove the chain tensioner and seal.



34. Remove the bolt and separate the drive sprocket.

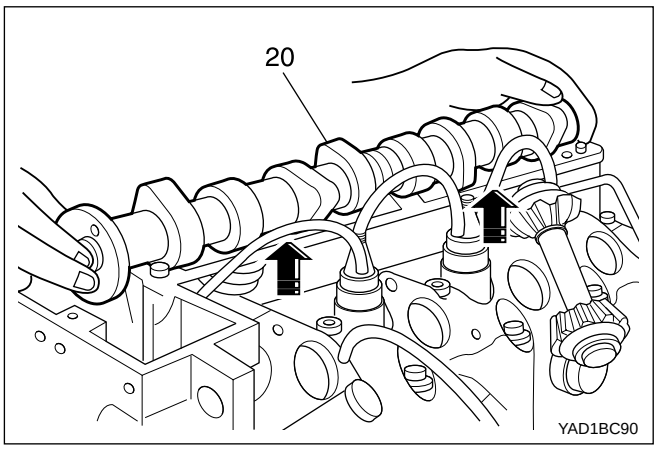
    Notice: During removal, be careful not to drop the sprocket and chain into the timing case.

    Carefully pull off the chain and then pull out the sprocket.



35. Remove the camshaft bearing cap bolts according to the numerical sequence.

    Notice: Remove the No.1 bolts first and then remove the No. 2 bolts. Do not remove the bolts at a time completely but remove them step by step evenly or camshaft can be seriously damaged.

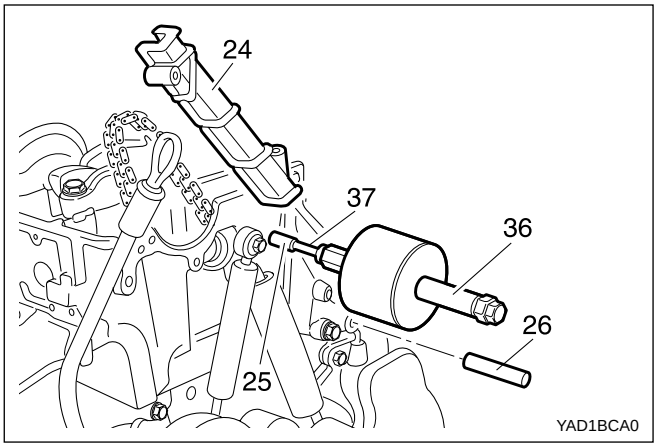


36. Remove the bearing caps and then pull out the camshaft(20) upward.

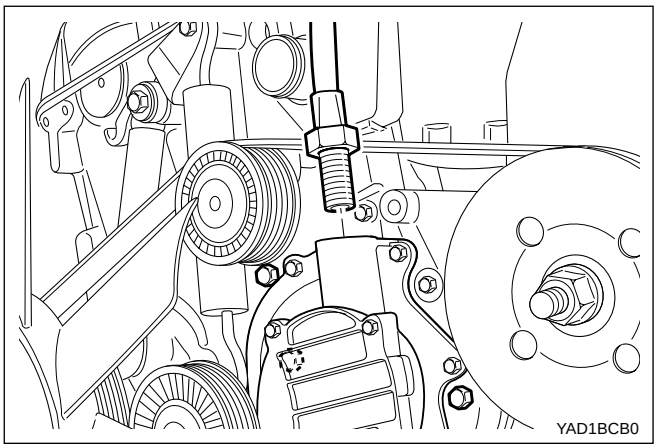
    Notice: Be careful not to miss the locking washer.

37. Remove the locking washer.

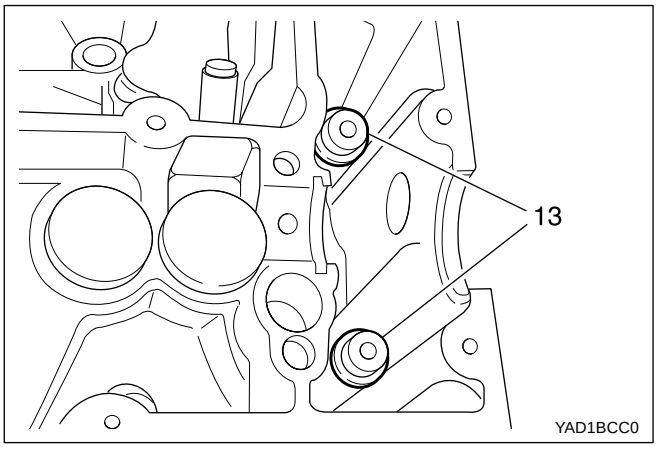
    Notice: Check the locking washer and replace if necessary.



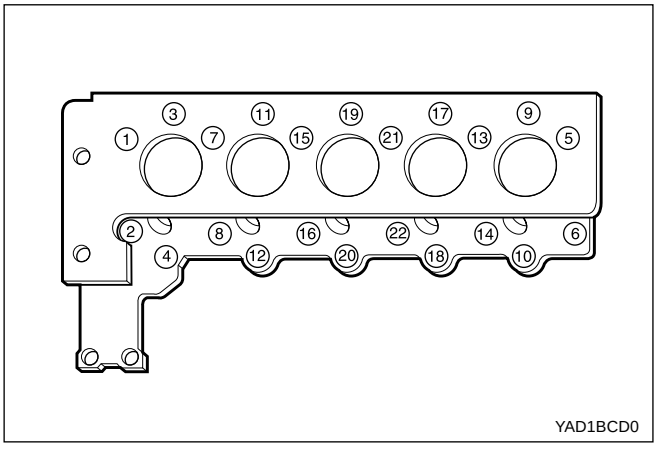
38. Using the sliding hammer 116 589 20 33 00 (36) and the threaded pin 116 589 02 34 00 (37), pull out the sliding rail pins (25, 26) and remove the sliding rail (24).



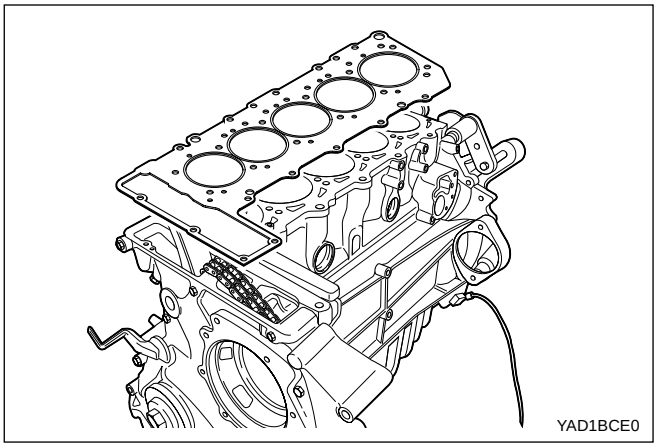
39. Remove the vacuum line from the vacuum pump.
40. Disconnect the vacuum pipe from thermo valve.



41. Remove the socket bolts (13) of the chain box using the T type socket wrench 116 589 03 07 00.

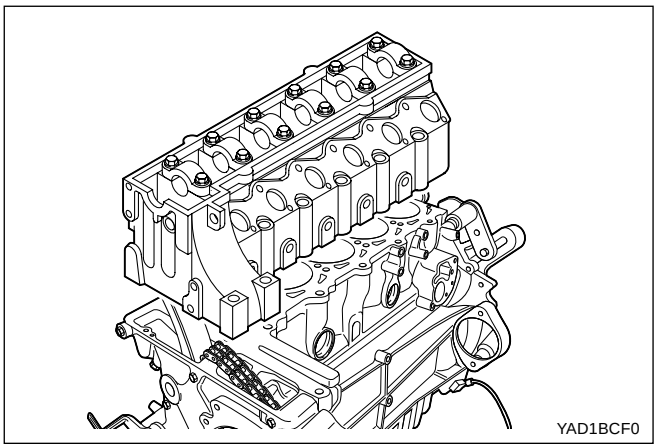


42. Remove the cylinder head bolts in numerical sequence.
43. Remove the cylinder head and gasket.


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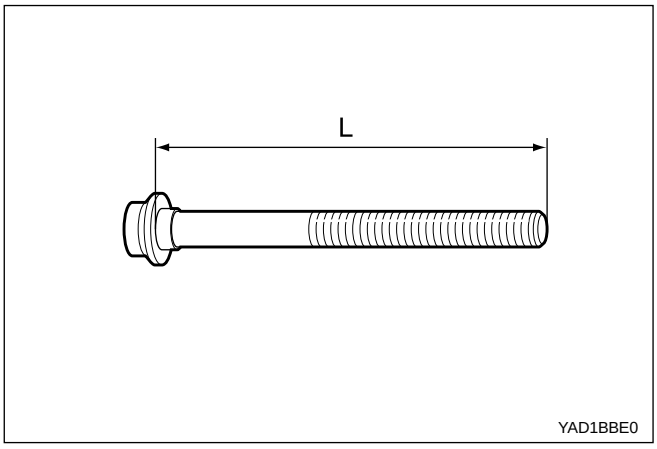
Installation Procedure

1. Replace the cylinder head gasket.


YAD1BCF0

2. Install the cylinder head onto the crankcase.

   Notice: Align the cylinder head holes with the guide pins.

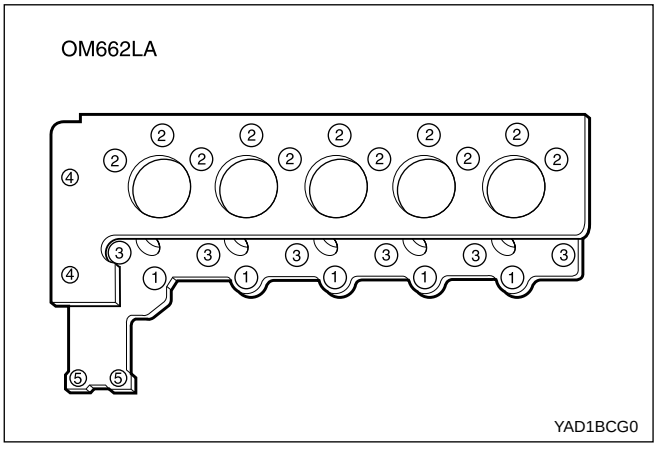


YAD1BBE0

3. Measure the length(L) of cylinder head bolts.

   Notice: If the max. length is exceeded, replace the bolts.

Thread Dia.	Length (L) when New	Max. Limit(L)
M10	80 mm	82 mm
M10	102 mm	104 mm
M10	115 mm	117 mm



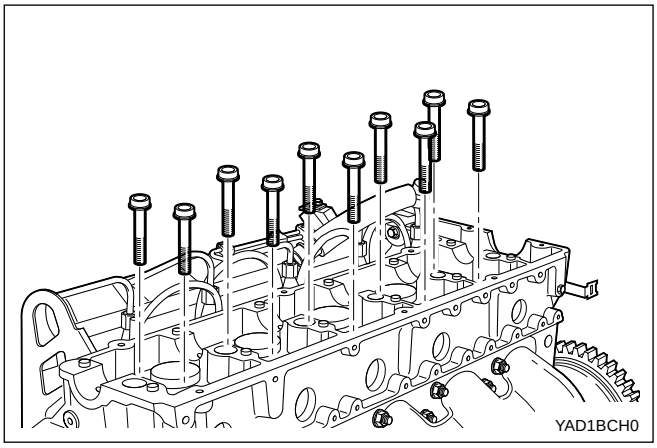
YAD1BCG0

4. Coat the head contact surface of bolts and thread with oil and insert them as shown.

   - **Cylinder head bolts arrangement**

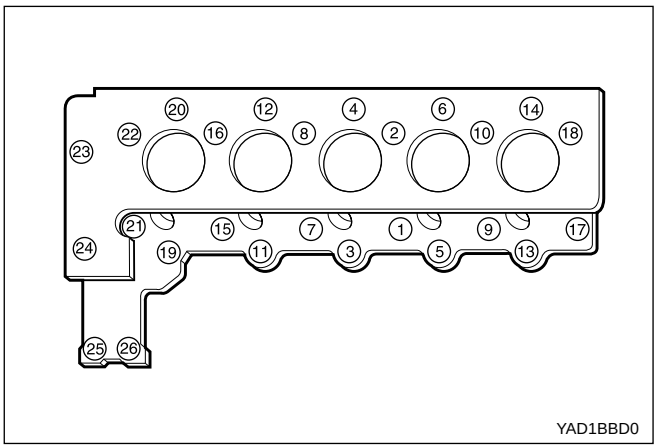
     Bore

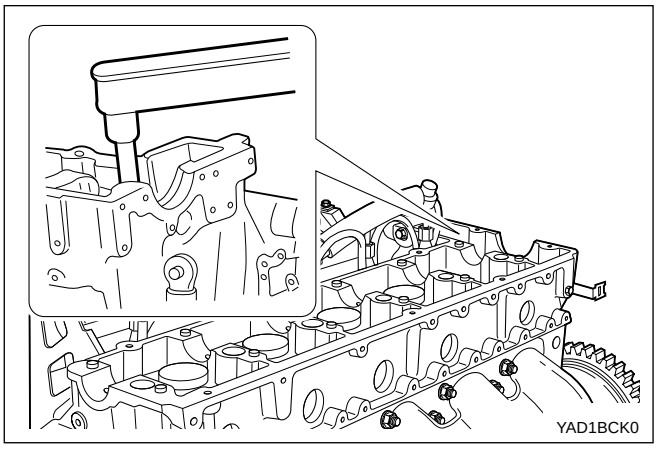
     1 ..... M10 × 80
     2 ..... M10 × 102
     3 ..... M10 × 115
     4 ..... M 8 × 50
     5 ..... M 8 × 80



5. Tighten the cylinder head bolts to specified torque and torque angle.

Tightening Torque	1st Step	10 N•m (89 lb-in)
	2nd Step	35 N•m (26 lb-ft)
	Torque Angle	90°
	Wait for	10 minutes
	Torque Angle	90°

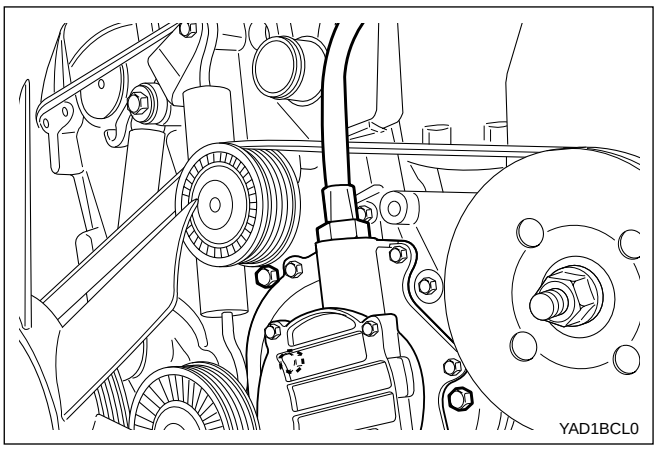




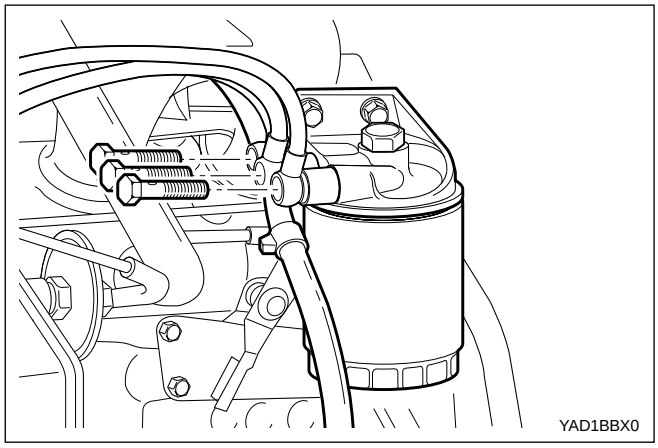
6. Install the socket bolts in the chain box using the T type socket wrench 116 589 03 07 00.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)



7. Connect the vacuum pipe to the thermo valve.
8. Connect the vacuum lines to the vacuum pump.

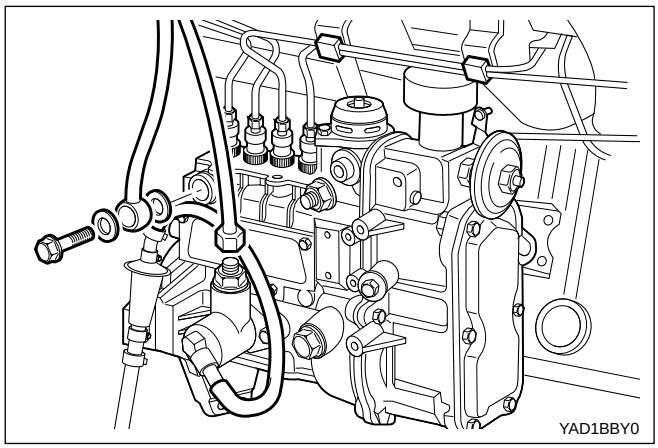


9. Install the fuel filter and connect the pipe.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

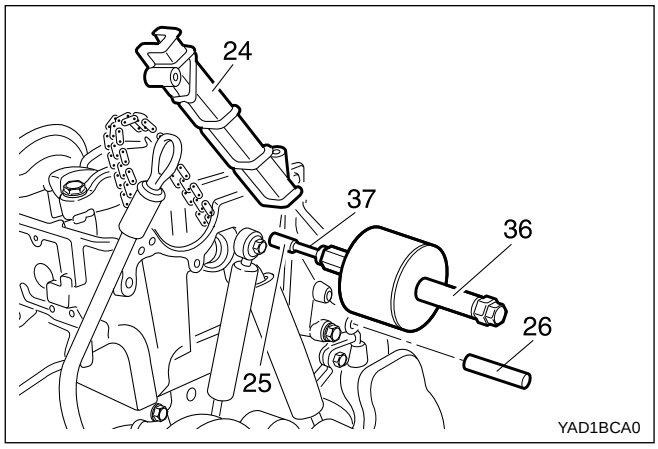
Be careful not to be confused the connections and hoses.



10. Connect the fuel line to the injection pump.

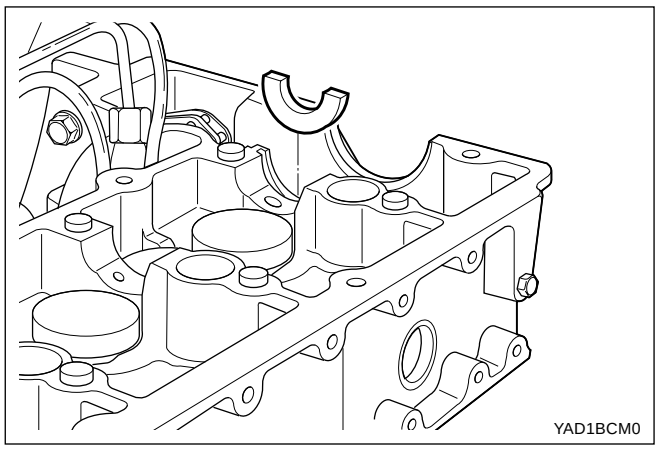
Installation Notice

Tightening Torque	13 N•m (10 lb-ft)

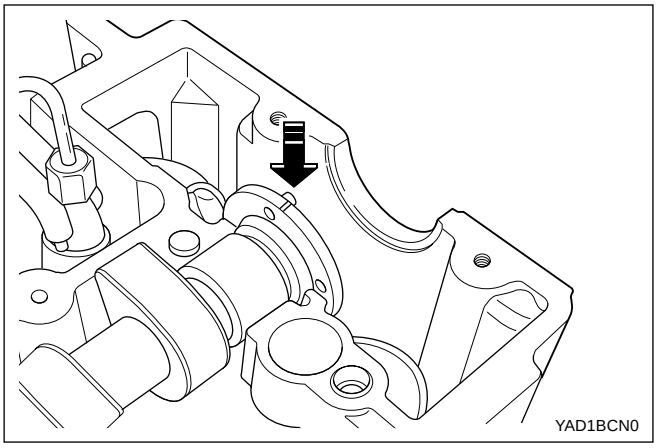


11. Install the sliding rail (24) and insert the sliding rail pins (25, 26) using the sliding hammer 116 589 20 33 00 (36) and threaded pin 116 589 02 34 00 (37).

Notice: Apply sealing compound on the each collar of the sliding rail pins.



12. Insert the locking washer.
13. Inspect the valve tappet and check that the tappet moves smoothly.

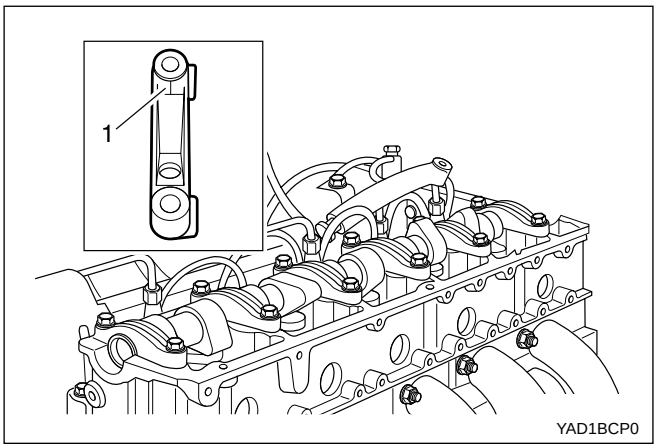

YAD1BCN0

14. Coat the camshaft with oil and install the camshaft on the cylinder head to be TDC mark(arrow) upward.
15. Measure the axial end play of the camshaft.

Installation Notice

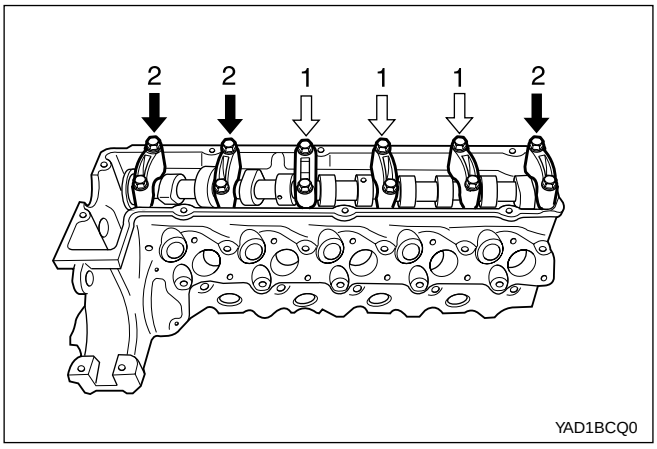
End Play	0.06 ~ 0.21 mm

If out of standard, adjust it with the proper thickness of locking washer.



YAD1BCP0

16. Install the bearing caps on the camshaft according to the number on the caps.



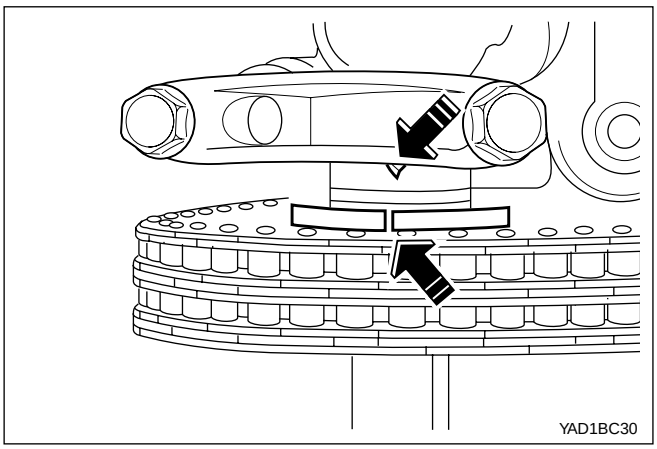
YAD1BCQ0

17. Tighten the bearing cap bolts according to the numerical sequence.

Installation Notice

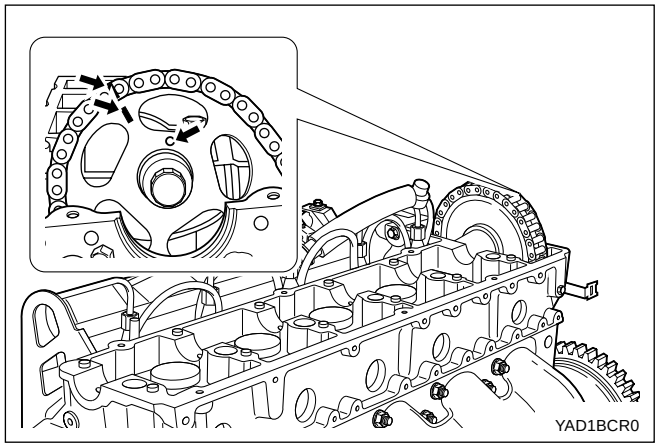
Tightening Torque	25 N•m (18 lb-ft)

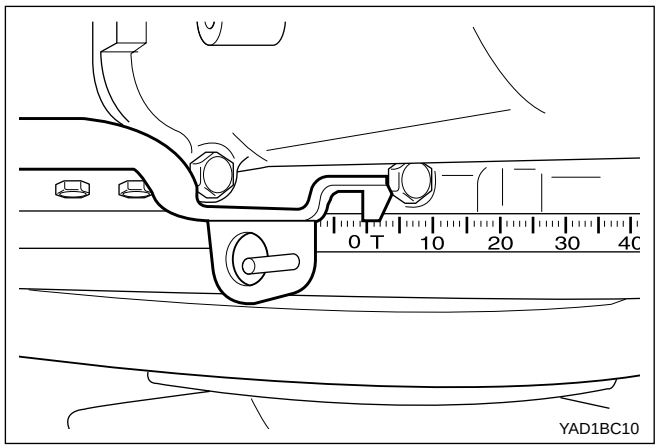
Tighten the No. 1 bolts (light arrow) first and then tighten the No. 2 bolts (dark arrow) stage by stage.


YAD1BC30

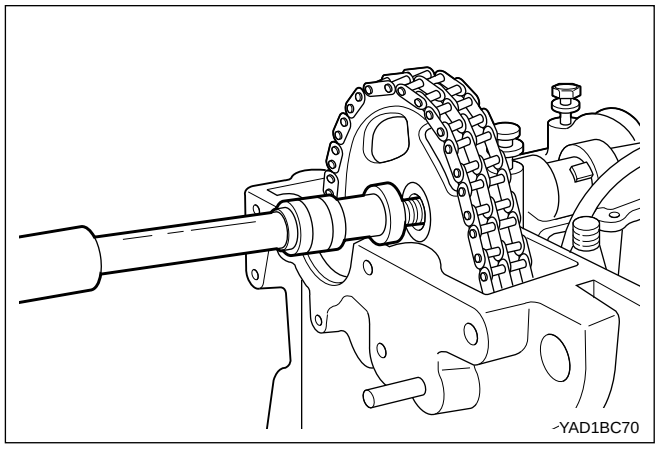
18. Position the camshaft on marking and install the camshaft sprocket.

Notice: Align the alignment marks on the chain and sprocket.





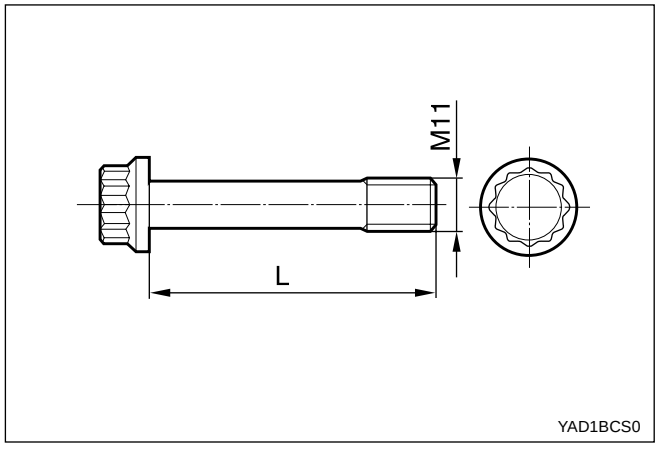
19. Check the TDC position of the crankshaft.



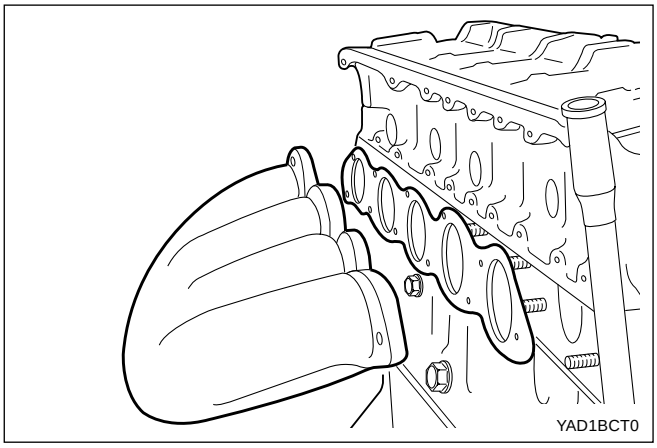
20. Install the camshaft sprocket bolt.

Installation Notice

Tightening Torque	1st Step	25 N•m (18 lb-ft)
	2nd Step	90°



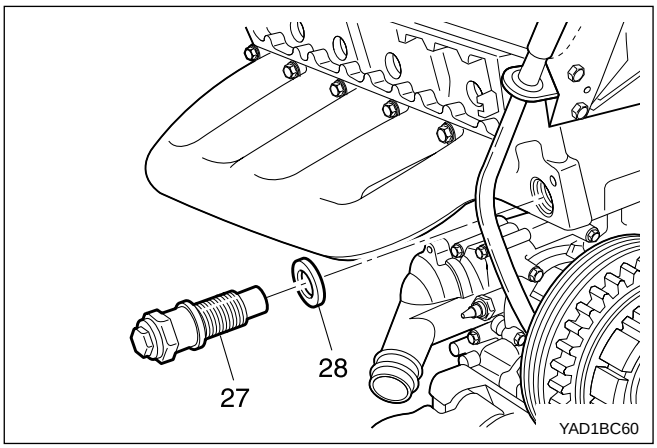
Notice: Measure the max. length ‘L’ and replace the bolt if it exceeds 53.6 mm.



21. Install the exhaust manifold and gasket.

Installation Notice

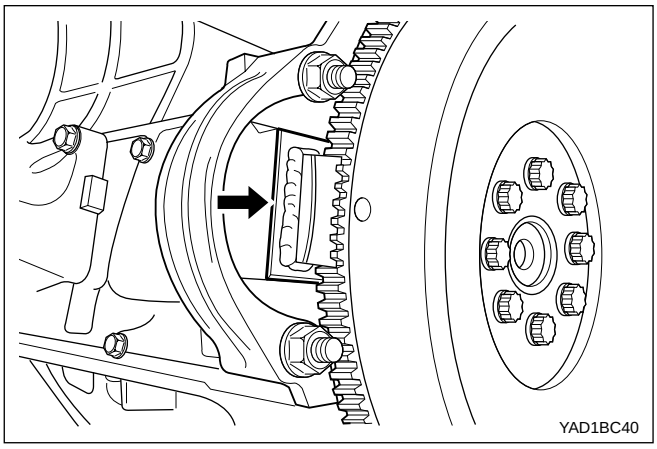
Tightening Torque	25 N•m (18 lb-ft)



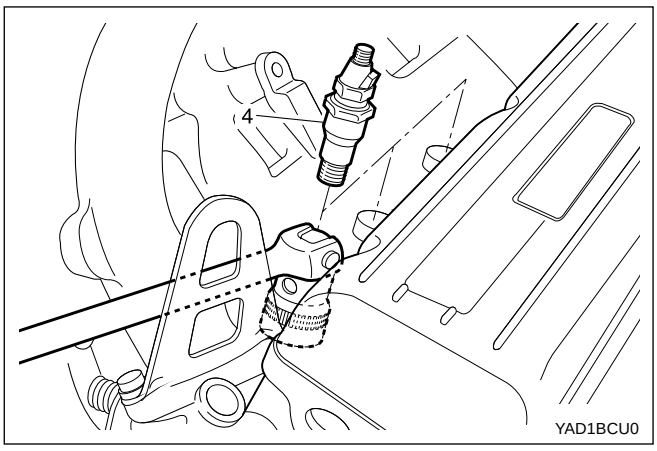
22. Replace the seal and then install the chain tensioner.

Installation Notice

Tightening Torque	80 N•m (59 lb-ft)



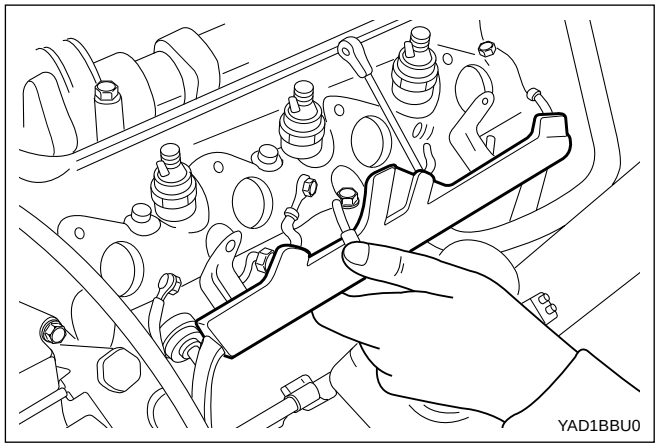
23. Remove the engine lock 602 589 00 40 00.



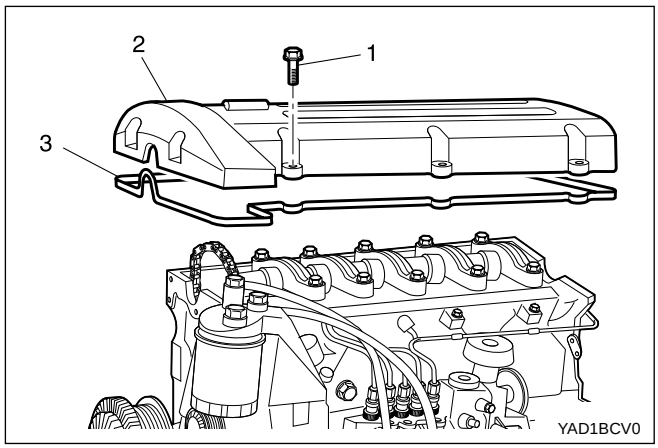
24. Insert the nozzle washer into the hole to face round part downward.
25. Install the fuel injection nozzle.

Installation Notice

Tightening Torque	40 N•m (30 lb-ft)



26. Connect the fuel hose.
27. Install the cable channel and connect the cables to glow plugs.

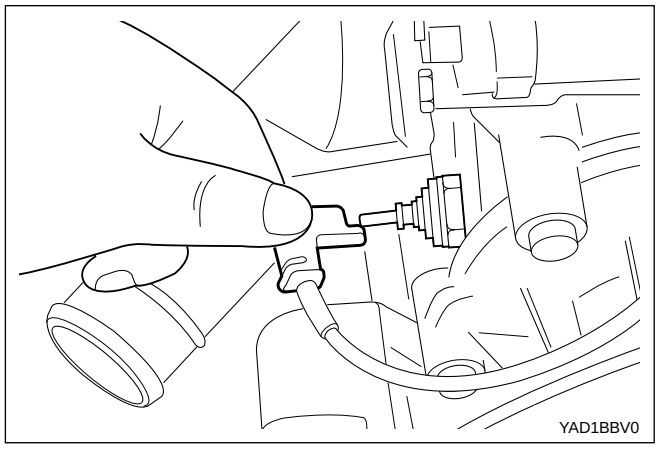


28. Replace the gasket and install the cylinder head cover.

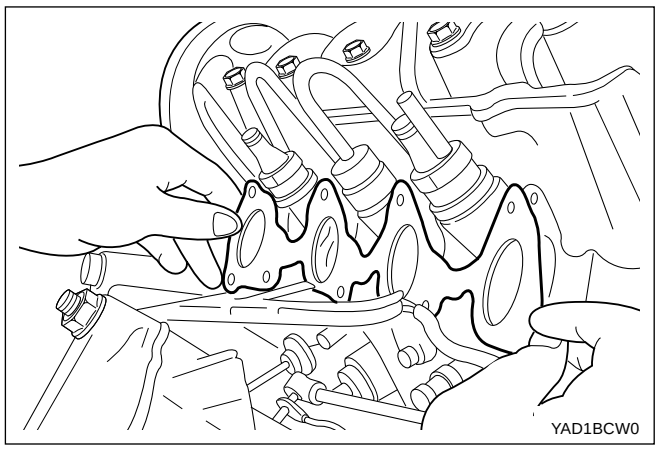
Installation Notice

Tightening Torque	10 N•m (89 lb-in)

29. Install the blow-by hose.



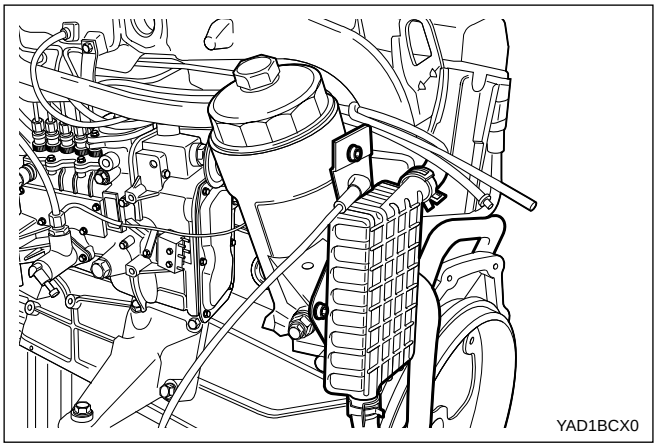
30. Connect the wires to the engine coolant temperature sensor and the glow plug sensor.



31. Replace the intake manifold gasket.
32. Install the intake manifold.

Installation Notice

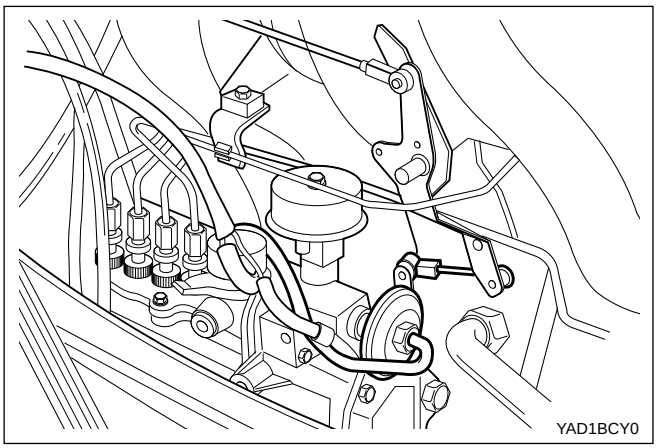
Tightening Torque	25 N•m (18 lb-ft)


YAD1BCX0

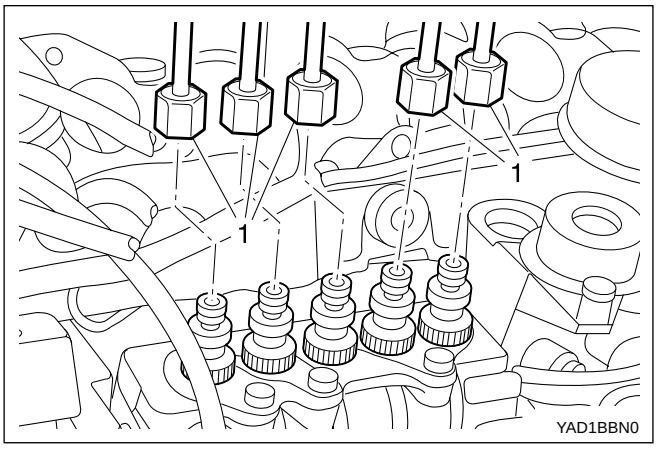
33. Replace the O-ring of heater feed pipe and install it to the cylinder head.

    Notice: For installation, clean the hole.

34. Install the bracket of heater feed pipe to the oil filter.


YAD1BCY0

35. Install the fuel pipe and the accelerator control linkage.

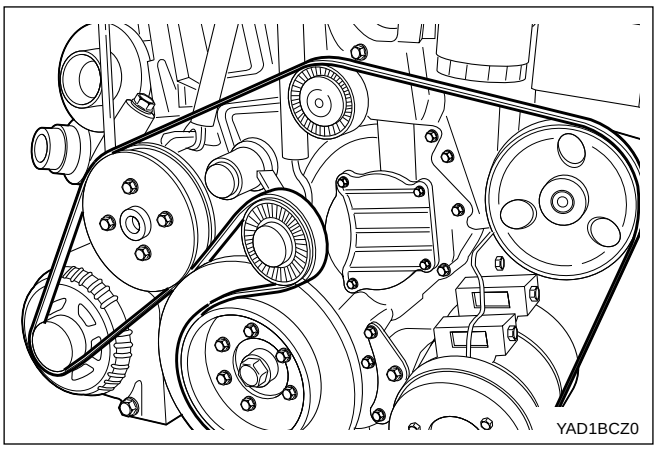


YAD1BBN0

36. Connect the fuel lines to the injection nozzles and to the injection pump.

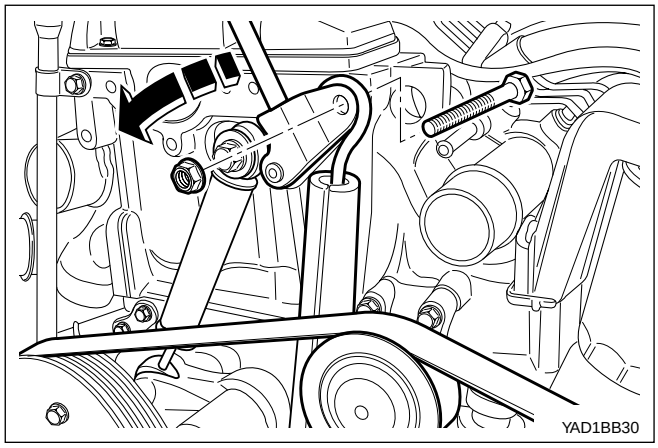
    Installation Notice

Tightening Torque	18 N•m (13 lb-ft)


YAD1BCZ0

37. Install the poly V-belt.

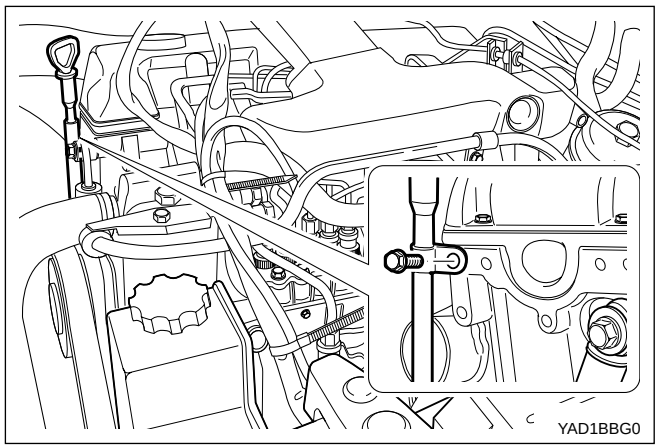
    Notice: Be careful not to contaminate the belt.



38. By inserting a rod into the tensioning lever upper hole and pulling the rod, install the bolt and then tighten the nut.

Installation Notice

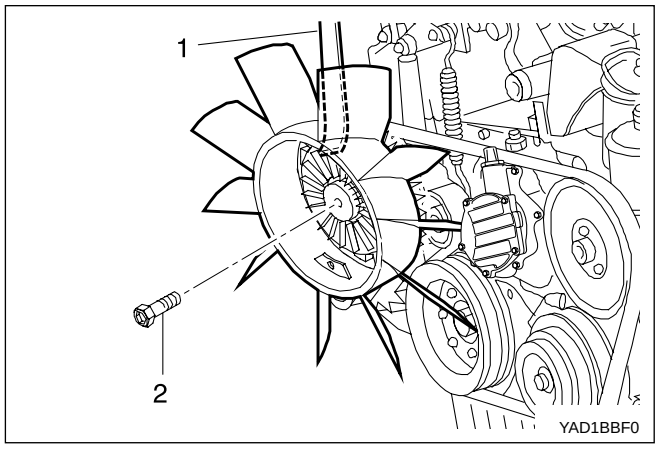
Tightening Torque	21 N•m (15 lb-ft)



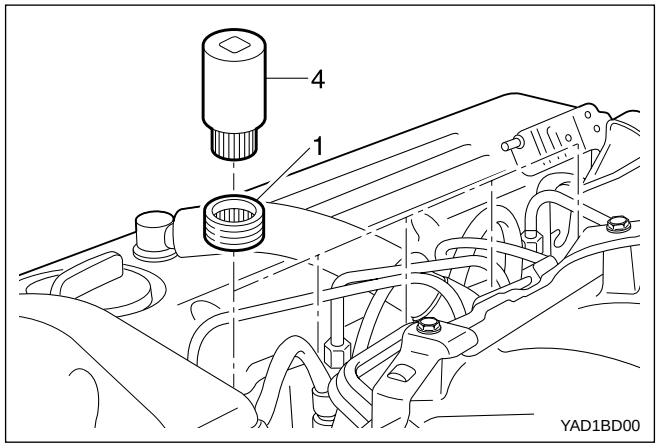
39. Install the oil dipstick tube bracket.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)



40. Hold the cooling fan with the counter holder 603 589 00 40 00 and tighten the bolt.



PRECHAMBER

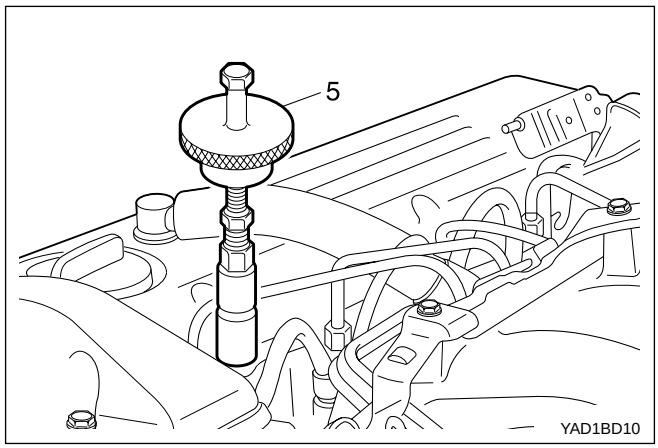
Preceding work: Removal of glow plug
Removal of fuel injection nozzle

Tools Required

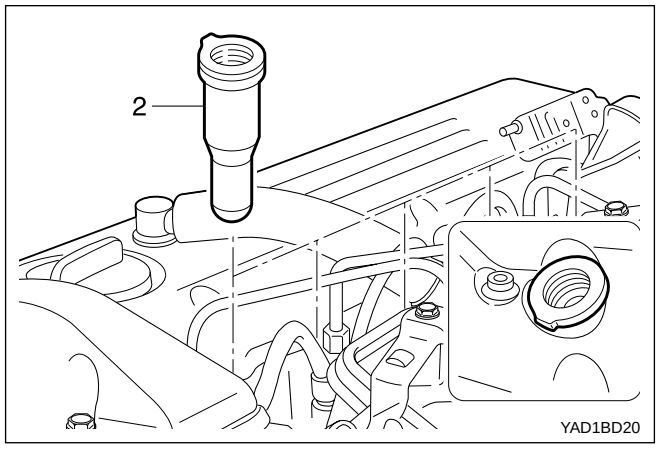
603 589 00 09 00 Serration Wrench
667 589 03 63 00 Sliding Hammer

Removal Procedure

1. Using the serration wrench 603 589 00 09 00 (4), remove the threaded ring (1).

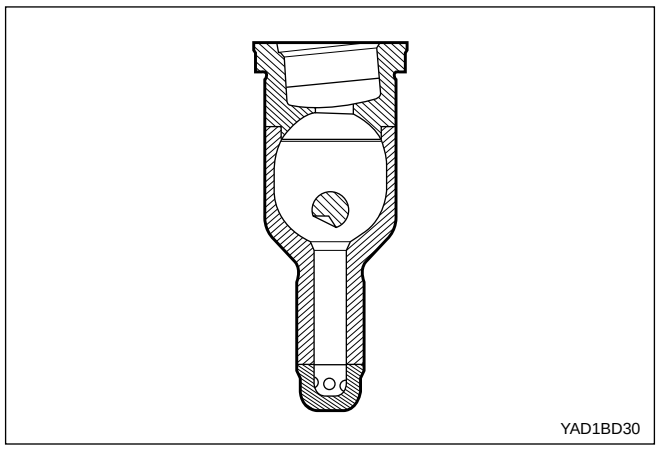


2. Install the sliding hammer 667 589 03 63 00 (5) into the prechamber.



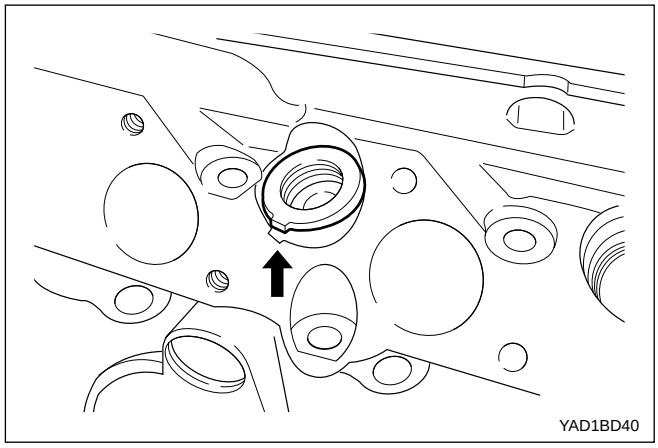
3. Remove the perchamber (2).

   Notice: After removing the prechamber, cover over the bores with clean rag.



4. Inspect the prechamber.

   Notice: If the prechamber seats in the cylinder head are leaking or if the prechambers are replaced, the sealing surfaces in the cylinder head must be remachined.



Installation Procedure

Notice: In case the prechambers are reused, inspect the prechambers thoroughly, if the ball pin by heat and fire is broken, it can not be used.

1. Clean the sealing surface of the prechamber.
2. Insert the prechamber into the cylinder head at the same time aligning the cam on the collar of the prechambers with the slots in the cylinder head.

Installation Notice

Thickness of Spacer Ring	0.3, 0.6, 1.0 mm

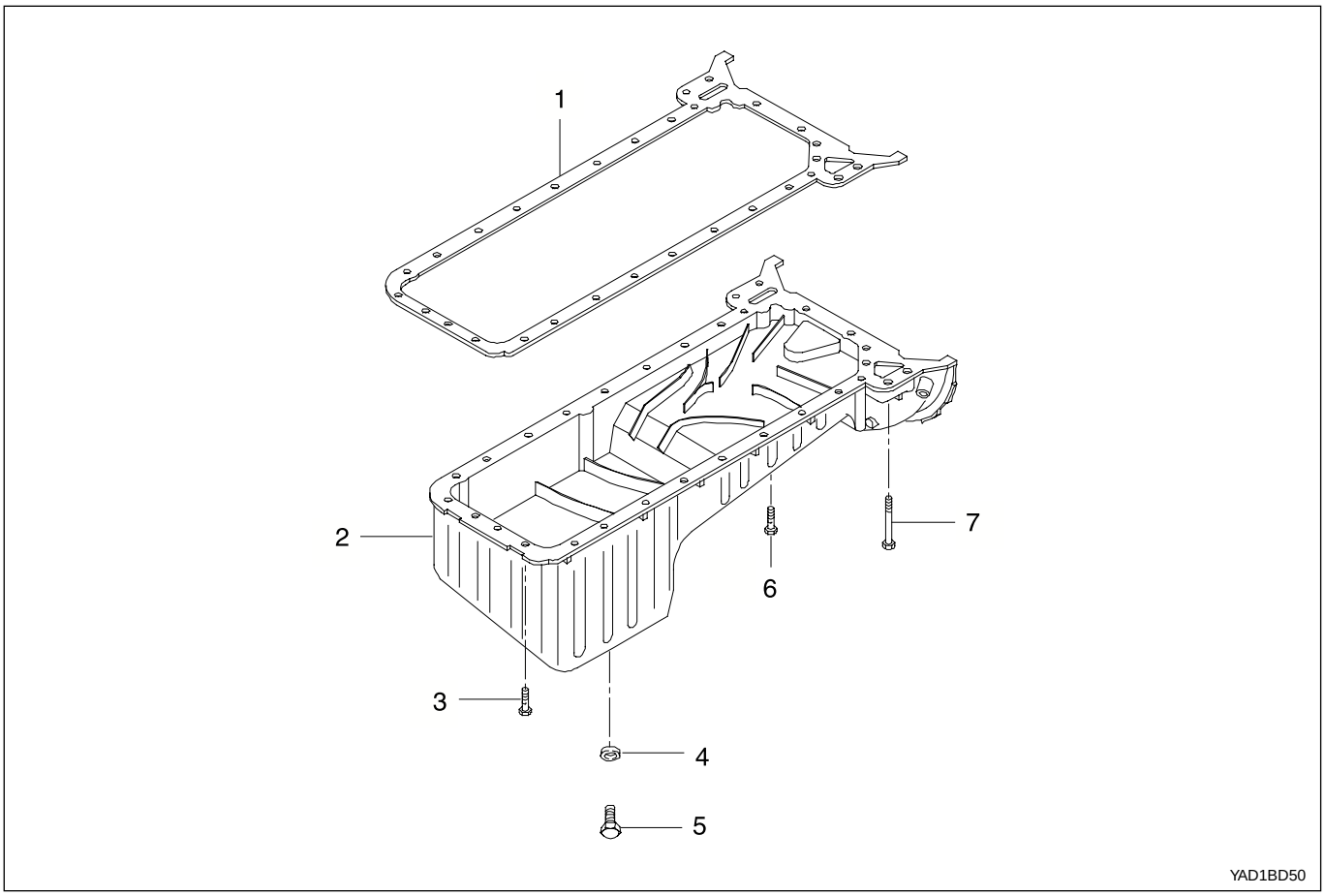
If the spacer rings are fitted to the prechambers, the spacer rings should be replaced with rings of the same thickness.

3. Coat the threaded ring with oil and assemble the ring by using the serration wrench 603 589 00 09 00.

Installation Notice

Tightening Torque	130 N•m (96 lb-ft)

OIL PAN

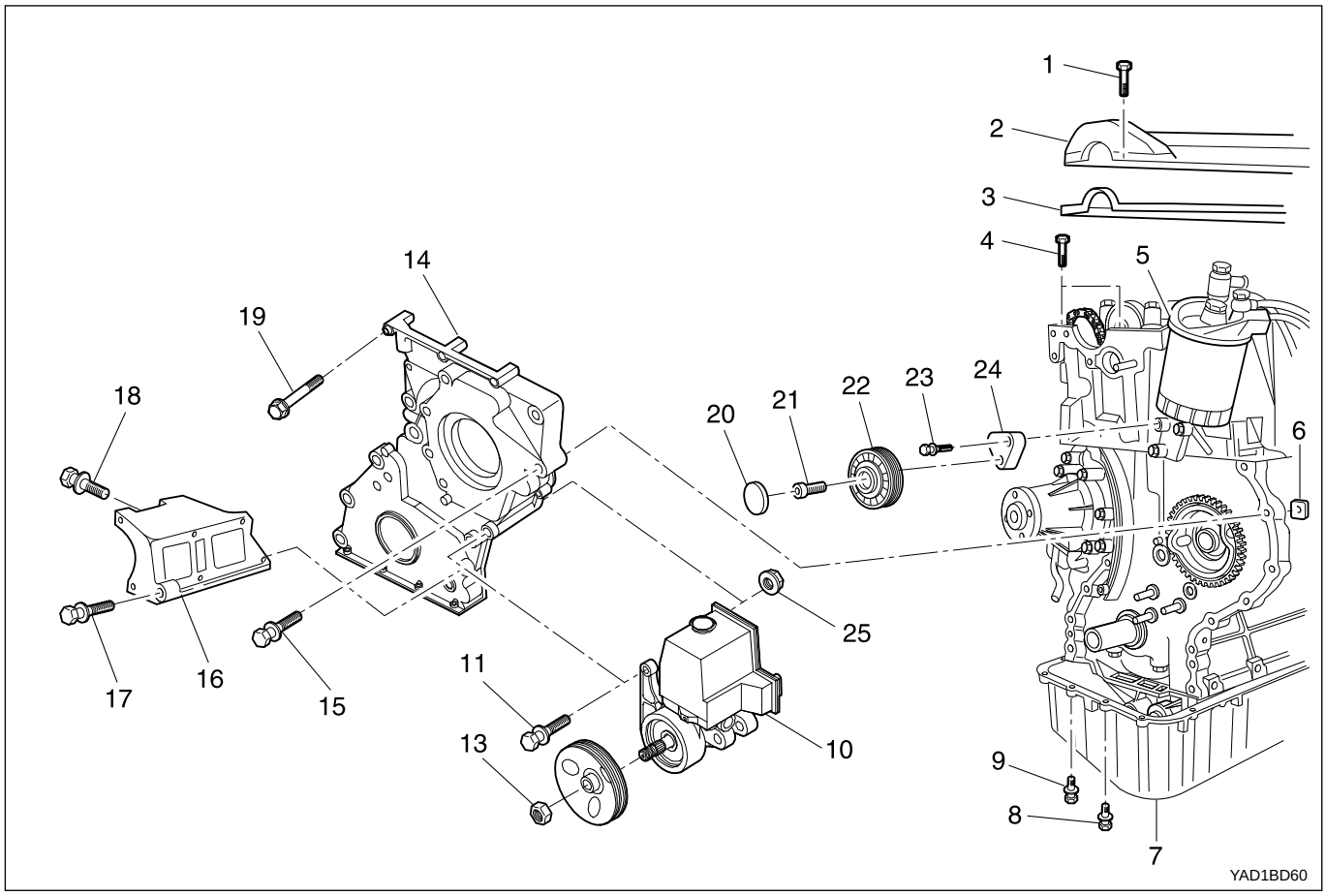


1	Gasket ..... Replace	5	Drain Plug ..... 25 N•m (18 lb-ft)
2	Oil Pan	6	Bolt ..... 10 N•m (89 lb-in)
3	Bolt ..... 10 N•m (89 lb-in)	7	Bolt ..... 25 N•m (18 lb-ft)
4	Washer ..... Replace		

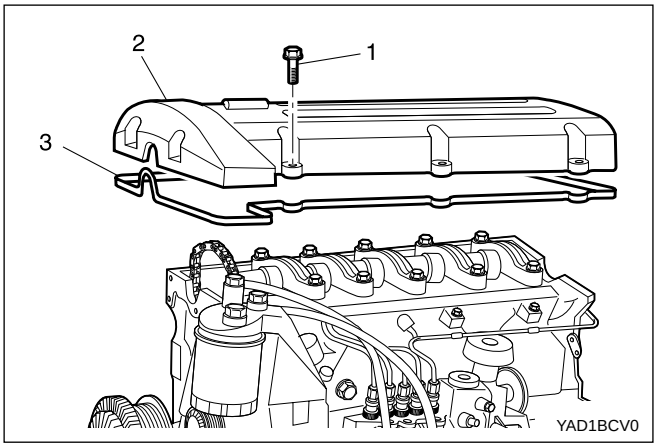
Notice: Replace the washer seal with new one.

TIMING CASE COVER

Preceding Work : Removal of the cooling fan
Removal of the V-belt tensioning device
Removal of the vibration damper and hub
Removal of the generator



1 Bolt ..... 10 N•m (89 lb-in)
2 Cylinder Head Cover
3 Gasket ..... Replace
4 Socket Bolt ..... 25 N•m (18 lb-ft)
5 Fuel Filter
6 Square Nut
7 Oil Pan
8 Socket Bolt ..... 10 N•m (89 lb-in)
9 Bolt ..... M6 : 10 N•m (89 lb-in)
..... M8 : 23 N•m (17 lb-ft)
10 Power Steering Pump
11 Bolt
12 Belt Pulley
13 Bolt ..... 32 N•m (24 lb-ft)
14 Timing Case Cover
15 Bolt ..... 23 N•m (17 lb-ft)
16 Generator Bracket
17 Bolt ..... 45 N•m (33 lb-ft)
18 Bolt ..... 25 N•m (18 lb-ft)
19 Bolt ..... 10 N•m (89 lb-in)
20 Closing Cover
21 Socket Bolt ..... 23 N•m (17 lb-ft)
22 Guide Pulley
23 Bolt ..... 9 N•m (80 lb-in)
24 Guide Pulley Bracket
25 Nut ..... 23N•m (17 lb-ft)

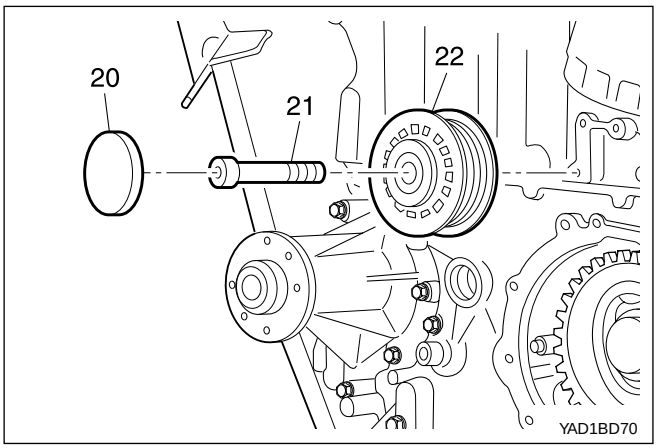


Tools Required

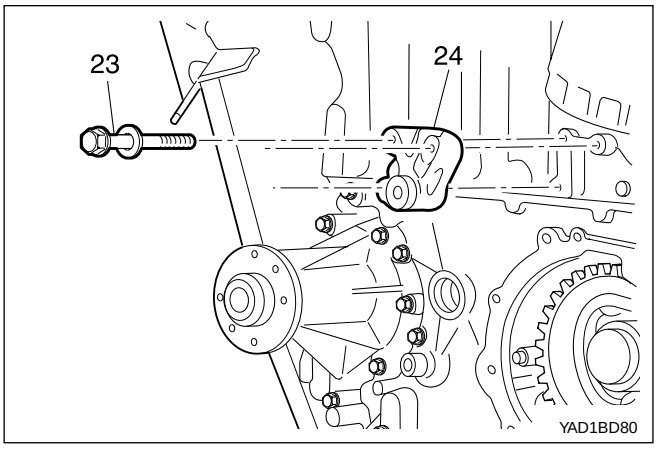
116 589 03 07 00 T Type Socket Wrench

Removal Procedure

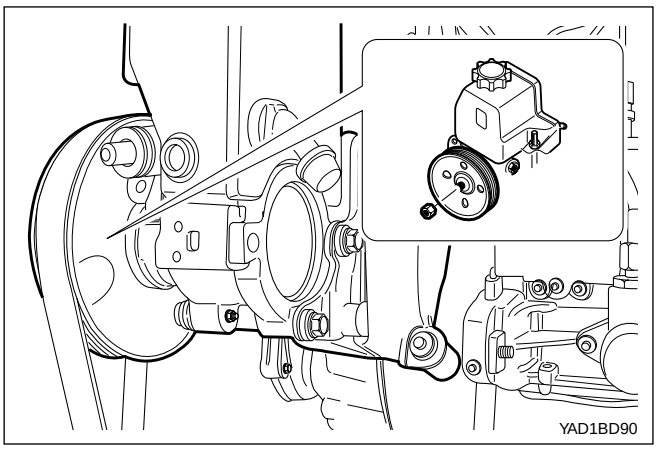
1. Remove the fan clutch and cooling fan belt pulley.
2. Drain the engine oil completely.
3. Remove the crankshaft pulley.
4. Loosen the bolt (1) and then remove the cylinder head cover (2) and gasket.
5. Remove the vacuum pump.



6. Detach the closing cover (20). Remove the bolts (21) and then remove the guide pulley (22).



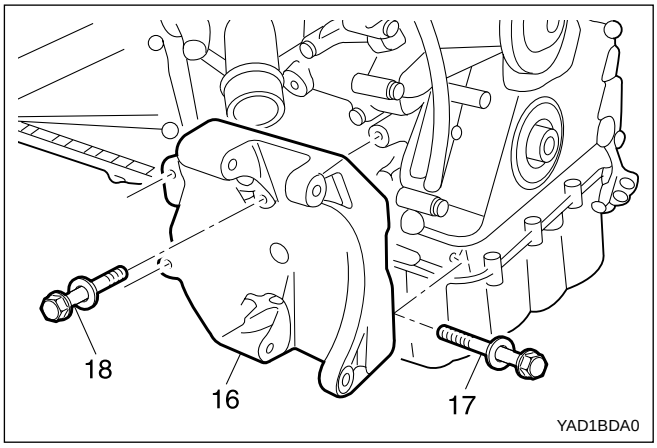
7. Remove the guide pulley bracket (24).



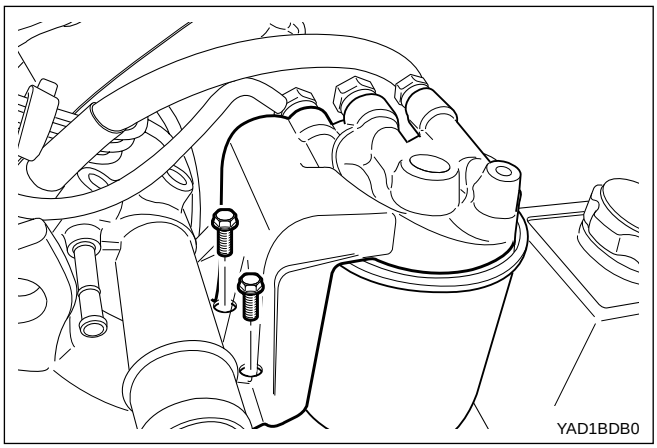
8. Disconnect the pipes of power steering pump and remove the belt pulley.

   Notice: Be careful not to lose the key.

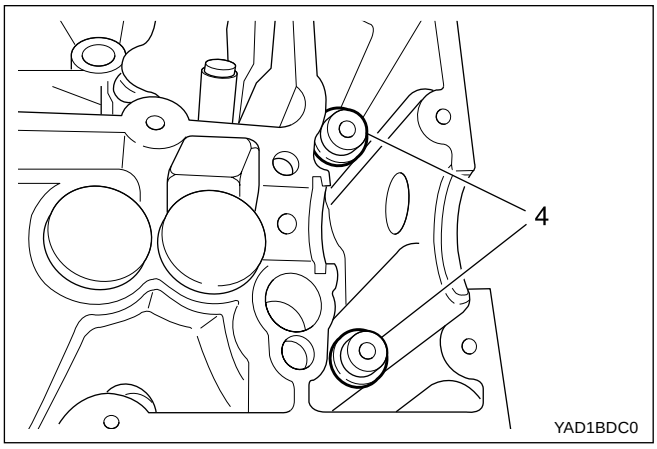
9. Remove the nut and pull out the bolt and then remove the power steering pump.



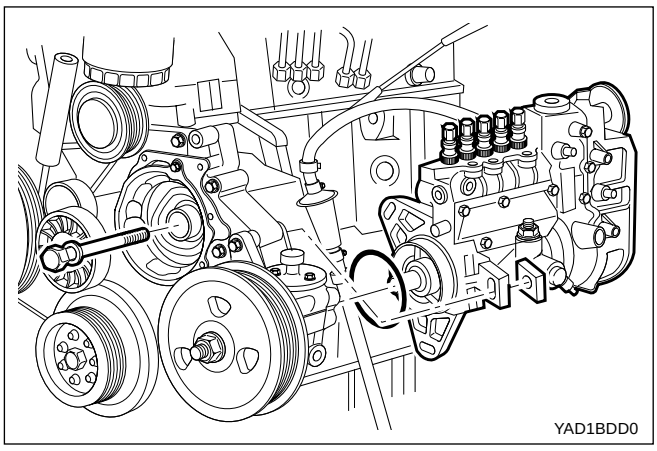
10. Remove the generator bracket (16).



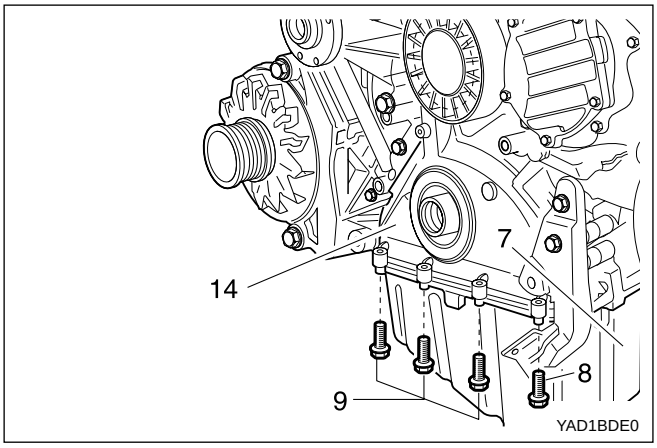
11. Remove the fuel filter.



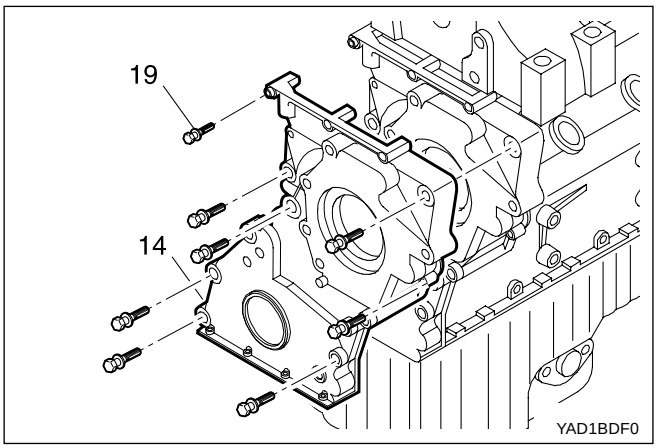
12. Remove the camshaft.
13. Remove the socket bolts (4) in the chain box using the socket wrench 115 589 03 07 00.



14. Remove the injection pump. Refer to *Section 1F3 Diesel Engine Control.*



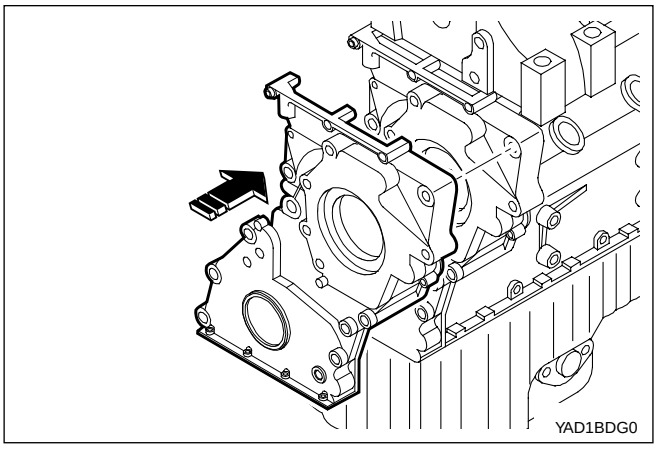
15. Remove the oil pan bolts (8, 9) in the area of the timing case cover (14).
16. Slightly loosen the remaining oil pan bolts.



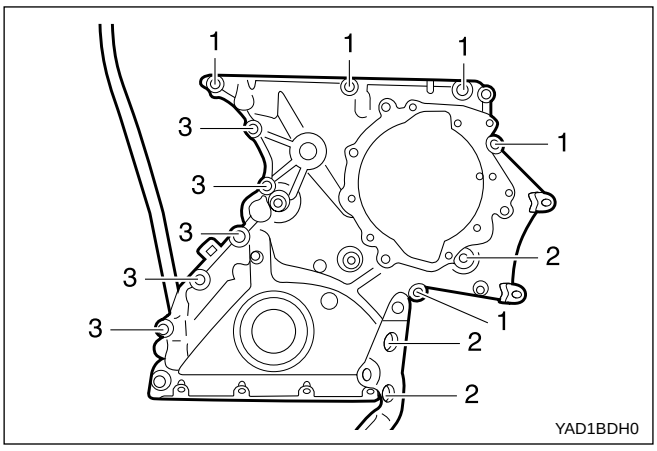
17. Remove the timing case cover (19) bolts and then remove the timing case cover (14).

    Notice: Be careful not to damage the cylinder head gasket or oil pan gasket.

Installation Procedure



1. Thoroughly clean the sealing surface and apply sealant.



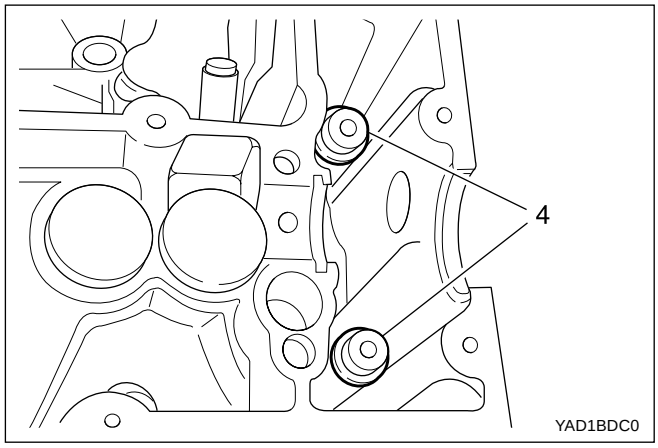
2. Install the timing case cover.

   Installation Notice

Tightening Torque	10 N•m (89 lb-in)

   Bolts arrangement

   1. M6 x 60
   2. M6 x 70
   3. M6 x 40



3. Tighten the socket bolts in the chain box.

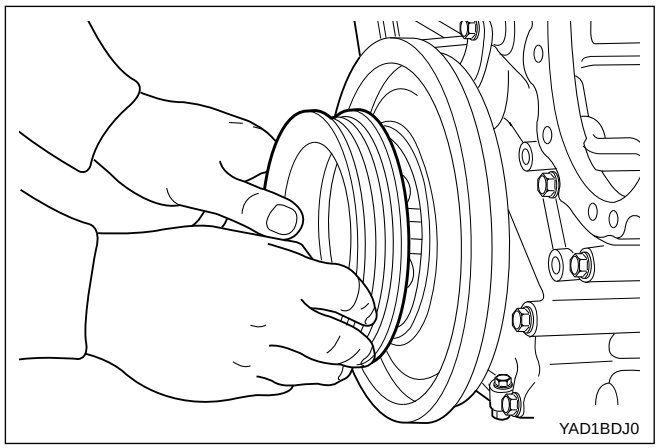
Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

4. Tighten the oil pan bolts.

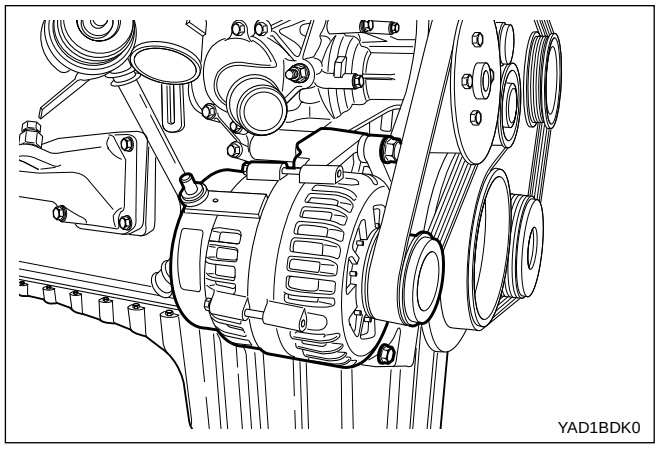
Installation Notice

Tightening Torque	Socket Bolt	10 N•m (89 lb-in)
	M6 Bolt	10 N•m (89 lb-in)
	M8 Bolt	25 N•m (18 lb-ft)



5. Install the flange, vibration damper and crankshaft belt pulley.

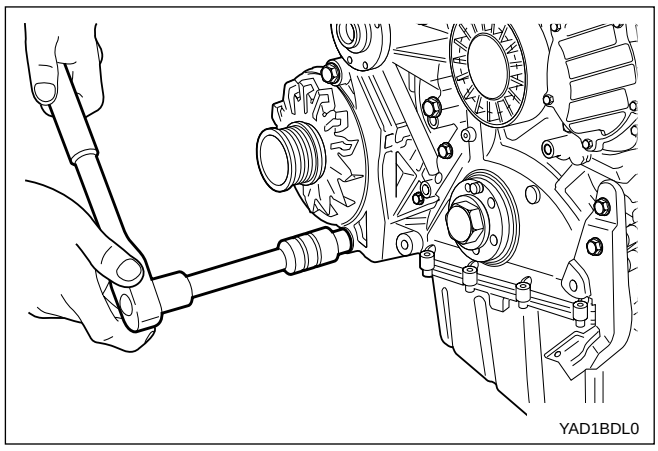
Notice: Replace front radial seal if necessary.



6. Install the generator bracket.

Installation Notice

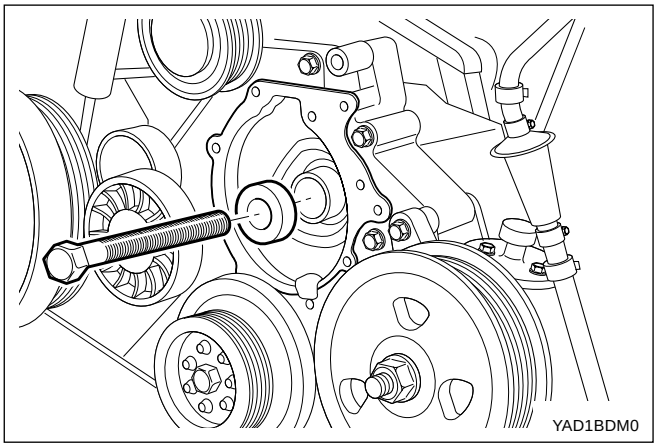
Tightening Torque	Front	25 N•m (18 lb-ft)
	Side	25 N•m (18 lb-ft)



7. Install the generator.

Installation Notice

Tightening Torque	Upper	25 N•m (18 lb-ft)
	Lower	45 N•m (33 lb-ft)



8. Install the cylinder head cover.

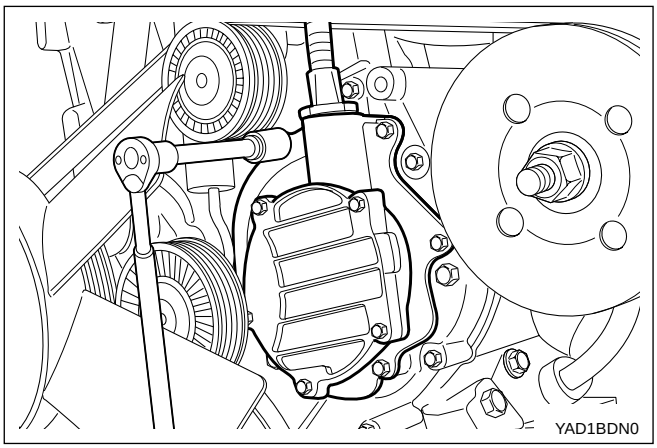
Installation Notice

Tightening Torque	10 N•m (89 lb-in)

9. Tighten the injection pump mounting bolts.

Installation Notice

Tightening Torque	23 N•m (17 lb-ft)



10. Install the fuel filter.

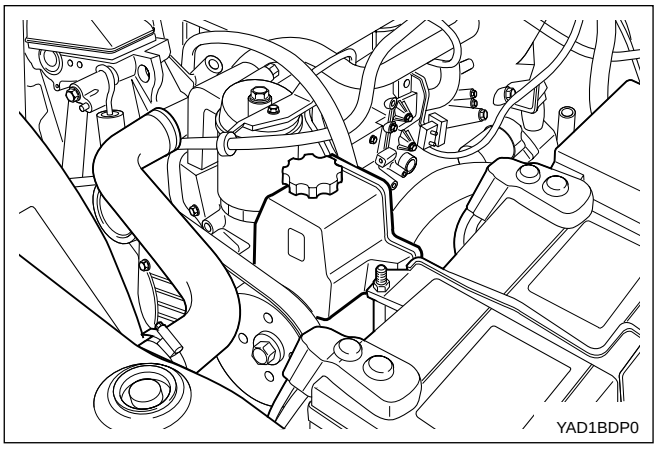
Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

11. Install the vacuum pump.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)



12. Install the power steering pump.

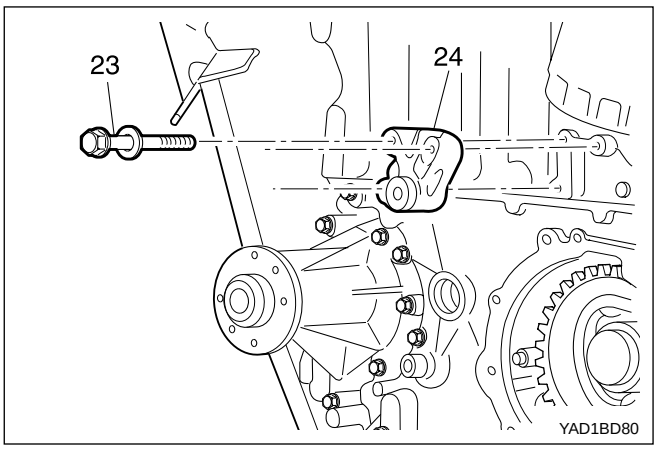
Installation Notice

Tightening Torque	23 N•m (17 lb-ft)

13. Install the power steering pump pulley.

Installation Notice

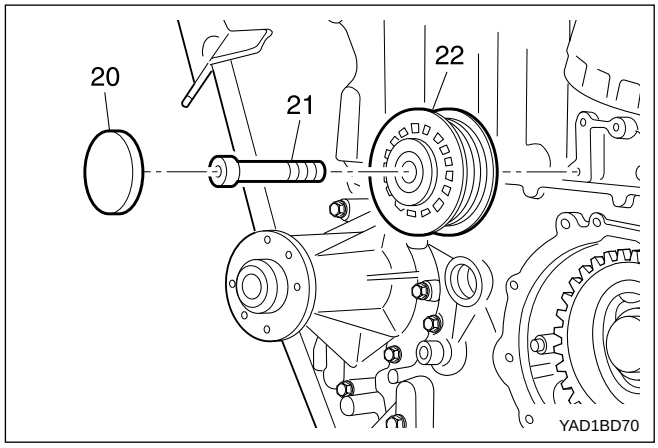
Tightening Torque	32 N•m (24 lb-ft)



14. Install the guide pulley bracket.

Installation Notice

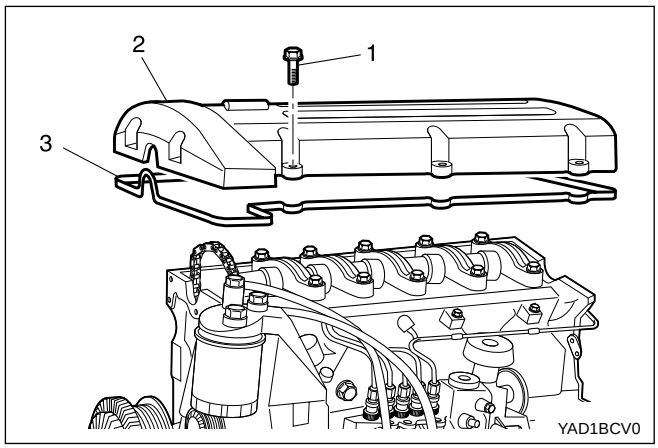
Tightening Torque	9 N•m (80 lb-in)



15. Install the guide pulley (22) and fit the closing cover (20).

Installation Notice

Tightening Torque	23 N•m (17 lb-ft)



16. Replace the gasket (3) and install the cylinder head cover (2).

Installation Notice

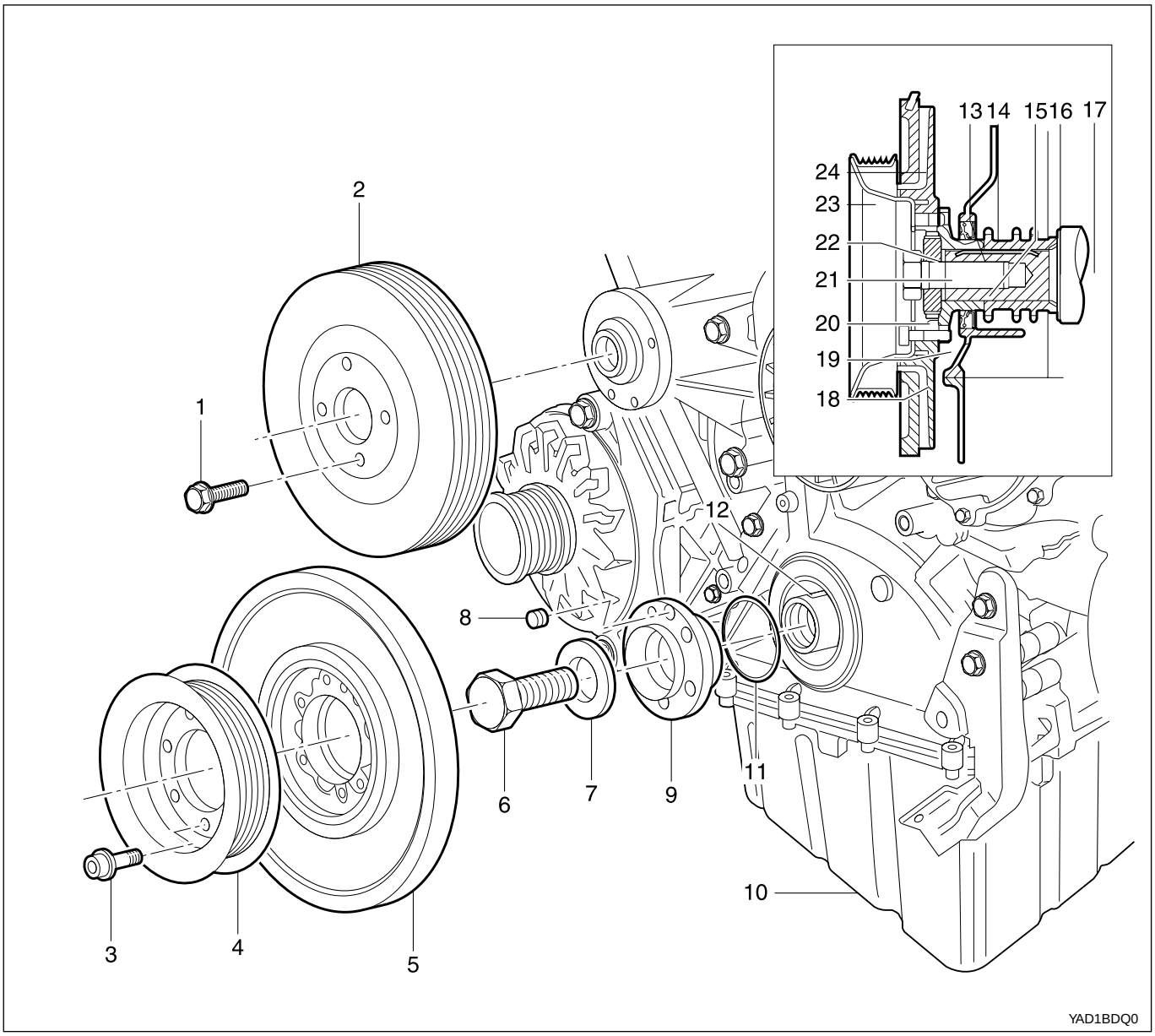
Tightening Torque	10 N•m (89 lb-in)

17. Install the cooling fan belt pulley and fan clutch.
18. Install the belt tensioning device and then install the belt.
19. Install the cooling fan.
20. Fill the engine oil and check oil leaks by running the engine.

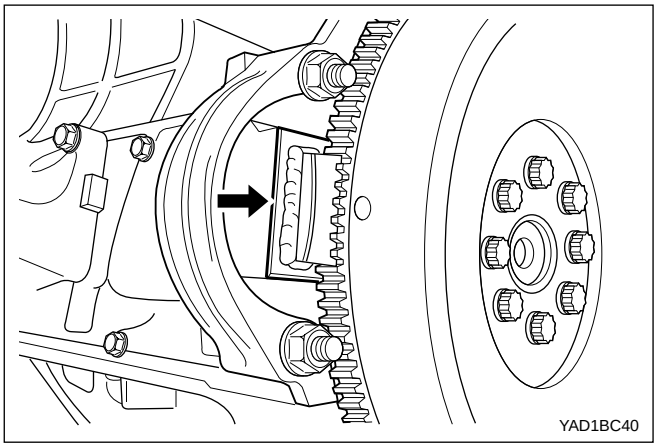
CRANKSHAFT ASSEMBLY

VIBRATION DAMPER AND HUB

Preceding Work: Removal of the cooling fan
Removal of poly V-belt



1 Bolt ..... 10 N•m (89 lb-in)
2 Cooling Fan Belt Pulley
3 Socket Bolt ..... 23 N•m (17 lb-ft)
4 Crankshaft Belt Pulley
5 Vibration Damper
6 Bolt ..... 200 N•m (148 lb-ft)+ 90°
7 Washer
8 Straight Pin
9 Hub
10 Oil Pan
11 Radial Seal
12 Key
13 Radial Seal
14 Timing Gear Case Cover
15 Key
16 Crankshaft Sprocket
17 Crankshaft
18 Socket Bolt ..... 23 N•m (17 lb-ft)
19 Washer
20 Bolt ..... 20 N•m (148 lb-ft)+ 90°
21 Hub
22 Straight Pin
23 Crankshaft Velt Pulley
24 Vibration Damper



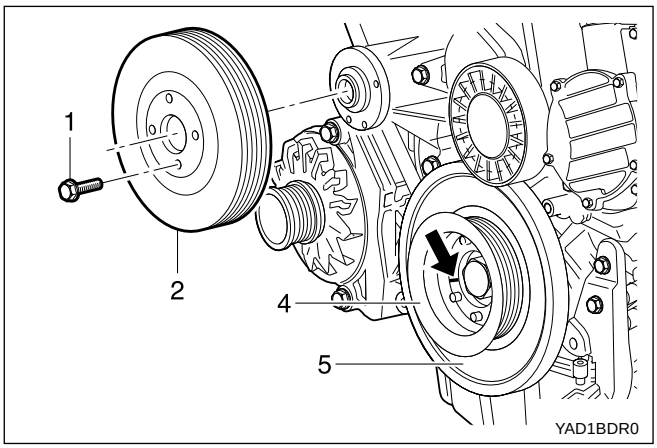
Tools Required

103 589 00 33 00 Puller
601 589 03 14 00 Sleeve
602 589 00 40 00 Engine Lock

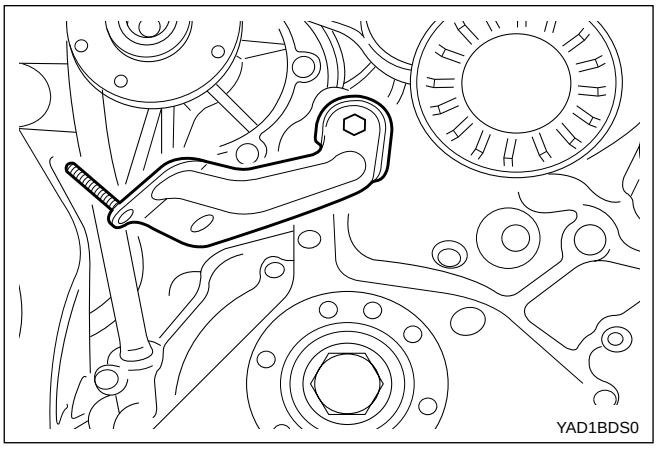
Removal Procedure

1. Remove the starter motor and install the engine lock 602 589 00 40 00 into the flywheel ring gear.
2. Remove the poly V-belt.
3. Remove the cooling fan.

   Notice: Keep the fan in vertical position.

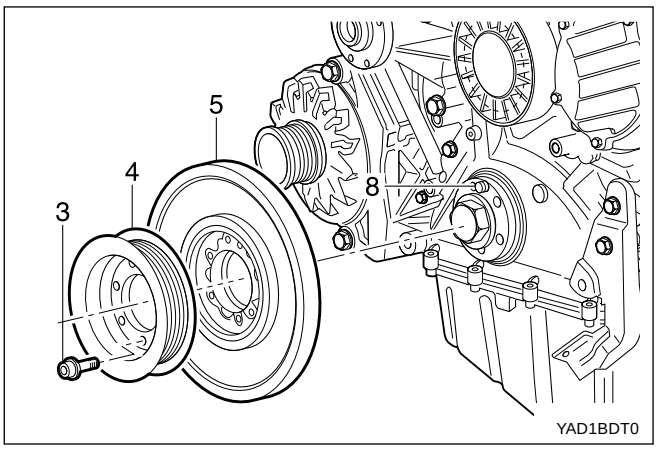


4. Remove the cooling fan belt pulley (2).
5. Place alignment marks (arrow) on the vibration damper (5) and crankshaft belt pulley (4).

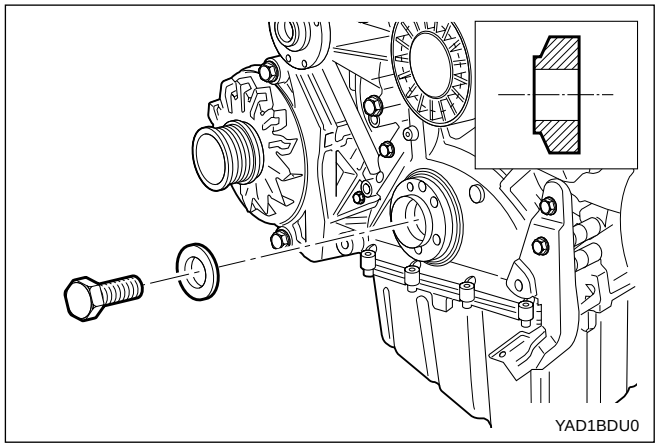


6. Remove the timing sensor bracket.

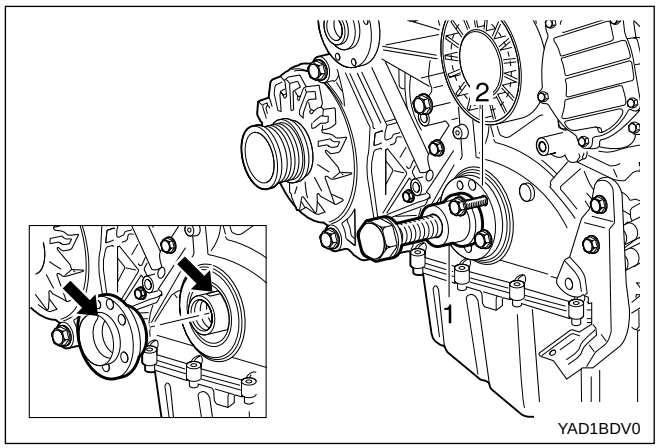
   Notice: Remove if necessary.



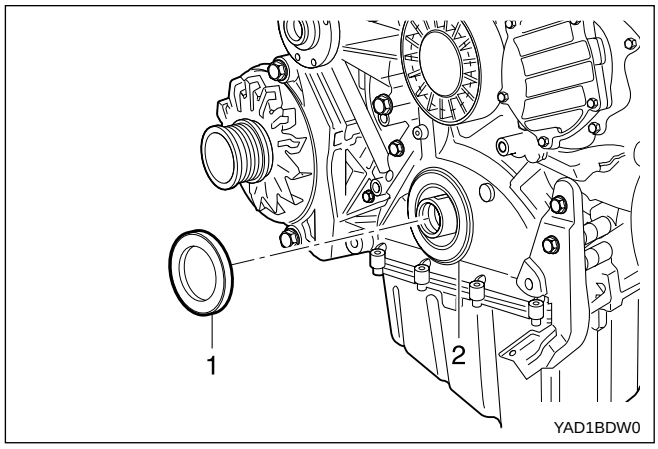
7. Remove the socket bolts (3) and then remove the belt pulley (4) and vibration damper (5).



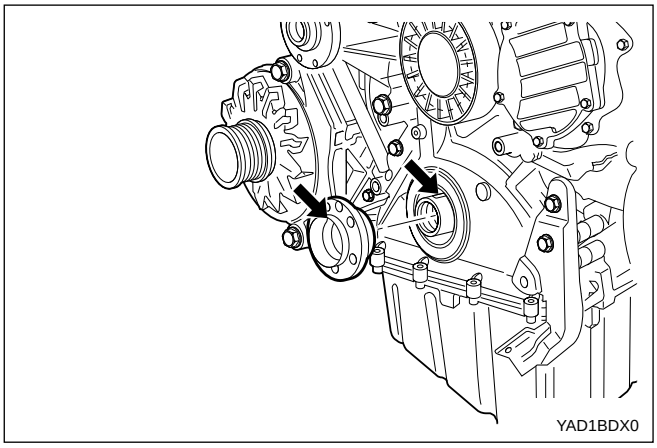
8. Remove the washer and bolt.



9. Remove the hub by using a puller 103 589 00 33 00.



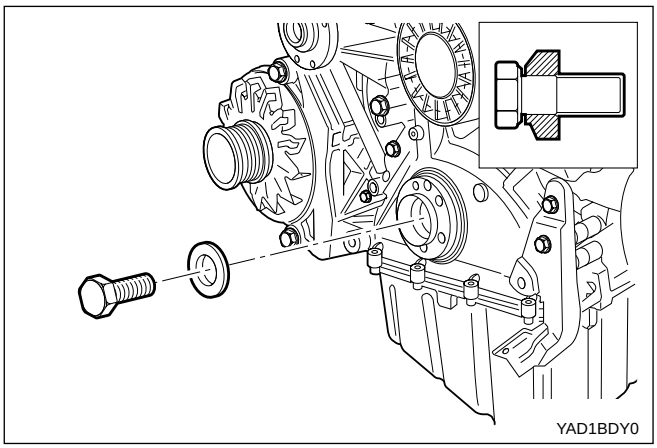
10. Pull out the radial seal (1) and be careful not to damage the sealing surface of timing case cover.



Installation Procedure

1. Install the hub.

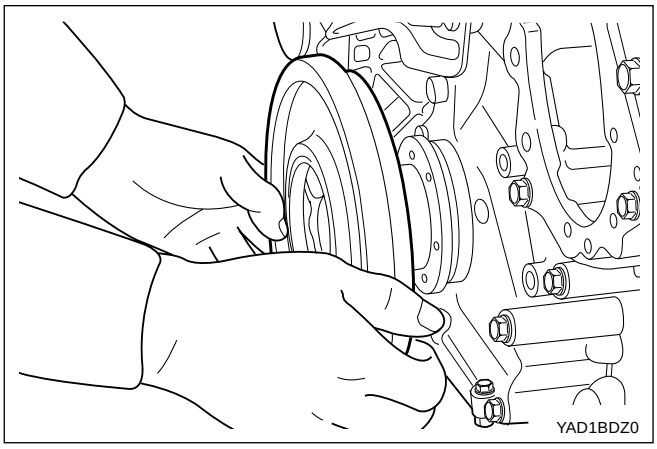
   Notice: Exactly align the woodruff key and the groove of hub (arrow).



2. Install the washer and tighten the bolt.

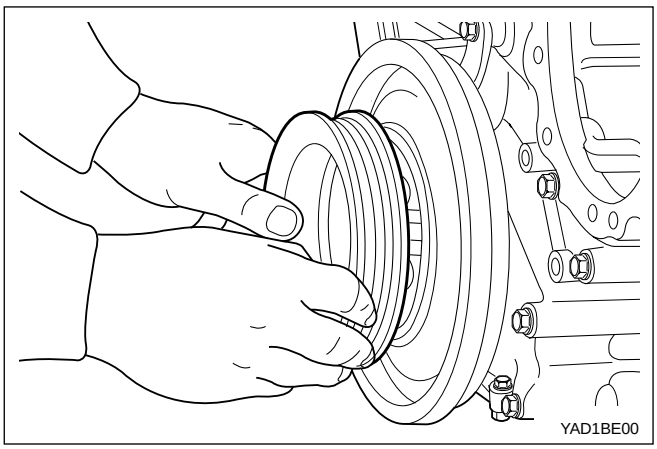
   Installation Notice

Tightening Torque	200 N•m (148 lb-ft)+ 90°



3. Install the vibration damper.

   Notice: Exactly align and insert onto the straight pin.

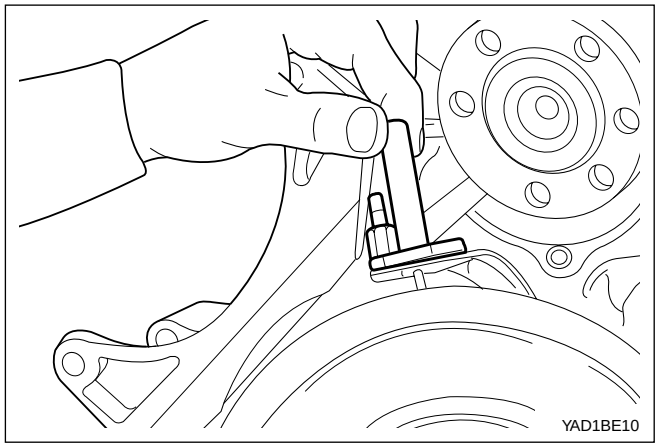


4. Install the crankshaft belt pulley.

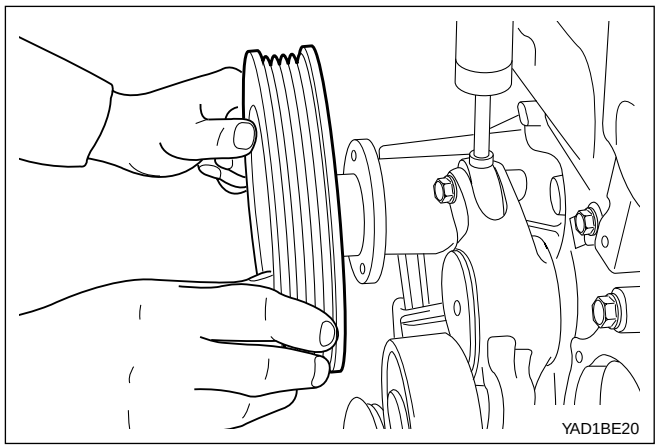
   Installation Notice

Tightening Torque	23 N•m (17 lb-ft)

   Align the alignment marks.



5. Install the timing sensor bracket.
   Refer to “TDC Setting” in this section.

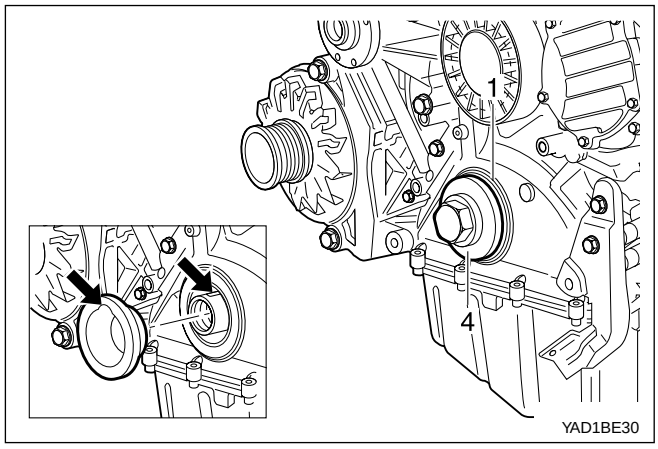


6. Install the cooling fan pulley.

   Installation Notice

Tightening Torque	10 N•m (89 lb-in)

7. Install the cooling fan.
8. Install the fan belt.
9. Remove the engine lock 602 589 00 40 00.

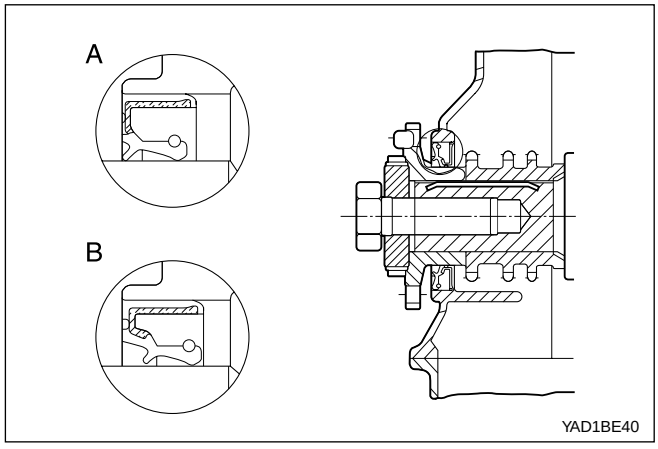


10. Throughly clean the mounting bore of the radial seal.
11. Coat a little oil on the sealing lip of new radial (1) and contact surface.

    Notice: Don’t use grease.

12. Install the radisl seal (1) by using a sleeve 601 589 03 14 00 (4).

    Notice: Align the groove of sleeve and woodruff key (arrow).

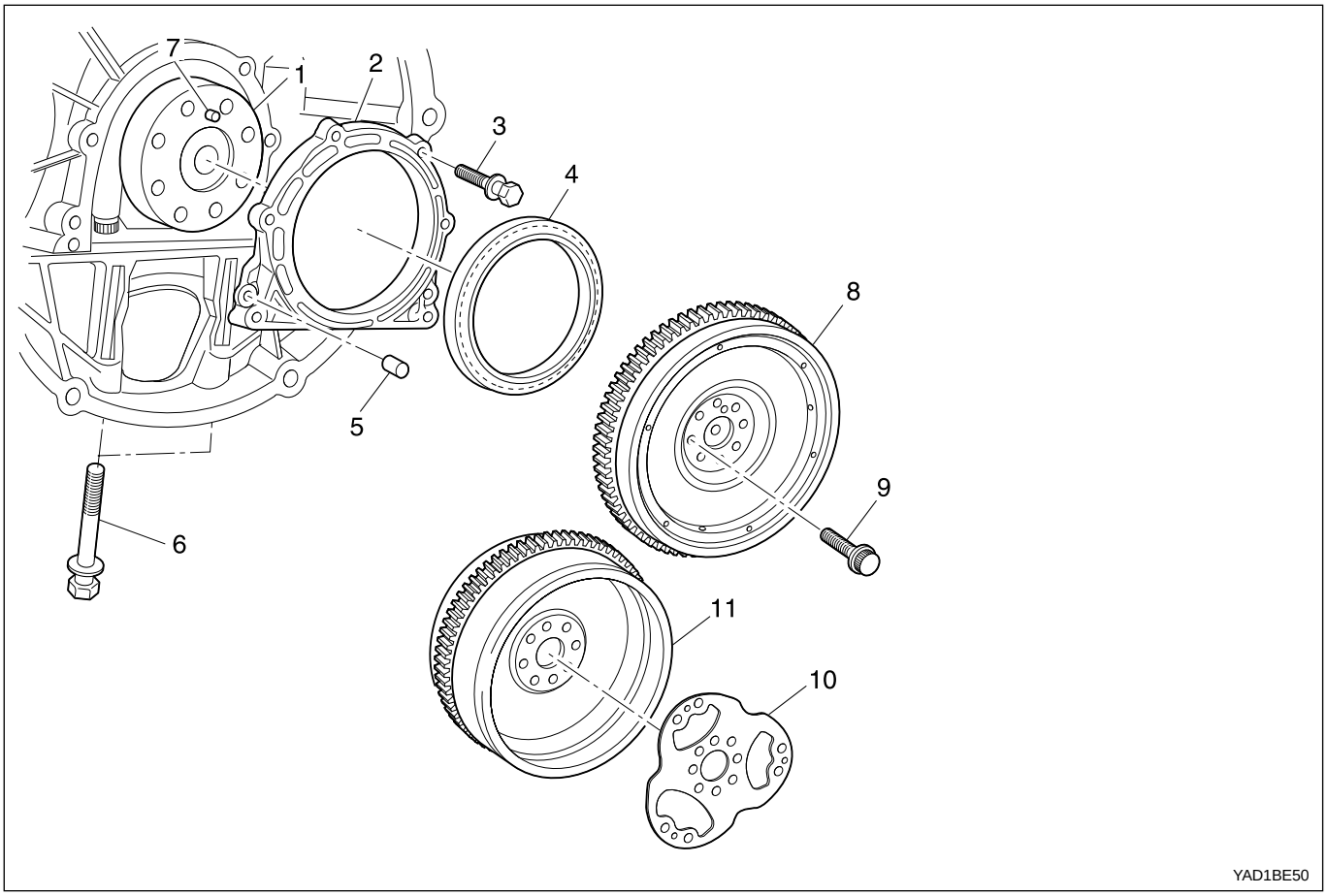


Notice: The sealing lip of the repair radial seal is offset to the inside by 2 mm to ensure that is does not run in any groove which the standard radial seal may have left on the crankshaft flange.

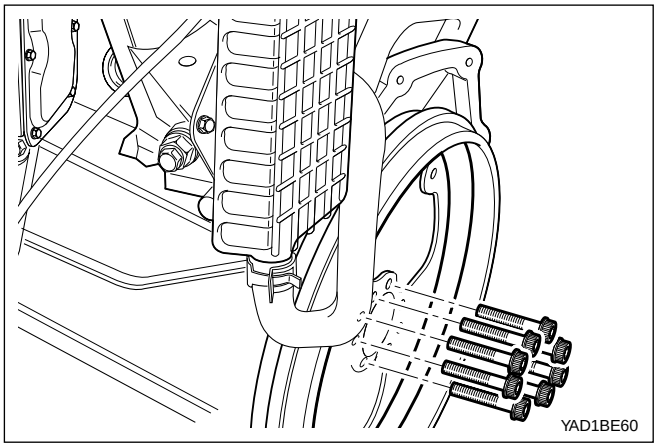
A Standard Radial Seal
B Repair Radial Seal

FLYWHEEL AND CRANKSHAFT END COVER

Preceding Work: Removal of the transmission
Removal of the clutch



1 Crankshaft Flange
2 End Clver ..... Clean Loctite 573
3 Bolt..... 10 N•m (89 lb-in) Loctite 573
4 Radial Seal..... Replace
5 Dowel Sleeve
6 Bolt..... 10 N•m (89 lb-in) Loctite 573
7 Straight Pin
8 Flywheel (Manual Transmission)
9 12-Sided Stretch Bolt
..... Check, 45 N•m (33 lb-ft)+ 90°
10 Drive Plate (Automatic Transmission)
11 Flywheel (Automatic Transmission)


YAD1BE60

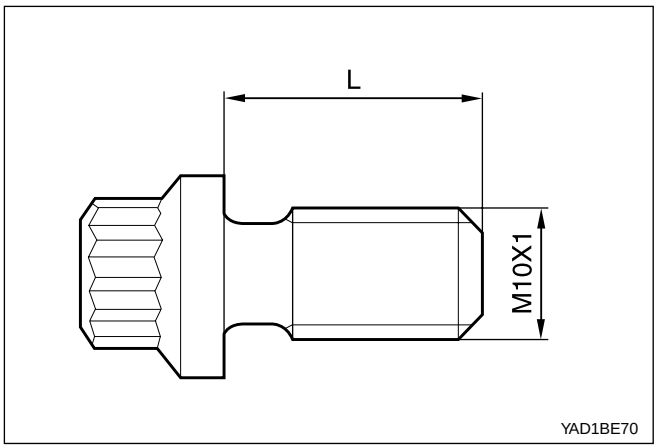
Tools Required

601 589 03 43 00 Oil Seal Assembler
602 589 00 40 00 Engine Lock

Removal Procedure

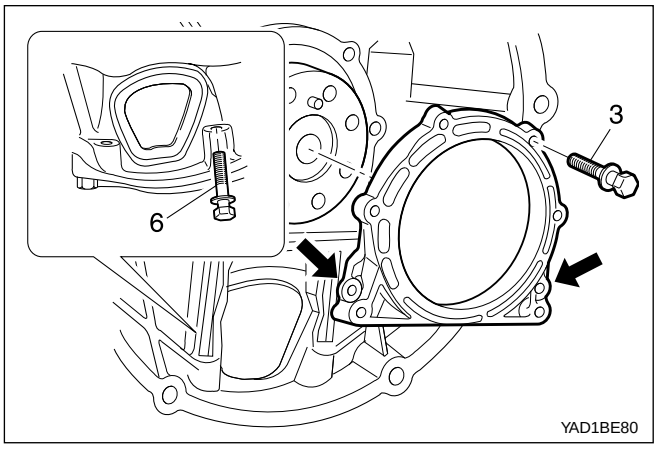
1. Install the engine lock 602 589 00 40 00.
2. Remove the 12-sided stretch bolts.

   Notice: Remove the flywheel and drive plate, if equipped with automatic transmission.



YAD1BE70

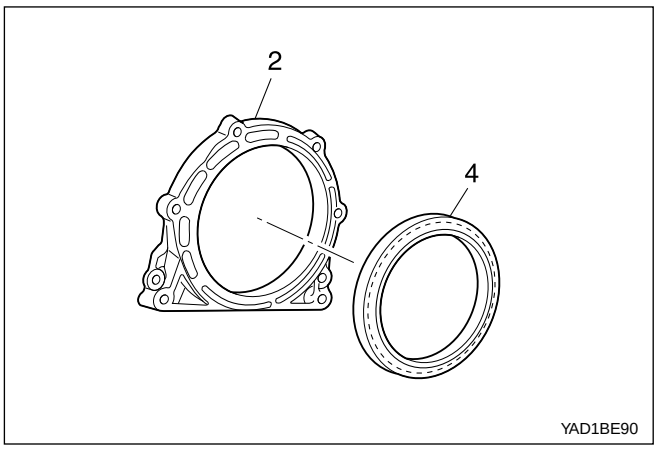
Notice: If the length 'L'of bolts exceeds 22.5 mm, replace the bolts.



YAD1BE80

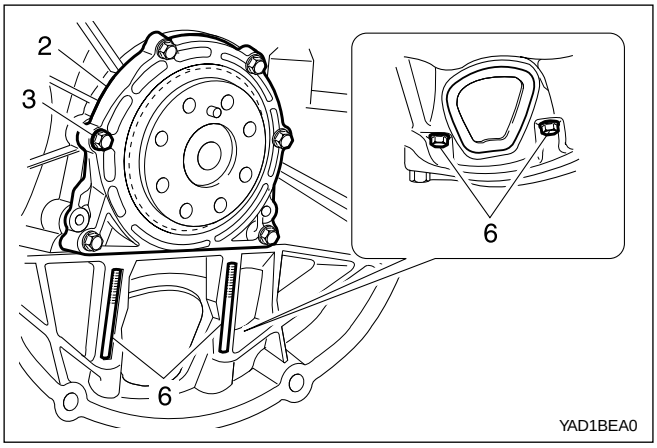
3. Remove the bolts (3. 6) from end cover, by pulling out the lug (arrow), remove the cover.

   Notice: Be careful not to damage the oil pan gasket.



YAD1BE90

4. Remove the radial seal (4) with care not to damage the sealing surface.



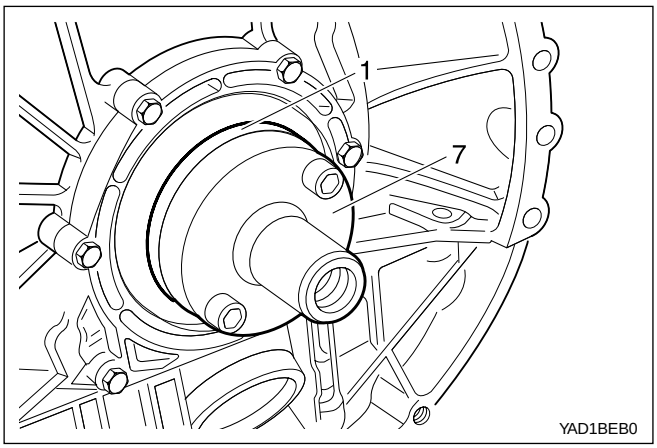
Installation Procedure

1. Throughly clean the sealing surface of end cover and apply Loctite 573.
2. Clean the groove of radial seal.
3. Apply Loctite 573 on the bolts and install the end cover.

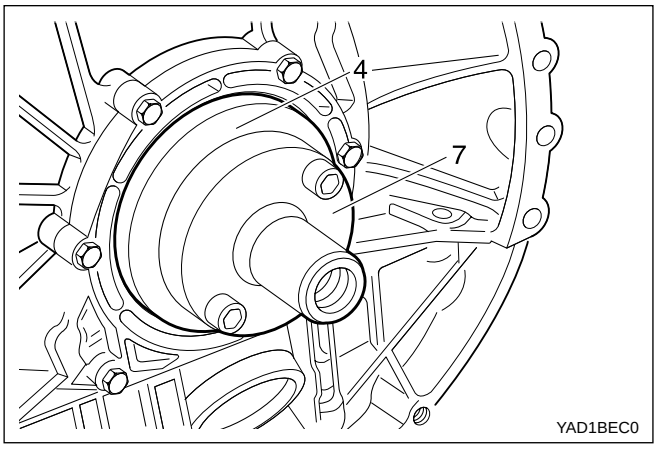
Installation Notice

Tightening Torque	10 N•m (89 lb-in)

Be careful not to damage the oil pan gasket.



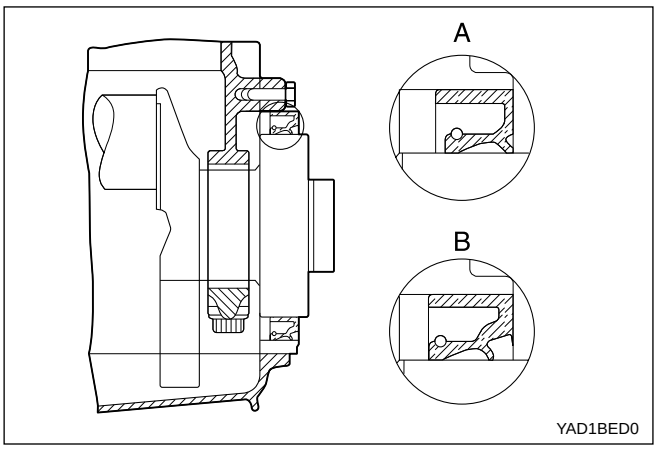
4. Install the inner oil seal assembler 601 589 03 43 00 to the crankshaft flange.



5. Coat a little oil on the sealing lip of new radial seal and contacting surface.

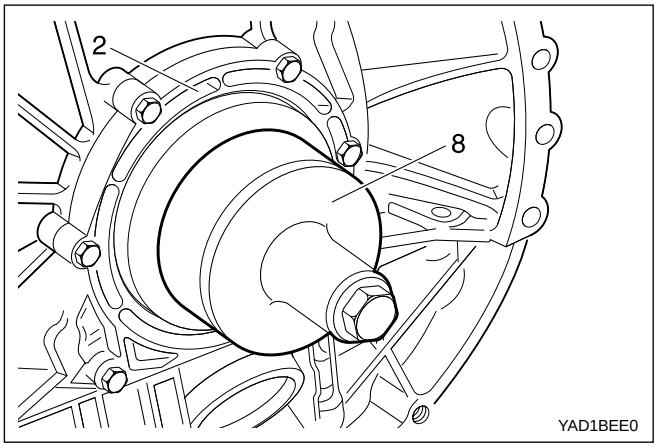
   Notice: Don't use grease.

6. Insert the new radial seal (4) on to the oil seal assembler 601 589 03 43 00 (7).



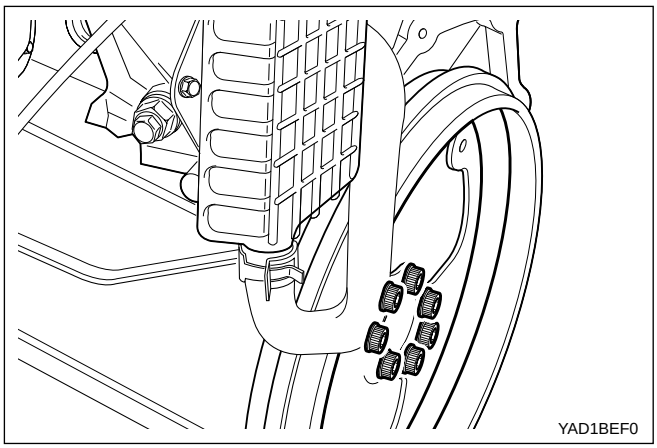
Notice: The sealing lip of the repair radial seal is offset to the inside by 3 mm to ensure that is does not run in any groove which the standard radial seal may have left on the crankshaft flange.

A Standard Radial Seal
B Repair Radial Seal



7. Install the outer oil seal assembler 601 589 03 43 00 on the seal and by tightening the bolts, press the radial seal into the end cover as far as the stop.

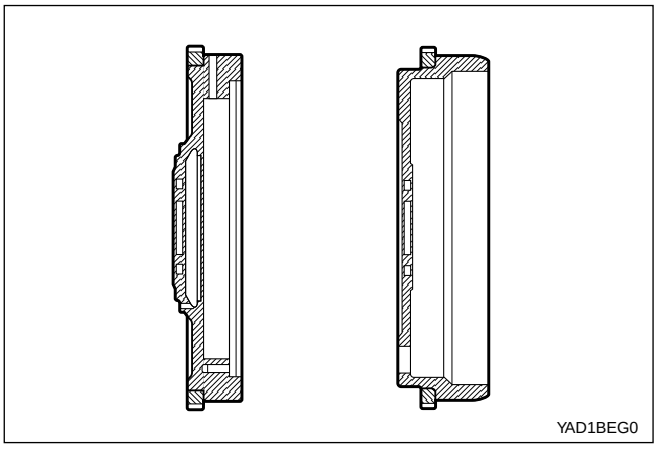
   Notice: The seal must be positioned exactly at right angles in the end cover to ensure that it provide a proper seal.



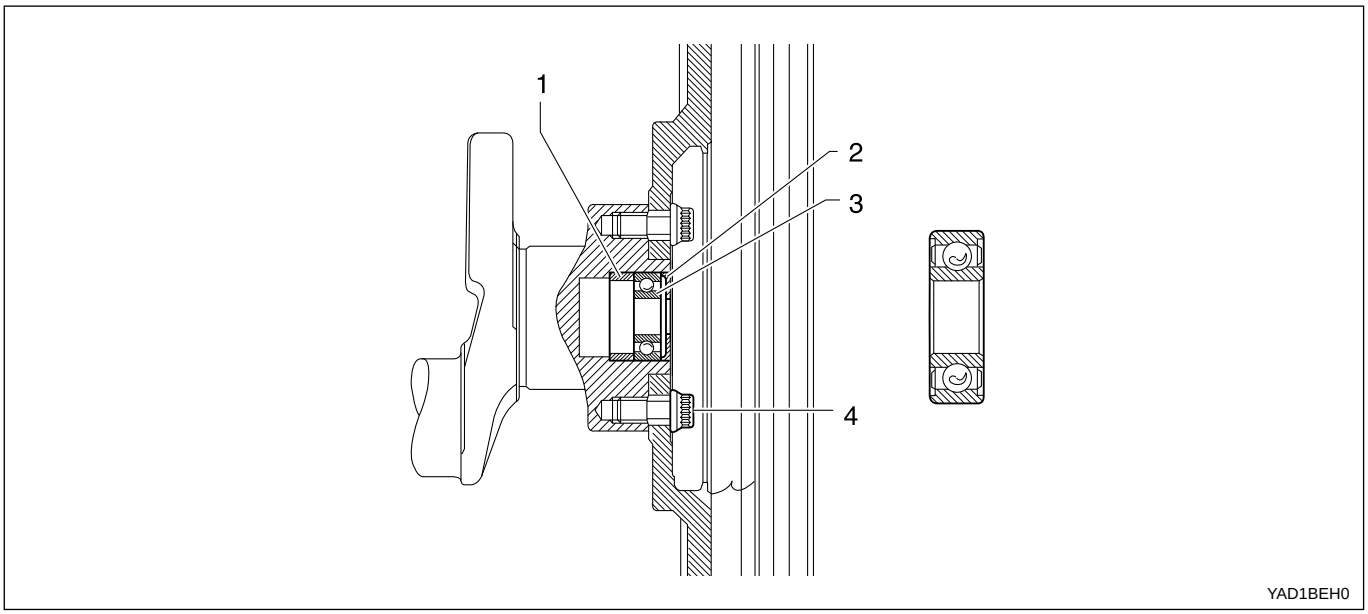
8. Install the flywheel.

   Installation Notice

Tightening Torque	45 N•m (33 lb-ft)+ 90°



CRANKSHAFT BALL BEARING

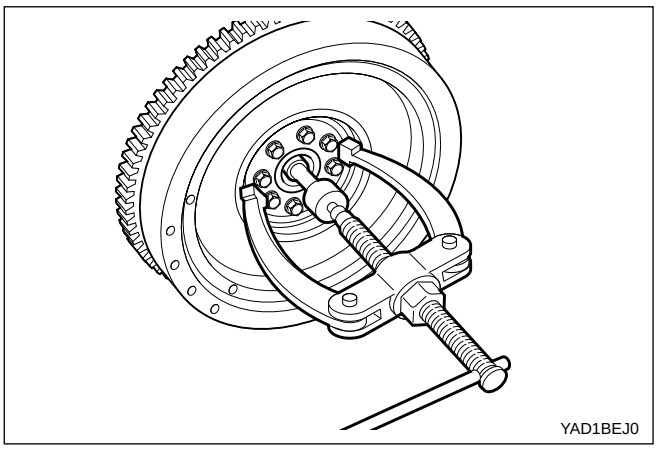


1 Spacer
2 Cover ..... Replace
3 Ball Bearing
4 Bolt ..... 45 N•m (33 lb-ft)+ 90°

Notice: Manual transmission only.

Tools Required

000 589 25 33 00 Internal Extractor
000 589 33 33 00 Counter Support

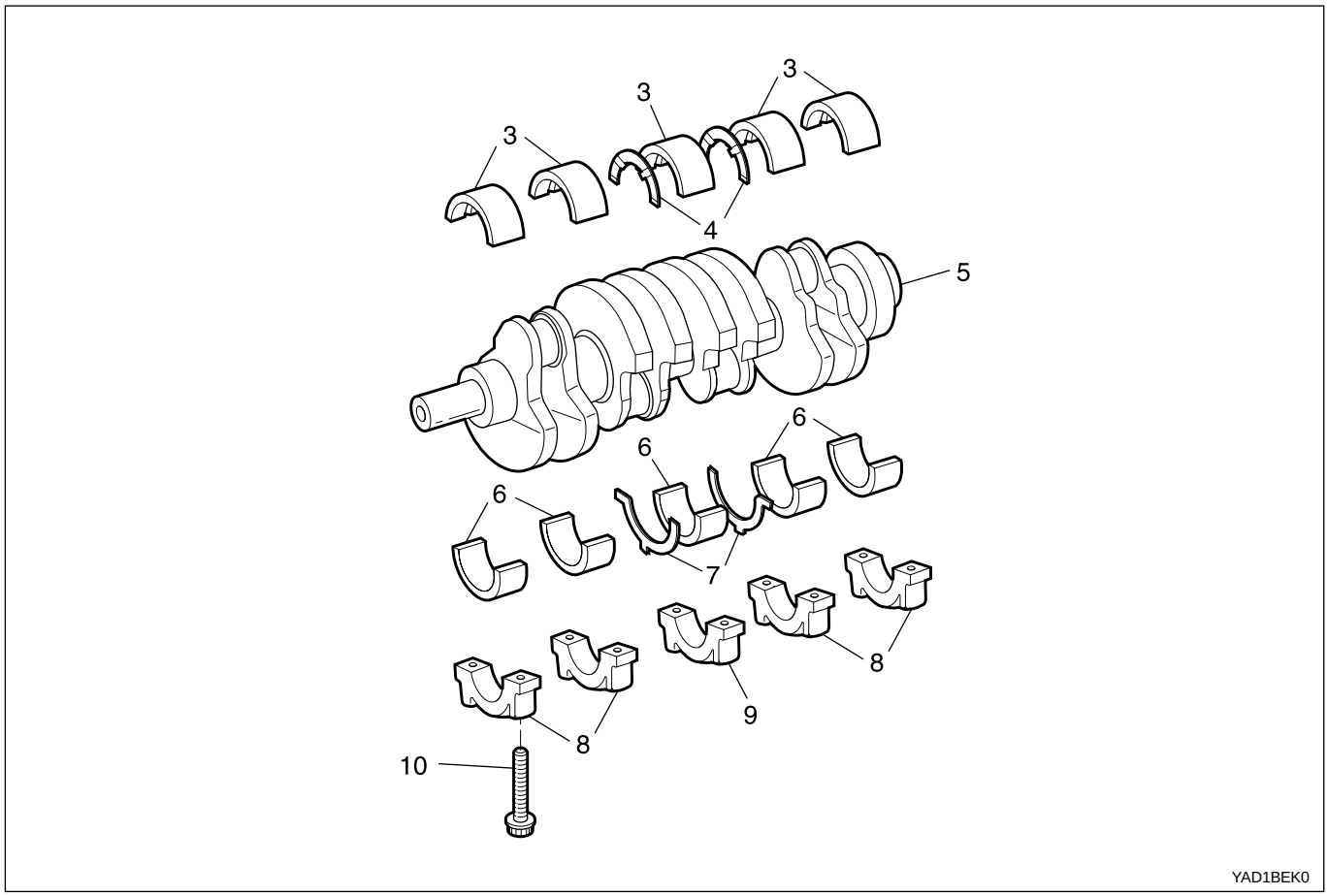


Removal & Installation Procedure

1. Remove the manual transmission.
2. Using a internal extractor 000 589 25 33 00 and counter support 000 589 33 33 00, pull out the locking ring and ball bearing together.
3. Apply Loctite 241 on the new ball bearing and then insert the ball bearing to be stopped at the spacer ring by using a proper mandrel.

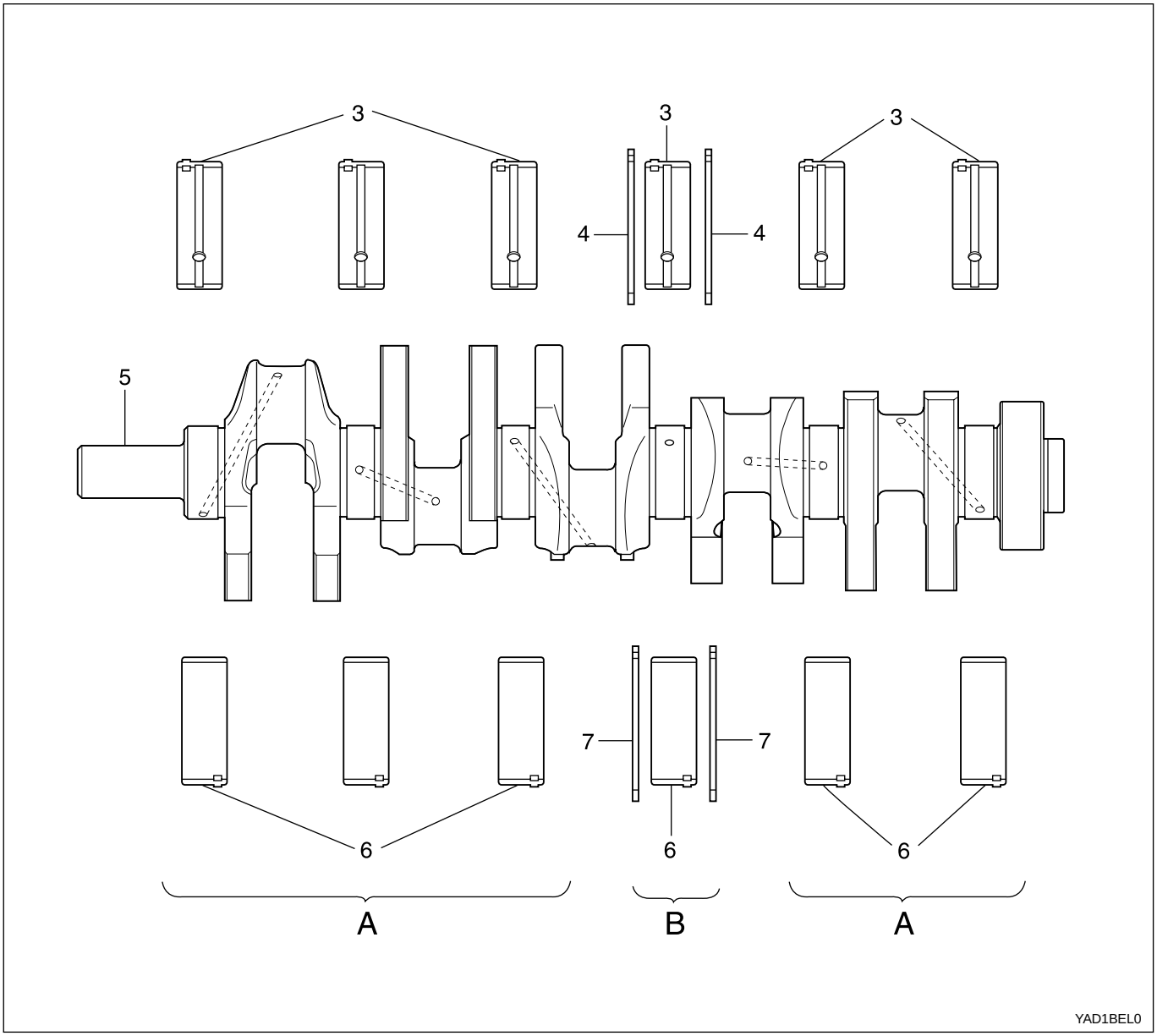
CRANKSHAFT

Preceding Work: Removal of the end cover
Removal of the piston
Removal of the crankshaft sprocket



3 Crankshaft Main Bearing Shells (Upper)
4 Trust Bearings (Upper)
5 Crankshaft
6 Crankshaft Main Bearing Shells (Lower)
7 Thrust Bearings (Lower)
8 Crankshaft Bearing Cap
9 Crankshaft Bearing Cap (Fit Bearing)
10 12-sided Stretch Bolts .... 55 N•m (41 lb-ft)+ 90°

Thrust Washer and Bearing Arrangement



3 Crankshaft Main Bearing Shells (Upper)
4 Thrust Bearings (Upper)
5 Crankshaft
6 Crankshaft Main Bearing Shells (Lower)
7 Thrust Bearings (Lower)

A Radial Bearings
B Radial and Axial Bearings (Thrust Bearing)

Notice: The gaps between the bearing shell and bore and between the bearing shell and journal are different each other. Refer to service data.

Crankshaft Standard and Repair Sizes

	Crankshaft bearing journal diameter	Thrust bearing journal width	Thrust bearing journal diameter
Standard size	50.950 - 57.965	24.500 - 24.533	47.950 - 47.965
		24.600 - 24.633	
Repair size 1	57.500 - 57.715	24.700 - 24.733	47.700 - 47.715
Repair size 2	57.450 - 57.465	24.900 - 24.933	47.450 - 47.650
Repair size 3	57.200 - 57.215	25.000 - 25.033	47.200 - 47.215
Repair size 4	56.950 - 56.965	-	46.950 - 46.965

Bearing Clearances

		Crankshaft bearing	Thrust bearing
Radial clearances	New	0.027 - 0.051 mm	0.026 - 0.068 mm
	Limit	Max. 0.070 mm	Max. 0.080 mm
Axial clearances	New	0.100 - 0.254 mm	-
	Limit	Max. 0.300 mm	-

Matching Fit Bearing Journal Width to Thrust Bearings

Fit bearing journal width	Thrust bearings thickness
24.500 - 24.533 mm	2.15 mm
24.600 - 24.633 mm	2.20 mm
24.700 - 24.733 mm	2.25 mm
24.900 - 24.933 mm	2.35 mm
25.000 - 25.033 mm	2.40 mm

Notice:

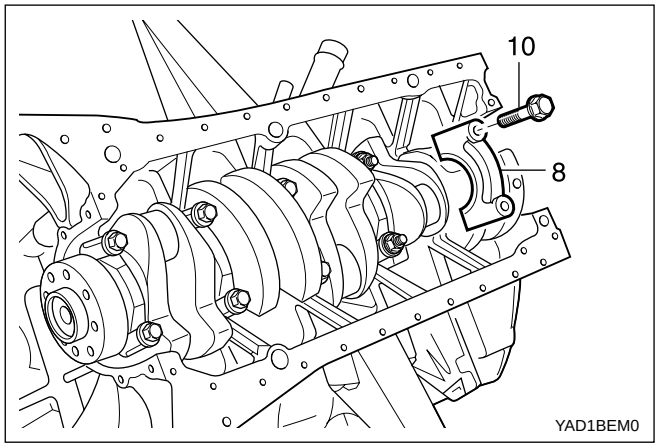
- Measure crankshaft axial clearance and adjust with proper thrust Bearing.
- The same thickness of washer must be installed on both sides of the fit bearing.

Matching Crankshaft Bearing Shells to Basic Bearing Bore in Crankshaft

Marking of basic bearing bore in lower parting surface	Color code of relevant crankshaft bearing shell
1 punch mark or blue	Blue or white-blue
2 punch marks or yellow	Yellow or white-yellow
3 punch marks or red	Red or white-red

Matching Crankshaft Bearing Shells to Basic Bearing Journal of Crankshaft

Marking of bearing journals on crank webs	Color code of relevant crankshaft bearing shell
Blue or white-blue	Blue or white-blue
Yellow or white-blue	Yellow or white-yellow
Red or white-blue	Red or white-red



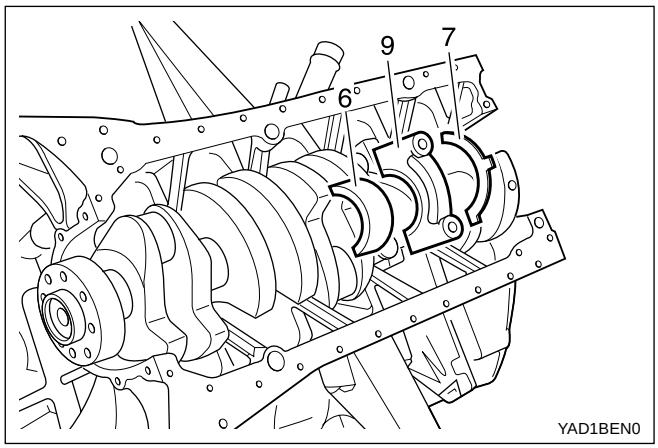
Tools required

001 589 53 21 00 Dial Gauge
363 589 02 21 00 Dial Gauge Holder
366 589 00 21 05 Extension

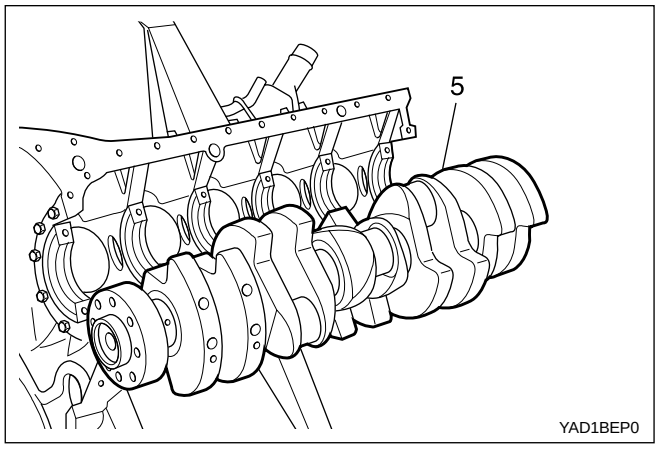
Removal & Installation Procedure

1. Remove the bearing cab bolt.
2. Remove the bearing caps (8).

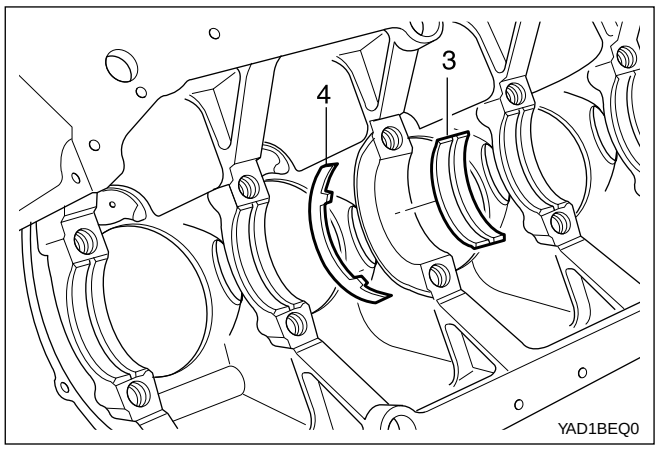
   Notice: The crankshaft bearing caps are marked with stamped numbers. Remove the bearing cap from the vibration damper side.



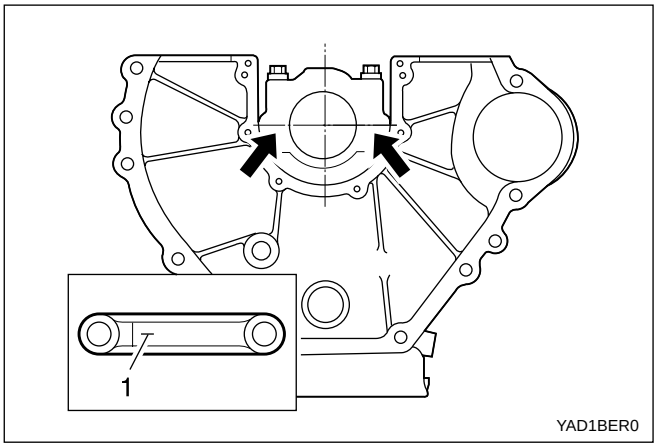
3. Remove the crankshaft bearing caps (9) and lower thrust bearings (7).
4. Remove the lower bearing shell (6) from the bearing cap (9).



5. Remove the crankshaft (5).



6. Remove the upper thrust bearings (4).
7. Remove the upper bearing shells (3) from crankcase.



8. Thoroughly clean the oil gallery.
9. Select a proper new bearing shells with reference to table.
10. Coat the new bearing shells with oil and insert into the crankcase and into the crankshaft bearing caps.

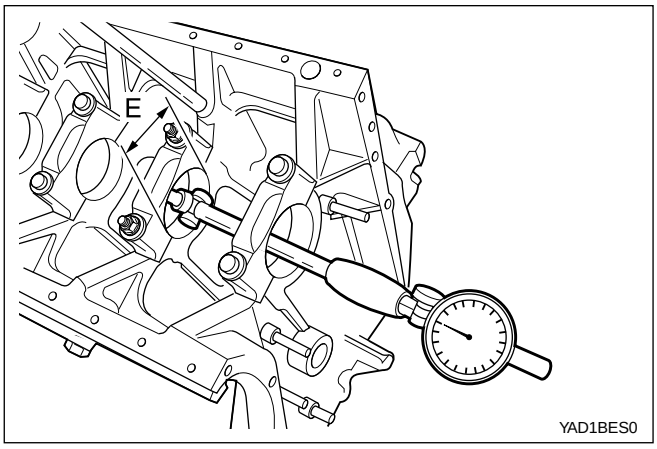
    Notice: Do not mix up upper and lower crankshaft bearing shells.

11. Install the bearing caps according to marking and tighten the 12-sided stretch bolts.

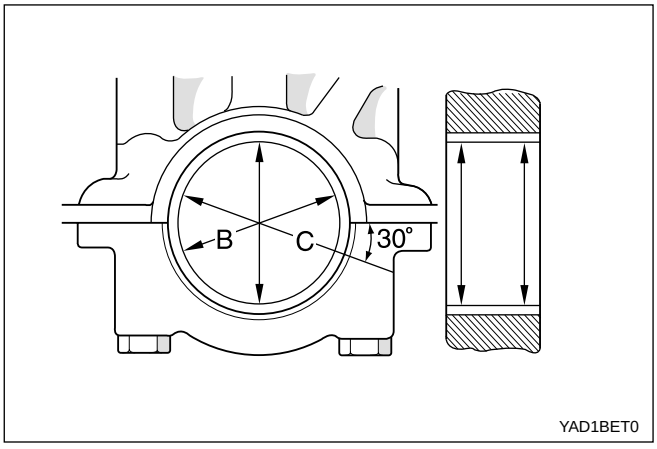
    Installation Notice

Tightening Torque	55 N•m (41 lb-ft)+ 90°

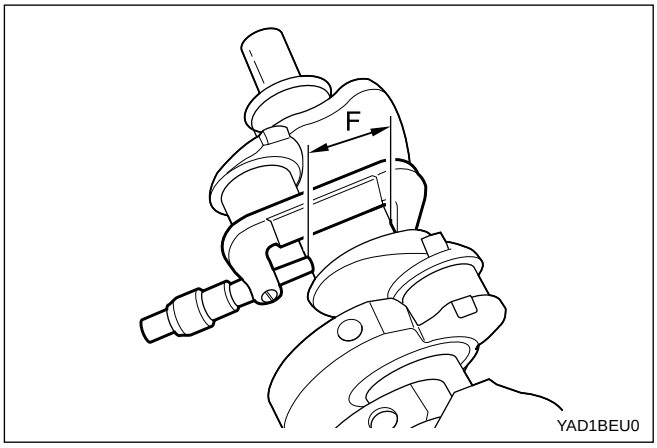
    No. 1 is vibration damper side.



12. Measure crankshaft bearing diameters (E) using the dial gauge 001 589 53 21 00 and extension 366 589 00 21 05.

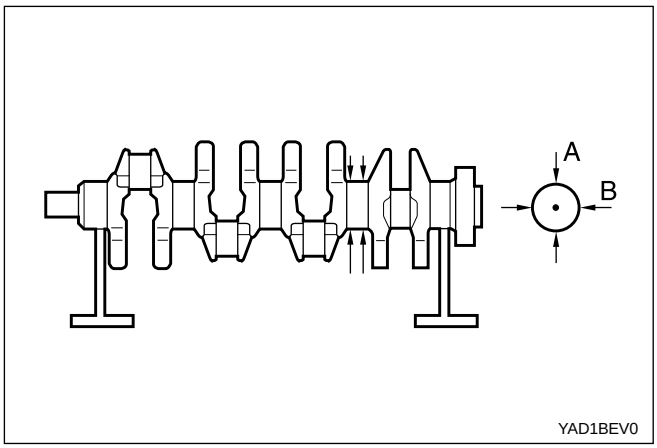


13. Measure at 3 points (A, B and C) and if the average value of B and C is less than A's value, the average value of B and C is the mean value and if more than A's value, A's value is the mean value.



14. Measure crankshaft bearing journal diameter (F).

    Notice: When measured in A and B, the runout should not exceed 0.010 mm.

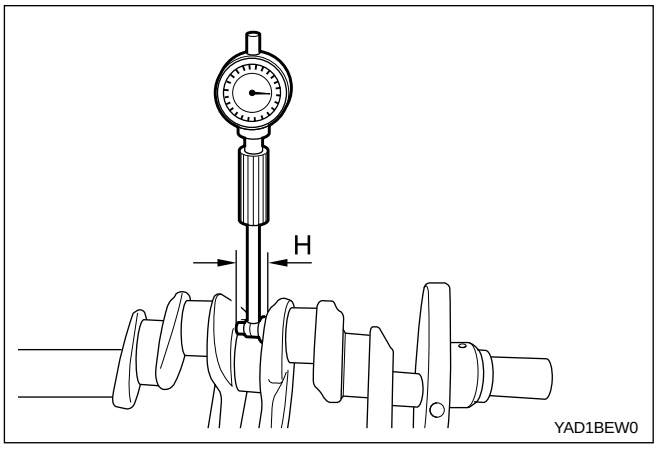


15. Measure radial clearance of crankshaft bearing (G).

Clearance 'G'	0.027 - 0.051 mm

    Notice: If 'G' is out of standard, replace the bearing shells and adjust the radial clearance of crankshaft bearing.

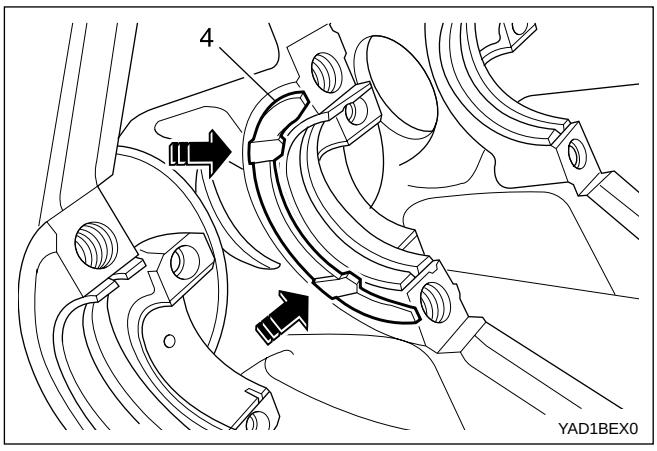
    Example) Measured value 'E' = 57.700 mm
    Measured value 'F' = 57.659 mm
    Clearance 'G' = 0.041 mm



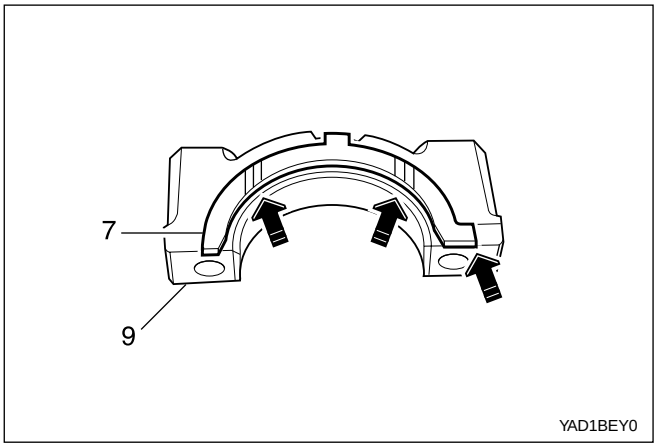
16. Remove the crankshaft bearing cap.

17. Measure width of thrust bearing journal (H) and adjust with proper thrust bearings (see table).

    Notice: The same thickness of thrust washers should be installed on both sides of the thrust bearing.

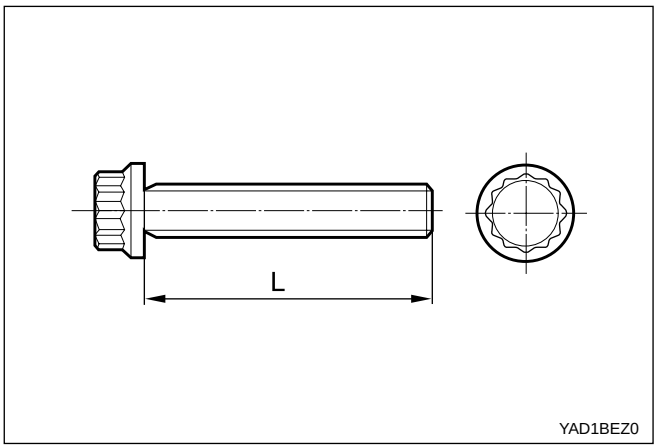


18. Coat the upper thrust bearing (4) with oil and insert into the crankcase so that the oil grooves are facing the crank webs (arrow).

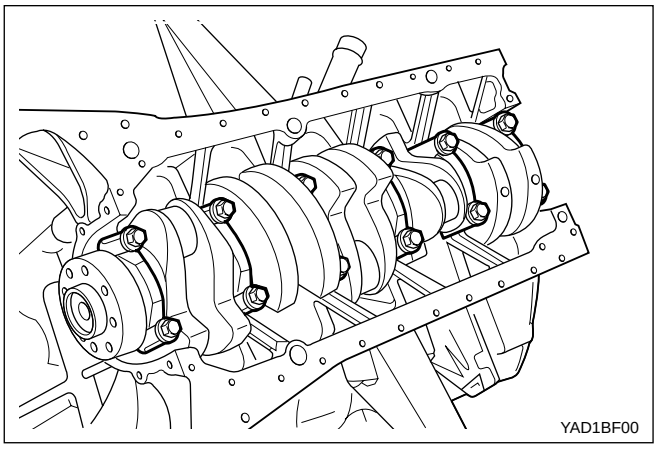


19. Coat the lower thrust bearing (7) with oil and insert into the crankshaft bearing cap so that the oil grooves are facing the crank webs (arrow).

    Notice: The retaining lugs should be positioned in the grooves (arrow).



Notice: If the max. length of bolts (L) exceed 63.8 mm, replace them.

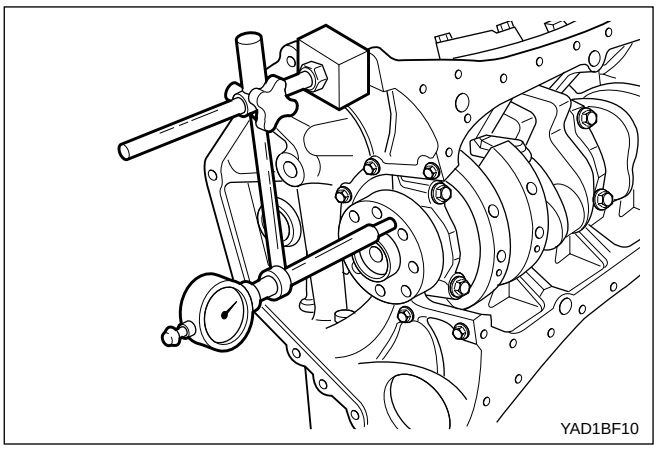


20. Coat the new crankshaft with engine oil and place it on the crankcase.
21. Install the crankshaft bearing caps according to marking and tighten the bolts.

    Installation Notice

Tightening Torque	55 N•m (41 lb-ft)+ 90°

    Install from No. 1 cap.

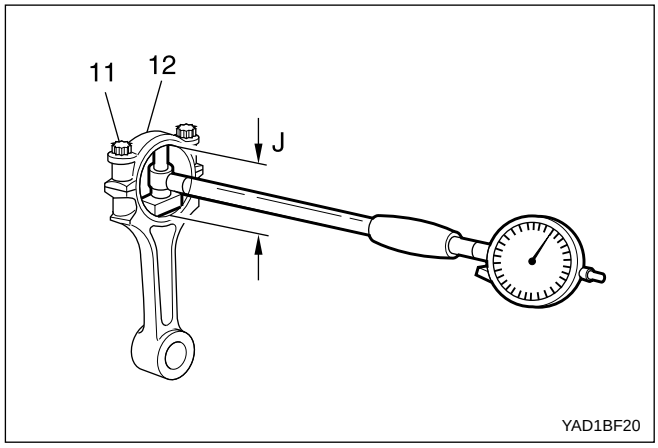


22. Rotate the crankshaft with hand and check whether it rotates smoothly.
23. Measure crankshaft bearing axial clearance using dial gauge 001 589 53 21 00 and dial gauge holder 363 589 02 21 00.

Clearance	0.100 - 0.245 mm

    Notice: If the clearance is out of standard, adjust the axial clearance of crankshaft bearing by replacing the thrust washers.

    Notice: The same thickness of thrust washers should be installed on both sides of the thrust bearing.

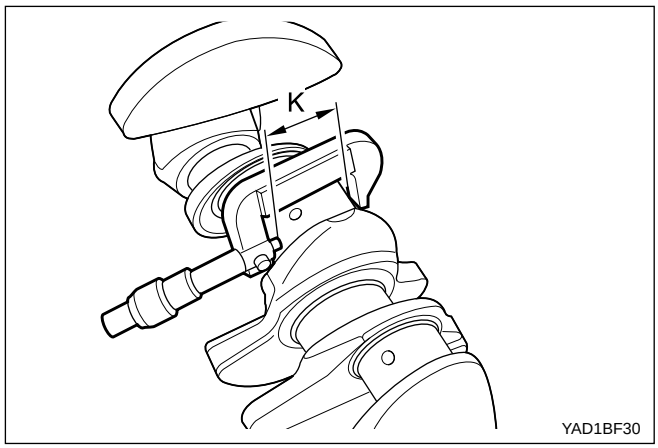


24. Insert the new connecting rod bearing shells into the connecting rod and connecting rod bearing cap and tighten the 12-sided stretch bolts (11).

Installation Notice

Tightening Torque	35 N•m (26 lb-ft)+ 90°

25. Measure inner diameter of connecting rod bearing.



26. Measure connecting rod bearing journal diameter (K).

Notice: Refer to measurement of the crankshaft bearing journal diameter.

27. Measure the radial clearance (L) of the connecting rod bearing.

Example) Measured value 'J' = 47.700 mm
Measured value 'K' = 47.653 mm
Clearance 'L' = 0.047 mm

Radial Clearance 'L'	0.026 - 0.068 mm

Notice: If the clearance is out of standard, adjust the radial clearance of connecting rod bearing by replacing the connecting rod bearing shells.

28. Remove the connecting rod bearing cap.
29. Install the piston.
30. Rotate the crankshaft by hand and check whether it rotates smoothly.
31. If the bearings are damaged,
    - replace the oil presser relief valve.
    - clean the oil pump and oil filter housing carefully and replace the hose if necessary.

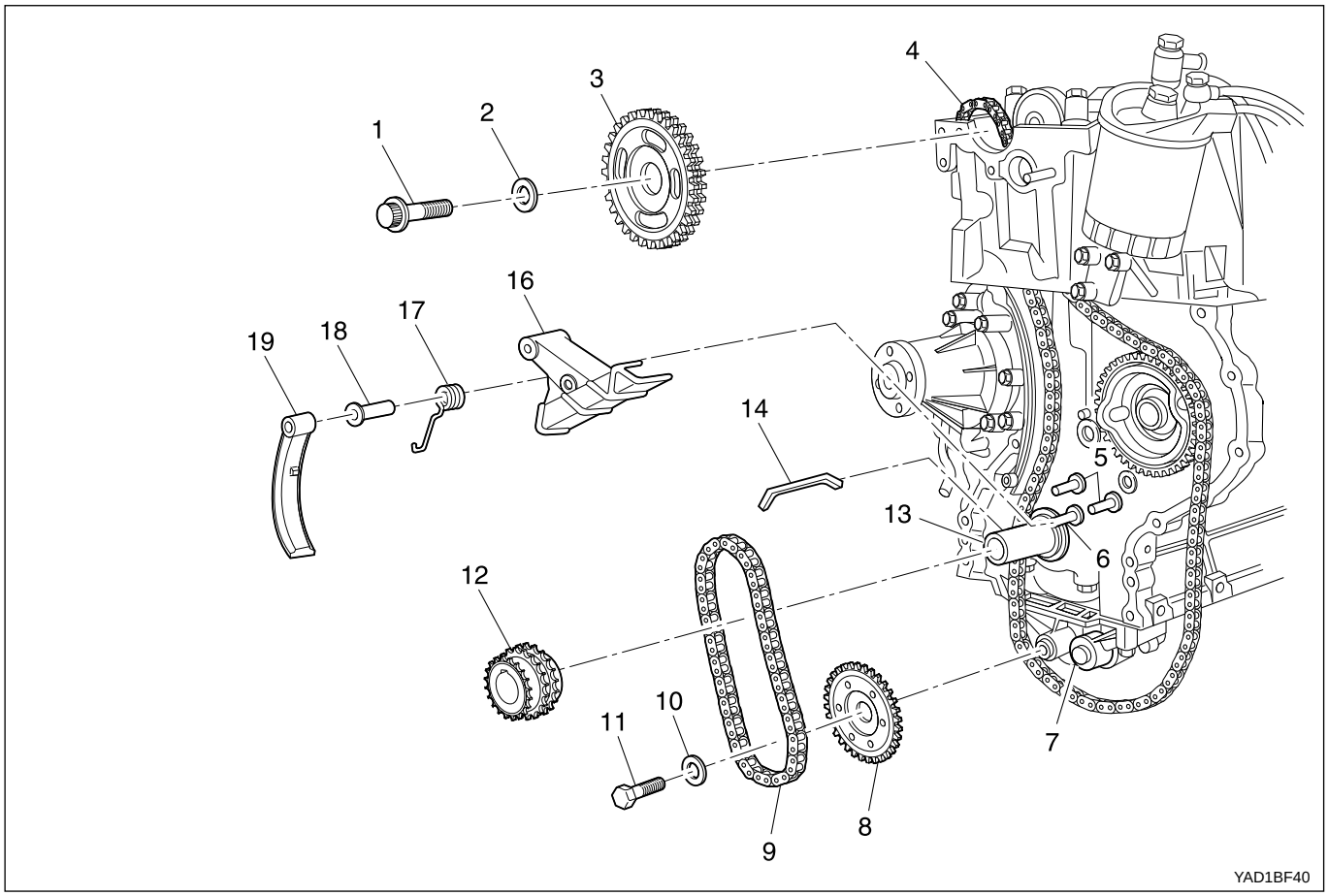
Notice: After assembling the engine, check the camshaft timing, adjust the start of fuel injection and check the TDC sensor bracket setting.

32. Fill oil and run the engine and then check the oil pressure and oil level.

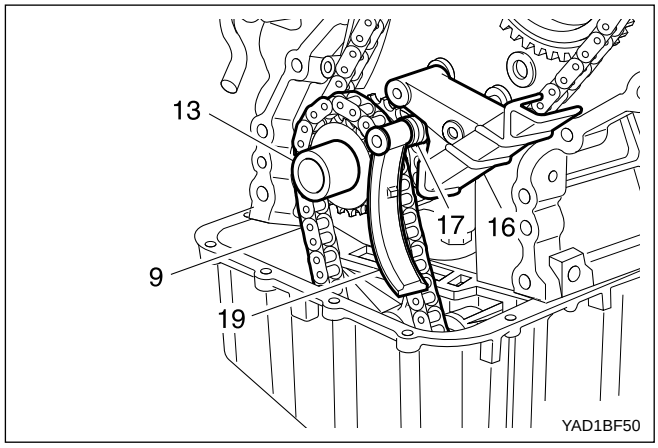
Notice: Install the original oil filter element and then change the engine oil and oil filter element after 1,000 - 1,500 km.

CRANKSHAFT SPROCKET

Preceding Work: Removal of oil pan
Removal of timing case cover



1 12-Sided Stretch Bolt (M11) ..... Check, 25 N•m (18 lb-ft)+ 90°
2 Washer
3 Camshaft Sprocket
4 Timing Chain
5 Bearing Pin
6 Bearing Pin
7 Oil Pump
8 Oil Pump Sprocket
9 Oil Pump Chain
10 Washer
11 Bolt ..... 25 N•m (18 lb-ft)
12 Crankshaft Sprocket
13 Crankshaft
14 Key
16 Guide Rail
17 Spring
18 Bushing
19 Tensioning Lever



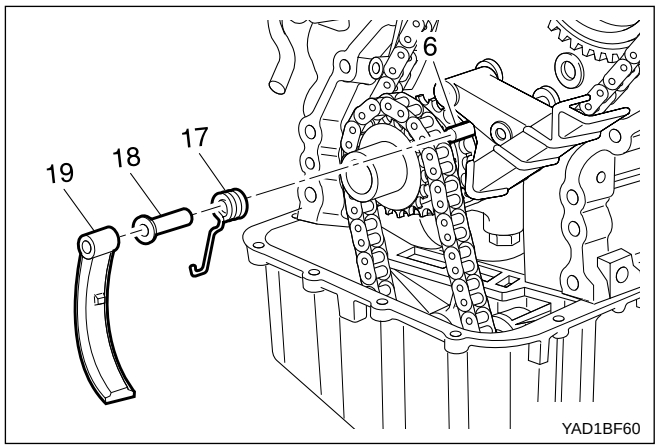
Special Tools

102 589 05 33 00 Puller

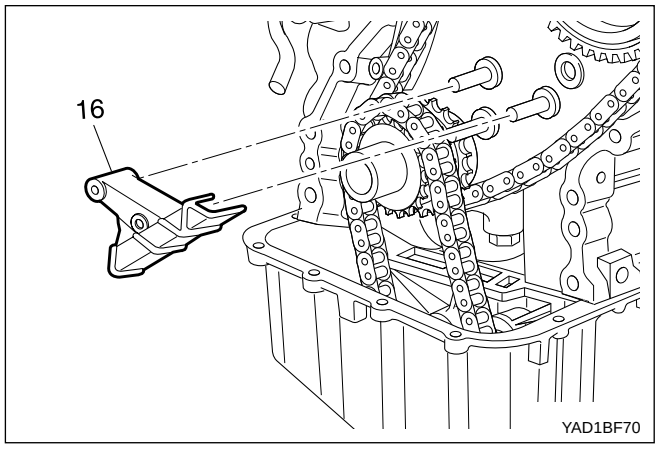
116 589 07 15 00 Drift

Removal Procedure

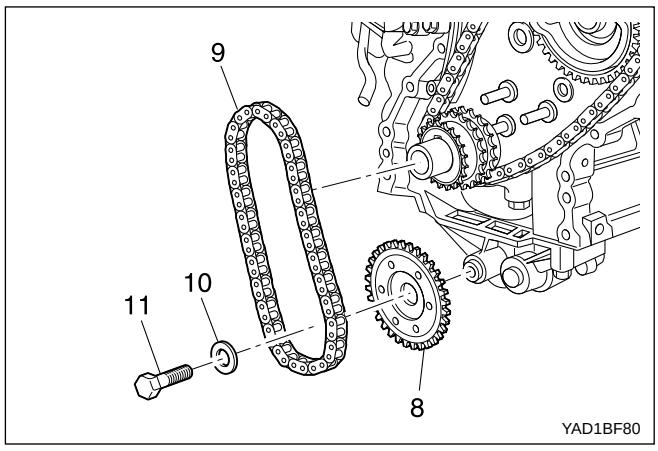
1. Pull out the tensioning lever (19) together with the spring (17) and guide rail (16) far enough until the tensioning lever has passed the oil pump chain (9) and is resting against the crankshaft (13).



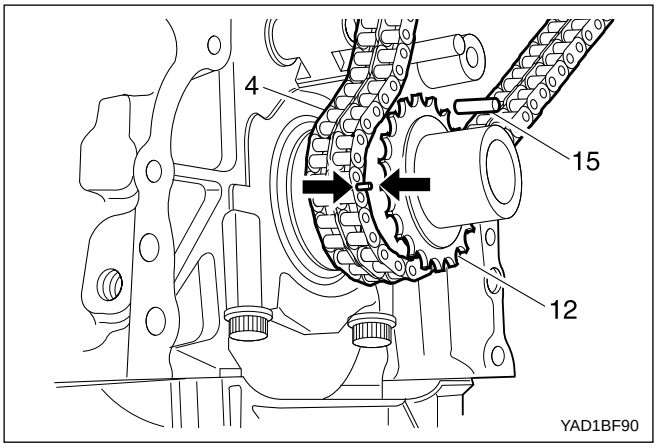
2. Pull out tensioning lever (19), spring (17) and bushing (18) from the bearing pin (6).



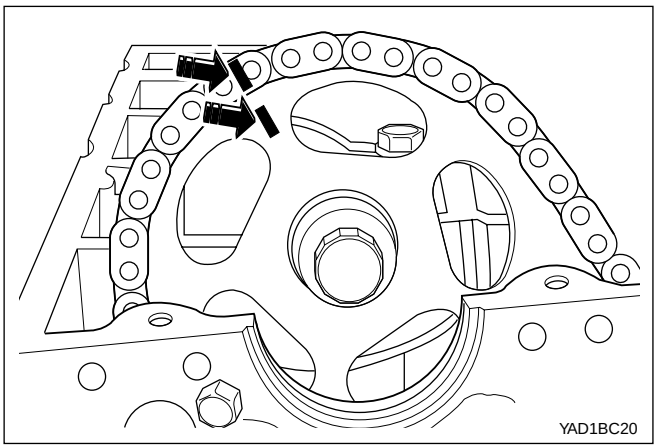
3. Pull out the guide rail (16).



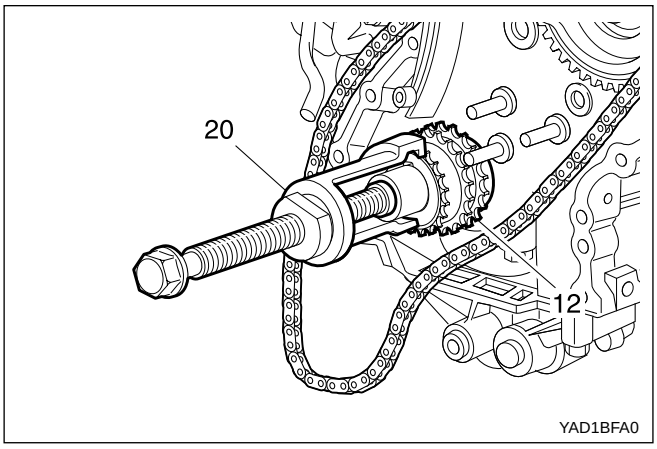
4. Remove the bolt(11) and then remove the washer (10), oil pump chain (9) and sprocket (8).



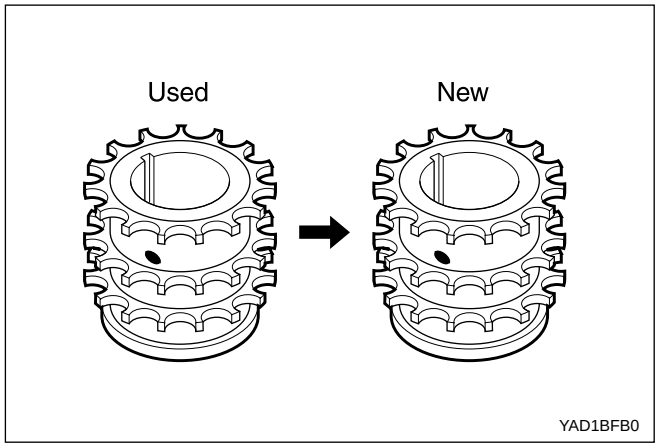
5. Place alignment marks (arrow) on the timing chain (4) and crankshaft sprocket (12).
6. Remove the woodruff key (15).



7. Place alignment marks (arrow) on the timing chain (4) and camshaft sprocket (3).
8. Remove the chain tensioner.
9. Remove the bolt (1) and then remove the washer (2) and camshaft sprocket (3).



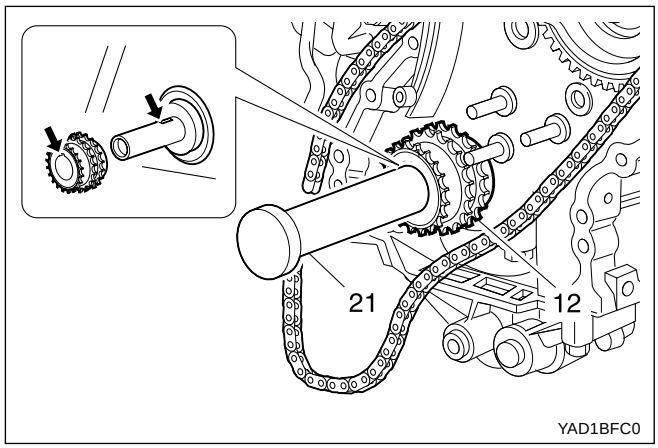
10. Remove the crankshaft sprocket (12) by using a puller 102 589 05 33 00 (20).



Installation Procedure

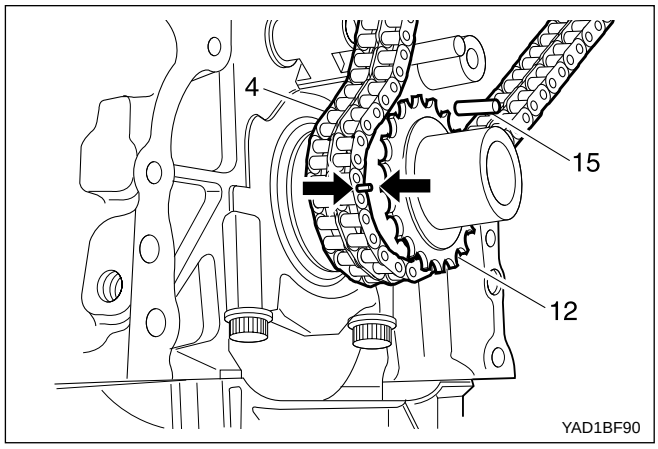
1. Put the same alignment mark on the new crankshaft sprocket as in the old sprocket.

   Notice: Check the timing chain, camshaft sprocket, injection pump timing sprocket, oil pump chain and oil pump sprocket for wear and replace if necessary.



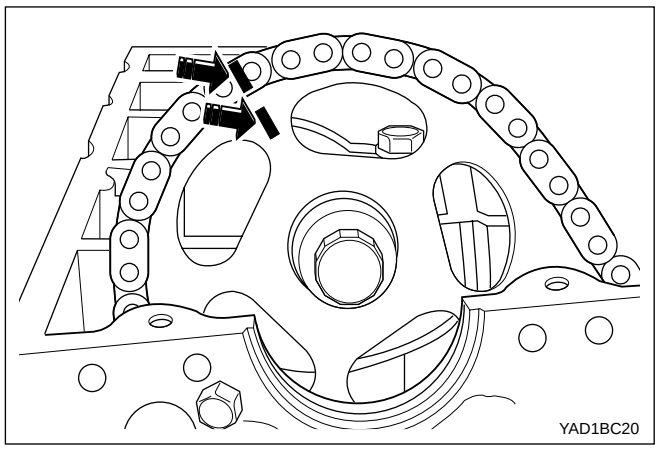
2. Install the new crankshaft sprocket (12) by using a drift 116 589 07 15 00 (21).

   Notice: Align the groove of sprocket and woodruff key (arrow) exactly.



3. Fit the timing chain (4) on the crankshaft sprocket (12).

   Notice: Align the alignment marks (arrow) on the chain and sprocket.

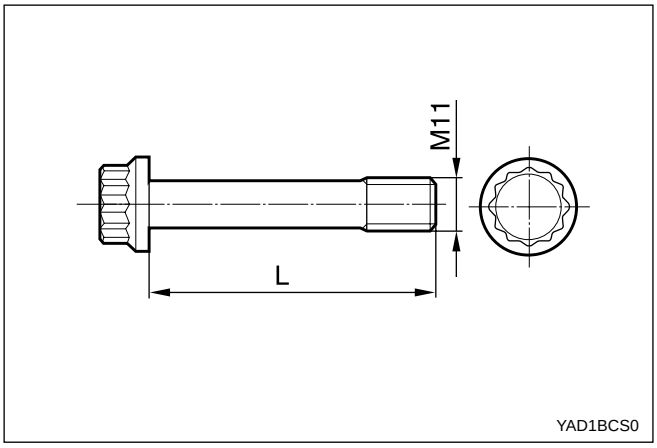


4. Install the camshaft sprocket (3).

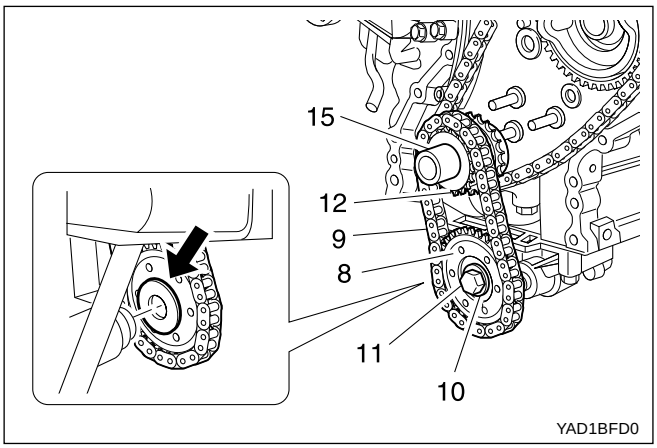
   Installation Notice

Tightening Torque	25 N•m (18 lb-ft)+ 90°

   Pay attention on the alignment marks and dowel pin (arrow).



Notice: If the max. length 'L' of the stretch bolt exceeds 53.6 mm, replace it.



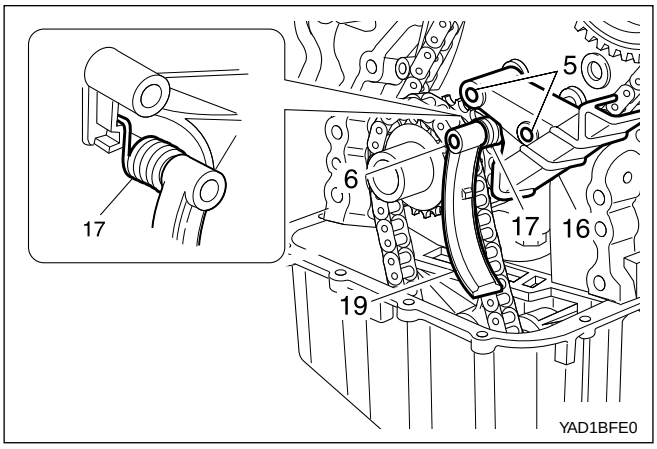
5. Fit the oil pump chain (9) on the crankshaft sprocket (12) and insert the oil pump sprocket (8) into the oil pump chain and then install it on the oil pump.

   Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

   The curved side of the oil pump sprocket should face the oil pump.

6. Insert the woodruff key (15).

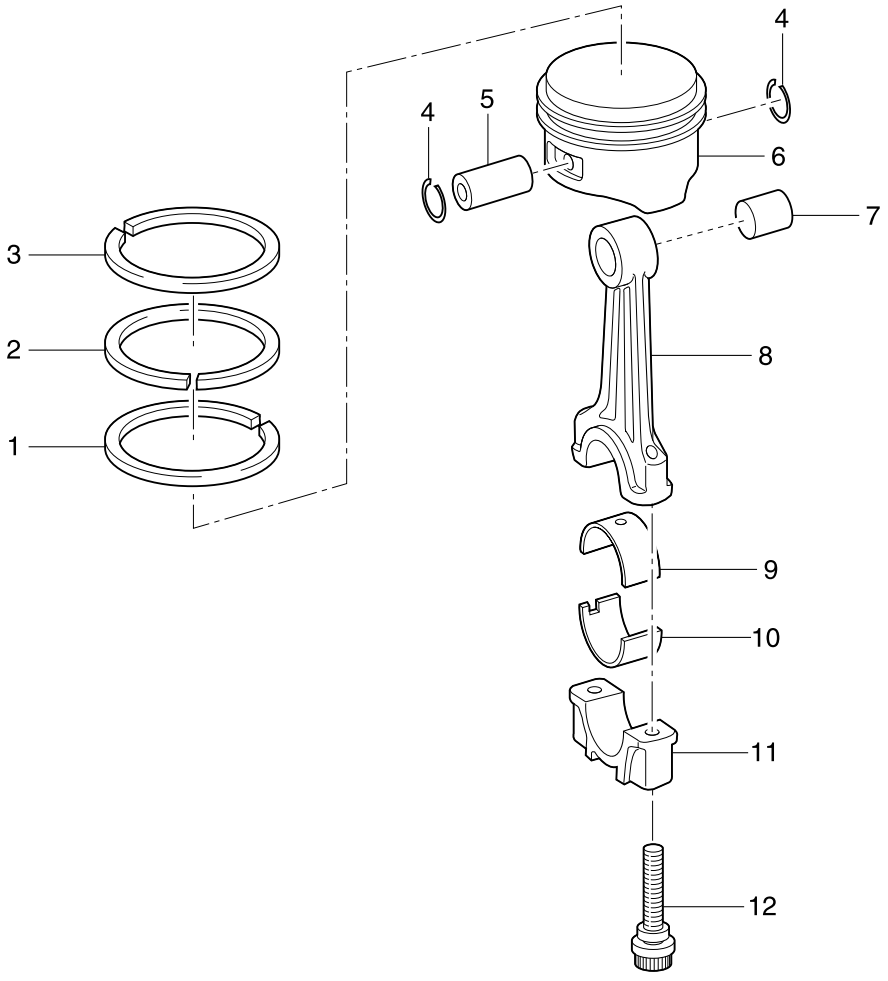


7. Install the guide rail (16). Attach the spring (17) to guide rail and to tensioning lever together onto the bearing pins (5, 6).

   Notice: Ensure that the spring is correctly located in the guide rail (arrow).

PISTON

Preceding Work: Removal of the cylinder head
Removal of the oil pump



1 Oil Ring
2 2nd Ring
3 Top Ring
4 Snap Ring ..... Replace
5 Piston Pin
6 Piston
7 Connecting Rod Bushing ..... Check
8 Connecting Rod
9 Connecting Rod Upper Bearing Shell
10 Connecting Rod Lower Bearing Shell
11 Connecting Rod Bearing Cap
12 Connecting Rod Bolt ..... 35 N•m (26 lb-ft)+ 90°

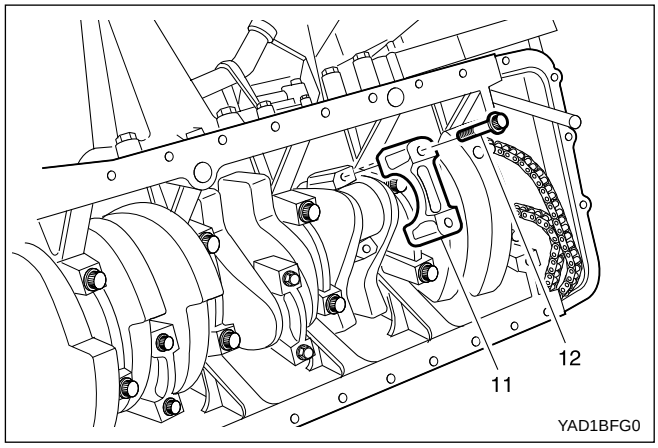
Notice: There are two kinds of connecting rods (for machining) and they are different in weight approx. 15g. When replacing the connecting rod, measure its weight and ensure that a engine has the same weight of connecting rods. If not, there would be a unbalancing of engine.

Service Data

Piston clearance	Max. 0.12 mm
Piston crown protrusion in TDC position	0.735 - 0.965 mm
Connecting rod bushing diameter	26.012 - 26.018 mm

Connecting Rod Bolt Dimensions

Thread	M9 x 1
Stretch shaft (C) diameter (new)	7.4 mm
Minimum stretch shaft diameter (C)	7.1 mm
Length (L) (new)	52 mm

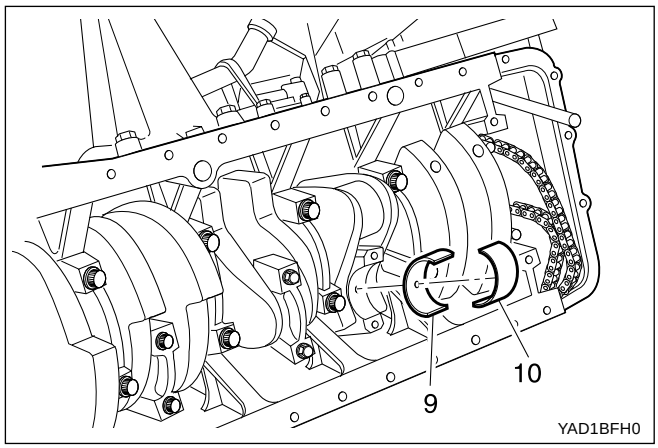


Tools Required

000 589 04 14 00 Tensoning Strap
001 589 53 21 00 Dial Gauge
363 589 02 21 00 Dial Gauge Holder

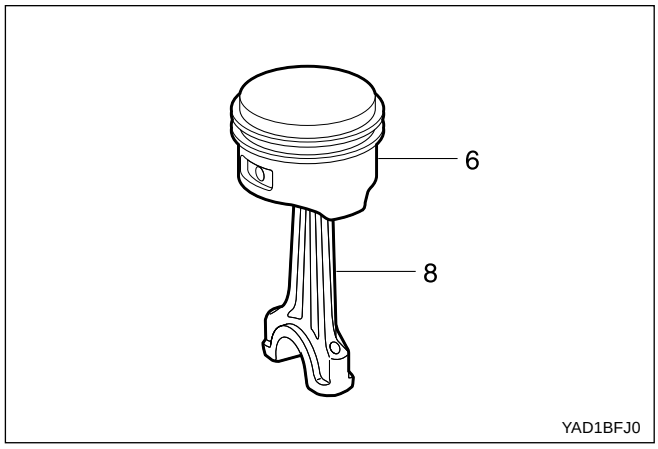
Removal Procedure

1. Remove combustion residues from the cylinder bores.
2. Remove the connecting rod bolts (12) and then remove the connecting rod bearing caps (11).

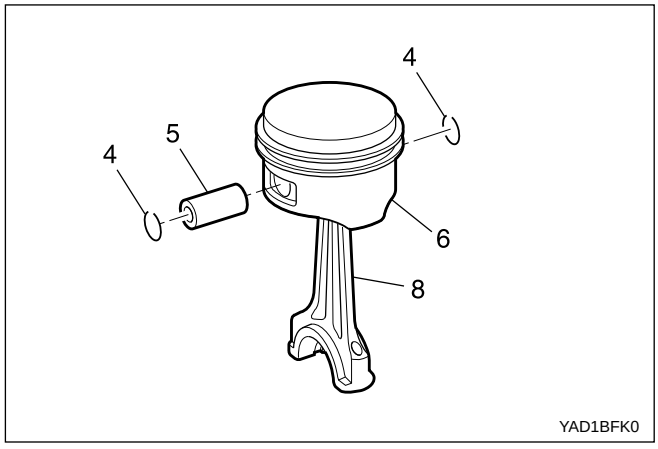


3. Remove the connecting rod bearing shells (9, 10).

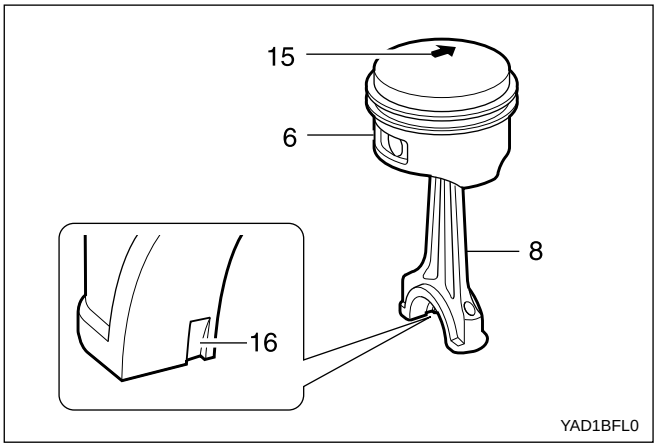
   Notice: Be careful not mix the bearing caps and shells each other.



4. Remove the piston (6) and connecting rod (8).

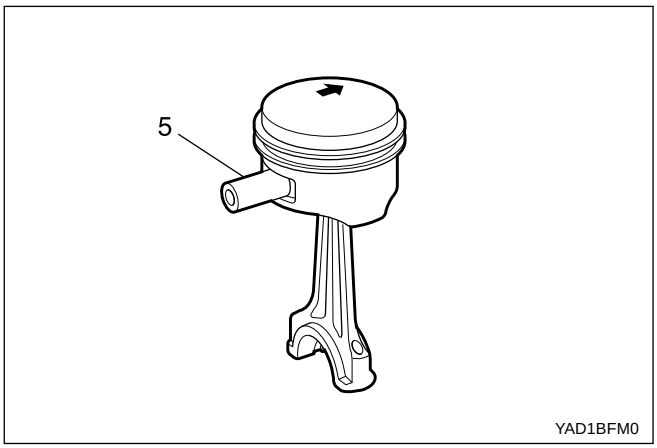


5. Remove the snap ring (4) and pull out the piston pin (5).
6. Separate the piston and connecting rod.



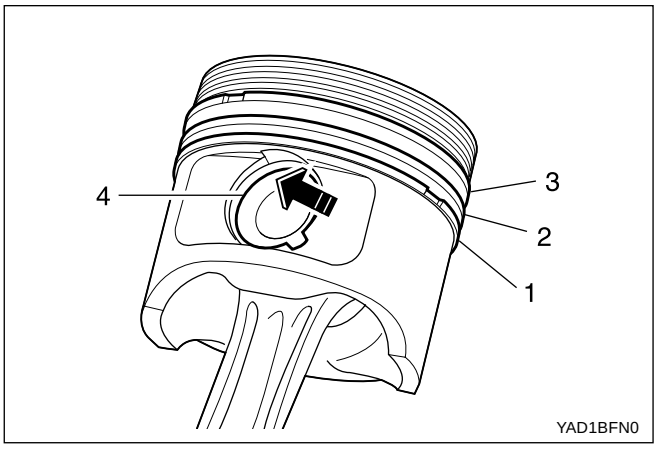
Installation Procedure

1. Fit the piston onto the connecting rod so that the arrow (15) and the locking slot (16) are facing in direction of the vehicle.

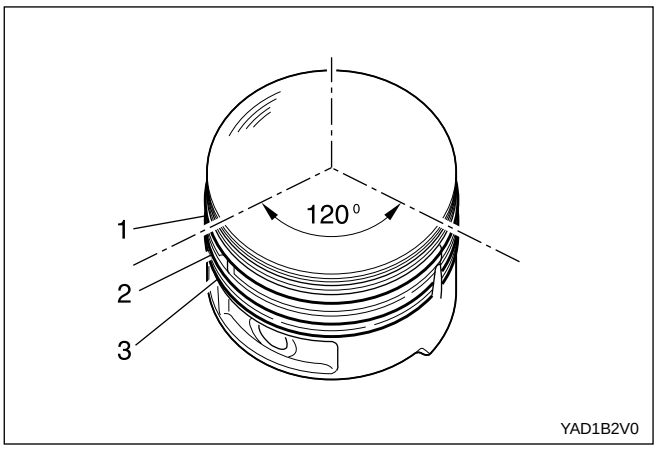


2. Coat the piston pin (15) with engine oil and insert it by hand.

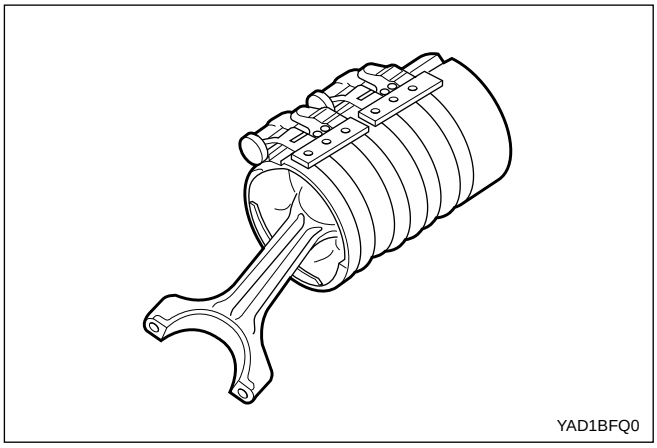
   Notice: Do not heat up the piston.



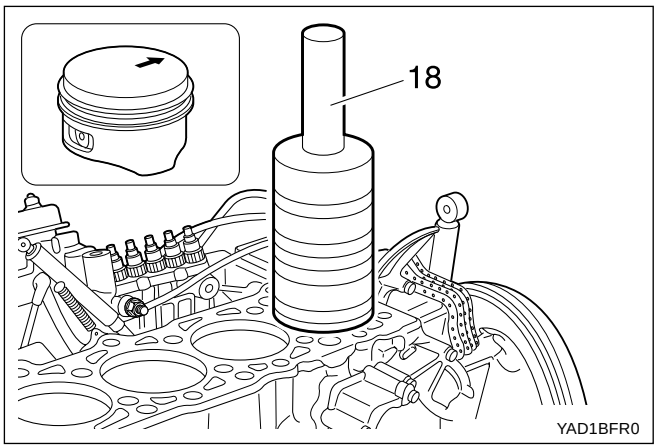
3. Install the new snap ring (4) into the grooves (arrow).
4. Check the piston rings (1, 2, 3) and replace them if necessary.



5. Install and arrange the piston rings to be evenly 120° from each ends gap.


YAD1BFQ0

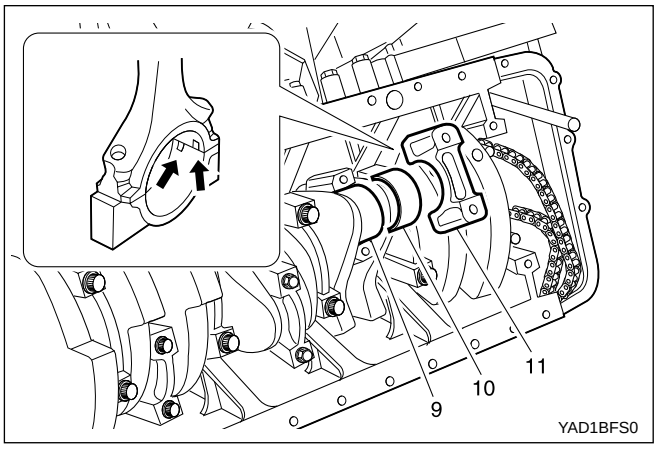
6. Coat the cylinder bore, connecting rod bearing journal, connecting rod bearing shell and piston with oil.
7. Compress the piston rings with a tensioning strap 000 589 04 14 00.



YAD1BFR0

8. Insert the piston assembly into the cylinder with a wooden stick (18).

   Notice: The arrow on the piston crown must point toward the front of vehicle.



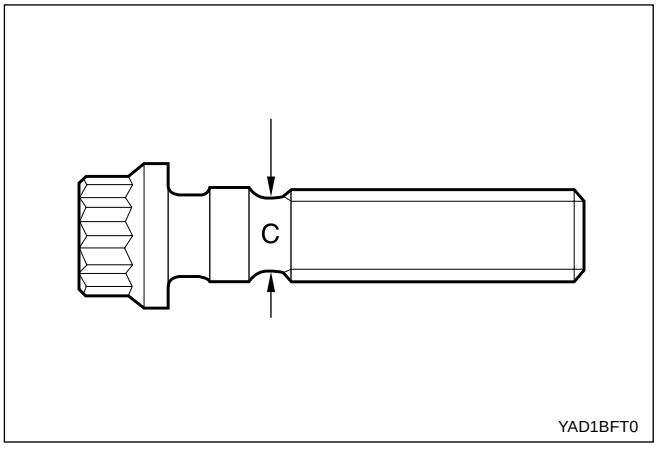
YAD1BFS0

9. Insert the connecting rod bearing shells (9, 10).

   Notice: Be careful of the difference in upper and lower bearing shells and not to be changed.

10. Position the connecting rod bearings caps.

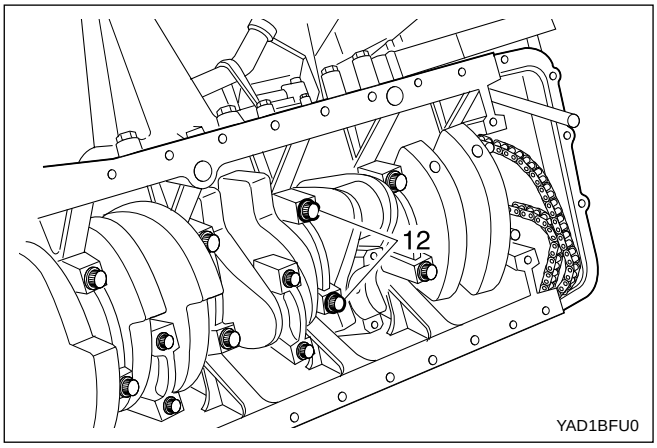
    Notice: Position so that the retaining lugs are on the same side of the connecting rod bearing (arrow).



YAD1BFT0

11. Measure stretch shaft diameter (C) of the connecting rod bolts.

Limit ‘C’	7.1 mm

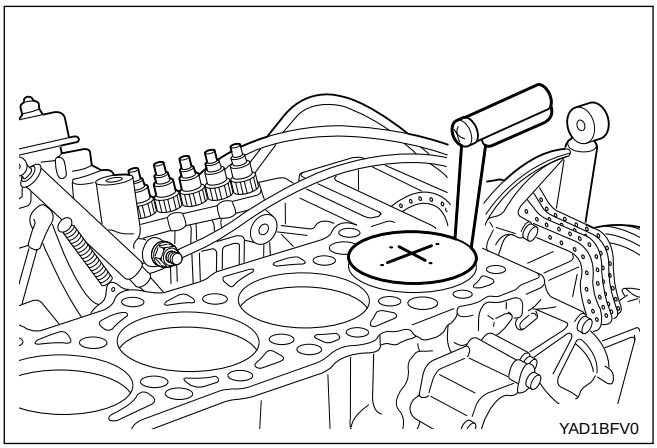


12. Coat the bolts (12) with oil and then tighten the bolts.

Installation Notice

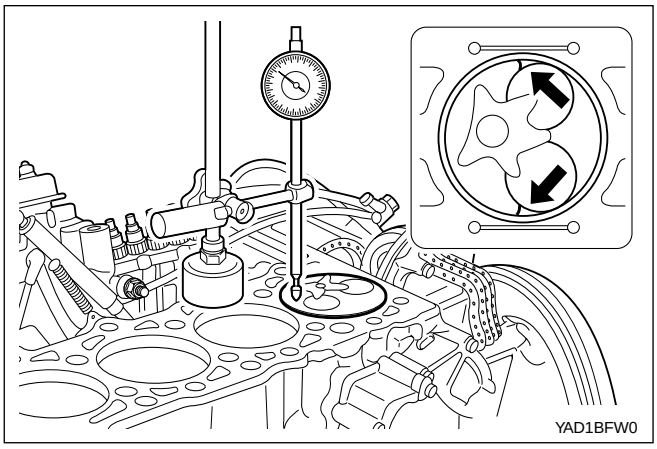
Tightening Torque	35 N•m (26 lb-ft)+ 90°

13. Rotate the crankshaft and check axial clearance between the connecting rod and crankshaft.



14. Measure clearance between the piston crown and cylinder.

Standard	Max. 0.12 mm



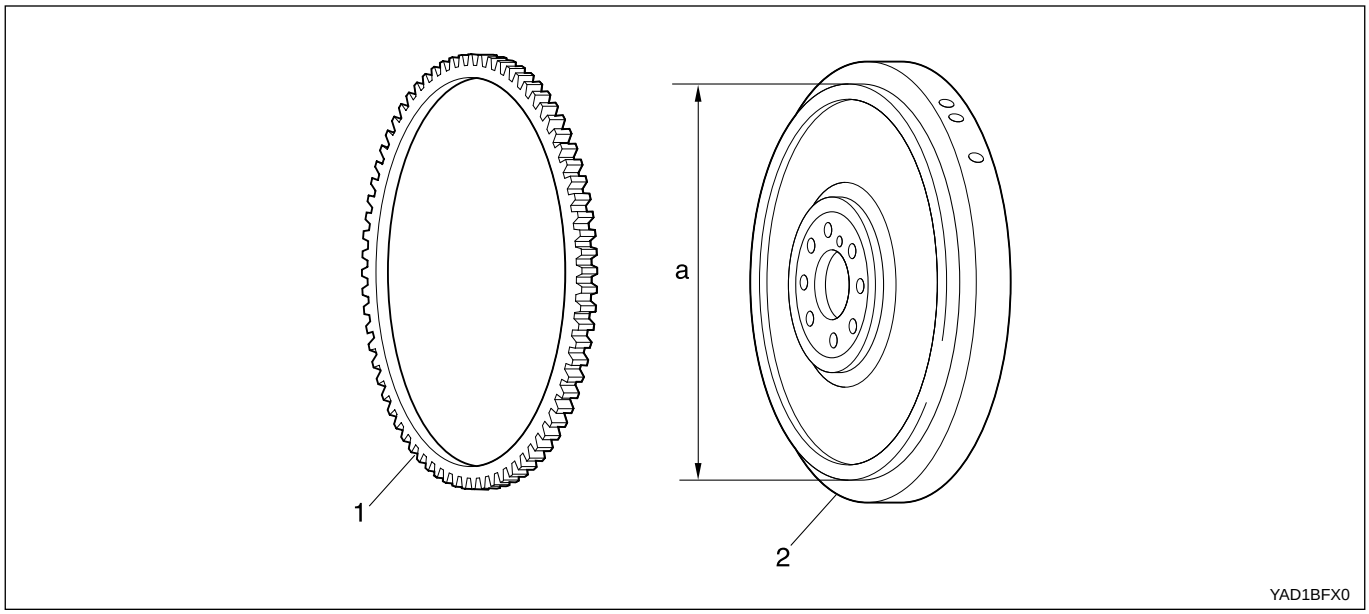
15. Position the piston at TDC and measure the distance between the piston crown and the crankcase surface using dial gauge 001 589 00 53 21 and dial gauge holder 363 589 02 21 00.

Standard	Max. 0.965 mm

Notice: Measure at points marked.

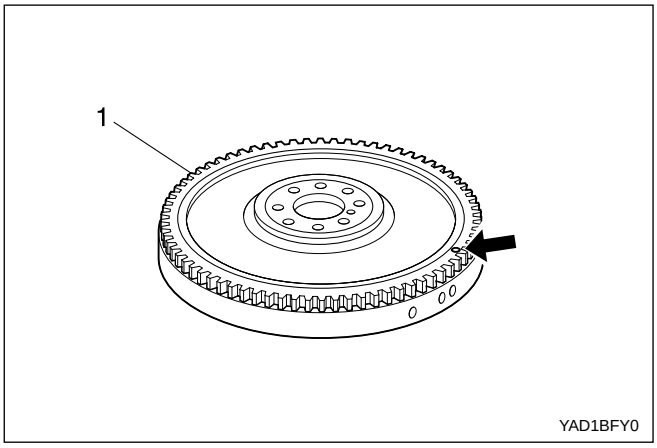
FLYWHEEL RING GEAR

Preceding Work: Removal of flywheel



1 Ring Gear
2 Flywheel

a Centering Collar Diameter



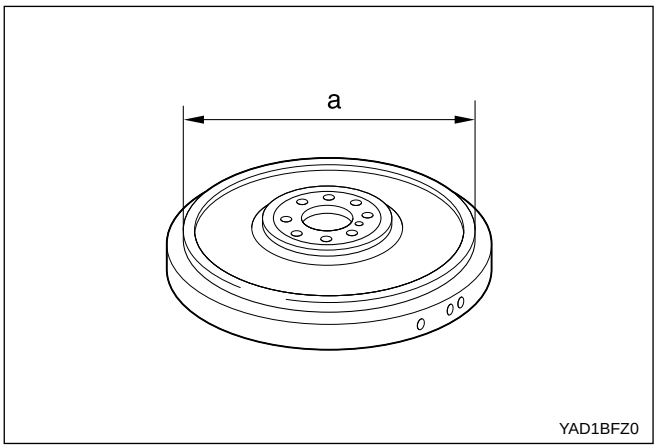
Tools Required

001 589 53 21 00 Dial Gauge

363 589 02 21 00 Dial Gauge Holder

Replacement Procedure

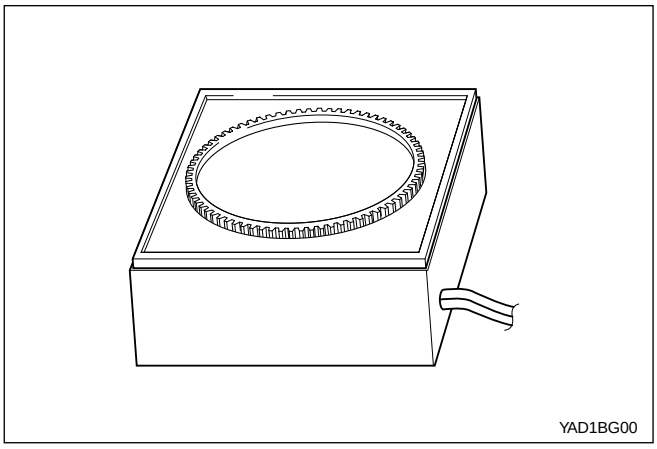
1. Drill a hole into the ring gear (1) (arrow) and snap with a chisel.
2. Thoroughly clean the collar surfaces of ring gear.



3. Measure diameter (a) of centering collar.

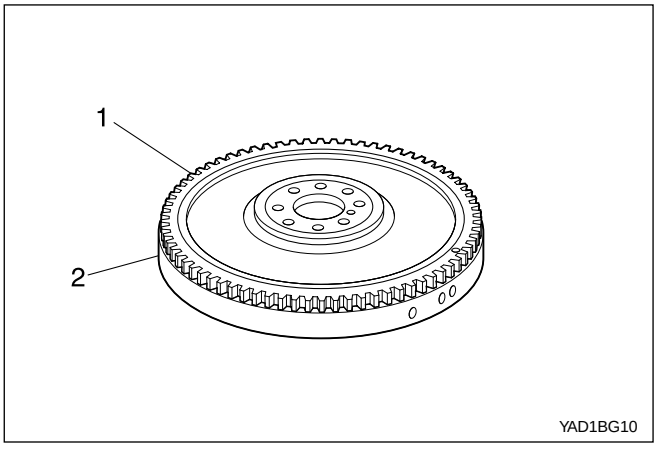
Diameter ‘a’	275 + 0.5 mm

Notice: If out of standard, replace the flywheel.

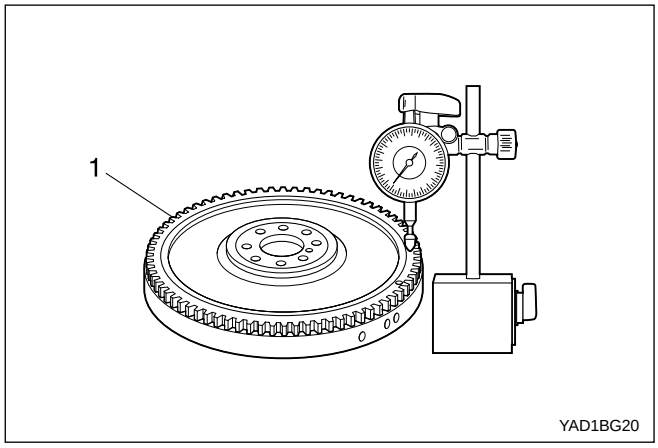


4. Heat up the new ring gear up to 220°C (428°F) by using a heating device.

Notice: Use temperature measuring chalk.



5. Install the new ring gear (1) onto the flywheel (2) by using a drift.



6. Measure axial runout of ring gear (1) on a surface plate using dial gauge 001 589 53 21 00 and dial gauge holder 363 589 02 21 00.

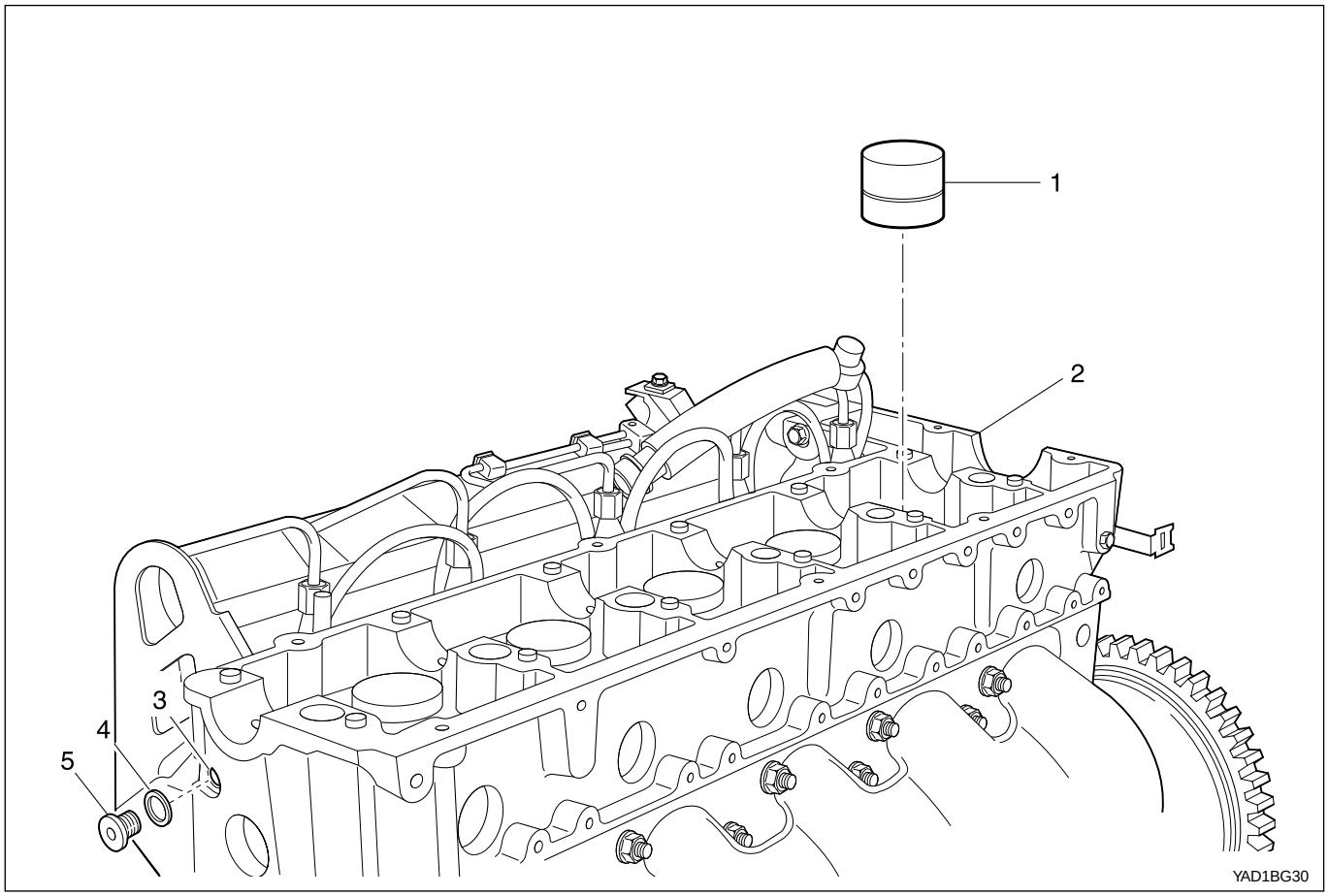
Limit	Max. 0.4 mm

Notice: For correct measurement, put the flywheel on the flat measuring board.

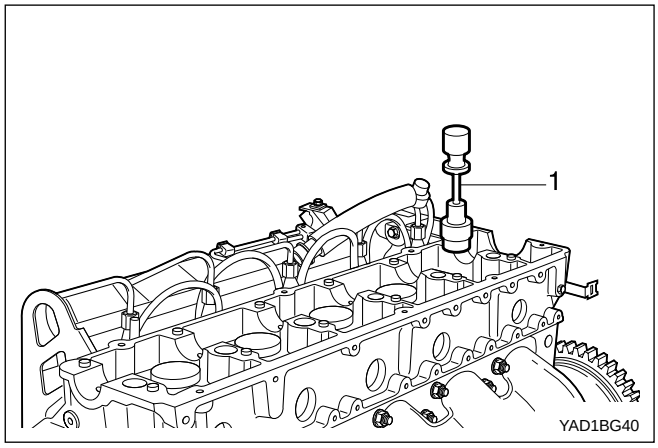
TIMING DEVICE AND VALVE

VALVE TAPPETS

Preceding Work: Removal of camshaft



1 Valve Tappet
2 Cylinder Head
3 Oil Gallery
4 Seal ..... Replace
5 Screw Plug

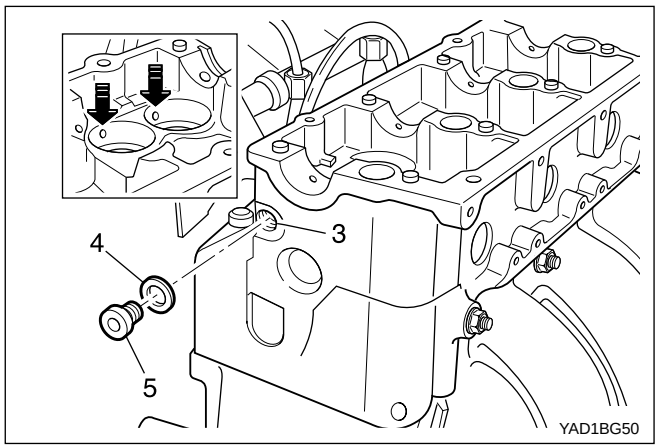


Tools Required

102 589 03 40 00 Magnetic Bar

Replacement Procedure

1. Pull out the valve tappet (1) using magnetic bar 102 589 03 40 00.

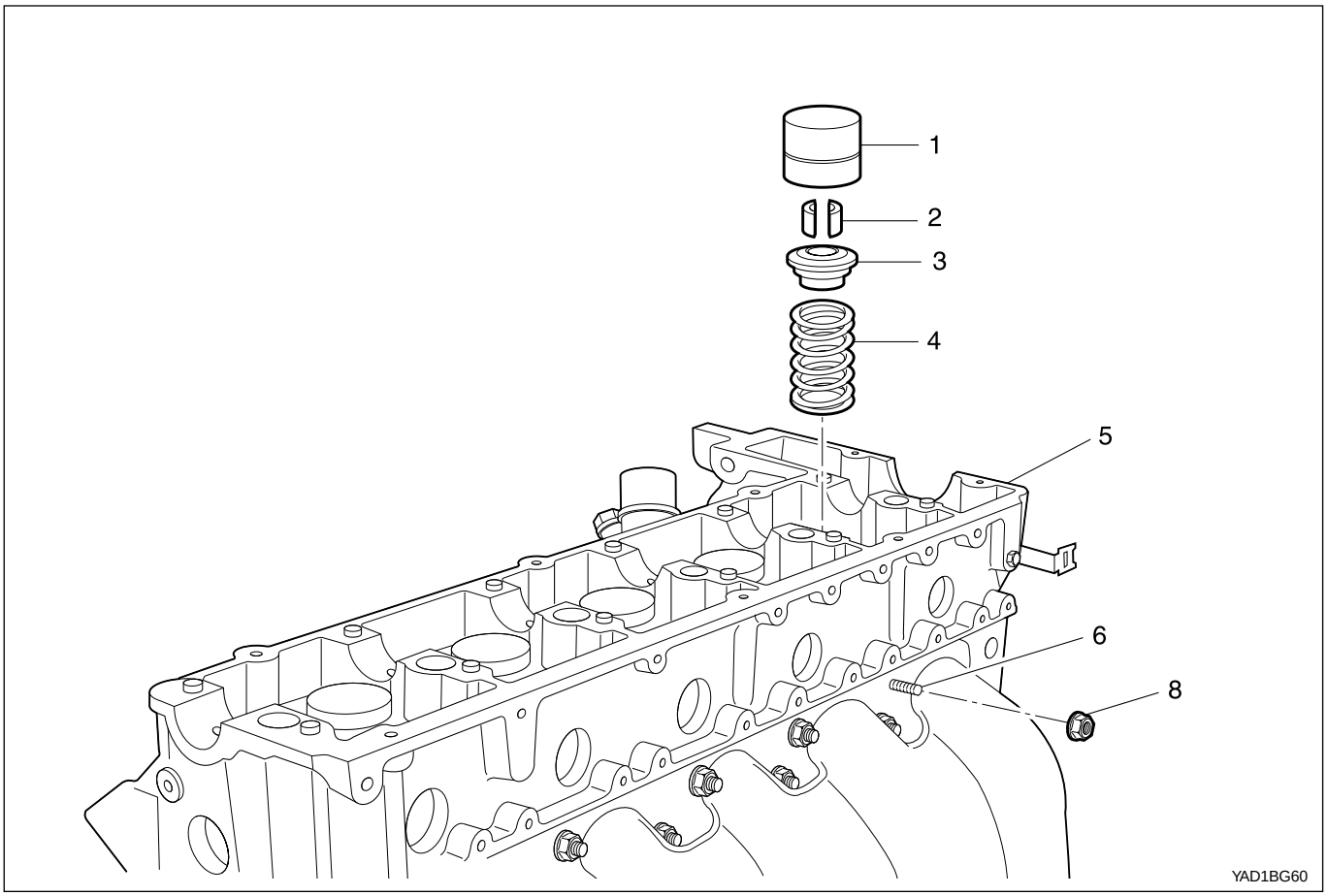


2. Remove the plug (5) and blow compressed air into the oil gallery (3). At this time, check that the outlet bores (arrow) at the seat of the valve tappet are clear.
3. Replace the seal (4) and tighten the plug (5).
4. Insert the new valve tappet.

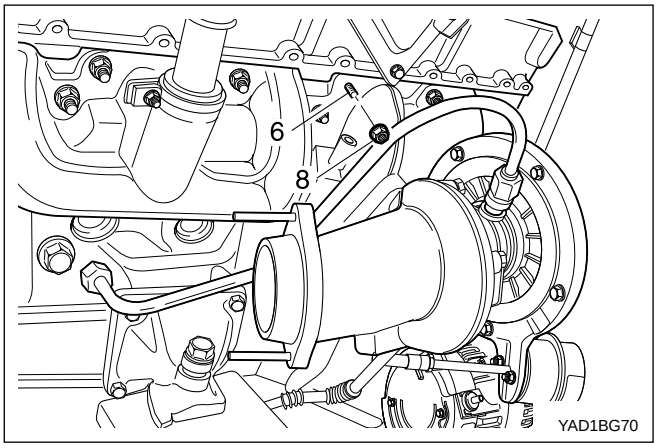
   Notice: Coat the valve tappet with oil.

VALVE SPRINGS (CYLINDER HEAD REMOVED)

Proceding Work: Remove of cylinder head



1 Valve Tappet
2 Valve Cotters
3 Spring Retainer
4 Valve Spring ..... Check, replace if necessary
5 Cylinder Head
6 Stud Bolt ..... 12 N•m (106 lb-in)
7 Nut ..... Replace, 25 N•m(18 lb-ft)



Tools Required

102 589 03 40 00 Magnetic Bar
116 589 06 63 00 Magnetic Finger
601 589 01 59 00 Assembling Board
601 589 02 59 00 Supporting Bridge
667 589 00 31 00 Press Lever

Removal & Installation Procedure

1. Remove the nuts (8) uniformly and then remove the washer (7), exhaust manifold (9) and gasket.

Installation Notice

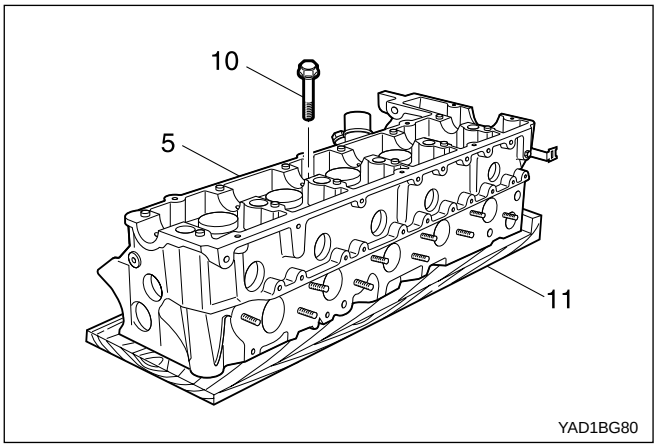
Check the stud bolt (6) for damage and replace if necessary.

Tightening Torque	12 N•m (106 lb-in)

Replace the gasket and tighten the nuts (8).

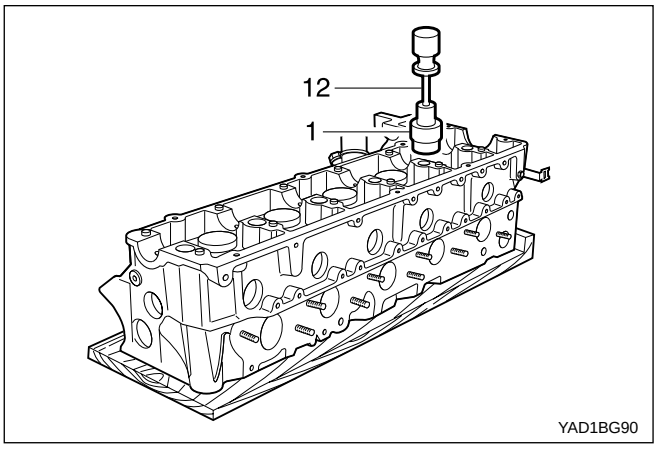
Tightening Torque	25 N•m (18 lb-ft)

2. Install the assembling board 601 589 01 59 00 (11) to the cylinder head with 4 cylinder head blots (10).

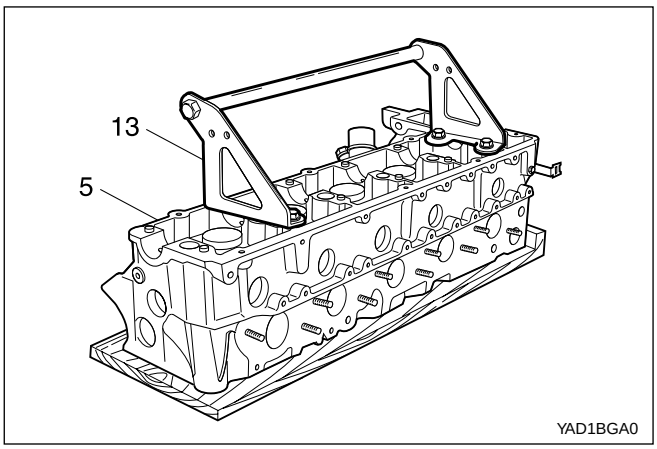


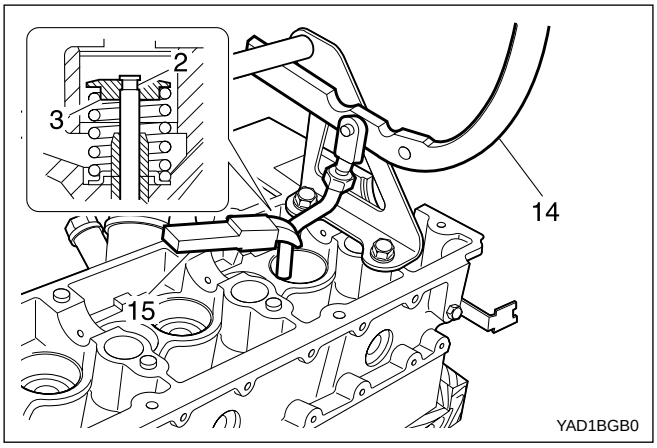
3. Pull out the valve tappet (1) with magnetic bar 102 589 03 40 00 (12).

Notice: Place the valve tappets upside down (open end upward).



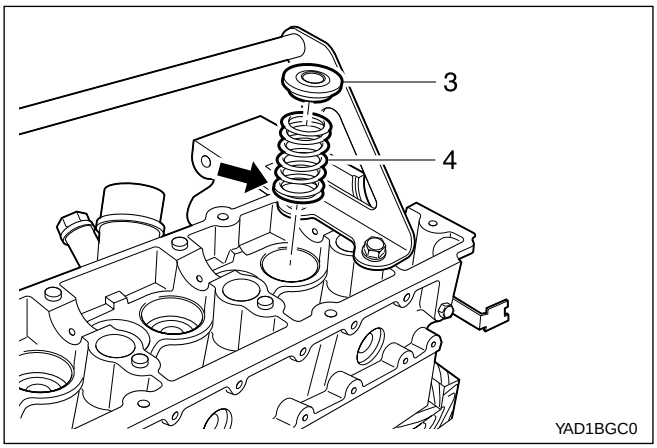
4. Install the supporting bridge 601 589 02 59 00 (13) on the cylinder head (5).





5. Using the press lever 667 589 00 31 00 (14), press the spring retainer downward and remove the valve cotters (2) with magnetic finger 116 589 06 63 00 (15).

   Notice: Be careful not to damage guide bore of the valve tappet.



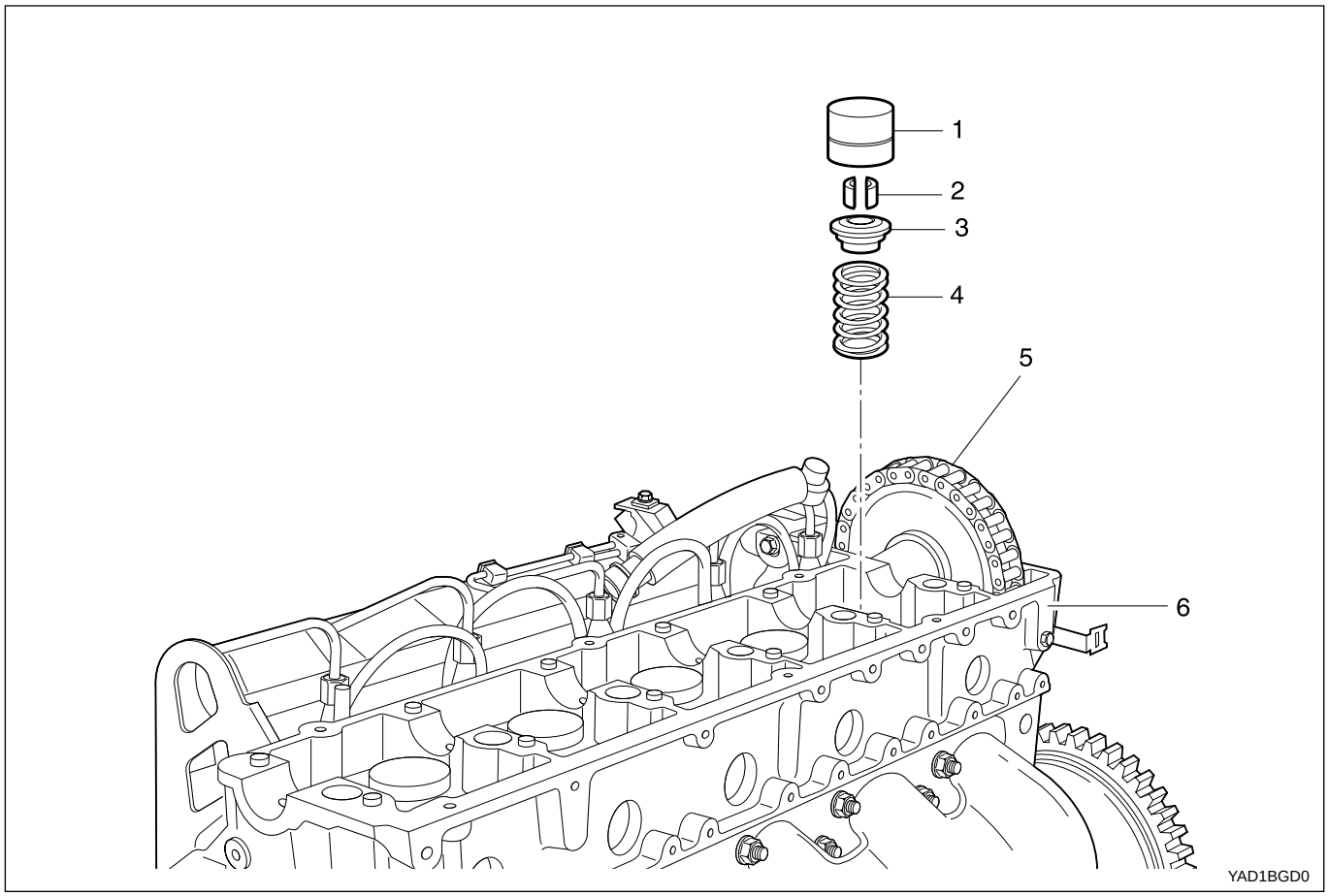
6. Remove the spring retainer (3) and spring (4).

   Notice: Install the valve spring with the color coding (arrow) facing down.

7. Check the valve spring and replace if necessary.
8. Installation should follow the removal procedure in the reverse order.

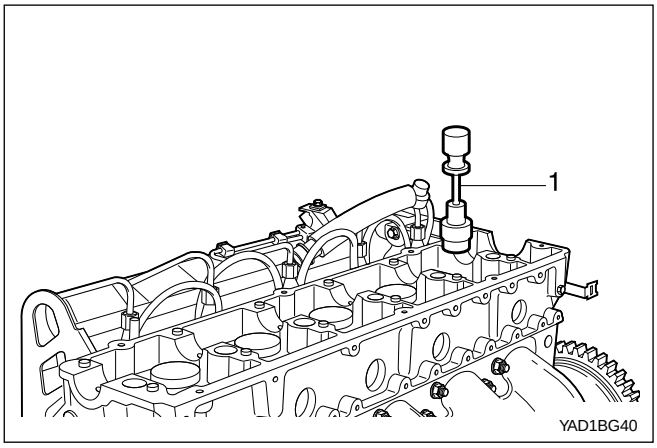
VALVE SPRINGS (CYLINDER HEAD INSTALLED)

Preceding Work: Removal of camshaft



1 Valve Tappet
2 Valve Cotters
3 Spring Retainer
4 Valve Spring ..... Check, replace if necessary
5 Timing Chain
6 Cylinder Head

Notice: Remove the valve springs only when the piston is at TDC.



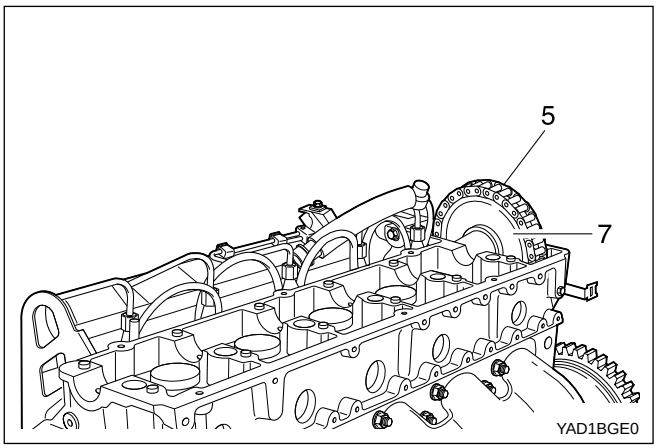
Tools Required

102 589 03 40 00 Magnetic Bar
116 589 06 63 00 Magnetic Finger
603 589 01 40 00 Holding Wheel
667 589 00 31 00 Press Lever
667 589 02 63 00 Supproting Bar

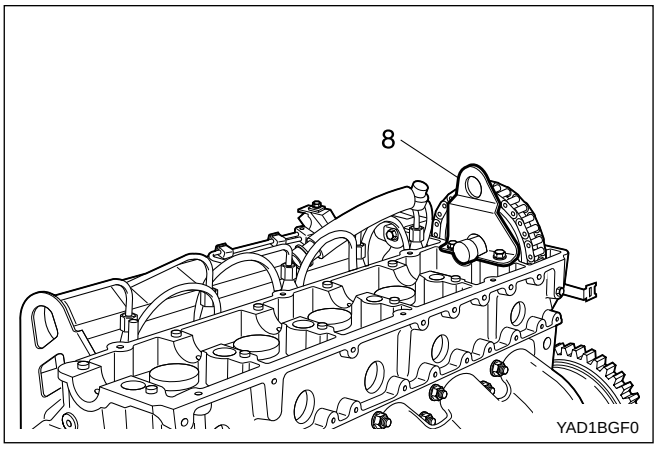
Removal & Installation Procedure

1. Remove the valve tappet (1) with magentic bar 102 589 03 40 00.

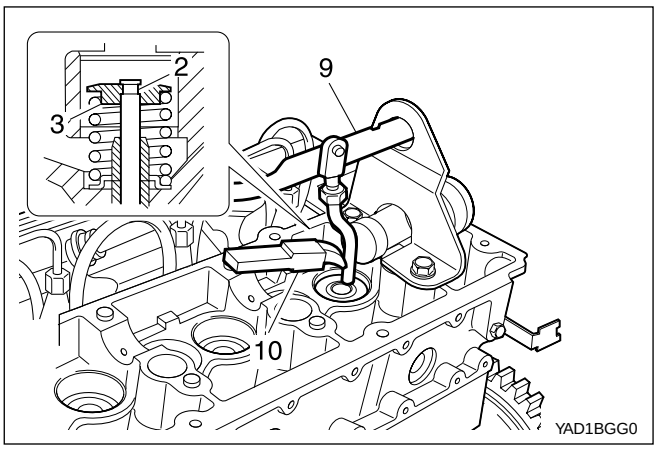
   Notice: Place the valve tappets upside down (open end upward).



2. Install the holding wheel 603 589 01 40 00 (7) into the timing chain of camshaft sprocket piston.
3. Position the piston of relevant cylinder at TDC.

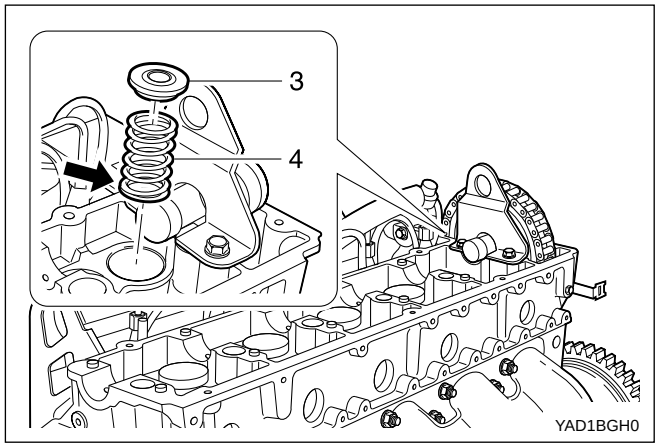


4. Install the supporting bar 667 589 02 63 00 (8).

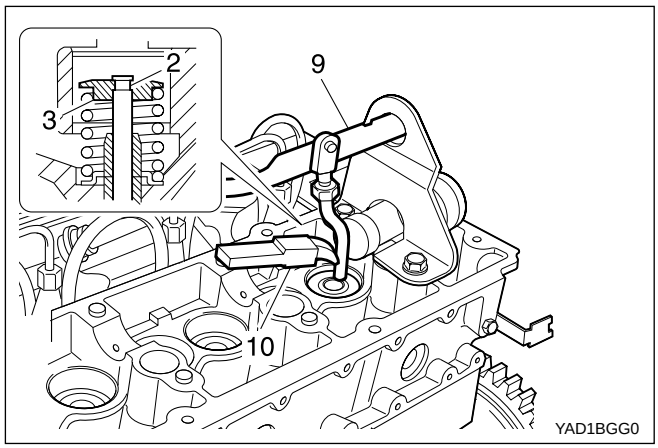


5. Using the press lever 667 589 00 31 00 (9), press the spring retainer (3) downward and remove the valve cotters (2) with magnetic finger 116 589 06 63 00 (10).

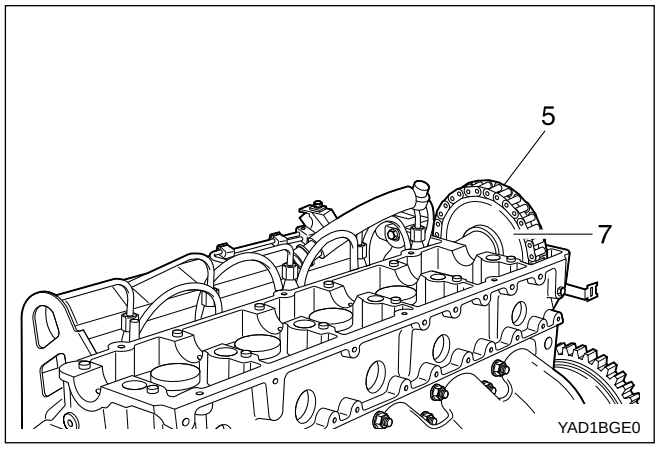
   Notice: Be careful not to damage guide bore of the valve tappet.



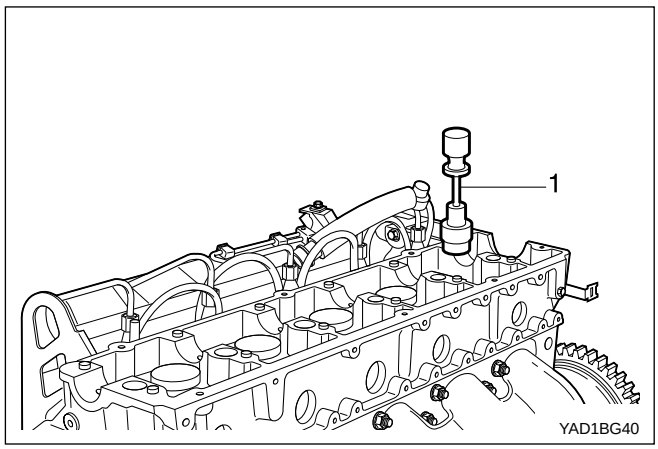
6. Remove the spring retainer (3) and spring (4).
7. Check the valve spring and replace if necessary.
8. Insert valve spring (4) with the color coding (arrow) facing down and insert valve spring Retainer (3).



9. By press the spring retainer (3) with press lever 667 589 00 31 00 (9), install the valve cotters with magnetic finger 116 589 06 63 00 (10).



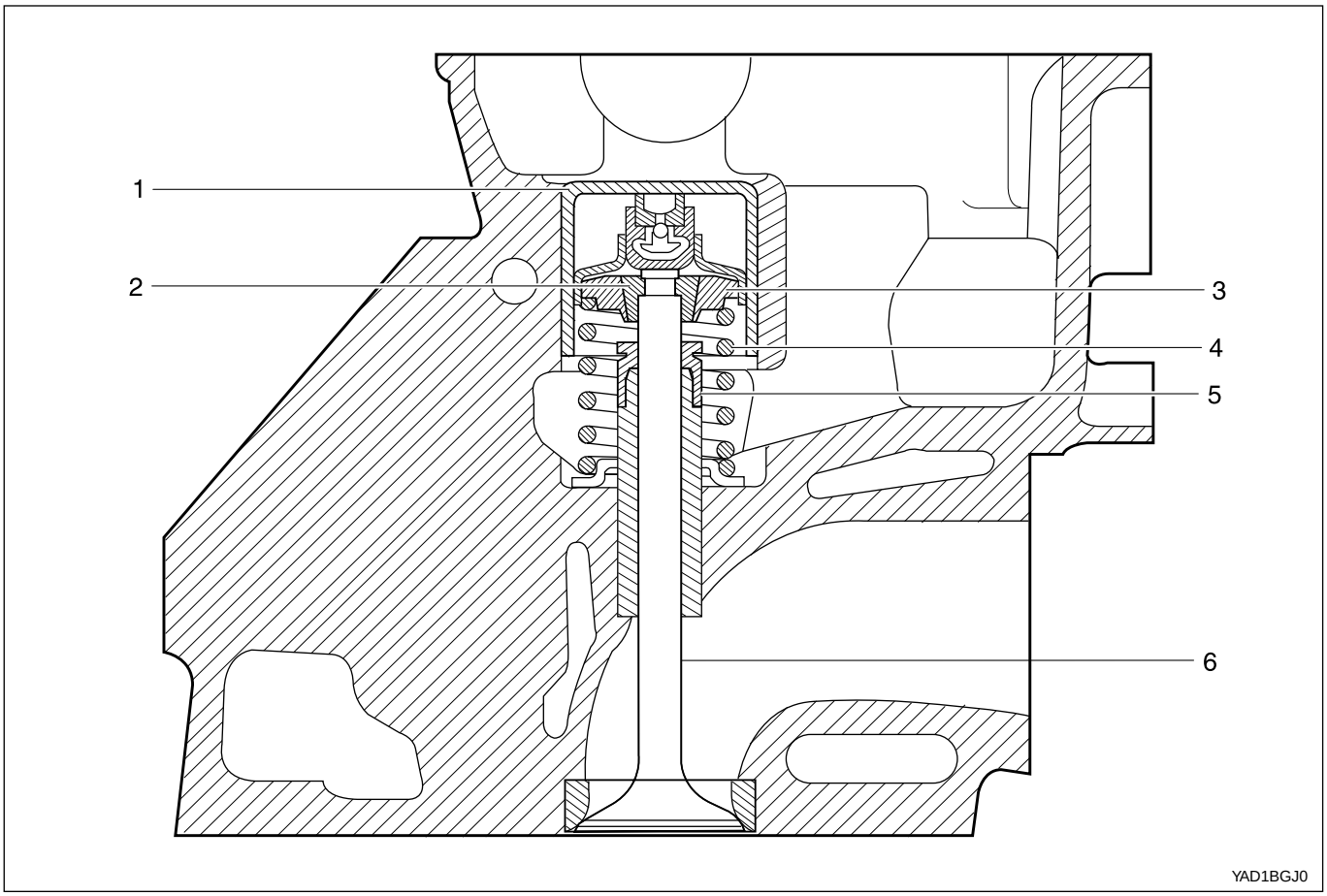
10. Remove the supporting bar 667 589 02 63 00.
11. Remove the holding wheel 603 589 01 40 00 (7) from the timing chain (5).



13. Coat the valve tappet with oil and install it with magnetic bar 102 589 03 40 00.

VALVE STEM SEALS

Preceding Work: Removal of camshaft.

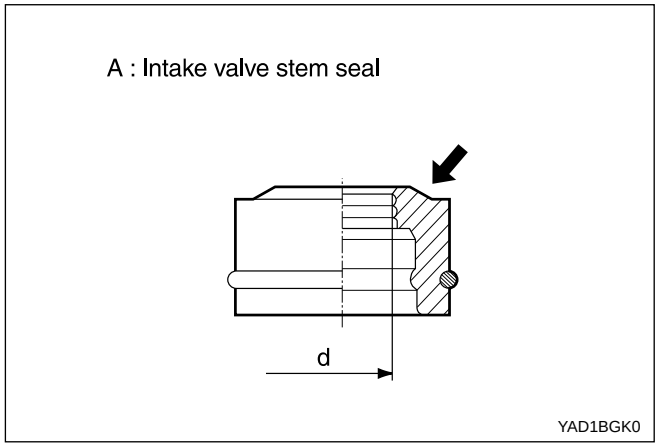


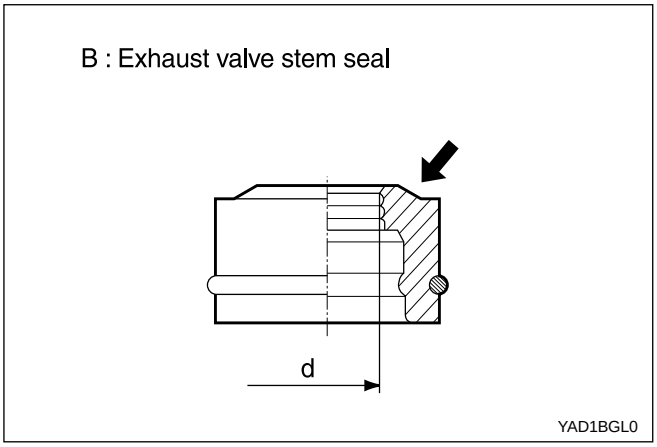
1 Valve Tappet
2 Valve Cotters
3 Spring Retainer
4 Valve Spring ..... Check, replace if necessary
5 Valve Stem Seal
6 Valve

Notice: Remove the valve stem seals when the pistion is positioned at TDC.

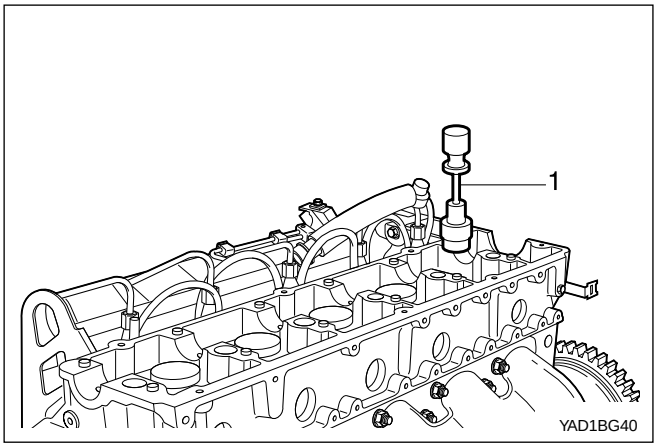
Tools Required

102 589 03 40 00 Magnetic Bar
104 589 00 37 00 Pliers
116 589 06 63 00 Magnetic Finger
601 589 02 43 00 Drift
603 589 01 40 00 Holding Wheel
667 589 00 31 00 Press Lever
667 589 02 63 00 Supporting Bar





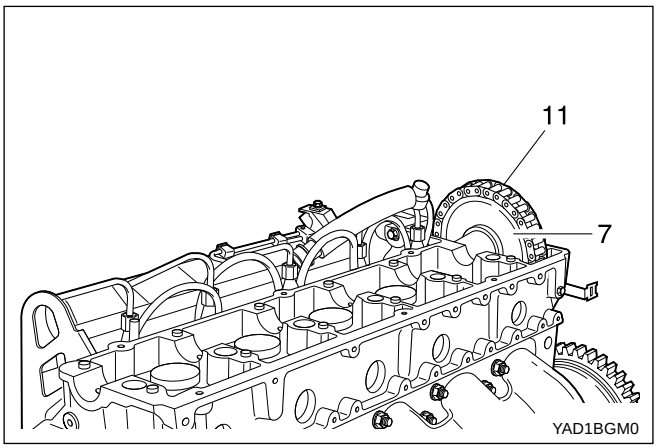
	Intake valve stem seal	Exhaust valve stem seal
Chamfer	Offset	All round
Inner diameter ‘d’	7.3mm	8.2 mm
Color	Brown	Green
Wire ring	Black	Yellow



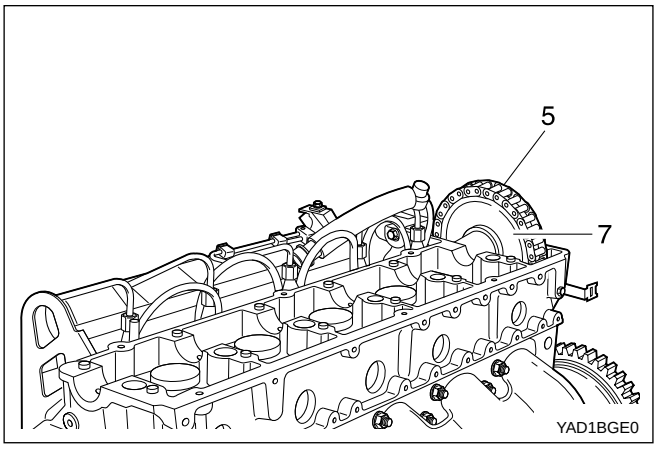
Replacement Procedure

1. Remove the valve tappet (1) with magnetic bar 102 589 03 40 00.

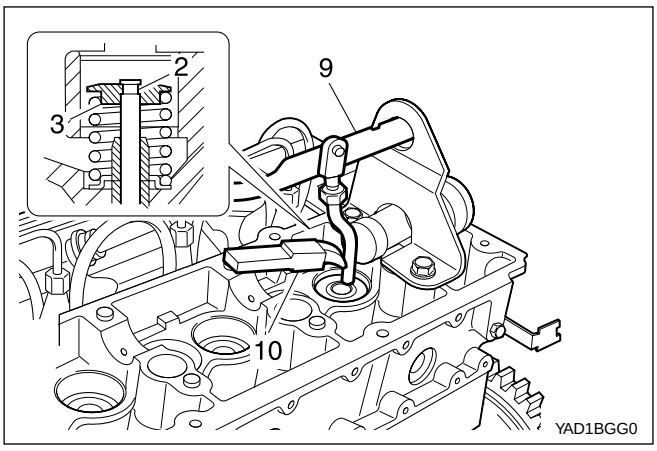
   Notice: Place the valve tappets upside down (open end upward).



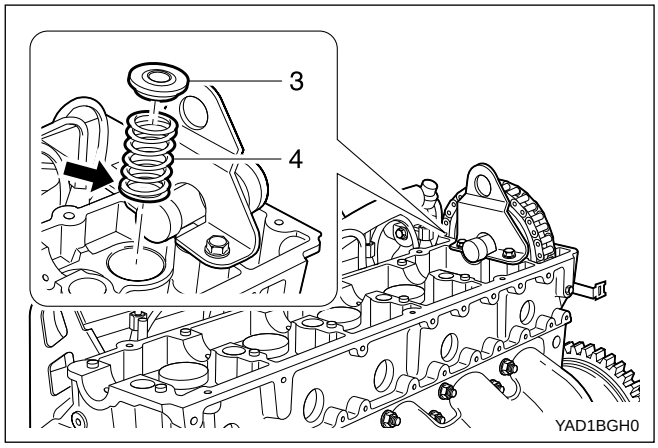
2. Install the holding wheel 603 589 01 40 00 (7) into the timing chain (11).
3. Position the piston of relevant cylinder at TDC.



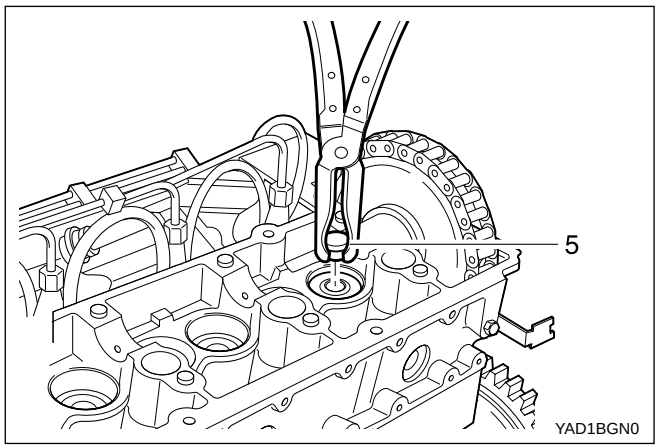
4. Install the supporting bar 667 589 02 63 00 (8).



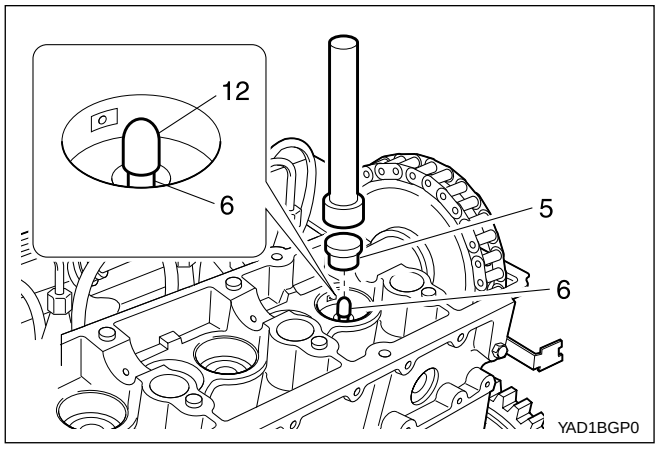
5. Using press lever 667 589 00 31 00 (9), press the spring retainer (3) downward and remove the valve collets with magnetic finger 116 589 06 63 00 (10).



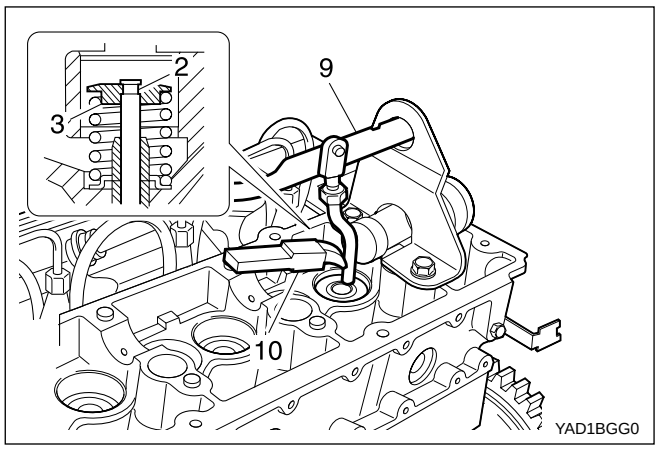
6. Remove the spring retainer (3) and valve spring (4).



7. Remove the valve stem seal with pliers 104 589 00 37 00 (5).

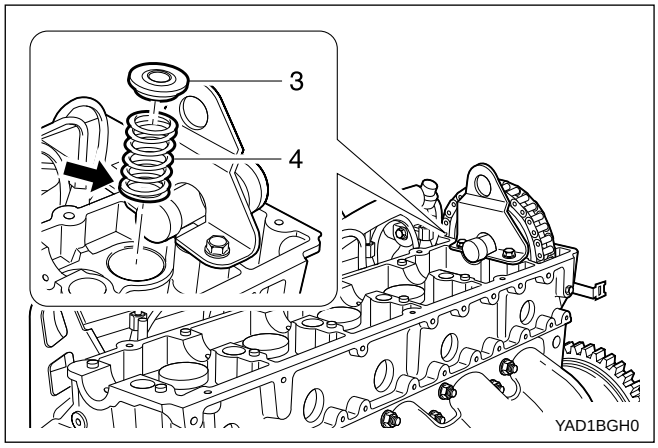


8. Insert the cap (12) onto the valve (6) and install the new valve stem seal (5) with drift 601 589 02 43 00 and then remover the cap.

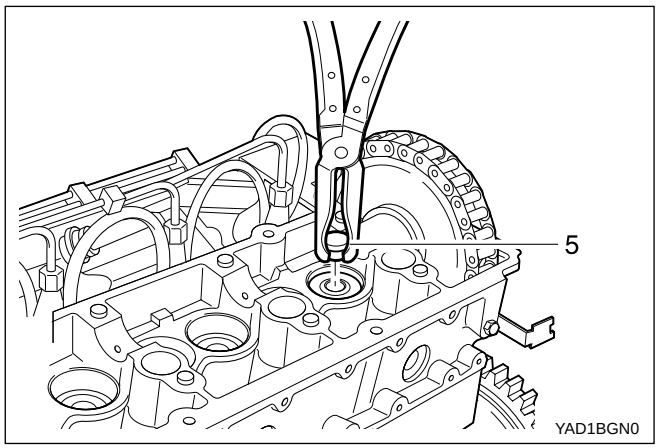


9. By pressing the spring seat with press lever 667 589 00 31 00 (9), install the valve cotters (2) with magnetic finger 116 589 06 63 00 (10).

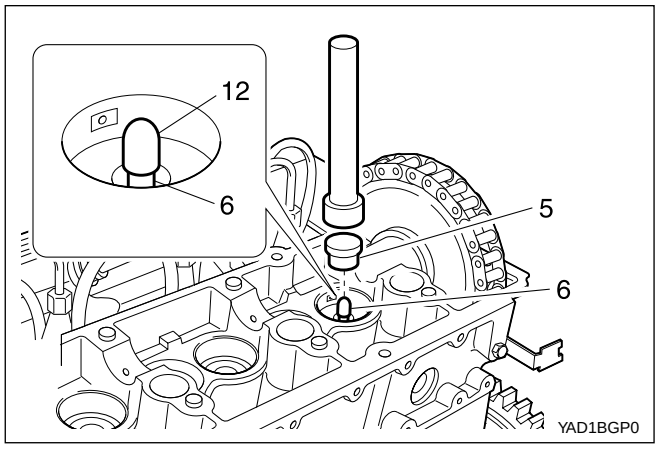
   Notice: Be careful not to damage guide bore of the valve tappet.



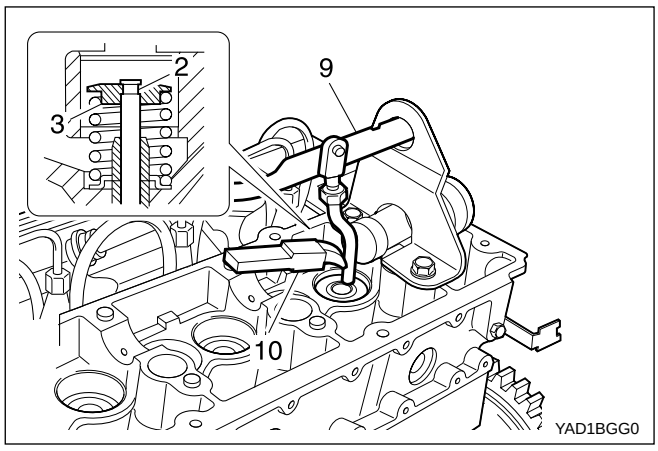
6. Remove the spring retainer (3) and valve spring (4).



7. Remove the valve stem seal with pliers 104 589 00 37 00 (5).



8. Insert the cap (12) onto the valve (6) and install the new valve stem seal (5) with drift 601 589 02 43 00 and then remover the cap.

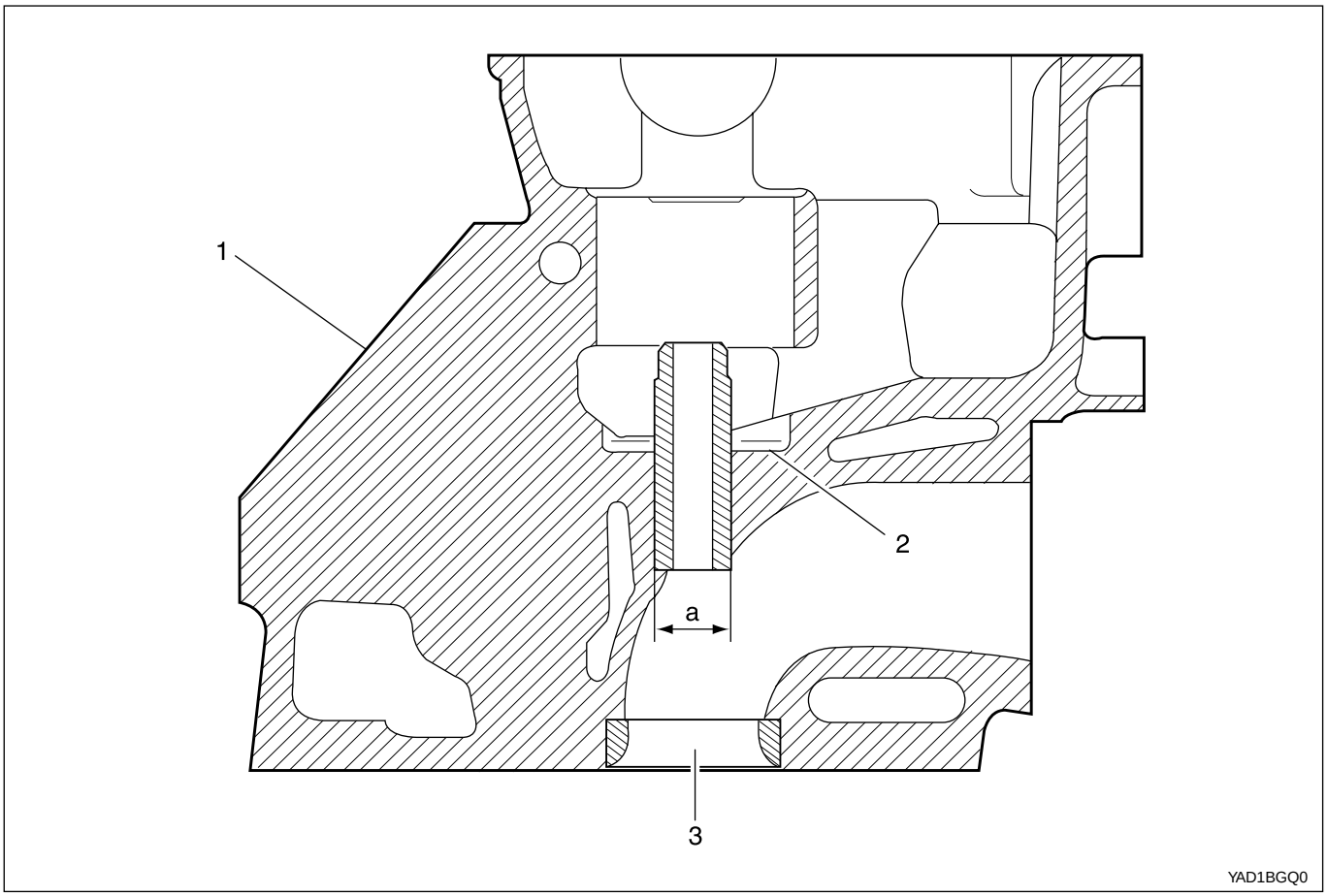


9. By pressing the spring seat with press lever 667 589 00 31 00 (9), install the valve cotters (2) with magnetic finger 116 589 06 63 00 (10).

   Notice: Be careful not to damage guide bore of the valve tappet.

VALVE GUIDES

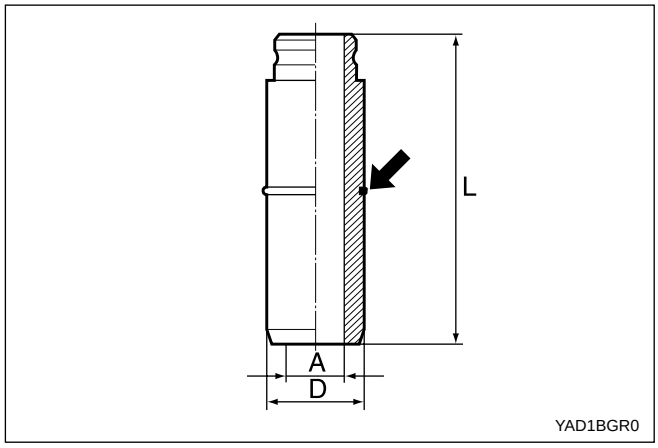
Preceding Work: Removal of cylinder head
Removal of valve spring
Removal of valve



1 Cylinder Head
2 Valve Guide
3 Valve Seat Ring
a Basic Bore Diameter

Service Data

	Item	Outer Diameter ' D '	Color Code	Basic Bore Diameter 'a'	Overlap 'D' - 'a'	Valve Guide Inner Diameter' A '	Length ' L'
Intake	Repair size 1	14.251	Red	14.200 - 14.211	0.029 - 0.051	8.000 - 8.030	39.5
	Repair size 2	14.440 - 14.451	White	14.400 - 14.411			
Exaust	Repair size 1	14.240 - 14.251	Red	14.200 - 14.211	0.029 - 0.051	9.000 - 9.050	37.7
	Repair size 2	14.440 - 14.451	White	14.400 - 14.411			



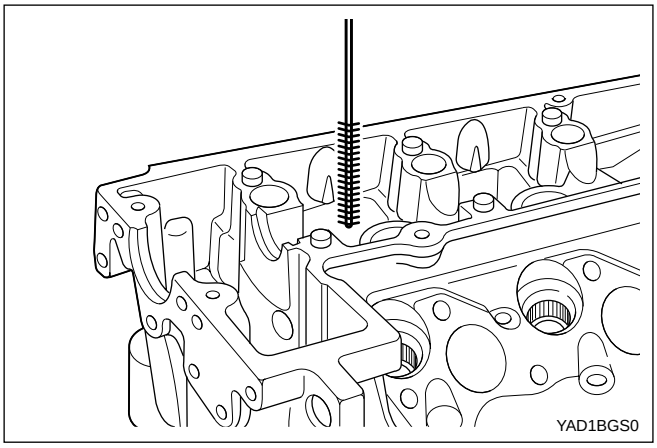
Notice: Measure center (arrow) of the valve guide and if the inner diameter 'A' exceeds standard value, replace the guide.

Tools Required

000 589 10 53 00	Reamer (for Exhaust)
000 589 10 68 00	Cylinder Brush
000 589 21 53 00	Reamer (for Intake)
102 589 00 23 00	GO / NO GO Gauge (for Intake)
103 589 02 15 00	Drift (for Exhaust)
103 589 03 15 00	Drift (for Intake)
115 589 34 63 00	Mounting Device
117 589 03 23 00	GO / NO GO Gauge (for Exhaust)
346 589 00 63 00	Super Cooling Box
601 589 05 15 00	Drift (for Intake)
601 589 06 15 00	Drift (for Exhaust)

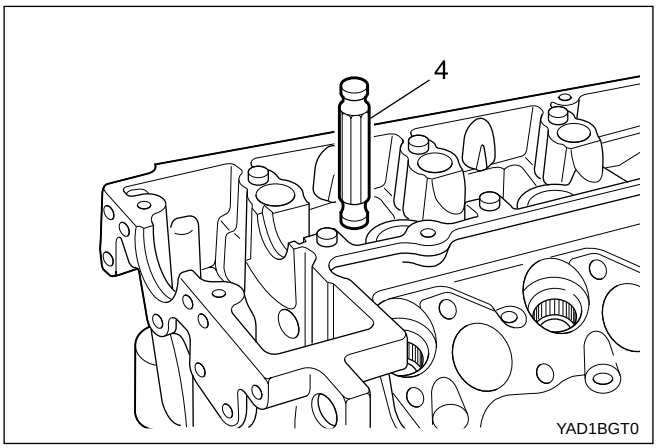
Matching Valve Seat - Broaching Tools - Guide Sleeves

Valve Seat	Broaching Tool No.	Guide Sleeve Tool No.	Guide Sleeve Side
Intake	115 589 00 53 00 (14.2 mm)	102 589 00 63 00	B
Exhaust		102 589 08 63 00	B
Intake	115 589 01 53 00 (14.4 mm)	601 589 15 63 00	A
Exhaust			B

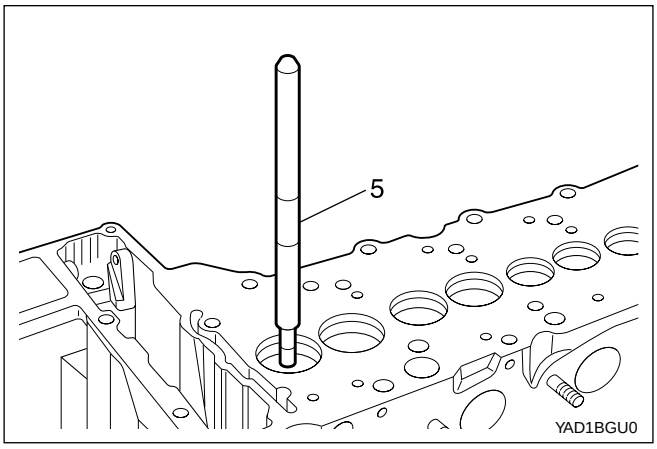


Checking

1. Thoroughly clean the valve guide bore using a cylinder brush 000 589 10 68 00.



2. Insert the GO/NO GO gauge (Intake: 102 589 00 23 00, Exhaust: 117 589 03 23 00) into the valve guide bore. If the NO GO side is inserted fully, replace the valve guide (Intake 8 mm, Exhaust 9mm).

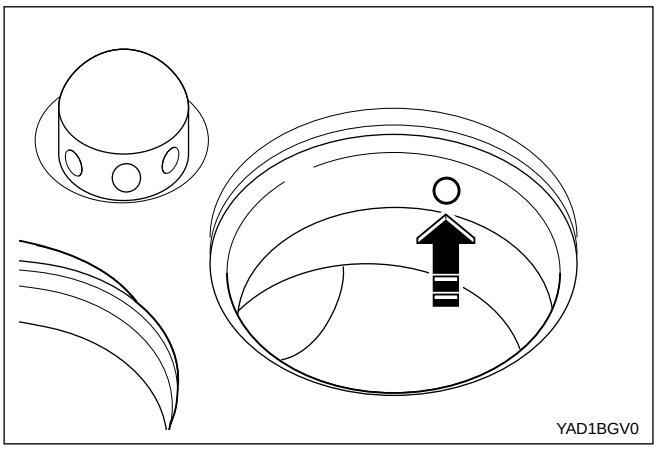


Replacement Procedure

1. Drive out the valve guide (2) by using a drift (Intake: 103 589 03 15 00, Exhaust: 103 589 02 15 00) (5).

   Notice: The valve guide must be driven out upward of the cylinder head.

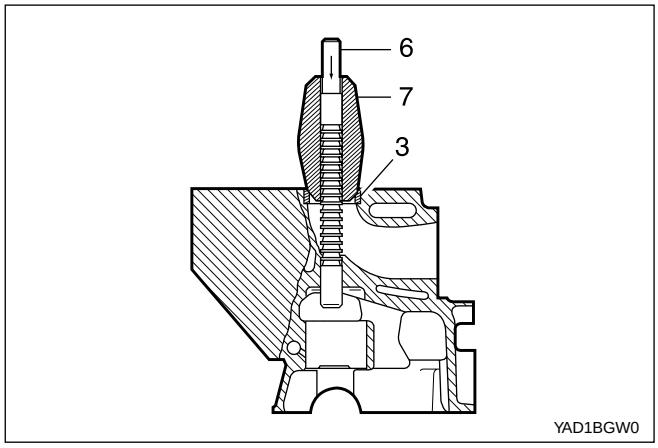
2. Thoroughly clean the basic bore by using a cylinder brush 000 589 10 68 00.
3. Check the basic bore in cylinder head for scoring marks and ream to next repair size if necessary.



4. Reaming basic bore in cylinder head (repair size).
   - Thoroughly remove carbon deposits in cylinder head.

     Notice: Particularly remove the insides of the valve seat rings.

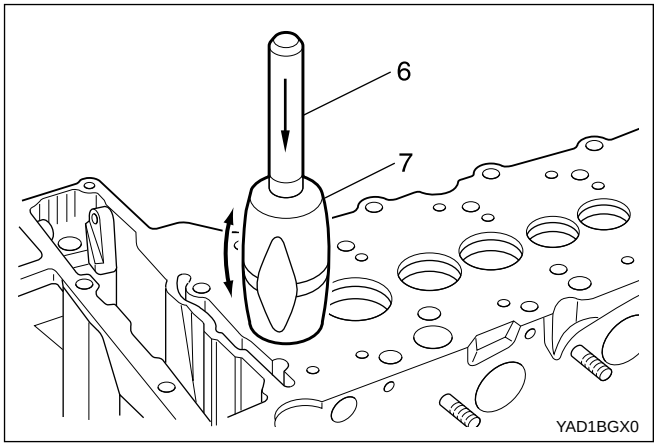
   - Remove the elevation (arrow) of intake valve seat rings.



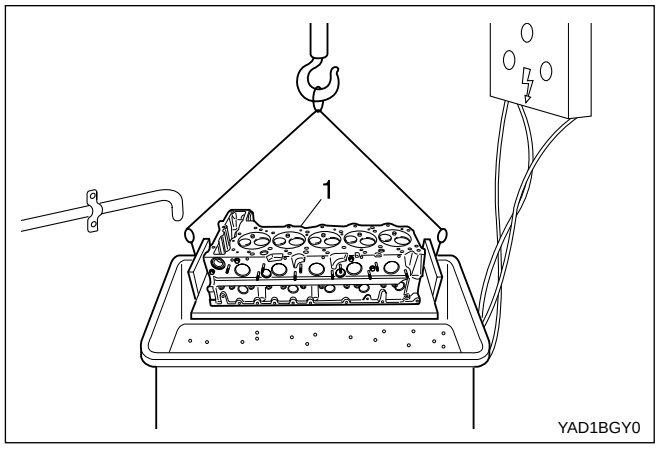
- Select correct broaching tool and guide sleeve (refer to the table).

  Notice: Before broaching work, the broaching tool must be cleared of swarf with a stiff plastic brush.

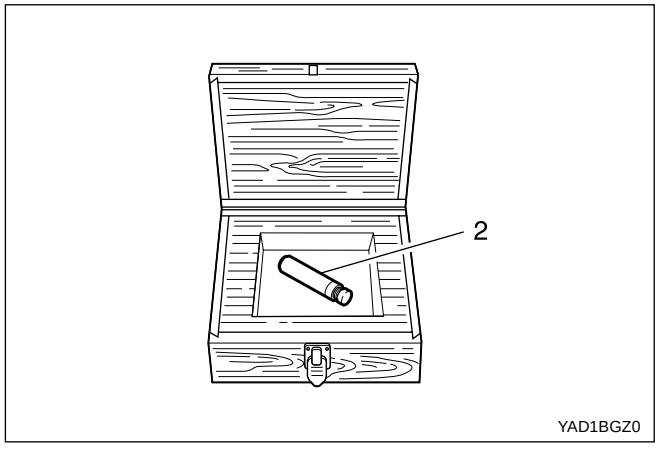
- Lubricate the basic bore, guide sleeve and broaching tool with petroleum.
- Push broaching tool (6) in broaching direction (arrow) into the guide sleeve (7) far enough so that the first cut of the broaching tool is positioned in the basic bore when guide sleeve is fitted onto the valve seat ring (3).



- Center the guide sleeve (7) in the valve seat ring (3) by turning.
- Knock through the broaching tool (6) with a plastic hammer (approx. 25 g) and aluminum drift.

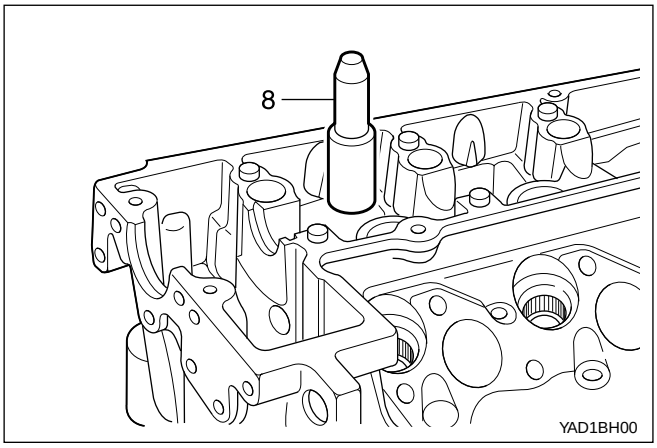


5. Heat the cylinder head (1) in a wear tank to approx. 80°C (176°F) with mounting device 115 589 34 63 00.



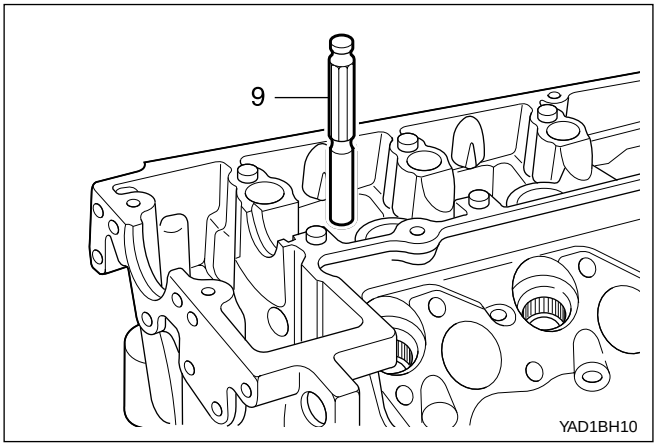
6. Cool down the new valve guide (2) into the super cooling box 346 589 00 63 00 with liquid nitrogen.

   Notice: Do not touch the cooled valve guide by hand.



7. Drive in new valve guide with drift (Intake: 601 589 05 15 00, Exhaust: 601 589 06 15 00) (8) until the wire ring makes contact.

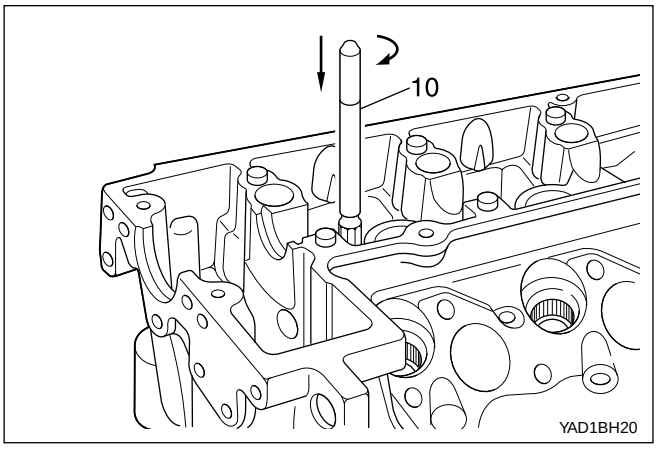
   Notice: The valve guide must be driven in from the cylinder head cover.



8. Check the valve guide bore with GO / NO GO gauge (Intake: 102 589 00 23 00, Exhaust: 117 589 03 23 00) (9).

   The GO side (marked '0') should just still drop. If the GO side cannot be inserted, the bore of valve guide should be reamed.

   Notice: Perform the check only on cooled down cylinder head.

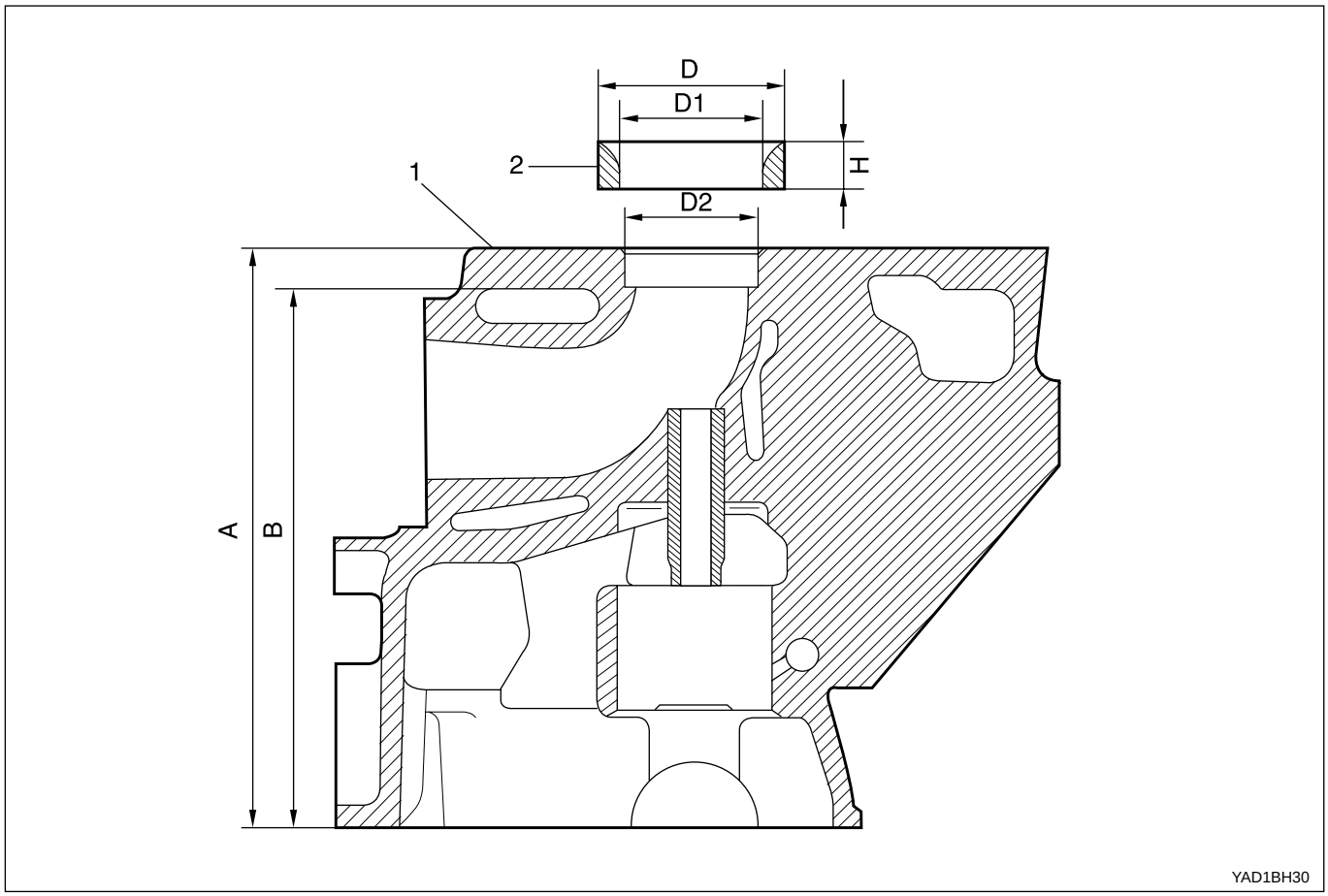


9. If necessary, ream the valve guide bore evenly with a reamer (Intake: 000 589 21 53 00, Exhaust: 000 589 10 53 00) (10).

   Notice: Never turn the reamer against the direction of rotation.

VALVE SEAT RINGS

Preceding Work: Removal of valve
Checking of valve guide, replace if necessary
Removal of prechamber



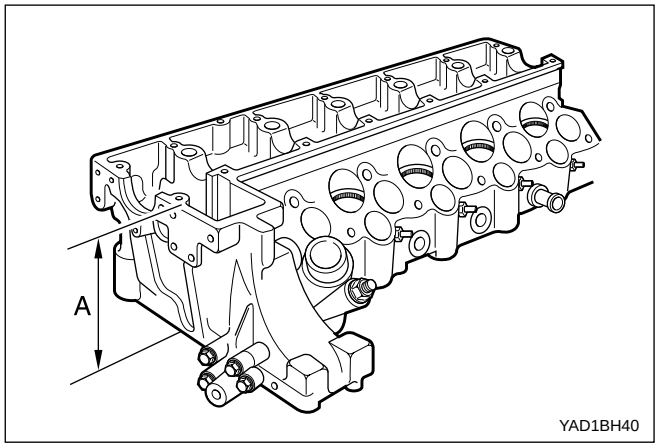
1 Cylinder Head
2 Valve Seat Ring
A Height (Cylinder Head Upper / Lower Surface)
B Height (Cylinder Head Cover Surface / Seat of Valve Seat Ring)
D Valve Seat Ring Outer Diameter
D1 Valve Seat Ring Inner Diameter
D2 Basic Bore Diameter
H Height of Valve Seat Ring

Service Data

Item	Intake	Exhaust
D2	40.000 - 40.016 mm	37.000 - 37.016 mm
D	40.084 - 40.100 mm	37.084 - 37.100 mm
D1	33.400 - 33.600 mm	30.400 - 30.600 mm
H	6.955 - 7.045 mm	6.955 - 7.045 mm
Overlap U=D-D2	0.068 - 0.100 mm	0.068 - 0.100 mm
B	133.4 mm	133.4 mm
A	142.5 mm	142.5 mm

Commercial Tools

Cylinder Head Clamping Device	Hunger D-8000 München 70 Type Ventilknecht K2000 Order No. 221 00 100
Valve Seat Turning Tool	Hunger D-8000 München 70 Type VDS 1A Order No. 236 03 308
Ring Seat Turning Tool	Hunger D-8000 München 70 Type RDS 1 Order No. 219 00 100
Pneumatic Removal / Installation Device (Drift : 8 mm, 9 mm, 14 mm)	Hunger D-8000 München 70 Type PVM 1
Tensioning Head	Hunger D-8000 München 70 Order No. 250 15 250
Cutting Tool for Recessing Grooves	Hunger D-8000 München 70 Order No. 217 93 601
Test Set for Valves	Hunger D-8000 München 70 Order No. 216 69 210
Internal Dial Gauge (Range : 25 - 60 mm)	Mahr D-7300 Esslingen Order No. 844
External Micrometer (Range : 25 - 60 mm)	Mahr D-7300 Esslingen Order No. 40 S
Electrically Heated Water Tank	Otto Dürr D-7123 Sachsenherm - Ochsenbach



Tools Required

115 589 34 63 00 Mounting Device

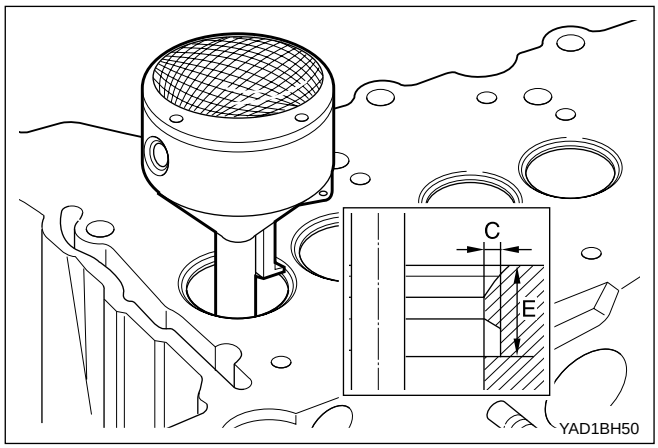
345 589 00 63 00 Super Cooling Box

Removal Procedure

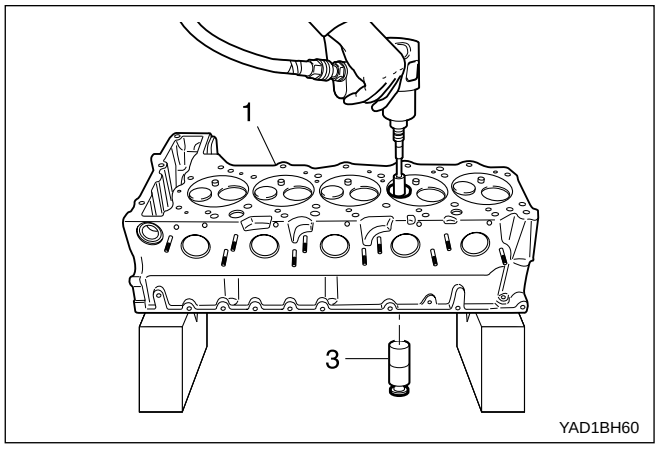
1. Measure dimension ‘A’.

Limit	142.5 mm

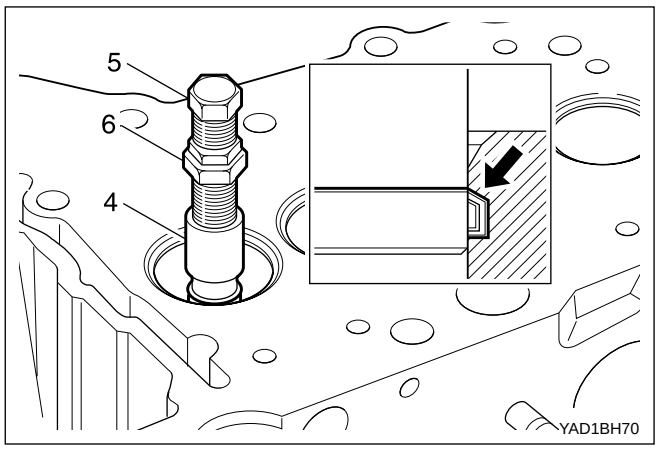
2. Clamp the cylinder head with clamping device.



3. Cut groove into the valve seat ring so that dimension ‘C’ is approx. 2 mm and dimension ‘E’ is approx. 6 mm.



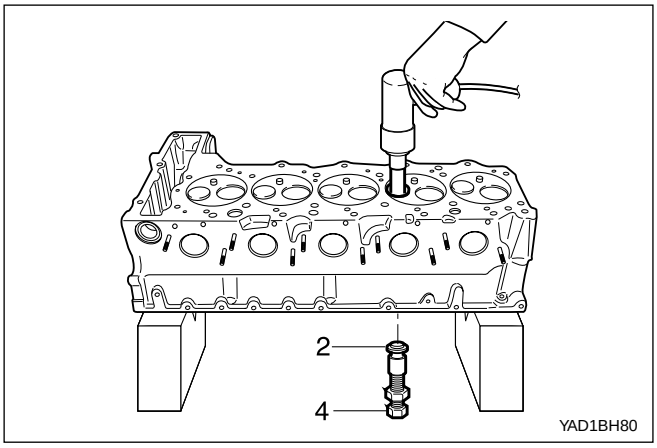
4. Remove the cylinder head from the clamping device and place it onto wooden blocks.
5. Remove the valve guide (3) by using a drift (Intake: 8 mm, Exhaust: 9 mm).



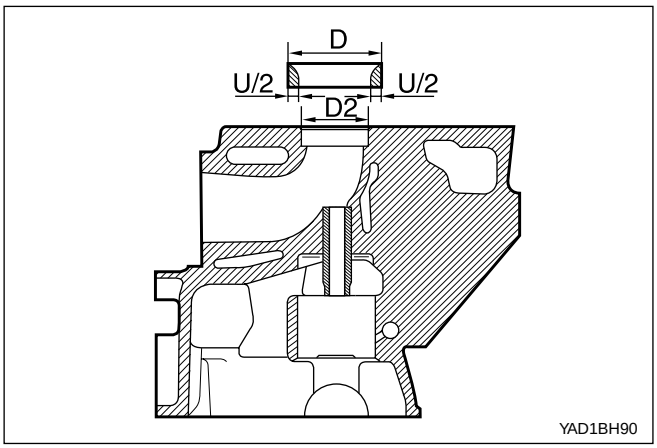
6. Insert the tensioning head (4) and extracted wedges(arrow) by turning the bolt (5).

   Notice: Carefully tighten the bolt (5) otherwise the valve seat ring in the cylinder head will be excessively tensioned.

7. Lock the bolt (5) with nut (6).



8. Turn over the cylinder head.
9. Remove the tensioning head (4) and valve seat ring (2) with drift (14 mm) and removal tool.
10. Clean the basic bore of valve seat ring.

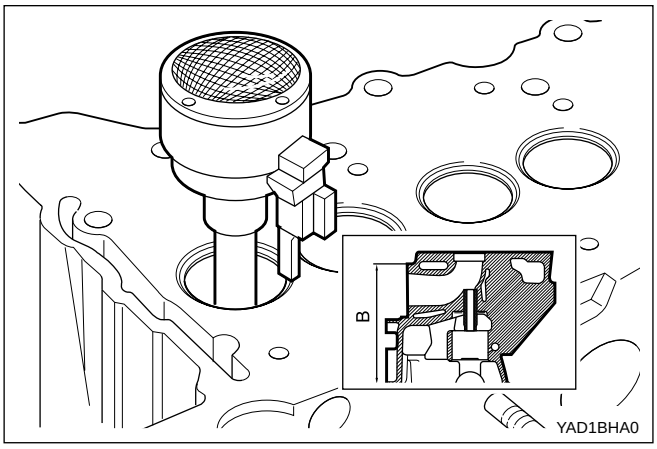


11. Measure the basic bore diameter (D2) and outer diameter (D) of the new valve seat ring (standard size).
12. Calculate the overlap value 'U' (D - D2).

Overlap Valve 'U'	0.068 - 0.100 mm

Example) Measured value D = 37.100 mm
Measured value D2 = 37.010 mm
Overlap value 'U' = 0.090 mm

If overlap value 'U' is out of standard, machine the basic bore for the valve seat ring.



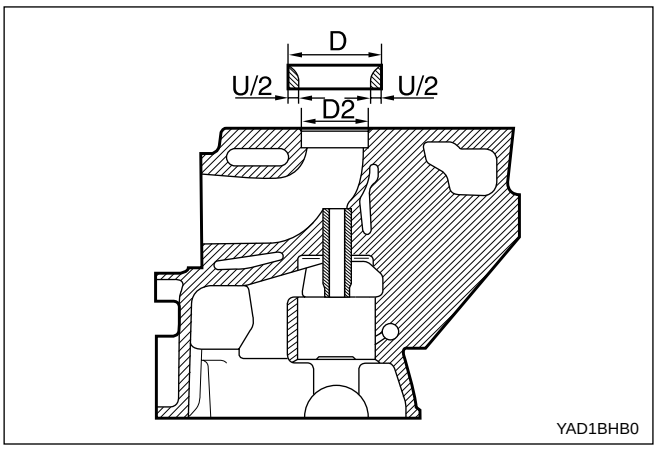
13. Clamp the cylinder head with clamping device.
14. Machining basic bore for valve seat ring (repair size).

Notice: Maintain minimum value of 'B'.

- Machine the basic bore.

Limit

Max. D2	Intake	40.516 mm
	Exhaust	37.516 mm
Min. B		133.4 mm

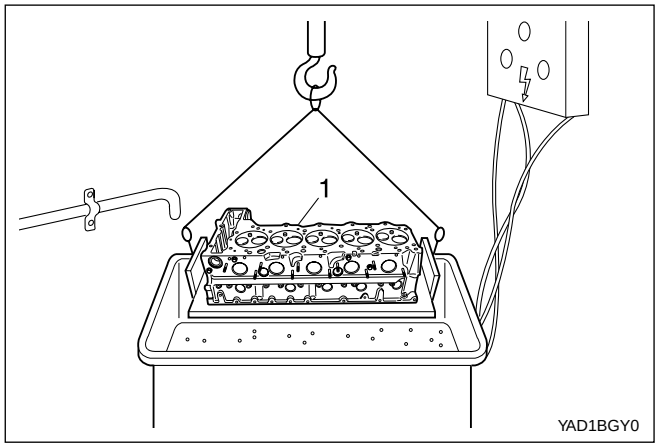


- Measure machined basic bore and outer diameter 'D' of valve seat ring (repair size).
- Measure the overlap 'U'

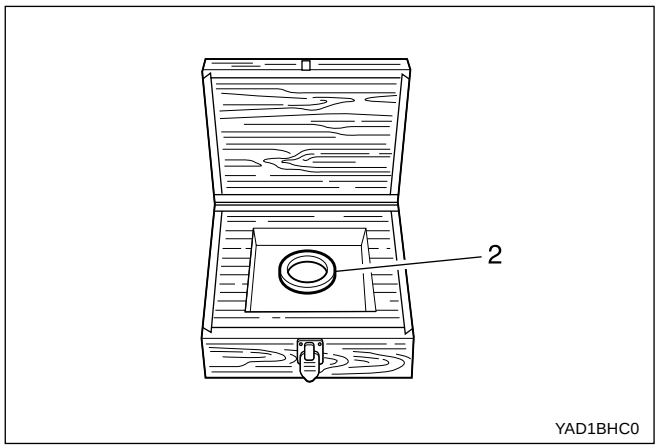
Overlap 'U' (D - D2)	0.068 - 0.100 mm

Example) Measured value D = 37.600 mm
Measured value D2 = 37.480 mm
Overlap U = 0.120 mm

The basic diameter D2 must be machined by 0.020 mm in order to get the required overlap value.

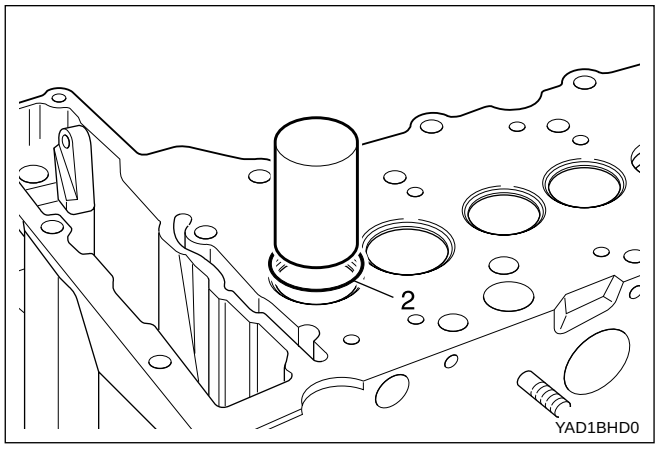


15. Hang the cylinder head (1) to the lifting device and heat in a water tank to approx. 80°C(176°F) with mounting device 115 589 34 63 00.

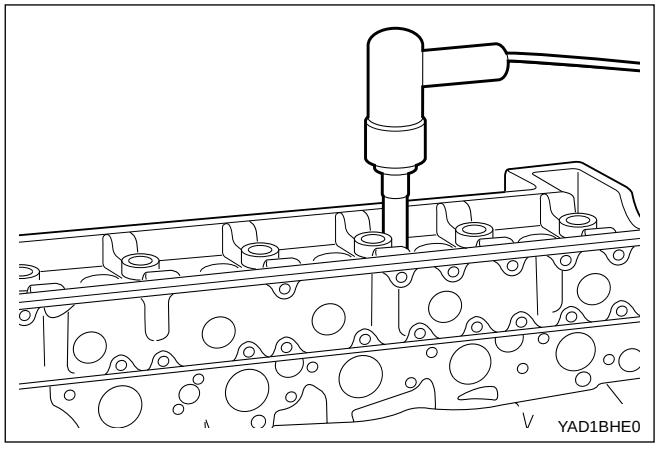


16. Cool down new valve seat ring (2) into the cooling box 345 589 00 63 00 with liquid nitrogen.

    Notice: Do not touch the cooled valve seat rings with hand.



17. Drive in new valve seat ring (2) with a proper wooden drift.



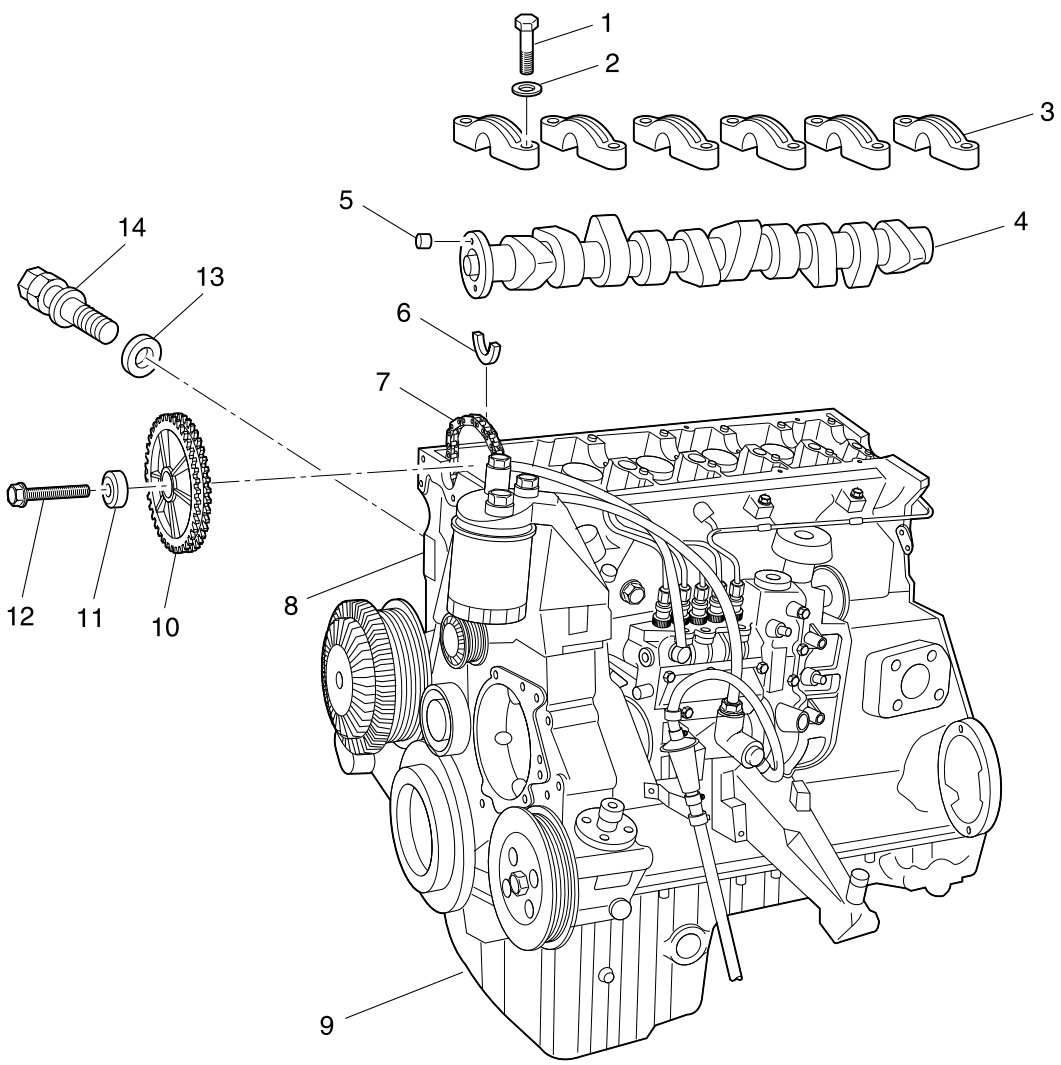
18. Install the valve guide (3) with a proper drift (Intake: 8 mm, Exhaust: 9 mm) and assembling tool.

    Notice: The valve guide must be driven in from the cylinder head cover.

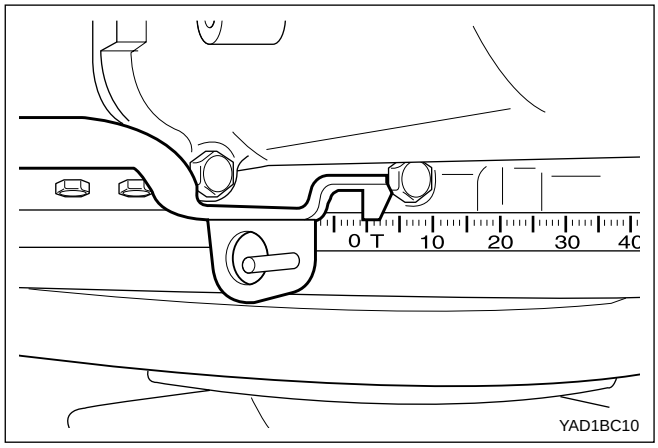
19. Machine the valve seats.

CAMSHAFT

Preceding Work: Removal of cylinder head cover



1 Bolt ..... 25 N•m (18 lb-ft)
2 Washer
3 Camshaft Bearing Cap
4 Camshaft
5 Dowel Pin
6 Locking Washer
7 Timing Chain
8 Cylinder Head
9 Oil Pan
10 Camshaft Sprocket
11 Washer
12 12-Sided Bolt (M11)
..... Check, 25 N•m (18 lb-ft)+ 90°
13 Gasket ..... Replace
14 Chain Tensioner ..... 80 N•m (59 lb-ft)



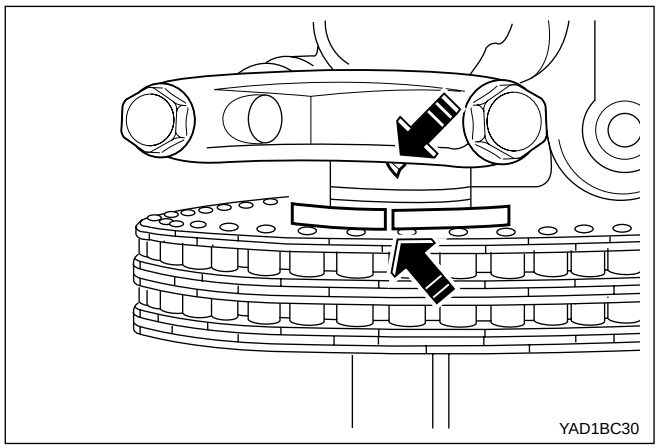
Tools Required

602 589 00 40 00 Engine Lock

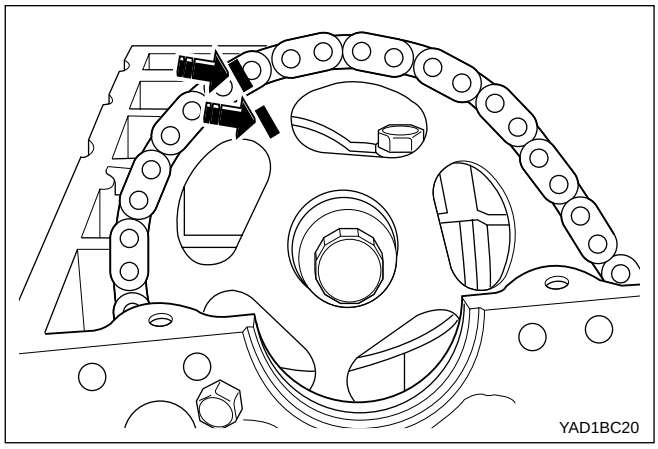
Removal Procedure

1. Rotate the crankshaft and position the piston of No.1 cylinder at TDC.

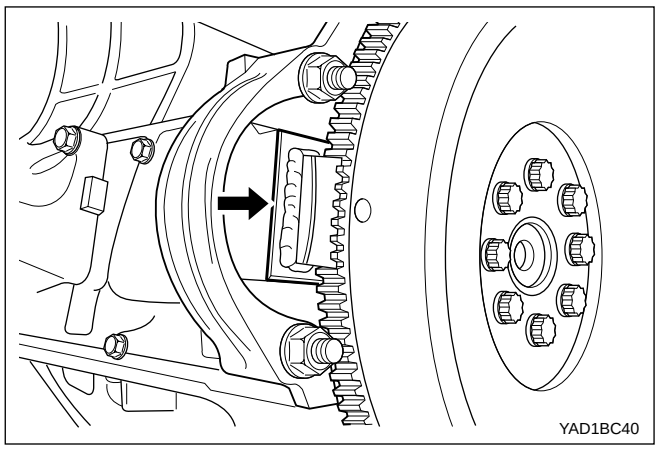
   Notice: Do not rotate the crankshaft in the opposite direction of engine rotation.



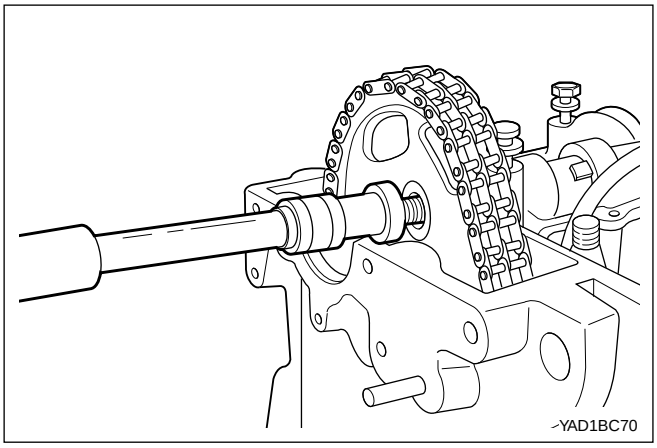
In this position, the markings of the camshaft/ camshaft bearing cap (arrow) must be aligned.



2. Place alignment marks on the camshaft sprocket and timing chain.

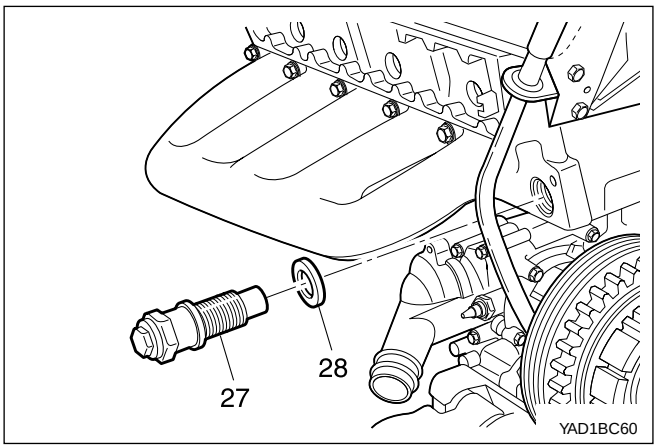


3. Remove the starter motor and install the engine lock 602 589 00 40 00.

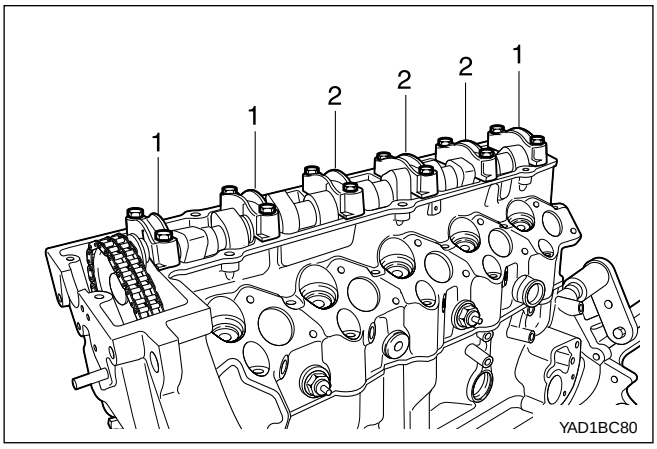


4. Remove the bolt and then remove the camshaft sprocket.

   Notice: During removal, be careful not to drop the sprocket with chain. Remove the chain carefully and then pull out the sprocket.

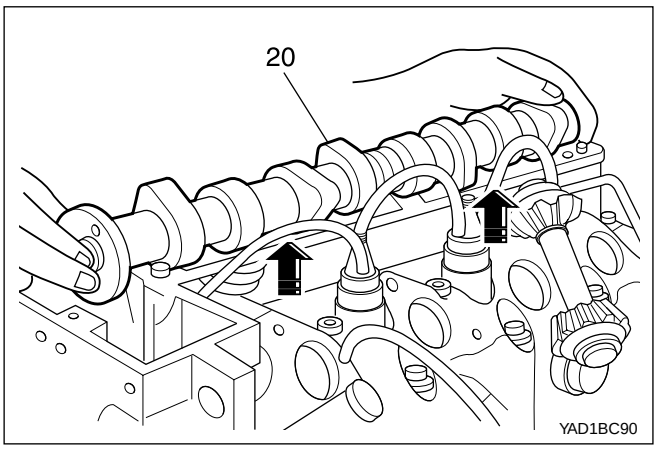


5. Remove the chain tensioner.



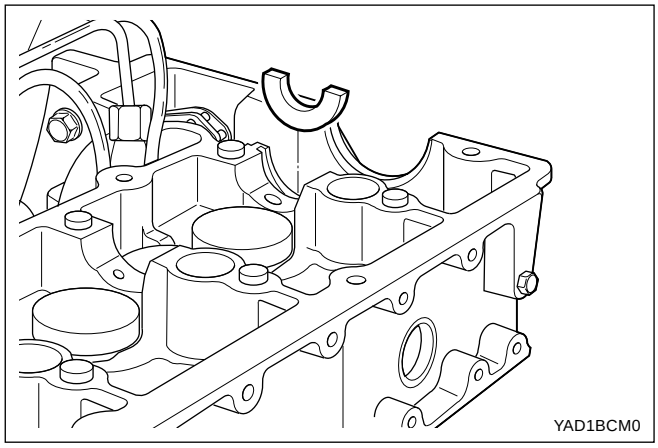
6. Remove the camshaft bearing cap bolts according to the removal order.

   Notice: Remove the camshaft bearing cap bolts of 1 first and then remove the bolts of 2 one revolution in stages until the counter-pressure is released. In order to avoid damaging the camshaft, it is essential to adhere to the removal order for the camshaft bearing caps.



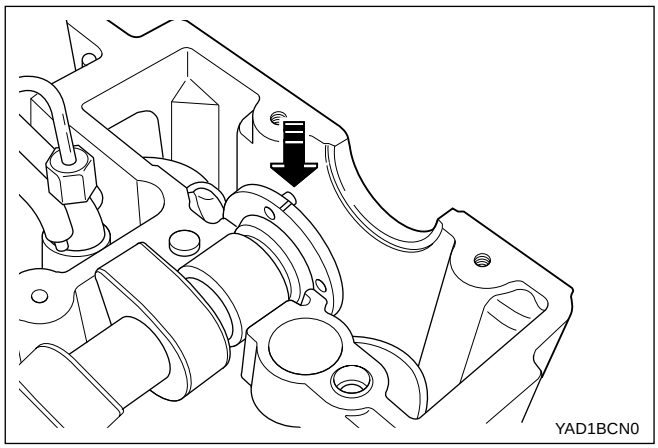
7. Remove the camshaft bearing cap.
8. Pull off the camshaft.

   Notice: Be careful not to miss front locking washer.


YAD1BCM0

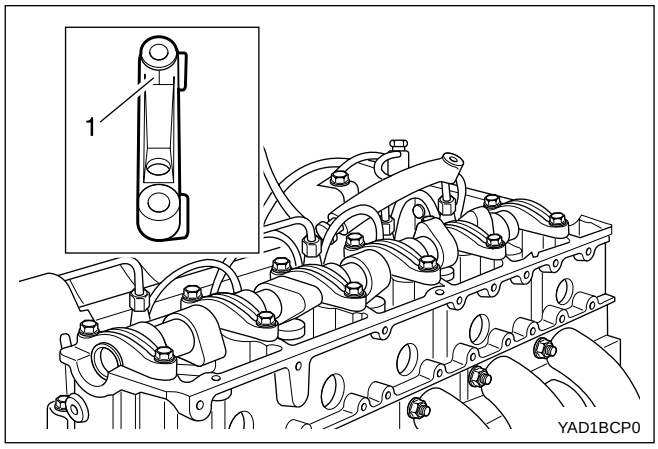
9. Pull out the locking washer.

   Notice: Check the condition of locking washer and replace if necessary.


YAD1BCN0

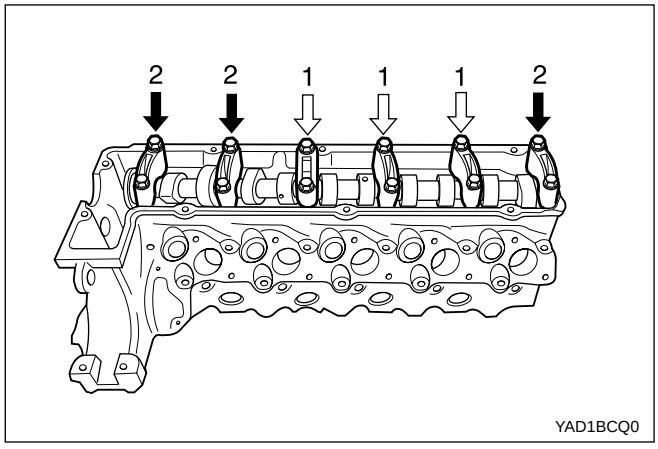
Installation Procedure

1. Insert the locking washer.
2. Check the valve tappet and ensure that tappet moves smoothly.
3. Coat the camshaft with oil and install the camshaft onto the cylinder head so that the TDC marking (arrow) is positioned upward vertically.



YAD1BCP0

4. Install the camshaft bearing caps according to markings(1, 2, 3 etc.).



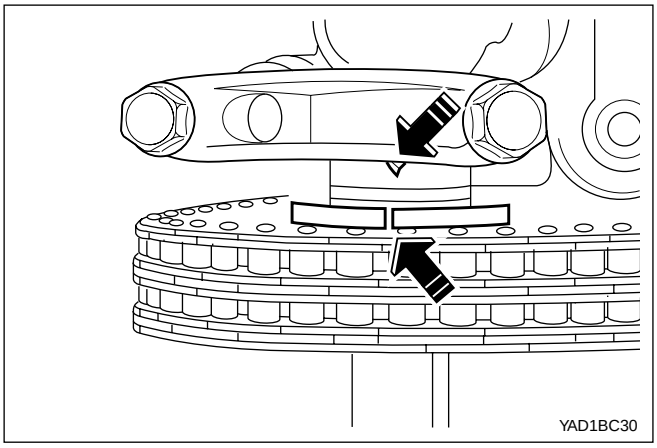
YAD1BCQ0

5. Tighten the camshaft bearing cap bolts acccording to installation order.

   Installation Notice

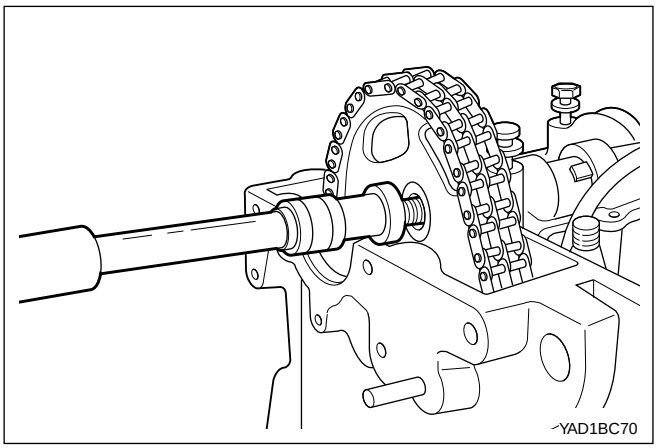
Tightening Torque	25 N•m (18 lb-ft)+ 90°

   Tighten the No. 1 bolts (light arrow) by one revolution in stages first and then tighten the No. 2 bolts (dark arrow).


YAD1BC30

6. Install the camshaft sprocket to be aligned the markings of the camshaft / camshaft bearing cap (arrow).

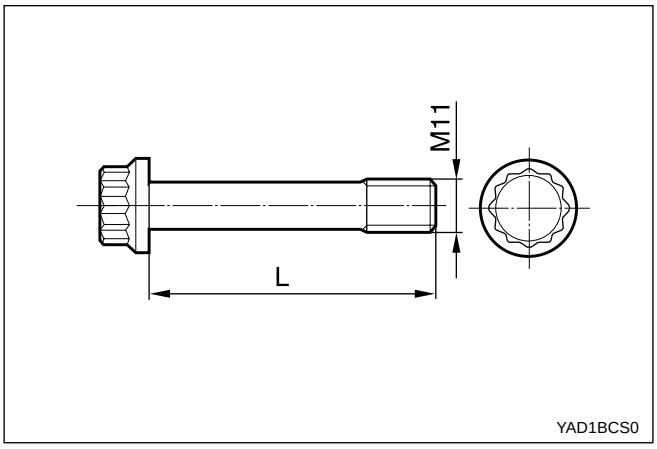
   Notice: Align the alignment marks on the timing chain and sprocket.


YAD1BC70

7. Tighten the camshaft sprocket bolt.

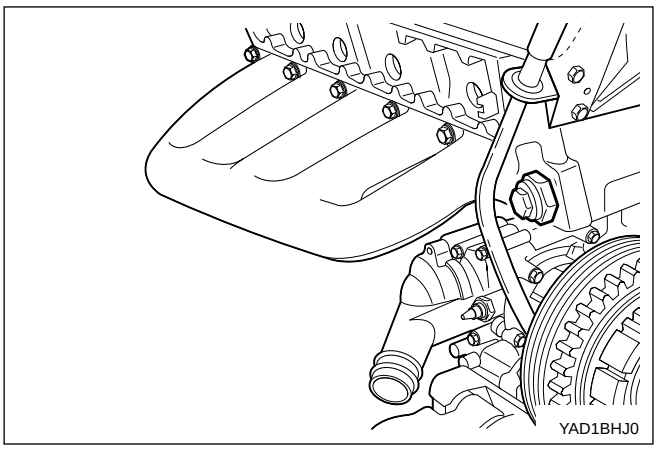
   Installation Notice

Tightening Torque	25 N•m (18 lb-ft)+ 90°



YAD1BCS0

Notice: If max. length 'L' of the 12-sided bolt exceeds 53.6mm, replace it.


YAD1BHJ0

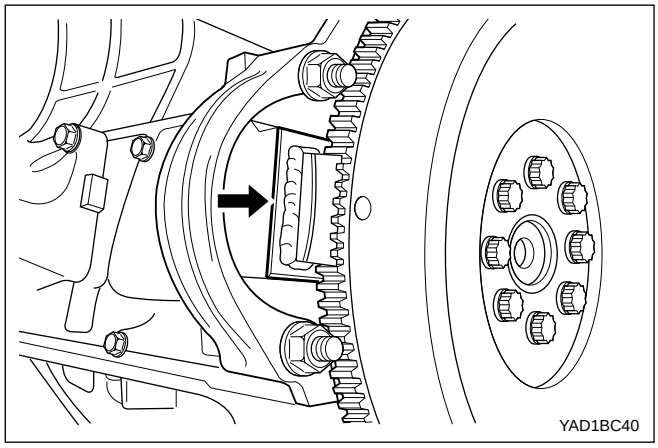
8. Install the chain tensioner.

   Installation Notice

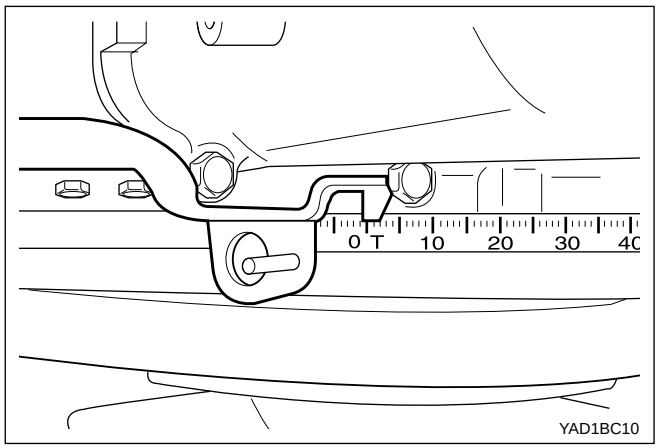
Tightening Torque	80 N•m (59 lb-ft)

   Replace the seal.

   Before installation, by pumping in the oil approx. 10 times, fill the oil.



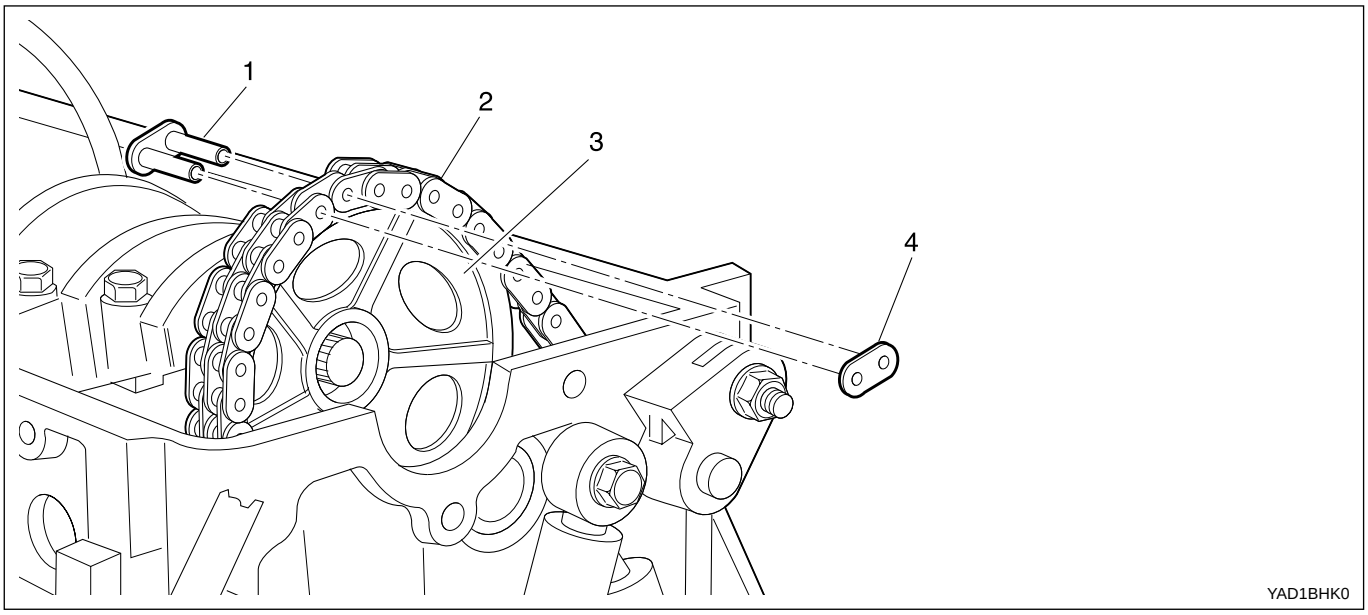
9. Remove the engine lock 602 589 00 40 00.



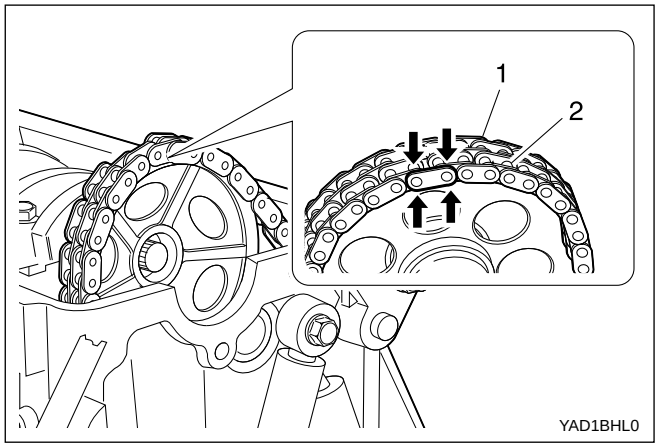
10. Check the TDC marking of OT on the crankshaft.

TIMING CHAIN

Preceding Work: Removal of glow plug
Removal of chain tensioner
Removal of cooling fan
Removal of cylinder head cover



1 Chain Link
2 Timing Chain
3 Camshaft Sprocket
4 Outer Plate

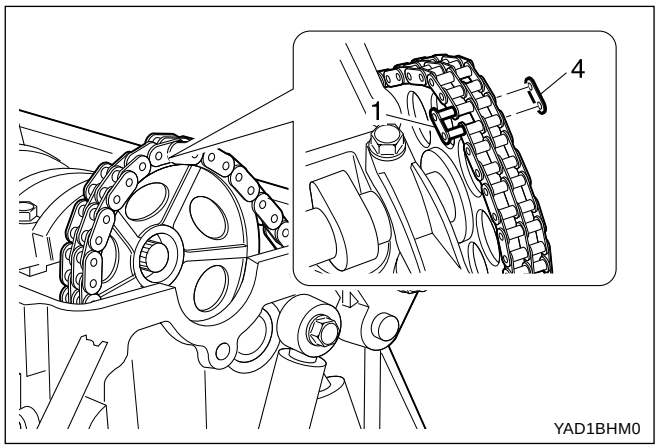


Tools Required

000 589 58 43 00 Chain Assembling Device

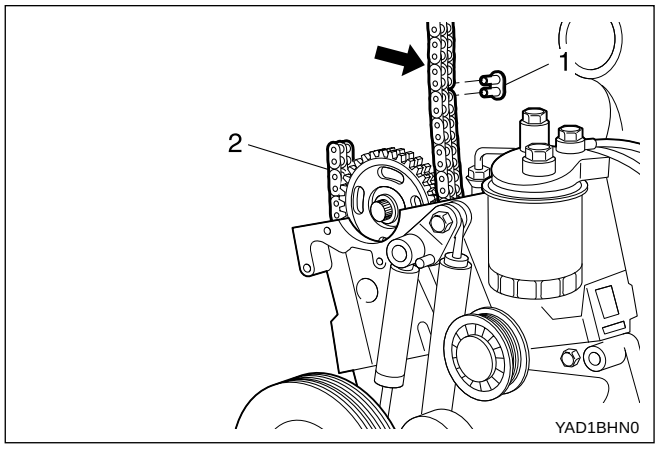
Replacement Procedure

1. Cover over the chain box with cleaning rag and grind off both chain pins (arrow) at a chain link (1) of the timing chain.

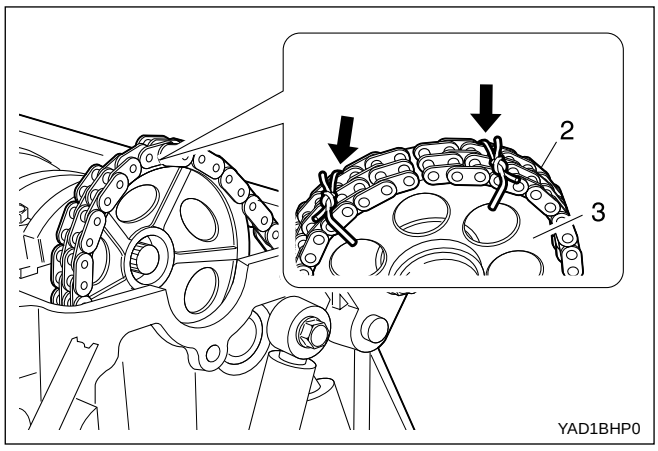


2. Remove the outer plate (4) and chain link (1).

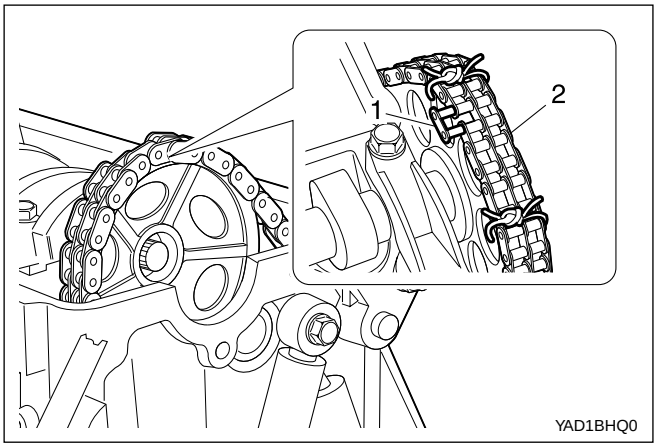
   Notice: Ensure that the ends of the timing chain do not drop into the chain box.



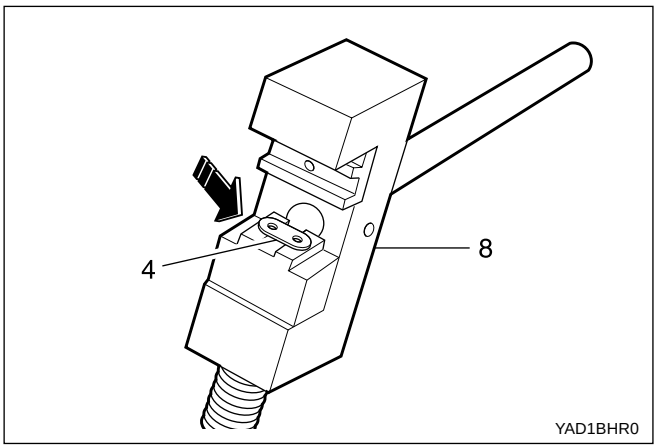
3. Loosen the chain tension with approx. 4 turns.
4. Connect the new timing chain (arrow) with chain link (1) to the old timing chain (2).



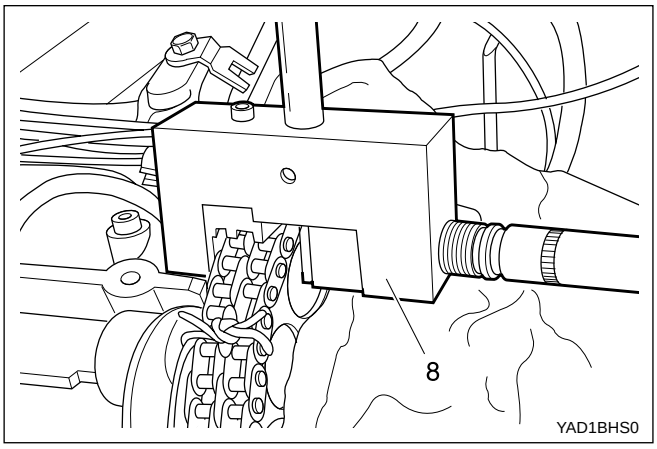
5. By rotating the crankshaft in the of engine rotation, pull out the old timing chain with installing the new timing chain.
6. Remove the old timing chain and hold the ends of the new timing chain to camshaft sprocket (3) with wire (arrow).



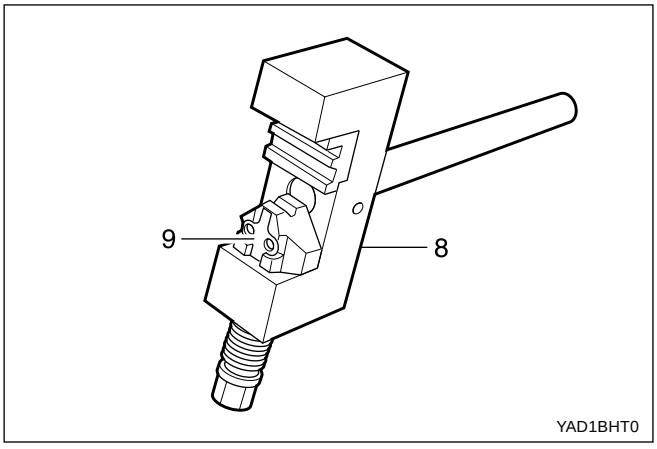
7. Insert the new chain link (1) to connect the chain.



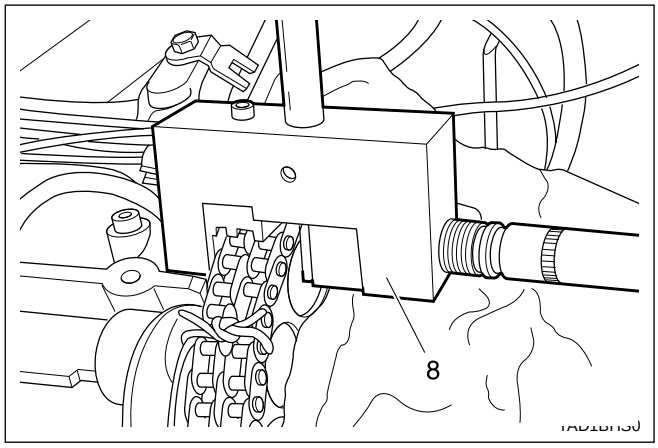
8. Insert the new outer plate (4) into the chain assembling device 000 589 58 43 00 tool (8) and then the outer plate will be held by a magnet.



9. Place the chain assembling device 000 589 58 43 00 (8) onto the chain link and press the outer plate on as far as the stop.

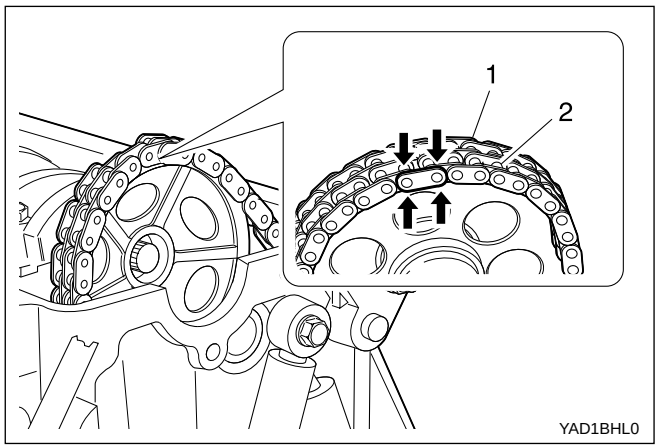


10. Switch over the die (9) of the chain assembling device 000 589 58 43 00 (8).

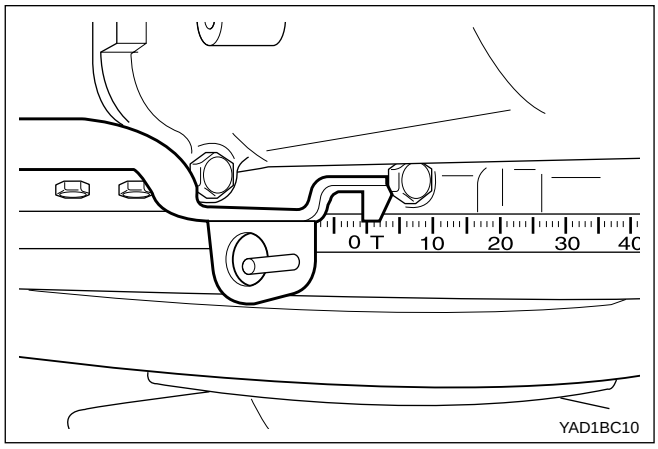


11. Place the fitting tool (8) onto the chain link and rivet the chain pins one by one.

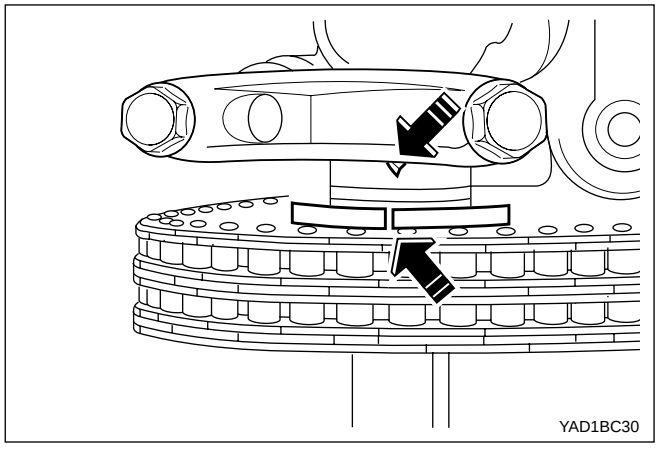
Tightening Torque	35 - 40 N•m (20 - 30 lb-ft)



12. Check the riveting of chain pins and re-rivet if necessary.
13. Remove the wire.

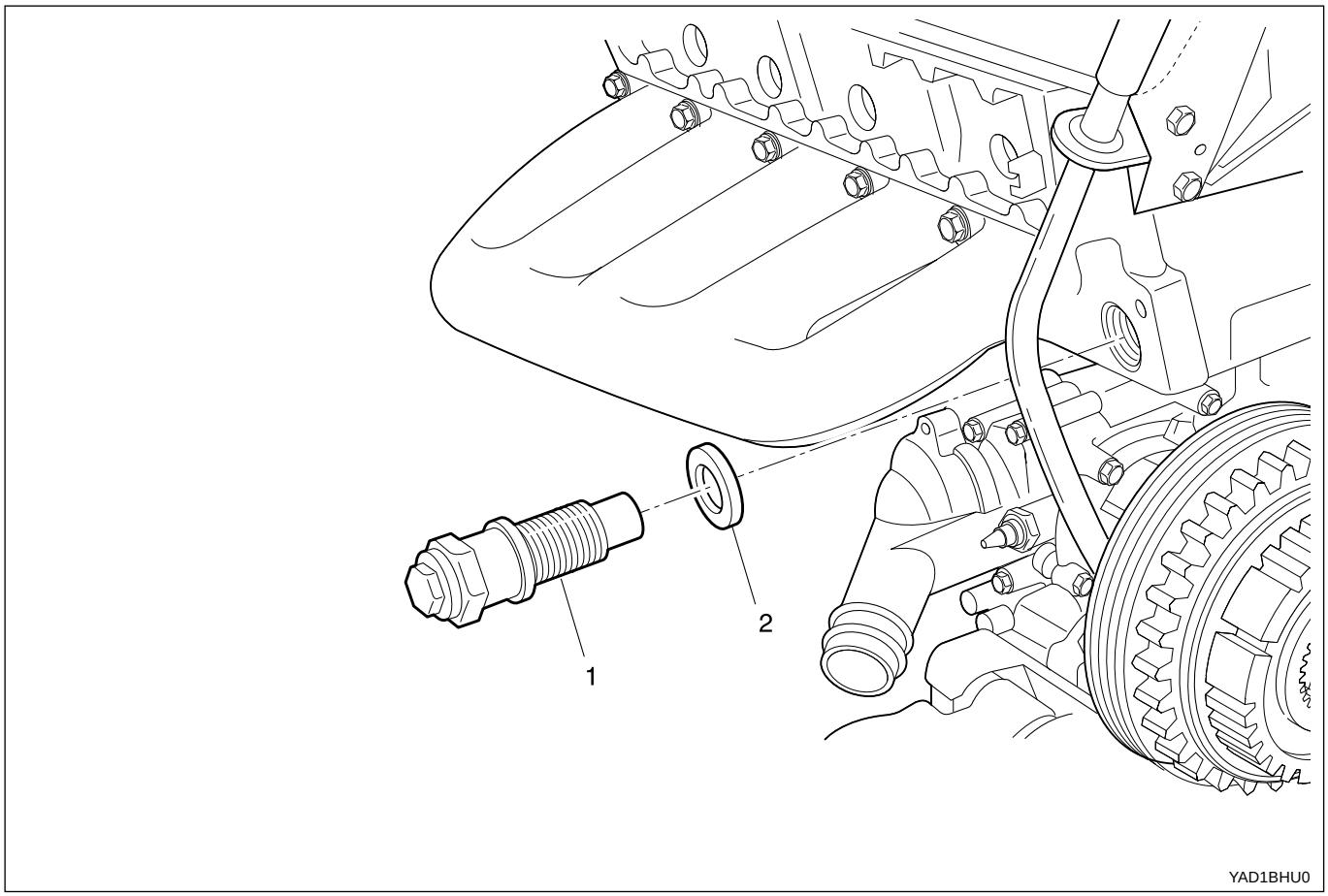


14. Position the no.1 cylinder at TDC.



Notice: In this position, the marking on camshaft / camshaft bearing cap (arrow) must also be aligned. If the markings are not aligned, the timing chain must be re-set and the injection pump timing has to be set.

CHAIN TENSIONER

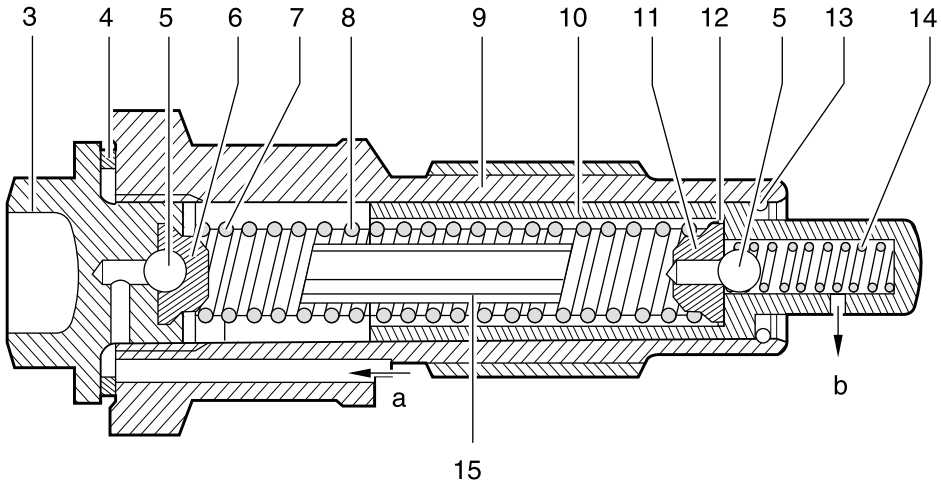


1 Chain Tensioner ..... 80 N•m (59 lb-ft)
2 Seal ..... Replace

Notice: Always install the chain tensioner to be filled with oil.

Place the chain tensioner in engine oil up to over the collar on the hexagon head with the thrust pin facing up. Slowly push down the thrust pin as far as the stop 7~10 times with the aid of a press or a column drill.

Faulty chain tensioners should be replaced completely.

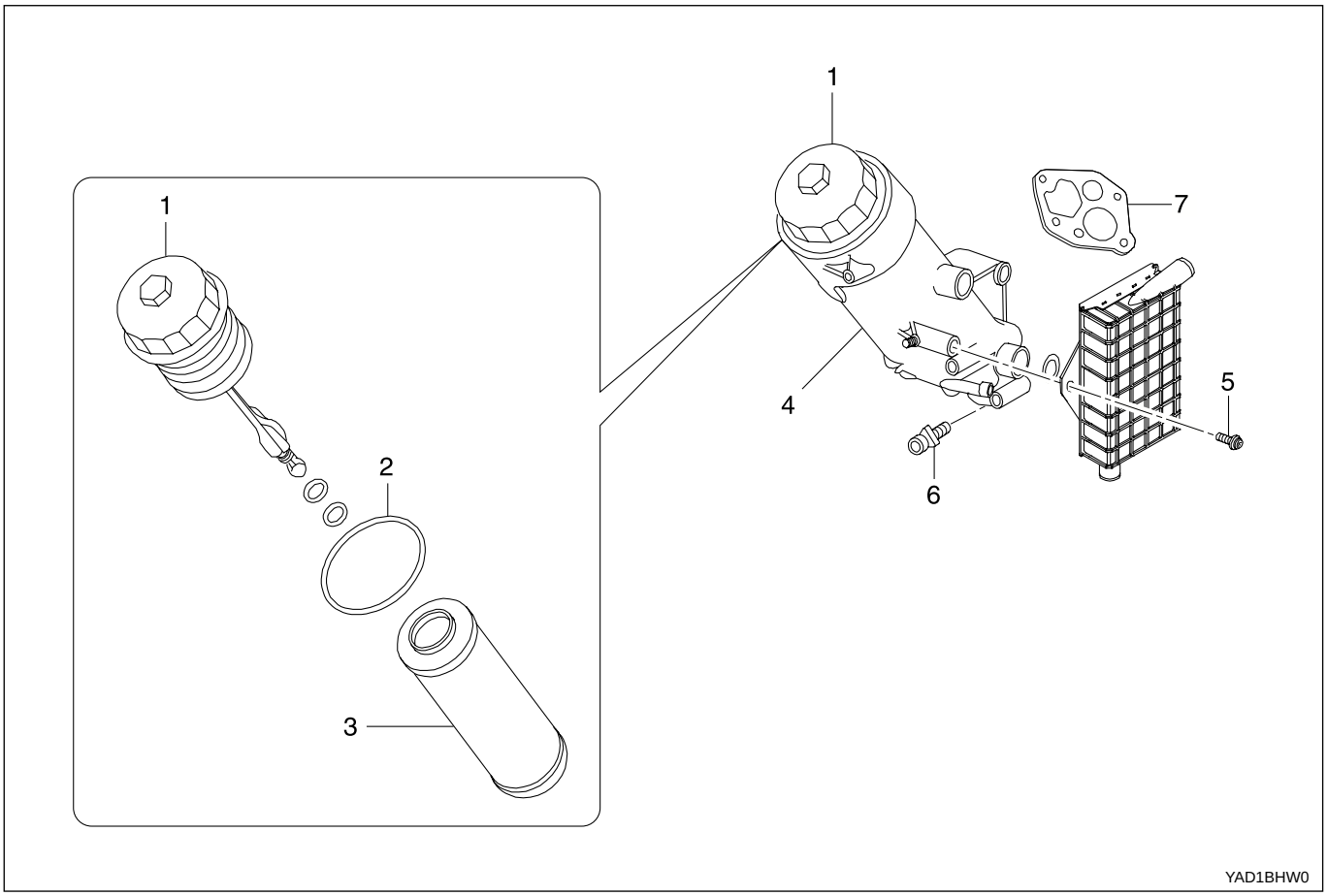


3 Screw Plug
4 Aluminum Gasket
5 Ball
6 Ball Guide
7 Compression Spring
8 Compression Spring
9 Housing
10 Thrust Pin
11 Valve Disc
12 O-Ring
13 Snap Ring
14 Compression Spring
15 Filler

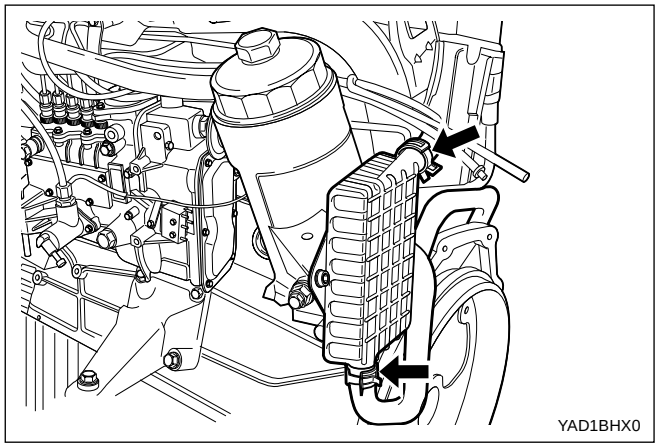
a Feed Bore from Cylinder Head
b To Oil Pan

LUBRICATION SYSTEM

OIL FILTER

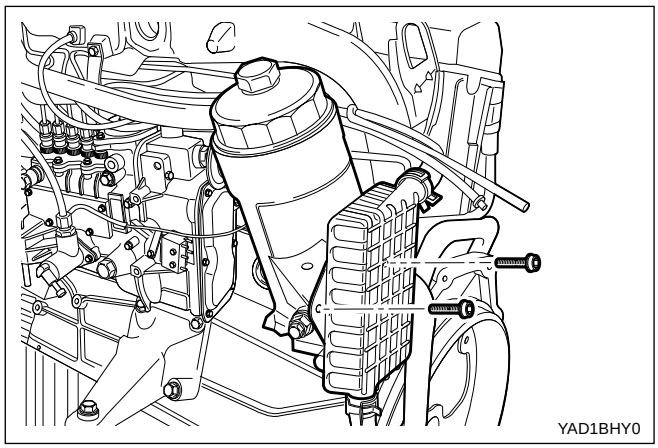


1 Housing Cap ..... 25 N•m (18 lb-ft)
2 O-Ring ..... Replace
3 Oil Filter ..... Element replace if necessary
4 Oil Filter Housing
5 Bolt ..... 25 N•m (18 lb-ft)
6 Oil Pressure Switch
7 Gasket



Removal & Installation Procedure

1. Disconnect the oil cooler inlet and outlet hoses.



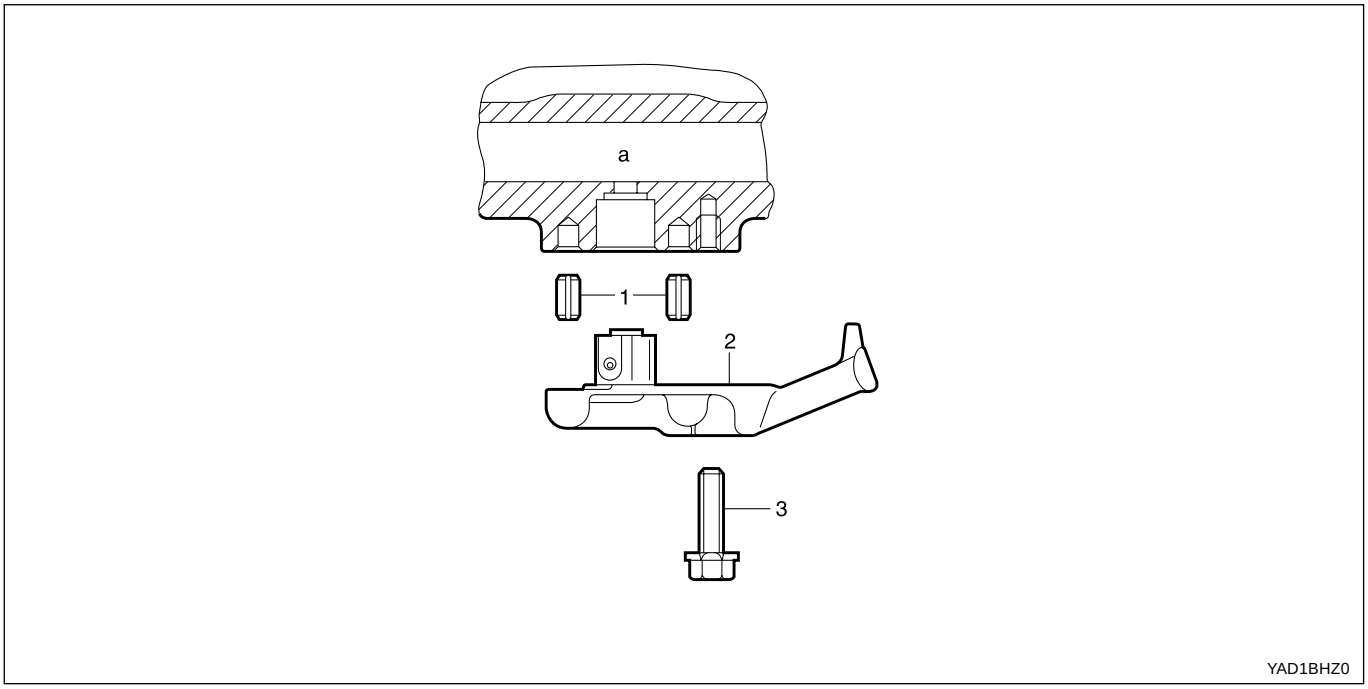
2. Remove the oil pressure switch line.
3. Remove the oil filter housing bolts and oil filter housing.

Installation Notice

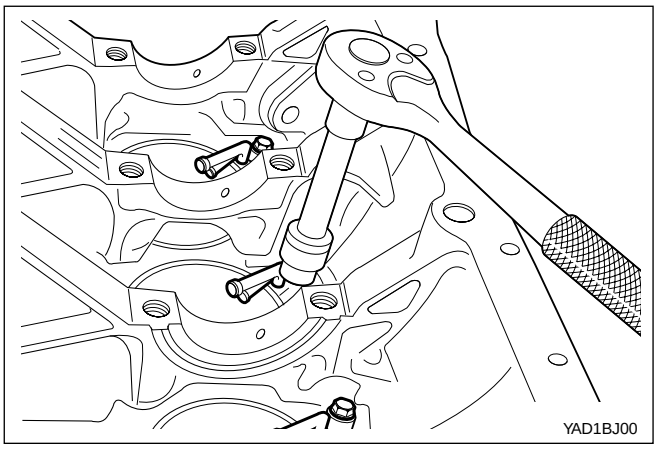
Tightening Torque	25 N•m (18 lb-ft)

4. Clean the sealing surface.
5. Installation should follow the removal procedure in the reverse order.

OIL SPRAY NOZZLE



1 Fitting Sleeve
2 Oil Spray Nozzle
3 Combination Bolt ..... 10 N•m (89 lb-in)
a Oil Duct



Removal & Installation Procedure

1. Remove oil pan or crankshaft.
2. Loose the bolt and then remove the nozzle.

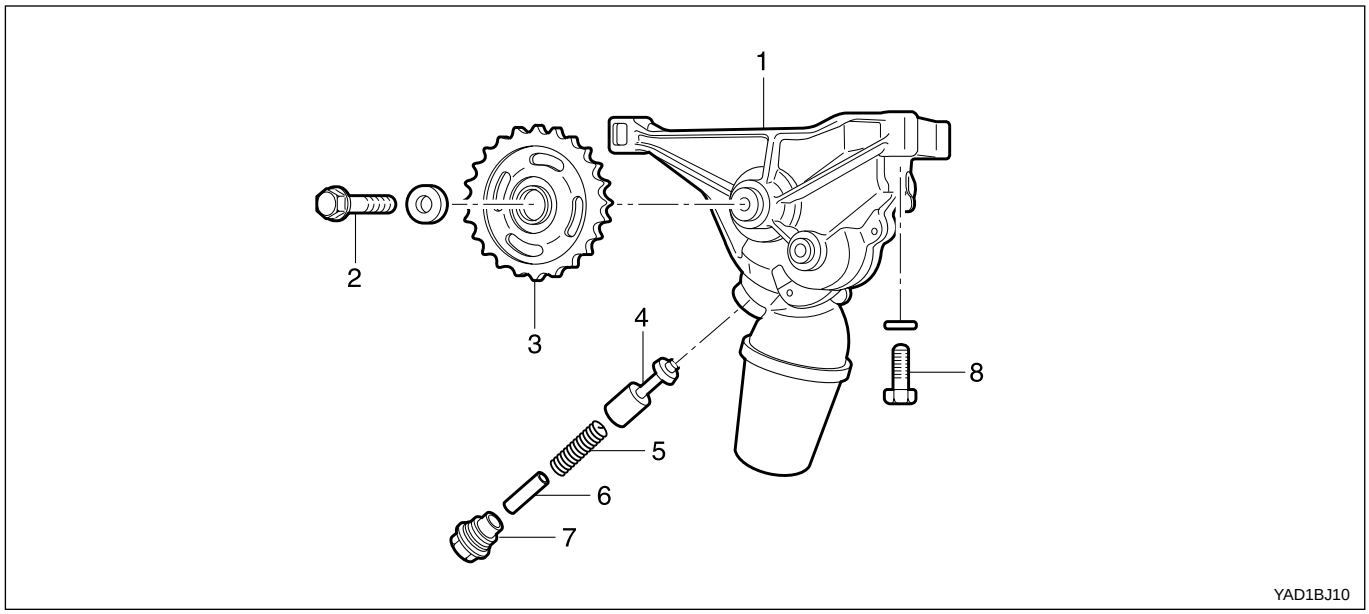
Installation Notice

Tightening Torque	10 N•m (89 lb-in)

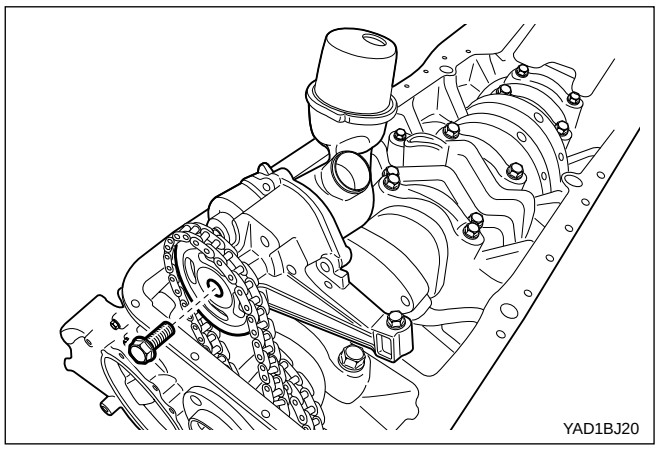
3. Installation should follow the removal procedure in the reverse order.

OIL PUMP

Preceding Work: Removal of oil pan



1 Oil Pump
2 Bolt ..... 25 N•m (18 lb-ft)
3 Sprocket
4 Poston
5 Pressure Spring
6 Guide Pin
7 Screw Plug ..... 50 N•m (37 lb-ft)
8 Bolt ..... 25 N•m (18 lb-ft)

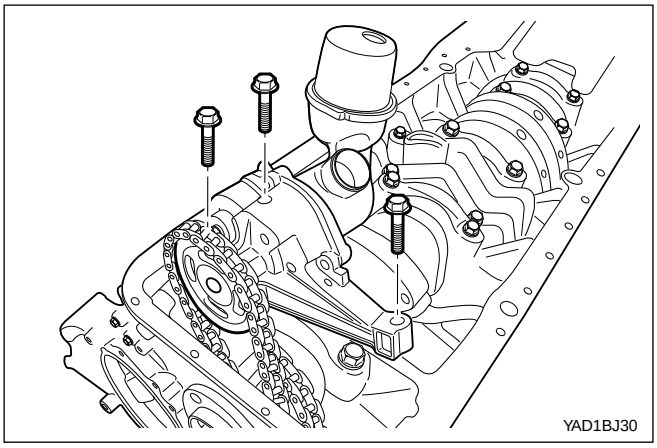


Removal & Installation Procedure

1. Removae the bolt from the oil pump drive sprocket and separate the gear and the oil pump drive chain.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)



2. Remove the oil pump mounting bolts and oil pump.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

3. Unscrew the screw plug and remove the relief valve.

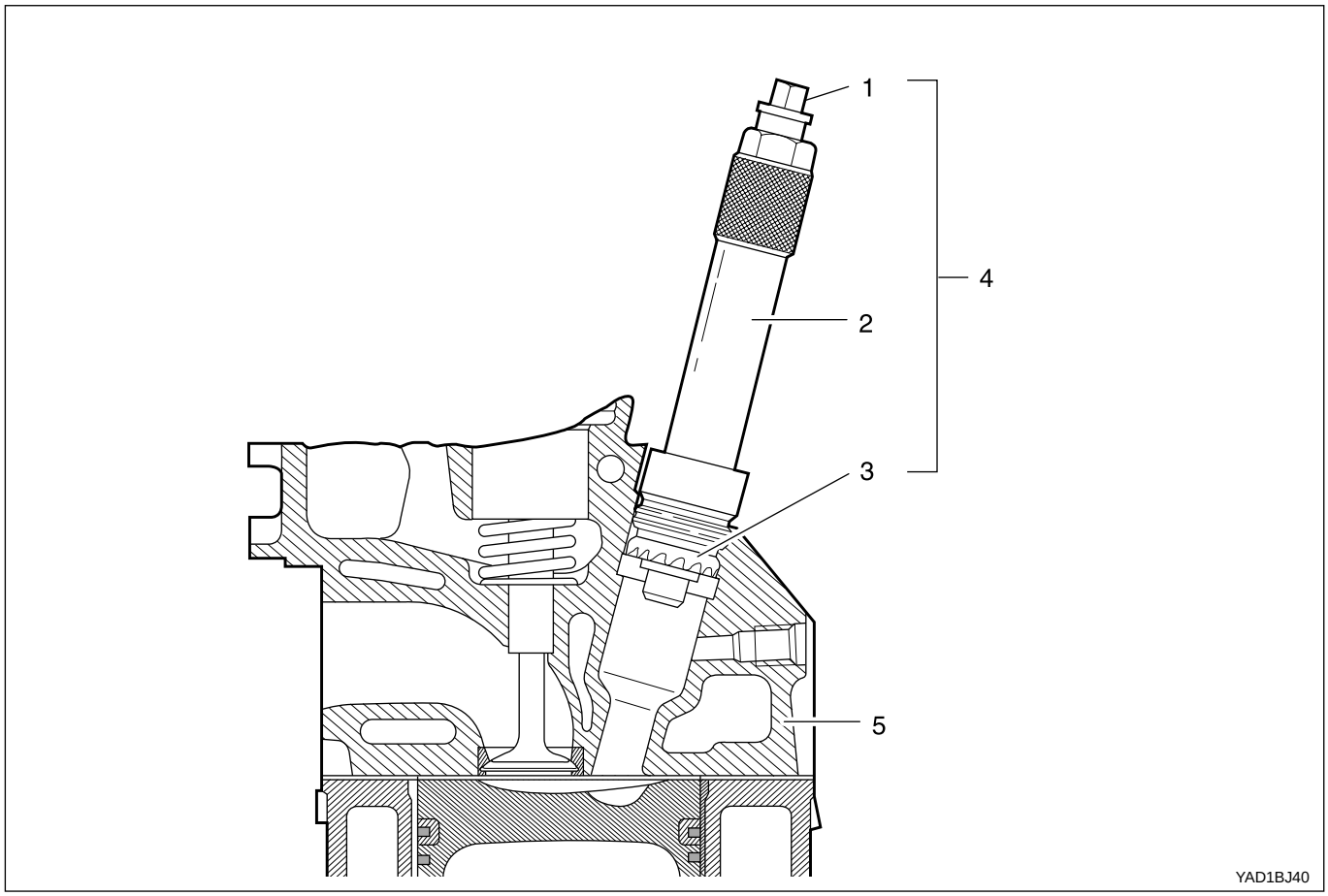
Installation Notice

Tightening Torque	50 N•m (37 lb-ft)

4. Installation should follow the removal procedure in the reverse order.

UNIT REPAIR

MILLING OF PRECHAMBER SEALING SURFACE



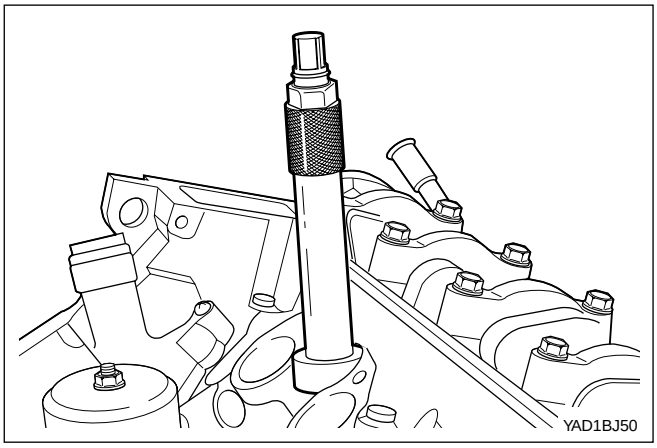
1 Drift
2 Sleeve
3 Milling Cutter
4 Counter Sink (Special Tool - 601 589 00 66 00)
5 Cylinder Head

Notice: The prechamber sealing surface may only be remachined once with the cylinder head fitted. It is essential to adhere to the specified projection ‘C’ of the prechamber of 7.6 - 8.1mm.

This ensures that the required clearance exists between prechamber and piston crown with the piston in TDC. For this reason, spacer rings should be inserted on remachined sealing surfaces.

Thickness of spacers	0.3, 0.6, 1.0 mm

If a spacer ring is already fitted, or a marking is made on the cylinder head, the cylinder head must be removed and size ‘C’ measured if further remachining is necessary on a prechamber sealing surface.



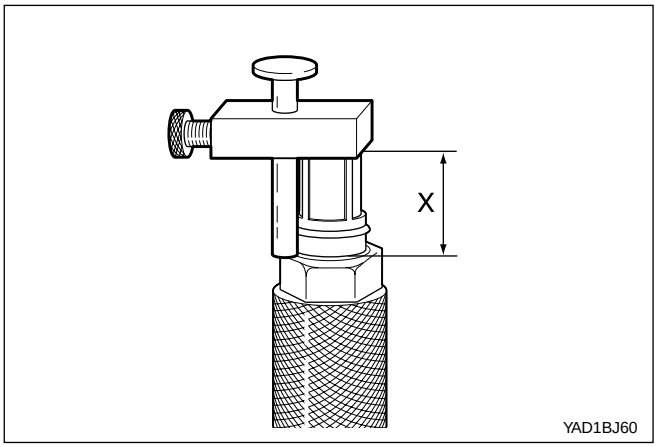
Tools Required

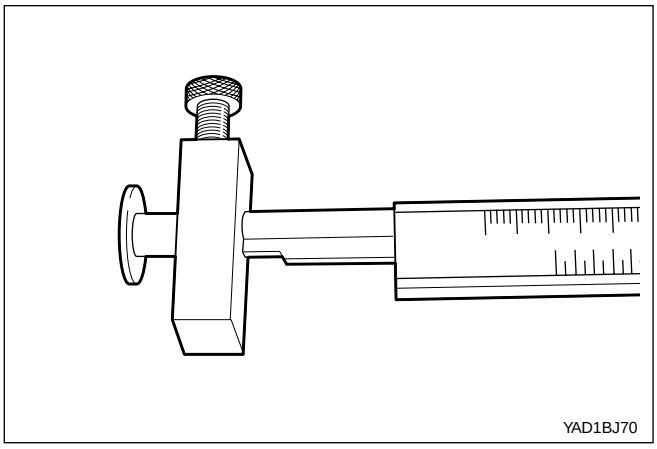
601 589 00 66 00 Counter Sink

607 589 00 23 00 Height Gauge

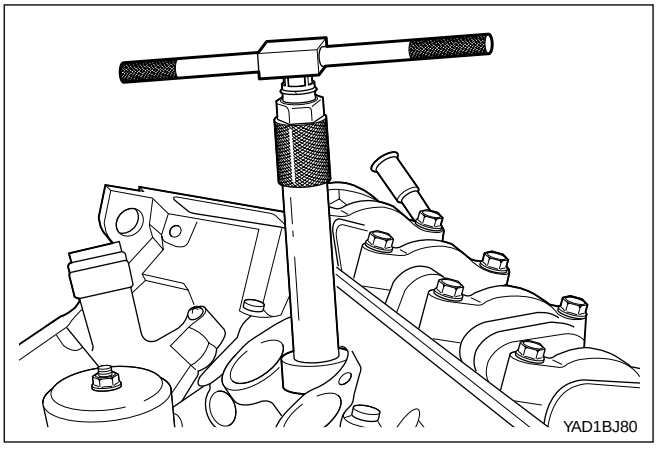
Milling of the Prechamber Sealing Surface

1. Remove the injection nozzle.
2. Remove the prechamber.
3. Cover the prechamber bore to avoid any chips dropping into the combustion chamber.
4. Remove the protective sleeve from the counter sink 601 589 00 60 00 and rotate the counter sink 601 589 00 60 00 into the prechamber bore to be machined as far as the stop.
5. Maintain size ‘X’ from the top edge of mandrel to the top edge of the sleeve with the height gauge 667 589 00 23 00.





6. Measure the ‘X’ by using a vernier caliper.



7. Mount the turning tool onto the counter sink 601 589 00 60 00 and rotate to the right approx. 5 revolutions by applying slight pressure.

8. Remeasure size ‘X’ and compare it with the first measurement and determine the thickness of spacer ring.

Ex

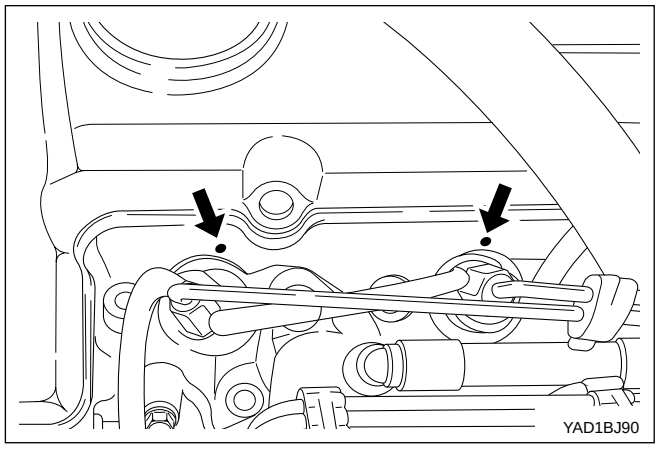
Size before machining	25.7 mm
Size after machining	25.5 mm

The spacer ring should be selected so that it is at least 0.1 mm and not more than 0.3 mm thicker than the measured on the sealing surface. In this example, the necessary thickness of spacer ring should be within 0.3 ~ 0.5 mm and the thickness of spacer ring to be installed is 0.3 mm.

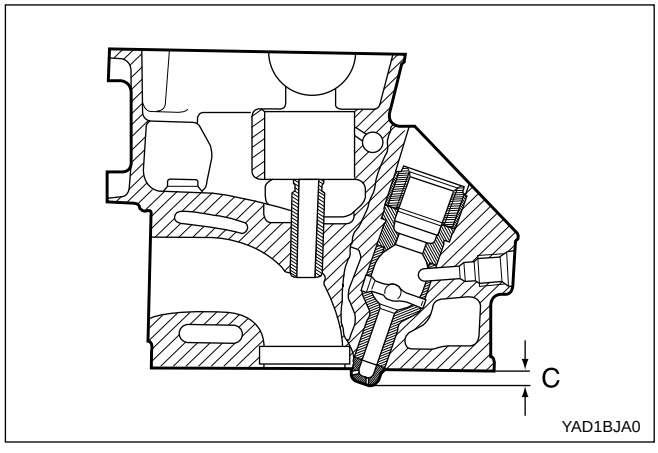
9. Remove the counter sink 601 589 00 60 00 and clean the chips.

Notice: If the sealing surface is not completely flat, remachine the sealing surface.

10. Remove rag from the prechamber bore and crank the engine with starter motor to threw out any chips which may have got into the combustion chamber.
11. Insert the proper spacer ring into the prechamber sealing surface.



12. Punch a mark on the cylinder head above the prechamber sealing surface which has been machined.



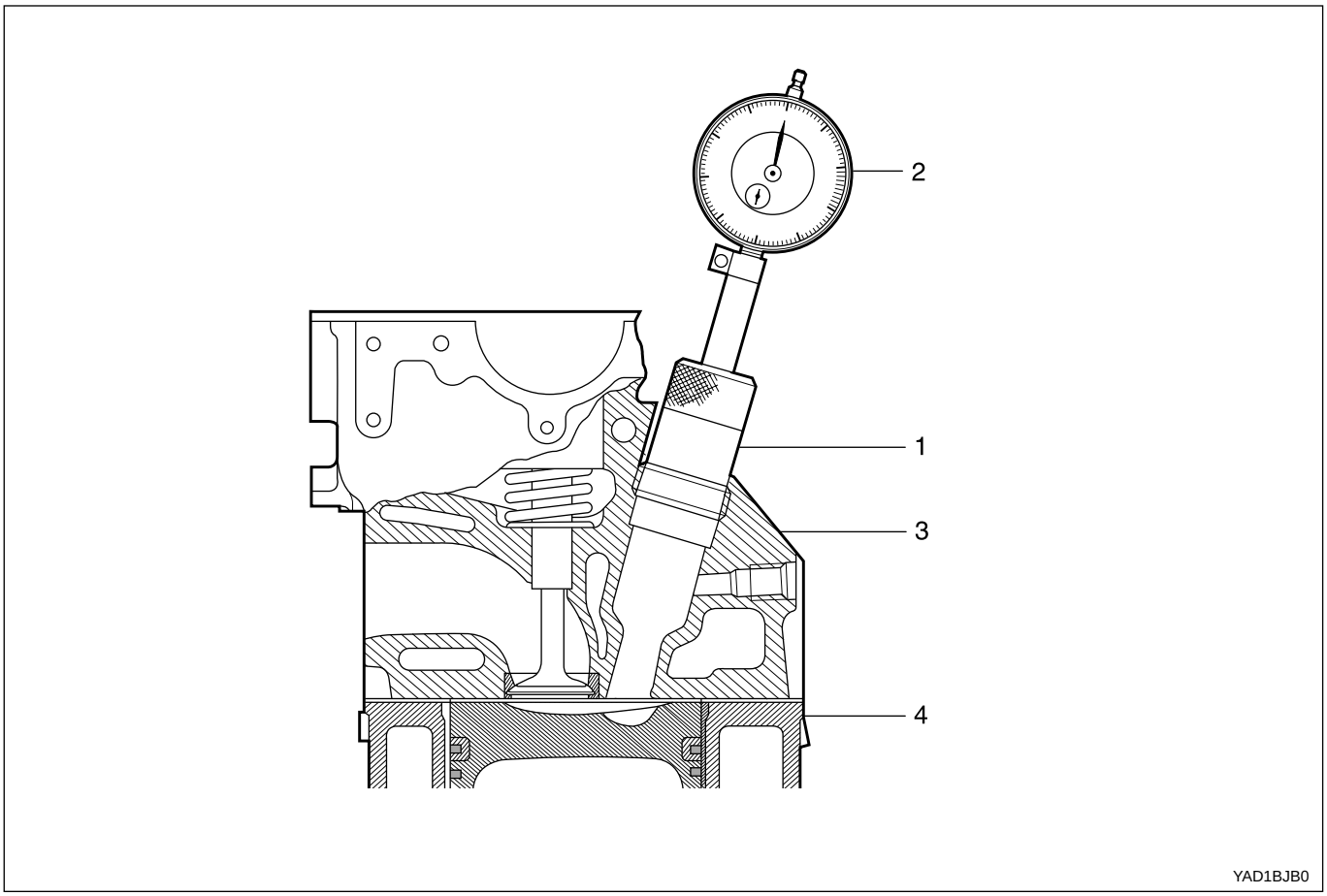
13. Install the prechambers.

Notice: If the cylinder head is removed, the projection ‘C’ is measured in place of size ‘X’ and the appropriate size of spacer ring selected.

Normal Projection (C)	7.6 - 8.1 mm

TDC (TDC SENSOR BRACKET) SETTING

Preceding Work: Removal of No.1 cylinder prechamber



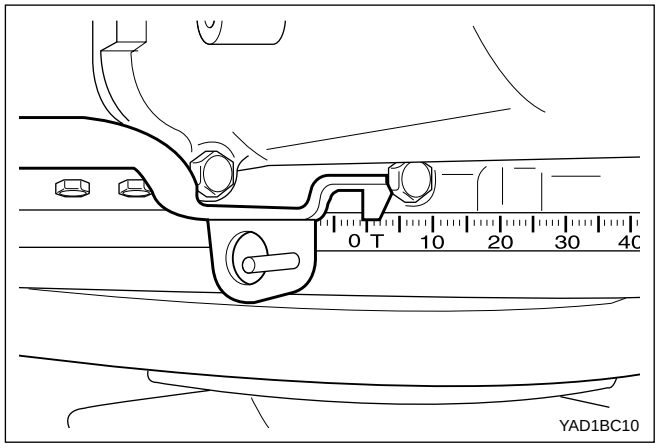
1 Measuring Device
2 Dial Gauge
3 Cylinder Head
4 Piston ..... Set at TDC

Notice:

The TDC sensor bracket must be adjusted in case of followings.

- When replacing the TDC sensor bracket.
- When replacing the crankshaft, the hub or the vibration damper.
- When replacing or installing the timing case cover.
- After engine overhauling.

* If the cylinder head is removed, the measuring pin of the dial gauge can be positioned on the piston crown. This is done by placing the magnetic dial holder on the mating surface of the crankcase.

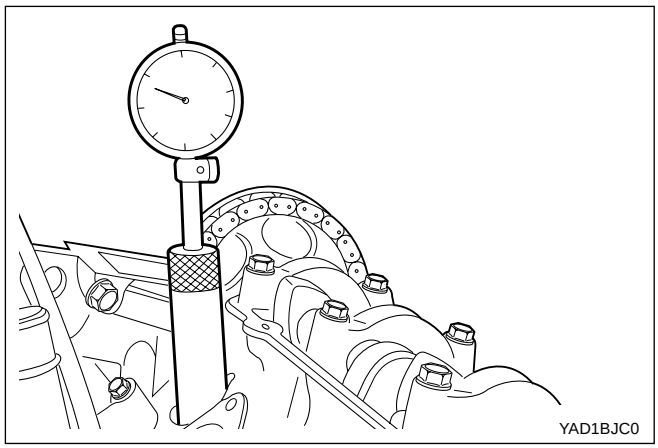


Tools Required

001 589 32 21 00 Dial Gauge
601 589 07 21 00 Measuring Device
667 589 01 21 00 Fixing Device

Setting (With Cylinder Head Installed)

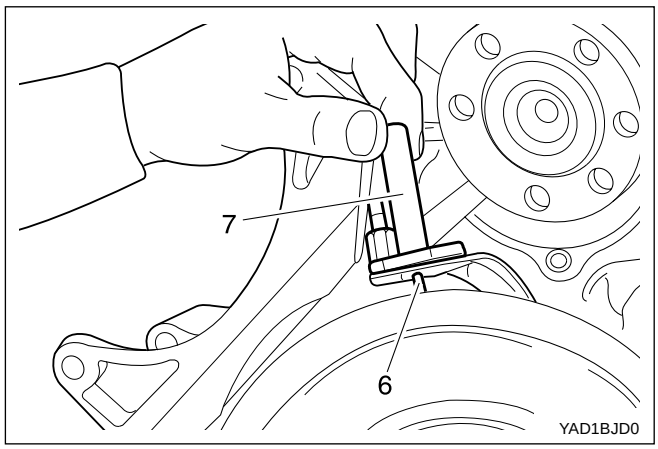
1. Remove the prechamber of No. 1 cylinder.
2. Position the piston of No.1 cylinder at BTDC 10°.



3. Install the measuring device 601 589 07 21 00 into the prechamber bore and position the dial gauge 001 589 53 21 00 with a preload of 5mm.
4. Slowly rotate the crankshaft in the direction of engine rotation until the large pointer on the dial gauge 001 589 53 21 00 stops (TDC position).

   Notice: The position of TDC is when the large pointer on the dial gauge is stopped before moving back.

5. Remove the reinstall the measuring device and position the dial gauge 001 589 53 21 00 scale at '0'.
6. Slowly rotate the crankshaft in the direction of engine rotation until the dial gauge 001 589 53 21 00 has moved back (counterclockwise) by 3.65 mm.



7. Insert fixing device into the sensor bracket.

   Notice: The pin (6) on the vibration damper must engage into the slot of the fixing device 667 589 01 21 00 (7).

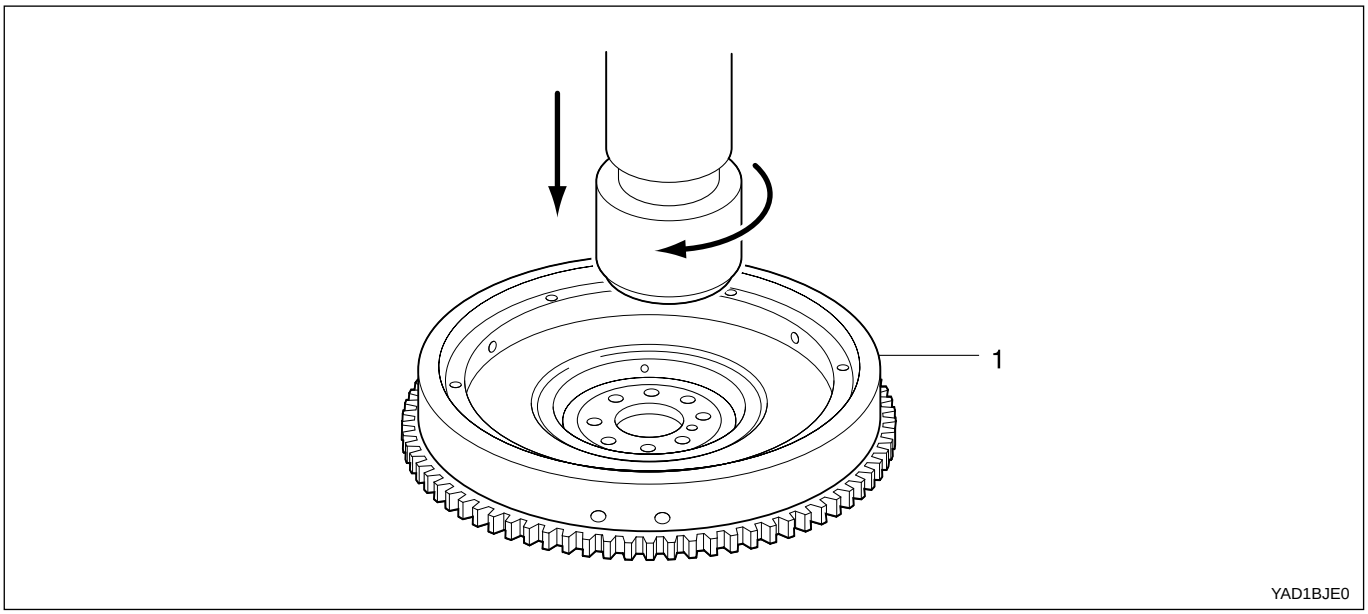
8. If the pin does not engage, adjust the setting of the sensor bracket by removing and tightening of the sensor bracket bolts.

   Installation Notice

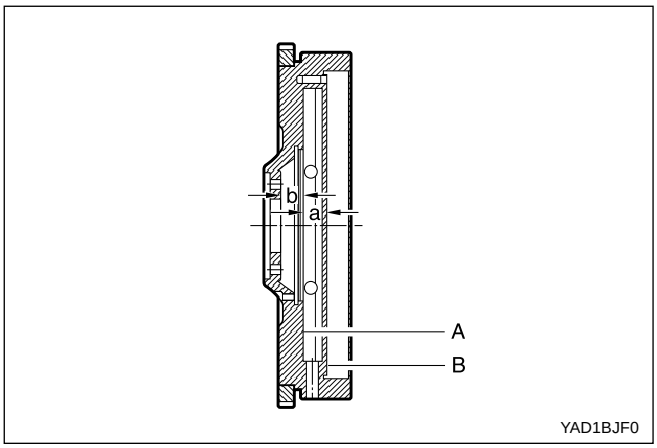
Tightening Torque	10 N•m (89 lb-in)

   The timing mark on the damper must be positioned at ATDC 20°.

MACHINING OF FLYWHEEL



1 Flywheel



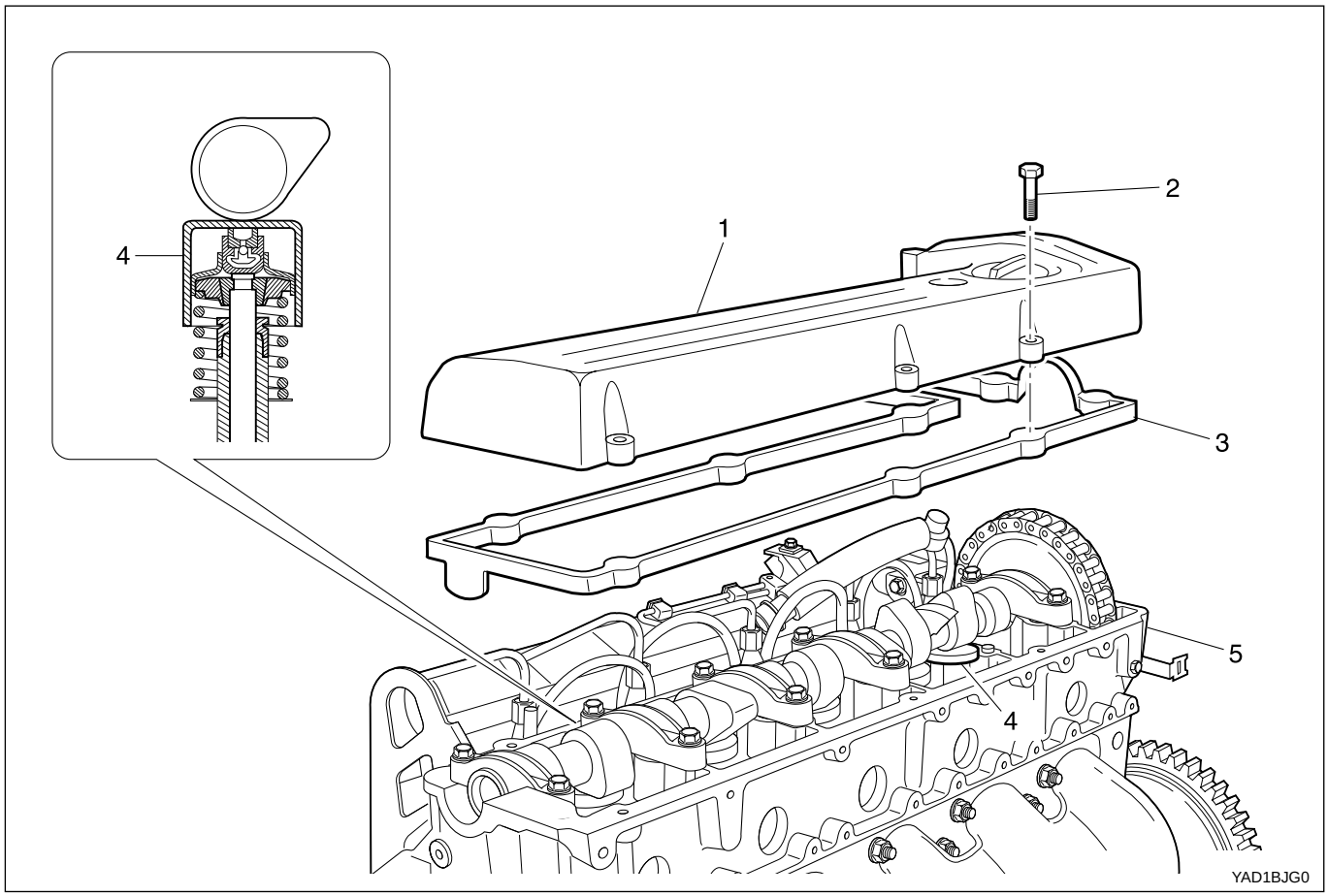
Machining of Flywheel

Notice: Flywheels which have scorch marks, scoring or cracks in the clutch surface should be machined by grinding or precision-turning. If the scores or cracks are severe than permissible specifications, replace the flywheel.

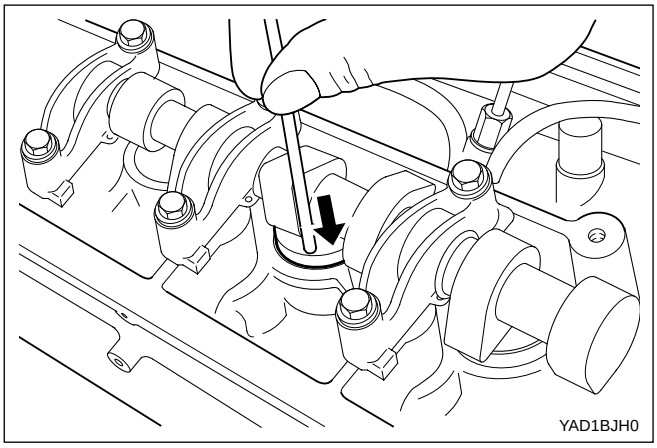
Distance ‘a’	19.3 - 19.5 mm	
Distance ‘b’	New	16.6 mm
	Repair up to	15.6 mm
Max. axial runout		0.05 mm

- When machining the clutch surface ‘A’, the mounting surface (B) for the clutch pressure plate should also be machined in accordance with ‘A’ to keep the distance ‘a’.
- Do not machine under ‘b’ value.
- When machining, fix the flywheel exactly not to exceed the standard runout.

HYDRAULIC VALVE CLEARANCE COMPENSATION ELEMENT CHECK



1 Cylinder Head Cover
2 Bolt.....10 N•m (89 lb-in)
3 Gasket..... Replace
4 Valve Tappet
5 Cylinder Head



Checking

Notice: The noise which continues short time during short travel (frequent starting of the engine) or engine starting after a long time storage is normal operating conditions. So, it does not need to be repaired. Determine the malfunctions in valve clearance compensation device with noise through following tests. If defective, replace as respectively.

1. Run the engine at more than 3000rpm for approx. 4 minutes.
2. Stop the engine. After 5minutes, check the engine oil level and adjust if necessary.
3. Remove the cylinder head cover.
4. Check the valve tappets at TDC position of each cylinders.
5. Using a drift, lightly press the valve tappet and measure clearance between the cam and valve tappet.

   Notice: If the clearance exceeds 0.4mm, replace the valve tappet.

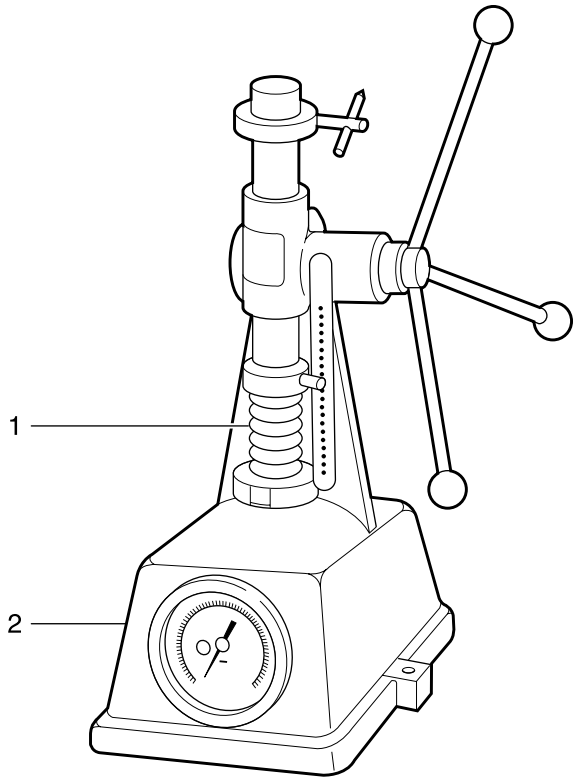
6. If a valve tappet moves down too far in comparison to the others, replace the valve tappet.
7. Rotate the engine and check the remaining valve tappets.

   Notice:

   - Unnecessary rotation of the engine will damage the valve tappets.
   - Do not rotate the engine by using the camshaft sprocket bolt or to the opposite direction of the engine rotation.

VALVE SPRINGS CHECK

Preceding Work : Removal of valve spring



YAD1BJJ0

1 Valve Spring

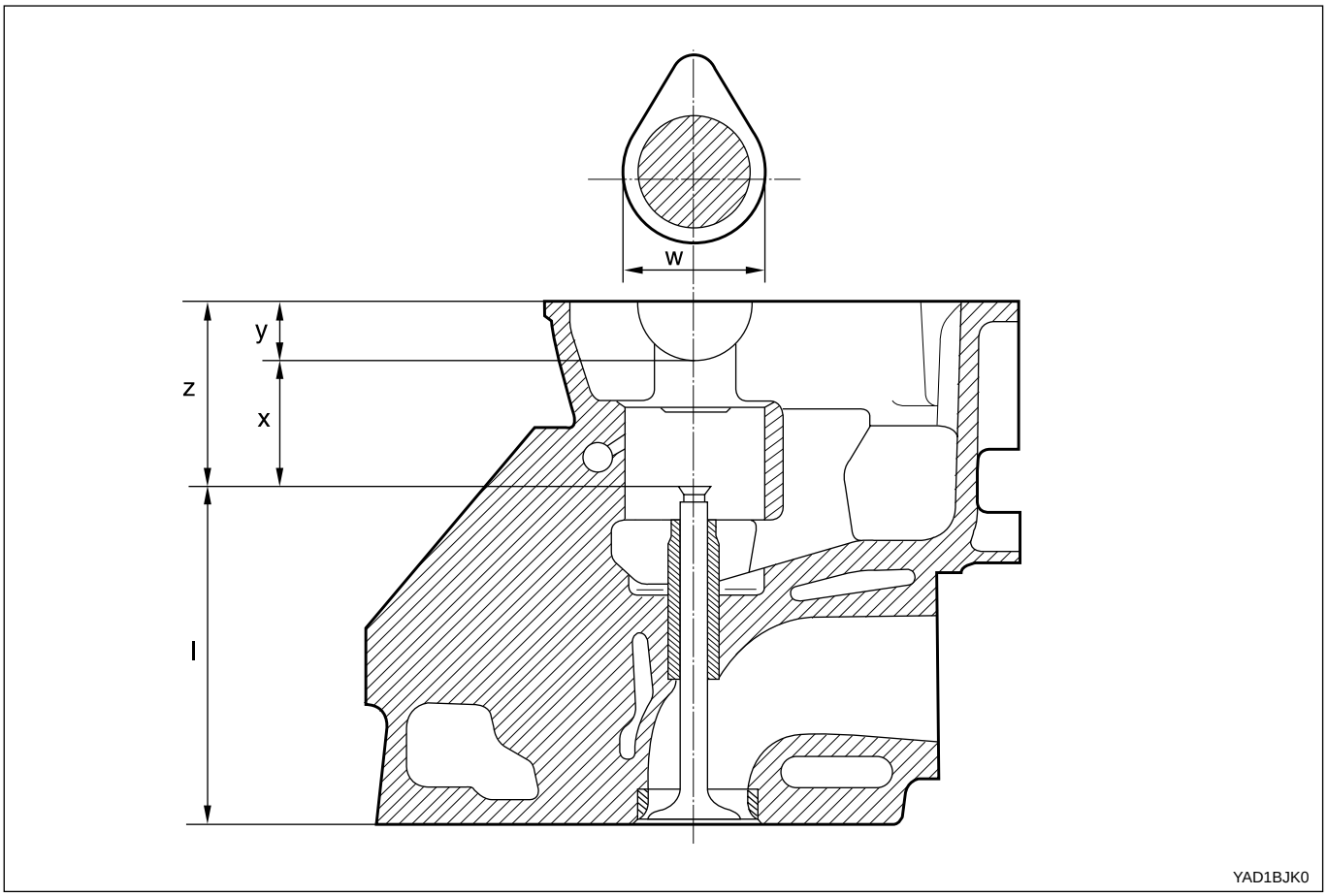
2 Spring Scale

Service Data

Outer diameter	Wire diameter	Free length	At preloaded		
			Length	Tension (new)	Limit
33.1 mm	4.20 mm	50.0 mm	27 mm	680 - 740 N	612 N

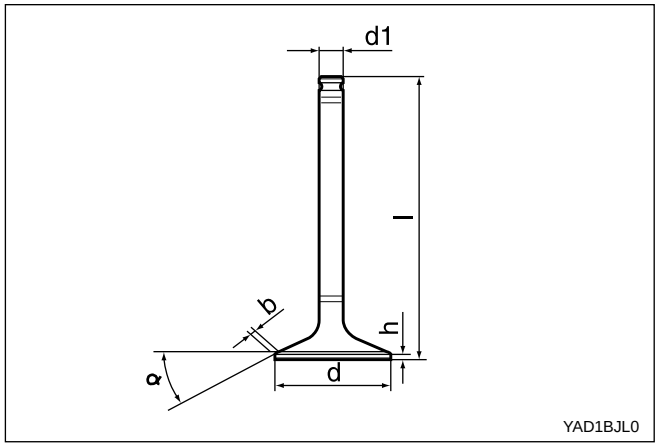
CHECK AND MACHINING OF VALVES

Preceding Works: Removal of cylinder head
Removal of the vale spring
Removal of the valve

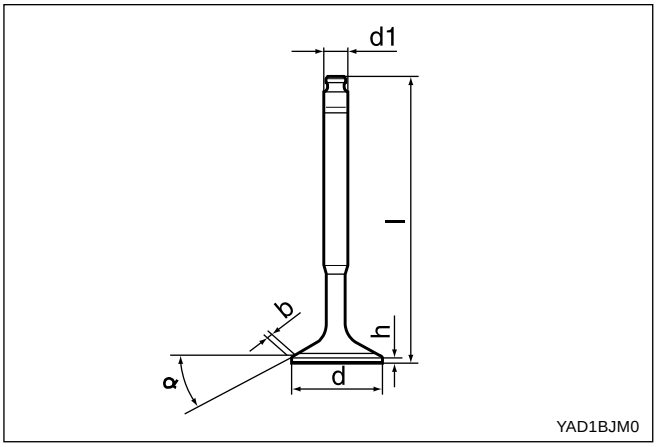


l Valve Length
w Camshaft Cam Basic Diameter
x Distance (Camshaft Basic Bore - Valve Stem)
y Half Camshaft Basic Bore Diameter
z Distance (Cylinder Head Cover Parting Surface - Valve Stem)

Intake Valve



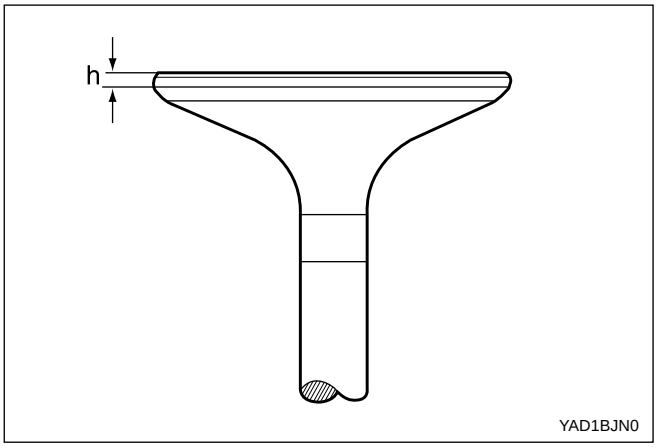
Exhaust Valve



Item		Intake Valve	Exhaust Valve
Valve Disc Diameter ‘d’		37.90 - 38.10 mm	34.90 - 35.10 mm
Valve Disc Height ‘h’		1.7 mm	1.7 mm
Setting Angle “α” o r Machining the Valve		45°	45°
Valve Stem Diameter ‘d1’		7.955 - 7.970 mm	9.945 - 8.960 mm
Valve Length ‘I’	Standard	106.20 - 106.60 mm	106.20 - 106.60 mm
	Repair	105.30 - 105.70	105.30 - 105.70 mm
Max. Permissible Runout at Valve Stem and Valve Seat		0.03 mm	0.03 mm

Matching Valves

	Camshaft Cam Basic Dia. W = 38.0 ± 0.2 mm	Camshaft Cam Basic Dia. W = 36.6 ± 0.2 mm	Valve to be used
Size (x)	19.5 - 20.3 mm	19.5 - 20.1 mm	Use machined valve, if needed new repair valve I = 105.5 ± 0.2 mm
Size (x)	20.4 - 21.4 mm	20.2 - 21.2 mm	Reuse valve
Size (x)	21.4 - 21.97 mm	21.2 - 21.97 mm	Use standard size valve I = 106.4 ± 0.2 mm



Tools Required

001 589 32 21 00 Dial Gauge

Commercial Tool

Valve corn grinding machine

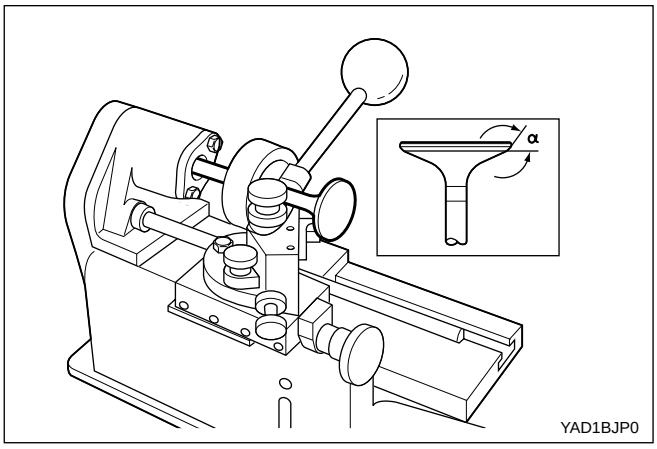
Checking and Machining Procedure

1. Clean the valves and do visual check.

   Notice: Valves with wobbled valve disc, with worn or scored valve stem should be replaced.

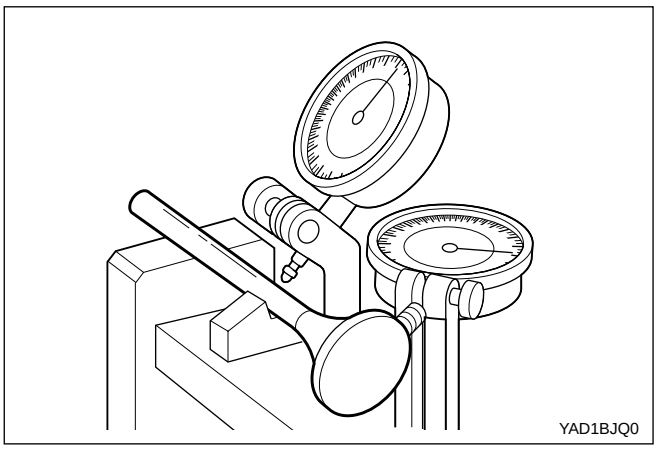
2. Measure valve disc height ‘h’.

Service data	Intake	1.7 ± 0.15 mm
	Exhaust	1.7 ± 0.15 mm



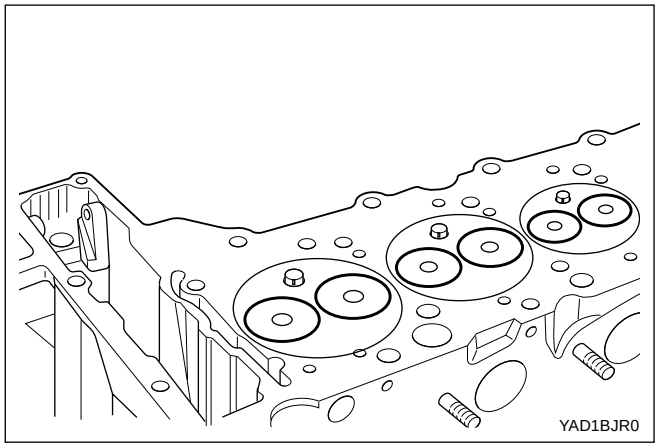
3. Machine the valve.

   Notice: Pay attention to setting angle ‘α’ .

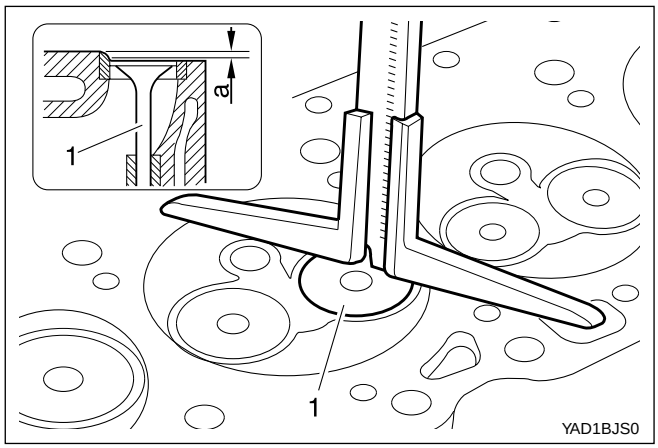


4. Measure radial runout between valve stem and valve seat with a dial gauge 001 589 32 21 00.

Limit	Max. 0.03 mm



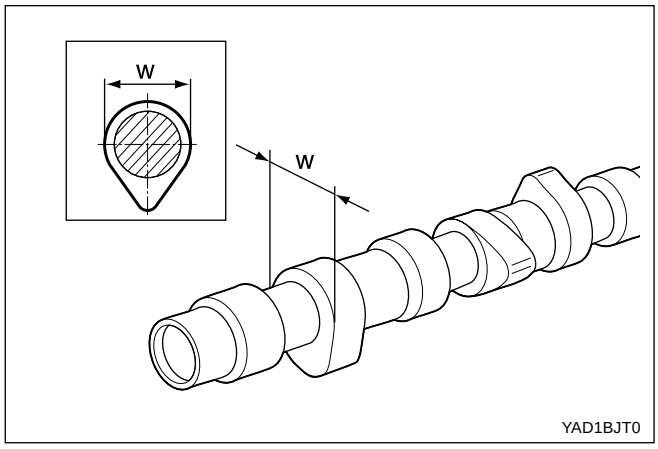
5. Clean the vales, valve seats and valve guides.
6. Coat the valve stem with oil and insert it into valve guide.



7. Insert the valves (1) into the valve guides according to marking.
8. Measure amount by which the valve arrears ‘a’.

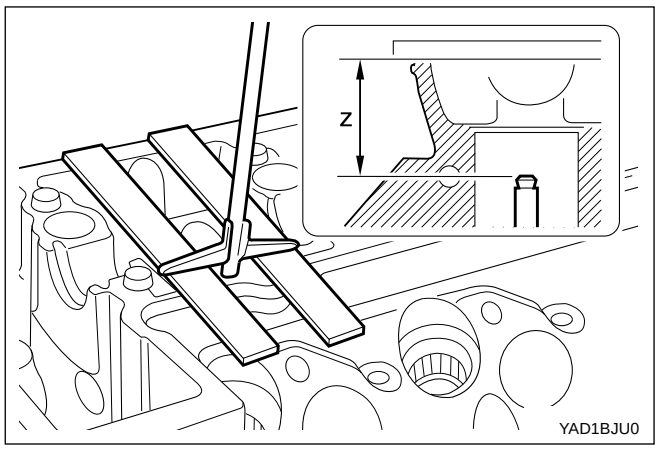
Arrears ‘a’	0.1 - 0.7 mm

Notice: If out of standard, replace the valve seat ring.



9. Measure camshaft cam basic diameter (w).

Diameter ‘w’	38 ± 0.2 mm or 37.6 ± 0.2 mm



10. Measure distance ‘z’ (cylinder head cover parting surface - valve stem).

11. The distance ‘x’ (camshaft basic bore - valve stem).

    ‘x’ = ‘z’ - ‘y’.

    Determine the valve to use according to this measurement (See ‘matching valves’)

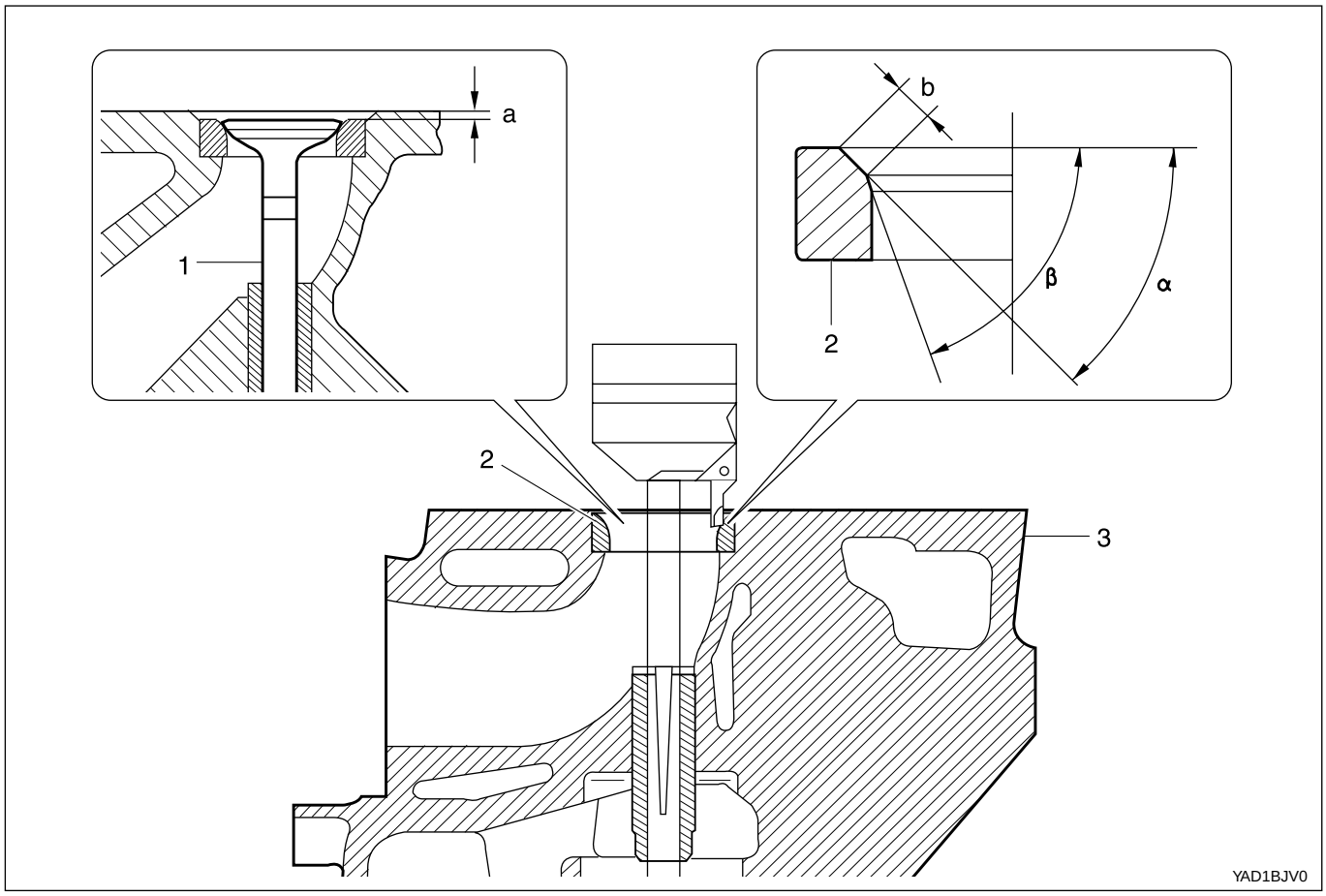
    Example) Measured value ‘w’ = 38.2 mm
    Measured value ‘z’= 36.5 mm
    Value ‘y’ = 15.5 mm

    ‘x’ = 36.5 - 15.5 = 21.0 mm

    In this case according to ‘Matching valves’ table, the installed valve may be used.

MACHINING OF VALVE SEAT

Preceding Work: Removal of prechamber
Removal and inspection of valve, replace if necessary
Inspection of valve guide, replace if necessary



1 Valve
2 Valve Seat Ring
3 Cylinder Head
4 Valve Guide

a Valve Arreare
b Valve Seat Width
α Valve Seat Angle
β Valve Seat Free Angle

Service Data

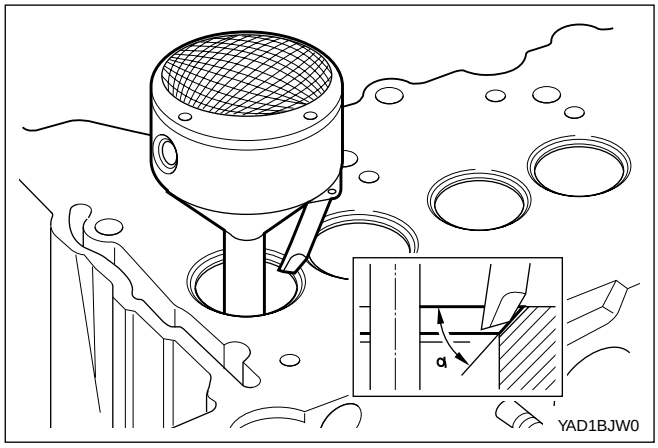
Item		Intake	Exhaust
Valve Arrears 'a'		0.1 - 0.7 mm	0.1 - 0.7 mm
Valve Seat Width 'b'		1.2 - 1.7 mm	1.5 - 2.0 mm
Valve Seat Angle 'α'		45°	45°
Valve Seat Free Angle 'β'		65°	65°
Permissible Radial Runout		0.03 mm	0.03 mm
Valve Length 'I'	Standard	106.20 - 106.60 mm	106.20 - 106.60 mm
	Repair	105.30 - 105.70 mm	105.30 - 105.70 mm

Matching Valves

	Camshaft Cam Basic Dia. w = 38.0 ± 0.2 mm	**Camshaft Cam Basic Dia. w = 37.6 ± 0.2 mm**	**Valve to be Used**
Size (x)	19.5 - 20.3 mm	19.5 - 20.1 mm	Use machined valve, if needed use pair valve 1 = 105.5 ± 0.2 mm
Size (x)	20.4 - 21.4 mm	20.2 - 21.2 mm	Reuse valve
Size (x)	21.4 - 21.97 mm	21.2 - 21.97 mm	Use standard size valve I = 106.4 ± 0.2 mm

Commercial Tools

Cylinder Head Clamping Devie	Hunger D-8000 München 70 Type Ventilknecht K2000 Order No. 221 00 100
Valve Seat Turning Tool	Hunger D-8000 München 70 Type VDS 1A Order No. 236 03 308
Test Sat for Valves	Hunger D-8000 München 70 Order No. 217 93 601

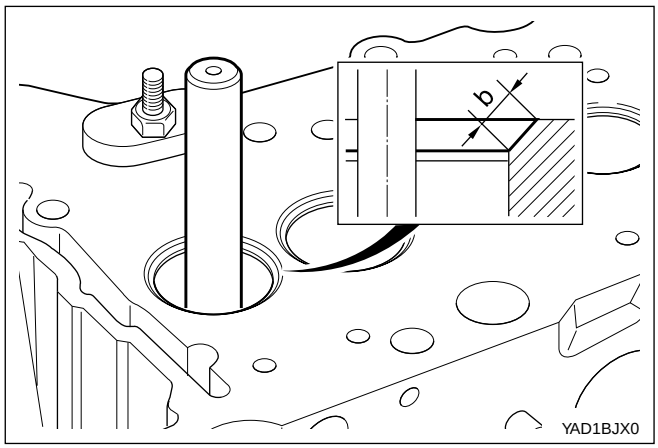


Machining Procedure

Valve machining is required :

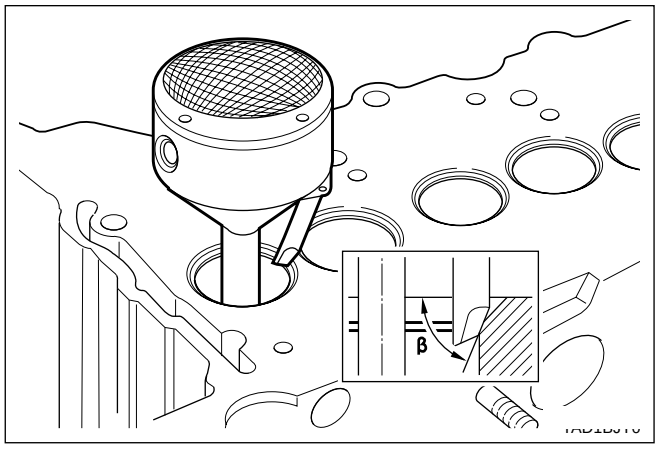
- When the valve is leaking.
- When replacing the valve.
- When replacing the valve guide.
- When replacing the valve seat or valve seatring.

1. Machine the valve seat (α=45°).

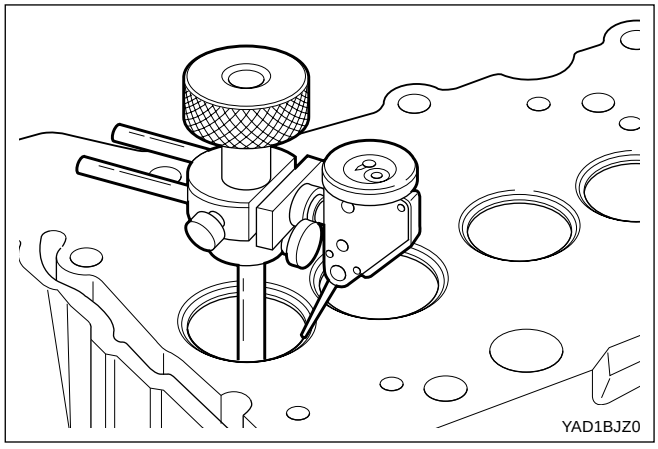


2. Measure valve seat width ‘b’.

Valve seat width ‘b’	Intake	1.2 - 1.7 mm
	Exhaust	1.5 - 2.0 mm

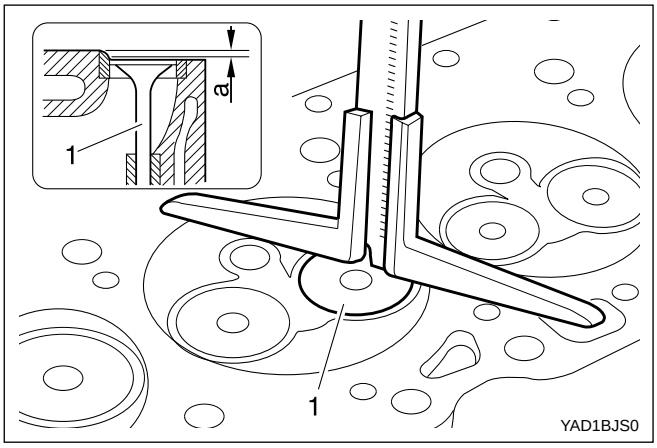


3. If the specification is exceeded, the valve seat width has to be corrected at the lower free angle of ‘β’ =65°.



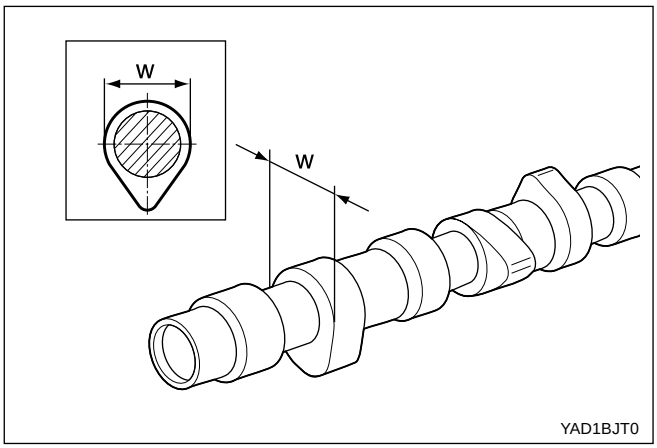
4. Measure radial runout.

Runout	Max. 0.03 mm



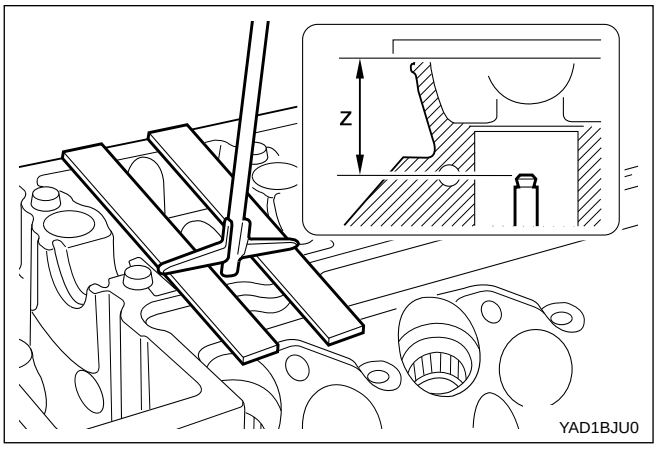
5. Insert the valve (1) into the valve guide according to marking and measure amount by which the valve arrears ‘a’.

Arrears ‘a’	0.1 - 0.7 mm

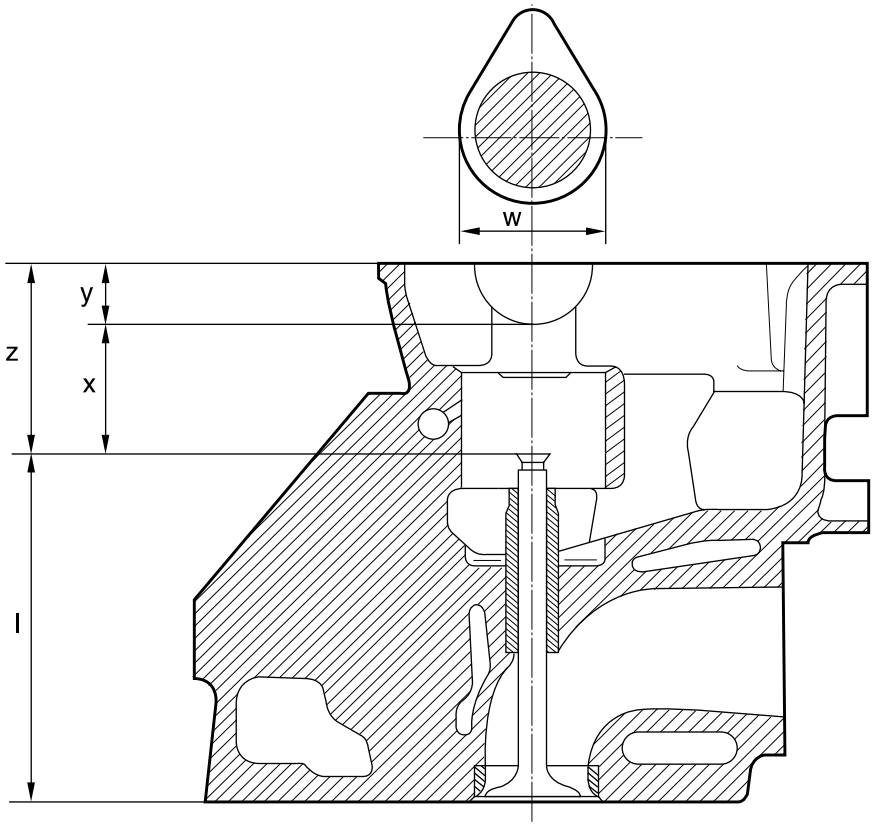


6. Measure camshaft cam basic circle diameter (w).

Diameter ‘w’	38 ± 0.2 mm or 37.6 ± 0.2 mm



7. Measure distance ‘z’ (cylinder head cover parting surface - valve stem).



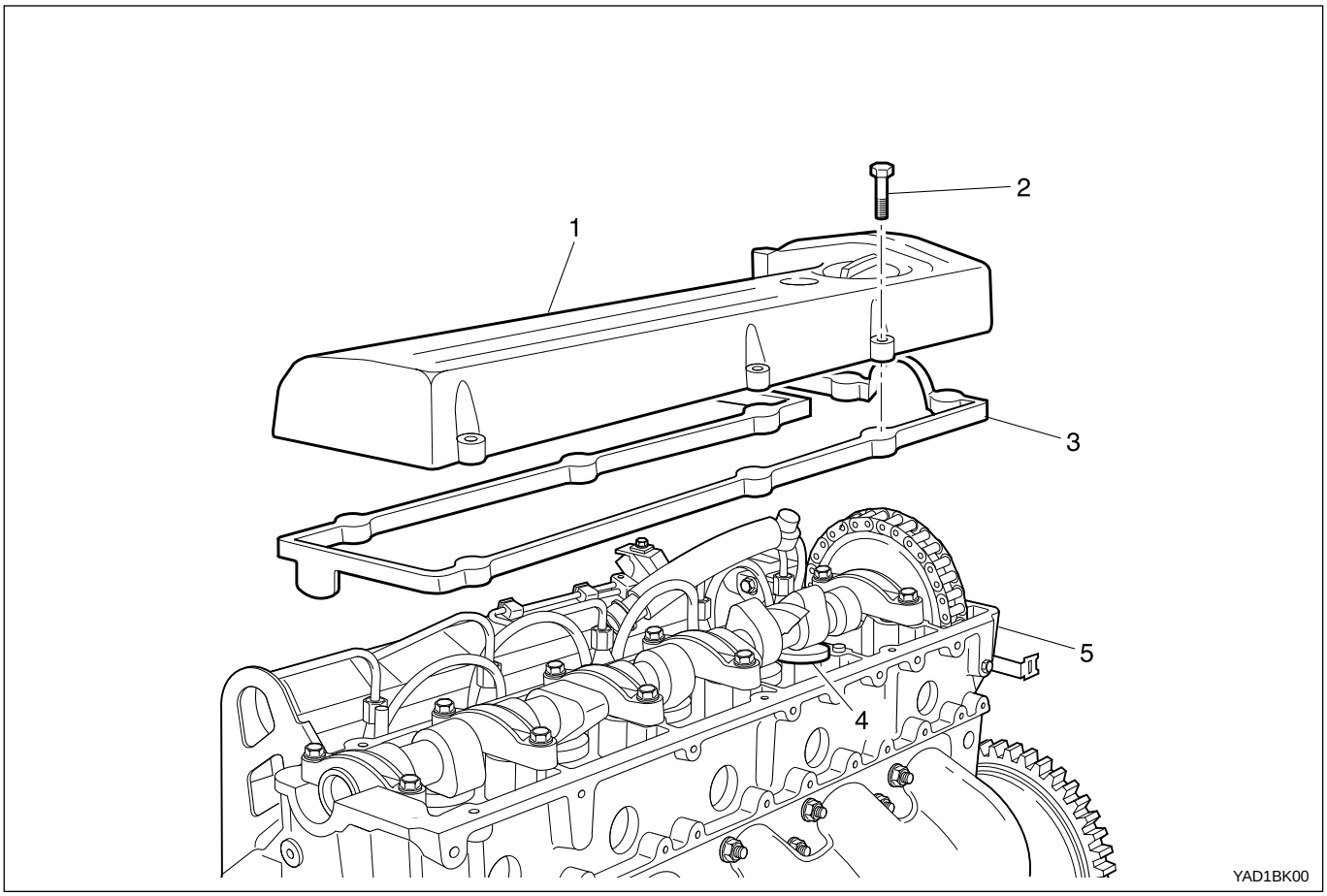
YAD1BJK0

l Length of Valve
w Camshaft Cam Basic Circle Diameter
x Distance (Camshaft Basic Bore - Valve Stem)
y Half Camshaft Basic Bore Diameter
z Distance (CylinderHead Cover Parting Surface - Valve Stem)

8. Measure ‘x’ (Camshaft basic bore - valve stem).
   ‘x’ = ‘z’ - ‘y’
9. Determine the valve to be used.
   (See ‘Matching valves’)
   Example) Measured value ‘w’ = 38.2 mm
   Measured value ‘z’ = 36.5 mm
   Value ‘y’ = 15.5 mm
   ‘x’ = 36.5 - 15.5 = 21.0 mm
   In the case of a camshaft cam basic circle diameter ‘w’ = 38.2 mm and a distance ‘x’ = 21.0 mm, the installed valve may be used.

CAMSHAFT TIMING TEST

Preceding Work: Removal of glow plug

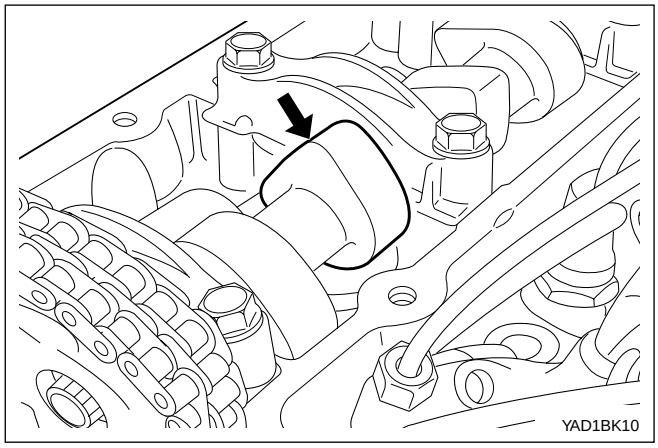


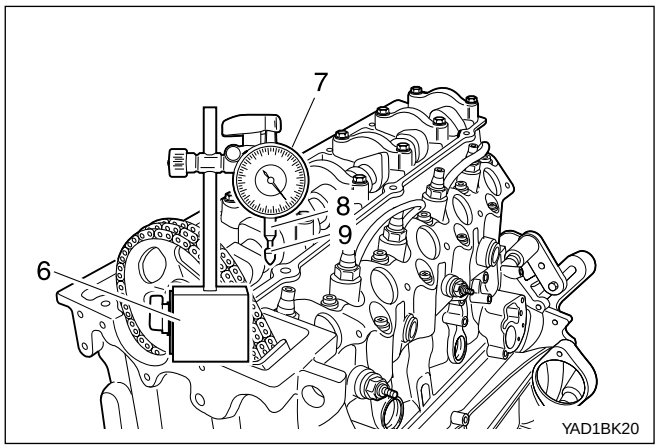
1 Cylinder Head Cover
2 Bolt.....10 N•m (89 lb-in)
3 Gasket..... Replace
4 Valve Tappet
5 Cylinder Head

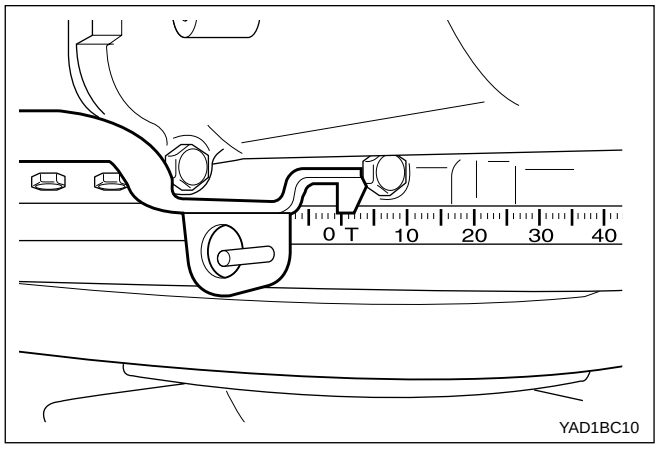
Timing

Condition of camshaft	Intake valve		Exhaust valve	
	Open	Close	Open	Close
New	ATDC 11.33°	ABDC 17°	BBDC 28°	BTDC 15.25°
After approx. 20,000km	ATDC 12°	ABDC 18°	BBDC 27°	BTDC 14°

*At 2mm of valve lifting stroke.







Tools Required

001 589 53 21 00 Dial Gauge
363 589 02 21 00 Dial Gauge Holder
366 589 00 21 05 Extension

Measurement Procedure

1. Remove the cylinder head cover.
2. Rotate the engine in the direction of engine rotation until the intake valve of no. 1 cylinder is completely closed. The cam lobe faces up (arrow).

   Notice: Do not rotate the engine at the bolt of the crankshaft sprocket. Do not rotate the engine in the opposite direction of engine rotation. If do, this will cause serious measuring errors.

3. Install the dial gauge holder 363 589 02 21 00 and dial gauge 001 589 53 21 00 (7) with the extension 366 589 00 21 05 (8) to the cylinder head and position the tracer pin (9) onto the valve tappet (intake valve of cylinder no.1) with a preload of min. 3mm.

   Notice: The tracer pin should be positioned exactly vertical.

4. Set the dial gauge to ‘0’.
5. Rotate the engine further in direction of rotation until the dial gauge has moved back by 2 mm (valve lift) to 1mm.
6. Check the timing.

New	ATDC 11.33°
After approx.	ATDC 12°

   Notice: If timing is out of standard, the camshaft should be checked for wear and the timing chain for stretch. If a difference of more than 4° exists, the timing chain should be replaced.

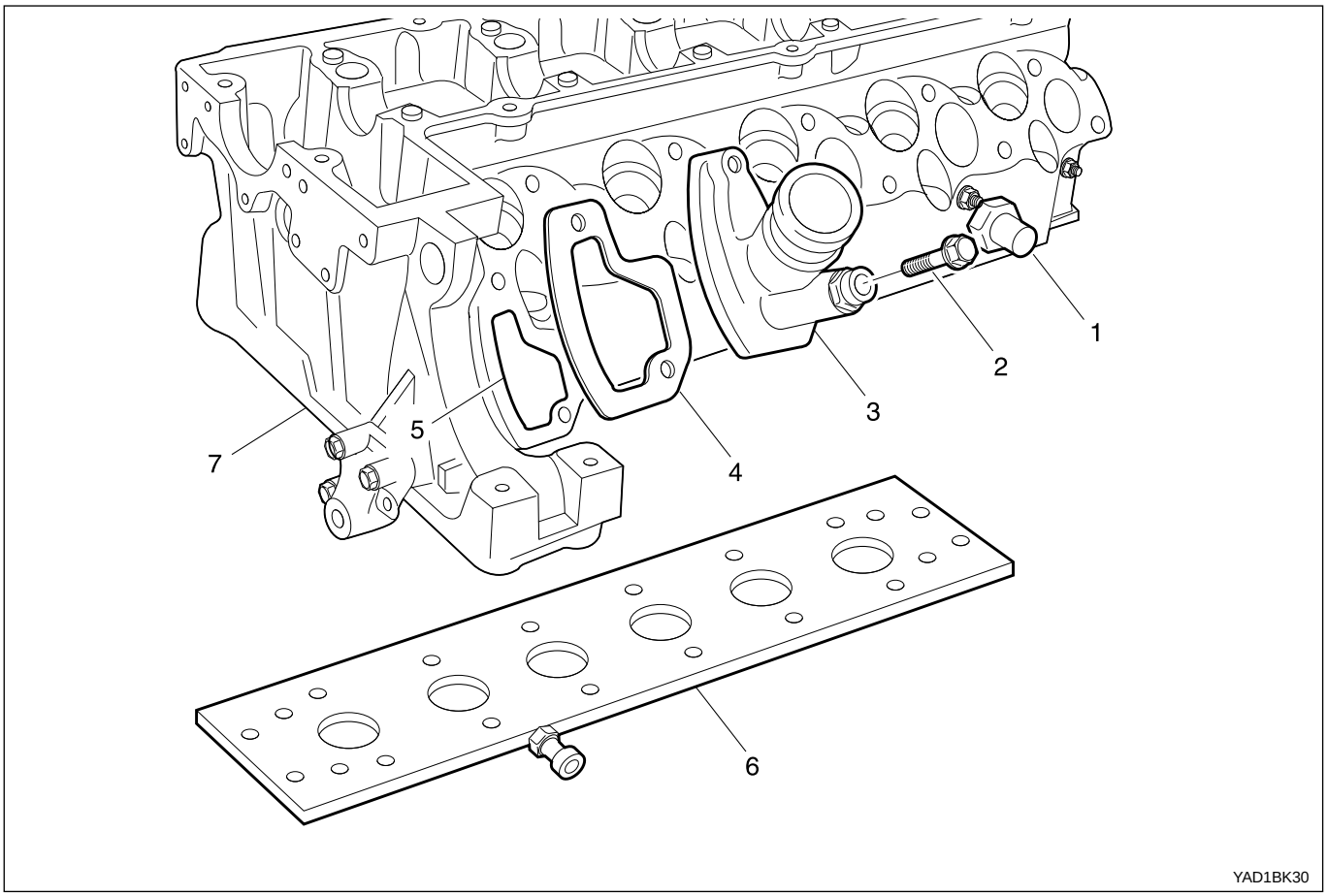
7. Replace the gasket and install the cylinder head cover.

   Installation Notice

Tightening Torque	10 N•m (89 lb-in)

CYLINDER HEAD PRESSURE LEAKAGE TEST

Preceding Work: Removal of the cylinder head
Removal of the exhaust manifold
Removal of the valve



1 Feed Pipe
2 Bolt
3 Return Connection
4 Gasket ..... Replace
5 Coolant Gallery ..... Sealing
6 Pressure Measuring Plate ..... Completely tight to the cylinder head
7 Cylinder Head .....
Immerse with pressure measuring plate into warm water of approx. 60°C (140°F) and pressurize with compressed air of 2 bar.

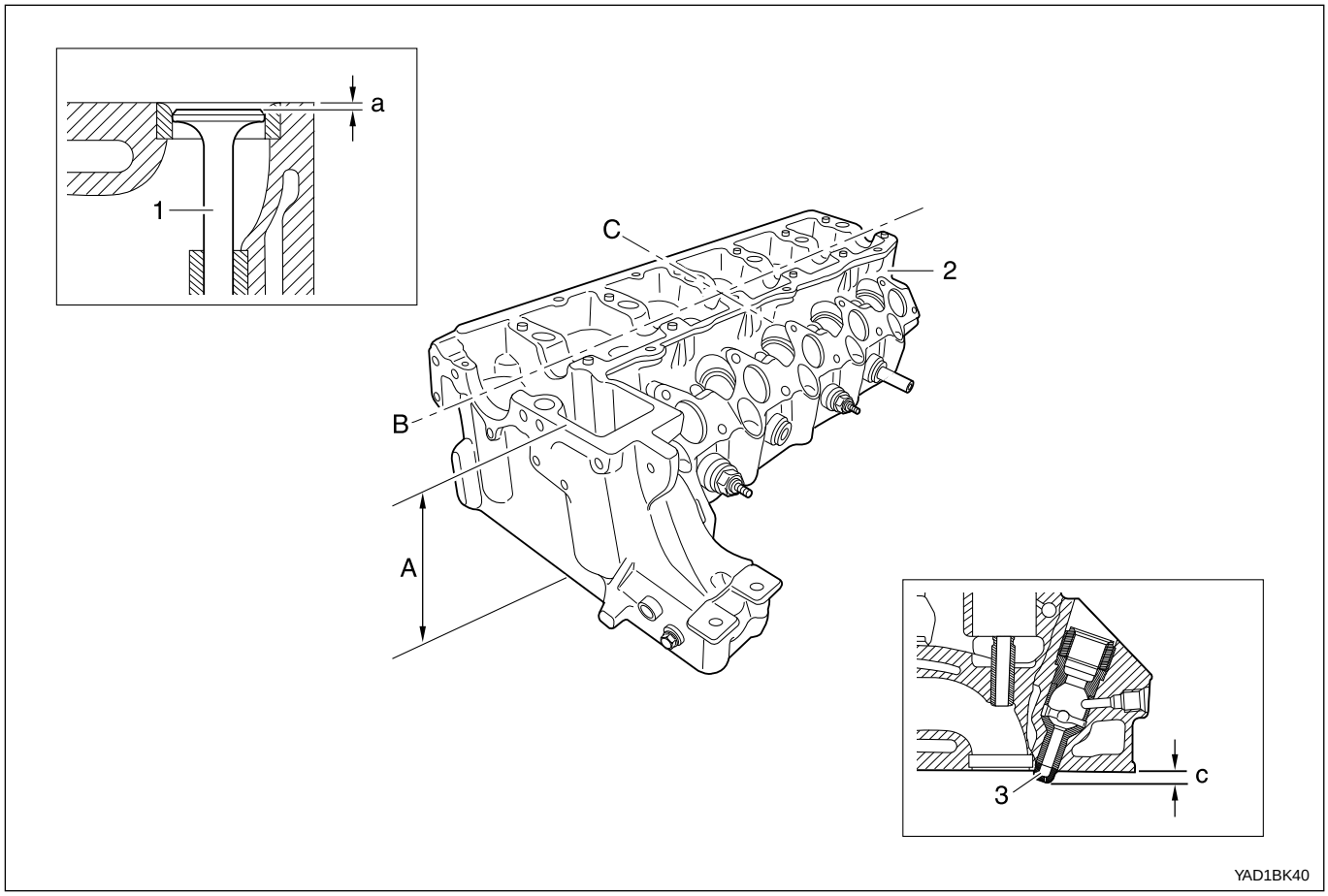
Notice: If air bubbles are seen, replace the cylinder head.

Tools Required

115 589 34 63 00 Mounting Device
601 589 00 25 00 Pressure Testing Device

FACING CYLINDER HEAD MATING SURFACE

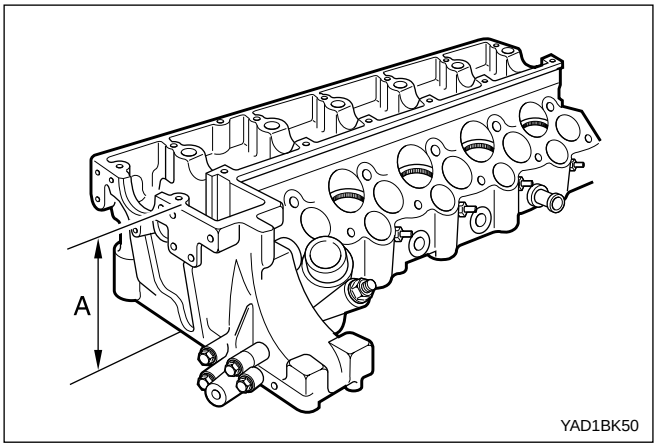
Preceding Work: Removal of prechamber
Cylinder head pressure leakage test



1 Valve
2 Cylinder Head
3 Prechamber
A Height of Cylinder Head
B Longitudinal Direction
C Transverse Direction
a Valve Arrears
b Prechamber Protrusion

Service Data

Height 'A' (Cylinder Head Surface - Cylinder Head Cover Surface)		142.9 - 143.1 mm
Minimum Height After Machining		142.5 mm
Permissible Unevenness of Parting Surface	In Longitudinal Direction	0.08 mm
	In Transverse Direction	0.0 mm
Permissible Variation of Parallelism (Longitud. direction)		Max. 0.1 mm
Peak-to-Valley Height		0.0017 mm
Valve Arrears 'a'	Intake Valve	0.1 - 0.7 mm
	Exhaust Valve	0.1 - 0.7 mm
Prechamber Protrusion 'c'		7.6 - 8.1 mm

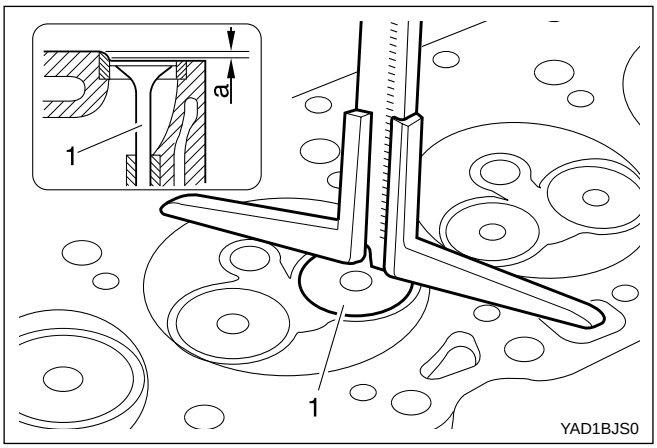


Measurement Procedure

1. Measure height ‘A’.

Limit	142.5 mm

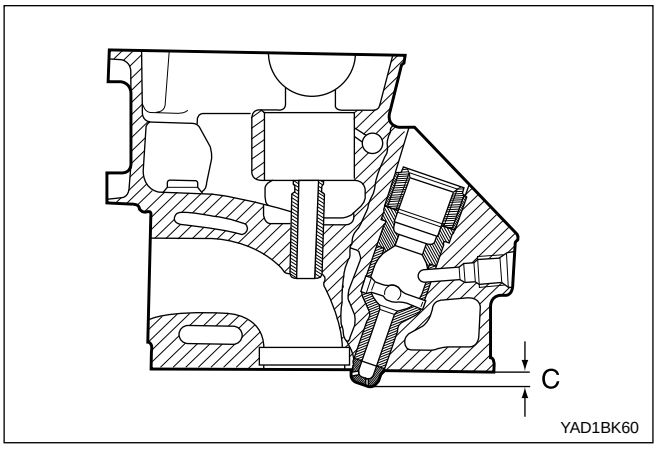
Notice: If the height is less than 142.5 mm, replace the cylinder head.



2. Insert the valve (1) and measure valve arrears ‘a’.

Valve Arrears ‘a’	0.1 - 0.7 mm

Notice: If out of standard, machine the valve seat.



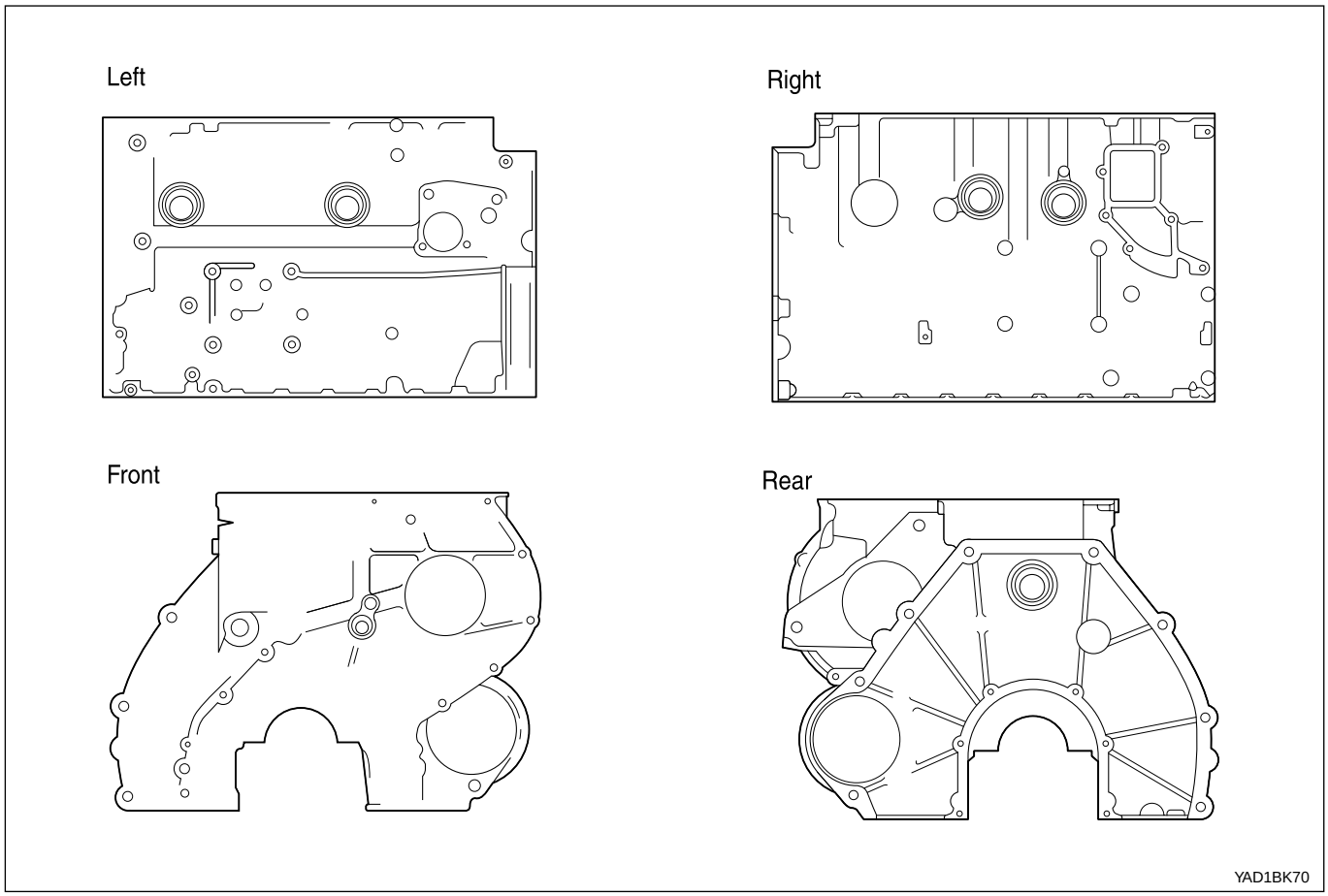
3. Install the prechamber and measure protrusion ‘c’

Protrusion ‘c’	7.6 - 8.1 mm

4. Assemble the engine and check the valve timing.

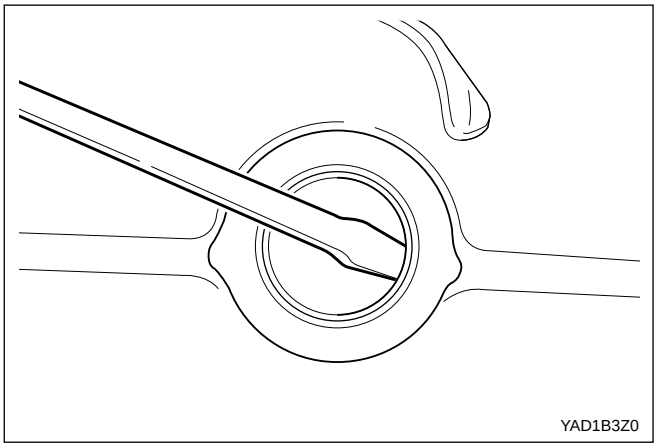
REPLACEMENT OF CRANKCASE CORE PLUG

Core Plug



Service Data

Left	ϕ 34 mm
	3 EA
Right	ϕ 34 mm
	3 EA
Front	ϕ 17 mm
	1 EA
Rear	ϕ 34 mm
	1 EA


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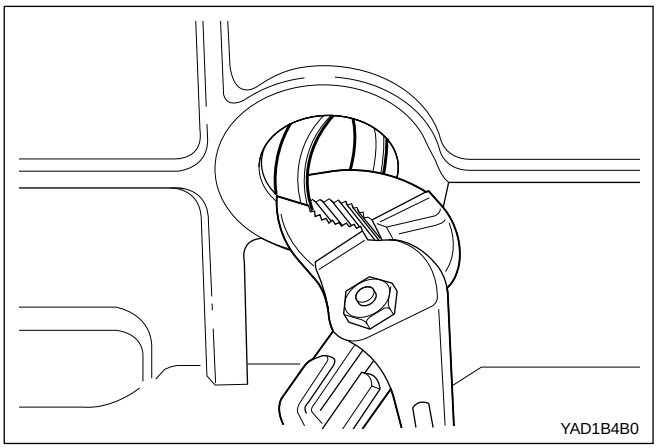
Tools Required

102 589 00 15 00 Drift

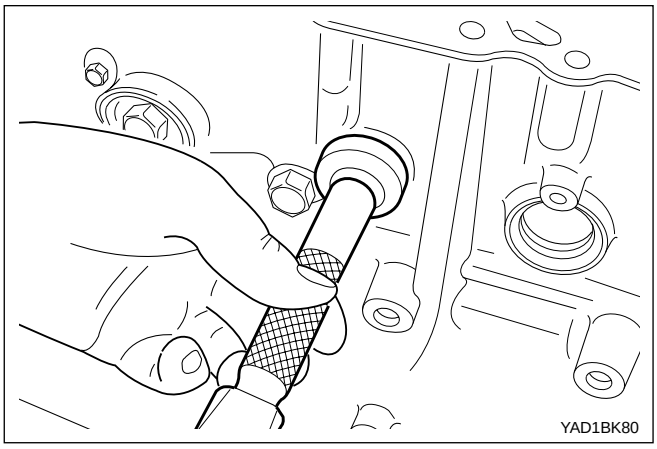
102 589 12 15 00 Drift

Replacement Procedure

1. Completely drain the coolant.
2. Remove any parts which impede access.
   (Example : transmission, injection pump)
3. Place the screwdriver to the deepdrawn edge of the core plug and pull forward and then rotate 90°.


YAD1B4B0

4. Pull out the core plug with pliers.

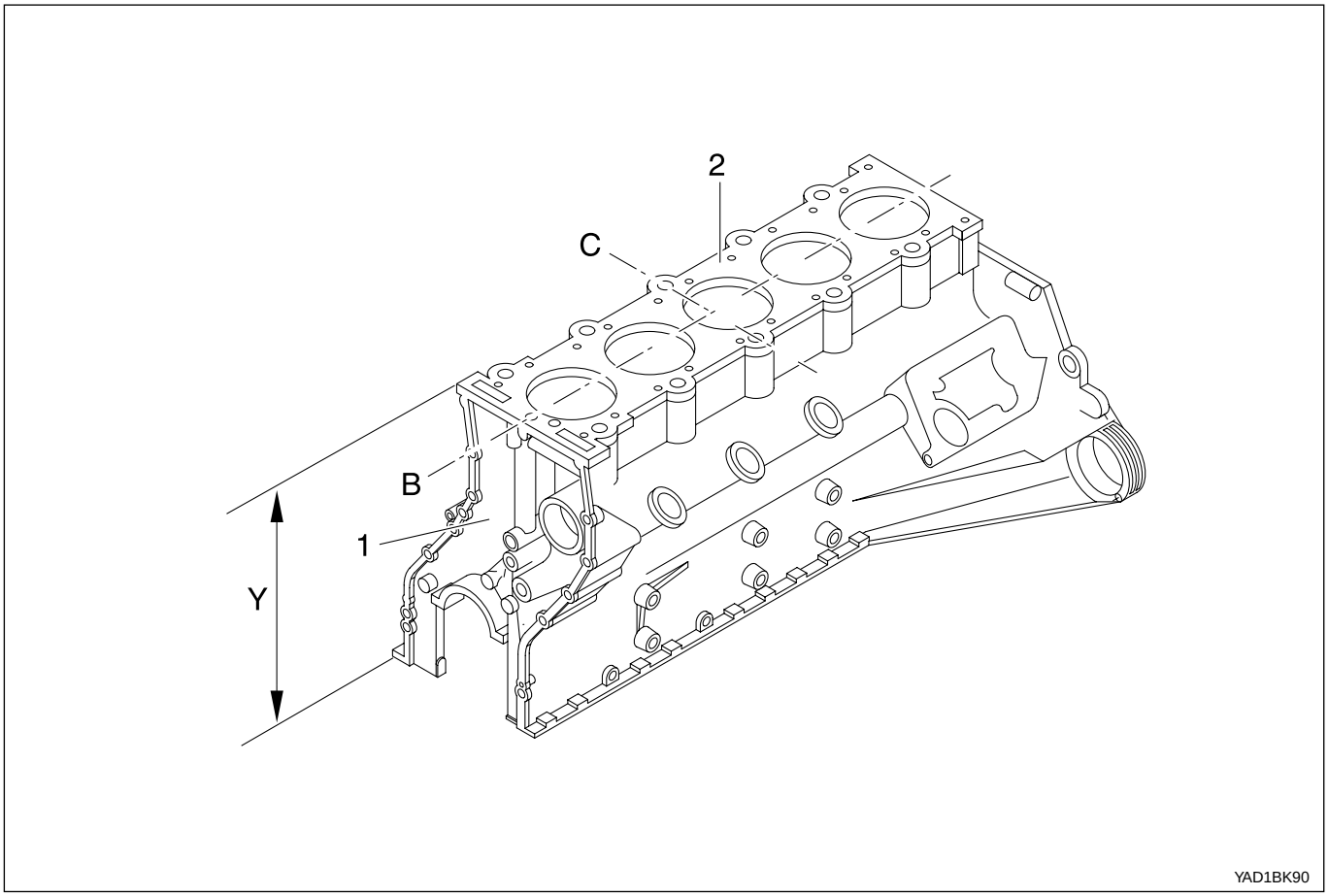

YAD1BK80

5. Thoroughly clean the sealing surface and apply Loctite 241.
6. Install the new core plug by using a drift.
7. Install the removed parts and fill the coolant.

   Notice: The adhesive must be allowed to harden for about 45 minutes before filling of coolant.

8. Warm up the engine and check the coolant for leaks.

FACING CRANKCASE CONTACTING SURFACE



1 Crankcase
2 Crankcase Contacting Surface

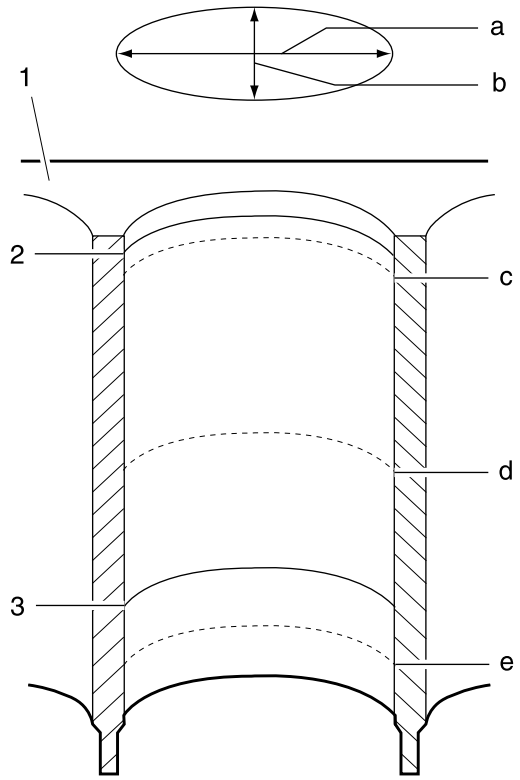
B Longitudinal Direction
C Transverse Direction

Y Height (crankcase upper surface - crankcase lower surface)

Service Data

Height 'Y'		Min. 299.62 mm
Permissible unevenness of contacting surface	In longitudinal direction (B)	0.06 mm
	In transverse direction (C)	0.06 mm
Permissible roughness upper contacting surface		0.0006 - 0.0016 mm
Permissible variation of parallelism of crankcase upper surface to lower surface in longitudinal direction		0.05 mm
Piston protrusion at TDC to crankcase upper surface	Max.	0.965 mm
	Min.	0.735 mm

CYLINDER BORE MEASUREMENT



YAD1BKA0

1 Crankcase Contacting Surface
2 TDC of 1 st Piston Ring
3 BDC of Ring

a Longitudinal Direction
b Transverse Direction
c,d,e Measuring Point

Service Data

Standard size	Code letter 'A'	89.000 - 89.006 mm
	Code letter 'X'	89.006 - 89.012 mm
	Code letter 'B'	89.012 - 89.018 mm
Wear limit in direction of travel and in transverse direction		Max. 0.20 mm
Permissible deviation of cylinder shape	When new	0.01 mm
	Wear limit	0.05 mm
Honing angle		50° ± 10°

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

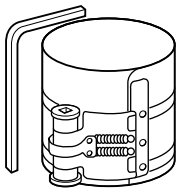
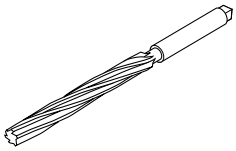
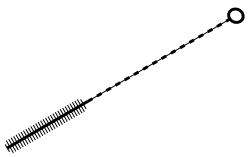
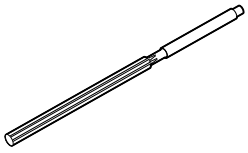
Application		N•m	Lb-Ft	Lb-In
12-Sided Stretch Bolt (Flywheel)		45 + 90°	33 + 90°	-
Camshaft Bearing Cap Bolt		25	18	-
Camshaft Sprocket Bolt		25 + 90°	18 + 90°	-
Chain Tensioner		80	59	-
Connecting Rod Bearing Cap Bolt		35 + 90°	26+ 90°	-
Cooling Fan Belt Pulley Bolt		10	-	89
Cooling Fan Shroud Bolt		3 - 7	-	27 - 62
Crankshaft Bearing Cap Bolt		55 + 90°	41 + 90°	-
Crankshaft Belt Pulley Bolt		23	17	-
Cylinder Head Bolt	1st Step	10	-	89
	2nd Step	35	26	-
	Torque Angel	90°	90°	-
	Wait For	10 min	10 min	-
	Torque Angel	90°	90°	-
Cylinder Head Cover Bolt		10	-	89
Damper Bolt		21	15	-
Drain Plug (Cylinder Head)		30	22	-
End Cover Bolt		10	-	89
Engine Mounting Bolt		50 - 75	37 - 55	-
Exhaust Manifold Nut		25	18	-
Fuel Filter Pipe Bolt		25	18	-
Fuel Line (to Injection Pump)		13	10	-
Fuel Pipe (to Injection Nozzle)		18	13	-
Fuel Pipe (to Injection Pump)		18	13	-
Generator Bracket Bolt		25	18	-
Generator Mounting Bolt	Upper	25	18	-
	Lower	45	33	-
Guide Pulley Bolt		23	17	-
Guide Pulley Bracket Bolt		9	-	80
Hub Bolt		200 + 90°	148 + 90°	-
Idle Pulley Bolt		23	17	-
Injection Nozzle		40	30	-
Injection Pump Mounting Bolt		23	17	-
Intake Manifold Nut		25	18	-
Oil Dipstick Tube Bracket Bolt		10	-	89
Oil Filter Housing Bolt		25	18	-
Oil Filter Housing Cap		25	18	-

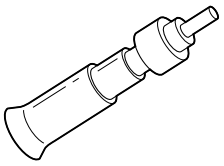
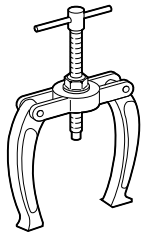
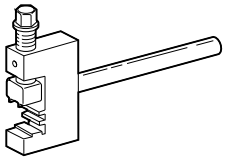
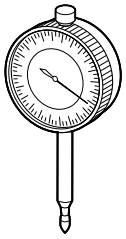
FASTENER TIGHTENING SPECIFICATIONS (Cont'd)

Application		N•m	Lb-Ft	Lb-In
Oil Pan Bolt	Socket Bolt	10	-	89
	M6	10	-	89
	M8	25	18	-
Oil Pan Drain Plug		25	18	-
Oil Pump Mounting Bolt		25	18	-
Oil Pump Sprocket Bolt		25	18	-
Oil Pump Screw Plug		50	37	-
Oil Spray Nozzle Bolt		10	-	89
Power Steering Dump Pulley Bolt		32	24	-
Prechamber Threaded Ring		130	96	-
Skid Plate Bolt		28 - 47	21 - 35	-
Socket Bolt		25	18	-
Stud Bolt		12	-	106
TDC Sensor Bracket Bolt		10	-	89
Tensioning Lever Nut		21	15	-
Tensioning Pulley Bolt		29	21	-
Timing Case Cover Bolt		10	-	89
Transmission Mounting Bolt		54 - 68	40 - 50	-
Turbo Charger to Exhaust Pipe Bolt		30	22	-
Vacuum Pump Mounting Bolt		10	-	89

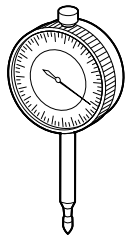
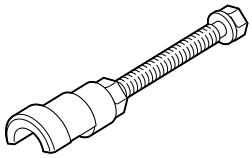
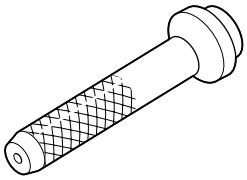
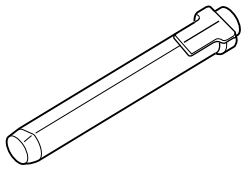
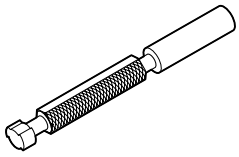
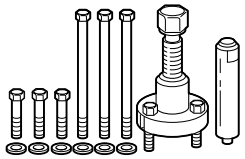
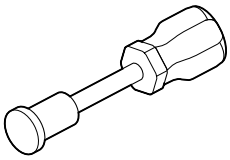
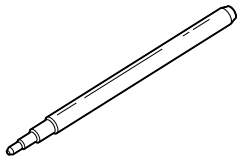
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

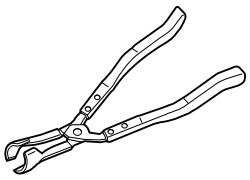
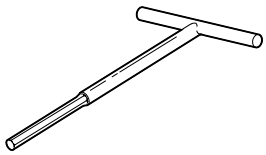
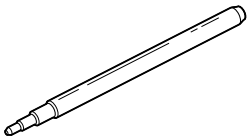
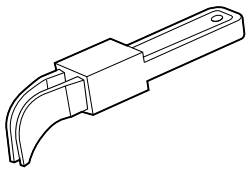
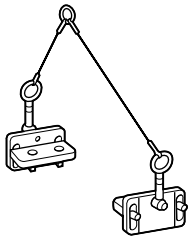
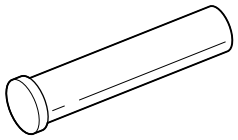
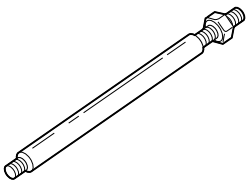
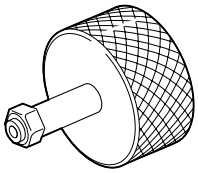
 YAD1BKW0	**000 589 04 14 00 Tensioning Strap**
 YAD1BLC0	**000 589 10 53 00 Reamer (for Exhaust)**
 YAD1BL60	**000 589 10 68 00 Cylinder Brush**
 YAD1BLD0	**000 589 21 53 00 Reamer (for Intake)**

 YAD1BKS0	**000 589 25 33 00 Internal Extractor**
 YAD1BKR0	**000 589 33 33 00 Counter Support**
 YAD1B1W0	**000 589 58 43 00 Chain Assembling Device**
 YAD1BLG0	**001 589 32 21 00 Dial Gauge**

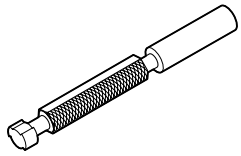
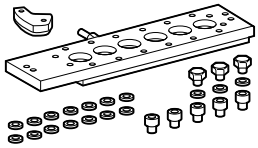
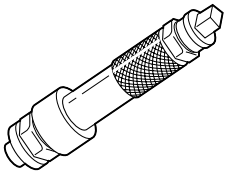
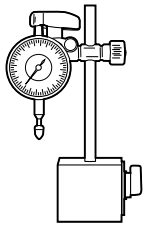
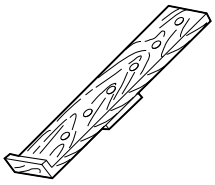
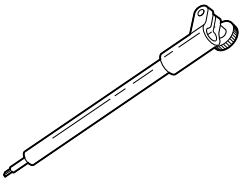
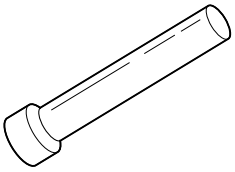
SPECIAL TOOLS TABLE (Cont'd)

 YAD1BKJ0	**001 589 53 21 00 Dial Gauge**	 YAD1BKU0	**102 589 05 33 00 Puller**
 YAD1B3Y0	**102 589 00 15 00 (ϕ 34) Drift**	 YAD1B1A0	**102 589 12 15 00 (ϕ 17) Drift**
 YAD1BLF0	**102 589 00 23 00 Go/No Go Gauge (for Intake)**	 YAD1BKM0	**103 589 00 33 00 Puller**
 YAD1BKX0	**102 589 03 40 00 Magnetic Bar**	 YAD1BL80	**103 589 02 15 00 Drift (for Exhaust)**

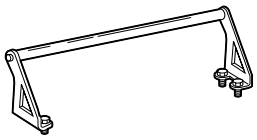
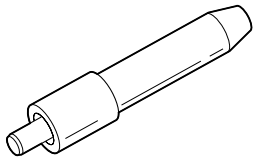
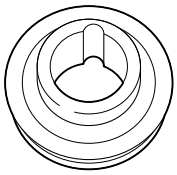
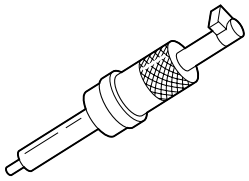
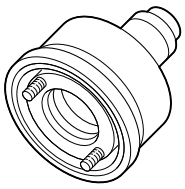
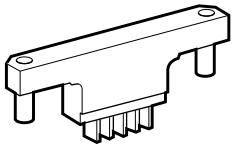
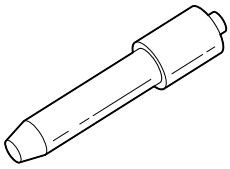
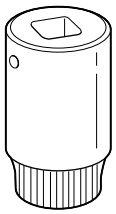
SPECIAL TOOLS TABLE (Cont'd)

 YAD1BL40	**104 589 00 37 00** **Pliers**	 YAD1BKF0	**116 589 03 07 00** **T Type Socket Wrench**
 YAD1BL70	**105 589 03 15 00** **Drift (for Intake)**	 YAD1BL10	**116 589 06 63 00** **Magnetic Finger**
 YAD1BKG0	**115 589 34 63 00** **Mounting Device**	 YAD1BKV0	**116 589 07 15 00** **Drift**
 YAD1BLH0	**116 589 02 34 00** **Thread Bolt**	 YAD1B580	**116 589 20 33 00** **Sliding Hammer**

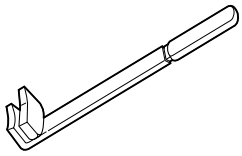
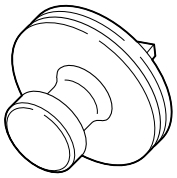
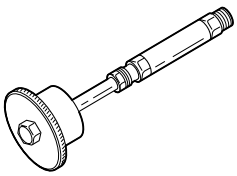
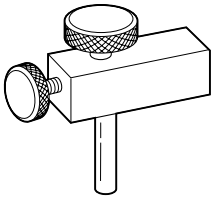
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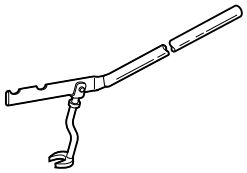
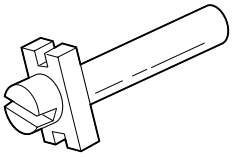
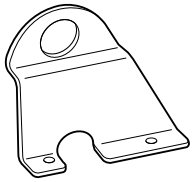
 YAD1BLE0	**117 589 03 23 00** **Go/No Go Gauge** **(for Exhaust)**	 YAD1BKH0	**601 589 00 25 00** **Pressure Testing Device**
 YAD1BL90	**346 589 00 63 00** **Super Cooling Box**	 YAD1BKD0	**601 589 00 66 00** **Counter Sink**
 YAD1BKQ0	**363 589 02 21 00** **Dial Gauge Holder**	 YAD1BKY0	**601 589 01 59 00** **Assembling Board**
 YAD1BKP0	**366 589 00 21 05** **Extension**	 YAD1BL50	**601 589 02 43 00** **Drift**

SPECIAL TOOLS TABLE (Cont'd)

 YAD1BKZ0	**601 589 02 59 00 Supporting Bridge**	 YAD1BLB0	**601 589 06 15 00 Drift (for Exhaust)**
 YAD1B790	**601 589 03 14 00 Sleeve**	 YAD1BKK0	**601 589 07 21 00 Measuring Device**
 YAD1BKN0	**601 589 03 43 00 Oil Seal Assembler**	 YAD1B720	**602 589 00 40 00 Engine Lock**
 YAD1BLA0	**601 589 05 15 00 Drift (for Intake)**	 YAD1BKB0	**603 589 00 09 00 Serration Wrench**

SPECIAL TOOLS TABLE (Cont'd)

 YAD1B4K0	**603 589 00 40 00** **Counter Holder**
 YAD1BL20	**603 589 01 40 00** **Holding Wheel**
 YAD1BKC0	**657 589 03 63 00** **Sliding Hammer**
 YAD1BKE0	**667 589 00 23 00** **Height Gauge**

 YAD1BL00	**667 589 00 31 00** **Press Lever**
 YAD1BKL0	**667 589 01 21 00** **Fixing Device**
 YAD1BL30	**667 589 02 63 00** **Supporting Bar**

SECTION 1F1

M162 ENGINE CONTROLS

CAUTION: Disconnect the negative battery cabl e beforer emoving or i nstalling any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless other-wise noted.

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ENGINE AND ECM PROBLEM CHECK REPORT

VEHICLE AND CUSTOMER INFORMATION

Date Problem Occurred			
Customer Name		Vehicle Model	
Driver Name		VIN	
Purchase date		Engine Model	
License No.		Mileage	Km miles

MIL INFORMATION

Condition of MIL	☐ Remains on ☐ Sometimes illuminates ☐ Does not illuminate
DTC inspection (if available)	☐ Normal ☐ Malfunction code(s) (code) ☐ Freeze Frame data ( )

PROBLEM DESCRIPTION

☐ Engine Does Not Start	☐ No cranking ☐ No initial combustion ☐ No complete combustion
☐ Hard to Start	☐ Slow cranking ☐ Others
☐ Poor Idling	☐ Incorrect first Idle ☐ Abnormal idle rpm ☐ High (rpm) ☐ Low (rpm) ☐ Idling Unstable ☐ Others
☐ Poor Driveability	☐ Hesitation ☐ Back fire ☐ Muffler explosion (after-burning) ☐ Surging ☐ Knocking ☐ Poor performance ☐ Other
☐ Engine Stall	☐ Soon after starting ☐ After accelerator pedal depressed ☐ After accelerator pedal released ☐ During A/C operation ☐ Shifting from N to D or D to N ☐ At full steering ☐ Others
☐ Others	

CONDITION WHEN PROBLEM OCCURS

Problem Frequency	☐ Constant ☐ Intermittent (times per day/month) ☐ Once only ☐ Others
Weather	☐ Fine ☐ Cloudy ☐ Rainy ☐ Snowy ☐ Various/Others
Ambient Temperature	☐ Hot ☐ Warm ☐ Cool ☐ Cold (approx.____°F/____°C)
Place	☐ Highway ☐ Suburbs ☐ Inner City ☐ Uphill ☐ Downhill ☐ Rough Road ☐ Others
Engine Temperature	☐ Cold ☐ Warming Up ☐ Before warming up ☐ After warm-up ☐ Any temp. ☐ Others
Engine Operation	☐ Starting ☐ Just after starting (min.) ☐ Idling ☐ Racing ☐ Driving ☐ Constant speed ☐ Acceleration ☐ Deceleration ☐ A/C switch ON/OFF ☐ Other

FAILURE CODES TABLE (Cont'd)

Failure code	See Page	Description
44	1F1-62	Cooling fan (HI) relay short circuit to power
45	1F1-62	Cooling fan (HI) relay short circuit to ground or open
54	1F1-41	Purge control circuit malfunction
56	1F1-23	No.1 knock sensor signal failure
57	1F1-23	No.2 knock sensor signal failure
58	1F1-17	Camshaft position sensor signal : No.1 cylinder synchronization failure
59	1F1-78	CAN communication failure : MSR data transmission not plausible
60	1F1-78	CAN communication failure : ASR data transmission not plausible
62	1F1-61	Clutch switch defective
64	1F1-11	No ignition voltage output (No.1 ignition coil)
65	1F1-11	No ignition voltage output (No.2 ignition coil)
66	1F1-11	No ignition voltage output (No.3 ignition coil)
67	1F1-13	Crankshaft position sensor adaptation failure
68	1F1-25	Random/Multiple Misfire
71	1F1-29	Starter signal recognition failure
72	1F1-37	No.1 injector short circuit to battery
73	1F1-37	No.1 injector short circuit to ground or open
74	1F1-37	No.2 injector short circuit to battery
75	1F1-37	No.2 injector short circuit to ground or open
76	1F1-37	No.3 injector short circuit to battery
77	1F1-38	No.3 injector short circuit to ground or open
78	1F1-38	No.4 injector short circuit to battery
79	1F1-38	No.4 injector short circuit to ground or open
80	1F1-72	Oxygen sensor high voltage
81	1F1-73	Bank 1 system short term fuel trim adaptation below lean threshold
82	1F1-72	Oxygen sensor no activity detected
83	1F1-72	Oxygen sensor not lean after overrun fuel shut -off
84	1F1-72	Oxygen sensor slow response
85	1F1-72	Oxygen sensor heater failure
86	1F1-72	Oxygen sensor heater short circuit to battery
87	1F1-72	Oxygen sensor heater short circuit to ground or open
89	1F1-72	Oxygen sensor low voltage
93	1F1-73	Bank 1 system short term fuel trim adaptation above rich threshold
96	1F1-73	Bank 1 system short term fuel trim at rich stop
97	1F1-73	Bank 1 system short term fuel trim at lean stop
98	1F1-73	Bank 1 system idle adaptation failure (above rich threshold)
99	1F1-73	Bank 1 system idle adaptation failure (below lean threshold)
100	1F1-73	Bank 1 system learning control failure (rich, low load)
101	1F1-73	Bank 1 system learning control failure (lean, low load)
102	1F1-73	Bank 1 system learning control failure (rich, high load)

FAILURE CODES TABLE (Cont'd)

Failure code	See Page	Description
103	1F1-73	Bank 1 system learning control failure (lean, high load)
104	1F1-47	Throttle position sensor 1 low voltage
105	1F1-47	Throttle position sensor 1 high voltage
108	1F1-47	Throttle position sensor 2 low voltage
109	1F1-47	Throttle position sensor 2 high voltage
110	1F1-80	Throttle actuator learning data fault
116	1F1-47	Throttle actuator learning control failure
117	1F1-80	Exceed fuel -cut safety time
119	1F1-47	Throttle valve return spring failure
120	1F1-80	Cruise control interruption memory failure
121	1F1-47	Throttle actuator failure
122	1F1-59	Accelerator pedal position sensor signal failure
123	1F1-47	Different Mass air flow sensor signal with throttle position sensor
125	1F1-47	Both throttle position sensors failure
126	1F1-48	Throttle position sensor 1 not plausible with throttle position sensor 2
127	1F1-48	High permanent throttle signal
129	1F1-64	Cruise control "OFF" due to message counter failure
130	1F1-64	Vehicle speed signal failure
131	1F1-64	Vehicle speed signal failure
132	1F1-64	Cruise control lever failure
133	1F1-64	Cruise control acceleration failure
134	1F1-64	Cruise control deceleration failure
135	1F1-67	Stop lamp switch failure
136	1F1-79	ECU failure (RAM)
137	1F1-79	ECU failure (EPROM)
138	1F1-80	Call monitoring
139	1F1-80	Servo motor control output interruption memory failure
140	1F1-80	Servo motor open/short
141	1F1-82	Unprogramed ECU with immobilizer
142	1F1-79	Uncoded/unprogramed ECU
143	1F1-79	ECU failure (EEPROM/Flash-EPROM checksum failure)
144	1F1-79	ECU failure (coding ID checksum failure)
145	1F1-79	ECU failure (coding checksum failure)
146	1F1-79	ECU failure (programing checksum failure)
150	1F1-65	TCS input signal short circuit to battery
151	1F1-65	TCS input signal short circuit to ground or open
160	1F1-59	Accelerator pedal position sensor 1 low voltage
161	1F1-59	Accelerator pedal position sensor 1 high voltage
162	1F1-59	Accelerator pedal position sensor 2 low voltage
163	1F1-59	Accelerator pedal position sensor 2 high voltage
164	1F1-59	Accelerator pedal position sensor 1 not plausible with pedal position sensor 2

DIAGNOSTIC INFORMATION AND PROCEDURE

FAILURE CODE DIAGNOSIS

CLEARING FAILURE CODES

Notice: To prevent Engine Control Module(ECM) damage, the key must be OFF when disconnecting or reconnecting the power to the ECM (for example battery cable, ECM pigtail connector, ECM fuse, jumper cables, etc.)

Parameters listed in the table may not be exactly the same as your reading due to the type of instrument or other factors. If a failure code is displayed during the “TROUBLE CODE” in scan tool check mode, check the circuit for the code listed in the table below. For details of each code, turn to the page referred to under the “See Page” for the re-spective “Failure Code” in the below table.

Failure codes should be cleared after repairs have been completed.

FAILURE CODES TABLE

Failure Code	See Page	Description
00	1F1-56	Engine coolant temperature sensor low voltage
01	1F1-56	Engine coolant temperature sensor high voltage
02	1F1-56	Engine coolant temperature sensor plausibility
03	1F1-52	Intake air temperature sensor low voltage
04	1F1-52	Intake air temperature sensor high voltage
05	1F1-52	Intake air temperature sensor plausibility
06	1F1-56	Engine coolant temperature insufficient for closed loop fuel control
08	1F1-28	System voltage too low
09	1F1-52	Mass air flow sensor plausibility
10	1F1-52	Mass air flow sensor low voltage
11	1F1-52	Mass air flow sensor high voltage
17	1F1-13	Crankshaft position sensor signal failure (no engine revolution signal)
18	1F1-13	Crankshaft position sensor signal failure (rpm > max. value)
19	1F1-17	Camshaft position senosr signal : No.1 cylinder recognition failure
20	1F1-13	Crankshaft position sensor signal failure (gap recognition failure)
21	1F1-79	Transmission coding failure
23	1F1-77	CAN communication failure : ASR/MSR
24	1F1-77	CAN communication failure : ABS
25	1F1-82	Communication with transponder missing
26	1F1-77	CAN communication failure : TCU (A/T only)
27	1F1-78	CAN communication failure : TOD (E32 only)
29	1F1-78	CAN communication failure : ID 200h not plausible
30	1F1-78	CAN communication failure : ID 208h not plausible
31	1F1-78	CAN communication failure : communication initialization failure
32	1F1-68	Engine rpm output circuit short circuit to battery
33	1F1-68	Engine rpm output circuit short circuit to ground or open
34	1F1-33	Fuel pump relay short circuit to battery
35	1F1-33	Fuel pump relay short circuit to ground or open
40	1F1-41	Purge control valve short circuit to battery
41	1F1-41	Purge control valve short circuit to ground or open

FAILURE CODES TABLE (Cont'd)

Failure code	See Page	Description
167	1F1-59	Both setpoint accelerator pedal position sensor defective
185	1F1-48	Mass air flow sensor and throttle position sensor failure
186	1F1-80	ECU failure (incompatible CPU)
187	1F1-80	ECU failure (CPUs communication failure)
188	1F1-80	ECU failure (CPU 2 configuration failure)
189	1F1-80	ECU failure (CPU 2 fault)
190	1F1-80	ECU failure (CPU run time failure between CPUs)
192	1F1-38	No.5 injector short circuit to battery
193	1F1-38	No.5 injector short circuit to ground or open
194	1F1-38	No.6 injector short circuit to battery
195	1F1-38	No.6 injector short circuit to ground or open
198	1F1-66	Resonance flap short circuit to battery
199	1F1-66	Resonance flap short circuit to ground or open
226	1F1-21	Camshaft actuator short circuit to battery
227	1F1-21	Camshaft actuator short circuit to ground or open
228	1F1-63	A/C compressor relay short circuit to battery
229	1F1-63	A/C compressor relay short circuit to ground or open
231	1F1-80	ECU failure (CPU 2 cruise control message counter failure)
232	1F1-80	Over decceleration limit (CPU 2)
233	1F1-80	Over acceleration limit (CPU 2)
234	1F1-80	Cruise control lever dual operation (CPU 2)
235	1F1-80	Cruise control lever safety terminal failure (CPU 2)
236	1F1-80	Unusual pedal position variation (CPU 2)
237	1F1-80	Unusual throttle position variation (CPU 2)
238	1F1-80	Unusual throttle controller monitor data comparison fault (CPU 2)
239	1F1-81	Unusual accelerator pedal position sensor comparison fault (CPU 2)
240	1F1-81	Throttle potentiometer comparision fault (CPU 2)
241	1F1-81	Unusual CPU communication (CPU 2)
242	1F1-81	Unusual CPU configuration (CPU 2)
243	1F1-81	A/D converter failure (CPU 2)
244	1F1-81	Accelerator pedal position sensor setpoint fault between CPU 1 and CPU 2
245	1F1-81	Position controller setpoint fault between CPU 1 and CPU 2
246	1F1-81	MSR setpoint fault between CPU 1 and CPU 2
247	1F1-81	Idle control setpoint fault between CPU 1 and CPU 2
248	1F1-81	A/D converteroverflow (CPU 2)
249	1F1-81	ROM f aul t (CPU 2)
250	1F1-81	RAM f aul t (CPU 2)
251	1F1-85	Cycle monitor fault (CPU 2)

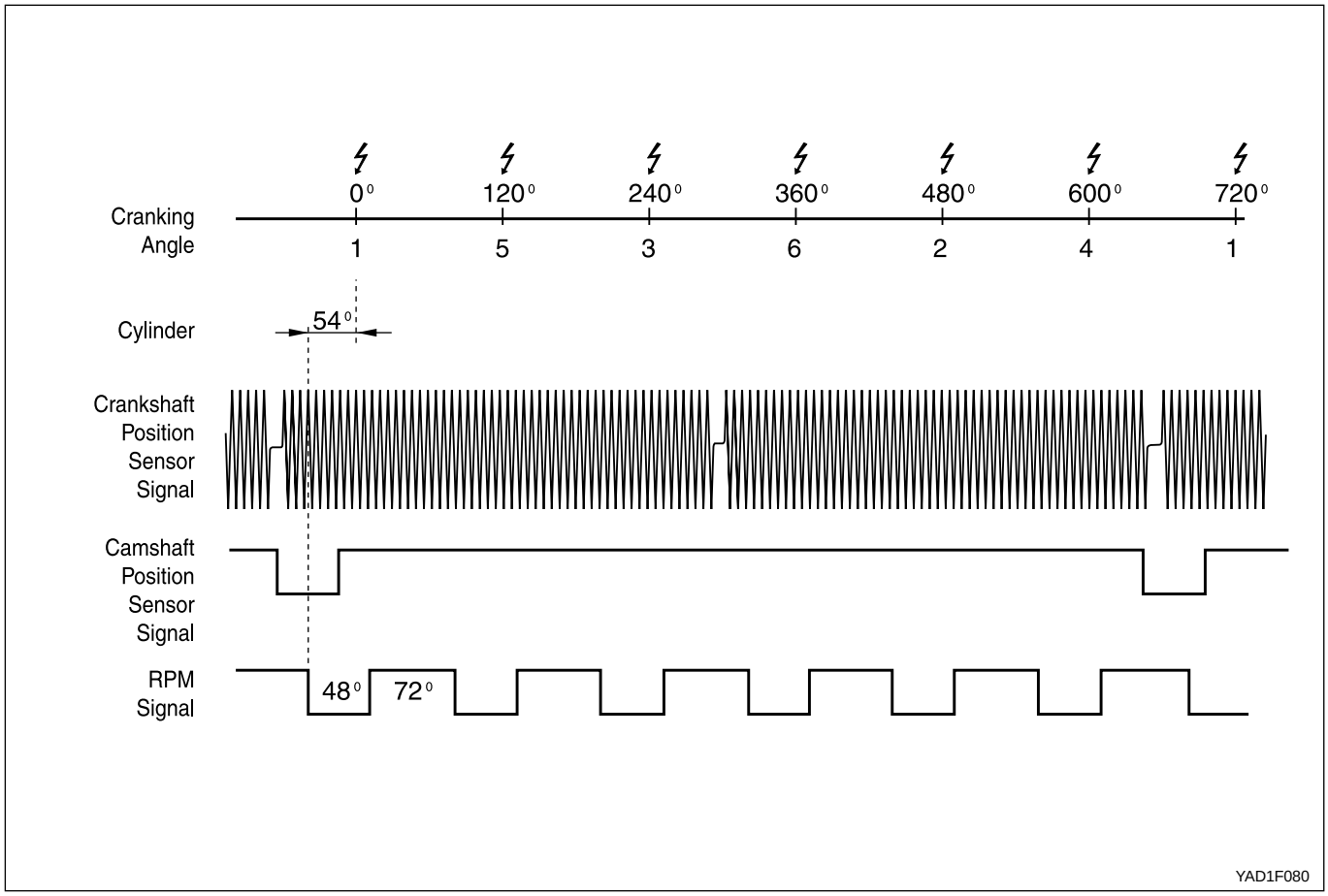
IGNITION SYSTEM

This ignition system does not use a conventional distributor and coil. It uses a crankshaft position sensor input to the Engine Control Module (ECM). The ECM then determines Electronic Spark Timing (EST) and triggers the electronic ignition system ignition coil.

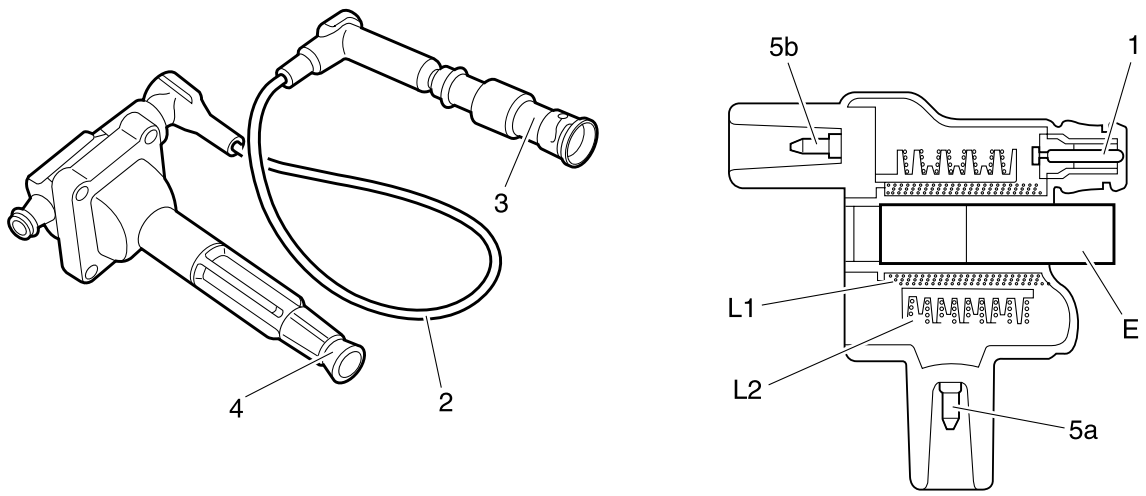
This type of distributorless ignition system uses a ‘‘waste spark” method of spark distribution. Each cylinder is paired with the cylinder that is opposite it (1-6 or 2-5 or 3-4). The spark occurs simultaneously in the cylinder coming upon the compression stroke and in the cylinder coming up on the exhaust stroke. The cylinder on the exhaust stroke requires very little of the available energy tofire the spark plug. The remaining energy is available to the spark plug in the cylinder on the compression stroke.

These systems use the EST signal from the ECM to control the EST. The ECM uses the following information:

- Engine load (mass air flow sensor).
- Engine temperature.
- Intake air temperature.
- Crankshaft position.
- Engine speed (rpm).



IGNITION COIL



YAD1F090

1 Control Cable Connection
2 Ignition Cable
3 Spark Plug Connector
4 Coupling Plug
5a, 5b Secondary Voltage Connection
E Iron Core
L1 Secondary Ignition Coil
L2 Primary Ignition Coil

The Electronic Ignition (EI) system ignition coil is located on the cylinder head cover. The double ended coils receive the signal for the Engine Control Module (ECM) which controls the spark advance.

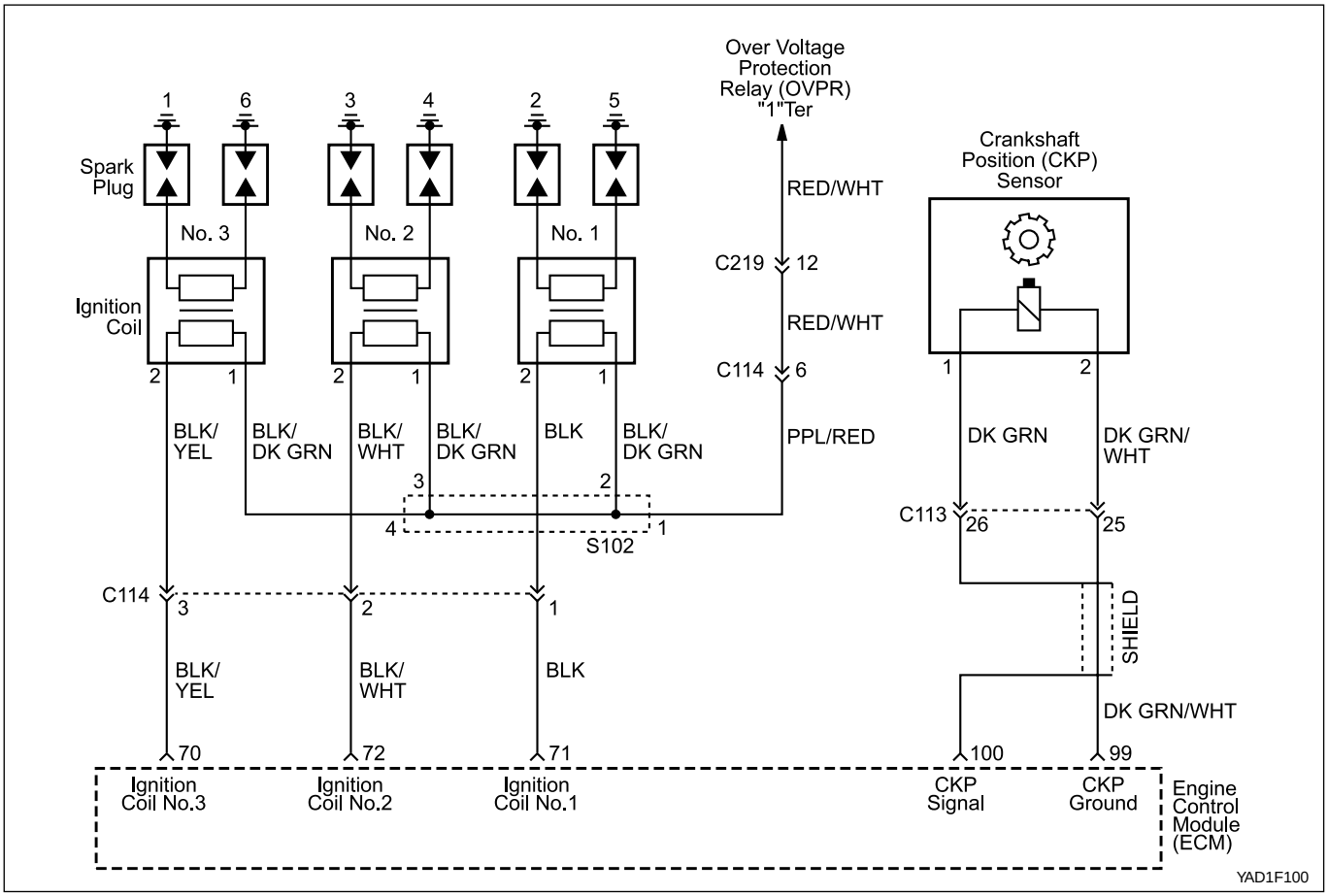
Each EI system ignition coil provides the high voltage to two spark plugs simultaneously;

T1/1: cylinder 2 and 5

T1/2: cylinder 3 and 4

T1/3: cylinder 1 and 6

The EI system ignition coil is not serviceable and must be replaced as an assembly.



Failure Code	Description	Trouble Area	Maintenance Hint
64	No ignition voltage output (No. 1 ignition coil)	Malfunction of ignition circuit Primary current values or secondary short circuit	• Inspection the ECM pin 70 (71 and72) about short circuit or open with bad contact • Inspection the power source to ignition • Inspection the power source to ignition coil • Inspection the ignition coil, high tension cords etc. • Inspection the spark plug (wet, cracks, wear, improper gap, burned electrodes, heavy deposit) • Inspection the ECM
65	No ignition voltage output (No. 2 ignition coil)		
66	No ignition voltage output (No. 3 ignition coil)		

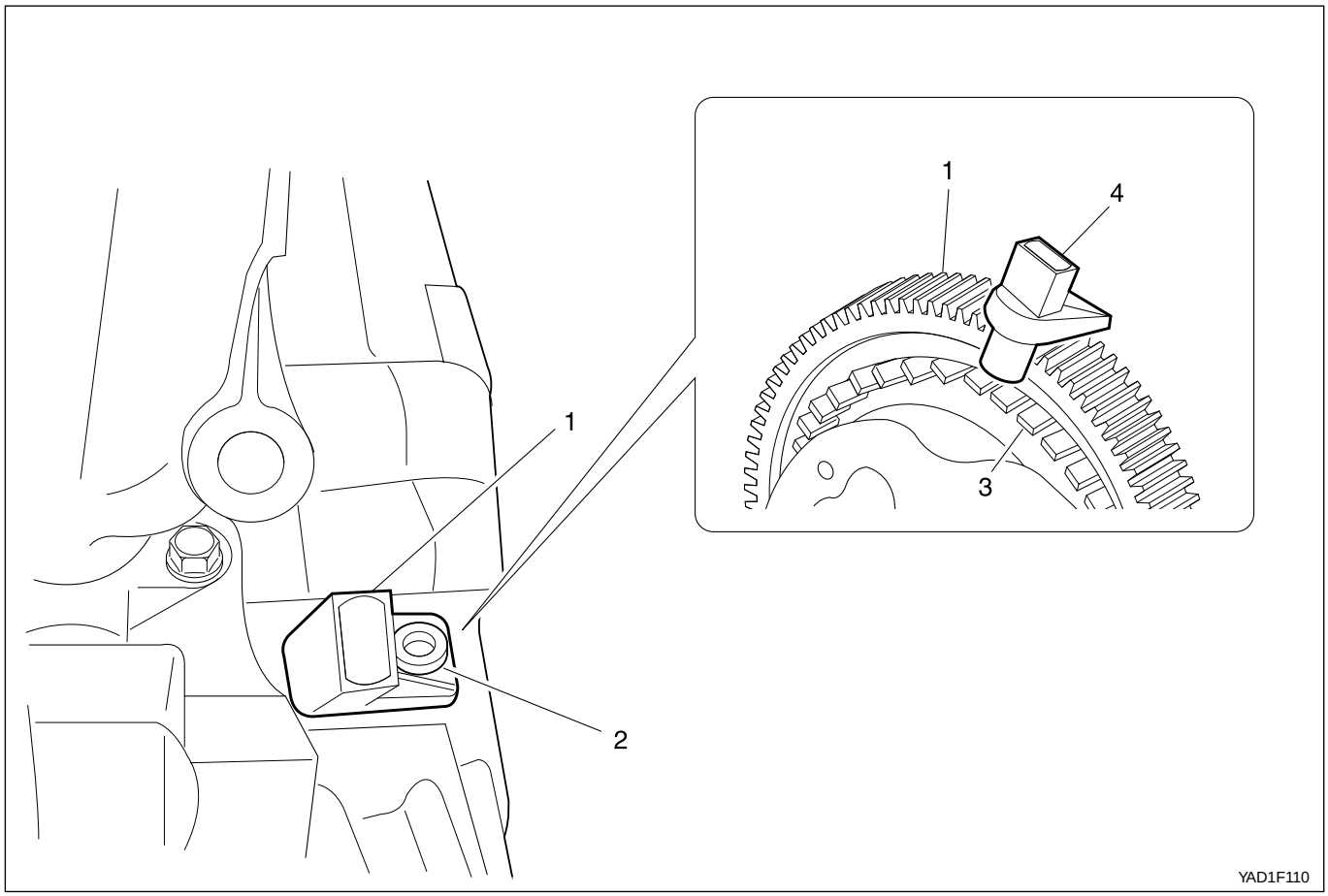
Circuit Description

The Electronic Ignition (EI) system uses a waste spark method of spark distribution. The Crankshaft Position (CKP) sensor sends reference pulses to the ECM. The ECM then triggers the EI system ignition coils. Once the ECM triggers the EI system ignition coils both of the connected spark plugs fire at the same time. One cylinder is on its compression stroke at the same time that the other is on the exhaust stroke, resulting in lower energy needed to fire the spark plugin the cylinder on its exhaust stroke.

This leaves there remainder of the high voltage to be used to fire the spark plug in the cylinder on its compression stroke.

Since the CKP sensor is in a fixed position, timing adjustments are not possible or needed.

CRANKSHAFT POSITION (CKP) SENSOR

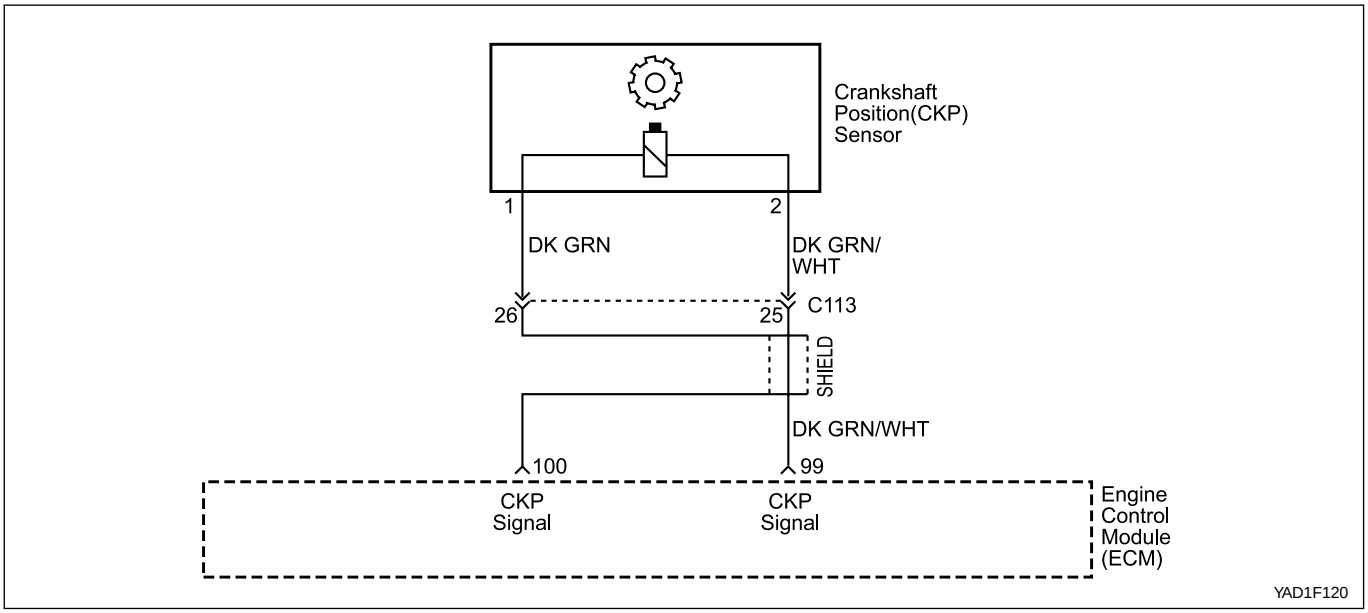


1 Crankshaft Position Sensor
2 Bolt
3 Segment
4 Flywheel

This Electronic Ignition (EI) system uses inductive or pick up type magnetic Crankshaft Position (CKP) sensor. The CKP sensor is located in the opposite side of the crankshaft pulley and triggers the pick-up wheel teeth which is equipped 60 - 2 teeth with a gap of 2 teeth at 360 degree spacing. This sensor protrudes throughits mount to within 1.1 ± 0.14 mm.

The output of the sensor is a sinusoidal signal. Each tooth of the pick-up 60 - 2 wheel generates a positive half wave.

The Engine Control Module (ECM) uses this sensor signal to generate timed ignition and injection pulses that it sends to the ignition coils and to the fuel injectors.



Failure Code	Description	Trouble Area	Maintenance Hint
17	Crankshaft position sensor signal failure (no engine revolution signal)	Even through cam position recognition is normal, no crankshaft position signal recognition	• Monitoring the actual rpm through or scan tool • Inspection the ECM pin 100, 99 about short circuit with bad contact • Inspection the CKP sensor • Inspection the air gap between sensor and drive plate • Inspection the drive plate (teeth condition) • Inspection the ECM
18	Crankshaft position sensor signal failure (rpm > max. value)	When more than applicable revolution values or implausible to 60-2 teeth scan tool	
20	Crankshaft position sensor signal failure (gap recognition failure)	When implausible recognition of cam and crank angle signal or intermittent sensing the signal or error count of undetected gap.	
67	Crankshaft position sensor adaptation failure	When faulty crank angle sensor adaption	

Circuit Description

The 58X reference signal is produced by the CKP sensor. During one crankshaft revolution, 58 crankshaft pulses will be produced. The ECM uses the 58X reference signal to calculate engine rpm and CKP. The ECM constantly monitors the number of pulses on the 58X reference circuit and compares them to the number of Camshaft Position (CMP) signal pulses being received. If the ECM receives and incorrect number of pulses on the 58X reference circuit, this failure code will set.

Crankshaft Position Sensor Resistance Inspection

1. Disconnect the coupling “E” of ECM while the ignition switch is in “OFF” position.
2. Measure the resistance between the coupling terminal pin No. 99 and No. 100 using a multimeter.

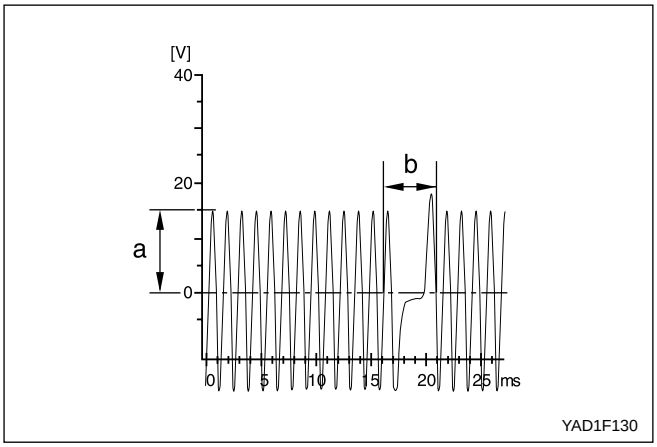
Specified Value	1,050 ~ 1,400 Ω

Notice: Measure the insulator resistance of the CKP sensor if out of the specified value.

Crankshaft Position Sensor Output Wave Inspection

1. Measure the output wave between the ECM terminals No. 99 and No. 100 using the scan tool or the oscilloscope while engine cranking (start motor activated).

   Notice: Check the segment or crankshaft position sensor and air gap if cannot get the output wave as shown in the figure.



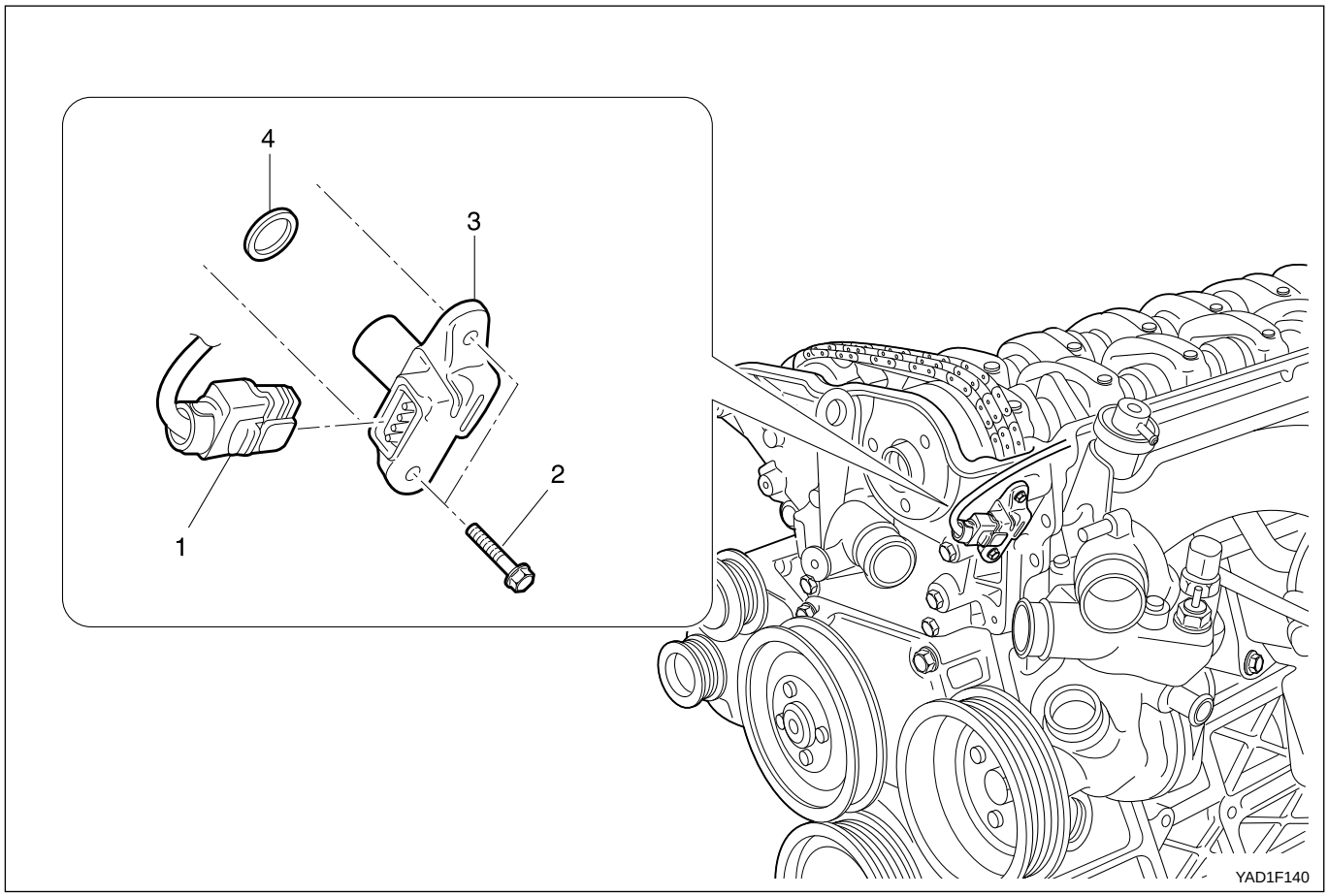
Crankshaft Position Sensor Insulator Resistance Inspection

1. Disconnect the coupling from ECM while the ignition switch is in “OFF” position.
2. Measure the resistance between the coupling terminal pin No. 100 and No. 69 using a multimeter.

Specified Value	>20 kΩ

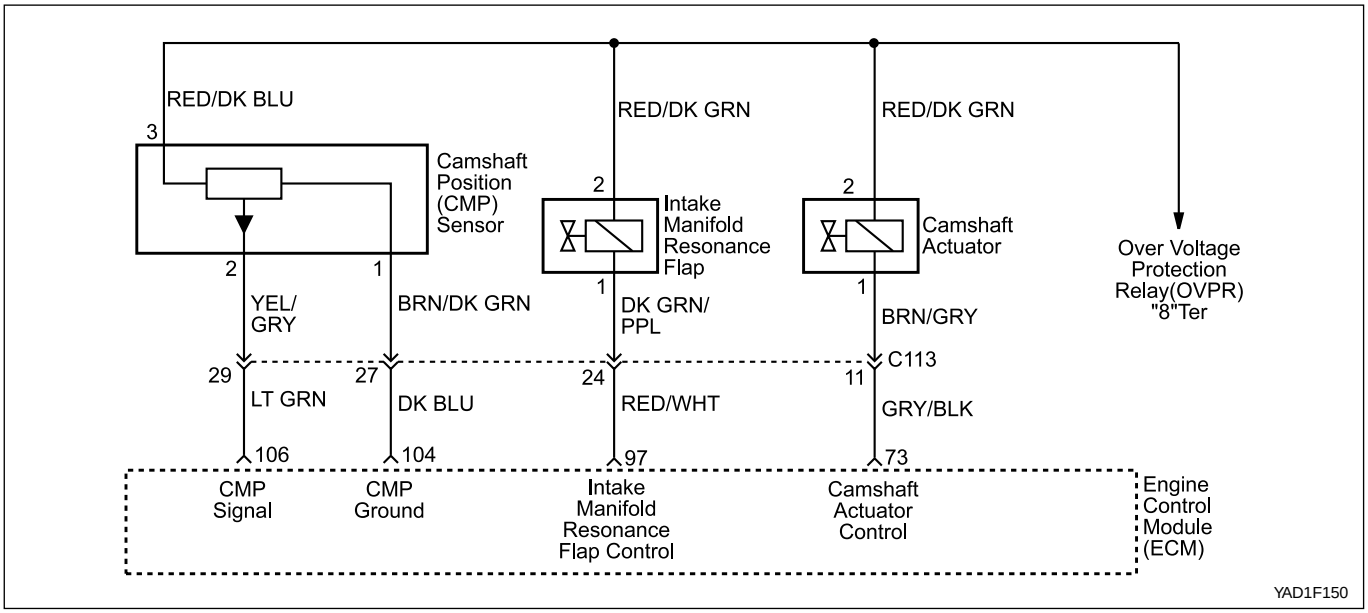
   Notice: Measure the check and ground terminal of the CKP sensor if out of the specified value.

CAMSHAFT POSITION (CMP) SENSOR



1 Camshaft Position Sensor Connector
2 Bolt
3 Camshaft Position Sensor
4 O-ring

The Camshaft Position (CMP) sensor sends a CMP signal to the Engine Control Module (ECM). The ECM uses this signal as a “synchronized pulse” to trigger the injectors in the proper sequence. The ECM uses the CMP signal to indicate the position of the #1 piston during its power stroke. This allows the ECM to calculate true sequential fuel injection mode of operation.



Failure Code	Description	Trouble Area	Maintenance Hint
19	Camshaft position sensor signal : No. 1 cylinder recognition failure	When no cam recognition signal during TN 24 counts more. (maintain the constant low or high level)	• Inspection the source voltage of CMP sensor • Inspection the ECM pin 106, 104 about short circuit or open with bad contact • Inspection the CMP sensor • Inspection the damage of sensor or sprocket • Inspection the ECM
58	Camshaft position sensor signal : No. 1 cylinder synchronization failure	When synchronization fault of cylinder 1 (TDC recognition)	

Circuit Description

The CMP sensor sends a cam position signal to the ECM. If the cam position signal is lost while the engine is running, the fuel injection system shifts to a calculated sequential fuel injection mode based on the last fuel injection pulse, and the engine continuous to run.

Camshaft Position Sensor Signal Voltage Inspection

1. Measure the voltage between the ECM terminal No. 11 and No. 106 while the engine speed is at idle.

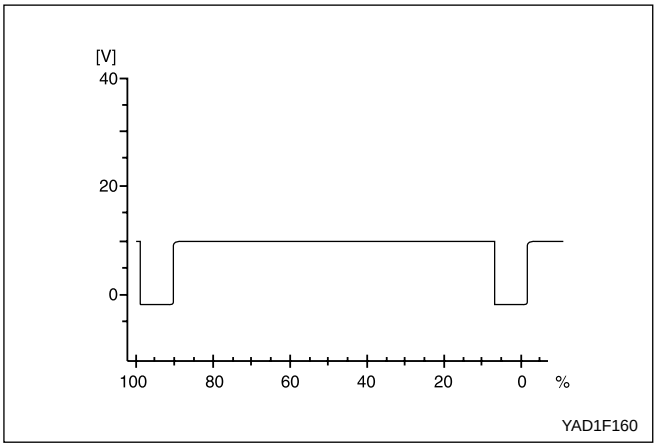
Specified Value	1.2 ~ 1.7 v

Notice: The signal voltage will be changed in the range of 1.2 ~ 1.7 v.

Camshaft Position Sensor Output Wave Inspection

1. Measure the output wave between the ECM terminals No. 104 and No. 106 using the scan tool or the oscilloscope while engine speed is at idle.

   Notice: Replace the CAM sensor if cannot get the out-put wave as shown in the figure.



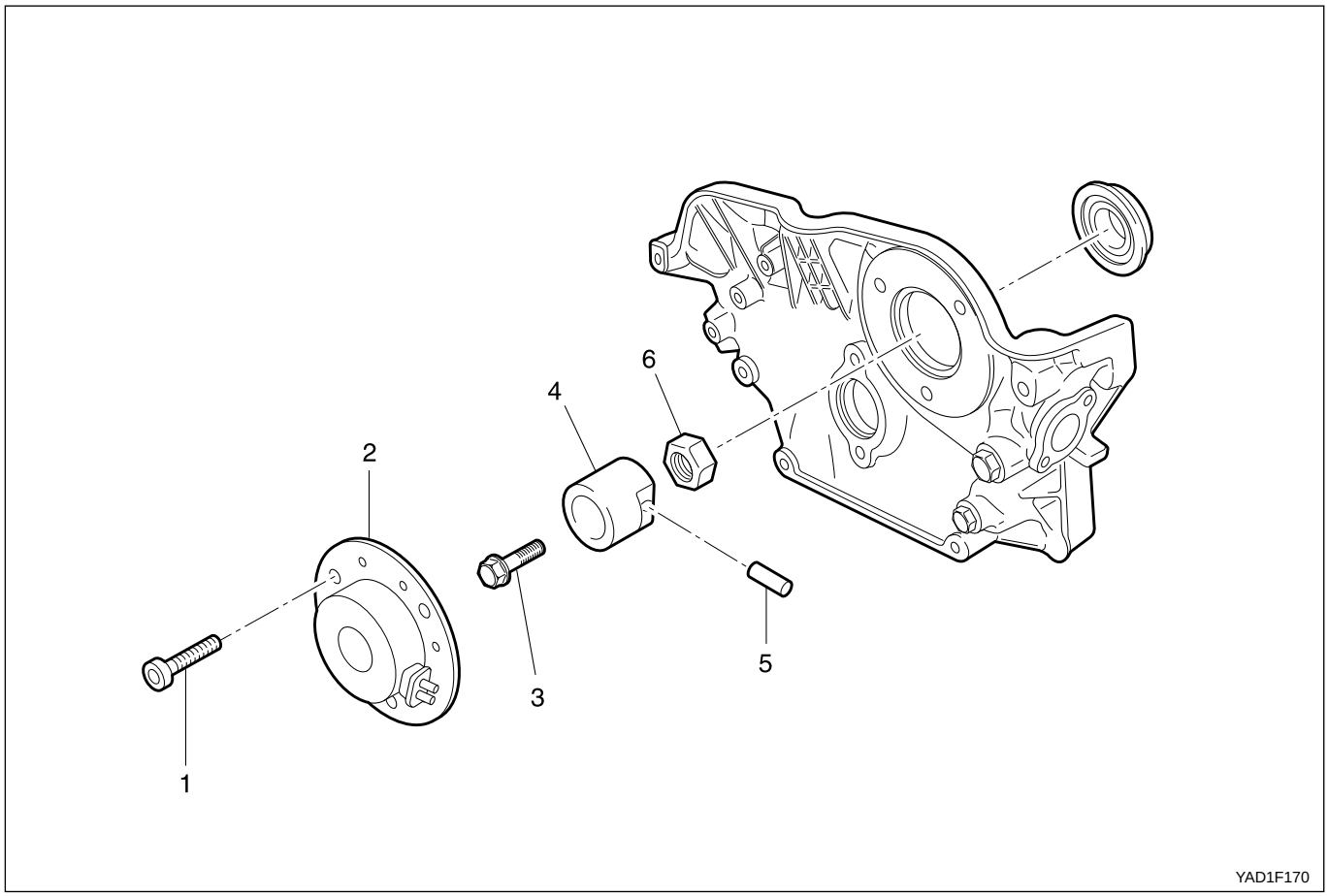
Camshaft Position Sensor Power Supply Inspection

1. Disconnect the CMP sensor Connector.
2. Measure the voltage between the No. 1and No. 3 pin of the CMP sensor connector while the ignition switch is in “ON” position.

Specified Value	11 ~ 14 v

   Notice: If the measured value is not within the specified value, check the cable.

CAMSHAFT ACTUATOR

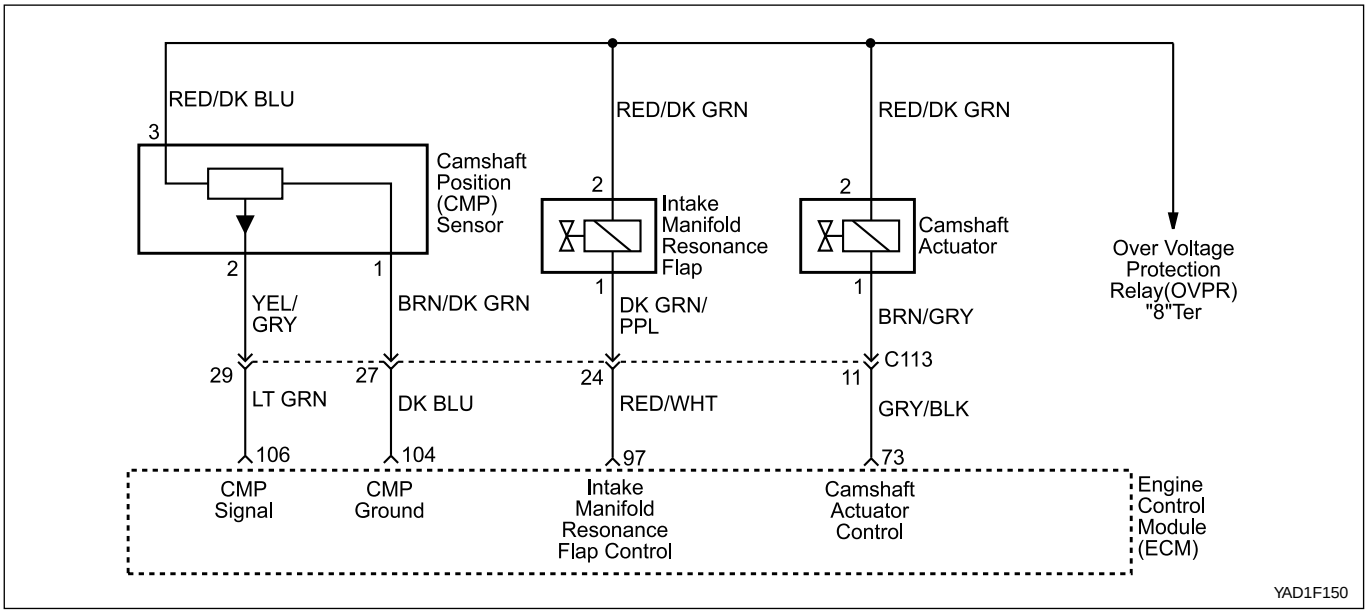


1 Bolt
2 Camshaft Actuator
3 Bolt
4 Armature
5 Roll Pin
6 Nut

When the engine is running, the camshaft actuator rotates the intake camshaft hydraulically and mechanically relative to the camshaft sprocket by 32° crank angle to the “advanced” position and back to the “retard” position.
The camshaft actuator is actuated electro-mechanically by the Engine Control Module (ECM).
The positioning time of apporx. 1 second is dependent on the engine oil pressure at the camshaft actuator and on the oil viscosity and oil temperature, respectively.
The camshaft indicator on the camshaft sprocket provides the camshaft rotational speed to the position sensor as an input parameter for the engine ignition control unit.

Operation Condition of Camshaft Actuator

Engine RPM	Camshaft Position	Effect
Engine stop	Retard	-
0 ~ 1,500 rpm	Retard	Idle speed is improved Blow-by gas is decreased Valve overlap is decreased
1,500 ~ 4,300 rpm	Advanced	Torque is increased Fuel loss is decreased NOx is decreased
Above 4,300 rpm	Retard	Engine overrun is prohibited



Failure Code	Description	Trouble Area	Maintenance Hint
226	Camshaft actuator short circuit to battery	When malfunction of cam phasing control	• Monitoring the actual operational status through scan tool • Inspection the ECM pin 73 about short circuit or open • Inspection the power source short circuit or open to cam actuator • Inspection the magnet and hardware • Inspection the ECM
227	Camshaft actuator short circuit to ground or open		

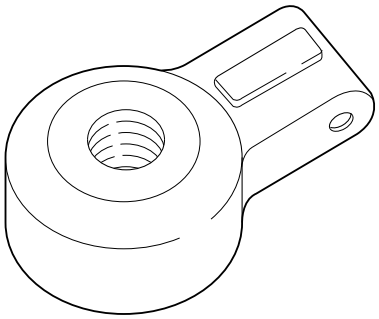
Camshaft Actuator Current Consumption Inspection

1. Run the engine to reach the coolant temperature above 70 °C.
2. Increase the engine rpm up to 2000 rpm
3. Measure the current between the No. 1 and No. 2 pin of the camshaft actuator connector.

Specified Value	1 ~1.5 A

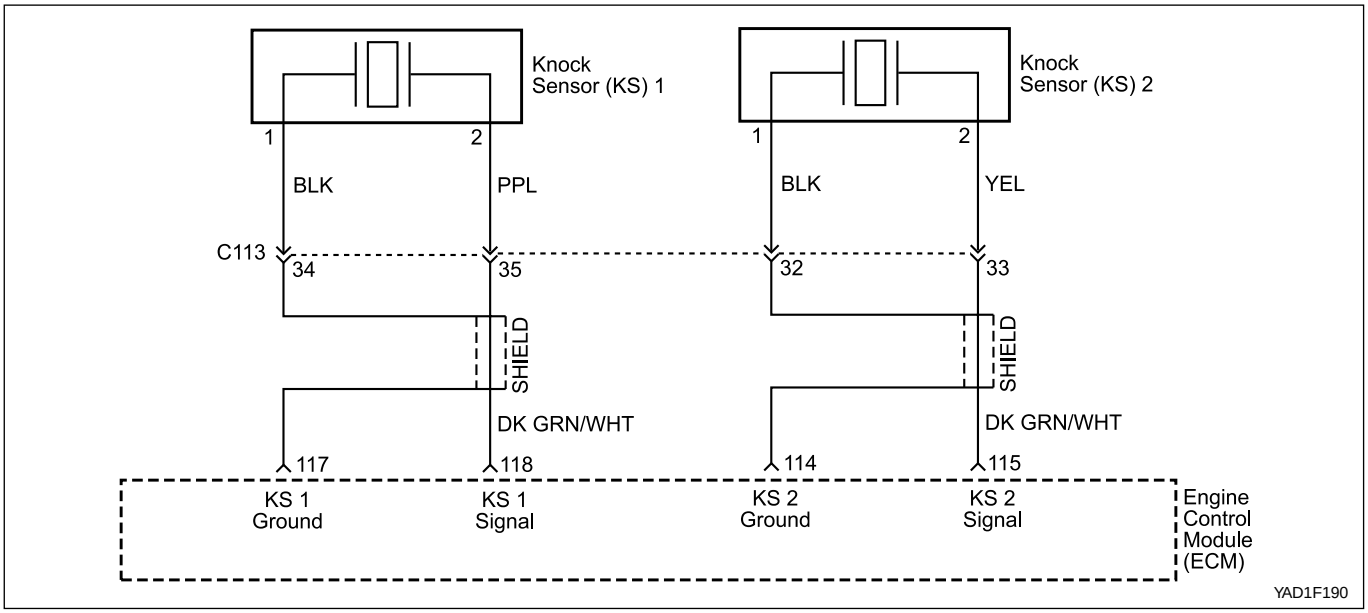
Notice: If the measured value is not within the specified value, check the cable.

KNOCK SENSOR (KS)



YAD1F180

The Knock Sensor (KS) detects abnormal knocking in the engine. The two KS are mounted in the engine block near the cylinders. The sensors produce an output voltage which increases with the severity of the knock. This signal is sent to the Engine Control Module (ECM) via a shielded cable. The ECM then adjusts the ignition timing to reduce the spark knock.



Failure Code	Description	Trouble Area	Maintenance Hint
56	No. 1 knock sensor signal failure	When recognition in more than control gain threshold at normal operational condition of other system during over 75 and 3,000 rpm running area (cylinder 1, 2, 3)	• Inspection the ECM pin 118, 117about short circuit or open with bad contact • Inspection the KS 1 malfunction • Inspection the ECM • Inspection the ECM pin 115, 114 about short circuit or open with bad contact • Inspection the KS 2 malfunction • Inspection the ECM
57	No. 2 knock sensor signal failure	When recognition in more than control gain threshold at normal operational condition of other system during over 75 and 3,000 rpm running area (cylinder 4, 5, 6)	

Circuit Description

The KS system is used to detect engine detonation, allowing the ECM to retard the ignition control spark timing based on the KS signal being received. The KS signal's amplitude and frequency depend upon the amount of knock being experienced. The ECM monitors the KS signal and can diagnose the KS sensor and circuitry.

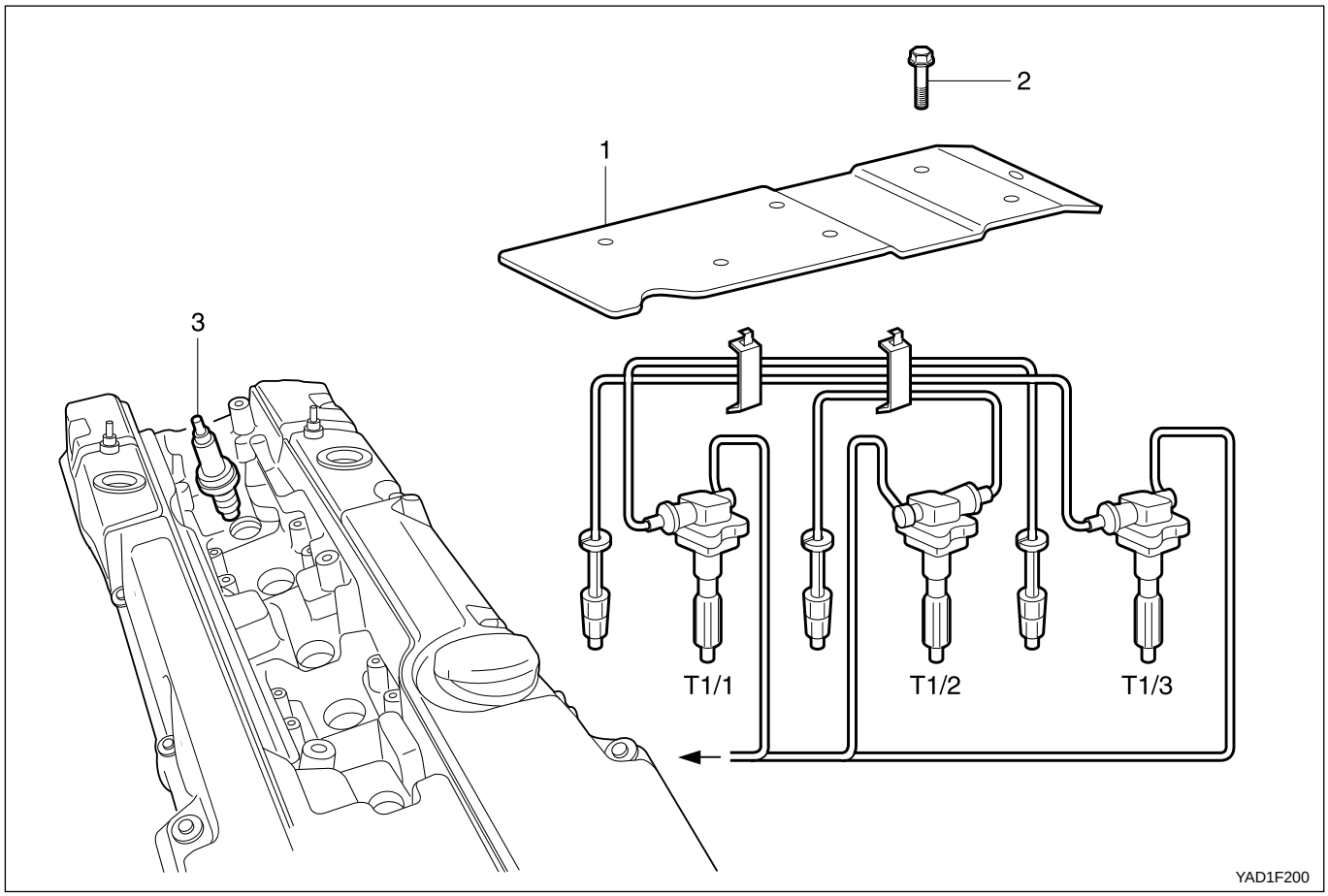
Knock Sensor Resistance Inspection

1. Disconnect the coupling from ECM while the ignition switch is in "OFF" position.
2. Measure the resistance between the coupling terminal pin No. 118 and No. 117 and terminal pin No. 115 and No. 114 using a multimeter.

Specified Value	>10 MΩ

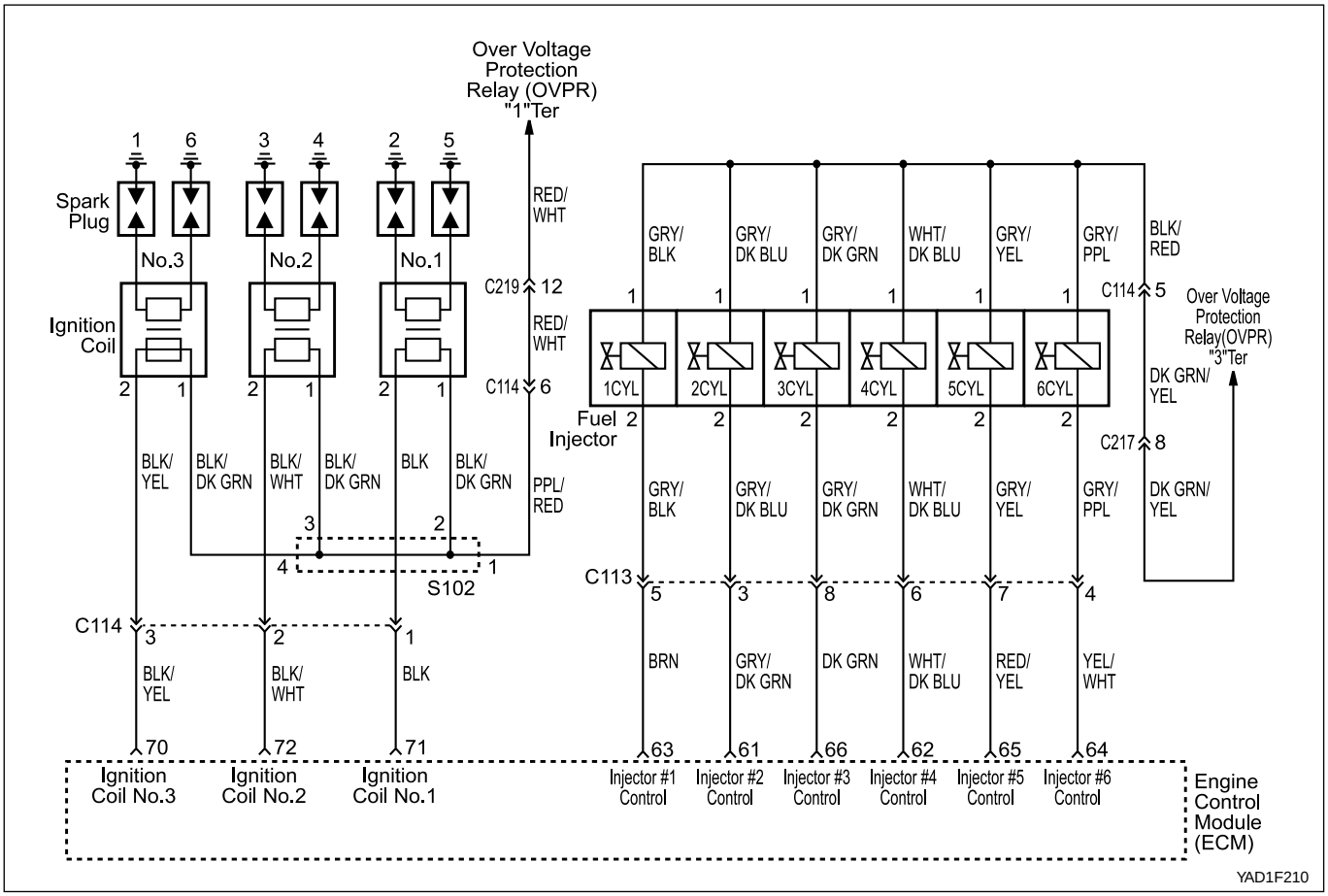
Notice: Replace the KS if the measured values is out of the specified values. Check the connector and wire connection between ECM and the KS if the measured values are normal.

SPARK PLUG



1 Ignition Coil Cable Cover
2 Bolt
3 Spark Plug

T 1/1 Ignition Coil Cylinder 2 and 5
T 1/2 Ignition Coil Cylinder 3 and 4
T 1/3 Ignition Coil Cylinder 1 and 6



Failure Code	Description	Trouble Area	Maintenance Hint
68	Random / Multiple Misfire	When detection misfire of multiple cylinder for source of over the emission threshold or catalyst damage	• Inspection the ignition system • Inspection the injection system • Inspection the fuel pressure • Inspection the compression pressure • Inspection the valve timing or clearance • Inspection the air flow sensor • Inspection the crankshaft position sensor and air gap • Inspection the engine wiring system • Inspection the Engine Control Module (ECM)

Circuit Description

The ECM monitors the crankshaft and camshaft positions to detect if the engine is misfiring. The ECM looks for a quick drop in crankshaft speed. Misfire multiple cylinder is monitored by engine roughness measuring. The actual roughness value is compared with the actual (emission and catalyst damage) threshold.

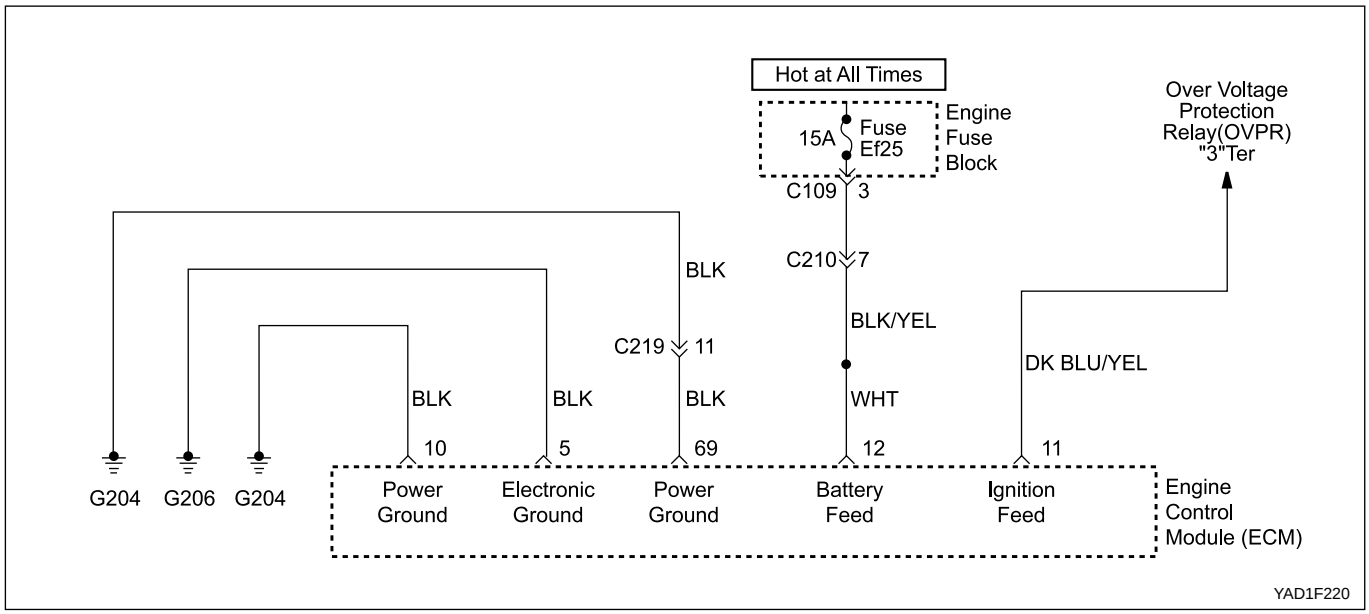
Spark Plug Cable Resistance Inspection

1. Turn the ignition switch “OFF” position.
2. Disconnect the spark plug cables Refer to *Section 1E1, Engine electrical.*
3. Measure the spark plug resistance using a multimeter.

Specified Value	1.8 ~ 2.2 kΩ

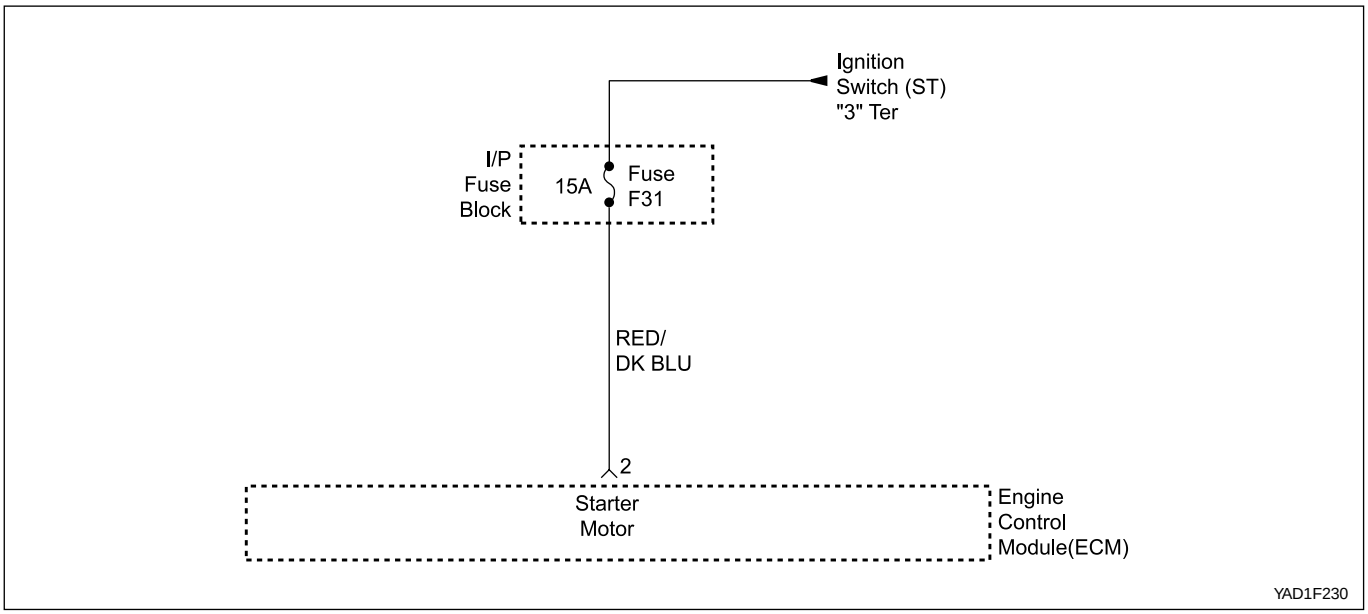
Notice: Replace the spark plug cable if the measured values is out of the specified values.

SYSTEM VOLTAGE



Failure Code	Description	Trouble Area	Maintenance Hint
08	System voltage too low	Malfunction in recognition of system source voltage. Less than minimum 8 volts in 2,000 rpm below, or less than 10 volts in 2,000 rpm above.	• Monitoring the actual battery voltages through the scan tool • Inspection the Engine Control Module (ECM) pin 12, 11, 10, 5 about short circuit or open with bad contact • Inspection the over voltage protection relay • Inspection the battery • Inspection ECM

IGNITION SWITCH



Failure Code	Description	Trouble Area	Maintenance Hint
71	Starter signal recognition failure	When not detection of starter signal	• Inspection the Engine Control Module (ECM) pin 2 circuit short or open with bad contact • Inspection ECM

FUEL SYSTEM

The function of the fuel metering system is to deliver the correct amount of fuel to the engine under all operating conditions.

The fuel is delivered to the engine by the individual fuel injectors mounted into the intake manifold near each cylinder.

The main fuel control sensors are the Mass Air Flow (MAF) sensor and the oxygen (O2) sensors.

The MAF sensor monitors the mass flow of the air being drawn into the engine. An electrically heated element is mounted in the intake air stream, where it is cooled by the flow of incoming air. Engine Control Module (ECM) modulates the flow of heating current to maintain the temperature differential between the heated film and the intake air at a constant level. The amount of heating current required to maintain the temperature thus provides an index for the mass air flow. This concept automatically compensates for variations in air density, as this is one of the factors that determines the amount of warmth that the surrounding air absorbs from the heated element. MAF sensor is located between the air filter and the throttle valve.

Under high fuel demands, the MAF sensor reads a high mass flow condition, such as wide open throttle. The ECM uses this information to enrich the mixture, thus increasing the fuel injector on—time, to provide the correct amount of fuel. When decelerating, the mass flow decreases. This mass flow change is sensed by the MAF sensor and read by the ECM, which then decreases the fuel injector on—time due to the low fuel demand conditions.

The O2 sensors are located in the exhaust pipe before catalytic converter. The O2 sensors indicate to the ECM the amount of oxygen in the exhaust gas, and the ECM changes the air/fuel ratio to the engine by controlling the fuel injectors. The best air/fuel ratio to minimize exhaust emissions is 14.7 to 1, which allows the catalytic converter to operate most efficiently. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a “closed loop” system.

The ECM uses voltage inputs from several sensors to determine how much fuel to provide to the engine. The fuel is delivered under one of several conditions, called ‘‘modes”.

Starting Mode

When the ignition is turned ON, the ECM turns the fuel pump relay on for 1 second. The fuel pump then builds fuel pressure. The ECM also checks the Engine Coolant Temperature (ECT) sensor and the Throttle Position (TP) sensor and determines the proper air/fuel ratio for starting the engine. This ranges from1.5 to 1 at -36 °C (-33 °F) coolant temperature to 14.7 to 1 at 94 °C (201 °F) coolant temperature. The ECM controls the amount of fuel delivered in the starting mode by changing how long the fuel injector is turned on and off. This is done by ‘‘pulsing” the fuel injectors for very short times.

Run Mode

The run mode has two conditions called ‘‘open loop” and ‘‘closed loop”.

Open Loop

When the engine is first started and it is above 690 rpm, the system goes into “open loop” operation. In “open loop”, the ECM ignores the signal from the O2S and calculates the air/fuel ratio based on inputs from the ECT sensor and the MAF sensor. The ECM stays in “open loop” until the following conditions are met:

- The O2 has a varying voltage output, showing that it is hot enough to operate properly.
- The ECT sensor is above a specified temperature (22.5 °C).
- A specific amount of time has elapsed after starting the engine.

Closed Loop

The specific values for the above conditions vary with different engines and are stored in the Electronically Erasable programmable Read-Only Memory (EEPROM). When these conditions are met, the system goes into “closed loop” operation. In “closed loop”, the ECM calculates the air/fuel ratio (fuel injector on-time) based on the signals from the O2 sensors. This allows the air/fuel ratio to stay very close to 14.7 to 1.

Acceleration Mode

The ECM responds to rapid changes in throttle position and airflow and provides extra fuel.

Deceleration Mode

The ECM responds to changes in throttle position and airflow and reduces the amount of fuel. When deceleration is very fast, the ECM can cut off fuel completely for short periods of time.

Battery Voltage Correction Mode

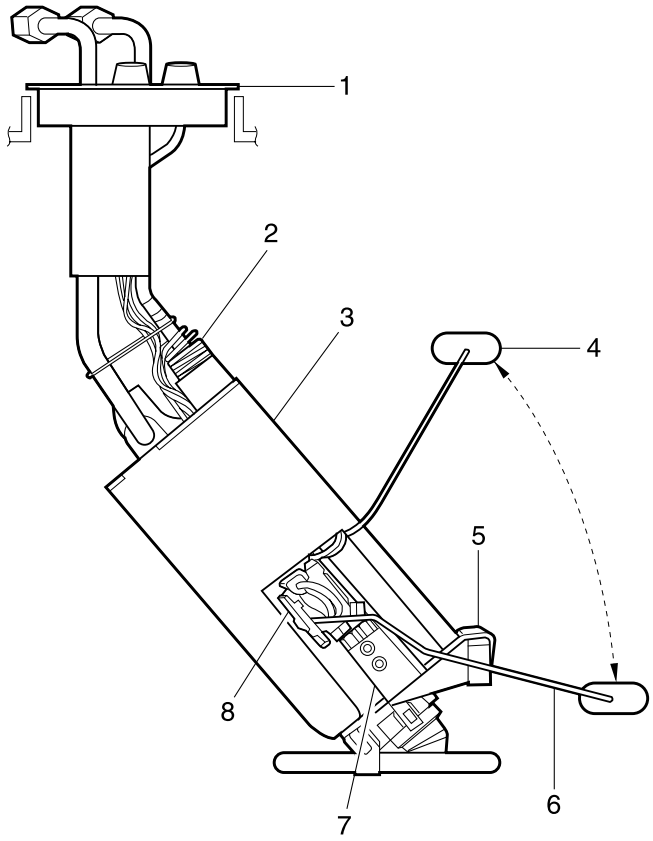
When battery voltage is low, the ECM can compensate for a weak spark delivered by the ignition module by using the following methods:

- Increasing the fuel injector pulse width.
- Increasing the idle speed rpm.
- Increasing the ignition dwell time.

Fuel Cut-Off Mode

No fuel is delivered by the fuel injectors when the ignition is off. This prevents dieseling or engine run-on. Also, the fuel is not delivered if there are no reference pulses received from the CKP sensor. This prevents flooding.

FUEL PUMP

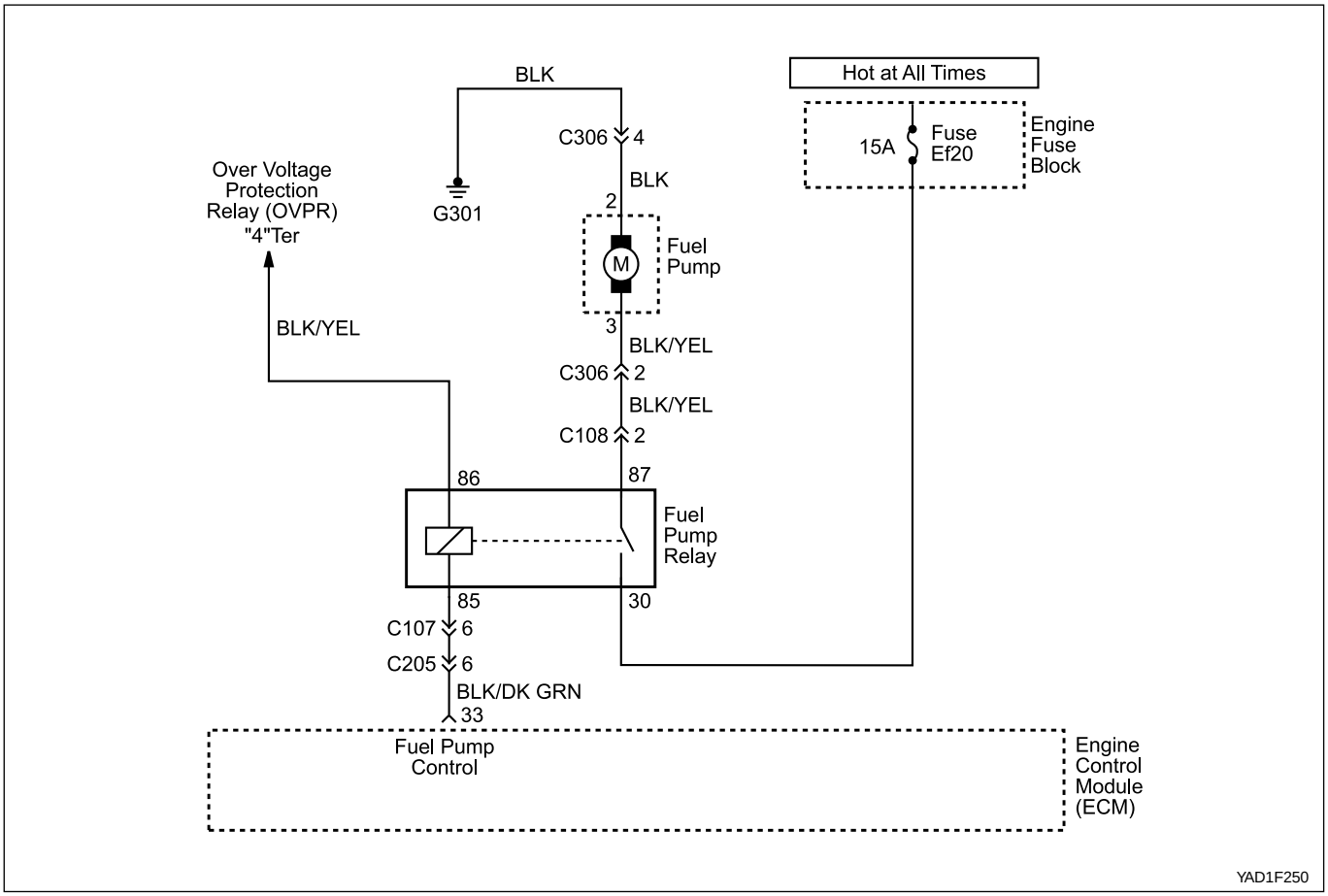


YAD1F240

1 Flange and Harness Assembly
2 Spring
3 Fuel Pump
4 Float
5 Thermistor
6 Float Arm
7 Thermistor Housing
8 Resistor Card and Wiper

Requirements for Fuel Pump

Item	Specified Value	Item	Specified Value
System Pressure	3.8 bar	Minimum Delivery at 8V	30 Litre/Hr
Maximum Pressure	8.5 bar (12 V)	Operating Voltage	8 V
Minimum Pressure	5.0 bar (12 V)	Maximum Allowable Current	7.5 A
Nominal Voltage	12 V	Ambient Temperature	-30 ~ +70 °C
Minimum Amount of Fuel Supply	114 Liter/Hr (12 V, 3.8 bar, -30 ~ +70 °C)	Maximum Amount of Fuel Supply	165 Liter/Hr (12V, 3.8 bar, -30 ~ +70 °C)



Failure Code	Description	Trouble Area	Maintenance Hint
34	Fuel pump relay short circuit to battery	When short circuit to power source	• Inspection the Engine Control Module (ECM) pin 33 about short circuit or open with bad contact • Inspection the fuel pump relay • Inspection the ECM
35	Fuel pump relay short circuit to ground or open	When short circuit to ground or open open with bad contact	

Circuit Description

When the ignition switch is turned ON, the ECMwill activate the pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running and the ECMis receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut off the fuel pump within 2 seconds after the ignition switch is turned ON, engine stopped or engine stalled.

Fuel Pump Relay Inspection

Measure the voltage between the ECM terminal No. 33 and ground.

Ignition Switch : ON	0 V (for1 ~ 2 sec.)
Cranking	0 V

Measure the Fuel Delivery from the Fuel Pump

1. Disconnect the return pipe from fuel distributor and insert the appropriate hose into it.
2. Place the hose end into the beaker with the minimum capacity of 1 Liter
3. Turn the ignition switch to “ON” position.
4. Connect the terminal No. 33 and No. 5 of ECM with a service wire.
5. Measure the fuel delivery from the fuel pump

Specified Value	1 Liter/max. 35 sec.

Notice: Check the fuel filter and fuel line when the fuel delivery is not within specified value.

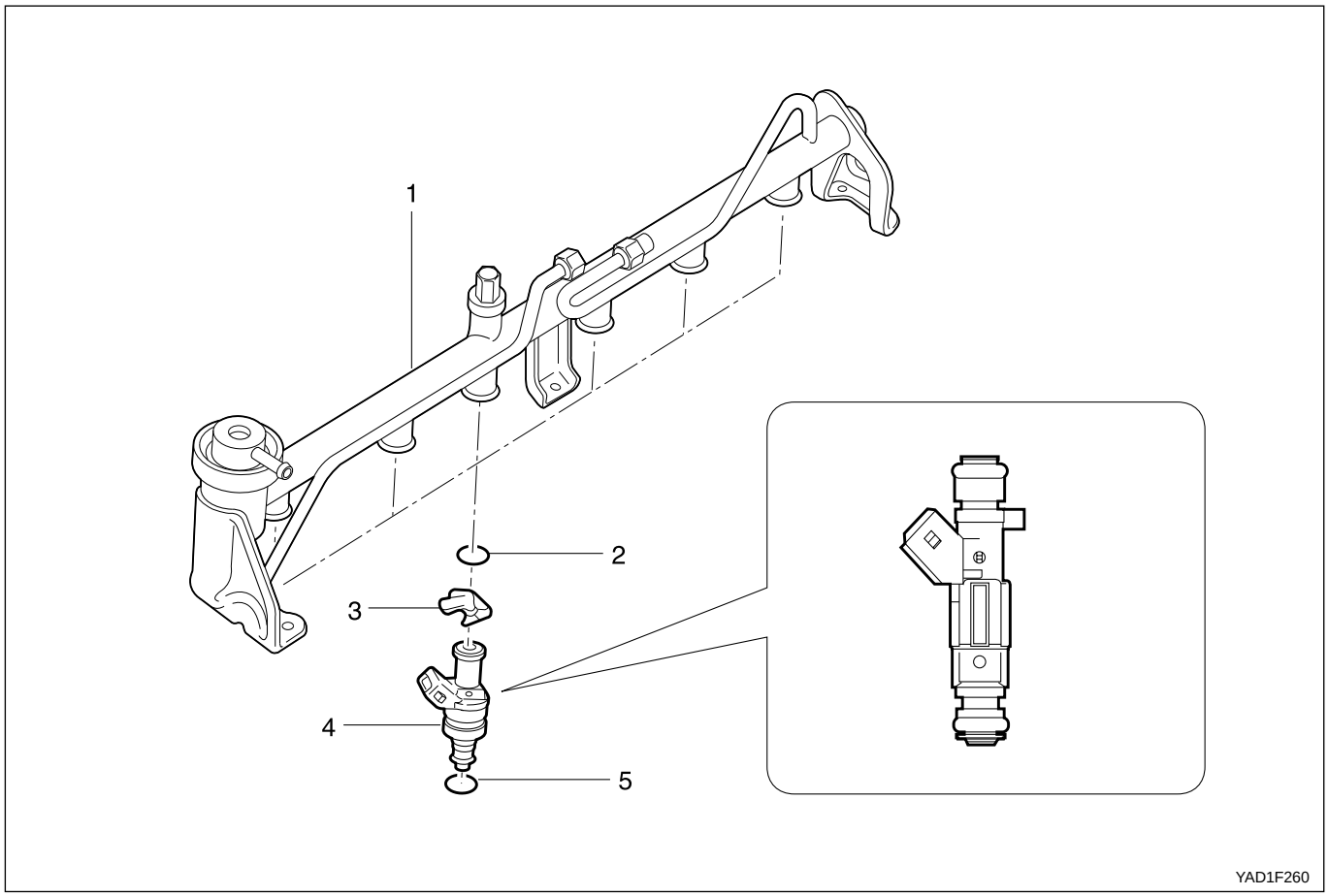
Measure the Current Consumption of Fuel Pump

1. Remove the fuel pump relay from fuse and relay box in trunk, and turn the ignition switch to “ON” position.
2. Using a multimeter, measure the current consumption by connecting the terminal No. 30 and No. 87 of the fuel pump relay connector.

Specified Value	5 ~9 A

Notice: Replace the fuel pump relay if the measured value is over 9 A.

FUEL INJECTOR

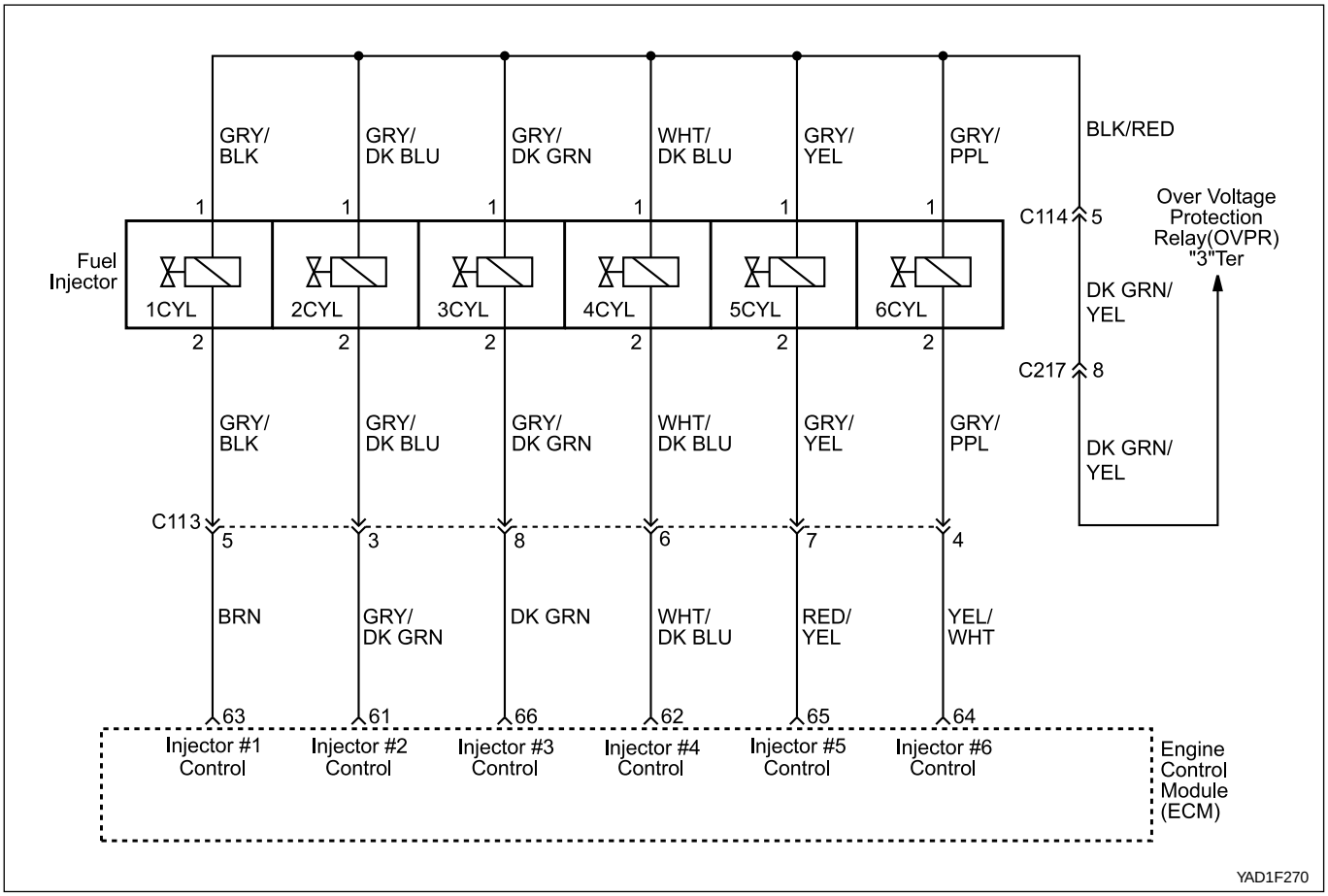


1 Fuel Rail
2 O-Ring
3 Injector Bracket
4 Injector
5 O-Ring

The Multipoint Fuel Injection (MFI) assembly is a solenoid-operated device controlled by the Engine Control Module (ECM) that meters pressurized fuel to an each individual cylinder. The injector sprays the fuel, in precise quantities at a point in time determined by the ECM, directly to ward the cylinder intake valve. ECM energizes the fuel injector solenoid to lift the needle valve and to flow the fuel through the orifice. This injector's discharge orifice is calibrated to meet the effective fuel atomization necessary for both ensuring the maximum homogeneity in the air-fuel mixture and holding the condensation along the walls of the intake tract to a minimum.

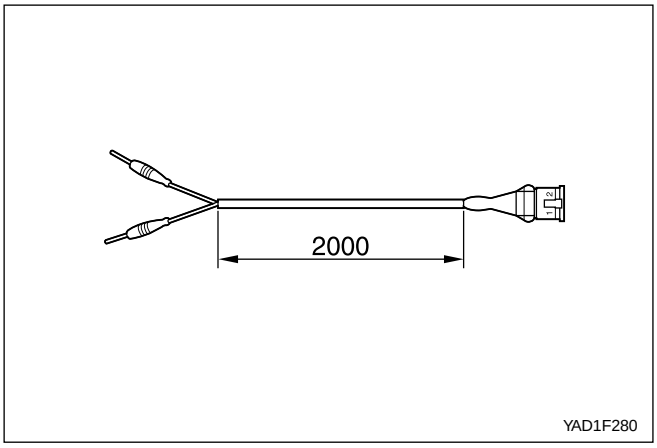
Fuel enters the top feed injector from above and flows through its vertical axis. The lower end extends into the intake valve. Fuel from the tip is directed at the intake valve, causing it to become further atomized and vaporized before entering the combustion chamber.

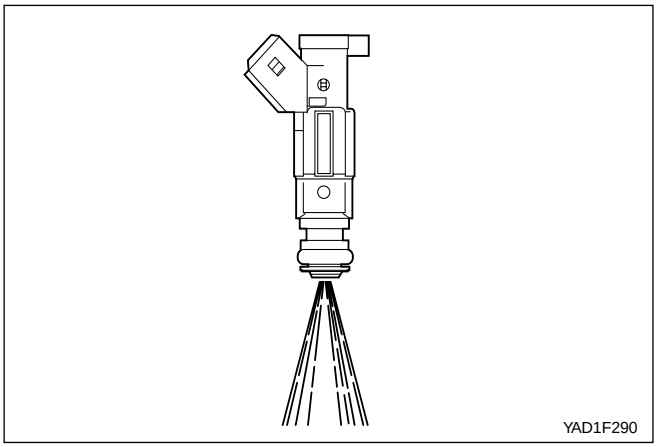
A fuel injector which is stuck partially open would cause a loss of fuel pressure after the engineis shut down. Also, an extended crank time would be noticed on some engines. Dieseling could also occur because some fuel could be delivered to the engine after the ignition is turned off.



Failure Code	Description	Trouble Area	Maintenance Hint
72	No. 1 injector short circuit to battery	When malfunction of injector circuit Injector #1 short circuit to power	• Inspection the power to injector #1 or bad contact • Inspection the injector • Inspection the ECM
73	No. 1 injector short circuit to ground or open	When malfunction of injector circuit Injector #1 short circuit to ground or open	• Inspection the ECM pin 63 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
74	No. 2 injector short circuit to battery	When malfunction of injector circuit Injector #2 short circuit to power	• Inspection the power to injector #2 or bad contact • Inspection the injector • Inspection the ECM
75	No. 2 injector short circuit to ground or open	When malfunction of injector circuit Injector #2 short circuit to ground or open	• Inspection the ECM pin 61 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
76	No. 3 injector short circuit to battery	When malfunction of injector circuit Injector #3 short circuit to power	• Inspection the power to injector #3 or bad contact • Inspection the injector • Inspection the ECM

Failure Code	Description	Trouble Area	Maintenance Hint
77	No. 3 injector short circuit to ground or open	When malfunction of injector circuit Injector #3 short circuit to ground or open	• Inspection the ECM pin 66 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
78	No. 4 injector short circuit to battery	When malfunction of injector circuit Injector #4 short circuit to power	• Inspection the power to injector #4 or bad contact • Inspection the injector • Inspection the ECM
79	No. 4 injector short circuit to ground or open	When malfunction of injector circuit Injector #4 short circuit to ground or open	• Inspection the ECM pin 62 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
192	No. 5 injector short circuit to battery	When malfunction of injector circuit Injector #5 short circuit to power	• Inspection the power to injector #5 or bad contact • Inspection the injector • Inspection the ECM
193	No. 5 injector short circuit to ground or open	When malfunction of injector circuit Injector #5 short circuit to ground or open	• Inspection the ECM pin 65 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
194	No. 6 injector short circuit to battery	When malfunction of injector circuit Injector #6 short circuit to power	• Inspection the power to injector #6 or bad contact • Inspection the injector • Inspection the ECM
195	No. 6 injector short circuit to ground or open	When malfunction of injector circuit Injector #6 short circuit to ground or open	• Inspection the ECM pin 64 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM





Injector Spray Pattern Check

1. Turn the ignition switch OFF.
2. Remove the fuel injector connectors.
3. Remove the fuel distributor and injector with a unit. At this time, do not remove the supply and return line.

   Notice: Prepare the beaker for taking the fuel.

4. Connect the shop made cable to the injector with a firing order.
5. Connect the other end of shop made cable to the positive battery cable and negative battery cable.
6. Turn the ignition switch ON.
7. Check the injector for normal spray pattern as shown in the figure. Check injector for leaks or later drop

Injector Resistance Inspection

1. Turn the ignition switch OFF.
2. Remove the fuel injector connectors.
3. Measure the fuel injector coil resistance using a multimeter.

Specified Value	14 ~ 17 Ω

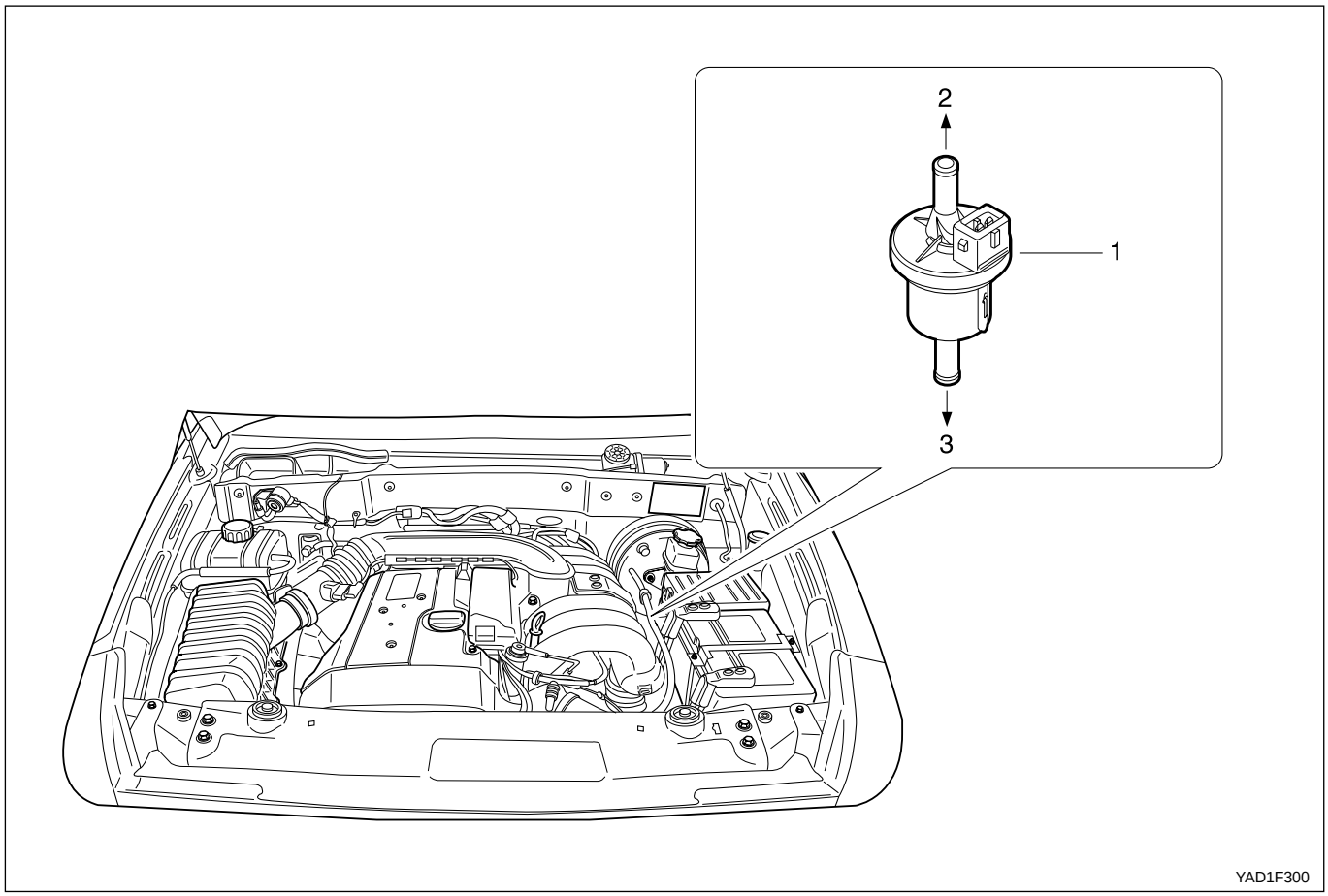
Notice: Replace the fuel injector if the measured value is out of the specified values. Check the connector and wire connection between the ECM and the injector if the measured values are normal.

Injector Pulse Width Inspection

1. Turn the ignition switch OFF.
2. Install the scan tool.
3. Turn the ignition switch ON.
4. Monitor the “INJECTION TIME” with a scan tool.

Cranking	8.0 ms
Engine Idle	3 ~5 ms
Wide Open Throttle (WOT)	14 ms

PURGE CONTROL VALVE



1 Purge Control Valve
2 Line to Engine
3 Line to Conister

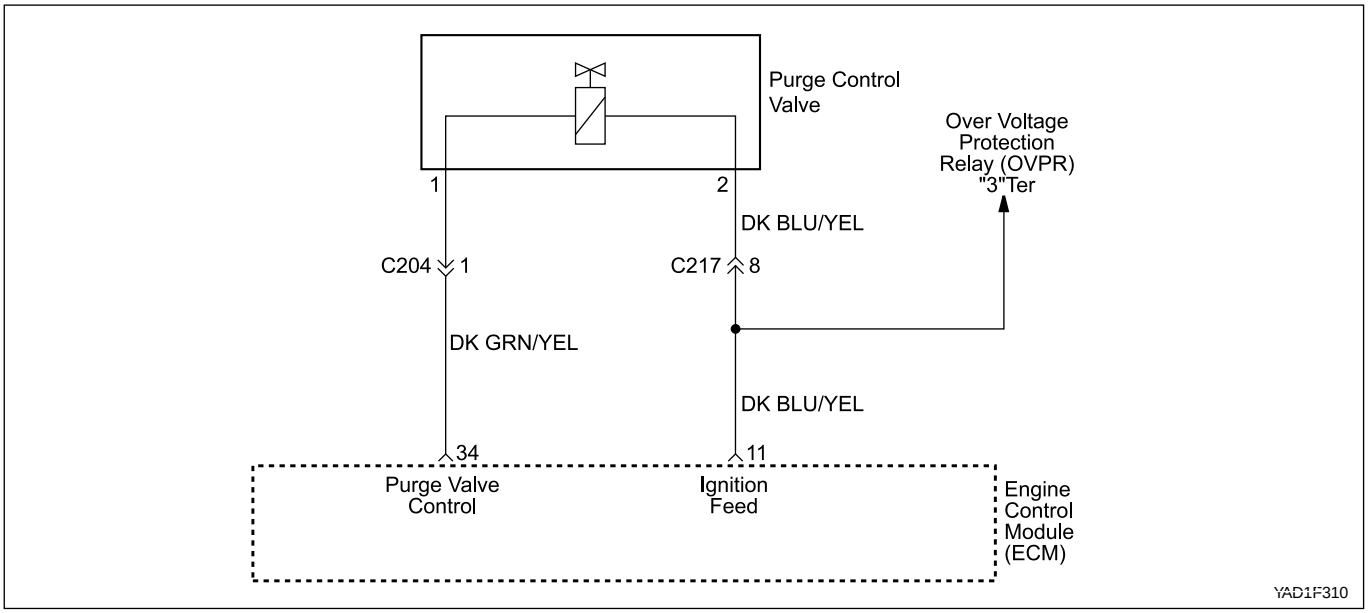
The fuel vaporization control system is in stalled to inhibit the fuel vaporized gas from discharging into the atmosphere.

The fuel vaporized gas that is accumulated in the canister abstracts through the purge control valve purification during the engine combustion (except the decreasing mode) and coolant temperature of over 80 °C. For this reason, the Engine Control Module (ECM) transacts the engine speed, air inflow quantity, coolant temperature, and intake temperature.

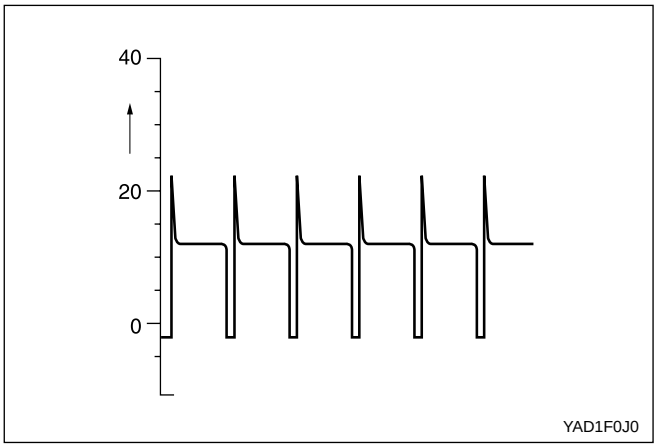
The purge control valve is activated by the ECM frequency according with the engine rotating speed to adjust the purification rate. The purification rate is determined by the continuous valve opening interval.

The purge control valve is activated by the ECM for the following conditions:

- Coolant temperature of over 80 °C
- Engine speed of over 1,000 rpm
- 2 minutes after starting
- When the fuel cut-off mode is not activated



Failure Code	Description	Trouble Area	Maintenance Hint
40	Purge control valve short circuit to battery	When short circuit to power source	• Inspection the ECM pin 34 about short circuit or open with bad contact. • Inspection the source power of valve • Inspection the purge control solenoid vale • Inspection the ECM
41	Purge control valve short circuit to ground or open	When short circuit to ground or open circuit or open with bad contact	
54	Purge control circuit malfunction	When malfunction of purge control : not work vale	



Test

1. Maintain the normal temperature and idling state by operating the engine.
2. Connect the ECM terminal No. 11 and No. 34 and check for normal operation through the output waves using oscilloscope.

   Notice: Test during purge control valve operation after the minimum of 1 minute after the engine turned on.

3. Connect the ECM terminal No. 34 and No.10 and check for current consumption during the ignition switch ON.

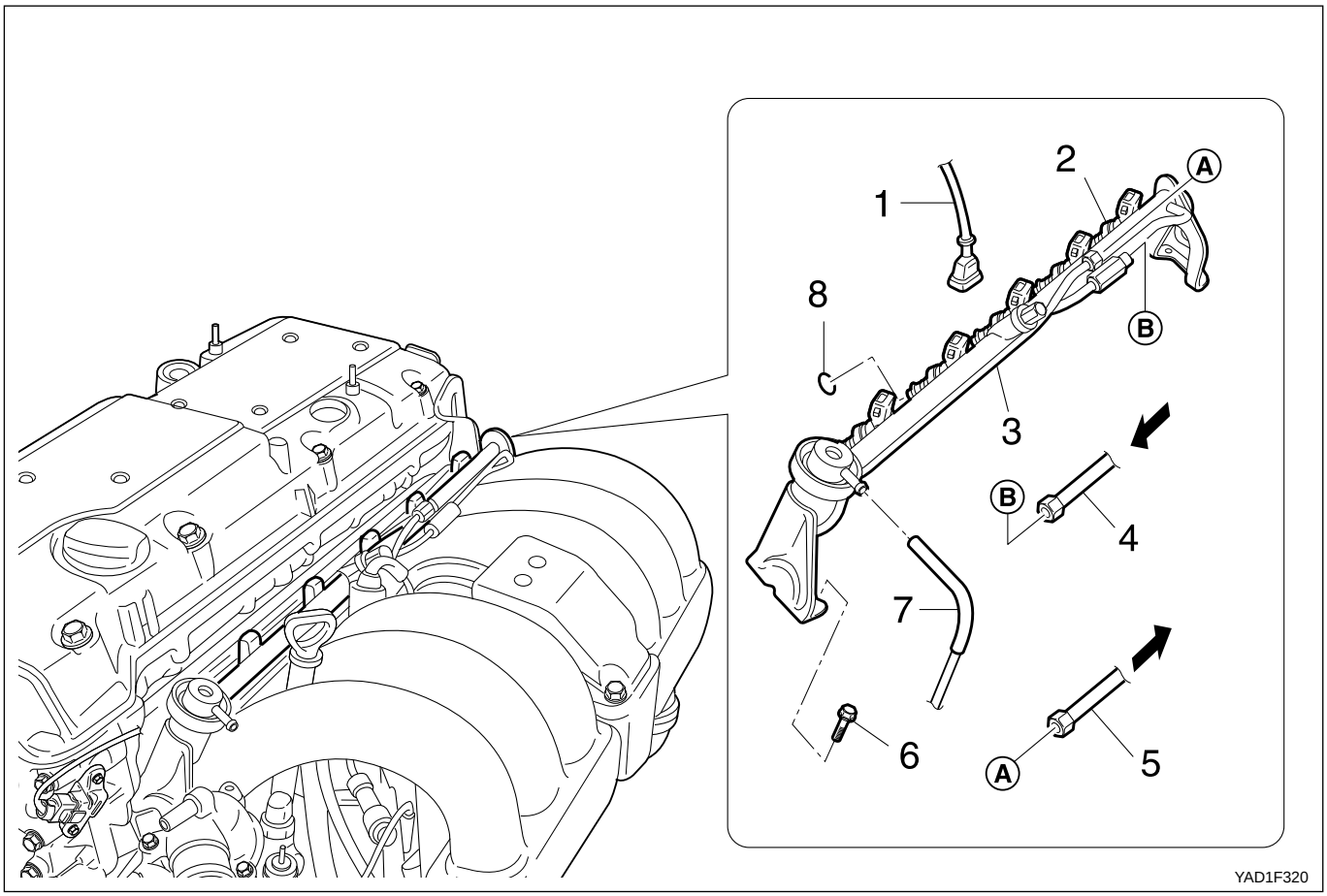
Specified Value	0.3 ~ 0.5 A

4. Remove the line to canister and measure the pressure with the vacuum pressure gauge.

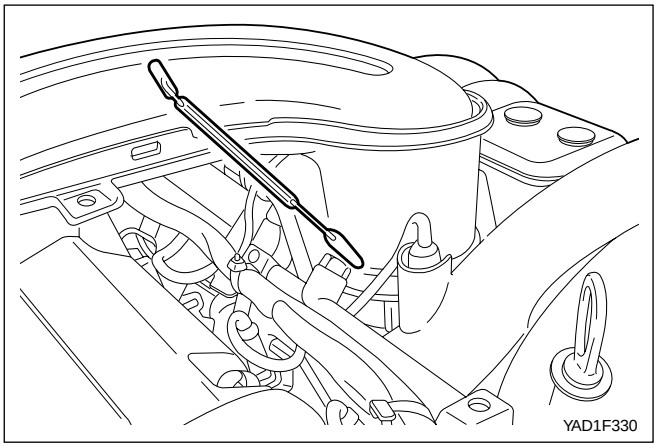
Specified Value	> 500 mbar (after approx. 1 min.) purge control valve operates at this time

Notice: Test while at normal temperature and at idling state by operating the engine.

FUEL RAIL



1 Injector Connector
2 Injector
3 Fuel Rail
4 Fuel Supply Line
5 Fuel Return Line
6 Bolt
7 Vacuum Hose
8 O-Ring



Fuel Pressure Test

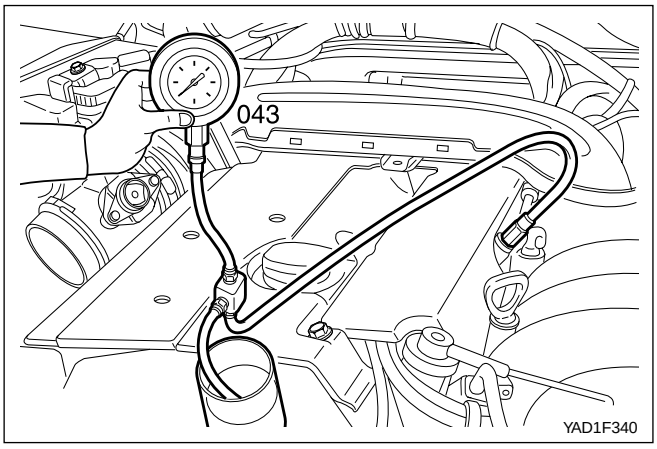
Tools Required

103 589 00 21 00 Fuel Pressure Gauge

1. Turn the ignition switch to “OFF” position.
2. Remove the fuel pressure test connector.
3. Connect the fuel pressure gauge to the fuel pressure test connector.
4. Test the fuel pressure at idling by operating the engine using the fuel pressure gauge 103 589 00 21 00.

Vacuum Hose Connected (bar)	3.2 ~ 3.6
Vacuum Hose Disconnected (bar)	3.7 ~ 4.2

5. Replace the pressure regulator diaphragm if out of the specification.



Internal Leakage Test

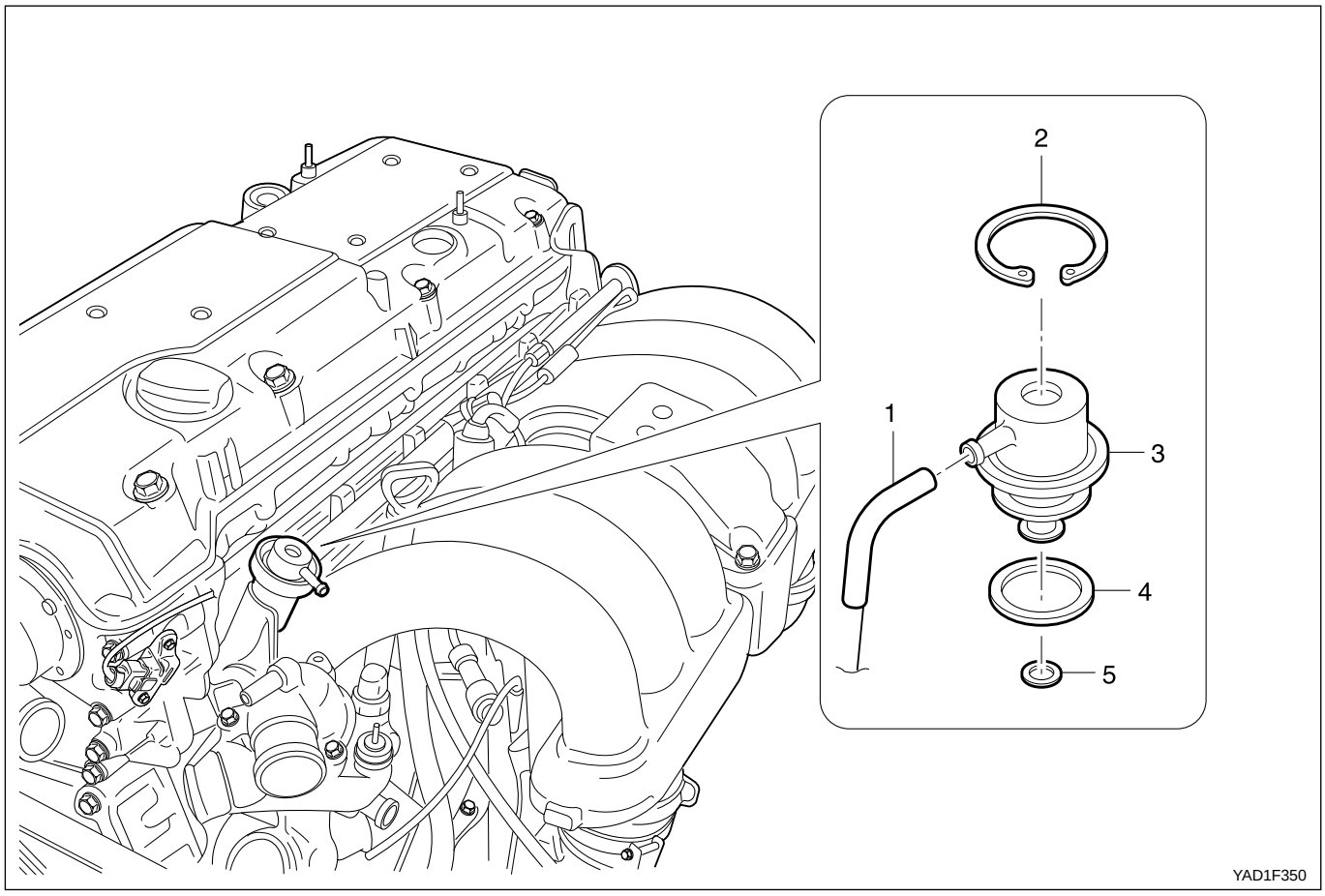
1. Connect thefuel pressure gauge 103 589 00 21 00 to the fuel pressure test connector.
2. Stop the engine for approximately 30 minutes and then check the fuel pressure changes.

Pressure change	
Fuel pressure drops slowly	• Fuel leakage at the injector • Faulty fuel pressure regulator’s diaphragm and O-ring
Fuel pressure drops rapidly	• Faulty check valve in the fuel pump

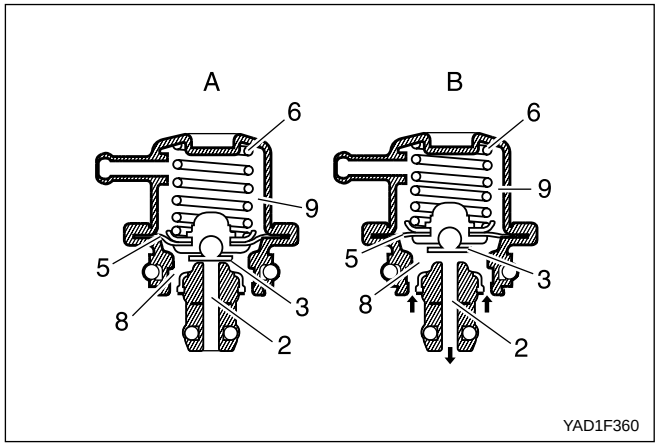
3. If there is no change in fuel pressure and maintain the following pressure over 30 minutes, it is normal.

Fuel pressure (bar)	≥ 2.5

FUEL PRESSURE REGULATOR



1 Vacuum Hose
2 Circlip
3 Fuel Pressure Regulator
4 O-Ring
5 O-Ring



2 Fuel return line
3 Valve
5 Diaphragm
6 Compression Spring
8 Fuel Chamber
9 Spring Chamber
A Valves Closed
B Valves Opened

Function of the Fuel Pressure Regulator

The fuel pressure regulator maintains the fuel pressure in the fuel line with the pressure of 3.2 bars to 3.8 bars according to the intake manifold pressure. This operating pressure cannot be changed, and the fuel injection volume will be only determined by the injection time.

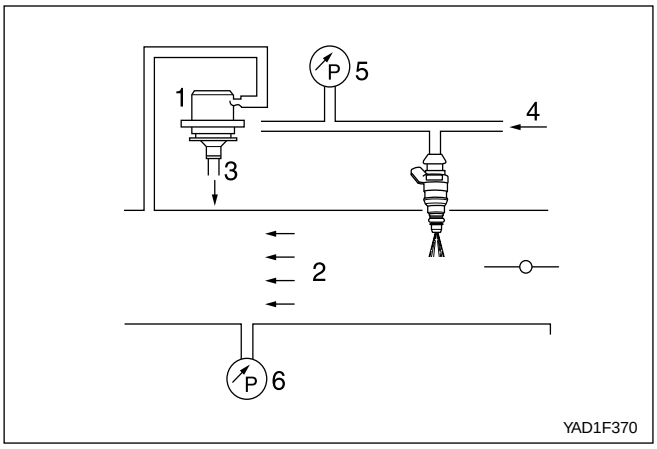
Over supplied fuel returns to the fuel tank through the return line.

<Operating at full load>

There is no negative pressure applied to the spring chamber (9) during the full load, and it is separated from the fuel chamber (8) by the diaphragm (5).

When the fuel pressure goes up, the diaphragm forces the compression spring (6) in the direction of compression. At this moment, the valve (3) sticks to the diaphragm by the fuel pressure, and the fuel return line (2) opens. The fuel over supplied returns to the fuel tank through the return line.

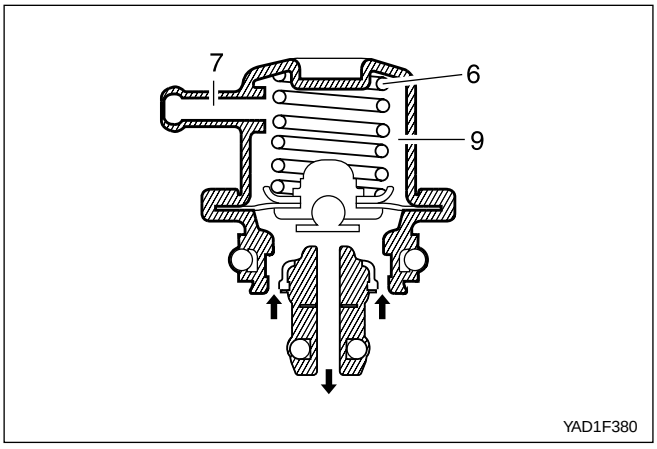
The pressure difference between the fuel pressure and the intake manifold is about 3.8 bars during the full load.



1 Fuel Pressure Regulator
2 Intake Manifold
3 Fuel Return (to fuel tank)
4 Fuel Supply (from fuel pump)
5 Fuel Pressure (approx. 3.8 bars)
6 Intake Manifold Negative Pressure (0 bar)

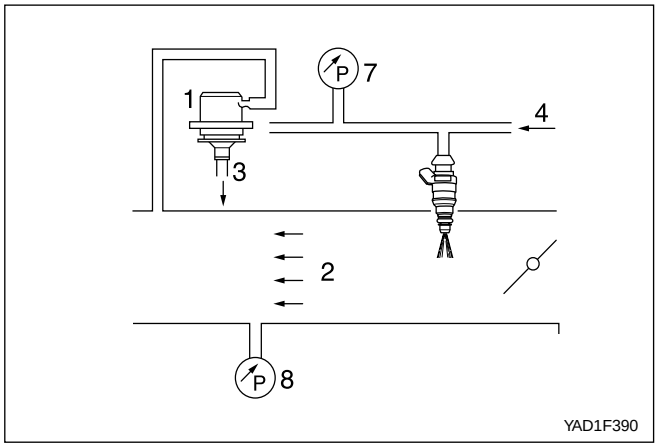
<Operating at Idle and partial load>

The spring chamber (9) is connected to the intake manifold with the vacuum hose at the intake pipe connection (7). The negative pressure generated in the intake manifold activates the diaphragm, and thus the fuel pressure gets reduced to the rate of the operating extent of the diaphragm by the intake manifold's negative pressure.



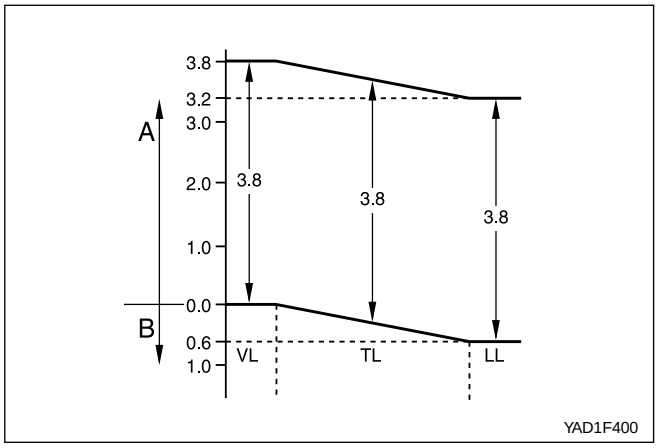
Consequently, the fuel pressure in the fuel distributor changes by the intake manifold's negative pressure, and the injector's fuel pressure gets reduced independently to the throttle valve's position. Thus, the fuel injection volume can only be determined according to the injector's injecting duration.

The pressure difference between the fuel pressure and the intake manifold is approx. 3.2 bars during idling.



1 Fuel Pressure Regulator
2 Intake Manifold
3 Fuel Return (to fuel tank)
4 Fuel Supply (from fuel pump)
7 Fuel Pressure (approx. 3.2 bars)
8 Intake Manifold Negative Pressure (0.6 bars)

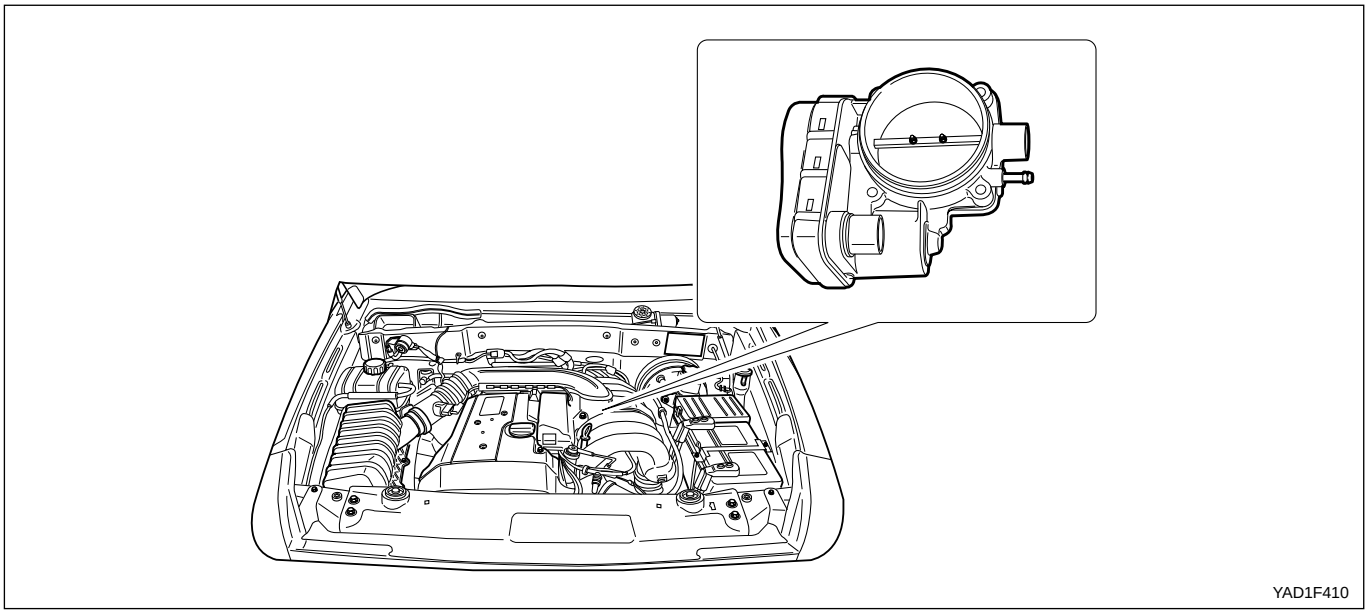
<Fuel Pressure Diagram>



A Fuel pressure
B Intake Manifold Negative Pressure
LL Idling
TL Partial load
VL Full load

INDUCTION SYSTEM

THROTTLE VALVE ACTUATOR



The throttle actuator is actuated by the Engine Control Module(ECM) according to the position of the accelerator pedal position.

It has two potentiometers which signal the position of the throttle valve to the ECM to enable it to recognize the various engine load states.

Ignition “Off”

In the de-energized states the throttle valve position is determined to be spring capsule.

Ignition “On”

When the ignition S/W on the servo motor in the throttle actuator is operated by the ECM. The throttle valve adopts a position in line with the coolant temperature.

Closed position

In the closed throttle position, the servo motor controls engine speed by operating the throttle valve further (greater mixture) or closing it further (reduced mixture), depending on coolant temperature and engine load. When this is done, the throttle valve can be closed further by the servo motor overcoming the force of the spring capsule (mechanical end stop). If the actuator is deenergized, the throttle valve is resting against the spring capsule.

Consequently, the throttle valve opening is a constant 10-12 °approximately.

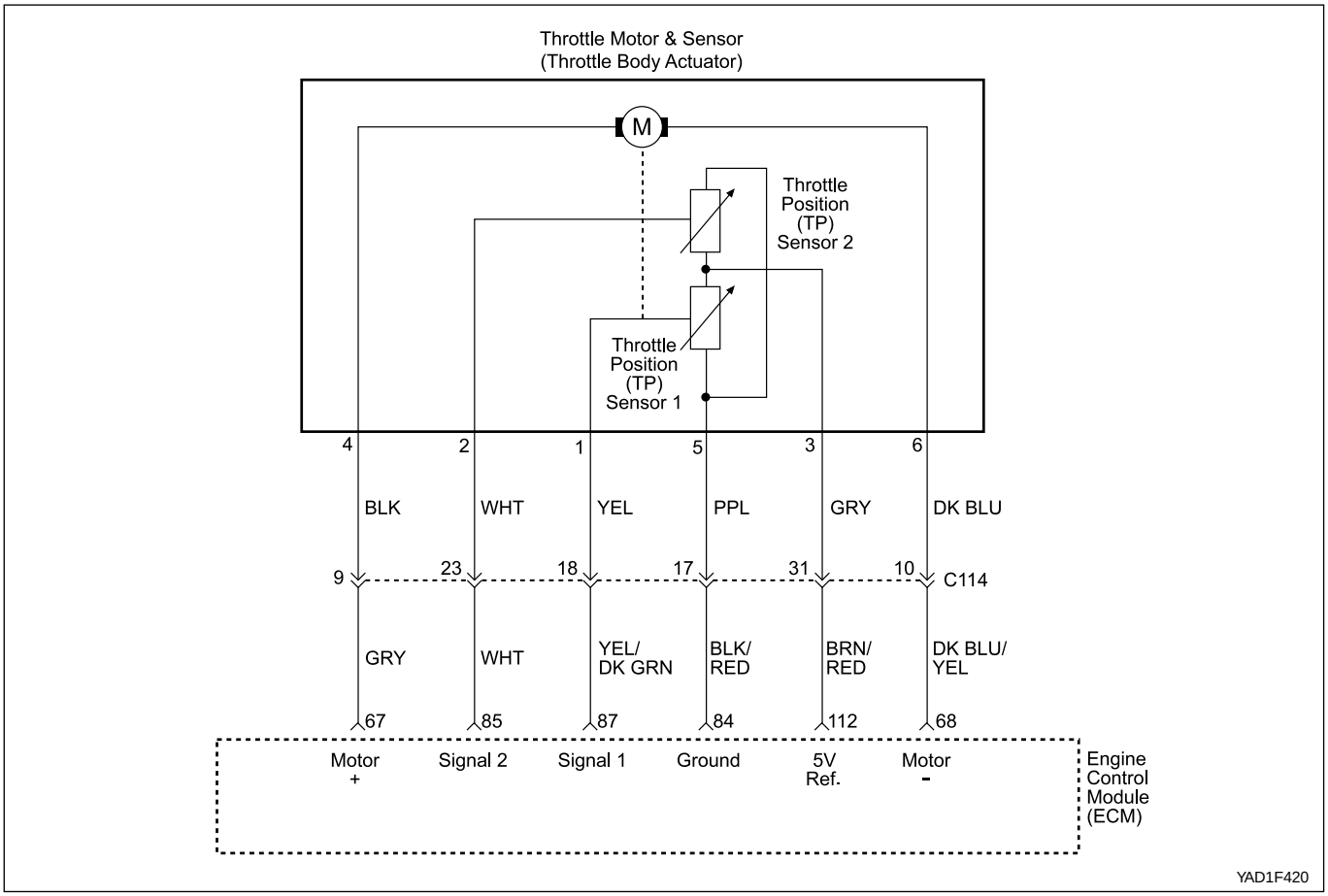
At no load, this produces an engine speed of about 1,800 rpm

Driving

When driving (part/full throttle), the servo motor controls the throttle valve in line with the various load states and according to the input signals from the pedal value sensor according to the input signals from the pedal value sensor according to the position of the accelerator pedal.

The function of the EA (electronic accelerator) in the ECM determines the opening angle of the throttle valve through the throttle actuator. Further functions are;

- Idle speed control
- Cruise control
- Reducing engine torque for ASR/ABS operation
- Electronic accelerator emergency running
- Storing faults
- Data transfer through CAN



Failure Code	Description	Trouble Area	Maintenance Hint
104	Throttle position sensor 1 low voltage	TPS 1 short circuit to ground or open	• Monitoring the actual values through • Inspection the ECM pin 84, 85, 87, 112, 67, 68 about short circuit or open with bad contact • Inspection the throttle valve actuator • Inspection the ECM
105	Throttle position sensor 1 high voltage	TPS 1 short circuit to power	
108	Throttle position sensor 2 low voltage	TPS 2 short circuit to ground or open	
109	Throttle position sensor 2 high voltage	TPS 2 short circuit to power	
116	Throttle actuator learning control failure	When actuator adaption fluctuation or not meet the condition scan tool	
119	Throttle valve return spring failure	When return spring defective of actuator with bad contact	
121	Throttle actuator failure	When supply voltage of the actuator short circuit to power Inspection the ECM	
123	Different mass air flow sensor signal with throttle position sensor	When shut down of output driver	
125	Both throttle position sensor failure	When defective of both potentiometers	

Failure Code	Description	Trouble Area	Maintenance Hint
126	Throttle position sensor 1 not plausible with Throttle position sensor 2	When difference between TPS 1 and TPS 2	• Monitoring the actual values through scan tool • Inspection the ECM pin 84, 85, 87, 112, 67, 68 about short circuit or open with bad contact • Inspection the throttle valve actuator • Inspection the ECM
127	High permanent throttle signal	When failure of wiring harness or actuator	
185	Mass air flow sensor and throttle position sensor failure	When difference between MAF and TPS signal	

Circuit Description

The ECM supplies a 5 volt reference signal and a ground to the TP sensor. The TP sensor sends a voltage signal back to the ECM relative to the throttle plate opening. The voltage signal will vary from approximately 0.3 ~ 0.9 volts at closed throttle, to over 4.0 ~ 4.6 volts at Wide Open Throttle (WOT).

The TP sensors serve for engine load control according to the drive pedal command. Load adjustments independent of the drive pedal command can be implemented; such functions are, for instance, idle control, speed control, drive slip control, load shock damping, and similar functions.

When the actuator current fails, the throttle valve is returned to emergency operating position by a spring. The throttle valve position, thereby the actuator drive position check back is provided by two potentiometers. The motor positions the throttle valve against the return spring force. Motor and return spring are two separate energy sources. Each of Them is able to position the throttle valve in emergency position alone. Throttle valve position check back and monitoring is provided by two actual value potentiometers connected to the engine control electronics.

Throttle Actuator Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the TPS 1 signal voltage at the ECM pin No. 87 and TPS 2 signal voltage at the ECM pin No. 85.

	Pedal Position	Specified Value
TPS 1	Closed	0.3 ~ 0.9 v
	Opened	1 4.0 ~ 4.6 v
TPS 2	Closed	4.0 ~ 4.6 v
	Opened	0.3 ~ 0.9 v

Throttle Actuator DC Motor Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 67 and No. 68.

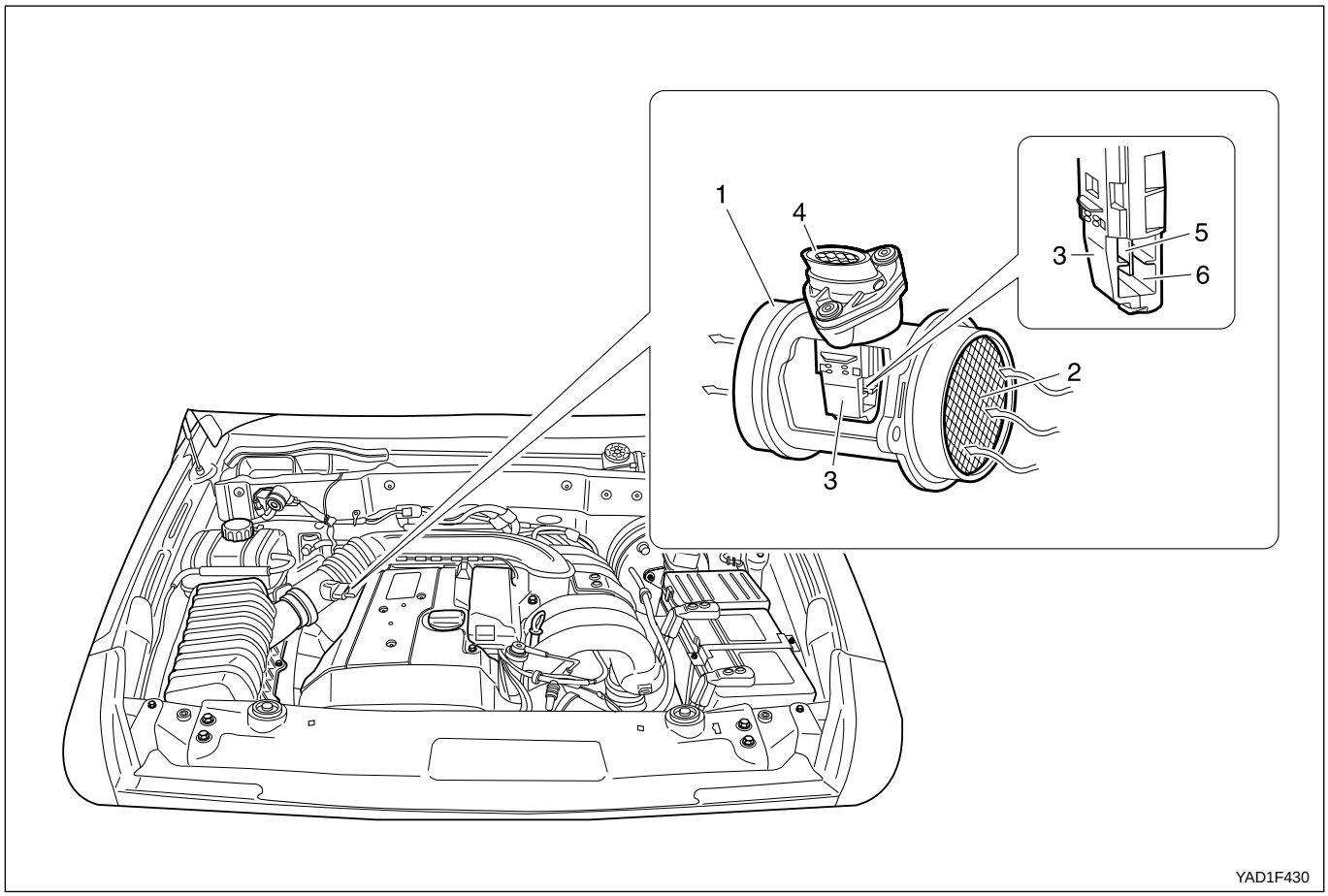
Application		Specified Value
Engine Status	Ignition “ON”	0.8 ~ 2.3 v
	Idling	1.0 ~ 2.5 v (Coolant temperature is over 70 °C)

Throttle Actuator DC Motor Resistance

1. Turn the ignition switch to “OFF” position.
2. Measure the resistance between the ECM pin No. 67 and No. 68.

Specified Value	<10 Ω

HOT FILM AIR MASS (HFM) SENSOR



1 Housing
2 Protector Net
3 Electronic Housing
4 Connector
5 Hot Film Air Mass Sensor
6 Measuring Port

The Hot Film Air Mass (HFM) sensor with recognition of flow direction related to pulsating flow is designed for recording load on Engine Control Module (ECM) by measuring the output voltage proportional to the reference voltage of the ECM.

Mass Air Flow Sensor

Mass Air Flow (MAF) is a thermal flow meter whose sensor element with its temperature sensors and heating area is exposed to the MAF to be measured. A heating area located in the center of a thin membrane is controlled to an over-temperature by a heating resistor and a temperature sensor of this membrane. And the value of over-temperature depends on the temperature of the in-flowing air.

Two temperature sensors on upstream and downstream of the heating area show the same temperature without incoming flow. With incoming flow, upstream part is cooled down but downstream temperature retains its temperature more or less due to the air heated up in the heating area. This temperature difference in quantity and direction depends on the direction of the incoming flow.

ECM modulates the flow of heating current to maintain the temperature differential between the heated film and the intake air at a constant level. The amount of heating current required to maintain the temperature thus provides an index for the MAF. This concept automatically compensates for variations in air density, as this is one of the factors that determines the amount of warmth that the surrounding air absorbs from the heated element. MAF sensor is located between the air filter and the throttle valve.

Under high fuel demands, the MAF sensor reads a high mass flow condition, such as Wide Open Throttle (WOT). The ECM uses this information to enrich the mixture, thus increasing the fuel injector on-time, to provide the correct amount of fuel. When decelerating, the mass flow decreases. This mass flow change is sensed by the MAF sensor and read by the ECM, which then decreases the fuel injector on-time due to the low fuel demand conditions.

To facilitate the installation of the HFM in the intake passage, lubricating agents may be used. However, when lubricants are used care must be taken to ensure that they do not enter the flow passage and cannot be sucked in with the air flow.

The following tables show the relationship between MAF and output voltage.

Mass Air Flow (kg/h)	Voltage (V)	Mass Air Flow (kg/h)	Voltage (V)
0	0.95 ~ 1.05	250	3.51
10	1.28	370	3.93
15	1.41	480	4.23
30	1.71	640	4.56
60	2.16	800	4.82
120	2.76		

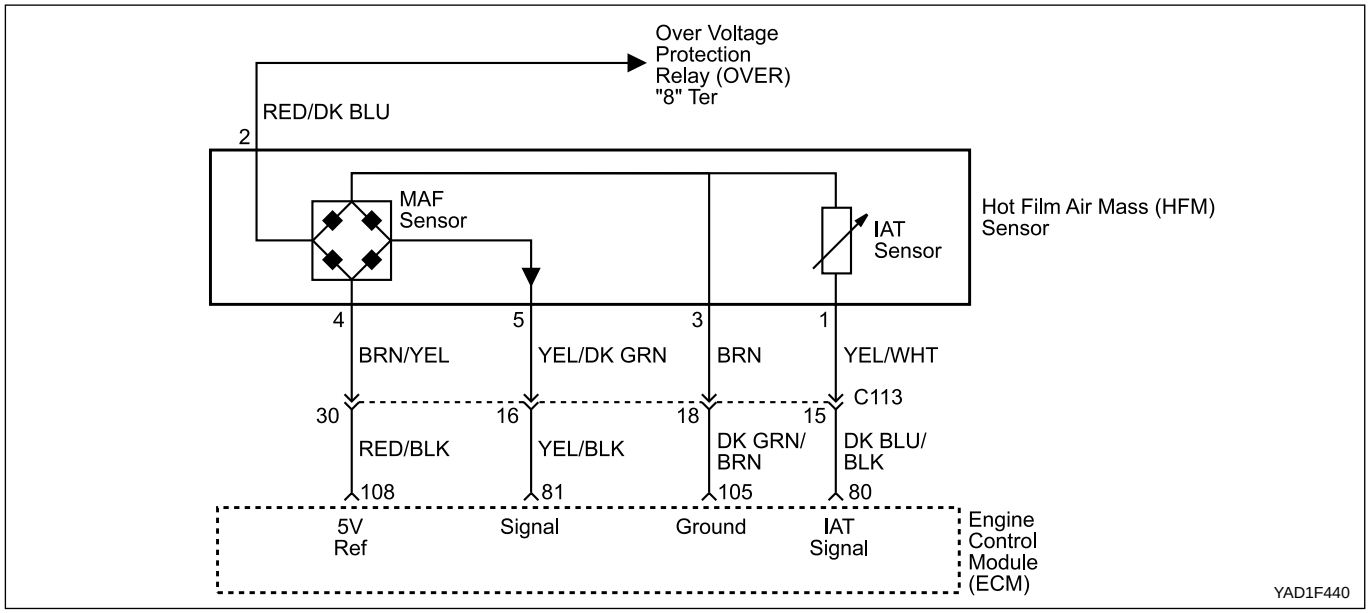
Intake Air Temperature

The Intake Air Temperature (IAT) sensor is a part of Hot Film Air Mass (HFM) sensor and is a thermistor, a resistor which changes value based on the temperature of the air entering the engine. Low temperature produces a high resistance, while high temperature causes a low resistance as the following table.

The ECM provides 5 volts to the IAT sensor through a resistor in the ECM and measures the change in voltage to determine the IAT. The voltage will be high when the manifold air is cold and low when the air is hot. The ECM knows the intake IAT by measuring the voltage.

The IAT sensor is also used to control spark timing when the manifold air is cold.

Temp. (°C)	R min.(Ω)	R nom. (Ω)	R max. (Ω)
-40	35140	39260	43760
-20	12660	13850	15120
0	5119	5499	5829
20	2290	2420	2551
40	1096	1166	1238
60	565	609	654
80	312	340	370
100	184	202	222
120	114	127	141
130	91	102	114



Failure Code	Description	Trouble Area	Maintenance Hint
03	Intake air temperature sensor low voltage	IAT sensor short circuit to ground or open	• Monitoring the actual air temperature through scan tool • Inspection the ECM pin 80, 79 about short circuit or open with bad contact • Inspection the IAT sensor (integrated in HFM sensor) • Inspection the ECM
04	Intake air temperature sensor high voltage	IAT sensor short circuit to power	
05	Intake air temperature sensor plausibility	Malfunction in recognition of IAT When functional problem	
09	Mass air flow sensor plausibility	Malfunction in recognition of MAF When air mass not plausible	• Monitoring the actual air mass flow through scan tool • Inspection the ECM pin 81, 105 about short circuit or open with bad contact • Inspection the MAF sensor (integrated 11 in HFM sensor) • Inspection the ECM
10	Mass air flow sensor low voltage	MAF sensor short circuit to ground or open	
11	Mass air flow sensor high voltage	MAF sensor short circuit to power	

Circuit Description

The heated element on the MAF is a platinum film resistor (heater). It is located on a ceramic plate together with the other elements in the bridge circuit. The temperature sensitive resistor (flow sensor) also included in the bridge. The separation of heater and flow sensor facilitates design of the control circuitry. Saw cuts are employed to ensure thermal decoupling between the heating element and the intake air temperature (IAT) sensor. The complete control circuitry is located on a single layer. The voltage at the heater provides the index for the mass air flow. The MAF's electronic circuitry then converts the voltage to a level suitable for processing in the ECM. This device does not need a burn off process to maintain its measuring precision over an extended period. In recognition of the fact that most deposits collect on the sensor element's leading edge, the essential thermal transfer elements are located downstream on the ceramic layer. The sensor element is also design to ensure that deposits will not influence the flow pattern around the sensor.

The IAT sensor uses a thermistor to control the signal voltage to the ECM. The ECM supplies 5 volt reference and a ground to the sensor. When the air is cold, the resistance is high; therefore the IAT signal voltage will be high. If the intake air is warm, resistance is low; therefore the IAT signal voltage will be low.

Mass Air Flow Sensor Input Voltage Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin

Application		Specified Value
Engine Status	Ignition “ON”	0.9 ~ 1.1 V
	Idling	1.3 ~ 1.7 V (Coolant temperature is over 70 °C)

Notice: If the measured value is not within the specified value, the possible cause may be in cable or MAF sensor in itself. Perform the 5 volt power supply inspection procedures.

Mass Air Flow Sensor 5 volt Power Supply Inspection

1. Turn the ignition switch to “OFF” position.
2. Disconnect the HFM sensor connector.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage between the ECM pin No. 108 and MAF sensor connecter terminal No. 3.

Specified Value	4.7 ~ 5.2 V

Notice: If the measured value is not within the specified value, the possible cause may be in cableor ECM coupling.

5. Measure the voltage between the ECM pin No. 105 and MAF sensor connecter terminal No. 4.

Specified Value	4.7 ~ 5.2 V

Notice: If the measured value is not within the specified value, the possible cause may be in cableor ECM coupling.

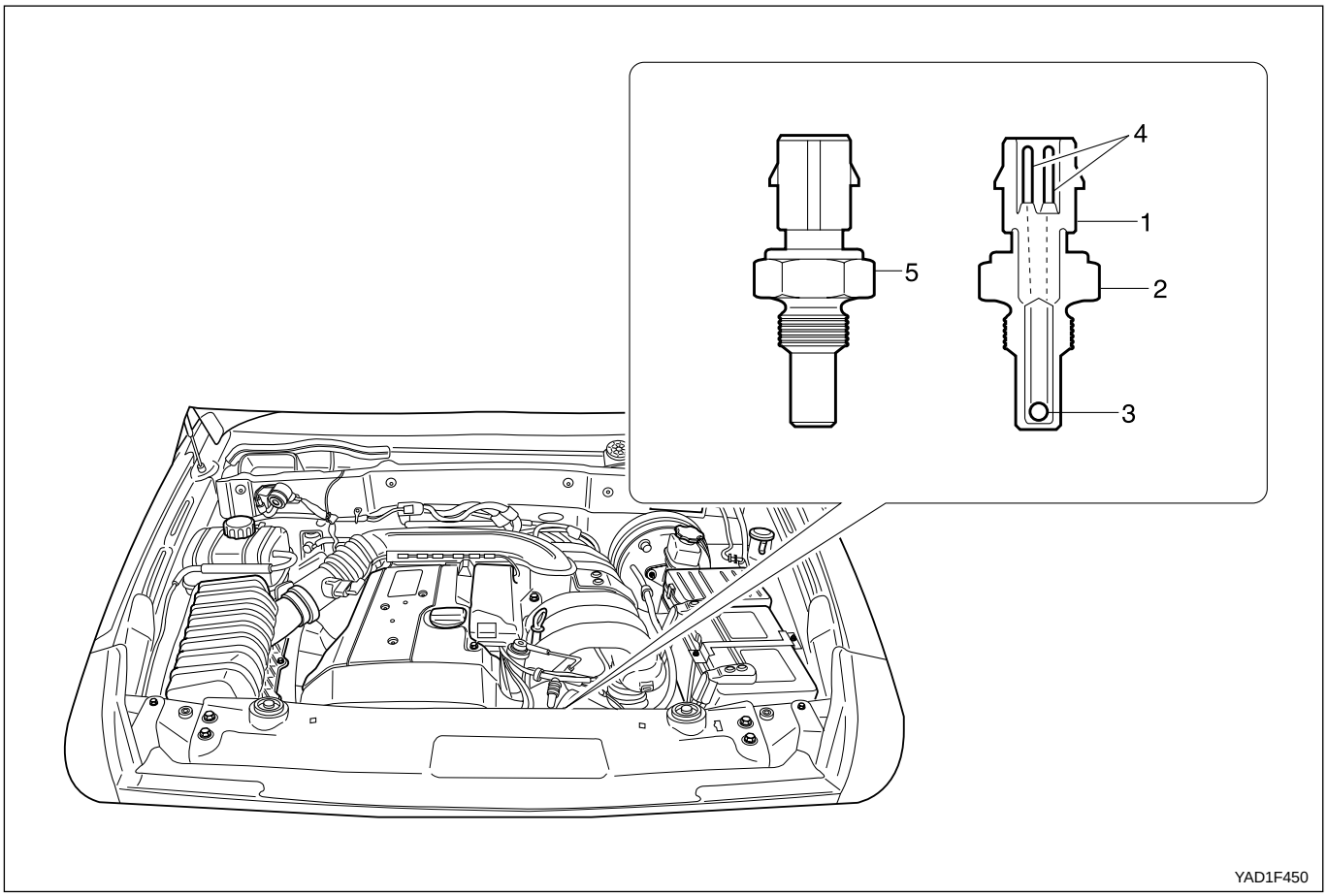
Mass Air Flow Sensor 12 volt Power Supply Inspection

1. Turn the ignition switch to “OFF” position.
2. Disconnect the HFM sensor connector.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage between the ECM pin No. 105 and MAF sensor connecter terminal No. 2.

Specified Value	11 ~ 14 V

Notice: If the measured value is not within the specified value, the possible cause may be in cable or Over Voltage Protection Relay (OVPR).

ENGINE COOLANT TEMPERATURE (ECT) SENSOR



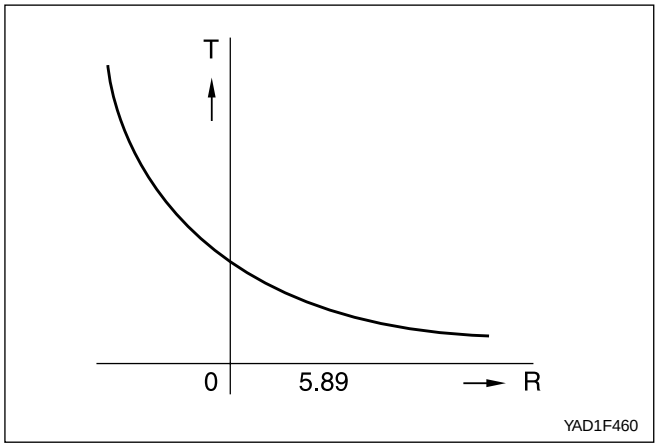
1 Artificial Resin Housing
2 Metal Housing
3 NTC (Negative Temperature Coefficient) Resistor
4 Connector
5 Engine Coolant Temperature Sensor

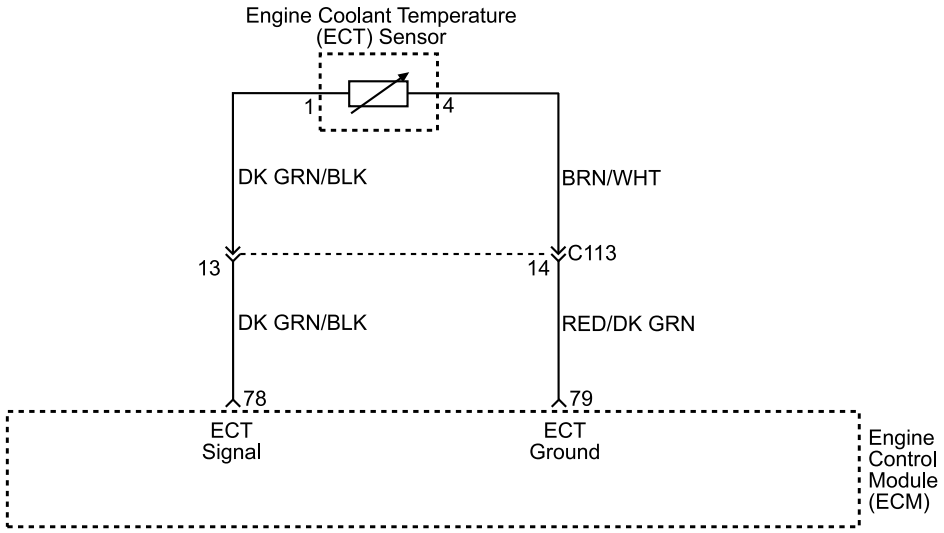
Engine Coolant Temperature (ECT) sensor detects coolant temperature and supplies information to the ECM. It is composed of metal housing with two NTC resistor, 4 pin connector. The ECM provides a 5 volt signal to the ECT sensor through a dropping resistor. When the engine is cold, the ECT sensor provides high resistance, which the ECM detects as a high signal voltage. As the engine warms up, the sensor resistance becomes lower, and the signal voltage drops. At normal engine operating temperature, the ECT signal will measure about 1.5 to 2.0 volts.

The ECM uses information about coolant temperature to make the necessary calculations for:

- Fuel delivery
- Ignition control
- Knock sensor system
- Idle speed
- Torque converter clutch application
- Canister purge
- Cooling fan operation
- Others

Temperature (°C)	Resistance (Ω)	Voltage (V)
-40	48,550	4.90
-30	27,000	4.82
-20	15,570	4.70
-10	9,450	4.52
0	5,890	4.43
10	3,790	3.96
20	2,500	3.57
30	1,692	3.14
40	1,170	2.70
50	826	2.26
60	594	1.86
70	434	1.51
80	322	1.22
90	243	0.98
100	185	0.78
110	143	0.63
120	111.6	0.50
130	88	0.40
140	71.2	0.33





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Failure Code	Description	Trouble Area	Maintenance Hint
00	Engine coolant temperature sensor low voltage	ECT sensor short circuit to ground or open	• Monitoring the actual coolant temperature through scan tool • Inspection the ECM pin 78, 79 about short circuit or open with bad contact • Inspection the ECT sensor • Inspection the ECM
01	Engine coolant temperature sensor high voltage	ECT sensor short circuit to power	
02	Engine coolant temperature sensor plausibility	Malfunction in recognition of ECT When drop to about 50 °C below after warm up	
06	Engine coolant temperature insufficient for closed loop fuel control	Malfunction in recognition of ECT When minimum temperature for lambda control after warm up	

Circuit Description

The ECT sensor uses a thermistor to control the signal voltage to the ECM. The ECM supplies a voltage on the signal circuit to the sensor. When the engine coolant is cold, the resistance is high; therefore the ECT signal voltage will be high

Engine Coolant Temperature Sensor Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the voltage between the ECM pin No. 78 and No. 79.

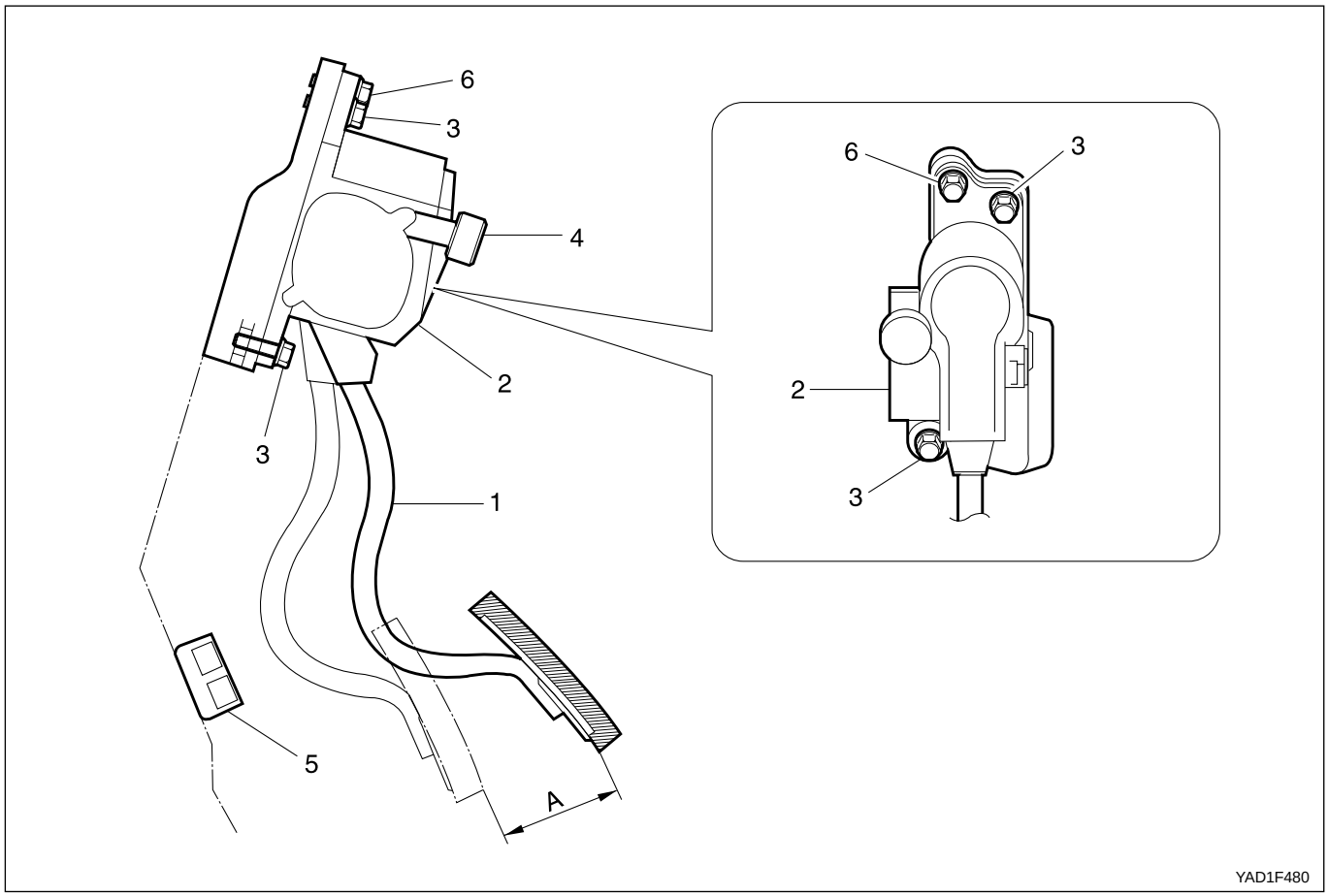
Temperature (°C)	Specified Value (V)
20	3.57
80	1.22
100	0.78

3. Turn the ignition switch to “OFF” position.
4. Disconnect the ECT sensor connector.
5. Turn the ignition switch to “ON” position.
6. Measure the resistance between the ECT sensor terminal pin No. 1 and No. 4.

Temperature (°C)	Specified Value (Ω)
20	2,500
80	322
100	185

Notice: Replace wiring and coolant temperature sensor if out of specified value.

ACCELERATOR PEDAL MODULE



1 Accelerator Pedal
2 Accelerator Pedal Sensor
3 Bolts
4 6-Pin Connector
5 Kick-down Switch
6 Nut

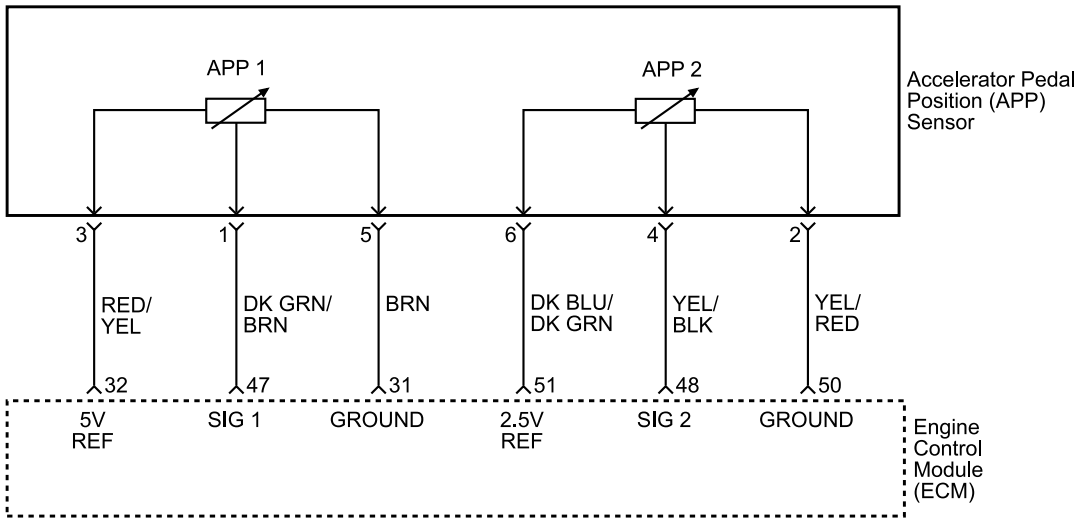
The Acceleration Pedal Position (APP) sensor is mounted on the accelerator pedal assembly. The sensor is actually two individual APP sensors and one housing. This sensor works with the Throttle Position (TP) sensor to provide input to the Engine Control Module (ECM) regarding driver requested accelerator pedal and throttle angle at the throttle body.

When the APP sensor is defected:

When the APP1 or APP 2 sensor is defected condition, the engine is still running at idle condition but, the accelerator pedal reaction is not response correctly and also, the engine rpm will be reacted to 4,000 rpm slowly. If the APP 1 sensor is out of order, the APP 2 sensor will be conducted with signal as a default signal but, the throttle valve opening is limited 60% and delayed opening speed.

When the TP sensor or servo motor is defected:

When the TP 1, 2 sensor or servo motor is defected condition, the throttle valve will be closed to the spring capsule by spring force, at this condition, the throttle valve will open 10° ~ 20°and engine rpm will be controlled by ECM with opening (On/Off) time of injector. The engine rpm will be maintaining 900 rpm (at idle) to 1,800 according to the engine load.



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Failure Code	Description	Trouble Area	Maintenance Hint
122	Acceleration pedal position sensor signal failure	When malfunction of APP sensor	• Monitoring the actual values through scan tool • Inspection the ECM pin 31, 47, 32, 48, 59, 51 about short circuit or open with • Inspection the APP sensor • Inspection the ECM
160	Acceleration pedal position 1 sensor low voltage	APP 1 sensor short circuit to ground or open	
161	Acceleration pedal position sensor 1 high voltage	APP 1 sensor short circuit to power	
162	Acceleration pedal position sensor 2 low voltage	APP 2 sensor short circuit to ground or open	
163	Acceleration pedal position sensor 2 high voltage	APP 2 sensor short circuit to power bad contact	
164	Accelerator pedal position sensor 1 not plausible with accelerator pedal position sensor 2	When difference between APP 1 sensor and APP 2 sensor	
167	Both setpoint accelerator pedal position sensor defective	When defective of both APP sensor	

Circuit Description

The ECM supplies a 5 or 2.5 volt reference signal and a ground to the APP sensor 1or 2. The ECM calculates on these signal lines. The APP sensor output changes as the accelerator pedal is moved. The output of the APP 1and APP2 sensor are low, about 0.4 ~ 0.7 volts and 0.2 ~ 0.35 volts respectively at the closed throttle position. As pushing the accelerator pedal, the output increases so that the output voltages will be about 4.3 ~ 4.8 volts and 2.1 ~ 2.4 volts individually when accelerating fully with the kick down, at Wide Open Throttle (WOT).

Acceleration Pedal Position Sensor 1 Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 47andNo. 31while operating the accelerator pedal as following conditions.
   - Not depress the pedal (closed throttle position)
   - Fully depress the pedal (full throttle with kick down)

Condition of Throttle Valve	Specified Value (V)
Closed Throttle Valve	0.3 ~ 0.7
Fully Depressed Throttle Valve	4.3 ~ 4.8

Notice: If measured value is not within the specified value, check the pedal valve sensor and the supply voltage to APP 1 sensor.

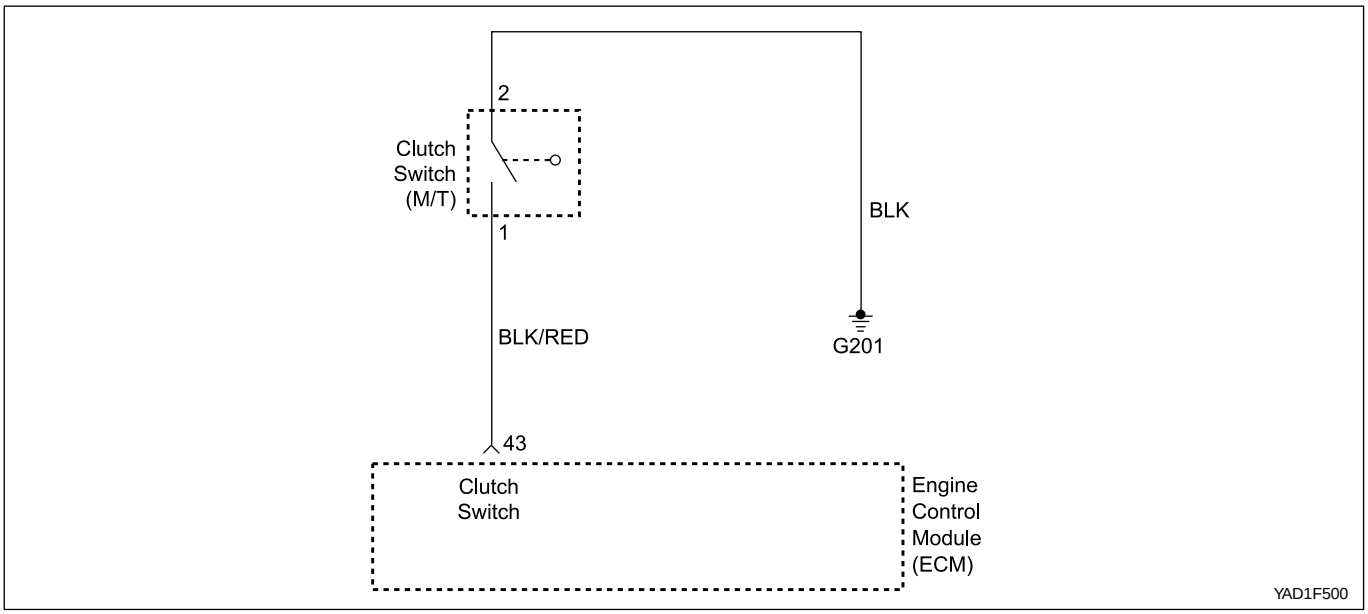
Acceleration Pedal Position Sensor 2 Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 48 and No. 50 while operating the accelerator pedal as following conditions.
   - Not depress the pedal (closed throttle position)
   - Fully depress the pedal (full throttle with kick down)

Condition of Throttle Valve	Specified Value (V)
Closed Throttle Valve	0.1 ~ 0.4
Fully Depressed Throttle Valve	2.1 ~ 2.5

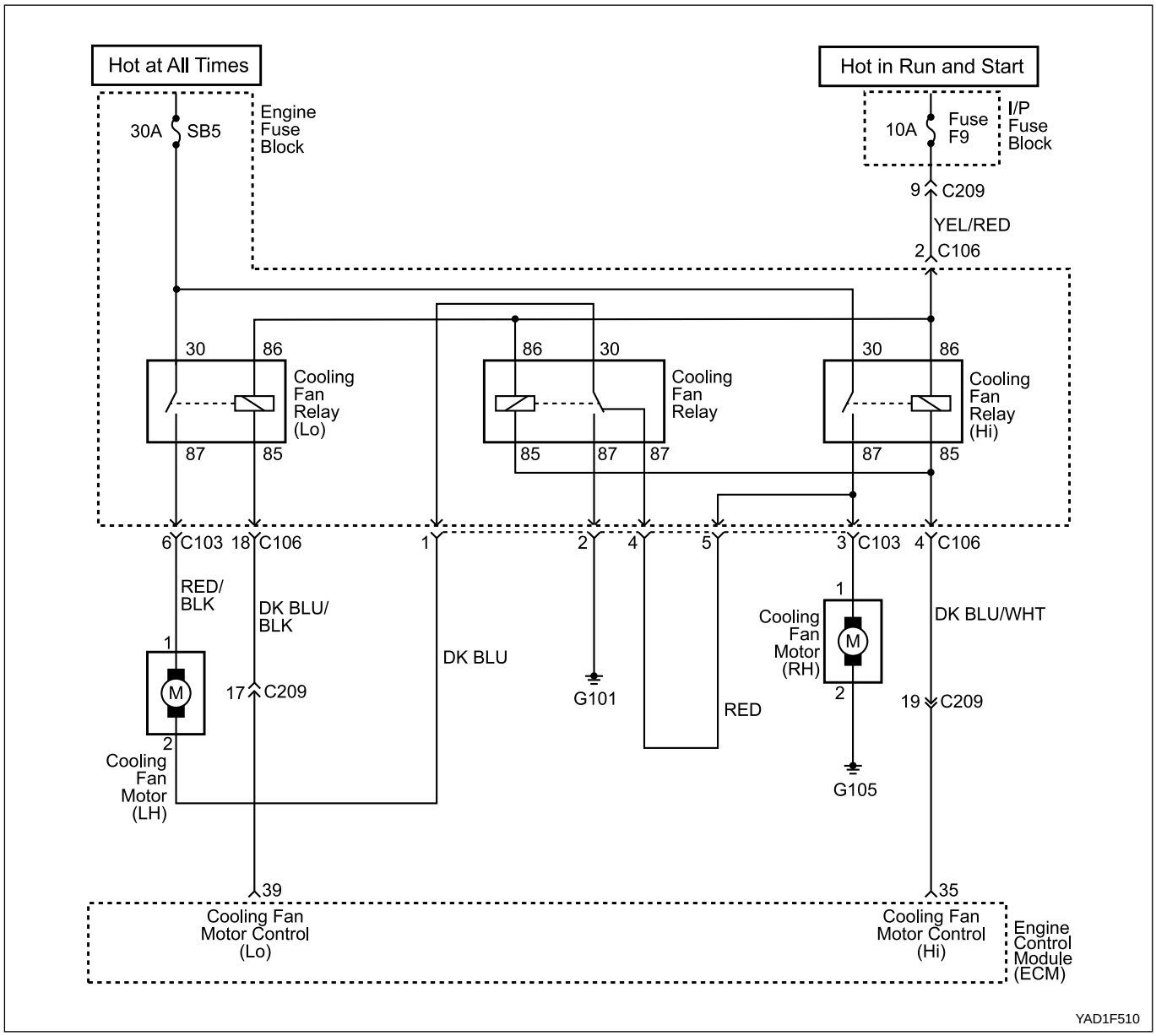
Notice: If measured value is not within the specified value, check the pedal valve sensor and the supply voltage to APP sensor 2.

CLUTCH SWITCH



Failure Code	Description	Trouble Area	Maintenance Hint
62	Clutch switch defective	When malfunction of clutch switch	• Inspection the Engine Control Module (ECM) pin 43 about shout circuit or open • Inspection the clutch switch • Inspection the ECM

COOLING FAN



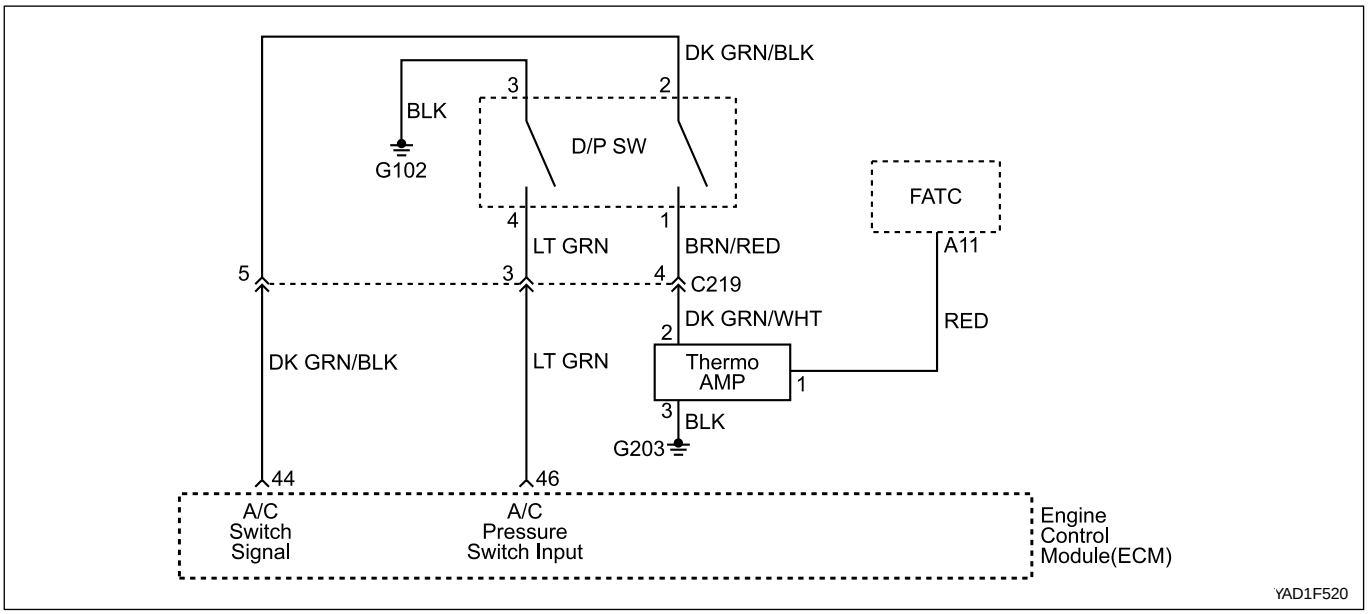
Failure Code	Description	Trouble Area	Maintenance Hint
44	Cooling fan (HI) relay short circuit to power	Cooling fan short circuit to power	• Inspection the Engine Control Module (ECM) pin 35 about short circuit or open with bad contact • Inspection the power source • Inspection the cooling fan • Inspection the ECM
45	Cooling fan (HI) relay short circuit to ground or open	Cooling fan short circuit to ground or open with bad contact	

Circuit Description

Ignition voltage is supplied directly to the cooling fan relay coil. The ECM controls the relay by grounding the control circuit. When the ECM is commanding a command ON, the voltage of the control circuit should be low (near 0 volt).

When the ECM is commanding the control circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the fault code to set.

A/C COMPRESSOR RELAY

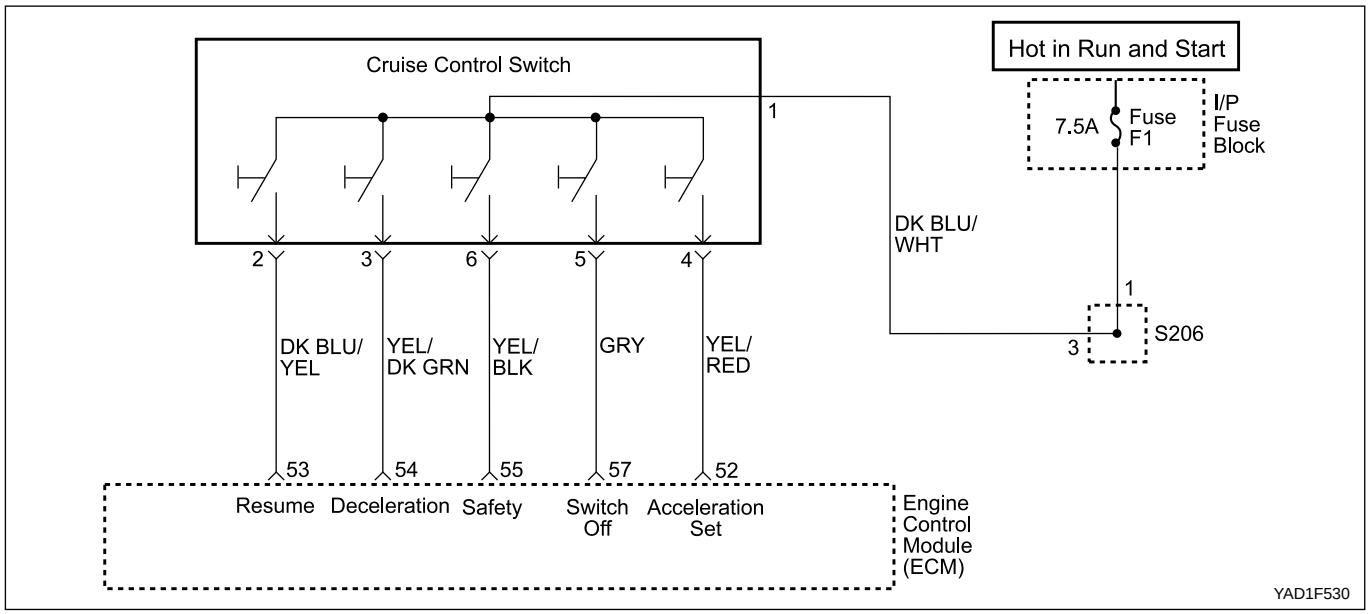


Failure Code	Description	Trouble Area	Maintenance Hint
228	A/C compressor relay short circuit to battery	When malfunction of A/C compressor control	• Monitoring the actual operation through scan tool • Inspection the Engine Control Module (ECM) pin 44 about short circuit or open with bad contact • Inspection the relay short circuit or open • Inspection the ECM
229	A/c compressor relay short circuit to ground or open		

Circuit Description

When the ECM detects that A/C has been requested, the ECM will activated the A/C clutch relay. When the relay has been activated, voltage should be present at both the A/C clutch relay and A/C switch circuit at ECM.

CRUISE CONTROL SWITCH

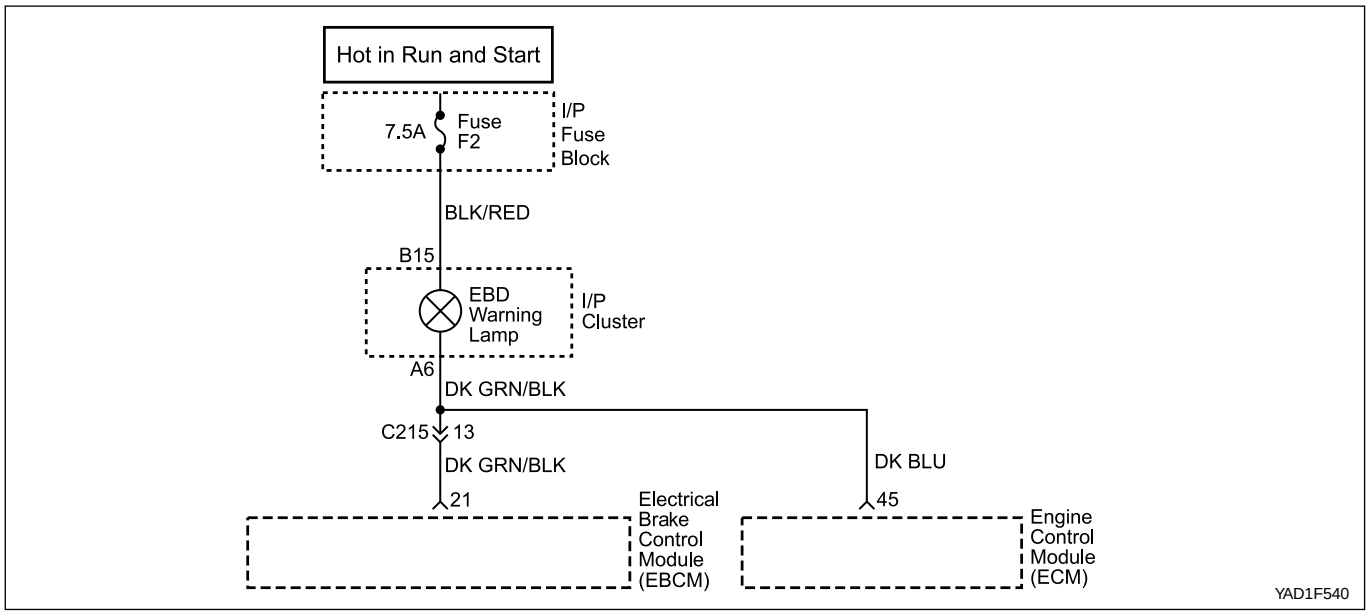


Failure Code	Description	Trouble Area	Maintenance Hint
129	Cruise control “OFF” due to message counter failure	Cruise control system message counter fault	• Monitoring the actual recognition status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 52 53 54 55 57 about short circuit or open with bad contact • Inspection the CAN and ABS • Inspection the cruise control lever switch • Inspection the ECM
130	Vehicle speed signal failure	When malfunction of auto-cruise system Implausible condition of vehicle speed signal.	
131	Vehicle speed signal failure		
132	Cruise control lever failure	Cruise control lever defective	
133	Cruise control acceleration failure	Cruise control system Implausible condition of acceleration signal	
134	Cruise control deceleration failure	Cruise control system Implausible condition of deceleration signal	

Circuit Description

Cruise control is an automatic speed control system that maintain a desired driving speed without using the accelerator pedal. The vehicle speed must be greater than 40 km/h to engage cruise control.

TRACTION CONTROL SYSTEM (TCS)

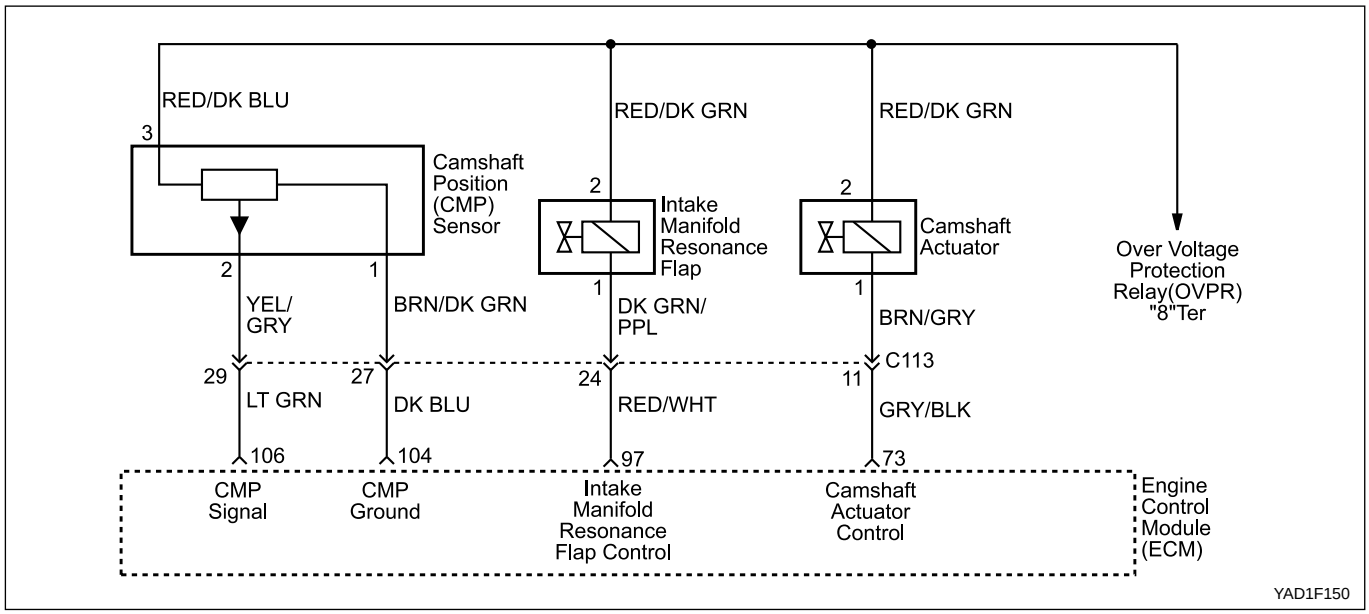


Failure Code	Description	Trouble Area	Maintenance Hint
150	TCS input signal short circuit to battery	TCS short circuit to power	• Inspection the Engine Control Module (ECM) pin 45 about short circuit or open with bad contact • Inspection the TCS lamp of I/P cluster. • Inspection the ECM
151	TCS input signal short circuit to ground or open	TCS short circuit to ground or open	

Circuit Description

Battery voltage is supplied to the TCS warning lamp with the ignition in ON and START. The warning lamp can be activated only by the Electrical Brake Control Module (EBCM) internally supplying ground to terminal 21. If the TCS input circuit is open or short, this failure code will be set.

RESONANCE FLAP



Failure Code	Description	Trouble Area	Maintenance Hint
198	Resonance flap short circuit to battery	Resonance flap short circuit to power	• Monitoring the actual operational status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 97 about short circuit or open with bad contact • Inspection the power source short circuit or open to resonance flap • Inspection the resonance flap solenoid and hardware • Inspection the ECM
199	Resonance flap short circuit to ground or open	Resonance flap short circuit to ground or open	

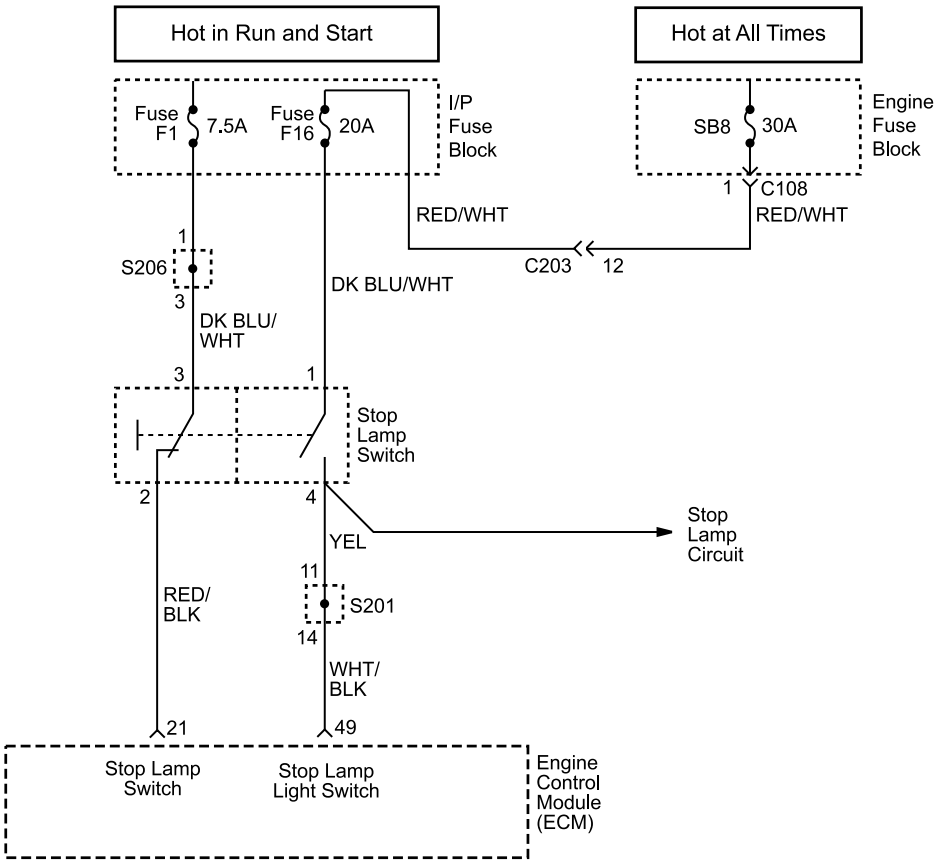
Circuit Description

A pneumatically actuated resonance flap is located on the intake manifold, and will be opened and closed by load, which operates resonance flap according to engine and controlled by ECM and rpm.

Resonance flap is closed at idle/partial load (less than 3,800/rpm). The switch valve will be adjusted by ECM and resonance flap will be closed. By increasing air flow passage through dividing intake air flow toward both air collection housing. This leads to a significant increase in the torque in the lower speed range.

Resonance flap is open at full load (over 3,800/rpm). The switch valve will not be adjusted by ECM and resonance flap will be open. The collected air in the air collection housing will not be divided and intake air passage will be shorten.

STOP LAMP SWITCH

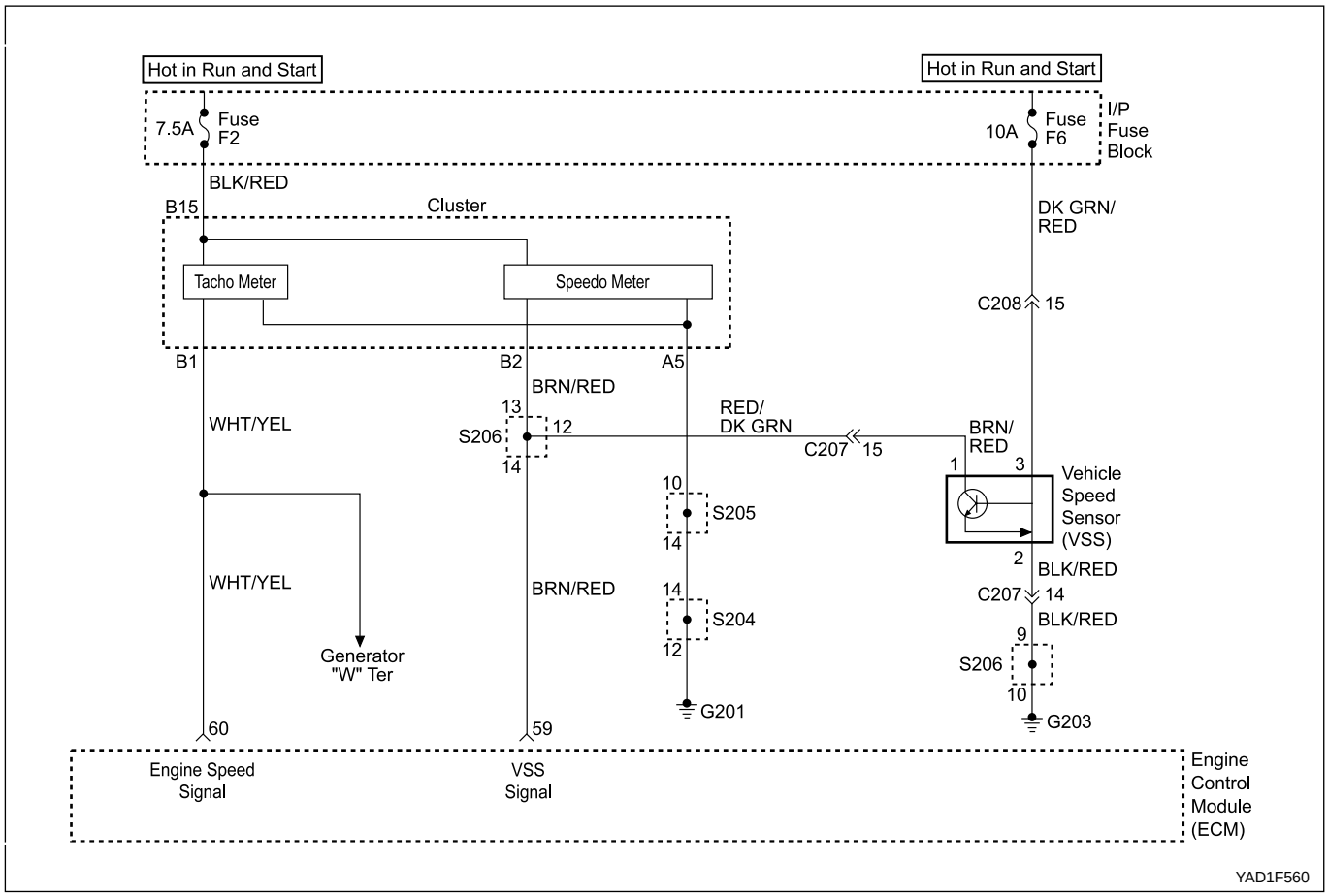


Failure Code	Description	Trouble Area	Maintenance Hint
135	Stop lamp switch failure	When malfunction of stop lamp switch - implausible condition of stop lamp signal input	• Monitoring the actual operational status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 49 about short circuit or open with bad contact • Inspection the contact condition of stop lamp switch • Inspection the ECM

Circuit Description

The stop lamp switch is normally opened. When the ignition switch ON and brake ON, the battery voltage is supplied to the ECM. A scan tool should display ON when brake pedal is depressed and should read OFF with brake pedal released.

ENGINE RPM



Failure Code	Description	Trouble Area	Maintenance Hint
32	Engine rpm output circuit short circuit to battery	When short circuit to battery	• Inspection the cluster panel board circuit • Inspection the ECM • Monitoring the actual rpm in cluster • Inspection the Engine Control Module (ECM) pin 60 about short circuit or open
33	Engine rpm output circuit short circuit to ground or open	When short circuit to ground or open	

EXHAUST SYSTEM

CATALYTIC CONVERTER

The purpose of the catalytic converter is to convert the three pollutants of carbon monoxide(CO), hydrocarbons (HC) and oxides of nitrogen (NOx) contained in the exhaust of gasoline engines, into the harmless compounds of water (H2O), carbon dioxide (CO2) and nitrogen (N2).

The catalytic converter contains a catalyst, a word coming from the Greek and which designates the element essential for catalyst which triggers chemical reactions without itself being consumed.

These catalysts in the 3-way catalytic converter are the rare metals platinum (Pt) and rhodium (Rh).

The catalytic converter consists essentially of three main elements. The exhaust gases flow through the catalytic converter and, in so doing, coming into contact with rare metals (Pt and Rh).

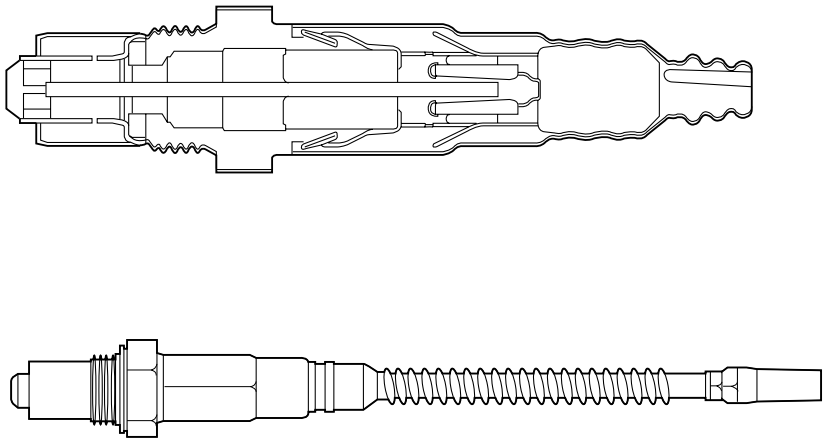
The following chemical reaction are produced.

$CO + O_2 \rightarrow CO_2$

$HC + O_2 \rightarrow CO_2 + H_2O$

$NO_x \rightarrow N_2 + O_2$

OXYGEN SENSOR



YAD1F570

The oxygen sensor is unique among the engine control sensors because is acts like a battery and is able to generate its own low voltage signal. It is located the exhaust system and monitors the amount of oxygen in the exhaust stream and provides feedback to the Engine Control Module (ECM).

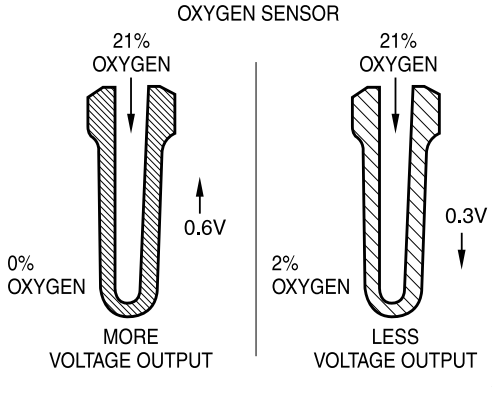
The electrically heated oxygen sensor warms up quickly and remains hot, even at idle when the exhaust manifold may cool down.

The ECM applies a reference voltage of 450 mv to the oxygen sensor, the ECM compares this reference voltage with the voltage generated by oxygen sensor. The amount of voltage the oxygen sensor generates is proportionate to the difference between the amount of oxygen in the outside air and the exhaust gases. The atmosphere contains about 21% oxygen. The exhaust from a rich air/fuel ratio contains almost no oxygen. With a large difference between the amounts of oxygen containing the two surface, the sensor generates less voltage.

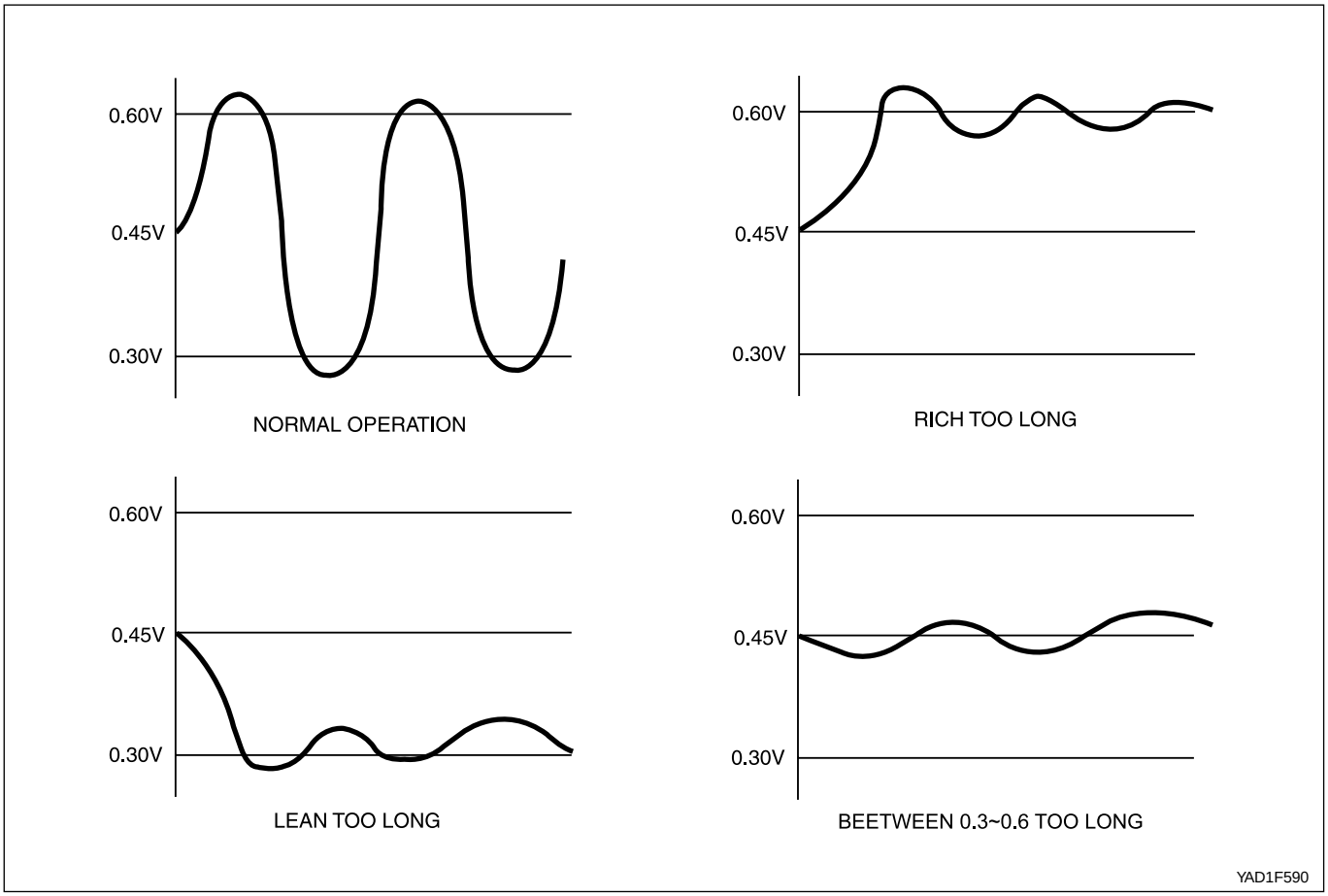
When the exhaust gas is rich (below 14.7:1), the voltage output is high, above450mv. When the exhaust gas is lean (above 14.7:1 air/fuel ratio), the sensor's voltage output is low, below 450 mv.

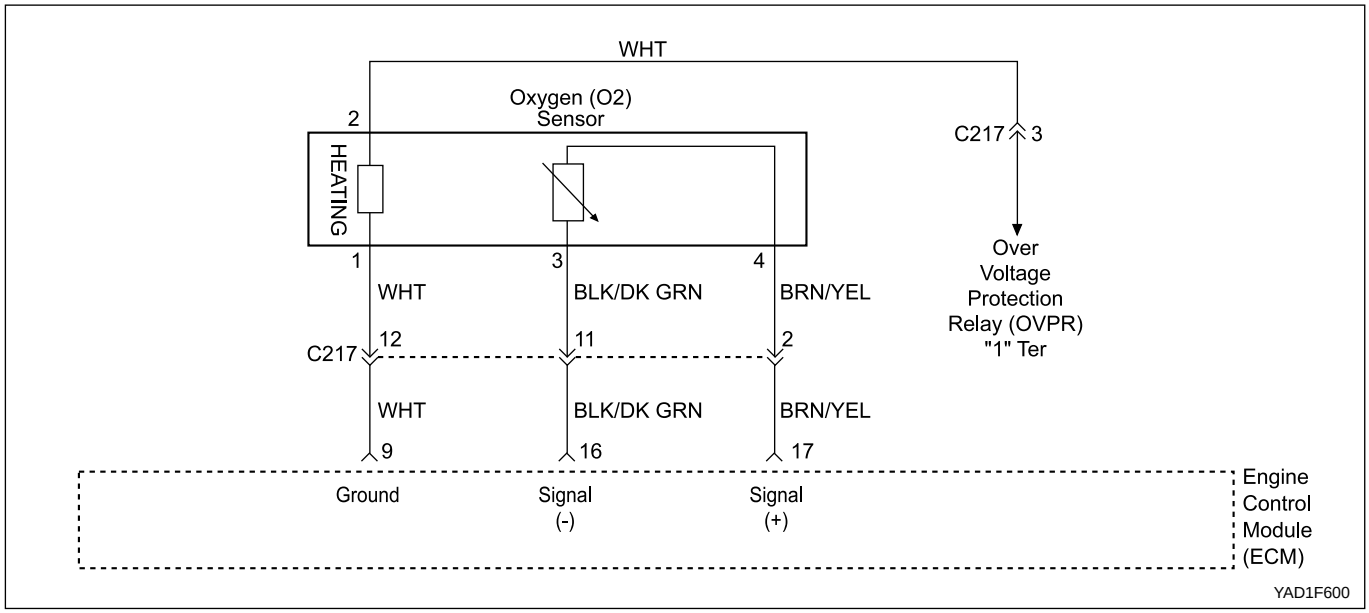
The ECM uses oxygen sensor information for:

- Open loop / closed loop criteria
- Ideal air / fuel ratio



YAD1F580


0.60V
0.45V
0.30V
NORMAL OPERATION
0.60V
0.45V
0.30V
RICH TOO LONG
0.60V
0.45V
0.30V
LEAN TOO LONG
0.60V
0.45V
0.30V
BEETWEEN 0.3~0.6 TOO LONG
YAD1F590



Failure Code	Description	Trouble Area	Maintenance Hint
80	Oxygen sensor high voltage	When recognition the output that more than nominal threshold, malfunction of sensing voltage.	• Monitoring the actual output signal through scan tool • Inspection the ECM pin 16, 17 about short circuit or open with bad contact • Inspection the oxygen sensor • Inspection the ECM
89	Oxygen sensor low voltage	When recognition the output that more than nominal threshold, malfunction of sensing voltage.	
82	Oxygen sensor no activity detected	When recognition the output that not active the sensor etc.	
83	Oxygen sensor not lean after overrun fuel shut-off	When recognition the output that no lean signal after overrun fuel shut-off	
84	Oxygen sensor slow response	When slow response of sensor signal	
85	Oxygen sensor heater failure	When recognition the heating circuit	• Monitoring the heating status through scan tool • Inspection the ECM pin 9 about short circuit or open with bad contact • Inspection the heating power source • Inspection the heating circuit of oxygen sensor • Inspection the ECM
86	Oxygen sensor heater short circuit to battery	When recognition the heating currents that more or less than set values (less than 0.2 A or more than 2 A)	
87	Oxygen sensor heater short circuit to ground or open	When recognition the heating voltages than less than set values (less than 2v)	

Failure Code	Description	Trouble Area	Maintenance Hint
81	Bank 1 system short term fuel trim adaptation below lean threshold	When recognition the value less than nominal control threshold, it means that when big deviation in control range of adaptation values through fuel and air mixture formation	• Inspection the intake air leakage • Inspection the injection quantities with injector block or leakage • Inspection the exhaust leakage • Inspection the ECM
93	Bank 1 system short term fuel trim adaptation above rich threshold	When recognition the value more than nominal control threshold, it means that when big deviation in control range of adaptation values through fuel and air mixture formation	
96	Bank 1 system short term fuel trim at rich stop	When recognition the short term fuel trim that more than nominal threshold	
97	Bank 1 system short term fuel trim at lean stop	When recognition the short term fuel trim that less than nominal threshold	
98	Bank 1 system idle adaptation failure (above rich threshold)	When recognition the long term fuel trim exceeds rich threshold	
99	Bank 1 system idle adaptation failure (below rich threshold)	When recognition the long term fuel trim exceeds lean threshold	
100	Bank 1 system learning control failure (rich, low load)	When recognition the long term fuel trim exceeds rich threshold	
101	Bank 1 system learning control failure (lean, low load)	When recognition the long term fuel trim exceeds lean threshold	
102	Bank 1 system learning control failure (rich, high load)	When recognition the long term fuel trim exceeds rich threshold	
103	Bank 1 system learning control failure (rich, low load)	When recognition the long term fuel trim exceeds lean threshold	

Circuit Description

In order to control emissions, a catalytic converter is used to covert harmful emissions into harmless water vapor and carbon dioxide. The ECM has the ability to monitor this process by using a oxygen sensor. The oxygen sensor produces and output signal which indicates the storage capacity of the catalyst. This in turn indicates the catalyst's ability to convert exhaust emission effectively. If the oxygen sensor pig tail wiring, connector, or terminal is damaged. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the oxygen sensor wire(s). Any attempt to repair the wires, connector, or terminal and degrade the oxygen sensor performance.

Oxygen Sensor Signal Voltage Inspection

1. Maintain the engine speed is at idle while the coolant temperature is over 80 °C.
2. Measure the oxygen sensor signal voltage between the ECM terminal No. 16 and No. 17.

Specified Value	2 ~ 1.0 V

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

Oxygen Sensor Heating Voltage Inspection

1. Maintain the engine speed is at idle while the coolant temperature is over 80 °C.
2. Measure the oxygen sensor signal voltage between the ECM terminal No. 11 and No. 9.

Specified Value	11 ~ 14 V

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

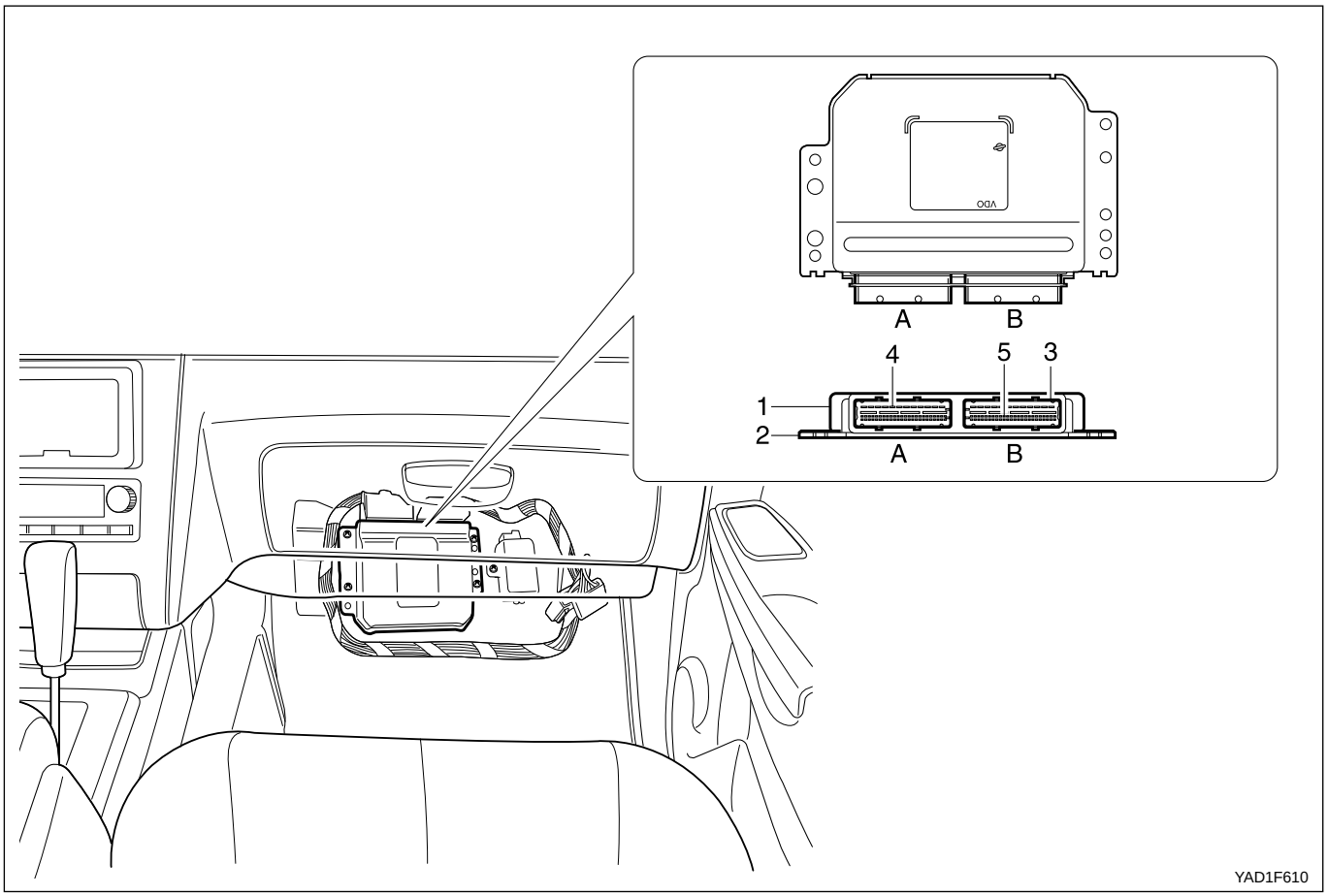
Oxygen Sensor Heating Current Consumption Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the oxygen sensor heating current consumption between the ECM terminal No. 9 and No. 5.

Specified Value	0.2 ~ 2.0 A

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

ENGINE CONTROL MODULE



1 Cover
2 Plate
3 Connector
4 Flat Pin
Vehicle Side : No. 1-12
Engine Side : No. 61-72
5 Pin
Vehicle Side : No. 13-60
Engine Side : No. 73-120
A Vehicle Side Connector : Black
B Engine Side Connector : Gray

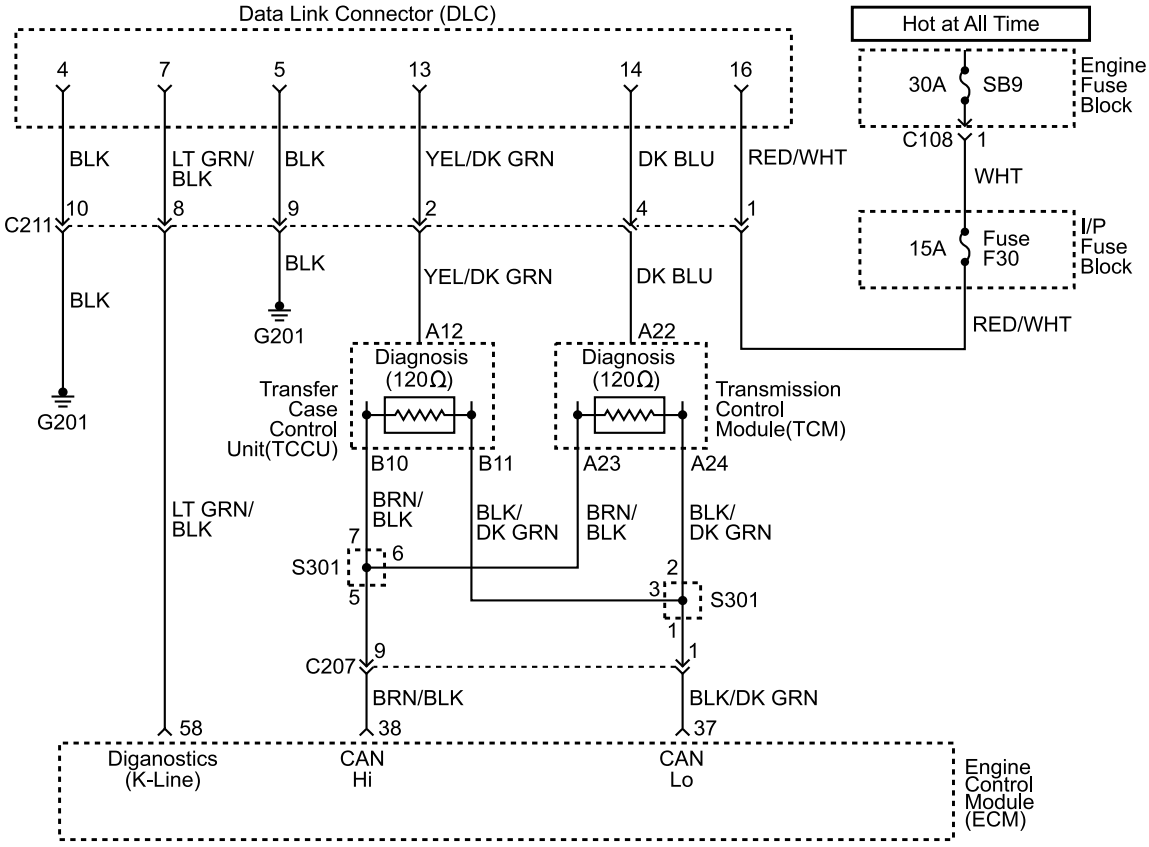
The Engine Control Module (ECM), located inside the right side kick panel, is the control center of the fuel injection system. It constantly looks at the information from various sensors and controls the systems that affect the vehicle's performance. Engine rpm and air mass are used to measure the air intake quantity resulting in fuel injection metering.

The ECM also performs the diagnostic functions of the system. It can recognize operational problems, store failure code(s) which identify the problem areas to aid the technician in making repairs.

There are no serviceable parts in the ECM. The calibrations are stored in the ECM in the Programmable Read Only Memory (PROM).

The ECM supplies either 5 or 12 volts to power the sensors or switches. This is done through resistance in the ECM which are so high in value that a test light will not come ON when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give and accurate reading because its resistance is too low. You must use a digital voltmeter with a 10 Mohm input impedance to get accurate voltage readings. The ECM controls output circuits such as the ignition coils, the fuel injectors, the fuel pump relay, the intake manifold resonance flap, the camshaft actuator, the canister purge valve, etc., by controlling the ground circuit.

SERIAL DATA COMMUNICATION



Failure Code	Description	Trouble Area	Maintenance Hint
23	CAN communication failure: ASR/MSR	When CAN signal message missing or implausibility for ASR/MSR unit or not initialized condition	• Inspection the ASR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
24	CAN communication failure: ABS	When CAN signal message missing or implausibility for ABS unit or not initialized condition	• Inspection the ABS unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
26	CAN communication failure: TCU (A/T only)	When CAN signal message missing or implausibility for TCU unit or not initialized condition	• Inspection the TCM unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM

Failure Code	Description	Trouble Area	Maintenance Hint
27	CAN communication failure: TOD (E32 only)	When CAN signal message missing or implausibility for TOD unit or not initialized condition	• Inspection the TOD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
29	CAN communication failure: ID 200h not plausible	When CAN signal message missing or implausibility for ABS/ABD unit or not initialized condition	• Inspection the ABS/ABD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
30	CAN communication failure: ID 208h not plausible	When CAN signal message missing or implausibility for ABS/ABD unit or not initialized condition	• Inspection the ABS/ABD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
31	CAN communication failure: communication initialization failure	When CAN signal message missing or implausibility for each unit (ABS, ASR, TCM, TOD etc.) or not initialized condition	• Inspection the each control unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
59	CAN communication failure: MSR data transmission not plausible	When CAN signal message missing or implausibility for MSR unit or not initialized condition	• Inspection the MSR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
60	CAN communication failure: ASR data transmission not plausible	When CAN signal message missing or implausibility for ASR unit or not initialized condition	• Inspection the ASR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM

Circuit Description

The provision for communicating with the ECM is the Data Link Connector (DLC). It is located in the instrument panel fuse block. The DLC is used to connect the scan tool. Battery power and ground is supplied for the scan tool through the DLC. CAN line is used to communicate with the other module such as the Transmission Control Module (TCM) and Transfer Case Control Unit (TCCU).

Keyword 2000 Serial Data Communications

Each bit of information can have one of two lengths: long or short. This allows vehicle wiring to be reduced by transmitting and receiving multiple signals over a singles wire. The message carried on KWP 2000 data streams are also prioritized. If two messages attempt to establish communications on the data line at the same time, only the message with higher priority will must wait.

INTERNAL FAILURE

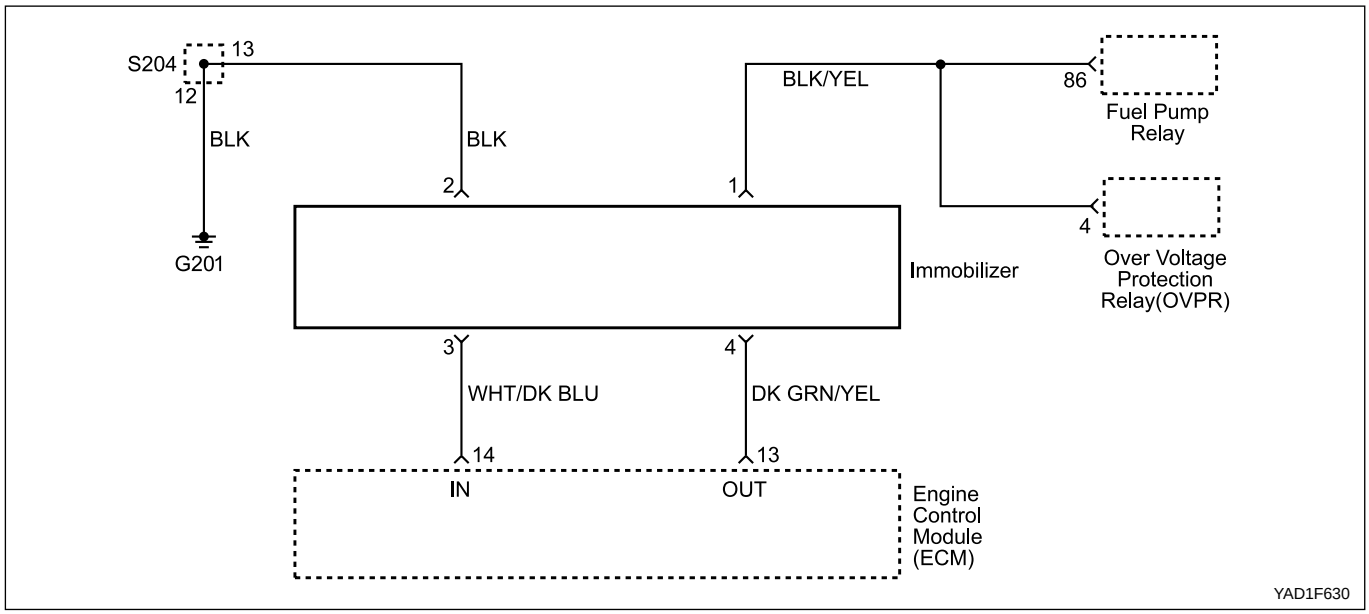
Failure Code	Description	Trouble Area	Maintenance Hint
21	Transmission coding failure	When faulty of variant coding of transmission	• Inspection the coding condition through scan tool • Inspection the Engine Control Module (ECM) • Inspection the CAN line • Inspection the TCM
136	ECM failure (RAM)	When malfunction of random access memory - ECM internal error	• Inspection the ECM
142	Uncoded/ unprogramed ECM	When malfunction of ECM coding-required ECM encoding	• Fulfill the ECM variant coding
137	ECM failure (EPROM)	When malfunction of ECM internal	• Inspection the ECM
143	ECM failure (EEPROM/ Flash - EPPOM checksum failure)		
144	ECM failure (coding ID checksum failure)		
145	ECM failure (coding checksum failure)		
146	ECM failure (programming checksum failure)		

ELECTRONIC THROTTLE CONTROLLER SAFETY MALFUNCTION

Failure Code	Description	Trouble Area	Maintenance Hint
110	Throttle actuator learning data fault	System internal failure	• Inspection the Engine Control Module (ECM)
117	Exceed fuel-cut safety time		
120	Cruise control interruption memory failure		
138	Call Monitoring		
139	Servo motor control output interruption memory failure		
140	Servo motor open/short		
186	ECM failure (incompatible CPU)		
187	ECM failure (CPUs communication failure)		
188	ECM failure (CPU 2 configuration failure)		
189	ECM failure (CPU 2 fault)		
190	ECM failure (CPU run time failure between CPUs)		
231	ECM failure (CPU 2 cruise control message counter failure)		
232	Over deceleration limit (CPU 2)		
233	Over acceleration limit (CPU 2)		
234	Cruise control lever dual operation (CPU 2)		
235	Cruise control lever safety terminal failure (CPU 2)		
236	Unusual pedal position variation (CPU 2)		
237	Unusual throttle position variation (CPU 2)		
238	Unusual throttle controller monitoring data comparison fault (CPU 2)		

Failure Code	Description	Trouble Area	Maintenance Hint
239	Unusual accelerator pedal position sensor comparison fault (CPU 2)	System internal failure	• Inspection the Engine Control Module
240	Throttle potentiometer comparison fault (CPU 2)		
241	Unusual CPU communication (CPU 2)		
242	Unusual CPU configuration (CPU 2)		
243	A/D converter failure (CPU 2)		
244	Accelerator pedal position sensor set-point fault between CPU 1 and CPU 2 (ECM)		
245	Position controller set-point fault between CPU 1 and CPU 2		
246	MSR setpoint fault between CPU 1 and CPU 2		
247	Idle control setpoint fault between CPU 1 and CPU 2		
248	A/D converter overflow (CPU 2)		
249	ROM fault (CPU 2)		
250	RAM fault (CPU 2)		
251	Cycle monitor fault (CPU 2)		

IMMOBILIZER



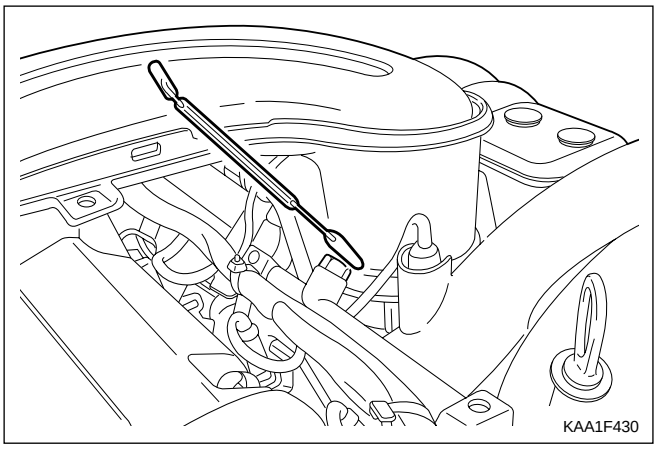
Failure Code	Description	Trouble Area	Maintenance Hint
25	Communication with transponder missing	When missing the transponder signal	• D Inspection the Engine Control Module (ECM) pin 13, 14 about short circuit or open with bad contact • Inspection the power source or ground short circuit or open of immobilizer unit • Inspection the transponder condition (broken etc.) • Inspection the ECM
141	Unprogramed ECM with immobilizer	When malfunction of immobilizer Required immobilizer encoding, no paired condition of immobilizer even through start trial	• Fulfill the immobilizer pairing

Circuit Description

Immobilizer is a device disabling vehicle ignition unless a specific key is used and designed to help prevent vehicle theft.

Immobilizer is comprised of two devices, a key with encoded transponder and ECM with the same encoding of the transponder. When a key is inserted into the hole to start vehicle and turned to ON, the ECM reads and decodes the transponder code and, if the same, starts the engine, it is called immobilizer. It means immobilizer system disables starting by stopping fuel supply if the code in the transponder does not match the code stored in ECM each other.

MAINTENANCE AND REPAIR


KAA1F430

ON-VEHICLE SERVICE

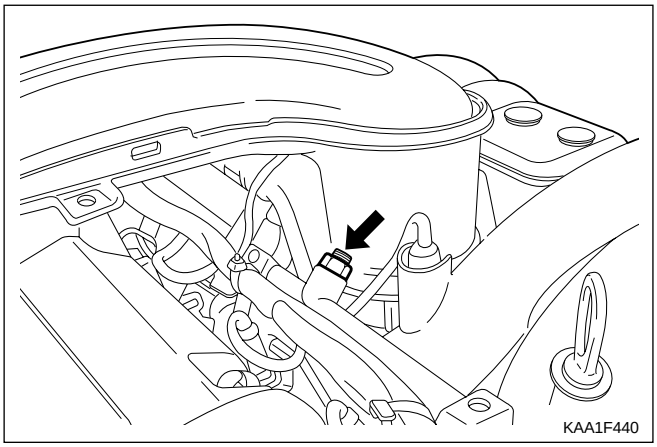
DISCHARGING THE PRESSURE IN FUEL SYSTEM

Removal and Installation Procedure

1. Remove the fuel pressure test connector.

   Installation Notice

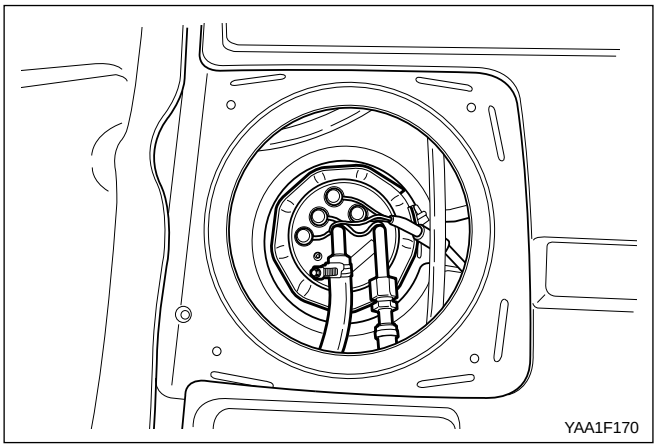
Tightening Torque	25 N•m (18 lb-ft)


KAA1F440

2. Remove the fuel pressure in fuel system by pressing the service valve with a clean, pointy tool.

   Notice: Place a cloth so that the fuel doesn't stain around.

3. Installation should follow the removal procedure in the reverse order.


YAA1F170

FUEL PUMP

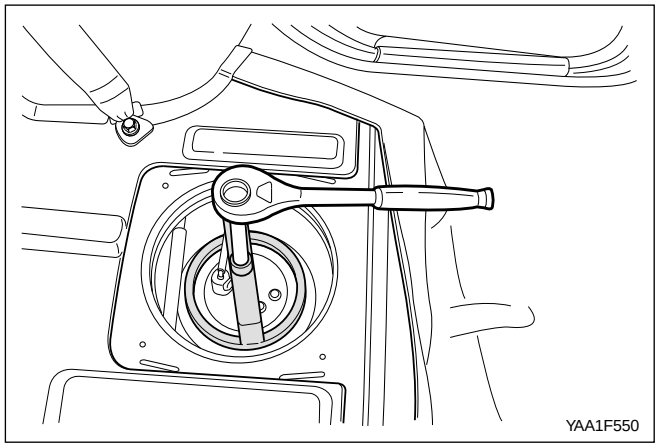
Tools Required

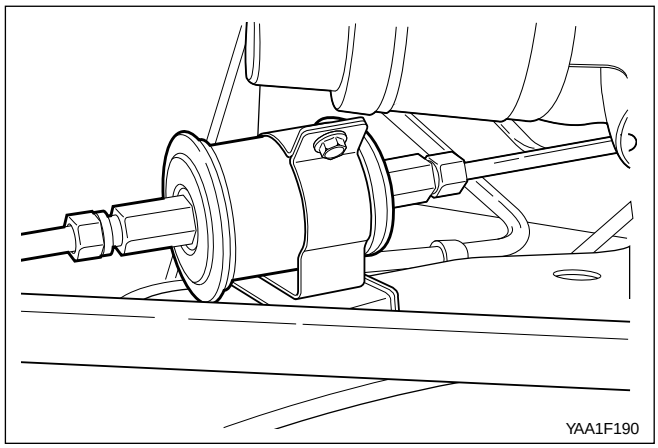
661 589 00 46 00 Fuel Tank Cap Wrench

Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel system pressure. Refer to "Discharging the Pressure in Fuel System" in this section.
2. Disconnect the negative battery cable.
3. Put aside the floor carpet to remove the fuel pump access cover.
4. Remove the fuel pump access cover.
5. Remove the fuel pump wiring connectors.
6. Disconnect the fuel supply and return pipes.
7. Remove the fuel pump locking cap band.


YAA1F550


YAA1F190

8. Using the fuel tank cap wrench 661 589 00 46 00, remove the locking cap.
9. Remove the pump from the fuel tank.

   Notice: Check the condition of the seal and replace if necessary. Drain the fuel before removing the pump.

10. Perform an operational check of the fuel pump.
11. Installation should follow the removal procedure in the reverse order.

FUEL FILTER

Removal and Installation Procedure

1. Disconnect the negative battery cable.

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

2. Relieve the fuel system pressure. Refer to “Discharging the Pressure in Fuel System” in this section.
3. Disconnect the fuel lines from the fuel filter.

   Installation Notice

Tightening Torque	28 N•m (21 lb-ft)

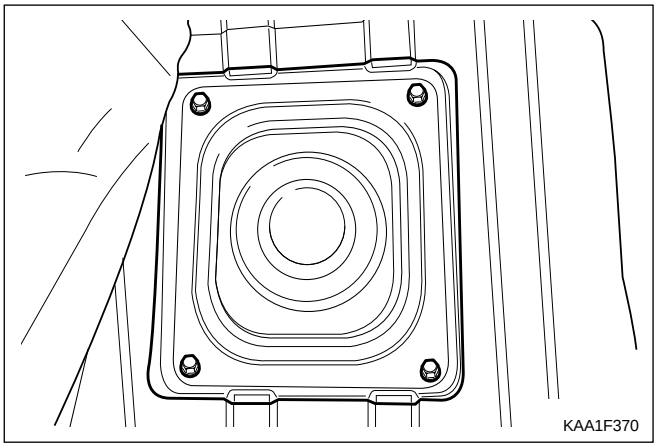
4. Remove the fuel filter mounting bracket bolt.

   Installation Notice

Tightening Torque	28 N•m (21 lb-ft)

   Notice: Place the fuel pump pad. There may be a corrosion due to the contact between the fuel filter and the bracket.

5. Remove the fuel filter.
6. Install the fuel filter.
7. Perform a leak test of the fuel filter.
8. Installation should follow the removal procedure in the reverse order.

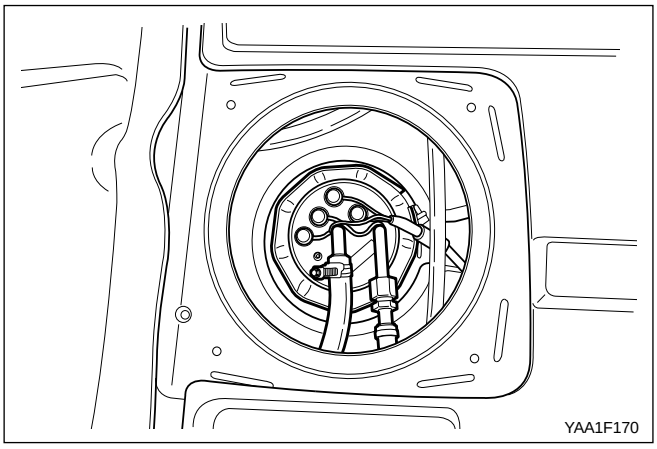

KAA1F370

FUEL TANK

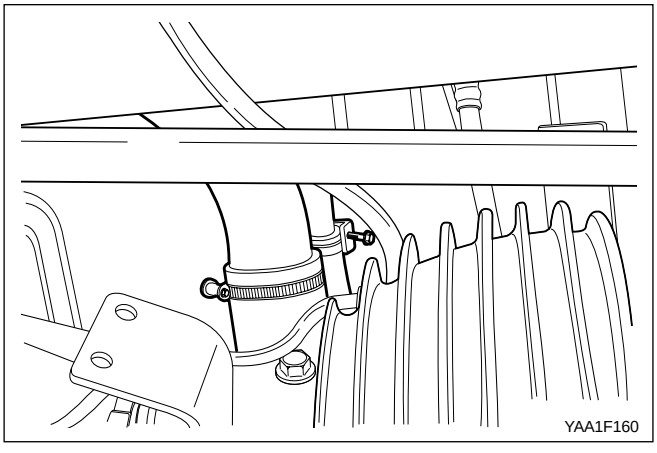
Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel pressure. Refer to “Discharging the Pressure in Fuel System” in this section.
2. Disconnect the negative battery cable.
3. Drain the fuel tank.
4. Put aside the floor carpet to remove the fuel pump access cover.
5. Remove the fuel pump access cover.


YAA1F170

6. Disconnect the return line.
7. Disconnect the supply line.
8. Disconnect the fuel tank-to-canister hose from the fuel tank.
9. Disconnect the fuel pump wiring connector.

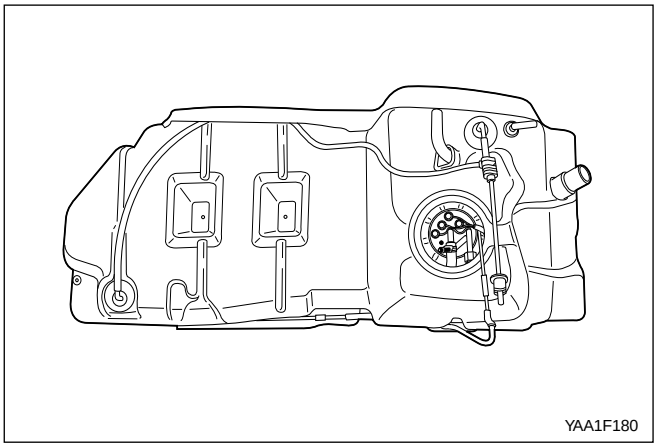

YAA1F160

10. Disconnect the fuel filler hose and air vent hose from the fuel tank.
11. Support the fuel tank.
12. Remove the fuel tank retaining nuts.

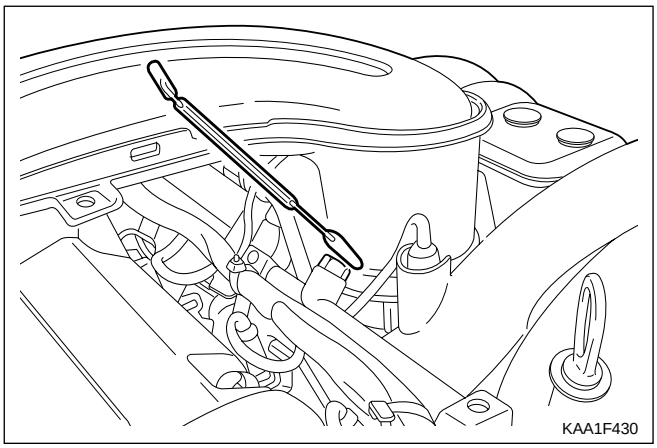
    Installation Notice

Tightening Torque	38 N•m (28 lb-ft)

13. Carefully lower the fuel tank.


YAA1F180

14. Turn the roll over valves counterclockwise at an angle of 90 degrees.
15. Turn the lock ring counterclockwise.
16. Remove and discard the gasket.
17. Installation should follow the removal procedure in the reverse order.


KAA1F430

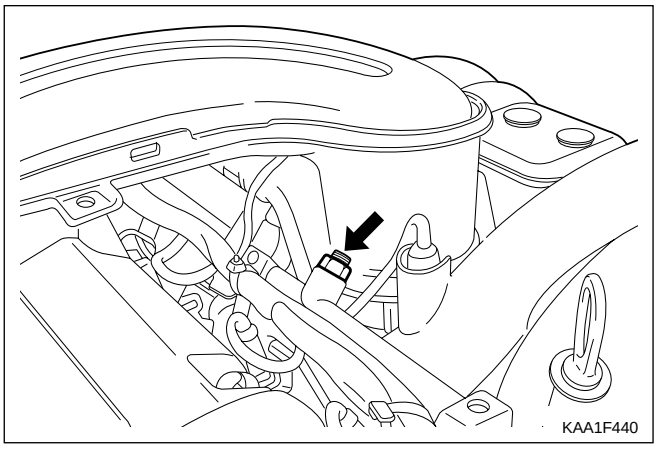
FUEL PRESSURE REGULATOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the fuel pressure test connector.

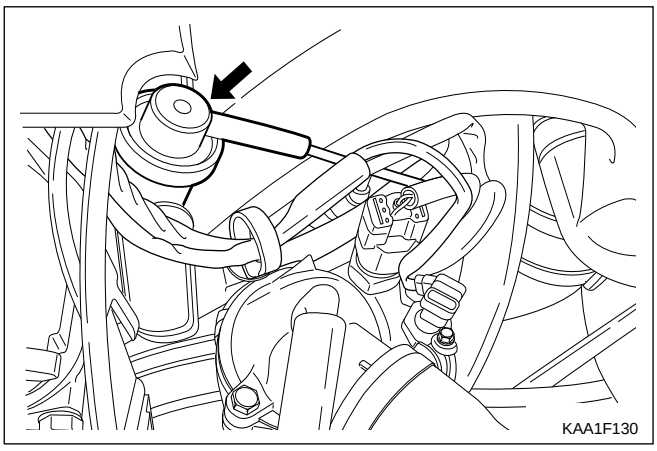
Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

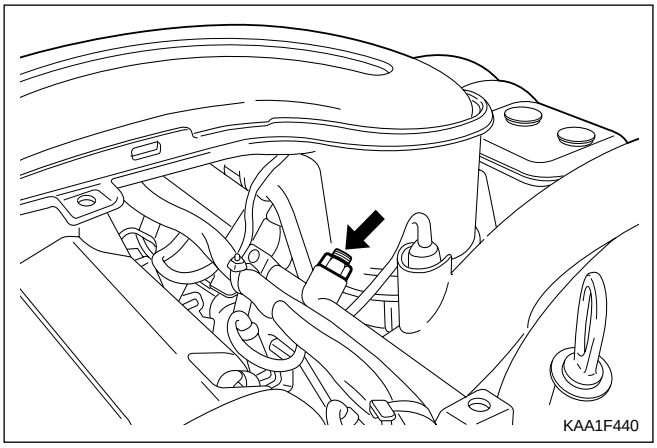

KAA1F440

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

3. Relieve the fuel pressure in fuel supply system by pressing the service valve.


KAA1F130

4. Disconnect the vacuum hose.
5. Disconnect the circlip and remove the fuel pressure regulator.
6. Apply the oil to O-ring lightly and then replace it.
7. Perform a leak test of the fuel pressure regulator with the engine off and the ignition on.
8. Installation should follow the removal procedure in the reverse order.

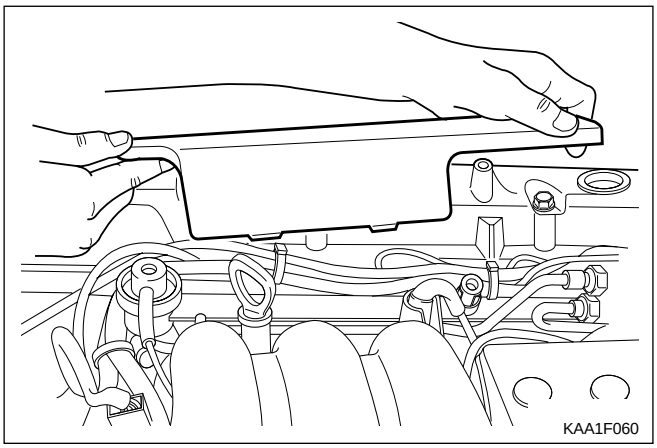


FUEL RAIL AND INJECTORS

Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoidfuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Discharge the fuel pressure from the fuel pressure test connector.
2. Disconnect the negative battery cable.
3. Disconnect the vacuum hose from the fuel pressure regulator.

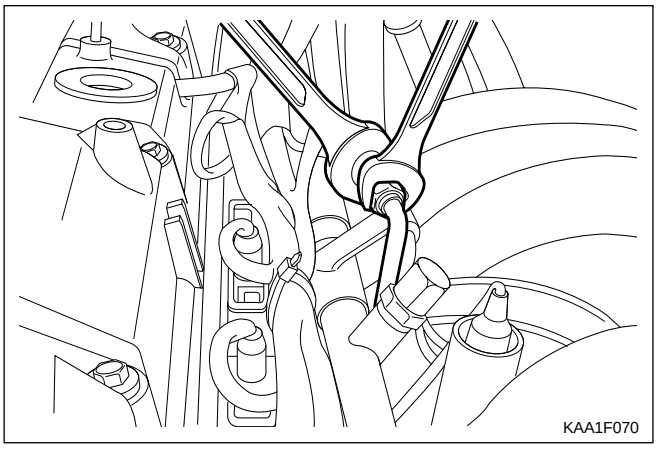


4. Remove the cable guide.
5. Disconnect the Hot Film Air Mass (HFM) sensor connector.
6. Remove the intake air duct mounting bolts.

Installation Notice

Tightening Torque	9 N•m (80 lb-ft)

7. Remove the intake air duct clamps.
8. Remove the intake air duct.



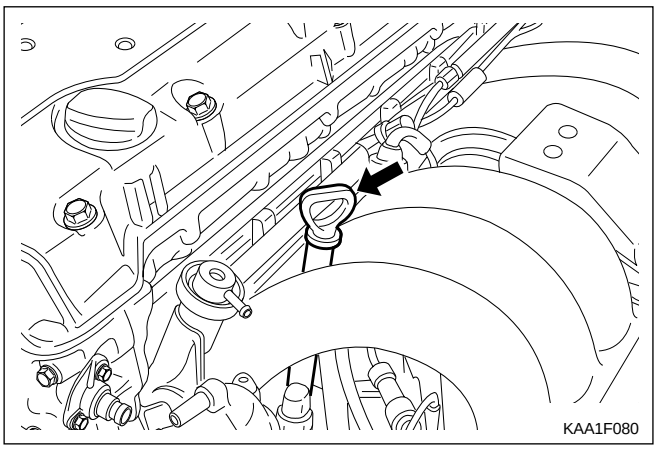
9. Remove the fuel return and supply line.

   Notice: For removal, cover around parts with cloths not to be stained by fuel. In case of checking the injector only, do not remove the fuel return and supply line.

Installation Notice

Tightening Torque	23 N•m (17 lb-ft)

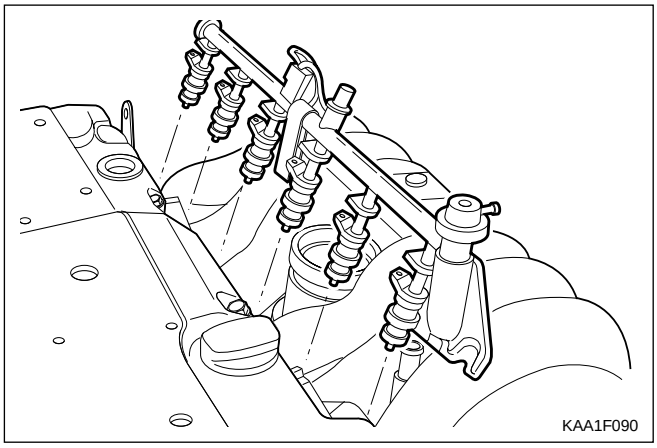
10. Remove the six injector connectors.



11. Remove the two left and two right bolts and one center bolt of the fuel rail assembly from the intake manifold.

Installation Notice

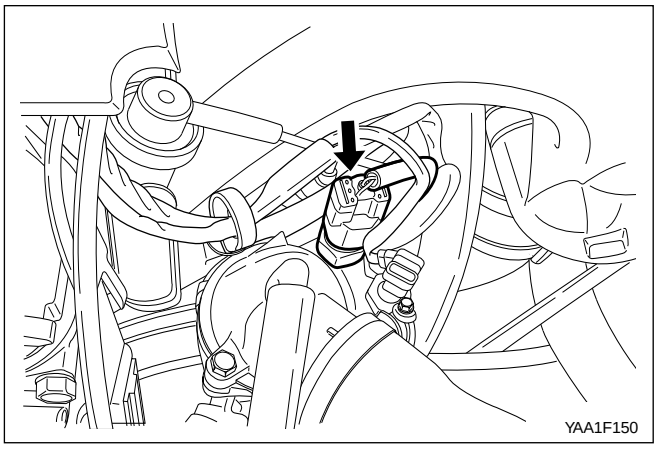
Tightening Torque	25 N•m (18 lb-ft)


KAA1F090

Notice: Before removal, the fuel rail assembly may be cleaned with as pray type cleaner, following package instructions. Do not immerse the fuel rails in liquid cleaning solvent. Use care in removing the fuel rail assembly to prevent damage to the electrical connectors and injector spray tips. Prevent dirt and other contaminants from entering open lines and passages. Fittings should be capped and holes plugged during service.

Important: If an injector becomes separated from the rail and remains in the cylinder head, replace the injector O-ring seals and the retaining clip.

12. Remove the injectors and the fuel rail carefully.
13. Remove the fuel injector retainer clips.
14. Remove the fuel injectors by pulling them down and out.
15. Discard the fuel injector O-rings.
16. Lubricate the new fuel injector O-rings with engine oil. Install the new O-rings on the fuel injectors.
17. Perform a leak check of the fuel rail and fuel injectors.
18. Installation should follow the removal procedure in the reverse order.


YAA1F150

ENGINE COOLANT TEMPERATURE SENSOR

Removal and Installation Procedure

1. Relieve the coolant system pressure.
2. Disconnect the negative battery cable.
3. Disconnect the engine coolant temperature sensor connector.

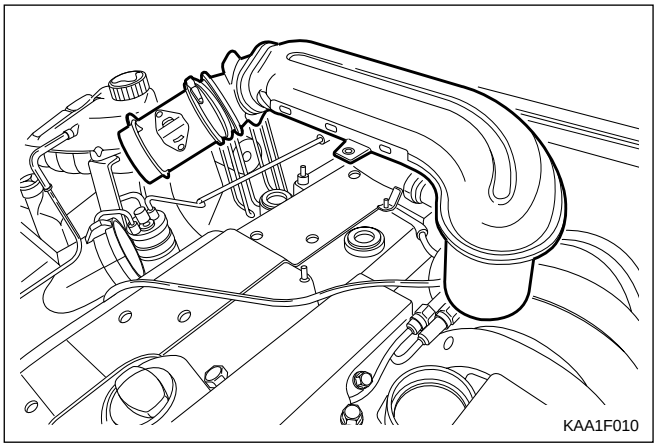
   Notice: Take care when handling the engine coolant temperature sensor. Damage to the sensor will affect the proper operation of the fuel injection system.

4. Remove the engine coolant temperature sensor from the pump hosing.

   Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

5. Installation should follow the removal procedure in the reverse order.


KAA1F010

THROTTLE BODY (INTEGRATED WITH THE ACTUATOR)

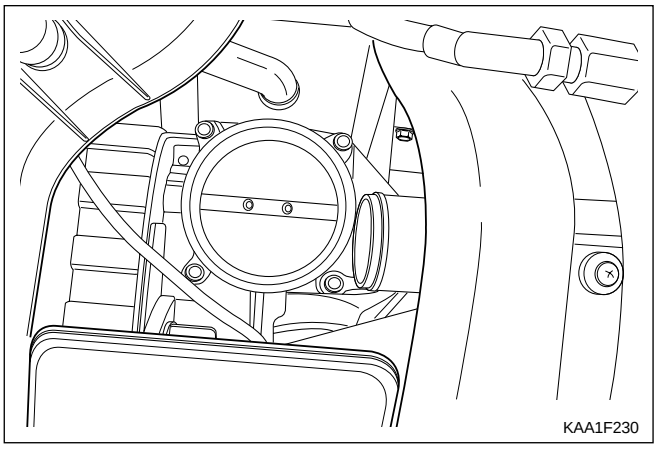
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the mass air flow sensor connector.
3. Disconnect the mass air flow sensor from the air filter housing.
4. Remove the intake air duct mounting bolts.

Installation Notice

Tightening Torque	9 N•m (80 lb-ft)

5. Remove the air inlet housing clamps.
6. Remove the inlet air housing.

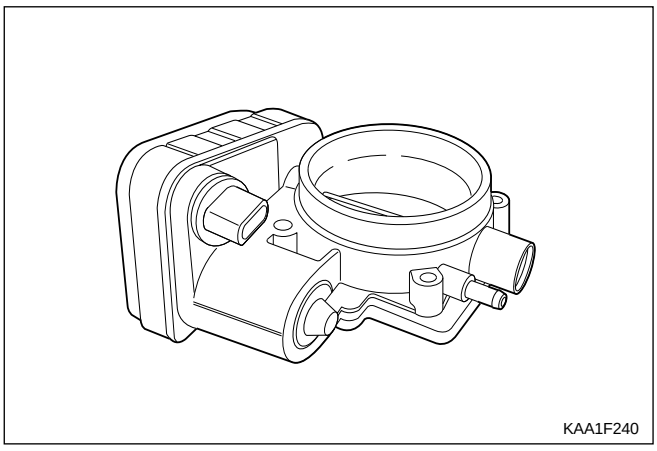

KAA1F230

7. Disconnect the throttle body electrical connector.
8. Remove the throttle body bolts.

Installation Notice

Tightening Torque	12 N•m (106 lb-ft)

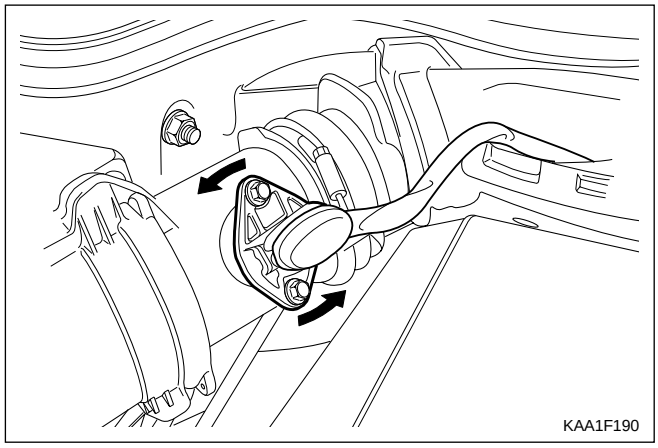
9. Remove the vacuum hose.


KAA1F240

10. Remove the throttle body and discard the gasket.

    Important: Use care in cleaning old gasket material. Sharp tools may damage sealing surfaces.

11. Installation should follow the removal procedure in the reverse order.


KAA1F190

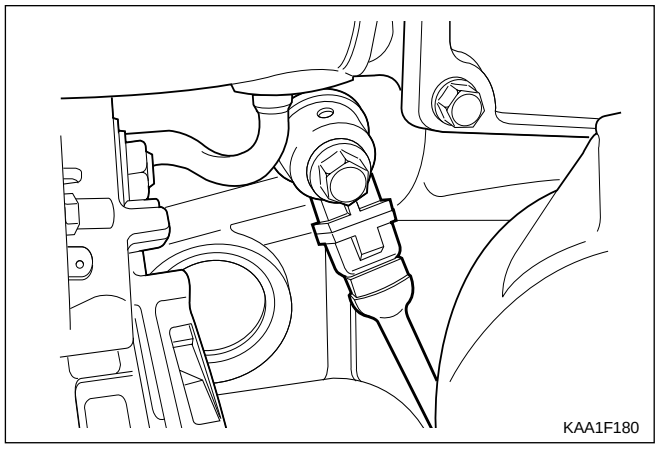
HOT FILM AIR MASS (HFM) SENSOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the Hot Film Air Mass (HFM) sensor electrical connector.
3. Remove the HFM sensor retaining screws.
4. Turn the HFM sensor coupling in the direction shown in the figure in the left so that it gets separated from the contact surface.

   Notice: Make sure the HFM sensor coupling connects completely with the contact surface installation.

5. Remove the HFM sensor.
6. Installation should follow the removal procedure in the reverse order.


KAA1F180

KNOCK SENSOR

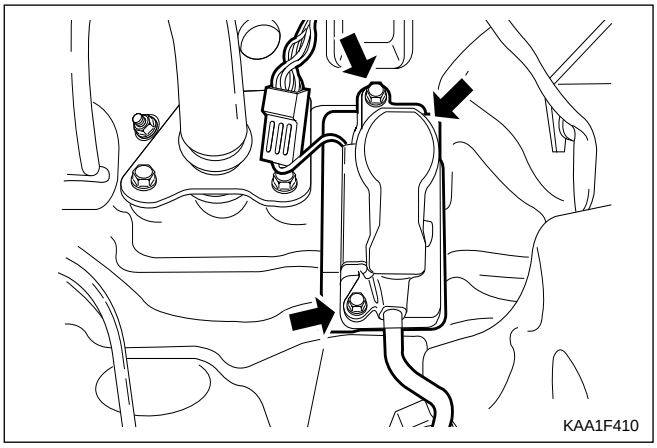
Removal and installation Procedure

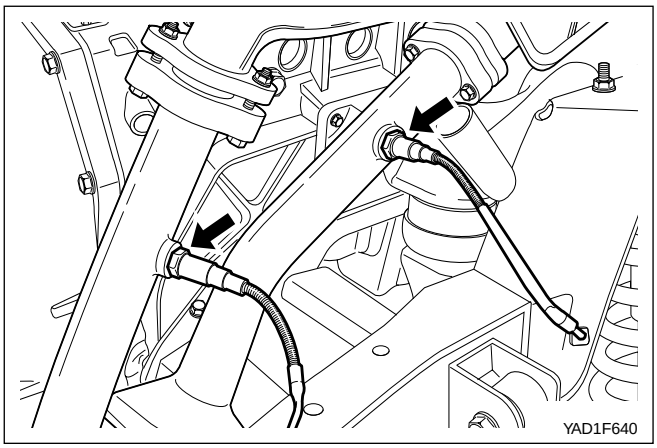
1. Disconnect the negative battery cable.
2. Disconnect the knock sensor electrical connector from the intake manifold bracket.
3. Remove the knock sensor mounting bolt from the knock sensor installed on the cylinder block.

   Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

4. Remove the knock sensor.
5. Installation should follow the removal procedure in the reverse order.





PEDAL POSITION SENSOR

Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the pedal position sensor connector.
3. Unscrew the bolts and nut.

Installation Notice

Tightening Torque	6 N•m (53 lb-ft)

4. Remove the pedal and sensor assembly.
5. Installation should follow the removal procedure in the reverse order.

OXYGEN SENSOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.

   Notice: The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or the connector could affect proper operation of the oxygen sensor. Do not drop the oxygen sensor.

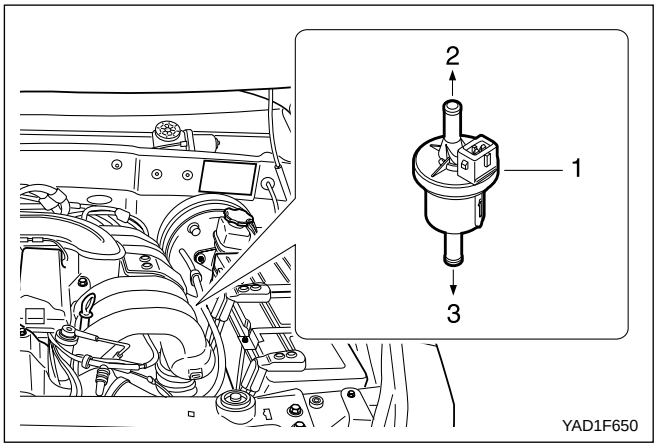
2. Disconnect the electrical connector.
3. Carefully remove the oxygen sensor from the exhaust pipe.

Installation Notice

Tightening Torque	55 N•m (41 lb-ft)

Important: A special anti-seize compound is used on the oxygen sensor threads. This compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or serviced sensors will al-ready have the compound applied to the threads. If a sensor is removed from any engine and is to be rein-stalled, the threads must have an anti-seize compound applied before reinstallation.

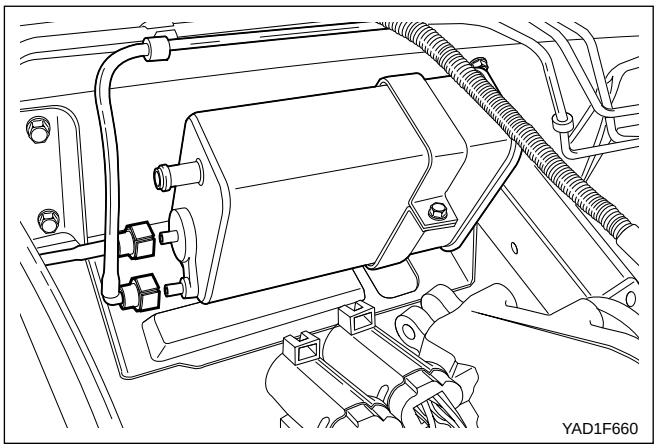
4. Coat the threads of the oxygen sensor with an anti-seize compound, if needed.
5. Installation should follow the removal procedure in the reverse order.



PURGE CONTROL VALVE

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the purge control valve connector.
3. Disconnect the throttle body-to-purge control valve hose from the purge control valve.
4. Disconnect the canister-to-purge control valve hose from the purge control valve.
5. Remove the purge control valve.
6. Installation should follow the removal procedure in the reverse order.

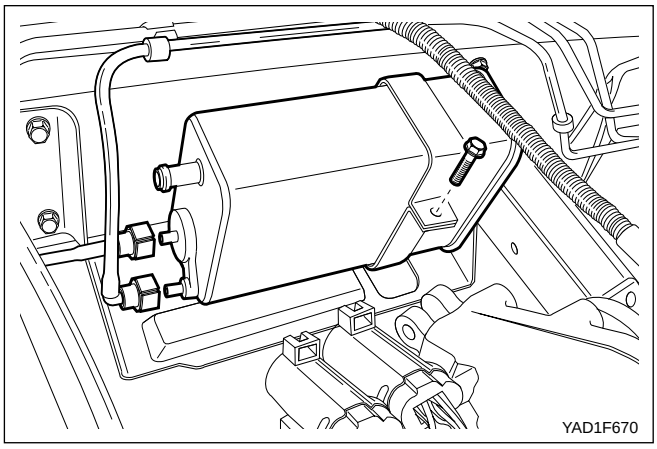


CANISTER

Removal and Installation Procedure

Caution: Canister and vacuum hoses contain fuel vapors. Do not smoke in the area or permit an open flame.

1. Disconnect the fuel tank-to-canister hose form the canister.
2. Disconnect the canister-to-purge control valve hose form the canister.

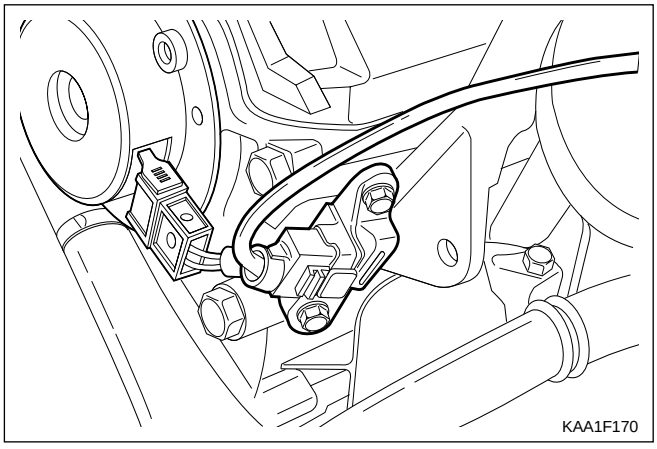


3. Remove the canister mounting bolts.

   Installation Notice

Tightening Torque	6 N•m (53 lb-ft)

4. Remove the canister.
5. Installation should follow the removal procedure in the reverse order.



CAMSHAFT POSITION SENSOR

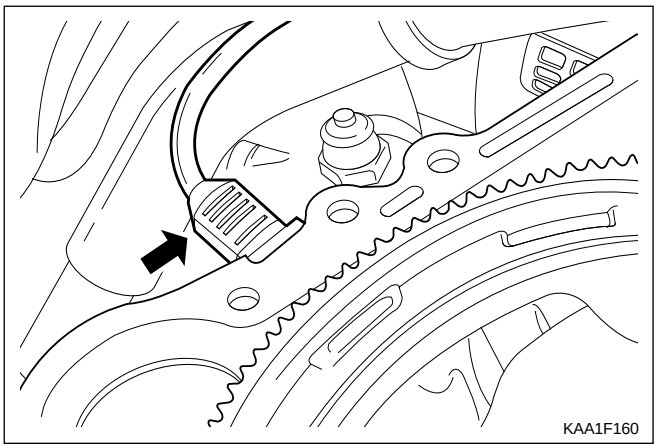
Removal and Installation Procedure

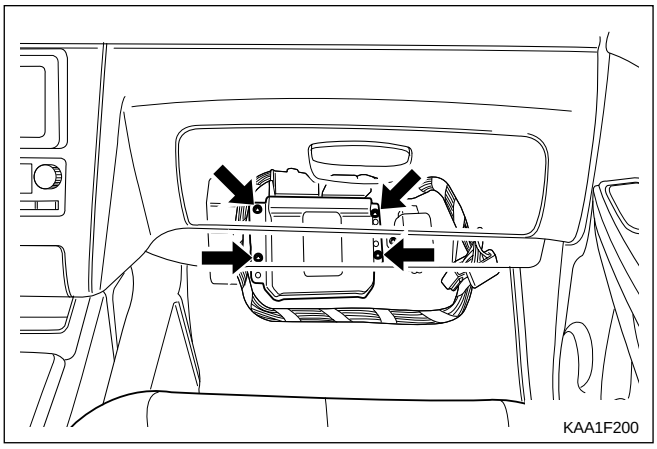
1. Disconnect the negative battery cable.
2. Disconnect the electrical connector from the camshaft position sensor.
3. Remove the camshaft position sensor retaining bolt.

   Installation Notice

Tightening Torque	10 N•m (89 lb-ft)

4. Check the O-ring for damage and replace it if neces sary.
5. Installation should follow the removal procedure in the reverse order.


KAA1F160


KAA1F200

CRANKSHAFT POSITION SENSOR

Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector at the crankshaft position sensor.
3. Remove the crankshaft position sensor retaining bolt.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

4. Installation should follow the removal procedure in the reverse order.

ENGINE CONTROL MODULE

Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Remove the cowl side trim form passenger side. Refer to *Section 9G, Interior trim.*
3. Remove the four securing nuts for the Engine Control Module (ECM) from the mounting bracket.

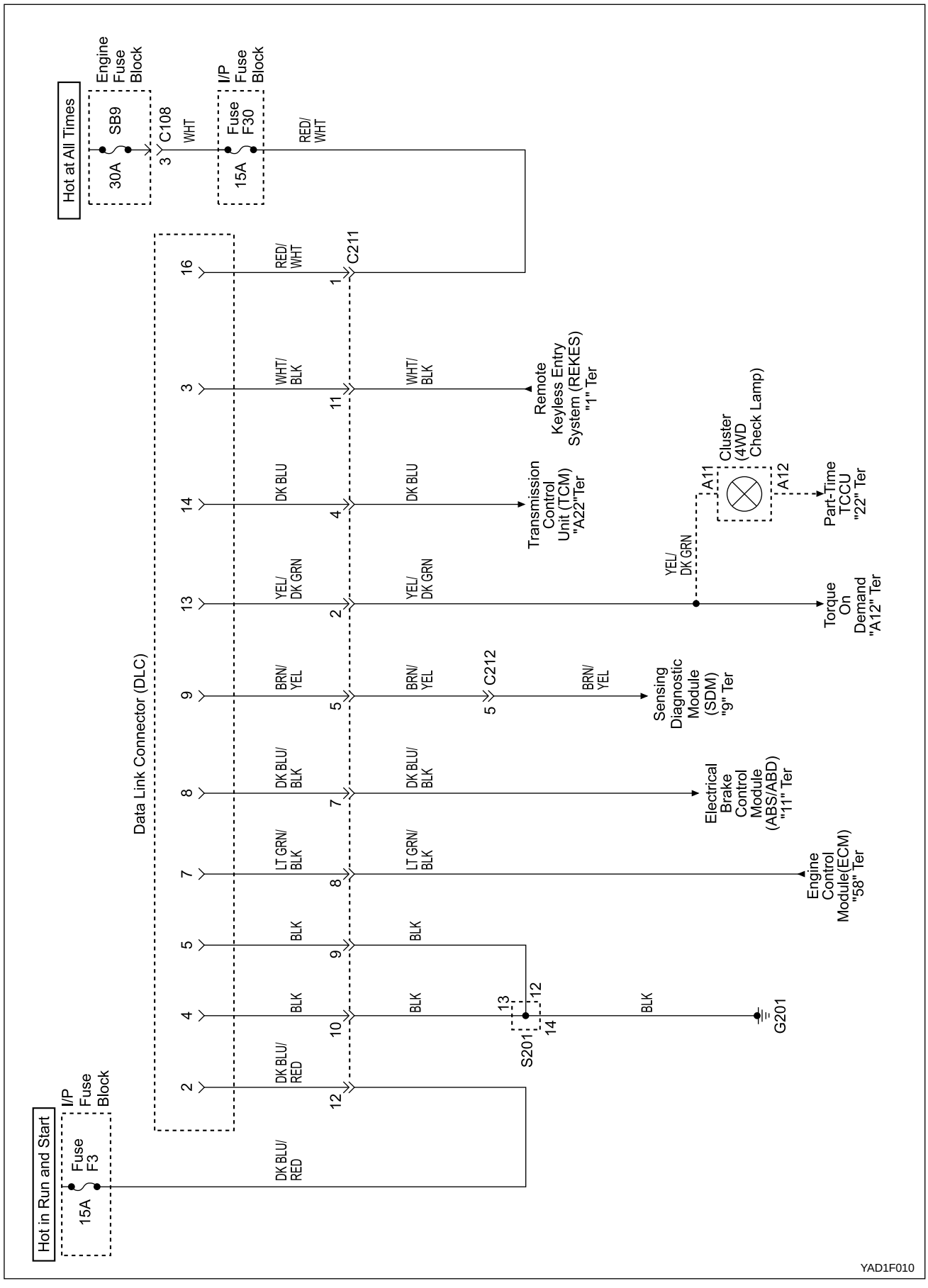
Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

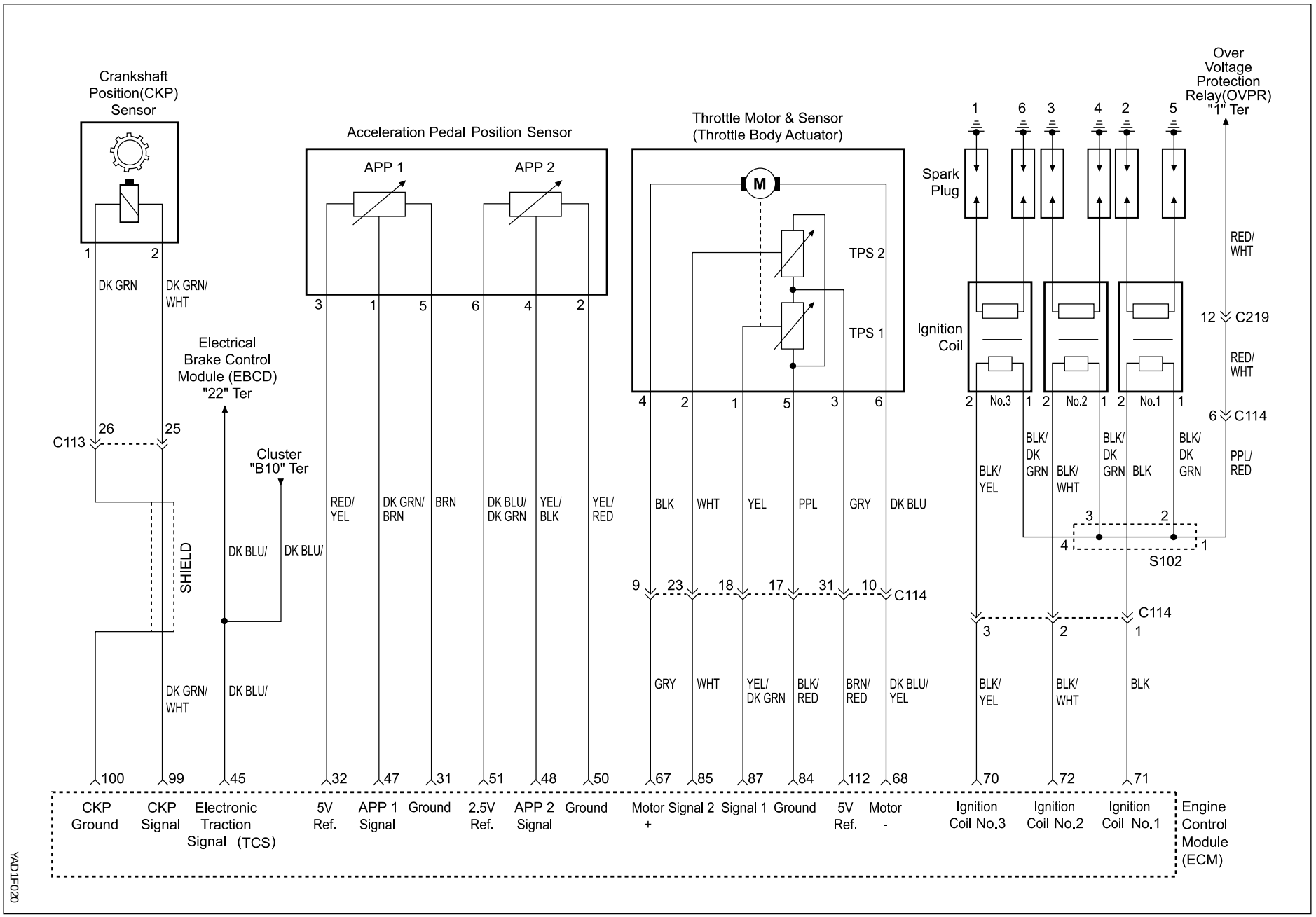
4. Pull out the ECM from the bracket.
5. Disconnect the vehicle side coupling.
6. Installation should follow the removal procedure in the reverse order.

SCHEMATIC AND ROUTING DIAGRAMS

ECM WIRING DIAGRAM (3.2L DOHC - 1 OF 7) (MSE 3.63D)

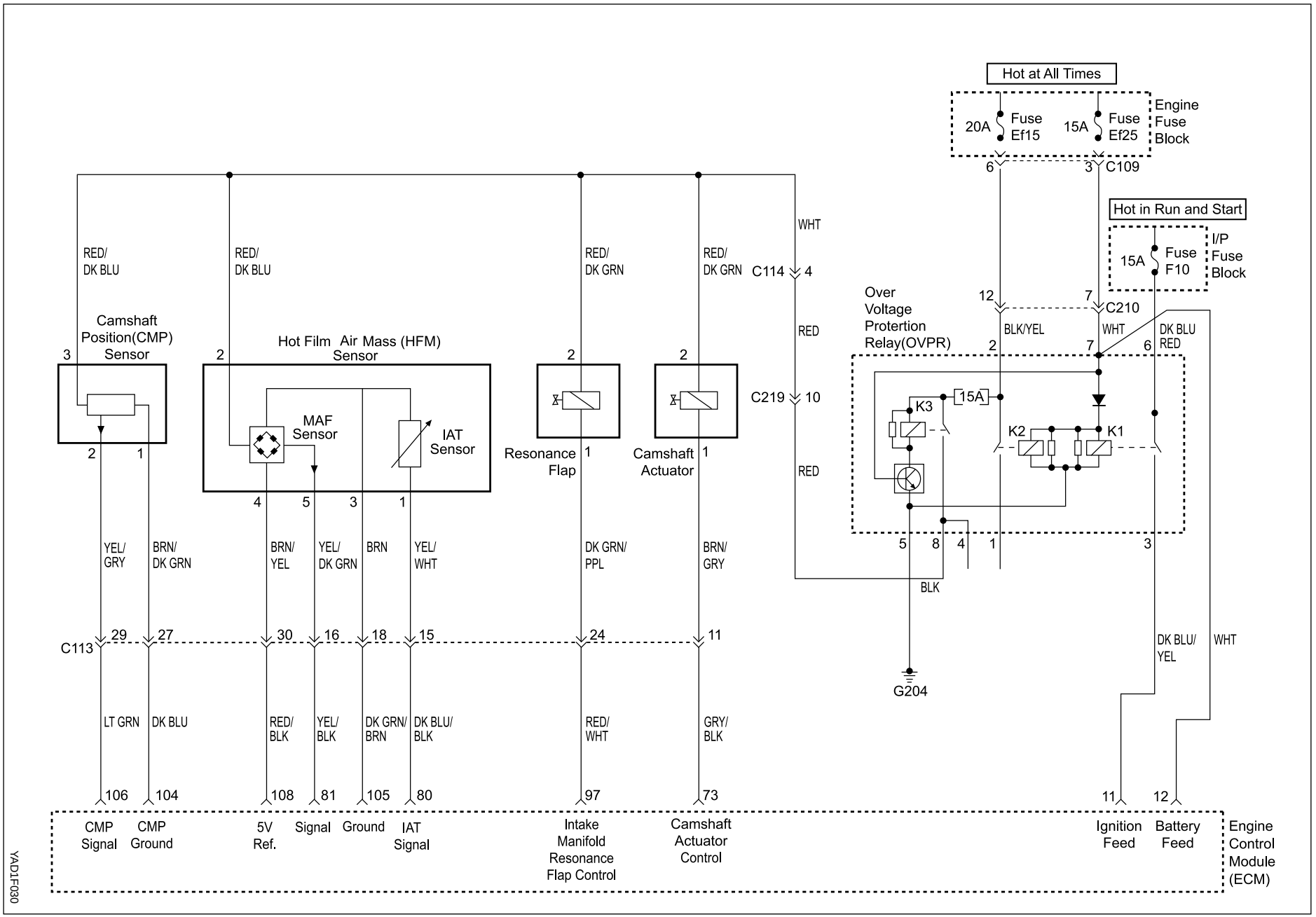


ECM WIRING DIAGRAM (3.2L DOHC - 2 OF 7) (MSE 3.63D)



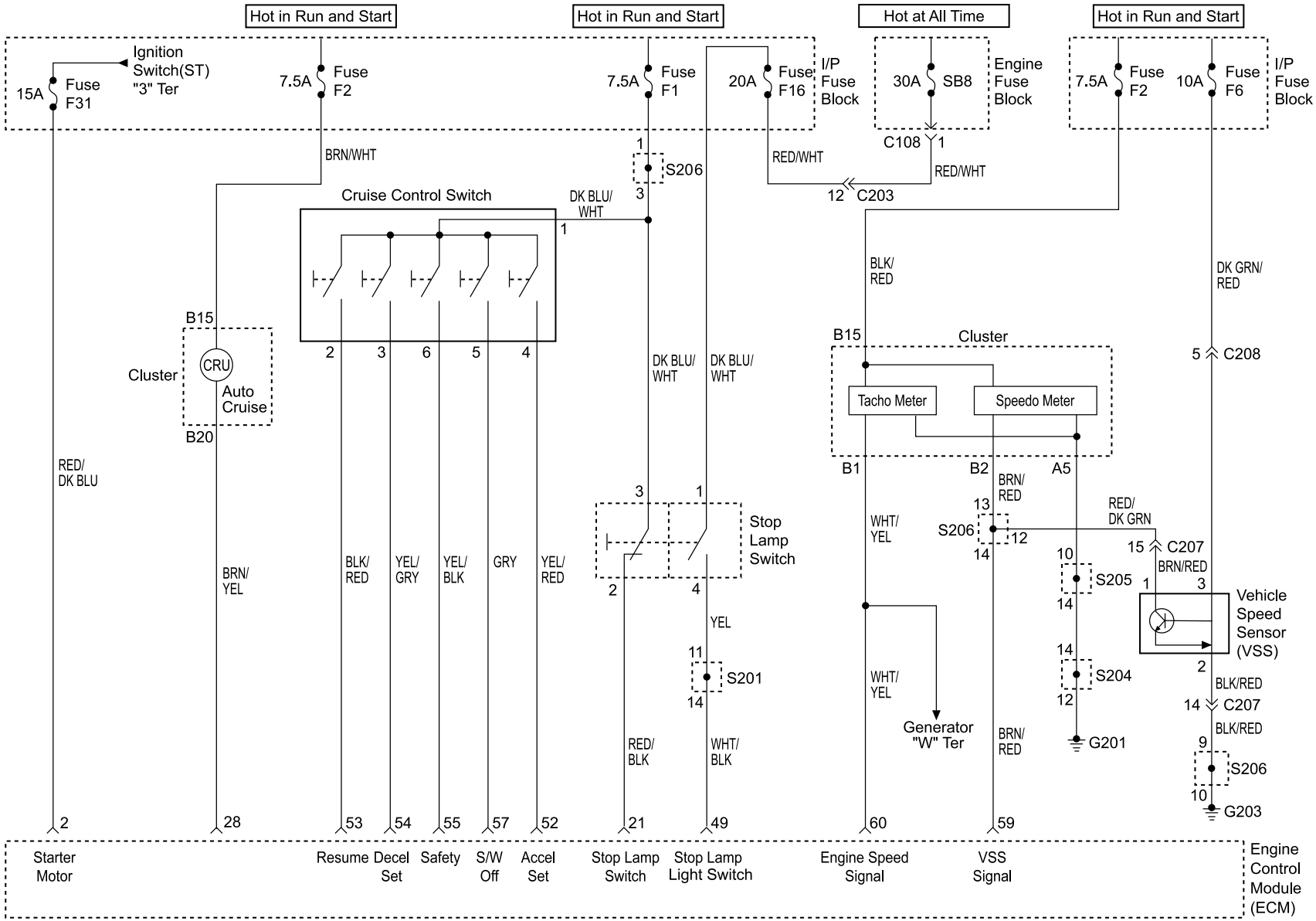
YAD1F020

ECM WIRING DIAGRAM (3.2L DOHC - 3 OF 7) (MSE 3.63D)

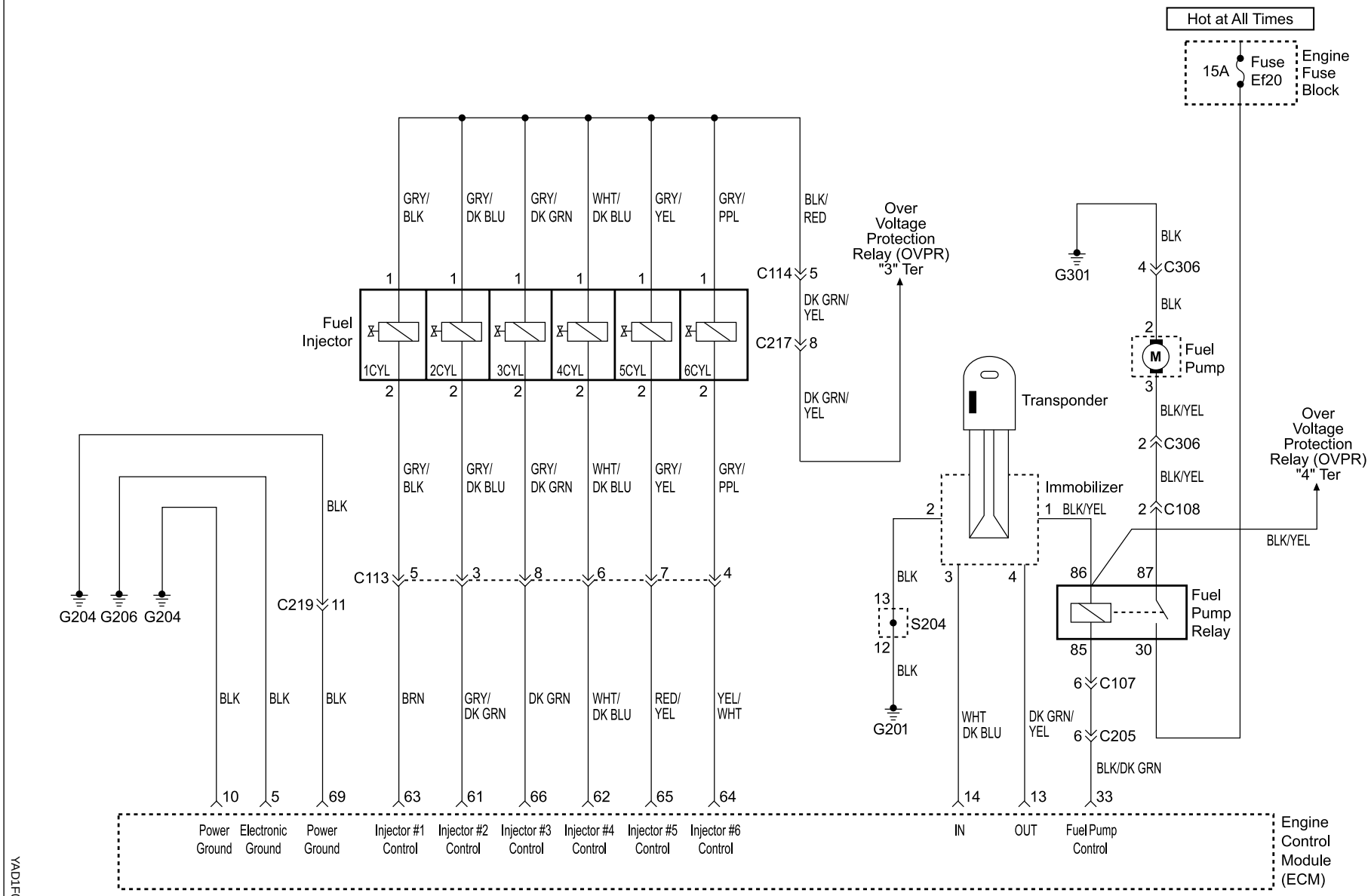


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ECM WIRING DIAGRAM (3.2L DOHC - 4 OF 7) (MSE 3.63D)

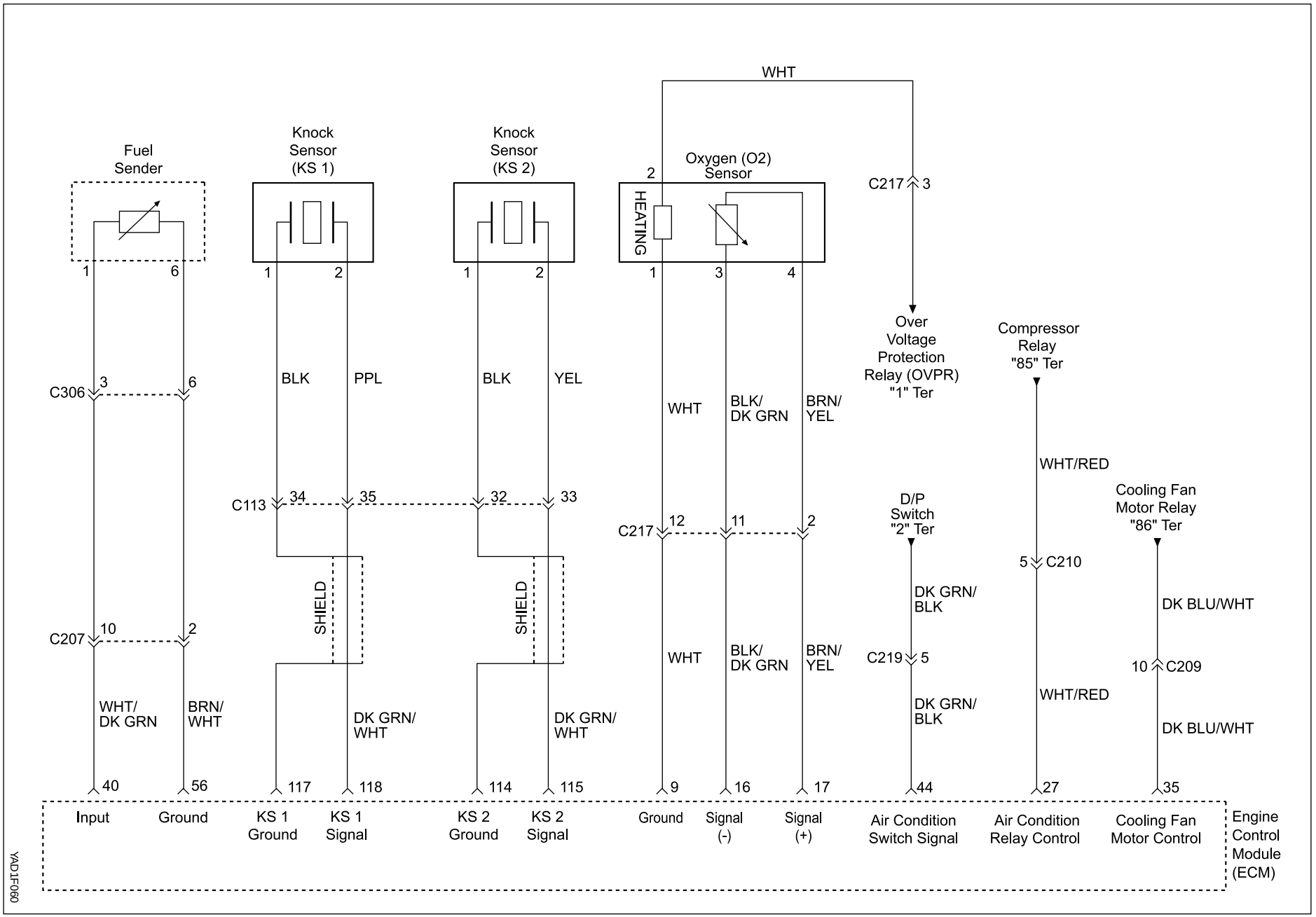


ECM WIRING DIAGRAM (3.2L DOHC - 5 OF 7) (MSE 3.63D)



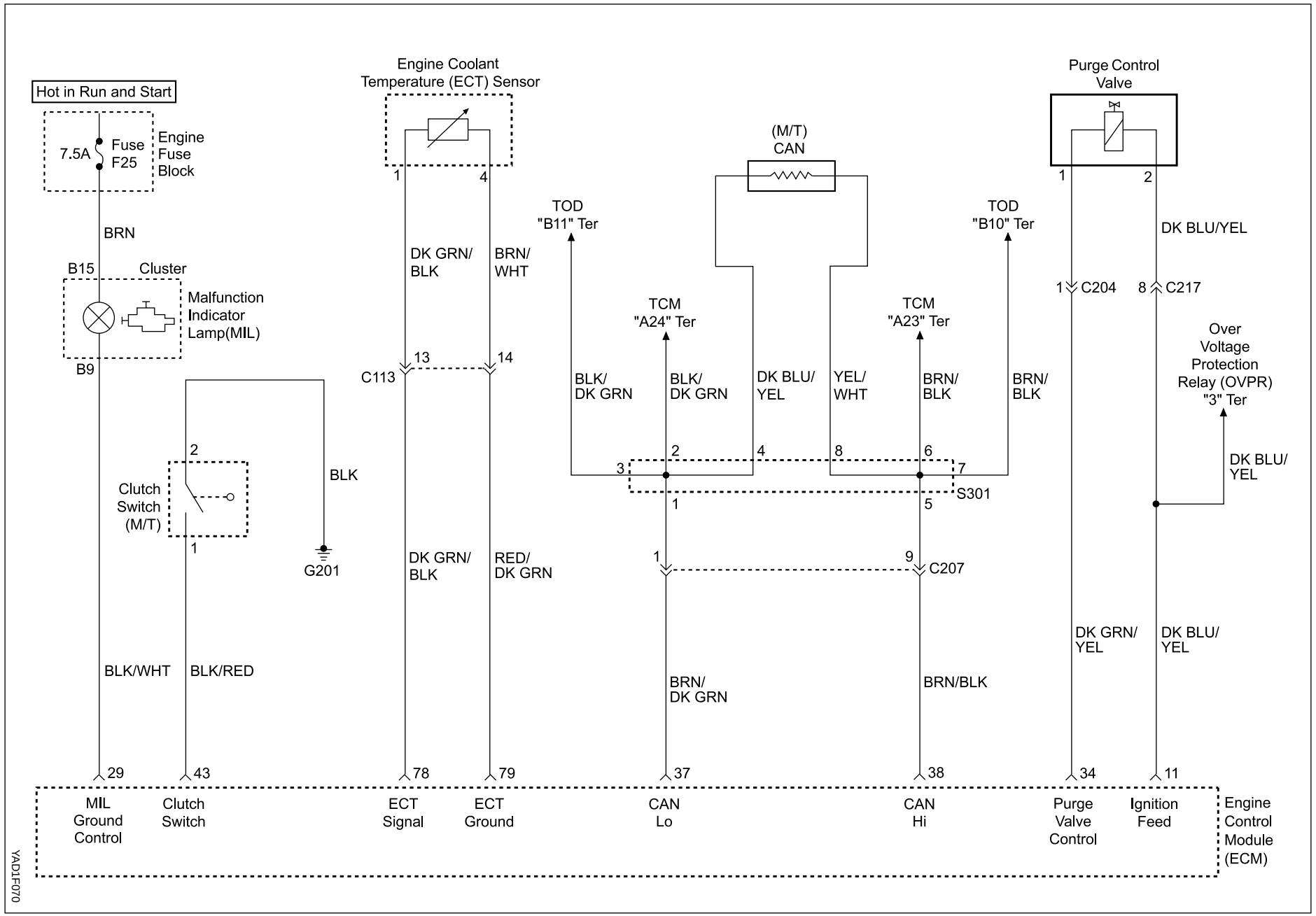
YAD1F050

ECM WIRING DIAGRAM (3.2L DOHC - 6 OF 7) (MSE 3.63D)



YAD1F060

ECM WIRING DIAGRAM (3.2L DOHC - 7 OF 7) (MSE 3.63D)



SPECIFICATIONS

ENGINE DATA DISPLAY TABLE

Parameter	Unit	Value
Engine Coolant Temp.	°C	greater than 95 °C after warm up
Intake Air Temp.	°C	-40 ~ 130 °C (varies with ambient temp. or engine mode)
Engine RPM	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Regular RPM	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Engine Load	%	18 ~ 25 %
Mass Air Flow Meter	Kg/h	16 ~ 25 Kg/h
Throttle Position Angle	°TA	0 °TA (up to 100 °TA at t he wi de open throttle)
Spark Advance	°CA	°CA (6 ~ 9 °CA)
Indicated Engine Torque	Nm	Varies with engine condition
Injection Time	ms	3 ~5 ms
Battery Voltage	V	13.5 ~ 14.1 v (engine running)
Front Axle Speed	Km/h	0 ~ 265 Km/h
Rear Axle Speed	Km/h	0 ~ 265 Km/h
Accel. Pedal Position 1	V	0.4 ~ 4.8 V
Accel. Pedal Position 2	V	0.2 ~ 2.4 V
Throttle Position 1	V	0.3 ~ 4.6 V
Throttle Position 2	V	0.3 ~ 4.6 V
Fuel Integrator		0.8 ~ 1.2
Oxygen Sensor	mv	100 ~ 900 mv
A/C S/W Condition	1=ON/0=OFF	-
Full Load State	1=ON/0=OFF	-
Shift Gear State (A/T)	1=ON/0=OFF	-
A/C Control State	1=ON/0=OFF	-
Clutch Switch (M/T)	1=ON/0=OFF	-
Cam Actuator State	1=ON/0=OFF	-
Knocking Control	1=ON/0=OFF	-
Protect Mission	1=ON/0=OFF	-
Purge Control Valve	1=ON/0=OFF	-
Lambda Function	1=ON/0=OFF	-
Catalyst Heating	1=ON/0=OFF	-
Overrun Fuel Cut	1=ON/0=OFF	-
Ful l Fuel Cut	1=ON/0=OFF	-
Brake Switch	1=ON/0=OFF	-
Cruise Control Status	1=ON/0=OFF	-

*Condition : Warmed up, idle, P/N or neutral

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Camshaft Position Sensor Retaining Bolts	10	-	89
Canister Mounting Bolts	6	-	53
Coolant Temperature Sensor	30	22	-
Crankshaft Position Sensor Retaining Bolt	10	-	89
Engine Control Module (ECM) Mounting Bracket Nuts	10	-	89
Fuel Filter Mounting Bracket Bolt	6	-	53
Fuel Filter Lines	28	21	-
Fuel Pressure Test Connector	25	18	-
Fuel Rail Assembly Bolts	25	18	-
Fuel Return And Supply Lines	23	17	-
Fuel Tank Retaining Nuts	38	28	-
Intake Air Duct Mounting Bolts	9	-	80
Knock Sensor Mounting Bolt	25	18	-
Oxygen Sensor	55	41	-
Pedal Position Censor Mounting Bolts And Nut	6	-	53
Throttle Body Bolts	12	-	106

FUEL SYSTEM SPECIFICATION

Use Only Unleaded Fuel Rated at 89 Octane or Higher

Fuel quality and additives contained in fuel have a significant effect on power output, drivability, and life of theengine.

Fuel with too low an octane number can cause engine knock.

Caution: Use of fuel with an octane number lower than 89 may damage engine and exhaust system.

Notice: To prevent accidental use of leaded fuel, the nozzles for leaded fuel are larger, and will not fit the fuel filler neck of your vehicle.

Do Not Use Methanol

Fuels containing methanol (wood alcohol) should not be used in vehicle.

This type of fuel can reduce vehicle performance and damage components of the fuel system.

Caution: Use of methanol may damage the fuel system.

Vehicle Fueling from Drums or Storage Containers

For safety reasons (particularly when using noncommercial fueling systems) fuel containers, pumps and hoses must be properly earthed.

Static electricity build up can occur under certain atmospheric and fuel flow conditions if unearthed hoses, par-ticularly plastic, are fitted to the fuel-dispensing pump.

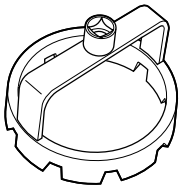
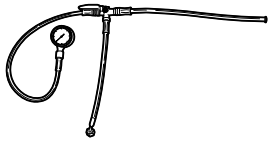
It is therefore recommended that earthed pumps with integrally earthed hoses be used, and that storage containers be properly earthed during all noncommercial fueling operations.

TEMPERATURE VS RESISTANCE

°C	°F	ECT sensor	IAT sensor
		ohms (Ω)	
Temperature vs Resistance Values (Approximate)			
130	266	88	102
120	248	111.6	127
110	230	143	159
100	212	202	202
90	194	261	261
80	176	340	340
70	158	452	452
60	140	609	609
50	122	835	835
40	113	1166	1166
30	86	1662	1662
20	68	2420	2420
10	50	3604	3604
0	32	5499	5499
-10	14	8609	8609
-20	-4	13850	13850
-30	-22	22960	22960
-40	-40	39260	39260

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAA1F890	**661 589 00 46 00** **Fuel Tank Cap Wrench**
 KAA1F490	**103 589 00 21 00** **Fuel Pressure Gauge**

SECTION 1F2

M161 ENGINE CONTROLS

CAUTION: Disconnect the negative battery cable before removi ng or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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ENGINE AND ECM PROBLEM CHECK REPORT

VEHICLE AND CUSTOMER INFORMATION

Date Problem Occurred			
Customer Name		Vehicle Model	
Driver Name		VIN	
Purchase date		Engine Model	
License No.		Mileage	Km miles

MIL INFORMATION

Condition of MIL	☐ Remains on ☐ Sometimes illuminates ☐ Does not illuminate
DTC inspection (if available)	☐ Normal ☐ Malfunction code(s) (code) ☐ Freeze frame data ( )

PROBLEM DESCRIPTION

☐ Engine Does Not Start	☐ No cranking ☐ No initial combustion ☐ No complete combustion
☐ Hard to Start	☐ Slow cranking ☐ Others
☐ Poor Idling	☐ Incorrect first Idle ☐ Abnormal idle rpm ☐ High (rpm) ☐ Low (rpm) ☐ Idling Unstable ☐ Others
☐ Poor Driveability	☐ Hesitation ☐ Back fire ☐ Muffler explosion (after-burning) ☐ Surging ☐ Knocking ☐ Poor performance ☐ Other
☐ Engine Stall	☐ Soon after starting ☐ After accelerator pedal depressed ☐ After accelerator pedal released ☐ During A/C operation ☐ Shifting from N to D or D to N ☐ At full steering ☐ Others
☐ Others	

CONDITION WHEN PROBLEM OCCURS

Problem Frequency	☐ Constant ☐ Intermittent (times per day/month) ☐ Once only ☐ Others
Weather	☐ Fine ☐ Cloudy ☐ Rainy ☐ Snowy ☐ Various/Others
Ambient Temperature	☐ Hot ☐ Warm ☐ Cool ☐ Cold (approx.____°F/____°C)
Place	☐ Highway ☐ Suburbs ☐ Inner City ☐ Uphill ☐ Downhill ☐ Rough Road ☐ Others
Engine Temperature	☐ Cold ☐ Warming Up ☐ Before warming up ☐ After warm-up ☐ Any temp. ☐ Others
Engine Operation	☐ Starting ☐ Just after starting (min.) ☐ Idling ☐ Racing ☐ Driving ☐ Constant speed ☐ Acceleration ☐ Deceleration ☐ A/C switch ON/OFF ☐ Other

DIAGNOSTIC INFORMATION AND PROCEDURE
FAILURE CODE DIAGNOSIS

CLEARING FAILURE CODES

Notice: To prevent Engine Control Module (ECM) damage, the key must be OFF when disconnecting or reconnecting the power to the ECM (for example battery cable, ECM pigtail connector, ECM fuse, jumper cables, etc.)

Parameters listed in the table may not be exactly the same as your reading due to the type of instrument or other factors. If a failure code is displayed during the “TROUBLE CODE” in scan tool check mode, check the circuit for the code listed in the table below. For details of each code, turn to the page referred to under the “See Page” for the respective “Failure Code” in the below table.

Failure codes should be cleared after repairs have been completed.

FAILURE CODES TABLE

Failure code	See Page	Description
00	1F2-56	Engine coolant temperature sensor low voltage
01	1F2-56	Engine coolant temperature sensor high voltage
02	1F2-56	Engine coolant temperature sensor plausibility
03	1F2-52	Intake air temperature sensor low voltage
04	1F2-52	Intake air temperature sensor high voltage
05	1F2-52	Intake air temperature sensor plausibility
06	1F2-56	Engine coolant temperature insufficient for closed loop fuel control
08	1F2-28	System voltage too low
09	1F2-52	Mass air flow sensor plausibility
10	1F2-52	Mass air flow sensor low voltage
11	1F2-52	Mass air flow sensor high voltage
17	1F2-13	Crankshaft position sensor signal failure (no engine revolution signal)
18	1F2-13	Crankshaft position sensor signal failure (rpm > max. value)
19	1F2-17	Camshaft position sensor signal : No.1 cylinder recognition failure
20	1F2-13	Crankshaft position sensor signal failure (gap recognition failure)
21	1F2-80	Transmission coding failure
23	1F2-78	CAN communication failure : ASR/MSR
24	1F2-78	CAN communication failure : ABS
25	1F2-84	Communication with transponder missing
26	1F2-78	CAN communication failure : TCU (A/T only)
29	1F2-79	CAN communication failure : ID 200h not plausible
30	1F2-79	CAN communication failure : ID 208h not plausible
31	1F2-79	CAN communication failure : communication initialization failure
32	1F2-67	Engine rpm output circuit short circuit to battery
33	1F2-67	Engine rpm output circuit short circuit to ground or open
34	1F2-33	Fuel pump relay short circuit to battery
35	1F2-33	Fuel pump relay short circuit to ground or open
40	1F2-41	Purge control valve short circuit to battery
41	1F2-41	Purge control valve short circuit to ground or open

FAILURE CODES TABLE (Cont'd)

Failure code	See Page	Description
44	1F1-62	Cooling fan (HI) relay short circuit to power
45	1F1-62	Cooling fan (HI) relay short circuit to ground or open
54	1F1-41	Purge control circuit malfunction
56	1F1-23	No.1 knock sensor signal failure
58	1F1-17	Camshaft position sensor signal : No.1 cylinder synchronization failure
59	1F1-79	CAN communication failure : MSR data transmission not plausible
60	1F1-79	CAN communication failure : ASR data transmission not plausible
64	1F1-11	No ignition voltage output (No.1 ignition coil)
65	1F1-11	No ignition voltage output (No.2 ignition coil)
67	1F1-13	Crankshaft position sensor adaptation failure
68	1F1-25	Random/Multiple Misfire
71	1F1-29	Starter signal recognition failure
72	1F1-37	No.1 injector short circuit to battery
73	1F1-37	No.1 injector short circuit to ground or open
74	1F1-37	No.2 injector short circuit to battery
75	1F1-37	No.2 injector short circuit to ground or open
76	1F1-37	No.3 injector short circuit to battery
77	1F1-38	No.3 injector short circuit to ground or open
78	1F1-38	No.4 injector short circuit to battery
79	1F1-38	No.4 injector short circuit to ground or open
80	1F1-72	Oxygen sensor high voltage
81	1F1-73	Bank 1 system short term fuel trim adaptation below lean threshold
82	1F1-72	Oxygen sensor no activity detected
83	1F1-72	Oxygen sensor not lean after overrun fuel shut -off
84	1F1-72	Oxygen sensor slow response
85	1F1-72	Oxygen sensor heater failure
86	1F1-72	Oxygen sensor heater short circuit to battery
87	1F1-72	Oxygen sensor heater short circuit to ground or open
89	1F1-72	Oxygen sensor low voltage
93	1F1-73	Bank 1 system short term fuel trim adaptation above rich threshold
96	1F1-73	Bank 1 system short term fuel trim at rich stop
97	1F1-73	Bank 1 system short term fuel trim at lean stop
98	1F1-73	Bank 1 system idle adaptation failure (above rich threshold)
99	1F1-73	Bank 1 system idle adaptation failure (below lean threshold)
100	1F1-73	Bank 1 system learning control failure (rich, low load)
101	1F1-73	Bank 1 system learning control failure (lean, low load)
102	1F1-73	Bank 1 system learning control failure (rich, high load)
103	1F1-73	Bank 1 system learning control failure (lean, high load)
104	1F1-47	Throttle position sensor 1 low voltage
105	1F1-47	Throttle position sensor 1 high voltage

FAILURE CODES TABLE (Cont'd)

Failure code	See Page	Description
108	1F1-47	Throttle position sensor 2 low voltage
109	1F1-47	Throttle position sensor 2 high voltage
110	1F1-82	Throttle actuator learning data fault
116	1F1-47	Throttle actuator learning control failure
117	1F1-82	Exceed fuel-cut safety time
119	1F1-47	Throttle valve return spring failure
120	1F1-82	Cruise control interruption memory failure
121	1F1-47	Throttle actuator failure
122	1F1-59	Accelerator pedal position sensor signal failure
123	1F1-47	Different Mass air flow sensor signal with throttle position sensor
125	1F1-47	Both throttle position sensors failure
126	1F1-48	Throttle position sensor 1 not plausible with throttle position sensor 2
127	1F1-48	High permanent throttle signal
129	1F1-64	Cruise control "OFF" due to message counter failure
130	1F1-64	Vehicle speed signal failure
131	1F1-64	Vehicle speed signal failure
132	1F1-64	Cruise control lever failure
133	1F1-64	Cruise control acceleration failure
134	1F1-64	Cruise control deceleration failure
135	1F1-66	Stop lamp switch failure
136	1F1-80	ECU failure (RAM)
137	1F1-80	ECU failure (EPROM)
138	1F1-82	Call monitoring
139	1F1-82	Servo motor control output interruption memory failure
140	1F1-82	Servo motor open/short
141	1F1-84	Unprogramed ECU with immobilizer
142	1F1-80	Uncoded/unprogramed ECU
143	1F1-80	ECU failure (EEPROM/Flash-EPROM checksum failure)
144	1F1-80	ECU failure (coding ID checksum failure)
145	1F1-80	ECU failure (coding checksum failure)
146	1F1-80	ECU failure (programing checksum failure)
150	1F1-65	TCS input signal short circuit to battery
151	1F1-65	TCS input signal short circuit to ground or open
160	1F1-59	Accelerator pedal position sensor 1 low voltage
161	1F1-59	Accelerator pedal position sensor 1 high voltage
162	1F1-59	Accelerator pedal position sensor 2 low voltage
163	1F1-59	Accelerator pedal position sensor 2 high voltage
164	1F1-59	Accelerator pedal position sensor 1 not plausible with pedal position sensor 2
167	1F1-59	Both setpoint accelerator pedal position sensor defective
185	1F1-48	Mass air flow sensor and throttle position sensor failure
186	1F1-82	ECU failure (incompatible CPU)

FAILURE CODES TABLE (Cont'd)

Failure code	See Page	Description
187	1F1-82	ECU failure (CPUs communication failure)
188	1F1-82	ECU failure (CPU 2 configuration failure)
189	1F1-82	ECU failure (CPU 2 fault)
190	1F1-82	ECU failure (CPU run time failure between CPUs)
226	1F1-21	Camshaft actuator short circuit to battery
227	1F1-21	Camshaft actuator short circuit to ground or open
228	1F1-63	A/C compressor relay short circuit to battery
229	1F1-63	A/C compressor relay short circuit to ground or open
231	1F1-82	ECU failure (CPU 2 cruise control message counter failure)
232	1F1-82	Over decceleration limit (CPU 2)
233	1F1-82	Over acceleration limit (CPU 2)
234	1F1-82	Cruise control lever dual operation (CPU 2)
235	1F1-82	Cruise control lever safety terminal failure (CPU 2)
236	1F1-82	Unusual pedal position variation (CPU 2)
237	1F1-82	Unusual throttle position variation (CPU 2)
238	1F1-82	Unusual throttle controller monitor data comparison fault (CPU 2)
239	1F1-83	Unusual accelerator pedal position sensor comparison fault (CPU 2)
240	1F1-83	Throttle potentiometer comparision fault (CPU 2)
241	1F1-83	Unusual CPU communication (CPU 2)
242	1F1-83	Unusual CPU configuration (CPU 2)
243	1F1-83	A/D converter failure (CPU 2)
244	1F1-83	Accelerator pedal position sensor setpoint fault between CPU 1 and CPU 2
245	1F1-83	Position controller setpoint fault between CPU 1 and CPU 2
246	1F1-83	MSR setpoint fault between CPU 1 and CPU 2
247	1F1-83	Idle control setpoint fault between CPU 1 and CPU 2
248	1F1-83	A/D converteroverflow (CPU 2)
249	1F1-83	ROM f aul t (CPU 2)
250	1F1-83	RAM f aul t (CPU 2)
251	1F1-83	Cycle monitor fault (CPU 2)

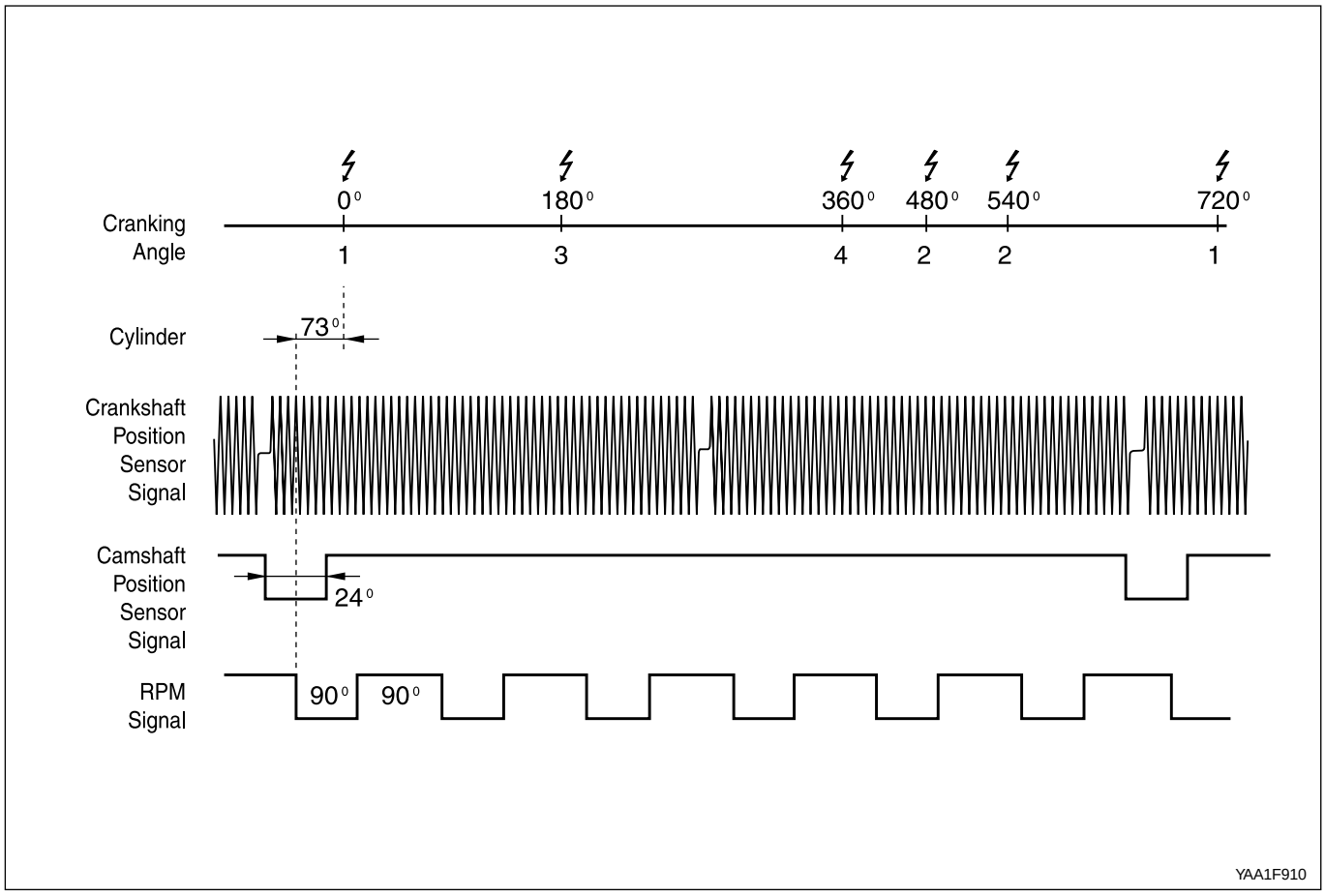
IGNITION SYSTEM

This ignition system does not use a conventional distributor and coil. It uses a crankshaft position sensor input to the Engine Control Module (ECM). The ECM then determines Electronic Spark Timing (EST) and triggers the electronic ignition system ignition coil.

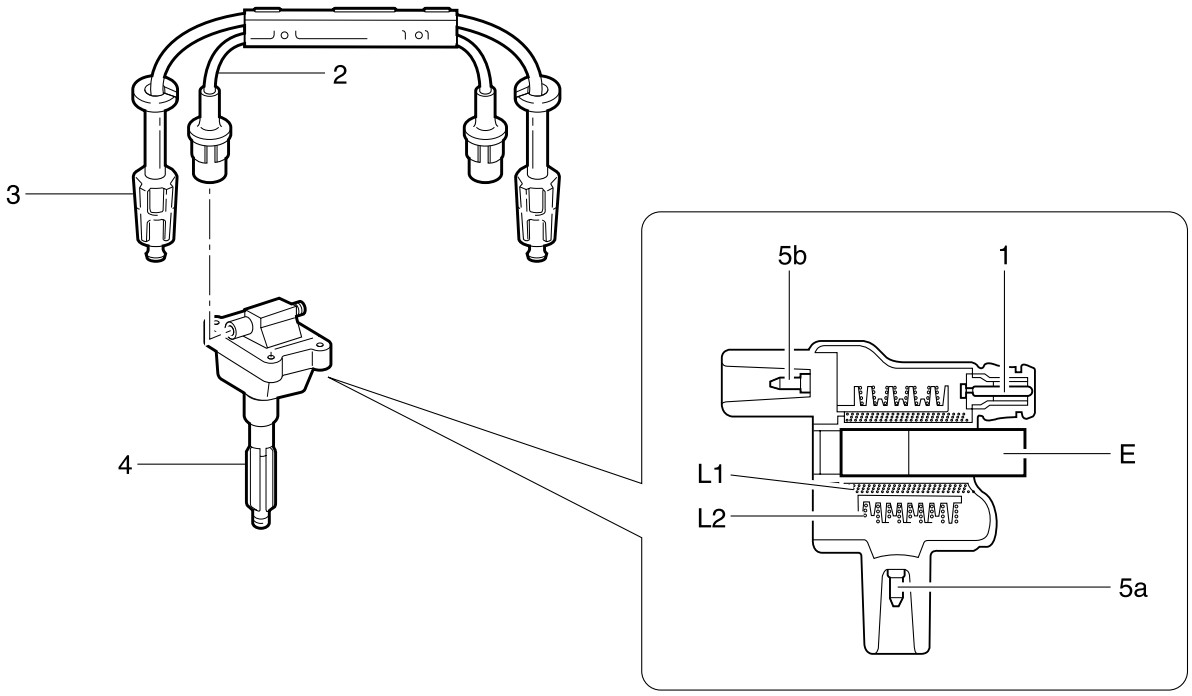
This type of distributorless ignition system uses a ‘‘waste spark” method of spark distribution. Each cylinder is paired with the cylinder that is opposite it (2-3 or 1-4). The spark occurs simultaneously in the cylinder coming up on the compression stroke and in the cylinder coming up on the exhaust stroke. The cylinder on the exhaust stroke requires very little of the available energy to fire the spark plug. The remaining energy is available to the spark plug in the cylinder on the compression stroke.

These systems use the EST signal from the ECM to control the EST. The ECM uses the following information:

- Engine load (mass air flow sensor).
- Engine temperature.
- Intake air temperature.
- Crankshaft position.
- Engine speed (rpm).



IGNITION COIL



1 Control Cable Connection
2 Ignition Cable
3 Spark Plug Connector
4 Coupling Plug
5a, 5b Secondary Voltage Connection
E Iron Core
L1 Secondary Ignition Coil
L2 Primary Ignition Coil

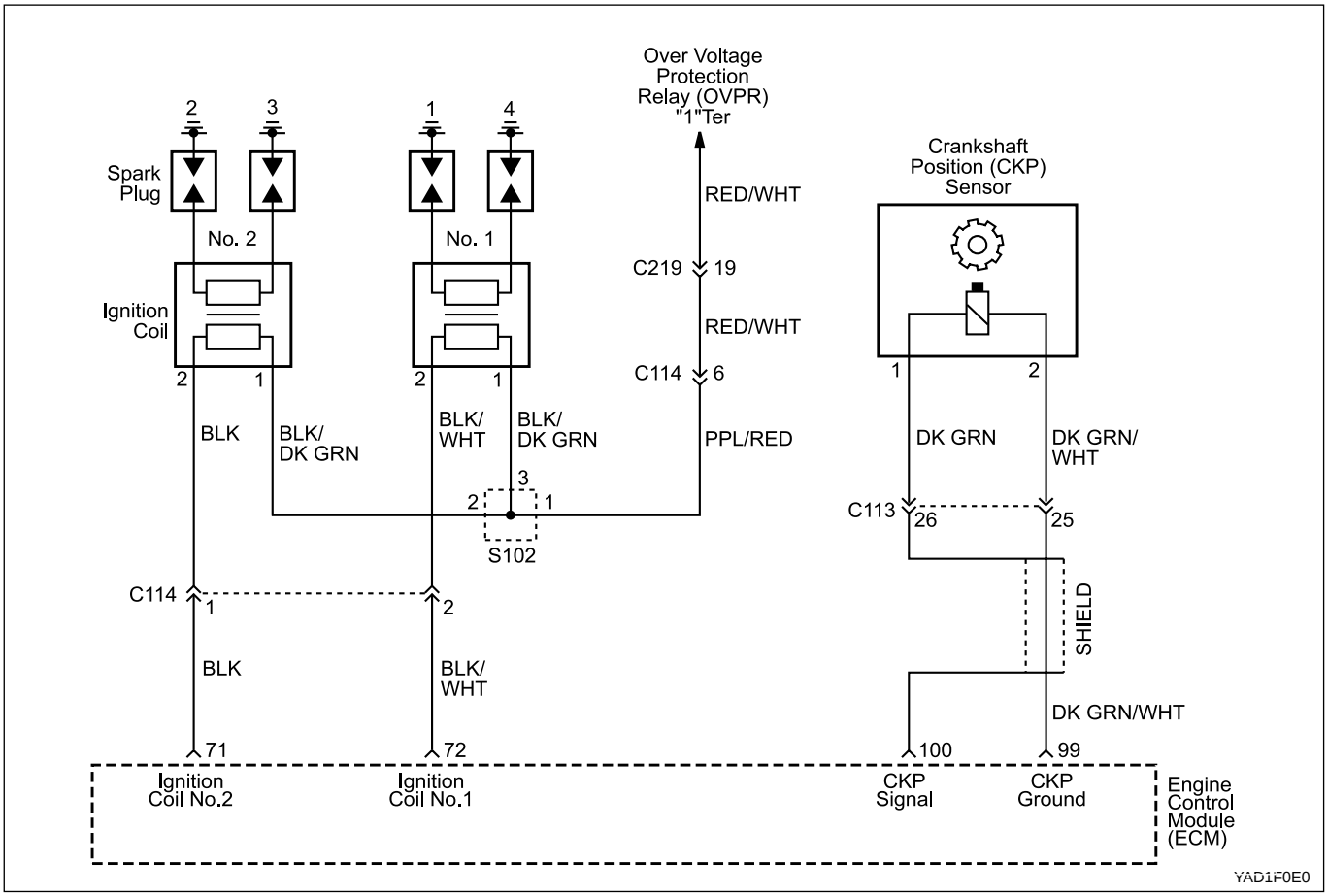
The Electronic Ignition (EI) system ignition coil is located on the cylinder head cover. The double ended coils receive the signal for the Engine Control Module (ECM) which controls the spark advance.

Each EI system ignition coil provides the high voltage to two spark plugs simultaneously;

T1/1: cylinder 1 and 4

T1/2: cylinder 2 and 3

The EI system ignition coil is not serviceable and must be replaced as an assembly.



Failure Code	Description	Trouble Area	Maintenance Hint
64	No ignition voltage output (No. 1 ignition coil)	Malfunction of ignition circuit Primary current values or secondary short circuit	• Inspection the ECM pin 71 and 72 about short circuit or open with bad contact • Inspection the power source to ignition coil • Inspection the ignition coil, high tension cords etc. • Inspection the spark plug (wet, cracks, wear, improper gap, burned electrodes, heavy deposit) • Inspection the ECM
65	No ignition voltage output (No. 2 ignition coil)		

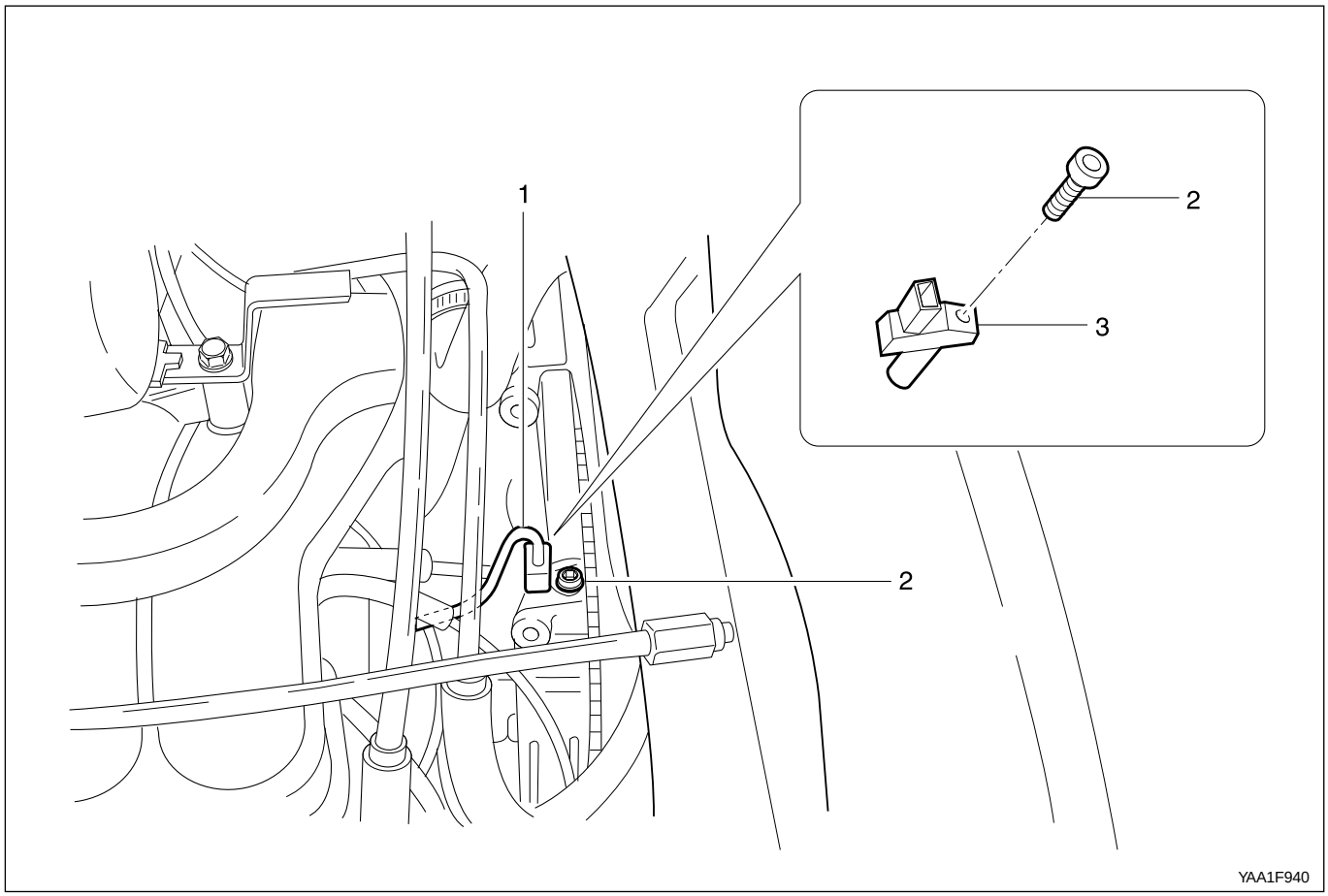
Circuit Description

The Electronic Ignition (EI) system uses a waste spark method of spark distribution. The Crankshaft Position (CKP) sensor sends reference pulses to the ECM. The ECM then triggers the EI system ignition coils. Once the ECM triggers the EI system ignition coils both of the connected spark plugs fire at the same time. One cylinder is on its compression stroke at the same time that the other is on the exhaust stroke, resulting in lower energy needed to fire the spark plug in the cylinder on its exhaust stroke.

This leaves the remainder of the high voltage to be used to fire the spark plug in the cylinder on its compression stroke.

Since the CKP sensor is in a fixed position, timing adjustments are not possible or needed.

CRANKSHAFT POSITION (CKP) SENSOR

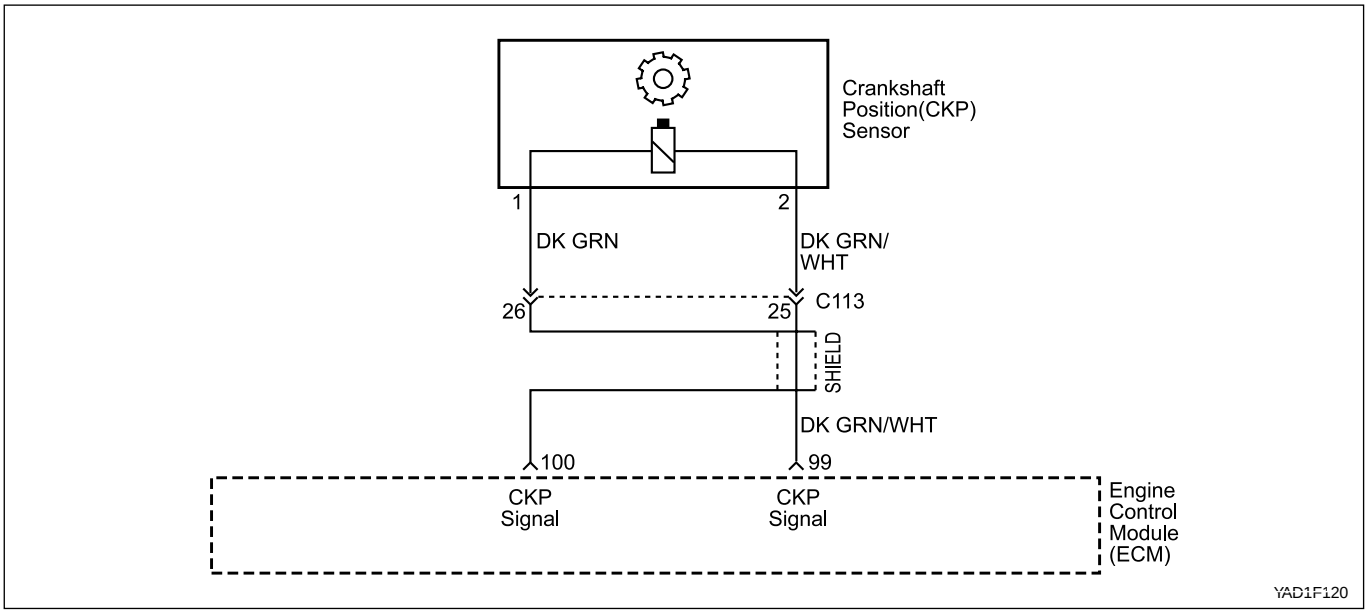


1 Crankshaft Position Sensor Connector
2 Bolt
3 Crankshaft Position Sensor

This Electronic Ignition (EI) system uses inductive or pick up type magnetic Crankshaft Position (CKP) sensor. The CKP sensor is located in the opposite side of the crankshaft pulley and triggers the pick-up wheel teeth which is equipped 60-2 teeth with agap of 2 teeth at 360 degree spacing. This sensor protrudes through its mount to within 1.1 ± 0.14 mm.

The output of the sensor is a sinusoidal signal. Each tooth of the pick-up 60-2 wheel generates a positive half wave.

The Engine Control Module (ECM) uses this sensor signal to generate timed ignition and injection pulses that it sends to the ignition coils and to the fuel injectors.



Failure Code	Description	Trouble Area	Maintenance Hint
17	Crankshaft position sensor signal failure (no engine revolution signal)	Even through cam position recognition is normal, no crankshaft position signal recognition	• Monitoring the actual rpm through or scan tool • Inspection the ECM pin 100, 99 about short circuit with bad contact • Inspection the CKP sensor • Inspection the air gap between sensor and drive plate • Inspection the drive plate (teeth condition) • Inspection the ECM
18	Crankshaft position sensor signal failure (rpm > max. value)	When more than applicable revolution values or implausible to 60-2 teeth.	
20	Crankshaft position sensor signal failure (gap recognition failure)	When implausible recognition of cam and crank angle signal or intermittent sensing the signal or error count of undetected gap.	
67	Crankshaft position sensor adaptation failure	When faulty crank angle sensor adaption	

Circuit Description

The 58X reference signal is produced by the CKP sensor. During one crankshaft revolution, 58 crankshaft pulses will be produced. The ECM uses the 58X reference signal to calculate engine rpm and CKP. The ECM constantly monitors the number of pulses on the 58X reference circuit and compares them to the number of Camshaft Position (CMP) signal pulses being received. If the ECM receives and incorrect number of pulses on the 58X reference circuit, this failure code will set.

Crankshaft Position Sensor Resistance Inspection

1. Disconnect the coupling “E” of ECM while the ignition switch is in “OFF” position.
2. Measure the resistance between the coupling terminal pin No. 99 and No. 100 using a multimeter.

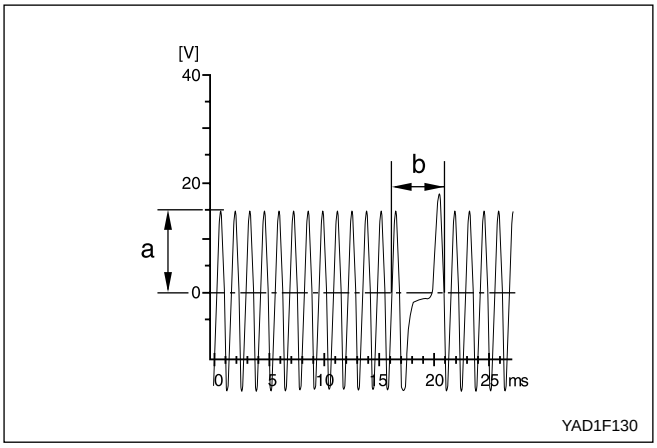
Specified Value	1,050 ~ 1,400 Ω

Notice: Measure the insulator resistance of the CKP sensor if out of the specified value.

Crankshaft Position Sensor Output Wave Inspection

1. Measure the output wave between the ECM terminals No. 99 and No. 100 using the scan tool or the oscilloscope while engine cranking (start motor activated).

   Notice: Check the segment or crankshaft position sensor and air gap if cannot get the output wave as shown in the figure.



a Voltage
b Identifying the No. 1-2 Missing Teeth

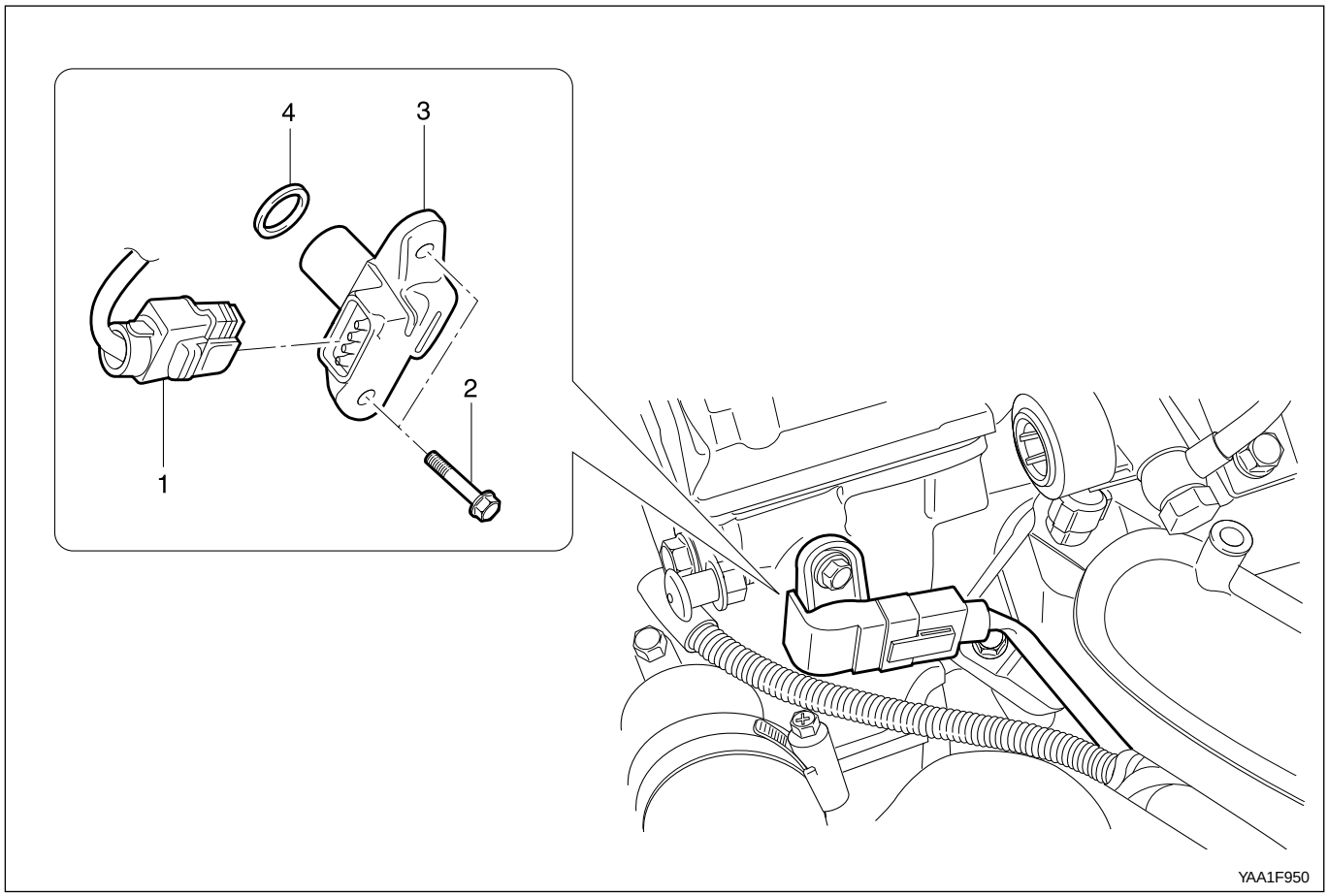
Crankshaft Position Sensor Insulator Resistance Inspection

1. Disconnect the coupling from ECM while the ignition switch is in “OFF” position.
2. Measure the resistance between the coupling terminal pin No. 100 and No. 69 using a multimeter.

Specified Value	>20 kΩ

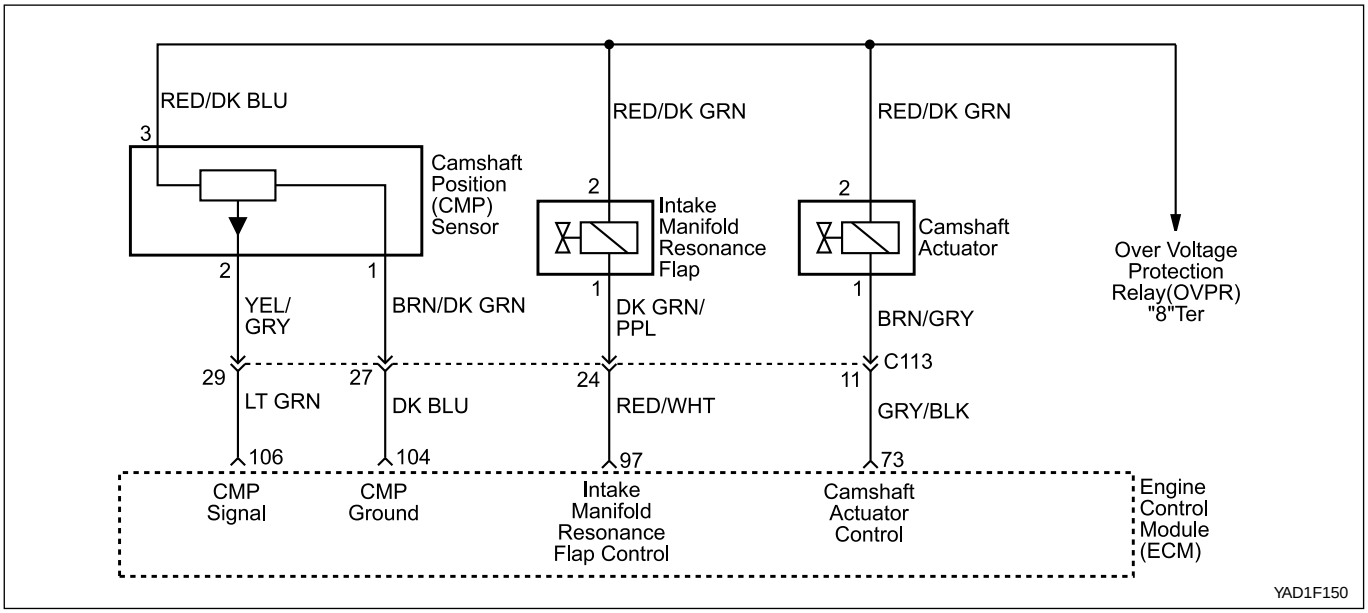
   Notice: Measure the check and ground terminal of the CKP sensor if out of the specified value.

CAMSHAFT POSITION (CMP) SENSOR



1 Camshaft Position Sensor Connector
2 Bolt
3 Camshaft Position Sensor
4 O-Ring

The Camshaft Position (CMP) sensor sends a CMP signal to the Engine Control Module (ECM). The ECM uses this signal as a “synchronized pulse” to trigger the injectors in the proper sequence. The ECM uses the CMP signal to indicate the position of the #1 piston during its power stroke. This allows the ECM to calculate true sequential fuel injection mode of operation.



Failure Code	Description	Trouble Area	Maintenance Hint
19	Camshaft position sensor signal : No. 1 cylinder recognition failure	When no cam recognition signal during TN 24 counts more. (maintain the constant low or high level)	• Inspection the source voltage of CMP sensor • Inspection the ECM pin 106, 104 about short circuit or open with bad contact • Inspection the CMP sensor • Inspection the damage of sensor or sprocket • Inspection the ECM
58	Camshaft position sensor signal : No. 1 cylinder synchronization failure	When synchronization fault of cylinder 1 (TDC recognition)	

Circuit Description

The CMP sensor sends a cam position signal to the ECM. If the cam position signal is lost while the engine is running, the fuel injection system shifts to a calculated sequential fuel injection mode based on the last fuel injection pulse, and the engine continuous to run.

Camshaft Position Sensor Signal Voltage Inspection

1. Measure the voltage between the ECM terminal No. 11 and No. 106 while the engine speed is at idle.

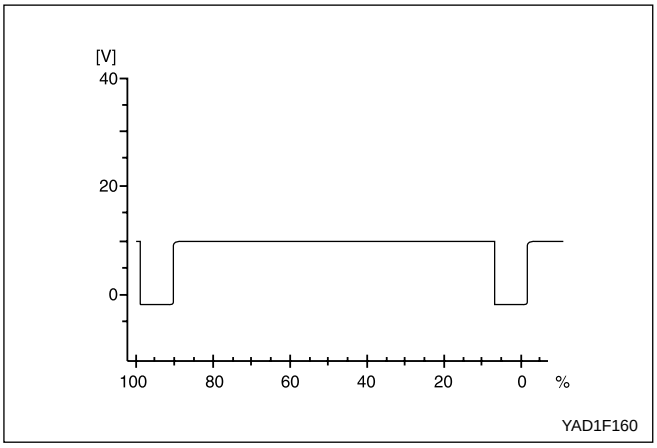
Specified Value	1.2 ~ 1.7 v

Notice: The signal voltage will be changed in the range of 1.2 ~ 1.7 v.

Camshaft Position Sensor Output Wave Inspection

1. Measure the output wave between the ECM terminals No. 104 and No. 106 using the scan tool or the oscilloscope while engine speed is at idle.

   Notice: Replace the CAM sensor if cannot get the output wave as shown in the figure.



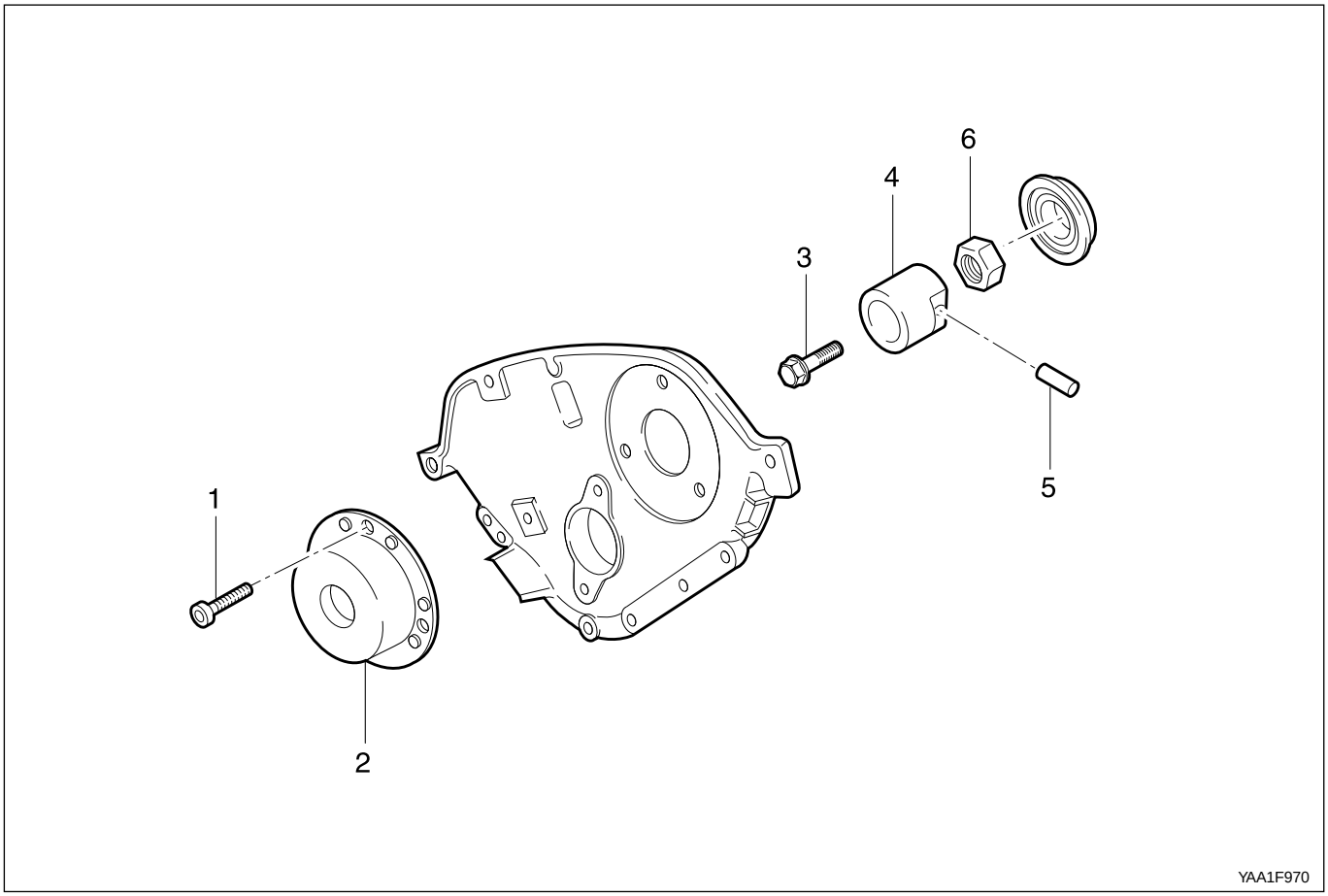
Camshaft Position Sensor Power Supply Inspection

1. Disconnect the CMP sensor Connector.
2. Measure the resistance between the No. 1 and No. 3 pin of the CMP sensor connector while the ignition switch is in “ON” position.

Specified Value	11 ~ 14 v

   Notice: If the measured value is not within the specified value, check the cable.

CAMSHAFT ACTUATOR



1 Bolt
2 Camshaft Actuator
3 Bolt
4 Armature
5 Roll Pin
6 Nut

When the engine is running, the camshaft actuator rotates the intake camshaft hydraulically and mechanically relative to the camshaft sprocket by 20 ° crank angle to the “advanced” position and back to the “retard” position.

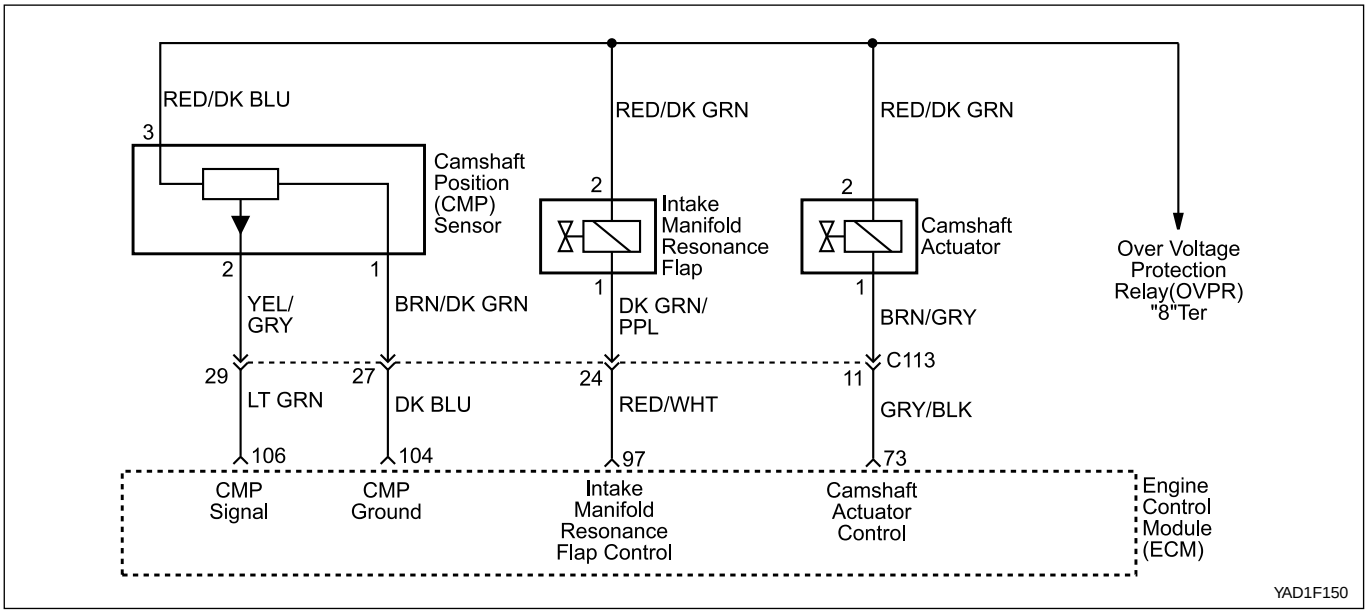
The camshaft actuator is actuated electro-mechanically by the Engine Control Module (ECM).

The positioning time of apporx. 1 second is dependent on the engine oil pressure at the camshaft actuator and on the oil viscosity and oil temperature, respectively.

The camshaft indicator on the camshaft sprocket provides the camshaft rotational speed to the position sensor as an input parameter for the engine ignition control unit.

Operation Condition of Camshaft Actuator

Engine RPM	Camshaft Position	Effect
Engine stop	Retard	-
0 ~ 1,740 rpm	Retard	Idle speed is improved Blow-by gas is decreased Valve overlap is decreased
1,740 ~ 3,540 rpm	Advanced	Torque is increased Fuel loss is decreased NOx is decreased
Above 3,540 rpm	Retard	Engine overrun is prohibited



Failure Code	Description	Trouble Area	Maintenance Hint
226	Camshaft actuator short circuit to battery	When malfunction of cam phasing control	• Monitoring the actual operational status through scan tool • Inspection the ECM pin 73 about short circuit or open • Inspection the power source short circuit or open to cam actuator • Inspection the magnet and hardware • Inspection the ECM
227	Camshaft actuator short circuit to ground or open		

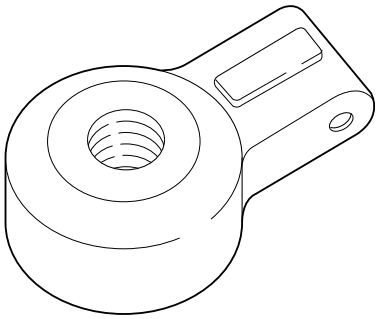
Camshaft Actuator Current Consumption Inspection

1. Run the engine to reach the coolant temperature above 70 °C.
2. Increase the engine rpm up to 2000 rpm
3. Measure the current between the No. 1 and No. 2 pin of the camshaft actuator connector.

Specified Value	1 ~1.5 A

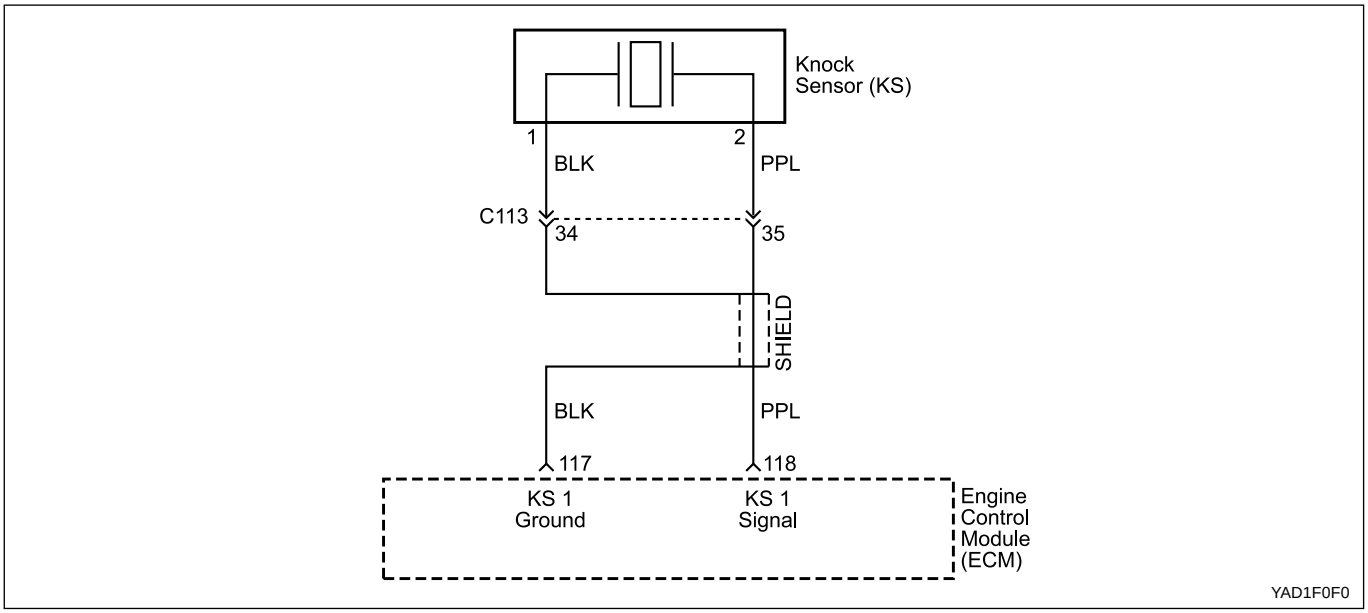
Notice: If the measured value is not within the specified value, check the cable.

KNOCK SENSOR (KS)



YAD1F180

The Knock Sensor (KS) detects abnormal knocking in the engine. The two KS are mounted in the engine block near the cylinders. The sensors produce an output voltage which increases with the severity of the knock. This signal is sent to the Engine Control Module (ECM) via a shielded cable. The ECM then adjusts the ignition timing to reduce the spark knock.



Failure Code	Description	Trouble Area	Maintenance Hint
56	No. 1 knock sensor signal failure	When recognition in more than control gain threshold at normal operational condition of other system during over 75 and 3,000 rpm running area (cylinder 1, 2, 3, 4)	• Inspection the ECM pin 118, 117 about short circuit or open with bad contact • Inspection the KS 1 malfunction • Inspection the ECM

Circuit Description

The KS system is used to detect engine detonation, allowing the ECM to retard the ignition control spark timing based on the KS signal being received. The KS signal's amplitude and frequency depend upon the amount of knock being experienced. The ECM monitors the KS signal and can diagnose the KS sensor and circuitry.

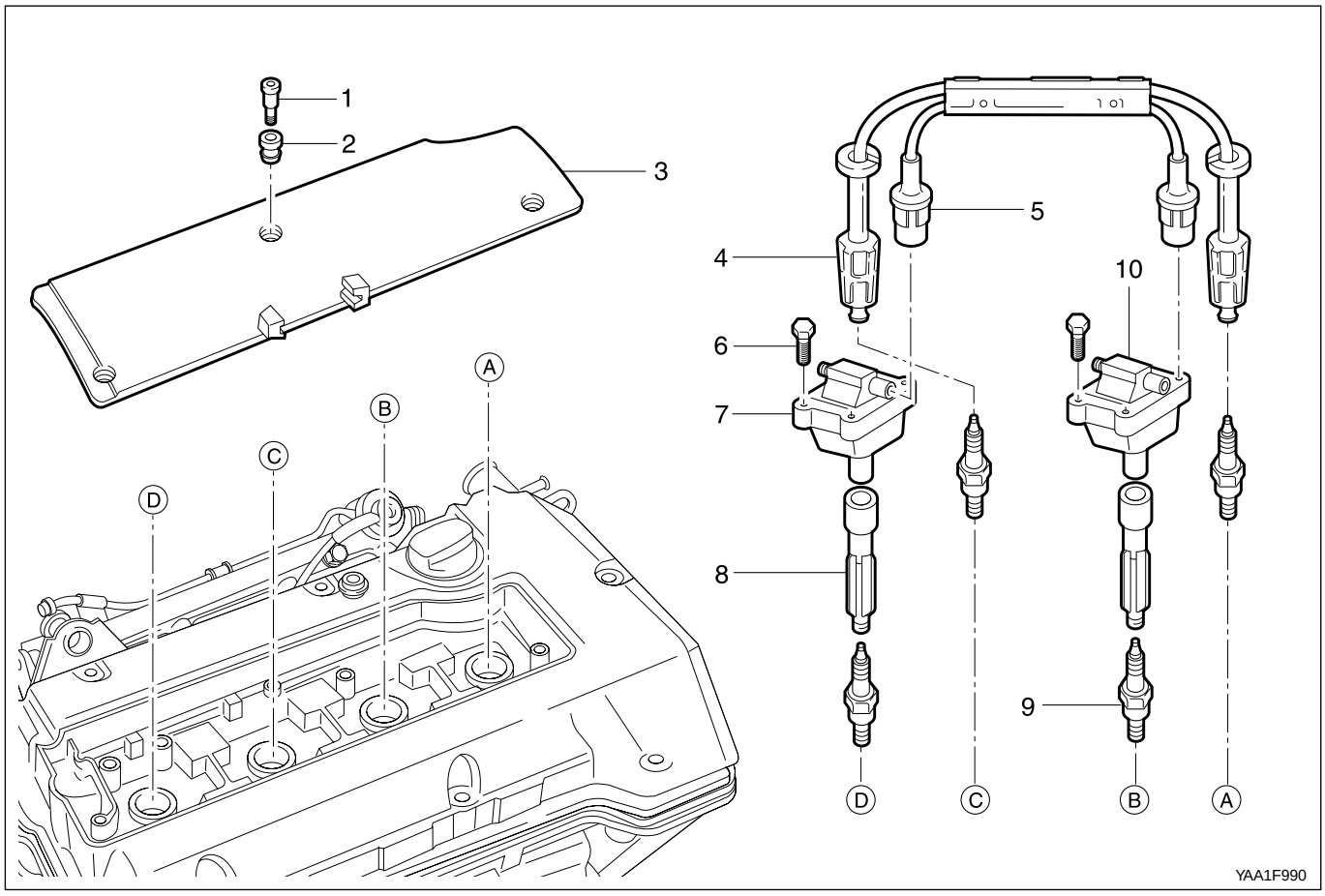
Knock Sensor Resistance Inspection

1. Disconnect the coupling from ECM while the ignition switch is in "OFF" position.
2. Measure the resistance between the coupling terminal pin No. 118 and No. 117 using a multimeter.

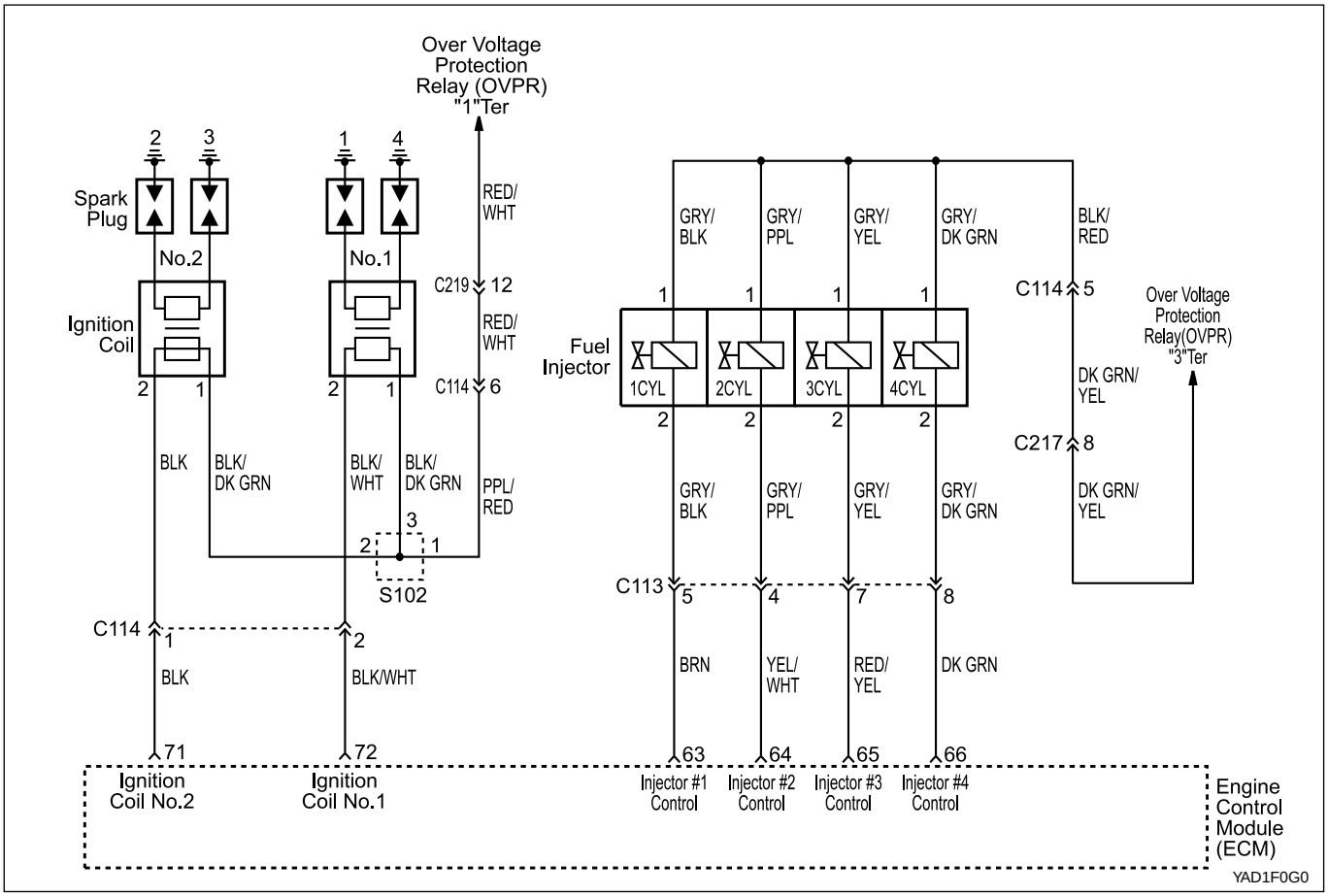
Specified Value	>10 MΩ

Notice: Replace the KS if the measured values is out of the specified values. Check the connector and wire connection between ECM and the KS if the measured values are normal.

SPARK PLUG



1 Screw
2 Adaptor
3 Ignition Coil Cable Cover
4 Spark Plug Connector
5 Ignition Coil Connector
6 Bolts
7 Ignition Coil (T 1/1)
8 Coupling Plug
9 Spark Plug
10 Ignition Coil (T 1/2)



Failure Code	Description	Trouble Area	Maintenance Hint
68	Random / Multiple Misfire	When detection misfire of multiple cylinder for source of over the emission threshold or catalyst damage	• Inspection the ignition system • Inspection the injection system • Inspection the fuel pressure • Inspection the compression pressure • Inspection the valve timing or clearance • Inspection the air flow sensor • Inspection the crankshaft position sensor and air gap • Inspection the engine wiring system • Inspection the Engine Control Module (ECM)

Circuit Description

The ECM monitors the crankshaft and camshaft positions to detect if the engine is misfiring. The ECM looks for a quick drop in crankshaft speed. Misfire multiple cylinder is monitored by engine roughness measuring. The actual roughness value is compared with the actual (emission and catalyst damage) threshold.

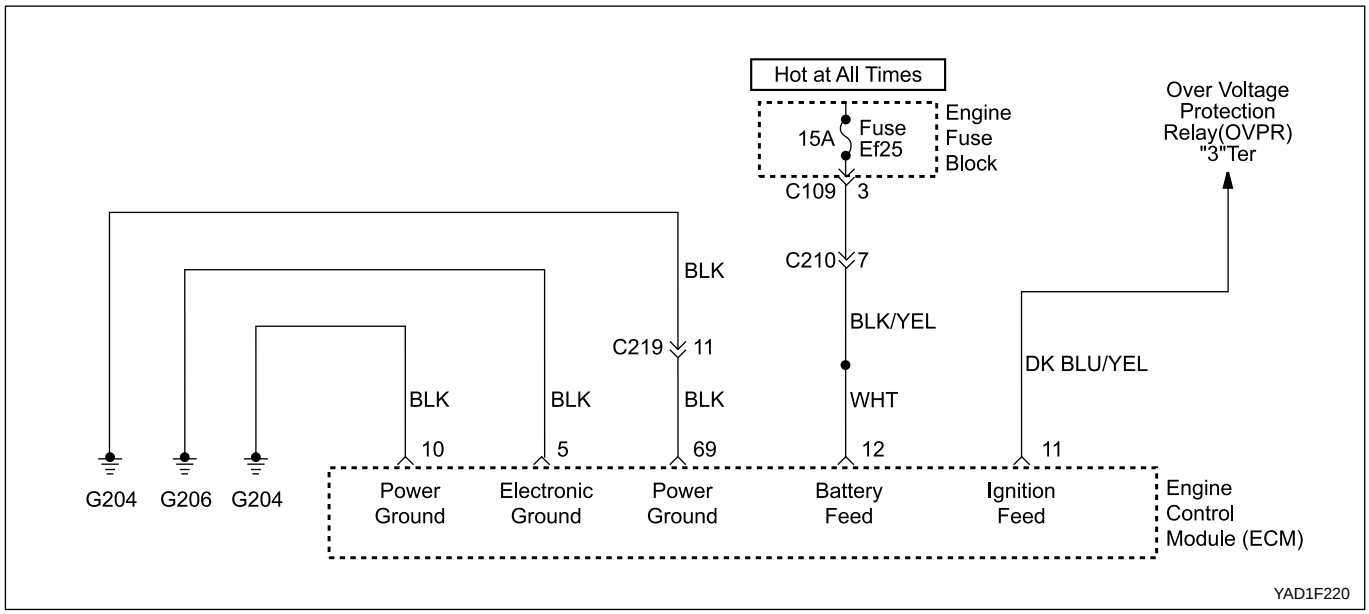
Spark Plug Cable Resistance Inspection

1. Turn the ignition switch “OFF” position.
2. Disconnect the spark plug cables Refer to *Section 1E1, Engine electrical.*
3. Measure the spark plug resistance using a multimeter.

Specified Value	1.8 ~ 2.2 kΩ

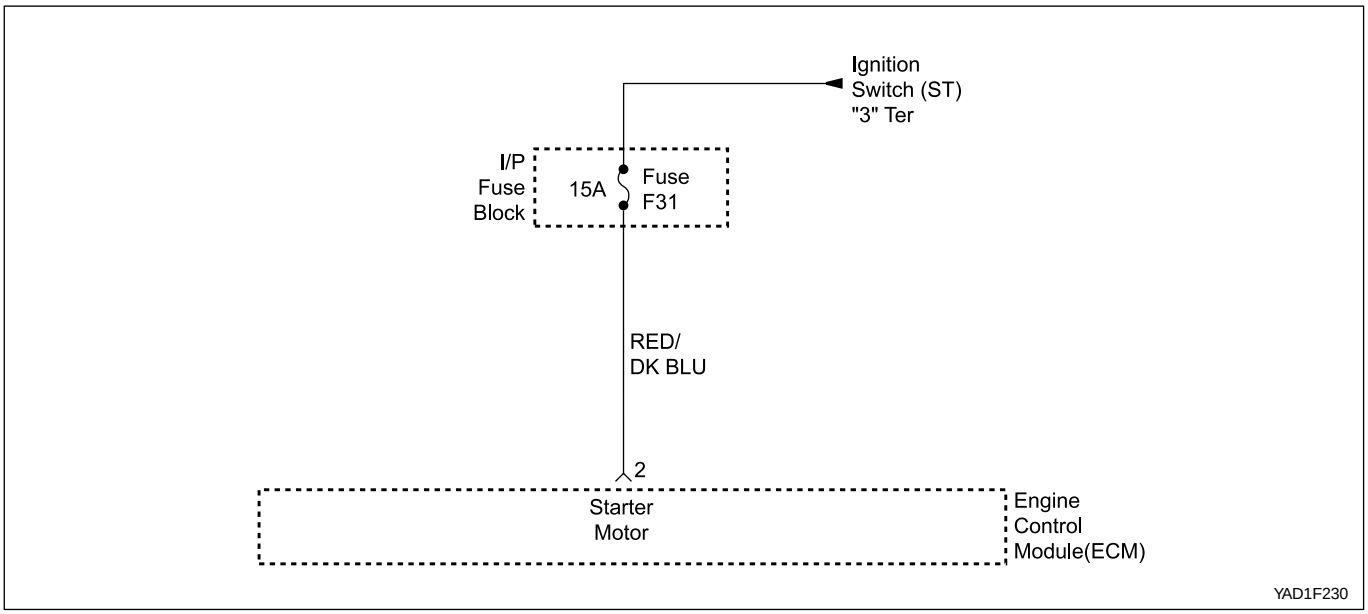
Notice: Replace the spark plug cable if the measured values is out of the specified values.

SYSTEM VOLTAGE



Failure Code	Description	Trouble Area	Maintenance Hint
08	System voltage too low	Malfunction in recognition of system source voltage. Less than minimum 8 volts in 2,000 rpm below, or less than 10 volts in 2,000 rpm above.	• Monitoring the actual battery voltages through the scan tool • Inspection the Engine Control Module (ECM) pin 12, 11, 10, 5 about short circuit or open with bad contact • Inspection the over voltage protection relay • Inspection the battery • Inspection ECM

IGNITION SWITCH



Failure Code	Description	Trouble Area	Maintenance Hint
71	Starter signal recognition failure	When not detection of starter signal	• Inspection the Engine Control Module (ECM) pin 2 circuit short or open with bad contact • Inspection ECM

FUEL SYSTEM

The function of the fuel metering system is to deliver the correct amount of fuel to the engine under all operating conditions.

The fuel is delivered to the engine by the individual fuel injectors mounted into the intake manifold near each cylinder.

The main fuel control sensors are the Mass Air Flow (MAF) sensor and the oxygen (O2) sensors.

The MAF sensor monitors the mass flow of the air being drawn into the engine. An electrically heated element is mounted in the intake air stream, where it is cooled by the flow of incoming air. Engine Control Module (ECM) modulates the flow of heating current to maintain the temperature differential between the heated film and the intake air at a constant level. The amount of heating current required to maintain the temperature thus provides an index for the mass air flow. This concept automatically compensates for variations in air density, as this is one of the factors that determines the amount of warmth that the surrounding air absorbs from the heated element. MAF sensor is located between the air filter and the throttle valve.

Under high fuel demands, the MAF sensor reads a high mass flow condition, such as wide open throttle. The ECM uses this information to enrich the mixture, thus increasing the fuel injector on-time, to provide the correct amount of fuel. When decelerating, the mass flow decreases. This mass flow change is sensed by the MAF sensor and read by the ECM, which then decreases the fuel injector on-time due to the low fuel demand conditions.

The O2 sensors are located in the exhaust pipe before catalytic converter. The O2 sensors indicate to the ECM the amount of oxygen in the exhaust gas, and the ECM changes the air/fuel ratio to the engine by controlling the fuel injectors. The best air/fuel ratio to minimize exhaust emissions is 14.7 to 1, which allows the catalytic converter to operate most efficiently. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a “closed loop” system.

The ECM uses voltage inputs from several sensors to determine how much fuel to provide to the engine. The fuel is delivered under one of several conditions, called “modes”.

Starting Mode

When the ignition is turned ON, the ECM turns the fuel pump relay on for 1 second. The fuel pump then builds fuel pressure. The ECM also checks the Engine Coolant Temperature (ECT) sensor and the Throttle Position (TP) sensor and determines the proper air/fuel ratio for starting the engine. This ranges from1.5 to 1 at -36 °C (-33 °F) coolant temperature to 14.7 to 1 at 94 °C (201 °F) coolant temperature. The ECM controls the amount of fuel delivered in the starting mode by changing how long the fuel injector is turned on and off. This is done by ‘‘pulsing” the fuel injectors for very short times.

Run Mode

The run mode has two conditions called ‘‘open loop” and ‘‘closed loop”.

Open Loop

When the engine is first started and it is above 690 rpm, the system goes into “open loop” operation. In “open loop”, the ECM ignores the signal from the HO2S and calculates the air/fuel ratio based on inputs from the ECT sensor and the MAF sensor. The ECM stays in “open loop” until the following conditions are met:

- The O2 has a varying voltage output, showing that it is hot enough to operate properly.
- The ECT sensor is above a specified temperature (22.5 °C).
- A specific amount of time has elapsed after starting the engine.

Closed Loop

The specific values for the above conditions vary with different engines and are stored in the Electronically Erasable Programmable Read-Only Memory (EEPROM). When these conditions are met, the system goes into “closed loop” operation. In “closed loop”, the ECM calculates the air/fuel ratio (fuel injector on- time) based on the signals from the O2 sensors. This allows the air/fuel ratio to stay very close to 14.7 to 1.

Acceleration Mode

The ECM responds to rapid changes in throttle position and airflow and provides extra fuel.

Deceleration Mode

The ECM responds to changes in throttle position and airflow and reduces the amount of fuel. When deceleration is very fast, the ECM can cut off fuel completely for short periods of time.

Battery Voltage Correction Mode

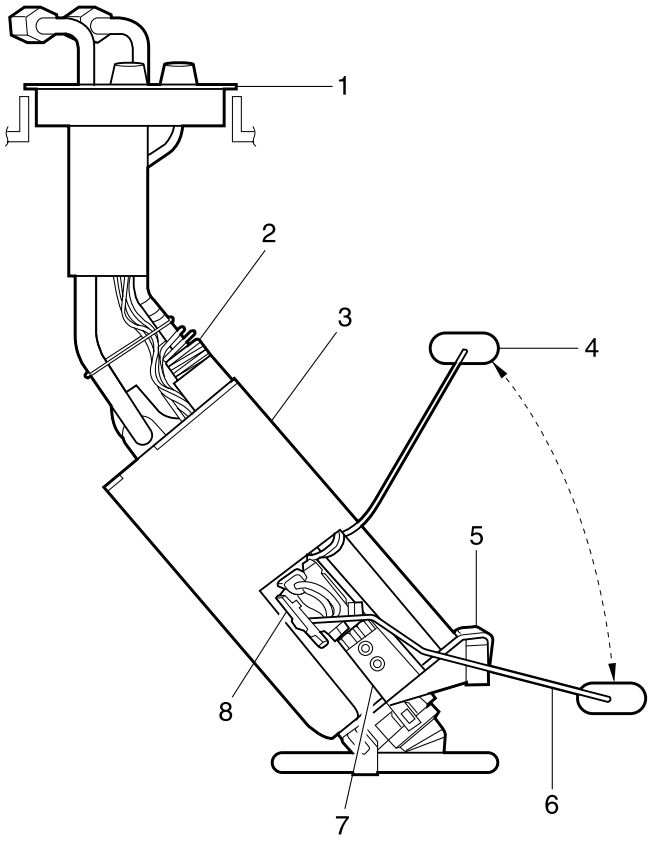
When battery voltage is low, the ECM can compensate for a weak spark delivered by the ignition module by using the following methods:

- Increasing the fuel injector pulse width.
- Increasing the idle speed rpm.
- Increasing the ignition dwell time.

Fuel Cut-Off Mode

No fuel is delivered by the fuel injectors when the ignition is off. This prevents dieseling or engine run-on. Also, the fuel is not delivered if there are no reference pulses received from the CKP sensor. This prevents flooding.

FUEL PUMP

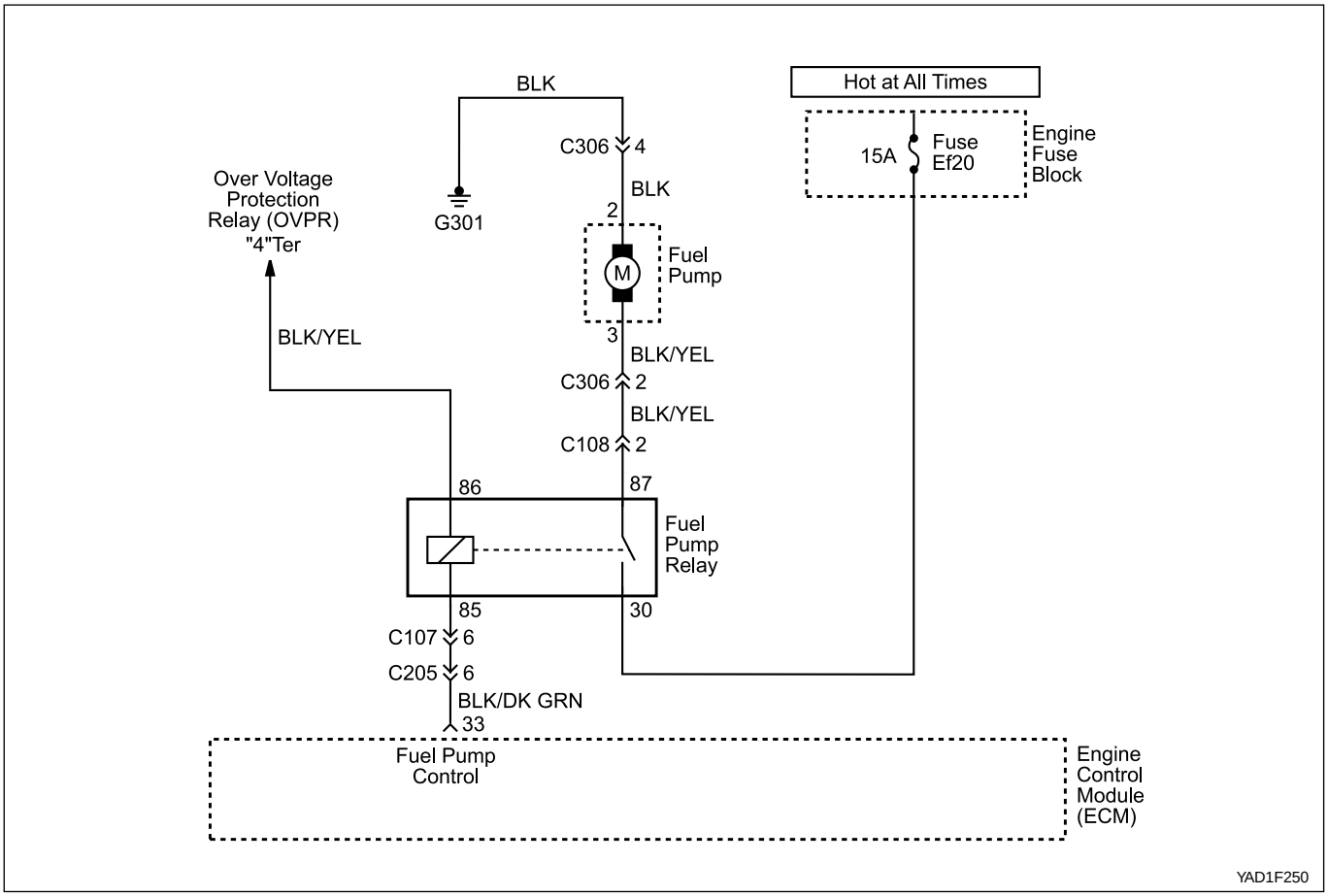


YAD1F240

1 Flange and Harness Assembly
2 Spring
3 Fuel Pump
4 Float
5 Thermistor
6 Float Arm
7 Thermistor Housing
8 Resistor Card and Wiper

Requirements for Fuel Pump

Item	Specified Value	Item	Specified Value
System Pressure	3.8 bar	Minimum Delivery at 8V	30 Litre/ Hr
Maximum Pressure	8.5 bar (12 V)	Operating Voltage	8 V
Minimum Pressure	5.0 bar (12 V)	Maximum Allowable Current	7.5 A
Nominal Voltage	12 V	Ambient Temperature	-30 ~ +70° C
Minimum Amount of Fuel Supply	114 Liter/ Hr (12 V, 3.8 bar, -30 ~ +70° C)	Maximum Amount of Fuel Supply	165 Liter/ Hr (12 V, 3.8 bar, -30 ~ +70° C)



Failure Code	Description	Trouble Area	Maintenance Hint
34	Fuel pump relay short circuit to battery	When short circuit to power source	• Inspection the Engine Control Module (ECM) pin 33 about short circuit or open with bad contact • Inspection the fuel pump relay • Inspection the ECM
35	Fuel pump relay short circuit to ground or open	When short circuit to ground or open	

Circuit Description

When the ignition switch is turned ON, the ECM will activate the pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut off the fuel pump within 2 seconds after the ignitions witch is turned ON, engine stopped or engine stalled.

Fuel Pump Relay Inspection

Measure the voltage between the ECM terminal No. 33 and ground.

Ignition Switch : ON	0 V (for 1 ~ 2 sec.)
Cranking	0 V

Measure the Fuel Delivery from the Fuel Pump

1. Disconnect the return pipe from fuel distributor and insert the appropriate hose into it.
2. Place the hose end into the beaker with the minimum capacity of 1 Liter
3. Turn the ignition switch to “ON” position.
4. Connect the terminal No. 33 and No. 5 of ECM with a service wire.
5. Measure the fuel delivery from the fuel pump.

Specified Value	1 Liter/max. 35 sec.

Notice: Check the fuel filter and fuel line when the fuel delivery is not within specified value.

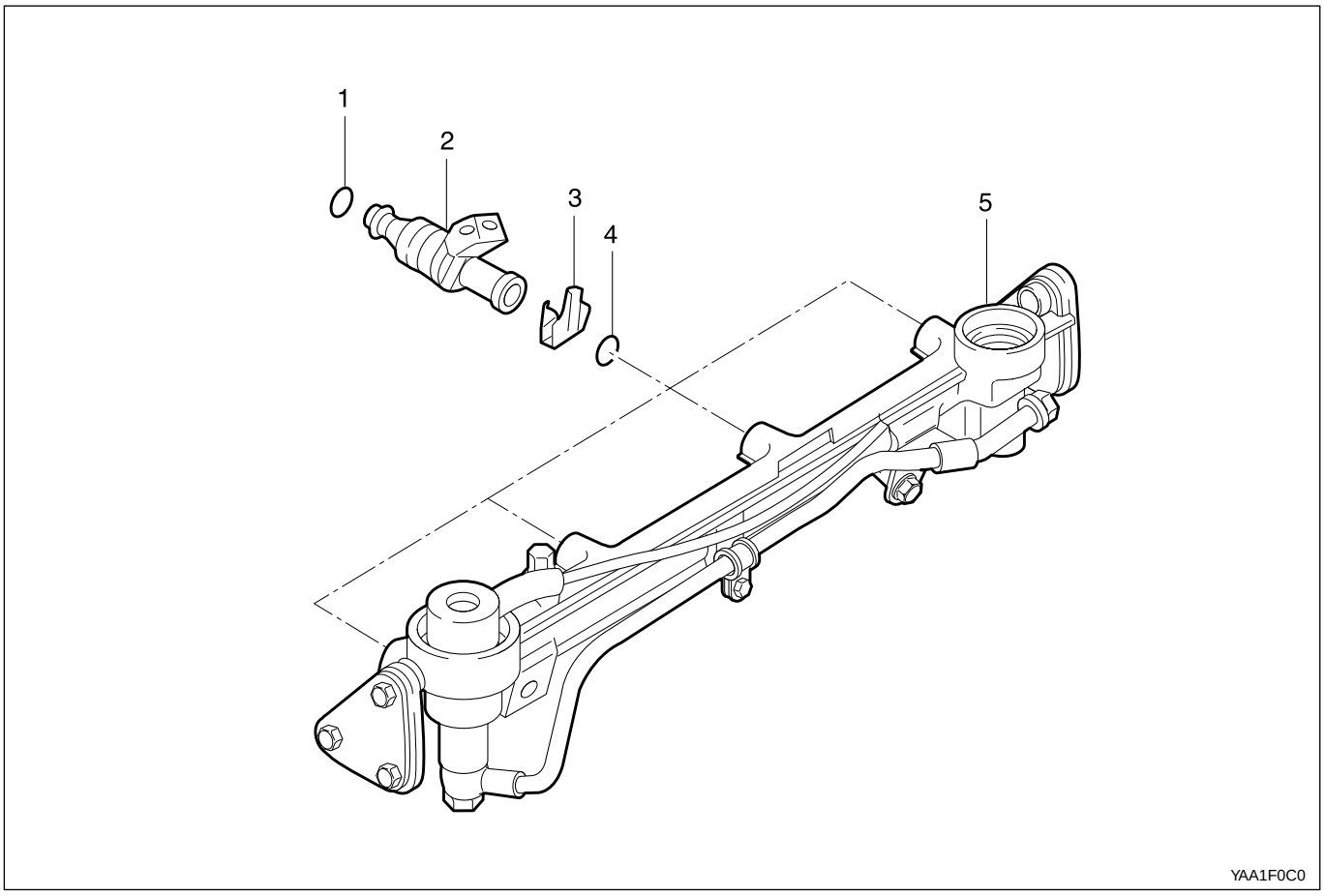
Measure the Current Consumption of Fuel Pump

1. Remove the fuel pump relay from fuse and relay box in trunk, and turn the ignition switch to “ON” position.
2. Using a multimeter, measure the current consumption by connecting the terminal No. 30 and No. 87 of the fuel pump relay connector.

Specified Value	5 ~ 9 A

Notice: Replace the fuel pump relay if the measured value is over 9 A.

FUEL INJECTOR

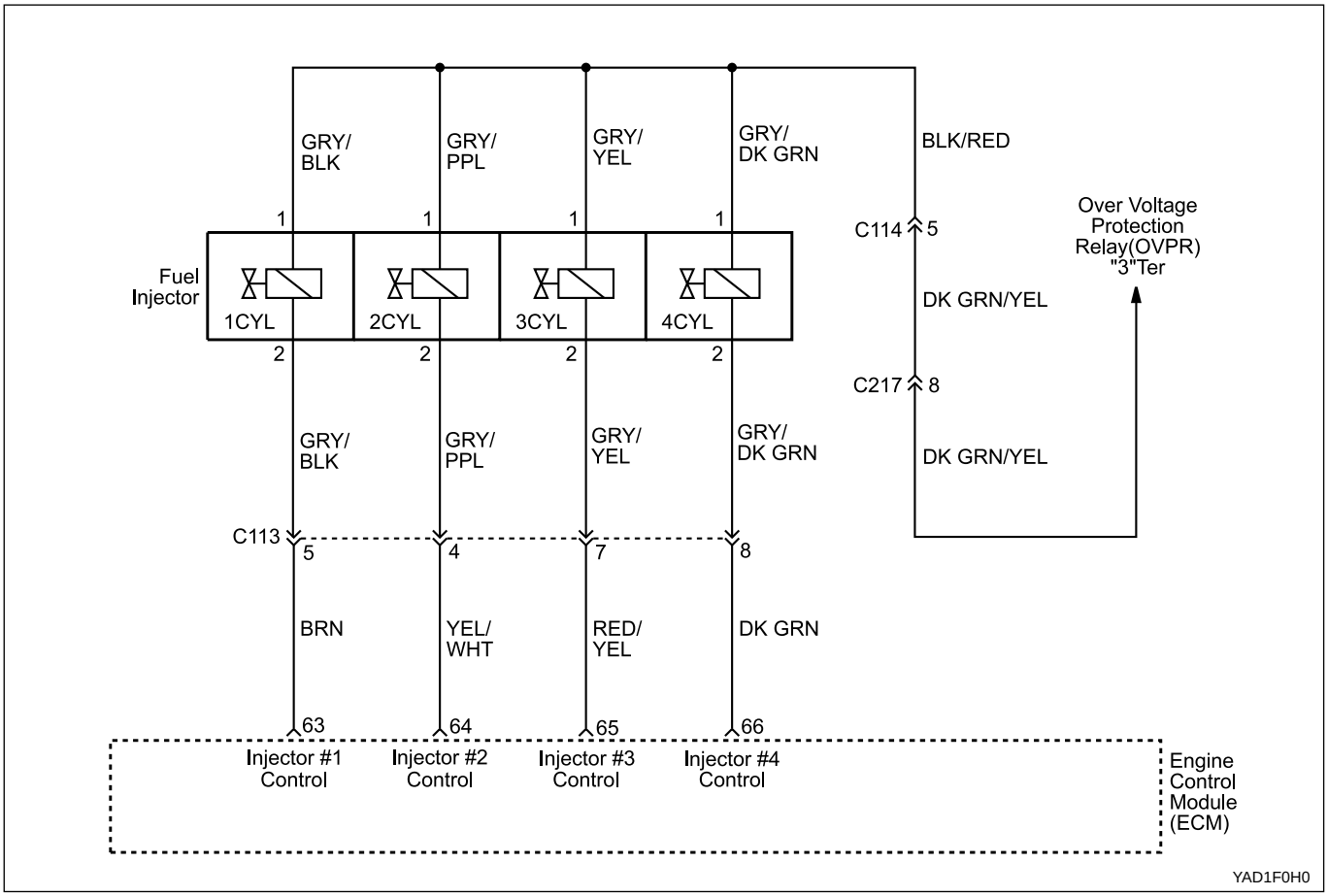


1 O-Ring
2 Injector
3 Injector Bracket
4 O-Ring
5 Fuel Rail

The Multipoint Fuel Injection (MFI) assembly is a solenoid-operated device controlled by the Engine Control Module (ECM) that meters pressurized fuel to an each individual cylinder. The injector sprays the fuel, in precise quantities at a point in time determined by the ECM, directly towad the cylinder intake valve. ECM energizes the fuel injector solenoid to lift the needle valve and to flow the fuel through the orifice. This injector's discharge orificeis calibrated to meet the effective fuel atomization necessary for both ensuring the maximum homogeneity in the air-fuel mixture and holding the condensation along the walls of the intake tract to a minimum.

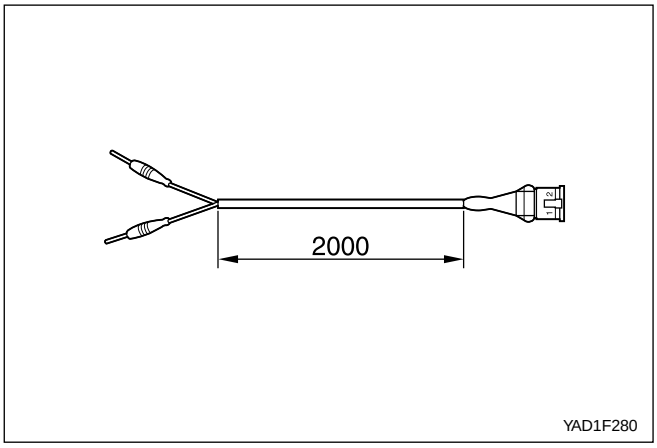
Fuel enters the top feed injector from above and flows through its vertical axis. The lower end extends into the intake valve. Fuel from the tip is directed at the intake valve, causing it to become further atomized and vaporized before entering the combustion chamber.

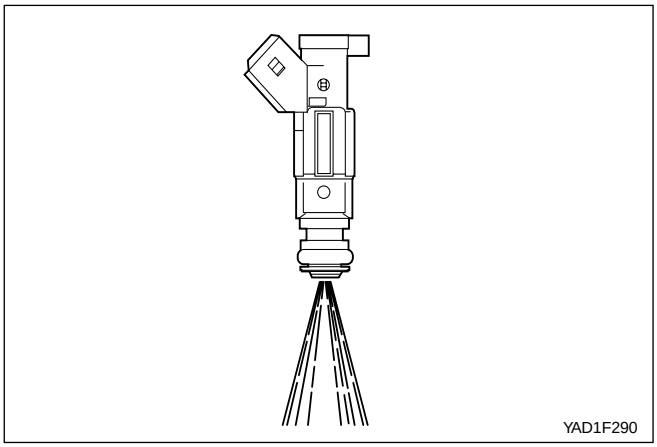
A fuel injector which is stuck partially open would cause a loss of fuel pressure after the engine is shut down. Also, an extended crank time would be noticed on some engines. Dieseling could also occur because some fuel could be delivered to the engine after the ignition is turned off.



Failure Code	Description	Trouble Area	Maintenance Hint
72	No. 1 injector short circuit to battery	When malfunction of injector circuit Injector #1 short circuit to power	• Inspection the power to injector #1 or bad contact • Inspection the injector • Inspection the ECM
73	No. 1 injector short circuit to ground or open	When malfunction of injector circuit Injector #1 short circuit to ground or open	• Inspection the ECM pin 63 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
74	No. 2 injector short circuit to battery	When malfunction of injector circuit Injector #2 short circuit to power	• Inspection the power to injector #2 or bad contact • Inspection the injector • Inspection the ECM
75	No. 2 injector short circuit to ground or open	When malfunction of injector circuit Injector #2 short circuit to ground or open	• Inspection the ECM pin 64 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
76	No. 3 injector short circuit to battery	When malfunction of injector circuit Injector #3 short circuit to power	• Inspection the power to injector #3 or bad contact • Inspection the injector • Inspection the ECM

Failure Code	Description	Trouble Area	Maintenance Hint
77	No. 3 injector short circuit to ground or open	When malfunction of injector circuit Injector #3 short circuit to ground or open	• Inspection the ECM pin 65 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
78	No. 4 injector short circuit to battery	When malfunction of injector circuit Injector #4 short circuit to power	• Inspection the power to injector #4 or bad contact • Inspection the injector • Inspection the ECM
79	No. 4 injector short circuit to ground or open	When malfunction of injector circuit Injector #4 short circuit to ground or open	• Inspection the ECM pin 66 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM





Injector Spray Pattern Check

1. Turn the ignition switch OFF.
2. Remove the fuel injector connectors.
3. Remove the fuel distributor and injector with a unit. At this time, do not remove the supply and return line.

   Notice: Prepare the beaker for taking the fuel.

4. Connect the shop made cable to the inject or with a firing order.
5. Connect the other end of shop made cable to the positive battery cable and negative battery cable.
6. Turn the ignition switch ON.
7. Check the inject or for normal spray pattern as shown in the figure. Check inject or for leaks or later drop

Injector Resistance Inspection

1. Turn the ignition switch OFF.
2. Remove the fuel injector connectors .
3. Meas ure the fuel injector coil resistance using a multimeter.

Specified Value	14 ~ 17 Ω

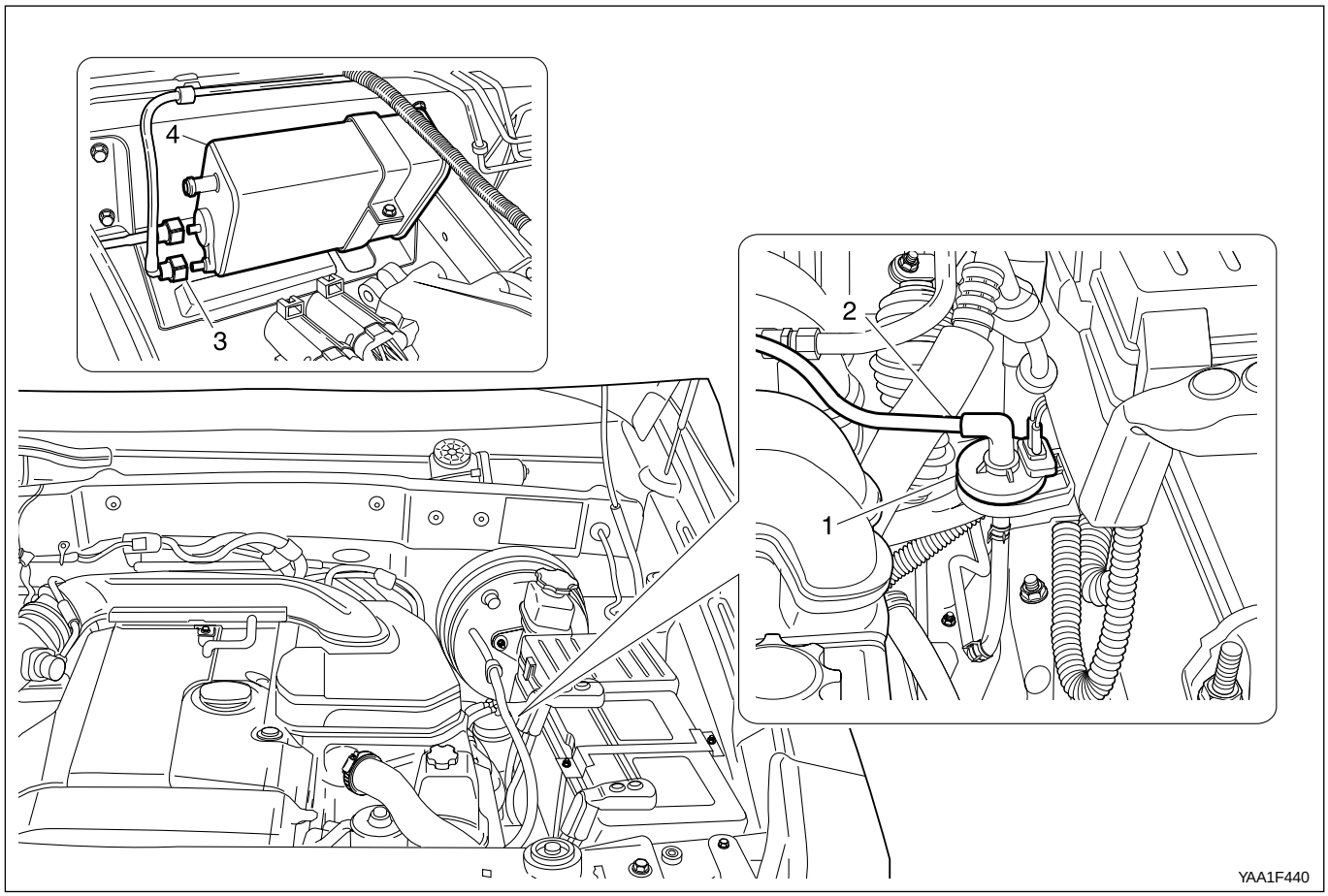
Notice: Replace the fuel injector if the measured value is out of the specified values . Check the connector and wire connection between the ECM and the injector if the measured values are normal.

Injector Pulse Width Inspection

1. Turn the ignition switch OFF.
2. Install the scan tool.
3. Turn the ignition switch ON.
4. Monitor the “INJECTION TIME” with a scan tool.

Cranking	8.0 ms
Engine Idle	3 ~ 5 ms
Wide Open Throttle (WOT)	14 ms

PURGE CONTROL VALVE



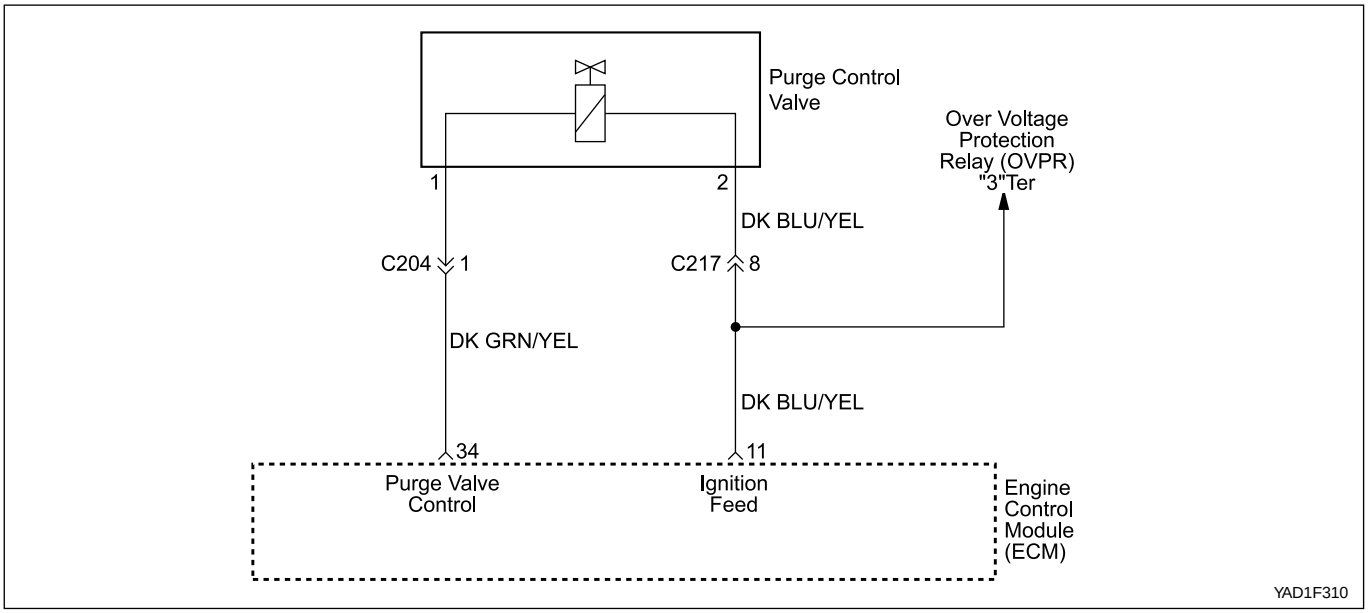
1 Purge Control Valve
2 Line to Engine
3 Line to Canister
4 Canister

The fuel vaporization control system is installed to inhibit the fuel vaporized gas from discharging into the atmosphere. The fuel vaporized gas that is accumulated in the canister abstracts through the purge control valve purification during the engine combustion (except the decreasing mode) and coolant temperature of over 80 °C. For this reason, the Engine Control Module (ECM) transacts the engine speed, air inflow quantity, coolant temperature, and intake temperature.

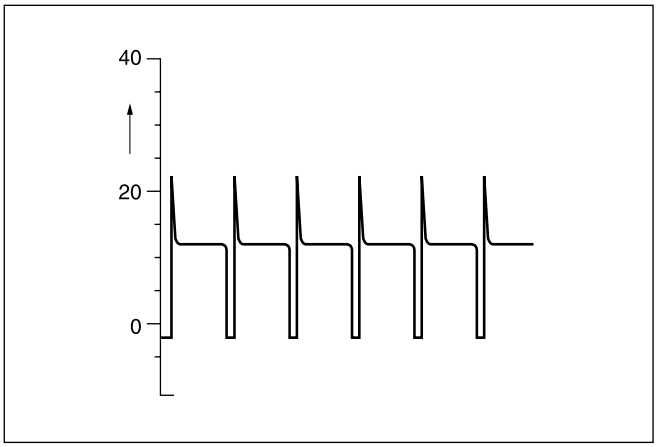
The purge control valve is activated by the ECM frequency according with the engine rotating speed to adjust the purification rate. The purification rate is determined by the continuous valve opening interval.

The purge control valve is activated by the ECM for the following conditions:

- Coolant temperature of over 80 °C
- Engine speed of over 1,000 rpm
- 2 minutes after starting
- When the fuel cut-off mode is not activated



Failure Code	Description	Trouble Area	Maintenance Hint
40	Purge control valve short circuit to battery	When short circuit to power source	• Inspection the ECM pin 34 about short circuit or open with bad contact • Inspection the source power of valve • Inspection the purge control solenoid vale • Inspection the ECM
41	Purge control valve short circuit to ground or open	When short circuit to ground or open	
54	Purge control circuit malfunction	When malfunction of purge control : not work	



Test

1. Maintain the normal temperature and idling state by operating the engine.
2. Connect the ECM terminal No. 11 and No. 34 and check for normal operation through the output waves using oscilloscope.

   Notice: Test during purge control valve operation after the minimum of 1 minute after the engine turned on.

3. Connect the ECM terminal No. 34 and No.10 and check for current consumption during the ignition switch ON.

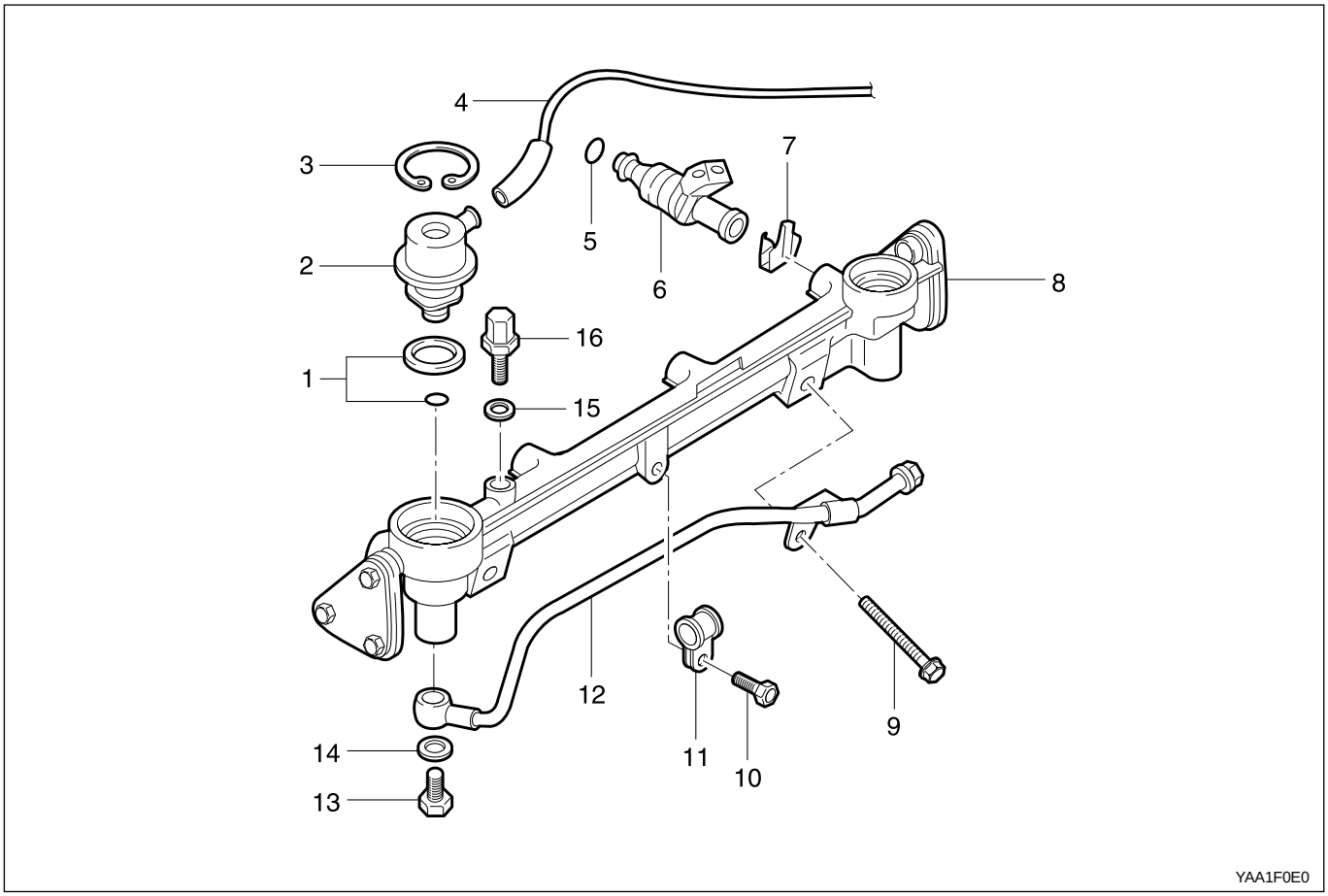
Specified Value	0.3 ~ 0.5 A

4. Remove the line to canister and measure the pressure with the vacuum pressure gauge.

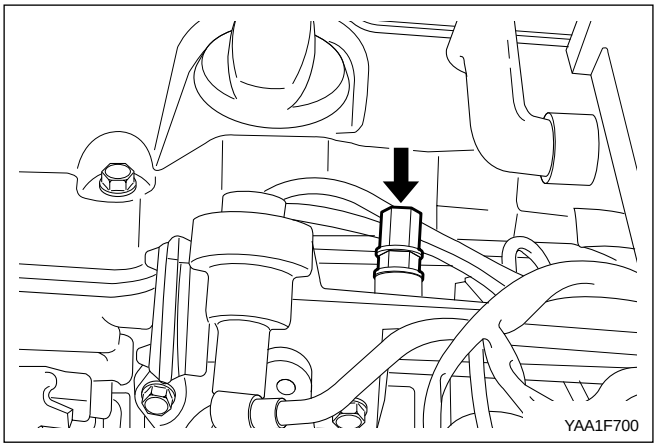
Specified Value	> 500 mbar (after approx. 1 min.) purge control valve operates at this time

Notice: Test while at normal temperature and at idling state by operating the engine.

FUEL RAIL



1 O-Ring
2 Fuel Pressure Regulator
3 Circlip
4 Vacuum Hose
5 O-Ring
6 Injector
7 Injector Bracket
8 Fuel Rail
9 Combination Bolt
10 Bolt
11 Clamp
12 Fuel Return Line
13 Hollow Bolt
14 Seal Ring
15 Seal Ring
16 Fuel Pressure Test Connector



Fuel Pressure Test

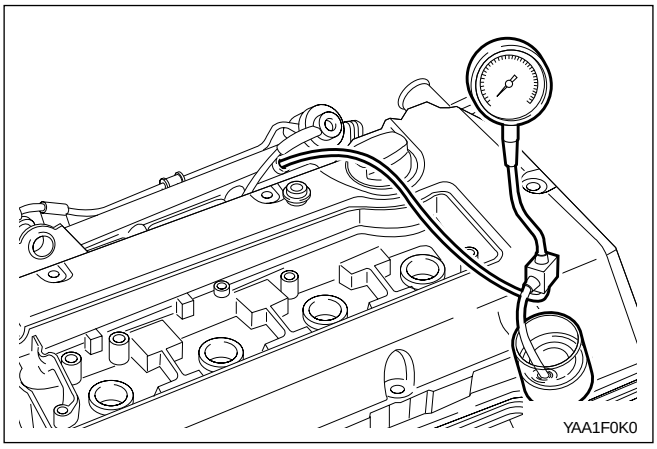
Tools Required

103 589 00 21 00 Fuel Pressure Gauge

1. Turn the ignition switch to “OFF” position.
2. Remove the fuel pressure test connector.
3. Connect the fuel pressure gauge to the fuel pressure test connector.
4. Test the fuel pressure at idling by operating the engine using the fuel pressure gauge 103 589 00 21 00.

Vacuum Hose Connected (bar)	3.2 ~ 3.6
Vacuum Hose Disconnected (bar)	3.7 ~ 4.2

5. Replace the pressure regulator diaphragm if out of the specification.



Internal Leakage Test

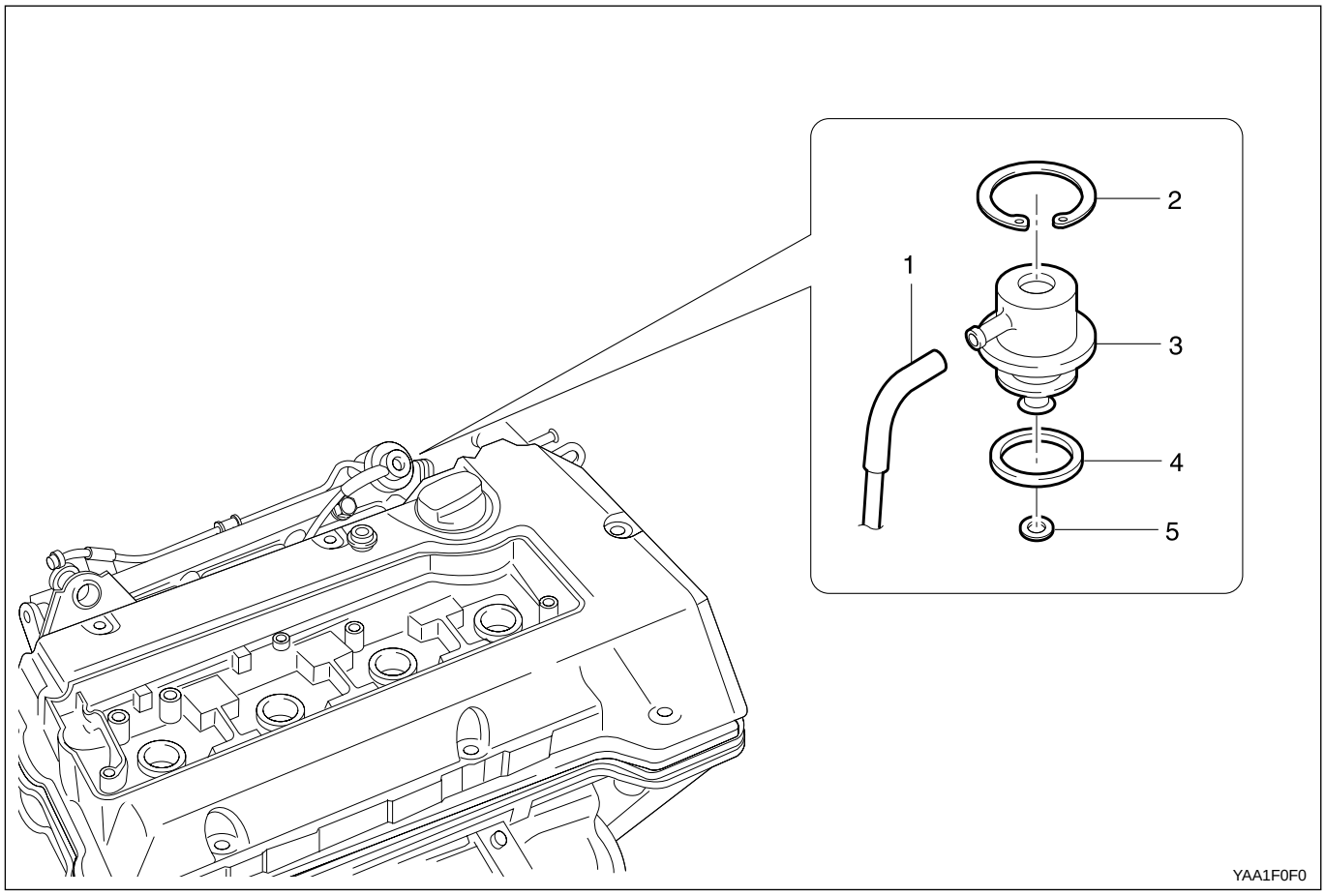
1. Connect the fuel pressure gauge103 589 002100 to the fuel pressure test connector.
2. Stop the engine for approximately 30 minutes and then check the fuel pressure changes.

Pressure change	
Fuel pressure drops slowly	• Fuel leakage at the injector • Faulty fuel pressure regulator’s diaphragm and O-ring
Fuel pressure drops rapidly	• Faulty check valve in the fuel pump

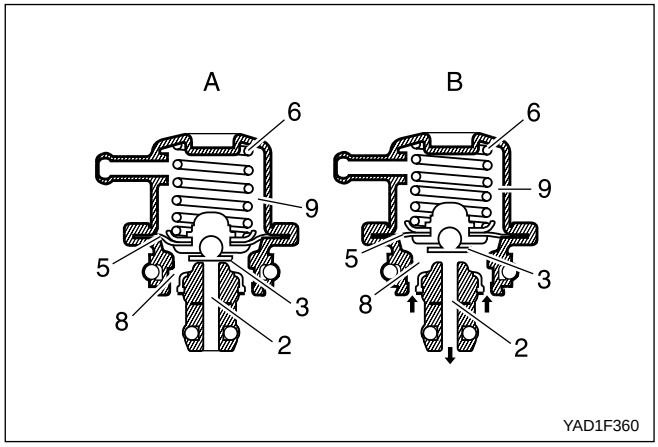
3. If there is no change in fuel pressure and maintain the following pressure over 30minutes, it is normal.

Fuel pressure (bar)	≥ 2.5

FUEL PRESSURE REGULATOR



1 Vacuum Hose
2 Circlip
3 Fuel Pressure Regulator
4 O-Ring
5 O-Ring



2. Fuel return line
3. Valve
5. Diaphragm
6. Compression Spring
8. Fuel Chamber
9. Spring Chamber

A. Valves Closed
B. Valves Opened

Function of the Fuel Pressure Regulator

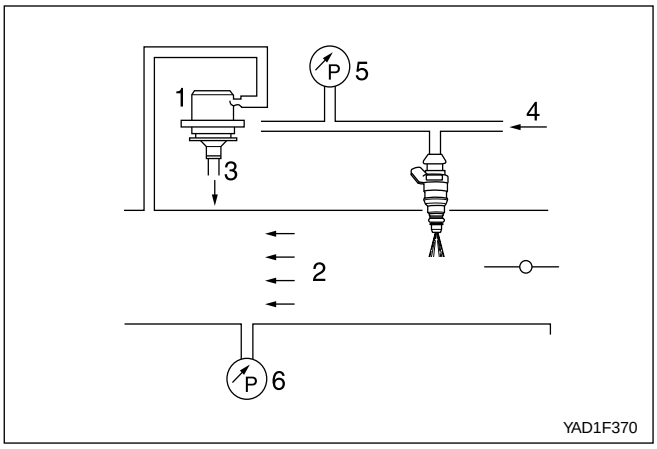
The fuel pressure regulator maintains the fuel pressure in the fuel line with the pressure of 3.2 bars to 3.8 bars according to the intake manifold pressure. This operating pressure cannot be changed, and the fuel injection volume will be only determined by the injection time. Over supplied fuel returns to the fuel tank through the return line.

<Operating at full load>

There is no negative pressure applied to the spring chamber (9) during the full load, and it is separated from the fuel chamber (8) by the diaphragm (5).

When the fuel pressure goes up, the diaphragm forces the compression spring (6) in the direction of compression. At this moment, the valve (3) sticks to the diaphragm by the fuel pressure, and the fuel return line (2) opens. The fuel over supplied returns to the fuel tank through the return line.

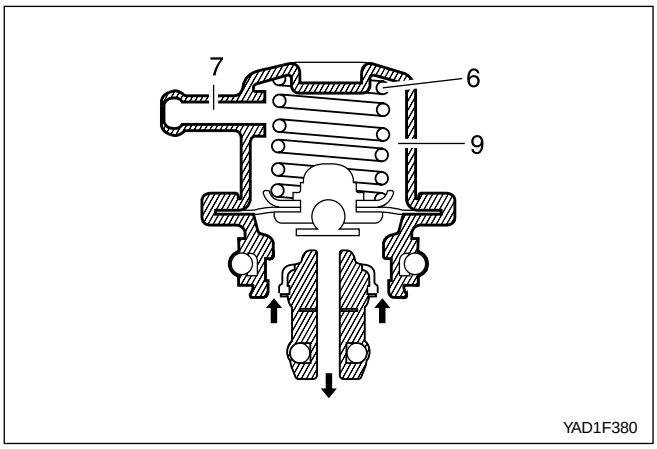
The pressure difference between the fuel pressure and the intake manifold is about 3.8 bars during the full load.



1. Fuel Pressure Regulator
2. Intake Manifold
3. Fuel Return (to fuel tank)
4. Fuel Supply (from fuel pump)
5. Fuel Pressure (approx. 3.8 bars)
6. Intake Manifold Negative Pressure (0 bar)

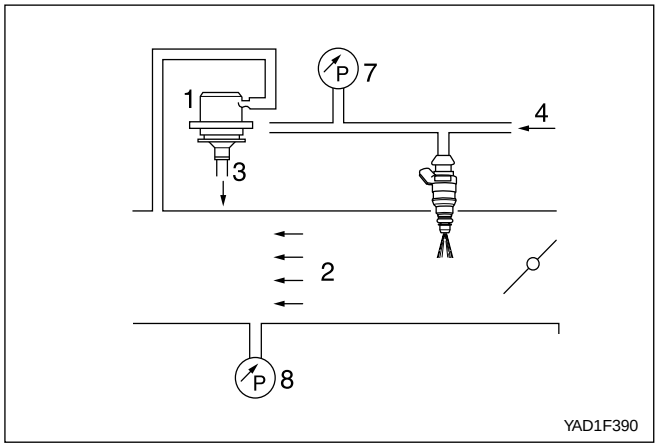
<Operating at Idle and partial load>

The spring chamber (9) is connected to the intake manifold with the vacuum hose at the intake pipe connection (7). The negative pressure generated in the intake manifold activates the diaphragm, and thus the fuel pressure gets reduced to the rate of the operating extent of the diaphragm by the intake manifold's negative pressure.



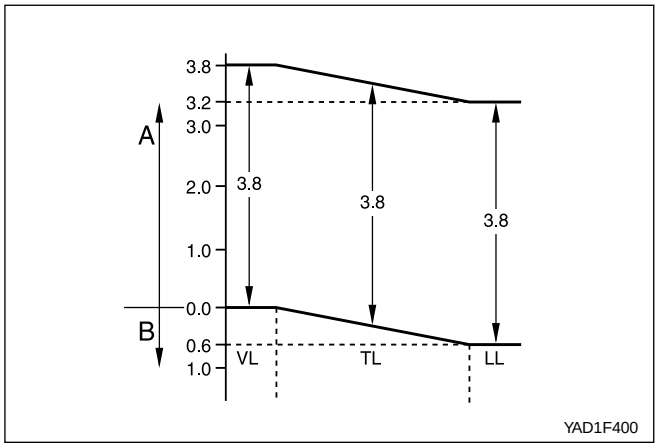
Consequently, the fuel pressure in the fuel distributor changes by the intake manifold's negative pressure, and the injector's fuel pressure gets reduced independently to the throttle valve's position. Thus, the fuel injection volume can only be determined according to the injector's injecting duration.

The pressure difference between the fuel pressure and the intake manifold is approx. 3.2 bars during idling.



1. Fuel Pressure Regulator
2. Intake Manifold
3. Fuel Return (to fuel tank)
4. Fuel Supply (from fuel pump)
7. Fuel Pressure (approx. 3.2 bars)
8. Intake Manifold Negative Pressure (0.6 bars)

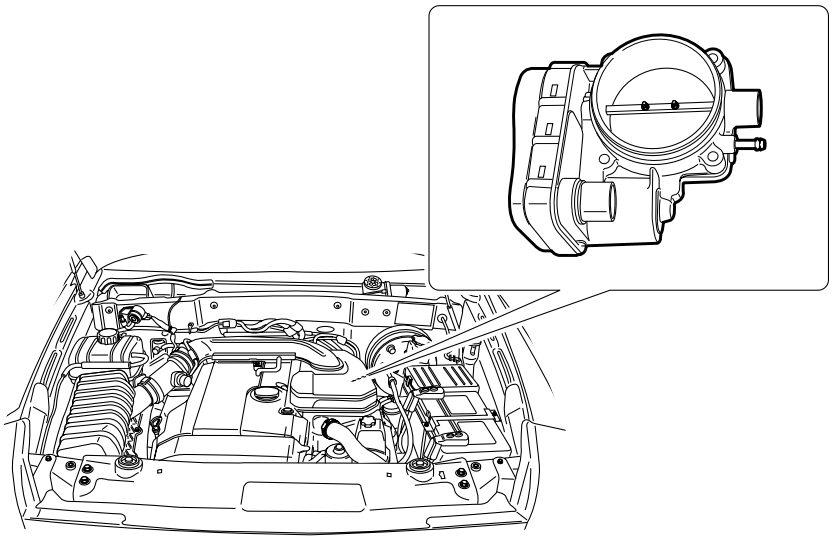
<Fuel Pressure Diagram>



A. Fuel pressure
B. Intake Manifold Negative Pressure
LL. Idling
TL. Partial load
VL. Full load

INDUCTION SYSTEM

THROTTLE VALVE ACTUATOR



YAA1F540

The throttle actuator is actuated by the Engine Control Module (ECM) according to the position of the accelerator pedal position.

It has two potentiometers which signal the position of the throttle valve to the ECM to enable it to recognize the various engine load states.

Ignition “Off”

In the de-energized states the throttle valve position is determined to be spring capsule.

Ignition “On”

When the ignition S/W on the servo motor in the throttle actuator is operated by the ECM. The throttle valve adopts a position in line with the coolant temperature.

Closed position

In the closed throttle position, the servo motor controls engine speed by operating the throttle valve further (greater mixture) or closing it further (reduced mixture), depending on coolant temperature and engine load. When this is done, the throttle valve can be closed further by the servo motor overcoming the force of the spring capsule (mechanical end stop). If the actuator is de-energized, the throttle valve is resting against the spring capsule.

Consequently, the throttle valve opening is a constant 10-12 °approximately.

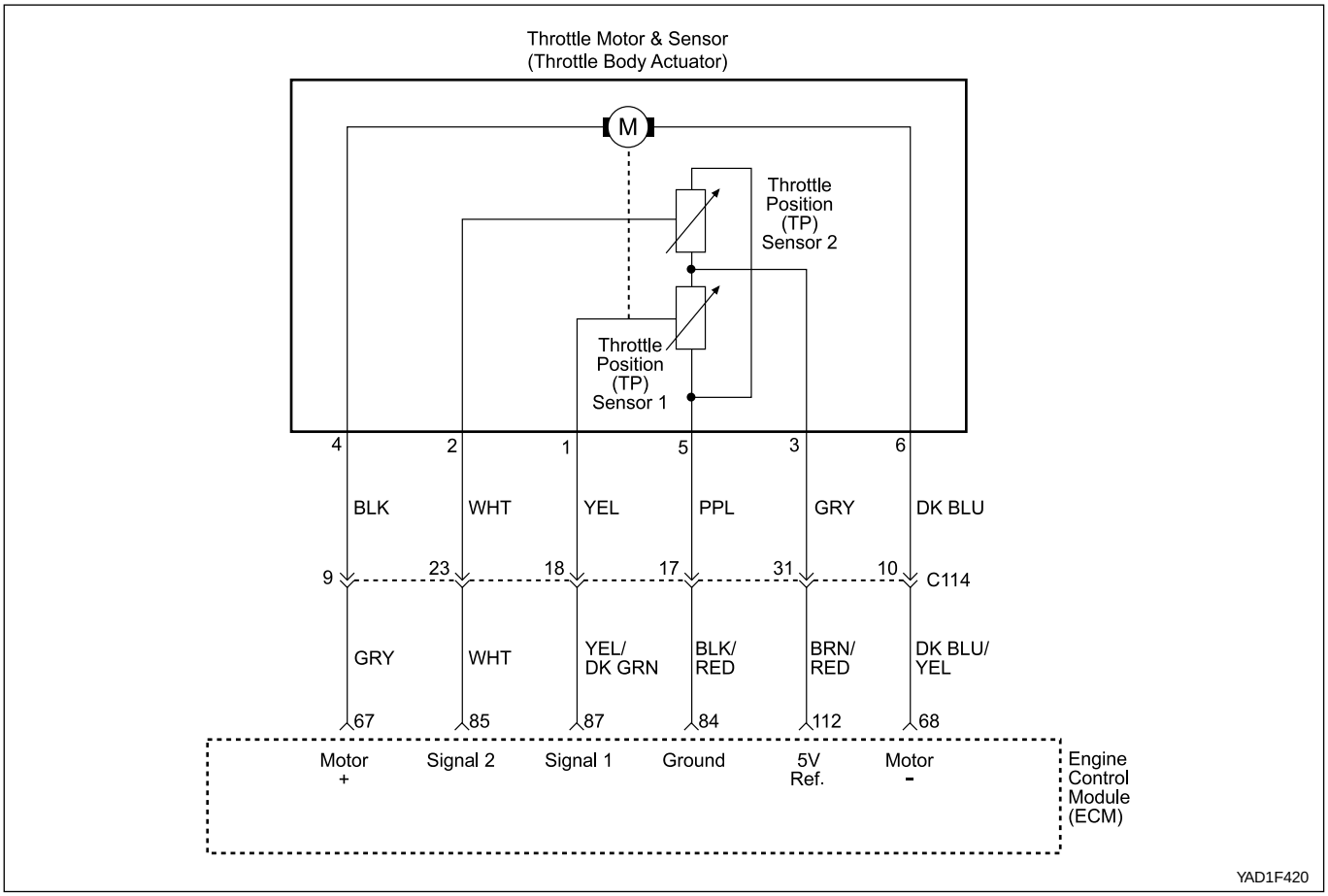
At no load, this produces an engine speed of about 1,800 rpm

Driving

When driving (part/full throttle), the servo motor controls the throttle valve in line with the various load states and according to the input signals from the pedal value sensor according to the input signals from the pedal value sensor according to the position of the accelerator pedal.

The function of the EA (electronic accelerator) in the ECM determines the opening angle of the throttle valve through the throttle actuator. Further functions are;

- Idle speed control
- Cruise control
- Reducing engine torque for ASR/ABS operation
- Electronic accelerator emergency running
- Storing faults
- Data transfer through CAN



Failure Code	Description	Trouble Area	Maintenance Hint
104	Throttle position sensor 1 low voltage	TPS 1 short circuit to ground or open	• Monitoring the actual values through scan tool • Inspection the ECM pin 84, 85, 87, 112, 67, 68 about short circuit or open with bad contact • Inspection the throttle valve actuator • Inspection the ECM
105	Throttle position sensor 1 high voltage	TPS 1 short circuit to power	
108	Throttle position sensor 2 low voltage	TPS 2 short circuit to ground or open	
109	Throttle position sensor 2 high voltage	TPS 2 short circuit to power	
116	Throttle actuator learning control failure	When actuat or adaption fluctuation or not meet the condition	
119	Throttle valve return spring failure	When return spring defective of actuator	
121	Throttle act uator failure	When supply voltage of the actuat or short circuit to power	
123	Different mass air flow sensor signal with throttle position sensor	When shut down of out put driver	
125	Both throttle position sensor failure	When defective of both potentiometers	

Failure Code	Description	Trouble Area	Maintenance Hint
126	Throttle position sensor 1 not plausible with Throttle position sensor 2	When difference between TPS 1 and TPS 2	• Monitoring the actual values through scan tool • Inspection the ECM pin 84, 85, 87, 112, 67, 68 about short circuit or open with bad contact • Inspection the throttle valve actuator • Inspection the ECM
127	High permanent throttle signal	When failure of wiring harness or actuator	
185	Mass air flow sensor and throttle position sensor failure	When difference between MAF and TPS signal	

Circuit Description

The ECM supplies a 5 volt reference signal and a ground to the TP sensor. The TP sensor sends a voltage signal back to the ECM relative to the throttle plate opening. The volt age signal will vary from approximately 0.3 ~ 0.9 volts at closed throttle, to over 4.0 ~ 4.6 volts at Wide Open Throttle (WOT).

The TP sensors serve for engine load control according to the drive pedal command. Load adjustments independent of the drive pedal command can be implemented; such functions are, for instance, idle control, speed control, drive slip control, load shock damping, and similar functions .

When the actuator current fails , the throttle valve is returned to emergency operating position by a spring. The throttle valve position, there by the actuator drive position check back is provided by two potentiometers. The motor positions the throttle valve against the return spring force. Motor and return spring are two separate energy sources . Each of them is able to position the throttle valve in emergency position alone. Throttle valve position check back and monitoring is provided by two actual value potentiometers connected to the engine control electronics.

Throttle Actuator Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the TPS 1 signal volt age at the ECM pin No. 87 and TPS 2 signal volt age at the ECM pin No. 85.

	Pedal Position	Specified Value
TPS 1	Closed	0.3 ~ 0.9 v
	Opened	4.0 ~ 4.6 v
TPS 2	Closed	4.0 ~ 4.6 v
	Opened	0.3 ~ 0.9 v

Throttle Actuator DC Motor Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal volt age between the ECM pin No. 67 and No. 68.

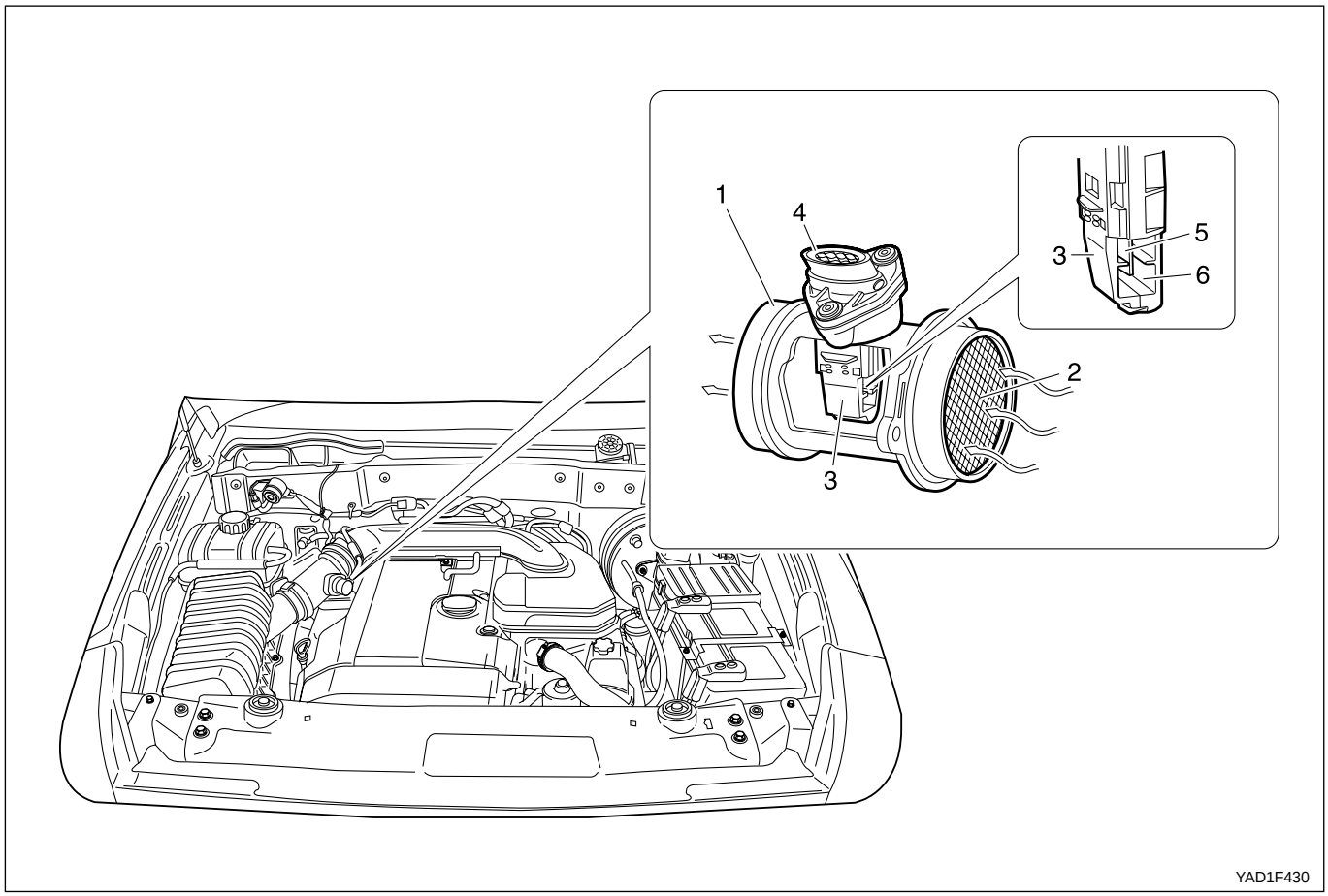
Application		Specified Value
Engine Status	Ignition “ON”	0.8 ~ 2.3 v
	Idling	1.0 ~ 2.5 v (Coolant temperature is over 70° C)

Throttle Actuator DC Motor Resistance

1. Turn the ignition switch to “OFF” position.
2. Measure the resistance between the ECM pin No. 67 and No. 68.

Specified Value	< 10 Ω

HOT FILM AIR MASS (HFM) SENSOR



1 Housing
2 Protector Net
3 Electronic Housing
4 Connector
5 Hot Film Air Mass Sensor
6 Measuring Port

The Hot Film Air Mass (HFM) sensor with recognition of flow direction related to pulsating flow is designed for recording load on Engine Control Module (ECM) by measuring the output voltage proportional to the reference voltage of the ECM.

Mass Air Flow Sensor

Mass Air Flow (MAF) is a thermal flow meter whose sensor element with its temperature sensors and heating area is exposed to the MAF to be measured. A heating area located in the center of a thin membraneis controlled to an over temperature by a heating resistor and a temperature sensor of this membrane. And the value of over-temperature depends on the temperature of the in-flowing air.

Two temperature sensors on upstream and downstream of the heating area show the same temperature without incoming flow. With incoming flow, upstream part is cooled down but downstream temperature retains its temperature more or less due to the air heated up in the heating area. This temperature difference in quantity and direction depends on the direction of the incoming flow.

ECM modulates the flow of heating current to maintain the temperature differential between the heated film and the intake air at a constant level. The amount of heating current required to maintain the temperature thus provides an index for the MAF. This concept automatically compensates for variations in air density, as this is one of the factors that determines the amount of warmth that the surrounding air absorbs from the heated element. MAF sensor is located between the air filter and the throttle valve.

Under high fuel demands, the MAF sensor reads a high mass flow condition, such as Wide Open Throttle (WOT). The ECM uses this information to enrich the mixture, thus increasing the fuel injector on-time, to provide the correct amount of fuel. When decelerating, the mass flow decreases. This mass flow change is sensed by the MAF sensor and read by the ECM, which then decreases the fuel injector on-time due to the low fuel demand conditions.

To facilitate the installation of the HFM in the intake passage, lubricating agents may be used. However, when lubricants are used care must be taken to ensure that they do not enter the flow passage and cannot be sucked in with the air flow.

The following tables show the relationship between MAF and output voltage.

Mass Air Flow (kg/h)	Voltage (V)	Mass Air Flow (kg/h)	Voltage (V)
0	0.95 ~ 1.05	250	3.51
10	1.28	370	3.93
15	1.41	480	4.23
30	1.71	640	4.56
60	2.16	800	4.82
120	2.76		

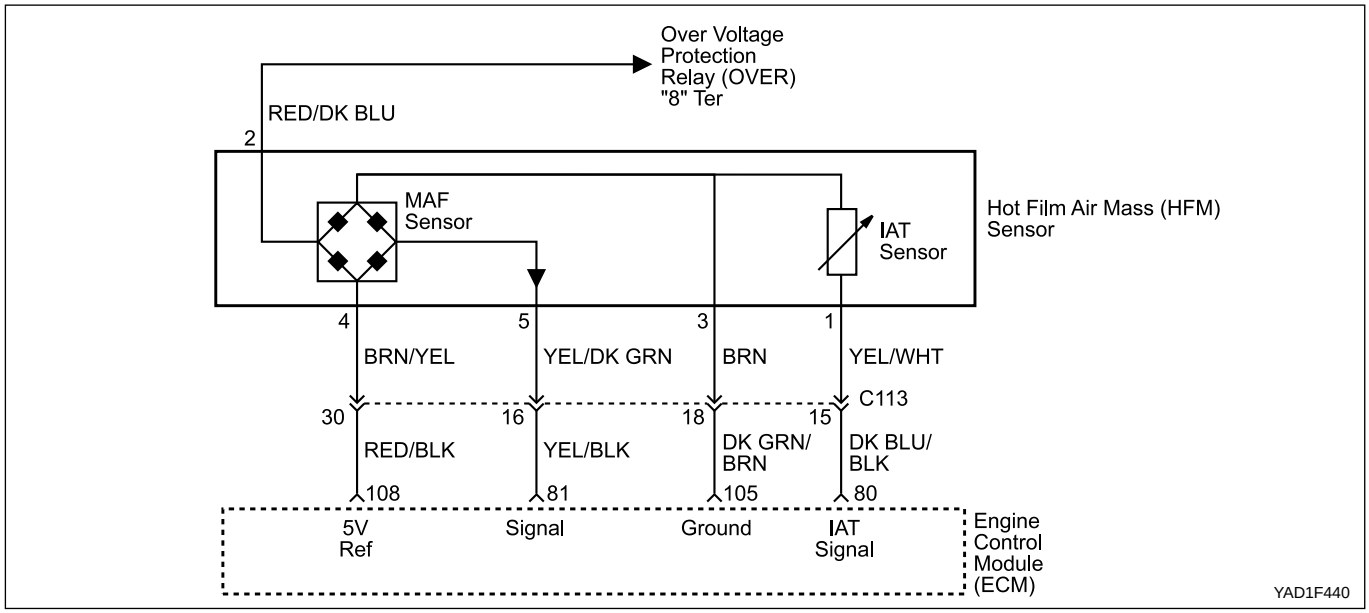
Intake Air Temperature

The Intake Air Temperature (IAT) sensor is a part of Hot Film Air Mass (HFM) sensor and is a thermistor, a resistor which changes value based on the temperature of theair entering the engine. Low temperature produces a high resistance, while high temperature causes a low resistance as the following table.

The ECM provides 5 volts to the IAT sensor through a resistor in the ECM and measures the change in voltage to determine the IAT. The voltage will be high when the manifold air is cold and low when the air is hot. The ECM knows the intake IAT by measuring the voltage.

The IAT sensor is also used to control spark timing when the manifold air is cold.

Temp. (°C)	R min.(Ω)	R nom. (Ω)	R max. (Ω)
-40	35140	39260	43760
-20	12660	13850	15120
0	5119	5499	5829
20	2290	2420	2551
40	1096	1166	1238
60	565	609	654
80	312	340	370
100	184	202	222
120	114	127	141
130	91	102	114



Failure Code	Description	Trouble Area	Maintenance Hint
03	Intake air temperature sensor low voltage	IAT sensor short circuit to ground or open	• Monitoring the actual air temperature through scan tool • Inspection the ECM pin 80, 79 about short circuit or open with bad contact • Inspection the IAT sensor (integrated in HFM sensor) • Inspection the ECM
04	Intake air temperature sensor high voltage	IAT sensor short circuit to power	
05	Intake air temperature sensor plausibility	Malfunction in recognition of IAT When functional problem	
09	Mass air flow sensor plausibility	Malfunction in recognition of MAF When air mass not plausible	• Monitoring the actual air mass flow through scan tool • Inspection the ECM pin 81, 105 about short circuit or open with bad contact • Inspection the MAF sensor (integrated in HFM sensor) • Inspection the ECM
10	Mass air flow sensor low voltage	MAF sensor short circuit to ground or open	
11	Mass air flow sensor high voltage	MAF sensor short circuit to power	

Circuit Description

The heated element on the MAF is a platinum film resistor (heater). It is located on a ceramic plate together with the other elements in the bridge circuit. The temperature sensitive resistor (flow sensor) also included in the bridge. The separation of heater and flow sensor facilitates design of the control circuitry. Saw cuts are employed to ensure thermal decoupling between the heating element and the intake air temperature (IAT) sensor. The complete control circuitry is located on a single layer. The voltage at the heater provides the index for the mass air flow. The MAF's electronic circuitry then converts the voltage to a level suitable for processing in the ECM. This device does not need a burn off process to maintain its measuring precision over an extended period. In recognition of the fact that most deposits collect on the sensor element's leading edge, the essential thermal transfer elements are located downstream on the ceramic layer. The sensor element is also design to ensure that deposits will not influence the flow pattern around the sensor.

The IAT sensor uses a thermistor to control the signal voltage to the ECM. The ECM supplies 5 volt reference and a ground to the sensor. When the air is cold, the resistance is high; therefore the IAT signal voltage will be high. If the intake air is warm, resistance is low; therefore the IAT signal voltage will be low.

Mass Air Flow Sensor Input Voltage Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 103 and No. 104.

Application		Specified Value
Engine Status	Ignition “ON”	0.9 ~ 1.1 V
	Idling	1.3 ~ 1.7 V (Coolant temperature is over 70°C)

Notice: If the measured value is not within the specified value, the possible cause may be in cable or MAF sensor in itself. Perform the 5 volt power supply inspection procedures.

Mass Air Flow Sensor 5 volt Power Supply Inspection

1. Turn the ignition switch to “OFF” position.
2. Disconnect the HFM sensor connector.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage between the ECM pin No. 108 and MAF sensor connecter terminal No. 3.

Specified Value	4.7 ~ 5.2 V

Notice: If the measured value is not within the specified value, the possible cause may be in cableor ECM coupling.

5. Measure the voltage between the ECM pin No. 105 and MAF sensor connecter terminal No. 4.

Specified Value	4.7 ~ 5.2 V

Notice: If the measured value is not within the specified value, the possible cause may be in cableor ECM coupling.

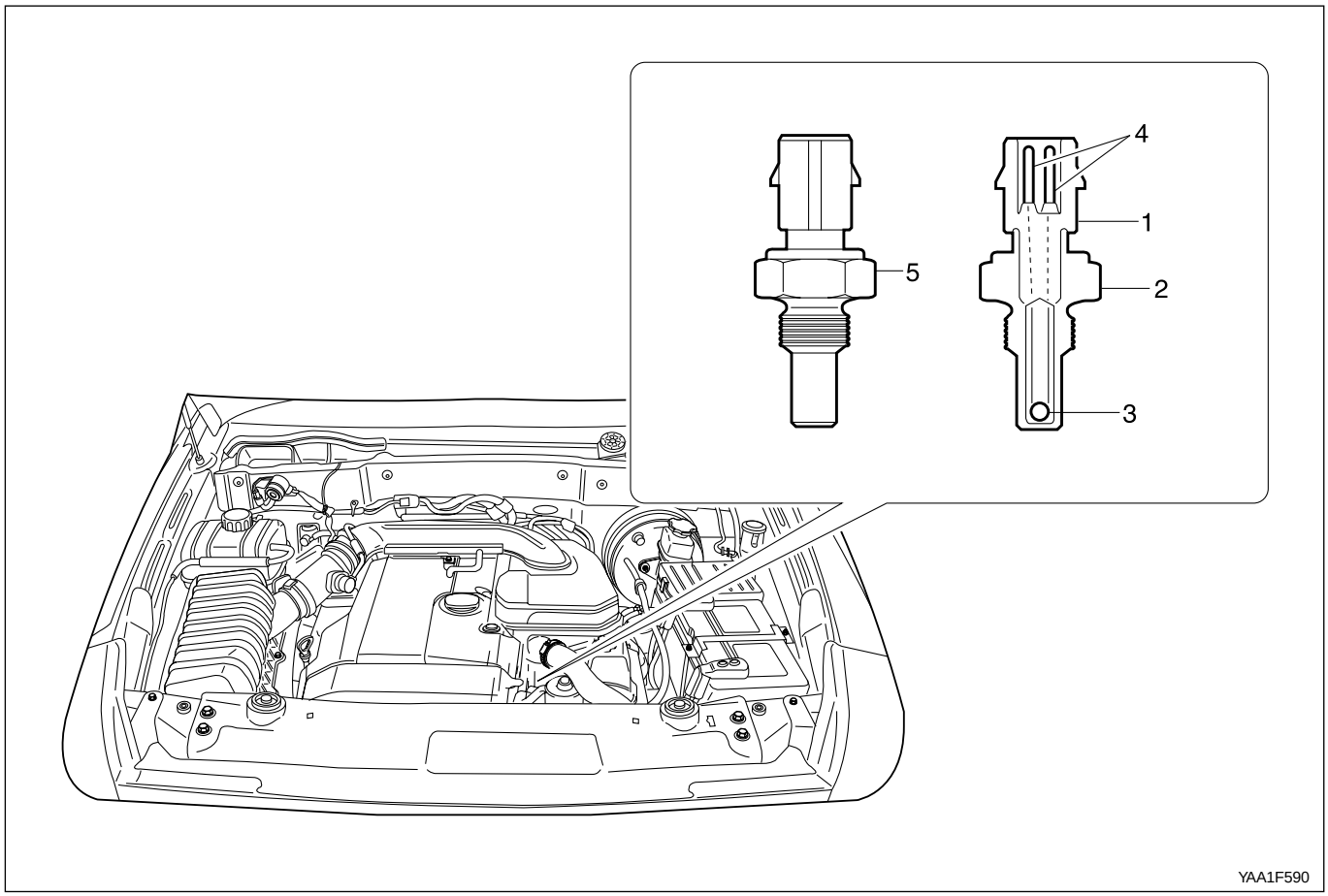
Mass Air Flow Sensor 12 volt Power Supply Inspection

1. Turn the ignition switch to “OFF” position.
2. Disconnect the HFM sensor connector.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage between the ECM pin No. 105 and MAF sensor connecter terminal No. 2.

Specified Value	11 ~ 14 V

Notice: If the measured value is not within the specified value, the possible cause may be in cable or Over Voltage Protection Relay (OVPR).

ENGINE COOLANT TEMPERATURE (ECT) SENSOR



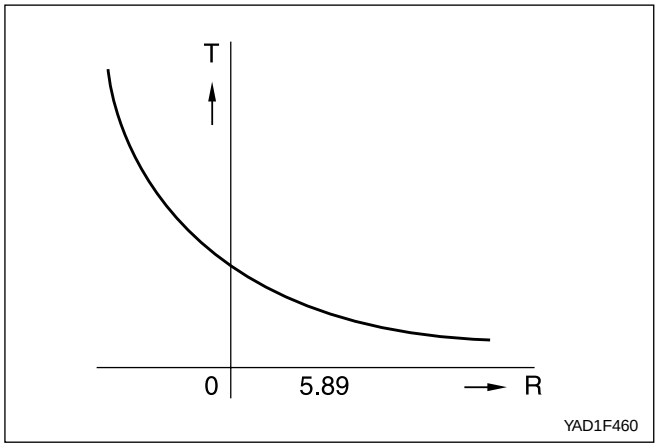
1 Artificial Resin Housing
2 Metal Housing
3 NTC (Negative Temperature Coefficient) Resistor
4 Connector
5 Engine Coolant Temperature Sensor

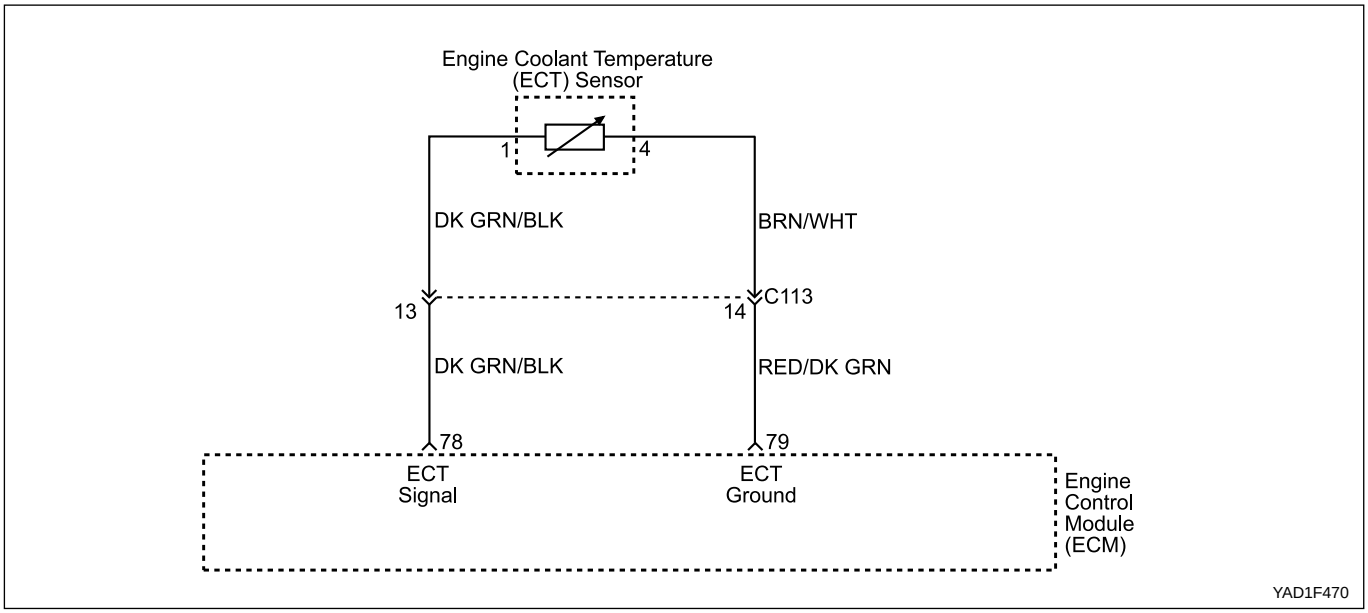
Engine Coolant Temperature (ECT) sensor detects coolant temperature and supplies information to the ECM. It is composed of metal housing with two NTC resistor, 4 pin connector. The ECM provides a 5 volt signal to the ECT sensor through a dropping resistor. When the engine is cold, the ECT sensor provides high resistance, which the ECM detects as a high signal voltage. As the engine warms up, the sensor resistance becomes lower, and the signal voltage drops. At normal engine operating temperature, the ECT signal will measure about 1.5 to 2.0 volts.

The ECM uses information about coolant temperature to make the necessary calculations for:

- Fuel delivery
- Ignition control
- Knock sensor system
- Idle speed
- Torque converter clutch application
- Canister purge
- Cooling fan operation
- Others

Temperature (°C)	Resistance (Ω)	Voltage (V)
-40	48,550	4.90
-30	27,000	4.82
-20	15,570	4.70
-10	9,450	4.52
0	5,890	4.43
10	3,790	3.96
20	2,500	3.57
30	1,692	3.14
40	1,170	2.70
50	826	2.26
60	594	1.86
70	434	1.51
80	322	1.22
90	243	0.98
100	185	0.78
110	143	0.63
120	111.6	0.50
130	88	0.40
140	71.2	0.33





Failure Code	Description	Trouble Area	Maintenance Hint
00	Engine coolant temperature sensor low voltage	ECT sensor short circuit to ground or open	• Monitoring the actual coolant temperature through scan t ool • Inspection the ECM pin 78, 79 about short circuit or open with bad contact • Inspection the ECT sensor • Inspection the ECM
01	Engine coolant temperature sensor high voltage	ECT sensor short circuit to power	
02	Engine coolant temperature sensor plausibility	Malfunction in recognition of ECT When drop to about 50° C below after warm up	
06	Engine coolant temperature insufficient for closed loop fuel control	Malfunction in recognition of ECT When minimum temperature for lambda control after warm up	

Circuit Description

The ECT sensor uses a thermistor to control the signal voltage to the ECM. The ECM supplies a voltage on the signal circuit to the sensor. When the engine coolant is cold, the resistance is high; therefore the ECT signal voltage will be high

Engine Coolant Temperature Sensor Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the voltage between the ECM pin No. 78 and No. 79.

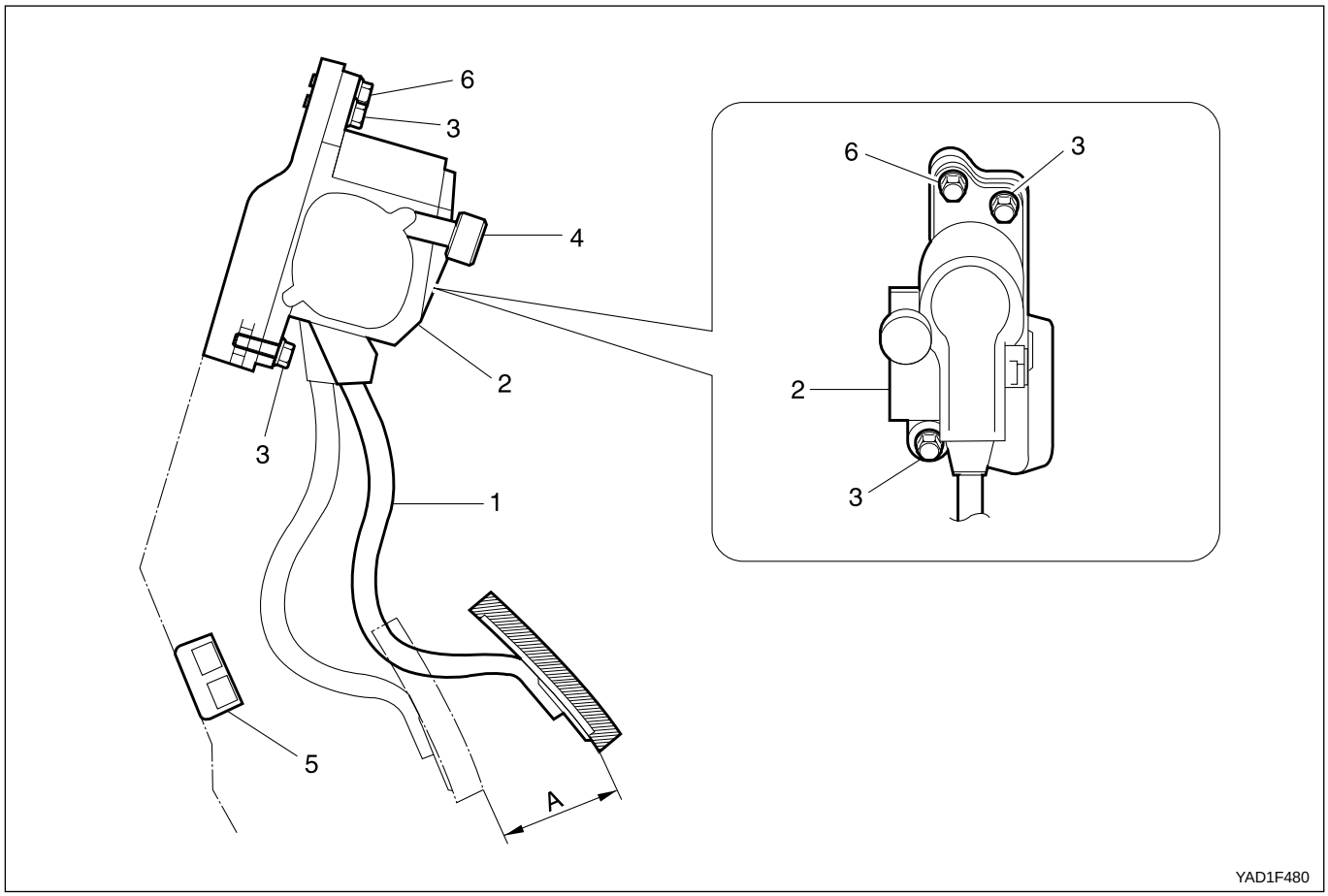
Temperature (°C)	Specified Value (V)
20	3.57
80	1.22
100	0.78

3. Turn the ignition switch to “OFF” position.
4. Disconnect the ECT sensor connector.
5. Turn the ignition switch to “ON” position.
6. Measure the resistance between the ECT sensor terminal pin No. 1 and No. 4.

Temperature (°C)	Specified Value (Ω)
20	2,500
80	322
100	185

Notice: Replace wiring and coolant temperature sensor if out of specified value.

ACCELERATOR PEDAL MODULE



1 Accelerator Pedal
2 Accelerator Pedal Sensor
3 Bolts
4 6-Pin Connector
5 Kick-down Switch
6 Nut

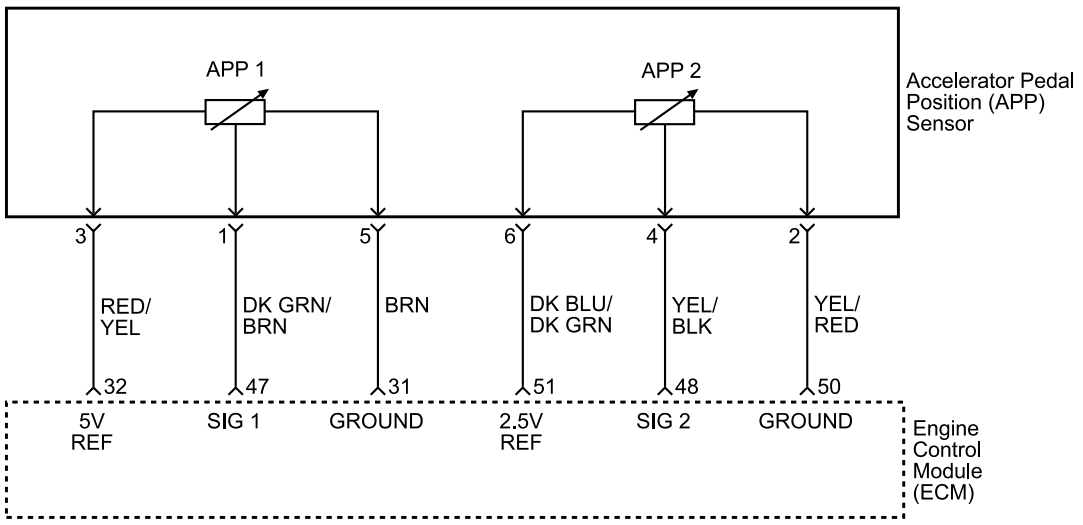
The Acceleration Pedal Position (APP) sensor is mounted on the accelerator pedal assembly. The sensor is actually two individual APP sensors and one housing. This sensor works with theThrottle Position (TP) sensor to provide input to the Engine Control Module (ECM) regarding driver requested accelerator pedal and throttle angle at the throttle body.

When the APP sensor is defected:

When the APP 1 or APP 2 sensor is defected condition, the engineis still running at idle condition but, the accelerator pedal reaction is not response correctly and also, the engine rpm will be reacted to 4,000 rpm slowly. If the APP 1 sensor is out of order, the APP 2 sensor will be conducted with signal as adefault signal but, the throttle valve opening is limited 60% and delayed opening speed.

When the TP sensor or servo motor is defected:

When the TP 1, 2 sensor or servomotor is defected condition, the throttle valve will be closed to the spring capsule by spring force, at this condition, the throttle valve will open 10° ~ 20° and engine rpm will be controlled by ECM will opening (On/Off) time of injector. The engine rpm will be maintaining 900 rpm (at idle) to 1,800 according to the engine load.



YAD1F490

Failure Code	Description	Trouble Area	Maintenance Hint
122	Acceleration pedal position sensor signal failure	When malfunction of APP sensor	• Monitoring the actual values through scan tool • Inspection the ECM pin 31, 47, 32, 48, 59, 51 about short circuit or open with bad contact • Inspection the APP sensor • Inspection the ECM
160	Acceleration pedal position 1 sensor low voltage	APP 1 sensor short circuit to ground or open	
161	Acceleration pedal position sensor 1 high voltage	APP 1 sensor short circuit to power	
162	Acceleration pedal position sensor 2 low voltage	APP 2 sensor short circuit to ground or open	
163	Acceleration pedal position sensor 2 high voltage	APP 2 sensor short circuit to power	
164	Accelerator pedal position sensor 1 not plausible with accelerator pedal position sensor 2	When difference between APP 1 sensor and APP 2 sensor	
167	Both setpoint accelerator pedal position sensor defective	When defective of both APP sensor	

Circuit Description

The ECM supplies a 5 or 2.5 volt reference signal and a ground to the APP sensor 1 or 2. The ECM calculates on these signal lines. The APP sensor output changes as the accelerator pedal is moved. The output of the APP 1 and APP 2 sensor are low, about 0.4 ~ 0.7 volts and 0.2 ~ 0.35 volts respectively at the closed throttle position. As pushing the accelerator pedal, the output increases so that the output voltages will be about 4.3 ~ 4.8 volts and 2.1 ~ 2.4 volts individually when accelerating fully with the kick down, at Wide Open Throttle (WOT).

Acceleration Pedal Position Sensor 1 Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 47 and No. 31 while operating the accelerator pedal as following conditions.
   - Not depress the pedal (closed throttle position)
   - Fully depress the pedal (full throttle with kick down)

Condition of Throttle Valve	Specified Value (V)
Closed Throttle Valve	0.3 ~ 0.7
Fully Depressed Throttle Valve	4.3 ~ 4.8

Notice: If measured value is not within the specified value, check the pedal valve sensor and the supply voltage to APP 1 sensor.

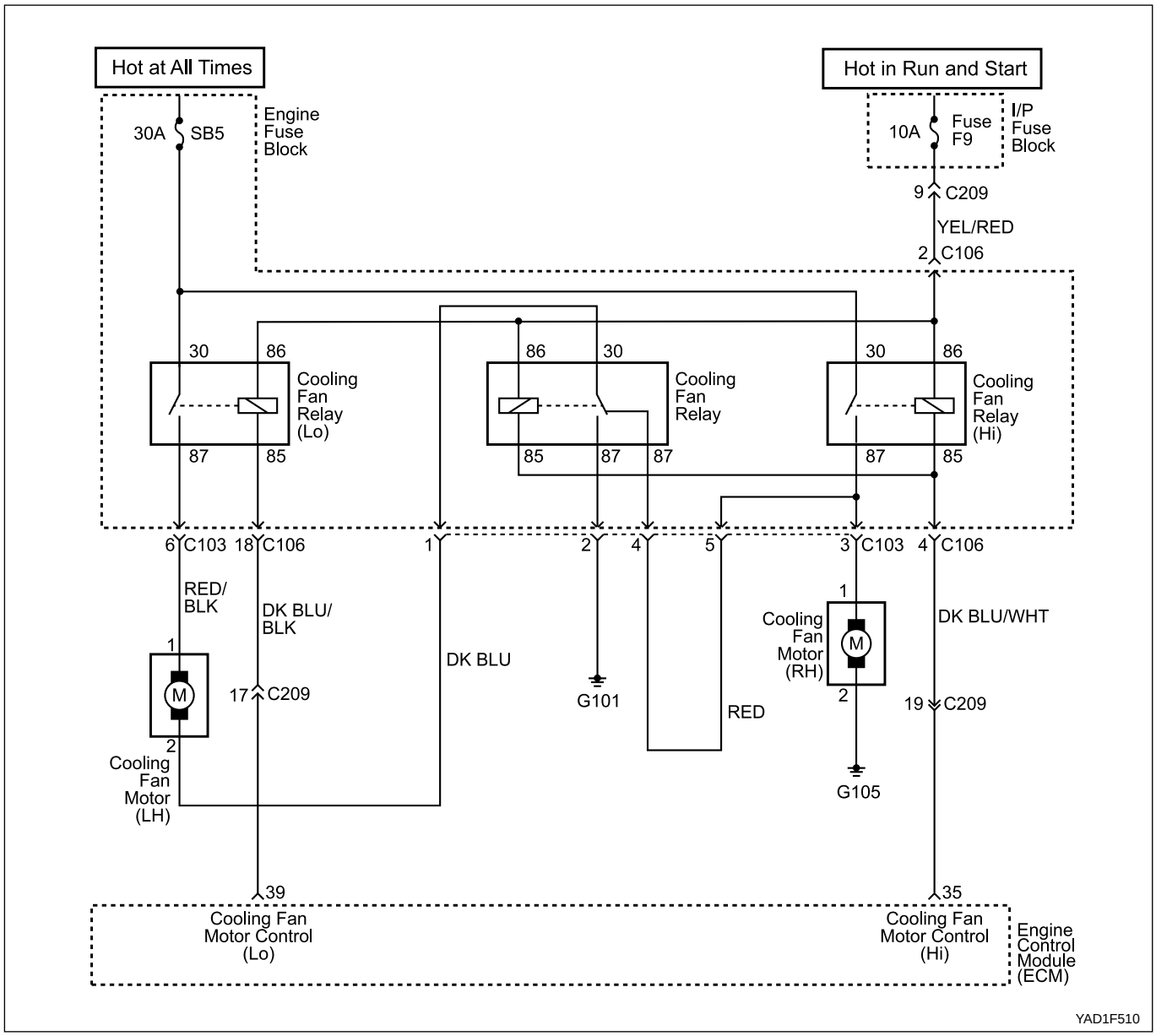
Acceleration Pedal Position Sensor 2 Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 48 and No. 50 while operating the accelerator pedal as following conditions.
   - Not depress the pedal (closed throttle position)
   - Fully depress the pedal (full throttle with kick down)

Condition of Throttle Valve	Specified Value (V)
Closed Throttle Valve	0.1 ~ 0.4
Fully Depressed Throttle Valve	2.1 ~ 2.5

Notice: If measured value is not within the specified value, check the pedal valve sensor and the supply voltage to APP sensor 2.

COOLING FAN



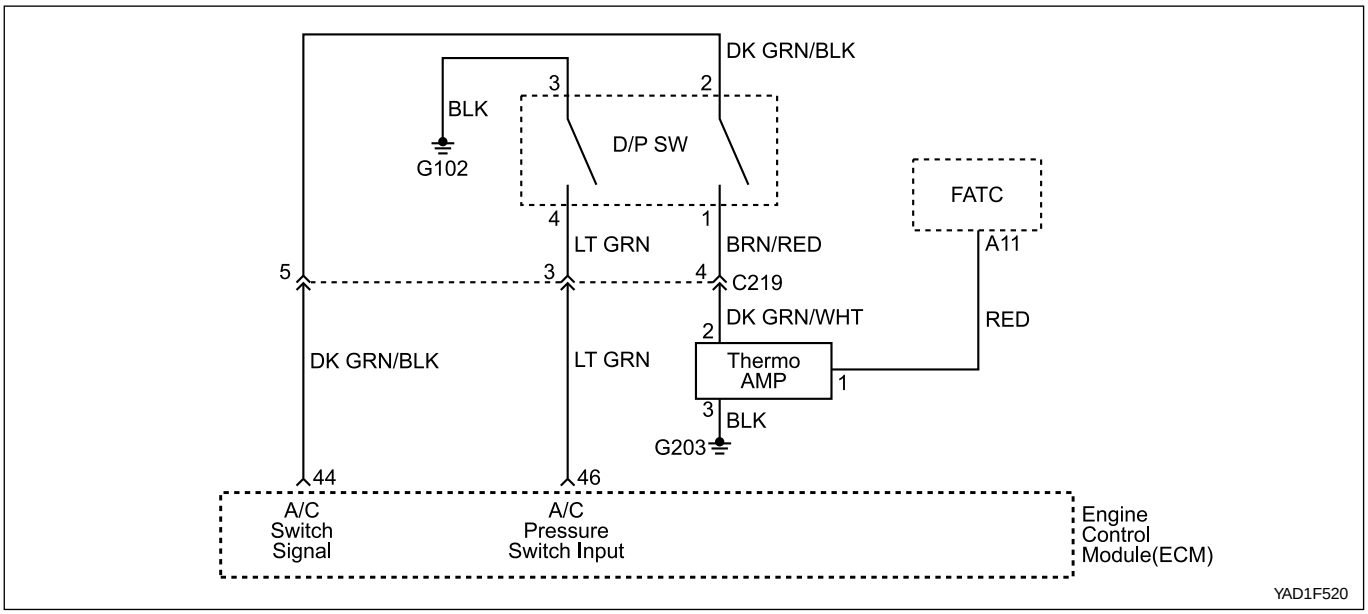
Failure Code	Description	Trouble Area	Maintenance Hint
44	Cooling fan (HI) relay short circuit to power	Cooling fan short circuit to power	• Inspection the Engine Control Module (ECM) pin 35 about short circuit or open with bad contact • Inspection the power source • Inspection the cooling fan • Inspection the ECM
45	Cooling fan (HI) relay short circuit to ground or open	Cooling fan short circuit to ground or open	

Circuit Description

Ignition voltage is supplied directly to the cooling fan relay coil. The ECM controls the relay by grounding the control circuit. When the ECM is commanding a command ON, the voltage of the control circuit should be low (near 0 volt).

When the ECM is commanding the control circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the fault code to set.

A/C COMPRESSOR RELAY

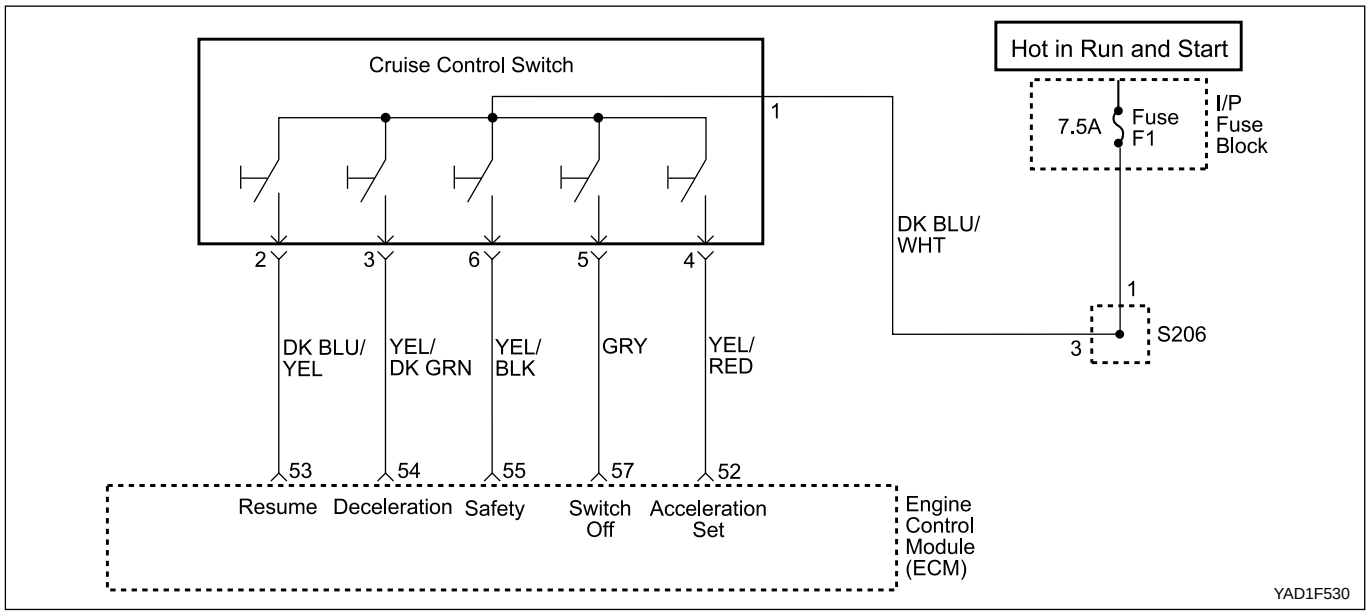


Failure Code	Description	Trouble Area	Maintenance Hint
228	A/C compressor relay short circuit to battery	When malfunction of A/C compressor control	• Monitoring the actual operation through scan tool • Inspection the Engine Control Module (ECM) pin 44 about short circuit or open with bad contact • Inspection the relay short circuit or open • Inspection the ECM
229	A/c compressor relay short circuit to ground or open		

Circuit Description

When the ECM detects that A/C has been requested, the ECM will activated the A/C clutch relay. When the relay has been activated, voltage should be present at both the A/C clutch relay and A/C switch circuit at ECM.

CRUISE CONTROL SWITCH

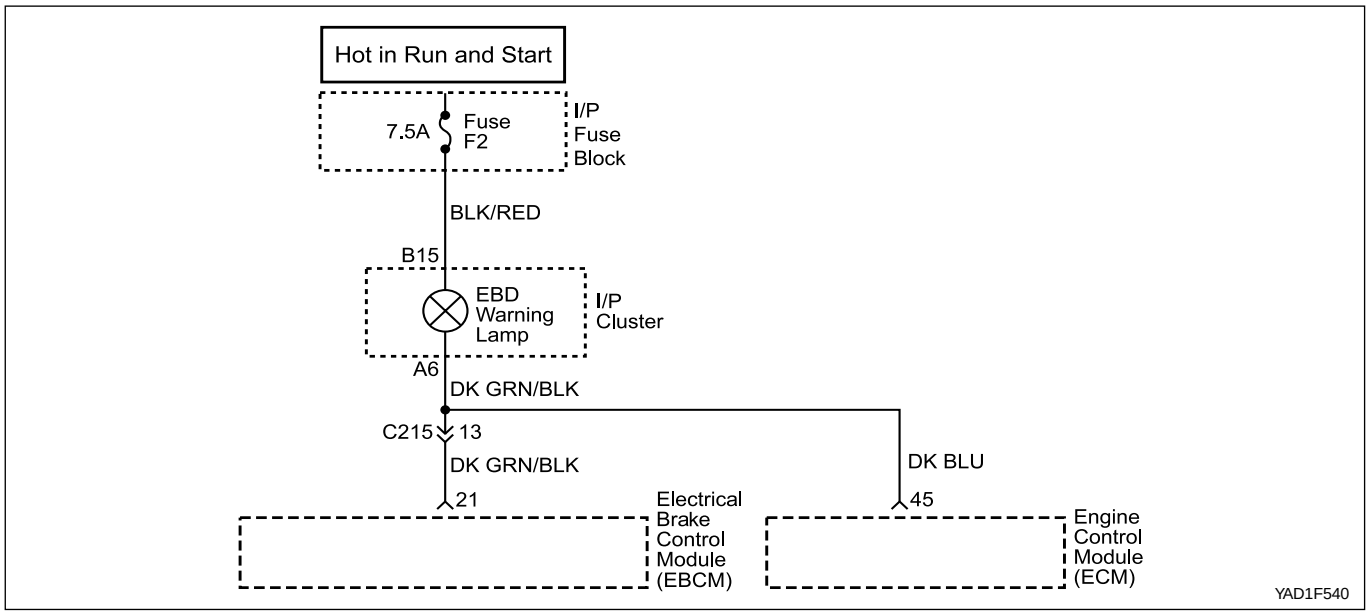


Failure Code	Description	Trouble Area	Maintenance Hint
129	Cruise control “OFF” due to message counter failure	Cruise control system message counter fault	• Monitoring the actual recognition status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 52, 53, 54, 55, 57 about short circuit or open with bad contact • Inspection the CAN and ABS • Inspection the cruise control lever switch • Inspection the ECM
130	Vehicle speed signal failure	When malfunction of auto-cruise system Implausible condition of vehicle speed signal.	
131	Vehicle speed signal failure		
132	Cruise control lever failure	Cruise control lever defective	
133	Cruise control acceleration failure	Cruise control system Implausible condition of acceleration signal	
134	Cruise control deceleration failure	Cruise control system Implausible condition of deceleration signal	

Circuit Description

Cruise control is an automatic speed control system that maintain adesired driving speed with out using the accelerator pedal. The vehicle speed must be greater than 40 km/h to engage cruise control.

TRACTION CONTROL SYSTEM (TCS)

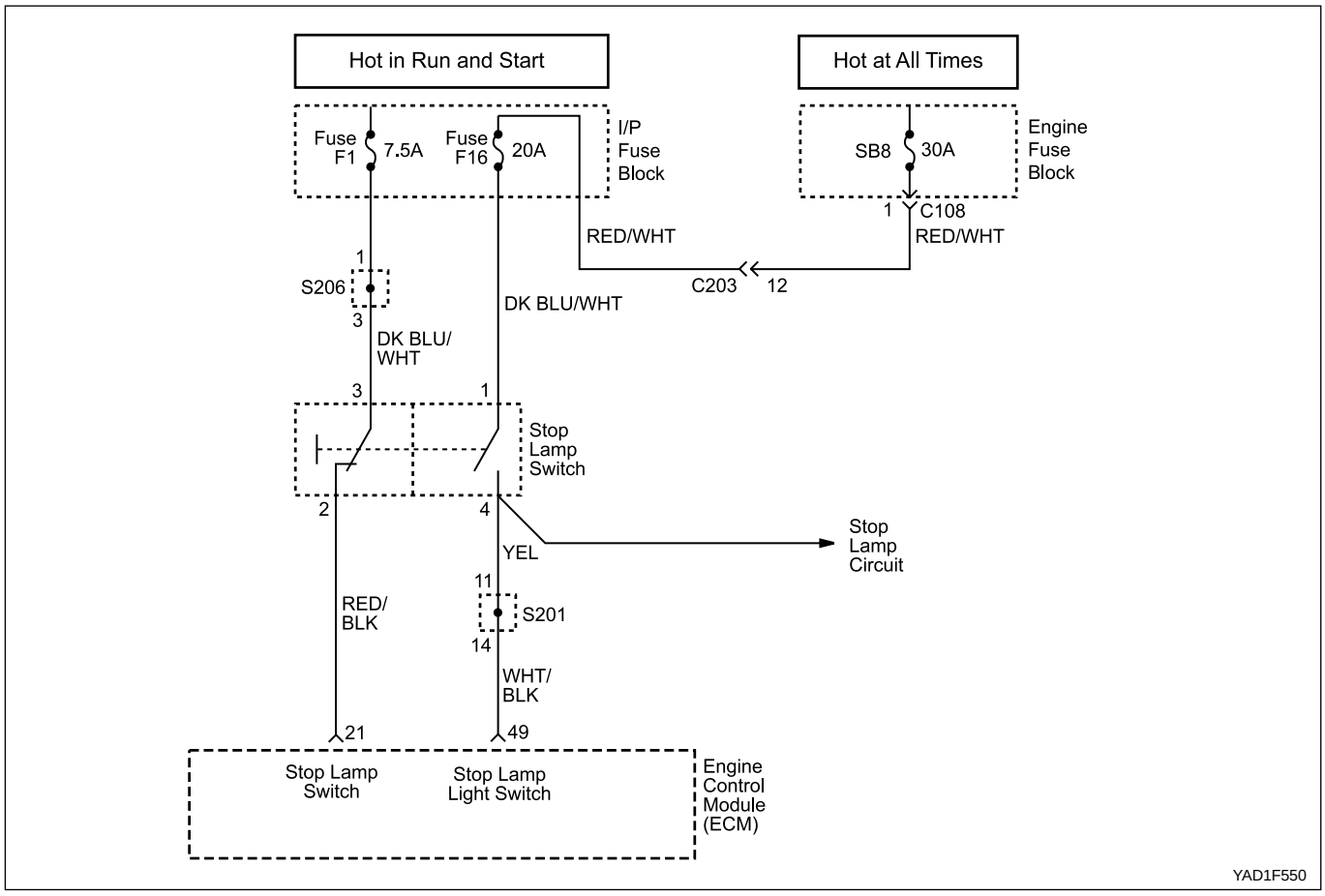


Failure Code	Description	Trouble Area	Maintenance Hint
150	TCS input signal short circuit to battery	TCS short circuit to power	• Inspection the Engine Control Module (ECM) pin 45 about short circuit or open with bad contact • Inspection the TCS lamp of I/P cluster. • Inspection the ECM
151	TCS input signal short circuit to ground or open	TCS short circuit to ground or open	

Circuit Description

Battery voltage is supplied to the TCS warning lamp with the ignition in ON and START. The warning lamp can be activated only by the Electrical Brake Control Module (EBCM) internally supplying ground to terminal 21. If the TCS input circuit is open or short, this failure code will be set.

STOP LAMP SWITCH

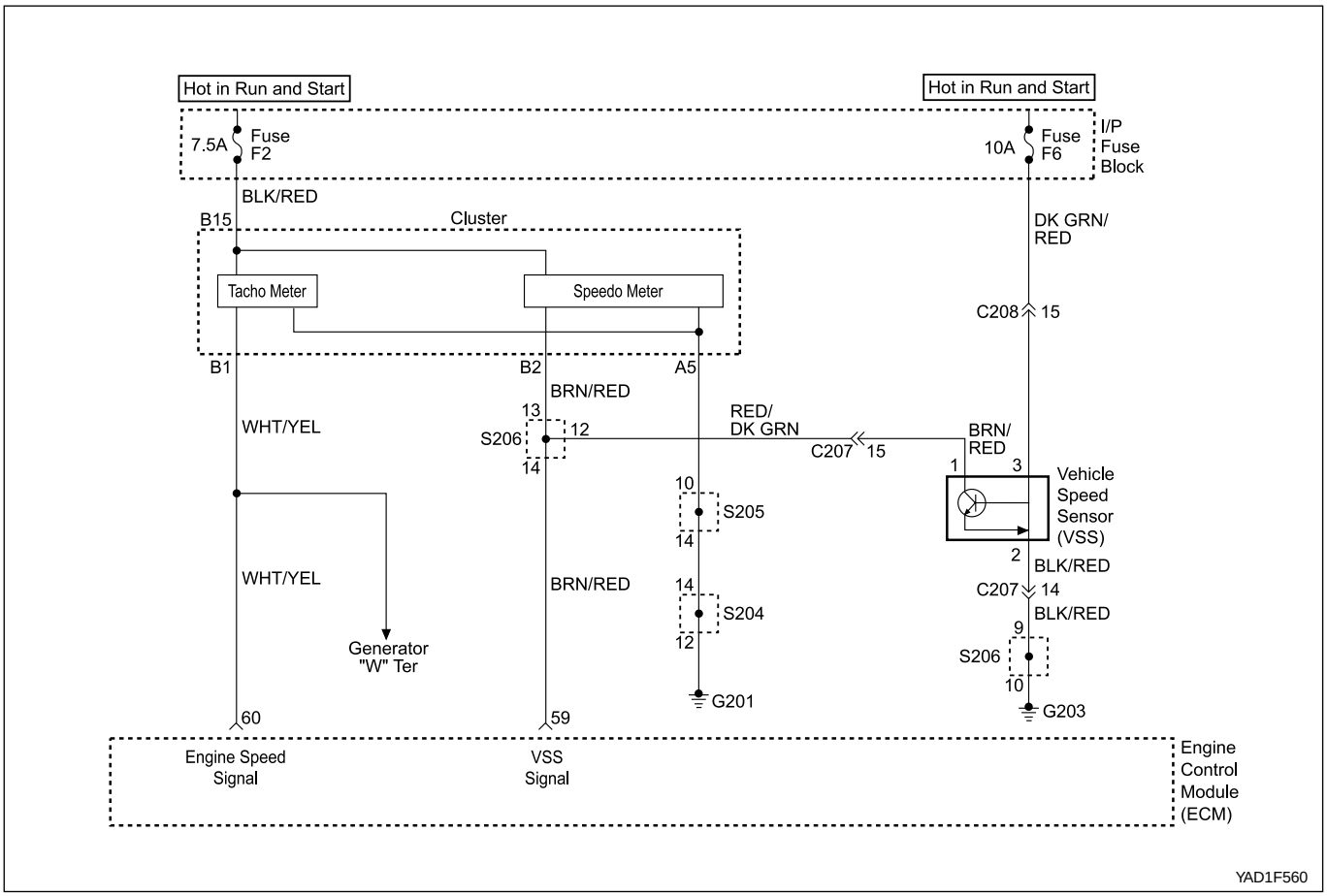


Failure Code	Description	Trouble Area	Maintenance Hint
135	Stop lamp switch failure	When malfunction of stop lamp switch-implausible condition of stop lamp signal input	• Monitoring the actual operational status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 49 about short circuit or open with bad contact • Inspection the contact condition of stop lamp switch • Inspection the ECM

Circuit Description

The stop lamp switch is normally opened. When the ignition switch ON and brake ON, the battery voltage is supplied to the ECM. A scan tool should display ON when brake pedal is depressed and should read OFF with brake pedal released.

ENGINE RPM



Failure Code	Description	Trouble Area	Maintenance Hint
32	Engine rpm output circuit short circuit to battery	When short circuit to battery	• Monitoring the actual rpm in cluster • Inspection the Engine Control Module (ECM) pin 60 about short circuit or open • Inspection the cluster panel board circuit • Inspection the ECM
33	Engine rpm output circuit short circuit to ground or open	When short circuit to ground or open	

EXHAUST SYSTEM

CATALYTIC CONVERTER

The purpose of the catalytic converter is to convert the three pollutants of carbon monoxide (CO), hydrocarbons (HC) and oxides of nitrogen (NOx) contained in the exhaust of gasoline engines, into the harmless compounds of water (H2O), carbon dioxide (CO2) and nitrogen (N2).

The catalytic converter contains acatalyst, a word coming from the Greek and which designates the element essential for catalyst which triggers chemical reactions without itself being consumed.

These catalysts in the 3-way catalytic converter are the rare metals platinum (Pt) and rhodium (Rh).

The catalytic converter consists essentially of three main elements. The exhaust gases flow through the catalytic converter and, in so doing, coming into contact with rare metals (Pt and Rh).

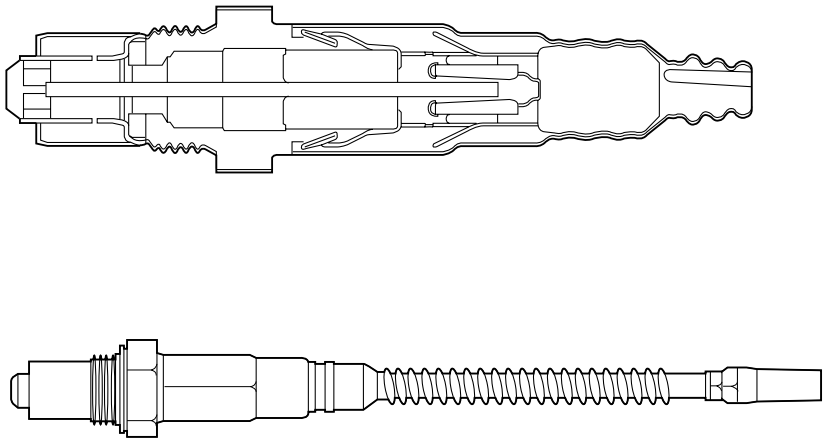
The following chemical reaction are produced.

$CO + O_2 \rightarrow CO_2$

$HC + O_2 \rightarrow CO_2 + H_2O$

$NO_x \rightarrow N_2 + O_2$

OXYGEN SENSOR



YAD1F570

The oxygen sensor is unique amongthe engine control sensors because is acts like a battery and is able to generate its own low voltage signal. It is located the exhaust system and monitors the amount of oxygen in the exhaust stream and provides feedback to the Engine Control Module (ECM).

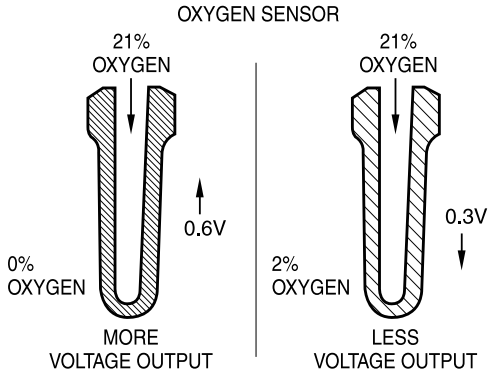
The electrically heated oxygen sensor warms up quickly and remains hot, even at idle when the exhaust manifold may cool down.

The ECM applies a reference voltage of 450 mv to the oxygen sensor, the ECM compares this reference voltage with the voltage generated by oxygen sensor. The amount of voltage the oxygen sensor generates is proportionate to the difference between the amount of oxygen in the outside air and the exhaust gases. The atmosphere contains about 21% oxygen. The exhaust from a rich air/fuel ratio contains almost no oxygen. With a large difference betweenthe amounts of oxygen containing the two surface, the sensor generates less voltage.

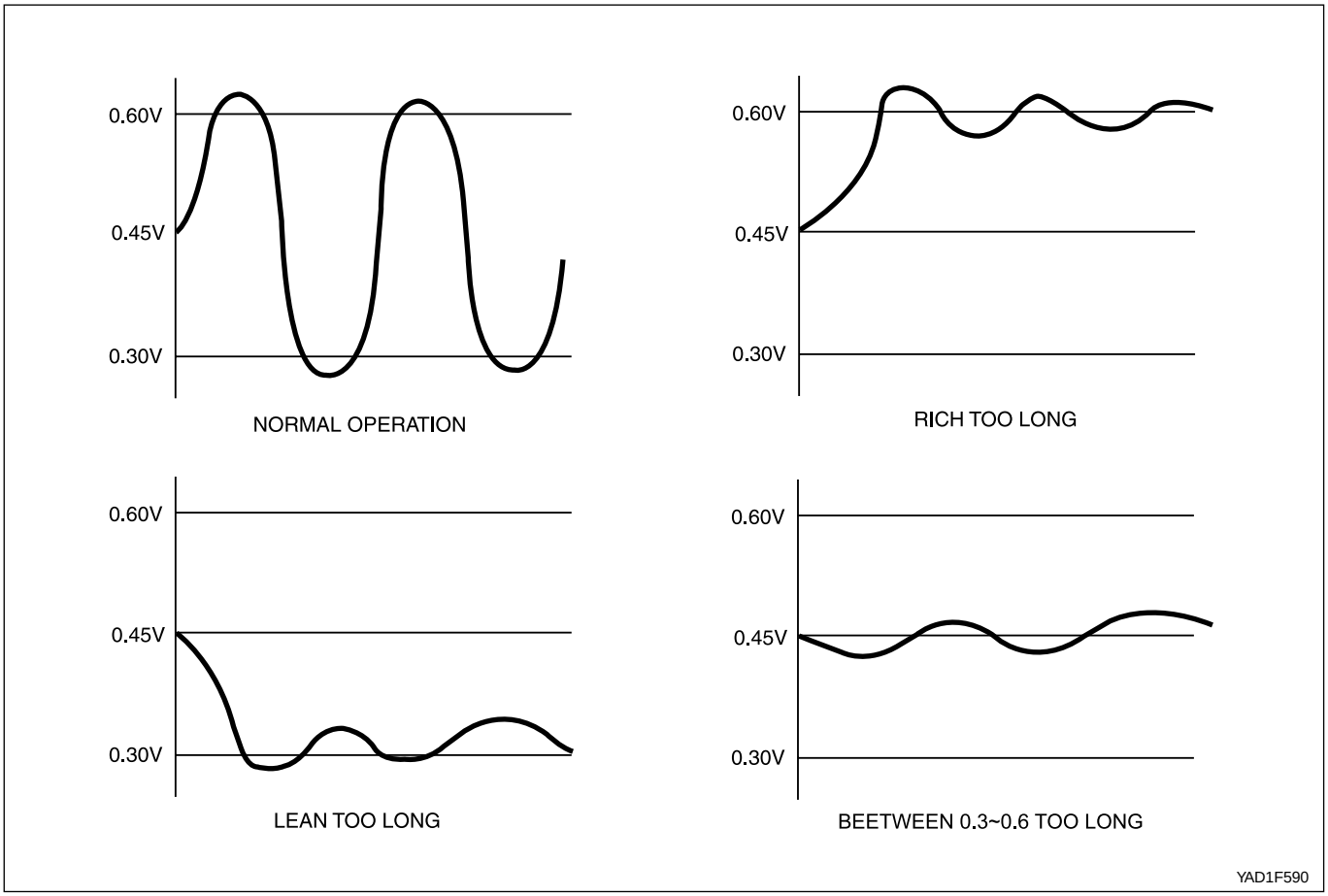
When the exhaust gas is rich (below 14.7:1), the voltage output is high, above 450 mv. When the exhaust gas is lean (above 14.7:1 air/fuel ratio), the sensor's voltage output is low, below 450 mv.

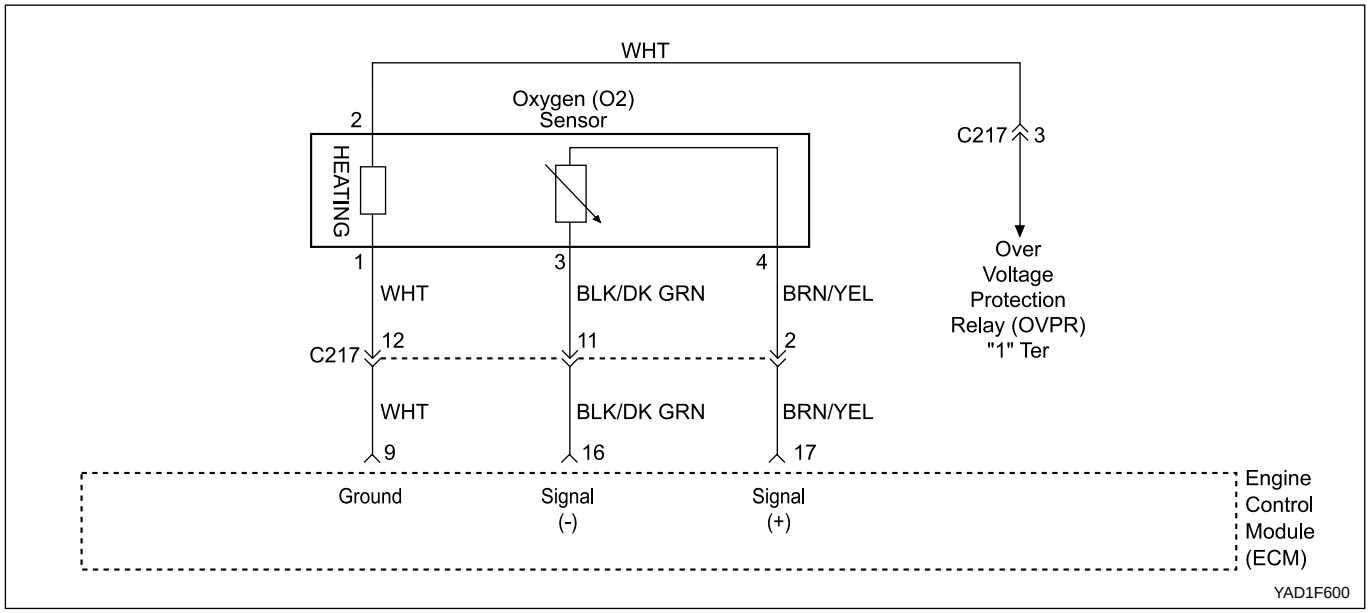
The ECM uses oxygen sensor information for:

- Open loop / closed loop criteria
- Ideal air / fuel ratio



YAD1F580


0.60V
0.45V
0.30V
NORMAL OPERATION
0.60V
0.45V
0.30V
RICH TOO LONG
0.60V
0.45V
0.30V
LEAN TOO LONG
0.60V
0.45V
0.30V
BEETWEEN 0.3~0.6 TOO LONG
YAD1F590



Failure Code	Description	Trouble Area	Maintenance Hint
80	Oxygen sensor high voltage	When recognition the output that more than nominal threshold, malfunction of sensing voltage.	• Monitoring the actual output signal through scan tool • Inspection the ECM pin 16, 17 about short circuit or open with bad contact • Inspection the oxygen sensor • Inspection the ECM
89	Oxygen sensor low voltage	When recognition the output that more than nominal threshold, malfunction of sensing voltage.	
82	Oxygen sensor no activity detected	When recognition the output that not active the sensor etc.	
83	Oxygen sensor not lean after overrun fuel shut-off	When recognition the output that no lean signal after overrun fuel shut-off	
84	Oxygen sensor slow response	When slow response of sensor signal	
85	Oxygen sensor heater failure	When recognition the heating circuit	• Monitoring the heating status through scan tool • Inspection the ECM pin 9 about short circuit or open with bad contact • Inspection the heating power source • Inspection the heating circuit of oxygen sensor • Inspection the ECM
86	Oxygen sensor heater short circuit to battery	When recognition the heating currents that more or less than set values (less than 0.2 A or more than 2 A)	
87	Oxygen sensor heater short circuit to ground or open	When recognition the heating voltages than less than set values (less than 2 v)	

Failure Code	Description	Trouble Area	Maintenance Hint
81	Bank 1 system short term fuel trim adaptation below lean threshold	When recognition the value less than nominal control threshold, it means that when big deviation in control range of adaptation values through fuel and air mixture formation	• Inspection the intake air leakage • Inspection the injection quantities with injector block or leakage • Inspection the exhaust leakage • Inspection the ECM
93	Bank 1 system short term fuel trim adaptation above rich threshold	When recognition the value more than nominal control threshold, it means that when big deviation in control range of adaptation values through fuel and air mixture formation	
96	Bank 1 system short term fuel trim at rich stop	When recognition the short term fuel trim that more than nominal threshold	
97	Bank 1 system short term fuel trim at lean stop	When recognition the short term fuel trim that less than nominal threshold	
98	Bank 1 system idle adaptationfailure (above rich threshold)	When recognition the long term fuel trim exceeds rich threshold	
99	Bank 1 system idle adaptation failure (below rich threshold)	When recognition the long term fuel trim exceeds lean threshold	
100	Bank 1 system learning control failure (rich, low load)	When recognition the long term fuel trim exceeds rich threshold	
101	Bank 1 system learning control failure (lean, low load)	When recognition the long term fuel trim exceeds lean threshold	
102	Bank 1 system learning control failure (rich, high load)	When recognition the long term fuel trim exceeds rich threshold	
103	Bank 1 system learning control failure (rich, low load)	When recognition the long term fuel trim exceeds lean threshold	

Circuit Description

In order to control emissions, a catalytic converter is used to covert harmful emissions into harmless water vapor and carbon dioxide. The ECM has the ability to monitor this process by using a oxygen sensor. The oxygen sensor produces and output signal which indicates the storage capacity of the catalyst. This in turn indicates the catalyst's ability to convert exhaust emission effectively. If the oxygen sensor pigtail wiring, connector, or terminal is damaged. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the oxygen sensor wire(s). Any attempt to repair the wires, connector, or terminal and degrade the oxygen sensor performance.

Oxygen Sensor Signal Voltage Inspection

1. Maintain the engine speed is at idle while the coolant temperature is over 80 °C.
2. Measure the oxygen sensor signal voltage between the ECM terminal No. 16 and No. 17.

Specified Value	0.2 ~ 1.0 V

Notice: If the measured value is not within the specified value, the possible causemay bein cable, oxygen sensor or ECM

Oxygen Sensor Heating Voltage Inspection

1. Maintain the engine speed is at idle while the coolant temperature is over 80 °C.
2. Measure the oxygen sensor signal voltage between the ECM terminal No. 11 and No. 9.

Specified Value	11 ~ 14 V

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

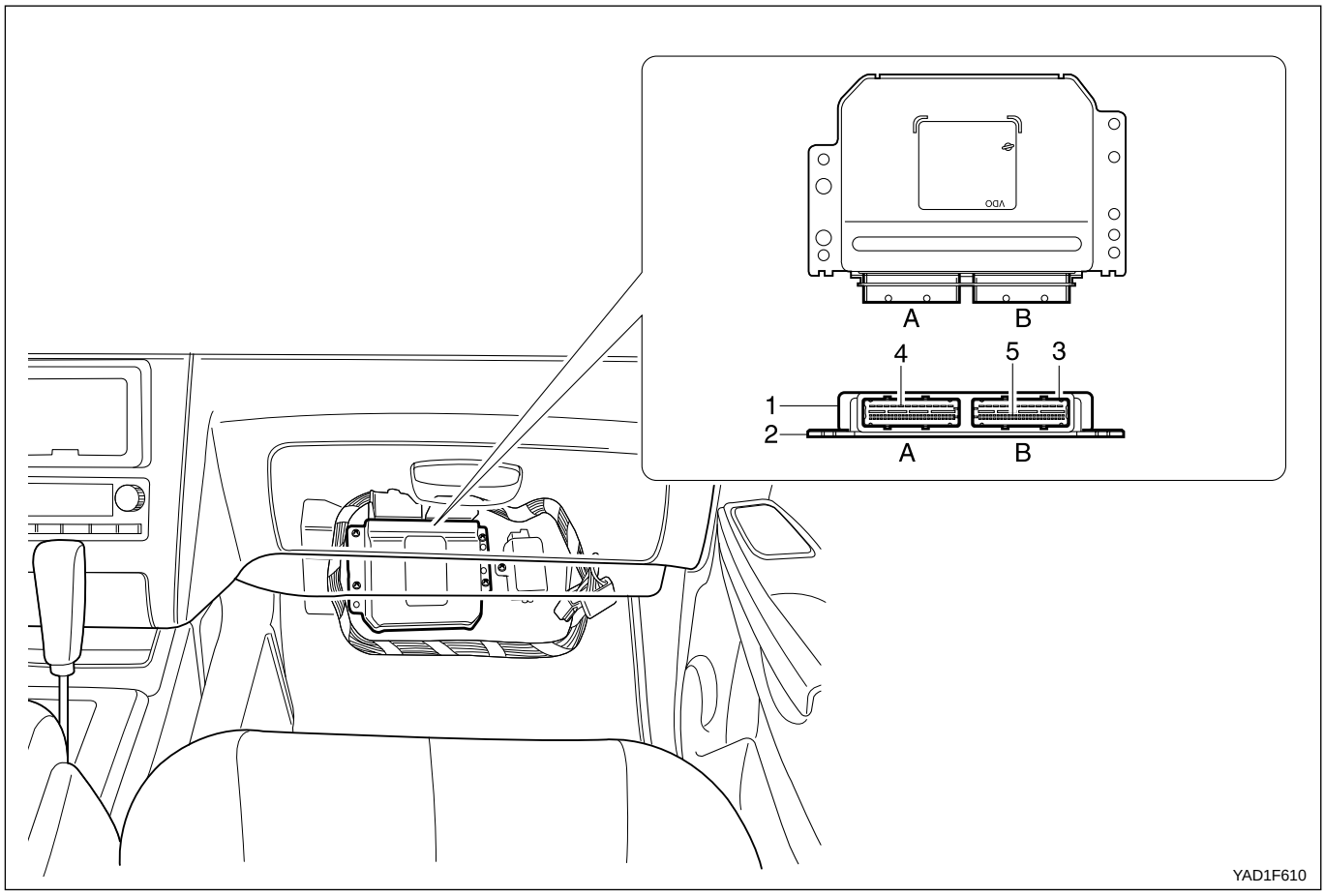
Oxygen sensor Heating Current Consumption Inspection

1. Turn the ignition switch to "ON" position.
2. Measure the oxygen sensor heating current consumption between the ECM terminal No. 9 and No. 5.

Specified Value	0.2 ~ 2.0 V

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

ENGINE CONTROL MODULE



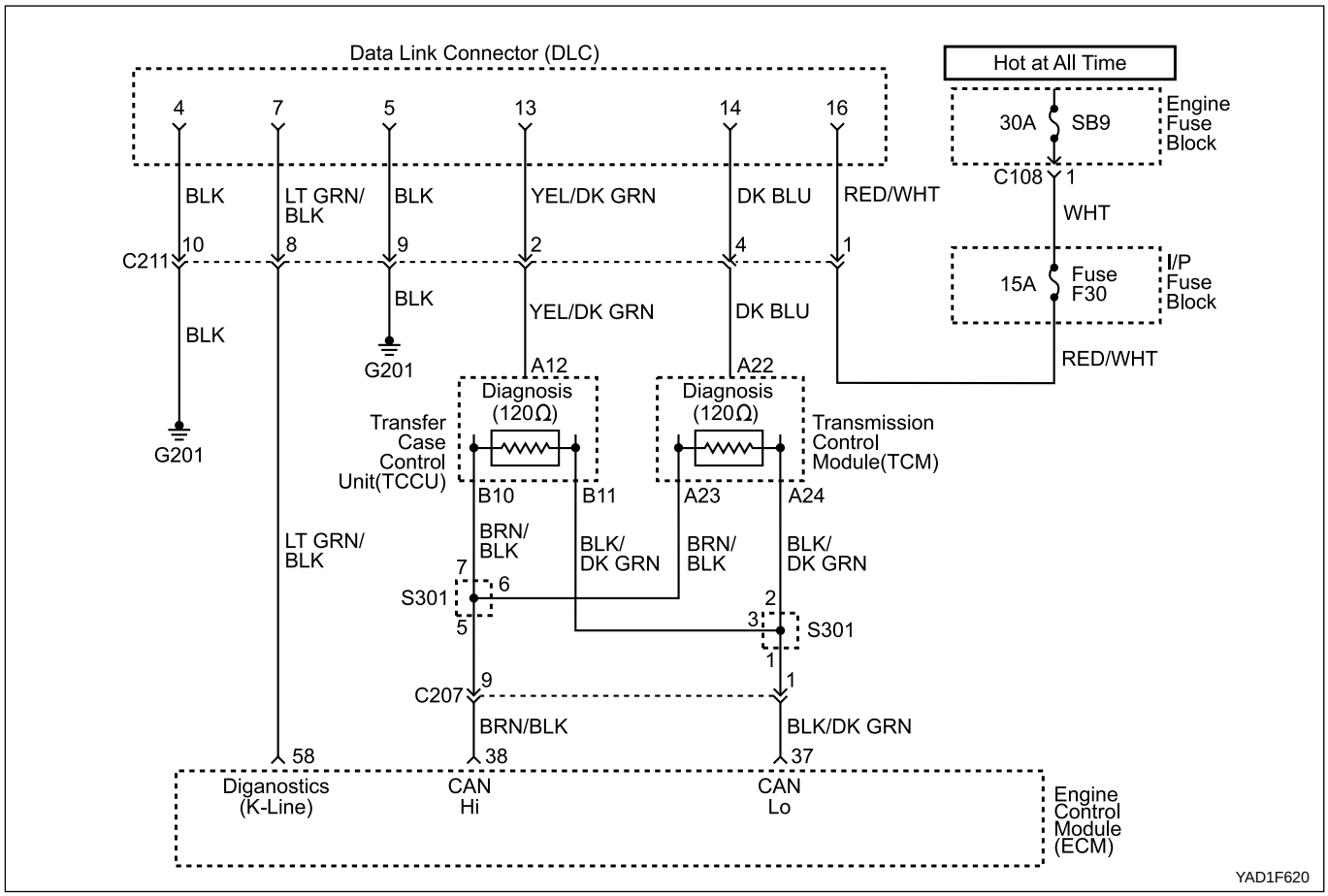
1 Cover
2 Plate
3 Connector
4 Plat Pin
Vehicle Side : No. 1-12
Engine Side : No. 61-72
5 Pin
Vehicle Side : No. 13-60
Engine Side : No. 73-120
A Vehicle Side Connector : Black
B Engine Side Connector : Gray

The Engine Control Module (ECM), located inside the right side kick panel, is the control center of the fuel injection system. It constantly looks at the information fromvarious sensors and controls the systems that affect the vehicle's performance. Engine rpm and air mass are used to measure the air intake quantity resulting in fuel injection metering. The ECM also performs the diagnostic functions of the system. It can recognize operational problems, store failure code(s) which identify the problem areas to aid the technician in making repairs.

There are no serviceable parts in the ECM. The calibrations are stored in the ECM in the Programmable Read Only Memory (PROM).

The ECM supplies either 5 or 12 volts to power the sensors or switches. This is done through resistance in the ECM which are so high in value that a test light will not come ON when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give and accurate reading because its resistance is too low. You must use a digital voltmeter with a 10 Mohm input impedance to get accurate voltage readings. The ECM controls output circuits such as the ignition coils, the fuel injectors, the fuel pump relay, the camshaft actuator, the canister purge valve, etc., by controlling the ground circuit.

SERIAL DATA COMMUNICATION



Failure Code	Description	Trouble Area	Maintenance Hint
23	CAN communication failure: ASR/MSR	When CAN signal message missing or implausibility for ASR/MSR unit or not initialized condition	• Inspection the ASR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
24	CAN communication failure: ABS	When CAN signal message missing or implausibility for ABS unit or not initialized condition	• Inspection the ABS unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
26	CAN communication failure: TCU (A/T only)	When CAN signal message missing or implausibility for TCU unit or not initialized condition	• Inspection the TCM unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM

Failure Code	Description	Trouble Area	Maintenance Hint
29	CAN communication failure: ID 200h not plausible	When CAN signal message missing or implausibility for ABS/ABD unit or not initialized condition	• Inspection the ABS/ABD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
30	CAN communication failure: ID 208h not plausible	When CAN signal message missing or implausibility for ABS/ABD unit or not initialized condition	• Inspection the ABS/ABD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
31	CAN communication failure: communication initialization failure	When CAN signal message missing or implausibility for each unit (ABS, ASR, TCM, TOD etc.) or not initialized condition	• Inspection the each control unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
59	CAN communication failure: MSR data transmission not plausible	When CAN signal message missing or implausibility for MSR unit or not initialized condition	• Inspection the MSR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
60	CAN communication failure: ASR data transmission not plausible	When CAN signal message missing or implausibility for ASR unit or not initialized condition	• Inspection the ASR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM

Circuit Description

The provision for communicating with the ECM is the Data Link Connector (DLC). It is located in the instrument panel fuse block. The DLC is used to connect the scan tool. Battery power and ground is supplied for the scan tool through the DLC. CAN line is used to communicate with the other module such as the Transmission Control Module (TCM) and Transfer Case Control Unit (TCCU).

Keyword 2000 Serial Data Communications

Each bit of information can have one of two lengths: long or short. This allows vehicle wiring to be reduced by transmitting and receiving multiple signals over a singles wire. The message carried on KWP 2000 data streams are also prioritized. If two messages attempt to establish communications on the data line at the same time, only the message with higher priority will must wait.

INTERNAL FAILURE

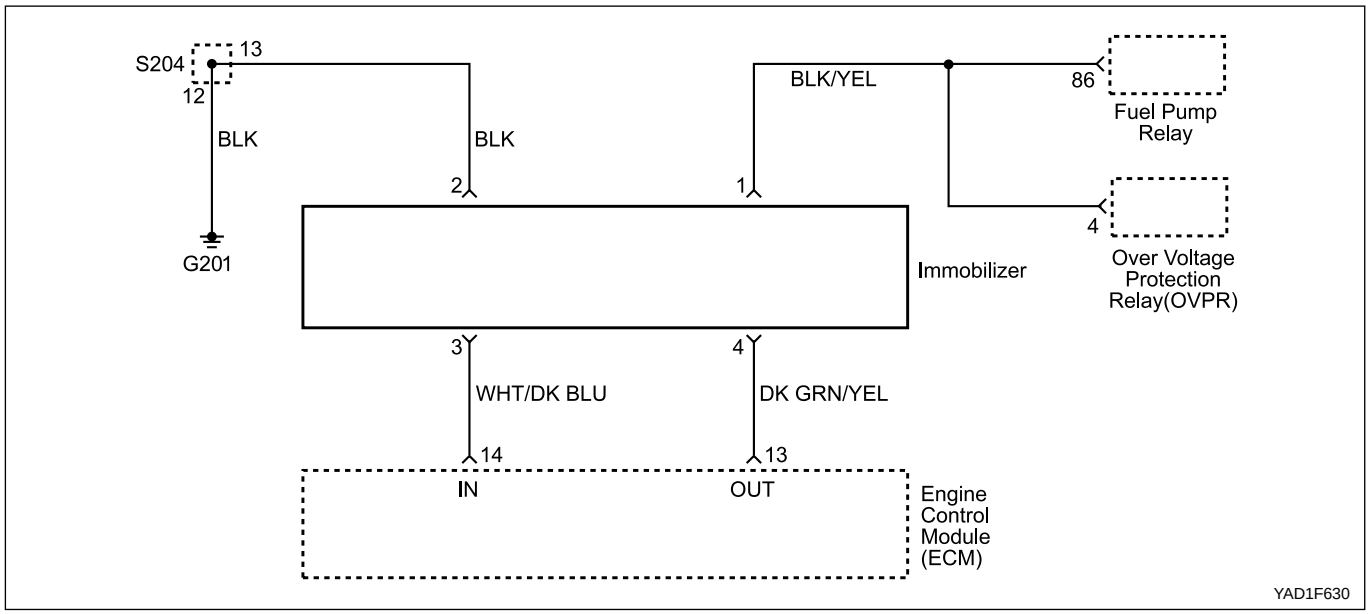
Failure Code	Description	Trouble Area	Maintenance Hint
21	Transmission coding failure	When faulty of variant coding of transmission	• Inspection the coding condition through scan tool • InspectiontheEngine ControlModule (ECM) • Inspection the CAN line • Inspection the TCM
136	ECM failure (RAM)	When malfunction of random access memory - ECM internal error	• Inspection the ECM
142	Uncoded/ unprogramed ECM	When malfunction of ECM coding-required ECM encoding	• Fulfill the ECM variant coding
137	ECM failure (EPROM)	When malfunction of ECM internal	• Inspection the ECM
143	ECM failure (EEPROM/ Flash-EPPOM checksum failure)		
144	ECM failure (coding ID checksum failure)		
145	ECM failure (coding checksum failure)		
146	ECM failure (program-ming checksum failure)		

ELECTRONIC THROTTLE CONTROLLER SAFETY MALFUNCTION

Failure Code	Description	Trouble Area	Maintenance Hint
110	Throttle actuator learning data fault	System internal failure	• Inspection the Engine Control Module (ECM)
117	Exceed fuel-cut safety time		
120	Cruise control interruption memory failure		
138	Call Monitoring		
139	Servo motor control output interruption memory failure		
140	Servo motor open/short		
186	ECM failure (incompatible CPU)		
187	ECM failure (CPUs communication failure)		
188	ECM failure (CPU 2 configuration failure)		
189	ECM failure (CPU 2 fault)		
190	ECM failure (CPU run time failure between CPUs)		
231	ECM failure (CPU 2 cruise control message counter failure)		
232	Over deceleration limit (CPU 2)		
233	Over acceleration limit (CPU 2)		
234	Cruise control lever dual operation (CPU 2)		
235	Cruise control lever safety terminal failure (CPU 2)		
236	Unusual pedal position variation (CPU 2)		
237	Unusual throttle position variation (CPU 2)		
238	Unusual throttle controller monitoring data comparison fault (CPU 2)		

Failure Code	Description	Trouble Area	Maintenance Hint
239	Unusual accelerator pedal position sensor comparison fault (CPU 2)	System internal failure	• Inspection the Engine Control Module (ECM)
240	Throttle potentiometer comparison fault (CPU 2)		
241	Unusual CPU communication (CPU 2)		
242	Unusual CPU configuration (CPU 2)		
243	A/D converter failure (CPU 2)		
244	Accelerator pedal position sensor setpoint fault between CPU 1 and CPU 2		
245	Position controller setpoint fault between CPU 1 and CPU 2		
246	MSR setpoint fault between CPU 1 and CPU 2		
247	Idle control setpoint fault between CPU 1 and CPU 2		
248	A/D converter overflow (CPU 2)		
249	ROM fault (CPU 2)		
250	RAM fault (CPU 2)		
251	Cycle monitor fault (CPU 2)		

IMMOBILIZER



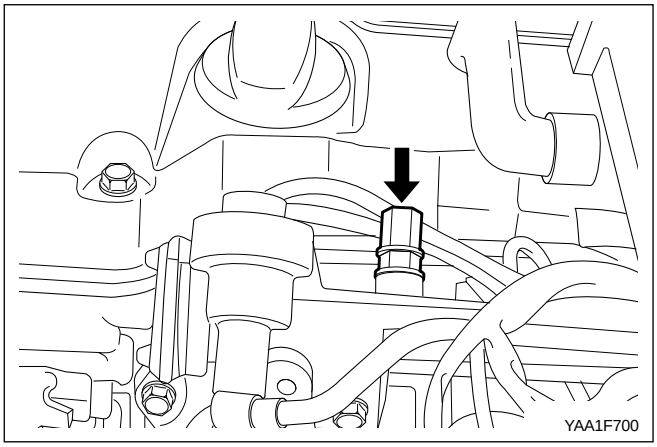
Failure Code	Description	Trouble Area	Maintenance Hint
25	Communication with transponder missing	When missing the transponder signal	• Inspection the Engine Control Module (ECM) pin 13, 14 about short circuit or open with bad contact • Inspection the power source or ground short circuit or open of immobilizer unit • Inspection the transponder condition (broken etc.) • Inspection the ECM
141	Unprogramed ECM with immobilizer	When malfunction of immobilizer Required immobilizer encoding, no paired condition of immobilizer even through start trial	• Fulfill the immobilizer pairing

Circuit Description

Immobilizer is a device disabling vehicle ignition unless a specific key is used and designed to help prevent vehicle theft.

Immobilizer is comprised of two devices, a key with encoded transponder and ECM with the same encoding of the transponder. When a key is inserted into the hole to start vehicle and turned to ON, the ECM reads and decodes the transponder code and, if the same, starts the engine, it is called immobilizer. It means immobilizer system disables starting by stopping fuel supply if the code in the transponder does not match the code stored in ECM each other.

MAINTENANCE AND REPAIR



ON-VEHICLE SERVICE

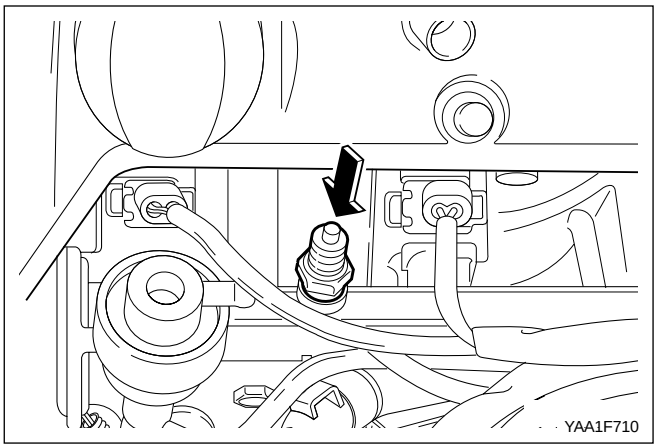
DISCHARGING THE PRESSURE IN FUEL SYSTEM

Removal and Installation Procedure

1. Remove the fuel pressure test connector.

   Installation Notice

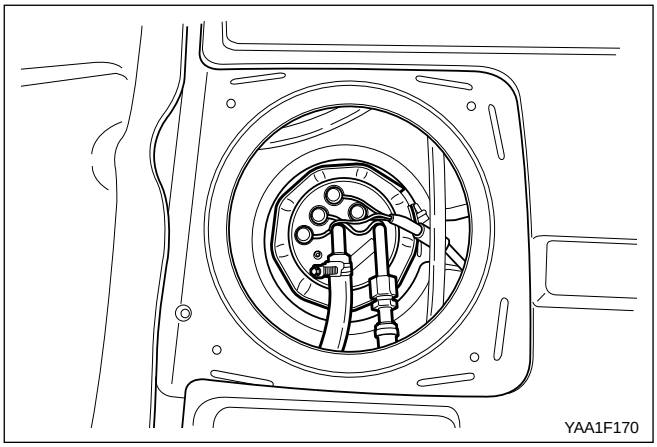
Tightening Torque	25 N•m (18 lb-ft)



2. Remove the fuel pressure in fuel systemby pressing the service valve with a clean, pointy tool.

   Notice: Place a cloth so that the fuel doesn't stain around.

3. Installation should follow the removal procedure in the reverse order.



FUEL PUMP

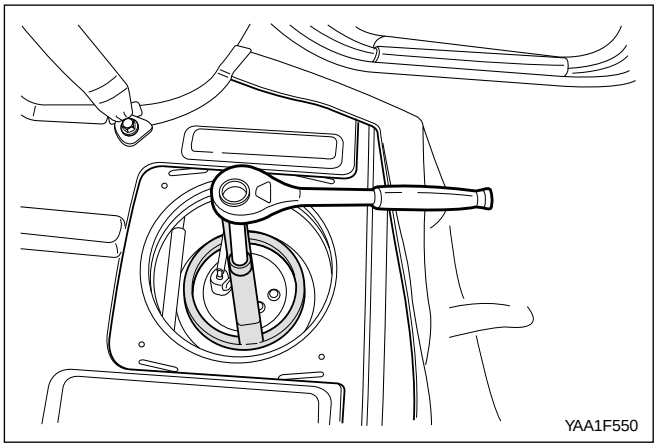
Tools Required

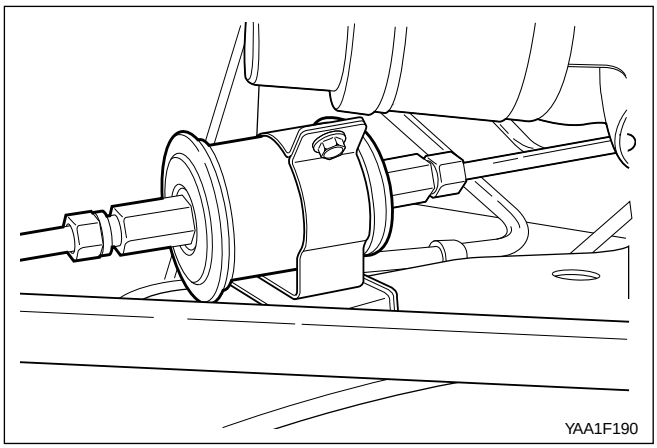
661 589 00 46 00 Fuel Tank Cap Wrench

Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel system pressure. Refer to "Discharging the Pressure in Fuel System" in this section.
2. Disconnect the negative battery cable.
3. Put aside the floor carpet to remove the fuel pump access cover.
4. Remove the fuel pump access cover.
5. Remove the fuel pump wiring connectors.
6. Disconnect the fuel supply and return pipes.
7. Remove the fuel pump locking cap band.


YAA1F550


YAA1F190

8. Using the fuel tank cap wrench 661 589 00 46 00, remove the locking cap.
9. Remove the pump from the fuel tank.

   Notice: Check the condition of the seal and replace if necessary. Drain the fuel before removing the pump.

10. Perform an operational check of the fuel pump.
11. Installation should follow the removal procedure in the reverse order.

FUEL FILTER

Removal and Installation Procedure

1. Disconnect the negative battery cable.

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

2. Relieve the fuel system pressure. Refer to “Discharging the Pressure in Fuel System” in this section.
3. Disconnect the fuel lines from the fuel filter.

   Installation Notice

Tightening Torque	28 N•m (21 lb-ft)

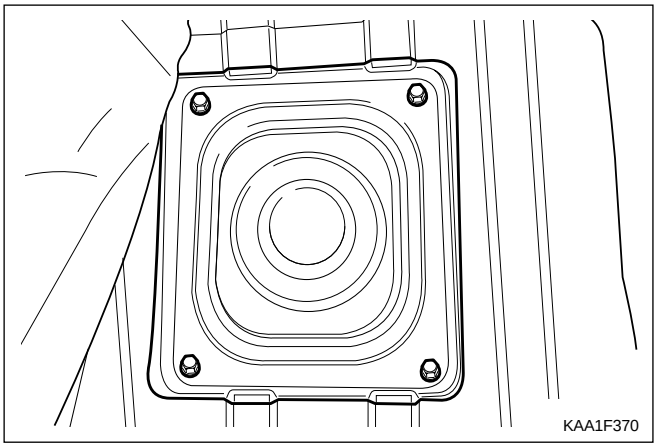
4. Remove the fuel filter mounting bracket bolt .

   Installation Notice

Tightening Torque	6 N•m (53 lb-in)

   Notice: Place the fuel pump pad. There may be acorrosion due to the contact between the fuel filter and the bracket.

5. Remove the fuel filter.
6. Install the fuel filter.
7. Perform a leak test of the fuel filter.
8. Installation should follow the removal procedure in the reverse order.

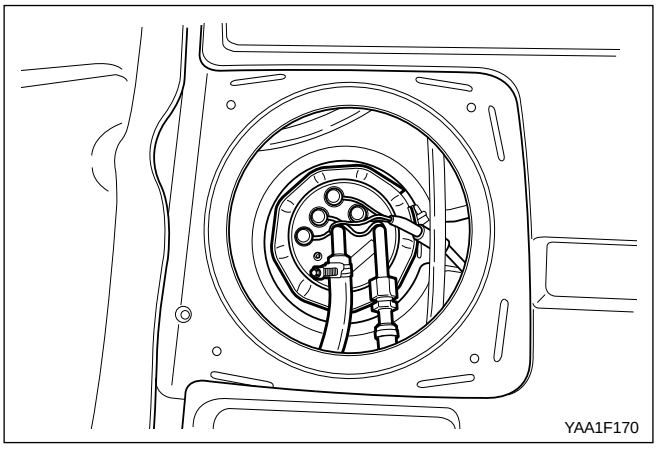

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FUEL TANK

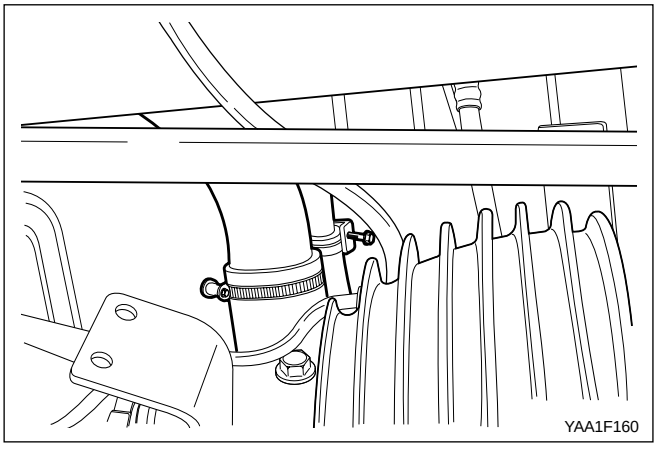
Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel pressure. Refer to “Discharging the Pressure in Fuel System” in this section.
2. Disconnect the negative battery cable.
3. Drain the fuel tank.
4. Put aside the floor carpet to remove the fuel pump access cover.
5. Remove the fuel pump access cover.


YAA1F170

6. Disconnect the return line.
7. Disconnect the supply line.
8. Disconnect the fuel tank-to-canister hose from the fuel tank.
9. Disconnect the fuel pump wiring connector.

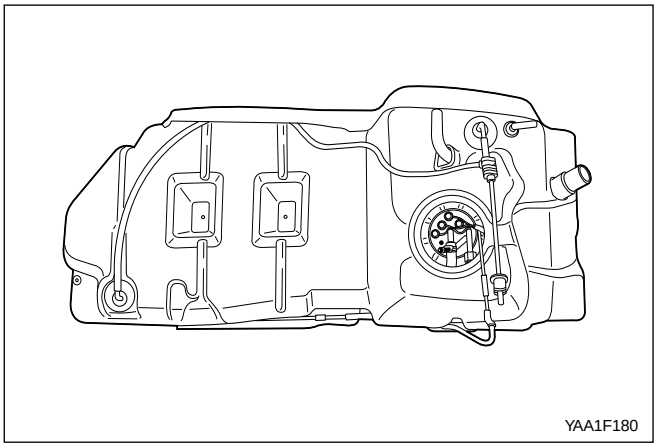

YAA1F160

10. Disconnect thefuel filler hoseand air vent hosefrom the fuel tank.
11. Support the fuel tank.
12. Remove the fuel tank retaining nuts.

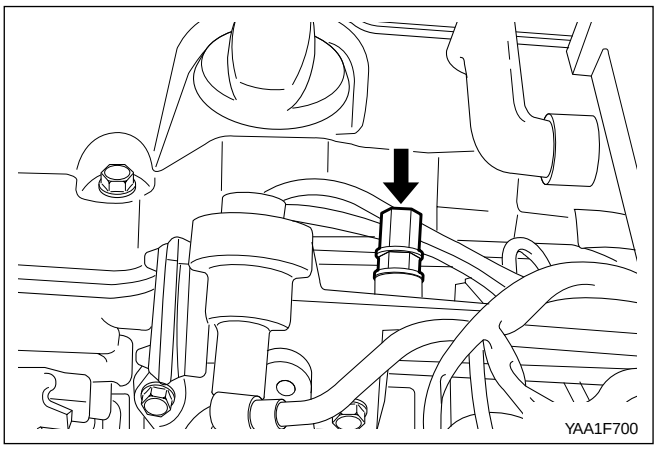
Installation Notice

Tightening Torque	38 N•m (28 lb-ft)

13. Carefully lower the fuel tank.


YAA1F180

14. Turn the rollover valves counterclockwise at an angle of 90 degrees.
15. Turn the lock ring counterclockwise.
16. Remove and discard the gasket.
17. Installation should follow the removal procedure in the reverse order.


YAA1F700

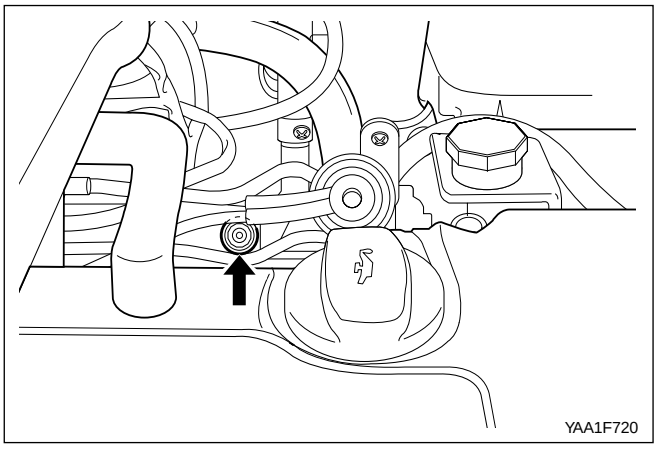
FUEL PRESSURE REGULATOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the fuel pressure test connector.

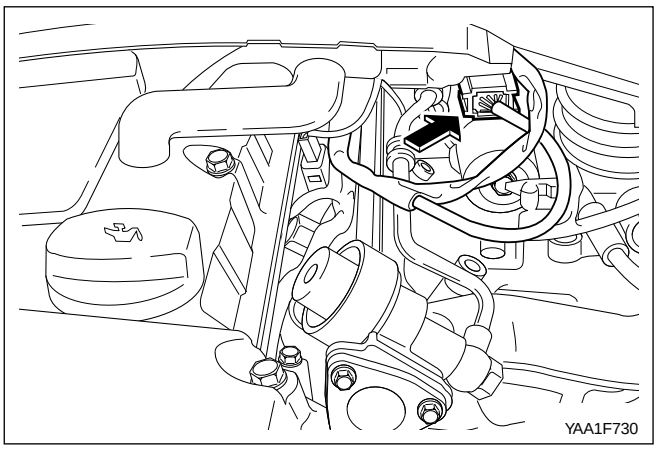
Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

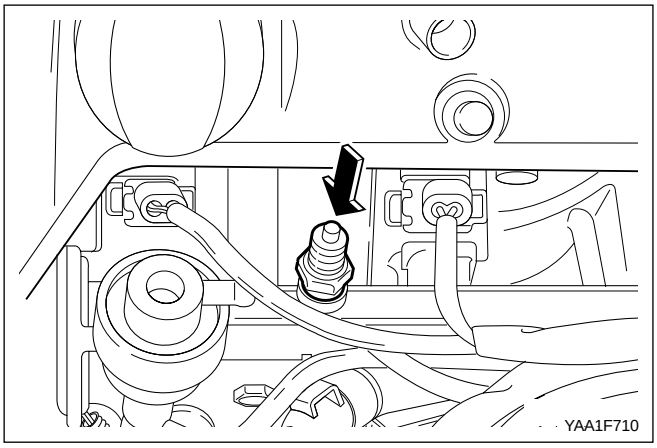

YAA1F720

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

3. Relieve the fuel pressure in fuel supply systemby pressing the service valve.


YAA1F730

4. Disconnect the vacuum hose.
5. Disconnect the circlip and remove the fuel pressure regulator.
6. Apply the oil to O-ring lightly and then replace it.
7. Perform a leak test of the fuel pressure regulator with the engine off and the ignition on.
8. Installation should follow the removal procedure in the reverse order.

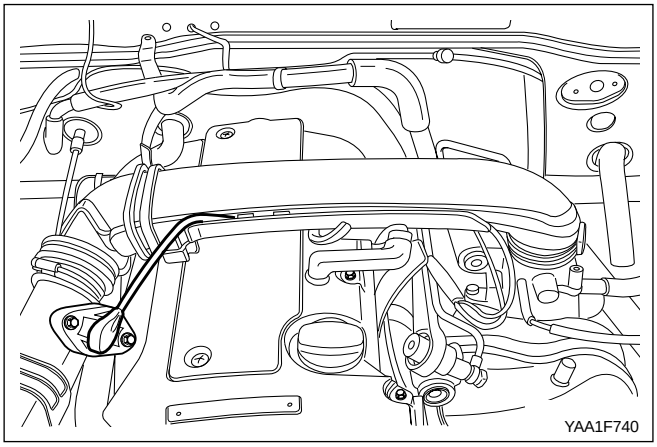


FUEL RAIL AND INJECTORS

Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Discharge the fuel pressure from the fuel pressure test connector.
2. Disconnect the negative battery cable.
3. Disconnect the vacuumhose from the fuel pressure regulator.

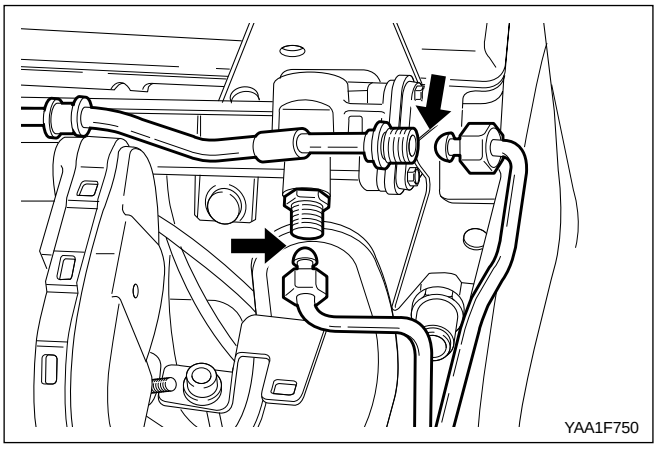


4. Remove the cable guide.
5. Disconnect the Hot Film Air Mass (HFM) sensor connector.
6. Remove the intake air duct mounting bolts.

Installation Notice

Tightening Torque	9 N•m (80 lb-in)

7. Remove the intake air duct clamps.
8. Remove the intake air duct.



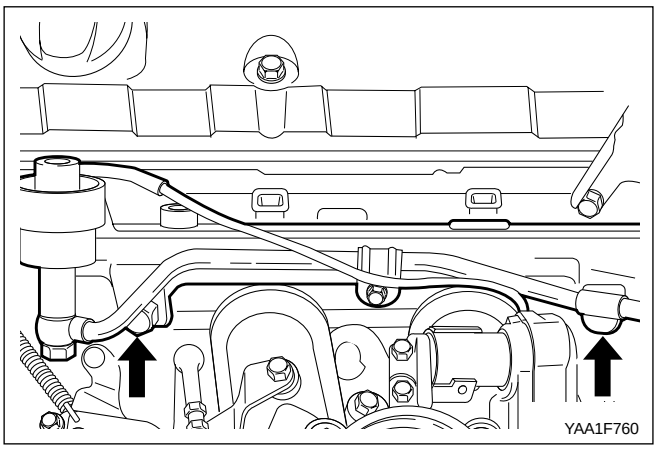
9. Remove the fuel return and supply line.

   Notice: For removal, cover around parts with cloths not to be stained by fuel. In case of checking the injector only, do not remove the fuel return and supply line.

Installation Notice

Tightening Torque	23 N•m (17 lb-ft)

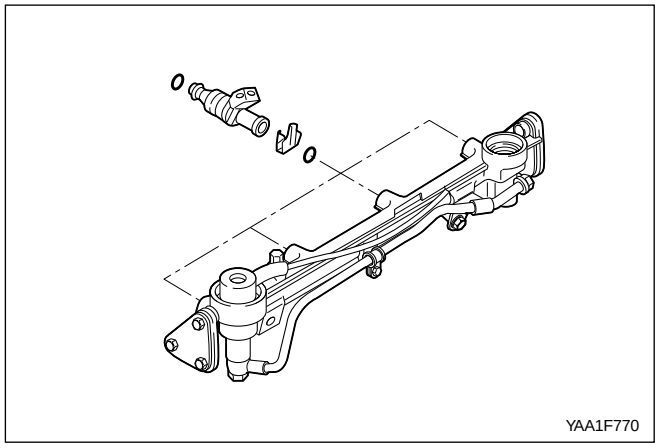
10. Remove the six injector connectors.



11. Remove the two left and two right bolts and one center bolt of the fuel rail assembly from the intake manifold.

Installation Notice

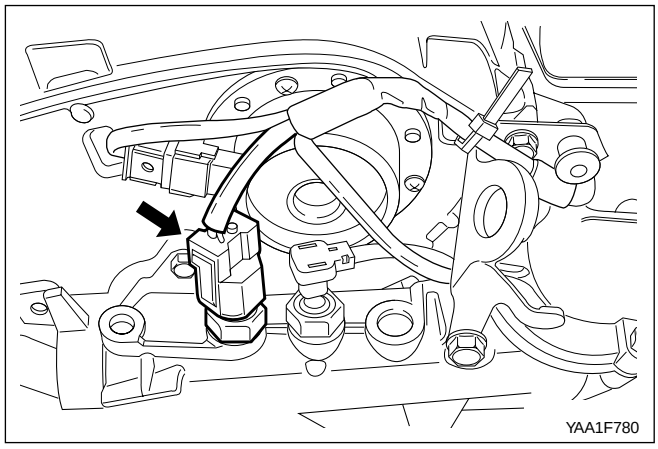
Tightening Torque	25 N•m (18 lb-ft)


YAA1F770

Notice: Before removal, the fuel rail assembly may be cleaned with a spray-type cleaner, following package instructions. Do not immerse the fuel rails in liquid cleaning solvent. Use care in removing the fuel rail assembly to prevent damage to the electrical connectors and injector spray tips. Prevent dirt and other contaminants from entering open lines and passages. Fittings should be capped and holes plugged during service.

Important: If an injector becomes separated from the rail and remains in the cylinder head, replace the injector O-ring seals and the retaining clip.

12. Remove the injectors and the fuel rail carefully.
13. Remove the fuel injector retainer clips.
14. Remove the fuel injectors by pulling them down and out.
15. Discard the fuel injector O-rings.
16. Lubricate the new fuel injector O-rings with engine oil. Install the new O-rings on the fuel injectors.
17. Perform a leak check of the fuel rail and fuel injectors.
18. Installation should follow the removal procedure in the reverse order.


YAA1F780

ENGINE COOLANT TEMPERATURE SENSOR

Removal and Installation Procedure

1. Relieve the coolant system pressure.
2. Disconnect the negative battery cable.
3. Disconnect the engine coolant temperature sensor connector.

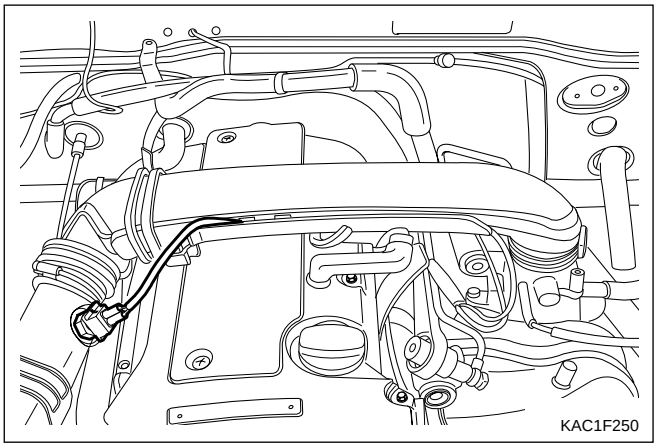
   Notice: Take care when handling the engine coolant temperature sensor. Damage to the sensor will affect the proper operation of the fuel injection system.

4. Remove the engine coolant temperature sensor from the pump hosing.

   Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

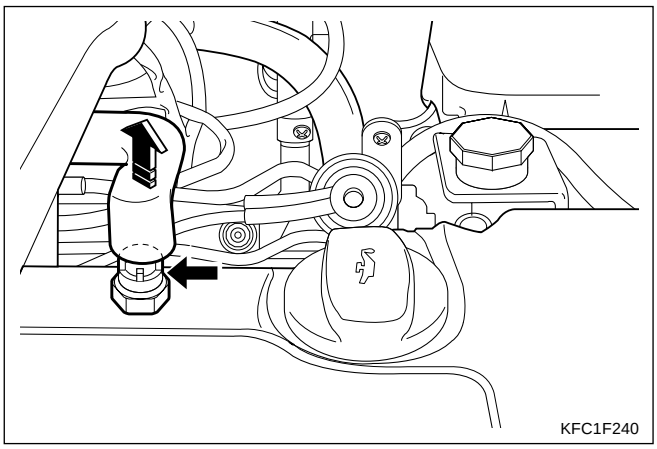
5. Installation should follow the removal procedure in the reverse order.


KAC1F250

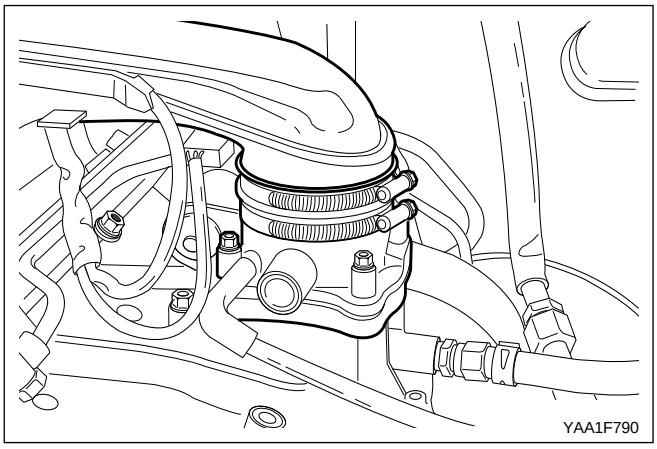
THROTTLE BODY (INTEGRATED WITH THE ACTUATOR)

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the intake air temperature (IAT) sensor connector.
3. Remove the intake air duct clamps.


KFC1F240

4. Remove the blow-by hose.
5. Remove the intake air duck.

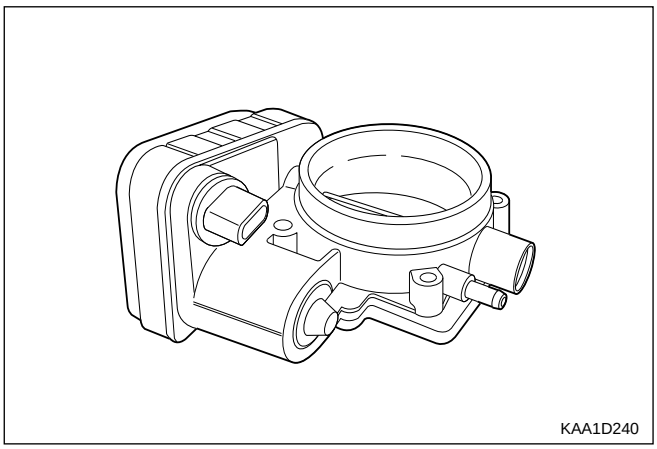

YAA1F790

6. Disconnect the throttle body electrical connector.
7. Remove the throttle body bolts.

Installation Notice

Tightening Torque	12 N•m (106 lb-in)

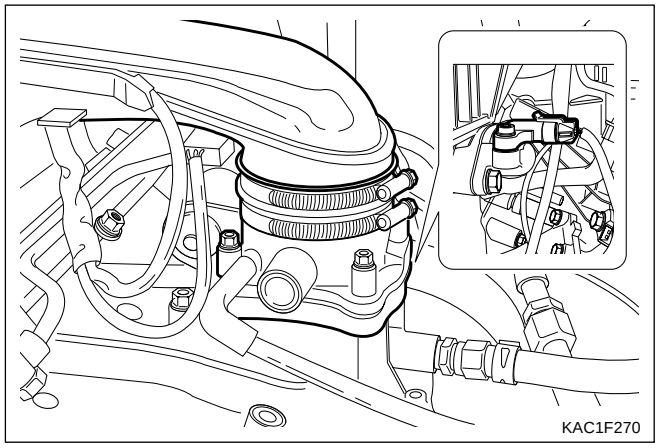
8. Remove the vacuum hose.


KAA1D240

9. Remove the throttle body and discard the gasket.

   Important: Use care in cleaning old gasket material. Sharp tools may damage sealing surfaces.

10. Installation should follow the removal procedure in the reverse order.



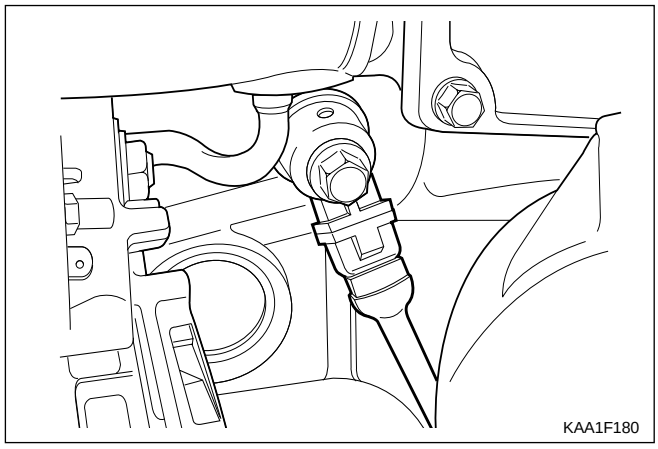
HOT FILM AIR MASS (HFM) SENSOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the Hot Film Air Mass (HFM) sensor electrical connector.
3. Remove the HFM sensor retaining screws.
4. Turn the HFM sensor coupling in the direction shown in the figure in the left so that it gets separated from the contact surface.

   Notice: Make sure the HFM sensor coupling connects completely with the contact surface installation.

5. Remove the HFM sensor.
6. Installation should follow the removal procedure in the reverse order.



KNOCK SENSOR

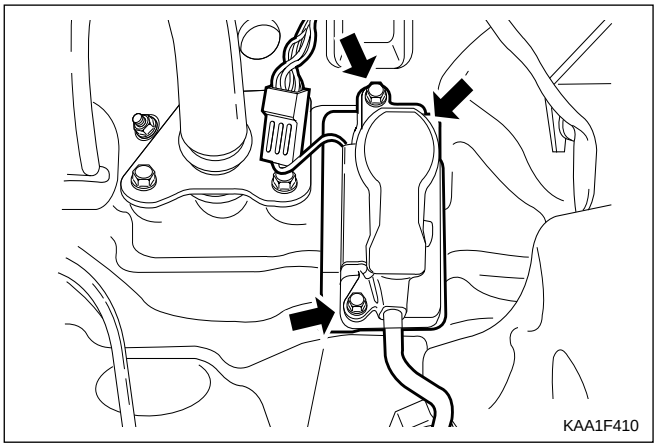
Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the knock sensor electrical connector from the intake manifold bracket.
3. Remove the knock sensor mounting bolt from the knock sensor installed on the cylinder block.

   Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

4. Remove the knock sensor.
5. Installation should follow the removal procedure in the reverse order.



PEDAL POSITION SENSOR

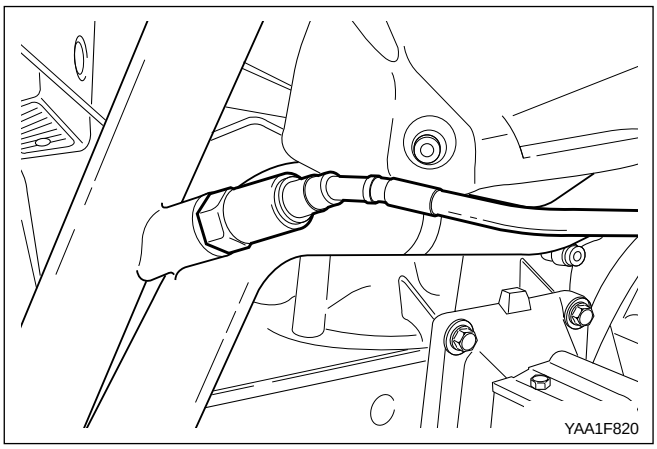
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the pedal position sensor connector.
3. Unscrew the bolts and nut.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)

4. Remove the pedal and sensor assembly.
5. Installation should follow the removal procedure in the reverse order.



OXYGEN SENSOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.

Notice: The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or the connector could affect proper operation of the oxygen sensor. Do not drop the oxygen sensor.

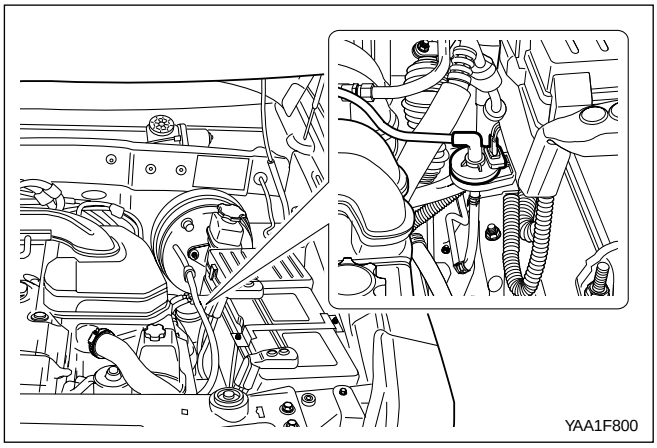
2. Disconnect the electrical connector.
3. Carefully remove the oxygen sensor from the exhaust pipe.

Installation Notice

Tightening Torque	55 N•m (41 lb-ft)

Important: A special anti-seize compound is used on the oxygen sensor threads. This compound consists of aliquid graphiteand glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or serviced sensors will already have the compound applied to the threads. If a sensor is removed from any engine and is to be reinstalled, the threads must havean antiseize compound applied before reinstallation.

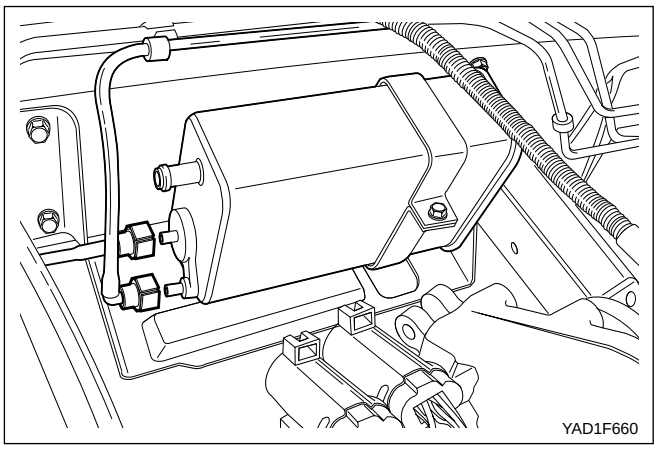
4. Coat the threads of the oxygen sensor with an anti-seize compound, if needed.
5. Installation should follow the removal procedure in the reverse order.



PURGE CONTROL VALVE

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the purge control valve connector.
3. Disconnect the throttle body-to-purge control valve hose from the purge control valve.
4. Disconnect the canister-to-purge control valve hose from the purge control valve.
5. Remove the purge control valve.
6. Installation should follow the removal provedure in the reverse order.

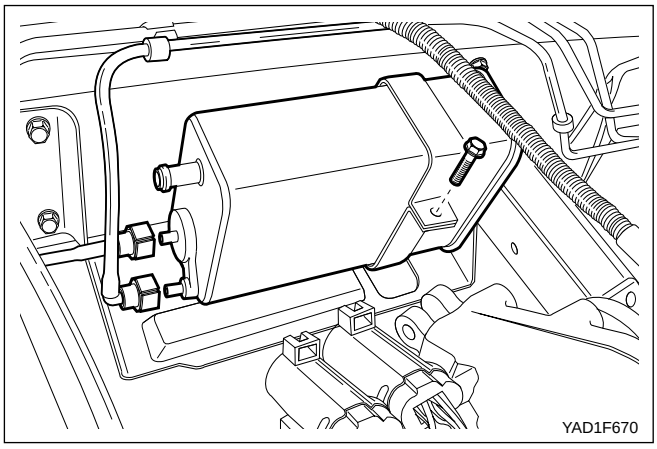


CANISTER

Removal and Installation Procedure

Caution: Canister and vacuum hoses contain fuel vapors. Do not smoke in the area or permit an open flame.

1. Disconnect the fuel tank-to-canister hose form the canister.
2. Disconnect the canister-to-purge control valve hose form the canister.

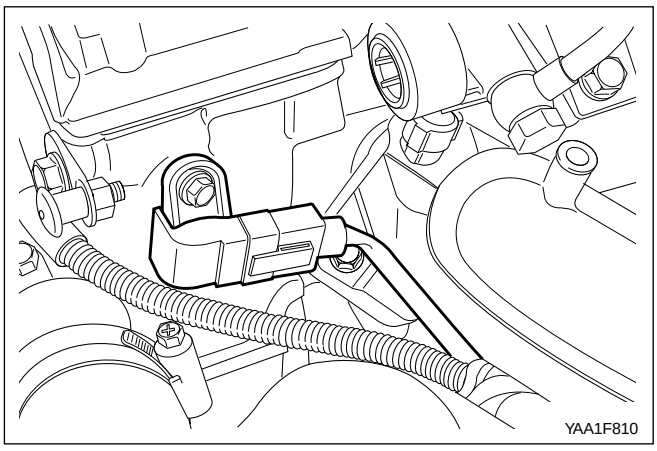


3. Remove the canister mounting bolts.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)

4. Remove the canister.
5. Installation should follow the removal procedure in the reverse order.



CAMSHAFT POSITION SENSOR

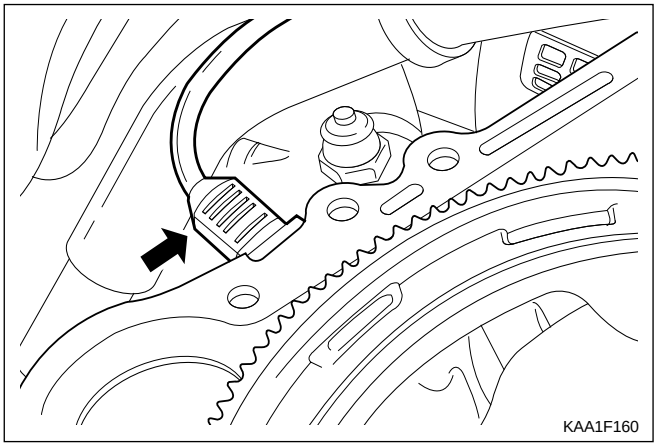
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector from the camshaft position sensor.
3. Remove the camshaft position sensor retaining bolt.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

4. Check the O-ring for damage and replace it if necessary.
5. Installation should follow the removal procedure in the reverse order.


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CRANKSHAFT POSITION SENSOR

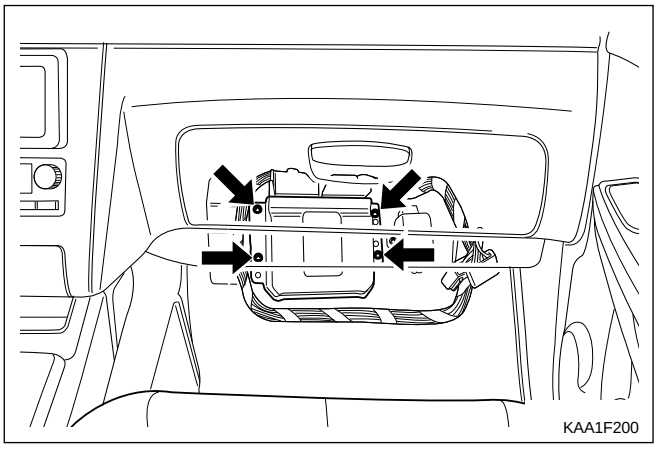
Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector at the crankshaft position sensor.
3. Remove the crankshaft position sensor retaining bolt.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

4. Installation should follow the removal procedure in the reverse order.


KAA1F200

ENGINE CONTROL MODULE

Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Remove the cowl side trim form passenger side. Re-er to *Section 9G, Interior trim.*
3. Remove the four securing nuts for the Engine Control Module (ECM) from the mounting bracket.

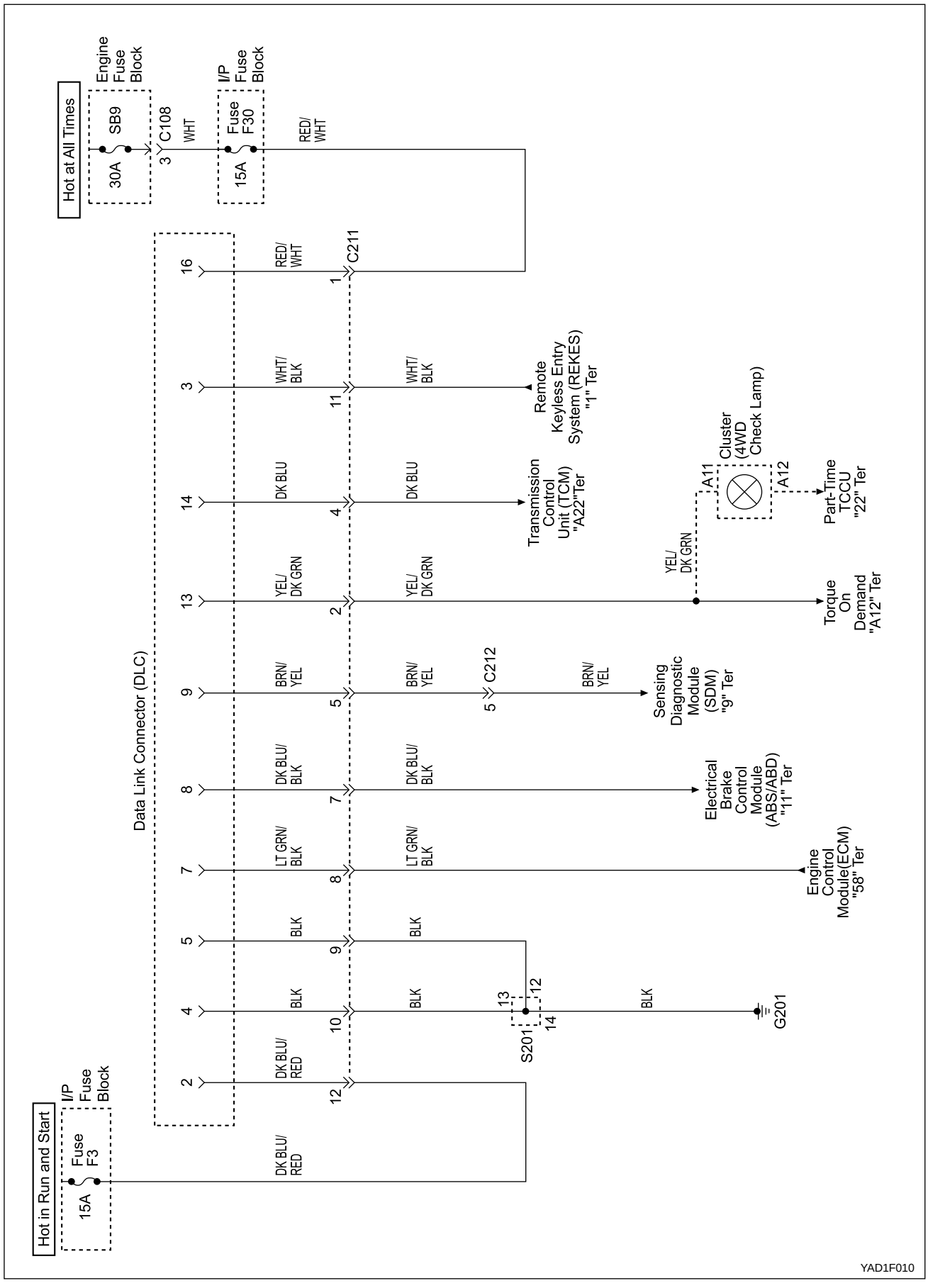
Installation Notice

Tightening Torque	10 N•m (89 lb-in)

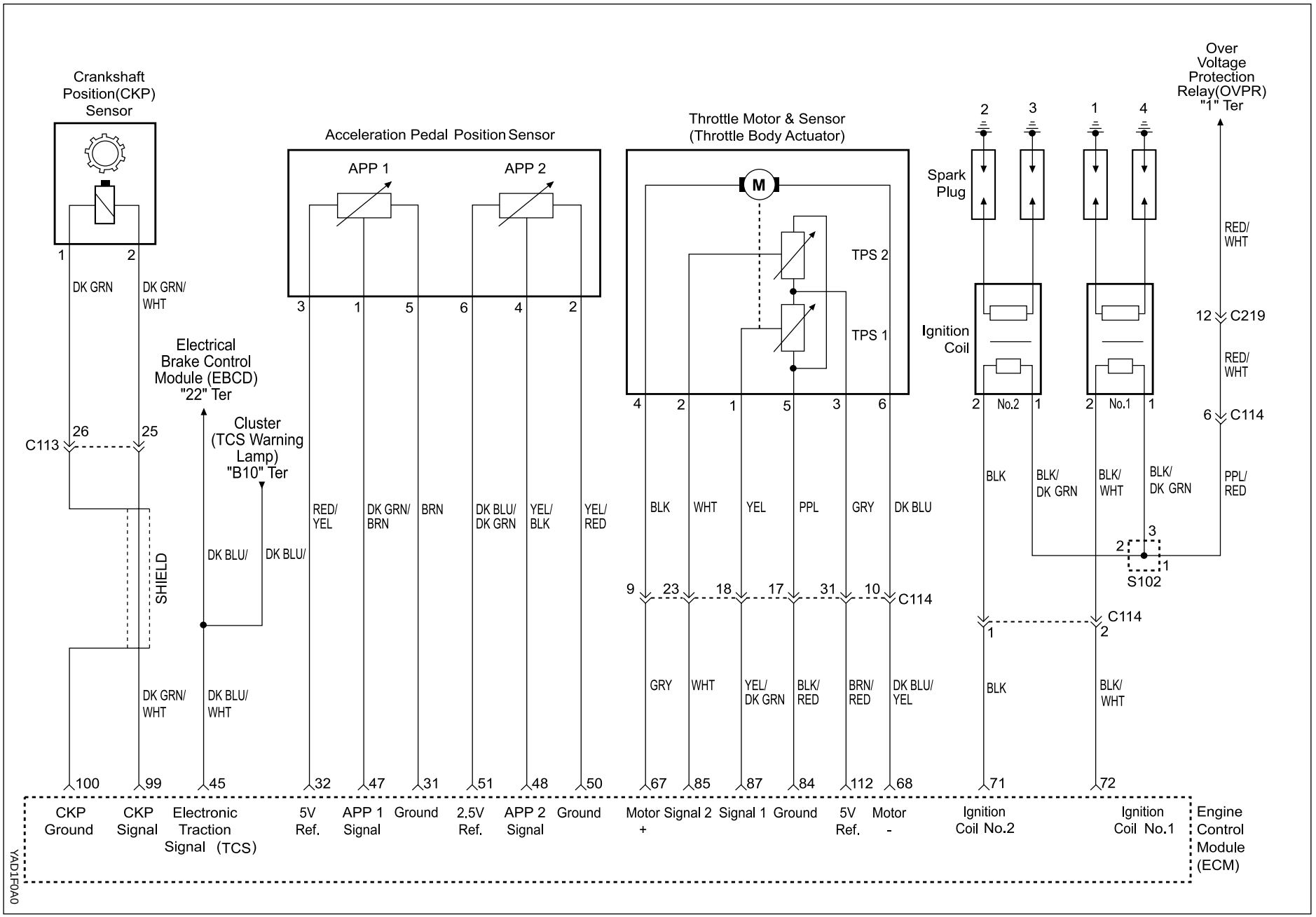
4. Pull out the ECM from the bracket.
5. Disconnect the vehicle side coupling.
6. Installation should follow the removal procedure in the reverse order.

SCHEMATIC AND ROUTING DIAGRAMS

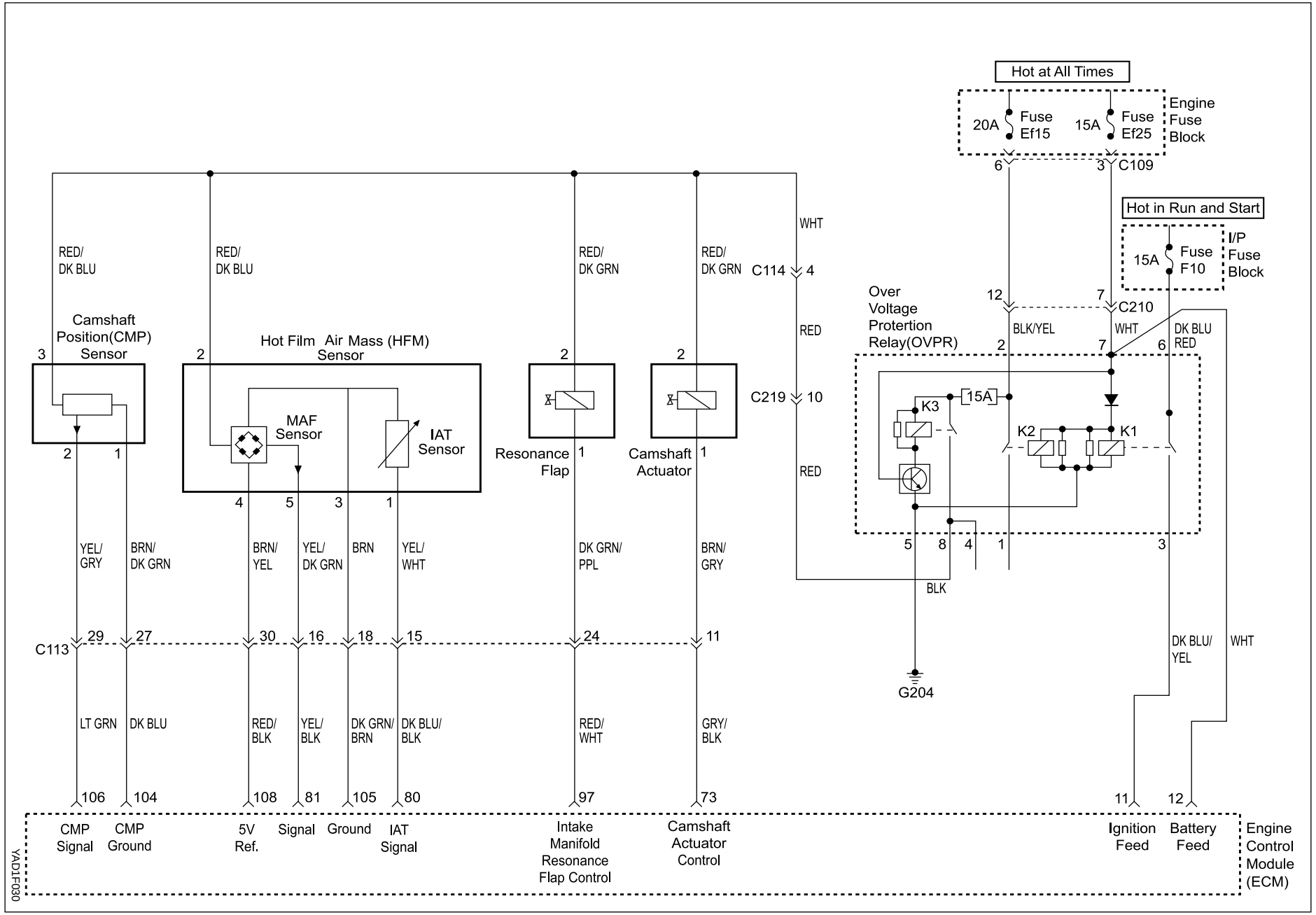
ECM WIRING DIAGRAM (2.3L DOHC - 1 OF 7) (MSE 3.53D)



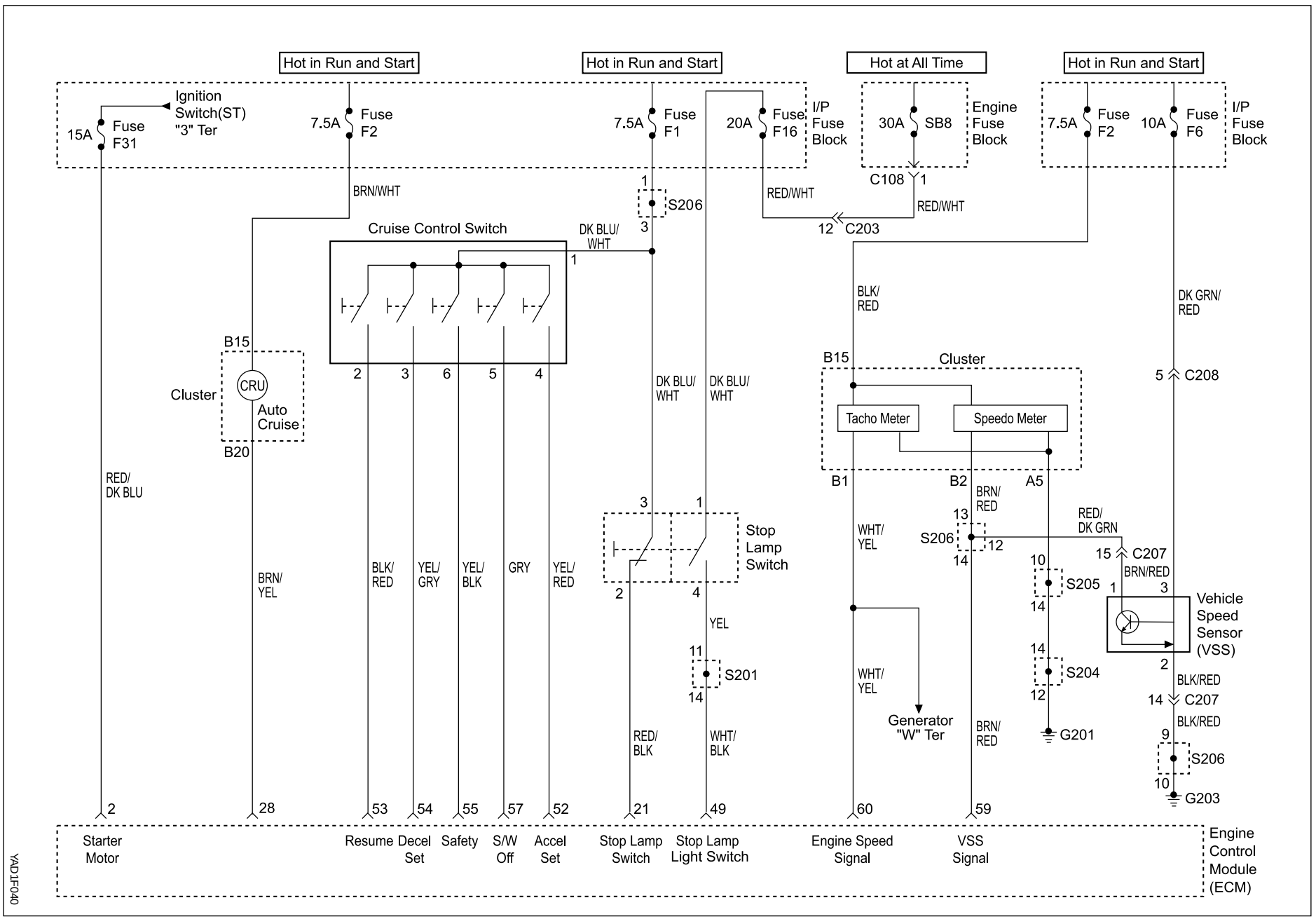
ECM WIRING DIAGRAM (2.3L DOHC - 2 OF 7) (MSE 3.53D)



ECM WIRING DIAGRAM (2.3L DOHC - 3 OF 7) (MSE 3. 53D)

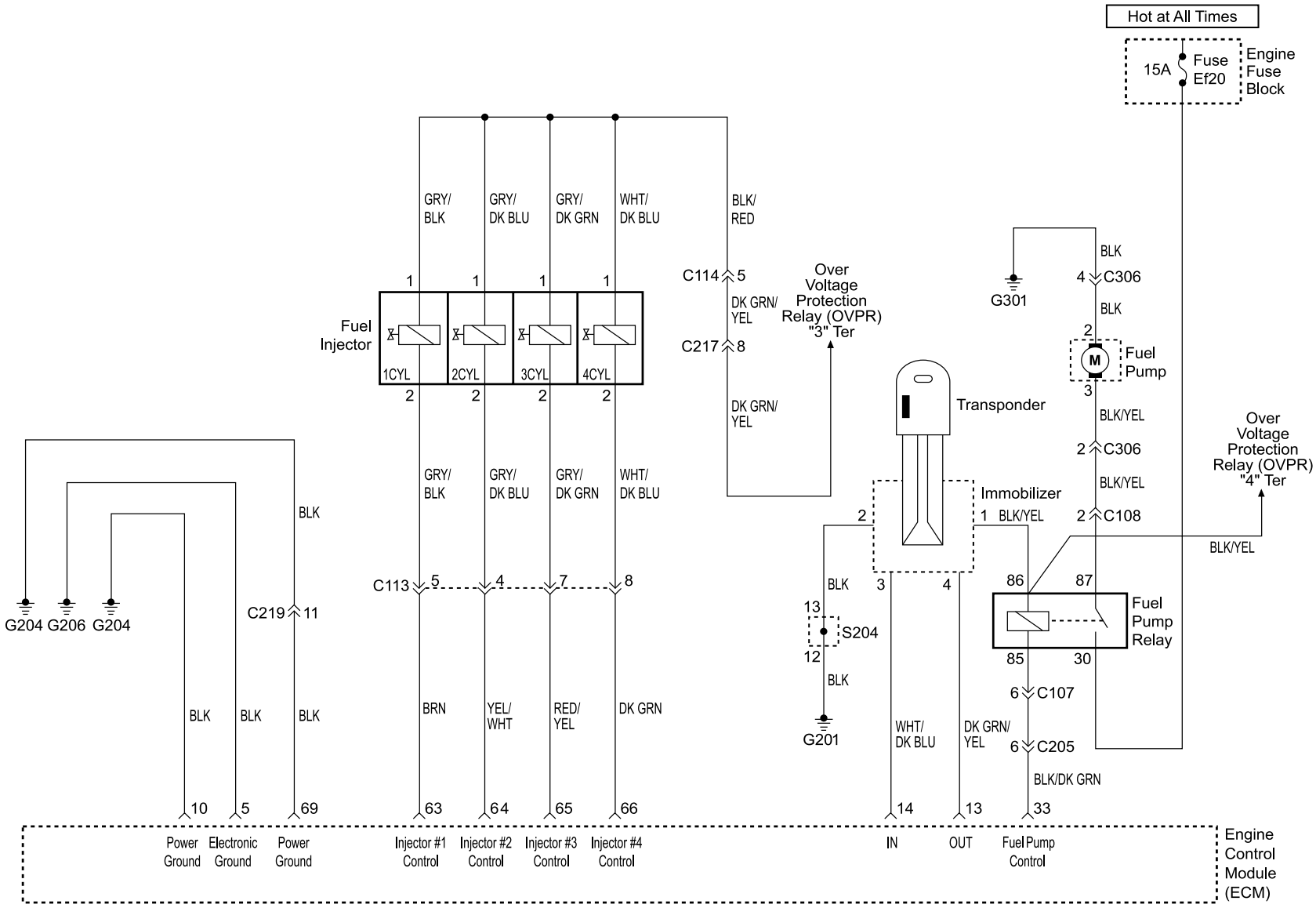


ECM WIRING DIAGRAM (2.3L DOHC - 4 OF 7) (MSE 3.53D)



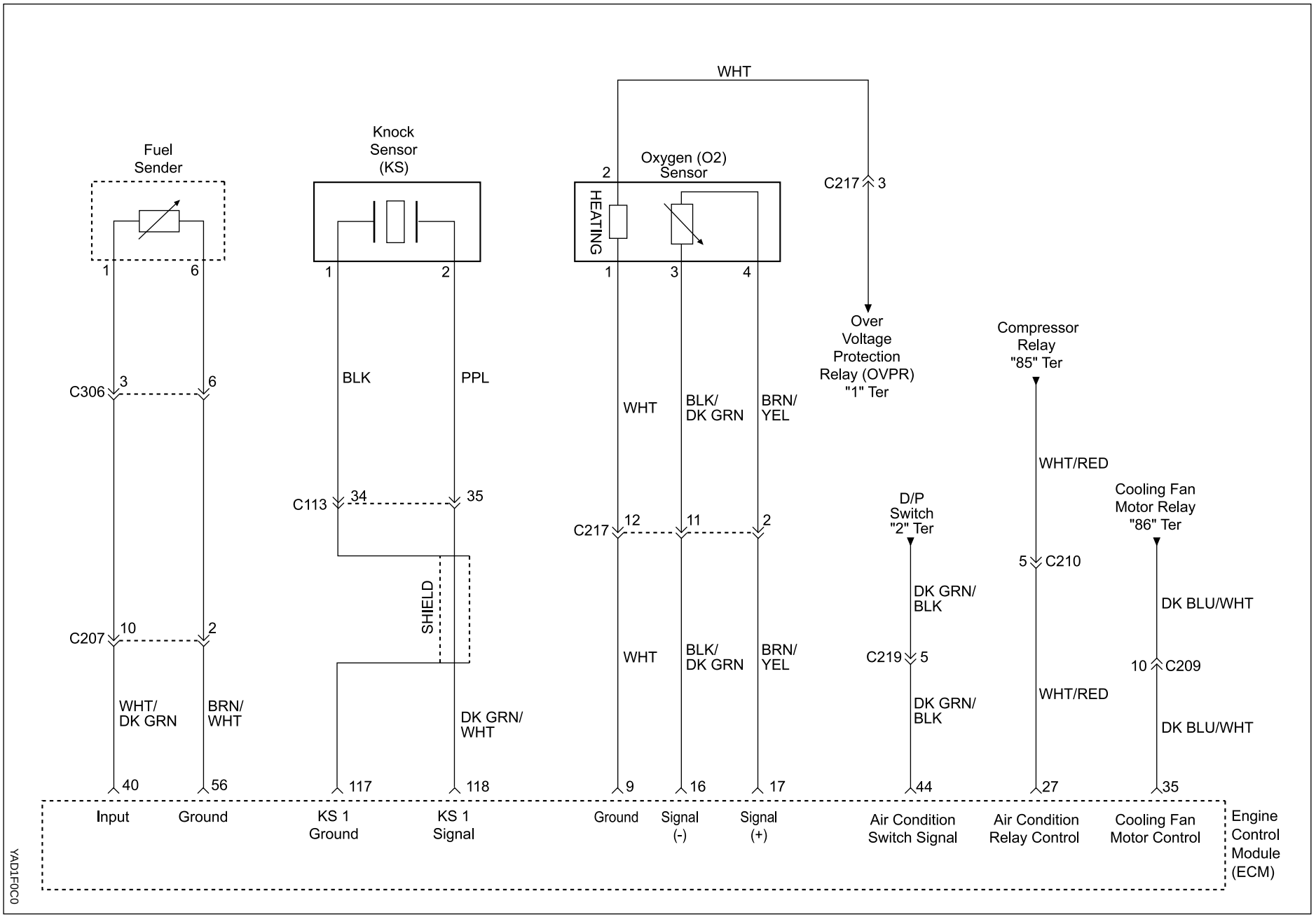
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ECM WIRING DIAGRAM (2.3L DOHC - 5 OF 7) (MSE 3.53D)

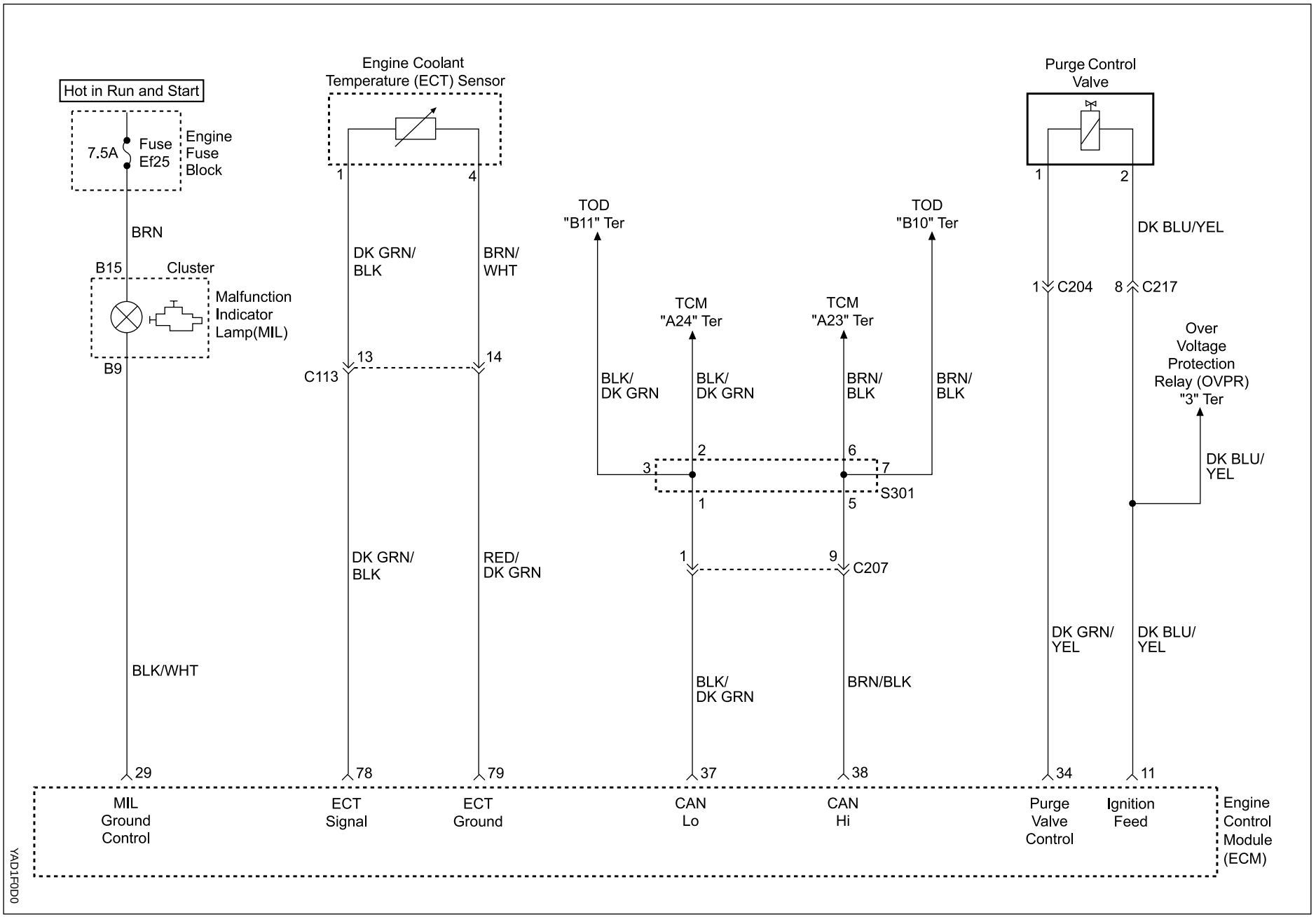


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ECM WIRING DIAGRAM (2.3L DOHC - 6 OF 7) (MSE 3.53D)



ECM WIRING DIAGRAM (2.3L DOHC - 7 OF 7) (MSE 3.53D)



SPECIFICATIONS

ENGINE DATA DISPLAY TABLE

Parameter	Unit	Value
Engine Coolant Temp.	°C	greater than 95 °C after warm up
Intake Air Temp.	°C	-40 ~ 130 °C (varies with ambient temp. or engine mode)
Engine RPM	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Regular RPM	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Engine Load	%	18 ~ 25 %
Mass Air Flow Meter	Kg/h	16 ~ 25 Kg/h
Throttle Position Angle	°TA	0 °TA (up to 100 °TA at the wide open throttle)
Spark Advance	°CA	°CA (6 ~ 9 °CA)
Indicated Engine Torque	Nm	Varies with engine condition
Injection Time	ms	3 ~ 5 ms
Battery Voltage	V	13.5 ~ 14.1 V (engine running)
Front Axle Speed	Km/h	0 ~ 265 Km/h
Rear Axle Speed	Km/h	0 ~ 265 Km/h
Accel. Pedal Position 1	V	0.4 ~ 4.8 V
Accel. Pedal Position 2	V	0.2 ~ 2.4 V
Throttle Position 1	V	0.3 ~ 4.6 V
Throttle Position 2	V	0.3 ~ 4.6 V
Fuel Integrator		0.8 ~ 1.2
Oxygen Sensor	mv	100 ~ 900 mv
A/C S/W Condition	1=ON/0=OFF	-
Full Load State	1=ON/0=OFF	-
Shift Gear State (A/T)	1=ON/0=OFF	-
A/C Control State	1=ON/0=OFF	-
Clutch Switch (M/T)	1=ON/0=OFF	-
Cam Actuator State	1=ON/0=OFF	-
Knocking Control	1=ON/0=OFF	-
Protect Mission	1=ON/0=OFF	-
Purge Control Valve	1=ON/0=OFF	-
Lambda Function	1=ON/0=OFF	-
Catalyst Heating	1=ON/0=OFF	-
Overrun Fuel Cut	1=ON/0=OFF	-
Full Fuel Cut	1=ON/0=OFF	-
Brake Switch	1=ON/0=OFF	-
Cruise Control Status	1=ON/0=OFF	-

* Condition : Warmed up, idle, P/N or neutral

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Camshaft Position Sensor Retaining Bolts	10	-	89
Canister Mounting Bolts	6	-	53
Coolant Temperature Sensor	30	22	-
Crankshaft Position Sensor Retaining Bolt	10	-	89
Engine Control Module (ECM) Mounting Bracket Nuts	10	-	89
Fuel Filter Mounting Bracket Bolt	6	-	53
Fuel Filter Lines	28	21	-
Fuel Pressure Test Connector	25	18	-
Fuel Rail Assembly Bolts	25	18	-
Fuel Return And Supply Lines	23	17	-
Fuel Tank Retaining Nuts	38	28	-
Knock Sensor Mounting Bolt	25	18	-
Oxygen Sensor	55	41	-
Pedal Position Censor Mounting Bolts And Nut	6	-	53
Throttle Body Bolts	12	-	106

FUEL SYSTEM SPECIFICATION

Use Only Unleaded Fuel Rated at 89 Octane or Higher

Fuel quality and additives contained in fuel have a significant effect on power output, drivability, and life of the engine.

Fuel with too low an octane number can cause engine knock.

Caution: Use of fuel with an octane number lower than 89 may damage engine and exhaust system.

Notice: To prevent accidental use of leaded fuel, the nozzles for leaded fuel are larger, and will not fit the fuel filler neck of your vehicle.

Do Not Use Methanol

Fuels containing methanol (wood alcohol) should not be used in vehicle.

This type of fuel can reduce vehicle performance and damage components of the fuel system.

Caution: Use of methanol may damage the fuel system.

Vehicle Fueling from Drums or Storage Containers

For safety reasons (particularly when using noncommercial fueling systems) fuel containers, pumps and hoses must be properly earthed.

Static electricity build up can occur under certain atmospheric and fuel flow conditions if unearthed hoses, particularly plastic, are fitted to the fuel-dispensing pump.

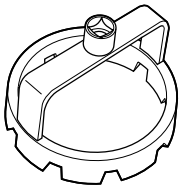
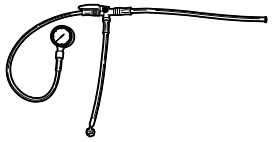
It is therefore recommended that earthed pumps with integrally earthed hoses be used, and that storage containers be properly earthed during all noncommercial fueling operations.

TEMPERATURE VS RESISTANCE

°C	°F	ECT sensor	IAT sensor
		ohms (Ω)	
Temperature vs Resistance Values (Approximate)			
130	266	88	102
120	248	111.6	127
110	230	143	159
100	212	202	202
90	194	261	261
80	176	340	340
70	158	452	452
60	140	609	609
50	122	835	835
40	113	1166	1166
30	86	1662	1662
20	68	2420	2420
10	50	3604	3604
0	32	5499	5499
-10	14	8609	8609
-20	-4	13850	13850
-30	-22	22960	22960
-40	-40	39260	39260

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAA1F890	**661 589 00 46 00** **Fuel Tank Cap Wrench**
 KAA1F490	**103 589 00 21 00** **Fuel Pressure Gauge**

SECTION 1F3

DIESEL ENGINE CONTROLS

Caution: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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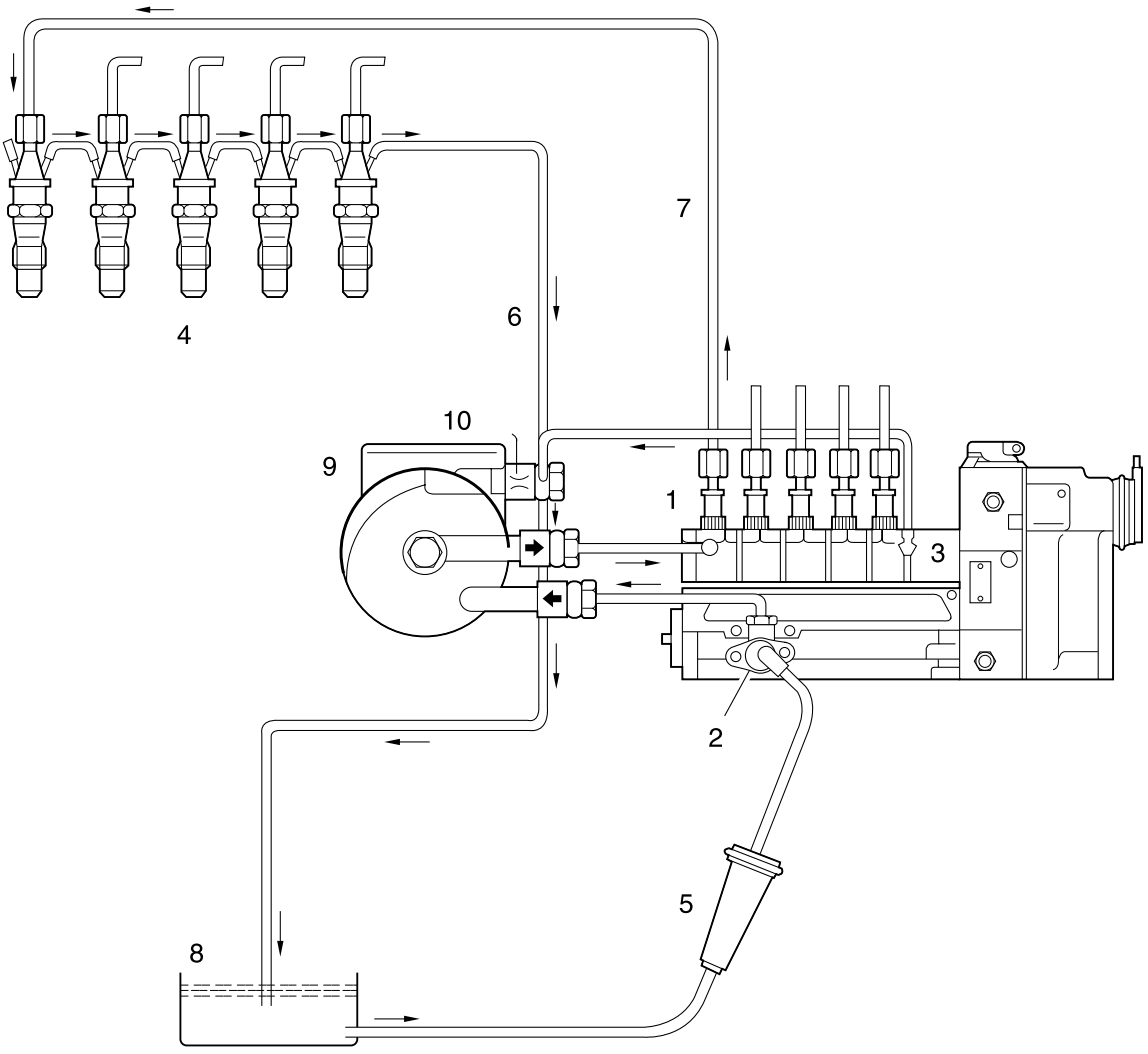
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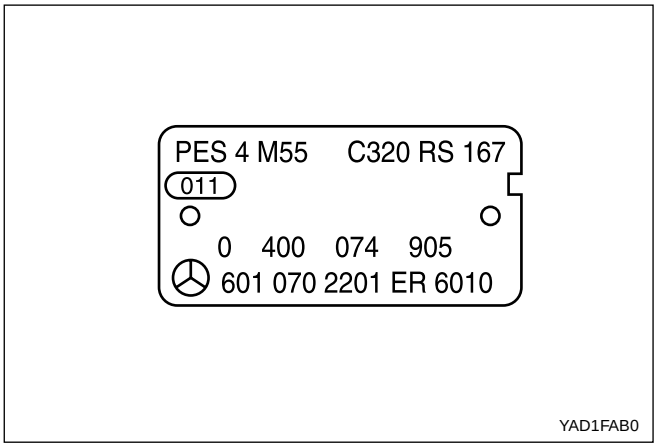
DESCRIPTION AND OPERATION

FUEL SYSTEM

Fuel Injection System



1 Fuel Injection Pump
2 Fuel Feed Pump
3 Overflow Valve
4 Injection Nozzle
5 Pre-filter
6 Fuel Return Hoses
7 Injection Line
8 Fuel Tank
9 Fuel Filter
10 Choke Orifice



Fuel Injection Pump Coding

PES 5M 55C 320 RS 167

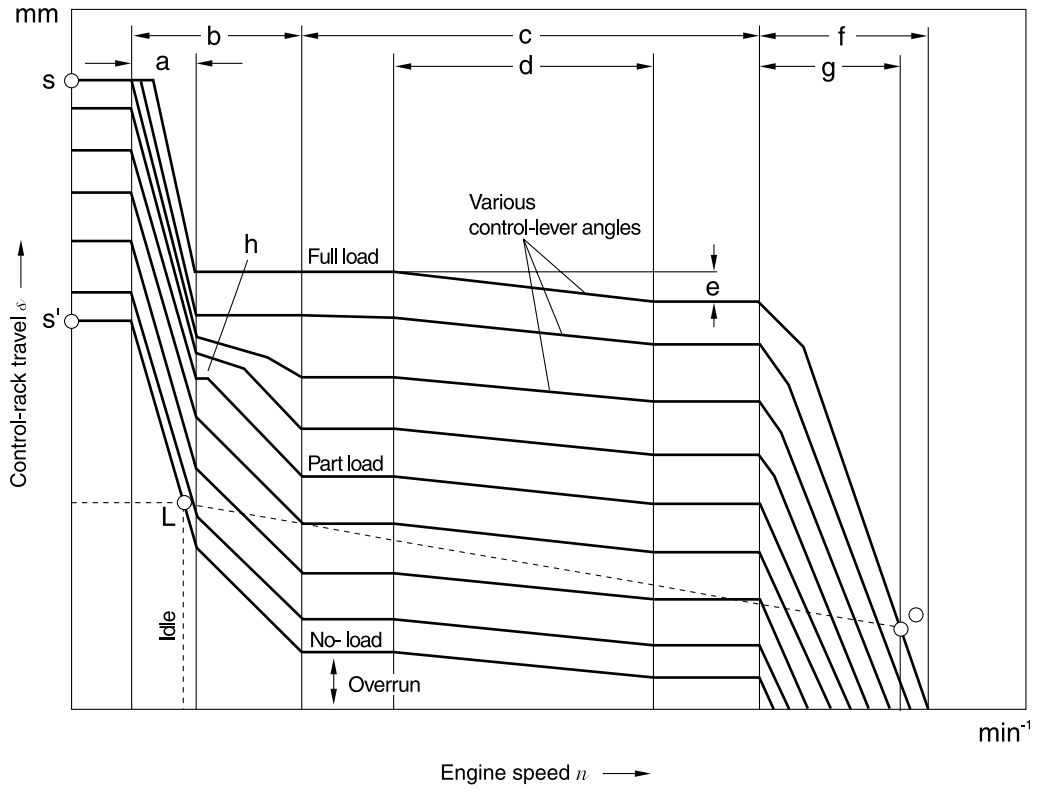
P Injection Pump
E Self - Driven
S End Flange Mounting
5 Number of Cylinders (5EA)
M Pump Size (Flange Stroke)
- M - 7 mm
- A - 8 mm
- M, W - 8 mm, 10 mm
- P - 10 mm, 11 mm, 12 mm
- Z - 12 mm
- O - 15 mm

55 Element Diameter
C Modification Letter
320 Assembly Number
R Direction of Rotation (clockwise)
S167 Special Version

GOVERNOR

RSF Minimum-maximum-speed governor

The RSF mechanical governor was developed specifically as a minimum-maximum-speed governor. It is suitable for use in those on-road vehicles (passenger cars and commercial vehicles) in which control requirements are restricted to low idle and high idle (maximum) speeds.control requirements are restricted to low idle and high idle (maximum) speeds. In the uncontrolled range between these two speed, the driver uses the accelerator pedal to directly adjust the setting of the injection-pump control rack so that the engine develops the right torque.



a Idle Range (Working Range of the Idle Spring)
b Extended Idle Range at No-Load and Minimum Part Load (Working Range of the Idle Spring and the Auxiliary Idle Spring)
c Uncontrolled Range
d Torque-Control Range (Working Range of the Torque-Control Spring)
e Torque-Control Travel
f Speed-Regulation Range (Working Range of the Governor Spring)
g Full-Load Speed Regulation to the High Idle Speed
h Start of the Auxiliary Idle-Spring Shutoff

S Start Setting With Accelerator Pedal fully Depressed (Cold-Start)
S ' Start Setting With Accelerator Pedal Released (Hot/ Warm Start)
L Low-Idle-Speed Setting
O High-Idle-Speed Setting

n_{1u} Low Idle Speed
n_{1o} High Idle Speed
n_{vo} Maximum Full-Load Speed
n_1 Speed at Start of Torque Control
n_2 Speed at End of Torque Control

Speed-sensing mechanism stage 1 (low idle)

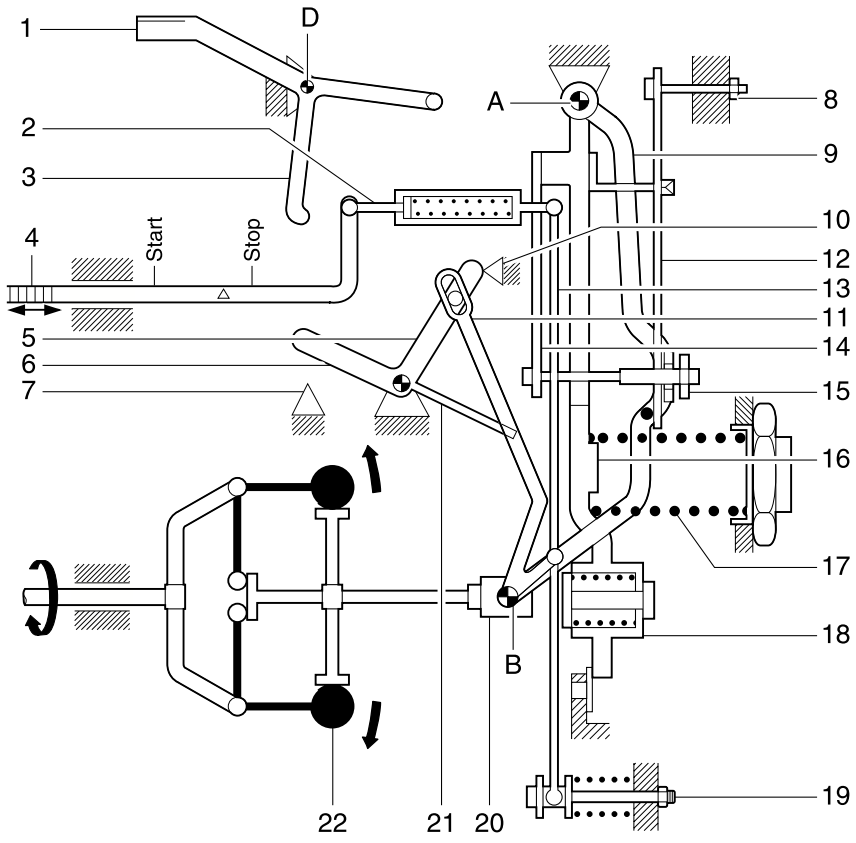
The force path starts at flyweights (22) and travels through sliding sleeve (20) and guide lever (9) to idle spring (12) and auxiliary idle spring (14). Both springs are leaf springs.

Speed-sensing machanism, stage 2 (until full-load speed regulation)

After completion of idle-speed sleeve travel, the force path is from governor sliding sleeve (20) through torque-control spring retainer (18) and tensioning lever (16) to governor spring (17).

The flyweights (22) are fastened directly to the injection-pump camshaft and when they move outward, governor sliding sleeve (20) is moved axially. The sliding sleeve does not move except in the idle, full-load torque-control, and speed-regulation breakaway ranges. The fuel delivery quantity needed for the required engine torque is selected by the actuator-mechanism control lever.

The guide lever (9) is movably connected at pivot point B with the governor sliding sleeve. In addition, guide lever and tensioning lever (16) also pivot at point A.



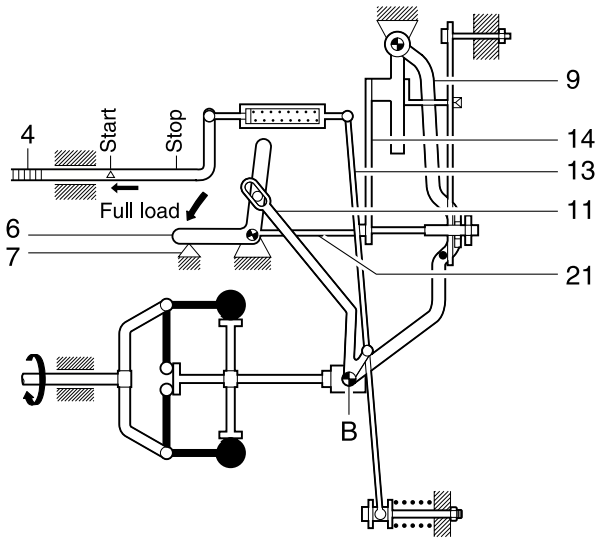
1 Stop(Shutoff) Lever
2 Strap
3 Stop Lever
4 Control Rack
5 Linkage Lever (Inner)
6 Control Lever (Outer)
7 Full-Load Stop
8 Adjusting Screw For Idle Speed
9 Guide Lever
10 Idle Stop
11 Reverse-Transfer Lever
12 Idle-Speed Spring
13 Variable-Fulcrum Lever
14 Auxiliary Idle Spring
15 Adjusting Screw for Auxiliary Idle Spring
16 Tensioning Lever
17 Governor Spring
18 Spring Retainer (Torque Control)
19 Full-Load Adjusting Screw
20 Governor Sliding Sleeve
21 Auxiliary-Idle-Spring Switch-Off Device
22 Flyweight

Actuator mechanism

Input of the desired valve is through control lever (6) linkage lever (5) and reverse-transfer lever (11) to variable fulcrum lever (13), and from there through strap (2) to injection-pump control rack (4). The strap is spring-loaded, and compensates for the extra movement of the fulcrum lever. Similar to the guide lever, the reverse-transfer lever is also flexibly mounted at pivot point B of the sliding sleeve, and is also attached to the fulcrum lever (13) via a shaft and bushing. Full-load delivery at the fulcrum lever's lower bearing point, which also acts as the spring-loaded yield point for the fulcrum lever for absorbing the sliding sleeve's additional travel in case of excessive speed. The bearing shaft of the stop lever (3) protrudes from the governor housing. Attached to its end is a stop (shutoff) lever (1) which switches off the engine, whereby the stop lever pulls the control rack in the stop (shoutoff) direction.

Starting the engine

The engine is to be started according to the vehicle manufacturer's operating instructions. Normally, it can be started without pressing the accelerator pedal. Only with a cold engine at low temperatures is the accelerator pedal to be pushed to the floor so that control lever (6) is shifted up against full-load stop(7) – a fixed stop on the governor housing. Reverse- transfer lever (11) swivels around pivot point B, and in doing so shifts fulcrum lever (13) in the "Start" direction. The result is that the control rack (4) is moved to the start setting and the engine receives the required start quantity. Rapid speed regulation from the governor start setting is made possible by lifting the auxiliary idle spring (14) away from fulcrum lever (9) by a switch-off device (21) when the control lever is in the full-load position.



YAD1FAE0

4 Control Rack
6 Control Lever (Outer)
7 Full-Load Stop
9 Guide Lever
11 Reverse-Transfer Lever
13 Variable-Fuicrum Lever
14 Auxiliary-Idle Spring
21 Auxiliary-Idle Spring Switch-Off

Cold-start setting (only the components concerned in the governing process shown.)

Operating Characteristics

Low idle speed

Once the engine starts and the accelerator pedal is released, a return spring pulls control lever (6) back to the low-idle position. Linkage lever (5) is now up against idle-speed stop screw(10).

During warm-up, low idle speed follows the idle-speed control curve and stabilizes at Point L.

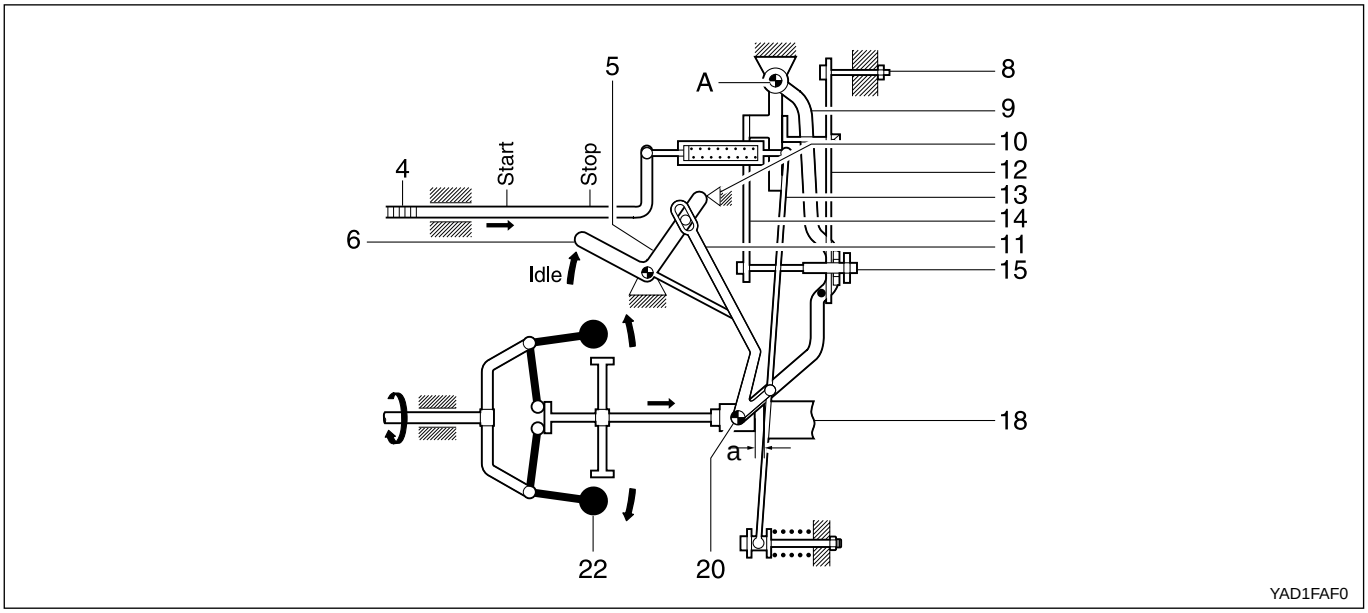
When speed increases, flyweights (22) move outward, and shift governor sliding sleeve (20) to the right. During operation within the idle range, sliding sleeve movement is transmitted through reverse-transfer lever (11) and fulcrum lever (13); moving the control rack (4) toward Stop (shutoff). At the same time, sliding-sleeve movement causes guide lever (9) to swivel about pivot point A, compressing the idle leaf spring (12). This spring's pretension (and thus the low idle speed) is set using adjusting screw(8). At a given speed, the fulcrum lever also comes up against the adjusting nut for auxiliary idle spring (14).

Intermediate speed

After passing through the idle stage (a), governor sliding sleeve (20) and spring retainer (18) for torque control come into contact with each other. In the uncontrolled range between idle and maximum speed, the position of the flyweights (22) remains constant up to high idle (maximum) speed, the only exception being for minor adjustments necessary for torque control. Control-rack setting and therefore delivery quantity are selected directly through control lever (6).

That is, the driver uses the accelerator pedal to select the delivery quantity necessary to increase speed or climb hills (control-lever position between idle stop and full-load stop).

If the driver depresses the accelerator pedal fully, the control rack shifts to the full-load delivery setting.



4 Control Rack
5 Linkage Lever (Inner)
6 Control Lever
8 Adjusting Screw For Idle Speed
9 Guide Lever
10 Idle Stop
11 Reverse-Transfer Lever
12 Idle-Speed Spring
13 Variable-Fulcrum Lever
14 Auxiliary Idle Spring
15 Adjusting Screw for Auxiliary Idle Spring
18 Spring Retainer (Torque Control)
20 Governor Sliding Sleeve
22 Flyweight

Idle-speed setting.

(only the components concerned in the governing process are shown)

Torque control

If torque control is fitted, full-load delivery quantity is reduced when a given speed n_1 is exceeded, because centrifugal force acting on sliding sleeve (20) exceeds the force of the torque-control spring fitted in spring retainer (18). The torque-control spring yields to this force. As a result, if speed increases further, control rack (4) shifts by the torque-control travel distance. Torque control ends at speed n_2.

Instead of positive torque control, the RDF governor can have negative torque control. Here the control-rack setting is controlled by a spring combination.

High idle (maximum) speed

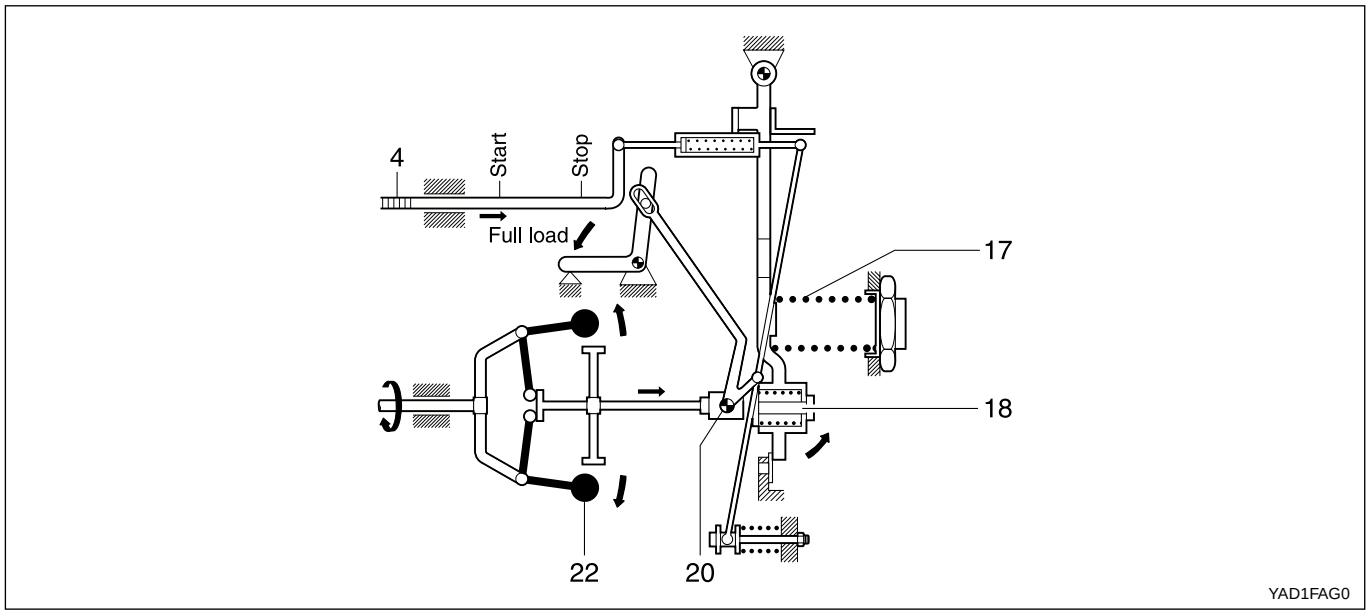
With the accelerator pedal pressed to the floor, the full-load quantity is injected until the maximum full-load speed n_{vo} is reached. If engine speed increases beyond full-load speed, the force exerted by the flyweights (22) suffices to overcome the force of governor spring (17) and full-load-speed regulation starts.

Engine speed increases slightly, and rack travel is reduced due to the rack being moved towards stop (shutoff) and the delivery quantity decreases.

Breakaway depends upon governor spring pretension. The engine adjusts to high idle (maximum) speed n_{10} when all load is removed.

When driving downhill with the accelerator released, the vehicle drives the engine (overrun) and accelerates it.

No fuel is injected during this operating mode (overrun fuel shutoff).



4 Control Rack
17 Governor Spring
18 Spring Retainer (Torque Control)
20 Governor Sliding Sleeve
22 Flyweight

Full-load setting

(only the components concerned in the governing process are shown)

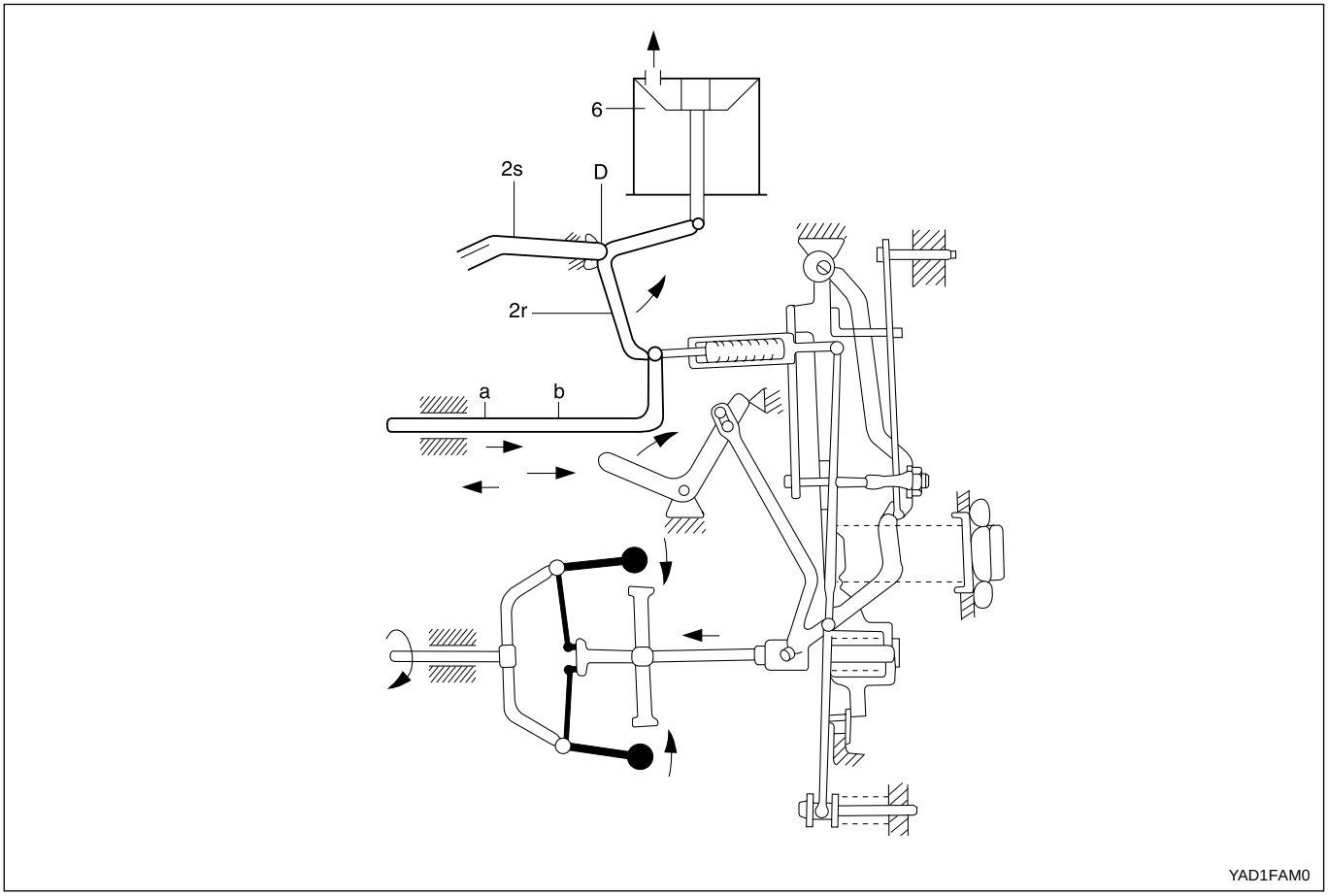
Stopping the engine

When Stop (shutoff) lever (1) is moved by hand, stop lever (3) shifts control rack (4) to the Stop (shutoff) position. The fuel supply is interrupted and the engine stops. A pneumatic shutoff device can also be used for engine switchoff.

Switching off

The vacuum unit (6) is connected to vacuum from the vacuum pump via the glow starter switch of the vehicle. As a result, the diaphragm of the vacuum unit is pulled against the compression spring.

The vacuum unit (6) is connected with a stop lever (2r). This lever pivots around the fulcrum “D” pulling the control rod of the injection pump into the “stop position”. The bypass spring of the fulcrum lever is overcome in this process. Via the emergency stop lever (2s) the control rod can likewise be pulled into “stop position” on the outside of the governor.

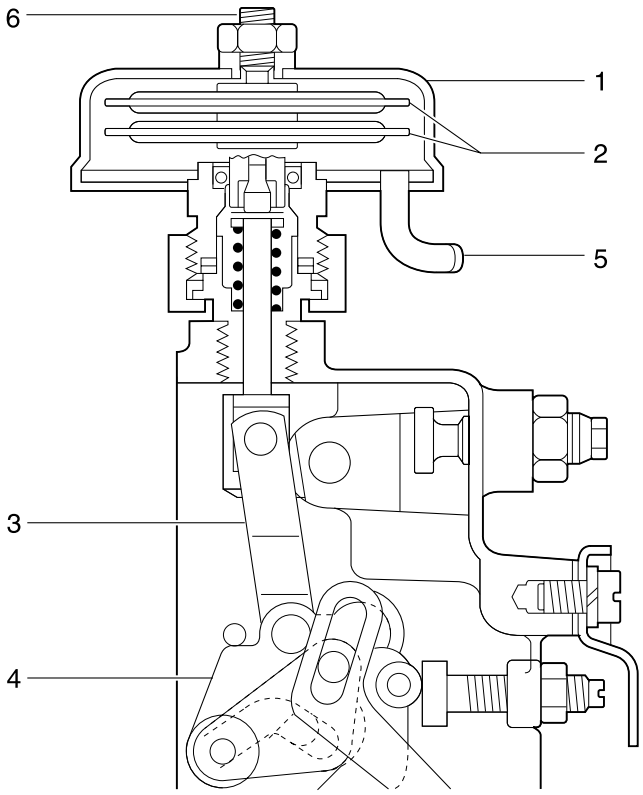


a Start
b Stop

ABSOLUTE METERING MANIFOLD PRESSURE COMPENSATOR (ALDA)

On a pressure-charged engine, the cylinder air charge depends upon the boost pressure, which in turn is influenced by the prevailing atmospheric pressure. The effects of variants in atmospheric pressure have an especially large influence when considerable differences in attitude are encountered in driving.

Because the engine's turbocharger further compresses the prevailing atmospheric pressure, the absolute pressure in the engine's intake manifold is a combination of the atmospheric pressure and the charge-air pressure. The absolute-metering manifold-pressure compensator registers this absolute pressure and adapts the fuel-delivery quantity accordingly.



YAD1FAJ0

1 Adjusting Screw
2 Aneroid Box
3 Connection for the Line to the Engine Manifold
4 Aneroid Capsule
5 Adaptation
6 Guide Plate

PNEUMATIC IDLE SPEED INCREASE (PLA)

Application

The injected fuel quantity needed by a diesel engine at idle decreases along with increasing engine temperature.

When the engine is cold, the temperature-dependent idle-speed increase fitted to the RSF governor raises the idle speed accordingly, there by improving the engine's warm-up behaviour. It also prevents the cold engine stalling when additional loads are switched, such as power-assisted steering, air-conditioner, etc.

The PLA ceases to function above a certain temperature.

Design and Function

Depending upon temperature, pressure is applied to the aneroid capsule's diaphragm which in turn shifts a sliding bolt to change the pretension on the idle spring. The control rack now moves towards "increased fuel quantity" via the governor linkage and the control rack.

Operation

Coolant temparature <0°c

The thermovalve is open. The vacuum of approx. 700 mbar reaches the vacuum unit idle speed increase via the thermovalve. The idle speed is increased by approx 100/min. The choke in the ventilation filter causes a pressure loss of approx 100 mbar.

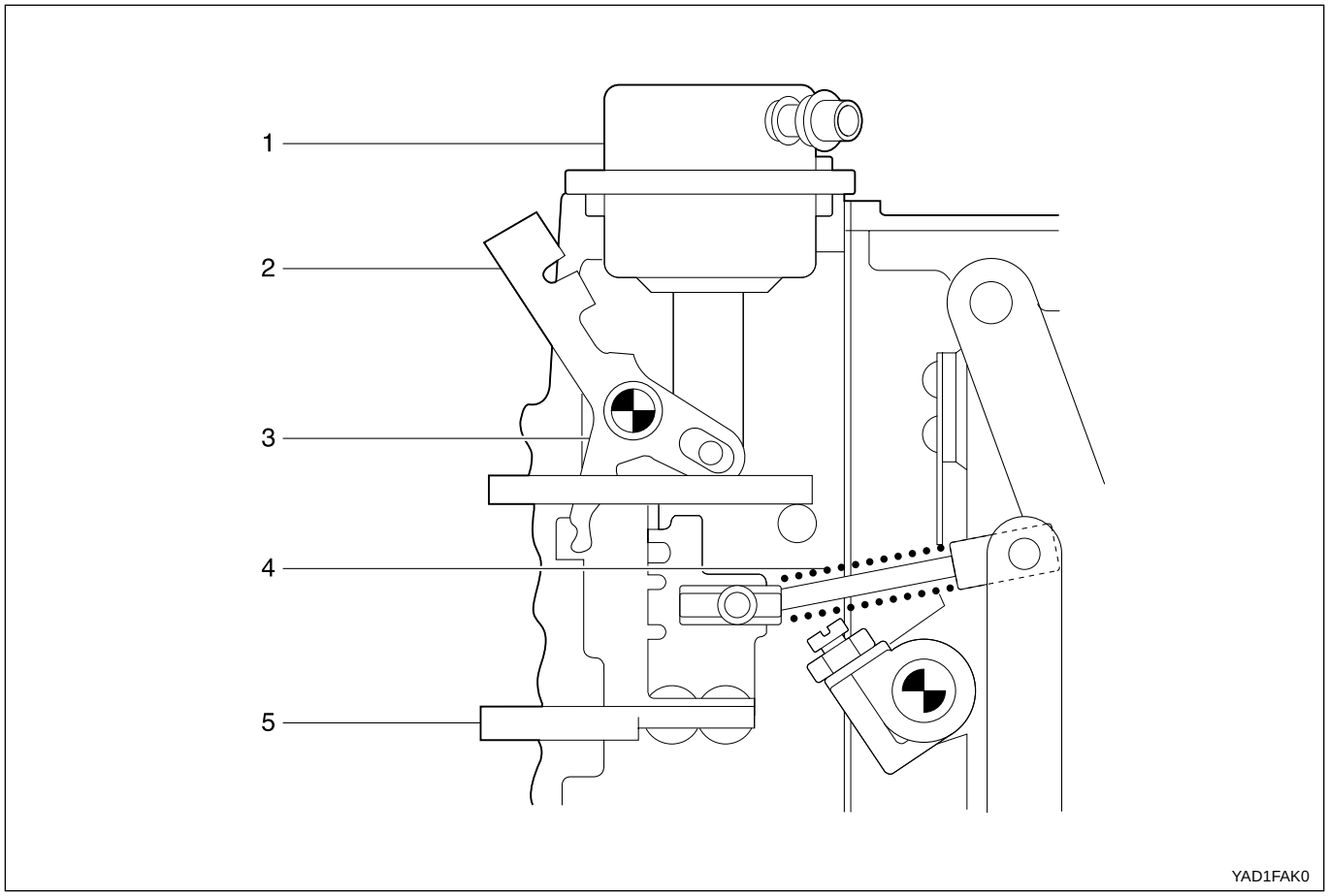
Coolant temperature >0°c

The thermovalve is closed. Atmospheric pressure reaches the vacuum unit through the choke in the ventilation filter. The speed increase is cancelled.

PNEUMATIC SHUT-OFF DEVICE (PNAB)

To shut off the engine, the key in the steering lock is turned to “stop”. This applies vacuum to the shut-off device diaphragm which pulls the control rack to the stop setting.

This device can only be installed on vehicle which are equipped with a vacuum pump.



1 Pneumatic Shut-Off Device
2 Shut-Off Lever for Manual Operation
3 Stop Lever
4 Spring-Loaded Strap
5 Control Rack

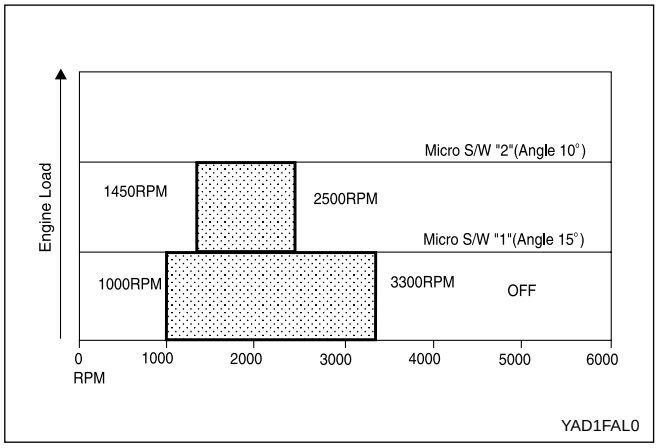
EXHAUST GAS RECIRCULATION (EGR) VALVE

The Exhaust Gas Recirculation (EGR) system is the device to lower the NOx (oxides of nitrogen) emission level caused by high combustion temperature.

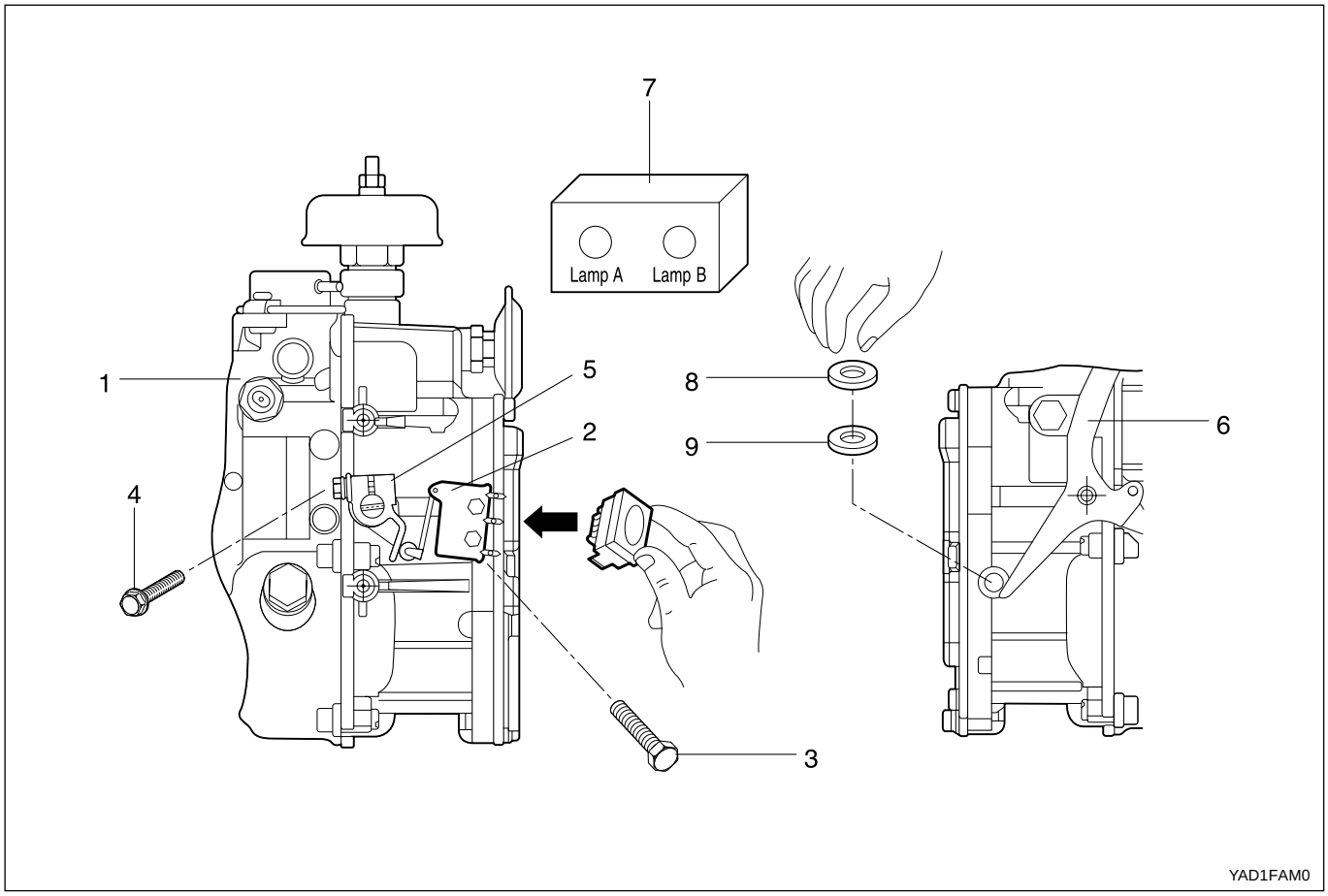
Because the combustion process of the diesel engine always needs excessive air, the exhaust gas contains large amount of NOx.

The EGR valve restricts NOx generation by recirculating some amount of the exhaust gas into the combustion chamber to reduce the combustion temperature.

But the recirculated gas results in reduced charging efficiency of mixture so that the engine performance drops down. Because of this fact, EGR valve is tuned to operate in the area where oxidized substances are generated much.



- Condition of working the EGR valve
  - 100 seconds after starting the engine
  - More than 200 RPM



1 Injection Pump
2 Micro Switch
3 Bolt
4 Screw ..... 5 N•m (44 lb-in)
5 Cam
6 Lever
7 Micro Switch
8 Adjusting Disc “A” Setting Indicator (10 inch)
9 Adjusting Disc “B” Setting Indicator (11 inch)

EGR Micro Switch Setting Procedure

Tools Required

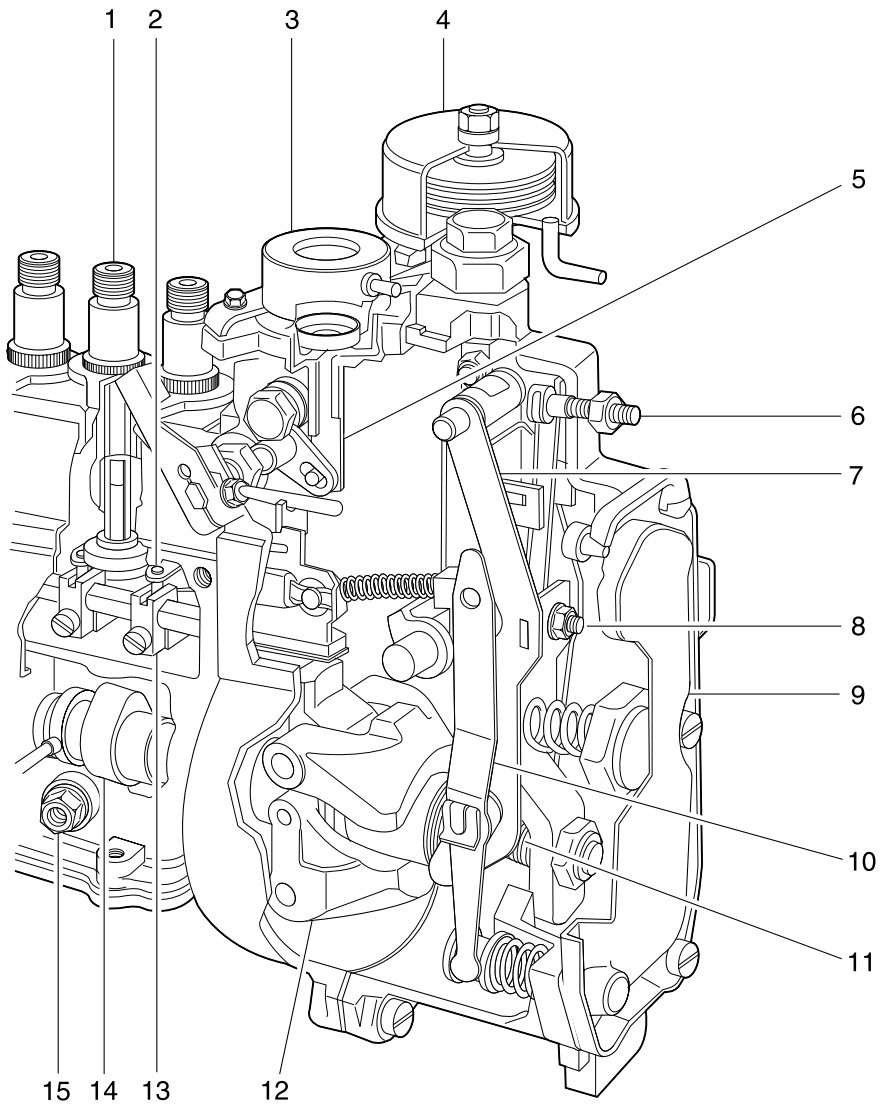
617 589 08 21 01 Micro switch Setting Device.

In turbo equipped vehicle, the timing of injection pump must be adjusted after repairing or replacement as follows:

1. Hold the injection with clamp (special) on the work bench.
2. Install the micro switch setting device 017 589 08 21 01 in the injection pump.
3. Adjust and fix the lever (6) at 10° ±1°
4. Insert the harness into the micro switch setting device 617 589 08 21 01.
5. Install the cam on the injection pump when the both lamps are “on”.
6. Install the screw.
7. At this moment, loosen the clamp and insert the adjusting disc “A” to the lever and check again.
8. If the lamp “A” is “on”, the setting is correct, thus, timing of injection pump is OK.
   If the both lamps are “on”, perform the setting as above procedure.

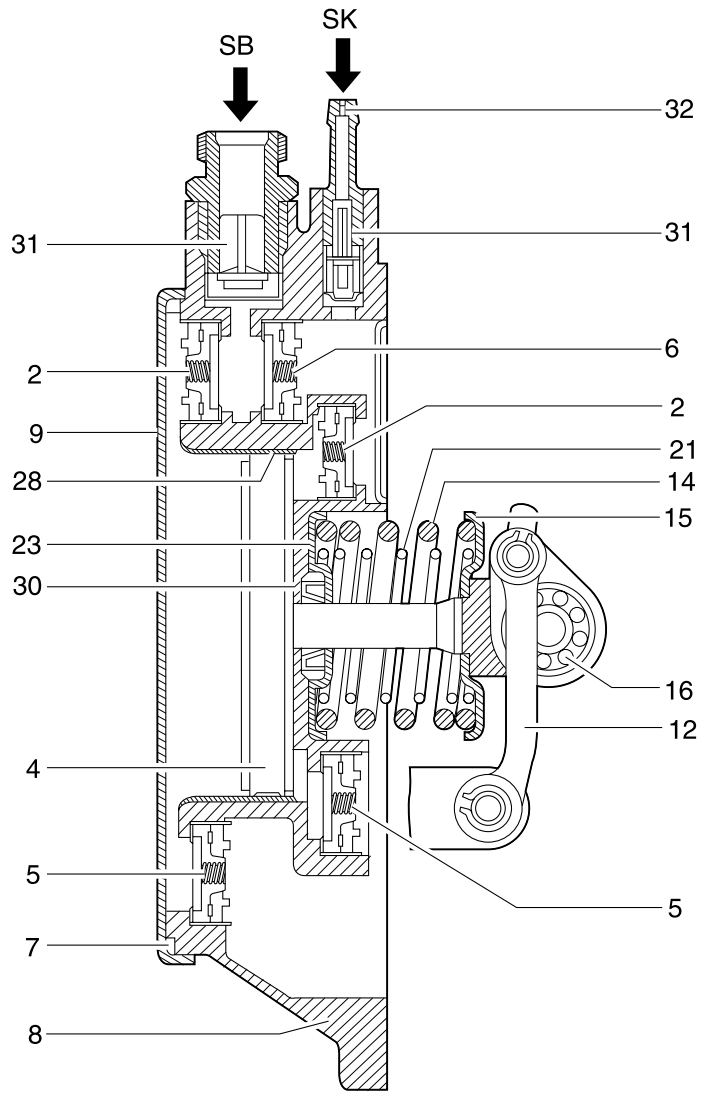
COMPONENT LOCATOR

FUEL INJECTION PUMP



1 Delivery Valve Holder
2 Control Lever
3 Engine Stop Unit
4 Idle Speed Adjustment (ALDA)
5 Stop Lever
6 Adjusting Screw for Idle Speed
7 Guide Lever
8 Adjusting Screw for Auxiliary Idle Speed
9 Governor Assembly
10 Hinge Lever
11 Spring Retainer (Torque Control)
12 Fly Weight
13 Clamping Piece
14 Plunger Driving Cam
15 Fuel Pump Driving Cam

VACUUM PUMP (SECTIONAL VIEW)

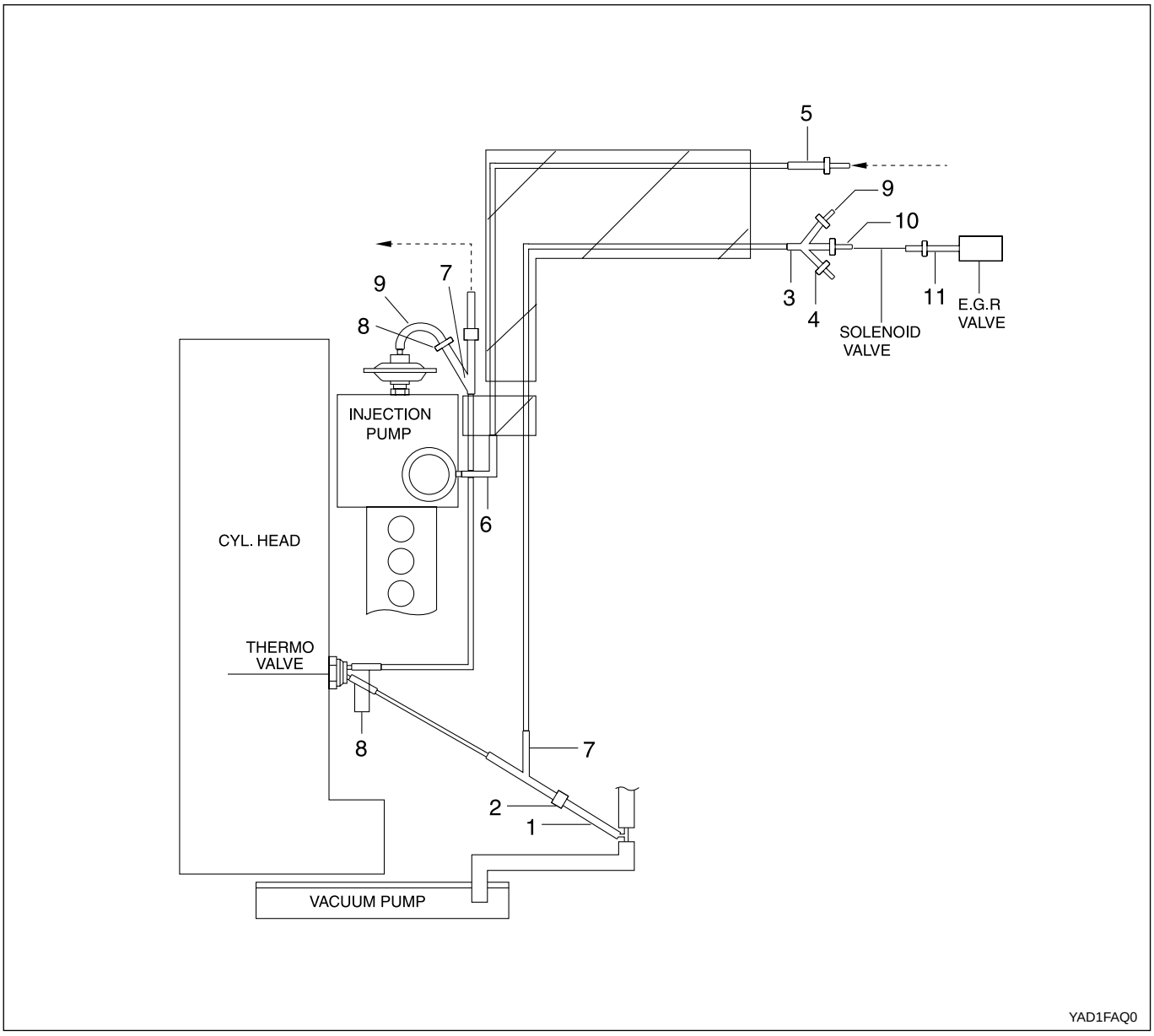


YAD1FAP0

2 Suction Valve
4 Piston
5 Pressure Valve
6 Safety Valve
7 O-Ring
8 Pump Housing
9 Pump Cover
12 Lever
14 Outer Return Spring
15 Inner Spring Retainer
16 Roller Cam
17 Piston Rod
21 Inner Return Spring
23 Upper Spring Retainer
28 Piston Ring
30 Seal Ring
31 Oil Return Valve
32 Restrictor
SB To Brake Booster
SK To Vacuum Lines

DIAGNOSTIC INFORMATION AND PROCEDURE

VACUUM CONTROL SYSTEM TEST



1 Rubber Hose
2 Air Filter
3 Distributor
4 Chock
5 Rubber Hose
6 Molding Hose
7 Distributor
8 Molding Hose
9 Connector
10 Chock Filter
11 Molding Hose

Service Data

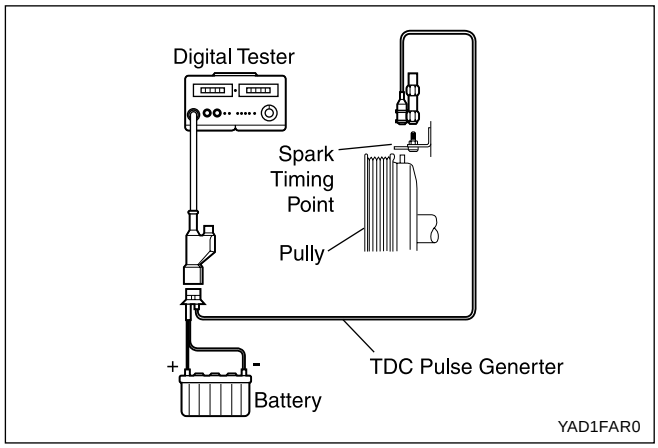
Idle Speed Increase	At least 100 rpm at approx. 500 mbr
Permissible Pressure Drop of System	400 - 500 mbar approx. 1 min

Tools Required

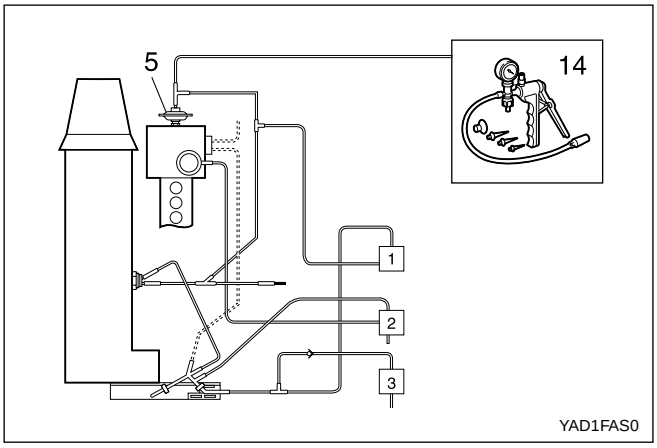
001 589 73 21 00 Vacuum Pump
201 589 13 21 00 Vacuum Tester
667 589 00 21 00 TDC pulse generator

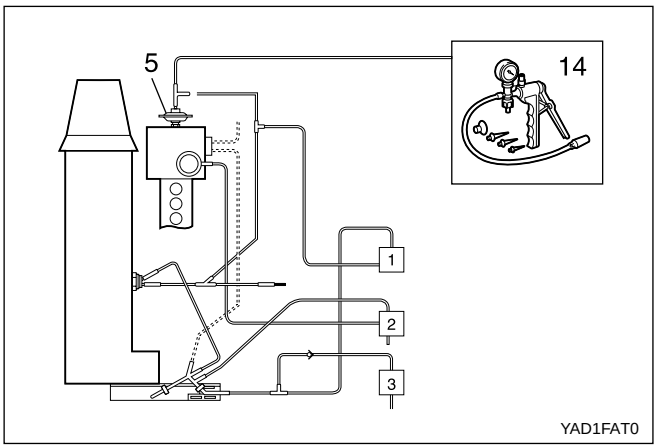
Commercial Tools

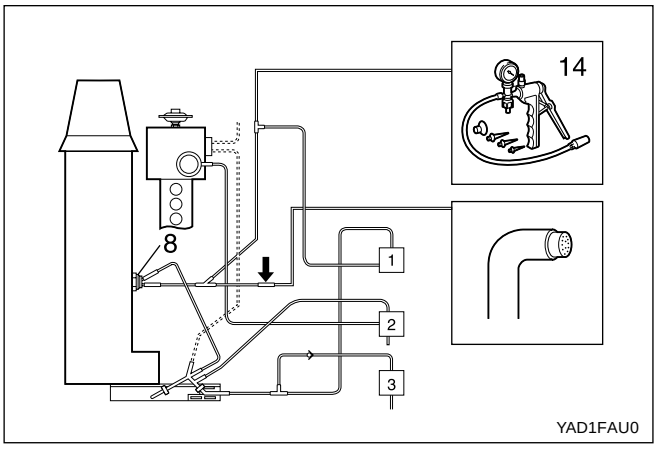
Digital tester	e.g Bosch MOT 001.03 Sun DIT 9000
Temperature measuring instrument with test probe WB24	e.g Ahlborm, Therm 2263 - 2 Eichenfeldstrabe 1 - 3 D - 8150 Holzkirichen

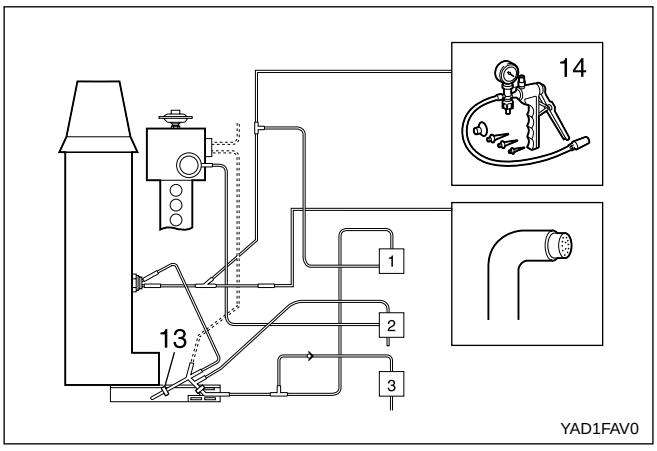


Tester Connection









Test step 1 (Coolant Temp. ≤ 0°C)

Connect vacuum pump (14) with Y adapter to PLA vacuum unit (5). Run engine at idle speed.

Vacuum ≧ 500 mbar?

YES

NO

Lines and connections leaking.
Faulty PLA vacuum unit.

(Remove the connection hose from vacuum pump)

Connect vacuum pump (14) direct to PLA vacuum unit (5) and pressurize with vacuum.

Vacuum is built up and idle speed increases approx. 150-200 rpm ?

YES

NO

Faulty PLA vacuum unit

(Coolant Temperature 0 ± 3°C)

Stop the engine and seal the air admission line with plug (arrow). Connect the vacuum pump to line to thermovalve and pressurize the line with vacuum.

Vacuum is built up?

YES

NO

Lines and connections leaking.
Faulty thermovalve.

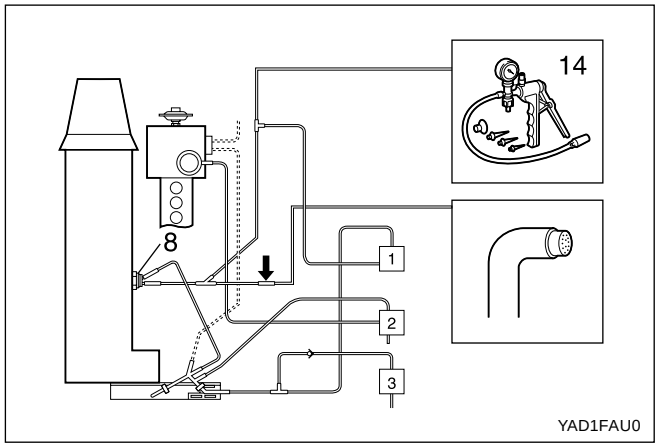
Detach line downstream of air admission filter (13).

Vacuum drops off?

YES

NO

Faulty thermovalve



Fit the line onto air admission filter. Built up vacuum with vacuum pump. Detach the plug from air admission line.

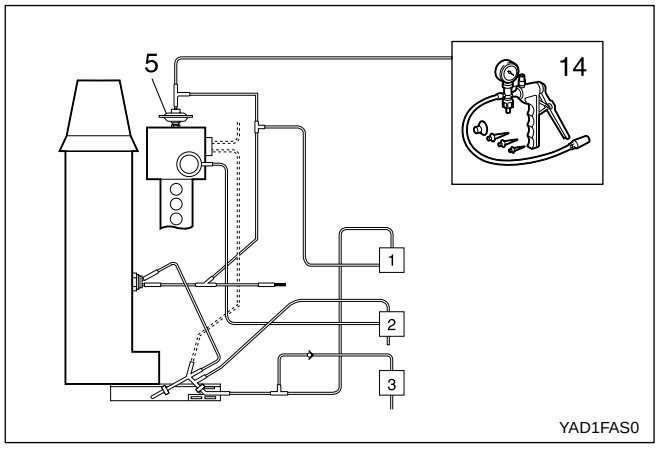
Vacuum drops off?

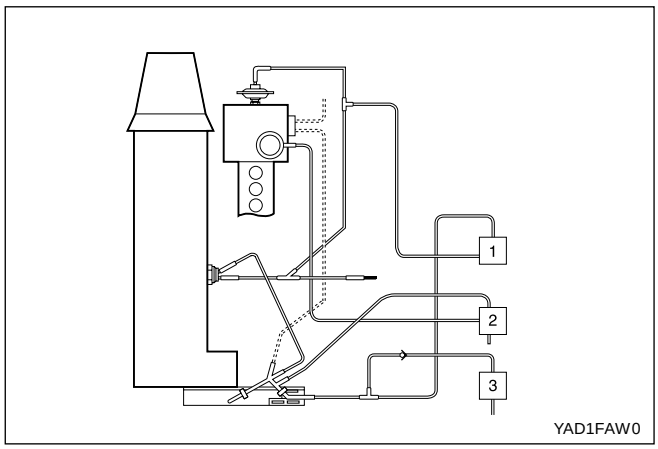
YES

NO

Faulty filter with restriction.

Go to test step 2.





Test step 2

Connect vacuum pump (14) with Y adapter to PLA vacuum unit (5). Run the engine at idle speed.

Vacuum drops to '0' at approx. ± 3°C of the thermovalve.

YES

NO

Faulty thermovalve. Defective filter with restriction.

Stop the engine. Detach the filter with restriction.

Filter with restriction is clear.

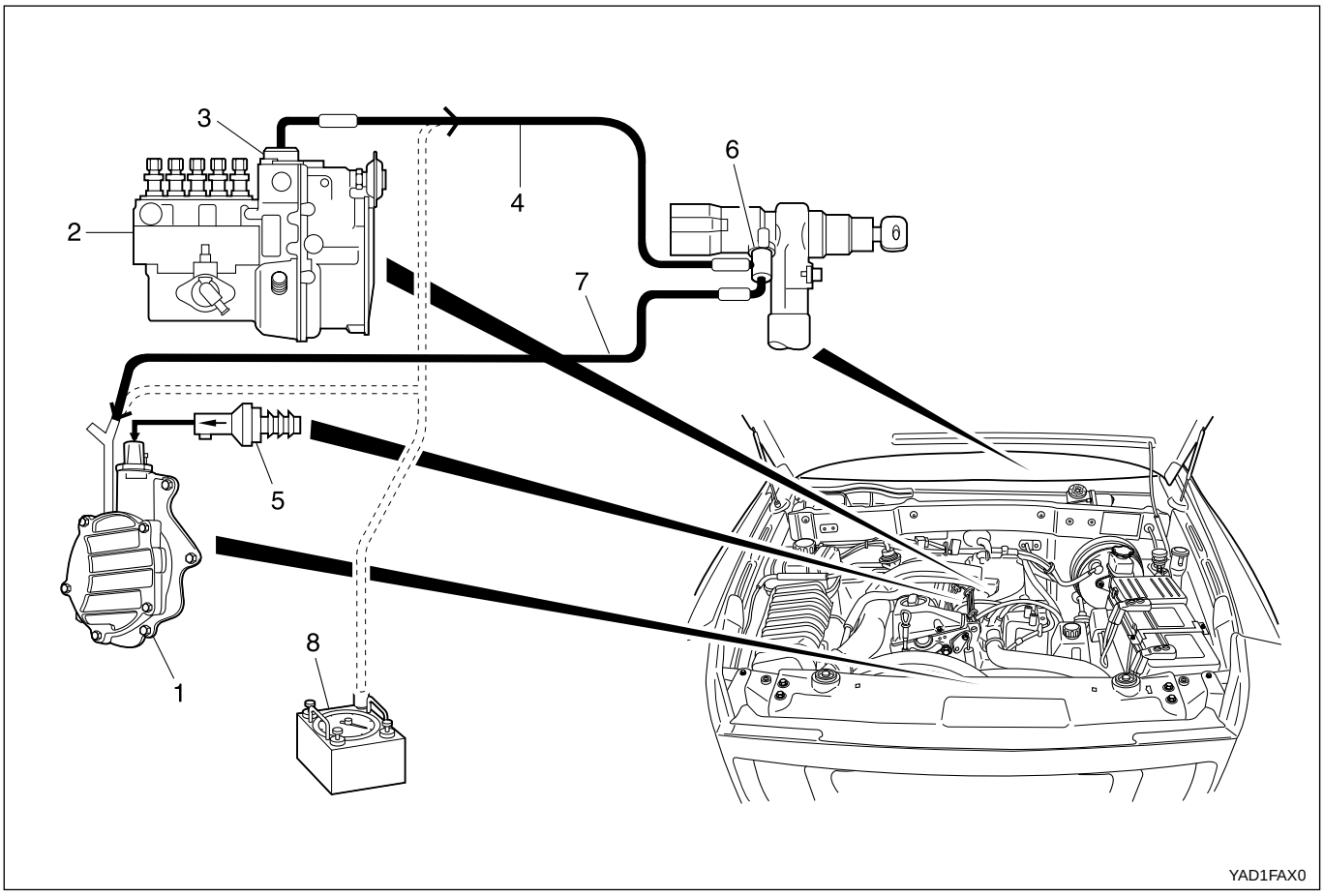
YES

NO

Defective filter with restriction.

OK

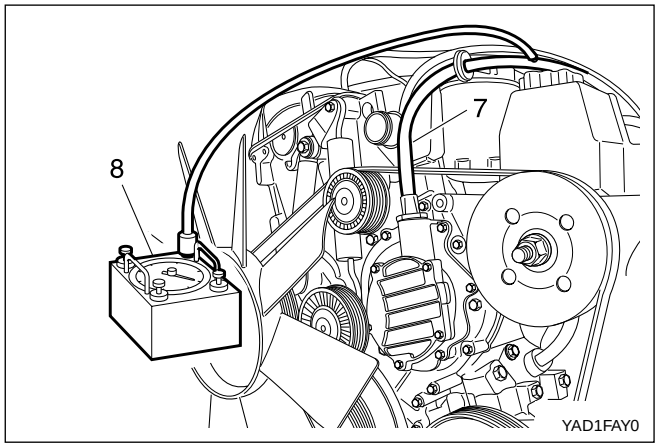
VACUUM SHUT-OFF LEAK TEST

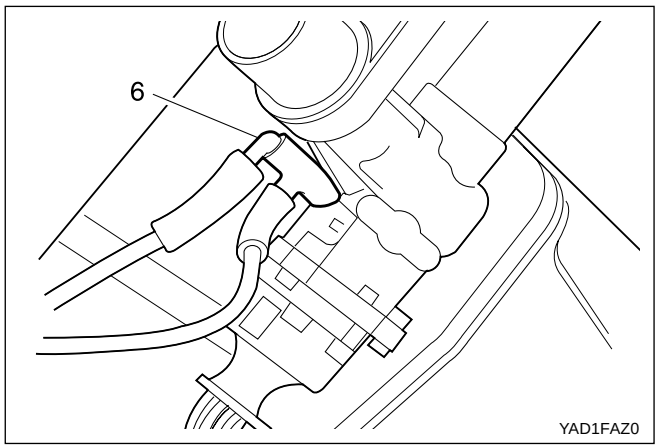


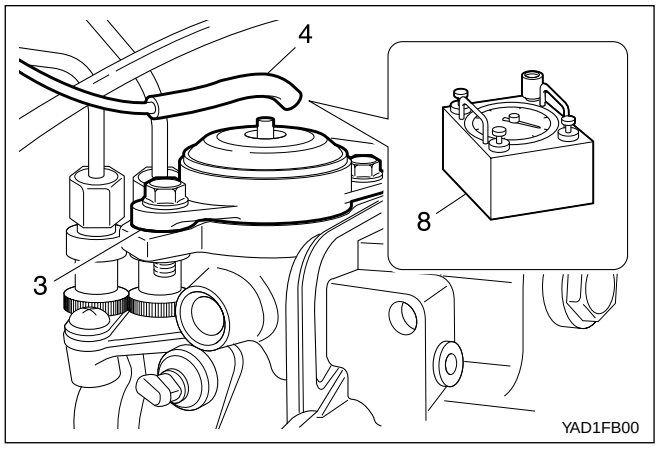
1 Vacuum Pump
2 Fuel Injection Pump
3 Engine Stop Unit
4 Control Line
5 Check Valve (to Brake Booster)
6 Engine Shut-Off Valve
7 Suction Line
8 Vacuum Tester

Service Data

Model	Permissible loss of vacuum
Entire System at 400 + 50 mbar Vacuum	6 mbar / min.
Individual Part at 300 + 50 mbar Vacuum	5 mbar / min.







Tools Required

201 589 13 21 00 Vacuum Tester

1. After fully warming up the engine, turn the ignition switch to 'LOCK' position.
2. Disconnect the suction (7) line from vacuum pump.
3. Connect the vacuum teater 201 589 13 21 00 (8) to suction line (7) and apply vacuum of 400 + 50 mbar.

Permissible loss of vacuum	6 mbar / min

If a vacuum drop is more than sperified value, check the engine shut-off valve or vacuum unit.

4. Engine Shut-off valve test
   - Turn the ignition switch to 'ON' position.
   - Connect the vacuum tester 201 589 13 21 00 to engine shut-off valve (6) and apply vacuum of 300 + 50 mbar.

Permissible loss of vacuum	5 mbar / min

If a vacuum drop is more than specified value, replace the engine shut-off valve (6)

Notice: Before replacing the valve for the glow starter system and the vacuum unit of the injection pump, check the hose lines and connections.

5. Vacuum Stop Unit Test.
   - Disconnect the control line (4) from the vacuum stop unit (3).
   - Connect the vacuum tester 201 589 13 21 00 to vacuum stop unit (3) and apply vacuum of 300 + 50 mbar.

Permissible loss of vacuum	5 mbar / min

   - If a vacuum drop is more than specified valve, replace the vacuum stop unit.

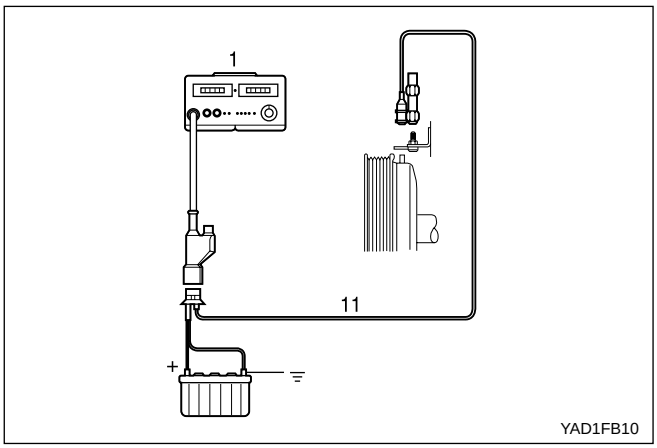
IDLE SPEED ADJUSTMENT

Service Data

Engine	Idle Speed
OM662LA Engine	720 - 820 rpm

Commercial Tool

Digital tester	e.g. Bosch, MOT 001.03
	Sun, DIT 9000



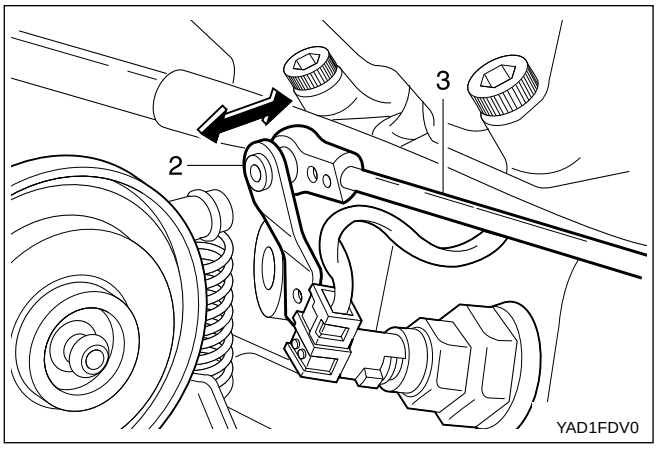
Tools Required

001 589 73 21 00 Vacuum Pump

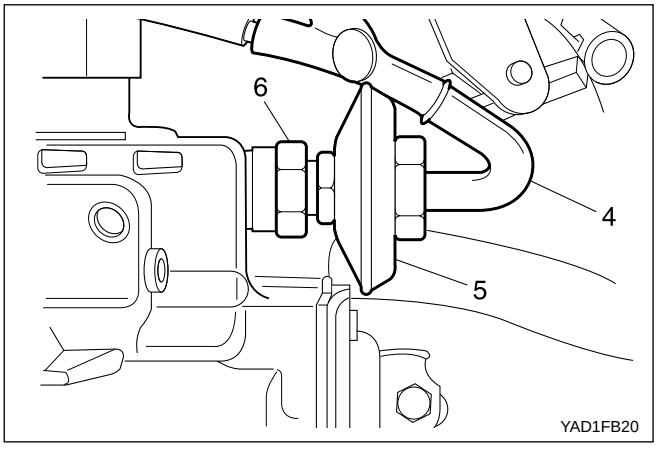
667 589 00 73 21 TDC Pulse Generator

Adjustment Procedure

1. Connect the digital tester (1) and TDC pulse generator 667 589 02 21 00 (11).
2. Run the engine and warm up the coolant to 60~80°C.



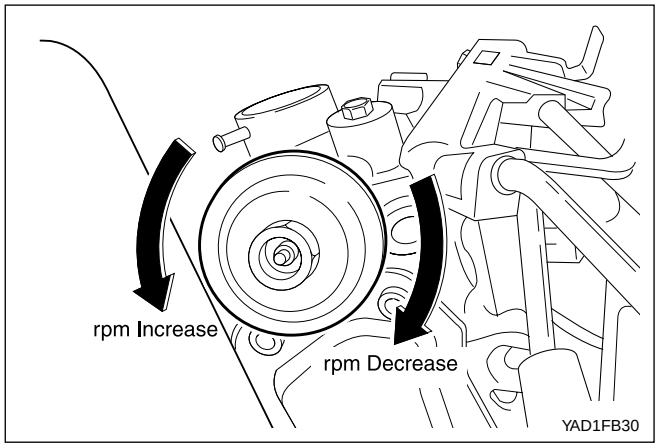
3. Disconnect the connecting rod (3) from control lever (2).



4. Disconnect the vacuum hose (4) from the PLA unit to check idle speed with tester.
5. Check idle speed with tester.

Idle Speed	720 - 820 rpm

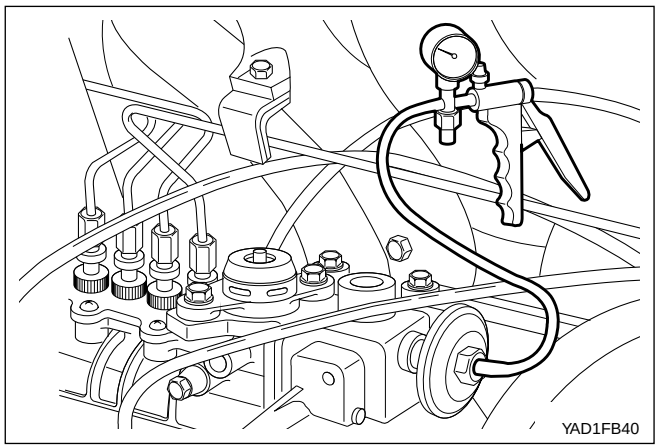
Notice: To adjust idle speed, loosen the locking nut (6) of PLA unit.



6. Ensure not to damage the idle spring in the governor and adjust idle speed by turning the PLA unit (5) slowly.

Clockwise	RPM Decrease
Counterclockwise	RPM Increase

Notice: Do not rotate the PLA unit over ½ turn from the position marking. If do, idle spring in the governor will be severely damaged.

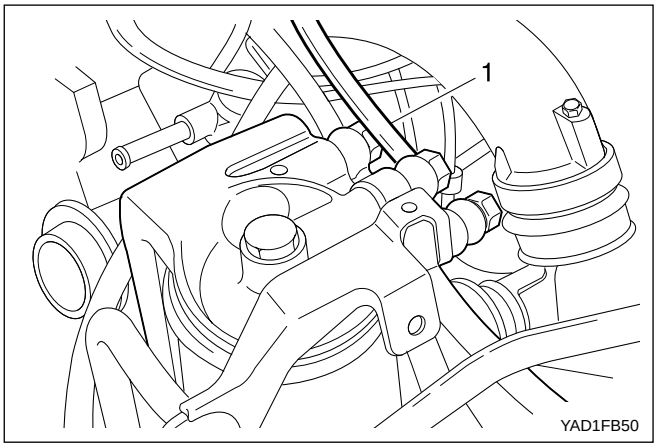


7. After adjustment, tighten the locking nut and place the position marking with different color of paint.

   Notice: If there are no changes in idle speed with PLA unit adjustment, perform the service at a BOSCH Service Center.

8. Connect the vacuum pump 001 589 73 21 00 to the PLA vacuum unit and build up vacuum approx. 500 mbar. If engine rpm increases by approx. 150 rpm. It is normal.

9. Connect the vacuum line (4).
10. Install the connecting rod.
11. Switch on all ancillaries and check the idle speed.



FUEL PUMP TEST

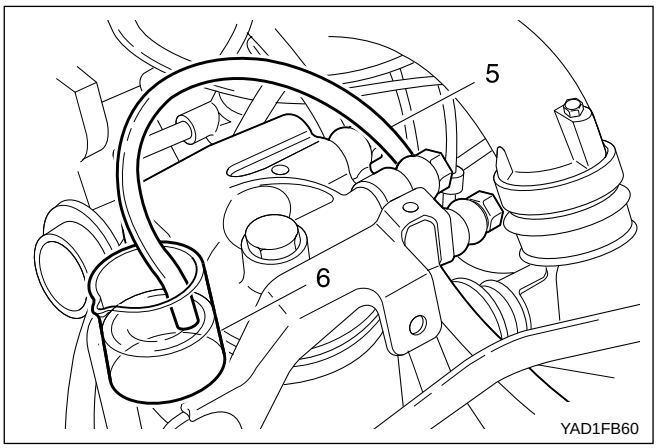
Notice: Before test, replace the fuel filter cartridge and fuel prefilter.

Fuel Feed Test

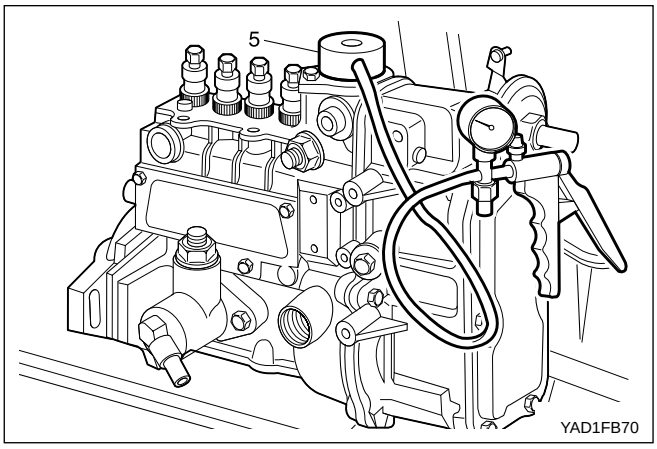
Tools Required

001 589 73 21 00 Vacuum Pump

1. Disconnect the fuel return line (1) and seal up it with plug.



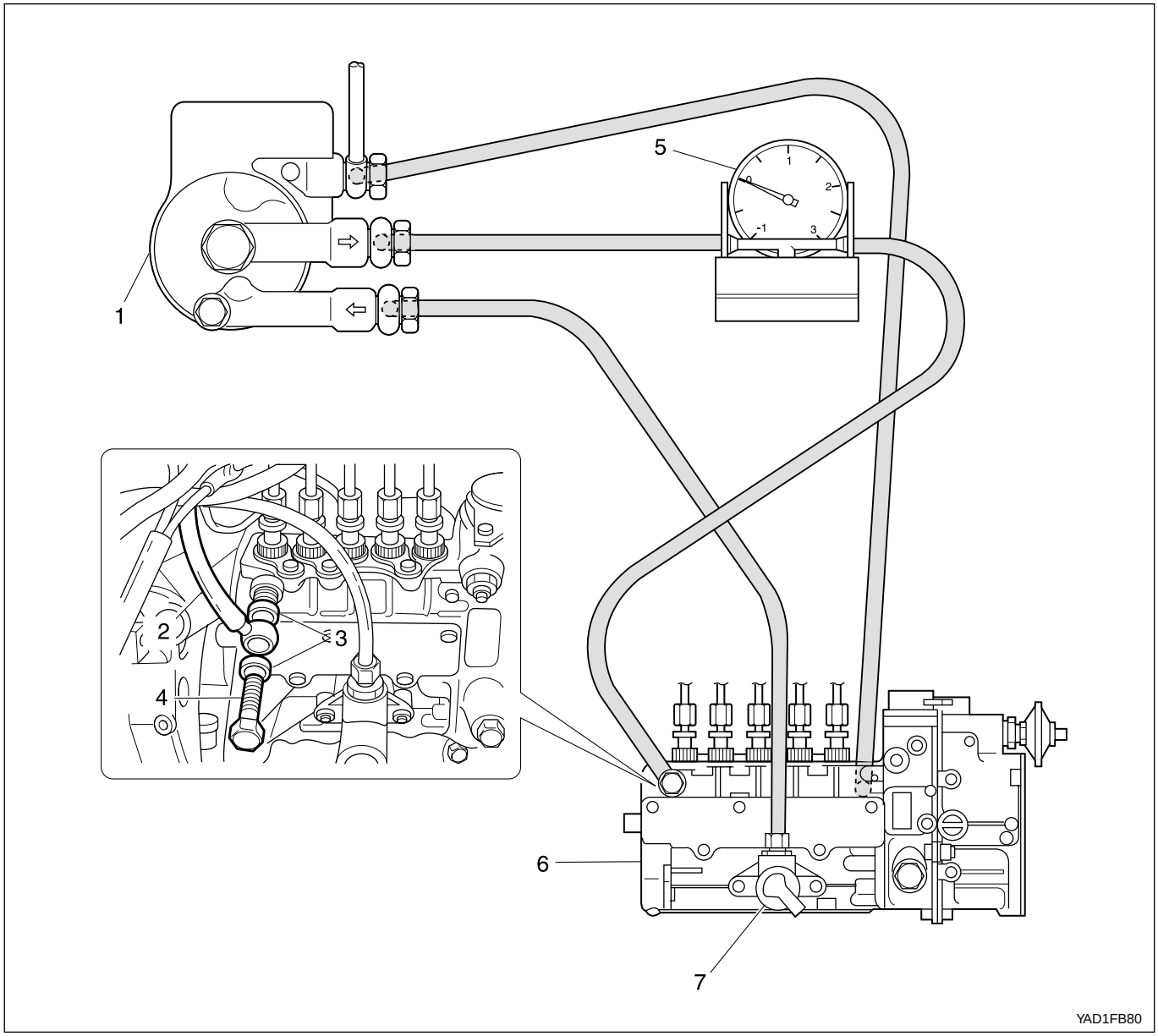
2. Insert the plastic hose (5) and put the end into the measuring beaker (6).



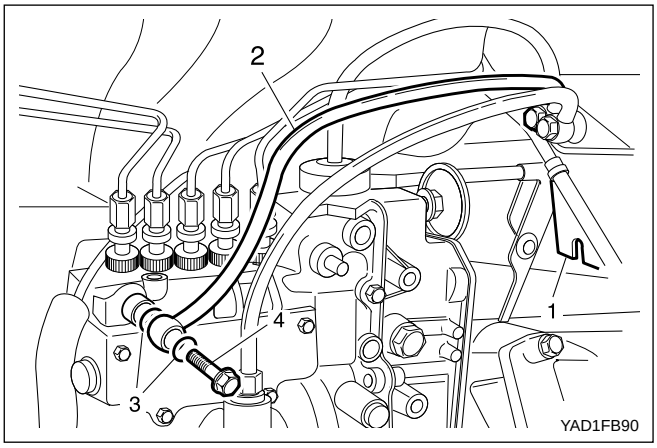
3. Disconnect the vacuum line from vacuum unit (engine stop) (5) and connect the vacuum pump 001 589 73 21 00 to the vacuum unit.
4. To avoid the engine starting, build up vacuum (approx. 500 mbar).
5. Operate the starter motor for exactly 30 seconds and measure fuel volume in the beaker.

Min. volume	150 cm^3 for 30 seconds

Fuel Pressure Test



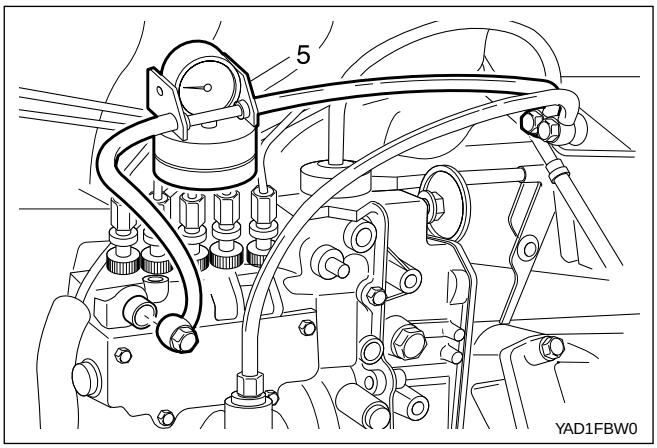
1 Fuel Filter Housing
2 Fuel Line
3 Seal ..... Replace
4 Bolt ..... 13 N•m (10 lb-ft)
5 Tester ..... At Idle Speed > 0.3 bar
..... At Full Load > 0.5 bar
6 Fuel Injection Pump
7 Fuel Pump



Tools Required

617 589 04 21 00 Tester

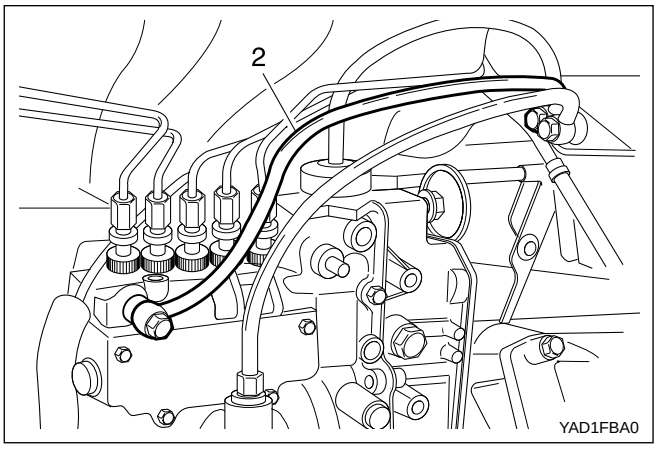
1. Disconnect the fuel line (2) from the fuel filter.
2. Remove the banjo bolt (4) from the fuel injection pump and remove the seals (3) and fuel line (2).



3. Connect the tester 617 589 04 21 00 (5).
4. Start the engine and read off the fuel pressure on tester 617 589 04 21 00 (5).

At Idle Speed	> 0.3 bar
At Full Load	> 0.5 bar

Notice: If out of standard, replace the fuel feed pump.



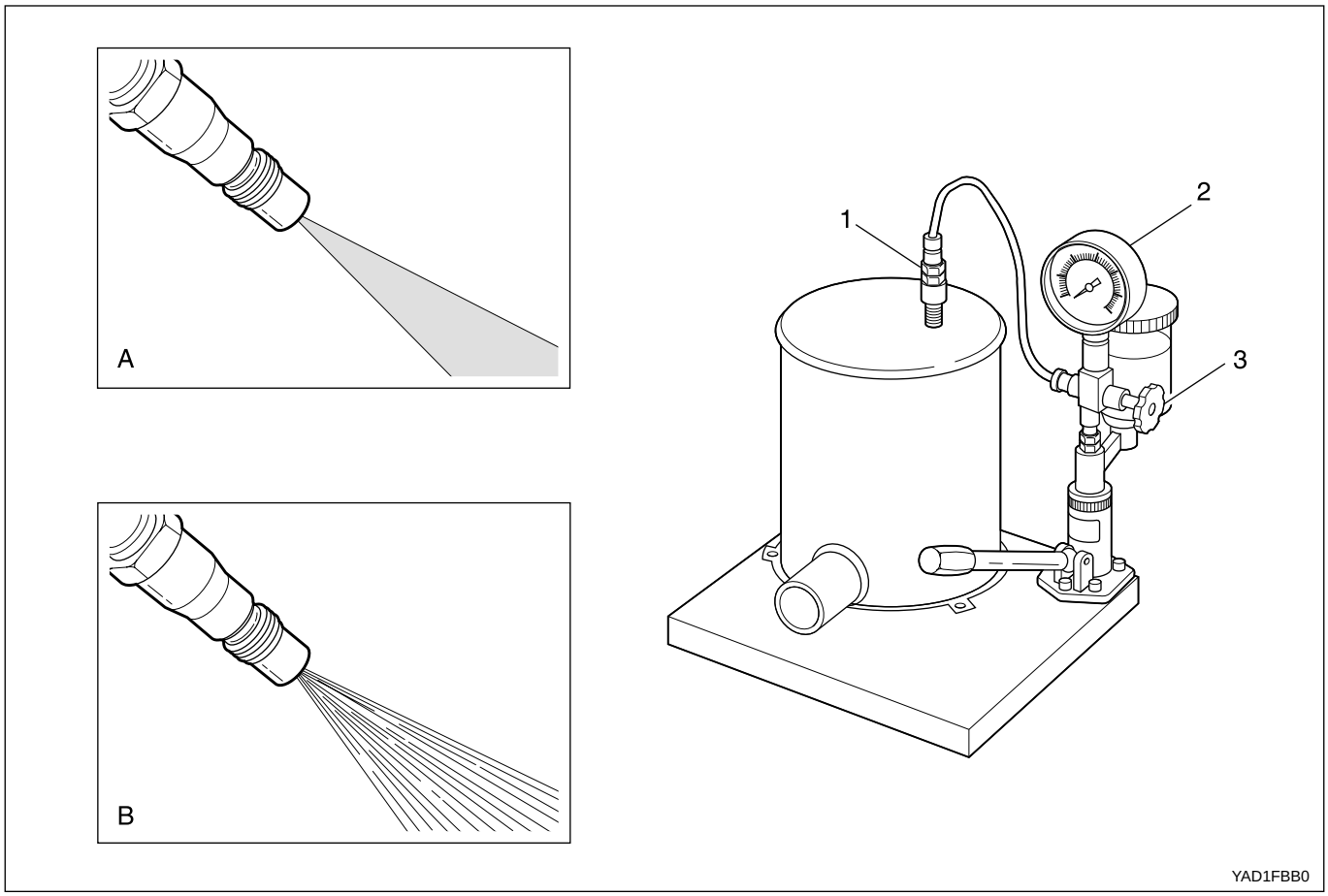
5. Stop the engine.
6. Remove the tester 617 589 04 21 00.
7. Replace the seal and connect the fuel line (2).

Inatallation Notice

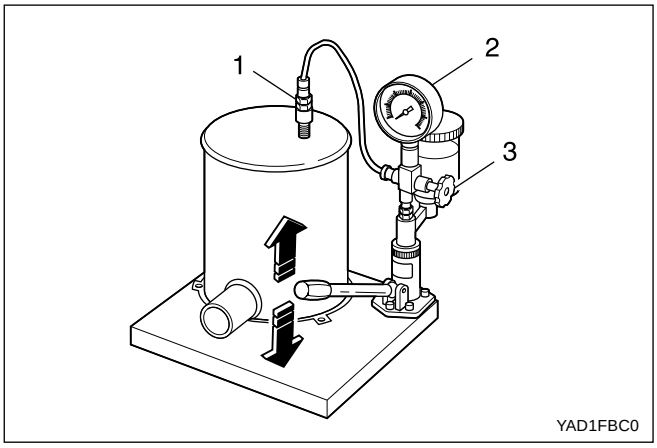
Tightening Torque	13 N•m (10 lb-ft)

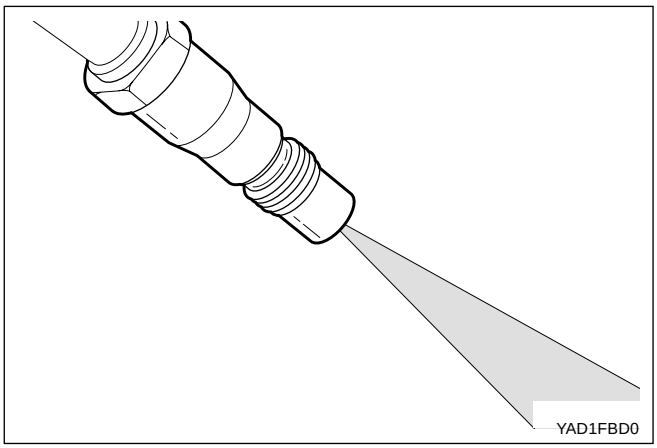
INJECTION NOZZLE TEST

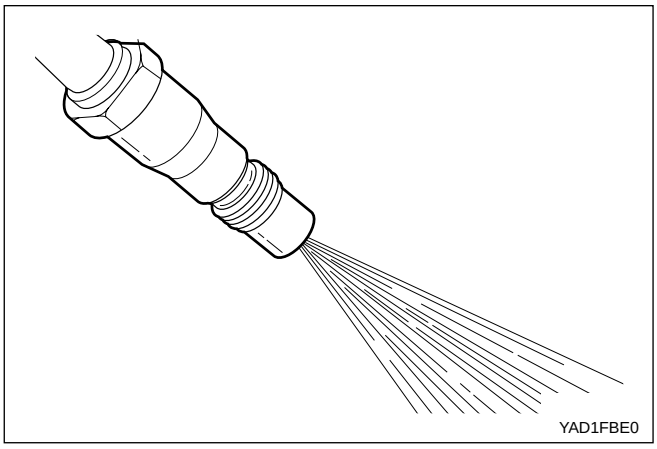
Preceding Work: Removal of fuel injection nozzle



1 Fuel Injection Nozzle .....New : 135 - 143 bar
..... Used : min. 120 bar
2 Tester
3 Valve
A Closed Spray = good
B Stringy Spray = poor







Tools Required

000 589 14 27 00 Fuel Injection Nozzle Tester

Notice: When testing the injection nozzle, do not place your hand into the spray of a nozzle. The spray will penetrate deep into the skin and destroy the tissue.

1. Connect the fuel injection nozzle to the fuel injection nozzle tester 000 589 14 27 00.
2. Close the valve (3) and pump 5 times strongly.
3. Chatter test :

   Slowly operate the hand lever at tester (approx. 1 stroke per second). The nozzle must spray with a gentle chattering.

4. Spray pattern test :

   Operate the hand lever at tester rapidly (approx. 2~3 strokes per second).

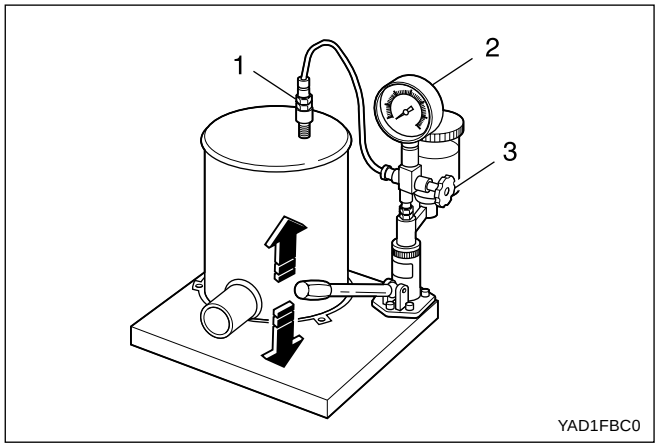
   - Good

     The spray pattern shows closed and well atomized.

   - Poor

     The spray pattern shows split, too wide and stringy.

     (Repair the fuel injection nozzle)



5. Opening pressure test :

   Open the valve (3) and slowly operate the hand lever at tester (approx. 1 stroke / second) and measure opening pressure.

New Nozzle	135 - 143 bar
Used Nozzle	Min. 120 bar
Difference Between Nozzles	Max. 5 bar

   Notice: If out of standard, repair the injection nozzle.

6. Leak test

   Slowly operate the hand lever at the tester until get a pressure of approx. 90 bar. Maintain this pressure for more than 20 seconds and within this period no drop of fuel should build up at the nozzle tip.

CHECKING AND ADJUSTING START OF DELIVERY

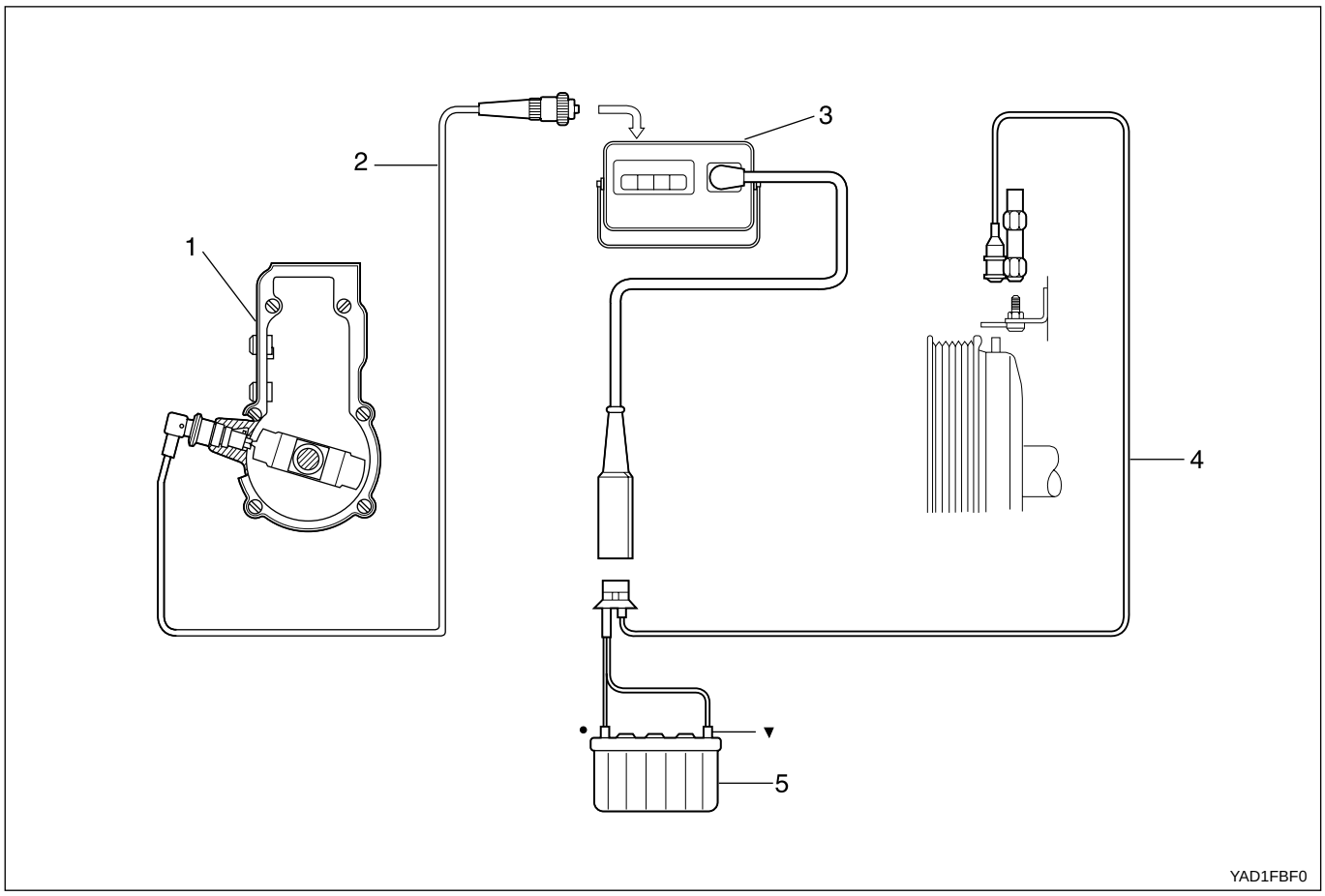
Governor Impulse Method (RIV)

In order to be able to register the relationship of the injection pump relative to the engine two signals are required.

- TDC impulse from the crankshaft.
- Governor impulse from the injection pump.

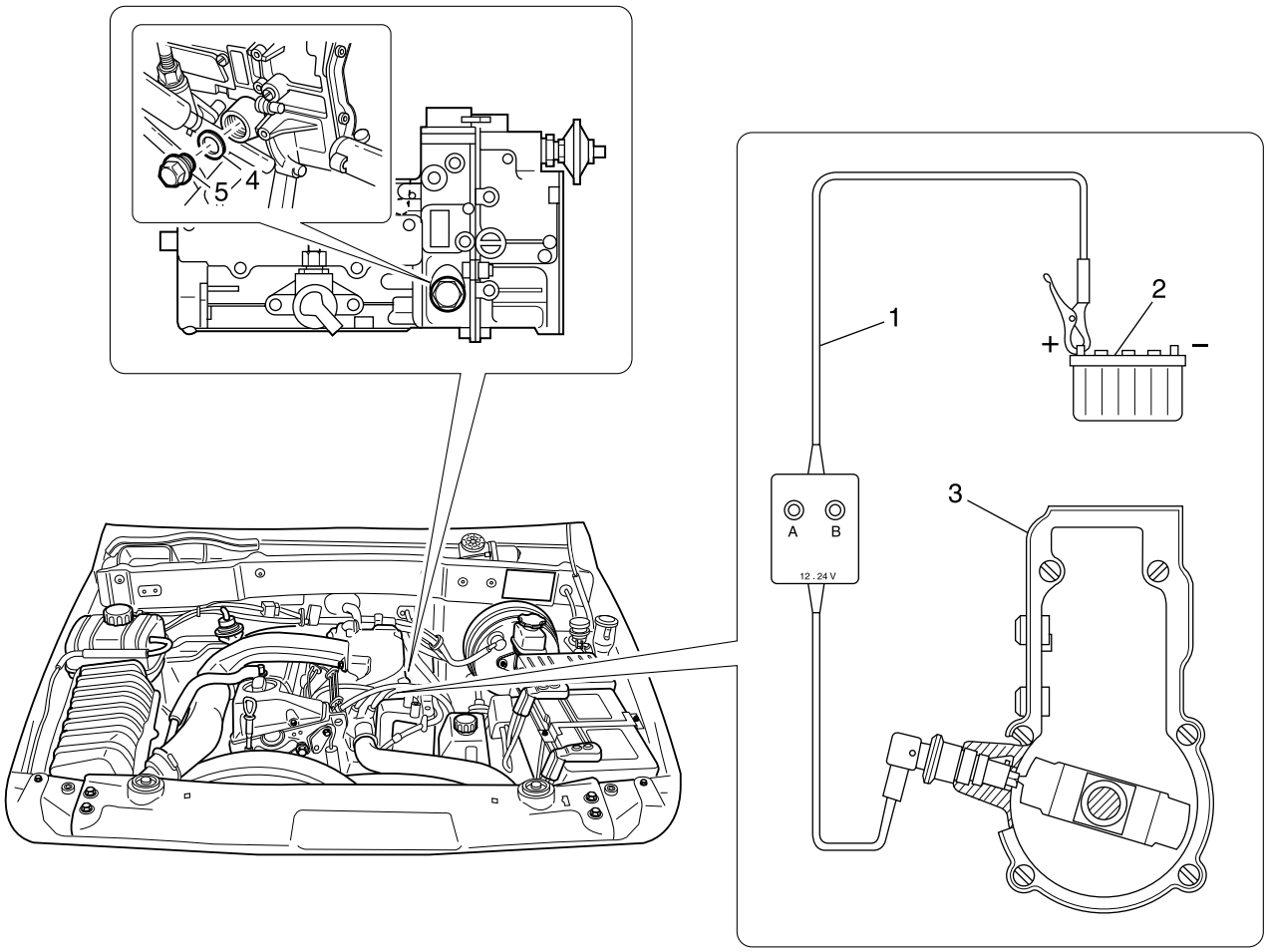
Both impulses are supplied by pulse generators.

In order to obtain a measuring signal the sensor pins must be moved past the pulse generators with a minimum speed (idle speed). A measuring instrument measures the time interval of the two impulses, converting the result into an angular value which is then indicated.



1 Fuel Injection Pump
2 RI Sensor
3 Digital Testor
4 TDC Pluse Sender Unit
5 Battery

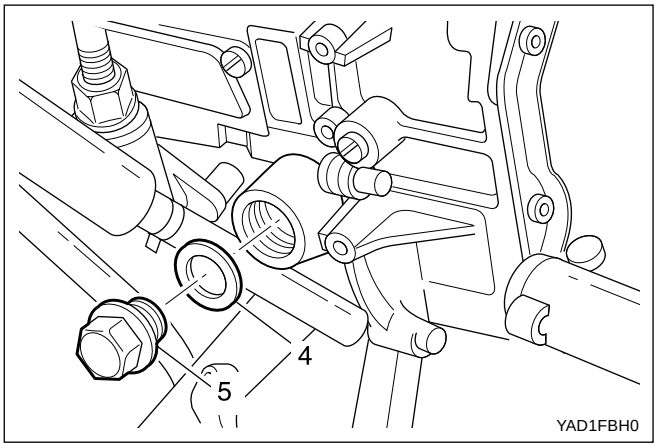
Position Sensor, RIV Method



1 Position Sensor
2 Battery
3 Fuel Injection Pump
4 Seal ..... Replace
5 Screw Plug ..... 30 N•m (22 lb-ft)

Service Data

Start of Delivery (RIV)	ATDC 14° - 16°



Tools Required

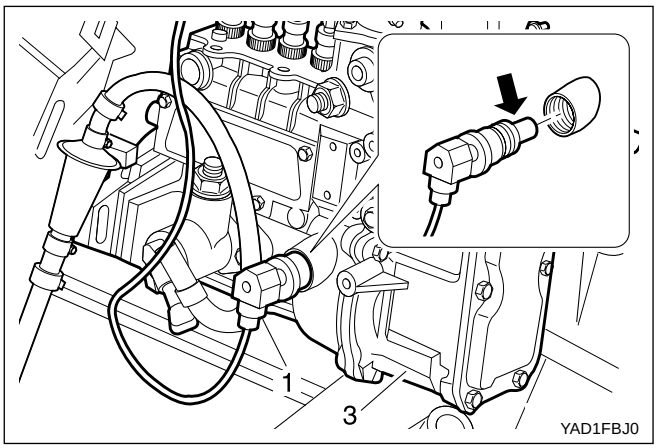
617 589 08 21 00 Position Sensor

Test Procedure

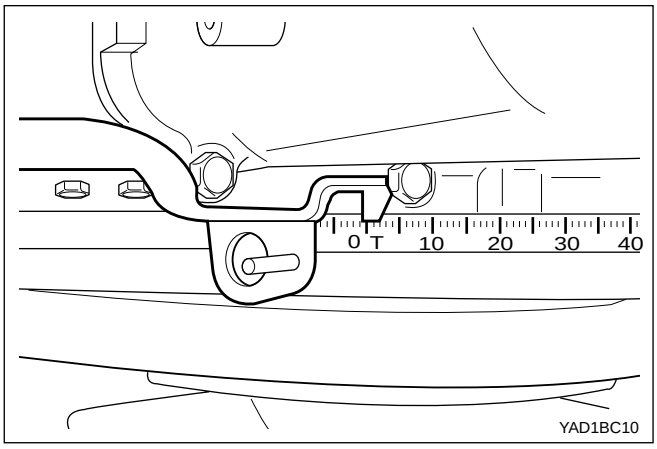
1. Remove the screw plug (5) and seal (4) and collect oil in a suitable vessel.

   Installation Notice

Tightening Torque	30 N•m (22 lb-ft)



2. Install the position sensor 617 589 08 21 00 (1) into the governor housing of the injection pump to be the guide pin of the position sensor facing up.
3. Connect the battery terminal of position sensor 617 589 08 21 00 (1) to positive terminal (+) of battery.

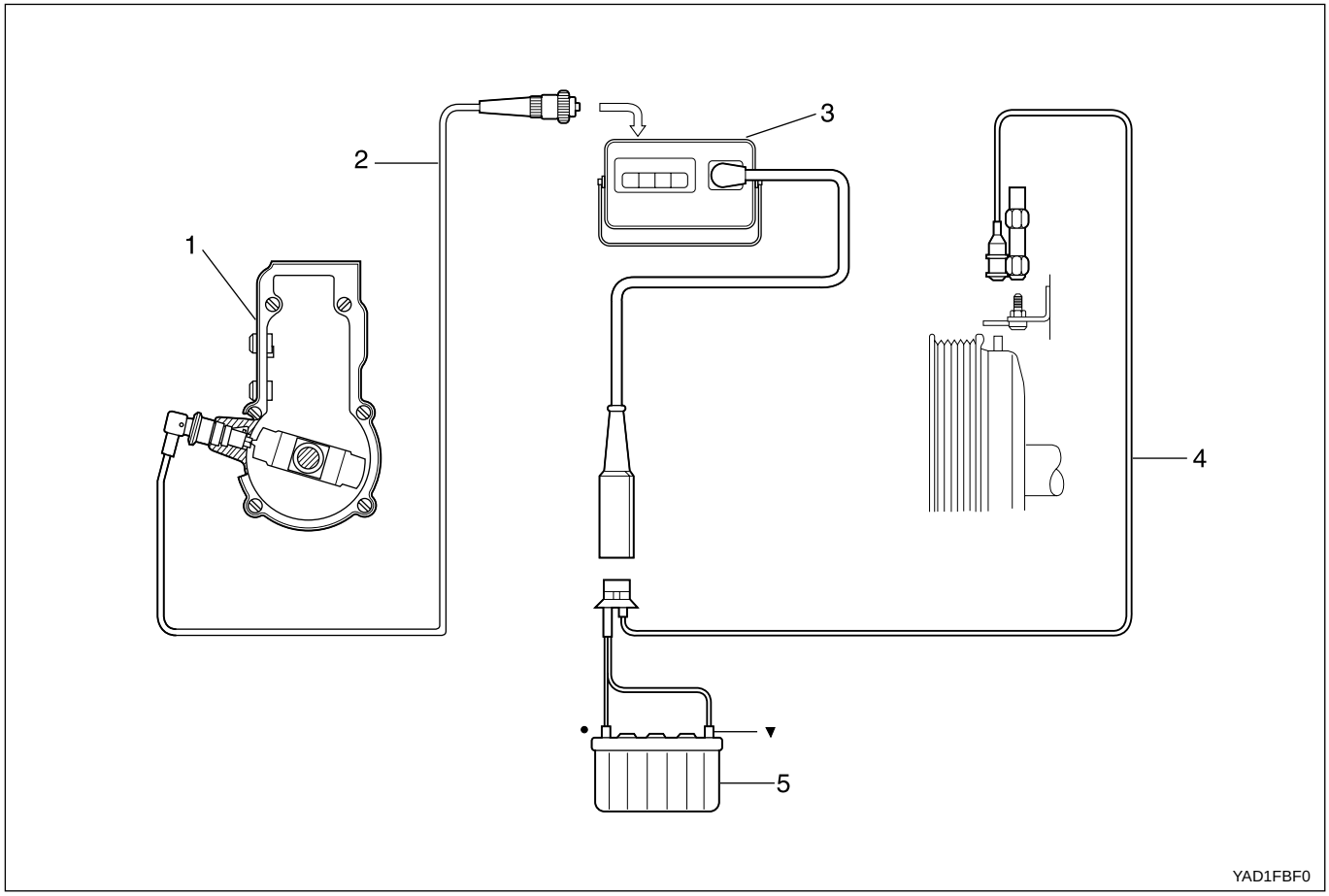


4. Rotate the crankshaft by hand (in direction of engine rotation) until the lamp ‘B’ lights up. Rotate the crankshaft carefully further until both lamps ‘A and B’ come on. In this position, check the Rl value on the crankshaft vibration damper.

Specification	ATDC 14° - 16°

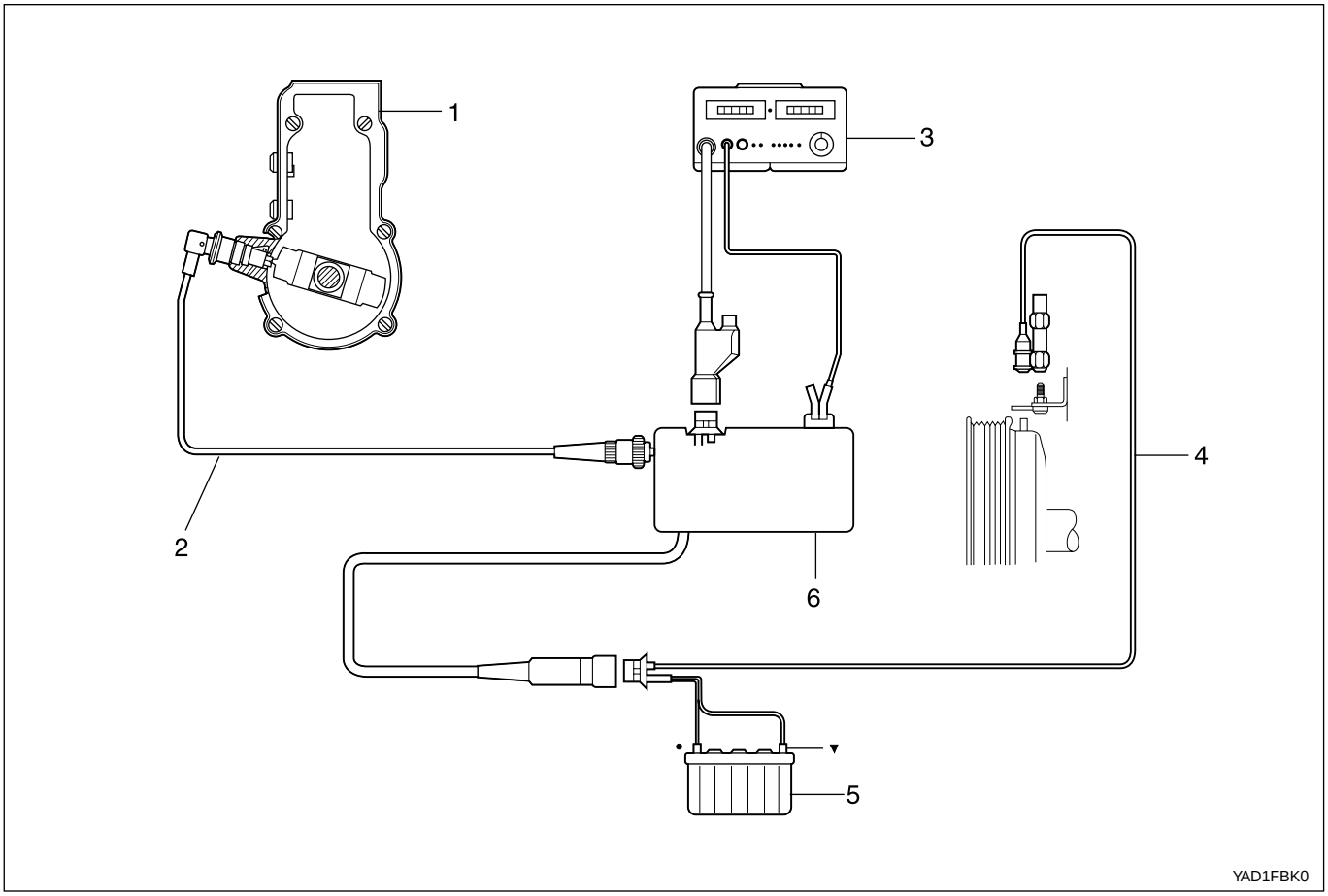
Notice: If only lamp ‘A’ lights up, repeat the test and if out of specification, adjust start of delivery.

Digital Tester, RIV Method
(Connection Diagram for Testers Without Adapter)



1 Fuel Injection Pump
2 Rl Sensor
3 Digital Tester
4 TDC Pulse Generator
5 Battery

(Connection Diagram for Testers With Adapter)



1 Fuel Injection Pump
2 RI Sensor
3 Digital Tester
4 TDC Pulse Sender Unit
5 Battery
6 RI Pulse Generator

Service Data

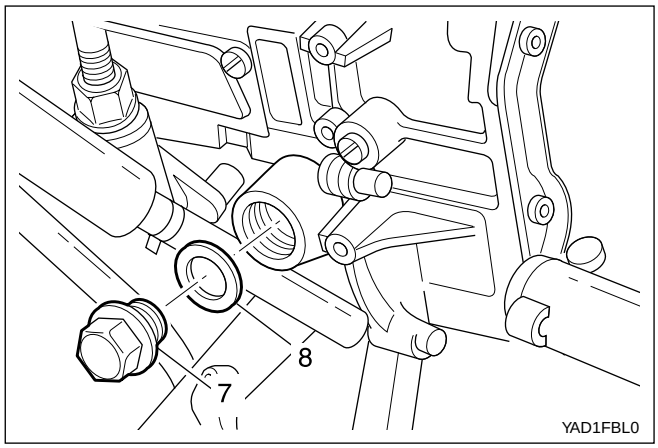
Start of Delivery (RIV)	ATDC 14° - 16°
Idle Speed	720 - 820 rpm

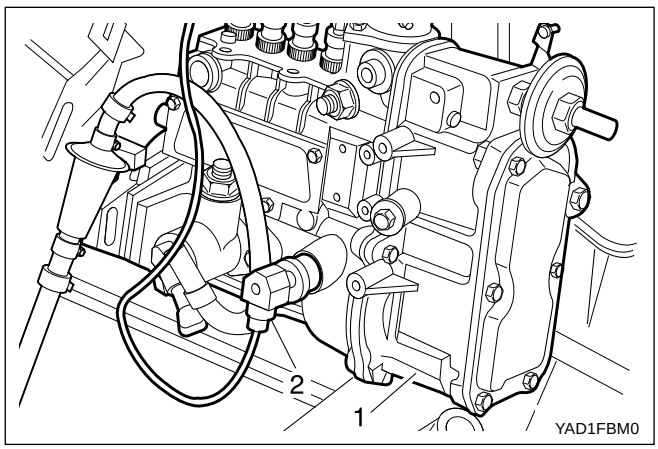
Tools Required

617 589 09 21 00 RI Adapter
617 589 10 21 00 RI Sensor
667 589 00 21 00 TDC Pulse Generator

Commercial Tools

Item		Tools
Digital Tester	With Pluse Generator	Bosch, MOT 001.03
		Hartmann & Braun. EOMT3
	Without Pulse Generator	Bosch, ETD 019.00
		Sun, DIT 9000
		ALV, Diesel - Tester 875





Test Procedure

1. Remove the screw plug (7) and seal (8) collect oil in a suitable vessel.
2. Install the RI sensor 617 589 10 21 00 into the governor housing of injection pump (1).
3. Connect the digital tester and TDC pulse generator 667 589 00 21 00 according to connection diagram.
4. Run the engine at idle speed and check the RI value on the digital tester

RI valve	ATDC 14° - 16°

Notice: If out of standard, adjust the start of delivery.

5. Stop the engine.
6. Remove the RI sensor, digital tester and TDC pulse generator.
7. Replace the seal and tighten the plug.

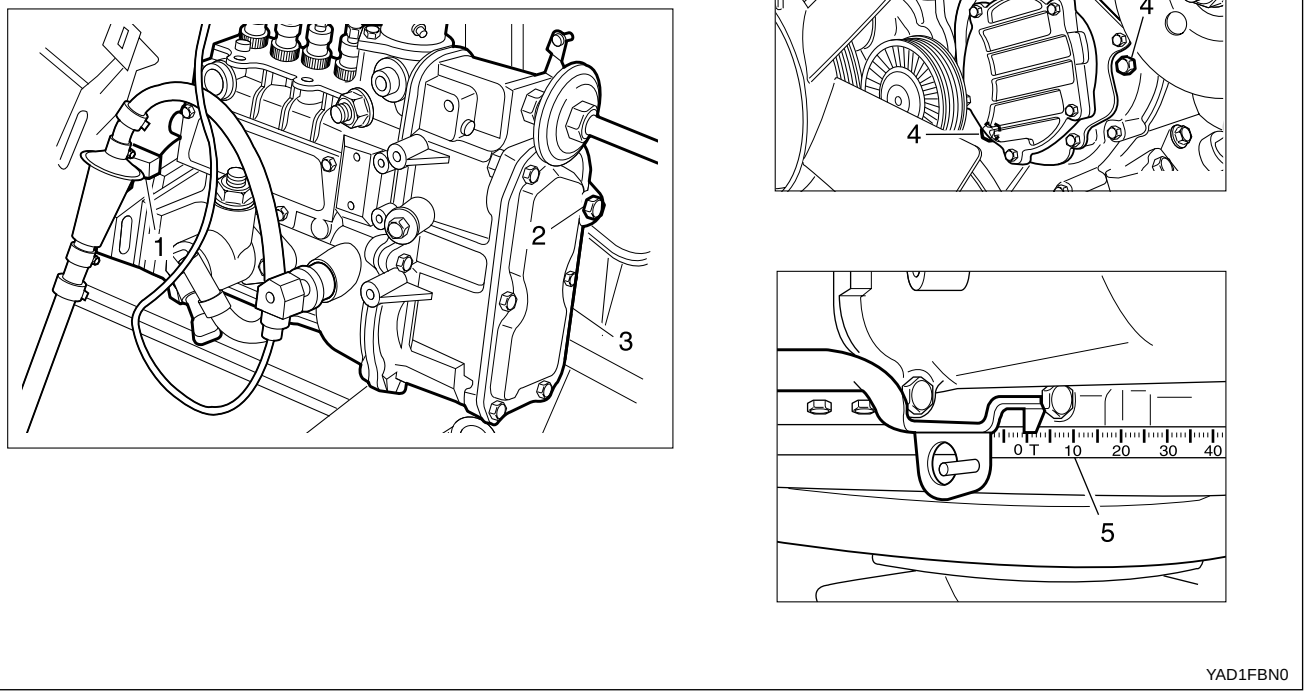
Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

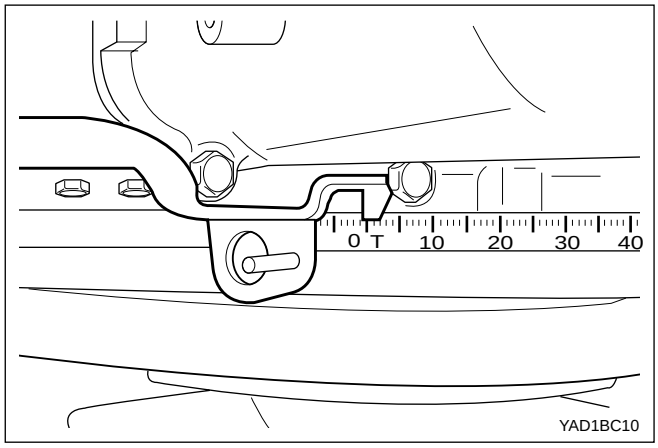
8. Check engine oil level and adjust if necessary.

After Testing - Position Sensor (RIV Method)

Preceding Work: Start of delivery test



1 Adjusting Screw
2 Bolt ..... 23 N•m (17 lb-ft)
3 Fuel Injection Pump
4 Bolt ..... 23 N•m (17 lb-ft)
5 Scale ..... RI start of delivery = 14° - 16° ATDC



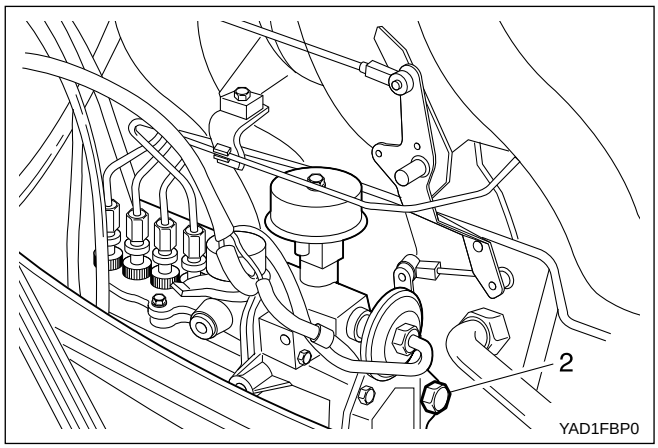
Tools Required

617 589 08 21 00 Position Sensor

Adjustment Procedure

1. Position the No. 1 cylinder at ATDC 15°

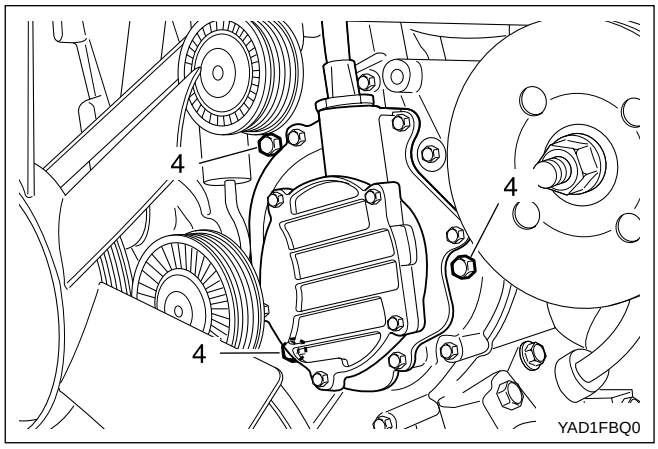
   Notice: Do not rotate the engine in opposite direction of engine rotation.



2. Remove the bolt (2) at the supporting bracket.

   Installation Notice

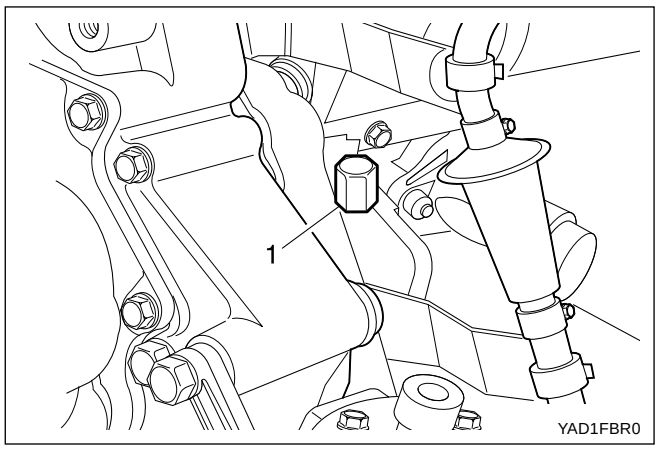
Tightening Torque	23 N•m (17 lb-ft)



3. Remove the bolt (4) at the timing case cover.

   Installation Notice

Tightening Torque	23 N•m (17 lb-ft)



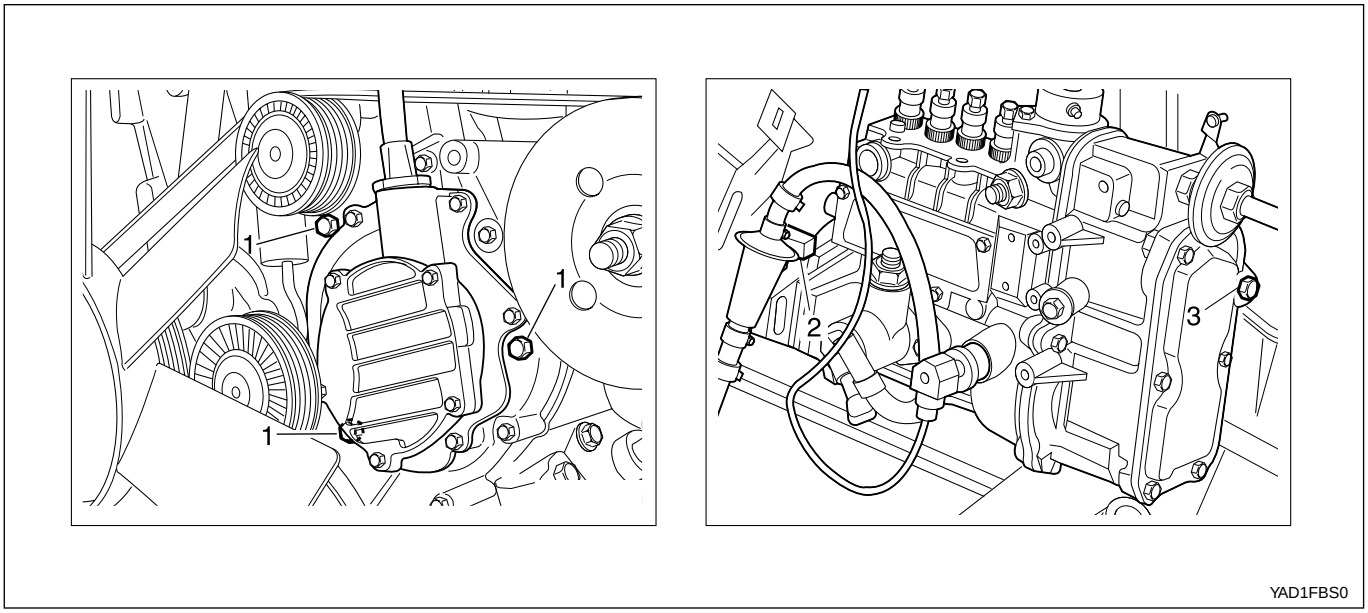
4. Turn the adjusting screw (1) until both lamps ‘A’, ‘B’ on the position sensor 617 589 08 21 00 light up.

To the right	Start of Delievery Retarded
To the left	Star of Delivery Advanced

   Notice: If the adjustment range is not adequate, remove the injection pump and reinstall.

5. After adjusting, retighten all the bolt to the specified torque.

After Testing - Digital Tester (RIV Method)



1 Bolt..... 23 N•m (17 lb-ft)
2 Adjusting
Screw .... To the right : start of delivery retarded
To the left : start of delivery advanced
3 Bolt..... 23 N•m (17 lb-ft)

Service Data

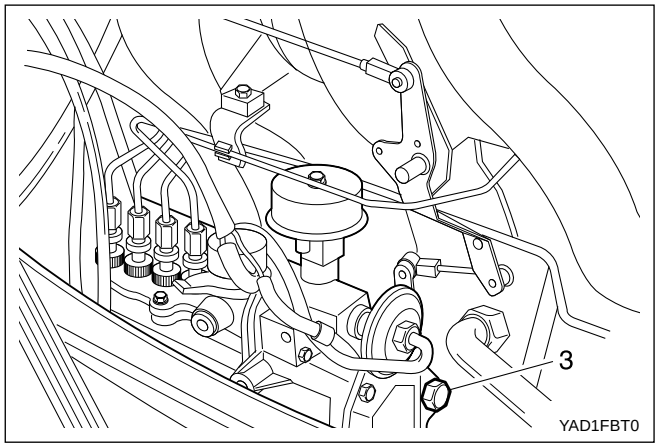
Start of Delivery (RIV)	ATDC 14° - 16°
Ldling Speed	720 - 820 rpm

Tools Required

617 589 09 21 00 RI Adaptor
617 589 10 21 00 RI Sensor
667 589 00 21 00 TDC Pulse Generator

Commercial Tools

Item		Tools
Digital Tester	With Pulse Generator	Bosch, MOT 001.03
		Hartmann & Braun, EOMT3
	Without Pulse Generator	Bosch, ETD 019.00
		Sun, DIT 9000
		ALV, Diesel - Tester 875

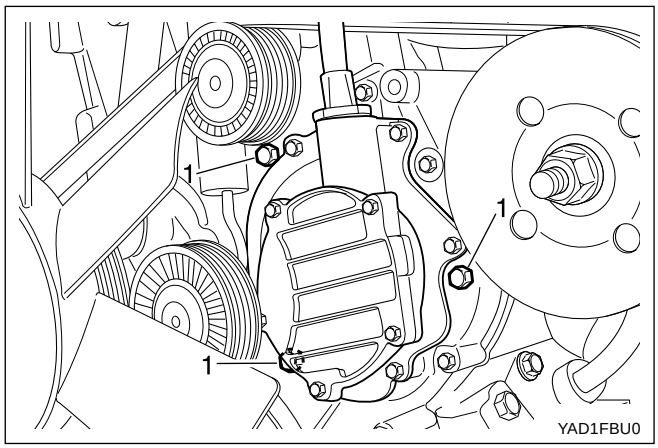


Adjustment Procedure

1. Remove the bolt (3) at the supporting bracket.

Installation Notice

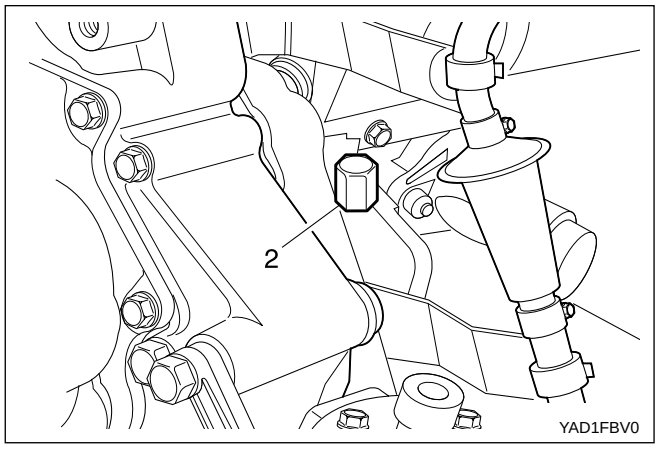
Tightening Torque	23 N•m (17 lb-ft)



2. remove the bolts (1) at the timing case cover.

Installation Notice

Tightening Torque	23 N•m (17 lb-ft)



3. Run the engine at idle speed.
4. Turn the adjusting screw (2) until the specification (15° ± 1° ATDC) is indicated on the digital tester.

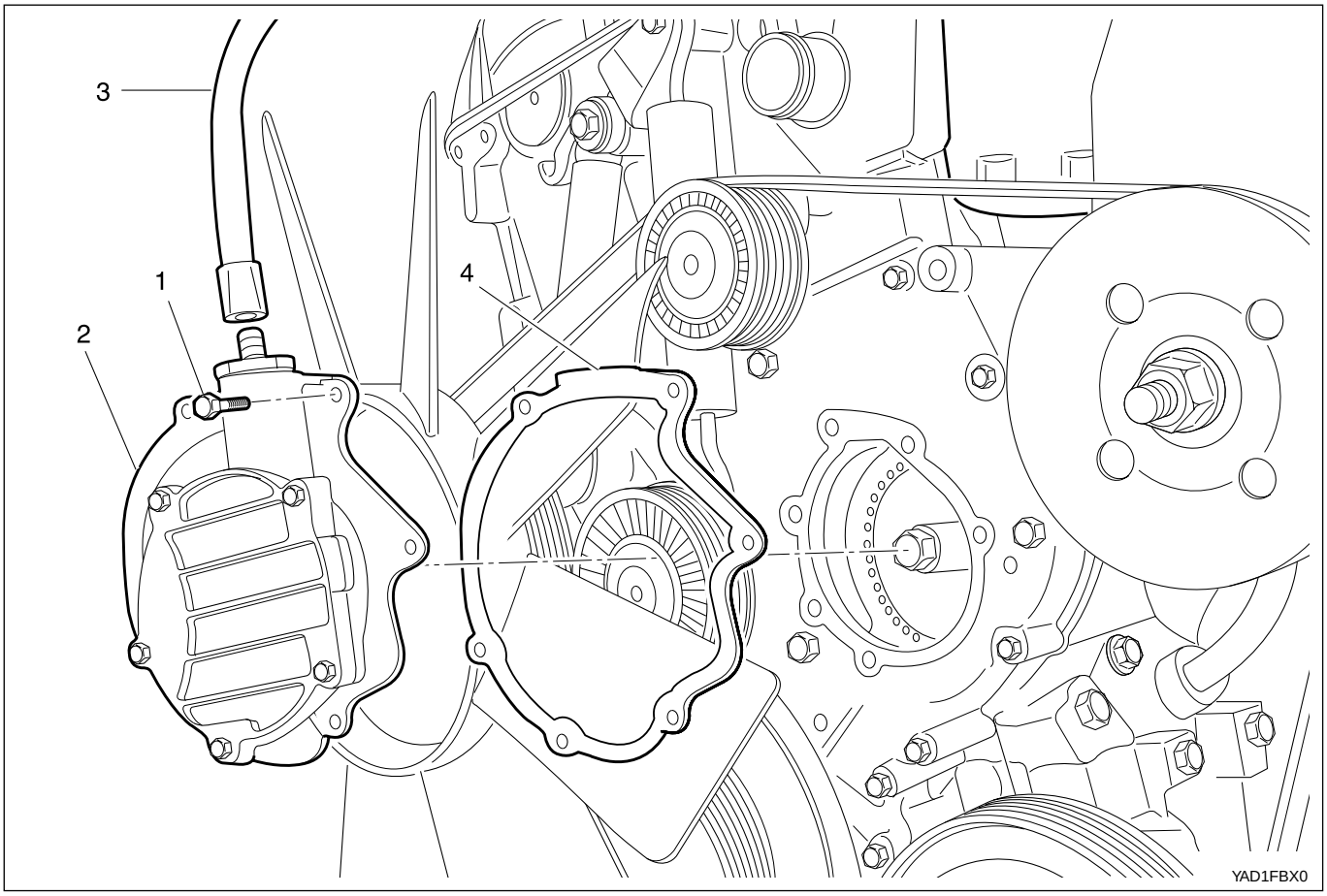
To the Right	Start of Delivery Retarded
To the Left	Start Delivery Advanced

REPAIR INSTRUCTIONS

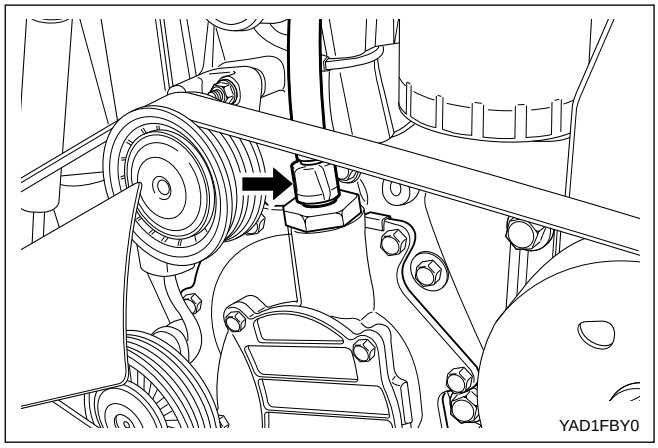
ON-VEHICLE SERVICE

VACUUM PUMP

Preceding Work: Removal the poly V-belt

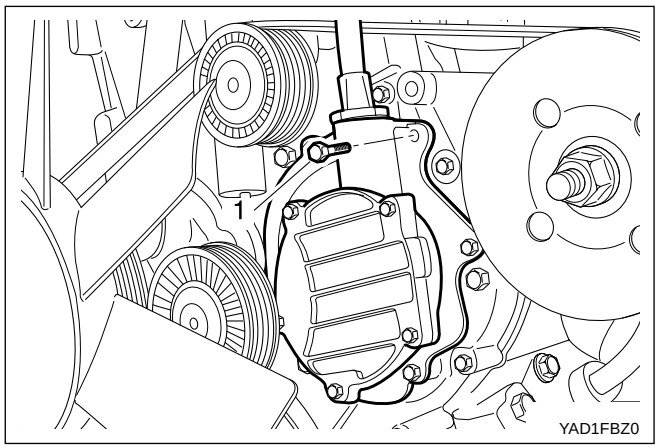


1 Bolt ..... 10 N•m (89 lb-in)
2 Vacuum Pump
3 Vacuum Line
4 Gasket ..... Replace



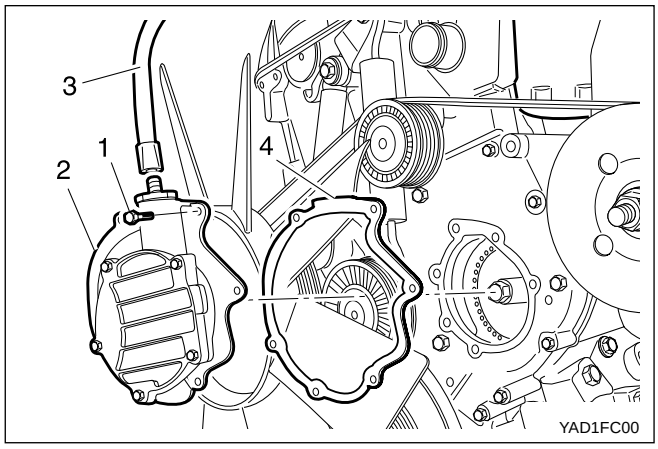
Removal & Installation Procedure

1. Remove the vacuum line.



2. Remove the bolts (1) evenly.

   Notice: If necessary, rotate the engine until the pressure on the tappet of the vacuum pump is released.



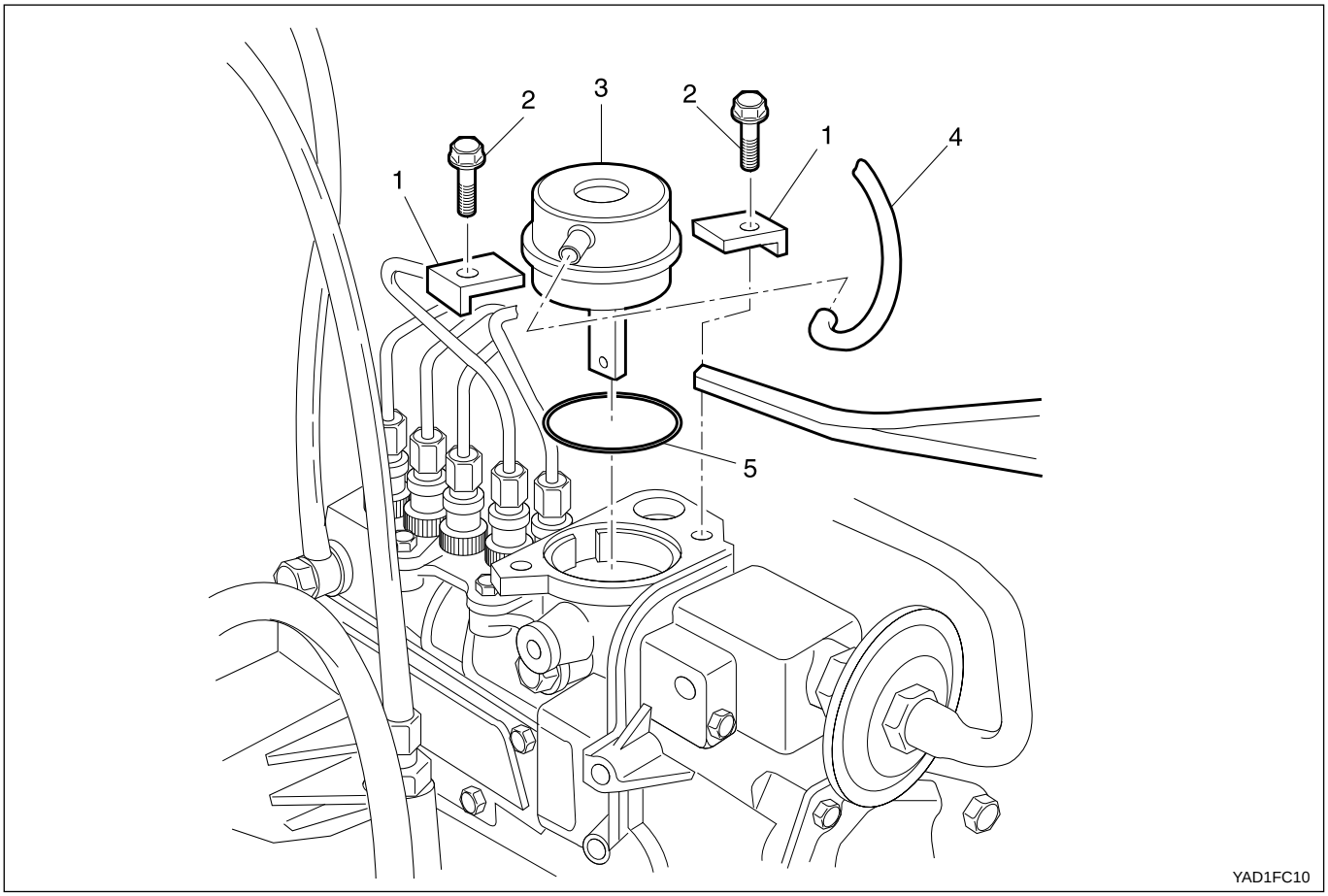
3. Remove the vacuum pump (2).
4. Install the vacuum pump (2).

   Installation Notice

Tightening Torque	10 N•m (89 lb-in)

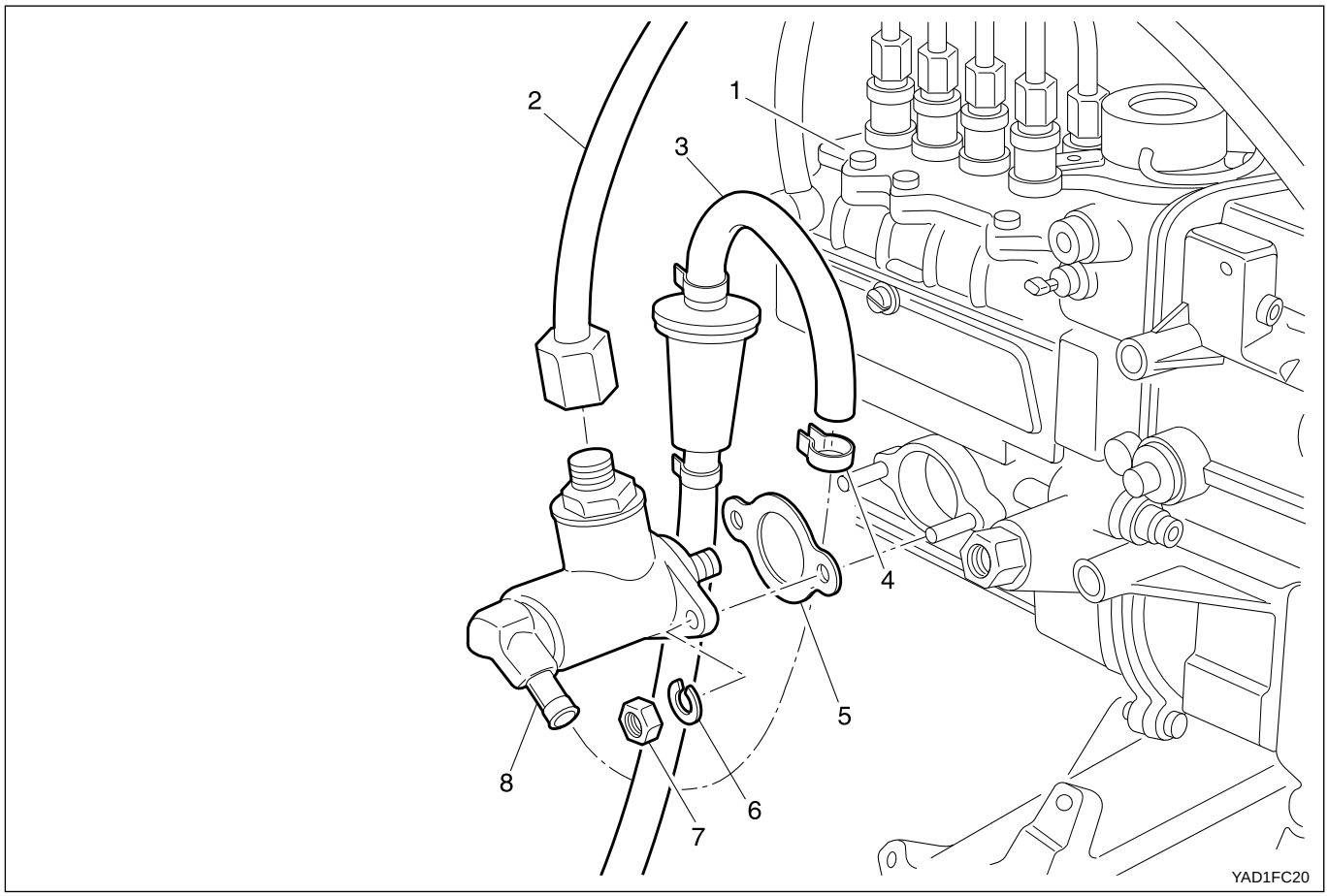
   Clean the gasket residues of sealing surface of vacuum pump and replace the gasket (5).
5. Connect the vacuum line.

VACUUM UNIT REPLACEMENT

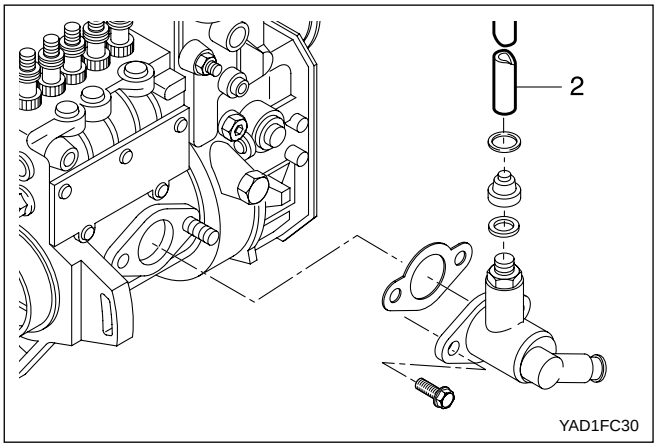


1 Bracket
2 Bolt
3 Vacuum Unit
4 Vacuum Line
5 Seal ..... Replace

FUEL PUMP



1 Fuel Injection Pump
2 Pressure Line ..... 13 N•m (10 lb-ft)
3 Suction Line
4 Hose Clip ..... Replace
5 Gasket ..... Replace
6 Spring Lock Washer
7 Hexagon Nuts ..... 18 N•m (13 lb-ft)
8 Fuel Pump

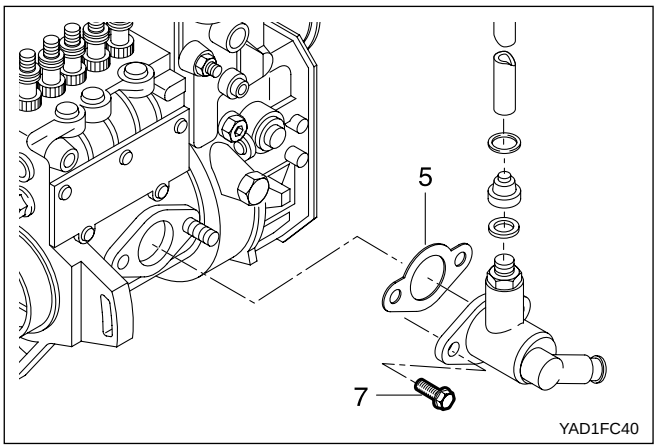


Removal & Installation procedure

1. Disconnect the fuel pressure and suction line.

   Installation Notice

Tightening Torque	13 N•m (10 lb-ft)

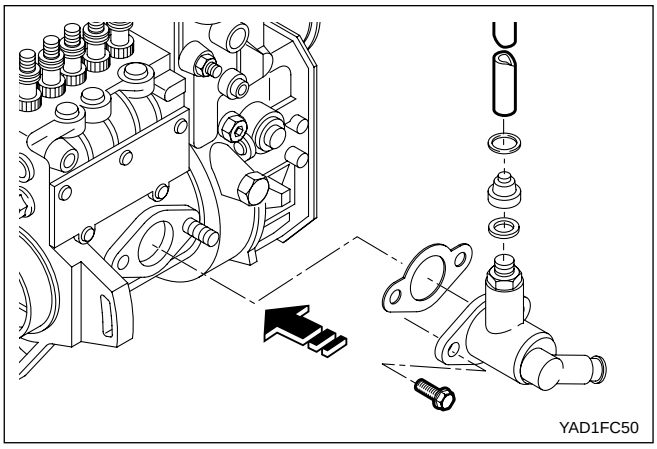


2. Remove the fuel pump mounting bolts.

   Installation Notice

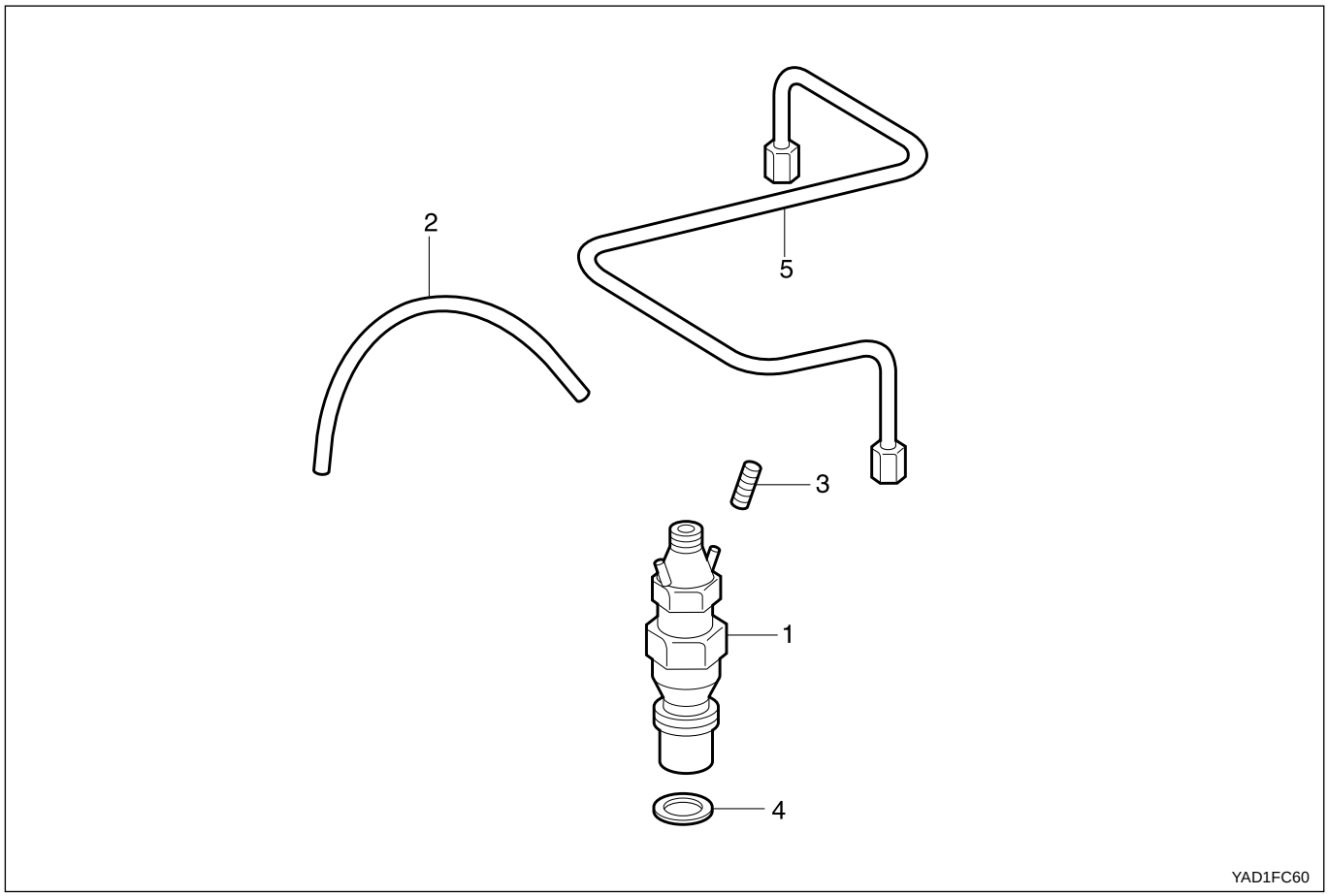
Tightening Torque	17 N•m (10 lb-ft)

3. Remove the fuel pump and gasket.

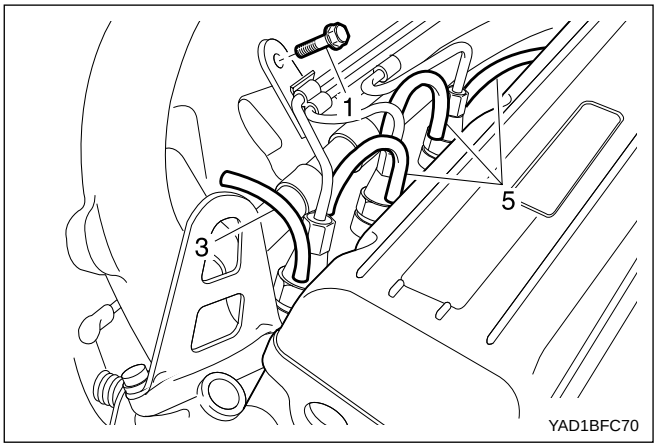


4. Installation should follow the removal procedure in the reverse order.

INJECTION NOZZLES



1 Fuel Injection Nozzle . 35 - 40N•m (26 - 30 lb-ft)
2 Fuel Return Hose
3 Plug
4 Nozzle Washer ..... Replace
5 Fuel Injection Pipe ..... 18 N•m (13 lb-ft)

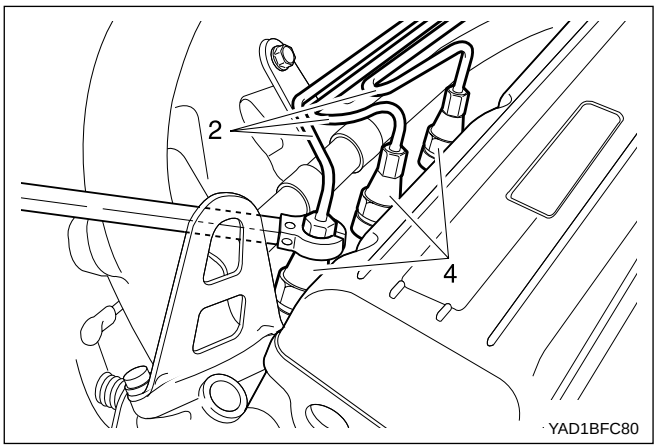


Tools Required

001 589 65 09 00 Serration Wrench

Removal & Installation Procedure

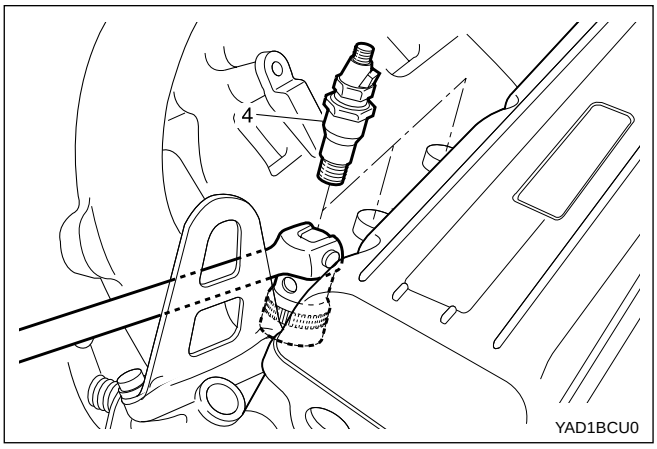
1. Remove the plastic clip from the injection pipe
2. Remove the fuel return hose (5).
3. Remove the plug(3).



4. Disconnect the injection pipes from the injection nozzles and push them to the side.

Installation Notice

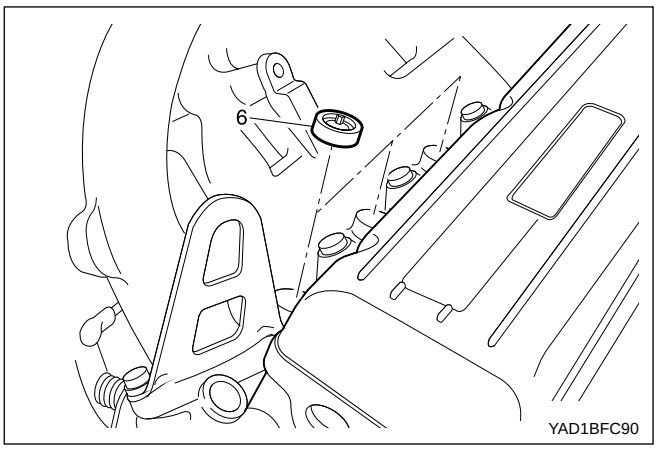
Tightening Torque	18 N•m (13 lb-ft)



5. Remove the fuel injection nozzle (4) with serration wrench 001 589 65 09 00.

Installation Notice

Tightening Torque	35 - 40 N•m (26 - 30 lb-ft)

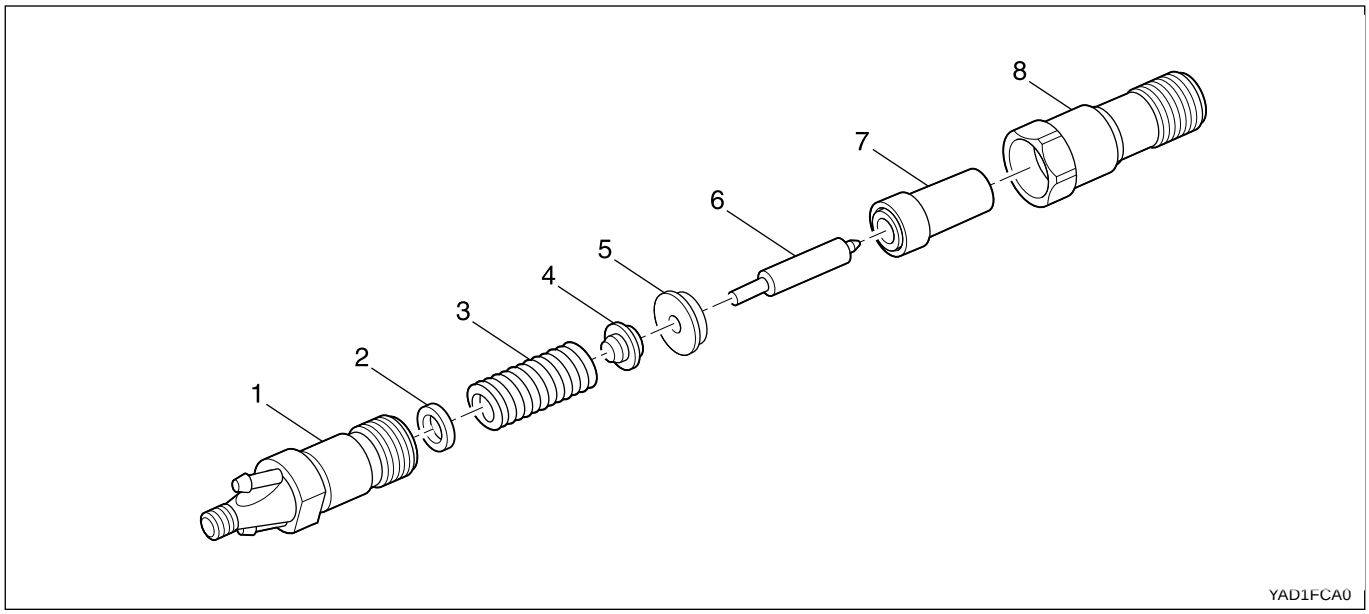


6. Replace the washers (6).
7. Installation should follow the removal procedure in the reverse order.

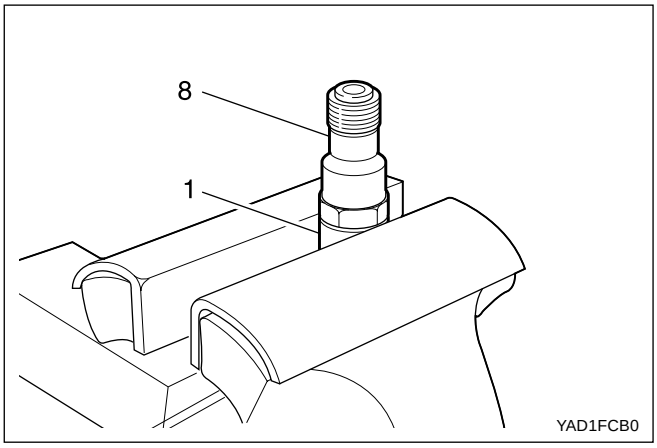
Notice: Pay attention to the installation position of new nozzle washer and tightening torque.

INJECTION NOZZLE REPAIR

Preceding Work: Removal of fuel injection nozzle



1 Nozzle Holder
2 Steel Washer
3 Compression Spring
4 Thrust Pin
5 Intermediate Disc
6 Nozzle Needle
7 Nozzle Body
8 Nozzle Tensioning Nut ..... 80 N•m (59 lb-ft)



Tools Required

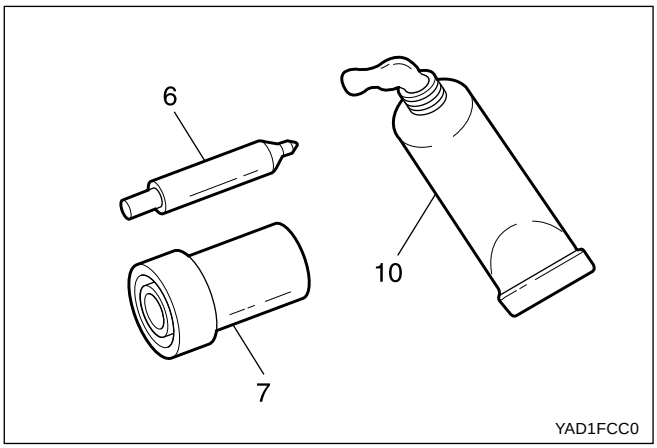
000 589 00 68 00 Cleaning Set

Repair Procedure

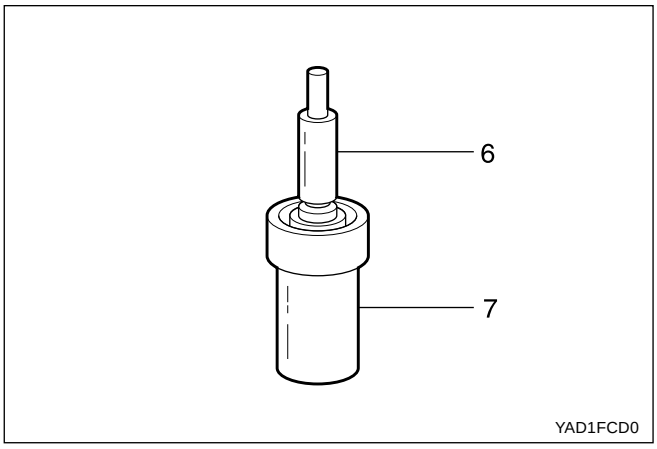
1. Clamp the nozzle holder (1) in a vice and remove the nozzle tensioning nut (8).

   Notice: Use protective jaws for clamping.

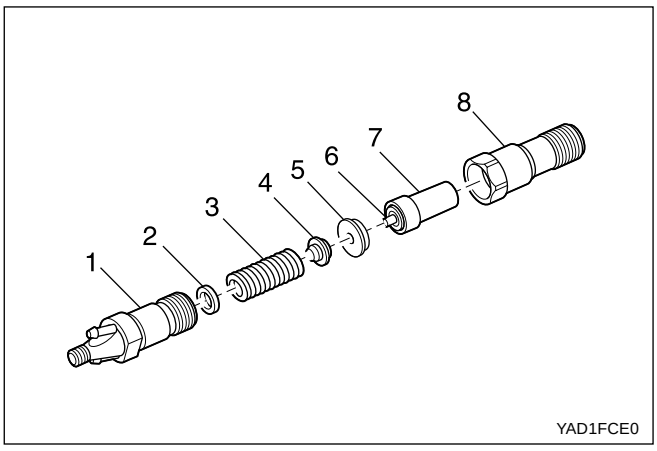
2. Disassemble the fuel injection nozzle.



3. Clean the nozzle needle (6) and nozzle body (7) with an abradant.
4. Clean the nozzle seat with cleaning cutter.



5. Immerse nozzle needle (6) and nozzle body (7) in filtered diesel fuel. When the nozzle body is held vertical, the weight of the nozzle needle must cause it to slide down toward the nozzle needle seat.



6. Assemble the injection nozzle so that the tip of the thrust (4) pin is facing toward the nozzle holder.

   Installation Notice

Tightening Torque	80 N•m (59 lb-ft)

   Nozzle needle (6) and nozzle body (7) should always be replaced as a pair.

7. Check the fuel injection nozzle and adjust opening pressure if necessary.

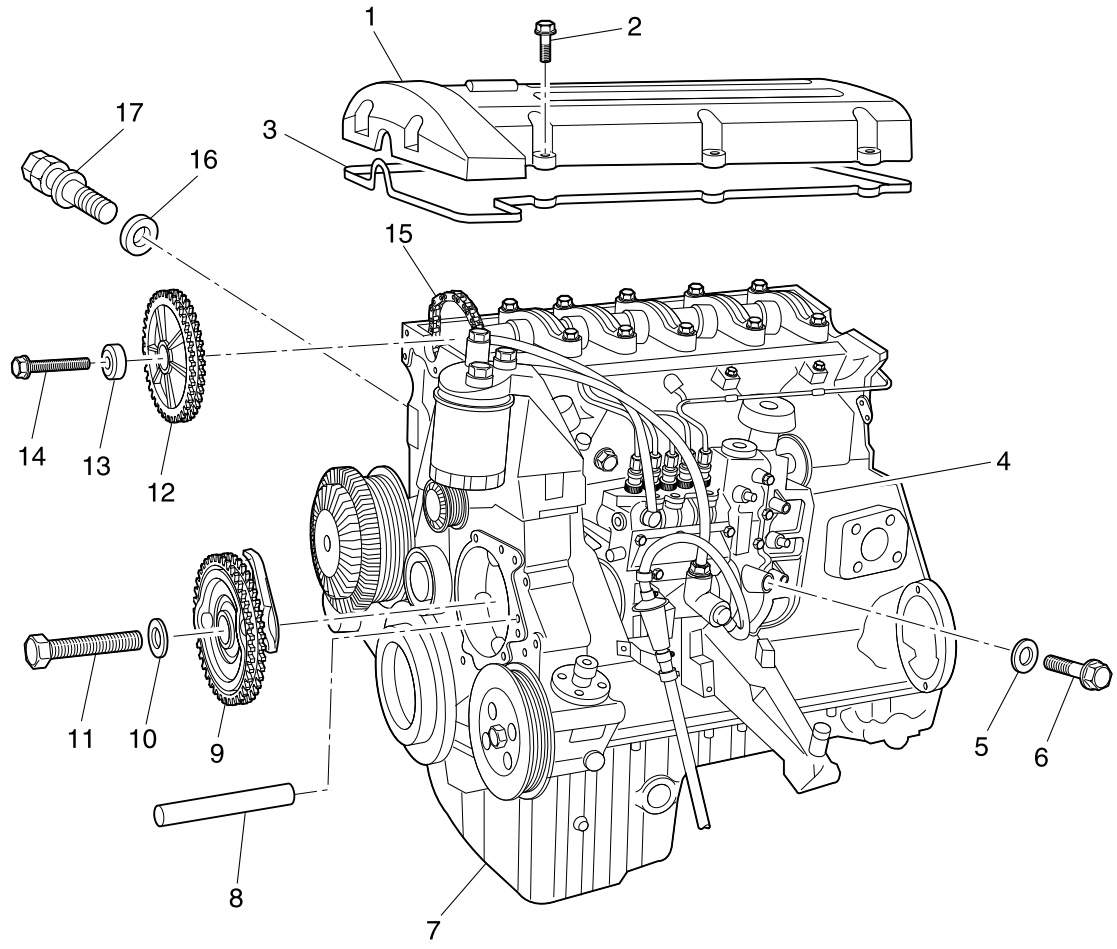
   Opening pressure adjustment

   Disassemble the fuel injection nozzle and replace the steel washer (2).

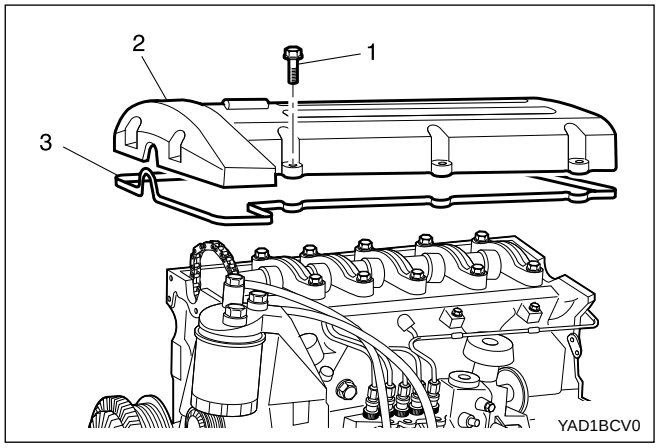
   Notice: Each 0.05 mm thickness of the washer results in a pressure difference of approx. 3 bar.

INJECTION TIMING DEVICE ASSEMBLY

Preceding Work : Removal of vacuum pump



1 Cylinder Head Cover
2 Bolt ..... 10 N•m (89 lb-in)
3 Gasket ..... Replace
4 Fuel Injection Pump
5 Seal ..... Replace
6 Screw Plug ..... 30 N•m (22 lb-ft)
7 Oil Pan
8 Locking Pin
9 Injection Timing Device
10 Washer
11 Bolt (Left-Hand Thread) ..... 46 N•m (34 lb-ft)
12 Camshaft Sprocket
13 Washer
14 12-Sided Stretch Bolt ..... Check, 25 N•m (18 lb-ft)+ 90°
15 Timing Chain
16 Seal
17 Chain Tensioner ..... 80 N•m (59 lb-ft)



Tools Required

116 589 02 34 00 Threaded Bolt
116 589 20 33 00 Sliding Hammer
601 589 00 08 00 Flange
601 589 05 21 00 Locking Screw
667 589 04 63 00 Retaining Plate

Removal & Installation Procedure

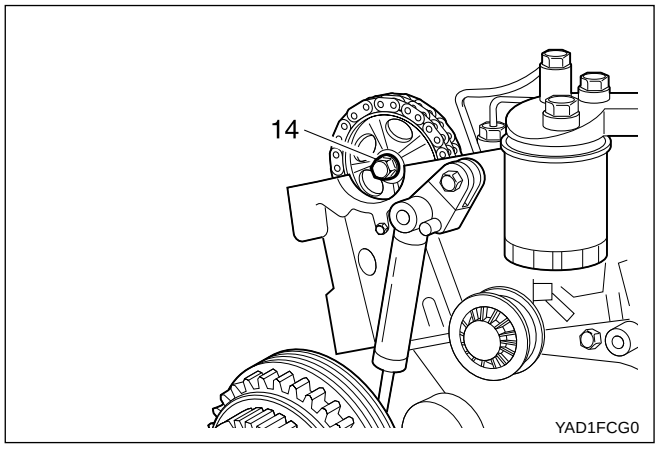
1. Remove the bolts (2) and then remove the cylinder head cover (1) and gasket (3).

   Installation Notice

Tightening Torque	10 N•m (89 lb-in)

   Replace the gasket.

   Rotate the engine 1 revolution by hand and check TDC marking of the crankshaft and camshaft.



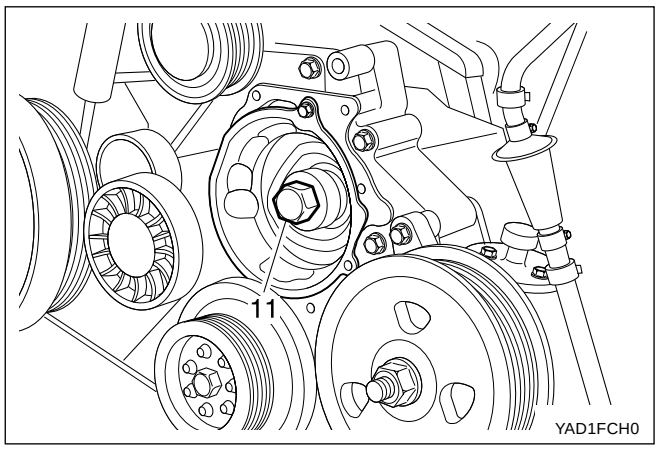
2. Loosen the camshaft sprocket bolt (14).

   Installation Notice

Tightening Torque	25 N•m (18 lb-ft)+ 90°

   Do not remove the bolt.

   If max. length of bolt exceeds 53.6 mm, replace it.

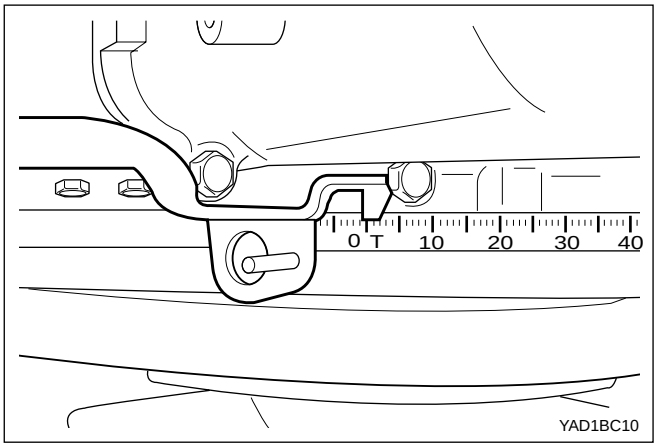


3. Loosen the bolt (11) (left-hand thread).

   Installation Notice

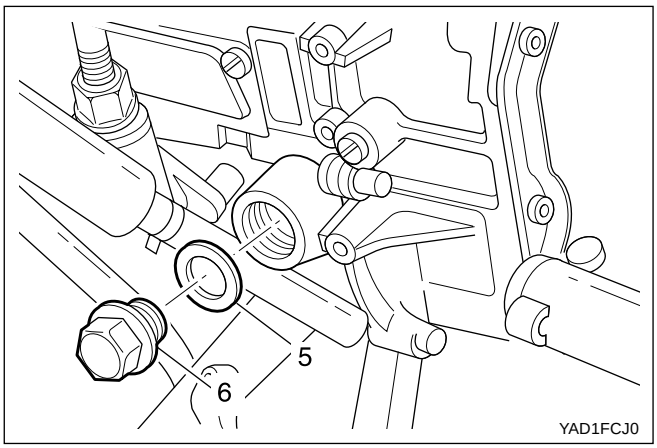
Tightening Torque	46 N•m (34 lb-ft)

   Do not remove the bolt.



4. Position the no.1 cylinder at ATDC 15°.

   Notice: Do not rotate the engine with camshaft sprocket bolt or opposite direction of the engine rotation.

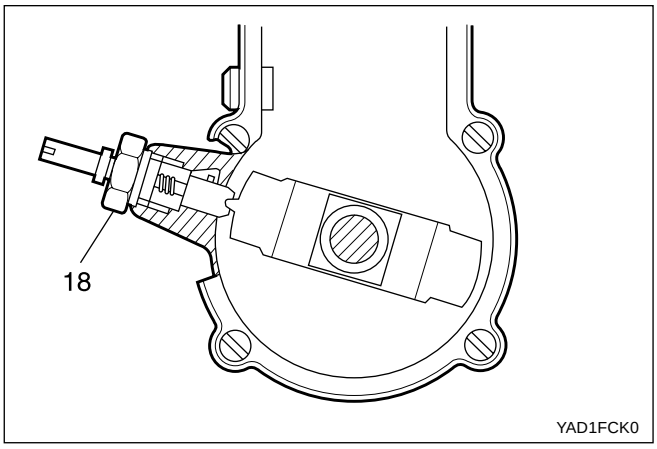


5. Remove the plug (6) and seal (5) from the fuel injection pump and collect oil in a suitable vessel.

   Installation Notice

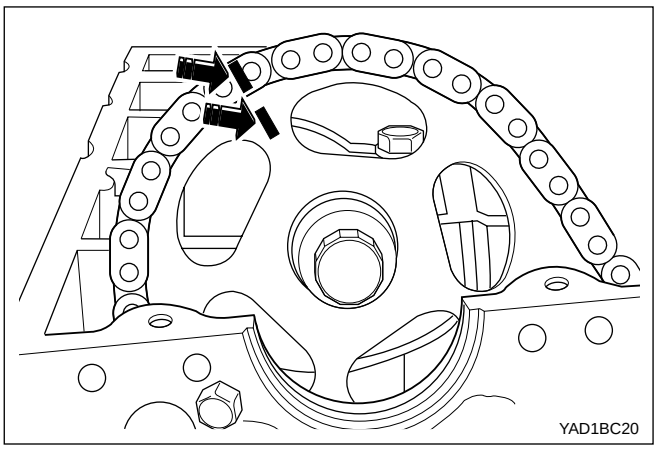
Tightening Torque	30 N•m (22 lb-ft)

   Replace the seal.

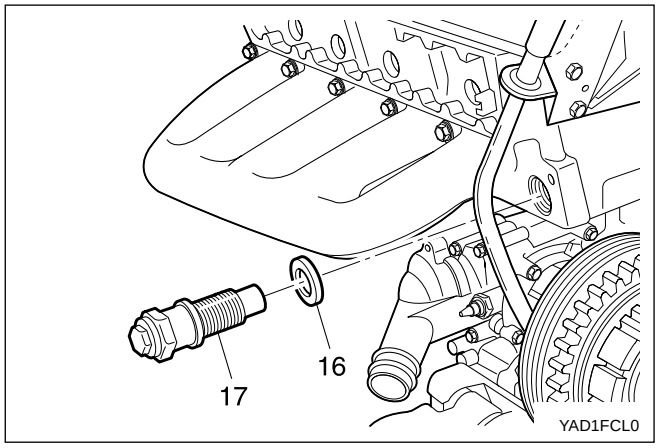


6. Install the locking screw 601 589 05 21 00 (18) into the injection pump.

   Notice: Before tightening the bolts for the injection timing device and the camshaft sprocket, always remove the locking screw 601 589 05 21 00 from the injection pump and reinstall the plug.



7. Place alignment marks (arrow) on the timing chain (12) and camshaft sprocket (15).

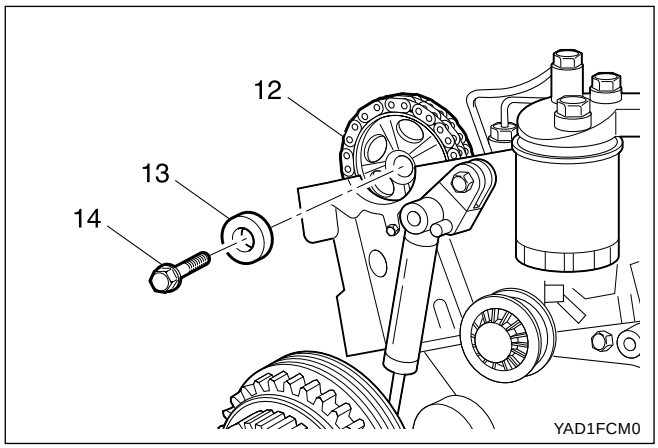


8. Remove the chain tensioner (17).

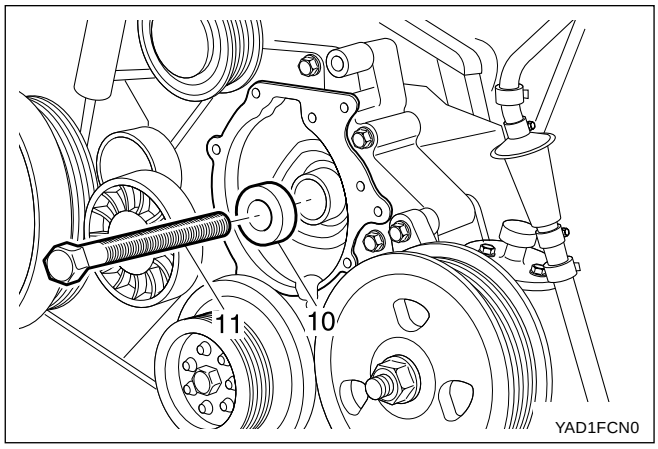
Installation Notice

Tightening Torque	80 N•m (59 lb-ft)

Replace the seal (16).

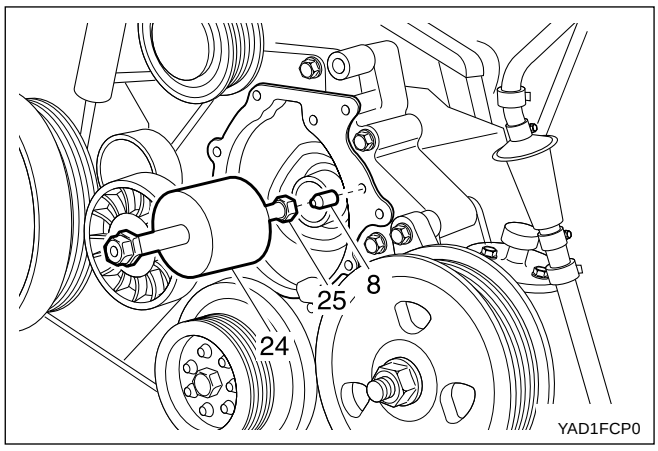


9. Pull out the 12-sided stretch bolt (14) and washer and remove the camshaft sprocket (12).

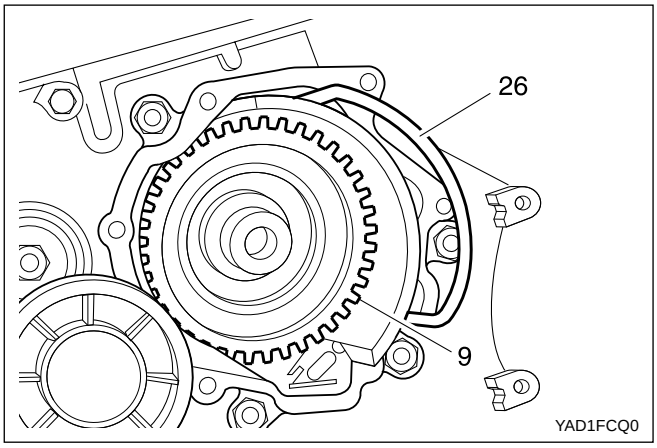


10. Pull out the bolt (11) and washer (10).

Notice: Be careful that the bolt is left-hand thread.



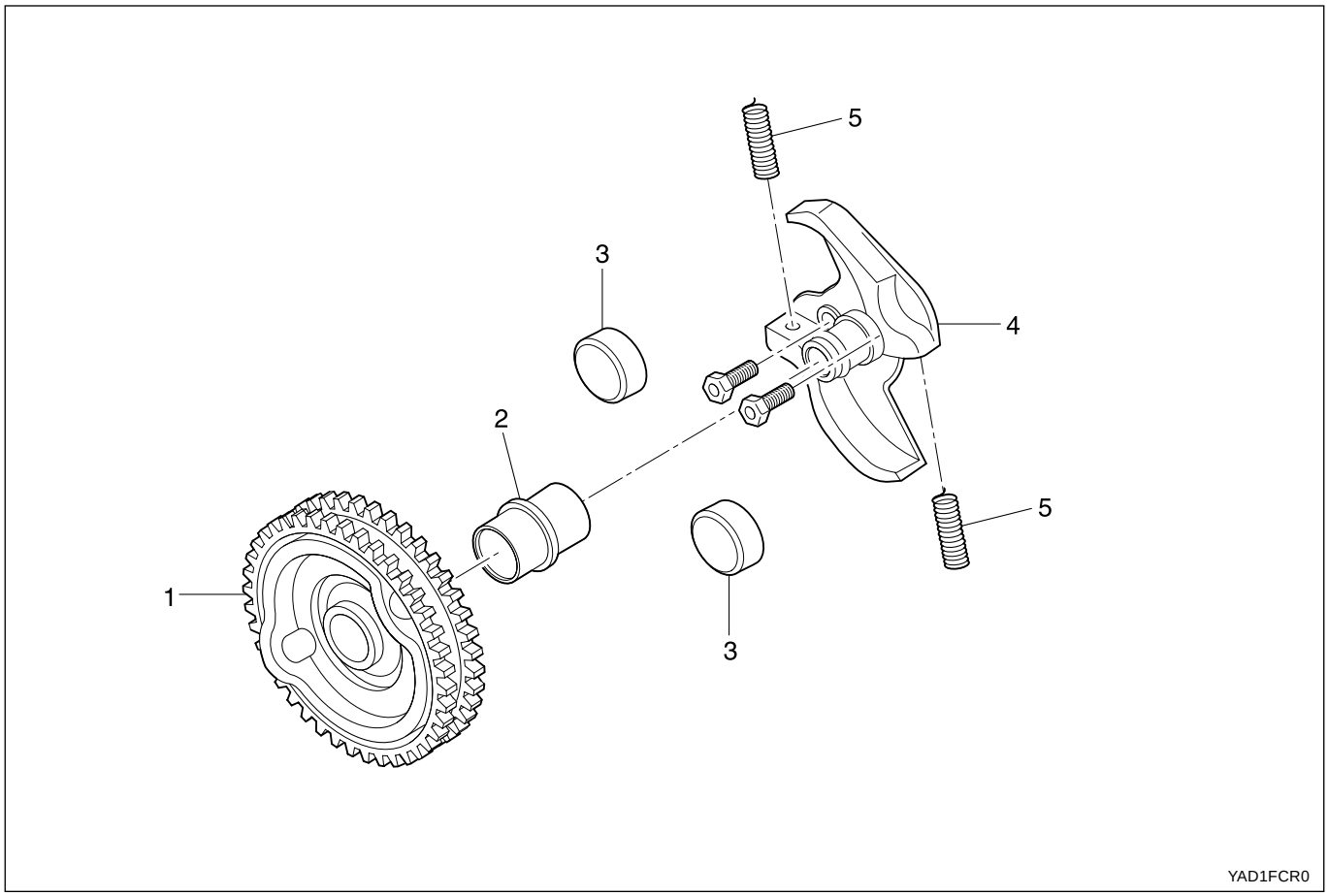
11. Using special tool (Sliding Hammer 116 589 20 33 00 - 24,Threaded bolt 116 589 02 34 00 - 25), remove the locking pin (8).



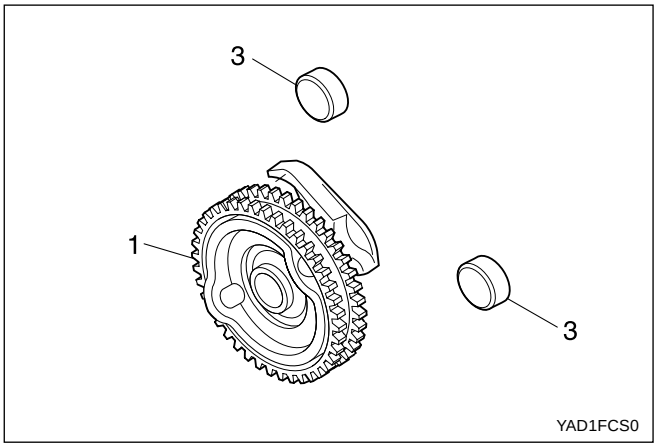
12. Push back the timing chain with retaining plate 667 589 04 63 00 (26) and remove the injection timing device (9).
13. Installation should follow the removal procedure in the reverse order.
14. After assembling the engine, check start of delivery and adjust if necessary.

INJECTION TIMING DEVICE

Preceding Work: Removal of injection timing device assembly

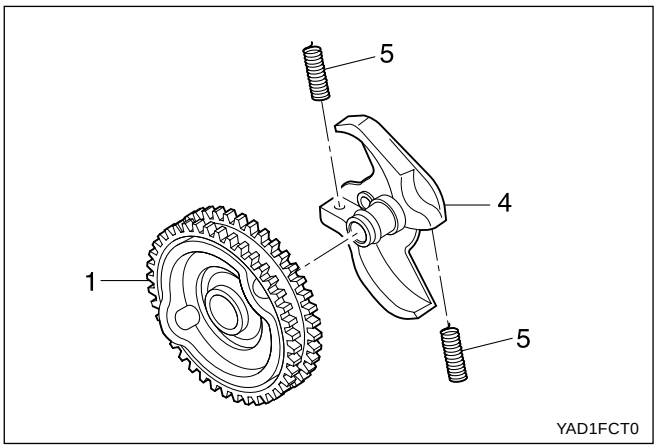


1 Cam Sprocket ..... Check
2 Bushing ..... Check
3 Governor Weights
4 Segment Flange and Drive Hub
5 Compression Springs

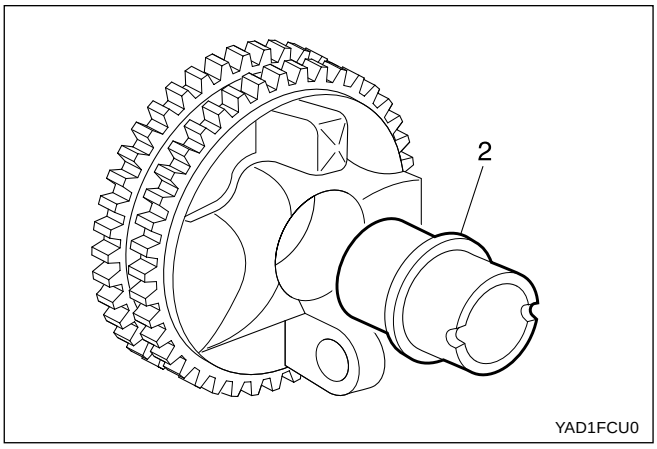


Removal & Installation Procedure

1. Remove the governor weights (3).



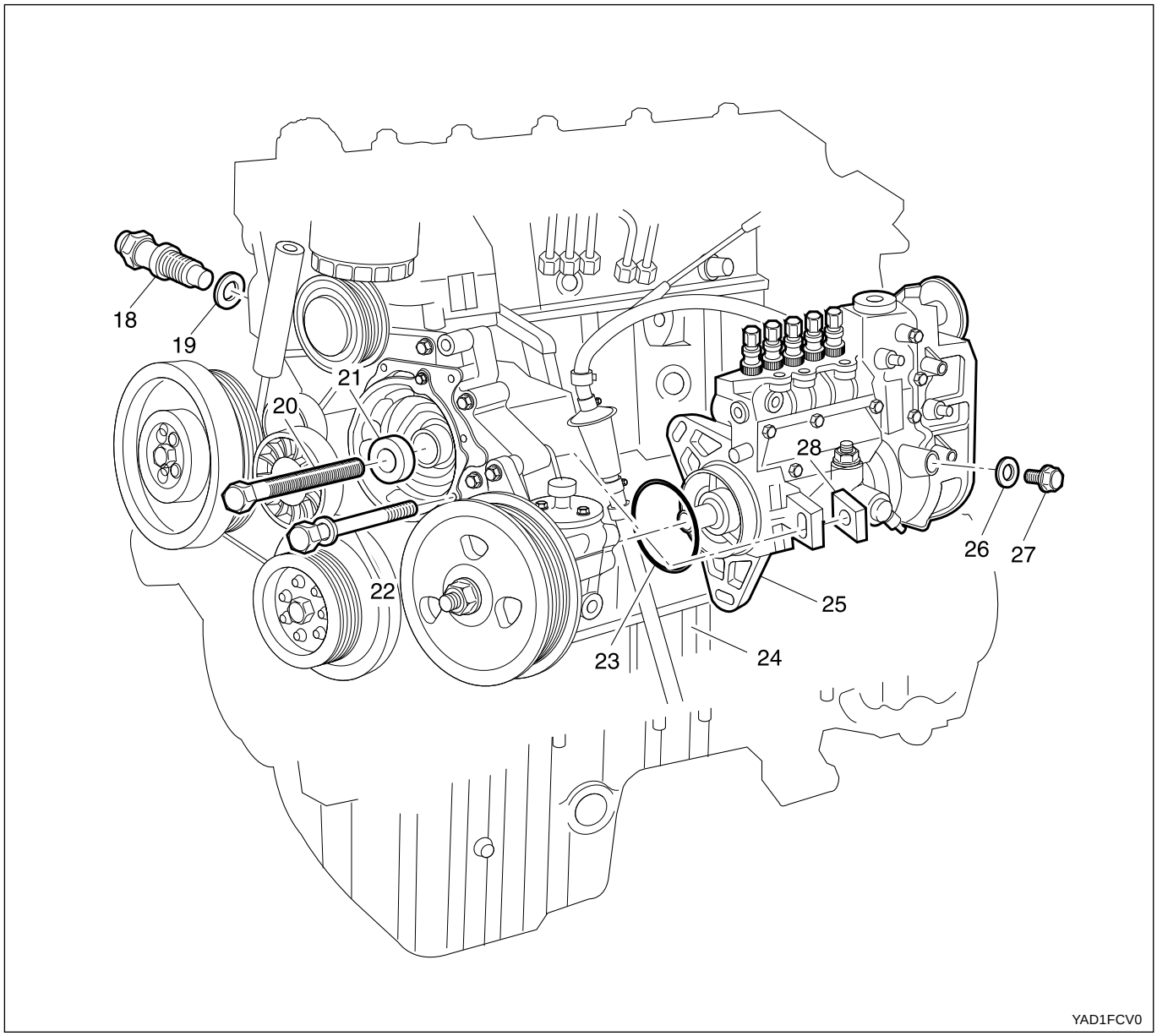
2. Pull out the compression springs (5) and cam sprocket (1) from the segment flange (4).



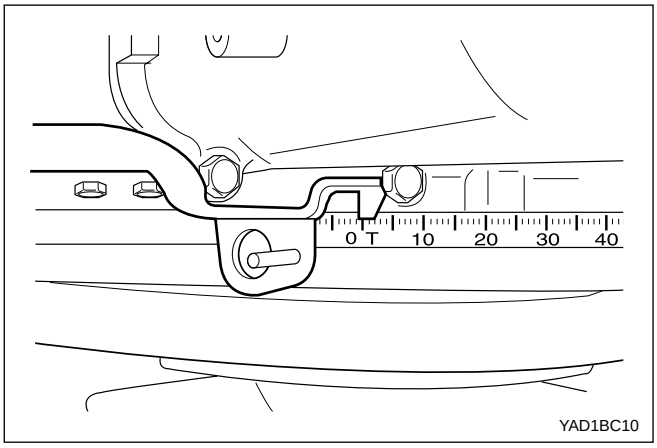
3. Knock out the bushing (2) with a proper drift.
4. Installation should follow the removal procedure in the reverse order.

FUEL INJECTION PUMP

Preceding Work: Removal of vacuum pump
Removal of air cleaner housing
Removal of intake manifold



18 Chain Tensioner ..... 80 N•m (59 lb-ft)
19 Seal ..... Replace
20 Bolt(Left-Hand Thread) ..... 46 N•m (34 lb-ft)
21 Washer
22 Bolt ..... 23 N•m (17 lb-ft)
23 Seal ..... Replace
24 Oil Pan
25 Fuel Injection Pump
26 Seal ..... Replace
27 Screw Plug ..... 30 N•m (22 lb-ft)
28 Square Nut



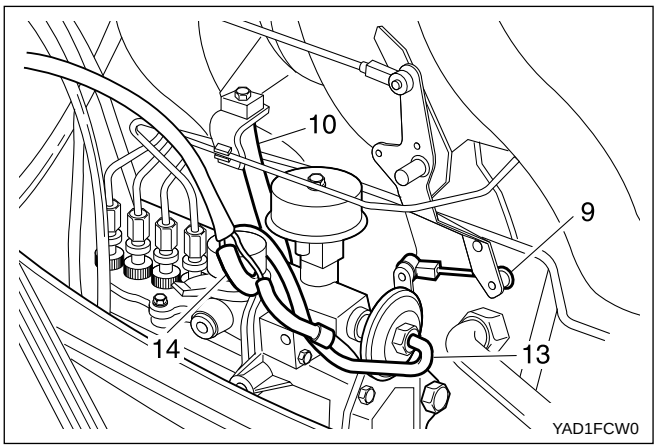
Tools Required

000 589 77 03 00	Box Wrench Insert
601 589 00 08 00	Flange
601 589 05 21 00	Locking Screw
601 589 05 14 00	Assembly Cage

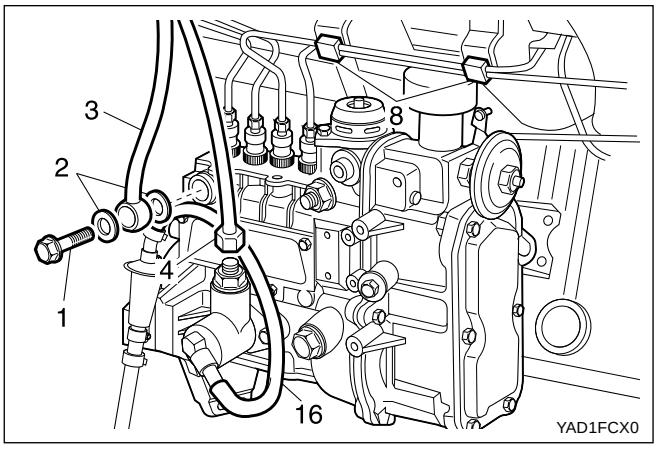
Removal Procedure

1. Position the no.1 cylinder at 15° ATDC.

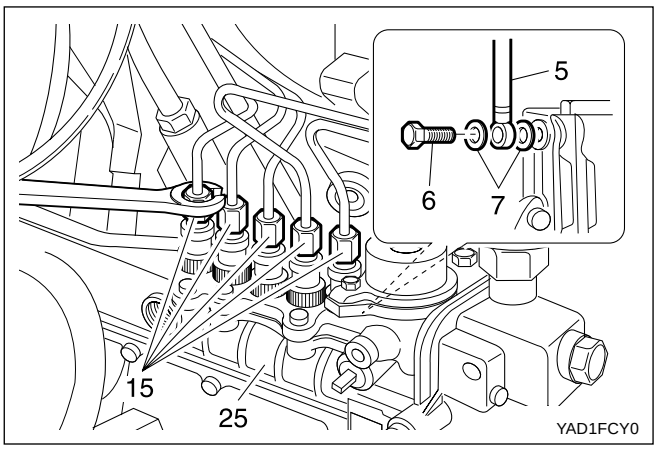
   Notice: Do not rotate the engine in opposition direction of engine rotation.



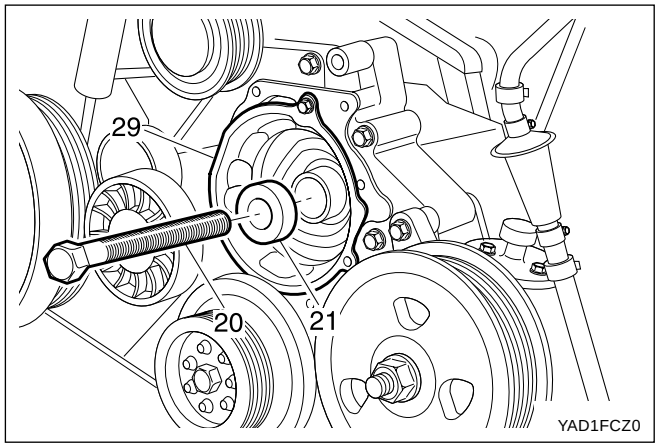
2. Remove the connecting rod (9).
3. Disconnect the vacuum lines (13, 14).
4. Remove the accelerator control damper (10).
   (Manual transmission vehicle)



5. Remove the suction line (16) and pressure line (4).
6. Remove the banjo bolt (1) and then remove the seal (2) and fuel line (3).
7. Remove the plastic clip (8) on the injection line.

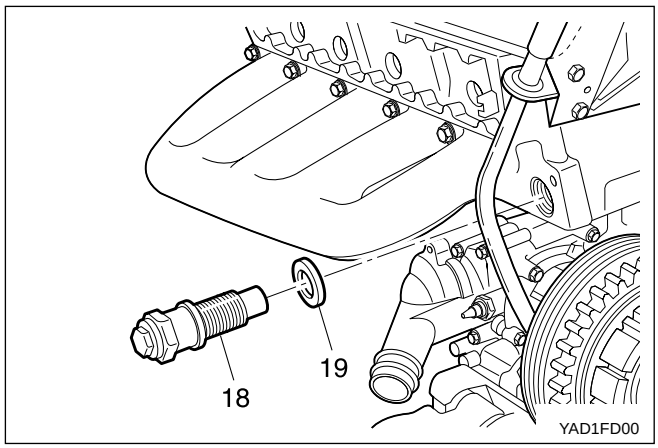


8. Disconnect the injection lines (15) from the injection pump (25).
9. Remove the banjo bolt (6) and then remove the seal (7) and return line (5).

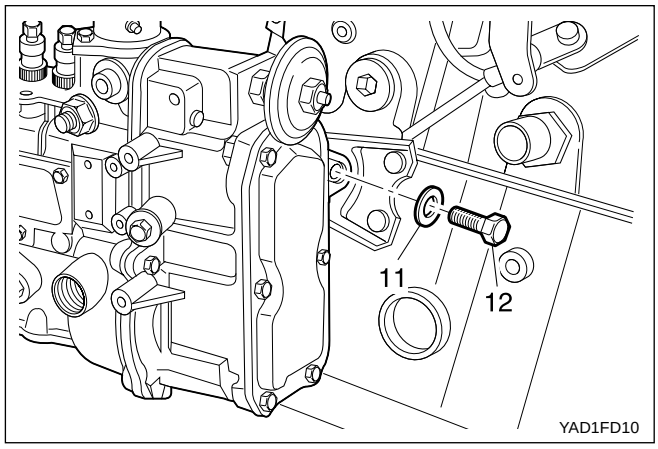


10. Install the assembly cage 601 589 05 14 00 (29) and remove the bolt (20) and pull off the washer (21).

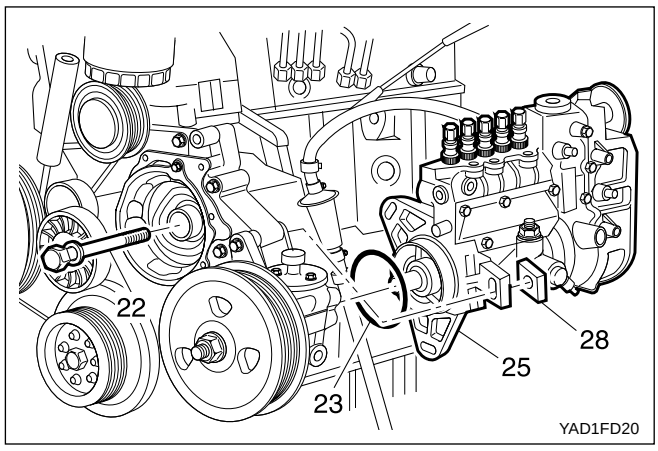
    Notice: Be careful that the bolt (20) is left hand thread.



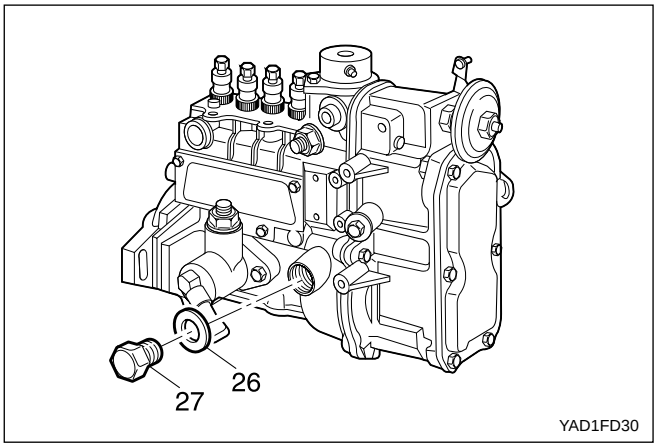
11. Remove the chain tensioner (18) and seal (19).



12. Remove the bolt (12) and pull off the washer (11).

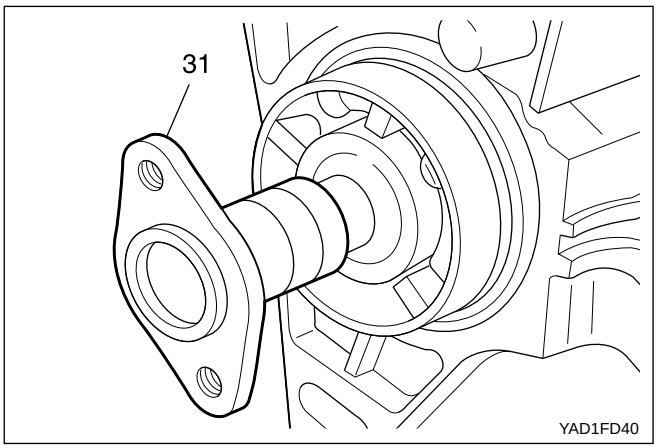


13. Remove the bolt (22) and pull off the square nut (28).
14. Pull out the fuel injection pump (25) and seal (23).

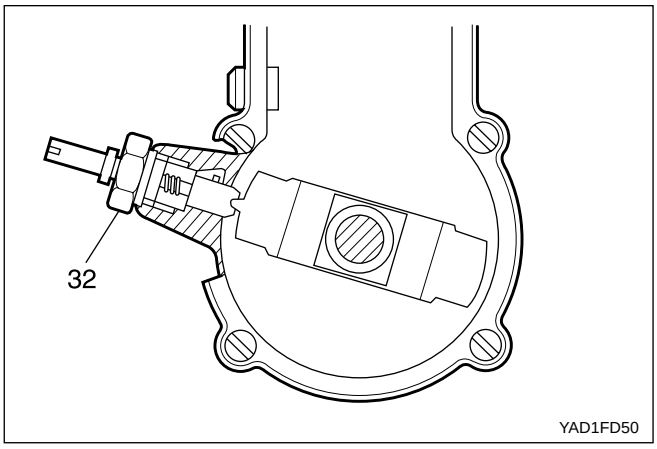


Installation Procedure

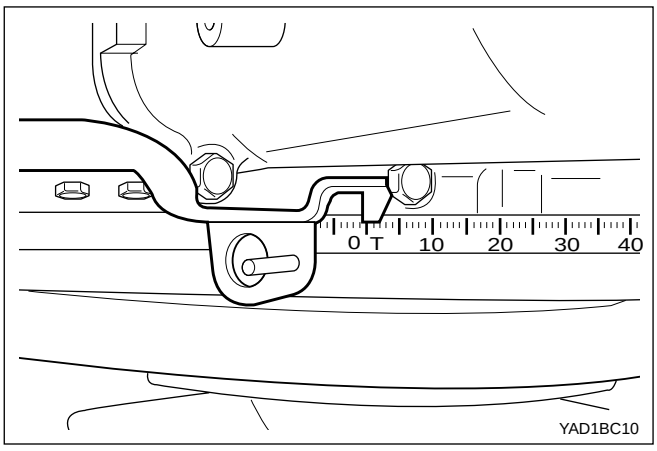
1. Remove the screw plug (27) and seal (26) and collect oil in a vessel.



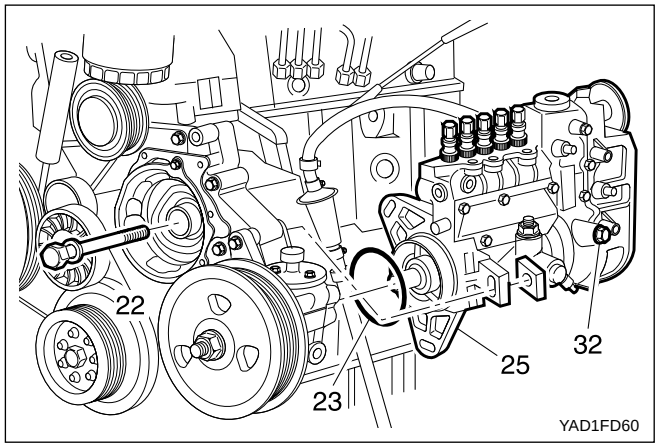
2. Insert flange 601 589 00 08 00 (31) onto the injection pump camshaft and turn until the cam of the governor is visible in the hole.



3. Tighten the locking screw 601 589 05 21 00.



4. Ensure that the no.1 cylinder is positioned at ATDC 15°.

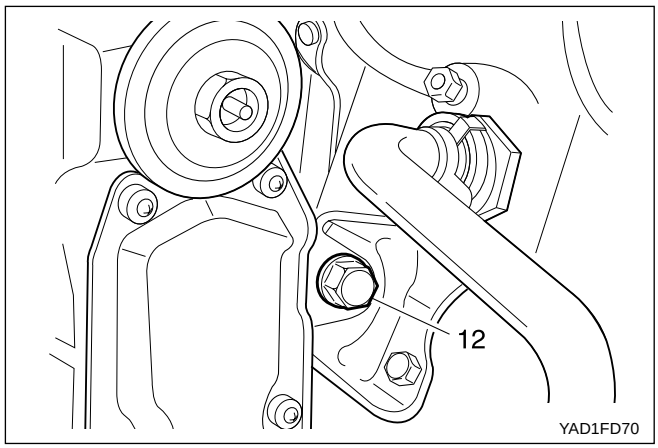


5. Coat the new seal (23) with engine oil and install it.
6. Insert the fuel injection pump (25) and tighten the bolts (22).

Installation Notice

Tightening Torque	23 N•m (17 lb-ft)

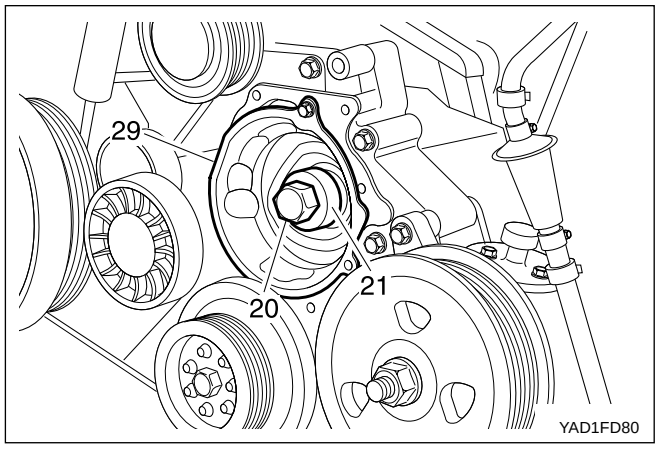
7. Remove the locking screw (32).



8. Tighten the bolt (12).

Installation Notice

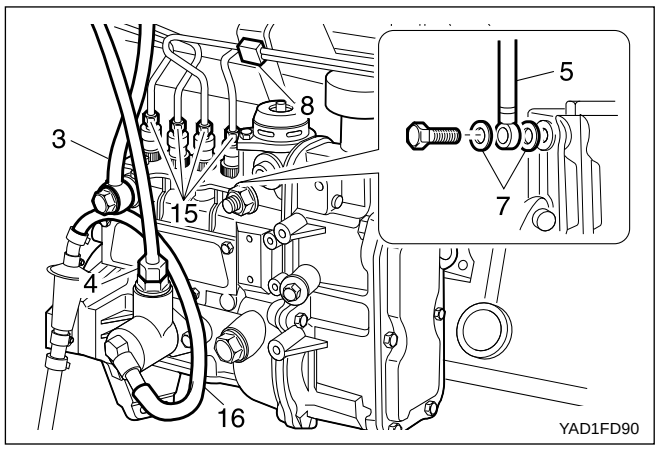
Tightening Torque	23 N•m (17 lb-ft)



9. Insert the washer (21) and tighten the bolts (20) and then remove the assembly cage 601 589 05 14 00 (29).

Installation Notice

Tightening Torque	46 N•m (34 lb-ft)



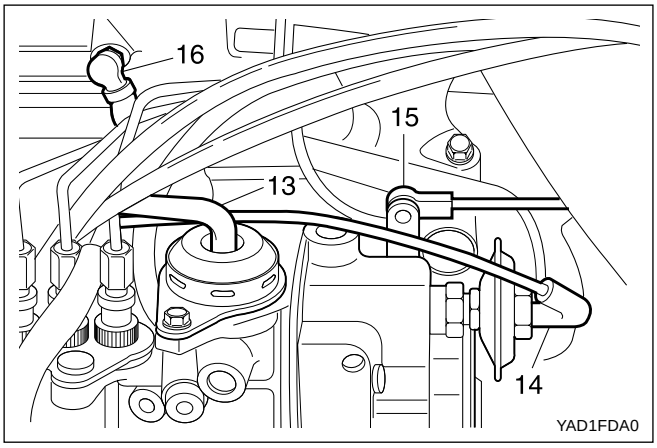
10. Connect the fuel pipes

Installation Notice

Return Line (5)	13 N•m (10 lb-ft)
Fuel Injection Line (15)	18 N•m (13 lb-ft)
Fuel feed Line (3)	13 N•m (10 lb-ft)
Suction and Pressure Line (4)	13 N•m (10 lb-ft)

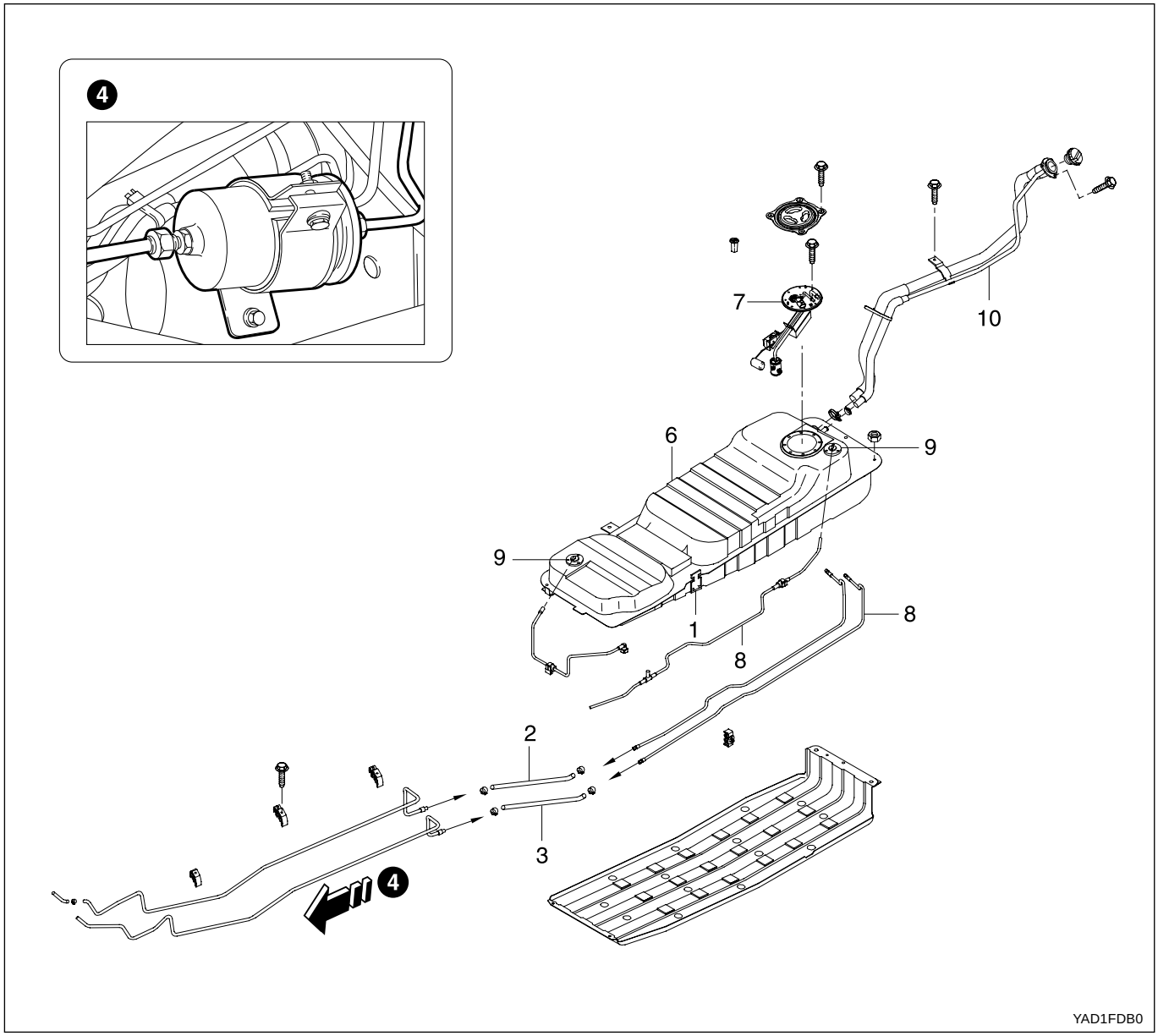
Replace the seal.

11. Assemble the plastic clip (8).

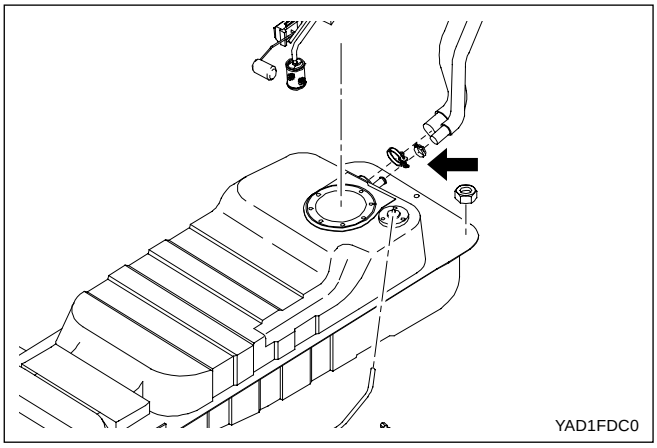


12. Connect the vacuum line (13, 14).
13. Connect the connecting rod (15).
14. connect the accelerator control damper (16). (Manual transmission vehicle)
15. Install the chain tensioner.
16. Install the vacuum pump.
17. Check the start of delivery.
18. Adjust the idle speed.

FUEL TANK



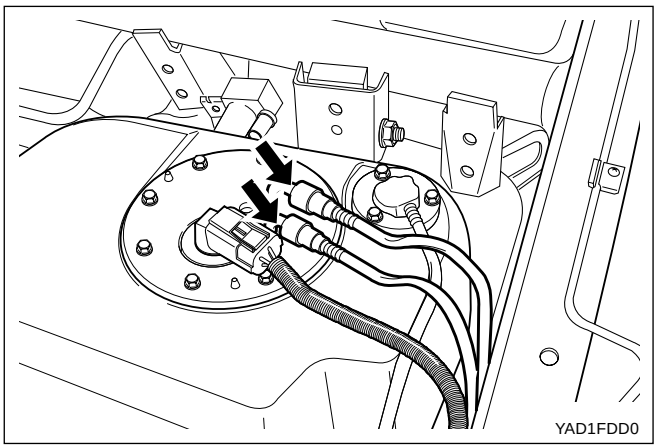
1 Fuel Tank Mounting Bracket
2 Fuel Return Line
3 Fuel Supply Line
4 Fuel Filter
6 Fuel Tank
7 Fuel Pump
8 Fuel Tank Rear Pipe
9 Fuel Tank Air Cap
10 Fuel Filler Assembly



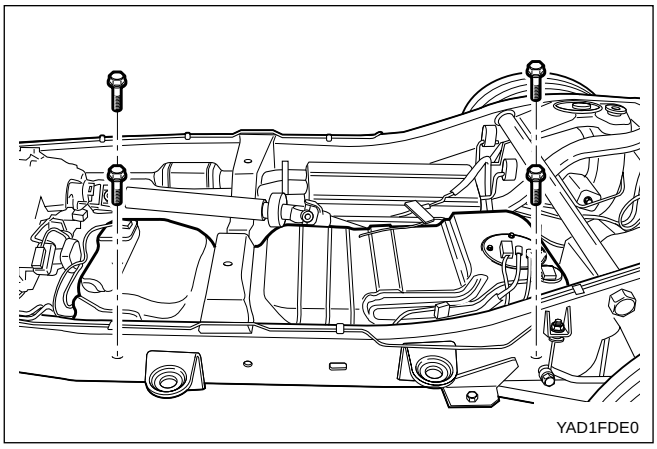
Removal & Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Disconnect the negative battery cable.
2. Disconnect the fuel filler hoses.



3. Put aside the floor carpet to remove the fuel pump access cover.
4. Remove the fuel pump access cover.
5. Disconect the fuel return and supply line.
6. Disconnect the fuel pump wiring connector.



7. Remove the fuel pump moumting bolts and bracket.
8. Carefully lower the fuel tank.
9. Installation should follow the removal precedure in the reverse order.

SPECIFICATIONS

GENERAL SPECIFICATIONS

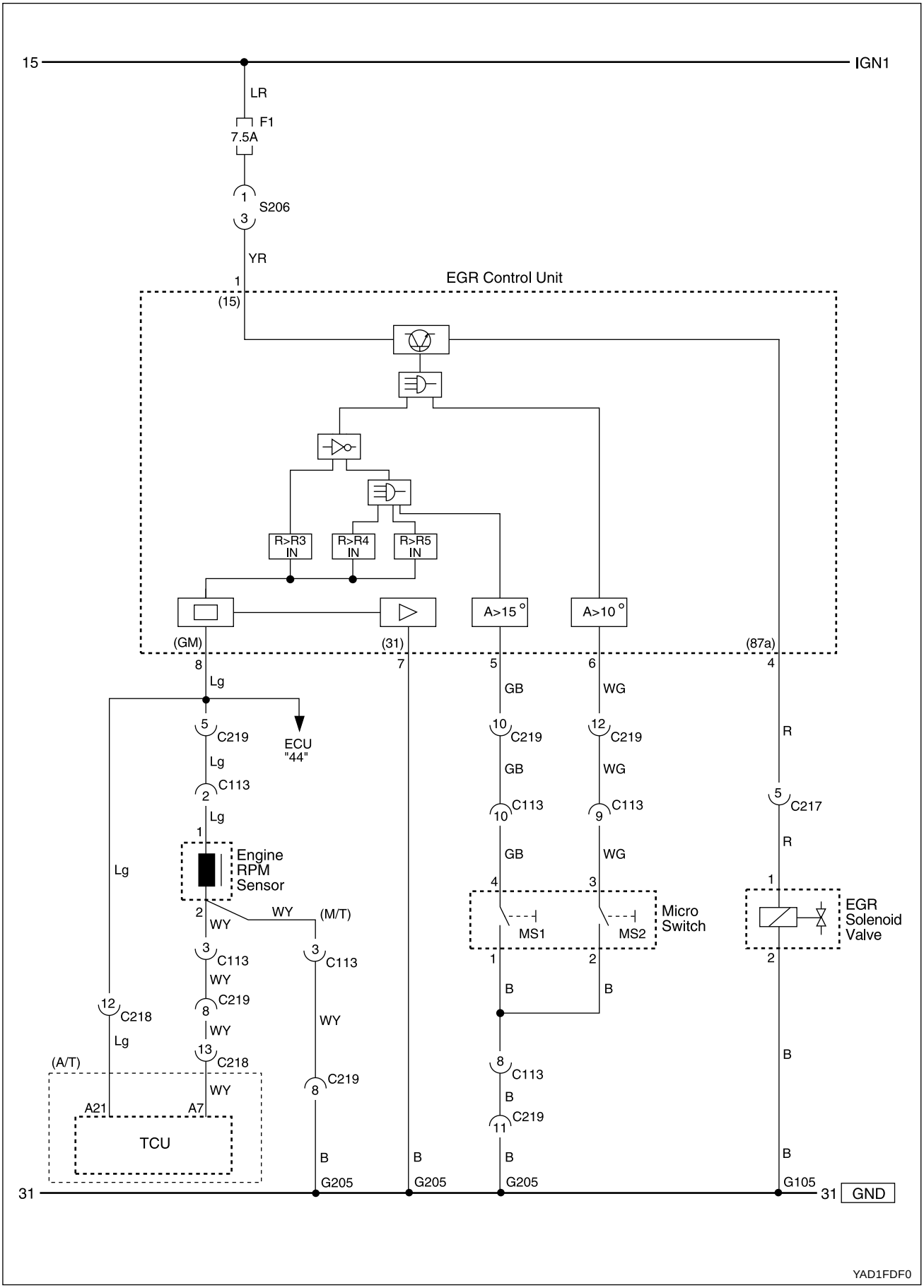
Fuel Distribution Type	Individual Injection Type (Same Number of Cylinder and Plunger)
Number of Cylinders	5 Cylinder
Mounting Type	End Flange Mounting
Drive Type	Inside Chain Connected with Camshaft
Flange Stroke	7 mm
Flange Outside Diameter	5.5 mm
Rack Movement	21 mm
Max. Speed	2,500 rpm
Injected Fuel Quantity / Stroke	35 mm^3 / Stroke
Lubrication Type	Sump Lubrication Type (Connected with Engine Oil Passage)

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb - Ft	Lb - In
Camshaft Sprocket Bolt	25 + 90°	18 + 90°	-
Chain Tensioner	80	59	-
Cylinder Head Cover Bolt	10	-	89
Fuel Feed Line (at Fuel Injection Pump)	13	10	-
Fuel Injection Nozzle	35 - 40	26 - 30	-
Fuel Injection Pipe	18	13	-
Fuel Injection Pump Mounting Bolt (at the Timing Cast Cover)	23	17	-
Fuel Injection Pump Supporting Bracket Bolt	23	17	-
Fuel Line Bolt (at Fuel Filter)	13	10	-
Fuel Pressure Line (at Fuel Pump)	13	10	-
Fuel Return Line (at Fuel Injection Pump)	13	10	-
Injection Timing Device Bolt	46	34	-
Nozzle Tensioning Nut	80	59	-
Screw Plug	30	22	-
Vacuum Pump Mounting Bolt	10	-	89

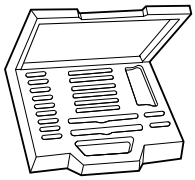
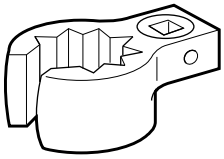
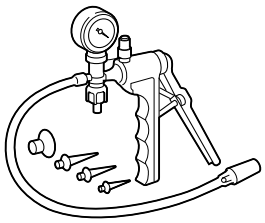
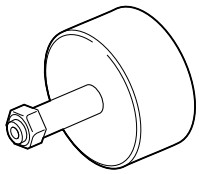
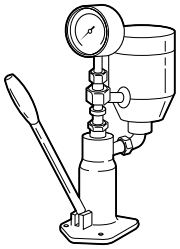
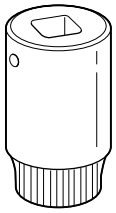
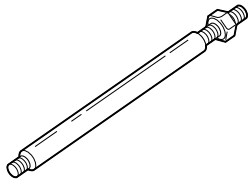
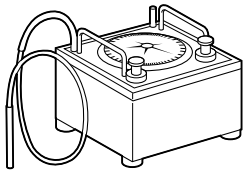
SCHEMATIC AND ROUTING DIAGRAMS

EGR SYSTEM

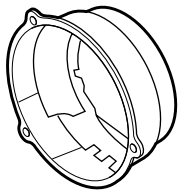
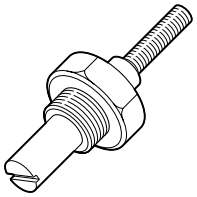
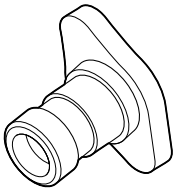
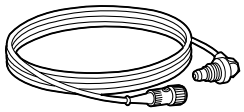
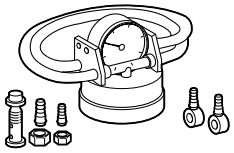
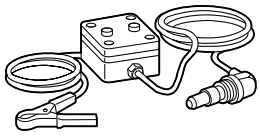
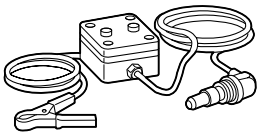
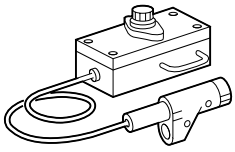


SPECIAL TOOLS AND EQUIPMENT

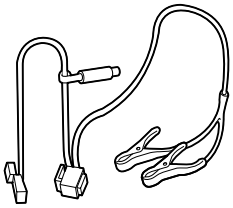
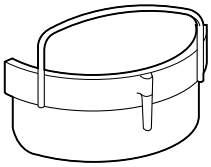
SPECIAL TOOLS TABLE

 YAD1FDU0	**000 589 00 68 00** **Cleaning Set**
 YAD1FDT0	**000 589 77 03 00** **Box Wrench Insert**
 YAD1A190	**001 589 73 21 00** **Vacuum Pump**
 YAD1B580	**116 589 20 33 00** **Sliding Hammer**
 YAD1FDK0	**000 589 14 27 00** **Fuel Injection Nozzle Tester**
 YAD1BKB0	**001 589 65 09 00** **Serration Wrench**
 YAD1BLH0	**116 589 02 34 00** **Threaded Bolt**
 YAD1FDG0	**201 589 13 21 00** **Vacuum Tester**

SPECIAL TOOLS TABLE (Cont'd)

 YAD1FDS0	**601 589 05 14 00** **Assembly Cage**	 YAD1FDQ0	**601 589 05 21 00** **Locking Sensor**
 YAD1FDP0	**610 589 00 08 00** **Flange**	 YAD1FDN0	**617 589 00 21 00** **Ri Sensor**
 YAD1FDJ0	**617 589 04 21 00** **Tester**		**617 589 08 21 01** **Micro Switch Setting Device**
 YAD1FDL0	**617 589 08 21 00** **Position Sensor**	 YAD1FDM0	**617 589 09 21 00** **Ri Adapter**

SPECIAL TOOLS TABLE (Cont'd)

 YAD1FDH0	**667 589 00 21 00** **TDC Pulse Generator**
 YAD1FDR0	**667 589 04 63 00** **Retaining Plate**

SECTION 2C

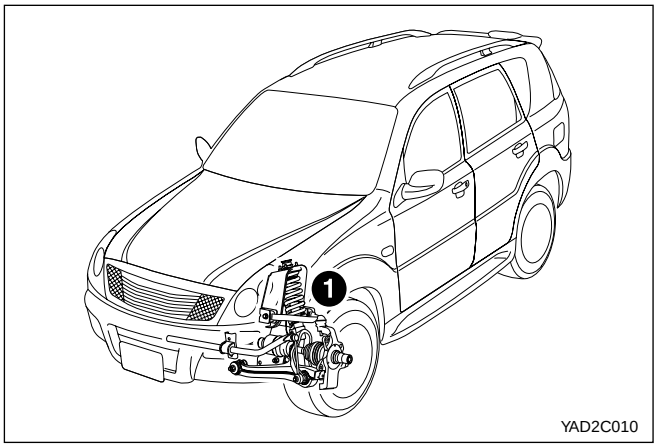
FRONT SUSPENSION

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Special Tools Table 2C-20

DESCRIPTION AND OPERATION

FRONT SUSPENSION



1. Front suspension type : Double Wishbone
2. Component
   - Knuckle, upper arm assembly, lower arm assembly, coil spring, shock absorber assembly, stabilizer.

The front suspension is a combination strut and spring design, with the control arms that pivot from the engine frame. The frame has isolation mounts on the body and a conventional rubber bushing is used on the lower control arm pivot. The front lower control arm bushing is mounted horizontally. The upper end of the strut is isolated by a rubber mount which contains a bearing to allow for wheel turning. The lower end of the steering knuckle pivots on a ball joint riveted to the control arm. The ball joint is fastened to the steering knuckle with a castellated nut and cotter pin.

Stabilizer

If the spring with lower spring constant is applied on the vehicle in order to increase the 'ride comfort', the vehicle's slope increases on turning due to the centrifugal force. Because its trend increases for the independent suspension system, the stabilizer bar should be applied to the system in order to make a balance the vehicle.

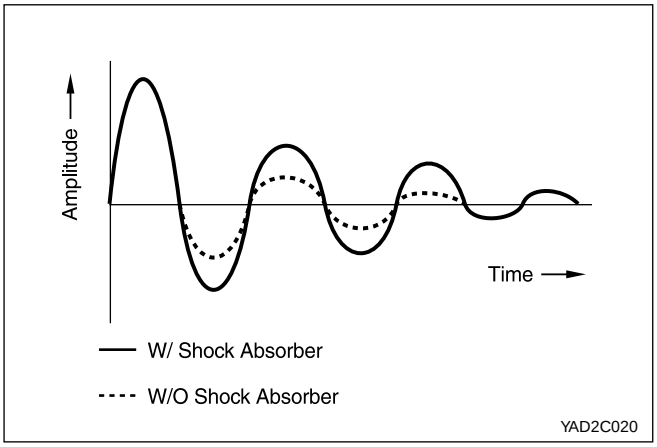
The stabilizer bar is the type of the torsion bar and the both end of the stabilizer bar are connected to the control bar, the center of the stabilizer bar is mounted to the body frame.

Coil Spring

The coil spring is made by winding solid steel rod to form the coil shape. Its energy absorption rate per weight is higher than that of the leaf spring and it allows to absorb little vibration properly resulted in keeping the ride comfort. Therefore, it's difficult to make a effect on vibration damping because there is not any friction between coils.

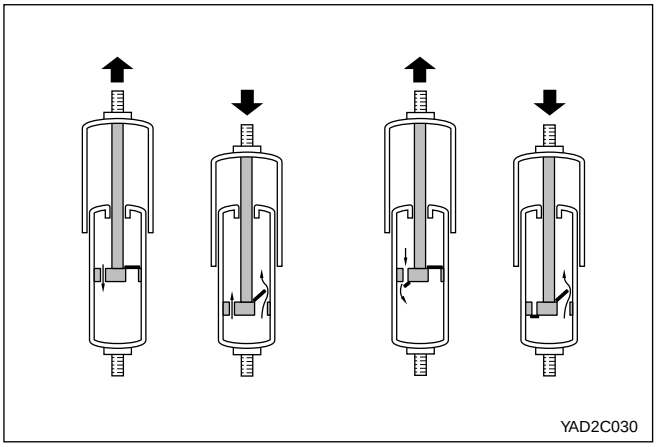
Shock Absorber

This vehicle is applied to the strut type and the telescopic double tube type. The shock absorber is connected to the piston rod in the strut. Positioned between the car body and the tire, acts with coil springs to insure a smooth ride ; dampens vibrations and improves driving stability and controllability by pressing the tires against the road surface.

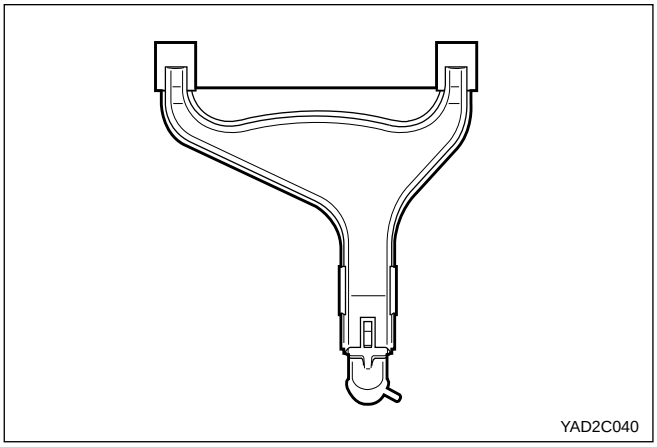


The telescopic shock absorber is consist of the tube with the piston and the rod, and the other cylinder tube. The piston section has the orifice and valve and the cylinder is filled fully with oil.

This double tube type enables to control the vibration properly because oil resistance forces are generated on compression and expansion of shock absorber. Thus, this double type is better than the mono tube type regarding the driving safety.



Upper/Lower Arm Assembly



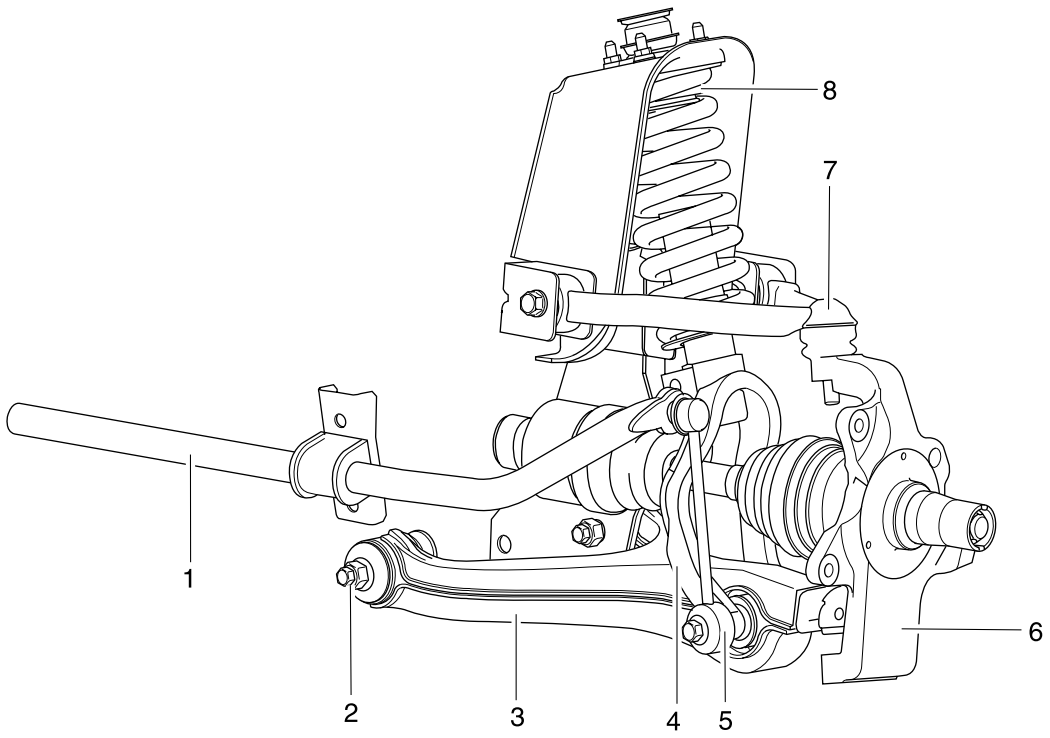
The lower arm assembly mounts the shock absorber with bushings in order to support the load delivered from the spring , the shock absorber and the bumper. The upper arm also supports the load delivering to the knuckle. This assembly enables to absorb the various shock and to ensure the driving safety.

SPECIFICATIONS

Application		Specification
Suspension System		Double Wishbone
Spring Type		Coil spring
Shock Absorber		Telescopic Double Tube Type(GAS)
Stabilizer		Torsion Bar Type
Wheel Alignment	Toe-In	2 ± 2 mm
	Camber	0° ± 30´ (Both side difference must be below 30´)
	Caster	2° 45 ± 30´ (Both side difference must be below 30´)

COMPONENT LOCATOR

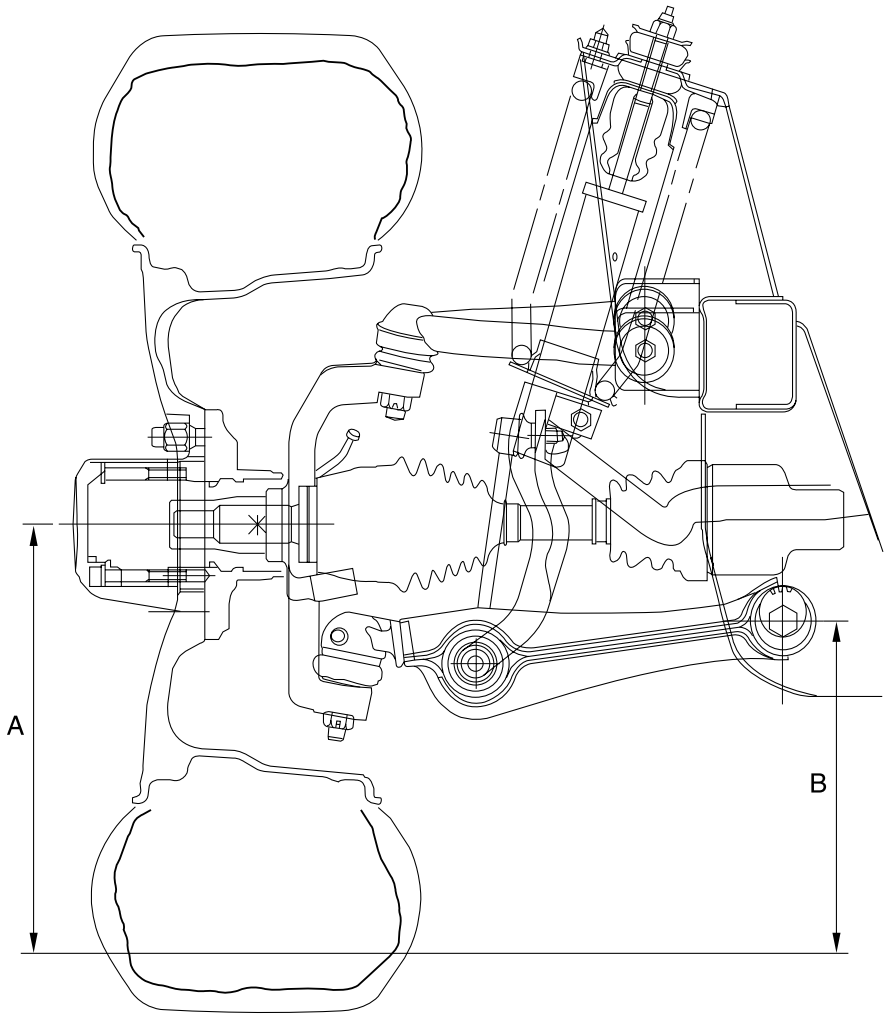
FRONT SUSPENSION ASSEMBLY



1 Stabilizer Bar
2 Cam bolt
3 Lower arm
4 Yoke
5 Stabilizer Bar Link
6 Knuckle
7 Upper arm
8 Shock Absorber Assembly (Including coil spring)

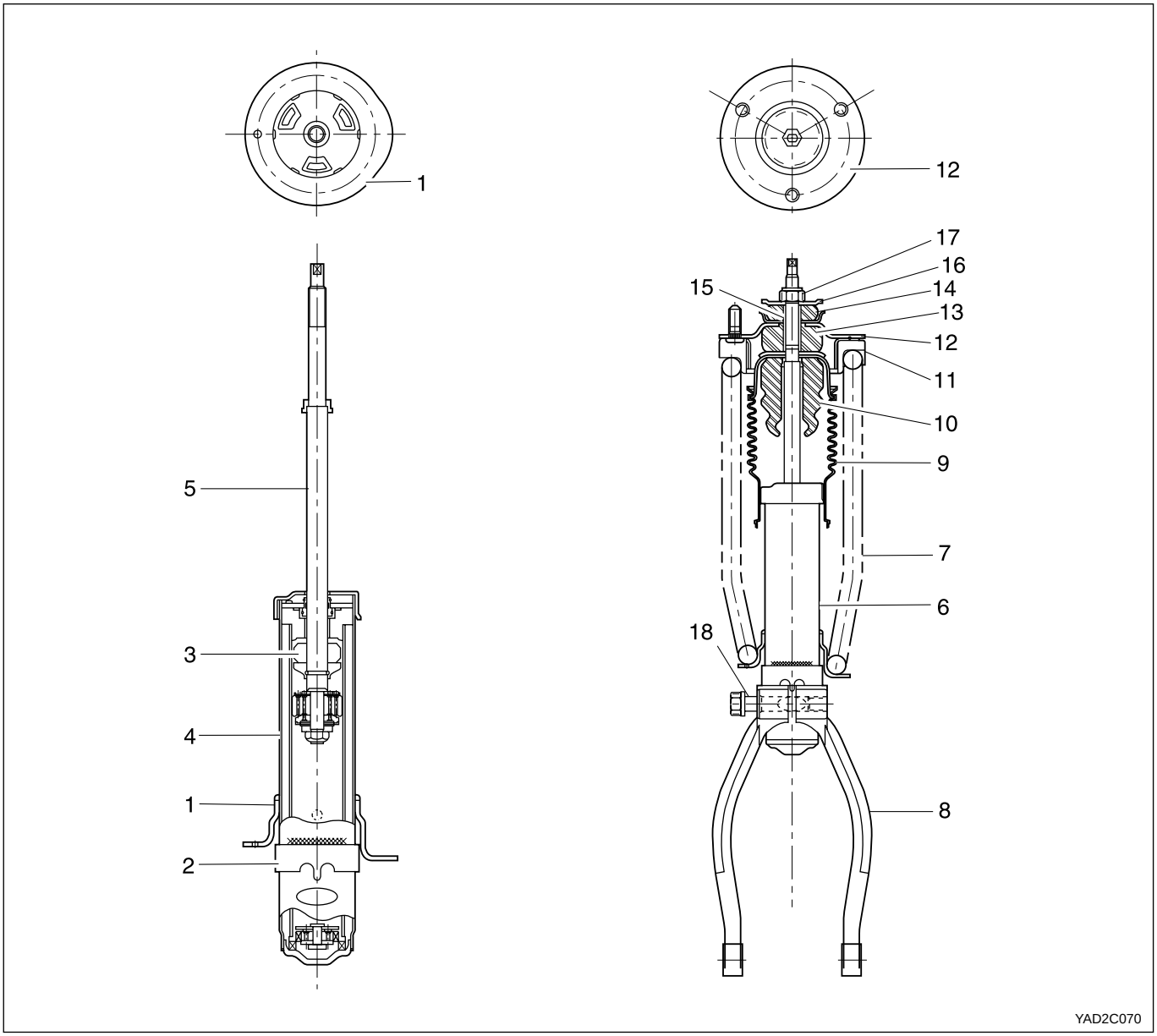
CROSS-SECTIONAL VIEW

SUSPENSION ASSEMBLY



YAD2C060

SHOCK ABSORBER



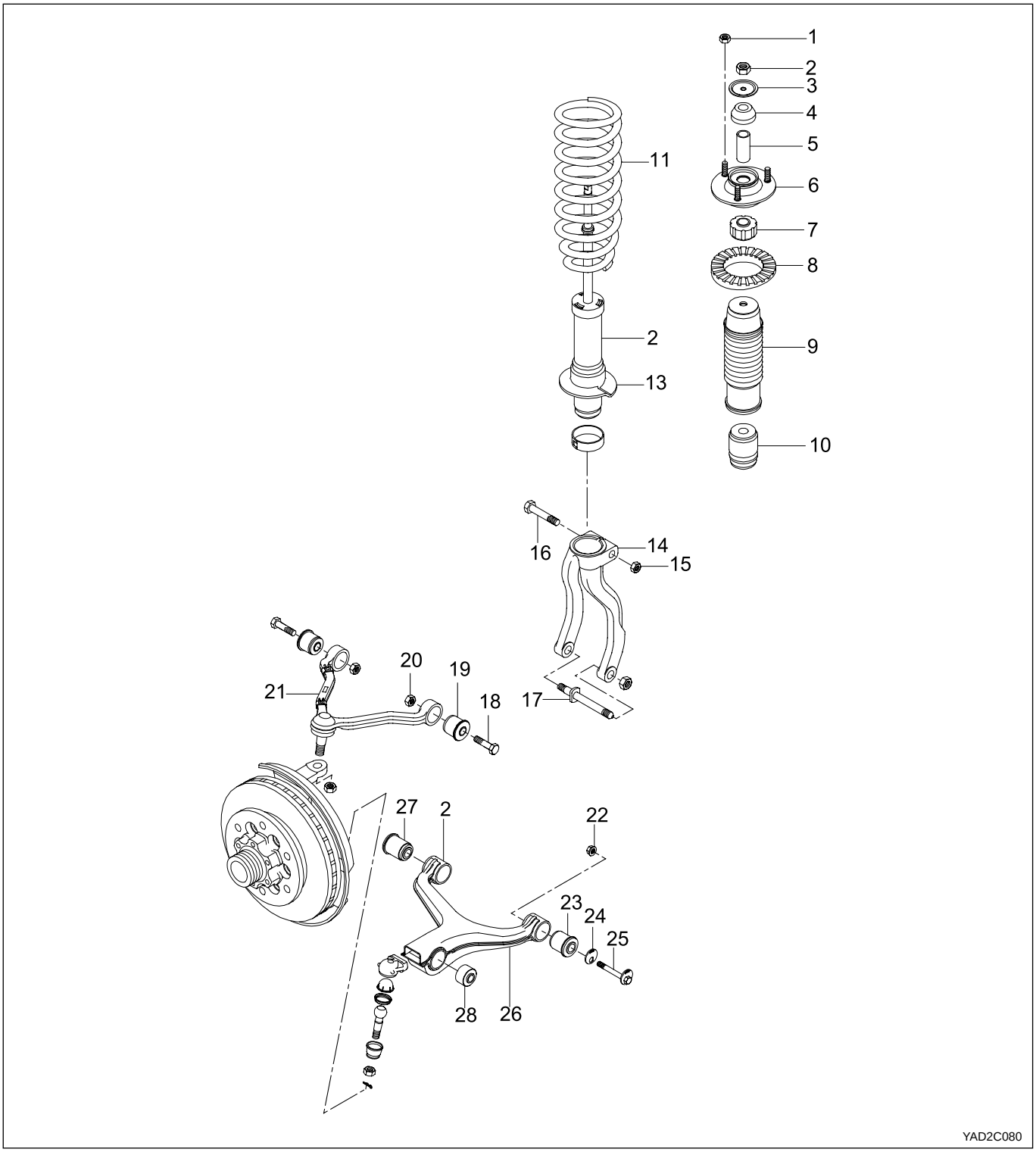
1 Lower Spring Sheet
2 Yoke Bracket
3 Rebound Stopper
4 Cylinder
5 Piston
6 Shock-Absorber assembly
7 Spring
8 Yoke
9 Boot
10 Bump Stopper
11 Spring Sheet Rubber
12 Upper Spring Sheet
13 Rubber
14 Rubber
15 Spacer
16 Washer
17 Nut
18 Bolt

DIAGNOSTIC INFORMATION AND PROCEDURES

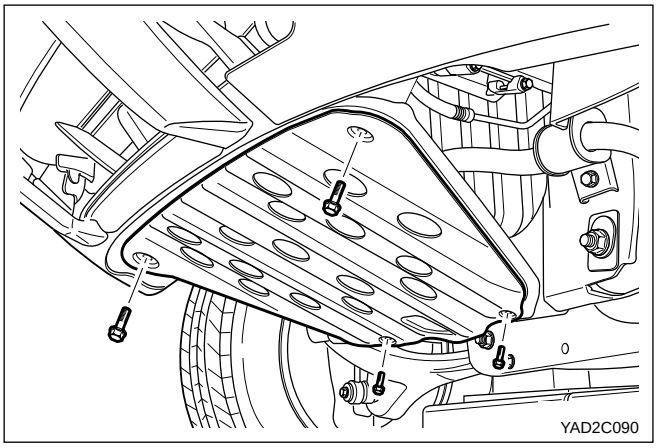
Symptom	Possible Cause	Action
Vehicle Rolling	Broken Stabilizer Bar	Replace
	Faulty Shock Absorber	Replace
Abnormal Noises	Loosening Mountings	Re-Tighten
	Damaged or Worn Wheel Bearing	Replace
	Damaged Shock Absorber	Replace
	Damaged Tire	Replace
Poor Riding	Over Inflated Tire	Pressure Adjust
	Faulty Shock Absorber	Replace
	Loosened Wheel Nut	Tighten as specified torque
	Bent or Broken Coil Spring	Replace
	Damaged Tire	Replace
	Worn Bushing	Replace
Vehicle Pulls to Right or Left	Deformed Arm Assembly	Replace
	Worn Bushing	Replace
	Bent or Broken Coil Spring	Replace
Hard Steering	Incorrect Front Wheel Alignment	Repair
	Excessive Resistance of Lower Arm Ball Joint	Replace
	Insufficient Tire Pressure	Adjust
	Faulty Power Steering	Repair or Replace
Steering Instability	Incorrect Front Wheel Alignment	Repair
	Worn or Loosened Lower Arm Bushing	Re-Tighten or Replace
Vehicle Bottoming	Worn or Broken Coil Spring	Replace

REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE



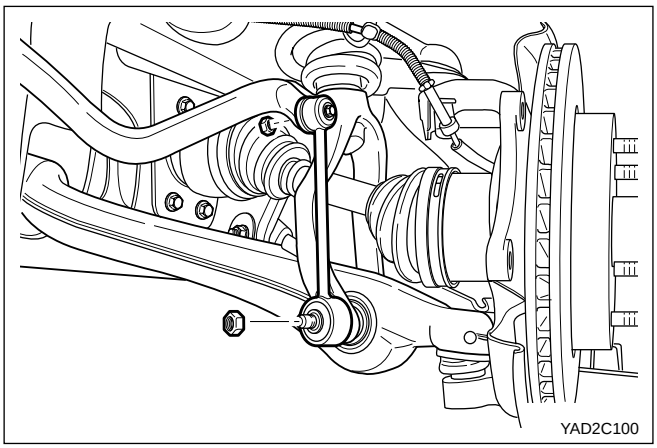
1 Nut
2 Nut
3 Washer
4 Rubber
5 Bushing
6 Upper Spring Sheet
7 Rubber
8 Spring Sheet Rubber
9 Boot
10 Boot
11 Spring
12 Shock Absorber
13 Lower Spring Sheet
14 Yoke
15 Nut
16 Bolt
17 Bolt
18 Bolt
19 Bushing
20 Nut
21 Upper Arm
22 Nut
23 Bushing
24 Washer
25 Bolt
26 Lower Arm
27 Bushing
28 Bushing


YAD2C090

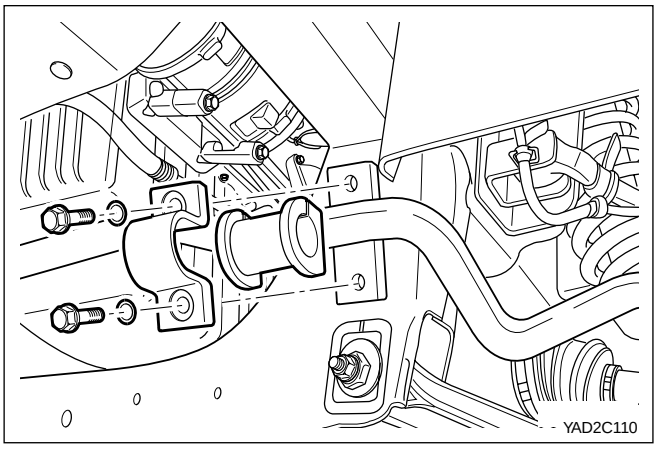
STABILIZER

Removal Procedure

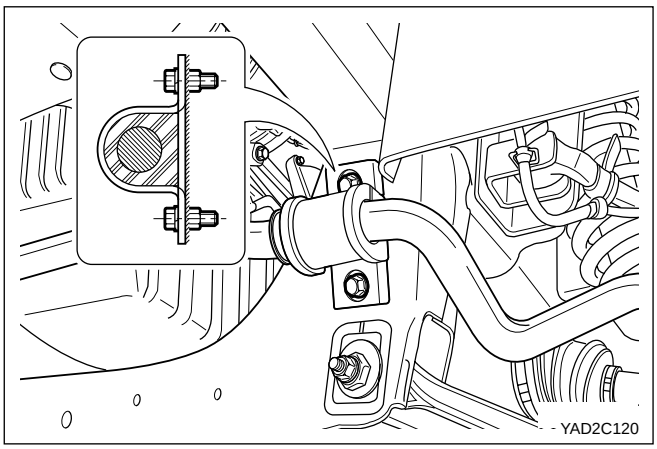
1. Remove the skid plate at front bottom side.


YAD2C100

2. Remove the upper mounting nut and the lower mounting nut from the front stabilizer bar link. Remove the front stabilizer bar link.


YAD2C110

3. Remove the mounting cap bolt from the front stabilizer bar and remove the front stabilizer bar.

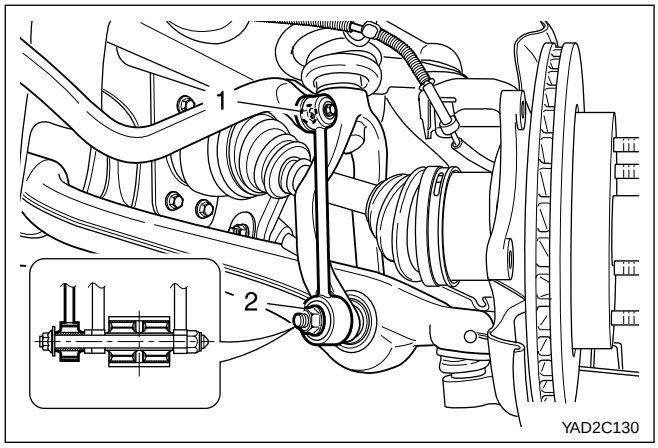

YAD2C120

Installation Procedure

1. Install the front stabilizer bar to the frame and tighten manually the stabilizer bar mounting cap bolt. It allows the bar link to install to it's original position.

Installation Notice

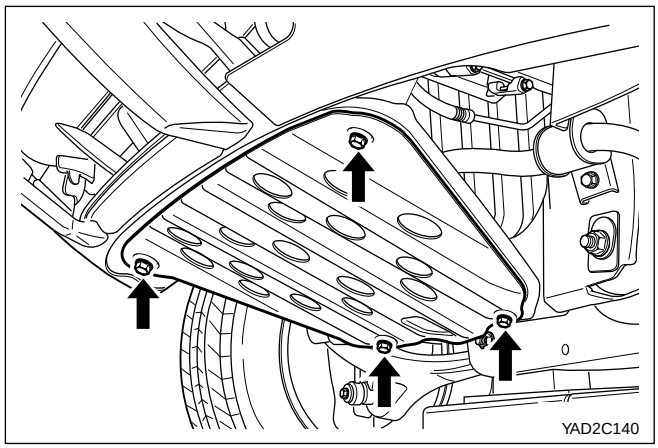
Tightening Torque	60 - 80 N•m (44 - 59 lb-ft)



2. Install the bra link between the stabilizer bar and the lower arm and tighten the mounting nut as the specified torque.

Installation Notice

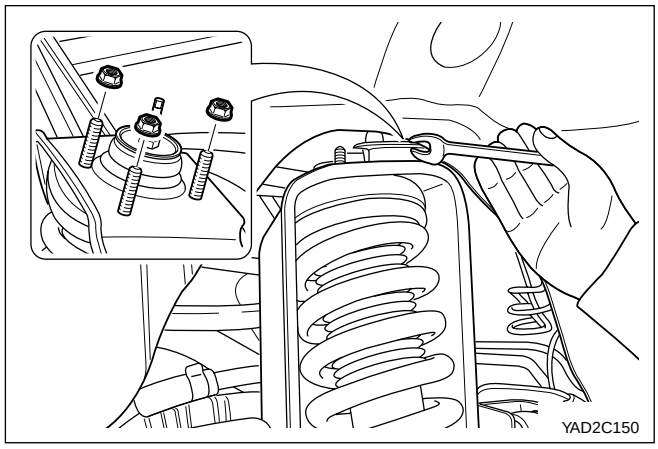
Tightening Torque	(1) 110 - 120 N•m
	(2) 110 - 130 N•m



3. Install the front stabilizer bar and the skid plate.

Installation Notice

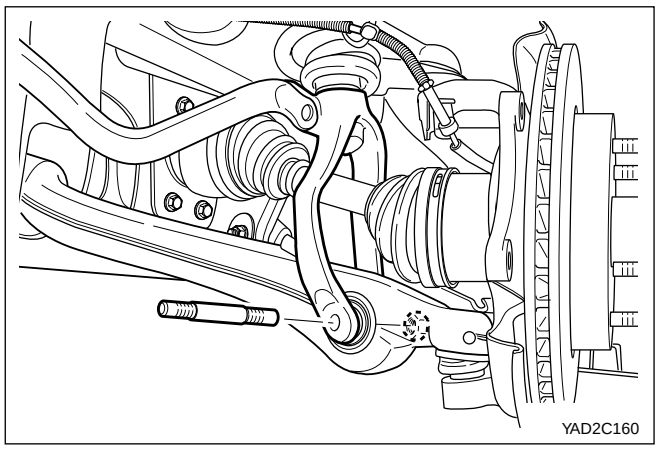
Tightening Torque	35 N•m (26 lb-ft)



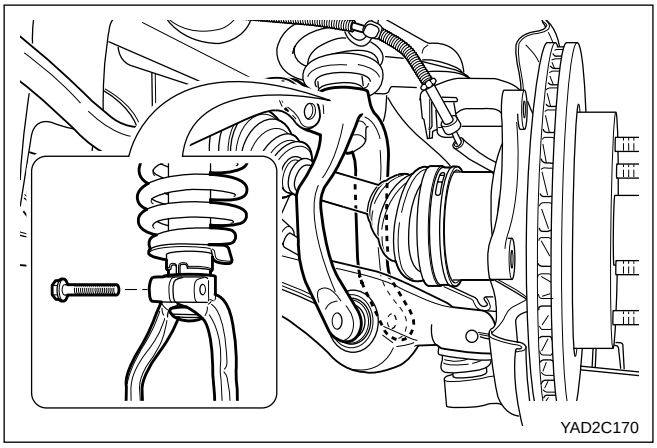
SHOCK ABSORBER ASSEMBLY

Removal Procedure

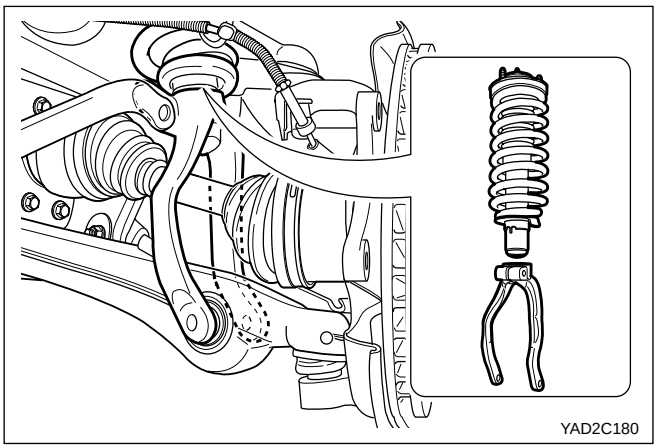
1. Remove three upper nuts from the shock absorber assembly.



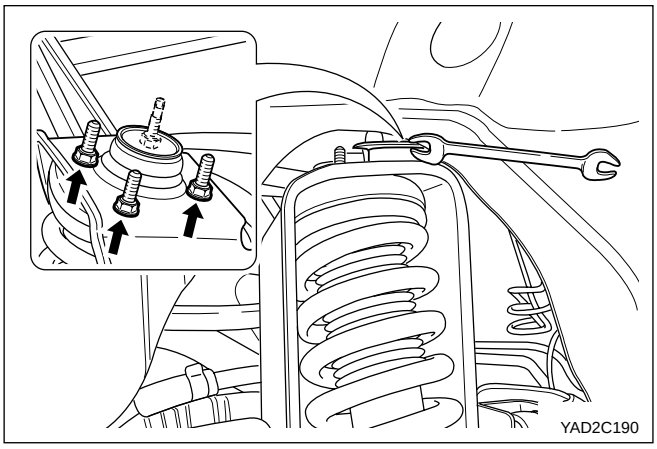
2. Remove the yoke mounting pin nut at the lower arm and the yoke mounting pin.



3. Remove the shock absorber and coil spring assembly. Separate the lower yoke mounting bolt and the yoke.
4. Remove the shock absorber yoke.



5. Separate the shock absorber assembly with pushing down the lower arm.

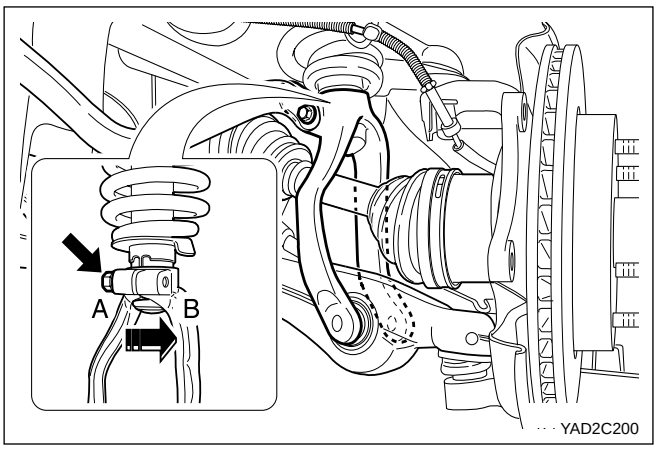


Installation Procedure

1. Install the coil spring(shock absorber) assembly and the yoke to the body. And then install the lower shock absorber into the yoke hole and insert the upper shock absorber to bolt hole by tightening the nut manually.

Installation Notice

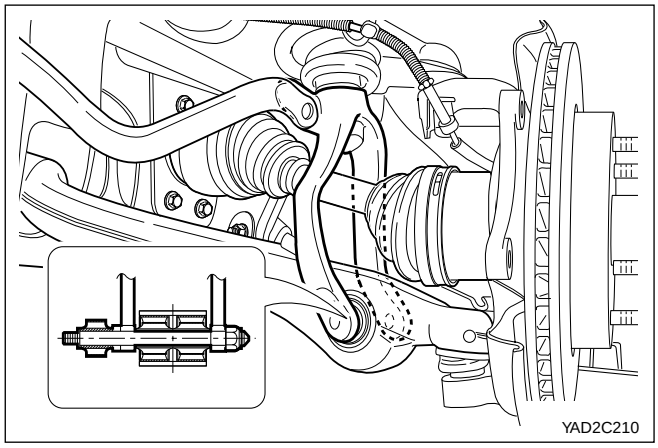
Tightening Torque	40 - 60 N•m (30 - 44 lb-ft)



2. Tighten bolts of the shock absorber assembly and yoke. Be careful to tightening direction of the bolt as shown.(See the arrow).

Installation Notice

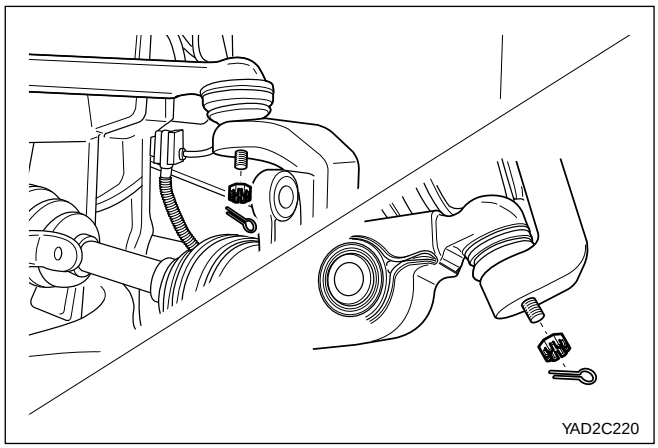
Tightening Torque	60 - 70 N•m (44 - 52 lb-ft)


YAD2C210

3. Fix the shock absorber yoke at the lower arm bolt hole and insert to tighten the yoke mounting pin to the hole.

Installation Notice

Tightening Torque	150 - 180 N•m


YAD2C220

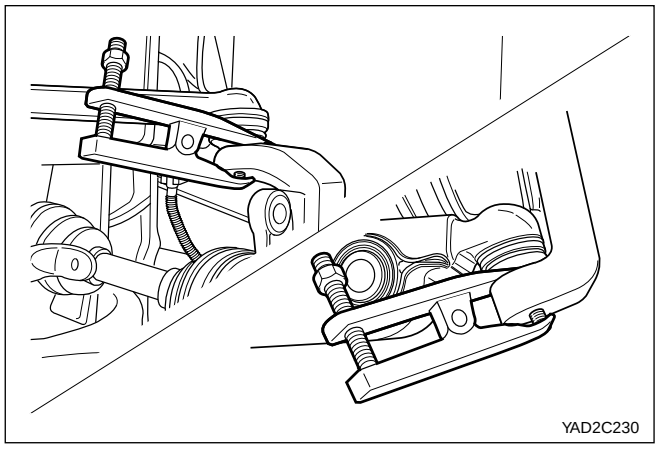
UPPER/LOWER ARM ASSEMBLY

Removal Procedure

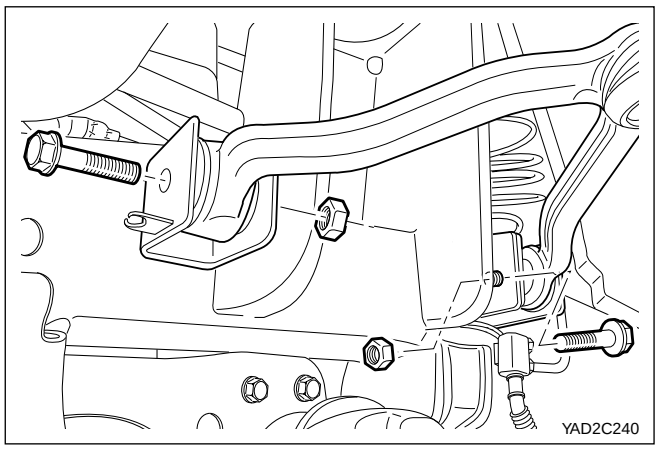
Notice: Perform the pre-work before the removal procedure.

- Remove the shock absorber.
- Remove the steering knuckle by referring the steering section.

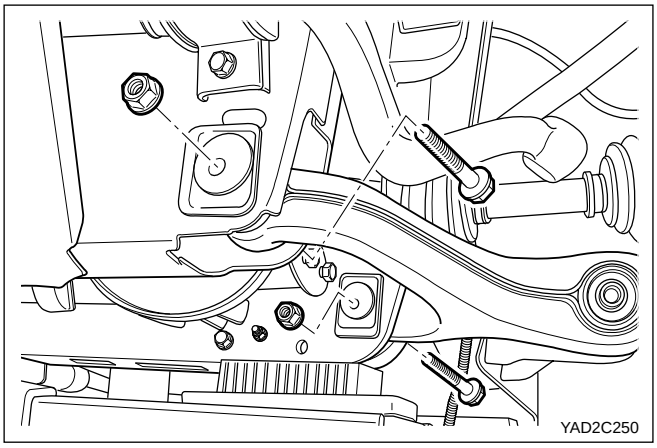
1. Remove the mounting nut (slotted nut) and the split pin (cotter pin) from the upper/lower arm ball joint.


YAD2C230

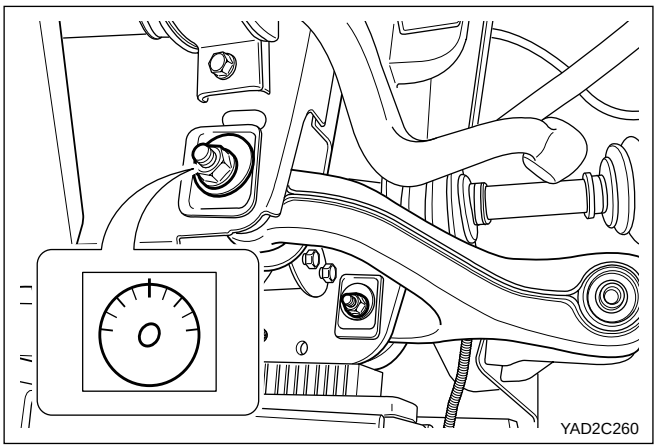
Notice: Separate the ball joint from the steering knuckle using the special tool as shown.


YAD2C240

2. Remove mounting bolts and nuts of the upper arm/ frame bracket (both front and rear) and separate the upper arm.



3. Remove mounting bolts and nuts of the lower arm (both front and rear) and separate the lower arm.



Installation Procedure

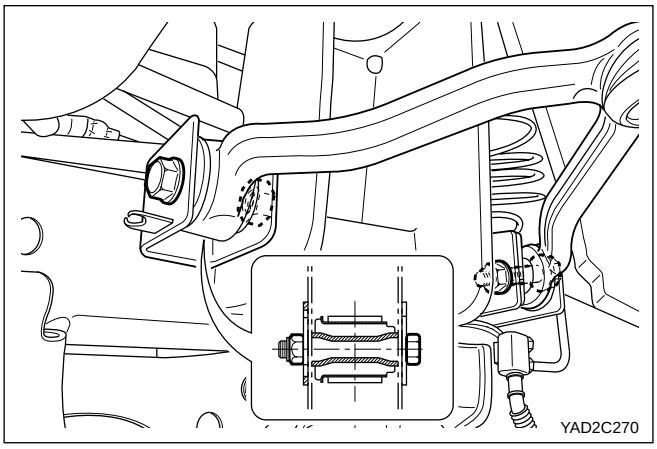
1. Install the lower arm to the frame bracket and tighten the mounting bolt and nut as the specified torque.

   Notice :

   - Tighten the bolt on the direction from rear side to front side of the vehicle.
   - Fix the bolt center with the bracket indication.

   Installation Notice

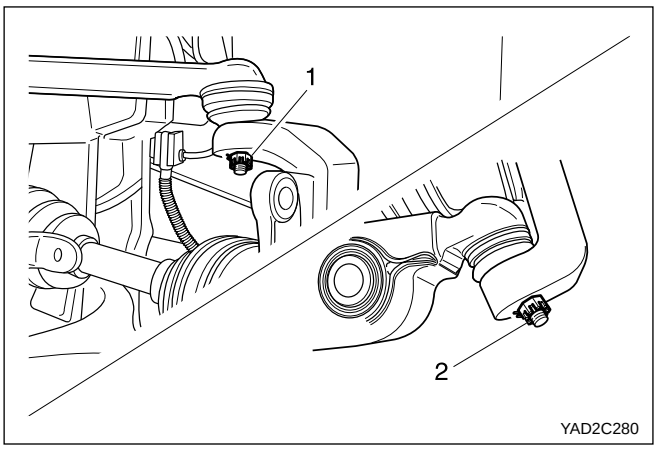
Tightening Torque	160 - 170 N•m



2. Install the upper arm to the frame bracket.

   Installation Notice

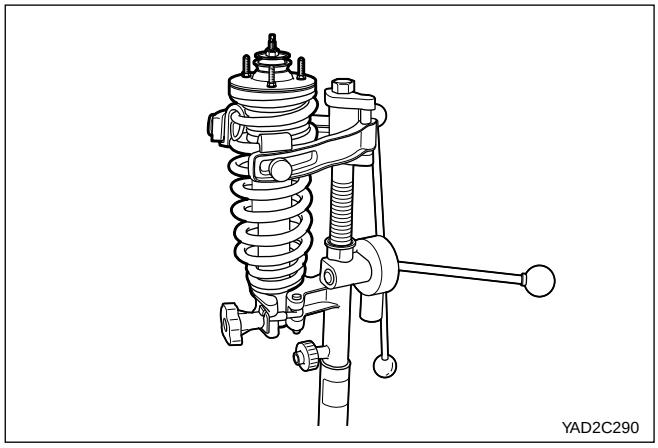
Tightening Torque	110 - 130 N•m

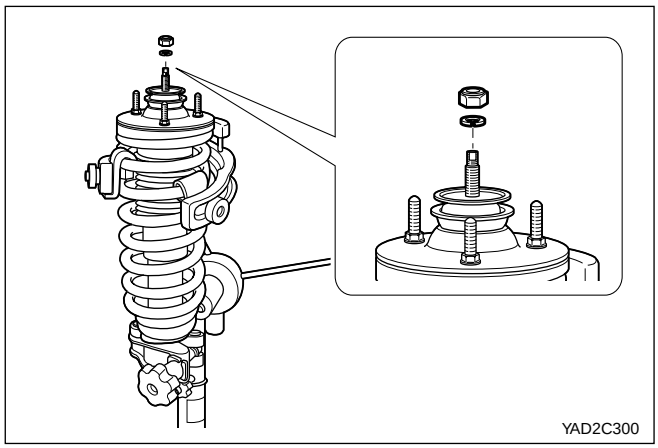


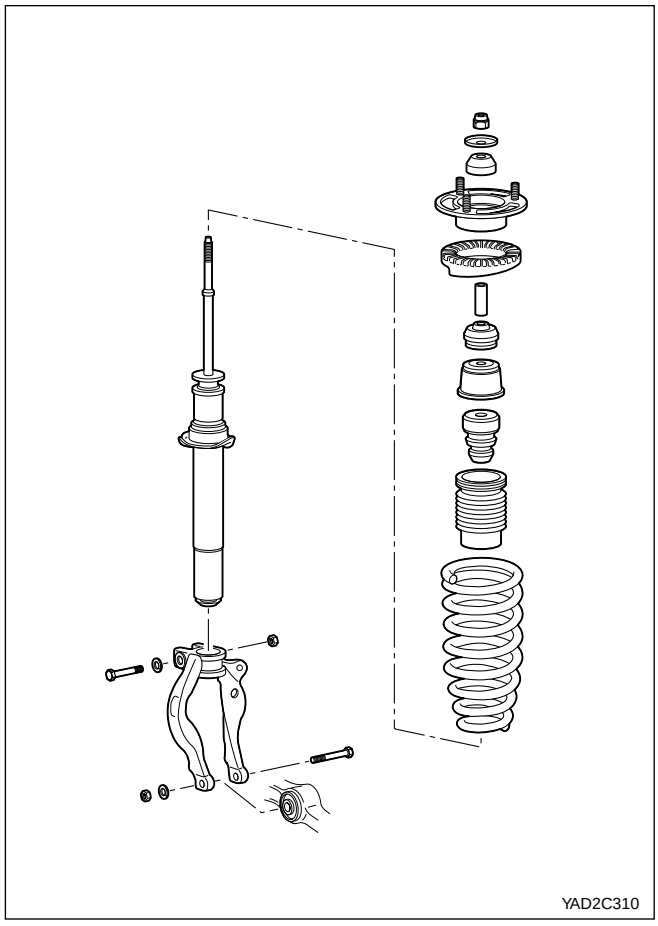
3. Install the knuckle assembly to the shaft and insert the ball joint of the upper/lower arm. And then tighten the slotted nut and split pin.

   Installation Notice

Slotted nut Tightening Torque	Upper side (1)	110 - 120 N•m
	Lower side (2)	110 - 130 N•m


YAD2C290


YAD2C300


YAD2C310

UNIT REPAIR

FRONT COIL SPRING

Removal Procedure

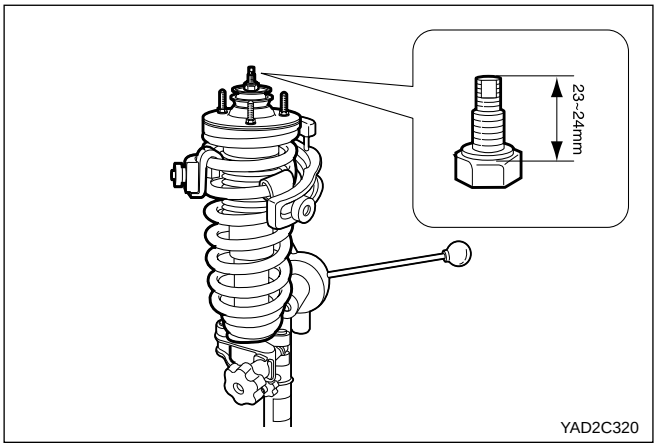
1. Remove the front coil spring assembly.
2. Fix the special tool to the coil spring assembly as shown and compress the coil spring.

   Notice: Install the special tool to the coil spring tightly not to separate it during work and be careful to spring end portion should look forward to the person during compressing the coil spring.

3. Remove the shock absorber mounting nut and remove the lock nut of the special tool in order to separate the shock absorber.

4. Remove the coil spring components in specified disassemble order.

   Notice: Be careful to cause the spring elasticity to any personal injury when it is separated the special tool from the coil spring.



Installation Procedure

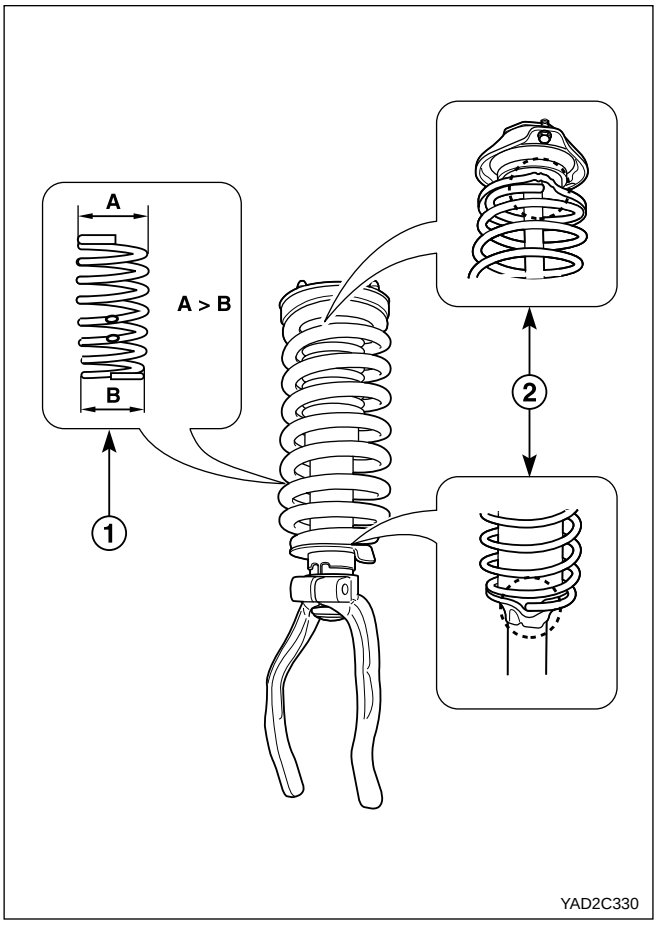
1. Compress the coil spring as the specified torque and install the related components. And then tighten the lock nut.

Installation Notice

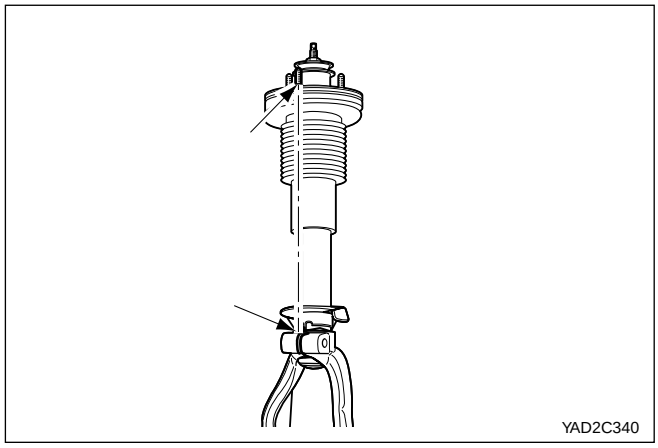
Length at compression	334 N•m
Tightening torque of lock nut	25 - 40 N•m (18 - 30 lb-ft)

Notice: Be careful to the installation direction for installing the coil spring.

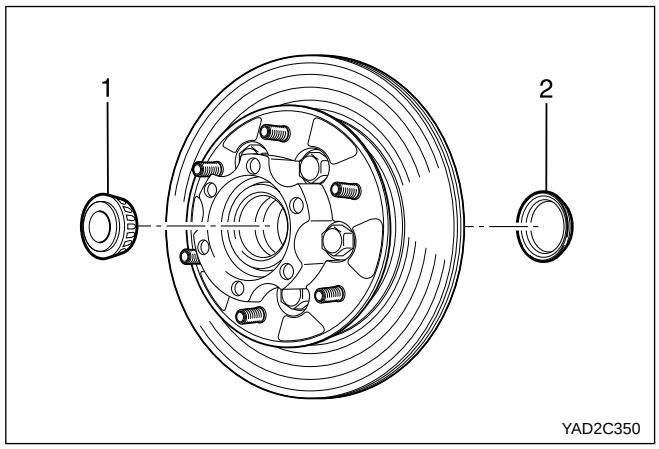
Note: When it's difficult to tighten the nut as specified torque, fix the length from upper lock nut to bolt end to 23 ~ 24 mm.



2. Check the coil spring installation.
   - Check the installation direction of the coil spring.
   - Verify that the coil spring is installed onto the spring sheet correctly.


YAD2C340

Notice: One of the upper bracket bolts should coincide with the lower yoke insert projection as shown.



YAD2C350

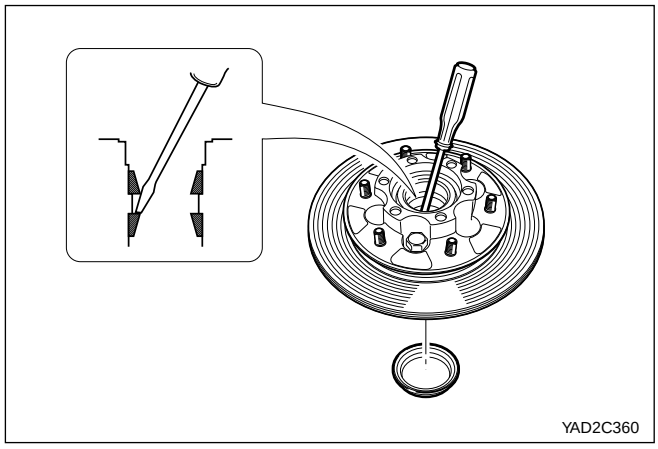
HUB AND BEARING

Disassembly/Assembly (Part time)

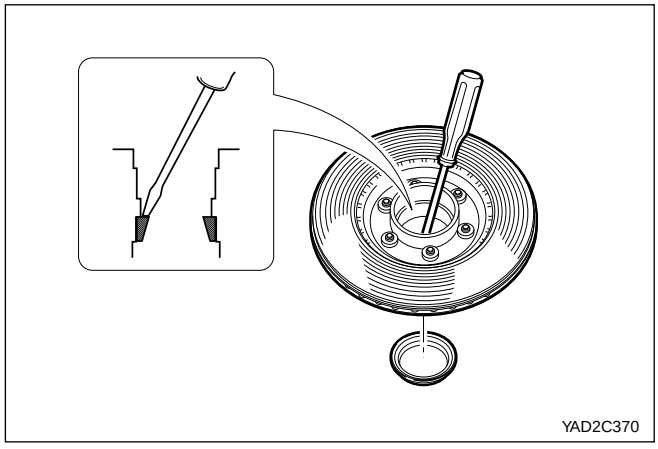
1. Remove the front hub and bearing assembly.
2. Remove the outer bearing (1) and inner seal.

   Notice: Always use a new part as replacing inner seal.

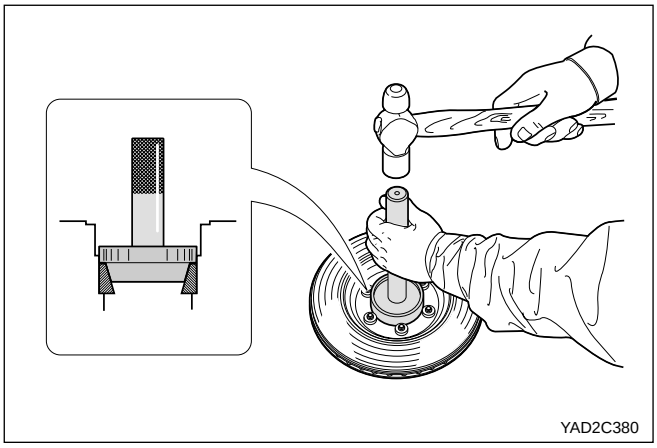
3. Remove the inner bearing (2).


YAD2C360

4. Remove the inner bearing race.

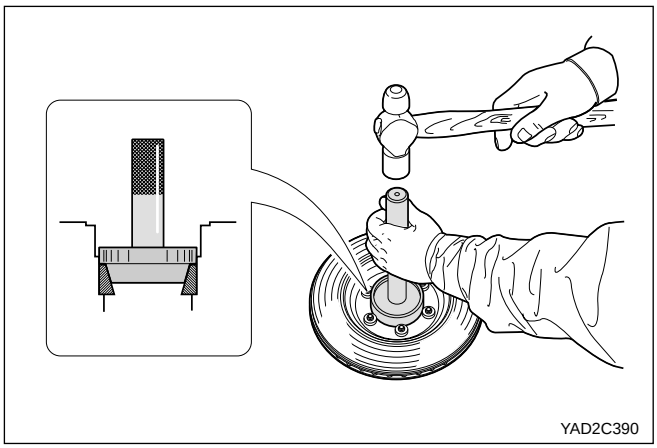

YAD2C370

5. Remove the outer bearing race.


YAD2C380

Notice:

- Install the outer bearing race using the front outer bearing race installer and handle.

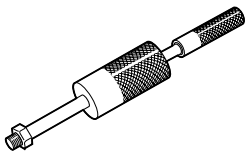
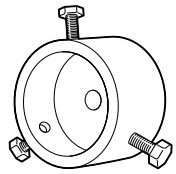
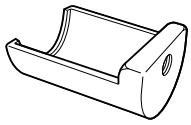
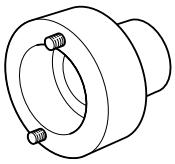
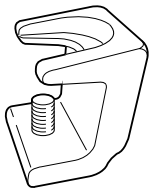
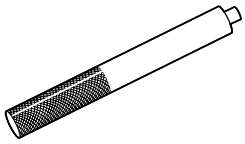
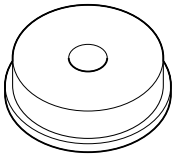
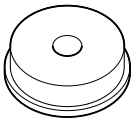

YAD2C390

- Install the inner bearing race using the front inner bearing race installer and handle

6. Installation should follow the removal procedure in the reverse order

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD2C400	**DW340 - 050** **Sliding Hammer**
 YAD2C410	**DW 340 - 060** **Front hub cap remover/ installer**
 YAD2C420	**DW340 - 070** **Front hub flange remover**
 YAD2C430	**661 589 01 07 00** **Front hub adjust nut remover/installer**
 YAD2C440	**661 589 13 33 00** **Ball joint remover**
 YAD2C450	**DW 340 - 021 - 01** **Handle**
 YAD2C460	**DW 340 - 021 - 02** **Front inner bearing race installer**
 YAD2C470	**DW 340 - 021 - 03** **Front outer bearing race installer**

SECTION 2D

REAR SUSPENSION

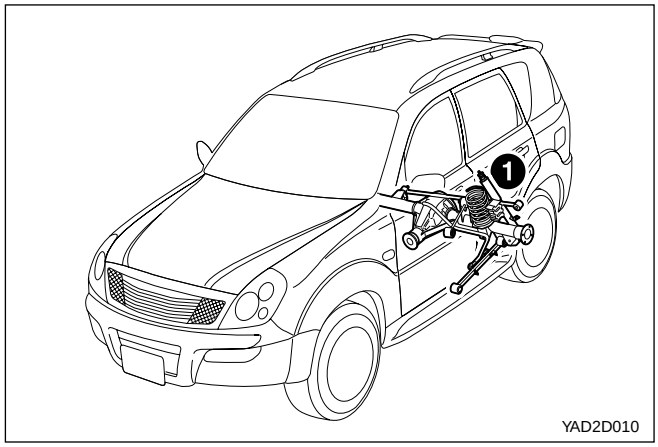
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DESCRIPTION AND OPERATION

REAR SUSPENSION

The rear suspension system is to keep the ride comfort or safety and this vehicle is applied to 5 link suspension system. This system consists of both coil spring, upper/lower arm, the lateral rod, stabilizer, connecting rod and bumper.



1. Stabilizer:

It enables to keep the balance on turning and to minimize the vehicle's slope when both right and left wheels move differently.

2. Lateral Rod:

It allows to control the load at the lateral direction.

3. Upper/Lower Arm:

It allows to control the load at the front/rear direction side.

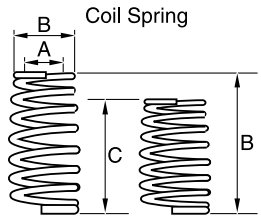
4. Shock Absorber:

It allows to absorb the vibration at the vertical direction in order to make ride comfort feel better and reduce the spring fatigue.

5. Coil Spring:

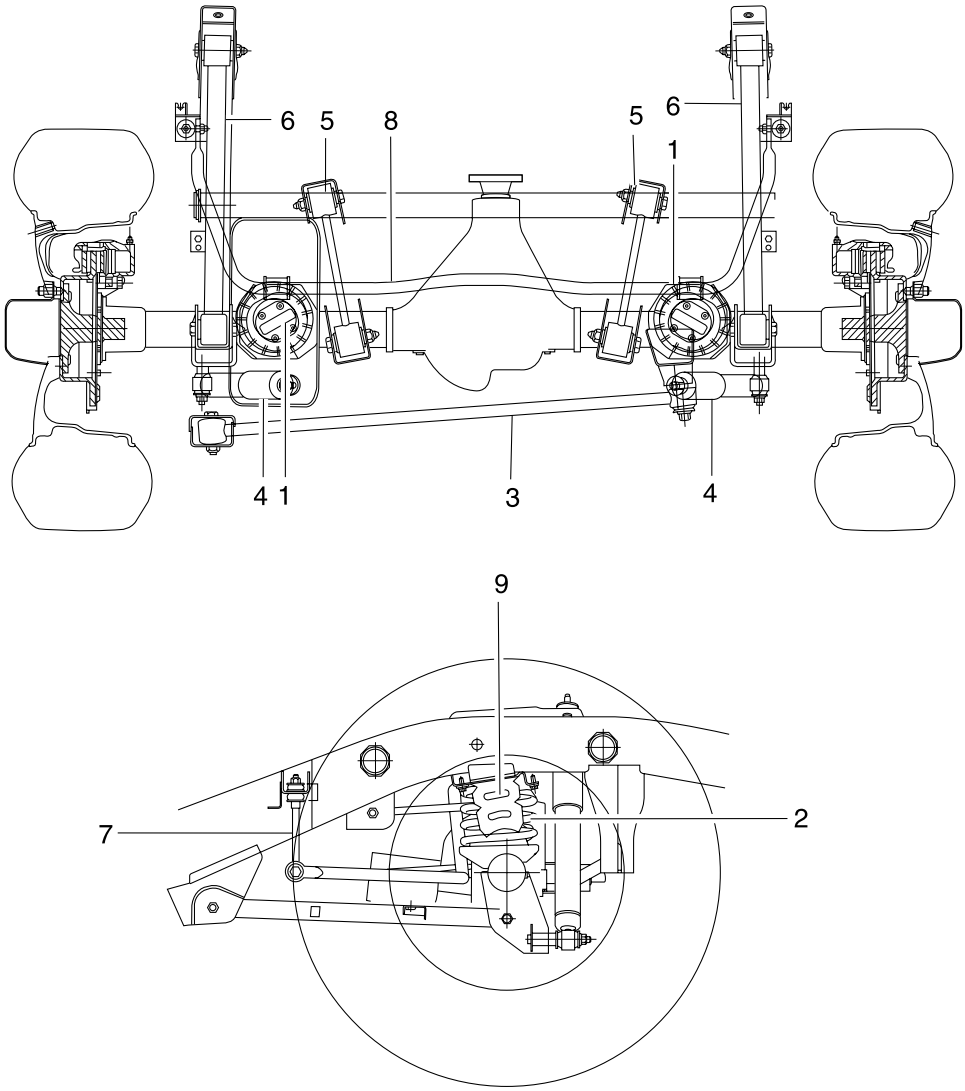
It is installed between the rear axle and body frame. This unit enables to release any shock or any vibration from tires in order to prevent its force from delivering to the body.

SPECIFICATIONS

Suspension Type	5 Links (Two Upper Arm, Two Lower Arm, One Lateral Rod)		
Spring Type	Coil Spring		
Stabilizer Type	Torsion Bar Type		
Shock Absorber	Type	Telescopic Double Tube Type	
	Max. Length	495 mm	
	Min. Length	308 mm	
 YAD2D020	Engine Type	GSL 3.2, DSL(A/T)	DSL(M/T)
	Coil O.D.	13.1 mm	13.0 mm
	Coil I.D(A)	Ø 114 mm	Ø114 mm
	Free-load Height(B)	405.7 mm	386.8 mm
	Compression Height(C)	260.0 mm	250.0 mm
	O.D(D)	Ø127.1 mm	Ø127.0 mm
	Constant	2.45 ± 5%	2.45 ± 5%

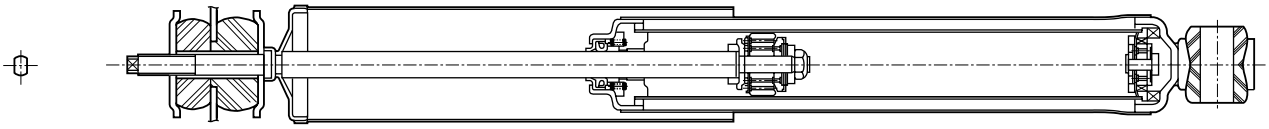
COMPONENT LOCATOR

REAR SUSPANSION ASSEMBLY



1 Coil Spring Seat(upper)
2 Coil Spring
3 Lateral Rod
4 Shock Absorber
5 Upper arm(link)
6 Lower Arm (link)
7 Stabilizer Link
8 Stabilizer
9 Pump Stopper

SHOCK ABSORBER

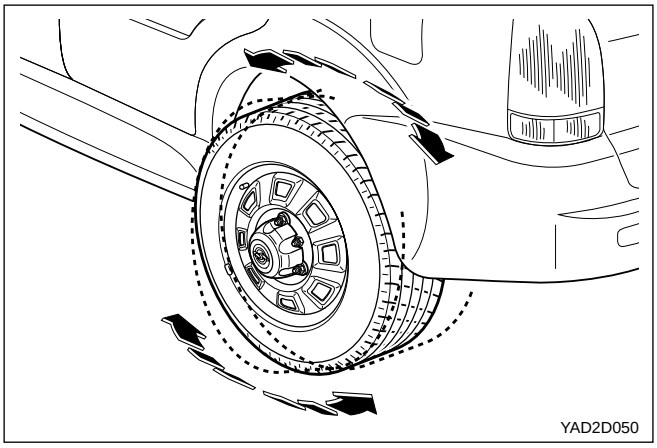


YAD2D040

DIAGNOSTIC INFORMATION AND PROCEDURES

REAR SUSPENSION

Symptom	Possible Cause	Action
Vehicle Rolling.	Broken Stabilizer Bar	Replace
	Faulty Shock Absorber	Replace
Abnormal Noises	Loosening Mountings	Re-Tighten
	Damaged or Worn Wheel Bearing	Replace
	Damaged Shock Absorber	Replace
	Damaged Tire	Replace
Poor Riding	Over Inflated Tire	Pressure Adjust
	Faulty Shock Absorber	Replace
	Loosened Wheel Nut	Tighten as specified torque
	Bent or Broken Coil Spring	Replace
	Damaged Tire	Replace
	Worn Bushing	Replace
Vehicle Pulls to Right or Left	Deformed Arm Assembly	Replace
	Worn Bushing	Replace
	Bent or Broken Coil Spring	Replace
Hard Steering	Excessive Resistance of Lower Arm Ball Joint	Replace
	Insufficient Tire Pressure	Replace
	Faulty Power Steering	Adjust
Steering Instability	Worn or Loosened Lower Arm Bushing	Re-Tighten or Replace
Vehicle Bottoming	Worn or Broken Coil Spring	Replace

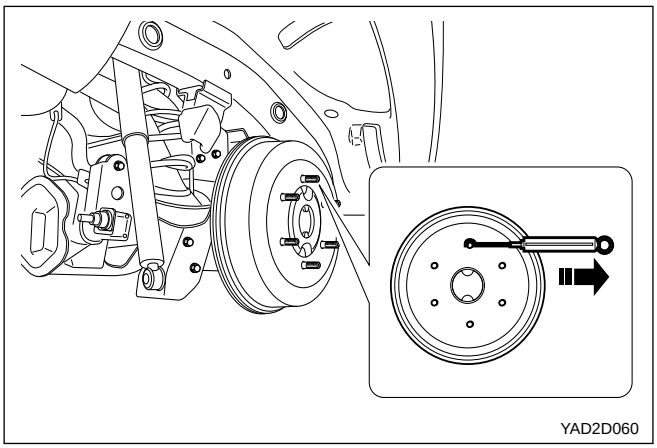

YAD2D050

WHEEL BEARING END PLAY

1. Release the parking brake.
2. Raise rear tires.
3. Inspect the wheel bearing end play by shaking the tire up & down.

Rear wheel bearing end play	0 mm

4. If the wheel bearing end play is excessive, retighten the castle nut.
5. If the wheel bearing end play continues to be excessive, replace the wheel bearing.


YAD2D060

WHEEL BEARING FREE LOAD

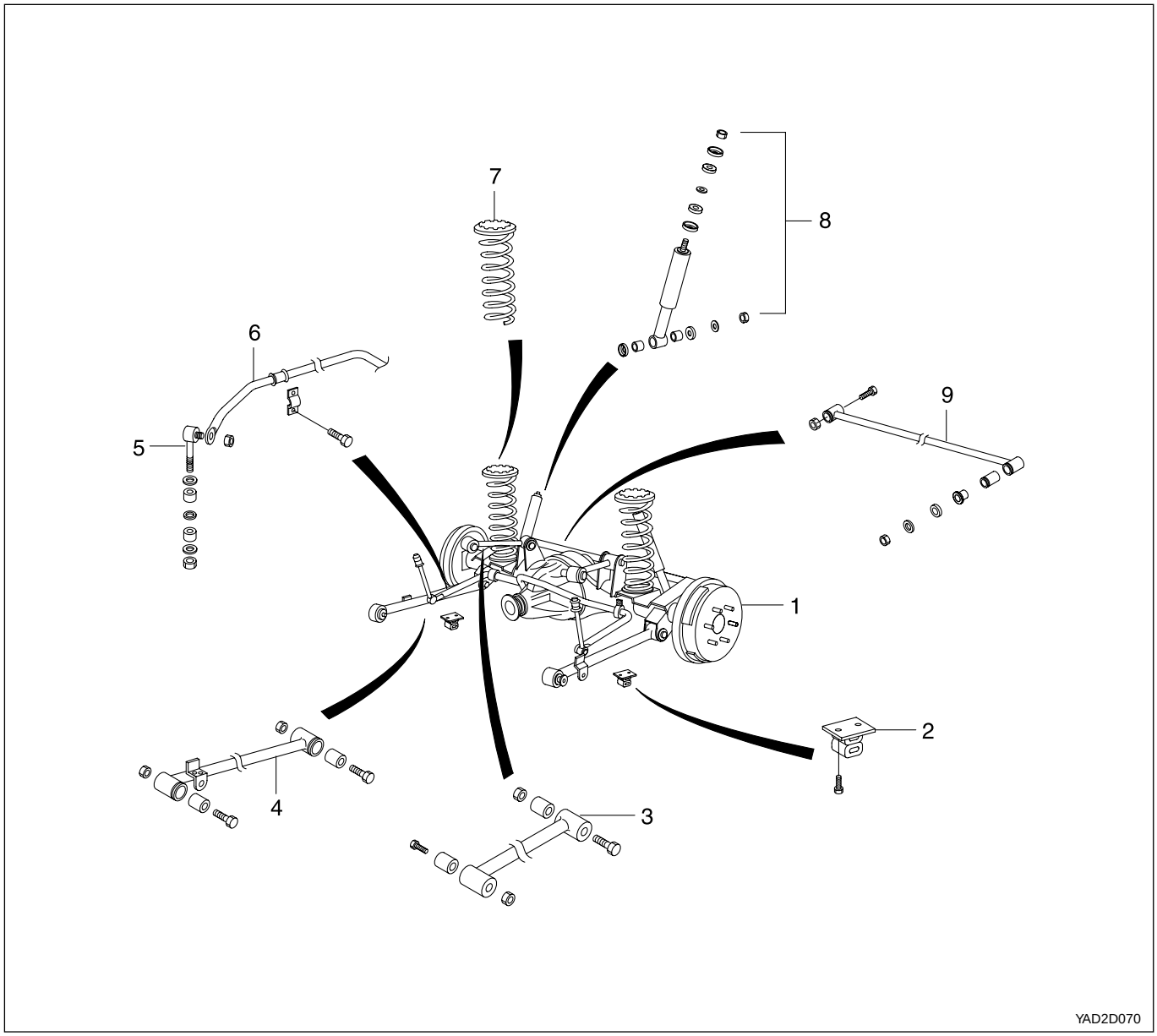
1. Release the parking brake.
2. Raise rear tires and rotate the tire repeatedly.
3. Remove the tire.
4. Hang the measuring tool to the hub bolt and measure the free load at the drum starts to rotate.
5. Check the free load of the rear wheel bearing within the specified value.

Specified free load	1.4 ~ 4.3 kg.cm

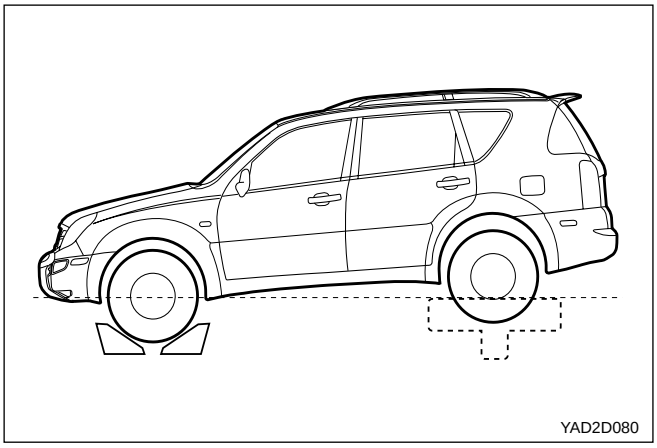
6. Retighten the castle nut as specified torque when the measured value is not within the specified value.
7. Replace the wheel bearing as needed.

REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE



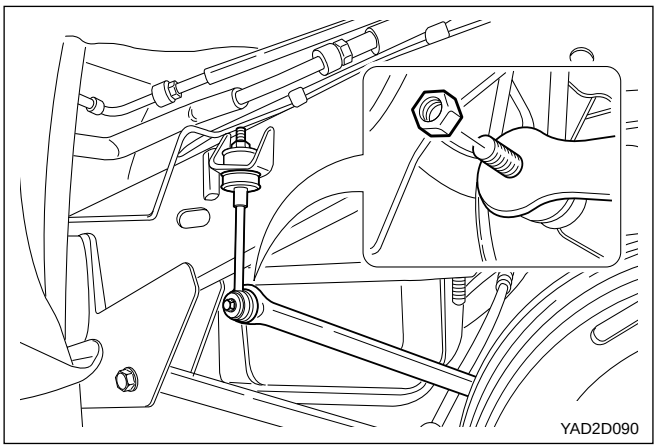
1 Rear Suspension Assembly
2 Rubber
3 Upper Arm
4 Lower Arm
5 Stabilizer Link
6 Stabilizer
7 Coil Spring
8 Shock Absorber
9 Lateral Rod


YAD2D080

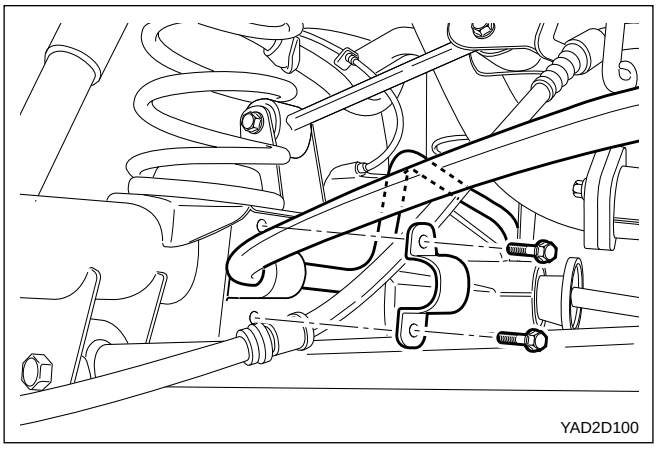
REAR SUSPENSION ASSEMBLY

Removal Procedure

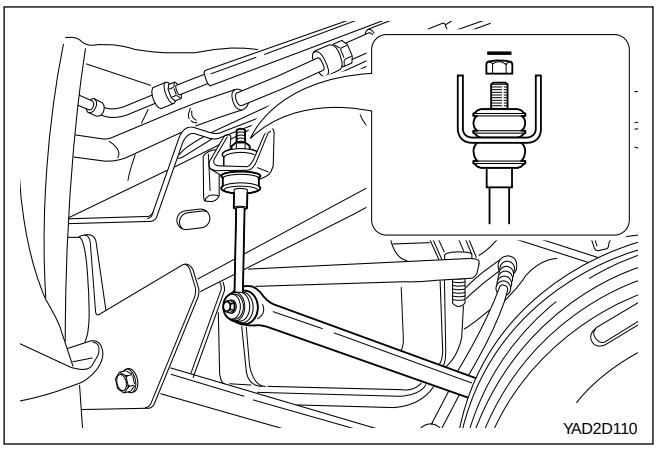
1. Support the rear axle housing bottom safely using the jack and fix the front wheel as shown.


YAD2D090

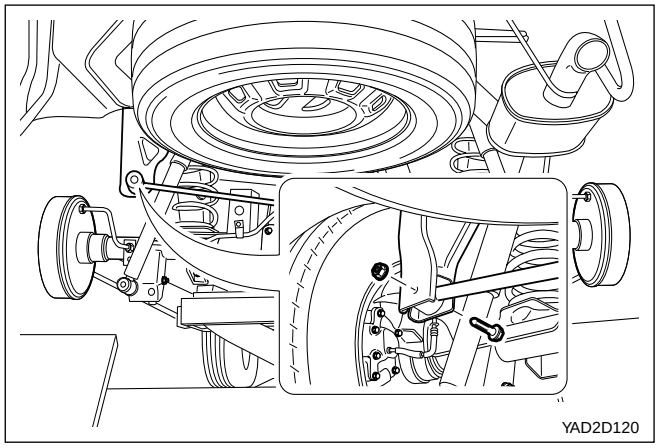
2. Remove the mounting nut of the lower link connected the stabilizer bar and separate the stabilizer bar.


YAD2D100

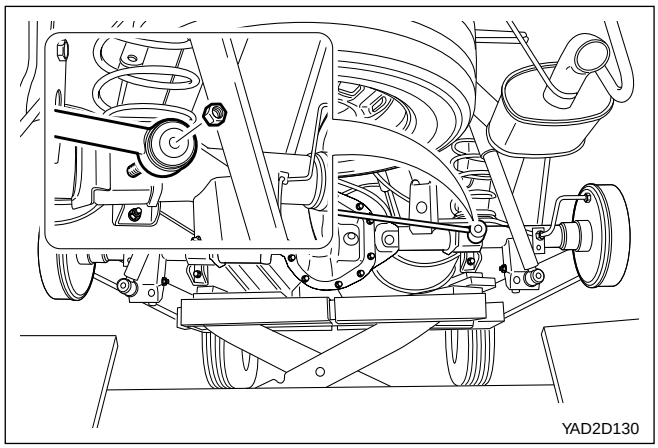
3. Remove the mounting cap bolt retaining both end of the stabilizer bar and remove the stabilizer bar, the mounting cap and the bushing.


YAD2D110

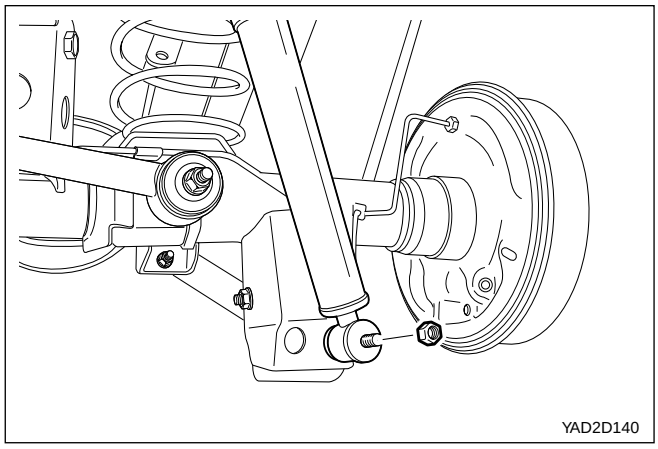
4. Remove the upper mounting nut of the link with the stabilizer bar removed and remove the link.



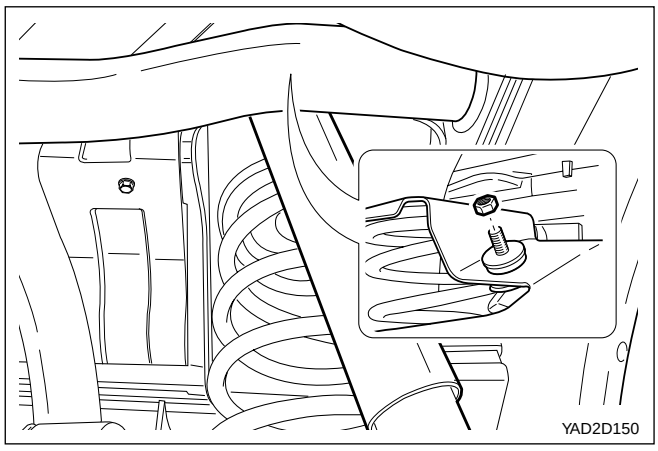
5. Remove the lateral rod mounting nut by retaining the frame.



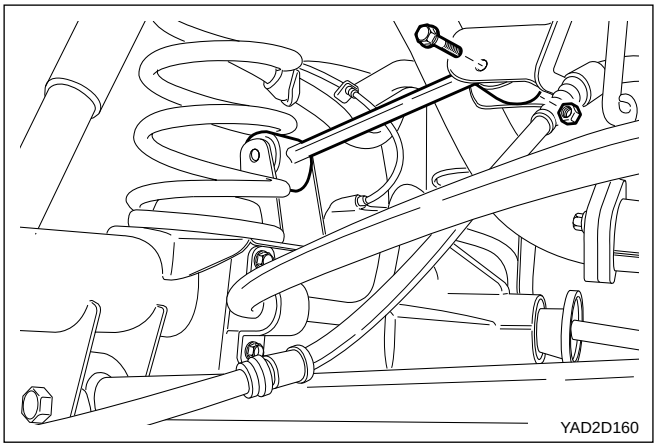
6. Remove the lateral rod mounting nut by retaining the axle and remove the lateral rod assembly.



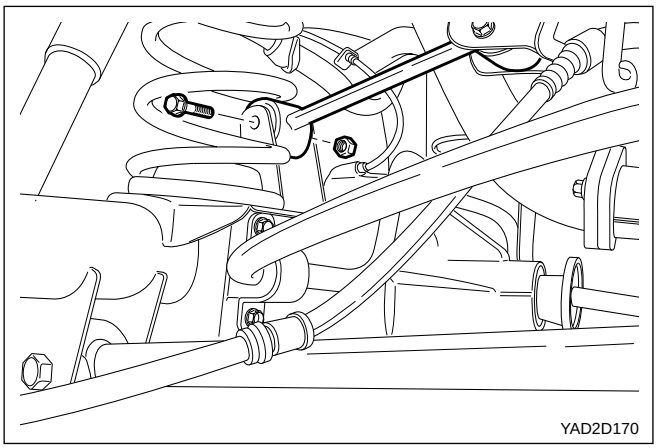
7. Remove the lower nut of the shock absorber.



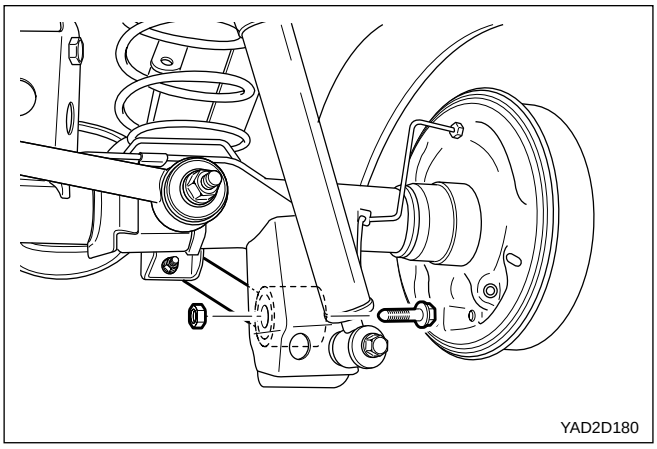
8. Remove the upper nut and remove the shock absorber



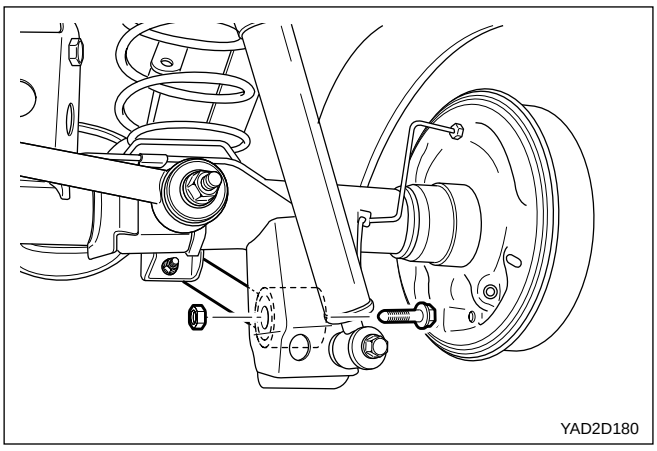
9. Remove the bolt and nut retaining the frame.



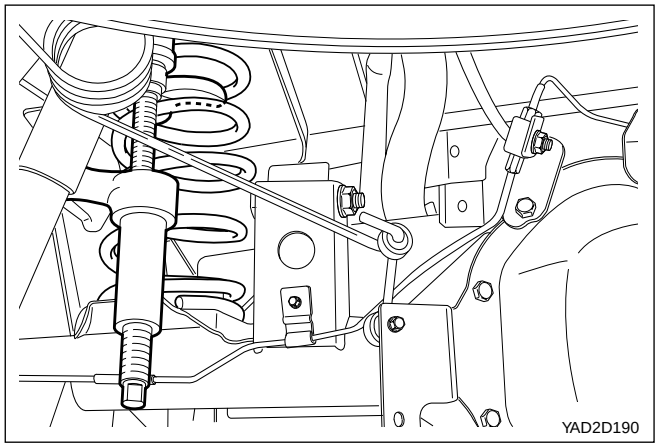
10. Remove the upper bolt and nut retaining the axle and remove the upper arm.



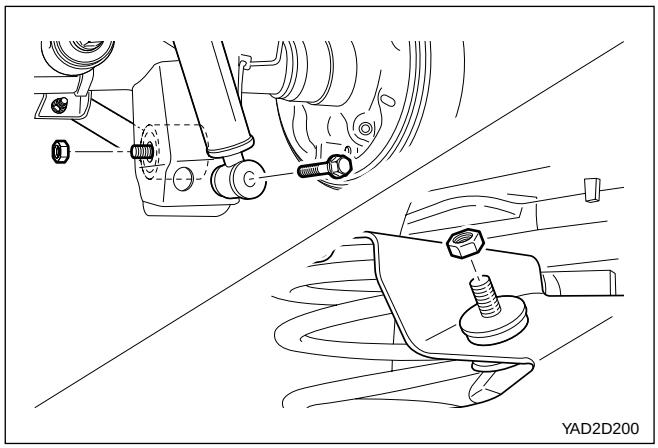
11. Remove the lower arm mounting the frame.



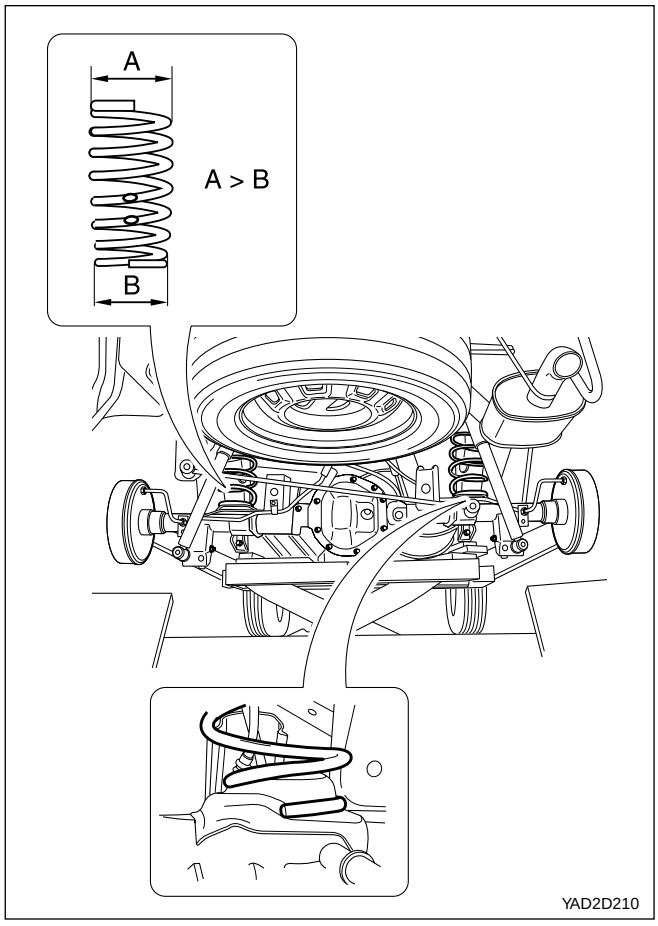
12. Remove the lower arm mounting bolt & nut retaining the axle and then remove the lower arm.



13. Loosen the brake & hose and remove the spring by pushing to incline the rear axle.



14. Remove the mounting nut of the shock absorber bottom and the upper arm. And then remove the spring.

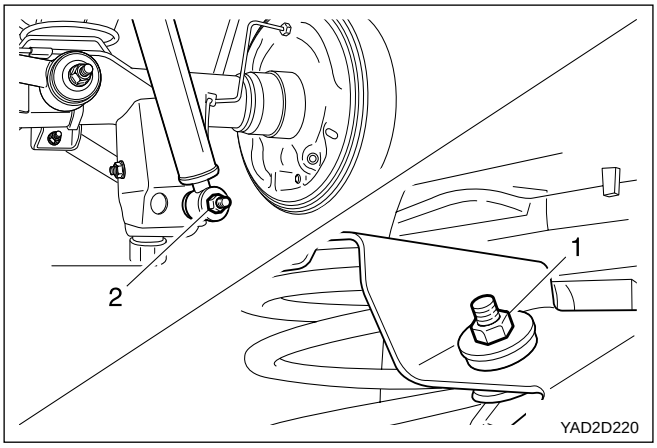


Installation Procedure

1. Installation should follow the removal procedure in the reverse order.
2. Be careful to the installation direction of the coil spring to install the spring correctly.

Notice:

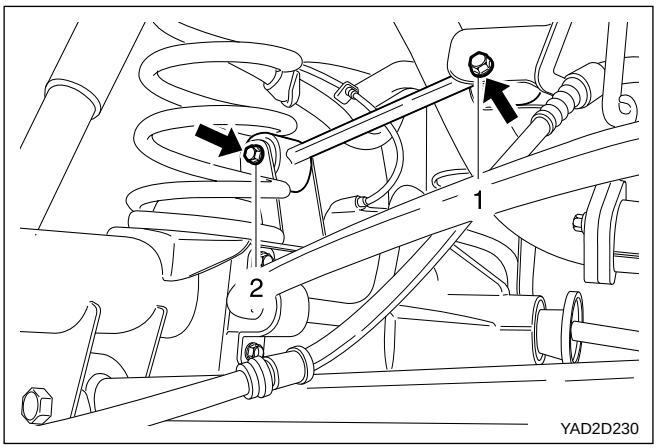
1. Be careful that the diameter of the upper coil spring is longer than that of the lower's.
2. Verify that the coil spring should be installed onto the spring seat of the axle and body(frame) correctly.



3. Insert the upper side of the shock absorber to the frame and tighten nuts manually. And then install the lower side's to the axle and tighten nuts as specified torque.

Installation Notice

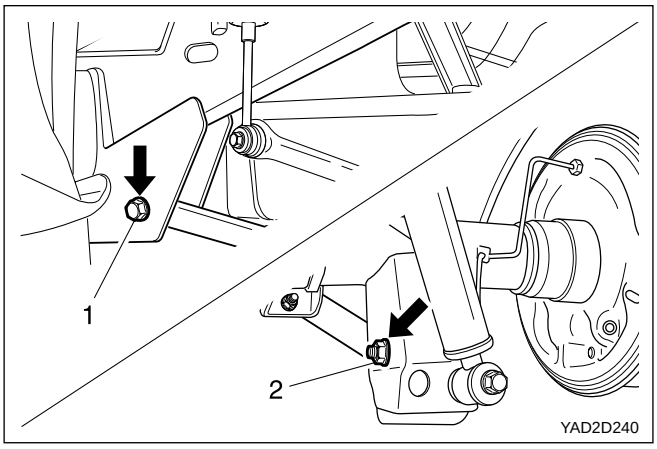
Upper side (1)	Tightening Torque : 30 - 45 N•m (22 - 33 lb-ft)
	Tightening Length : 6 - 9 mm
Lower side (2)	Tightening Torque : 50 - 65 N•m (37 - 48 lb-ft)



4. Install the upper arm to the frame bracket and the axle. And then tighten bolts as specified torque.

Installation Notice

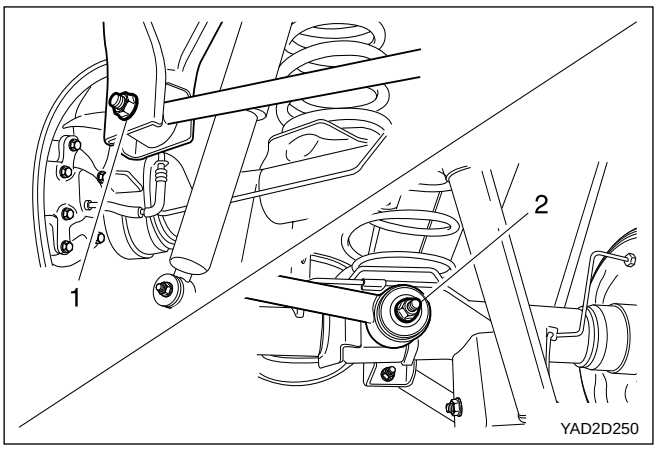
Tightening Torque(frame(1))	165 N•m
Tightening Torque(axle(2))	165 N•m



5. Install the lower arm to the frame bracket and the axle. And then tighten bolts as specified torque.

Installation Notice

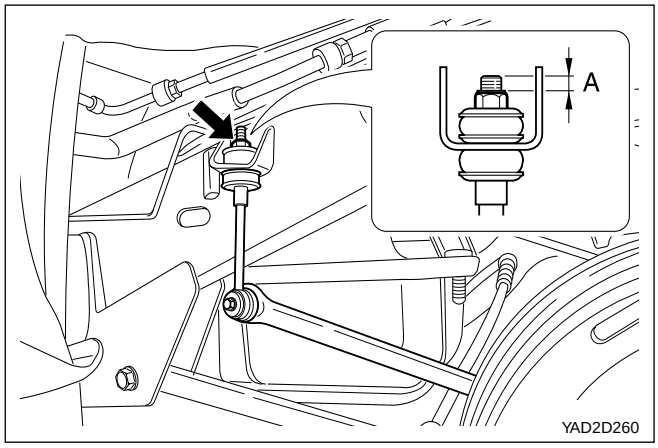
Tightening Torque(frame(1))	165 N•m
Tightening Torque(axle(2))	165 N•m



6. Install the lateral rod to both the frame and axle side.

Installation Notice

Tightening Torque(frame(1))	165 N•m
Tightening Torque(axle(2))	165 N•m

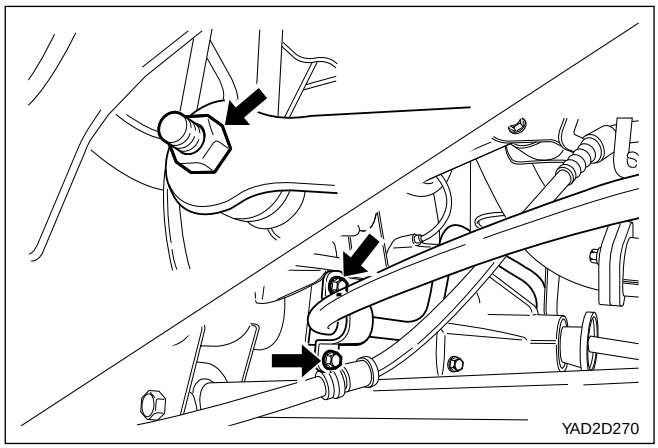


7. Install the connecting rod to the frame bracket.

   Notice: Follow the tightening length for installing the nut.

   Installation Notice

Tightening Torque	38 N•m (28 lb-ft)
Tightening Length(A)	7 - 12 mm



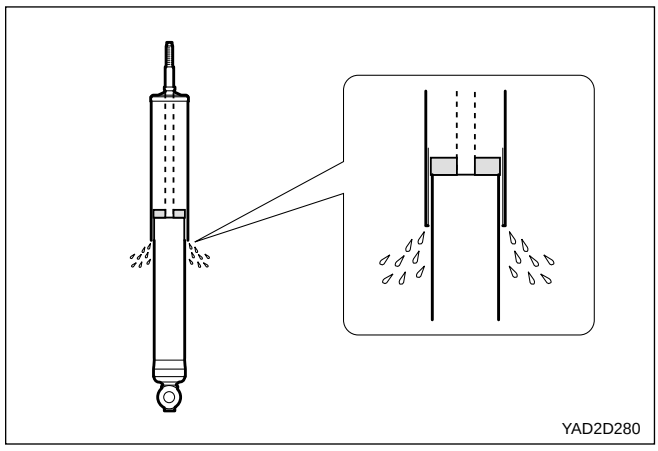
8. Install the stabilizer bar to the axle bracket with the mounting cap and connect the bar with the connecting rod. And then tighten the mounting cap bolt and nut as specified torque.

   Installation Notice

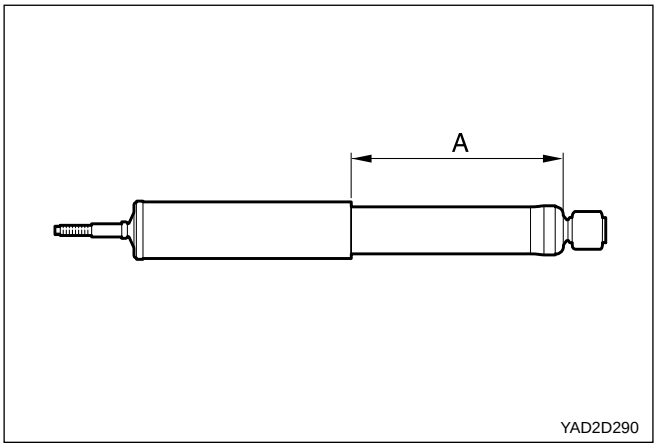
Tightening Torque	30 - 45 N•m (22 - 33 lb-ft)

9. The rubbers installation should follow the connecting order of the link rubber(packing).

   Notice: Always replace a new part when there is any wear or damage in the lever.



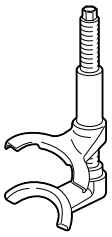
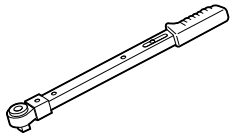
10. Check the shock absorber for any damage, oil leakage or abnormal noise.



Notice: For scrapping the gas shock absorber, drill the hole in the “A” section with the shock absorber full expansion and discharge the gas.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD2D300	**661 589 12 33 00** **Rear spring compressor**
 YAD2D310	**Torque Wrench**

SECTION 2E

TIRES AND WHEELS

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Maintenance 2E-16
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DESCRIPTION AND OPERATION

GENERAL

Tire And Wheel Balancing

There are two types of the tire and wheel balancing: static and dynamic.

Static balance is the equal distribution of weight around the wheel. Assemblies that are statically unbalanced cause a bouncing action called wheel tramp. This condition may eventually cause uneven tire wear.

Dynamic balance is the equal distribution of weight on each side of the centerline so that when the assembly spins there is no tendency for it to move from side to side. Assemblies that are dynamically unbalanced may cause wheel shimmy.

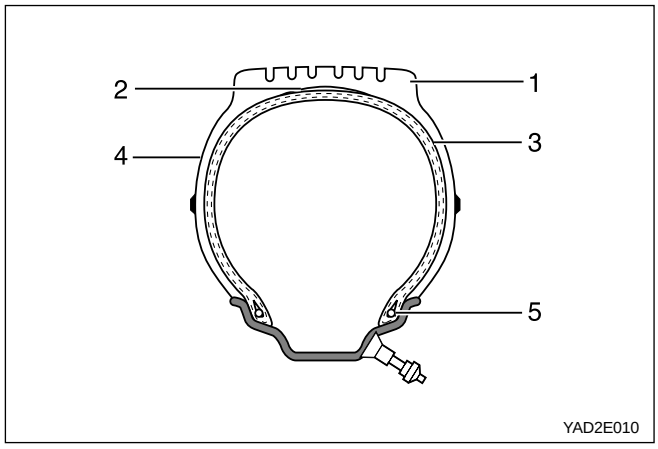
General Balance Precautions

Remove all deposits of foreign material from the inside of the wheel.

Caution: Remove stones from the tread in order to avoid operator injury during spin balancing.

Inspect the tire for any damage. Balance the tire according to the equipment manufacturer's recommendations.

Structure of Tubeless Tube



The tire structure is different slightly according to the types of the tire but a various type of the tire has the common structure as following;

1. Tread

   A part (that contacts) road surfaces directly is fixed on the outsude of carcass and breaker.

   It is a strong rubber coat made of high anti-abrasion rubber. Its running performance depends on is surface profile.

2. Breaker

   A cord belt between tread and carcass prevents damages of inner code due to outer shock and vibration.

3. Carcass

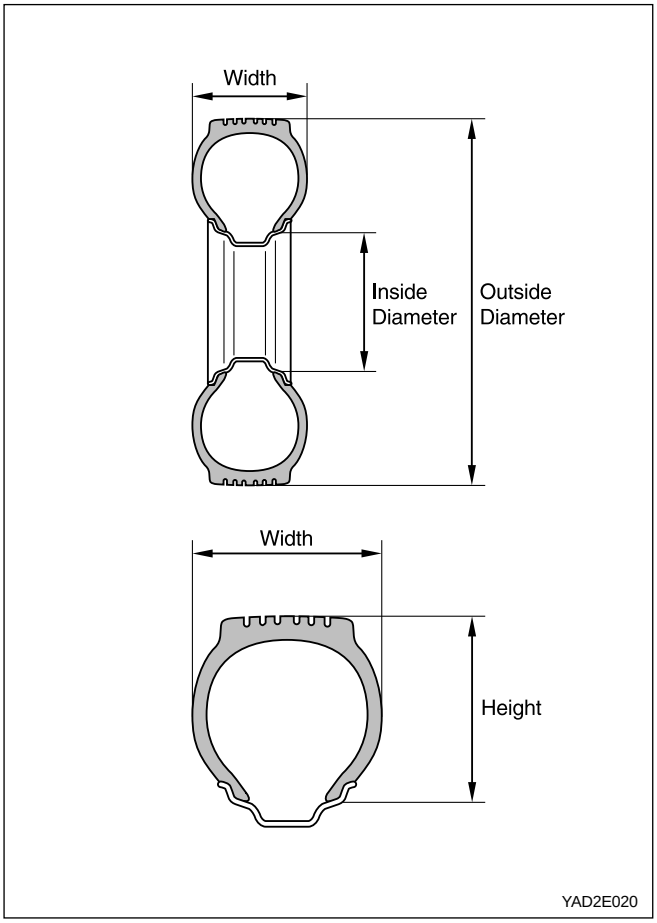
   This major part made by pilling code papers of strong synthetic fiber forms a structure of tire. Since it maintains tire pressure and endures applied load and shock to tire, it should have a high anti-fatigue characteristic.

4. Side Wall

   It is provided to improve the comfortable driving by protecting carcass and cushion movement.

5. Bead

   A steel wire winding the ending part of carcass code, coated with rubber film and wrapped with nylon cord papers. It fixes tire to a rim.



Convention for Radial Tire

P 225 / 75 R - 15 102 T

- T — Max Speed : 190 km/h
- 102 — Load Index : 850 kg
- 15 — Rim Diameter : 15 inch.
- R — Radial Tire
- 75 — Aspect Ratio = (Section Height ÷ Section Width) x 100 : 75 %
- 225 — Section Width : 225 mm
- P — Passenger Car

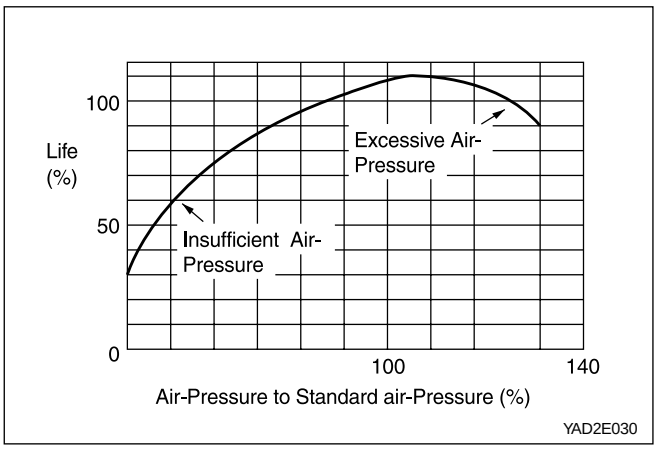
Max Speed Symbol

Symbol	Limit Speed (km/h)
F	80
M	130
N	140
P	150
Q	160
R	170
S	180
T	190
U	200
H	210
V	240
Z	Above 240

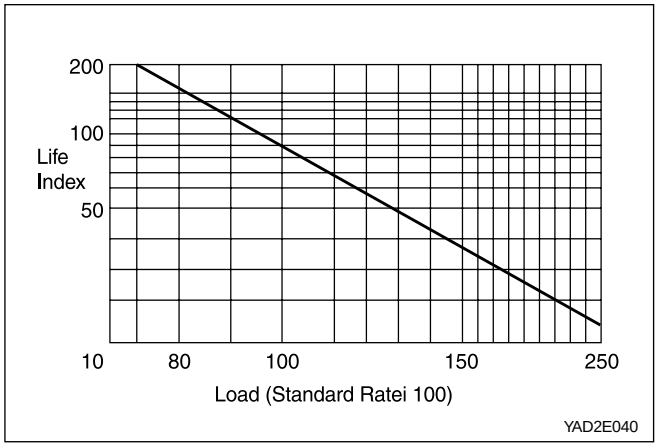
Load Index

Symbol	Limit Speed (km/h)
94	670
95	690
96	710
97	730
98	750
99	775
100	800
101	825
102	850
103	875
104	900
105	925

The Relation Between Inflation Pressure and Tire

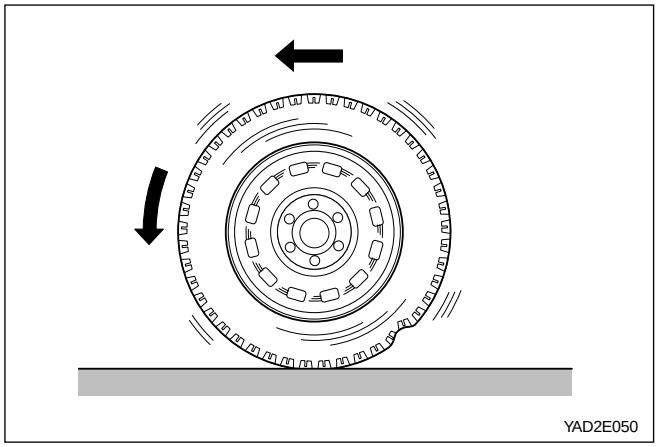


The Relation Between Load and Tire



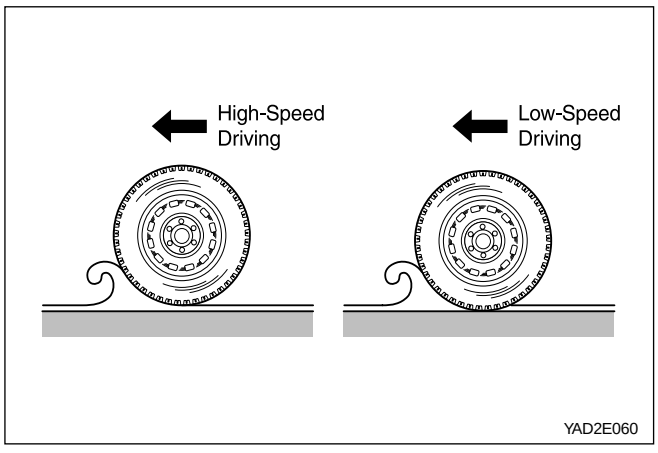
TIRE'S ABNORMAL ACTION

Standing Wave



During running the rotating tire repeats deformation and restoring movement generated in tread. But when the wheel rotating speed reaches high, the next deformation applied to tire before restoring last deformation so the trembling wave appears in the tread portion. The lower the tire pressure the severe the trembling wave appears during the high speed.

Hydroplaning



The condition of driving a vehicle fast on the road surface covered with water can cause tires to fail to rotate with a good contact on the surface, so results in remaining them a float. This is so-called hydroplaning. It causes brake failure, lower tractive force and losing the steering performance so it is very vulnerable condition.

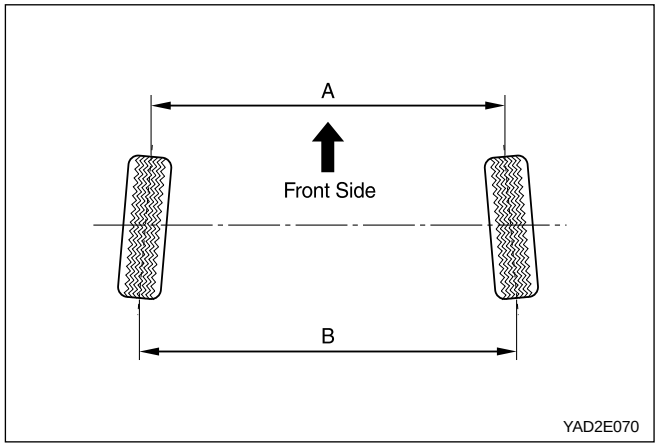
WHEEL ALIGNMENT

The first responsibility of engineering is to design safe steering and suspension systems. Each component must be strong enough to with stand and absorb extreme punishment. Both the steering system and the front and the rear suspension must function geometrically with the body mass.

The steering and suspension systems require that the front wheels self-return and that the tire rolling effort and the road friction be held to a negligible force in order to allow the customer to direct the vehicle with the least effort and the most comfort.

A complete wheel alignment check should include measurements of the rear toe and camber.

Toe-in



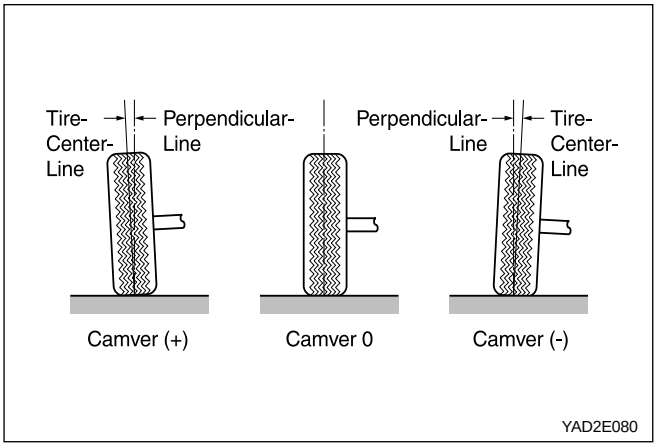
Toe-in is the turning in of the tires, while toe-out is the turning out of the tires from the geometric centerline or thrust line. The toe ensures parallel rolling of the wheels.

The toe serves to offset the small deflections of the wheel support system which occur when the vehicle is rolling forward.

The specified toe angle is the setting which achieves-degrees “0¡Æ” of toe when the vehicle is moving.

Incorrect toe-in or toe-out will cause tire wear and reduced fuel economy. As the individual steering and suspension components wear from vehicle mileage, additional toe will be needed to compensate for the wear. Always correct the toe dimension last.

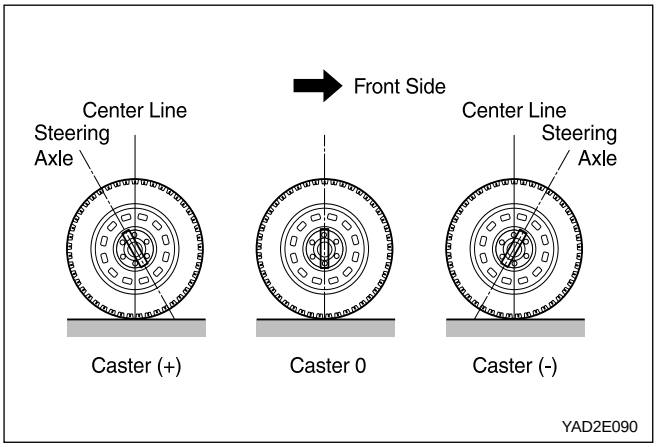
Camber



Camber is the tilting of the top of the tire from the vertical when viewed from the front of the vehicle. When the tires tilt outward, the camber is positive. When the tires tilt inward, the camber is negative. The camber angle is measured in degrees from the vertical. Camber influnces both directional control and tire wear.

If the vehicle has too much positive camber, the outside shoulder of the tire will wear. If the vehicle has too much negative camber, the inside shoulder of the tire will wear. Camber is measured in degrees and is not adjustable.

Caster



Caster is the tilting of the uppermost point of the steering axis either forward or backward from the vertical when viewed from the side of the vehicle. A backward tilt is positive and a forward tilt negative. Caster influences directional control of the steering but does not affect tire wear.

Weak springs or overloading a vehicle will affect caster. One wheel with more positive caster will pull toward the center of the car. This condition will cause the car to move or lean toward the side with the least amount of positive caster. Caster is measures in degrees and is not adjustable.

SPECIFICATIONS

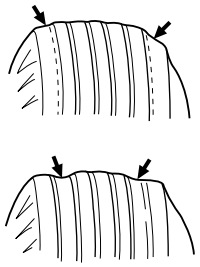
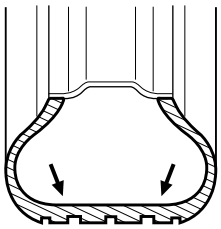
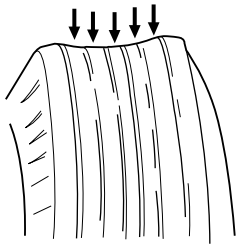
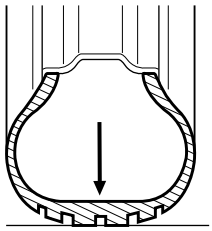
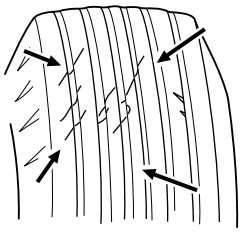
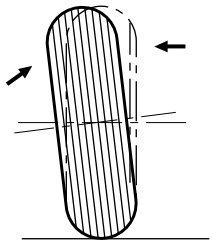
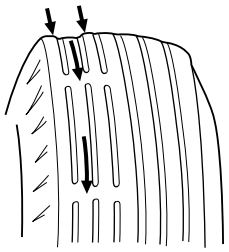
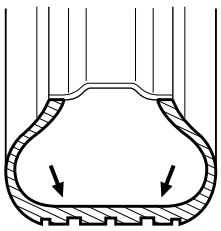
Wheel	Size	Aluminum Type	7JJ x 16
		Steel Type	6.5JJ x 16
	Wheel Nut Tightening Torque	Aluminum Wheel	8 - 12 kgf.m
		Steel Wheel	11 - 13 kgf.m
Tire	Type	Radial Tire	Radial Tire
	Inflation Pressure (psi)	P225/75R15	30 psi
		P235/70R16	30 psi
		P255/65R16	30 psi
Wheel Alignment	Toe-in	2 ± 2 mm	
	Camber	0° ± 30’ (Below 30' the difference between right and left)	
	Caster	2° 45 ± 30’ (Below 30' the difference between right and left)	

DIAGNOSTIC INFORMATION AND PROCEDURES

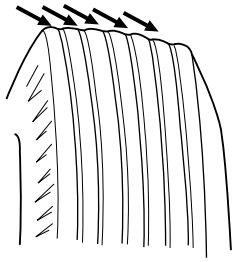
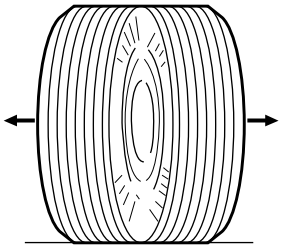
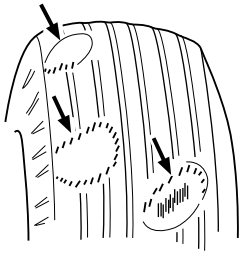
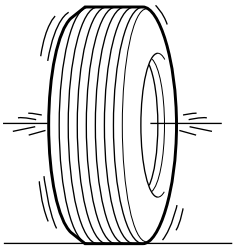
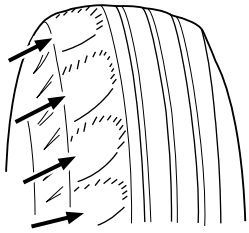
Condition	Cause	Action
Irregular tires wear	Improper tire inflation pressure	Adjust
	Poor wheel balance	Adjust
	Improper tire rotation	Rotation tires on the maintenance schedule
	Poor toe-in	Adjust
	Poor adjusting the pre-load of the wheel bearing	Adjust
	Poor braking performance	Adjust
Driving noise, Vibration	Low tire inflation pressure	Adjust
	Poor balance of wheels, tires	Adjust
	Severe vibration due to wheels, tires	Adjust or replacement
	Irregular tires wear	Check and adjust
Rapid wear	Excessive tire inflation pressure	Adjust
	High speed driving with low tire pressure	Adjust
	Excessive vehicle weight	Proper weight

GENERAL INSPECTION

INSPECTION THE APPEARANCE

Condition	Cause	Action
Rapid wear at shoulders  YAD2E100	Under inflation or lack of rotation  YAD2E110	Adjust inflation pressure
Rapid wear at center  YAD2E120	Over inflation or rotation  YAD2E130	
Tread damage  YAD2E140	Low the inflation pressure  YAD2E150	
Uneven wear  YAD2E160	Incorrect camber Incorrect toe-in  YAD2E110	Adjust camber

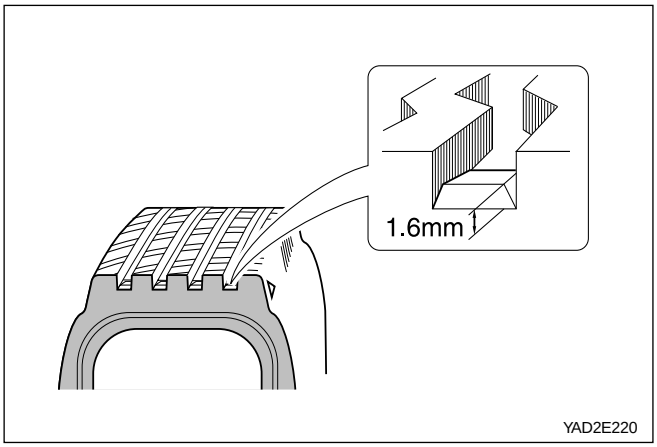
Inspection The Appearance (Cont'd)

Condition	Cause	Action
Feathered edge  YAD2E170	Incorrect toe-in  YAD2E180	Adjust toe-in
Bold spot  YAD2E190	Unbalanced wheel  YAD2E200	Adjust wheel balance
Sharply wear at the tread outside  YAD2E210	Unbalanced wheel	Adjust
	Wheel bearing play	Check play Check pre-load
	Ball joint play	Check
	Faulty shock absorber	Check

GENERAL INSPECTION

Inspection Tread

Inspect the tread condition on the tire surface and various damages resulting from the foreign material, crack, stone or nail etc. If there is any damage in the tire, repair or replace it.

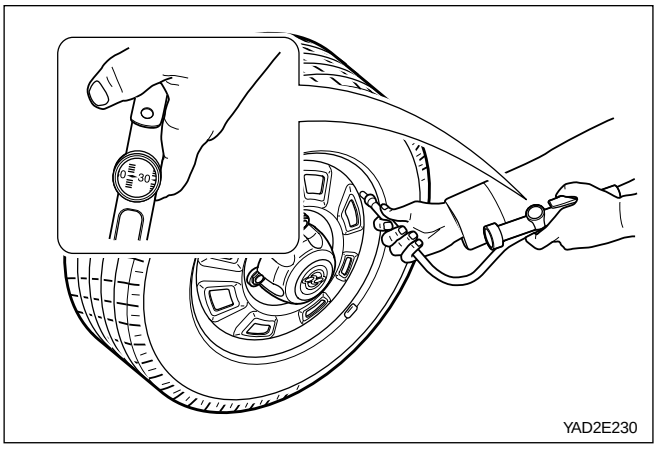


Tire Wear

- Measure the depth of the tire tread. If the depth of the tread is below the specified value, replace the tire.

Limit of the Tread Wear	1.6 mm (0.06 in.)

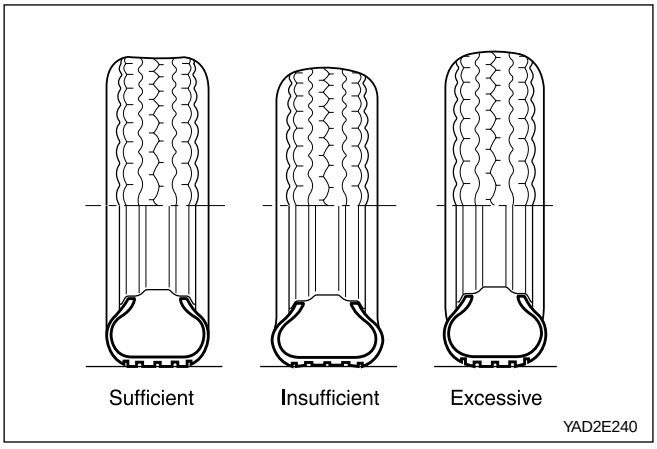
- You can see the mark '▲' in the groove, this is the indicator of the tread wear limit.
- The limit of the tread wear for all season tires are 1.6 mm as same as the general tires and the platform mark indicates as '↓' .



Inspection the Inflation of Tires

1. Inflation pressure

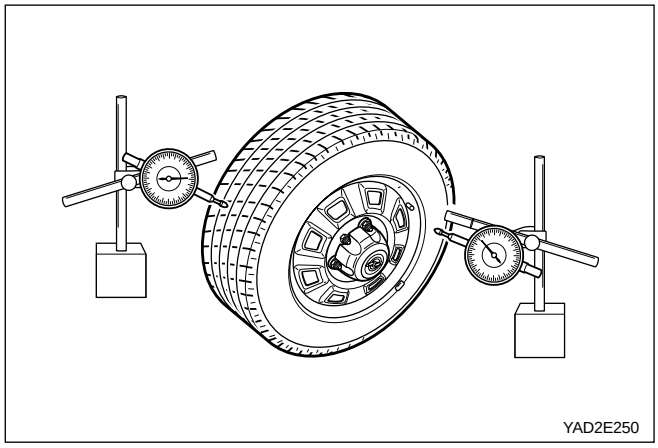
Front/Rear	2.1 kg/cm^2 (30 psi)



2. Inspect the pressure of the tire surface and check the inflation pressure.

Notice:

- Lower than recommended pressure can cause tire squeal on turns, hard steering, tire cord breakage and tire rim bruises, etc.
- Higher than recommended pressure can cause hard ride, tire bruising or damage and rapid tread wear at the center of the tire.


YAD2E250

Inspection Wheel Runout

- Measure wheel runout with an accurate dial indicator. Measurement may be taken with the wheels either on or off the vehicle, using an accurate mounting surface such as a wheel balancer. Measurements may be taken with or without the tire mounted on the wheel.

1. Measure the dial runout and lateral runout on both the inboard and outboard rim flanges.

   Specification

   Steel Wheel

   - Radial runout : 0.8 mm (0.03 inch)
   - Lateral runout : 1.0 mm (0.04 inch)

   Alloy Wheels

   - Radial runout : 0.8 mm (0.03 inch)
   - Lateral runout : 1.0 mm (0.04 inch)

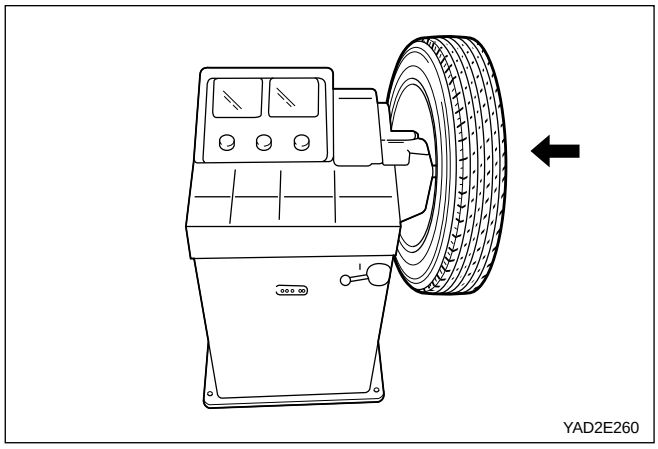
2. Measure free radial runout on the tire tread.

   Specification

   Steel and Alloy Wheels

   - Free radial runout : 1.5 mm (0.06 inch)
   - Free lateral runout : 1.5 mm (0.06 inch)

   Notice: If any measurement exceeds the above specifications, replace the applicable tires or wheels.

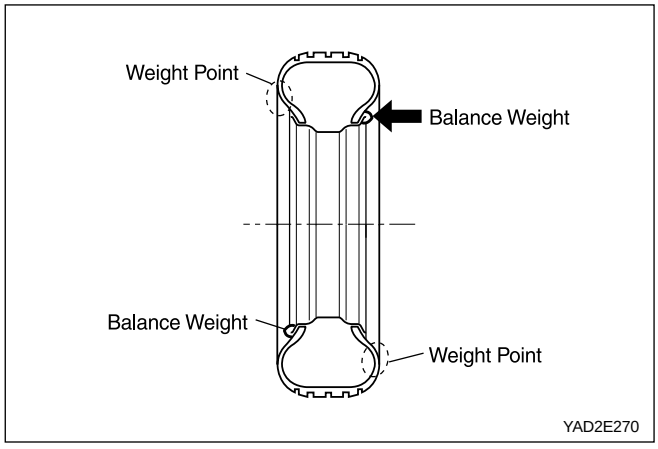

YAD2E260

Wheel Balance

Balance is the easiest procedure to perform and should be done first if the vibration occurs at high speeds or if the tires or the wheels are replaced.

When proceeding the wheel balancing procedure refer to the following;

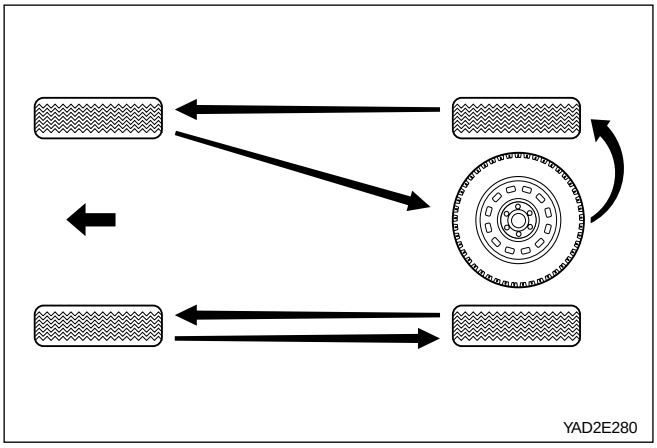
1. Do not the wheel weight over two at the inboard and the outboard flanges.
2. The total weight ofthe wheel weight should not exceed the 100 g (3.5 ounces)
3. Balancing the assemblies with the factory aluminum wheels requires the use of the special nylon-coated, clip-on wheel weights.



YAD2E270

Balance Weight

10 g	20 g	30 g	40 g	50 g	60 g
0.4 oz	0.7 oz	1.10 oz	1.40 oz	1.80 oz	2.10 oz



Rotation Tires

- Front and rear tires perform different jobs and can wear differently depending on the tires of road driven, driving condition, etc.

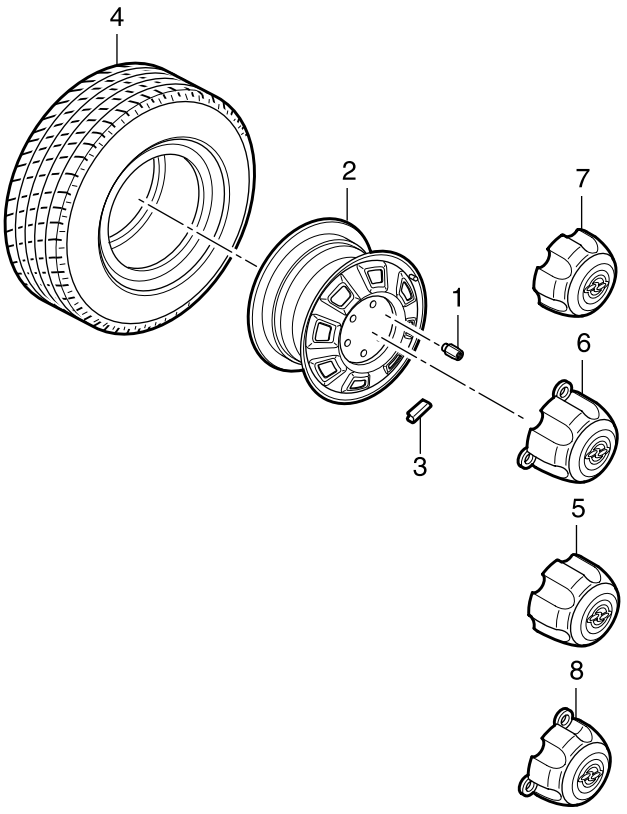
  The front tires will wear faster than the rear ones. To avoid uneven wear of tires and to prolong tire life, inspect and rotate the tires every 5,000 km (3,100 miles). After rotating the tires, adjust the tire inflation pressures and be sure to check wheel nuts tightness.

Caution at replacement tires

- Do not mix different types of tires on the same vehicle such as radial, bias and bias-belted tires except in emergencies, because vehicle handling may be seriously affected and may result in loss of control.

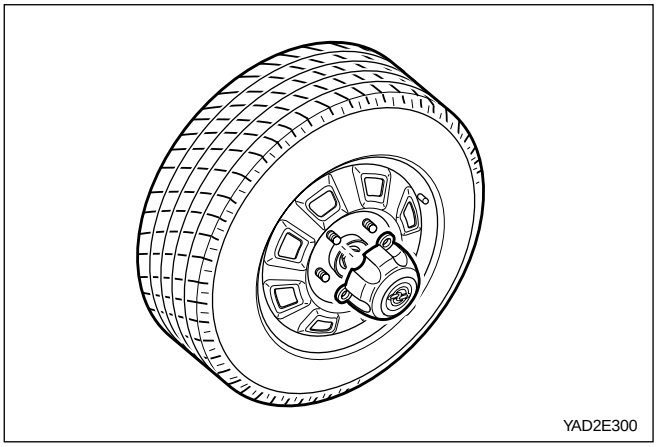
COMPONENT LOCATOR

TIRE AND WHEEL ASSEMBLY



1 Wheel Nut
2 Wheel
3 Balance Weight
4 Tire
5 Wheel Cap
6 Wheel Cap
7 Wheel Cap
8 Wheel Cap

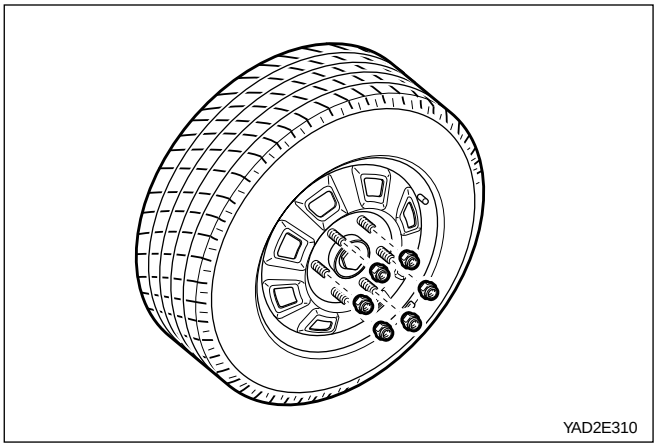
REPAIR INSTRUCTIONS


YAD2E300

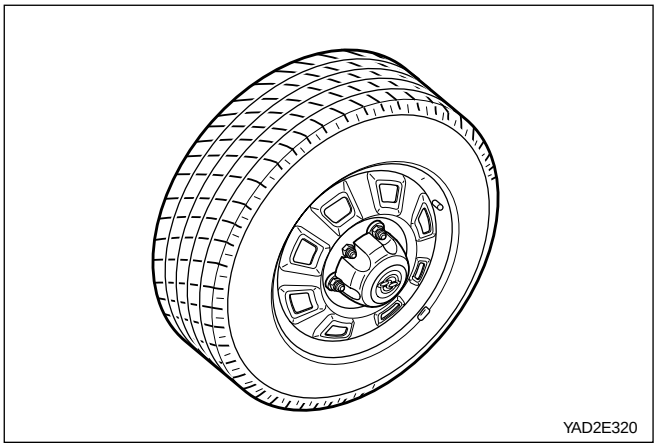
ON-VEHICLE SERVICE

GENERAL TIRE

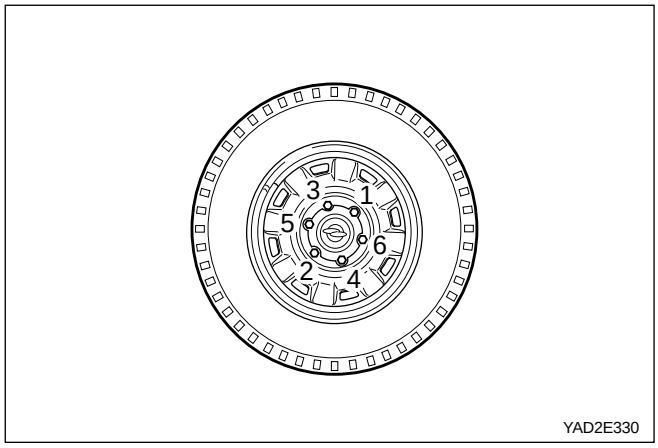
1. Remove the wheel cap.


YAD2E310

2. Loosen the wheel nuts and then raise and suitably support the vehicle.
3. Remove the wheel nuts.


YAD2E320

4. Installation should follow the removal procedure in the reverse order.

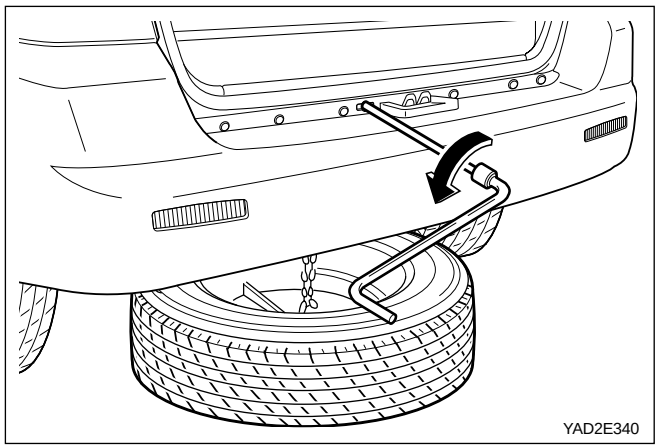


YAD2E330

General Instruction

- Clean the contact surface between the wheel and the hub.
- Do not apply oil or grease to the nuts and bolts (cause the wheel to work loose).
- Raise the tires 3 cm off the ground using the jacket.
- Tighten the wheel nuts diagonally as shown.

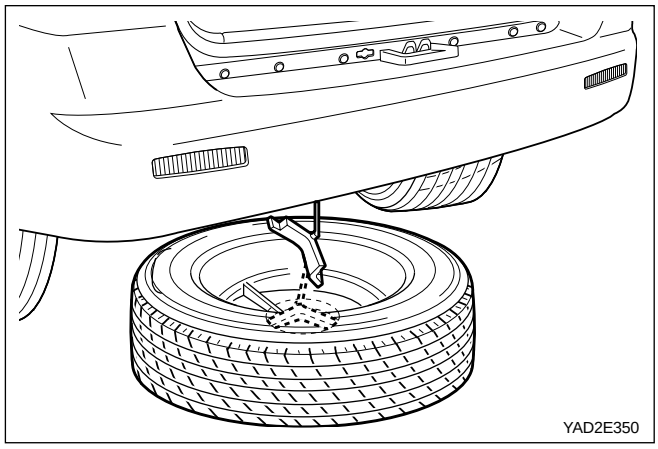
Tightening Torque	Steel Wheel: 80 - 120 N•m
	Alloy Wheel: 120 - 130 N•m


YAD2E340

SPARE TIRE

Removal Procedure

1. Prepare the spare tire handle and the wheel nut wrench.
2 Install the handle through the hole at the rear side of the vehicle.
3 Install the wheel nut wrench at the end of the handle.
4 Turn the wheel nut wrench counterclockwise until the spare tire takes down the ground.

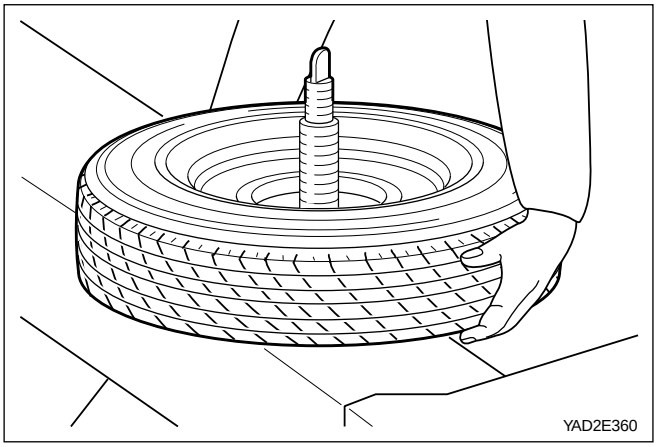

YAD2E350

5 Pull out the lift plate as shown.
6 Install the lift plate in the center of the wheel for installation.
7 Turn the handle clockwise until listen the sound “click”.
8 Remove the handle and the wheel nut wrench.

Notice:

- Keep the spare tire available always.
- When reinstall the spare tire, install the tire tightly.
- If the spare tire may move after installation, reinstall the tire or contact to the approved service shop for repair.
- For installing the spare tire on the vehicle, follow the installation direction. If you may install the tire in reverse direction, it is not possible to install it correctly.

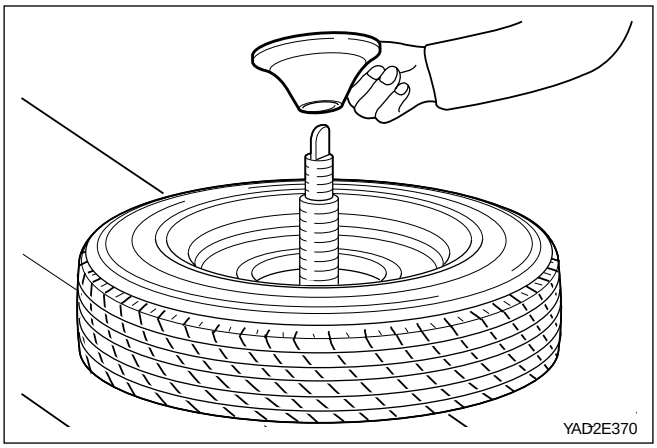
MAINTENANCE AND REPLACEMENT



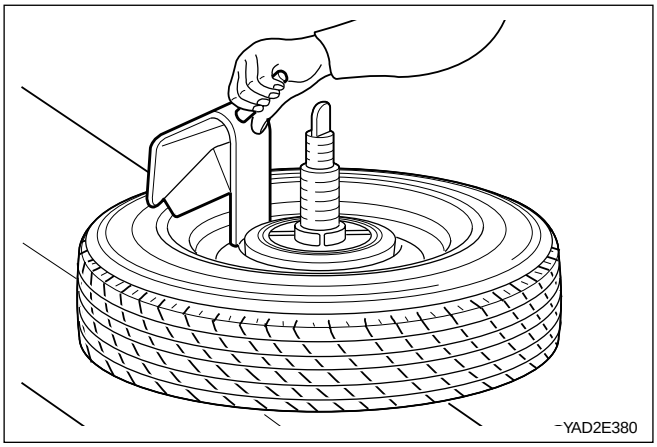
SEPARATION

1. Fix the tire into the equipment and pull out the valve core from the tire. Discharge the air inside the tire completely.

   Notice: The assembly and disassembly of the tire is dangerous working job. So, only the skillful worker must work this job following the approved procedures.

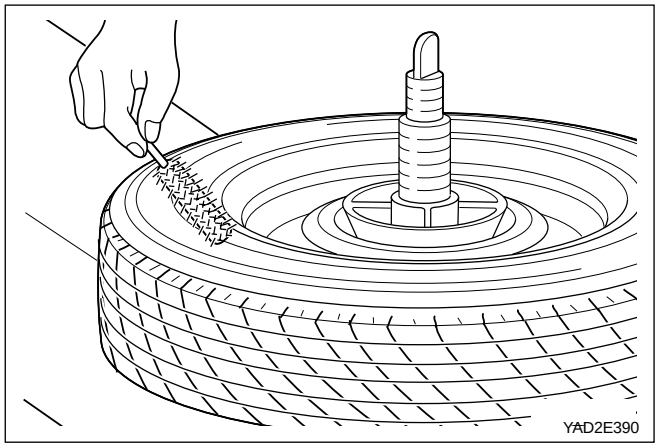


2. Tighten the locker in the center of the equipment to assemble the rim to the equipment.
3. Remove the balance weight on the rim.

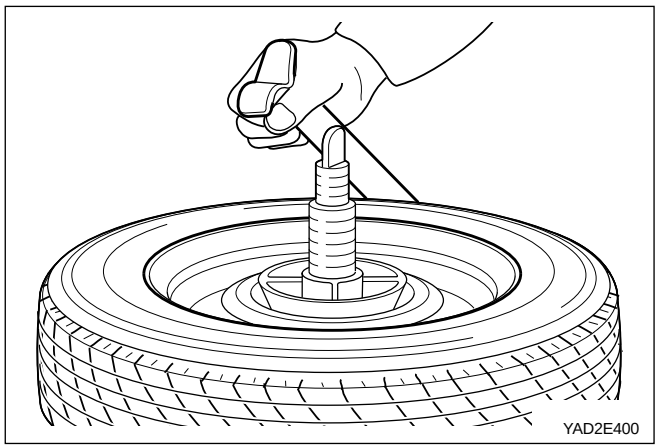


4. Separate the tire's bead from the rim flange using the approved lubricant.

   Notice: Do not use silicone, synthetic detergent and gasoline, etc.

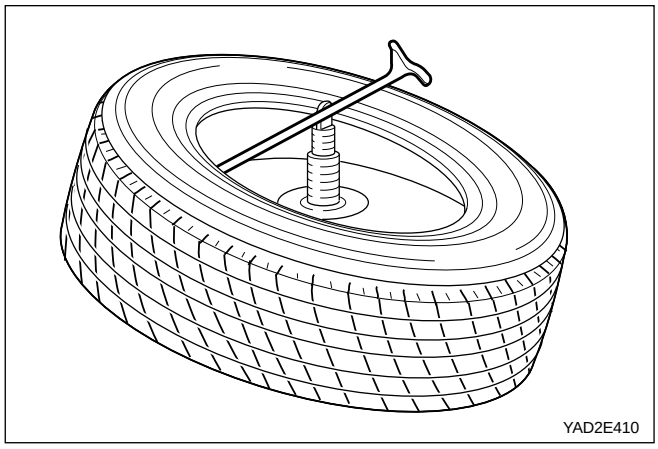


5. Apply the lubricant between the rim and the bead.



6. Insert the removal lever between the tire's bead and the rim and separate the rim from the tire.

   Notice: Do not use the tool that may cause any damage such as pipe, damaged bar.



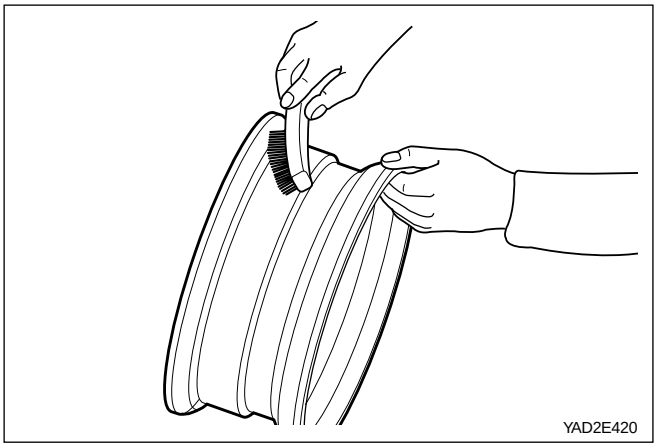
7. Pull out the opposite bead upward using the lever and then separate the bead from the rim.

MAINTENANCE

1. Check any damage the rim and replace as needed.

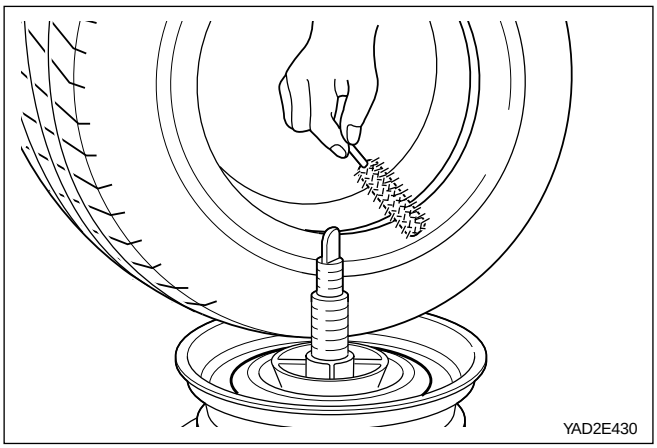
   Notice:

   - Do not repair the rim as welding or soldering.
   - Replace the new valve as replaces new tire.

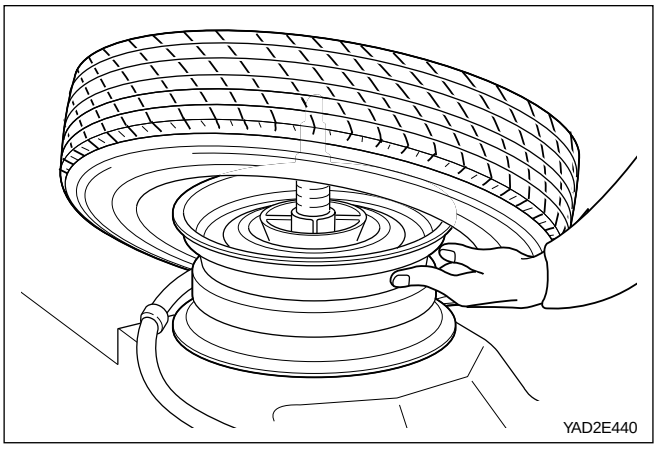

YAD2E420

INSTALLATION

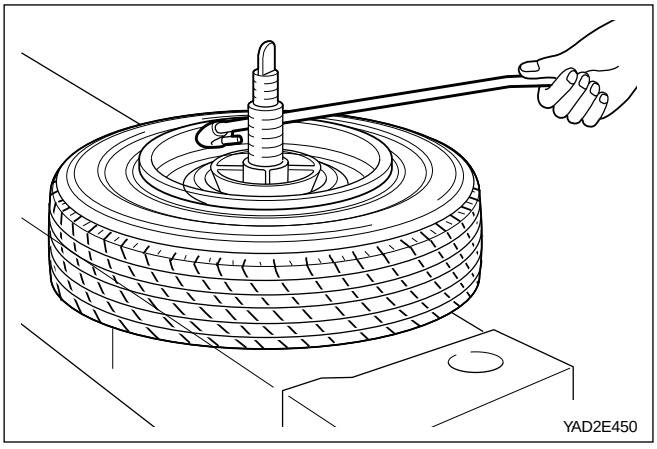
1. Clean the rust, damaged rubber and dust, etc on the rim's surface with the brush.


YAD2E430

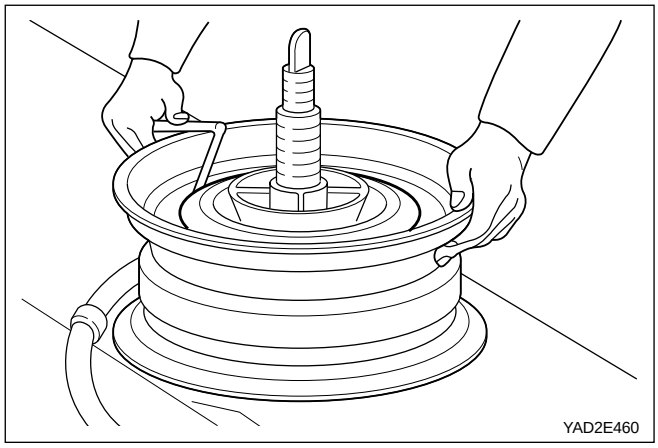
2. Install the rim to the equipment with the valve upward.
3. Tighten the locker in the center of the equipment to assemble the rim to the equipment.


YAD2E440

4. Apply the lubricant at the both bead portions and both rim's flange of the tire.


YAD2E450

5. Check any foreign material or liquid for the tire inside and then install to push down the tire.



6. Set the tire pressure to the specifications.

   Notice: Do not remove the tire from the equipment before setting the tire pressure.

Specification of the tire pressure	2.1 kg•cm^2 (30 psi)

SECTION 3A

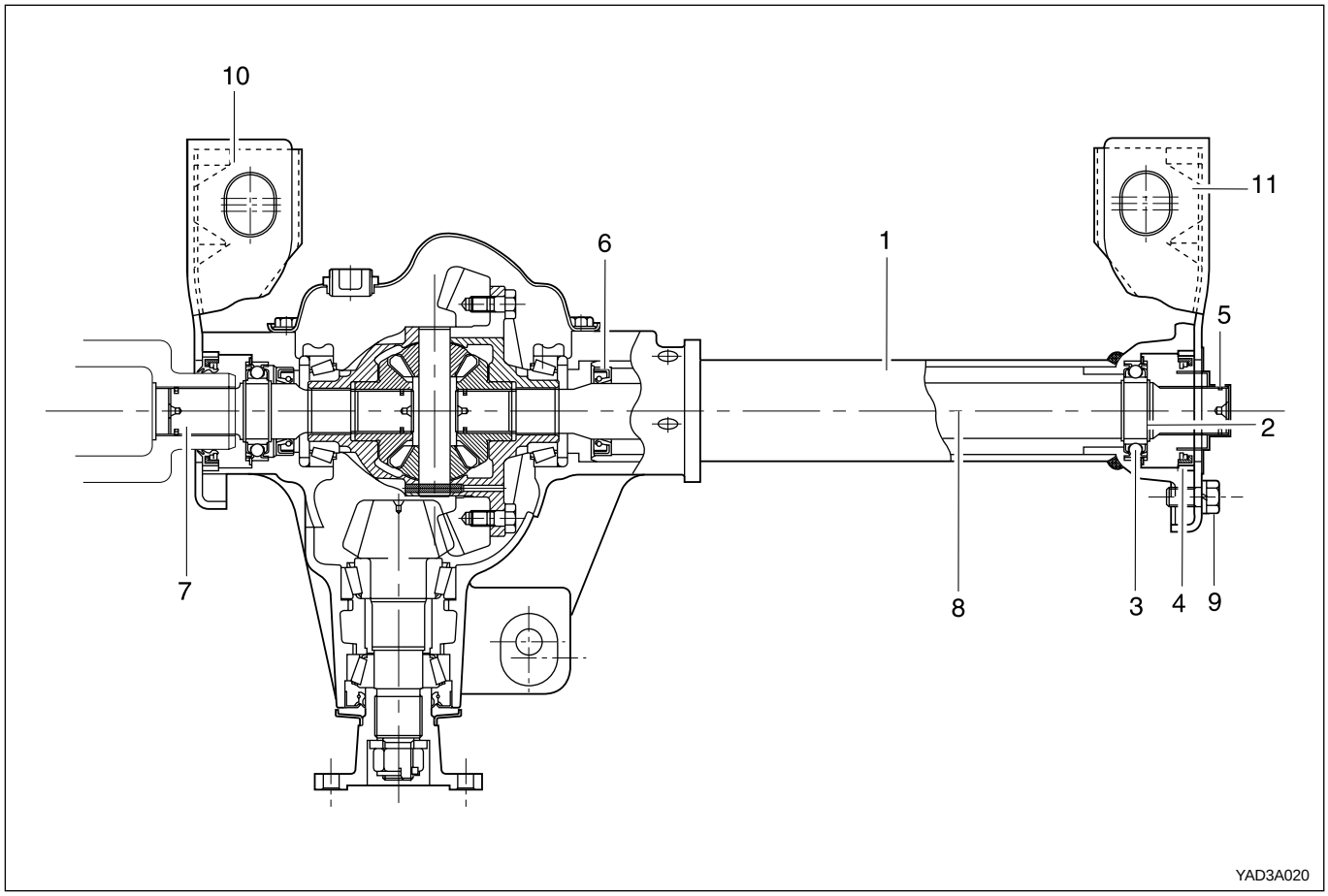
FRONT AXLE

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GENERAL DESCRIPTION AND OPERATION

FRONT AXLE HOUSING ASSEMBLY

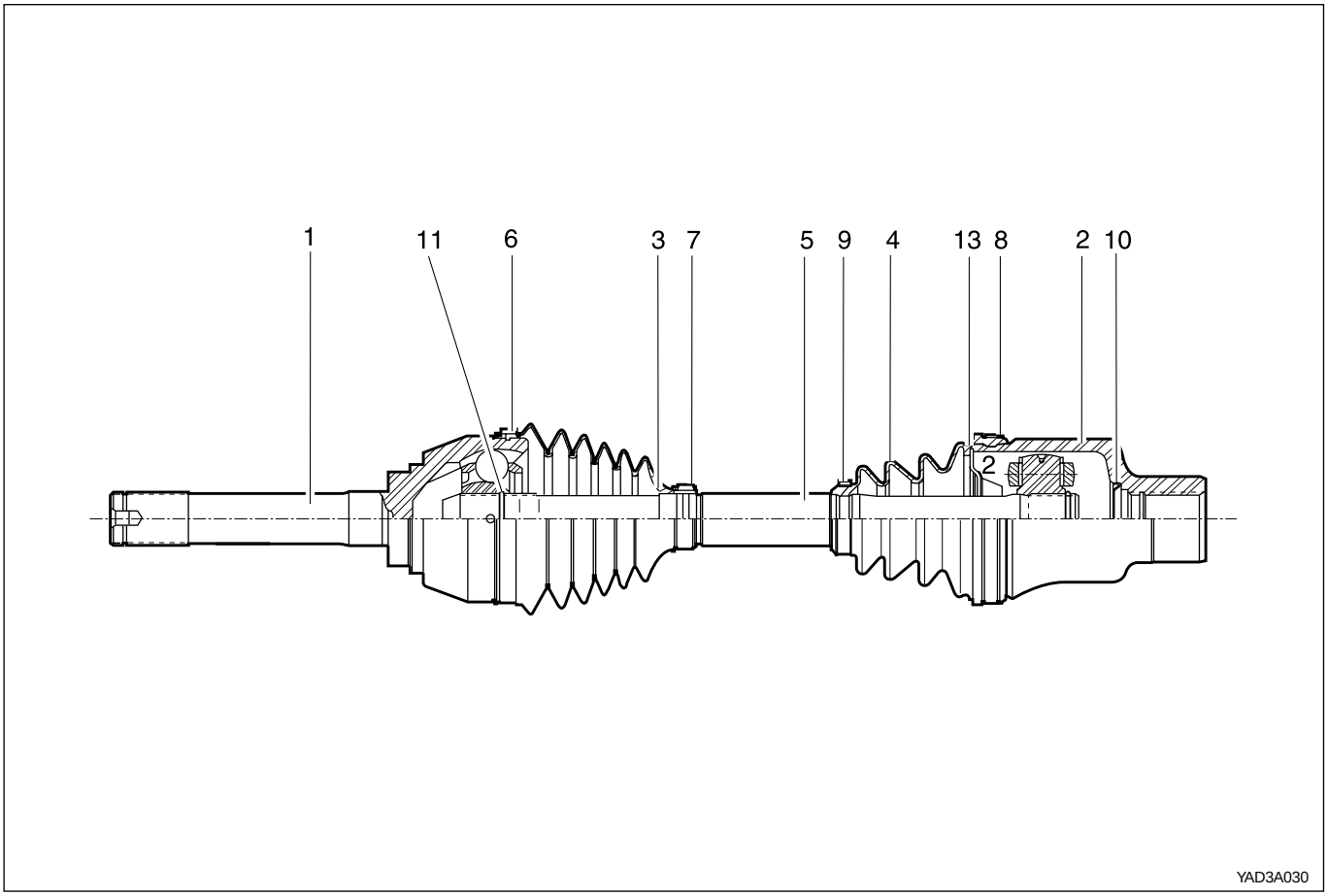


1 Axle Tube Assembly
2 Snap Ring
3 Ball Bearing
4 Oil Seal
5 Protector
6 Retainer
7 Inner Shaft (LH)
8 Inner Shaft (RH)
9 Bolt
10 Front Axle Bracket (LH)
11 Front Axle Bracket (RH)

The front axle is installed between the left and right wheel. It have the function which transfers the power of engine to the wheels. Especially, it transfers the high power to the front wheels when driving 4-wheel.

The axle shaft connected with CV joint in left/right of axle and differential carrier in center is installed. The length of left/right axle shaft is different and the structure is independent. Both ends part of shaft is fixed with the spline.

AXLE SHAFT ASSEMBLY



1 Drive Shaft
2 Housing (Inboard)
3 Boot (Outboard)
4 Boot (Inboard)
5 Shaft
6 Boot Band
7 Boot Band
8 Boot Band
9 Boot Band
10 Seal
11 Ball Joint

SPECIFICATIONS

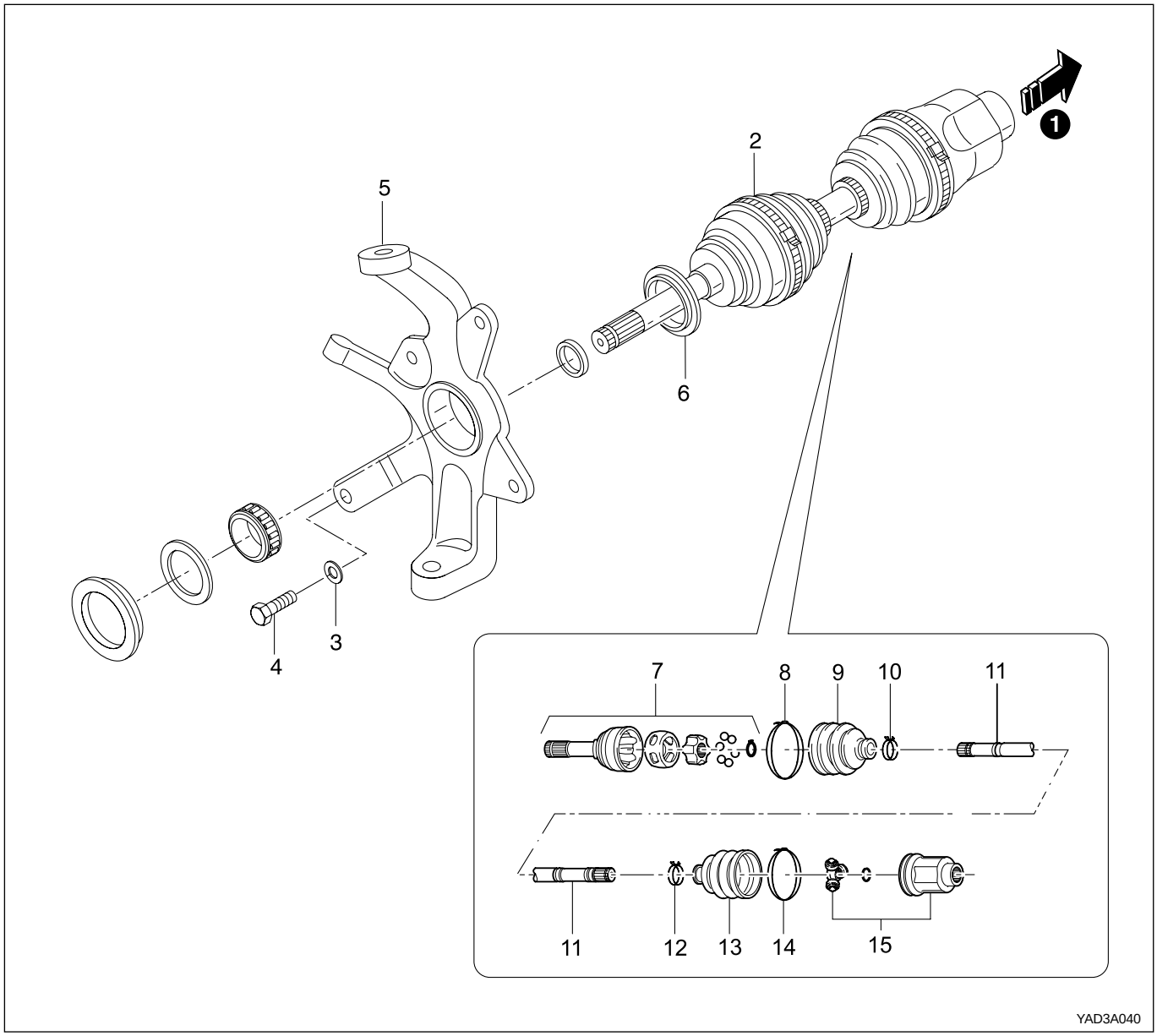
Drive Shaft Type		CV Joint
Axle Housing Type		Build up
Differential	Type	Conventional
	Gear Type	Hypoid Gear
Reduction Ratio Gaso. (E32 or E23)	Gasoline + M/T	3.73
	Diesel + M/T	4.27
	Gasoline + M/T	4.56
	Diesel + M/T	4.89
Oil	Capacity	1.4 L
	Specification	SAE 80W / 90 or API Gl-5

DIAGNOSIS INFORMATION AND PROCEDURES

Phenomena	Checks	Action
Noise (During Straight Driving)	Lack of Oil	Replenish
	Low Viscosity of Oil	Replace
	Inferior Oil	Replace
	Excessive Backlash of Ring Gears	Adjust
	Worn or Damaged Tooth of Ring and Pinion Gear	Replace
	Worn or Damaged Tooth of Drive Pinion Gear	Replace
	Wear of Side Bearing and Side Gear Spline	Replace
	Bending of Axle Housing	Replace
	Distortion of Differential Case	Replace
	Wear of Pinion Shaft	Replace
	Incorrect Drive Pinion Preload.	Adjust
	Incorrect Contact of Ring Gear and Pinion	Reassembly
Oil Leakage	Excessive Oil	Adjust
	Fault Seal of Carrier Contact Surface	Correct
	Axle Housing Crack	Replace
	Worn or Damaged Oil Seal	Replace
Noise (During Turning)	Worn or Damaged Tooth of Pinion or Side Gear	Replace
	Wear of Pinion Shaft	Replace
	Excessive Backlash of Pinion Gear and Side Gear	Replace
	Excessive End-Play of Rear Axle Shaft	Adjust
	Incorrect Contact of Side Gear and Differential Case	Replace
	Axle Housing Crack	Replace
	Distortion or Poor Installation of Drive pinion Oil Seal	Replace
	Damaged of Torn Drive Pinion Oil Seal	Replace
	Loosened Bearing Collar	Replace
	Worn or Damaged Universal Joint	Replace
	Worn or damaged Axle Shaft Bearing	Replace
Heating	Lack of Oil	Replenish
	Insufficient Backlash of Gears	Adjust
	Excessive Preload of Bearing	Adjust

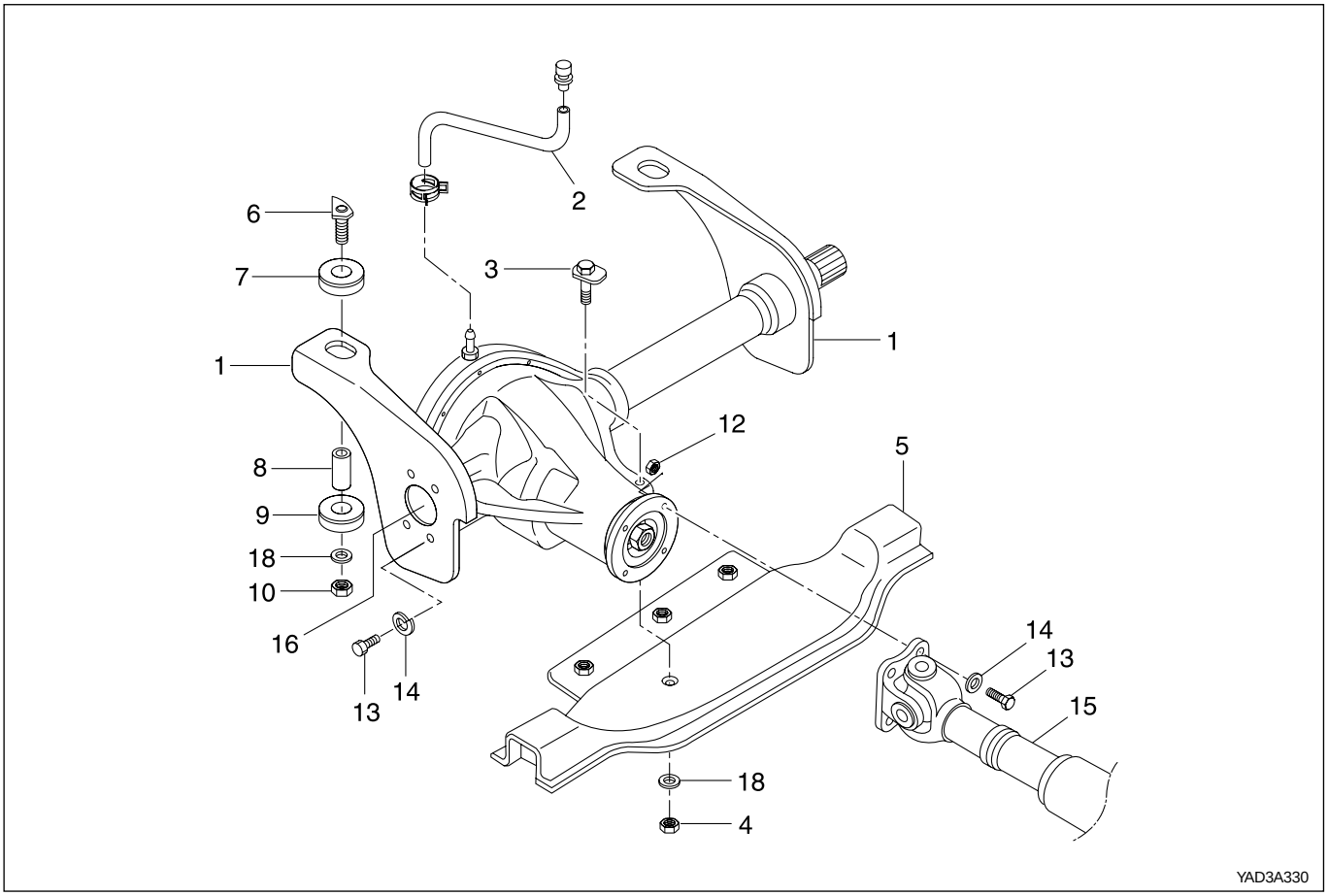
COMPONENT LOCATOR

FRONT AXLE SHAFT

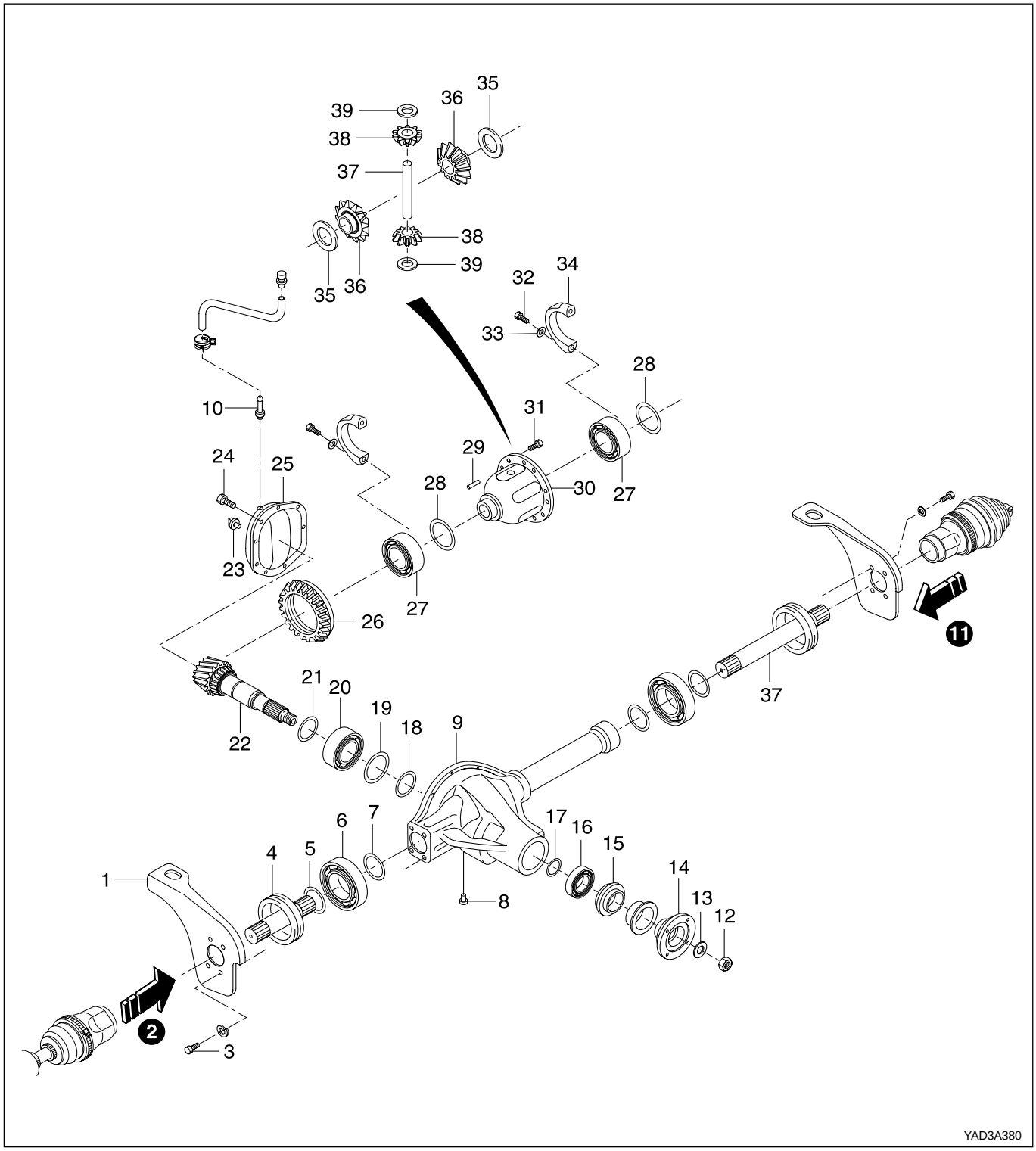


1 Front Axle Inner Shaft Mounting (Axle Housing)
2 Front Axle Drive Shaft
3 Washer
4 Bolt
5 Steering Knuckle
6 Dust Seal
7 Outboard Joint Assembly
8 Boot Clamp
9 Outboard Boot
10 Boot Clamp
11 Shaft
12 Boot Clamp
13 Inboard Boot
14 Boot Clamp
15 Inboard Joint Assembly

FRONT AXLE HOUSING

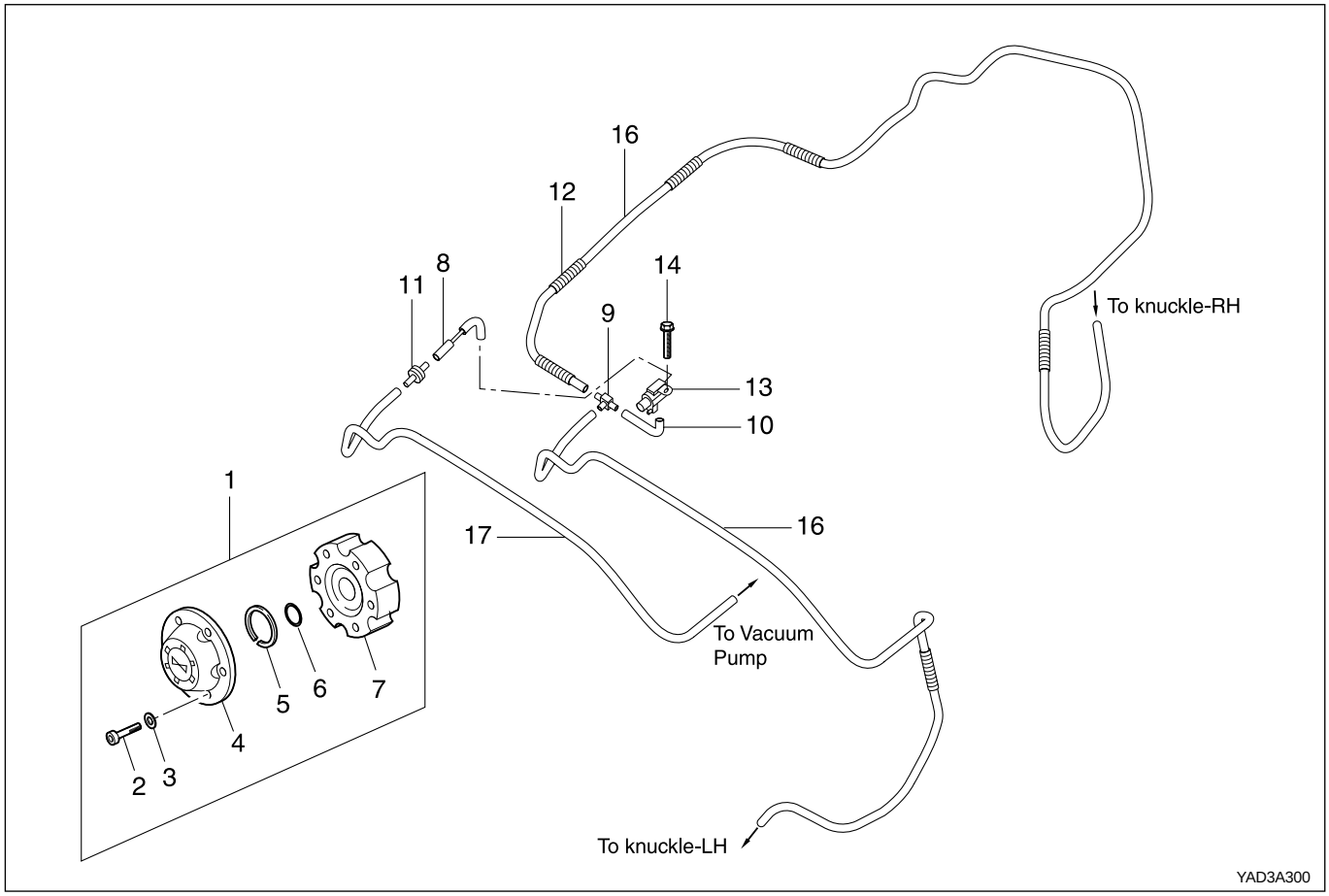


1 Axle Mounting Bracket
2 Breather Hose
3 Bolt
4 Nut
5 Cross Member
6 Bolt
7 Bushing
8 Spacer
9 Spacer
10 Nut
11 Front Axle Housing
12 Nut
13 Bolt
14 Washer
15 Inner Shaft (Left)
16 Inner Shaft (Right)
17 Washer Plain


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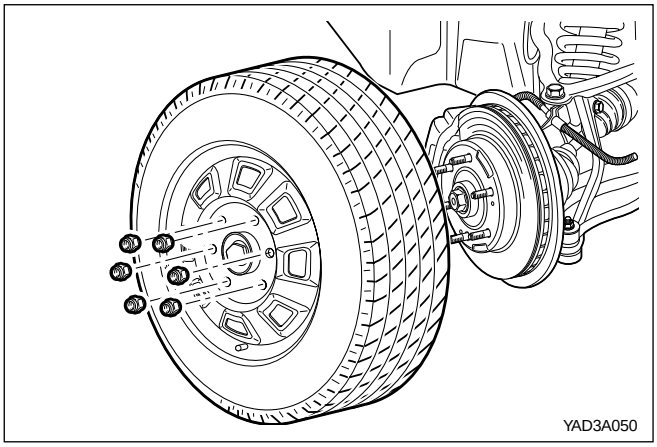
1 Front Axle Housing Mounting Bracket
2 Inner Shaft (Left)
3 Bolt
4 Oil Seal .....
..... Replace, Apply Grease to the Sealing Rib
5 Snap Ring
6 Bearing
7 Snap Ring
8 Oil Drain Plug
9 Front Axle Housing
10 Breather Nipple
11 Inner Shaft (Right)
12 Pinion Lock Nut
13 Washer
14 Companion Flange
15 Oil Seal .....
..... Replace, Apply grease to the sealing Rib
16 Bearing
17 Shim
18 Bearing Baffle
19 Shim
20 Bearing
21 Oil Slinger
22 Driver Pinion
23 Oil Filler Plug
24 Bolt
25 Axle Housing Cover ..... Apply Liquid Gasket
26 Ring Gear
27 Bearing
28 Shim
29 Shaft Lock Pin
30 Differential Case
31 Bolt
32 Bolt
33 Washer
34 Bearing Cap
35 Thrust Washer
36 Side Gear
37 Differential shaft
38 Differential Pinion
39 Thrust Washer

VACUUM LINE



1 Vacuum Auto-locking Hub Assembly
2 Bolt..... 50-60 N•m(37-44 lb-ft)
3 Washer
4 Auto-locking Hub Cap
5 Retaining Ring
6 Shim
7 Locking Hub
8 Hose and Tube Assembly
9 T-Connector
10 Hose Molded
11 Check Valve
12 Corrugated Tube
13 Auto-locking Hub Solenoid Valve
14 Bolt
15 Hose (L:2000/Yellow)
16 Hose (L:3200/Red)
17 Hose (L:1500/White) (DSL)
Hose (L:800/Blue) (GSL)

MAINTENANCE AND REPAIR

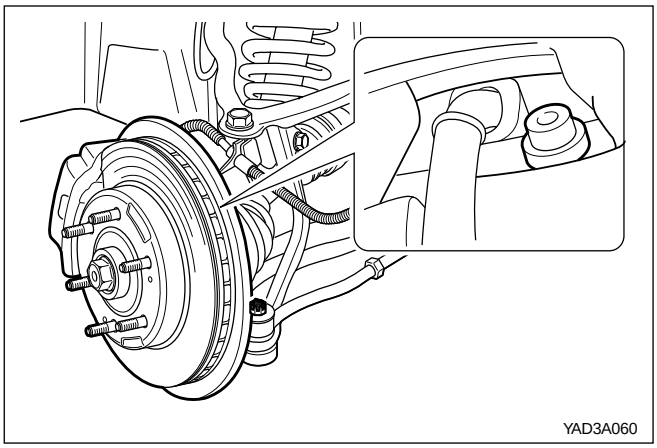

YAD3A050

ON-VEHICLE SERVICE

FRONT AXLE SHAFT

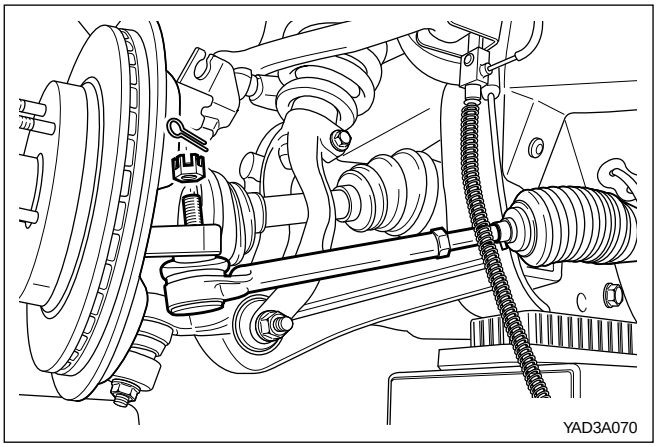
Removal

1. Remove the tire.


YAD3A060

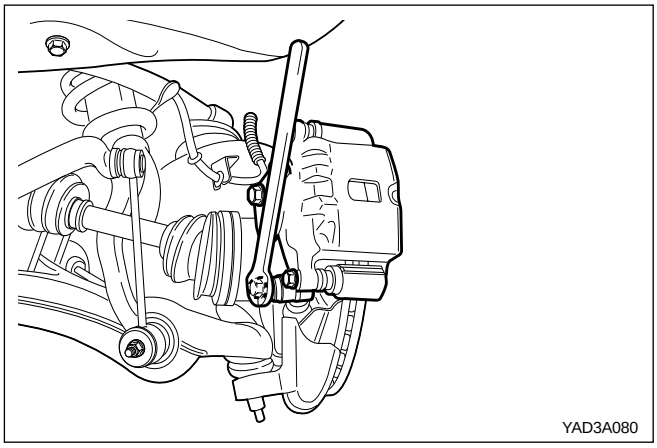
2. with ABS (Only part time vehicle)

   Remove the wheel speed sensor from the steering knuckle and pull off the cable.


YAD3A070

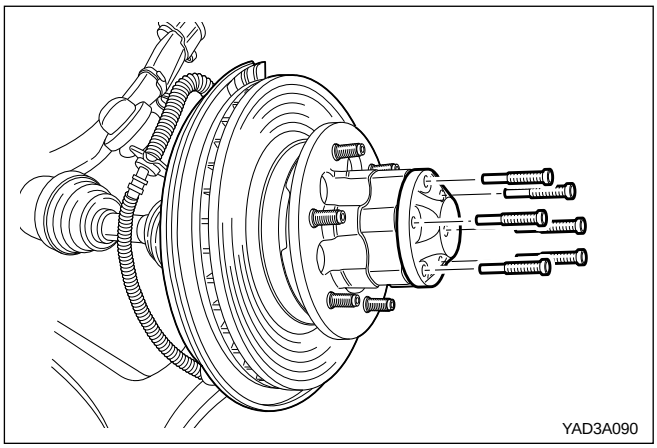
3. Remove the split pin from steering linkage link-knuckle mounting and pull off the slot nut and detach the link from knuckle arm.

   Notice: Replace the split pin with new one when it is installed again.

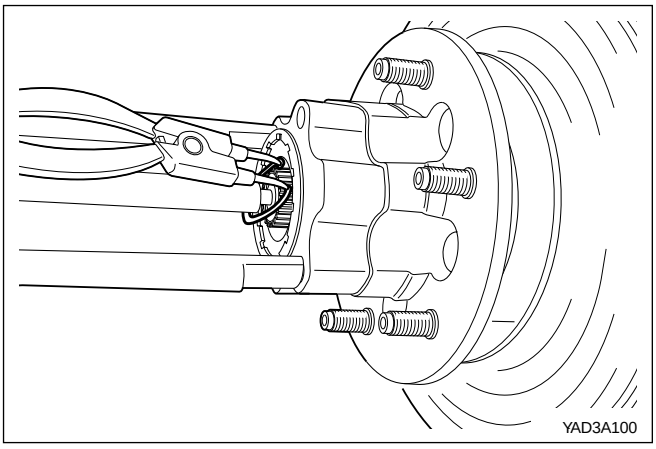

YAD3A080

4. Remove the two knuckle-brake caliper assembly mounting blots and pull off the caliper assembly.

   Notice: Be careful not to damage the brake oil hose.


YAD3A090

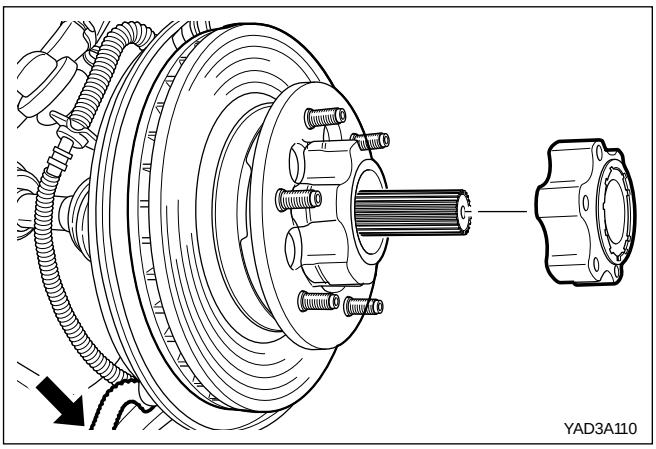
5. Vehicle with pant time transfer case only
   - Remove the hub mounting bolt & washer and pull off the hub cover.


YAD3A100

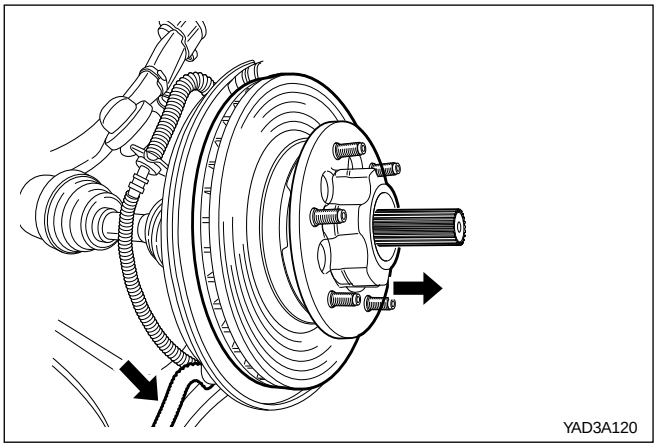
- Remove the retainer ring & outer shin in the drive shaft and pull off the lock.

Notice: For assembly, adjust the clearance between the snap ring & hub not to exceed 0.2mm. (Shim thickness : 0.2, 0.3, 0.5, 1.0mm)

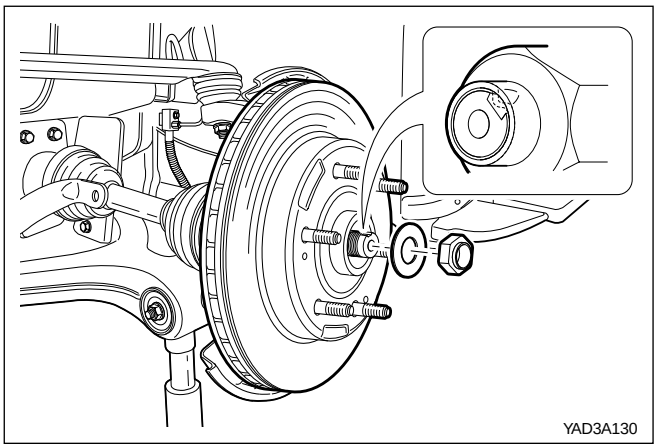
Notice: For assembly, be careful not to damage O-ring of the locking hub.


YAD3A110

- Detach the vacuum hose of locking hub from steering knuckle.

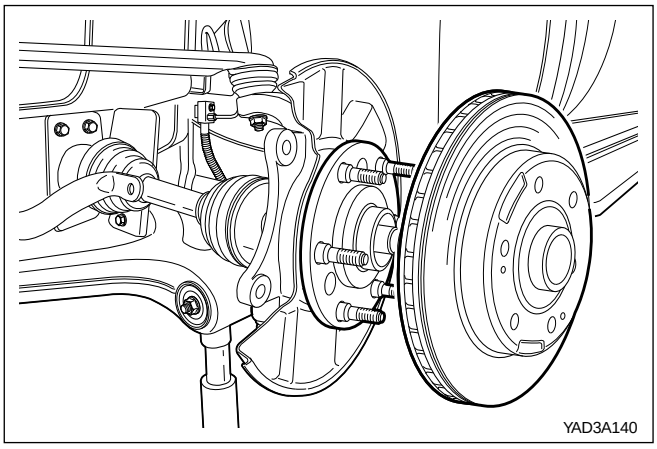


- Remove the hub & brake disc assembly.

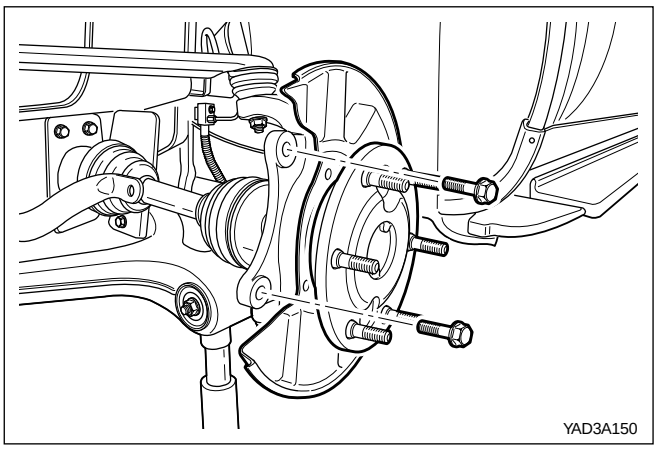


6. With full time transfer case only
   - Remove the hub nut & washer.

   Notice: For assembly, after you coincide the groove of drive shaft tip with the hub tip and cork, apply the paint and grease to the corking part.

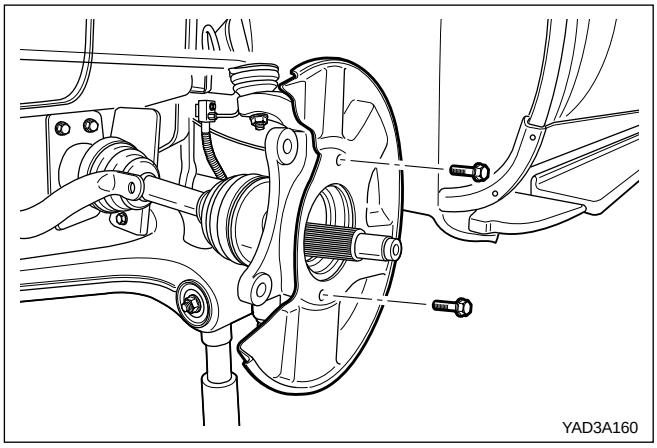


- Remove the front disc assembly from the axle shaft.

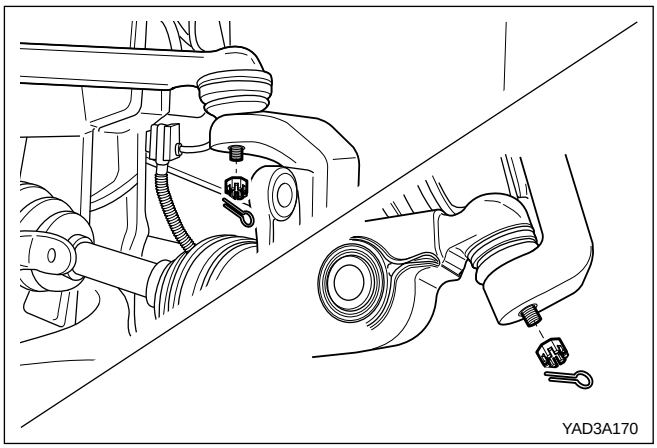


- Remove three wheel bearing bolts (M12) and pull off hub assembly by using the special tool.

Notice: For reassembly, replace the wheel bearing bolt with new one which applied the lock tight (blue color).



7. Remove two dust shield mounting bolts (M6) and pull off the dust shield.

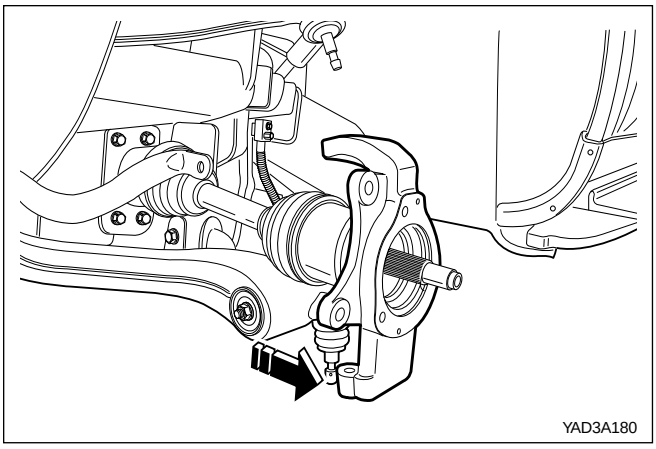


8. Remove the split pin and nut from the steering knuckle arm and upper arm ball joint connection.

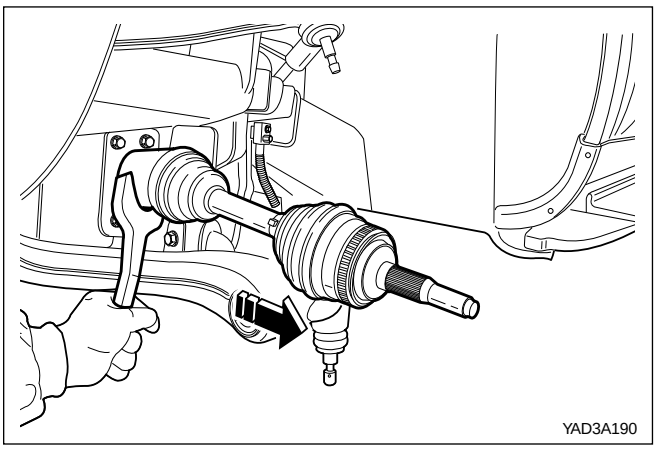
   Notice: For assembly, replace the split pin with new one.

9. Remove the split pin and nut from the steering knuckle arm and lower arm ball joint connection.

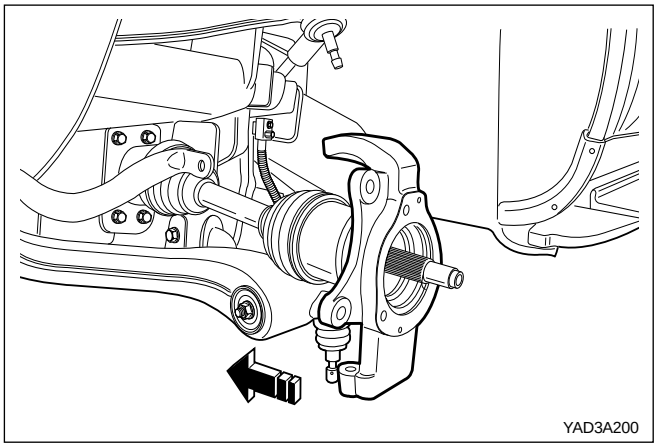
   Notice: For assembly, replace the split pin with new one.



10. Carefully remove the steering knuckle assembly.



11. Remove the drive shaft using the special tool.


YAD3A200

Installation

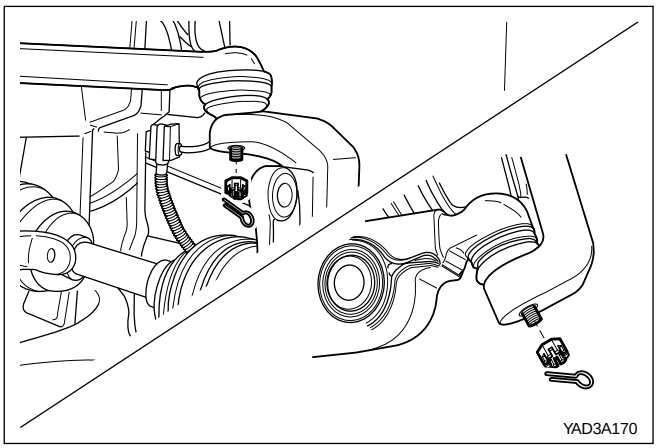
Clean all the parts. Check O-ring, snap ring for the wear and damage.

If damaged, replace them with new ones.

1. Insert the axle shaft to the axle housing. Be sure to insert the axle shaft to the housing.

   Notice: When you insert the axle shaft, be careful not to damage the boots.

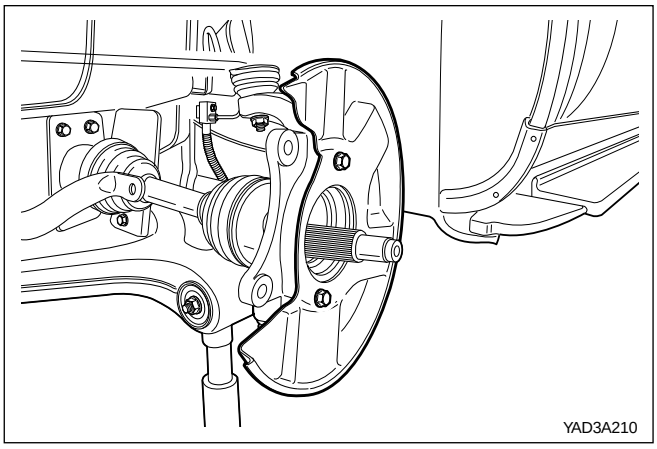
2. Install the steering knuckle to the axle shaft exactly.


YAD3A170

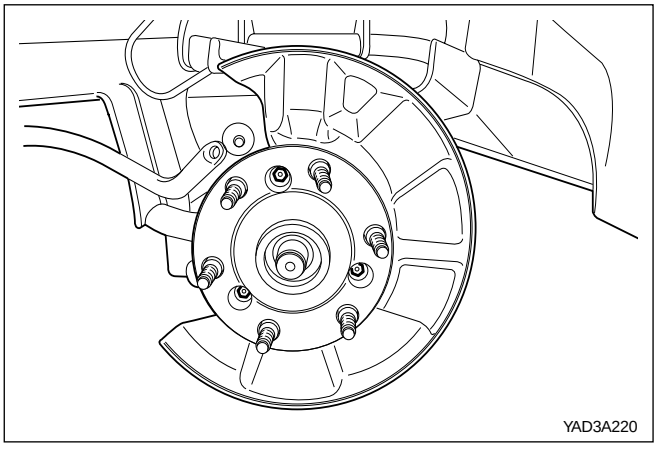
3. Install the steering knuckle to the upper/lower arm and fix the split pin.

   Installation Notice

Tightening Torque	Lower arm	140 - 160 N•m
	Upper arm	140 - 160 N•m


YAD3A210

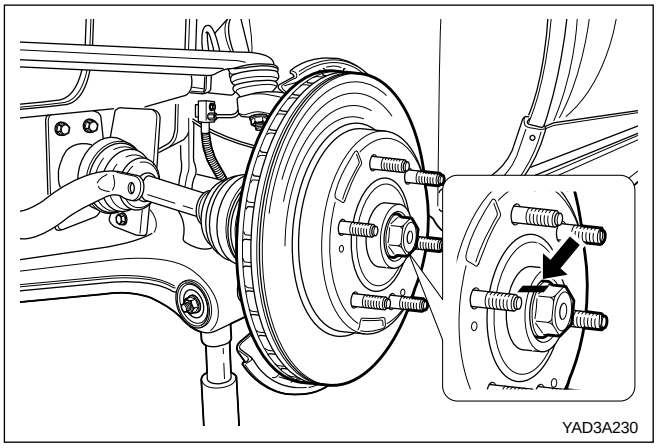
4. Install the dust shield to the knuckle.


YAD3A220

5. With full time transfer case only
   - Install the hub assembly to the axle shaft and tighten the hexagon bolts applied the lock tight (Blue color).

   Installation Notice

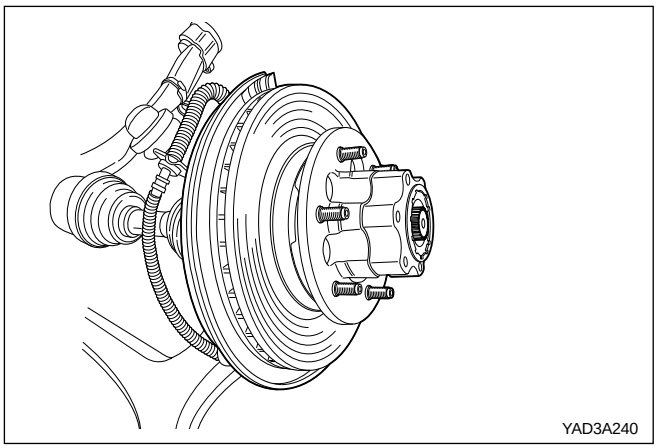
Tightening Torque	100 - 130 N•m



- Install the front disc and tighten the hub nut & washer. When you install then, align the hub nut-washer to the shaft end and tighten the hub nut as the specified torque. After bending the groove part of shaft, apply the painting and grease to the groove part.

Installation Notice

Tightening Torque	250 - 350 N•m



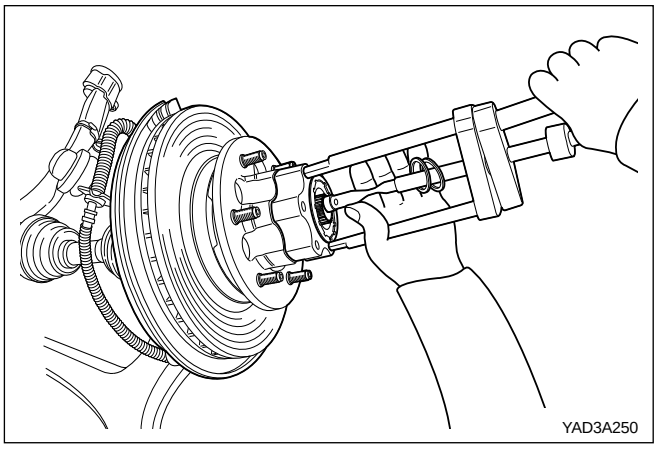
6. With part time transfer case
   - Install the brake disc assembly and tighten the fixing bolts.

Installation Notice

Tightening Torque	100 - 130 N•m

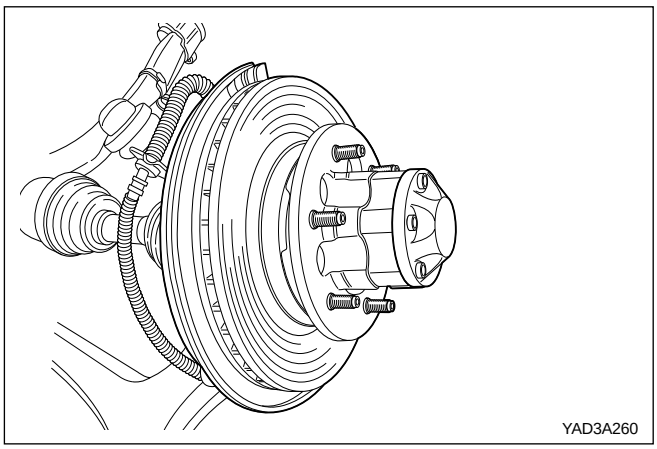
- Install the disc brake caliper assembly to the brake disc.
- Align the hub body to the flange mounting hole and insert it into the shaft.

Notice: When you insert the hub body, check the o-ring for the damage.



- Insert the shin in order that the clearance between snap ring and hub cover does not exceed Max 0.2mm on condition that you pull the shaft completely in outside direction. Fix the hub body using the snap ring.

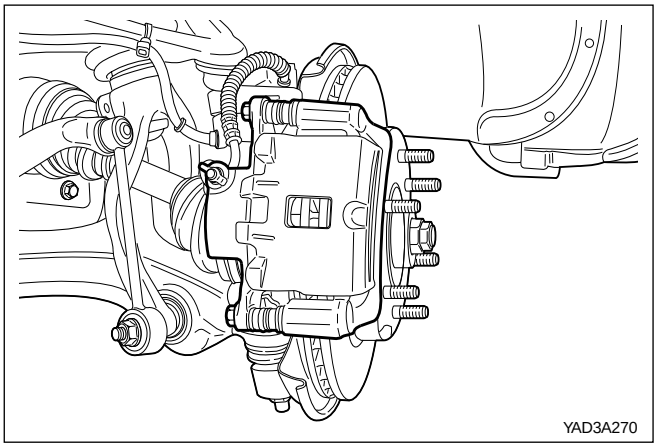
Shim thickness	0.2, 0.3, 0.5, 1.0 mm
Max. clearance	0.2 mm



- Install the hub cover to the body and tighten it as the specified torque.

Installation Notice

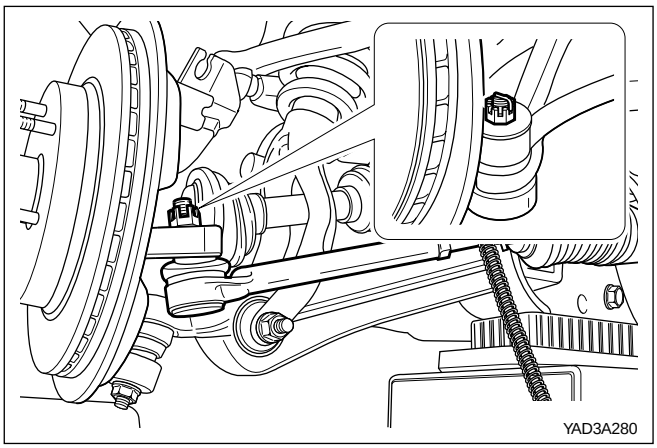
Tightening torque	50 - 60 N•m (37 - 44 lb-ft)


YAD3A270

7. Tighten the front disc brake caliper assembly mounting bolts on condition that the front disc is mounted.

Installation Notice

Tightening Torque	85 - 105 N•m

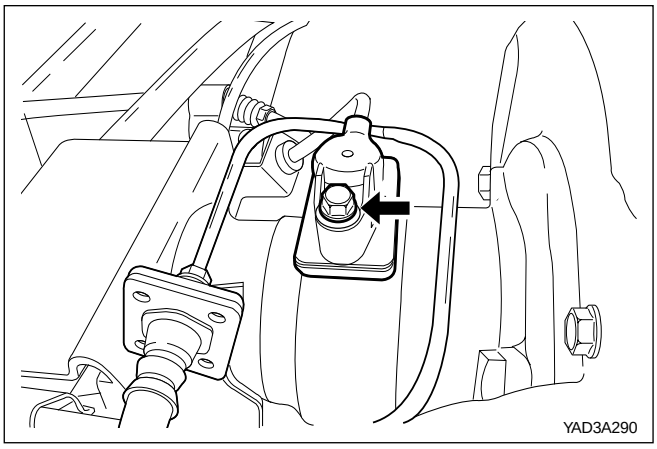

YAD3A280

8. Insert the steering linkage ends to the steering knuckle and tighten the slot nut.

Notice: When you install, replace the split pin with new one.

Installation Notice

Tightening torque	35 - 45 N•m (26 - 33 lb-ft)

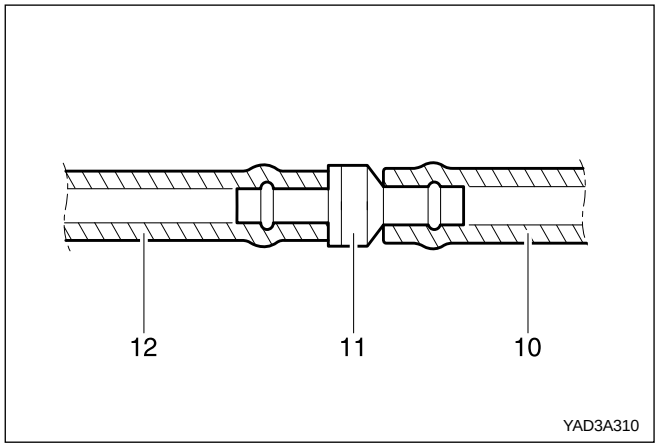

YAD3A290

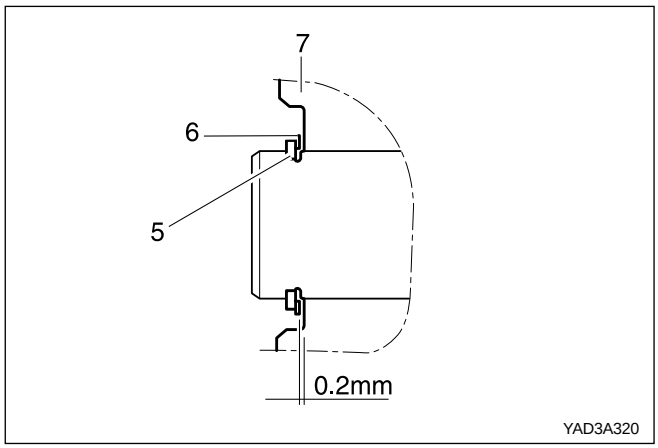
9. Install the wheel speed sensor and connect the vacuum line (with ABS only).

Installation Notice

ABS wheel speed sensor mounting bolt	6 - 8 N•m (53 - 71 lb-in)

10. Install the tire and test the braking force.





VACUUM LINE

Removal/Installation

1. Be careful not to change the direction of valve when connecting the check valve(11) with each hose.

2. Adjust the clearance between the retainer ring (5) and locking hub (7) to the normal value by using the appropriate shim (6).

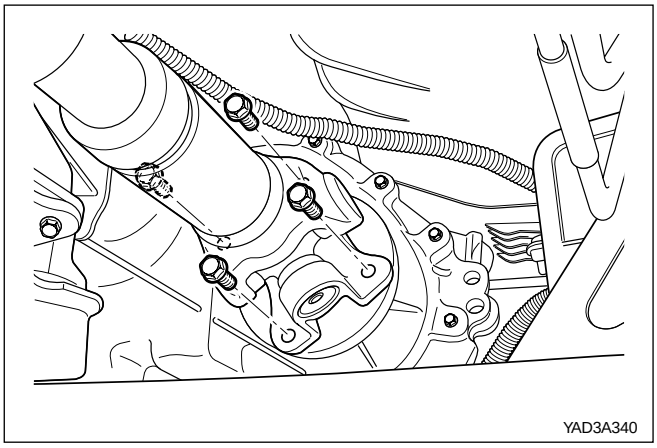
Normal	MAX. 0.2 mm

Notice: Shim thickness 0.1, 0.2, 0.3, 0.5, 1.0 mm

3. Tighten the auto locking hub cap bolt to the specified torque and order.

Installation Notice

Tightening Torque	50 - 60 N•m (37 - 44 lb-ft)


YAD3A340

AXLE HOUSING

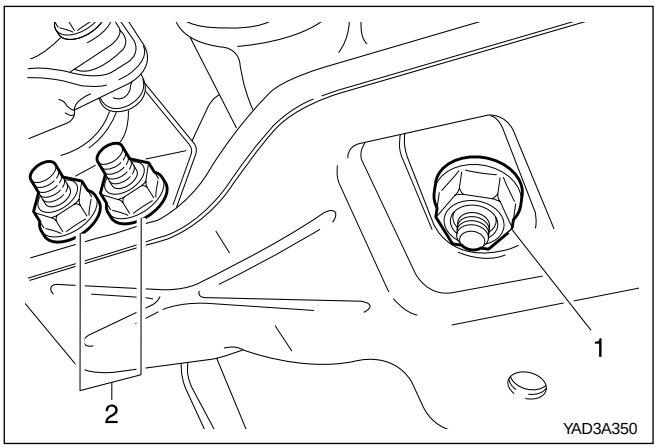
Removal/Installation

1. Remove the propeller shaft from the front axle input shaft.

   Installation Notice

Tightening Torque	81 - 89 N•m (60 - 66 lb-ft)

2. Remove the steering gear linkage.



YAD3A350

3. Remove the breather hose.
4. Remove the cross member and axle housing mounting nut (1).

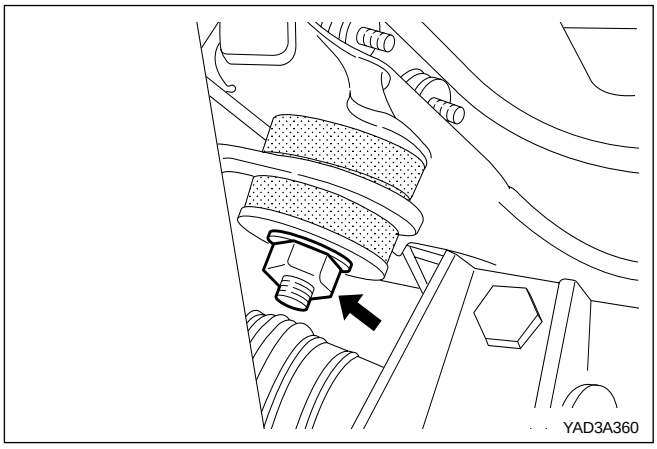
   Installation Notice

Tightening torque	95 - 142 N•m

5. Remove the frame and cross member mounting nut (2) and pull off the cross member.

   Installation Notice

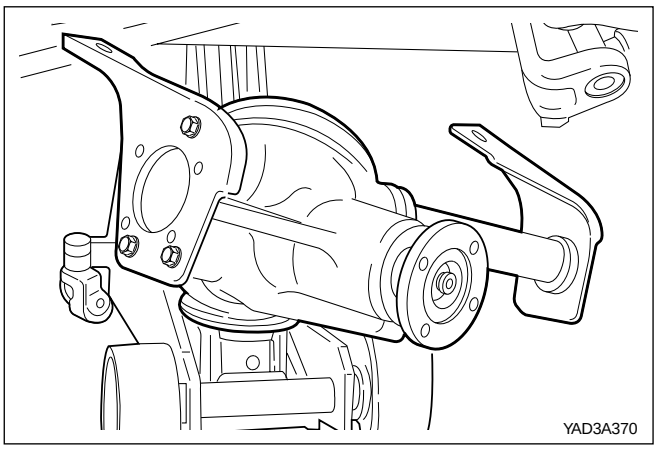
Tightening Torque	62 - 93 N•m (45 - 69 lb-ft)


YAD3A360

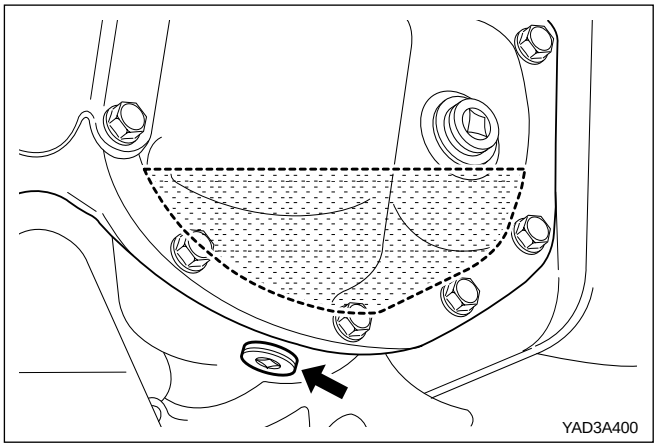
6. Support the axle housing on a suitable jack, remove the axle housing mounting bracket nuts.

   Installation Notice

Tightening Torque	62 - 93 N•m (45 - 69 lb-ft)


YAD3A370

7. Lowering the jack carefully, remove the axle housing assembly.
8. Installation should follow the removal procedure in the reverse order.



UNIT REPAIR

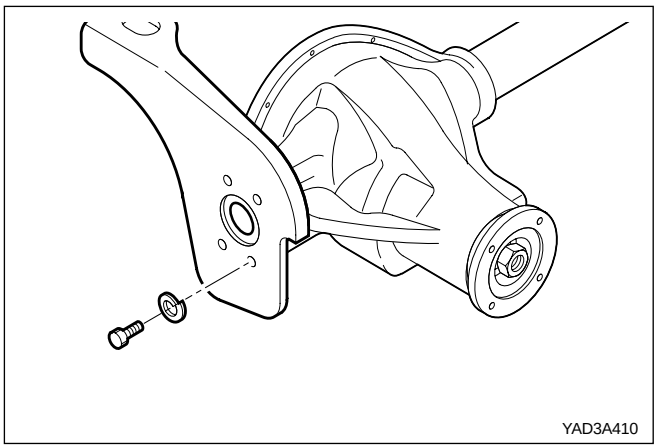
AXLE HOUSING ASSEMBLY

Disassembly

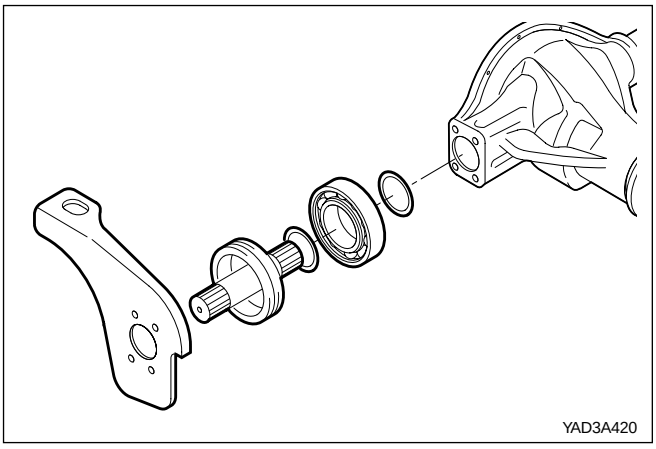
1. Remove the drain plug and drain the oil and than reinstall the drain plug.

   Installation Notice

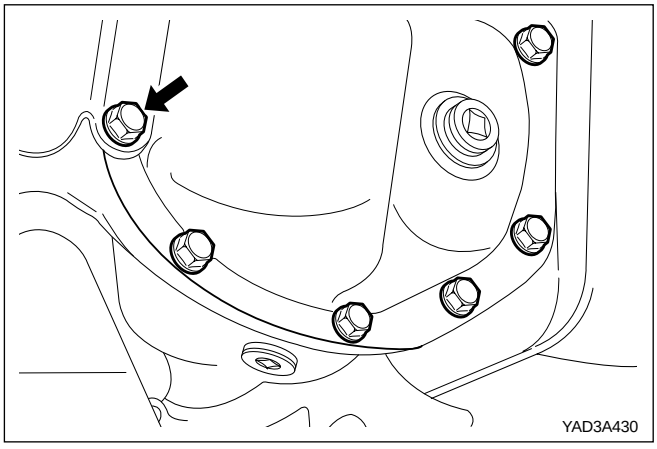
Tightening Torque	28 - 40 N•m (21 - 30 lb-ft)



2. Remove the axle housing mounting bracket bolt and pull off the bracket and inner shaft assembly.

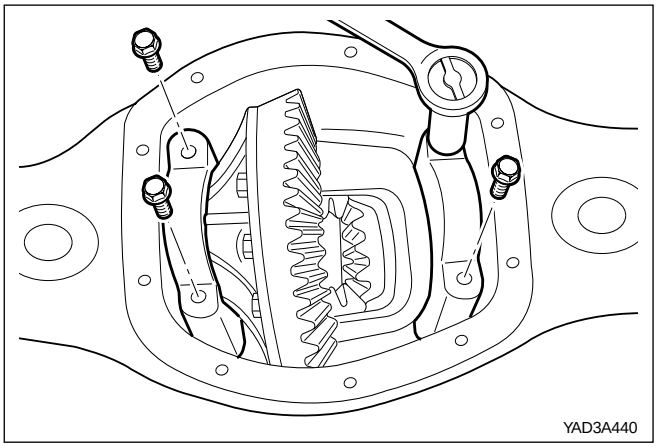


3. Remove the bearing fixing snap ring of inner shaft and pull off the bearing. Remove the inner shaft and housing bracket



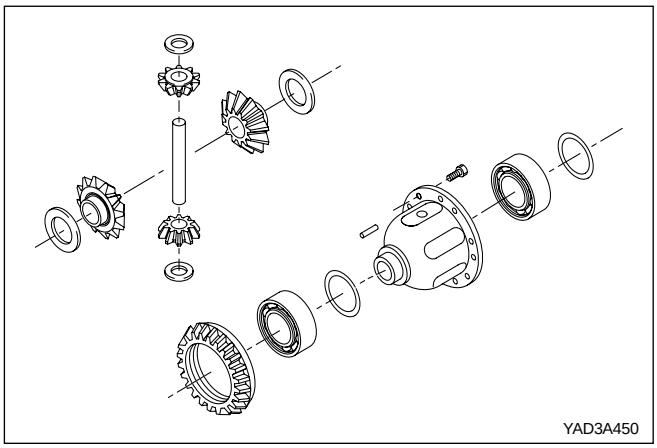
4. Remove the axle housing cover.

   Notice: Clean the gasket dregs of the cover and housing contact surface.

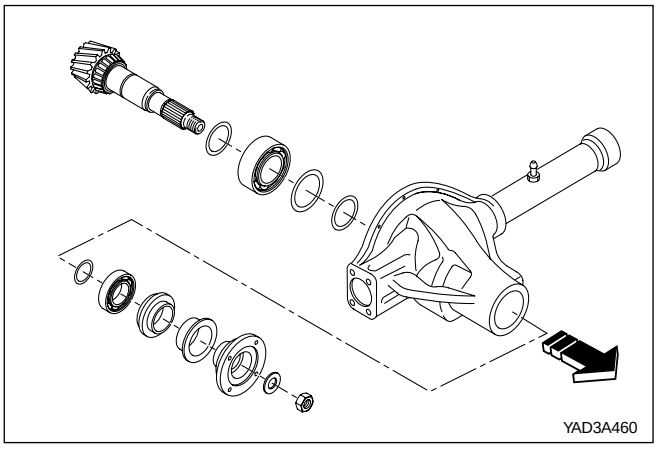


5. Remove the bearing cap mounting bolt and pull off the bearing cap. Pull out the differential carrier assembly.

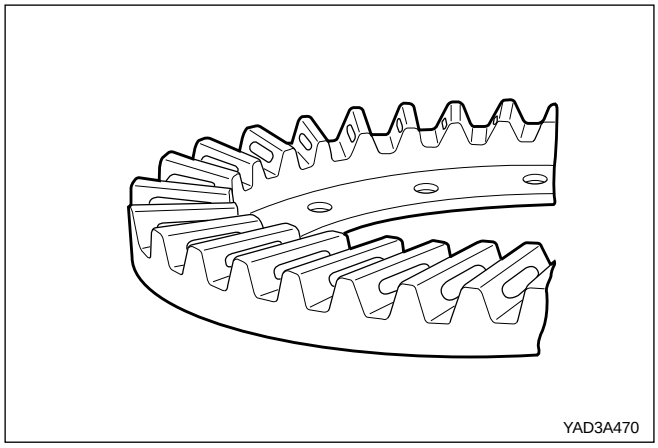
   Notice: Do alignment marks on the bearing dap not to change the caps before removal. When pulling out, be careful not to damage the axle housing.



6. Disassemble the parts of differential carrier assembly.



7. Remove the drive pinion lock nut. Disassemble the parts of drive pinion.

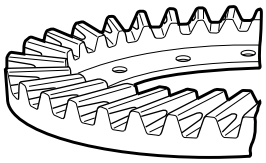
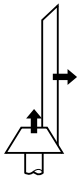
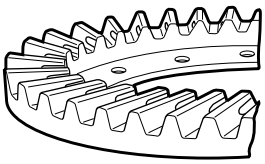
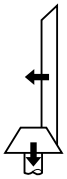
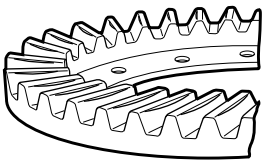
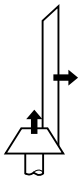
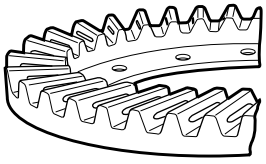
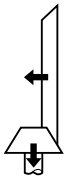

YAD3A470

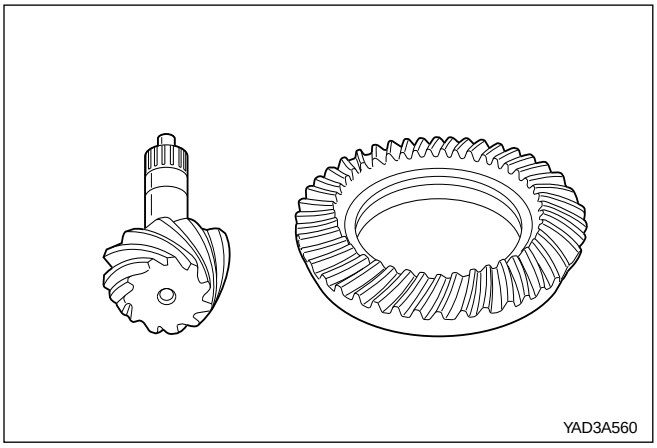
Inspection of Ring Gear Tooth Contact Pattern

1. Normal Contact

   Apply gear-marking compound (Prussian blue / red lead) on the ring gear teeth. Rotate the ring gear and check the tooth contact pattern.

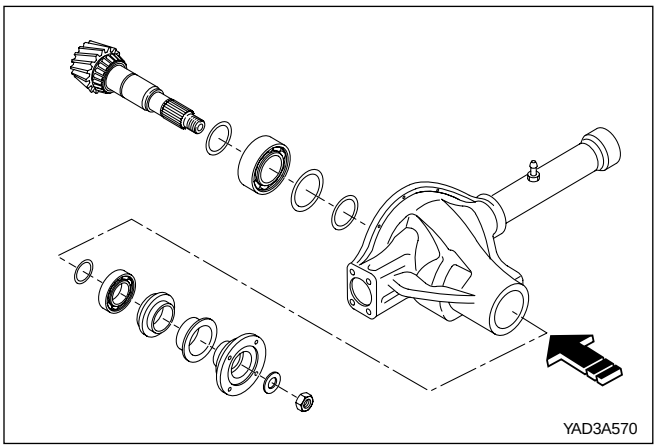
2. Abnormal Contact

Tooth contact pattern	Possible cause	Remedy
1. Heel contact  A YAD3A480	Excessive backlash • Noise can be occurred	Adjust backlash (Drecrease backlash) • Select proper shin to move the drive pinion toward the ring gear (toward toe)  B YAD3A490
2. Toe contact  A YAD3A500	Insufficient backlash • Tooth can be damaged or broken under heavy load	Adjust backlash (Increase backlash) • Select proper shim to move the drive pinion against the ring gear (toward heel)  B YAD3A510
3. Face contact  A YAD3A520	Excessive backlash • Drive pinion shaft is apart from the ring gear • Noise can be occurred	Adjust backlash (Increase pinion shim) • Move the drive pinion toward the ring gear (toward center of ring gear)  B YAD3A530
4. Flank contact  A YAD3A540	Insufficient backlash • Gear contacts on the low flank • Gear can be damaged or worn • Noise can be occurred	Adjust backlash (Decrease pinion shim) • Move the ring gear toward the drive pinion (toward ring gear center line)  B YAD3A550


YAD3A560

Assembly

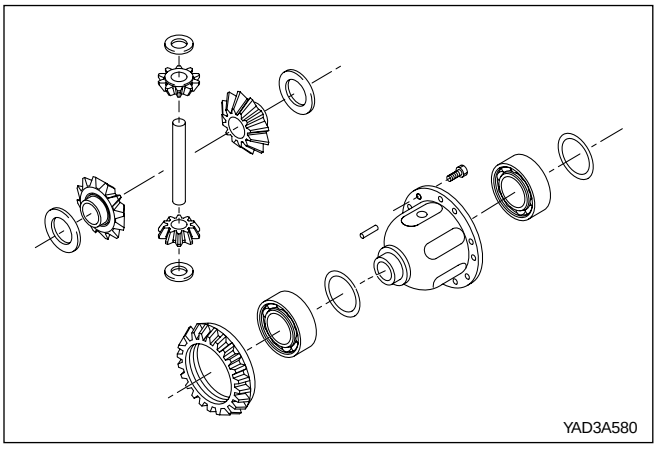
1. Clean all parts and check the followings.
   - Check the ring gear, drive pinion for wear and damage. If damaged, replace it as a set.
   - Check the bearing for sticks, wear, noise and turning resistance.
   - Check the side gear, pinion, pinion shaft and thrust washer for wear and damage.
   - Check the differential carrier for crack and wear (bearing contact surface). Check the gear case for crack.


YAD3A570

2. Assemble the drive pinion assembly to the axle housing and then tighten the pinion lock nut.

   Installation Notice

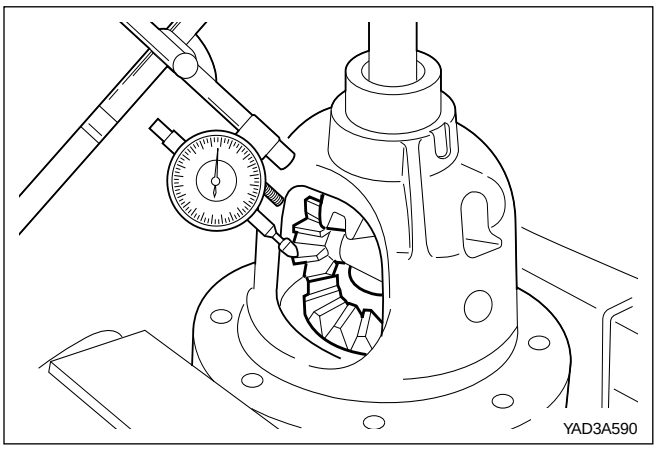
Tightening torque	240 - 310 N•m


YAD3A580

3. Assemble the differential carrier assembly. Align the ring gear to the mark of differential carrier, tighten the fixing bolts.

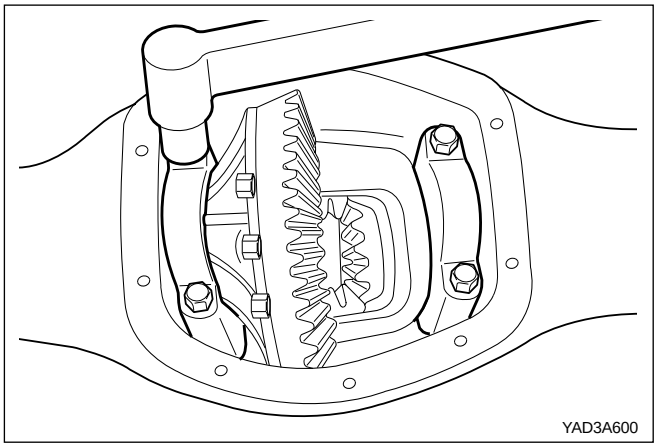
   Installation Notice

Tightening Torque	75 - 90 N•m (55 - 66 lb-ft)


YAD3A590

4. Measure the backlash of side gear and pinion gear.

Specified value	0 - 0.5 mm

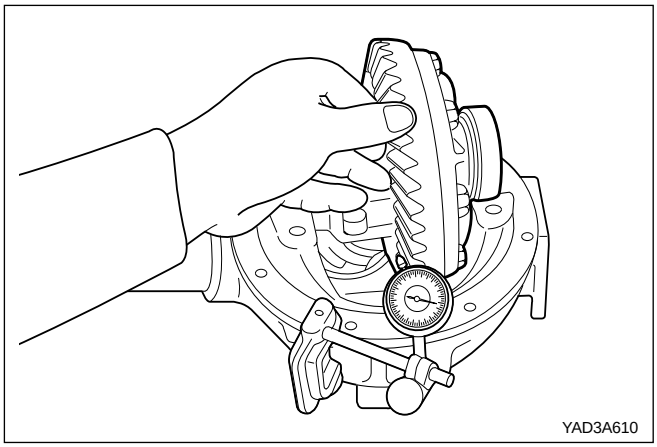


5. Install the differential carrier assembly into the axle housing. Set up the bearing cap and then tighten the cap bolts.

Installation Notice

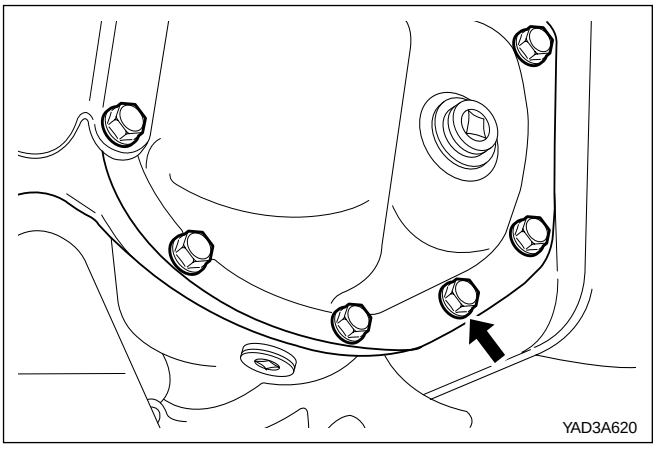
Tightening Torque	48 - 69 N•m (35 - 51 lb-ft)

Notice: Be careful not to change the caps. Be sure to keep the original position of the caps.



6. Measure the backlash of drive pinion and ring gear.

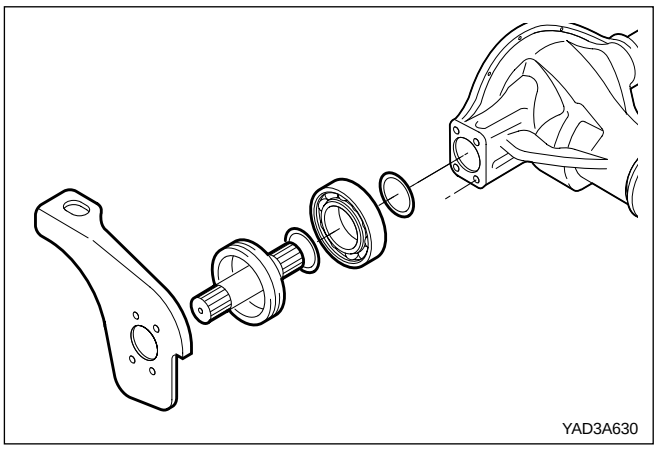
Specified value	0.13 - 0.20 mm



7. Install the axle housing cover. Tighten the fixing bolts.

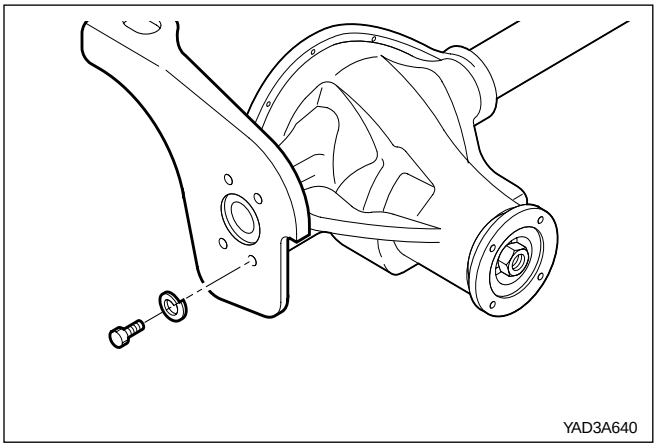
Installation Notice

Tightening Torque	39 - 46 N•m (29 - 34 lb-ft)



8. Assemble the parts of the front axle inner shaft and housing mounting bracket.

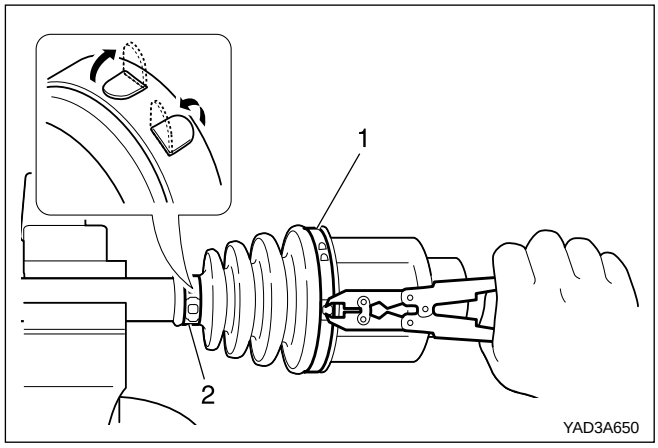
Notice: Apply the grease to the oil seal rib.


YAD3A640

9. Align the axle shaft and differential carrier spline and insert the axle shaft. Assemble the axle housing mowiting bracket to the axle housing.

Installation Notice

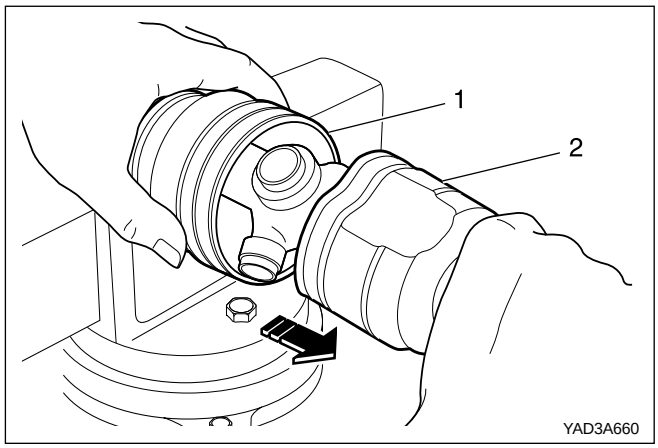
Tightening Torque	80 - 100 N•m (59 - 74 lb-ft)



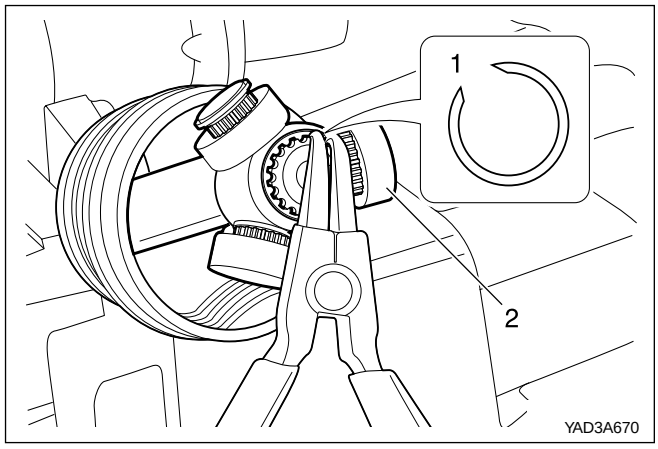
DIFFERENTIAL JOINT ASSEMBLY

1. Remove the drive axle.
2. Detach the joint boot clamp.
   ① Detach the boot clamp (large)
   - After pressing the clamp prominence using the special tool, detach the clamp.

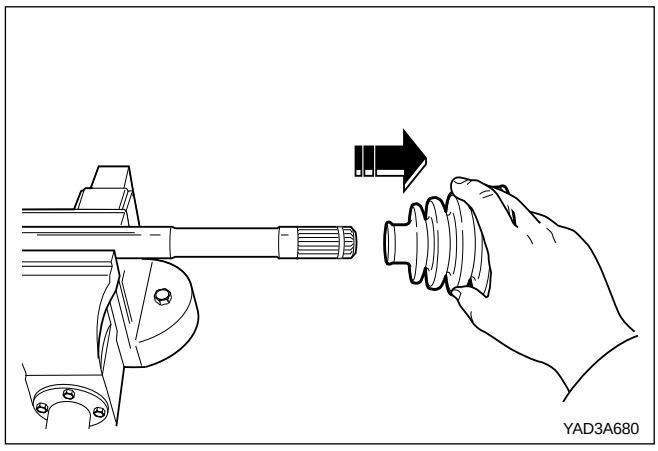
   ② Detach the boot clamp (small)
   - After unfolding the clamp holding part using the driver / hammer, detach the clamp.



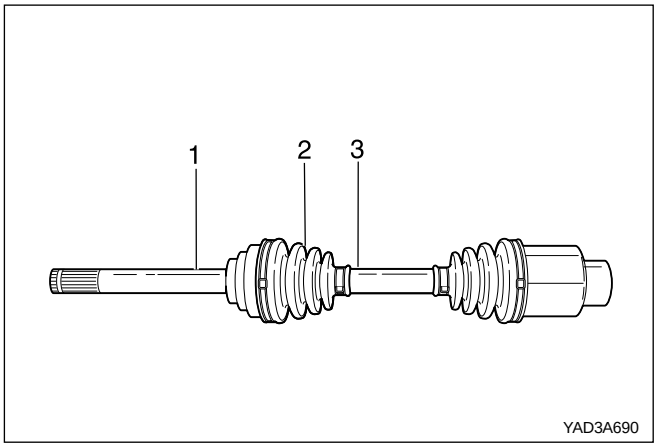
3. Detach the joint housing from the boot.
   ① Boot
   ② Joint housing



4. Get rid of the grease in the joing assembly.
5. Remove the triport joint.
   ① Pull out the circlip.
   ② Pull out the triport joint.



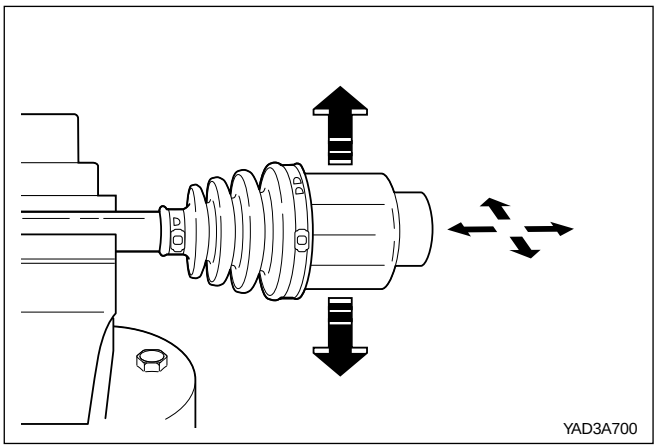
6. Remove the drive axle shaft boot.



Inspection

1. Check the shaft spline for the wear and damage.
2. Check the leakage by the boot crack, tears.
3. Check the bending of shaft.

   Notice: if the defect happens in one shaft, because the other is damaged, exchange the both.



Assembly

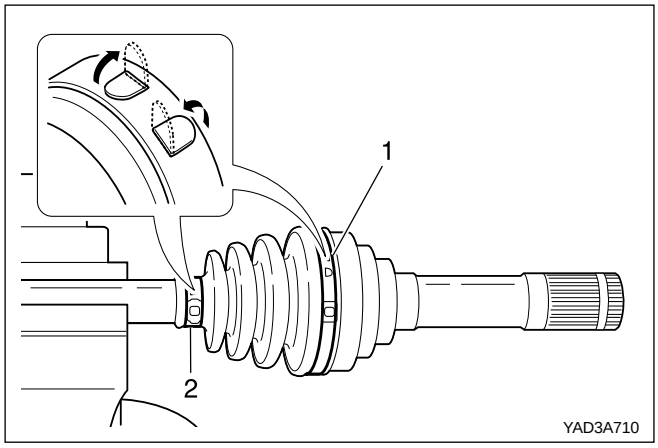
1. Assembly should follow the dismantlement in the reverse order.
2. Apply the specified grease to the joint housing.

Injection quantity	90 - 100 g

   Notice: If not use the specified grease, the joint and boot may be damaged.

   Notice: For assembly, replace the boot clamp with the new one.

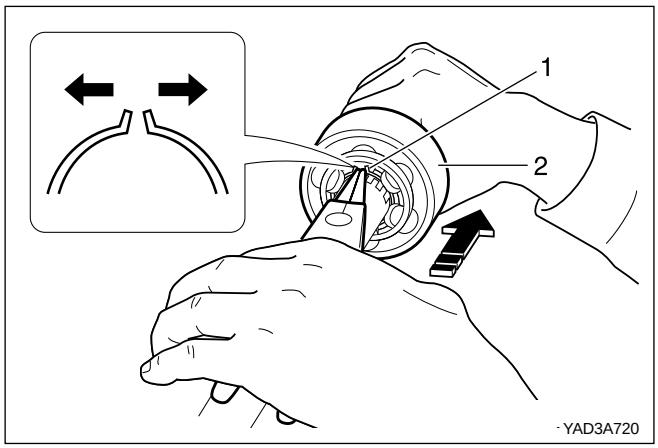
3. Check the followings after completing the assembly.
   - Check whether the joint move to up/down, left/right, forward freely.
   - Check whether the grease leak in the clamp part after checking the operation.



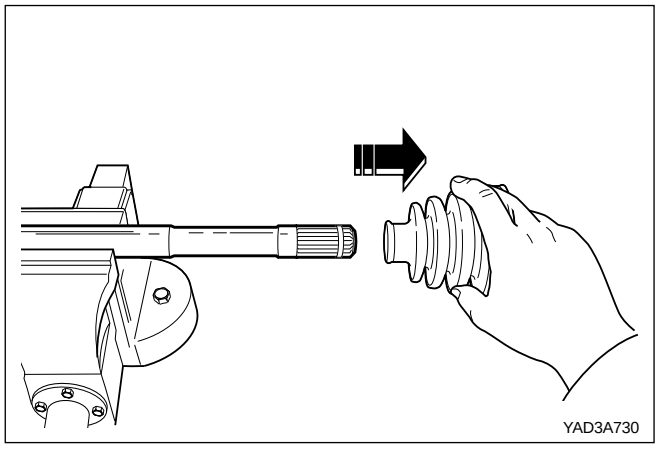
WHEEL JOINT ASSEMBLY

Disassembly

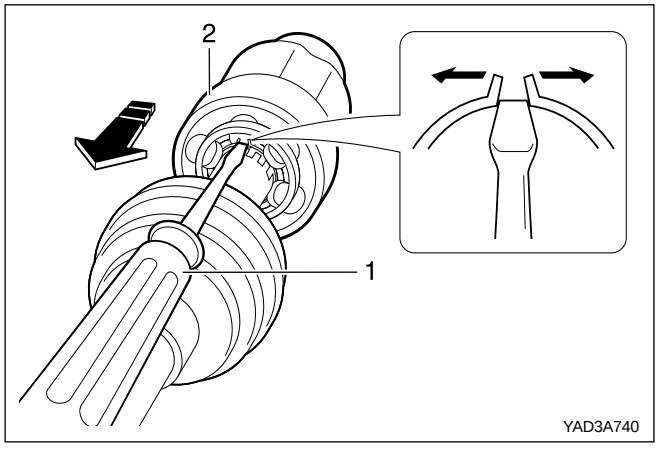
1. Remove the drive axle.
2. Detach the joint boot clamp.
   ① Detach the boot clamp (large)
   ② Detach the boot clamp (Small)
   - After unfolding the clamp holding part by using the driver/hammer, detach the clamp.



3. Get rid of the grease in the joint assembly.
4. Remove the joint assembly.
   ① Spread out the circlip.
   ② Pull out the joint assembly to the wheel side with the circlip spread out.

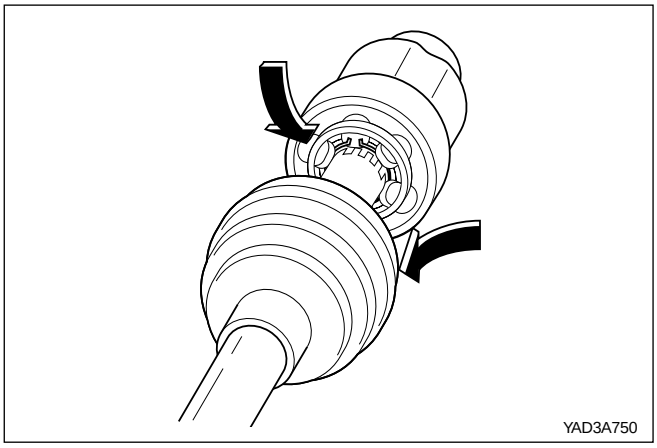


5. Remove the drive axle shaft.



Assembly

1. Assembly should follow the disassembly procedure in the reverse order.
2. Install the joint assembly.
   - Put the joint assembly in drive axle shaft to spread out the circlip opening slightly.
   ① Insert (-) driver into the circlip opening to spread out the circlip.
   ② Put the joint assembly in circlip home with the circlip spread out.

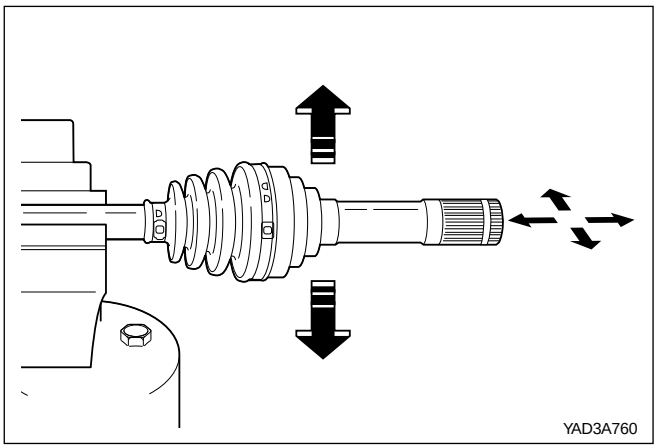

YAD3A750

3. Apply the specified grease to the joint housing.

Injection quantity	80 - 90 g

Notice: If not use the specified grease, the joint and boot may be damaged.

Notice: For assembly, replace the boot clamp with the new one.

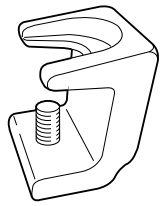
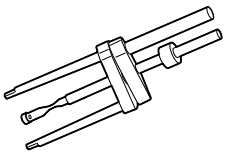

YAD3A760

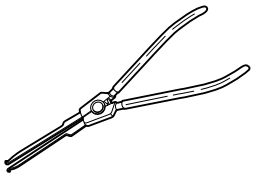
4. Check the followings after completing the assembly.
   - Check whether the joint move to up/down, left/right, forward freely.
   - Check whether the grease leak in the clamp part after checking the operation.

   Notice: Because the wheel joint cannot be repaired in single part, if there is defect, replace it whit the new assembly.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD3A770	**661 589 13 33 00** **Ball Joint Remover**
 YAD3A790	**Part Time Snap Ring Remover / Installer**

 YAD3A780	**Snap Ring Plier**

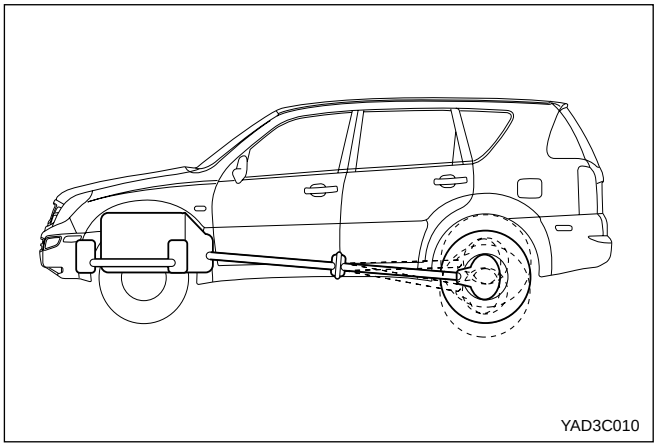
SECTION 3C

PROPELLER SHAFT

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GENERAL DESCRIPTION AND OPERATION


YAD3C010

The propeller shaft transfers the power through the transmission and transfer case to the front/rear axle differential carrier (final reduction fear). It is manufactured by a thin rounded steel pipe to have the strong resisting force against the torsion and bending. Both ends of propeller shaft is connected with the spider and the center of propeller shaft is connected with the spline because the height/length of transmission and axle is not constant. The rubber bushing which wraps the center bearing is installed in rear propeller shaft. So the vibration and balance is maintained constantly.

SPECIFICATIONS

Structure			Yoke & Spider Typed Universal Joint
Joint Type			Spider (Needle Roller Bearing)
Number of Spider	Front Shaft	Full Time T/C	2
		Part Time T/C	2
	Rear Shaft		3
Outer Diameter of Spider (mm)			Ø16.668
Tube Run-out (After Installation)			Within 0.4 mm
Front Shaft Dimension (LXI.DXO.D)	Diesel + M/T•A/T + 4408 T/C		607.1 × Ø59.5 × Ø63.5
	Gasoline + M/T•A/T + 4421 T/C		591.1 × Ø59.5 × Ø63.5
Rear Shaft Dimension (LXI.DXO.D)	Diesel + M/T•A/T + 4408 T/C		(585.2+569.5) × Ø59.5 × Ø63.5
	Gasoline + M/T•A/T + 4421 T/C		(566.1+569.5) × Ø59.5 × Ø63.5
Unbalance Quantity (at 4,500 RPM)			within 30 g·cm

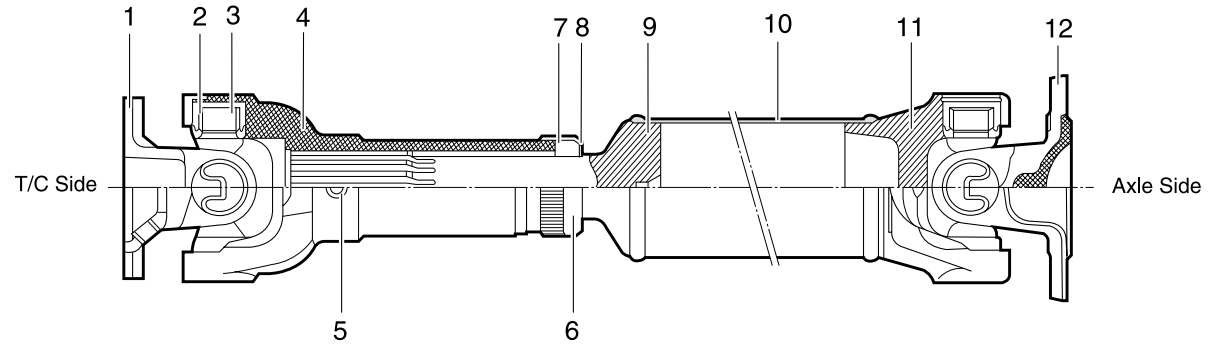
DIAGNOSTIC INFORMATION AND PROCEDURES

Phenomena	Checks	Action
Vibration	Incorrect Assembly of Sliding Joint	Adjust
	Bending of Propeller Shaft	Replace
	Poor Symmetry (Left/Right) of Universal Joint Snap Ring	Adjust
	Loosened Yoke connection bolt	Tightening
Noise	Worn or Damaged Universal Joint Bearing	Replace
	Separation of Universal Joint Snap Ring	Adjust/Replace
	Loosened Yoke connection part	Tightening
	Warn sliding Joint Spline pant	Replace
	Insufficient Grease	Replenish

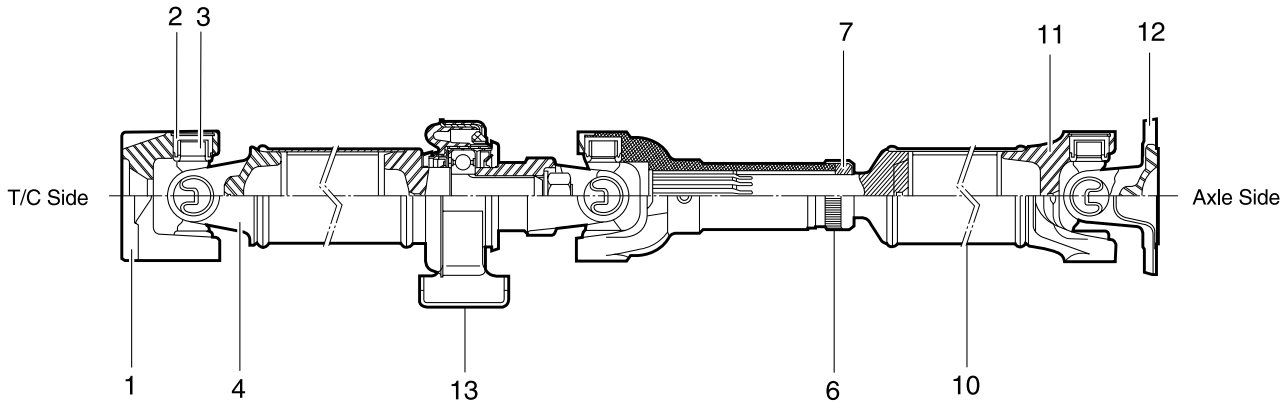
COMPONENT LOCATOR

CROSS SECTIONAL VIEW

Rear Propeller Shaft



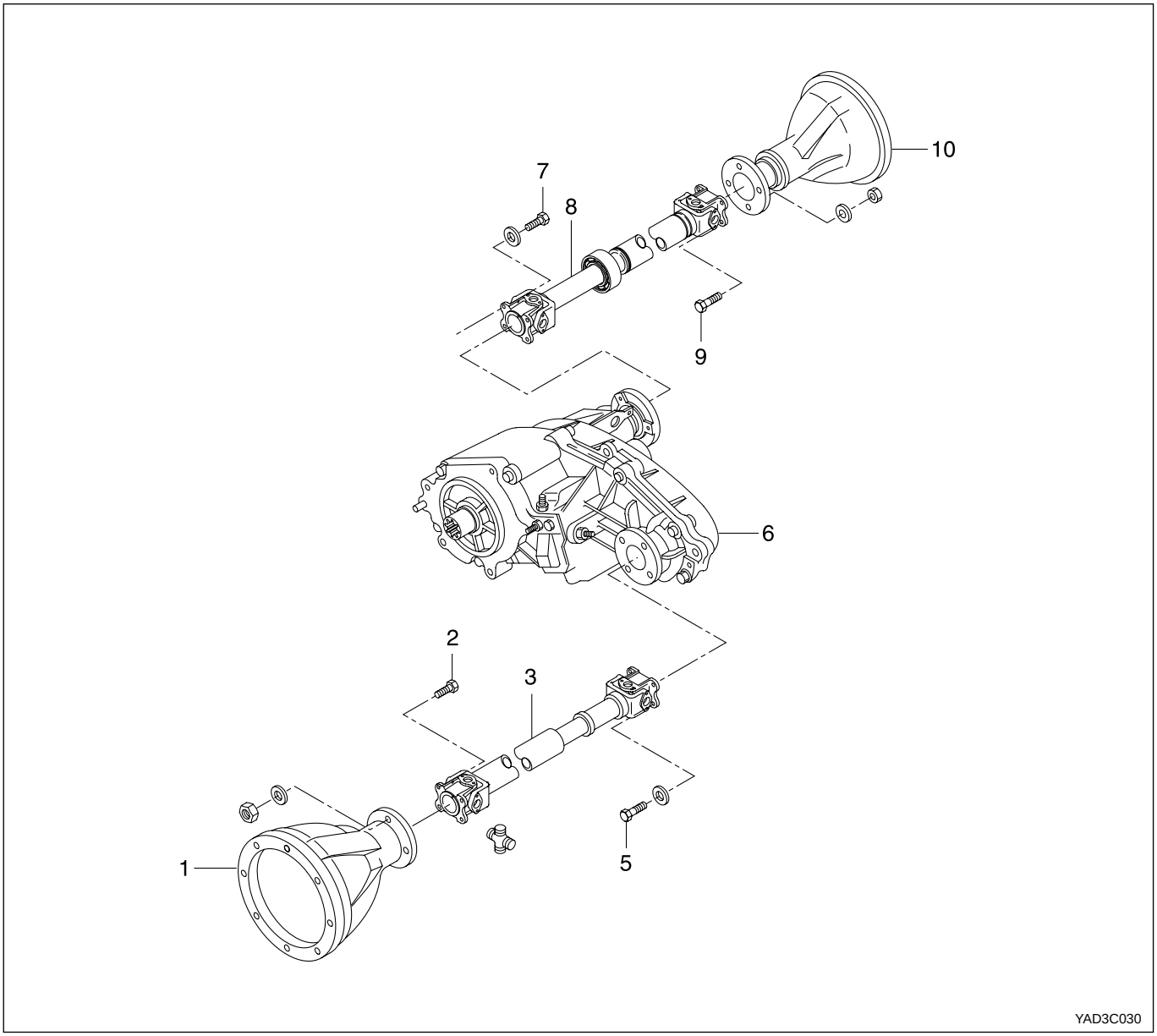
Rear Propeller Shaft



YAD3C020

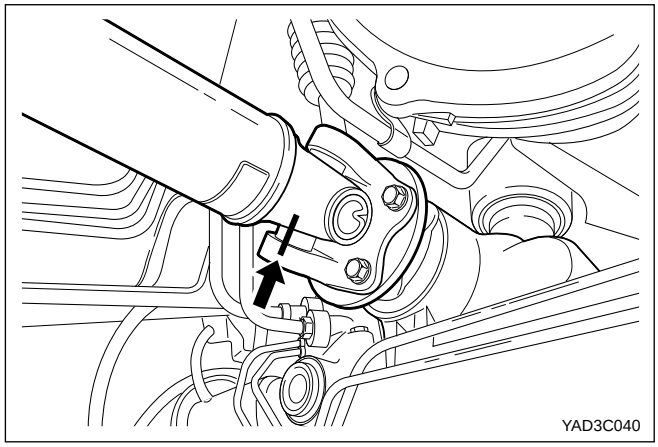
1 Flange Yoke
2 Journal Bearing Cap
3 Cross Shaft Journal
4 Slip Yoke Assembly
5 Grease Nipple
6 Dust Cap
7 Oil Seal
8 Split Washer
9 Slip Tube Shaft
10 Tube
11 Tube Yoke
12 Flange Yoke
13 Center Bearing

PROPELLER SHAFT ASSEMBLY



1 Front Axle
2 Bolt
3 Front Propeller Shaft
4 Bolt
5 Transfer Case
6 Bolt
7 Rear Propeller Shaft
8 Bolt
9 Rear Axle

MAINTENANCE AND REPAIR

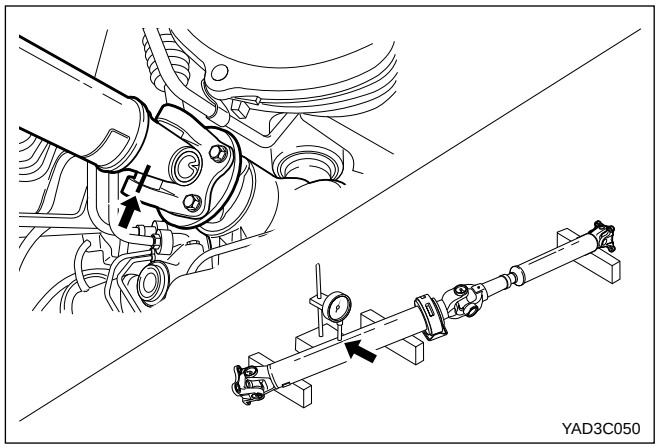

YAD3C040

ON-VEHICLE SERVICE

PROPELLER SHAFT ASSEMBLY

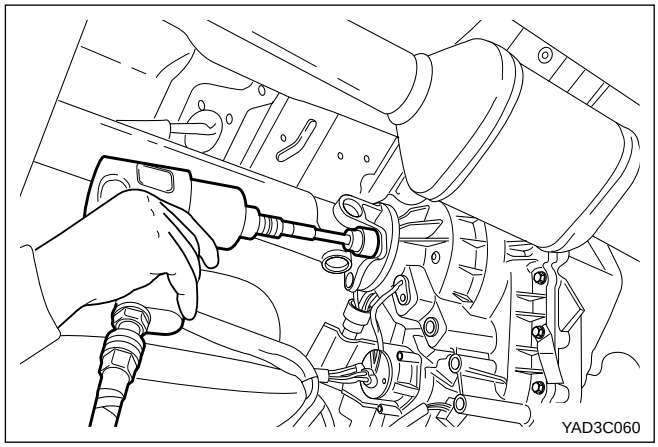
Removal

1. Do alignment marks before removing the propeller shaft.

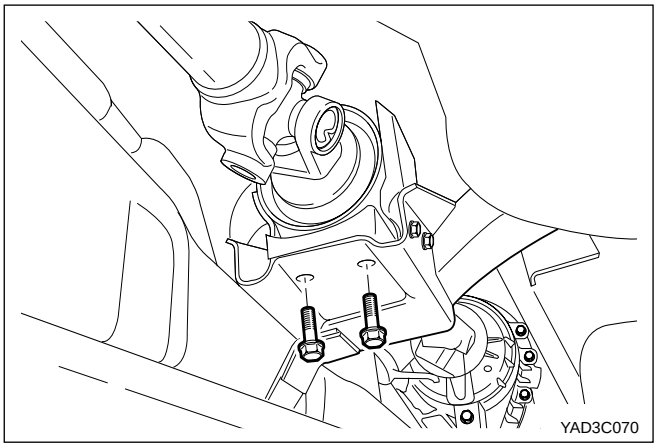

YAD3C050

2. Remove the flange yoke fixing bolt/nut that connects the front propeller shaft axle side with transfer case.

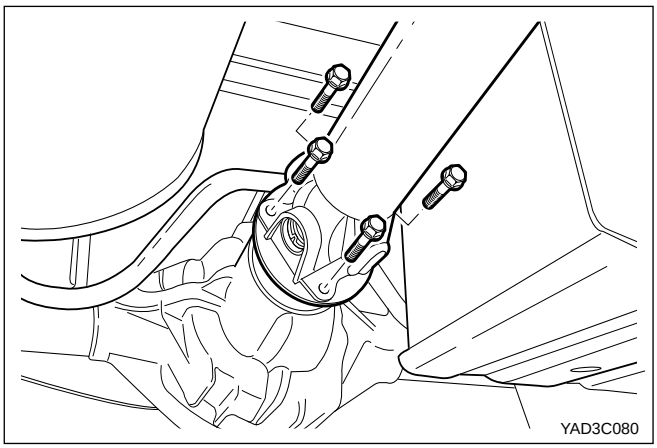
   Pull out the front propeller shaft assembly.


YAD3C060

3. Remove the flange yoke bolt/nut of transfer case side in rear propeller shaft.

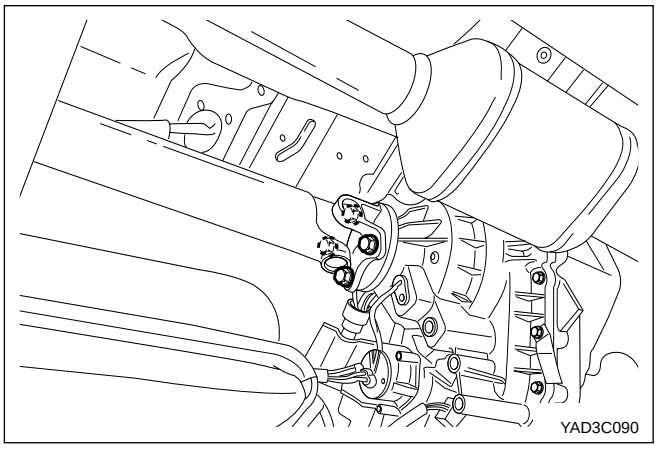


4. Remove the fixing bolt of middle bearing (center).



5. Remove the rear axle housing flange yoke bolts/ nuts of rear propeller shaft.

   Pull out the rear propeller shaft assembly.

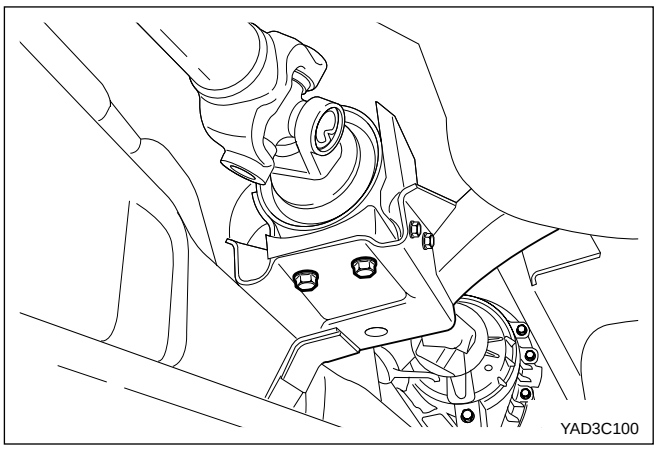


Installation

1. Check the disassembled parts visually.
2. Align the assembly mark of each propeller shaft.
3. Install the front propeller shaft.

Installation Notice

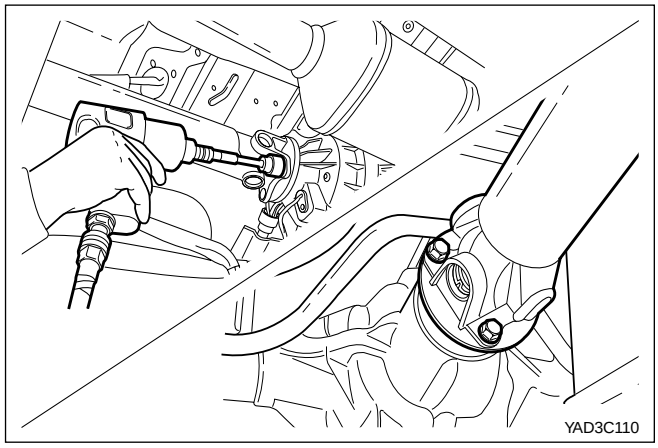
Tightening Torque	81 - 89 N•m (60 - 66 lb-ft)



4. Set up the rear propeller shaft between the transmission and axle housing. Tighten the center bearing manually.

Installation Notice

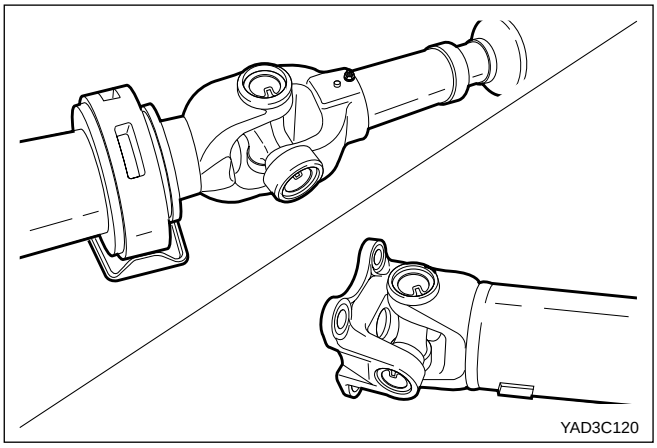
Tightening Torque	80 - 95 N•m (59 - 70 lb-ft)



5. Align the rear propeller shaft to the assembly mark. Tighten the bolts/nuts and then the center bearing bolts.

Installation Notice

Tightening Torque	70 - 80 N•m (52 - 59 lb-ft)

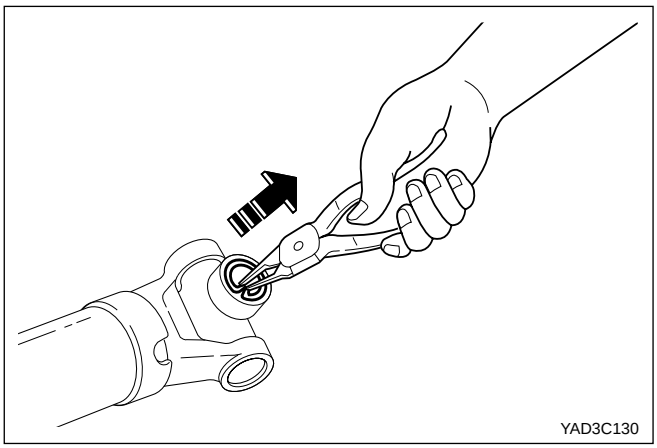

YAD3C120

UNIT REPAIR

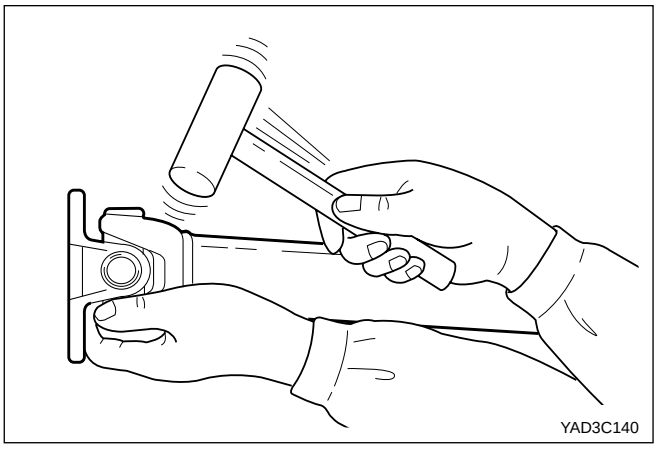
PROPELLER SHAFT

Disassembly

1. Mark the assembly mark and remove the propeller shaft.
2. Do alignment mark before separating the spider.

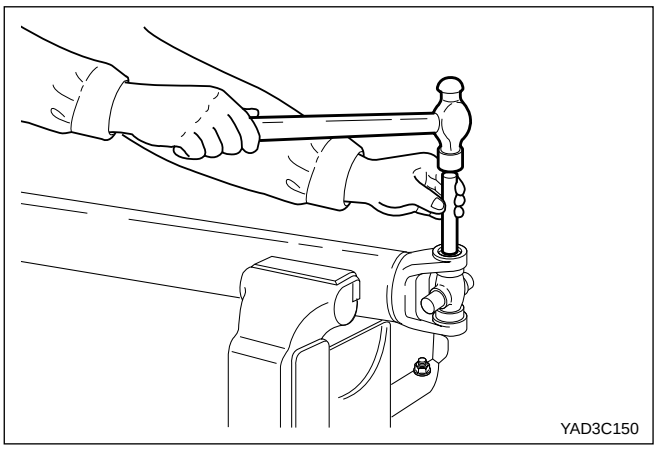

YAD3C130

3. Remove the snap ring using the snap ring plier.

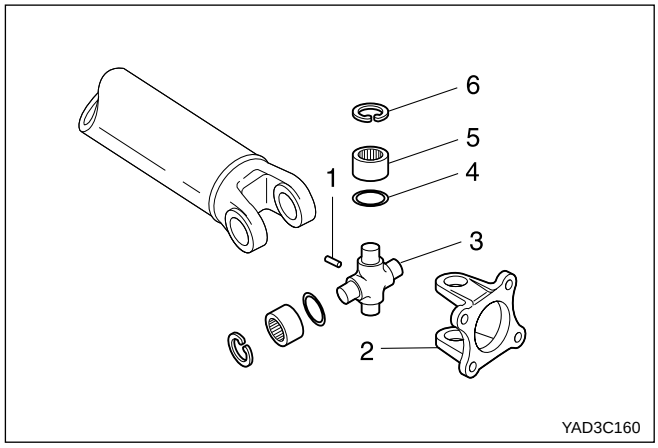

YAD3C140

4. Slightly tapping the yoke shoulder using a brass hammer, remove the bearing.

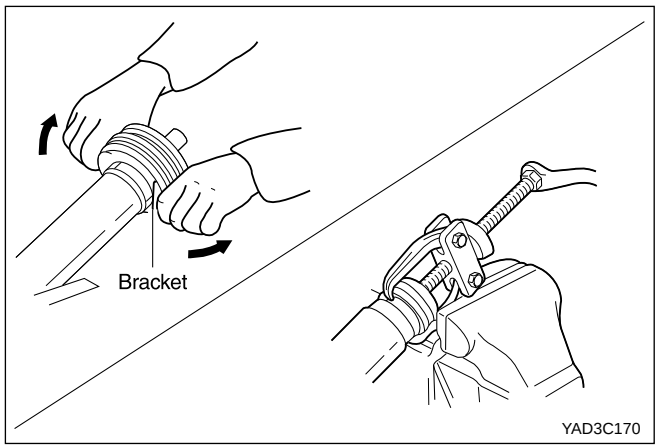
   Remove the remaining bearing in the same way.


YAD3C150

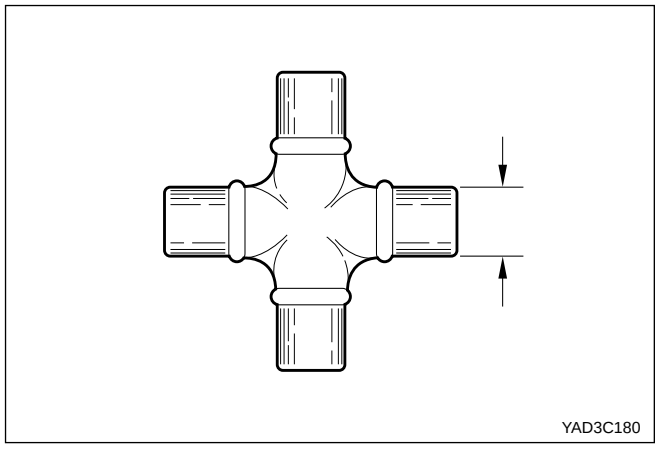
5. If it is not removed, clamp the welding part of yoke in the vise.



6. Disassemble the universal joint parts.
   As axles move up and down, universal joints allow drive angle to change without bending of propeller shaft.



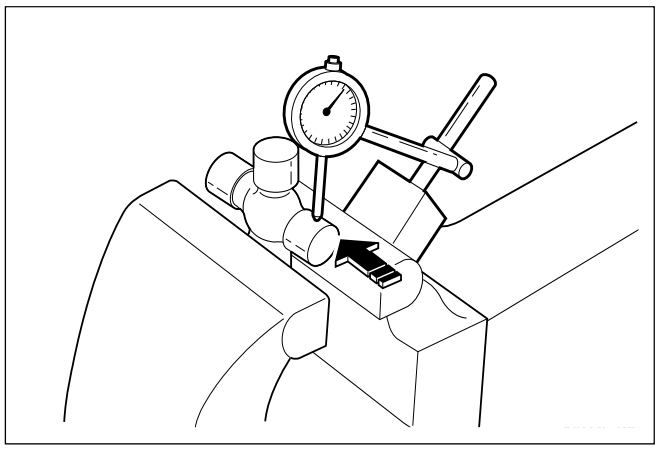
7. Remove the center bearing bracket and center bearing using the special tool.



Inspection

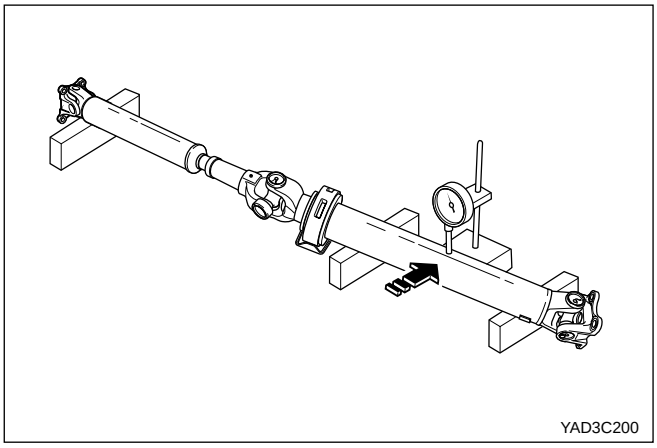
1. Visual Check
   Check the disassembled parts for wear and crack.
   Replace them if necessary.
2. Spider outer diameter

standard	16.647 mm
Limit	16.668 mm



3. Clearance between the spider and bearing

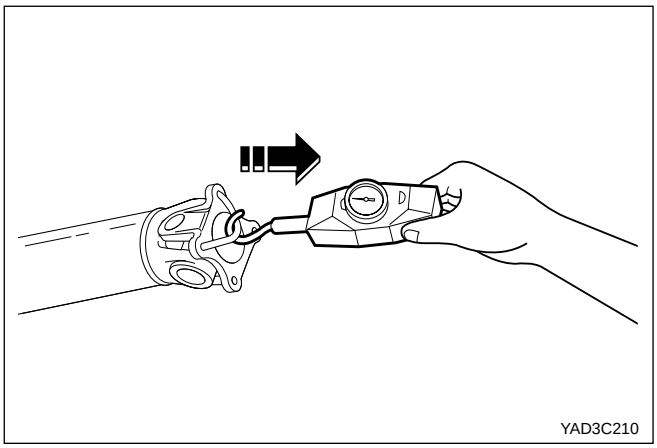
standard	0.03 ~ 0.098 mm
Limit	0.25 mm


YAD3C200

4. Propeller Shaft runout

   Using a dial gauge, measure propeller shaft runout by turning the shaft. If runout exceeds limit, adjust the propeller shaft using a press or replace it.

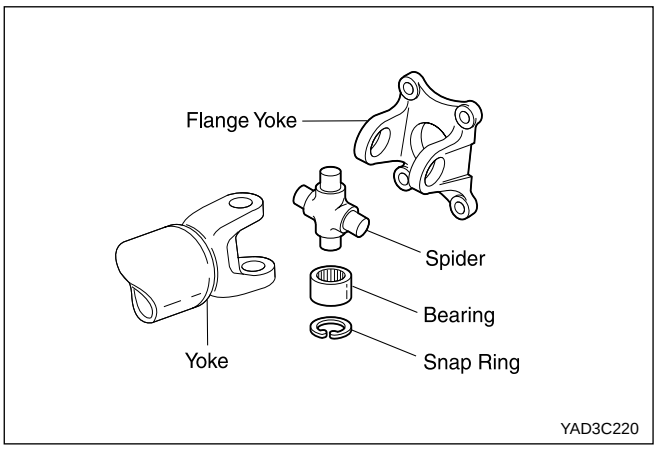
Limit	0.4 mm


YAD3C210

5. Universal joint starting torque

Specified Value	3 ~ 8 kg•cm

6. Major cause of vibration
   - Separation of balance weights
   - Excessive runout of the propeller shaft
   - Using the general bolts
   - Excessive wear of universal joint
   - Sticks in sleeve joint
   - Vibration is caused by front & rear universal joint, pinion angle change and is generally broke out when the vehicle speed is around 60 ~ 100km/h.

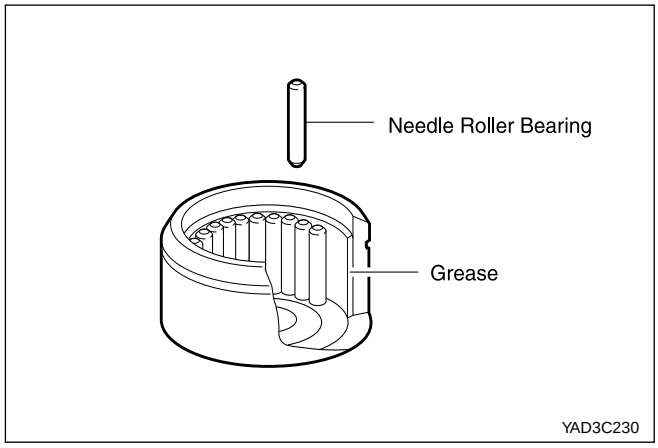


YAD3C220

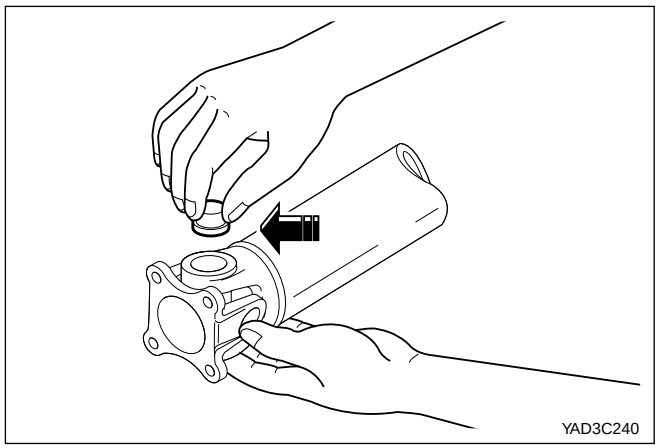
Assembly

Clean the disassembled parts and replace then if damaged.

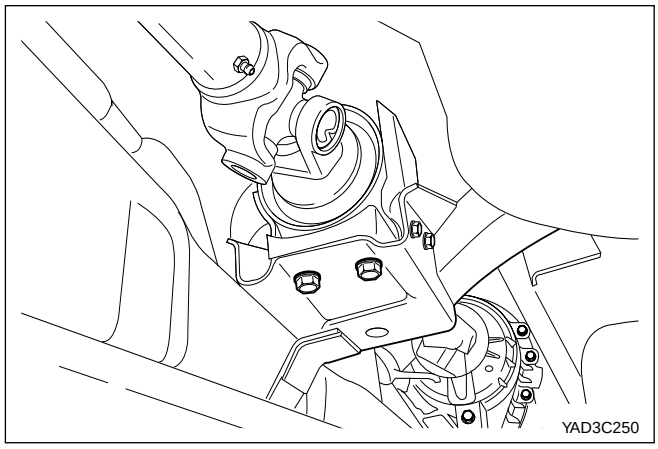
1. Align the alignment marks of the yoke and assemble the spider, bearing and snap ring.



2. Apply the grease to the inner of bearing cap of needle roller bearing and assemble the needle roller.



3. Install the bearing cap to the yoke and insert the spider. Install the opposite cap by tapping with a plastic hammer.



4. Assembly the center bearing to the rear propeller shaft.

SECTION 3D

REAR AXLE

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Rear Axle Housing 3D-13
Unit Repair 3D-18
Axle Assembly 3D-18
Differential Gear Assembly 3D-19

GENERAL DESCRIPTION AND OPERATION

SPECIFICATIONS

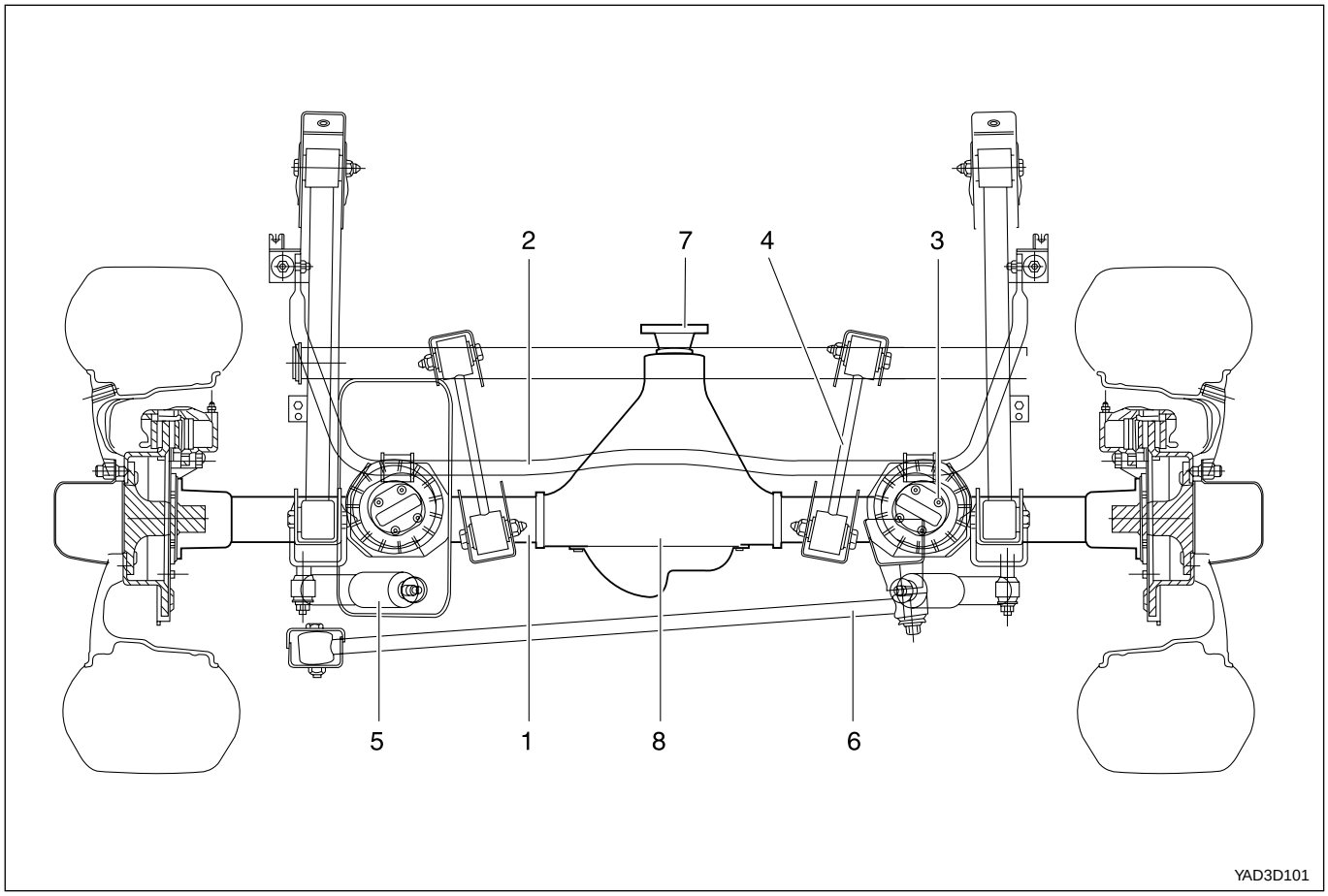
Axle Shaft Type		Semi-floating
Axle Housing Type		Build up
Differential	Type	Conventional Type
	Gear	Hypoid Gear
Reduction Ratio	Gasoline + A/T	3.73
	Diesel + A/T	4.27
	Gasoline + A/T	4.56
	Diesel + A/T	4.89
Oil	Capacity	1.9L
	Specification	SAE 80W/90 or API GL-5

DIAGNOSTIC INFORMATION AND PROCEDURES

Phenomena	Checks	Action
Noise (During Straight Driving)	Lack of Oil	Replenish
	Low Viscosity of Oil	Replace
	Inferior Oil	Replace
	Excessive Backlash of Ring Gears	Adjust
	Worn or Damaged Tooth of Ring and Pinion Gear	Replace
	Worn or Damaged Tooth of Drive Pinion Gear	Replace
	Wear of Side Bearing and Side Gear Spline	Replace
	Bending of Axle Housing	Replace
	Distortion of Differential Case	Replace
	Wear of Pinion Shaft	Replace
	Incorrect Drive Pinion Preload.	Adjust
	Incorrect Contact of Ring Gear and Pinion	Reassembly
Oil Leakage	Excessive Oil	Adjust
	Fault Seal of Carrier Contact Surface	Correct
	Axle Housing Crack	Replace
	Worn or Damaged Oil Seal	Replace
Noise (During Turning)	Worn or Damaged Tooth of Pinion or Side Gear	Replace
	Wear of Pinion Shaft	Replace
	Excessive Backlash of Pinion Gear and Side Gear	Replace
	Excessive End-Play of Rear Axle Shaft	Adjust
	Incorrect Contact of Side Gear and Differential Case	Replace
	Axle Housing Crack	Replace
	Distortion or Poor Installation of Drive pinion Oil Seal	Replace
	Damaged of Torn Drive Pinion Oil Seal	Replace
	Loosened Bearing Collar	Replace
	Worn or Damaged Universal Joint	Replace
	Worn or damaged Axle Shaft Bearing	Replace
Heating	Lock of Oil	Replenish
	Insufficient Backlash of Gears	Adjust
	Excessive Preload of Bearing	Adjust

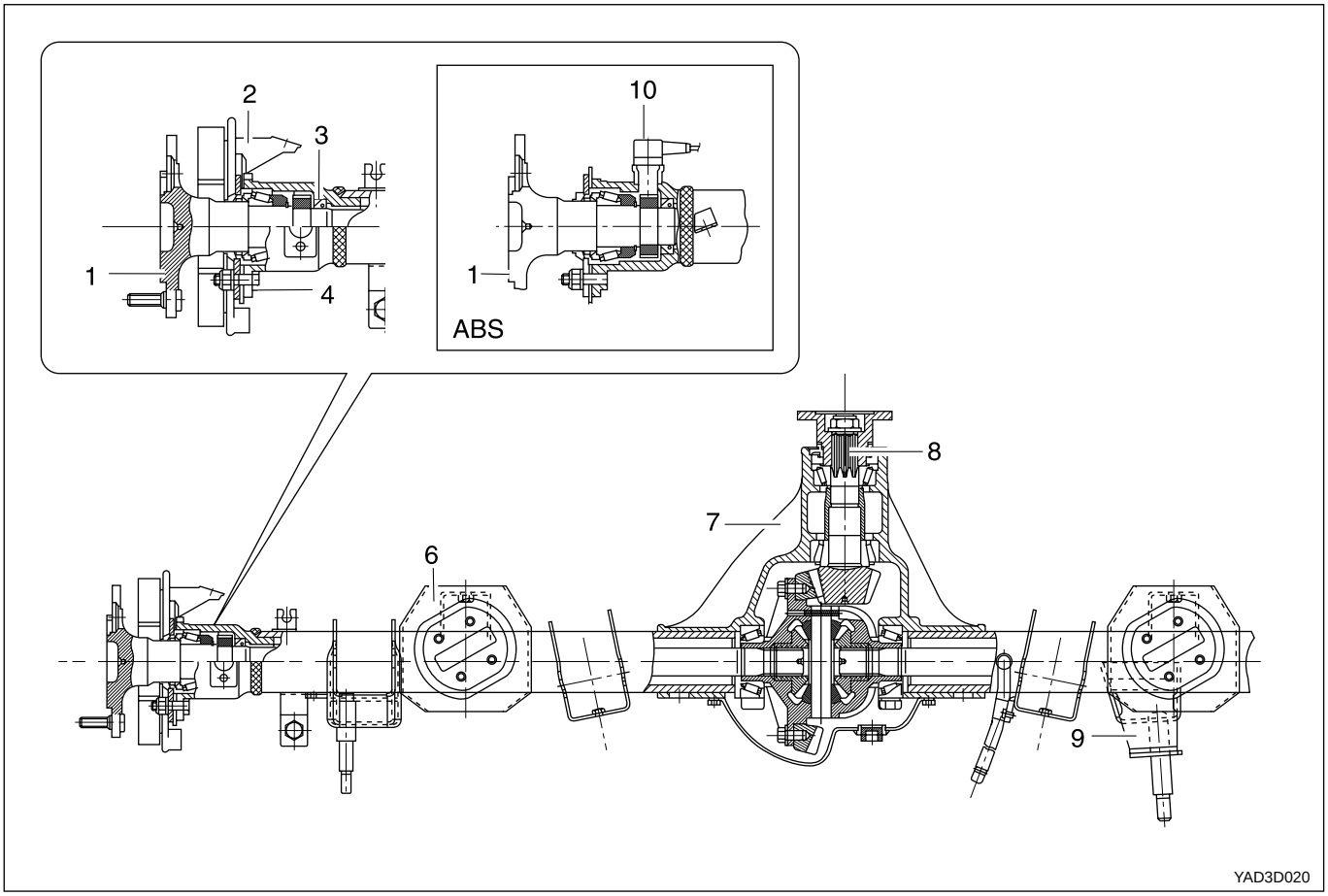
COMPONENT LOCATOR

REAR AXLE ASSEMBLY



1 Axle Shaft/Tube
2 Stabilizer Bar
3 Spring Seat & Spring
4 Upper Arm
5 Shock Absorber
6 Lateral Rod
7 Input Shaft
8 Axle Housing

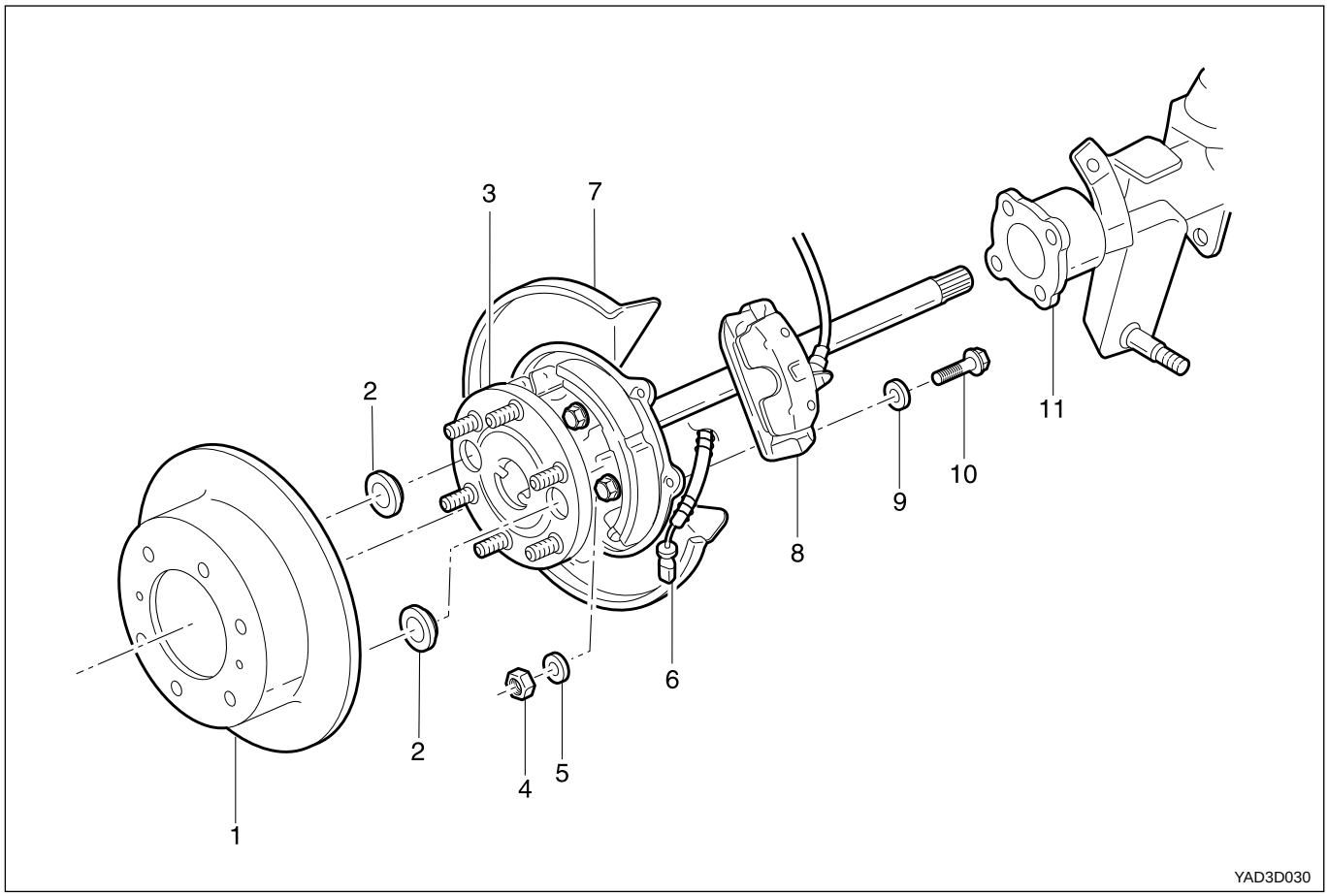
CROSS SECTIONAL VIEW



1 Rear Axle Shaft Assembly
2 Bracket Assembly
3 Hub Oil Seal
4 Bolt
5 Axle Shaft Tube
6 Coil Spring Seat (Lower)
7 Caliper Assembly
8 Input Shaft/Flange
9 Rod Mounting Bracket
10 Wheel Speed Sensor

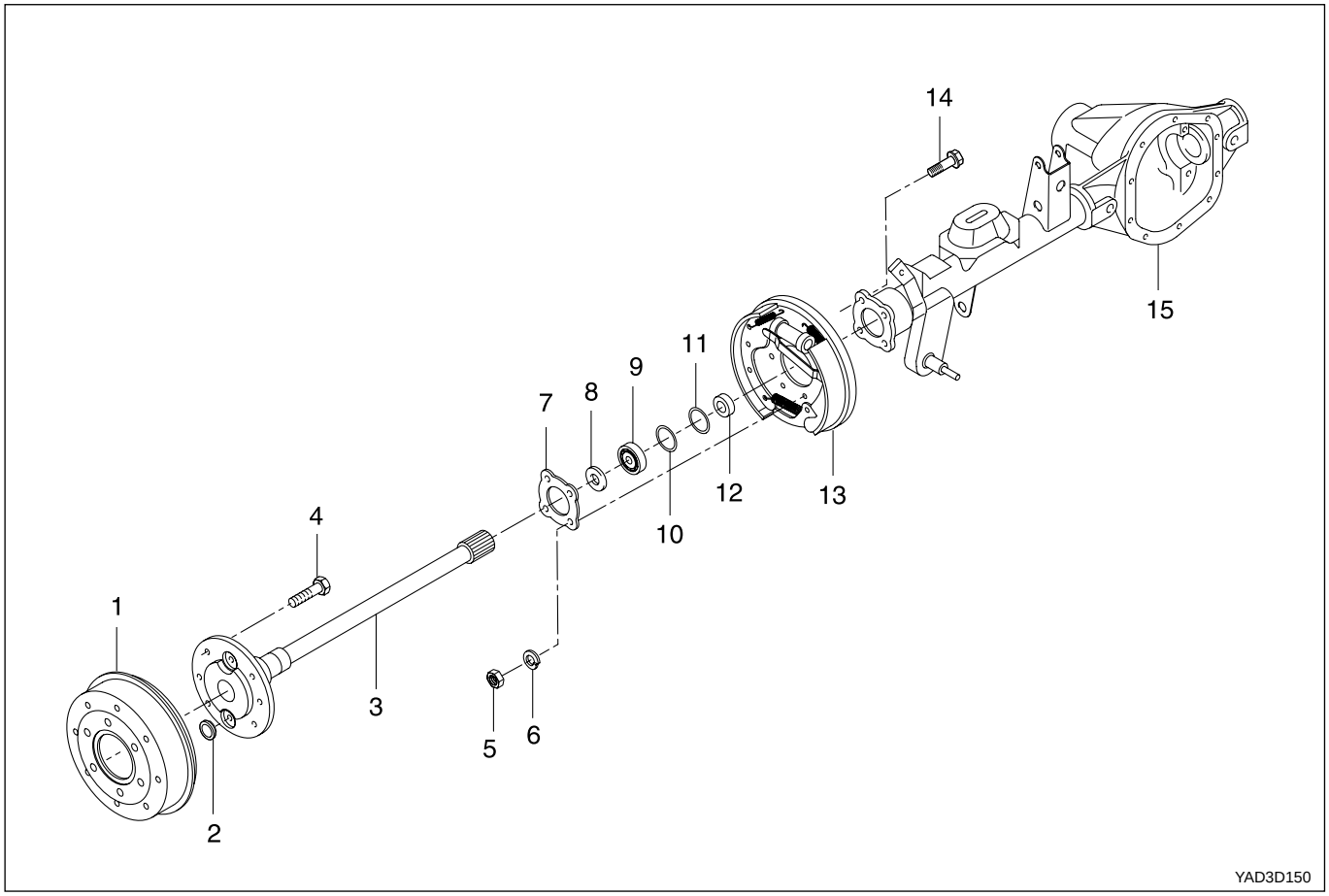
REAR AXLE SHAFT ASSEMBLY

With disc brake



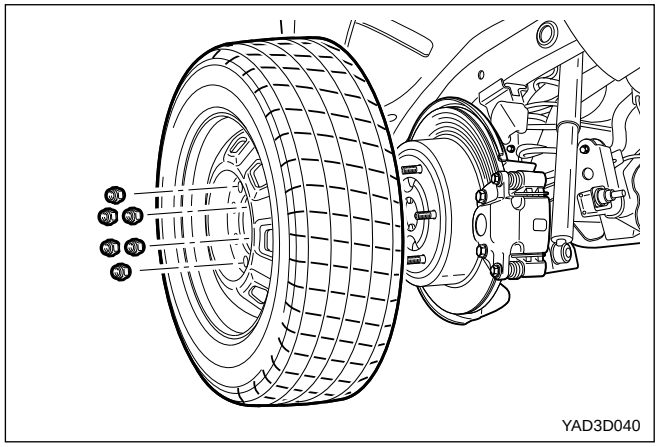
1 Brake Disc
2 Plug
3 Rear Axle Shaft
4 Nut
5 Washer
6 Parking Brake Cable
7 Parking Brake Lining & Back Plate Assembly
8 Brake Caliper Assembly
9 Spring Washer
10 Bolt
11 Rear Axle Housing

With drum brake



1 Brake Drum
2 Plug
3 Rear Axle Shaft
4 Wheel Bolt
5 Nut
6 Washer
7 Retainer Plate
8 Oil Seal
9 Bearing
10 Snap Ring
11 Snap Ring
12 Oil Seal
13 Brake Shoe & Back Plate Assembly
14 Bolt
15 Rear Axle Housing

MAINTENANCE AND REPAIR

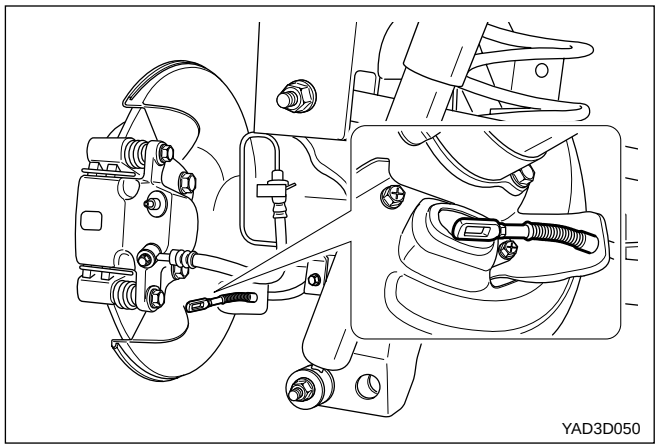

YAD3D040

ON-VEHICLE SERVICE

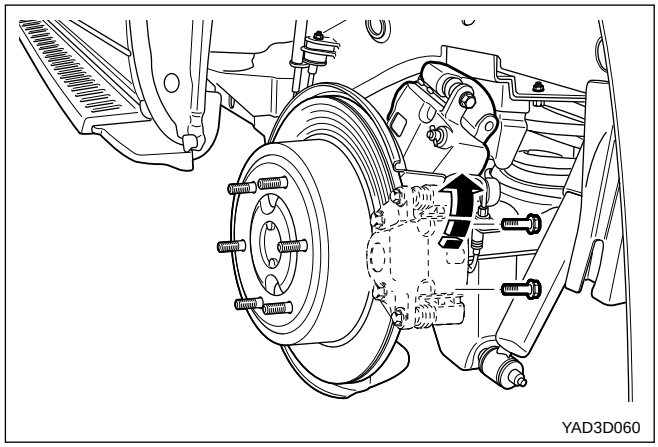
AXLE SHAFT ASSEMBLY (WITH DISC BRAKE)

Removal

1. Remove the tire.


YAD3D050

2. Release the parking brake.
3. Remove the fixing pin of parking brake.
4. After detaching the parking brake lever, detach the cable.

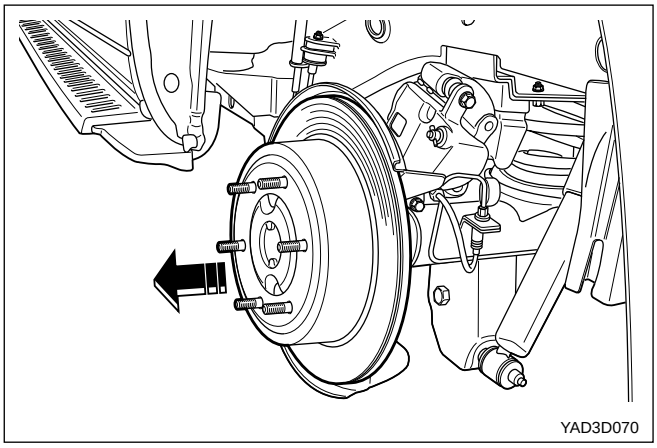

YAD3D060

5. Remove the two fixing bolt of brake caliper.

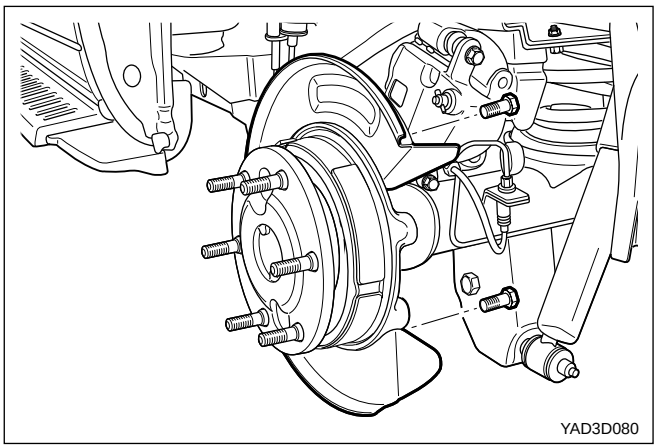
   Notice: Be careful not to damage the brake oil hose.

6. Remove the brake caliper assembly.

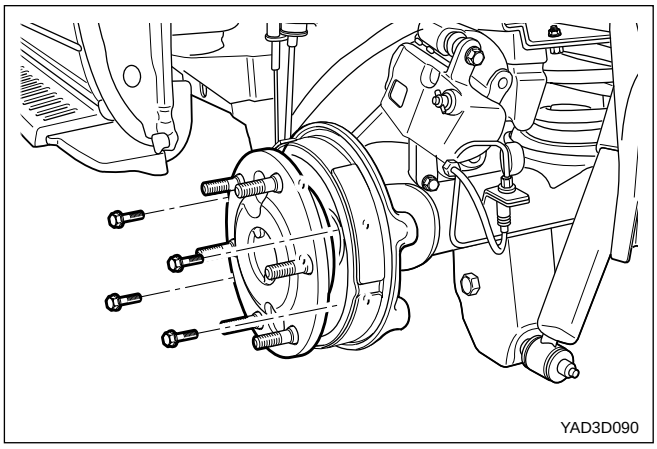
   Notice: If replacing the brake pad only, remove the upper fixing bolt of caliper pad and lower it.


YAD3D070

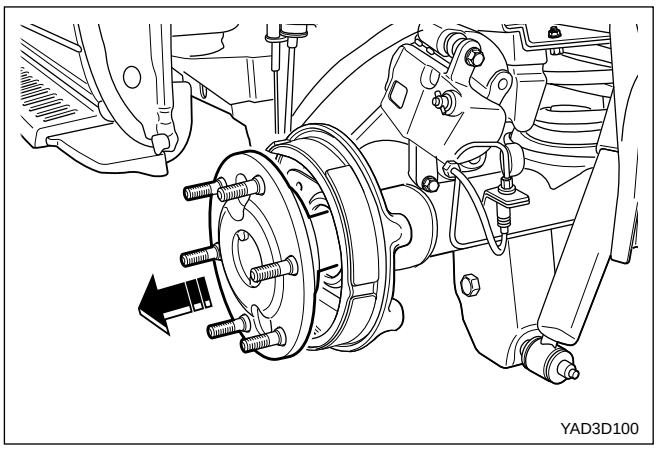
7. Remove the brake disc.


YAD3D080

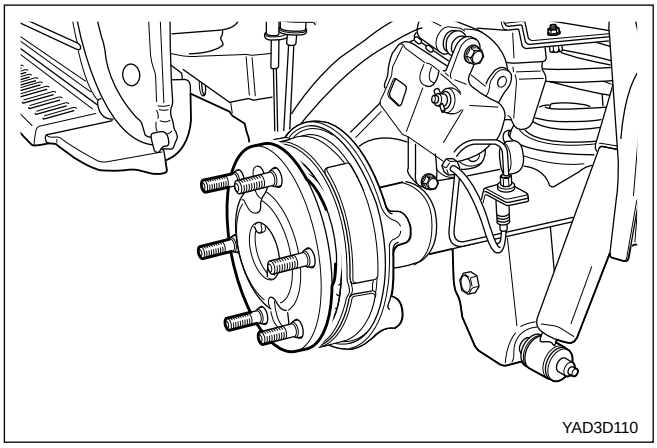
8. Remove the four fixing bolt of dust shield cover and then pull out the dust shield cover.


YAD3D090

9. Remove the two plastic plug in the axle shaft flange.
10. Remove the four fixing bolts & washers of axle housing flange from the retainer plate.


YAD3D100

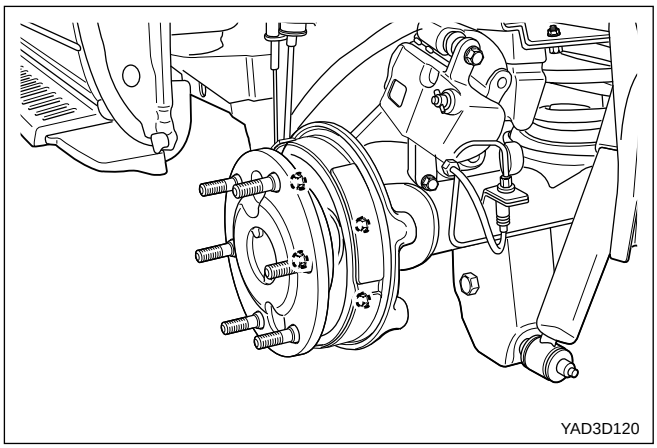
11. Remove the rear axle drive shaft.


YAD3D110

Installation

Clean the detached axle shaft, check the damage or wear.

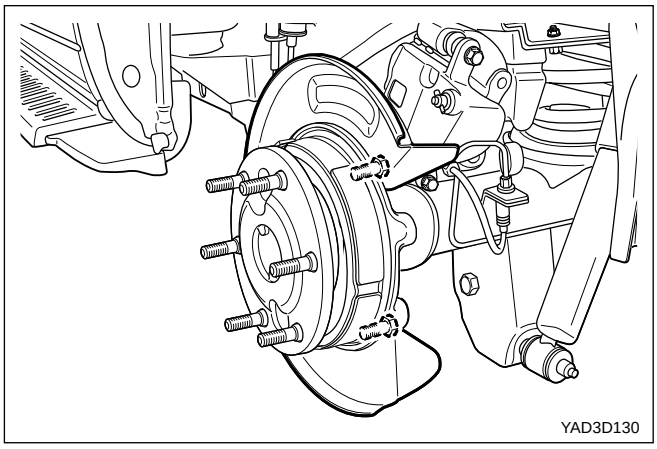
1. After checking the spline & shaft of rear axle shaft, assemble the shaft into the rear axle housing.


YAD3D120

2. Tighten the flange fixing bolts and washers with the retainer plate.

Installation Notice

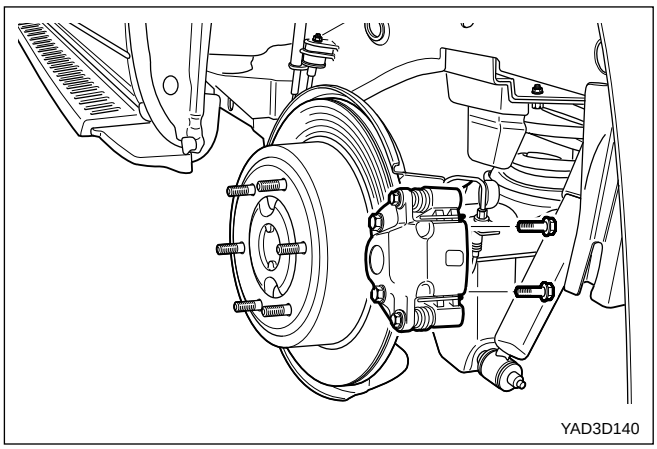
Tightening torque	50 - 65 N•m (37 - 48 lb-ft)


YAD3D130

3. Assemble the plastic plug n the rear axle flange and install the dust shield.

Installation Notice

Tightening torque	4 - 8 N•m (35 - 71 lb-in)

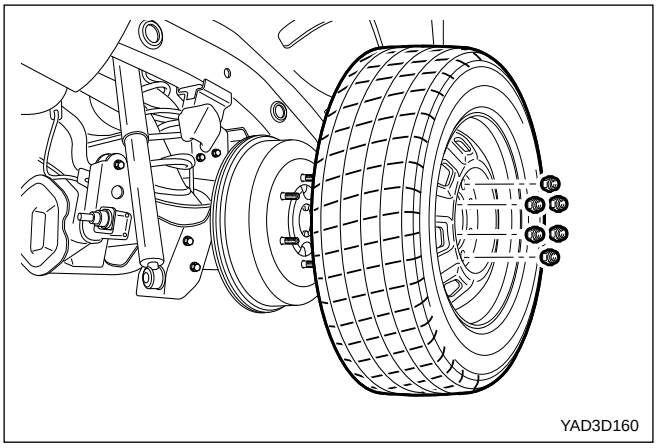

YAD3D140

4. Install the brake disc and caliper assembly.

Installation Notice

Tightening torque	85 - 105 N•m

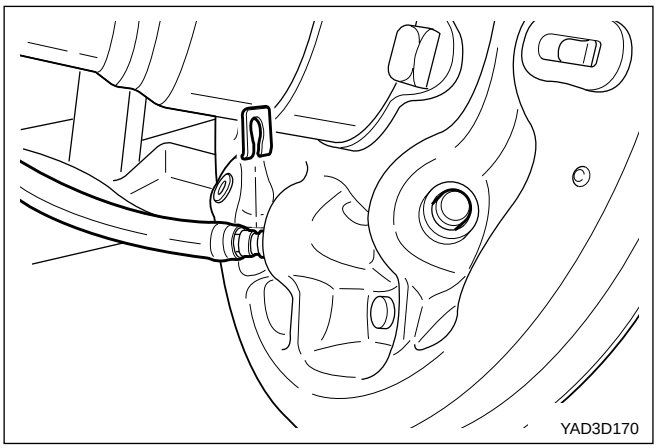
5. Install the parking brake cable and tire.


YAD3D160

AXLE SHAFT ASSEMBLY (WITH DRUM BRAKE)

Removal

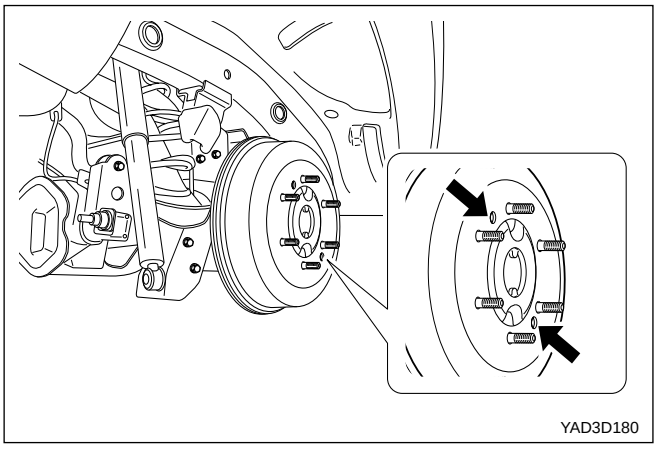
1. Release the parking brake.
2. Remove the tire.

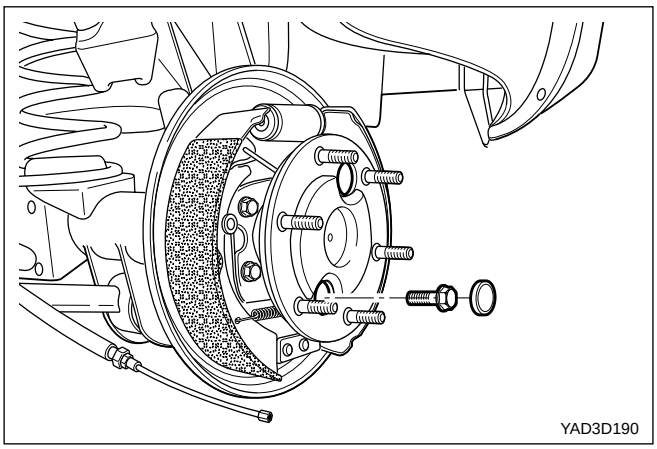

YAD3D170

3. Remove the brake drum.

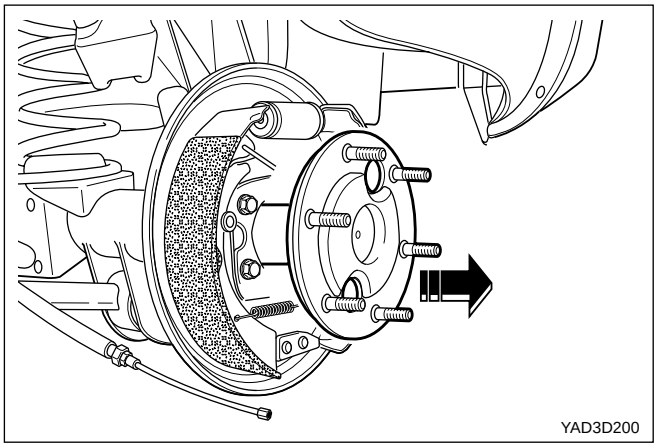
   Notice: Insert the bolt into the service hole, while tightening the both side bolts uniformly, remove the brake drum.

4. Remove the fixing pin of parking brake.
5. After detaching the cover of parking brake, disconnect the cable.

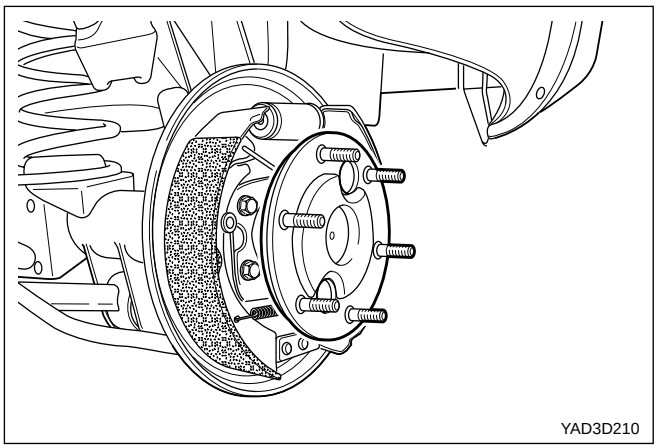

YAD3D180


YAD3D190

6. After pulling out the two plastic plug of axle shaft flange, remove the fixing nuts of inner bracket.


YAD3D200

7. Remove the axle shaft.

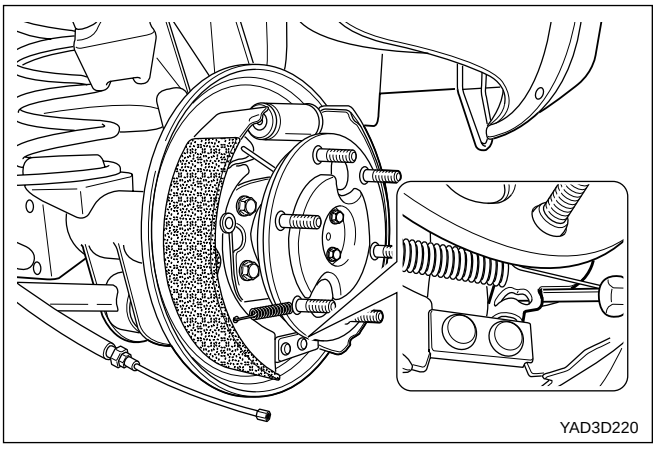

YAD3D210

Installation

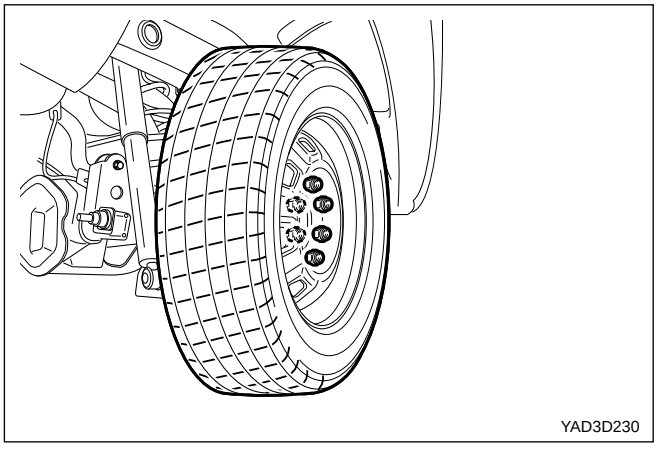
1. Check the rear axle shaft.
2. Insert the rear axle shaft into the axle housing and tighten the fixing nuts of axle shaft flange.

Installation Notice

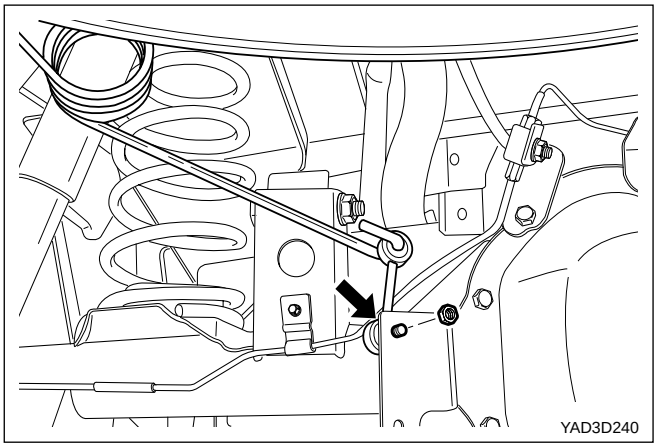
Tightening Torque	50 - 65 N•m (37 - 48 lb-ft)


YAD3D220

3. Connect the brake cable and install the brake drum.


YAD3D230

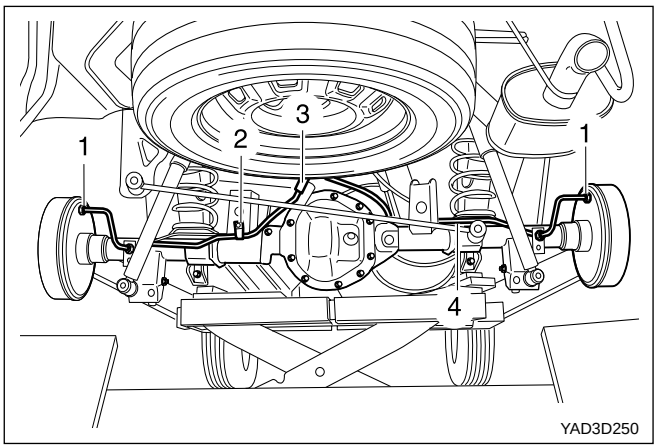
4. Install the tire and test the braking force.



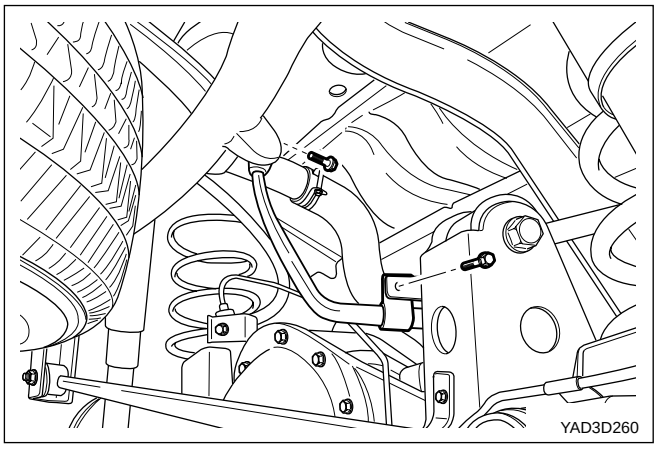
REAR AXLE HOUSING

Removal

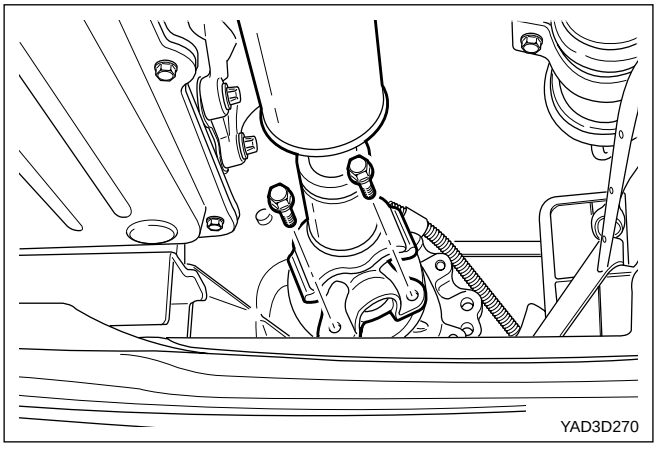
1. Remove the tire.
2. Remove the connecting rod of LCRV assembly & fixing nut of axle housing bracket.



3. Disconnect the brake oil hose & oil line (pipe)
   ① Brake pipe nut.
   ② Brake pipe mounting clip
   ③ 3-way connector
   ④ Brake pipe assembly

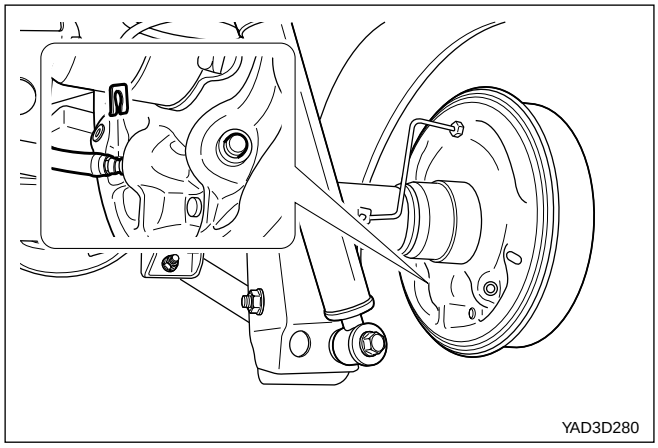


4. Detach the air breather.

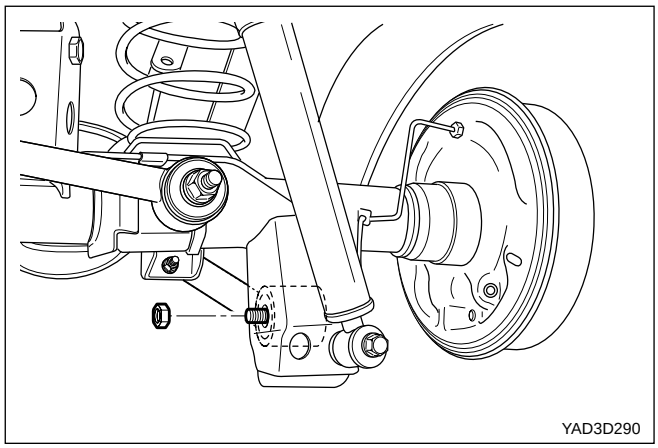


5. Remove the propeller shaft from rear axle input shaft.

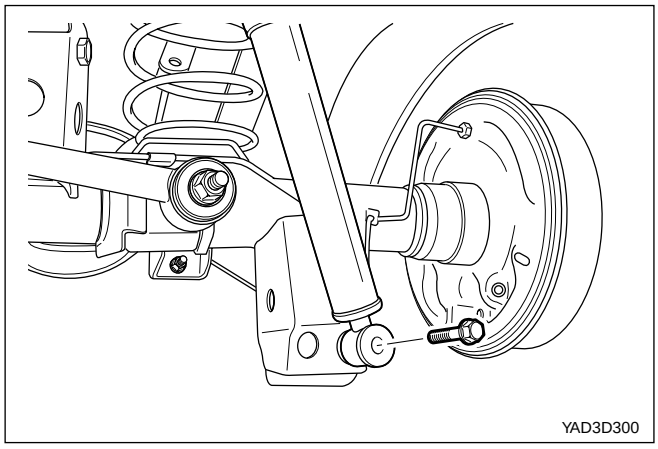
   Notice: Do alignment marks before removing.


YAD3D280

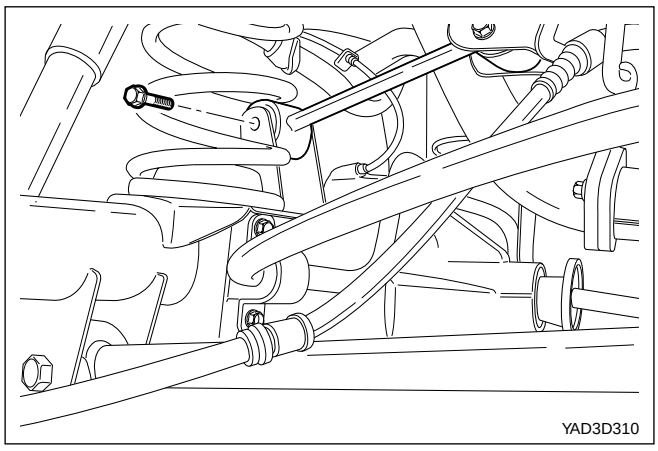
6. Pull out the fixing pin of parking brake.
7. After removing the parking brake lever, pull out the cable.


YAD3D290

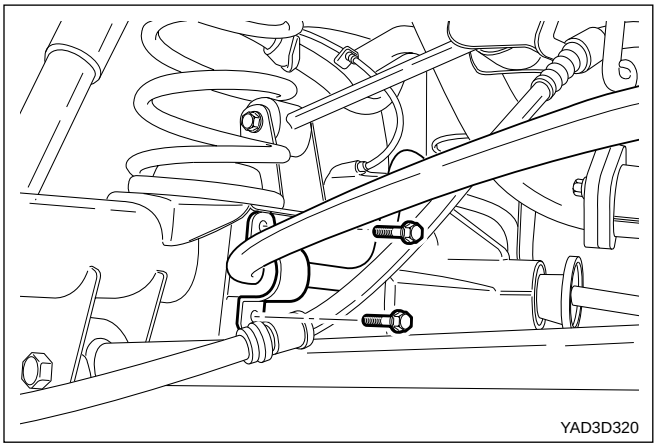
8. Remove the lower arm mounting nuts and remove the lower arm from the axle housing.


YAD3D300

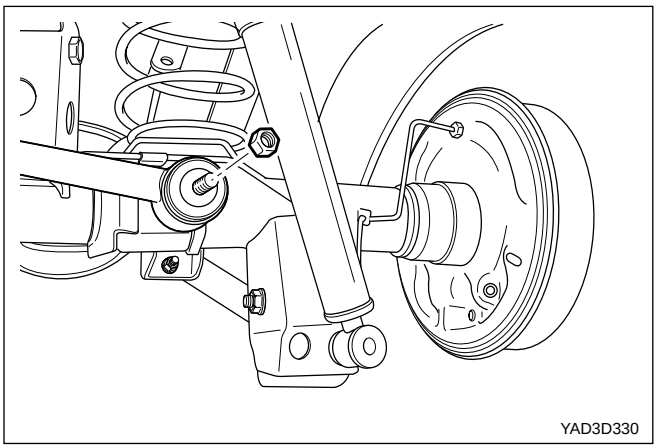
9. Detach the lower mounting of shock absorber from the axle housing.


YAD3D310

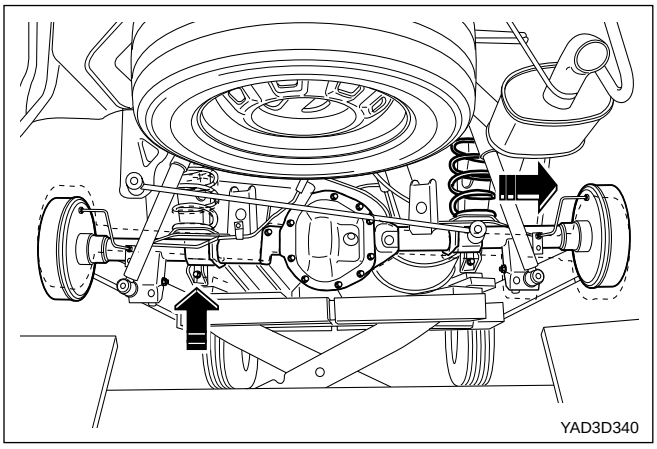
10. Remove the upper arm mounting nuts and remove the upper arm from the axle housing.



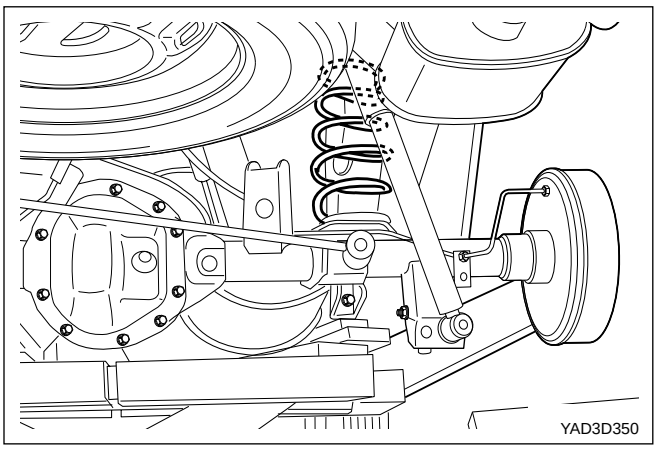
11. Remove the stabilizer bar.



12. Remove the lateral rod mounting nut and detach the lateral rod from the axle housing.

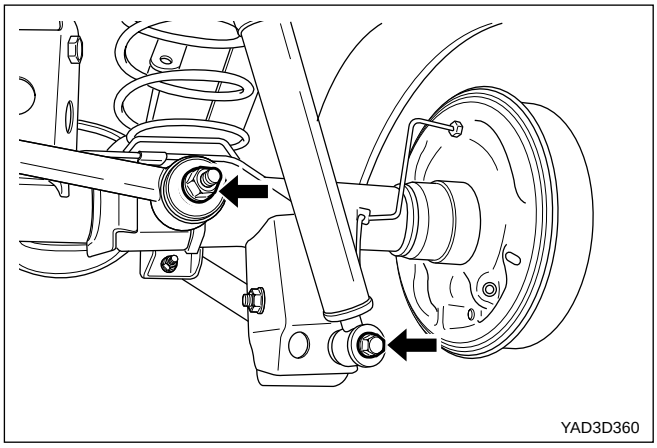


13. Lowering the axle slowly, remove the coil spring & spring seat.
14. Lower the axle housing by using the safety jack.



Installation

1. Placing the rear axle housing on the assembly position, install both coil springs.


YAD3D360

2. Install the lateral rod in axle hosing.

   Notice: Do not tighten the nuts completely.

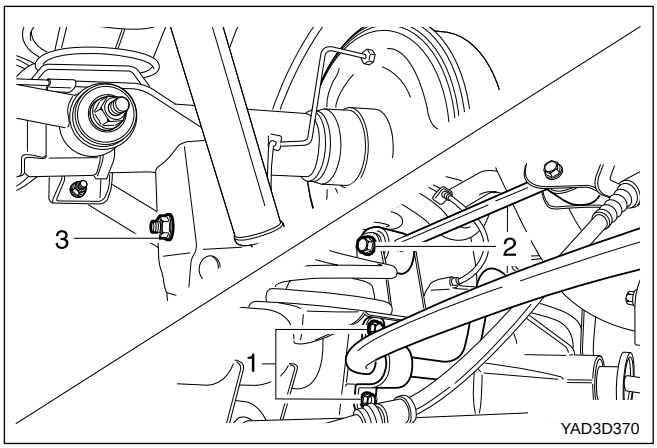
   Installation Notice

Tightening Torque	150 - 180 N•m

3. Install the shock absorber in axle housing.

   Installation Notice

Tightening Torque	30 - 45 N•m (22 - 33 lb-ft)

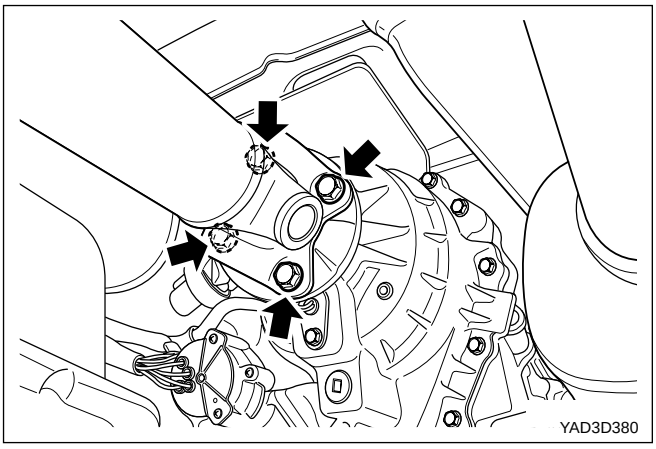


YAD3D370

4. Install the stabilizer bar and upper/lower arm in axle housing

   Installation Notice

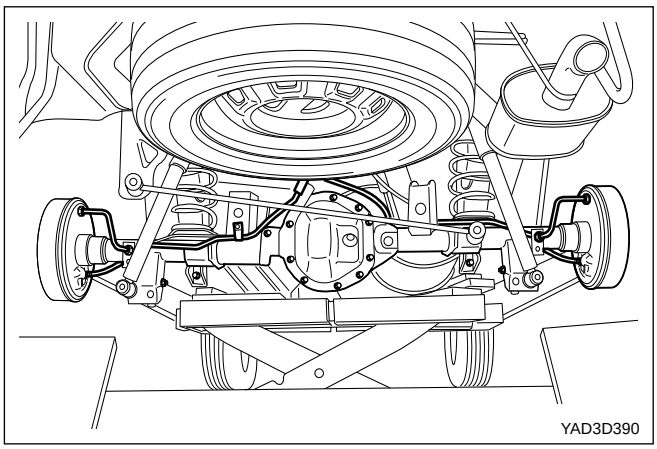
Stabilizer bar cap bolt	30 - 45 N•m (22 - 33 lb-ft)
Upper arm nut	150 - 180 N•m
Lower arm nut	150 - 180 N•m


YAD3D380

5. Install the propeller shaft of rear axle side and tighten above the fixing bolts/nuts.

   Installation Notice

Tightening Torque	70 - 80 N•m (52 - 59 lb-ft)

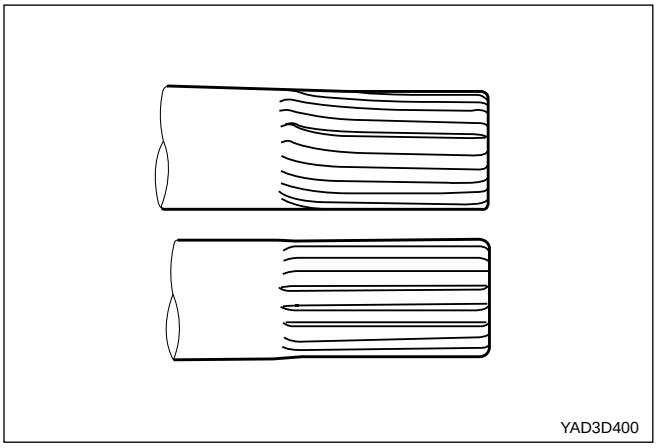

YAD3D390

6. Install the brake cable, air bleeder hose, oil pipe, LCRV unit in rear axle assembly with assembled completely.

   Installation Notice

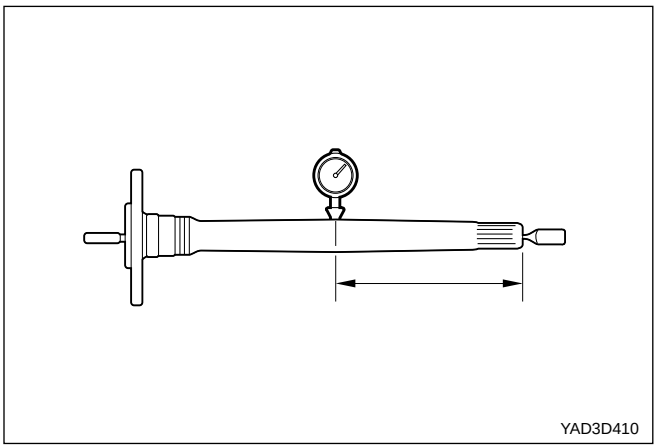
LCRV Mounting Bolt	12 - 23 N•m (9 - 17 lb-ft)
Air Breather Hose Bolt	6 - 8 N•m (53 - 71 lb-in)
Brake Oil Pipe (M10)	15 - 19 N•m (11 - 14 lb-ft)

7. Bleeding the air in brake, install the tire.


YAD3D400

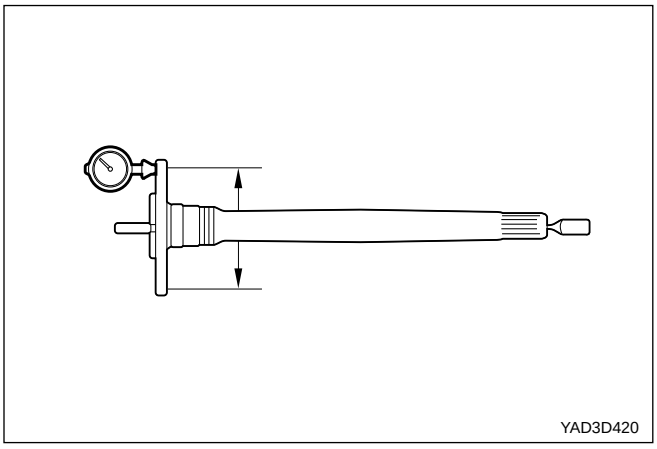
Inspection

1. Check the shaft spline for the wear and damage.


YAD3D410

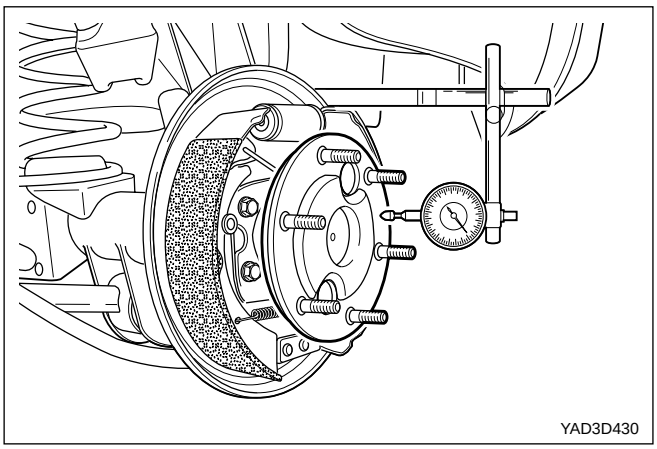
2. Measure the run-out of shaft.

Specified value	Within 1.0 mm


YAD3D420

3. Measure the run-out of shaft flange.

Specified value	Within 0.13 mm

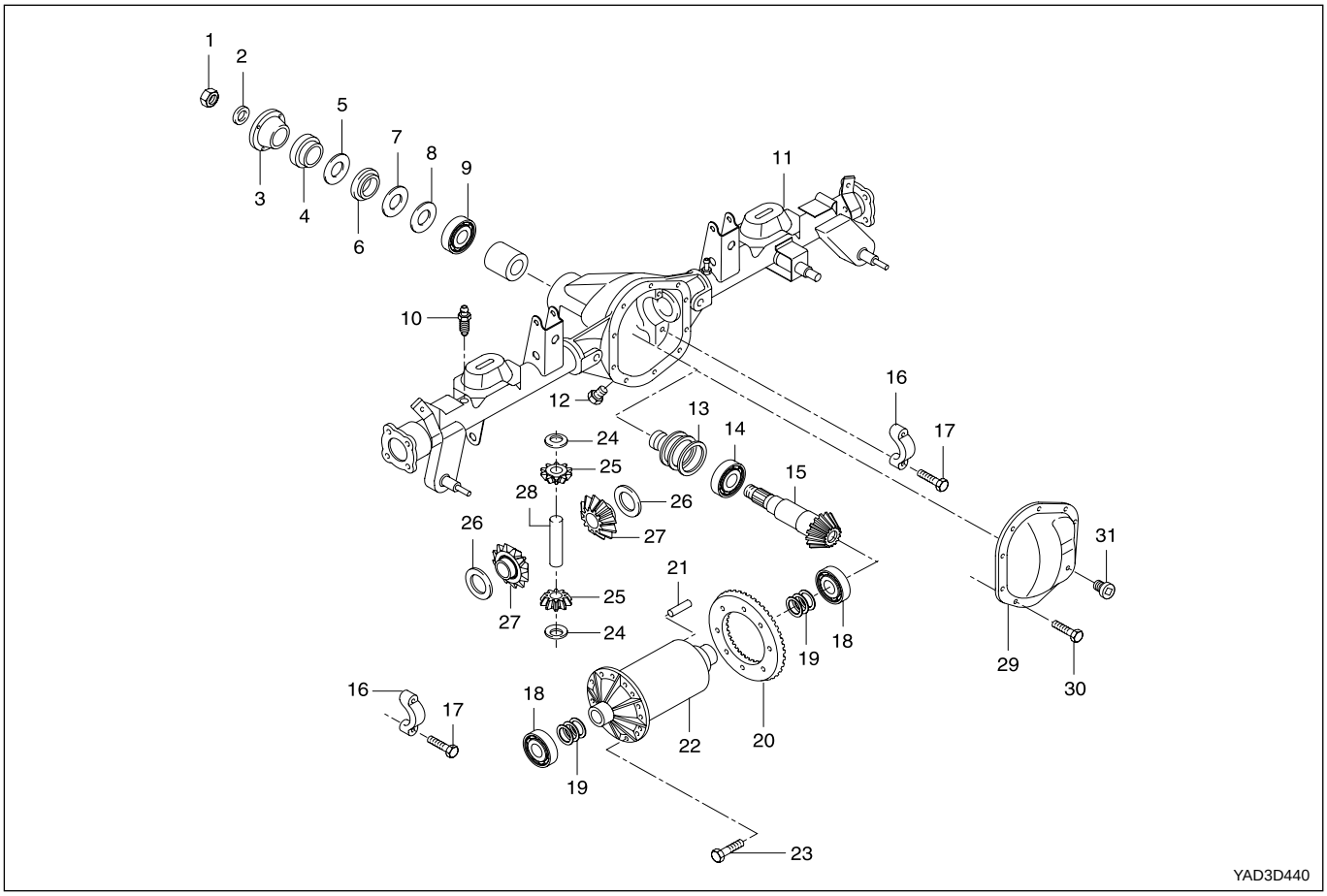

YAD3D430

4. Install the axle shaft and measure the clearance of shaft direction.

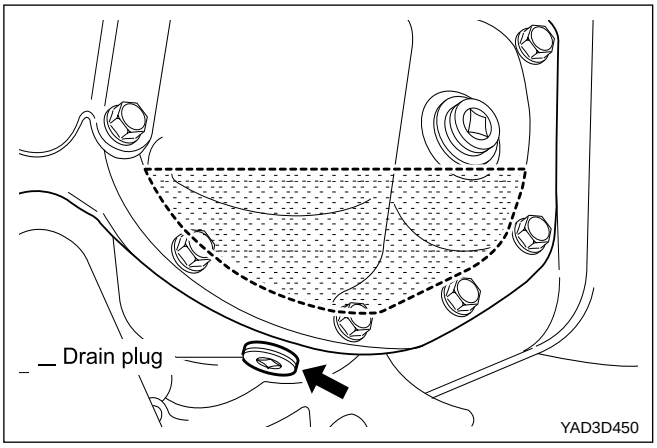
Specified value	Within 0.38 mm

UNIT REPAIR

AXLE ASSEMBLY



1 Drive Pinion Lock Nut ..... 240 - 310 N•m
2 Washer
3 Companion Flange
4 Pinion Oil Seal
5 Bearing Slinger
6 Bearing
7 Shim
8 Shim
9 Bearing Cup
10 Breather Nipple
11 Rear Axle Housing
12 Oil Drain Plug ..... 28 - 42 N•m
13 Shim
14 Bearing
15 Drive Pinion
16 Bearing Cap
17 Bolt ..... 87 - 124 N•m
18 Bearing
19 Shim
20 Ring Gear
21 Shaft Lock Pin
22 Differential Case
23 Ring Gear Mounting Bolt ..... 75 - 90 N•m
24 Thrust Washer
25 Differential Pinion
26 Thrust Washer
27 Side Gear
28 Differential Shaft
29 Housing Cover
30 Bolt ..... 38 - 46 N•m
31 Oil Filler Plug ..... 28 - 42 N•m



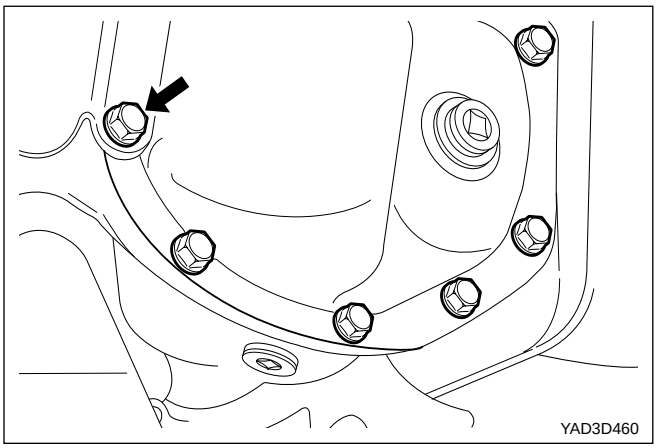
DIFFERENTIAL GEAR ASSEMBLY

Disassembly

1. Remove the drain plug and drain oil. Reinstall the drain plug.

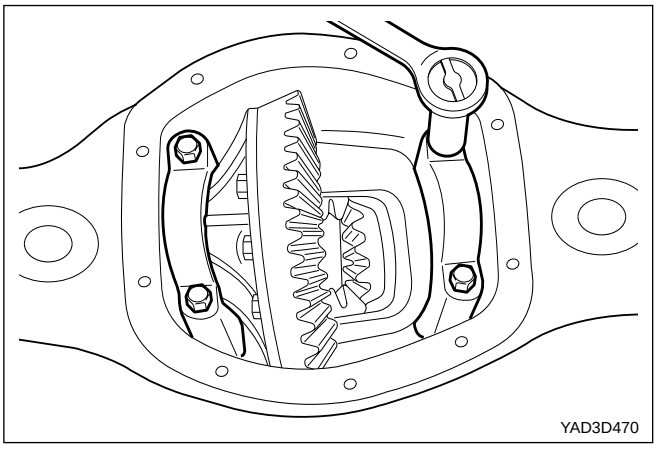
   Installation Notice

Tightening Torque	28 - 42 N•m (21 - 31 lb-ft)



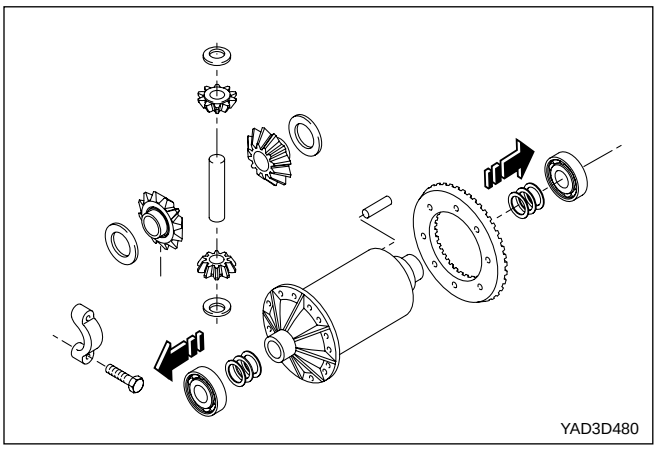
2. Remove the axle housing cover.

   Notice: Clean the cover and housing contact surface.

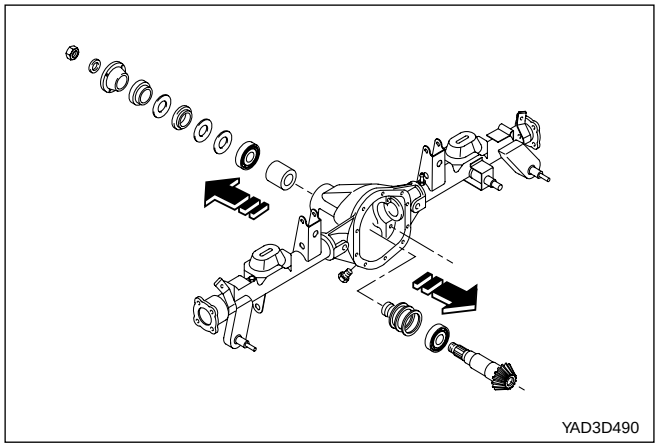


3. Remove the bearing cap bolts and remove the bearing cap. Pull out the differential carrier assembly.

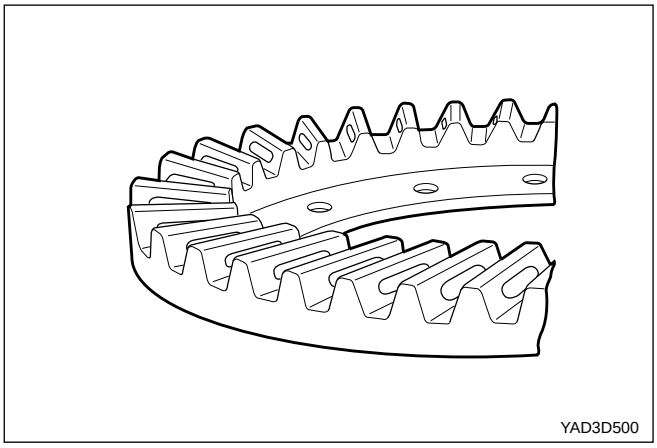
   Notice: Do alignment marks on the bearing cap not to change the caps before removal. When pulling out, be careful to damage the axle housing.



4. Disassemble the parts of differential carrier assembly.



5. Remove the drive pinion lock nut. Disassemble the parts of drive pinion

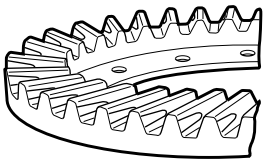
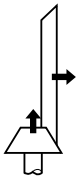
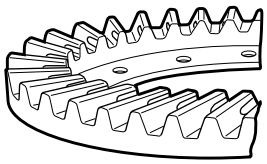
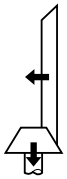
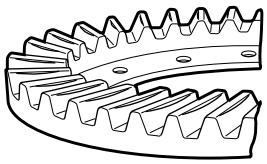
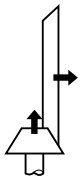
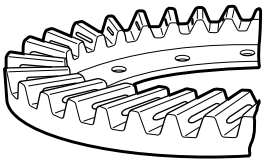
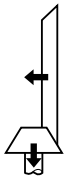

YAD3D500

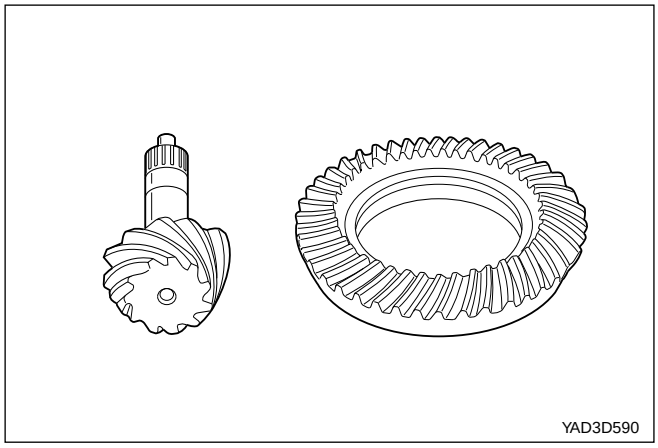
Inspection of Ring Gear Tooth Contact Pattern

1. Normal Contact

   Apply gear-marking compound (prussian blue/red lead) on the ring rear teeth. Rotate the ring gear and check the to the contact pattern.

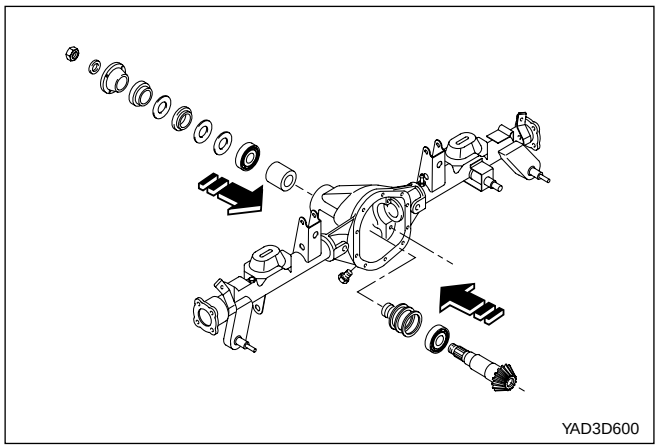
2. Abnormal contact

Tooth contact pattern	Possible cause	Remedy
1. Heel contact  A YAD3D510	Excessive backlash • Noise can be occurred	Adjust backlash (Drecrease backlash) • Select proper shin to move the drive pinion toward the ring gear (toward toe)  B YAD3D520
2. Toe contact  A YAD3D530	Insufficient backlash • Tooth can be damaged or broken under heavy load	Adjust backlash (Increase backlash) • Select proper shim to move the drive pinion against the ring gear (toward heel)  B YAD3D540
3. Face contact  A YAD3D550	Excessive backlash • Drive pinion shaft is apart from the ring gear • Noise can be occurred	Adjust backlash (Increase pinion shim) • Move the drive pinion toward the ring gear (toward center of ring gear)  B YAD3D560
4. Flank contact  A YAD3D570	Insufficient backlash • Gear contacts on the low flank • Gear can be damaged or worn • Noise can be occurred	Adjust backlash (Decrease pinion shim) • Move the ring gear toward the drive pinion (toward ring gear center line)  B YAD3D580


YAD3D590

Assembly

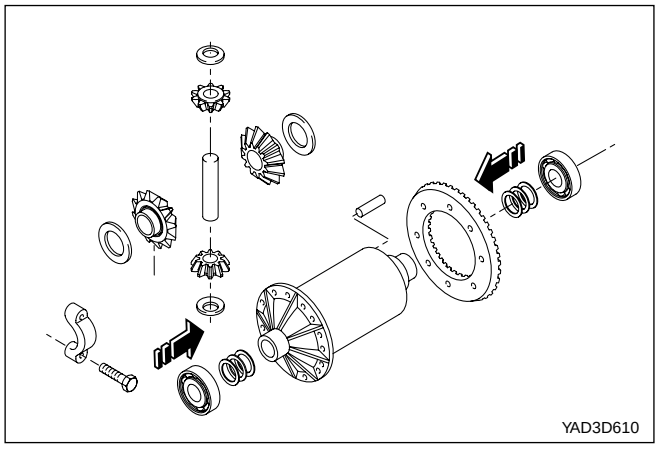
1. Clean all parts and check the followings.
   - Check the ring gear, drive pinion for wear and damage. If damaged, replace it as a set.
   - Check the bearing for sticks, wear, noise and turning resistance.
   - Check the side gear, pinion, pinion shaft and thrust washer for wear and damage.
   - Check the differential carrier for crack and wear (bearing contact surface). Check the gear case for crack.


YAD3D600

2. Assemble the drive pinion assembly to the axle housing and then tighten the pinion lock nut.

   Installation Notice

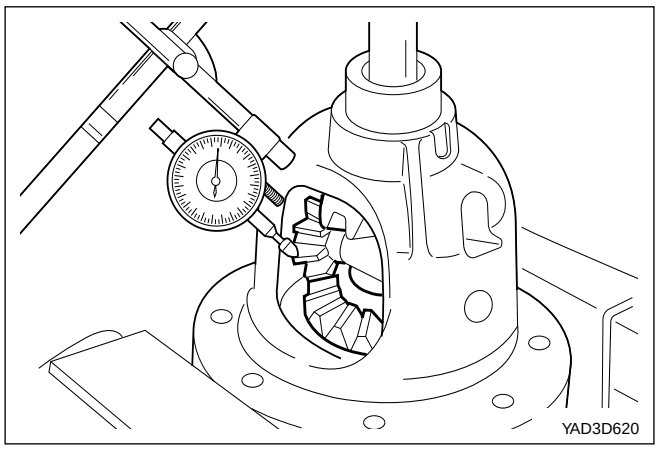
Tightening torque	240 - 310 N•m


YAD3D610

3. Assemble the differential carrier assembly. Align the ring gear to the mark of differential carrier, tighten the fixing bolts.

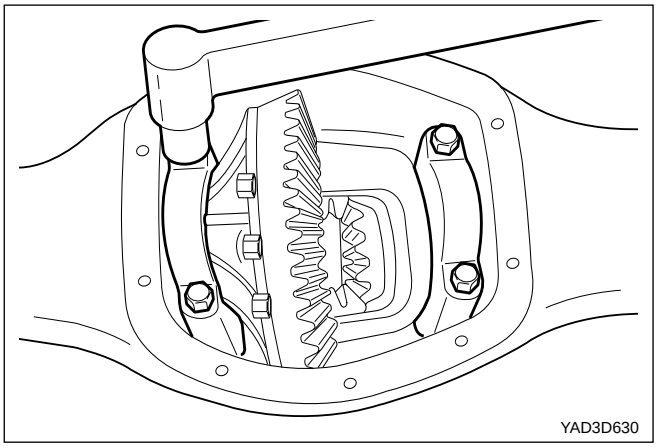
   Installation Notice

Tightening Torque	75 - 90 N•m (55 - 66 lb-ft)


YAD3D620

4. Measure the backlash of side gear and pinion gear.

Specified value	0 - 0.5 mm

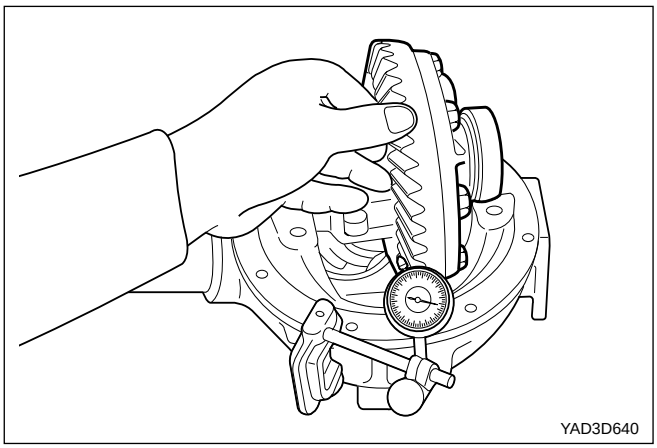

YAD3D630

5. Install the differential carrier assembly into the axle housing. Set up the bearing cap and then tighten the cap bolts.

Installation Notice

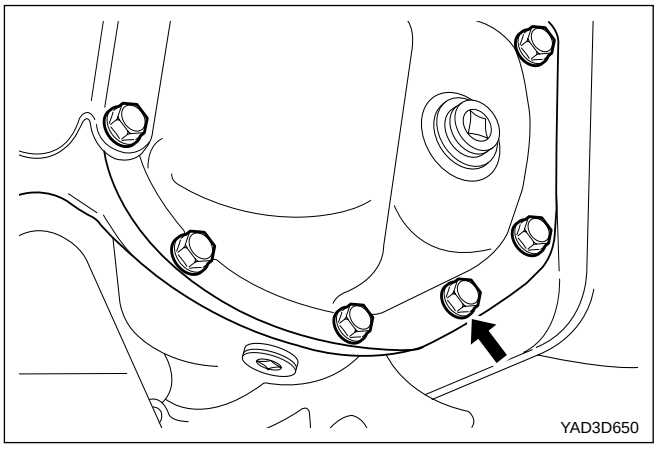
Tightening Torque	48 - 69 N•m (35 - 51 lb-ft)

Notice: Be careful not to change the caps. Be sure to keep the original position of the caps.


YAD3D640

6. Measure the backlash of drive pinion and ring gear.

Specified value	0.13 - 0.20 mm


YAD3D650

7. Install the axle housing cover. Tighten the fixing bolts.

Installation Notice

Tightening Torque	39 - 46 N•m (29 - 34 lb-ft)

SECTION 4A

BRAKE SYSTEM

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DESCRIPTION AND OPERATION

BRAKING SYSTEM TESTING

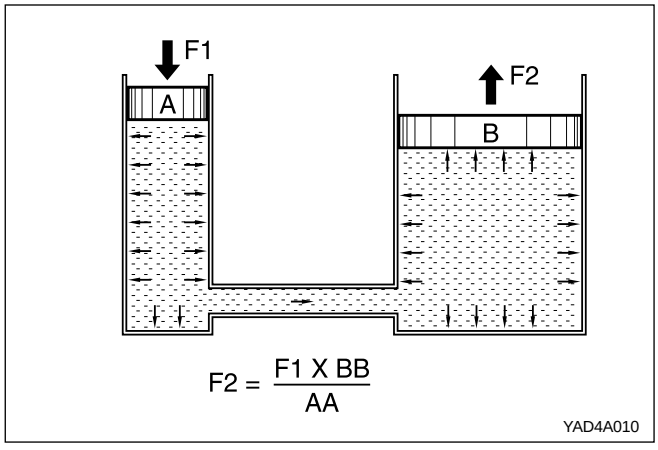
Brakes should be tested on a dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if the roadway is wet, greasy or covered with loose dirt which can cause tires not to grip the road unequally. Testing also will be inaccurate on a crowned roadway because the wheels tend to bounce.

Test the brakes at different vehicle speeds with both light-and heavy-pedal pressure; however, avoid locking the brakes and sliding the tires. Locked brakes and sliding tires do not indicate brake efficiency since heavily braked but turning wheels will stop the vehicle in less distance than locked brakes. More tire-to-road friction is present with a heavily braked, turning tire than with a sliding tire.

There are three major external conditions that affect brake performance:

- Tires having unequal contact and grip of the road will cause unequal braking. Tires must be equally inflated and the tread pattern of the right and the left tires must be approximately equal.
- Unequal loading of the vehicle can affect the brake performance since the most heavily loaded wheels require more braking power and thus more braking effort than the others.
- Misalignment of the wheels, particularly conditions of excessive camber and caster, will cause the brakes to pull to one side.

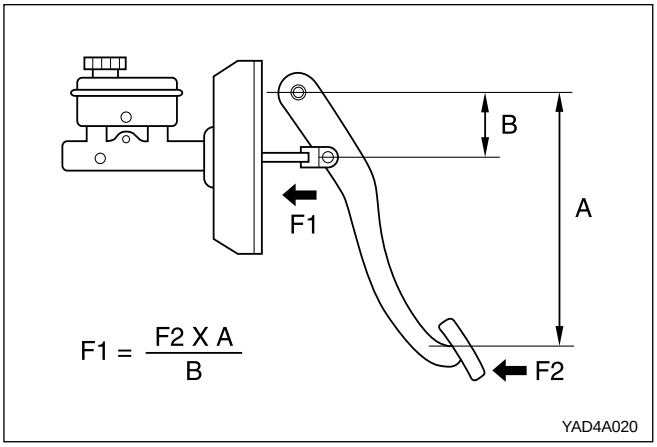
HYDRAULIC BRAKE SYSTEM



This system uses the principle of the leverage and PASCAL's. When you pushes the brake pedal, the pressure by adapting the pedal increases through the power booster and delivers it into the master cylinder to generate hydraulic pressure.

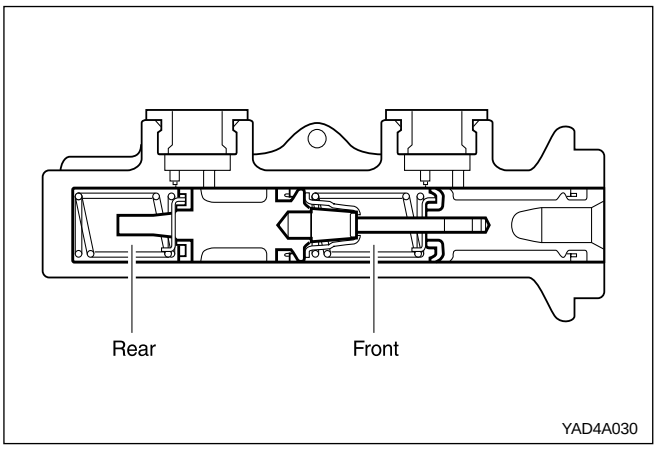
Hydraulic pressure generated by the master cylinder delivers to the caliper through the brake pipe or hose. This hydraulic pressure allows the caliper pad to push the disc plate. Thus it generates the braking forces.

BRAKE PEDAL



Brake pedal uses the principle of the leverage and increases the pressure into the master cylinder in order to generate the braking forces.

MASTER CYLINDER



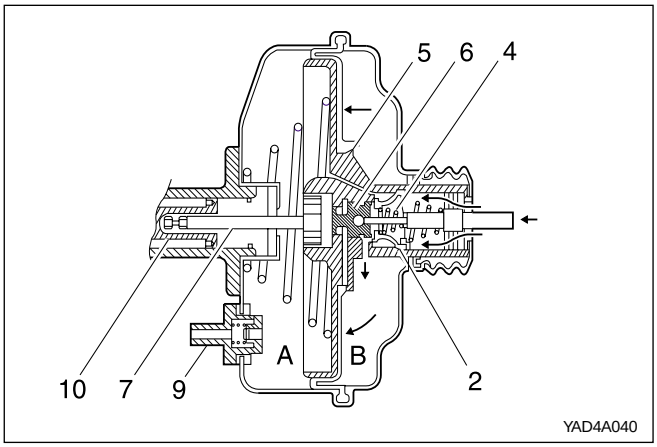
The master cylinder is designed for use in a diagonally split system. One front and one diagonally opposite rear brakes are served by the primary piston. The opposite front and rear brakes are served by the secondary piston.

The master cylinder incorporates the functions of the standard dual master cylinder, plus a low fluid level indicator and the proportioning valves in the non-antilock braking system. The proportioning valves limit the outlet pressures to the rear brakes after a predetermined master cylinder pressure has been reached. The brake master cylinder sensor is attached under the body of the plastic brake master cylinder reservoir.

BRAKE BOOSTER

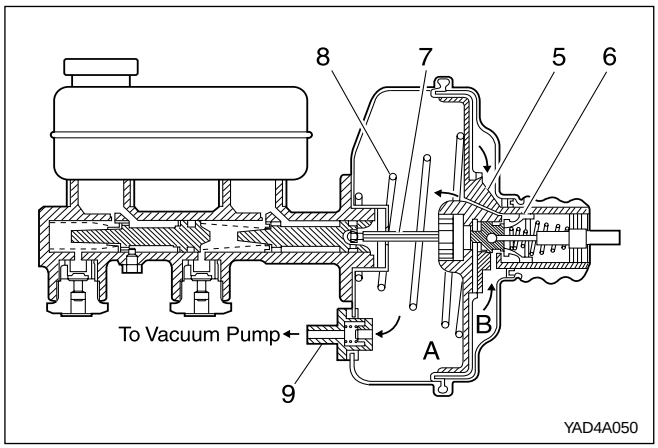
The brake booster is a double-diaphragm, vacuum-suspended unit. In normal operating mode, with the service brakes in the release position, a vacuum-suspended booster operates with a vacuum on both sides of its diaphragm. When the brakes are applied, air at atmospheric pressure is admitted to one side of the diaphragm to provide the power assist. When the brakes are released, atmospheric air is shut off from that side of the diaphragm. The air is then drawn from the booster through the vacuum check valve by the vacuum source.

1. Pressure Distribution At working



When it pushes the brake pedal, the booster pushrod (1) pushes the poppet (2) and valve plunger (3) and the poppet (2) goes closely to the power piston (5) resulting in closing the vacuum valve (9). The power cylinder (A) and (B) is isolated and the valve plunger (3) is separated from the poppet (2). And then the air valve (6) opens in order to flow air into (B) through the filter and thus, the power piston (5) enables to push the master cylinder pushrod (7) for pressure distribution.

2. Pressure Distribution After working



When it pushes off the brake pedal, the valve plunger (3) returns back to the original position by return spring (4) resulted in closing the air valve (6) and open the vacuum valve (9) in order to balance the pressures between (A) and (B) of the power cylinder. And then the power piston (5) returns back to the original position by the master cylinder reaction and the diaphragm return spring (8) pressure.

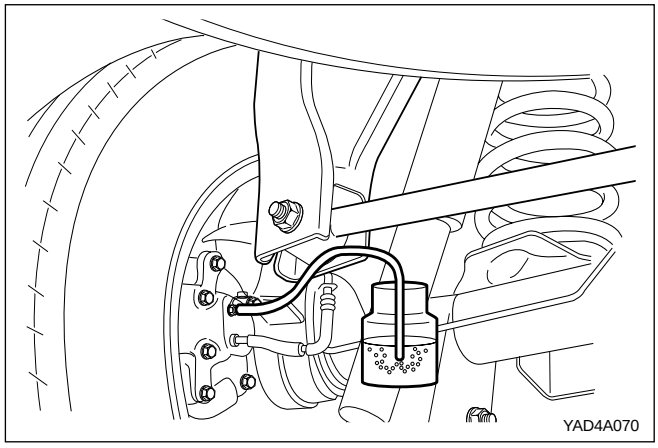
SPECIFICATIONS

Application		MANDO Brake		KDAC Brake	
		Drum Type	Disc Type	Drum Type	Disc Type
Brake Pedal	Pedal Ratio	4.3 : 1	←	←	-
	Pedal Stroke	138 mm	←	←	-
	Pedal Freeplay	1 ~ 4 mm	←	←	-
Master Cylinder	Type	Tandem Type (/W Lever Sensor)	←	←	-
	Inner Diameter	Ø 25.4 mm	←	←	←
Brake Booster	Type	Vacuum Booster Type	←	←	←
	Ratio	7 : 1	←	←	←
Front Brake	Type	-	Ventilated Disc Type	-	←
	I.D. of Caliper Cylinder	-	Ø 60 mm	-	Ø 60 mm
	Thickness of Brake Pad	-	10 mm	-	←
	Thickness of Disc Plate	-	24 mm	-	←
Rear Brake	Type	Drum Type	Solid Disc	Drum Type	←
	I.D of Drum	Ø 254 mm	-	Ø 254	-
	Shoe Type	Leading End Trailing Type	-	Leading End Trailing Type	-
	Lining	55 x 243 x 5 mm	-	55 x 243	-
	I.D. of Wheel Cylinder	Ø 23.87 mm	-	Ø 23.81 mm	-
	I.D. of Caliper Cylinder	-	Ø 42.9 mm	-	Ø 42 mm
	Thickness of Brake Pad	-	10 mm	-	10 mm
	Thickness of Disc Plate	-	10.4 mm	-	10.4 mm
Parking Brake	Type	Rear Wheel Internal Expansion			
	Type	Mechanical			
Brake Fluid	Spec.	DOT4 or DOT3			

DIAGNOSTIC INFORMATION AND PROCEDURES

Symptom	Check	Action
Noise Or Vehicle Vibration When Applied Brake	Incorrectly Mounted Back Plate or Caliper	Repair
	Loosened Bolt of Back Plate or Caliper	Retighten
	Crack or Uneven Wear of Brake Drum or Disc	Replace
	Foreign Material Inside the Brake Drum	Clean
	Pad or Lining Sticking to Contact Surface	Replace
	Excessive Clearance Between Caliper and Pad	Repair
	Uneven Contact of Pad	Repair
	Lack of Lubrication	Lubrication
	Loosened Suspension	Retighten
Pulls To One Side When Braking	Incorrect Tire Pressure Between Left and Right	Adjust
	Poor Contact of Pad or Lining	Repair
	Oil or Grease is Applied to Pad or Lining	Replace
	Bent or Uneven Wear of Drum	Replace
	Incorrectly Mounted Wheel Cylinder	Repair
	Faulty Auto Adjuster	Repair
Poor Braking	Dirty or Lack of Fluid	Replenish or Replace
	Air in Brake System	Bleeding
	Faulty Brake Booster	Repair
	Poor Contact of Pad or Lining	Repair
	Oil or Grease on Pad	Replace
	Faulty Auto Adjuster	Repair
	Over Heated Rotor Due to Dragging Pad or Lining	Repair
	Clogging Brake Line	Repair
	Faulty Proportioning Valve	Repair
Increasing Pedal Stroke (Pedal Goes To Floor)	Air in Brake System	Bleeding
	Fluid Leaking	Repair
	Excessive Clearance Between Push Rod and M/Cylinder	Adjust
Brake Dragging	Parking Brake is not Fully Released	Repair
	Incorrect Adjustment of Parking Brake	Adjust
	Weak Return Spring of Brake Pedal	Replace
	Incorrect Pedal Free-play	Repair
	Broken Rear Drum Brake Shoe Return Spring	Replace
	Lack of Lubrication	Lubrication
	Damaged Master Cylinder Check Valve or Piston Return Spring	Replace
	Insufficient Clearance Between Push Rod and Master Cylinder	Adjust
Poor Parking Brake	Worn Brake Lining	Replace
	Dirty Brake Lining Surface by Grease or Oil	Replace
	Binding Parking Brake Cable	Replace
	Faulty Auto Adjuster	Repair
	Excessive Lever Stroke	Adjust Lever Travel or Check the Cable

MAINTENANCE AND REPAIR



BLEEDING THE BRAKES

For Master Cylinder and Wheel Cylinder Replacement

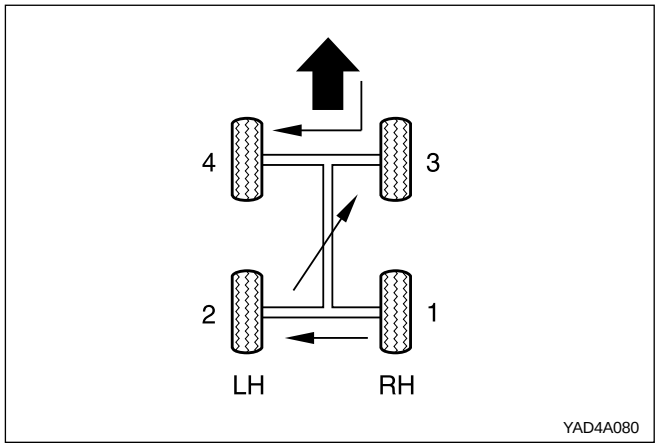
Notice: The bleeding sequence is as follows; right rear, left rear, right front and left front.

Check the fluid level and add fluid during the bleeding operation.

1. Raise the vehicle with the assistance worker riding up to replenish the oil in the brake oil reservoir tank.
2. Remove the bleeder screw and cap.
3. Attach a transparent tube over the valve. Allow the tube to hang submerged in brake fluid in a transparent container.
4. Slowly push the brake pedal several times and hold the brake pedal.
5. Tighten the bleeder screw after loosening the bleeder screw and draining the fluid.

   Notice: Hold the brake pedal until tightening the bleeder screw.

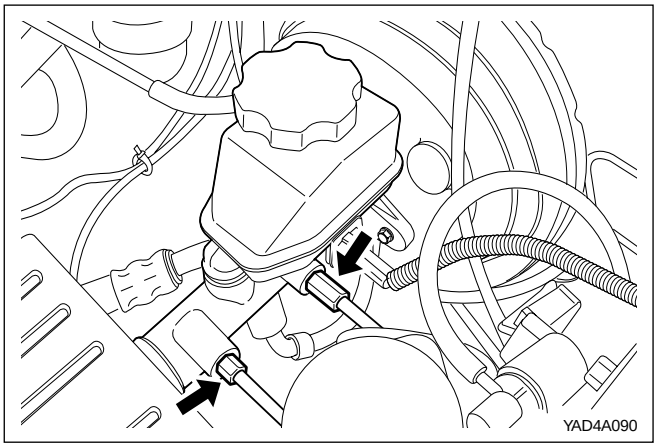
6. Repeat the step 5, 6 until all the air is removed.
7. Check the leaks for the bleeder screw.

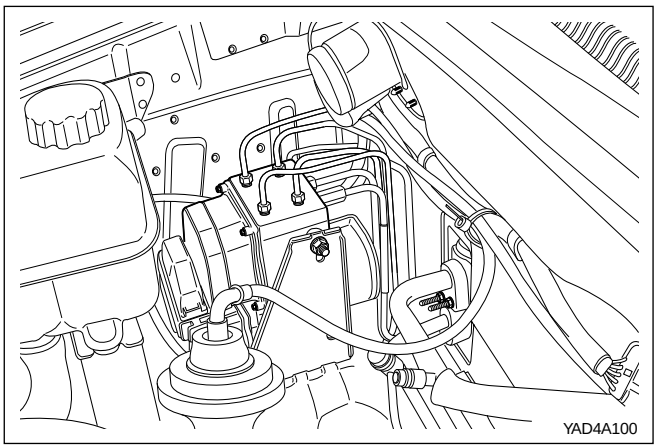


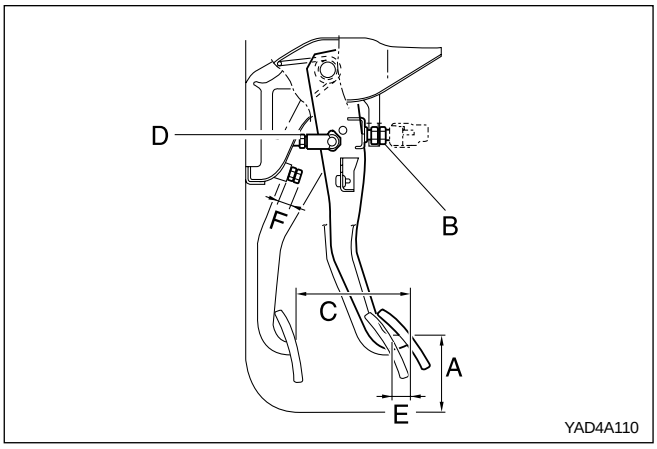
8. Bleed air in the system at four wheels in order as shown in the figure if pressure building is not enough by depressing the pedal after above air bleeding.

   Notice:

   - Always bleed the air after replacing brake fluid or master cylinder, caliper, brake hose and pipe.
   - Do not reuse the bled brake fluid.
   - Rapid pumping of the brake pedal pushes the master cylinder secondary piston down the bore in a manner that makes it difficult to bleed the system.
   - Care must be taken to prevent the brake fluid contacting any painted surface to prevent damage to the paint finish.
   - Check any leak for the applicable portion after bleeding.







For Master Cylinder Replacement

1. Add oil after master cylinder replacement.
2. Run the engine and depress the brake pedal several times to build pressure and then keep the pedal fully depressed.
3. Loosen the screw of primary and secondary pipe at the master cylinder outlets to bleed air.
4. Repeat above step No.3 several times until there are no more air bubbles.
5. Bleed air in the system at the hydraulic unit outlet pipe and wheel if pressure building is not enough by depressing the pedal only after above air bleeding.

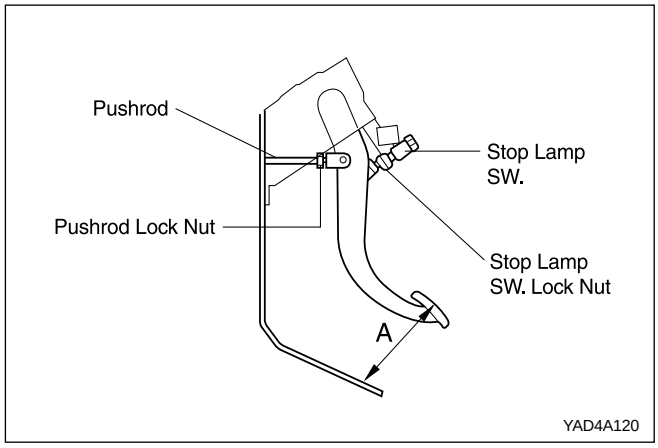
For Hydraulic Unit Replacement

1. Add oil after hydraulic unit replacement.
2. Run the engine and depress the pedal several times to build pressure and then keep the pedal fully depressed.
3. Loosen hydraulic pipe screws at the hydraulic unit outlets to bleed air.
4. Repeat above step No.3 several times until there are no more air bubbles.
5. Bleed air in the system from the wheel if pressure building is not enough by pressing the pedal only after above air bleeding.

BRAKE PEDAL

Pedal Travel Check

1. Start the engine.
2. Push the pedal three times.
3. With the brake depressed by about 30 kg (66.15 lb) load, measure the clearance between the pedal pad and the lower dash panel.
4. Check pad or shoe wear, any leak for the brake system when the measured value is below the specified value.
5. If the pedal height is not in the specified value, loosen the lock nut of the brake booster push rod and adjust the push rod length.



Pedal Height

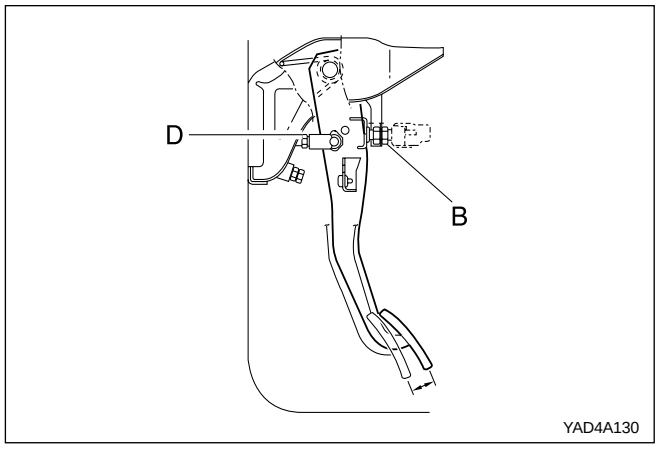
Specification (A)	177 mm (From the floor mat)

Notice: If the pedal height is not in the specified value, loosen the lock nut and adjust the height.

Pedal Free Play

Specification (C)	138 mm

Notice: If the pedal free play is not in the specified value, loosen the stop bolt and the lock nut and adjust free play up to max. travel.

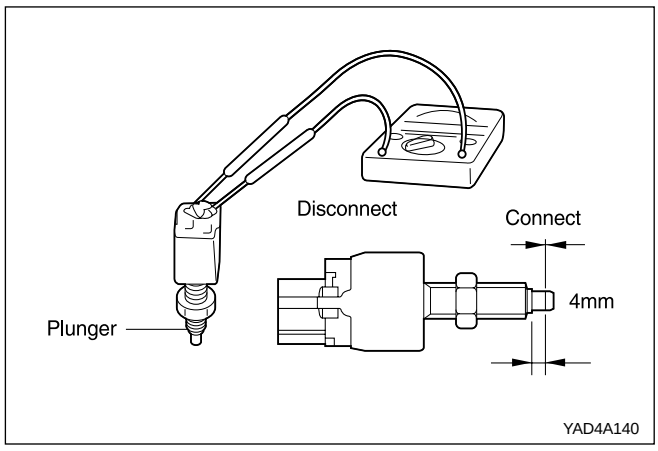


Brake Pedal Free Play

Push the brake pedal several times to discharge the vacuum of the power booster. Measure the pedal movement until the hardness is felt when pushing the brake pedal by hand.

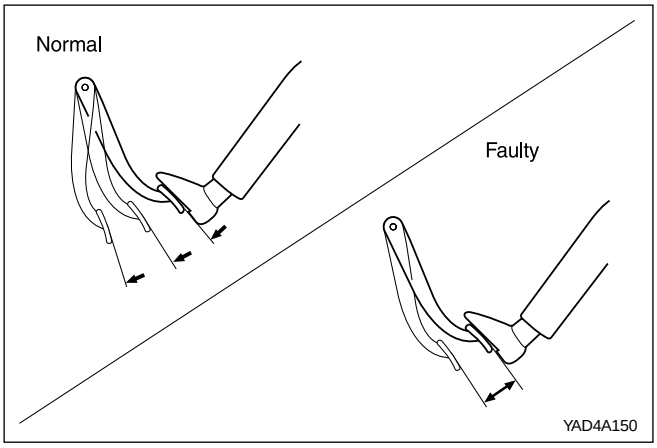
Specification	3 - 8 mm

If clearance is less than the specified value, verify that the clearance between the outer case of the stop lamp and the brake pedal within the specified value. If clearance is beyond on the specified value, it means that the clearance between the clevis pin and brake pedal arm is beyond. Check the faulty and repair, adjust as needed.



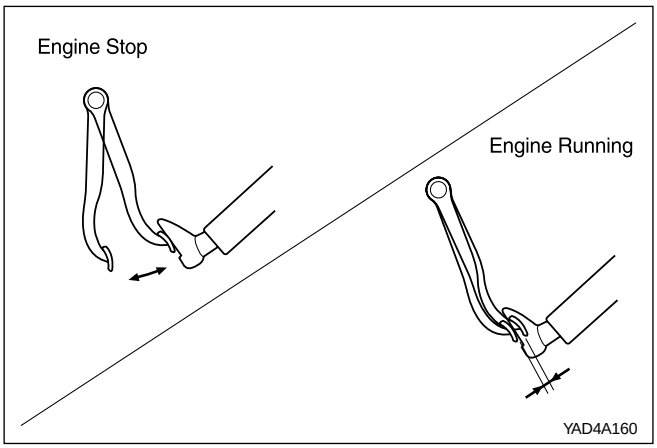
STOPLAMP SWITCH

The multi-meter connects the stoplamp switch connector and push the plunger. When the stoplamp switch does not connected with pushing the plunger, the stoplamp switch is normal.

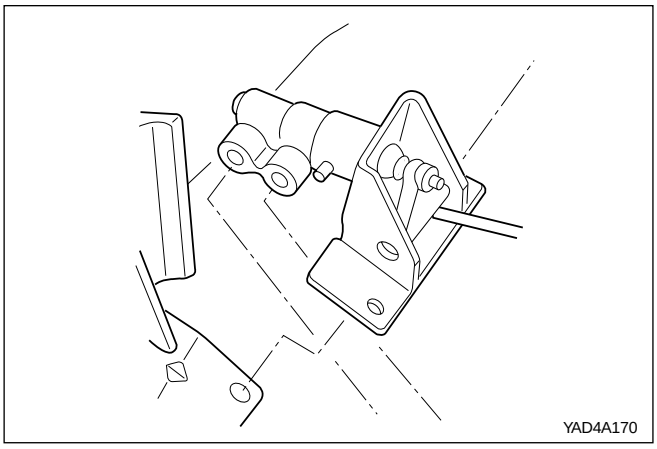


BRAKE BOOSTER FUNCTIONAL CHECK

1. With the engine stopped, eliminate vacuum in the booster by pumping the brake pedal several times.
2. Push the pedal down and hold in this position.
3. Start the engine.
4. The booster is OK if the pedal drops further because of extra force produced.



If the brake pedal does not drop, the vacuum system is probably defective and should be checked. If no defect is revealed by checking the vacuum system, the defect is in the booster itself.

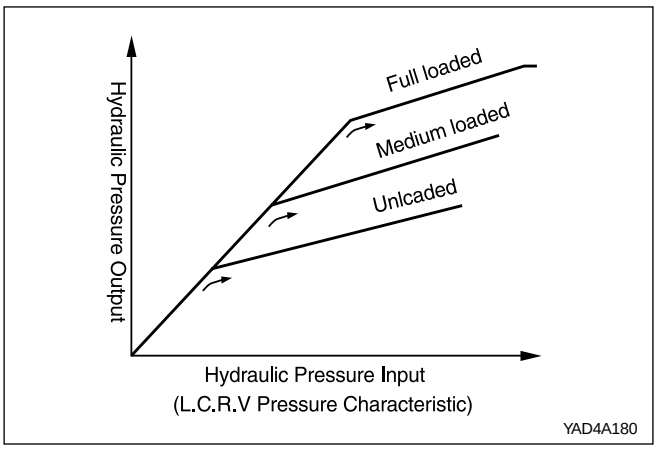


LCRV (LOAD CONSCIOUS REDUCING VALVE)

LCRV consists of sensing part and hydraulic control part.

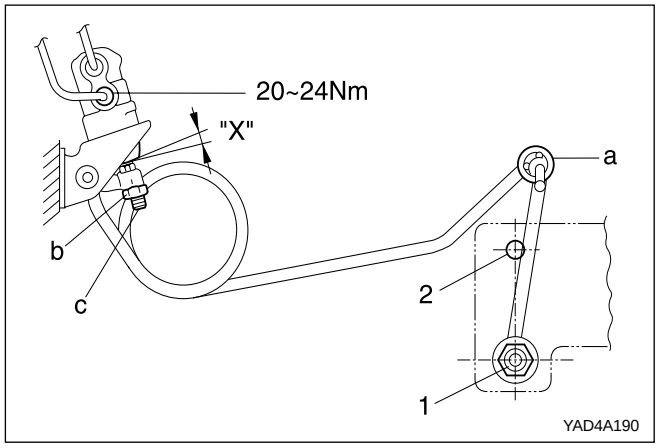
1. Sensing Part

   It detects the changes of vehicle height caused by vehicle load. It consists of load sensing spring and control lever which change according to vehicle load.



2. Hydraulic Control Part

   It consists of valve stem devices which controls hydraulic pressure according to load detected by sensing part.



Setting Method

1. Install the connecting rod (a) to the No.1 hole.
2. Adjust the clearance “X” to be 0mm and tighten the bolt (c) using the lock nut (b).

   Installation Notice

Tightening Torque	14 - 18 N•m (10 - 13 lb-ft)

3. Remove the connecting rod (a) from the No.1 hole and reinstall it to the No.2 hole.

   Installation Notice

Tightening Torque	14 - 18 N•m (10 - 13 lb-ft)

4. Place alignment marks between the lock nut (b) and adjusting screw (c) after the valve setting.
5. LCRV setting should be performed with unloaded vehicle condition.

Inspection

When it occurs the malfunction in the LCRV, the sensor spring, valve body assembly, rear axle or rear spring may be replaced. For these replacement, the following inspection should perform;

Symptom	Possible Cause	Action
Poor Braking Performance	Air in Brake System	Bleeding
	Poor Adjustment of Sensor Spring	Adjust
	Damaged Sensor Spring	Replace
	Fluid Leaking from LCRV	Replace
Rear Wheels Lock Early	Poor Adjustment of Sensor Spring	Adjust
	Internal Fluid Leaking of LCRV	Replace

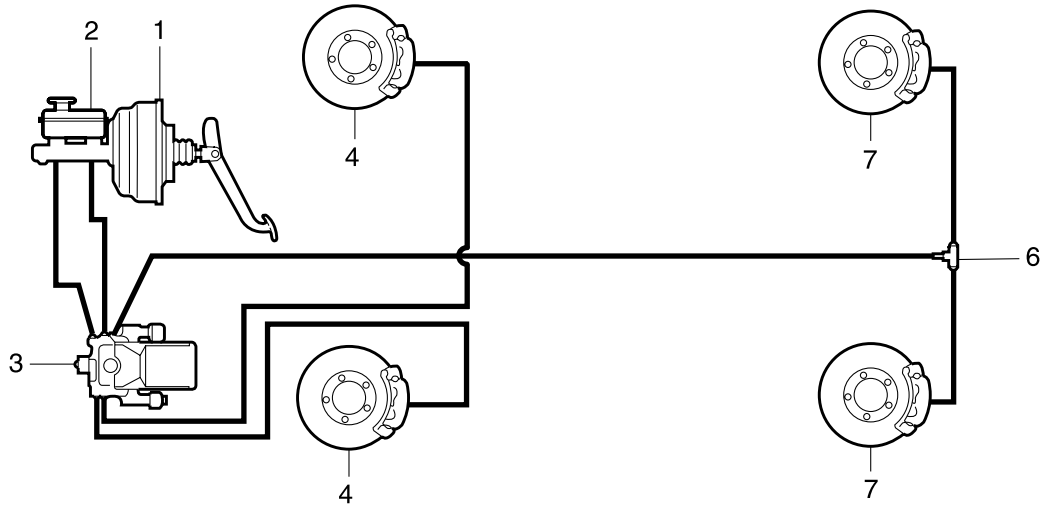
Notice:

- Fluid leaking from LCRV results from poor valve open/close or sealing wear caused by the foreign materials in the LCRV.
- When you change or repair the LCRV, it may affect the braking performance. Thus, ensure to use the approved part.

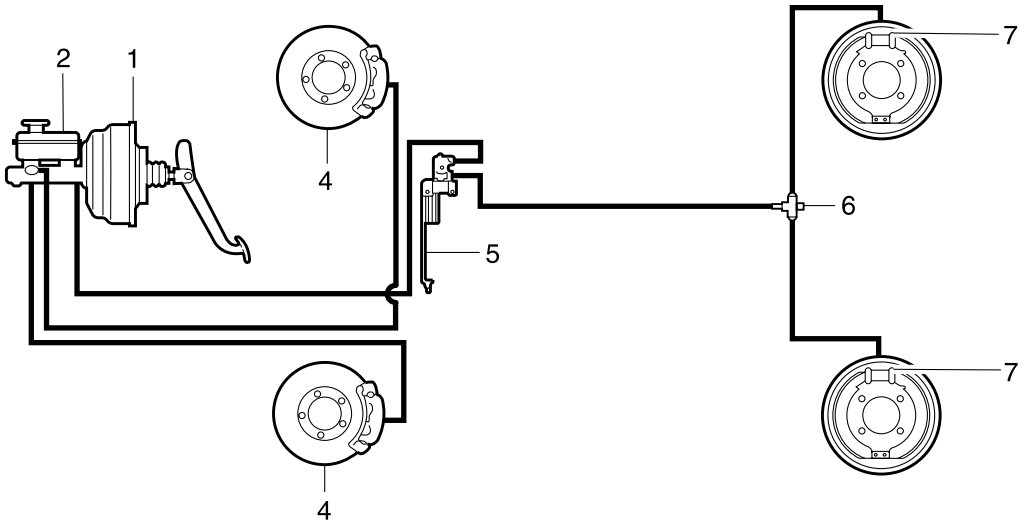
COMPONENT LOCATOR

HYDRAULIC LINE

ABS



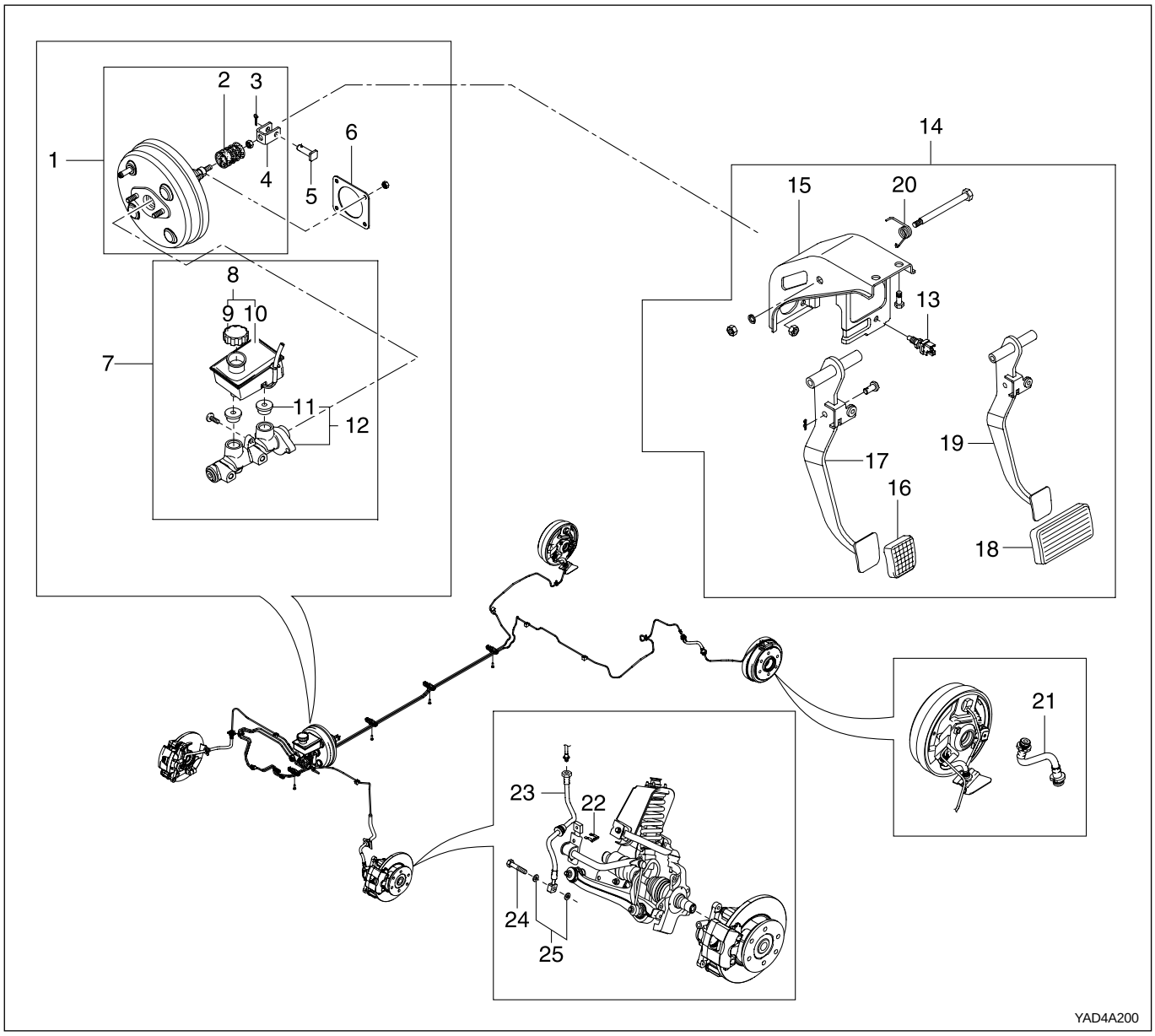
Non ABS



YAD4A060

1 Brake Booster
2 Brake Reservoir and Master Cylinder
3 ABS Control Unit
4 Front Disc Brake and Caliper
5 Hydraulic Pressure Control Valve (LCRV)
6 3-way Connector
7 Rear Drum (Disc) and Wheel Cylinder (Caliper)

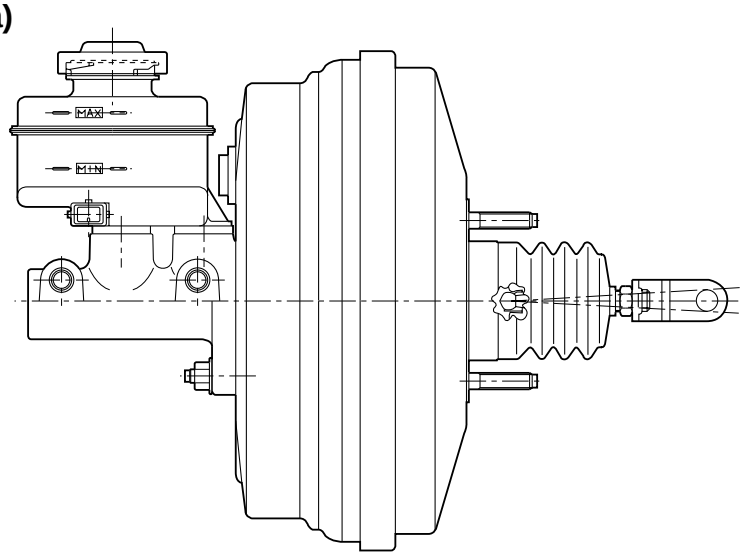
BRAKE SYSTEM (W/CBS)



1 Brake Booster
2 Brake Booster Boot
3 Cotter Pin
4 Clevis
5 Clevis Pin
6 Packing (1)
7 Master Cylinder Assembly
8 Brake Oil Tank Assembly
9 Brake Oil Tank Cap
10 Brake Oil Tank
11 Grommet Seal
12 Master Cylinder
13 Brake Stoplamp Switch
14 Pedal Assembly
15 Pedal Bracket Assembly
16 Clutch Pedal Pad
17 Clutch Pedal
18 Brake Pedal Pad
19 Brake Pedal
20 Brake Pedal Spring
21 Rear Brake Hose
22 Clip
23 Front Brake Hose
24 Union Bolt
25 Plain Washer

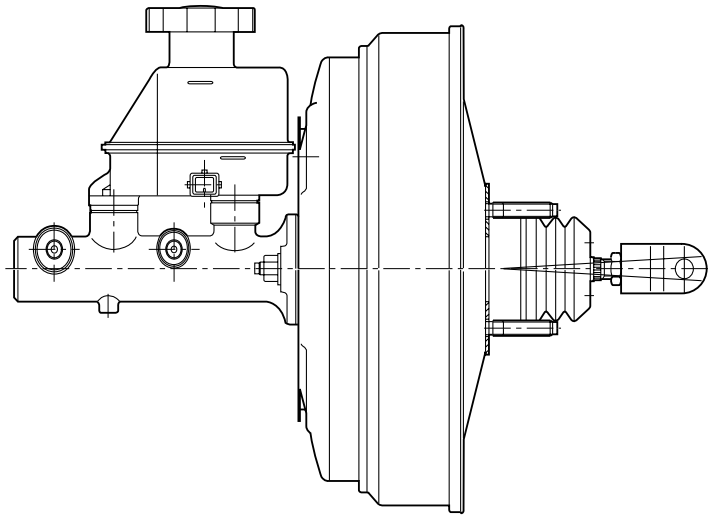
MASTER CYLINDER AND BOOSTER

KDAC (Delphi Korea)



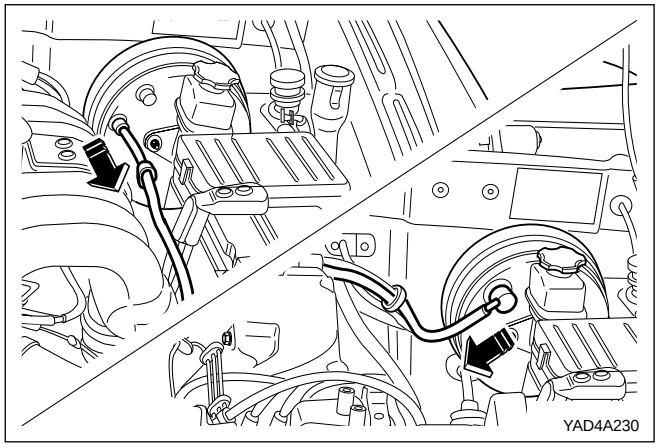
YAD4A210

MANDO



YAD4A220

REPAIR INSTRUCTIONS

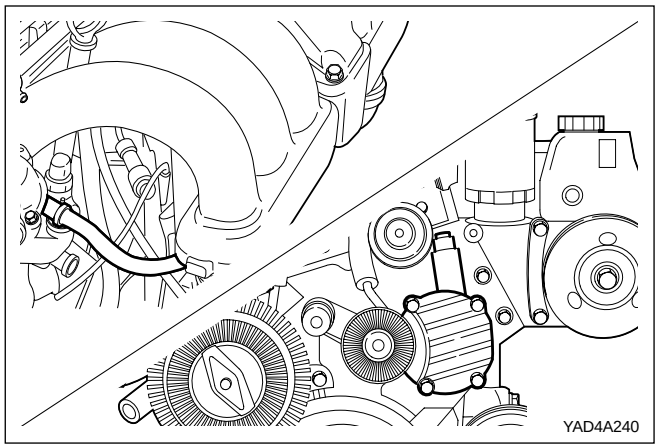


ON-VEHICLE SERVICE

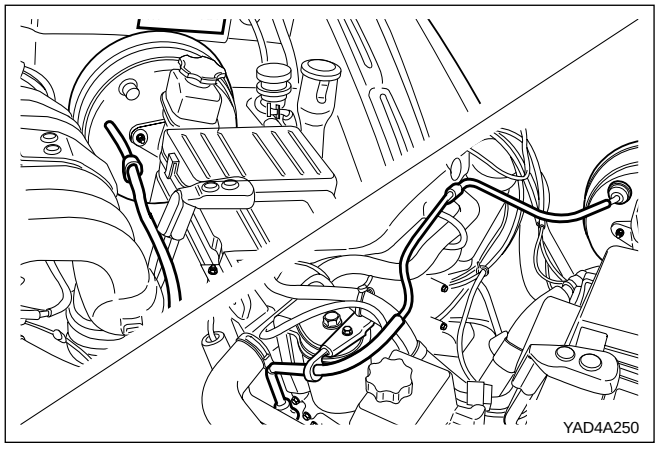
VACUUM HOSE

Removal Procedure

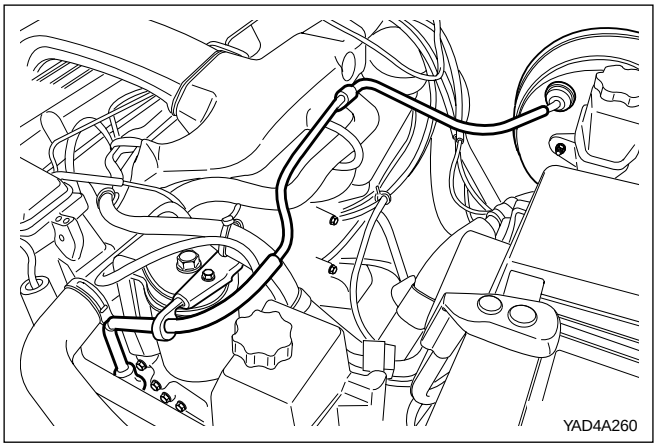
1. Disconnect the vacuum hose from the brake booster.



2. Disconnect the vacuum hose from the vacuum pump.



3. Remove the vacuum hose with the vacuum hose bracket.

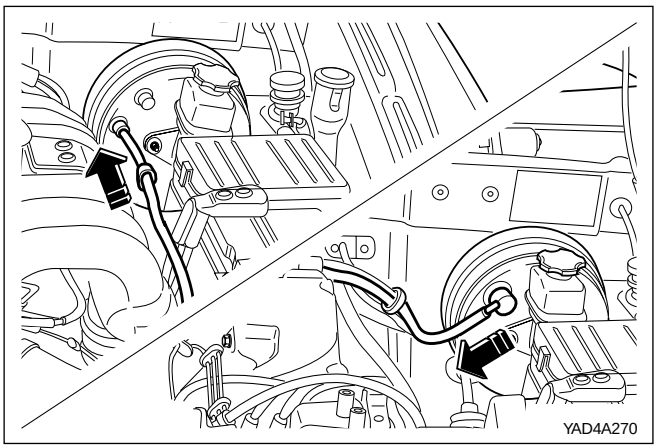


Installation Procedure

1. Install the vacuum hose between the vacuum pump and the power booster (Diesel Engine).

Tightening Torque

Bracket Mounting Bolt	35 - 45 N•m (26 - 33 lb-ft)
Union Bolt to Vacuum Pump	35 - 45 N•m (26 - 33 lb-ft)



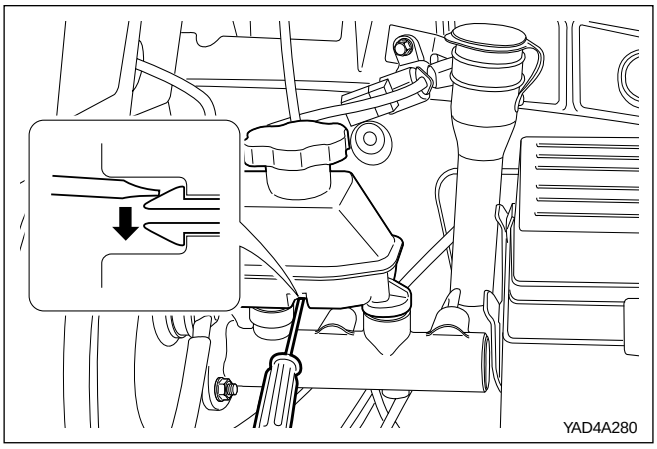
2. Install the vacuum hose between the vacuum pump and the power booster. (Gasoline Engine)

Tightening Torque

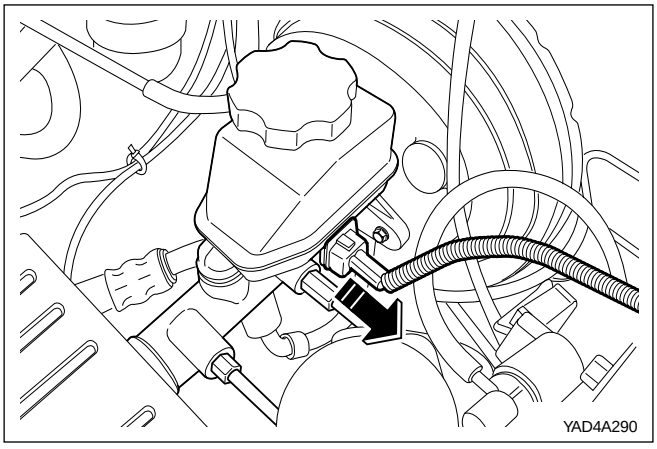
Bracket Mounting Bolt	35 - 45 N•m (26 - 33 lb-ft)
Union Bolt to Vacuum Pump	35 - 45 N•m (26 - 33 lb-ft)

BRAKE OIL LEVEL SWITCH

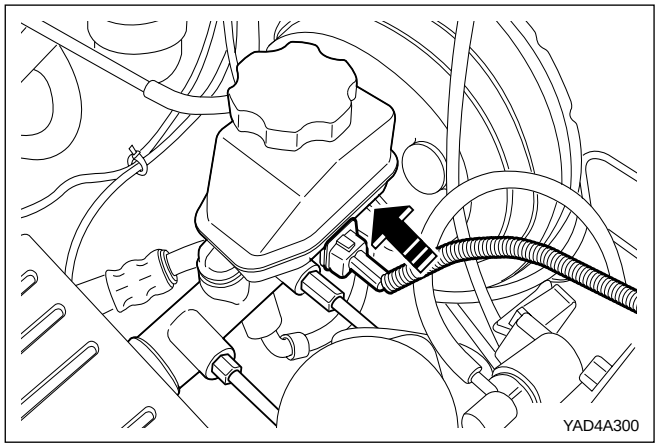
Removal & Installation Procedure



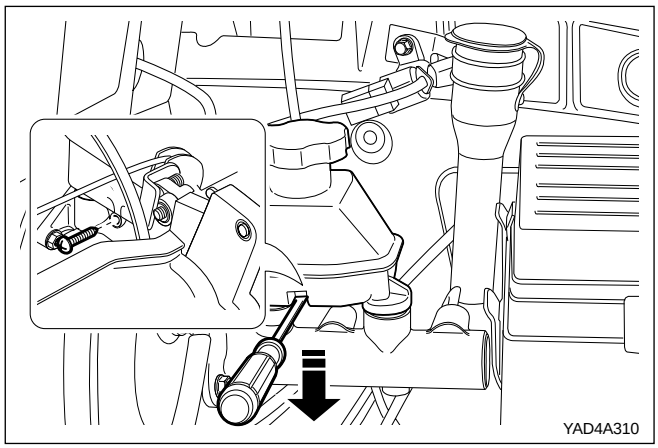
1. Disconnect the brake fluid level switch connector.



2. Disconnect the switch wiring connector.
3. Disconnect the switch from the brake oil tank.



4. Installation should follow the removal procedure in the reverse order.

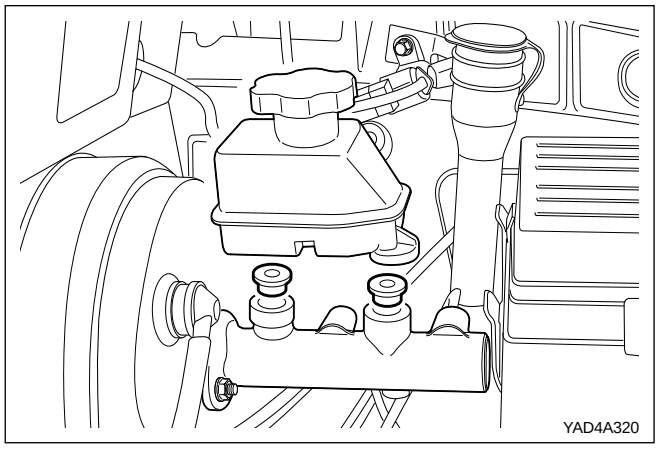


BRAKE FLUID RESERVOIR

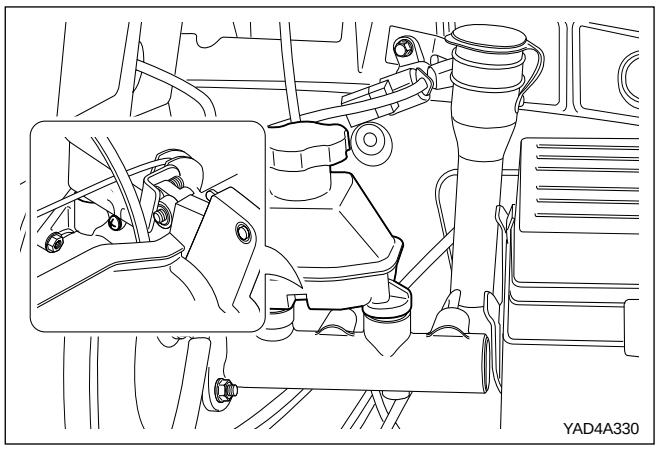
Removal & Installation Procedure

1. Remove the reservoir tank cap and drain the brake fluid completely.
2. Remove the brake reservoir tank using the driver.

   Notice: Note that pulling the reservoir tank out excessively result in damage of the tank on removal.



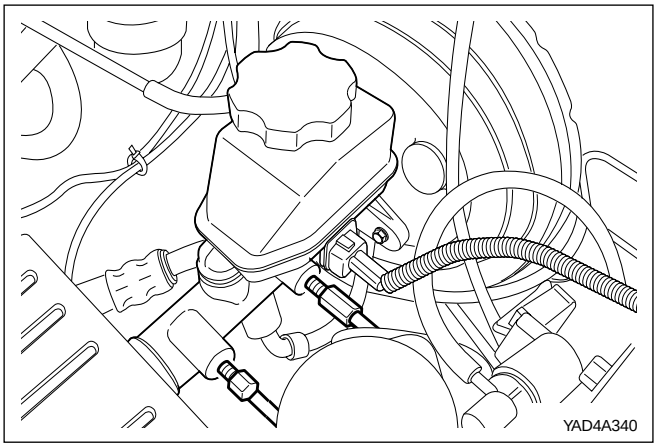
3. Remove the grommet from the master cylinder.



4. Installation should follow the removal procedure in the reverse order.

   Notice:

   - Lubricate the new brake fluid reservoir seals with clean brake fluid.
   - After the installation, bleed the brake system.

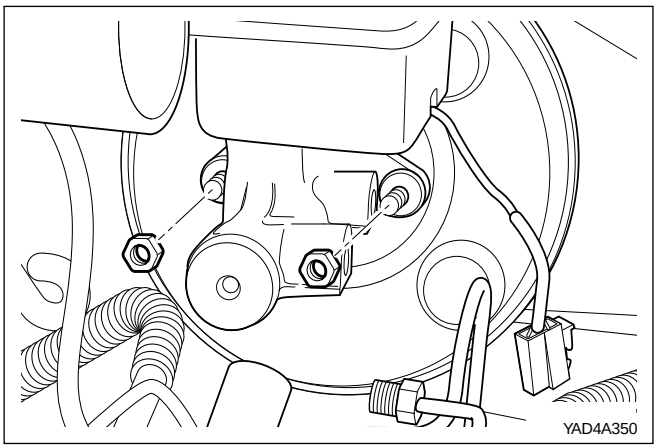


MASTER CYLINDER

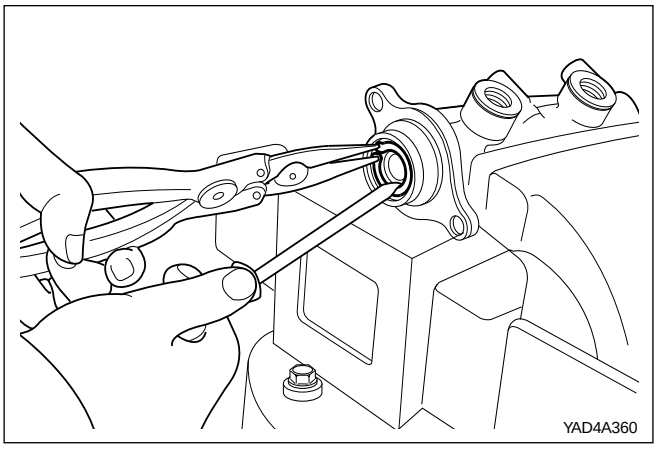
Removal Procedure

1. Disconnect the brake lines from the master cylinder.

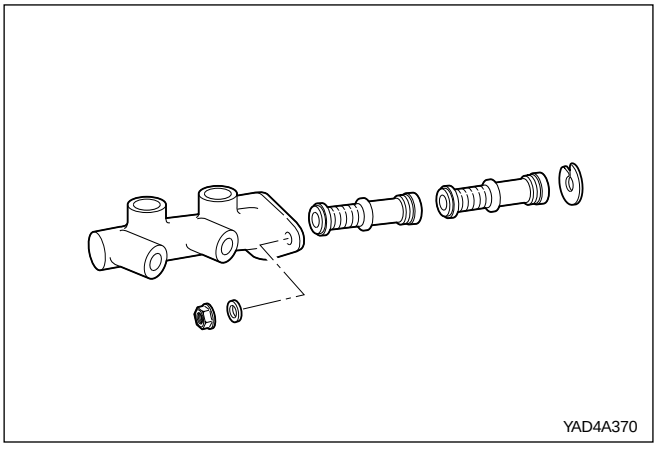
   Notice: The brake fluid may damage paintwork, if spillage onto paintwork, wash with cold water immediately.



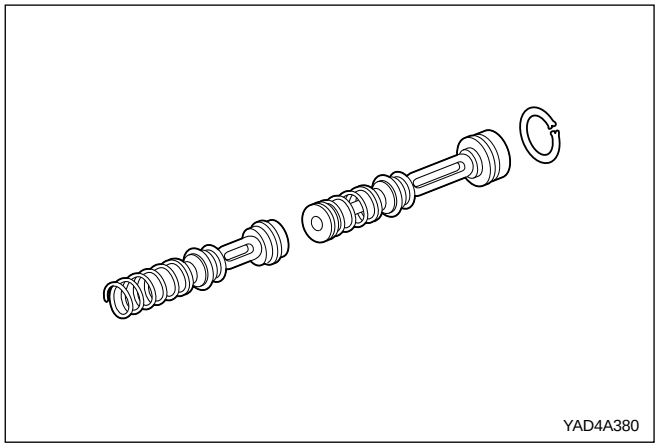
2. Loosen the mounting nut of the master cylinder and remove the master cylinder from the power booster.



3. Remove the master cylinder.
   - Retain the master cylinder in the vice and remove the retainer ring from the master cylinder using the snap ring plier.

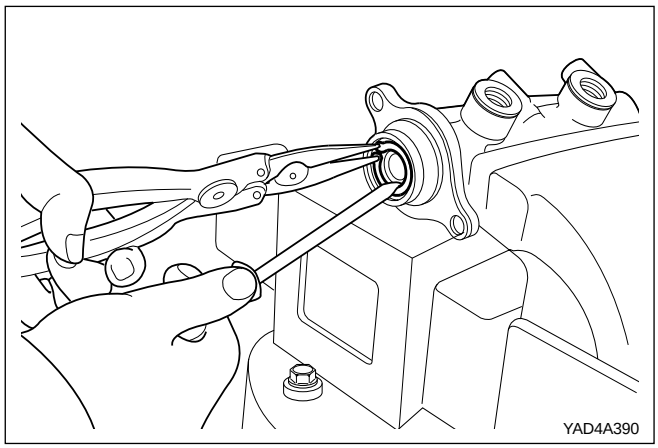


   - Remove the 1st piston and 2nd piston assembly from the master cylinder assembly.


YAD4A380

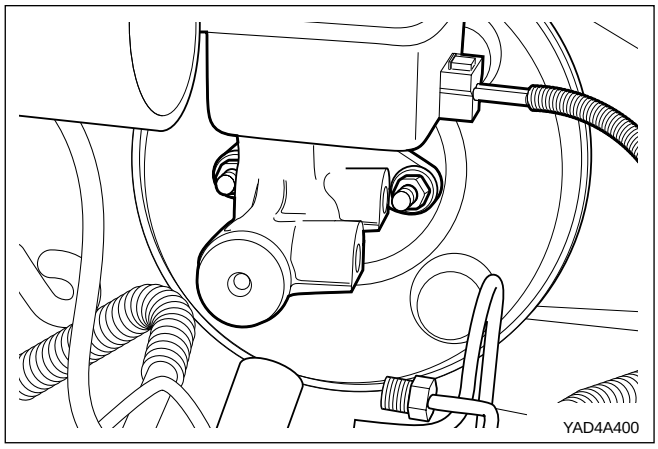
- Check the cylinder for excessive wear.

  Notice:
  - Replace the cylinder assembly when there occurs any damage or wear in the cylinder.
  - Clean the contaminated oil of the assembly.
- Install the 1st piston and 2nd piston assembly from the master cylinder assembly.


YAD4A390

Installation Procedure

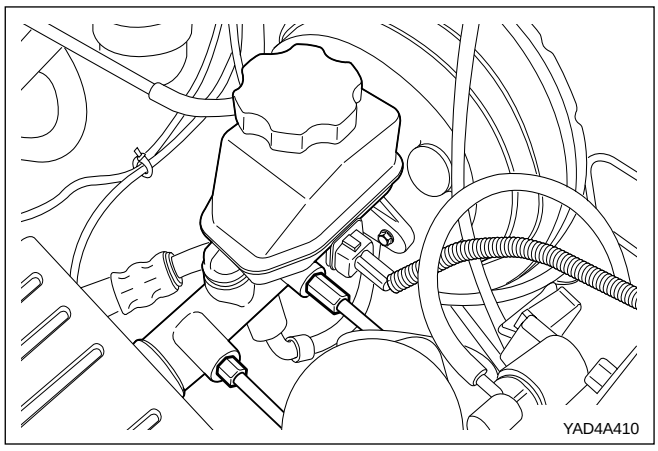
1. Install the retainer ring using the snap ring plier.


YAD4A400

2. Install the master cylinder into the booster.

   Installation Notice

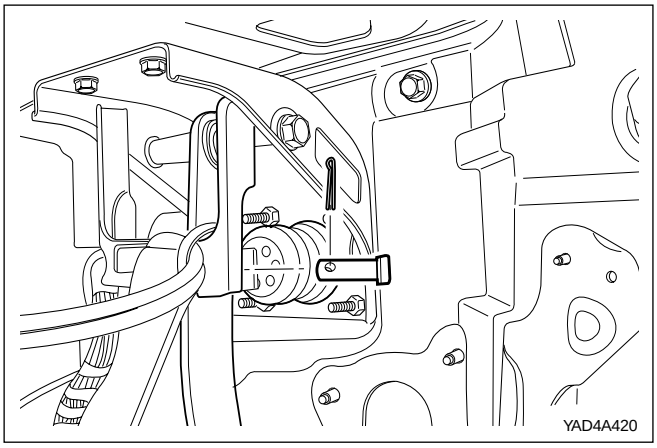
Tightening Torque	8 - 12 N•m (71 - 106 lb-in)


YAD4A410

3. Install the master cylinder completely and then connect the brake pipe.

   Installation Notice

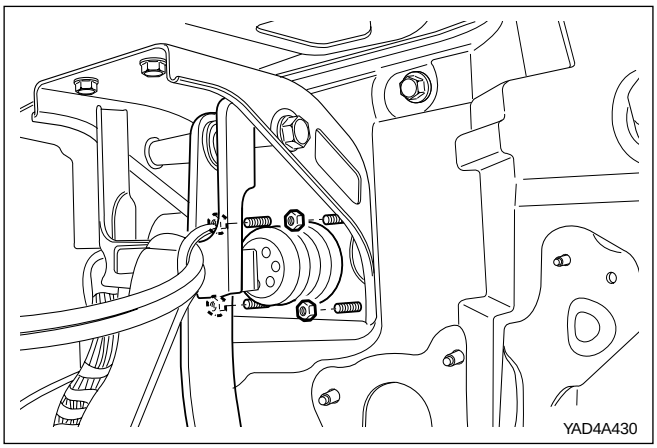
Tightening Torque	15 - 18 N•m (11 - 13 lb-ft)



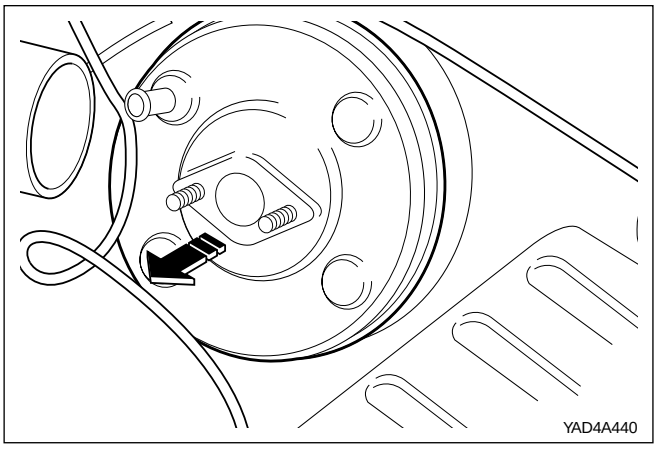
BRAKE BOOSTER

Removal Procedure

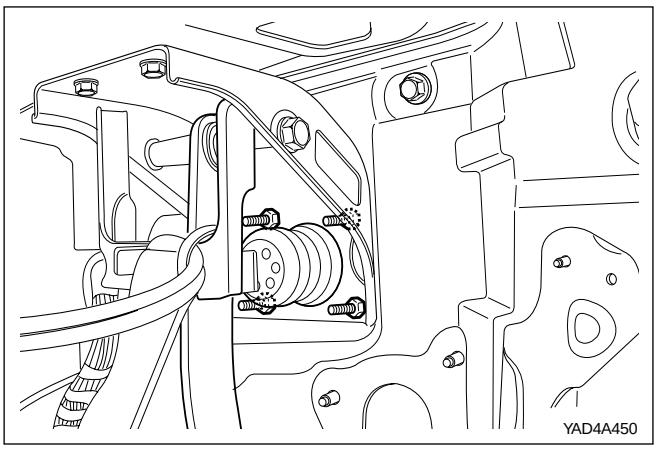
1. Remove the master cylinder assembly and pull out the cotter pin from the push rod of the brake booster.
2. Remove the clevis pin.



3. Remove the nuts mounting the booster.

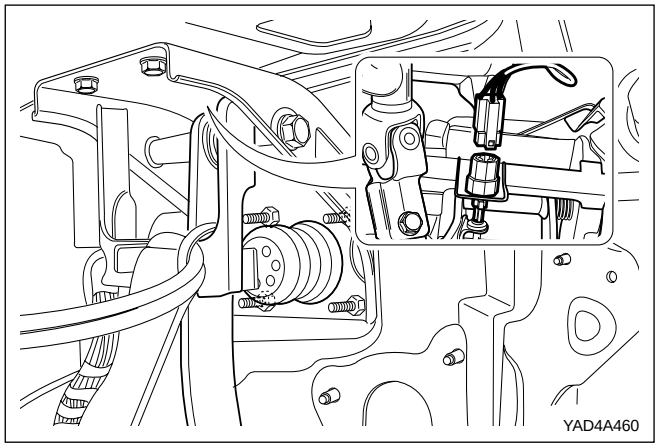


4. Remove the brake booster from the vehicle.



Installation Procedure

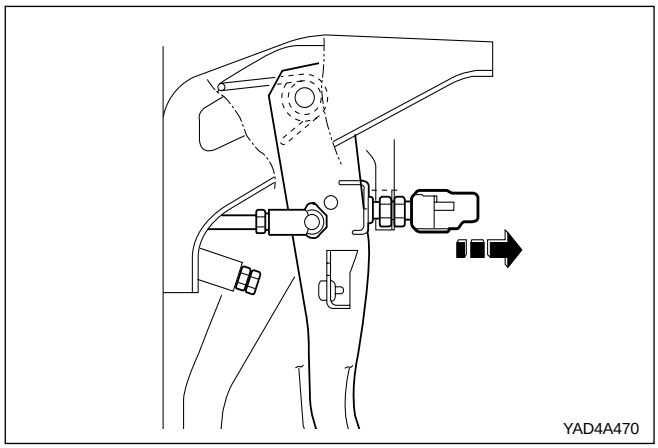
1. Installation should follow the removal procedure in the reverse order.
2. Bleed the brake system after the installation.



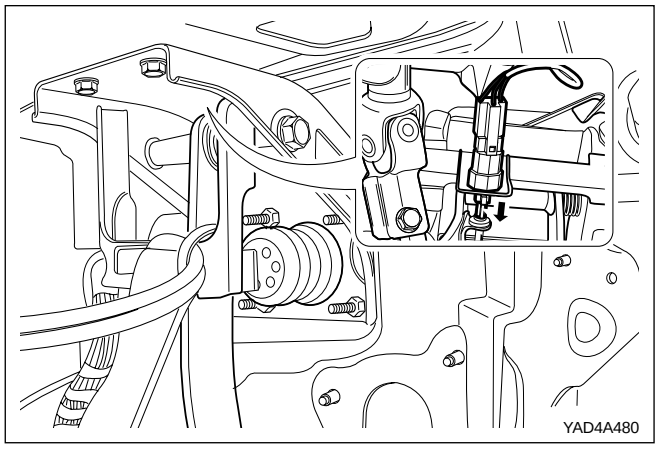
STOPLAMP SWITCH

Removal & Installation Procedure

1. Disconnect the negative battery cable.
2. Separate the stoplamp switch from the connector.

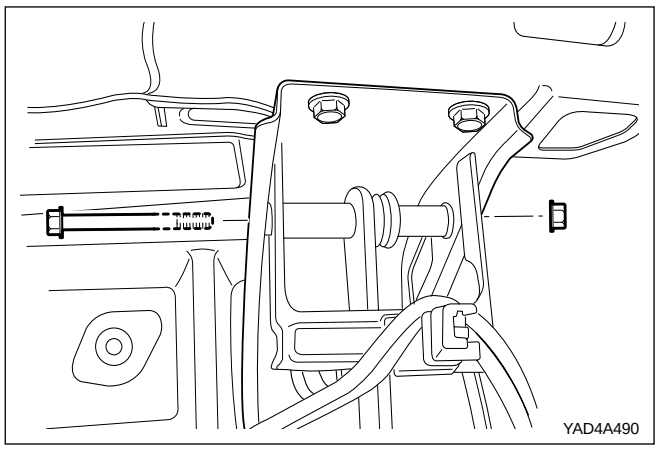


3. Remove the stoplamp switch nut and disconnect the switch.



4. Installation should follow the removal procedure in the reverse order.

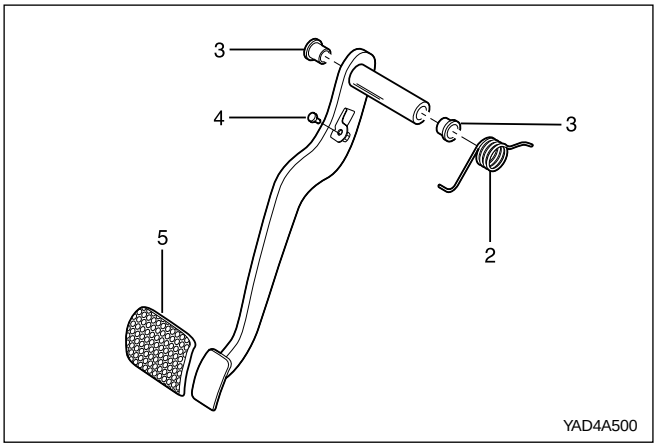
Tightening Torque	21 - 35 N•m (15 - 26 lb-ft)



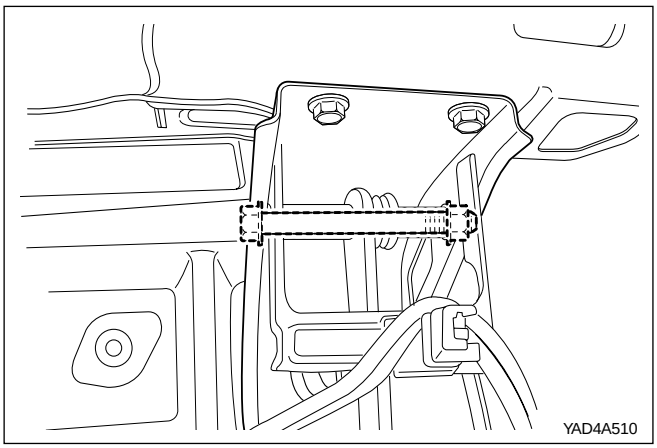
BRAKE PEDAL

Removal & Installation Procedure

1. Remove the bolts/nuts mounting the brake pedal and disconnect the cotter pin.

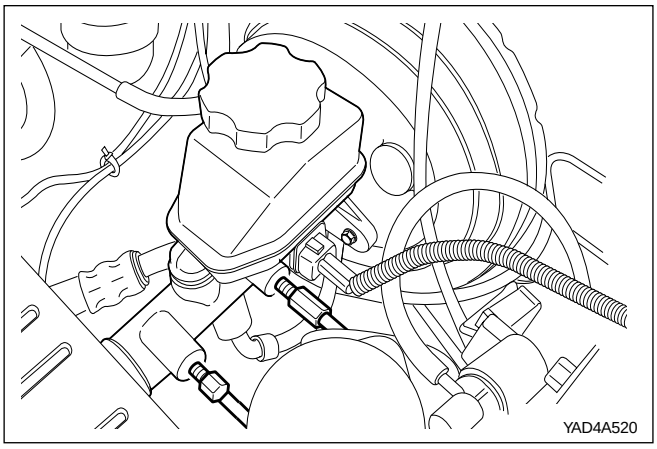


2. Remove the brake pedal assembly.



3. Installation should follow the removal procedure in the reverse order.

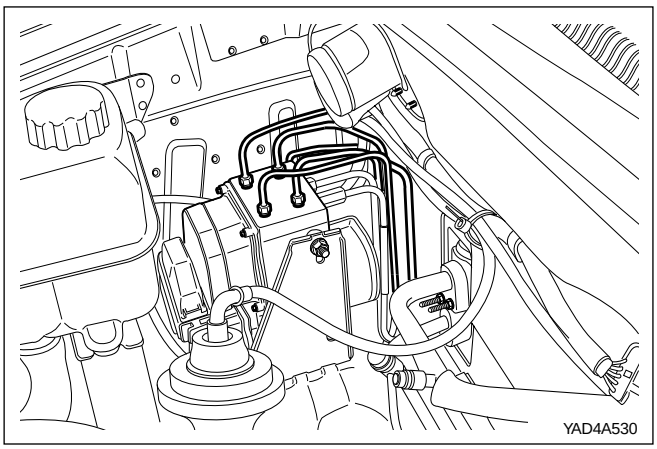
Tightening Torque	16 - 32 N•m (12 - 24 lb-ft)



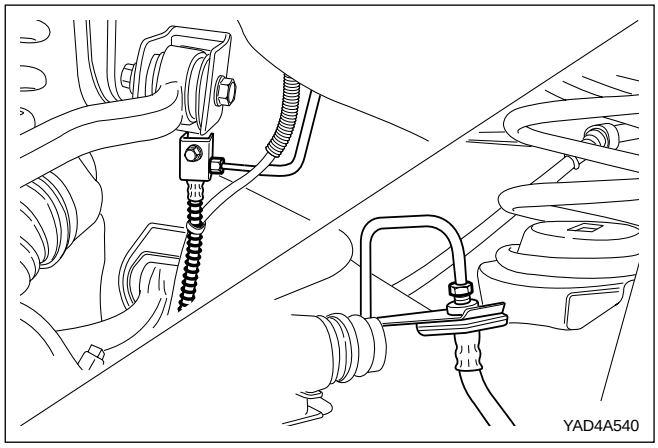
BRAKE HOSE & PIPE

Removal Procedure

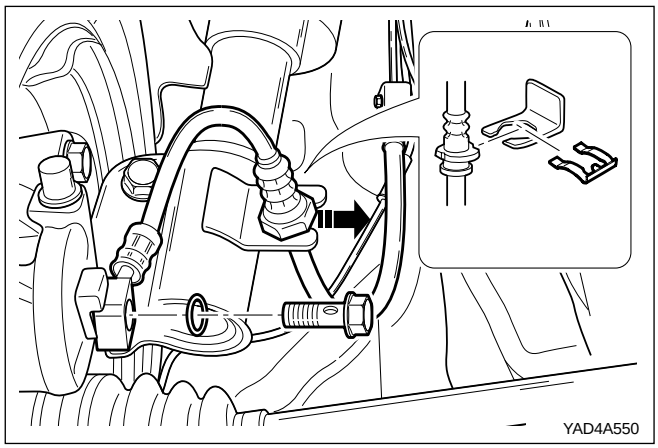
1. Remove the brake pipe.
   - Remove the pipe from the master cylinder.



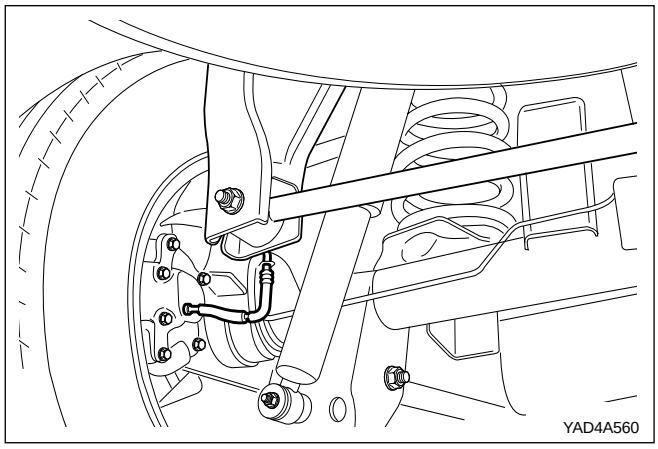
   - For ABS/ABD, remove the brake pipe from the control unit.



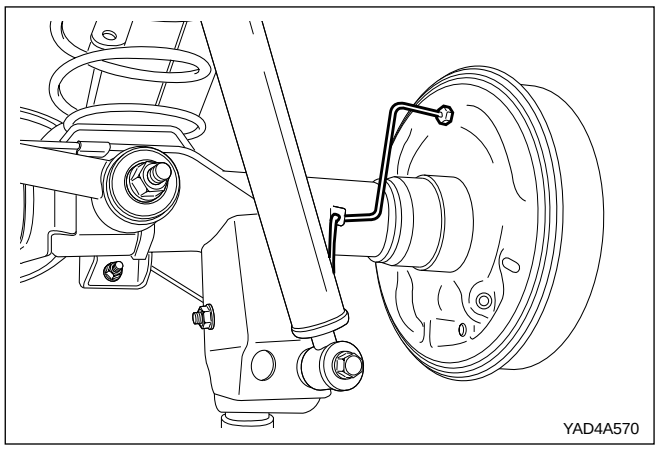
- Remove the bracket of the connecting pipe from the 3-way connector.



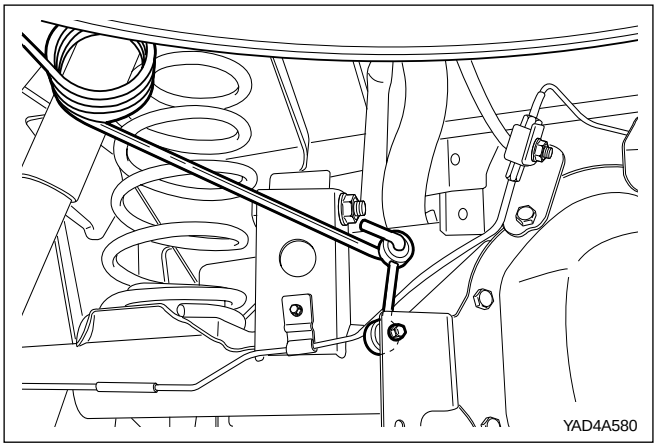
2. Remove the front brake hose.
   - Remove the brake pipe nut.
   - Remove the E-ring.
   - Disconnect the strut from the brake mounting.
   - Remove the union bolt from the caliper and remove the brake hose.



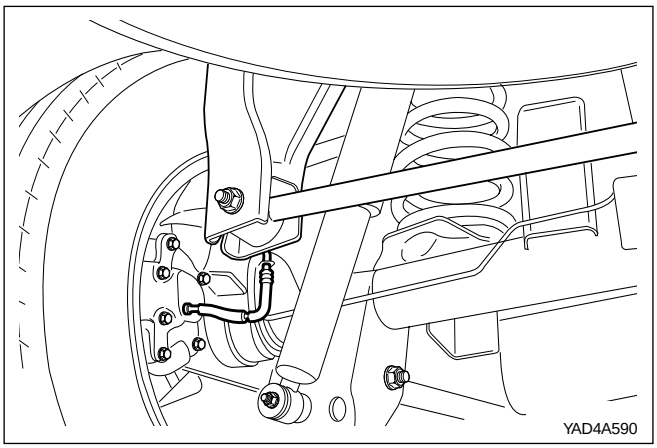
3. Remove the rear brake hose.
   - Remove the brake pipe nut.
   - Remove the E-ring.
   - Disconnect the strut from the brake mounting.
   - Remove the union bolt from the caliper and remove the brake hose.
     - For disc type : from the caliper



     - For drum type : from the cylinder



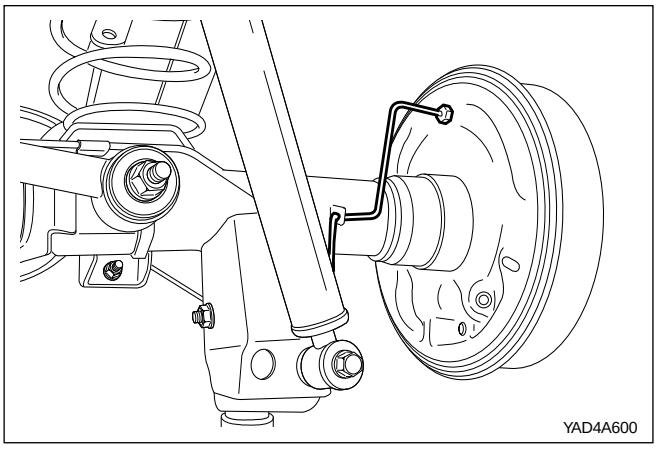
4. For non-ABS/ABD, remove the brake pipe to the rear brake at LCRV side.

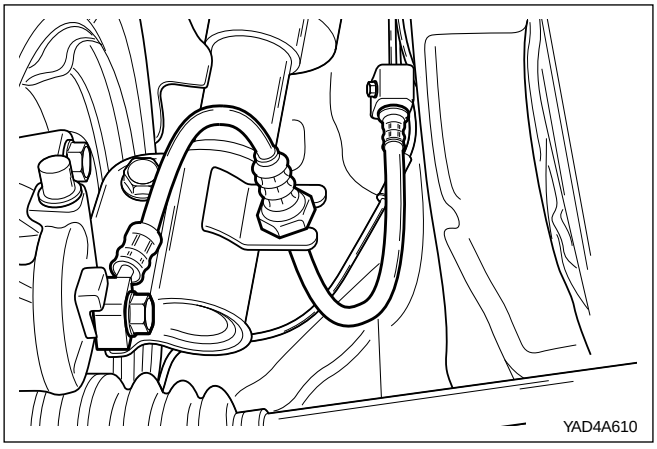


Installation Procedure

1. Install the rear brake hose and tighten the union bolts.

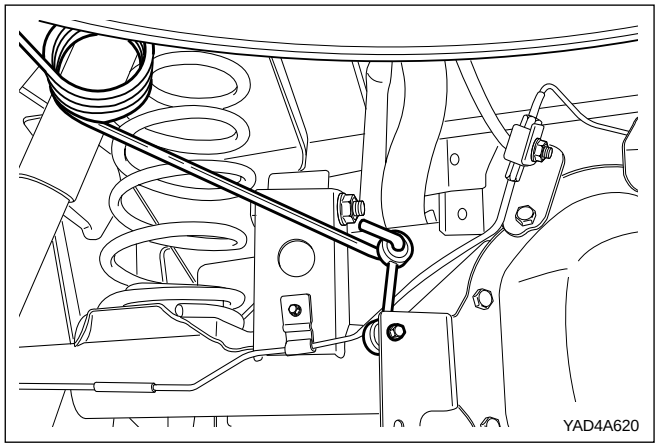
Tightening Torque at the caliper	15 - 18 N•m (11 - 13 lb-ft)
Tightening Torque at the wheel cylinder	15 - 19 N•m (11 - 13 lb-ft)





2. Install the front brake hose and tighten the union bolts.

Tightening Torque	15 - 18 N•m (11 - 13 lb-ft)

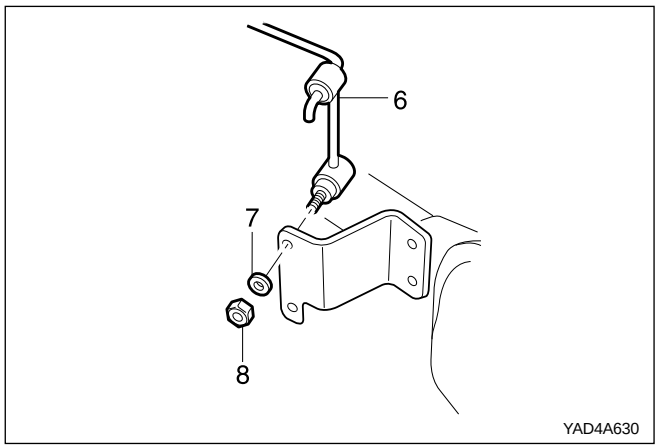


3. Install the brake pipe to the correct position.

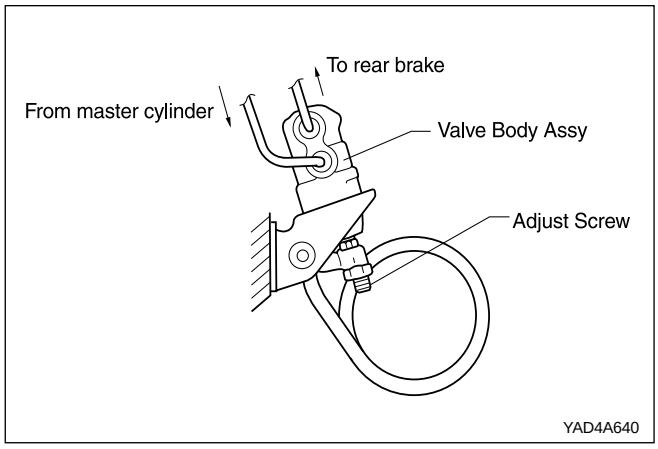
3-way Connector	15 - 19 N•m (11 - 14 lb-ft)
LCRV System	15 - 19 N•m (11 - 14 lb-ft)
ABS/ABD Control Unit	15 - 19 N•m (11 - 14 lb-ft)
Port (M12)	20 - 24 N•m (15 - 18 lb-ft)

4. Bleed the brake system after replacement of the pipes/hoses.

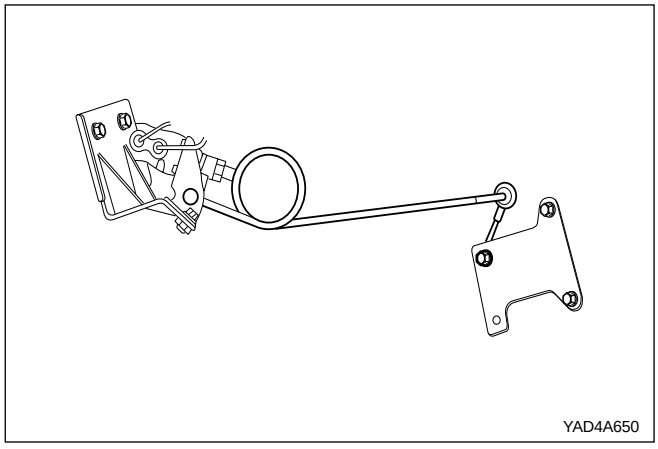
LCRV (LOAD CONSCIOUS REDUCING VALVE)



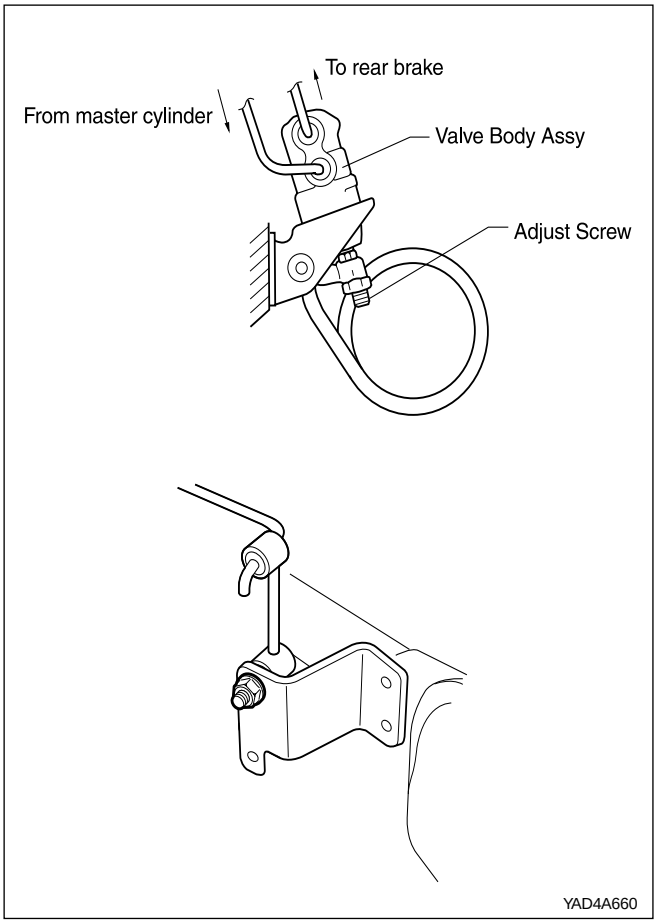
1. Remove the nut mounting the stud from the LCRV connecting rod.



2. Remove the brake pipe retaining the LCRV.



3. Remove the LCRV mounting bolt from the LCRV bracket and remove the LCRV.



4. Installation should follow the removal procedure in the reverse order.

Valve Body Mounting nut	14 - 18 N•m (10 - 13 lb-ft)
Bracket Mounting Bolt	10 - 13 N•m (89 - 115 lb-in)
Stud Mounting Nut	14 - 18 N•m (10 - 13 lb-ft)

Notice: Bleed the brake system.

SECTION 4B

FRONT BRAKE

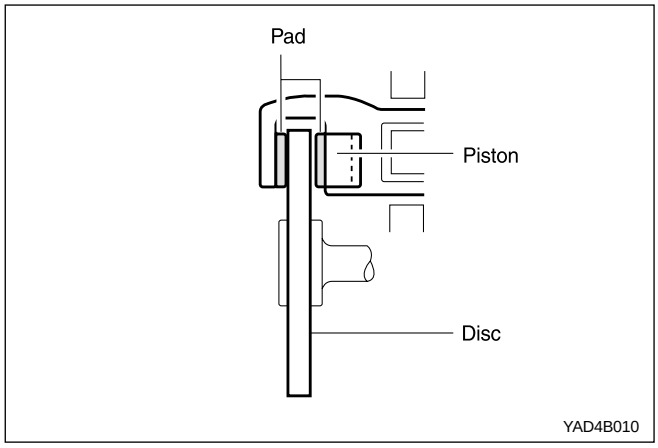
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DESCRIPTION AND OPERATION

CALIPER

This caliper has a single bore and is mounted to the steering knuckle with two mounting bolts. Hydraulic pressure, created by applying the brake pedal, is converted by the caliper to a stopping force. This force acts equally against the piston and the bottom of the caliper bore to move the piston outward and to slide the caliper inward, resulting in a clamping action on the rotor. This clamping action forces the linings against the rotor, creating friction to stop the vehicle.



CLEARANCE CALIBRATION

When the hydraulic pressure is applied to the piston, the piston moves leftward. The piston seal, which extent considerable pressure against the piston, moves with cylinder.

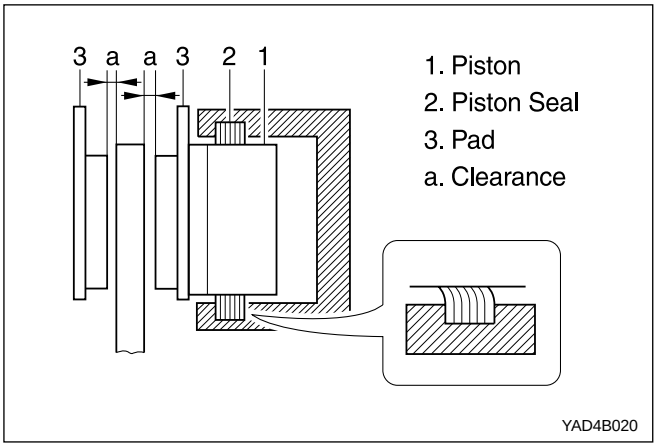
However, as a part of the piston seal is fixed into a grove in the cylinder shape of the seal is as shown in below figure, distorted toward the piston moving direction.

When the pressure is taken off from the brake pedal and the hydraulic pressure is released from the piston, a restoring elastic force is generated at the seal and pushes the piston rightward and back it in original position.

As the pads wear away and the clearance between rotor and pads become larger, the piston moves larger.

The seal then could change in shape further, but since end of the seal is fixed into the groove in the cylinder, the distortion is limited to the same amount as previously described.

The piston moves further to cover the distance of clearance. As the piston returns by the same distance and the rubber seal recovers its original shape, the clearance between the rotor and pads are maintained in original condition.



SPECIFICATIONS

	MANDO	Delphi Korea
Application	Ventilated Disc Type	←
Caliper Cylinder I.D.	Ø 60 mm	←
Pad Thickness	10 mm	←
Disc Thickness	24 mm	←

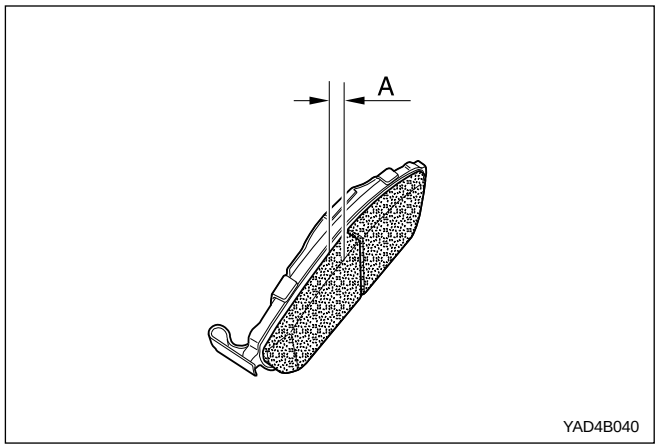
DIAGNOSTIC INFORMATION AND PROCEDURES

Condition	Possible Cause	Action
Poor Braking	Pad Wear, Hardening	Replace
	Oil Or Water Contamination On The Pad	Replace and Repair
	Inoperative Caliper	Replace
Uneven Braking	Pad Wear, Hardening	Replace
	Oil Or Water Contamination On The Pad	Replace and Repair
	Uneven Wear Or Twisted Of The Disc	Replace
	Inoperative Caliper	Replace
Dragging Brake	Inoperative Caliper Returning	Replace
Excessive Pedal Travel	Pad Wear	Replace
Noise and Vibration When Brake Applied	Pad Wear, Hardening	Replace
	Damage On The Disc	Replace
	Interference Of The Dust Cover	Repair
	Loose Caliper Mounting Bolts	Tighten

INSPECTION

Clean the dissembled parts and visually check the followings;

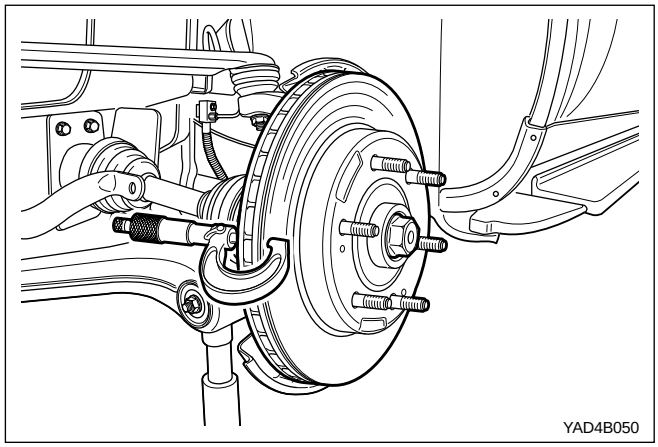
- Wear, rust and damage on the cylinder and piston
- Damage, crack on the caliper body and damage, wear on the guide pin
- Pad uneven wear and oil contamination
- Boot's damage and tear
- Disc plate's scratch and bending



PAD THICKNESS

1. Remove the front wheel.
2. Measure the thickness and replace as needed.

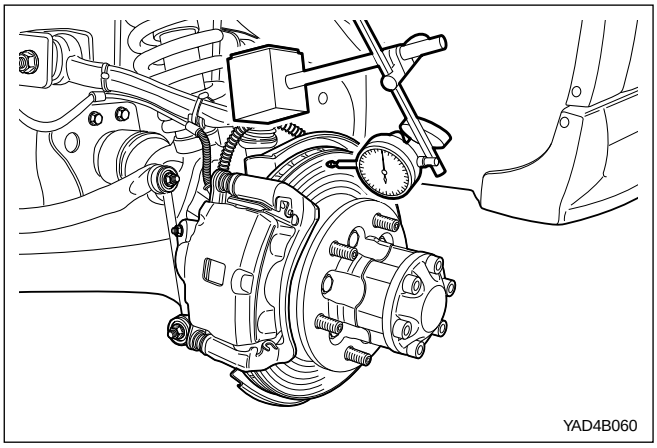
Thickness	Max wear Limit
10 mm	2 mm



BRAKE DISC THICKNESS

1. Measure the thickness of the rotor at four or more points around the circumference of the rotor.
2. If the thickness of the rotor is below the specified value, replace the brake rotor.

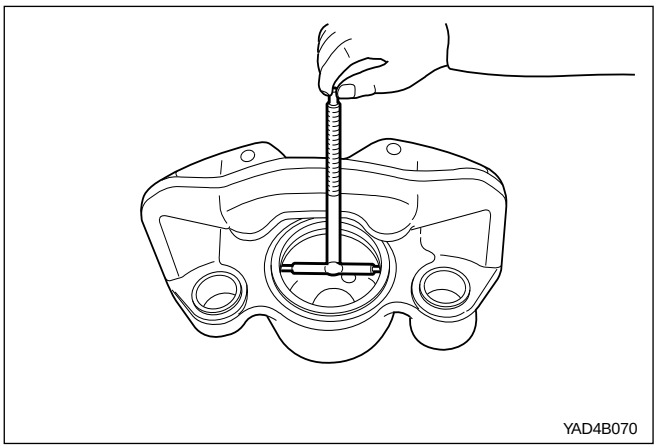
Thickness	Max wear Limit
24 mm	22 mm


YAD4B060

BRAKE DISC RUN OUT

1. Fasten a dial indicator to the brake disc side and measure the run out by rotating the disc.
2. If lateral run out exceeds the specification, replace the brake disc to prevent the pedal's vibration at braking.

Run Out Limit	0.03 mm (Disc only)
	0.07 mm (On vehicle)

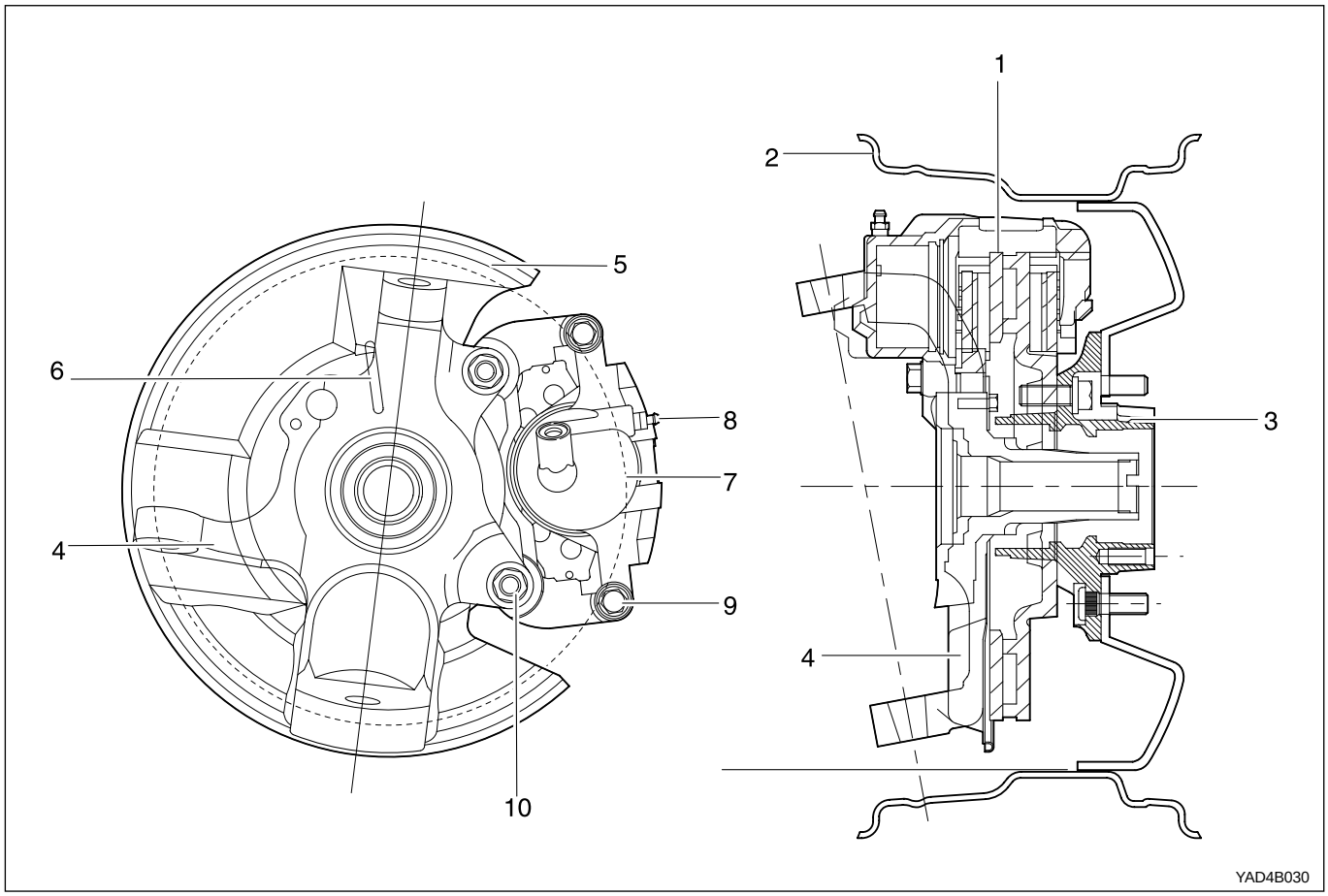

YAD4B070

CALIPER HOUSING I.D

Application		Spec.
Non-ABS/ABS	I.D	Ø 60.0 mm
	Wear Limit	Ø 61.0 mm

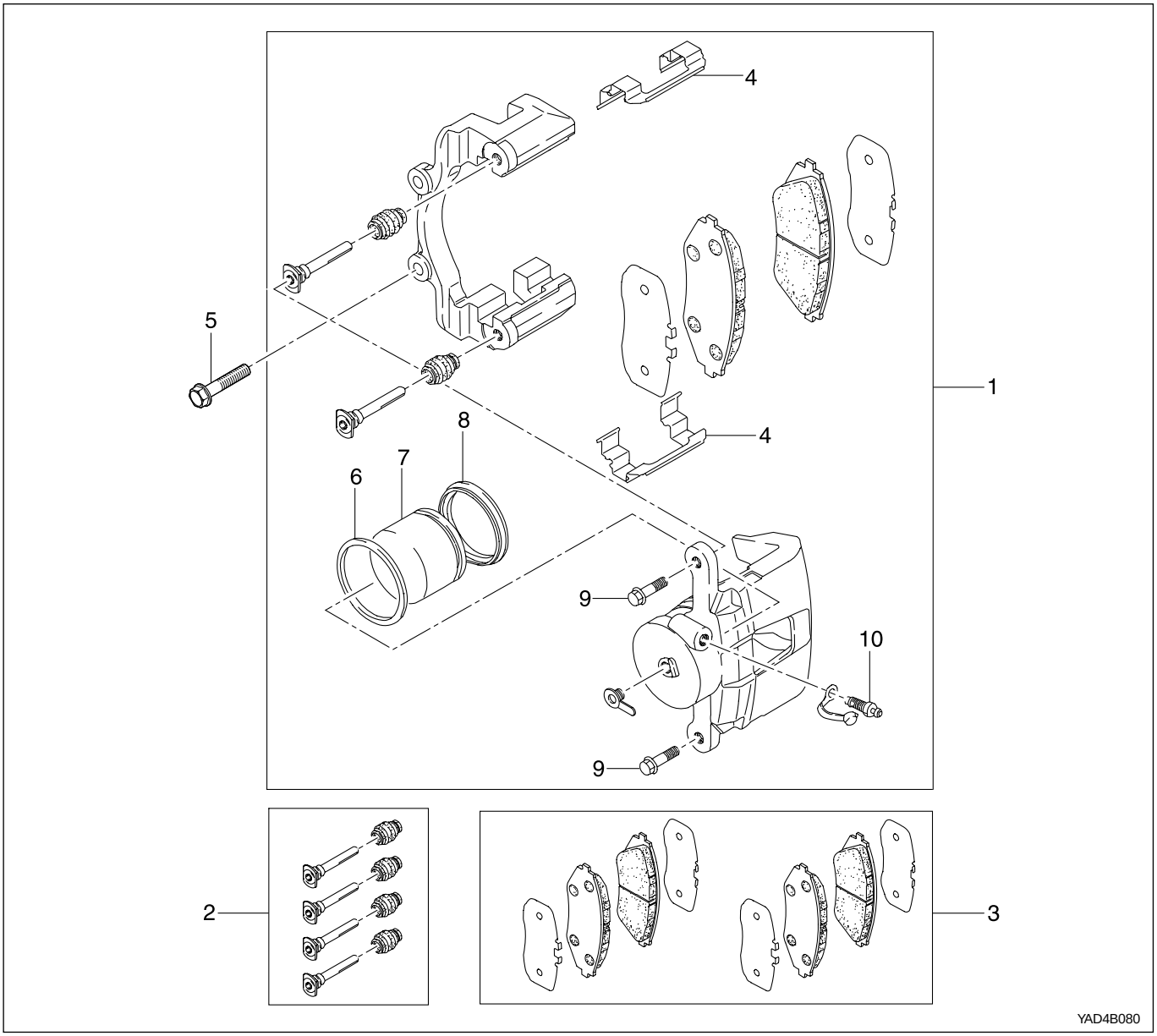
COMPONENT LOCATOR

CROSS-SECTIONAL VIEW



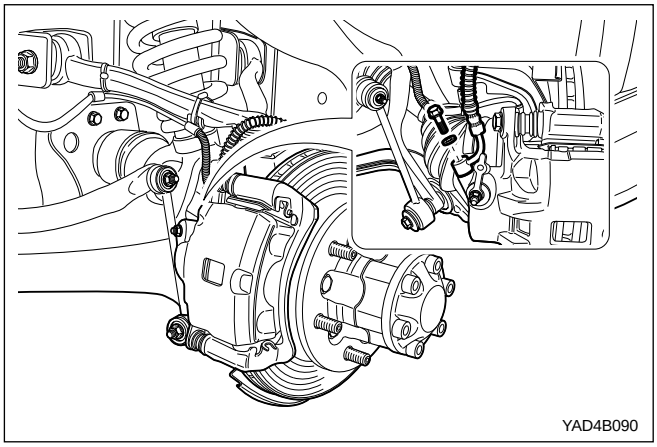
1 Brake Disc
2 Wheel (Rim)
3 Hub Range
4 Knuckle
5 Dust Shield
6 Vacuum Hose Nipple
7 Caliper
8 Brake Fluid Nipple
9 Caliper Guide Bolt
10 Caliper Bolt

FRONT CALIPER BRAKE



1 Brake Caliper Assembly
2 Guide Rod Set
3 Brake Pad
4 Brake Pad Spring
5 Caliper Mounting Bolt
6 Piston Seal
7 Piston
8 Piston Boot
9 Caliper Guide Rod Bolt
10 Bleeder Screw

REPAIR INSTRUCTIONS


YAD4B090

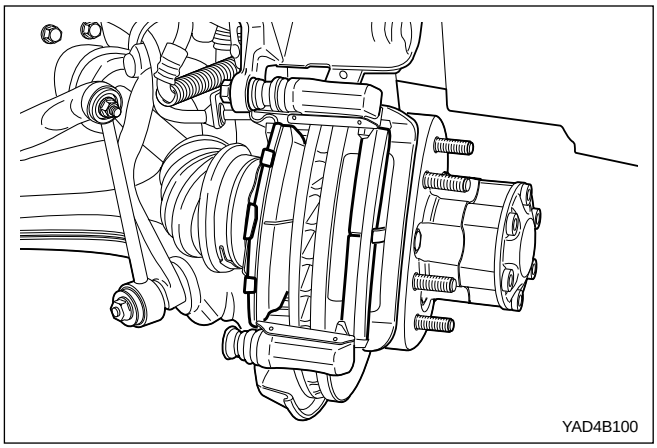
ON-VEHICLE SERVICE

FRONT BRAKE

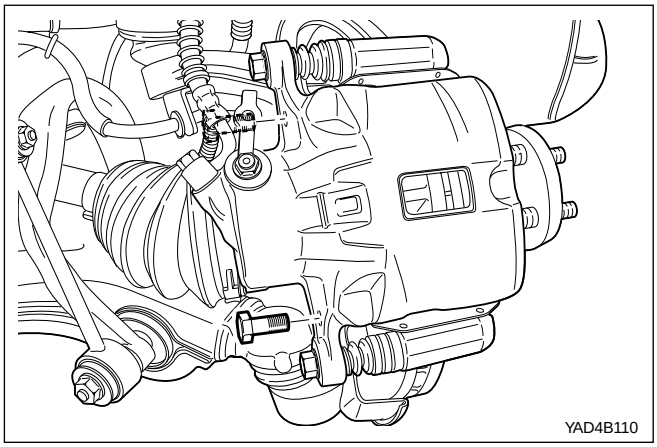
Removal Procedure

1. Remove the front wheel and remove the brake hose from the brake caliper.

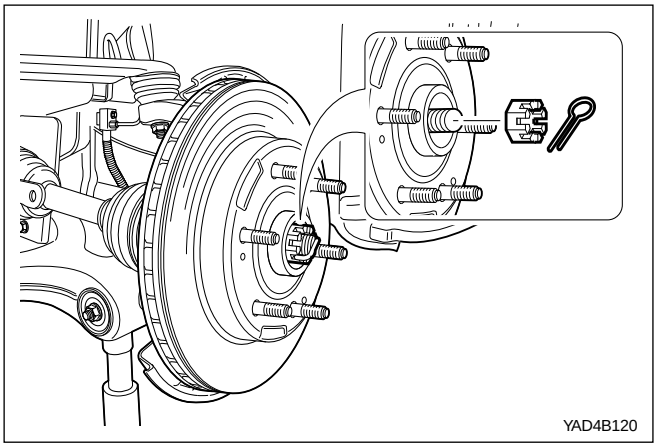
   Notice: Be carefully to prevent the brake fluid loss and contamination.


YAD4B100

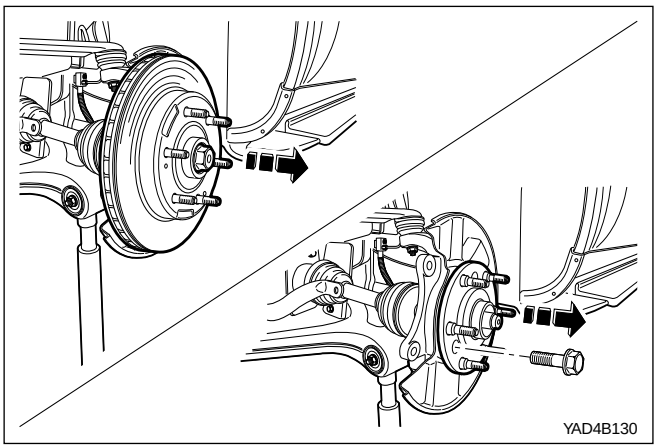
2. Remove the cylinder mounting bolt and remove the disc pad and the cylinder.


YAD4B110

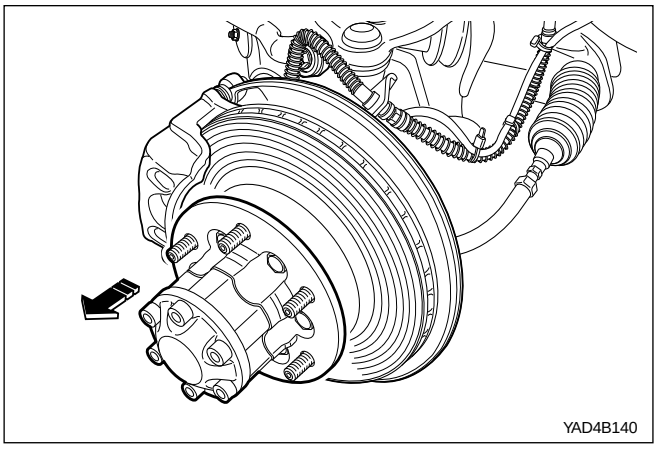
3. Remove the caliper mounting bolt and remove the caliper assembly.



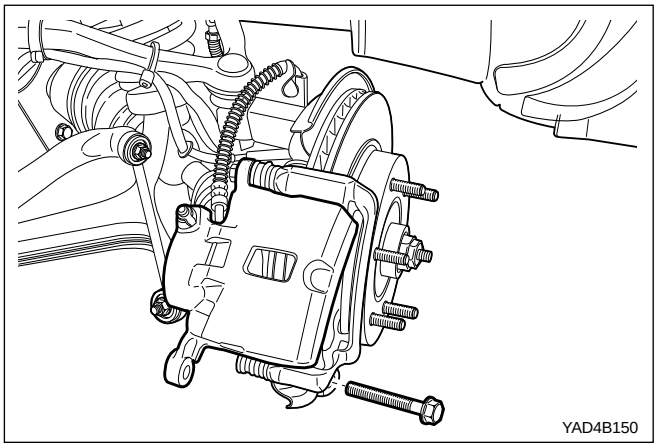
4. Remove the brake disc (Full-time 4WD)
5. Pull out the cotter pin from the front hub assembly and remove the lock nut. (Full-time 4WD)



6. Remove the hub assembly mounting bolt and remove the hub assembly.

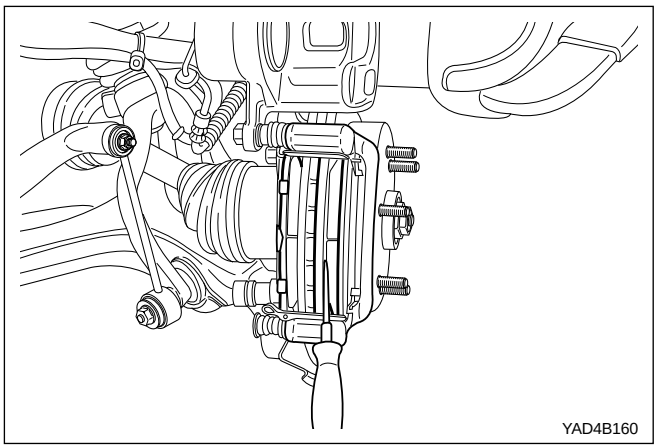


Notice: For part-time 4WD, remove the locking hub assembly and hub range before removing the brake disc.

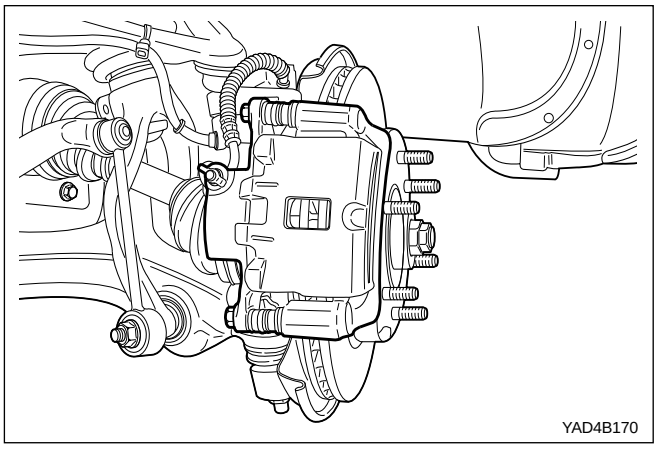

YAD4B150

BRAKE PAD REPLACEMENT

1. Remove lower mounting bolt of the brake caliper cylinder.

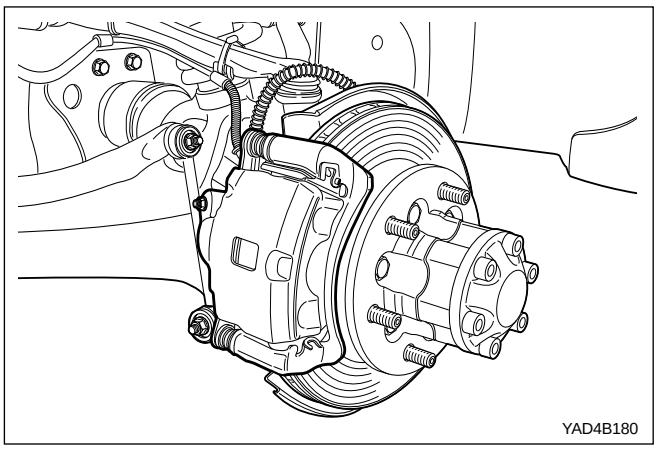

YAD4B160

2. Move the caliper cylinder assembly upward and fix it to prevent hose damage.

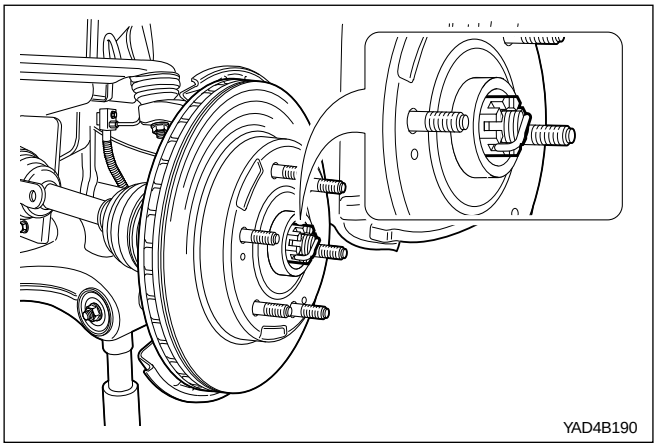

YAD4B170

3. Remove the brake pad and replace the new pad.
4. Install the caliper cylinder assembly and fasten the lower bolt.

Full-time

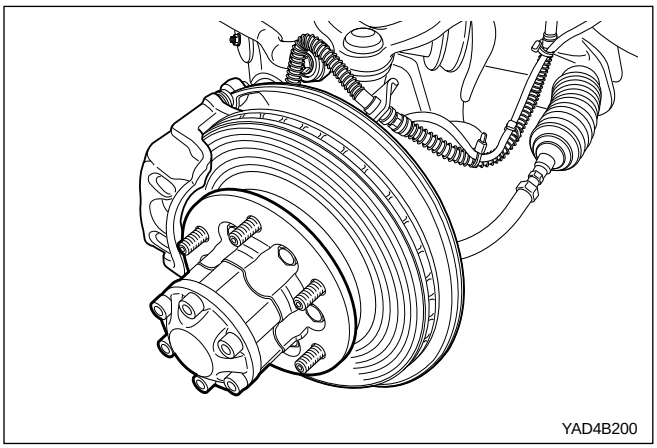

YAD4B180

Part-time

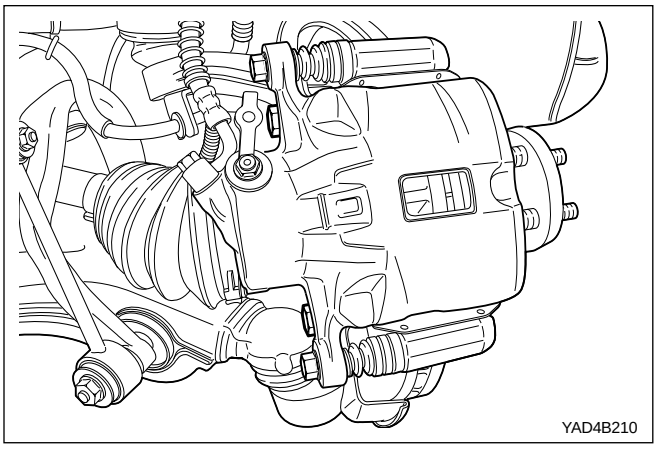

YAD4B190

Installation Procedure

1. Install the front brake disc assembly to the knuckle and fasten the lock nut as specified torque (full-time 4WD).


YAD4B200

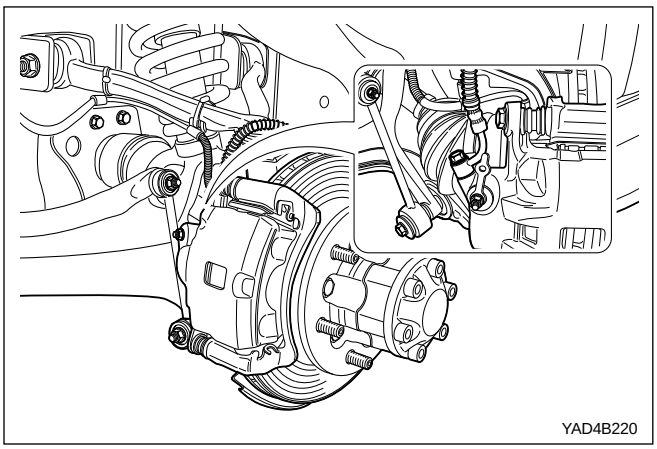
Install the front brake disc to the knuckle and install the locking hub & hub range. Fasten the mounting bolt (part-time 4WD).

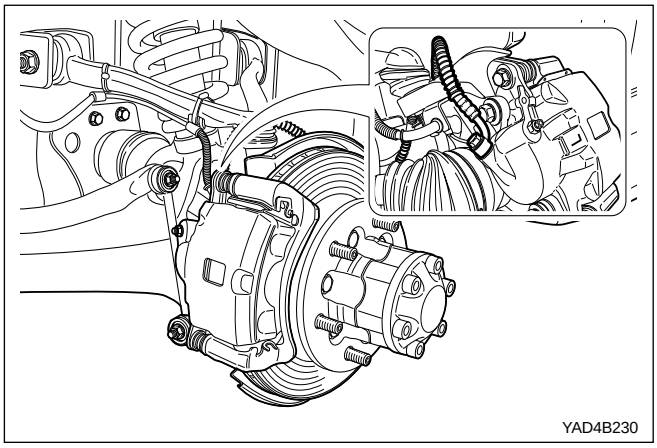

YAD4B210

2. Install the caliper assembly to the front disc and fasten the caliper mounting bolt.

Installation Notice

Tightening Torque	85 - 105 N•m (63 - 79 lb-ft)


YAD4B220



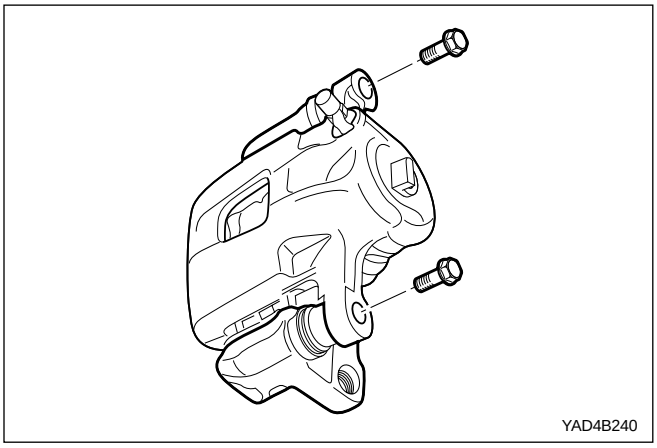
3. Connect the brake hose to the caliper cylinder.

   Installation Notice

Tightening Torque	7 - 13 N•m (62 - 115 lb-in)

   Notice: The washer should be replaced new part.

4. Bleed the brake system after replacement.

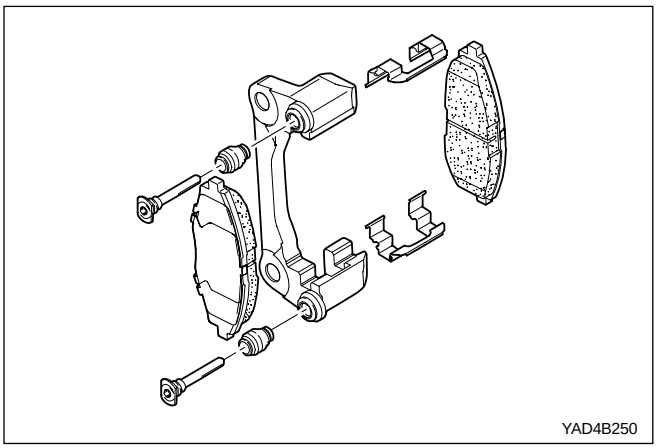

YAD4B240

UNIT REPAIR

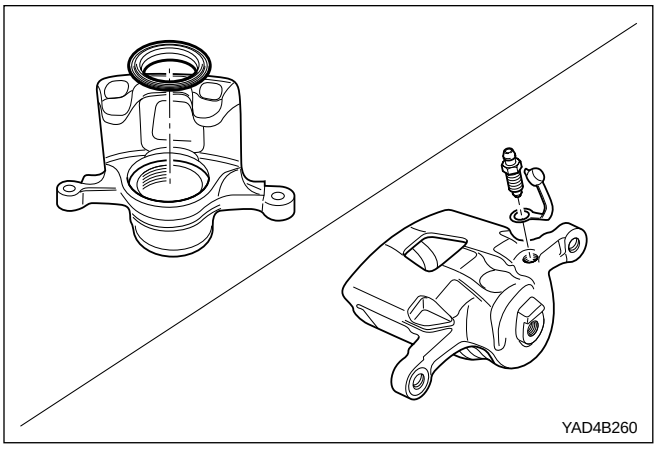
BRAKE CALIPER

Disassembly Procedure

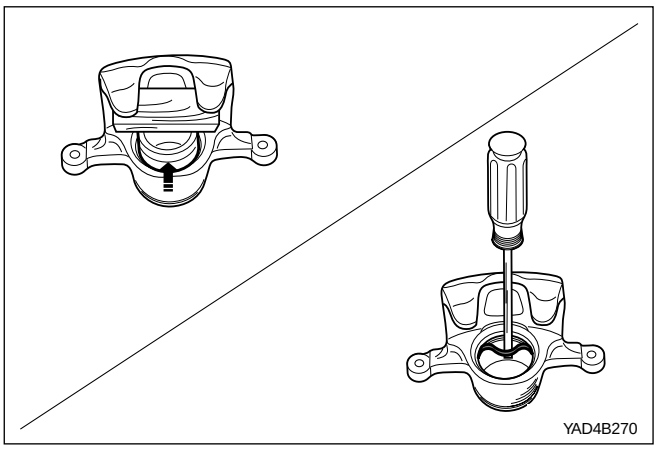
1. Remove the caliper assembly.
2. Separate the cylinder assembly and carrier.
   - Remove the guide rod bolt.
   - Separate the cylinder assembly and carrier.


YAD4B250

3. Disassemble the carrier.
   - Remove the pad.
   - Remove the spring.
   - Remove the guide rod and the boot.


YAD4B260

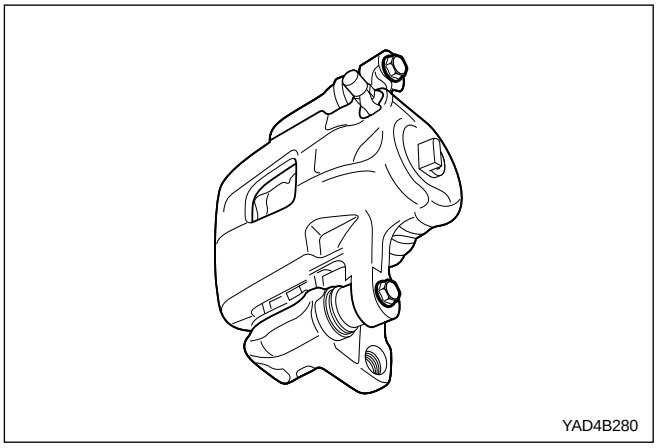
4. Remove the cylinder assembly.
   - Remove the bleeder plug.
   - Remove the bleeder plug cap.
   - Remove the piston boot.


YAD4B270

- Using the compressed air, blow out the piston from housing.

  Notice: Do not face in the direction of removing.

- Remove the piston.
- Remove the piston seal.


YAD4B280

Assembly Procedure

1. Installation should follow the removal procedure in the reverse order.

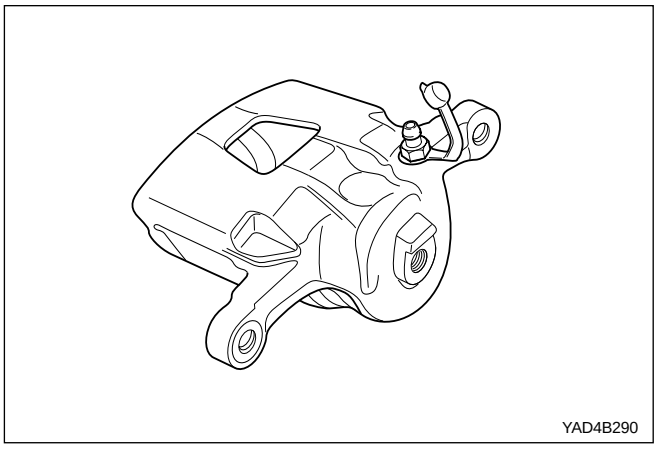
   Notice: Clean all the parts in denatured alcohol or brake fluid. Dry the parts with unlubricated compressed air and blow out all the passages in the housing and the bleeder valve.

   Apply the brake fluid on the surface of the piston and cylinder.

2. Fasten the guide rod bolt as specified torque.

   Installation Notice

Tightening Torque	22 - 32 N•m (16 - 24 lb-ft)


YAD4B290

3. Fasten the bleeder screw as specified torque.

   Installation Notice

Tightening Torque	7 - 13 N•m (62 - 115 lb-in)

SECTION 4C

REAR BRAKE

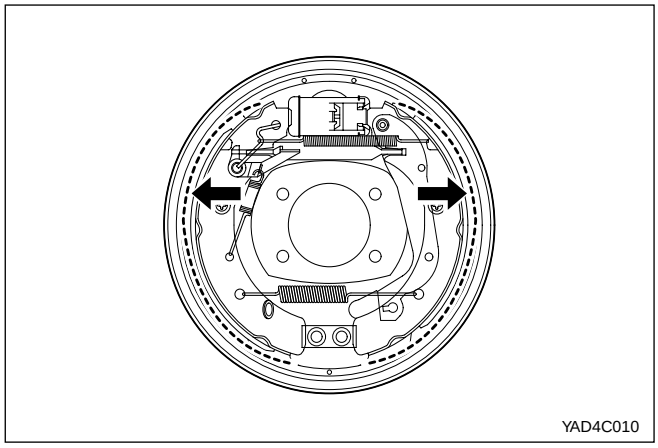
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DESCRIPTION AND OPERATION

DRUM BRAKE

This drum brake assembly is a leading/trailing shoe design.



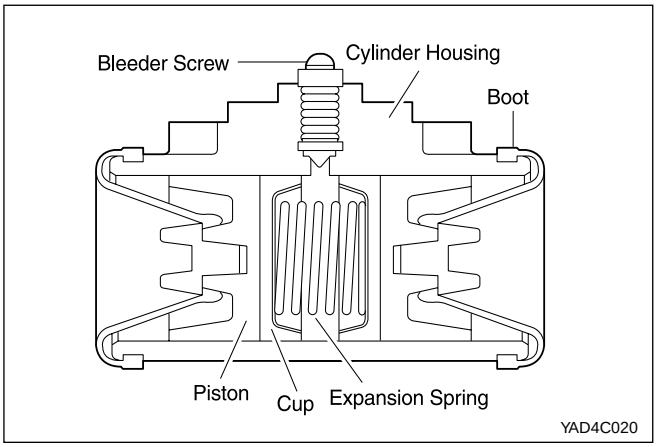
Both brake shoes are held against the wheel cylinder pistons by the lower return spring and the fixed anchor plate near the lower return spring. When the brakes are applied, the wheel cylinder pistons move both shoes out to contact the drum. With forward wheel rotation, the forward brake shoe will wrap into the drum and become selt-energized. With reverse wheel rotation, brake shoes is transferred to the anchor plate through the braking plate to the axle flange. Adjustment is automatic and occurs on any service brake application. Do not switch the position of shoes that have been in service, as this may render the self-adjustment feature inoperative and result in increased pedal travel.

The brake drum must have high abrasion resistance, heatproof, high stiffness, fatigue stiffness and strength enough not to make any deformation. The temperature of the drum surface comes up to 500 - 700 °C on brake operation by the friction with the lining. When the temperature of the drum surface continues to keep high, the friction coefficient goes down and the ‘fade development’ occurs. When the brake is applied often on the hill, any accident may be occur.

WHEEL CYLINDER

Both wheel cylinder diameters are same in order to balance the friction forces of both shoes.

The hydraulic pressure from the master cylinder is provided to the wheel cylinder and the piston in the wheel cylinder allows to push both shoes toward the drum resulted in generating the braking force.



1 Cylinder Housing	1 Cylinder Housing
2 Boot	2 Boot
3 Spring	3 Spring
4 Piston Cup	4 Piston Cup
5 Piston	5 Piston
6 Air Bleeder	6 Air Bleeder

BRAKE LINING

The brake lining is installed with the brake shoe and pushed toward the drum for applying the brake pedal.

Thus, lining must have high-heat tolerance, abrasion resistance and high friction coefficient.

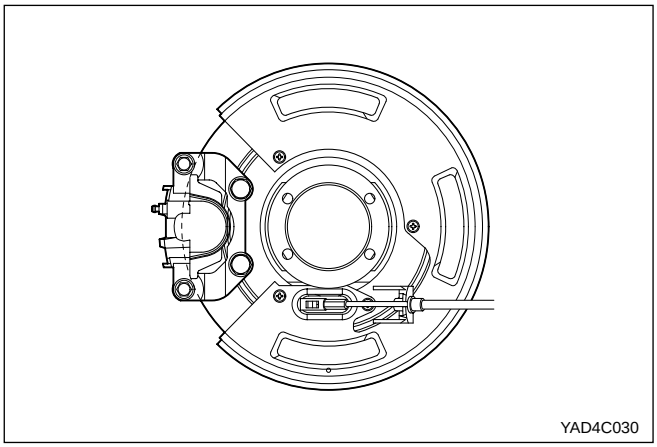
Brake Lining and Drum Clearance Automatic Control System

If the lining’s wear is excessive, the piston moves to long distance and the pedal travel increases. The clearance between the drum and the brake lining should be adjusted.

Generally the drum brake must be adjusted regularly and thus the clearance automatic control system enables to adjust the clearance between the brake lining and the drum resulting from brake lining wear.

DISC BRAKE

The disc brake uses at front wheel generally and recently has been using at rear wheel. The floating type caliper disc brake installed by this vehicle installs only brake cylinder per caliper at one side. When the master cylinder generates the hydraulic pressure, the piston pushes the pad in order to compress to the disc and at this time, the caliper is moved by this reaction resulted in pushing the pad at the other side to compress to the disc. Because the brake disc contacts atmospheric conditions and effect on good radiation, the braking variation keeps uniform forces, the uneven braking may not be generated on high speed driving.



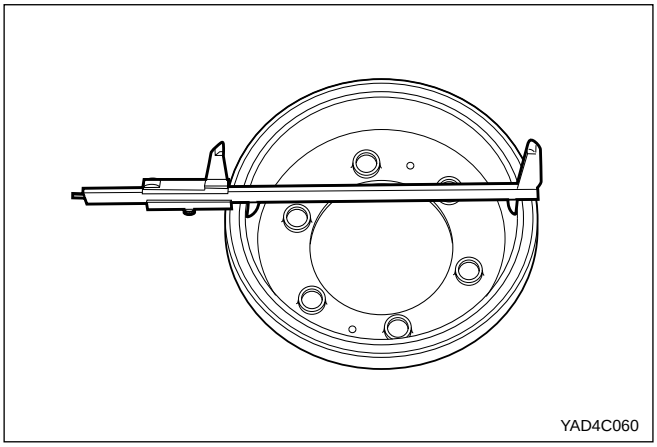
SPECIFICATIONS

Application	Drum Brake	Disc Brake	
		MANDO	Delphi Korea
Drum I.D.	Ø 254 mm	-	-
Shoe Type	Leading and Trailing	-	-
Lining Width x Length x Thickness	55 x 243 x 4.7 mm	-	-
Wheel Cylinder I.D.	Ø 23.81 mm	-	-
Caliper Cylinder I.D.	-	Ø 42.9 mm	Ø 42 mm
Brake Pad Thickness	-	10 mm	10 mm
Disc Thickness	-	10.4 mm	10.4 mm

DIAGNOSTIC INFORMATION AND PROCEDURES

Symptom	Possible Cause	Action
Poor Braking	Lining Wear, Hardening	Replace
	Oil Or Water Contamination On The Lining	Replace or Repair
	Inoperative Wheel Cylinder	Replace
	Inoperative Clearance Automatic Control System	Repair
Uneven Braking	Lining Wear, Hardening	Adjust
	Oil Or Water Contamination On The Lining	Replace or Repair
	Inoperative Wheel Cylinder	Replace
	Inoperative Clearance Automatic Control System	Repair
Dragging Brake	Damage Of The Brake Shoe Return Spring	Replace
	Inoperative Wheel Cylinder Returning	Replace
Excessive Pedal Travel	Lining Wear	Replace
	Inoperative Clearance Automatic Control System	Repair
Noise and Vibration When Brake Applied	Lining Wear, Hardening	Replace
	Foreign Material Inside Drum	Clean
	Loosen The Brake Plate Bolt	Tighten
	Drum Deformation Or Surface Damage	Replace
Inoperative Parking Brake	Lining Wear, Hardening	Replace
	Oil Contamination On The Lining	Replace
	Inoperative Clearance Automatic Control System	Repair

INSPECTION

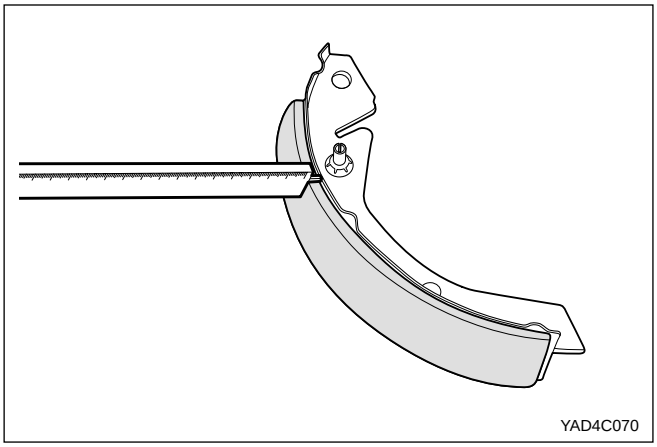

YAD4C060

DRUM BRAKE TYPE

1. Inspect the drum for crack or damage or deformation.
2. Measure the inside diameter.

Inside Diameter	Wear Limit
Ø 254 mm	Ø 255.5 mm

- Measure two more position.

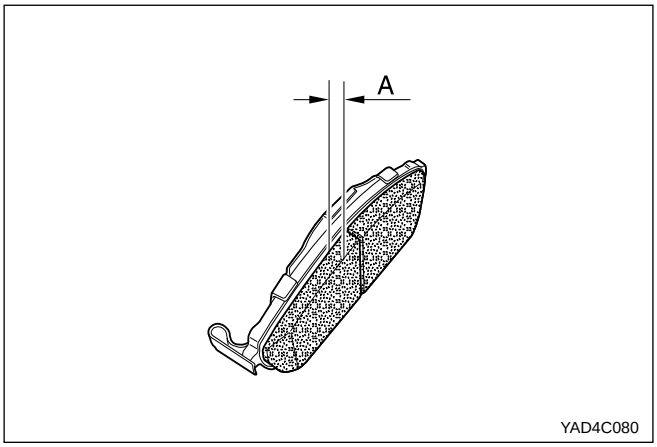

YAD4C070

Brake Lining

1. Inspect the surface hardening or excessive wear of the lining. Inspect the lining for stain with oil.
2. Measure the lining thickness.

Wear Limit	1 mm

- If the measured value is below the limit value, replace the brake lining.



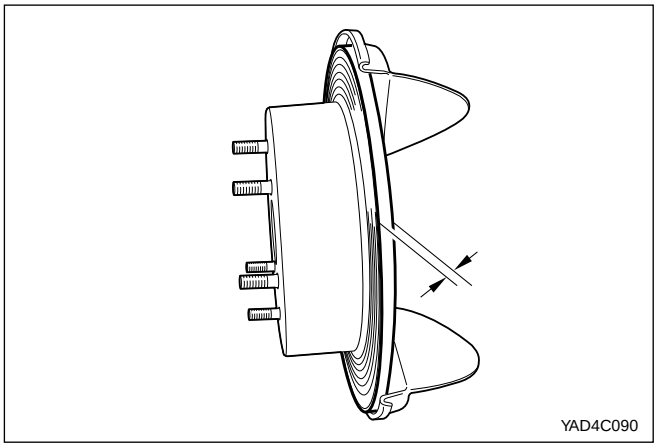
YAD4C080

DISC BRAKE TYPE

Pad Thickness

1. Remove the front wheel.
2. If the measured value is below the limit value, replace the pad.

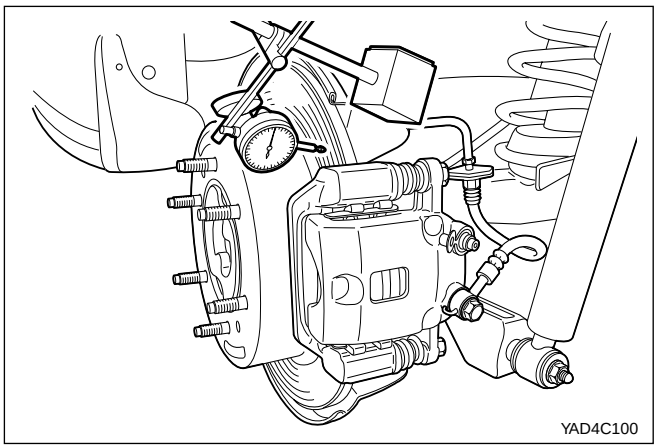
Wear Limit	2 mm


YAD4C090

Brake Disc Thickness

1. Measure the thickness of the rotor at four or more points around the circumference of the disc.
2. If the thickness of the brake disc is below the specified value, replace the brake disc.

Disc Thickness Limit	8.5 mm


YAD4C100

Brake Disc Run Out

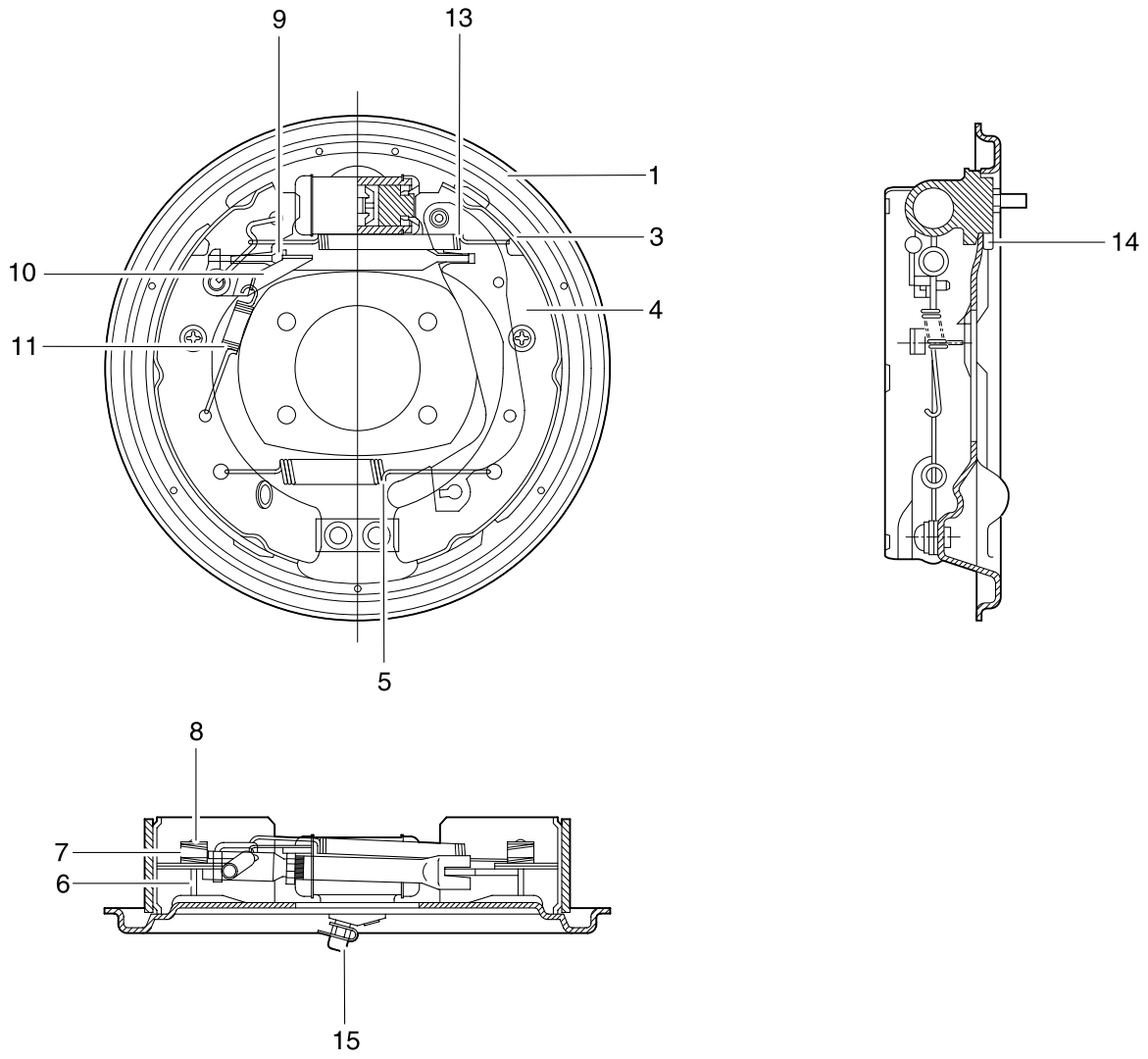
1. Set a dial indicator to the brake disc side and measure the run out by rotating the disc.

Run Out Limit	On-Vehicle	Max. 0.07 mm
	Disc only	Max. 0.03 mm

2. If lateral run out exceeds the specification, replace the brake disc to prevent the pedal's vibration at braking.

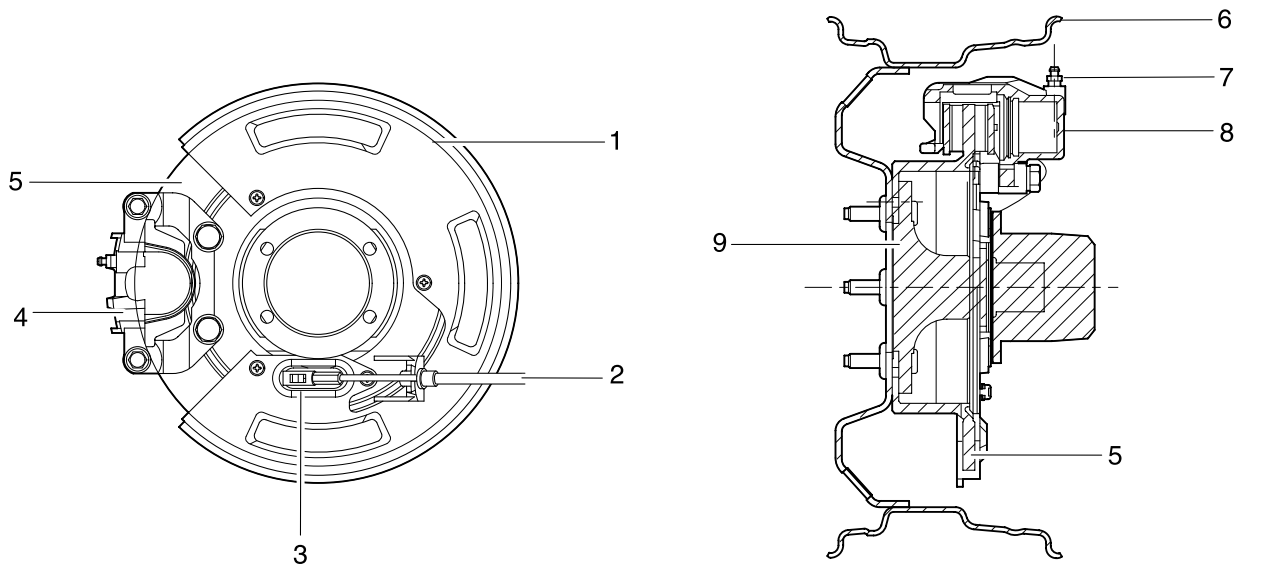
CROSS SECTIONAL VIEW

DRUM BRAKE (KDAC)



1 Backing Plate
2 Wheel Cylinder
3 Brake Shoe Lining
4 Brake Shoe
5 Lower Return Spring (Lower Shoe Spring)
6 Retainer Spring Pin
7 Compression Spring
8 Retainer Spring Plate
9 Adjuster Assembly
10 Adjuster Lever
11 Return Spring (Adjuster)
13 Upper Return Spring (Upper Shoe Spring)
14 Bolt
15 Air Bleeder Nipple

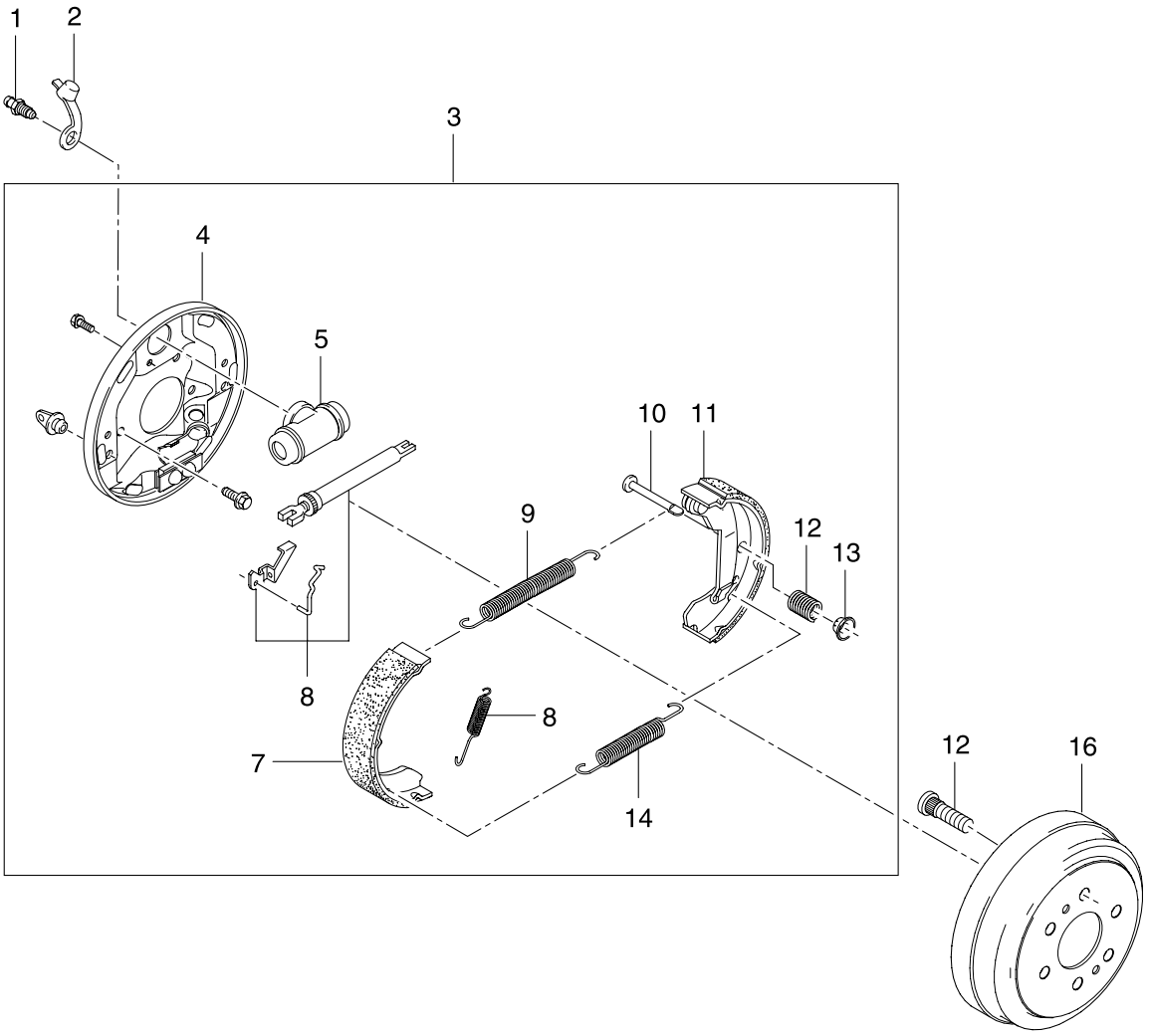
DISC BRAKE



1 Backing Plate
2 Parking Cable
3 Parking Cable Lever
4 Caliper Assembly
5 Disc
6 Wheel
7 Air Bleeder Nipple
9 Shaft Assembly

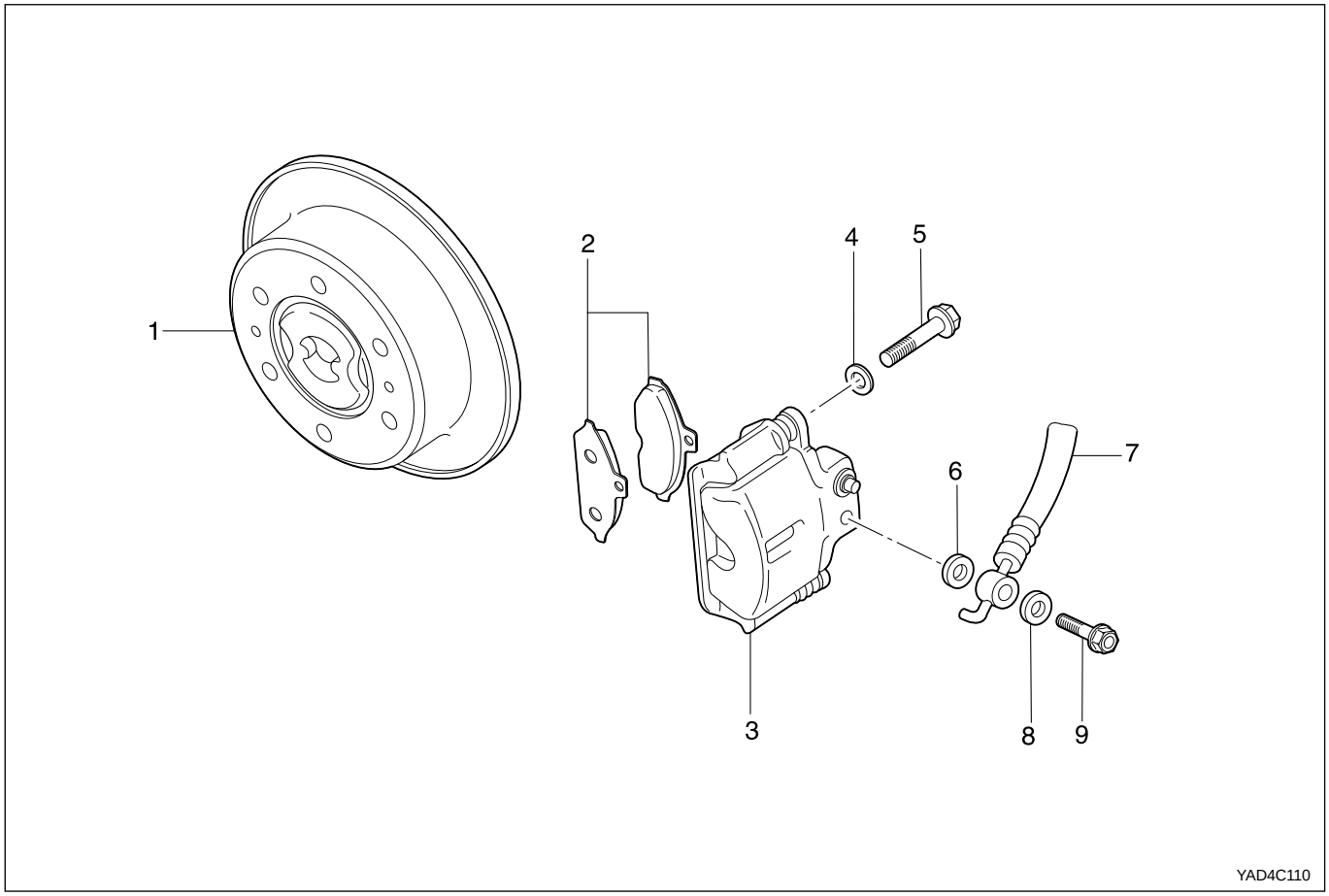
COMPONENT LOCATOR

DRUM BRAKE



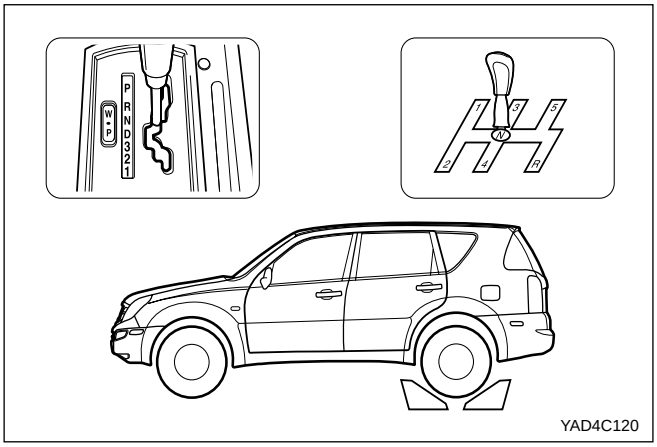
1 Bleeder Screw
2 Bleeder Screw Cap
3 Rear Brake Assembly
4 Rear Brake Plate
5 Wheel Cylinder
6 Strut Assembly (Clearance Automatic Control System)
7 Brake Leading Shoe
8 Middle Return Spring
9 Upper Return Spring
10 Brake Shoe Retaining Spring Pin
11 Trailing Shoe
12 Brake Shoe Retaining Spring
13 Brake Shoe Retaining Spring Cap
14 Lower Return Spring
15 Hub Bolt
16 Rear Brake Drum

DISC BRAKE



1 Rear brake disc assembly
2 Brake pad
3 Brake caliper
4 Gasket ..... Replace
5 Bolt ..... 20 N•m (15 lb-ft)
6 Gasket ..... Replace
7 Brake hose
8 Gasket ..... Replace
9 Hose bolt ..... 8 - 18 N•m

RERAIR INSTRUCTIONS



YAD4C120

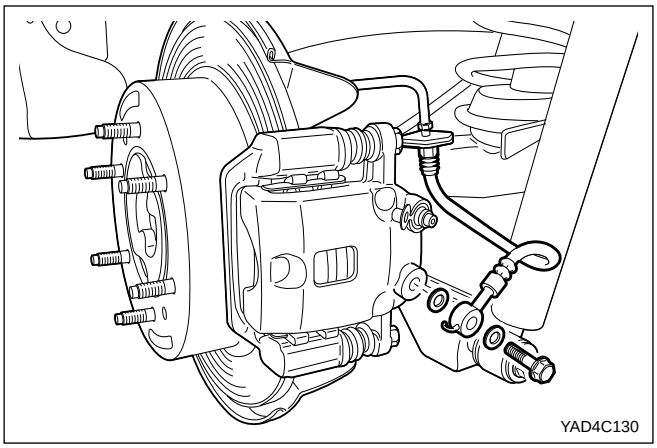
ON-VEHICLE SERVICE

DISC BRAKE ASSEMBLY

Removal Procedure

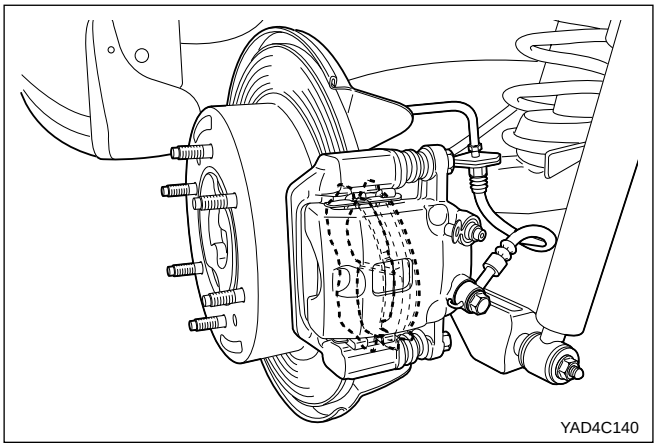
1. Remove the rear wheel.

   Notice:
   - Park the vehicle on the flat ground and fix the vehicle not to move it.
   - Release the parking brake.
   - Position the transmission in NEUTRAL.

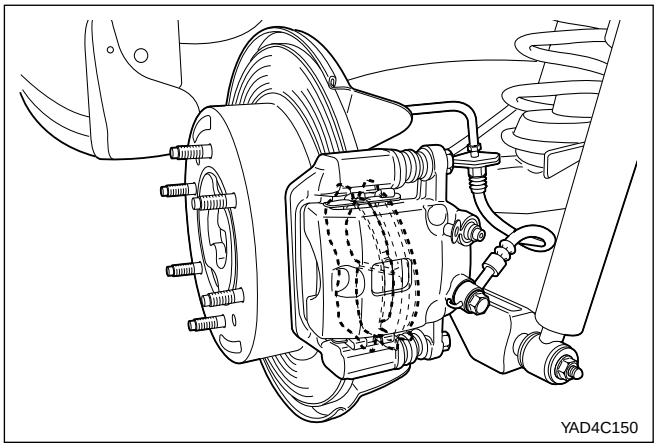

YAD4C130

2. Remove the brake hose from the rear brake caliper.

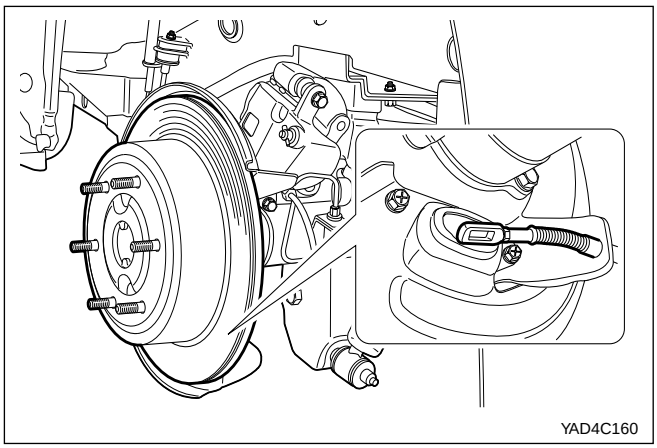
   Notice: Be carefully to prevent the brake fluid loss and contamination.


YAD4C140

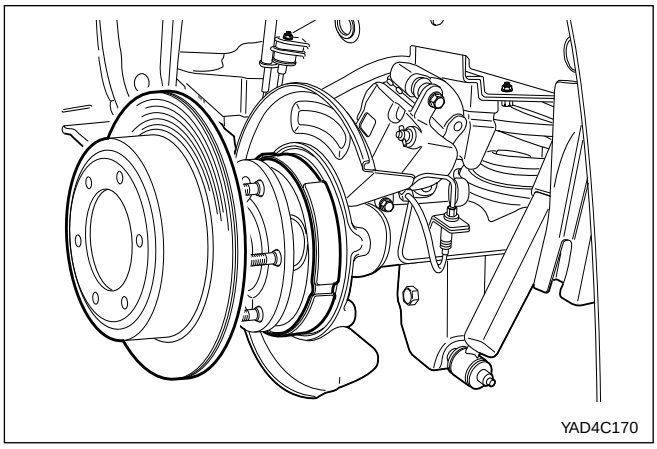
3. Remove the caliper cylinder mounting bolt and remove the disc pad and the cylinder.


YAD4C150

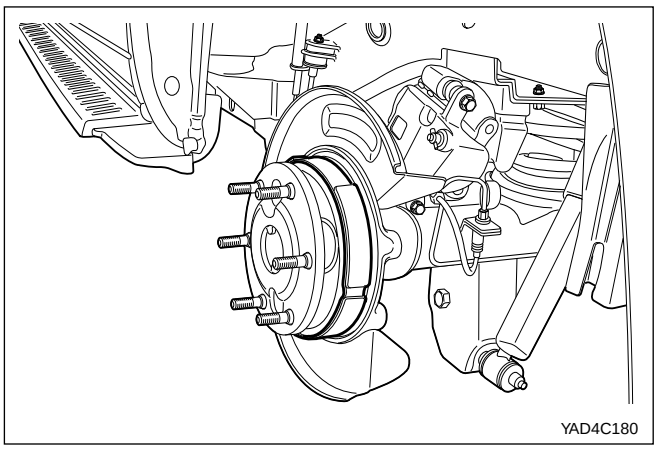
4. Remove the caliper mounting bolt and remove the caliper assembly.


YAD4C160

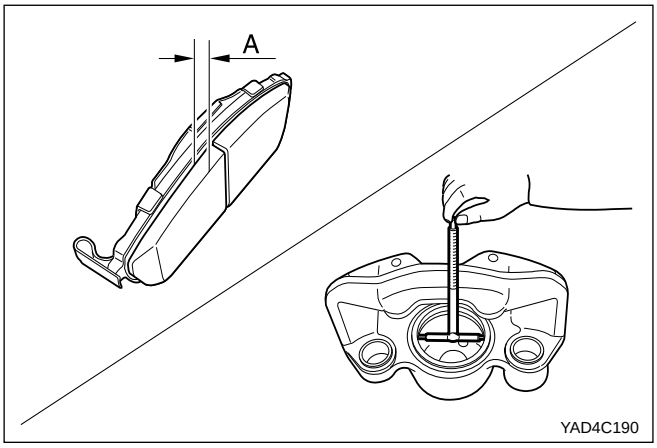
5. Disconnect the parking brake cable from the parking brake lever.


YAD4C170

6. Remove the brake disc.


YAD4C180

7. Using the rubber hammer, hit to separate the parking brake lining lightly and move the lining upward.



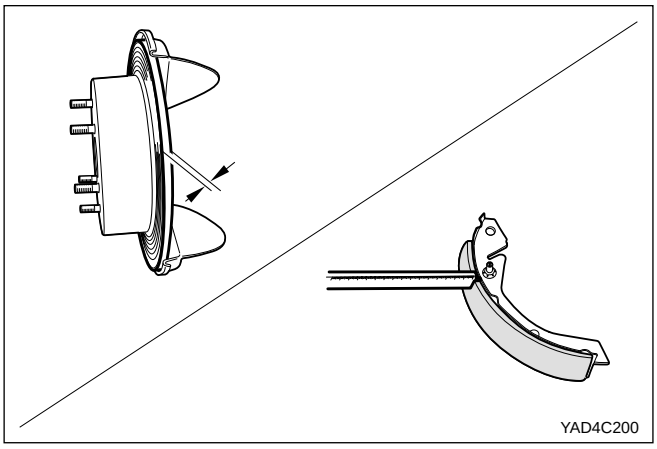
Inspection

1. Clean the dissembled parts and visually check the followings;
   - Wear, rust and damage on the cylinder and piston
   - Damage, crack on the caliper body and damage, wear on the guide pin
   - Pad uneven wear and oil contamination
   - Boot's damage and tear

2. Inspect the brake pad thickness.

Pad Thickness	Max wear Limit
10 mm	2 mm

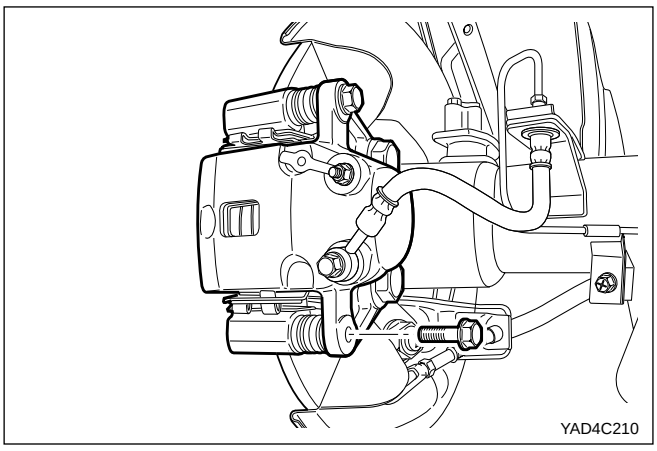
Notice: If the thickness of both pads is not same, replace both pads at the same time.



3. Inspect the disc thickness.

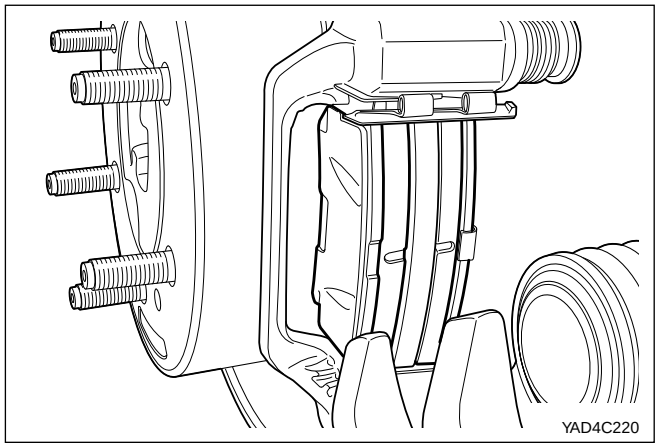
Pad Thickness	Max wear Limit
10.4 mm	8.5 mm

4. Inspect the disc plate's scratch and deformation.

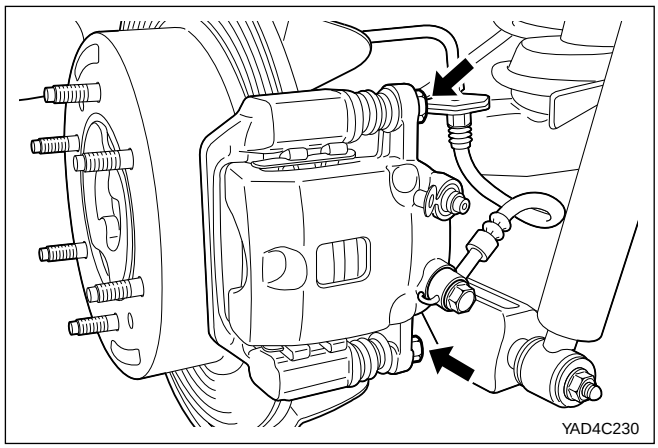


Brake Pad

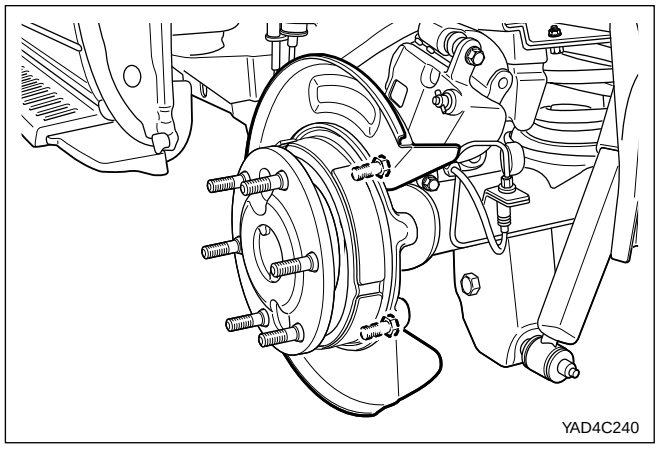
1. Remove the cylinder mounting bolt (lower) at the brake caliper.
2. Raise and fix the caliper assembly at the proper position not to cause any damage in the hoses or others.



3. Remove the brake pad and replace the new pad.



4. Install the caliper cylinder assembly and tighten the retaining bolt.



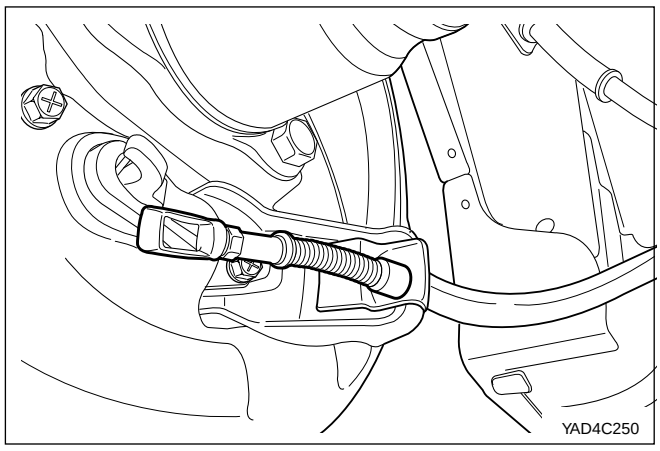
Installation Procedure

1. Install the brake lining between the backing plate and the flange.

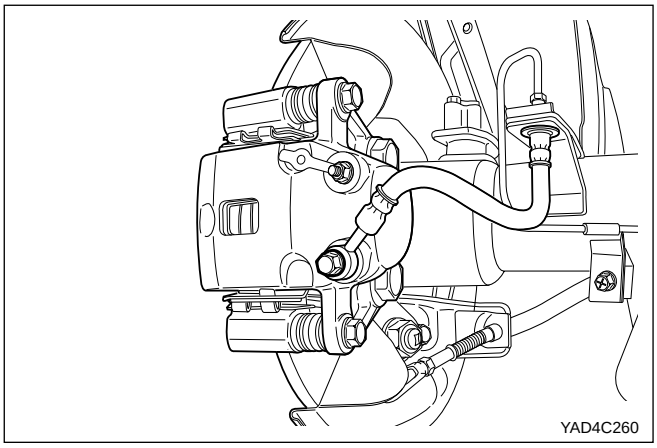
Installation Notice

Tightening Torque	4 - 8 N•m (35 - 71 lb-in)

Notice: Apply a certain amount of grease on the parking brake lining surface.



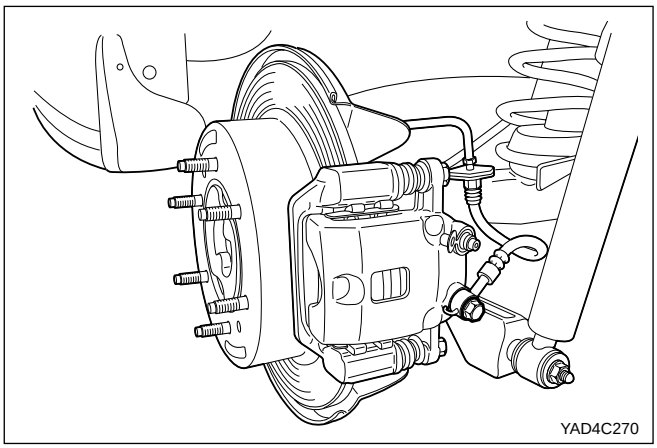
2. Install the brake disc and connect the parking brake cable to the lever.


YAD4C260

3. Install the caliper to the brake disc.

Installation Notice

Tightening Torque	4 - 8 N•m (35 - 71 lb-in)


YAD4C270

4. Install the brake hose.

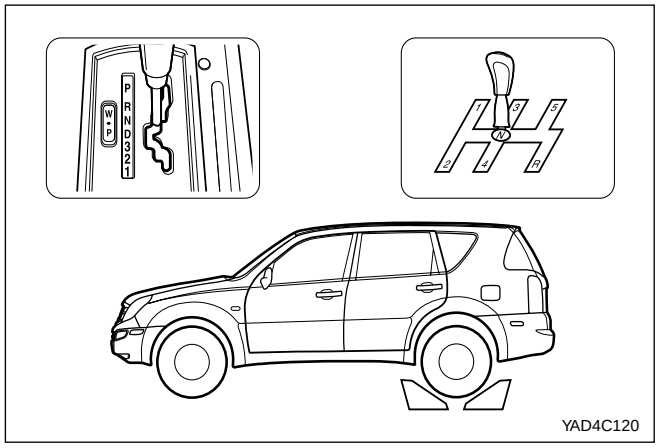
Notice: The washer should be replaced new part.

5. Tighten the air bleeder screw.

Installation Notice

Tightening Torque	7 - 13 N•m (62 - 115 lb-in)

6. Bleed the brake system after replacement.

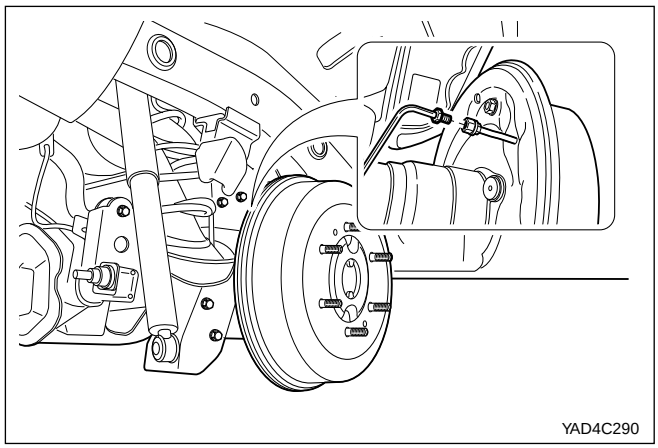


DRUM BRAKE ASSEMBLY

1. Remove the tires

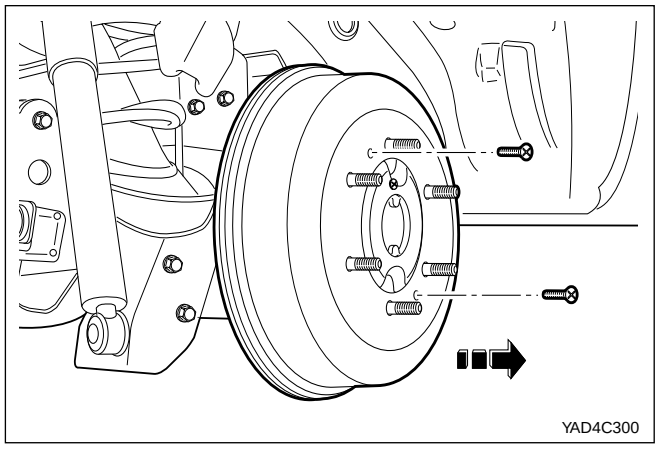
   Notice:

   - Park the vehicle on the flat ground and fix the vehicle not to move it.
   - Position the transmission in NEUTRAL.

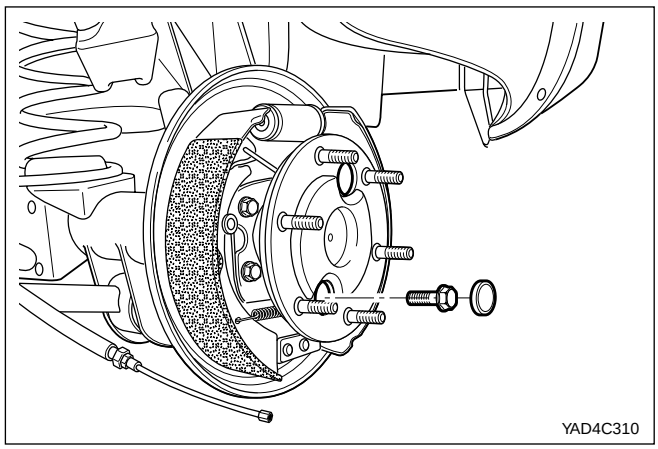


2. Disconnect the brake pipe from the rear brake.

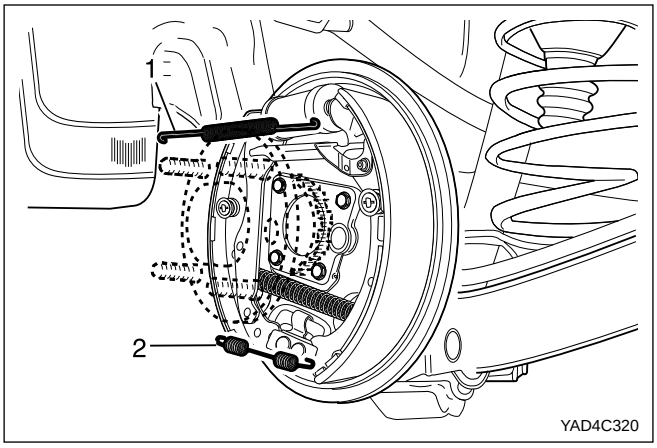
   Notice: Be carefully to prevent the brake fluid loss and contamination.



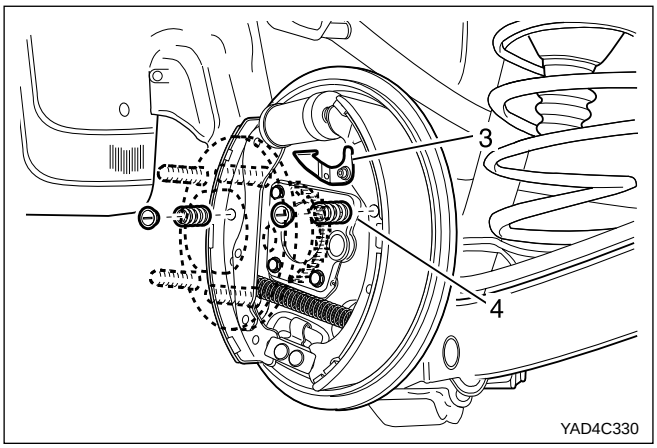
3. Insert the bolt (M8) to the service hole of the brake drum and remove the brake drum.

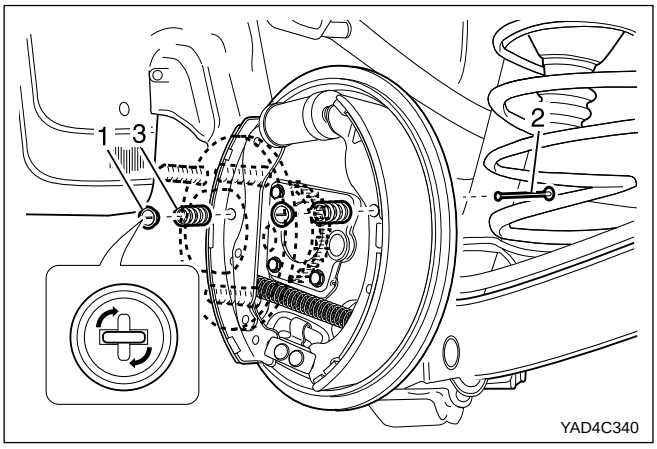


4. Remove the service hole plug of the axle shaft.

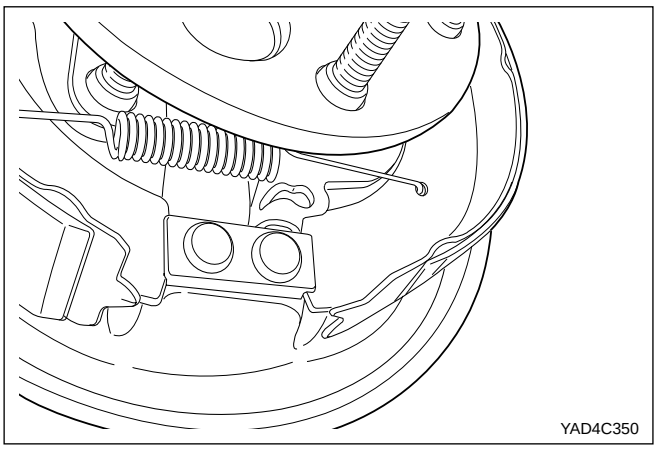


5. Remove the return spring.
   (1) Disconnect the upper return spring.
   (2) Disconnect the lower return spring.
   (3) Disconnect the lever spring.
   (4) Disconnect the adjuster lever from the adjuster.

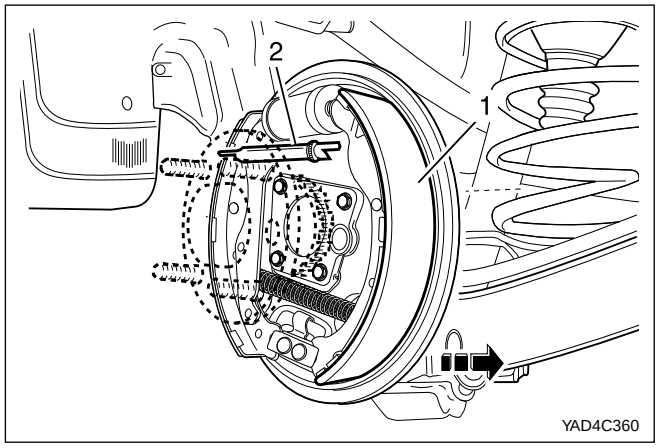




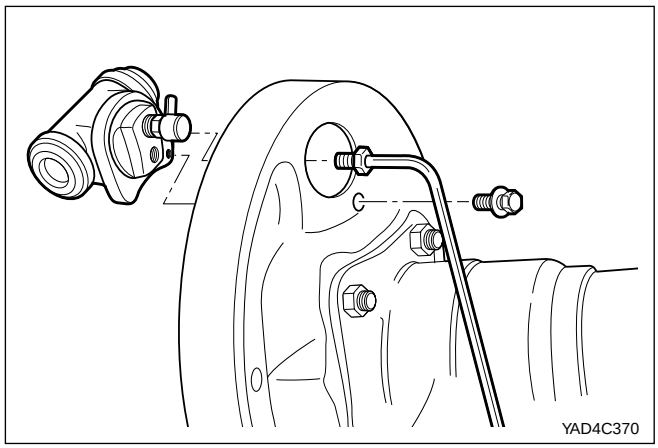
6. Rotate the lining shoe hold down-washer in the plug hole of the axle shaft flange and disconnect the pin and the spring.



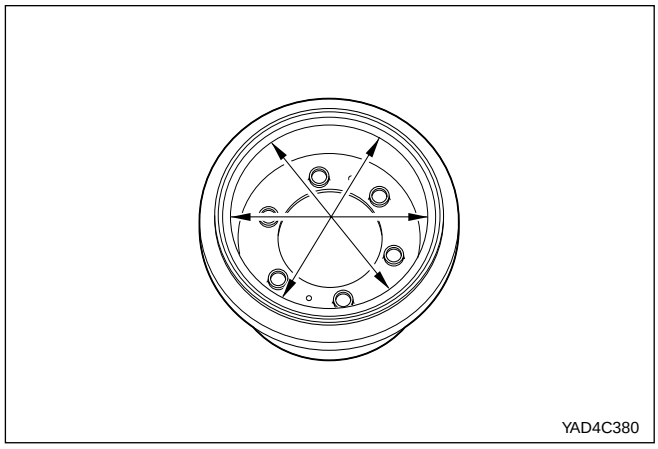
7. Disconnect the parking cable from the parking lever.



8. Disconnect the brake lining and adjuster lever.



9. Remove the wheel cylinder mounting bolt and remove the wheel cylinder.

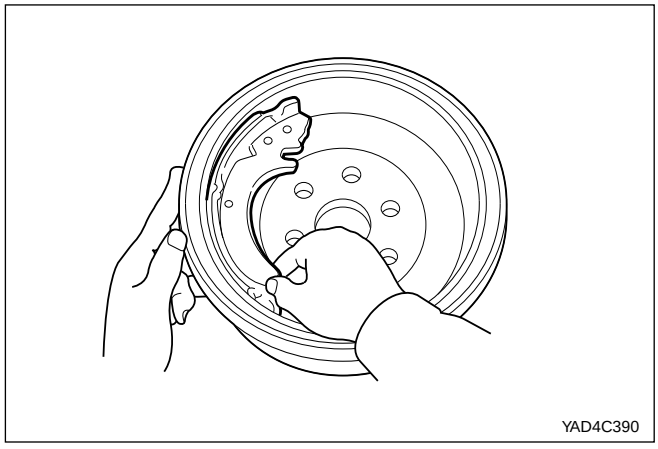


Inspection

1. Measure the inside diameter of the brake drum and replace as needed.

I.D.	Wear Limit
Ø 254 mm	Ø 255.5 mm

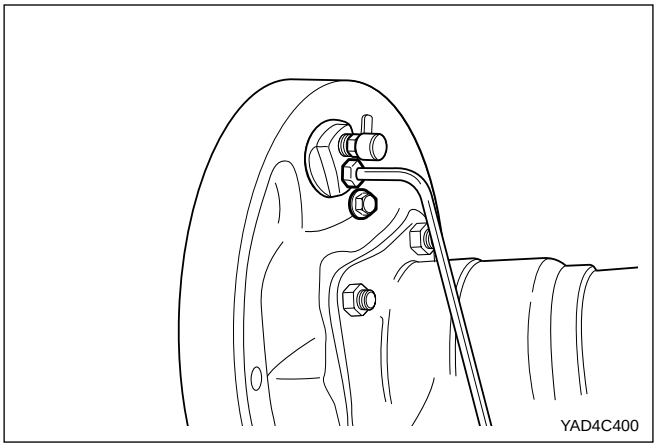
Notice: Measure two more position.



2. Inspect the surface between the lining and brake.

   Mark the brake drum inside using chalk and scrub the shoe & lining assembly. If there is excessive contact problem, replace the shoe & lining assembly or the brake drum.

   Notice: Clean any chalk mark after inspection complete.

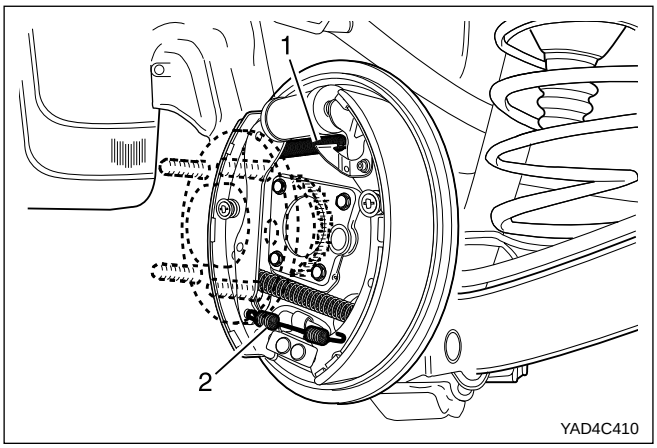

YAD4C400

Installation Procedure

1. Install the wheel cylinder to the backing plate.

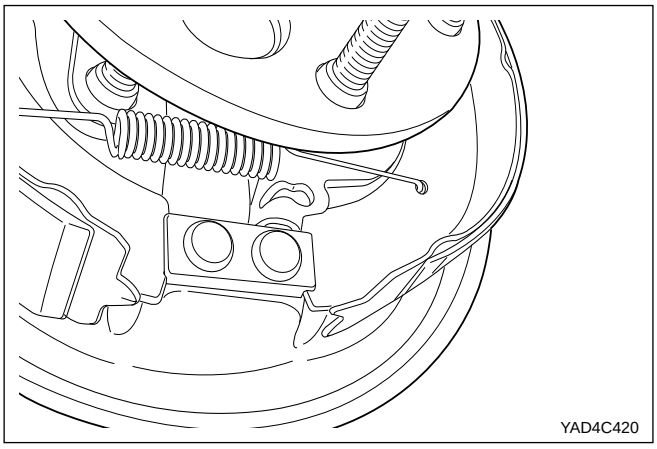
Installation Notice

Tightening Torque	8 - 12 N•m (71 - 106 lb-in)

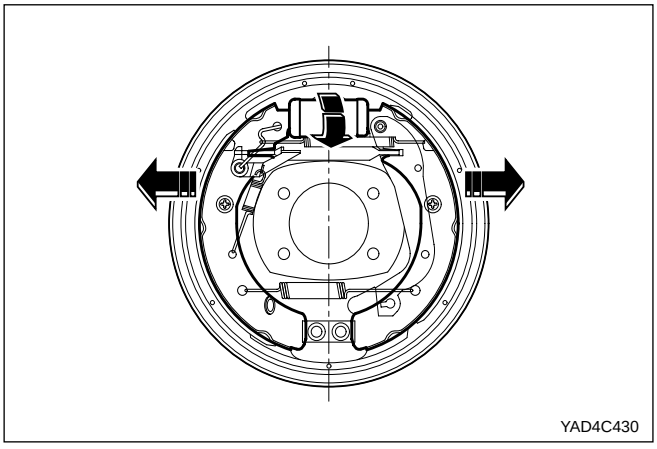


YAD4C410

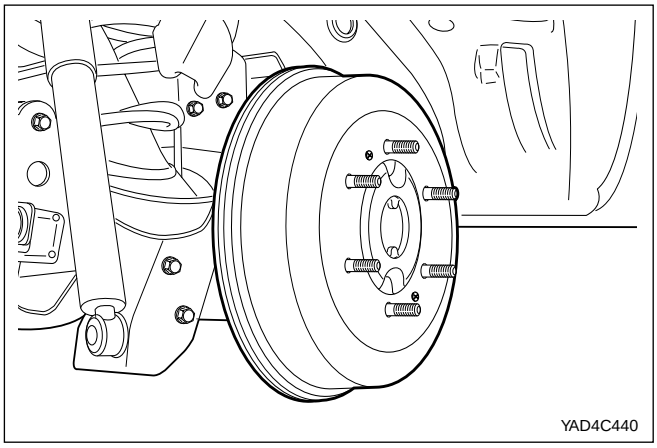
2. Install both brake linings between the wheel cylinder and the bottom anchor plate. And then install adjuster and each return spring.


YAD4C420

3. Connect the parking cable.

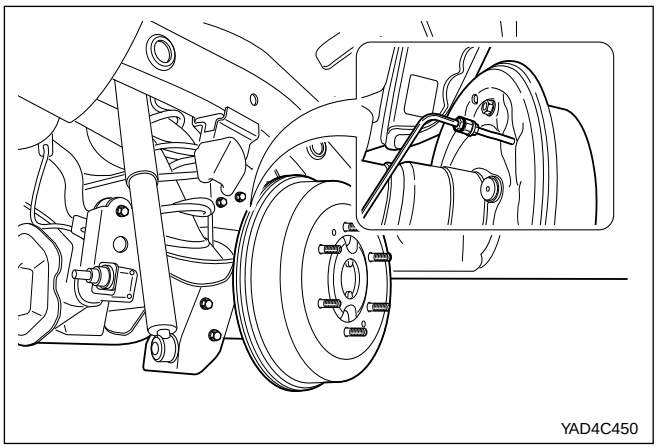

YAD4C430

4. The outside diameter of the lining set to Ø 253.08 - Ø 253.50 mm by rotating the adjuster screw.


YAD4C440

5. Install the plate and drum to the axle shaft sequently.
6. Check that the brake drum is rotated properly by hand.

   Notice: Adjust the adjuster screw as needed.


YAD4C450

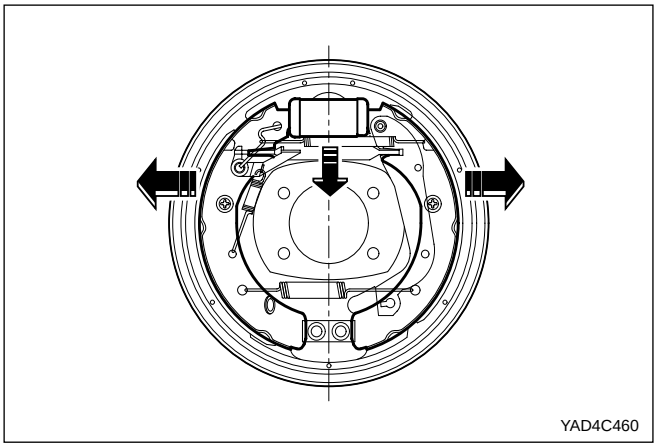
7. Connect the brake pipe to the wheel cylinder.

   Installation Notice

Tightening Torque	15 - 19 N•m (11 - 14 lb-ft)

8. Bleed the brake system and verify the parking brake operation.

   Install the tire.

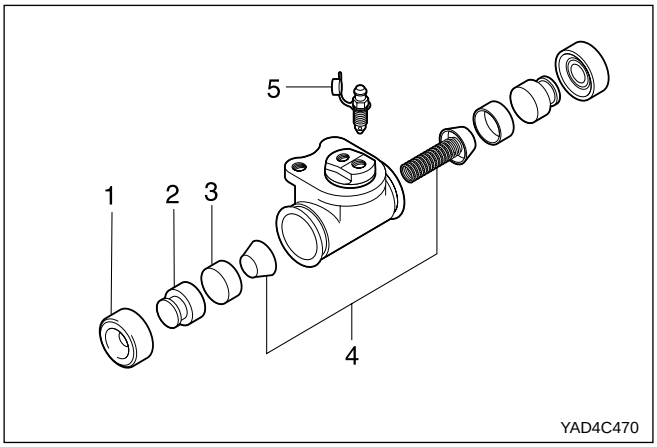

YAD4C460

UNIT REPAIR

WHEEL CYLINDER

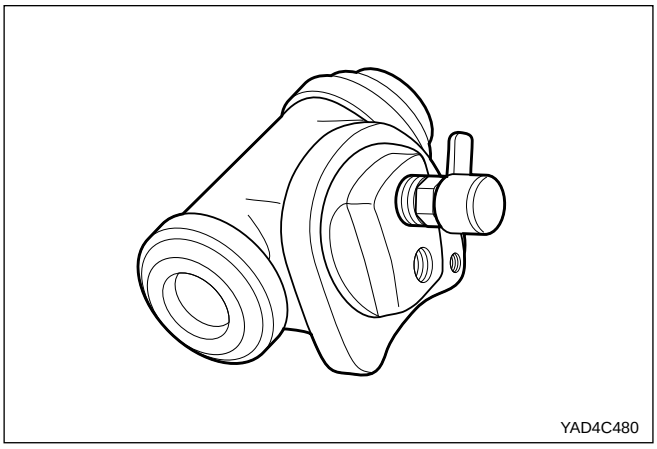
Disassembly Procedure

1. Remove the upper brake return spring and remove the wheel cylinder with pulling the upper lining outside.



YAD4C470

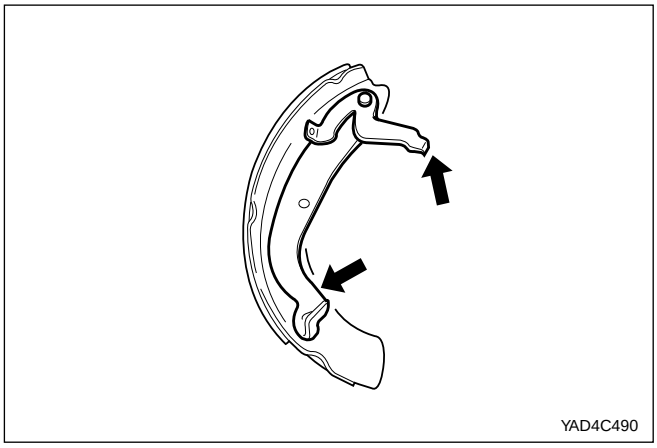
2. Disassembly the wheel cylinder assembly.
   - Remove the dust boot and do not reuse them (1).
   - Remove the piston (2).
   - Remove the piston cup and do not reuse it (3).
   - Remove the spring assembly (4).
   - Remove the bleeder screw (5).
3. Clean all the parts with the denatured alcohol. Dry the parts with unlubricated compressed air.


YAD4C480

4. Installation should follow the removal procedure in the reverse order.
5. Tighten the bleeder screw and wheel cylinder as specified torque.

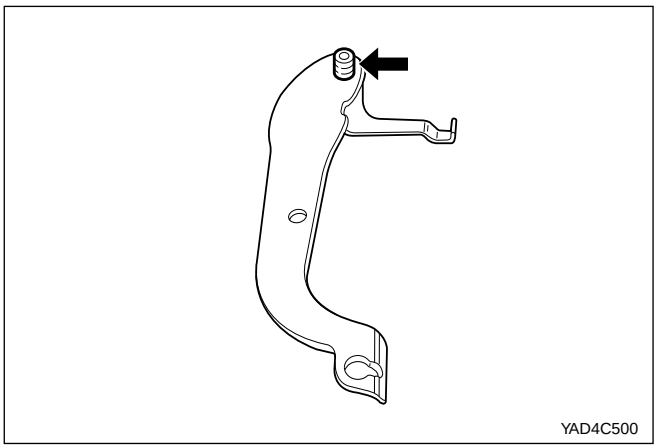
Bleeder Screw	7 - 10 N•m (62 - 89 lb-in)
Wheel Cylinder Mounting Bolt	8 - 12 N•m (71 - 106 lb-in)

Notice: Lubricate the new seals, the piston, the piston cup and the wheel cylinder bore with clean brake fluid before assembly.


YAD4C490

PARKING BRAKE LEVER

1. Disconnect the parking brake lever and the adjuster lever from the lining.


YAD4C500

2. Pull out the lever pin (arrow) and Disconnect the the parking brake lever and the adjuster lever.
3. Installation should follow the removal procedure in the reverse order.

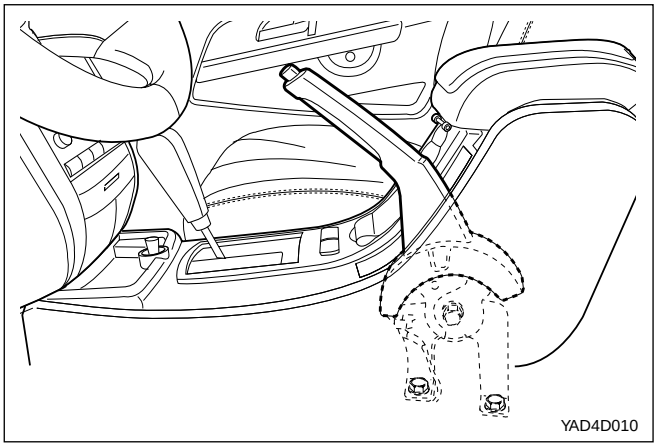
SECTION 4D

PARKING BRAKE

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Cross Sectional View 4D-5
Parking Brake Lever and Cable 4D-6
Repair Instructions 4D-7
On-Vehicle Service 4D-7
Parking Brake 4D-7

DESCRIPTION AND OPERATION

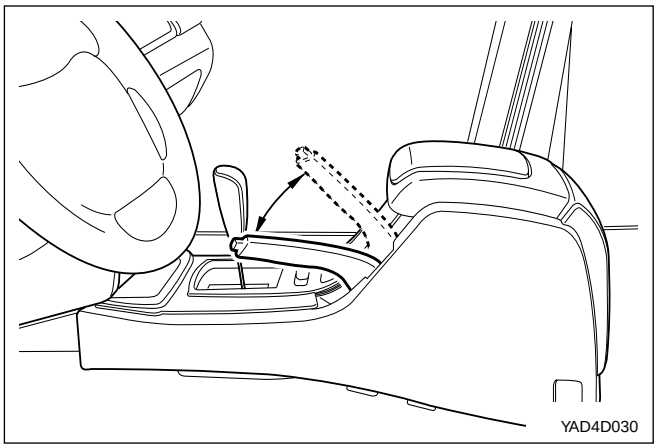


PARKING BRAKE

When the brake is firmly applied, the parking brake should the vehicle with ample pedal travel remaining. Check for frayed cables, rust, etc. or any condition that may inhibit present (or future) free movement of the parking brake lever assembly.

PARKING BRAKE SWITCH AND INDICATOR

When the parking brake lever is pulled out with the ignition ON, the parking brake indicator turns on via lever switch.



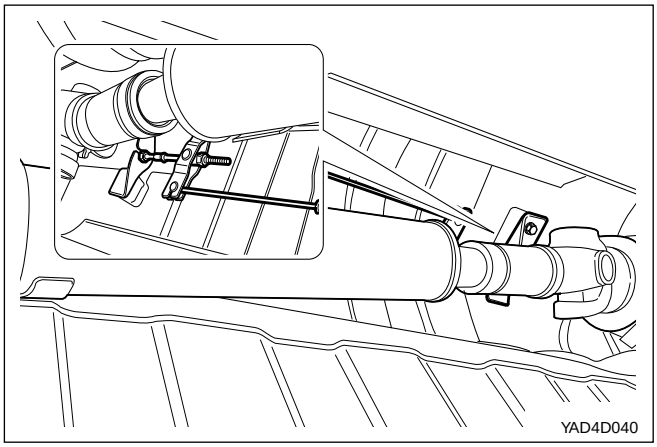
BRAKING INSPECTION

Inspect the parking brake as following;

1. Count the number of the notch sounds on pulling out the parking brake at 19kg force.

Specified Notch	5

2. If the notch number is over the specified value, adjust the notch number by the parking brake cable adjusting nut.
3. Check the parking brake force after adjusting the specified value.



4. If the braking force is not operated properly, check the parking brake lever and cable and replace them as needed.

SPECIFICATIONS

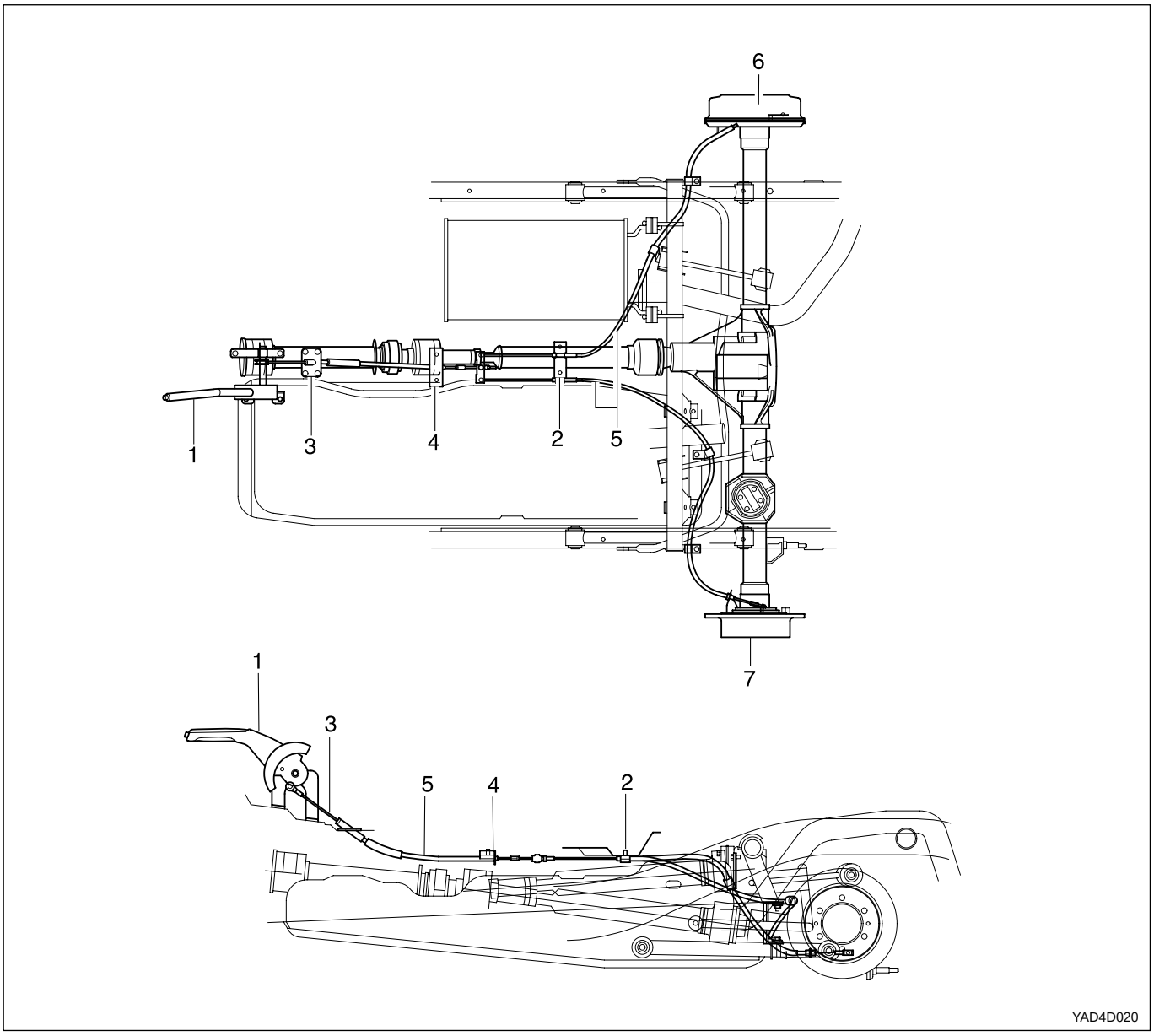
Application		Spec.
Parking Brake	Type	Mechanical Rear-Wheel Drive Internal Expanded
	Operation	Manual

DIAGNOSTIC INFORMATION AND PROCEDURE

Symptom	Possible Cause	Action
Poor Braking	Lining Wear, Hardening	Replace
	Oil Or Water Contamination On The Lining	Replace Or Repair
	Brake Cable Sticked Or Damage	Replace
	Excessive Pedal Travel	Notch Adjustment
	Inoperative Clearance Automatic Control System	Repair

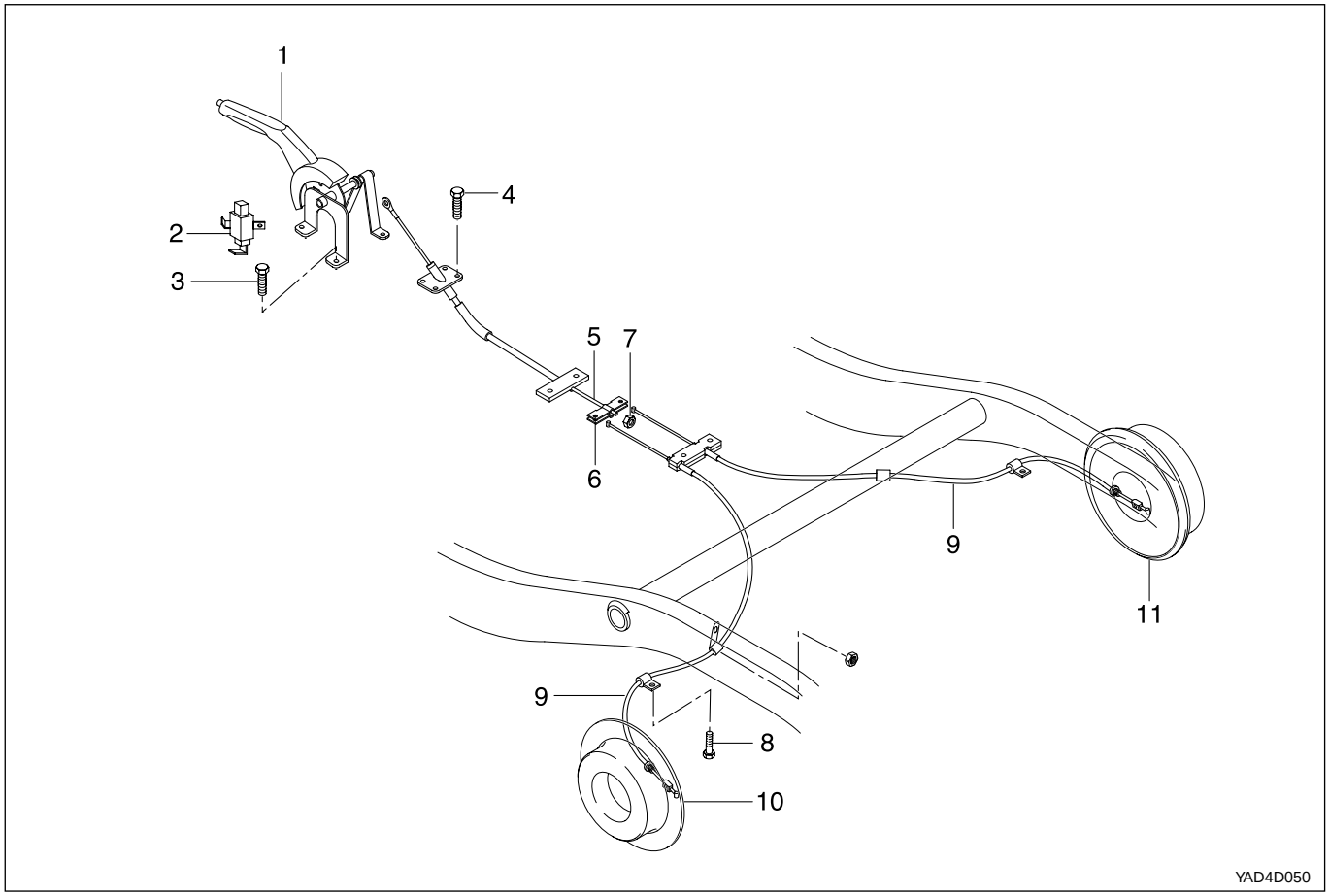
COMPONENT LOCATOR

CROSS SECTIONAL VIEW



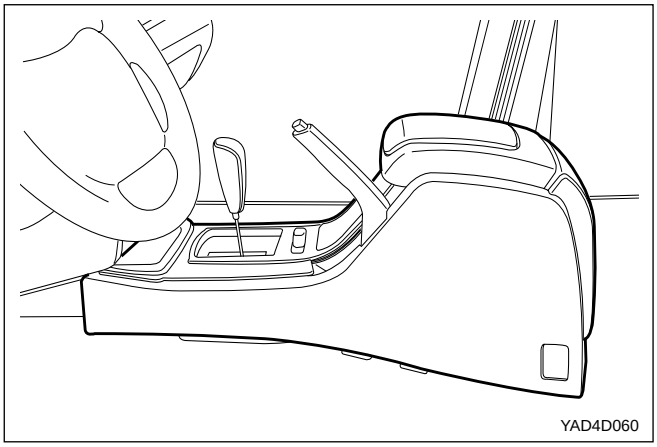
1 Parking Brake Lever
2 Parking Brake Cable Bracket (Rear)
3 Parking Brake Cable Bracket (Front)
4 Parking Brake Cable Bracket (Center)
5 Cable
6 With Drum Brake
7 With Disc Brake

PARKING BRAKE LEVER AND CABLE



1 Parking Brake Lever
2 Parking Brake Warning Lamp Switch
3 Bolt
4 Bolt
5 Front Parking Brake Cable
6 Equalizer
7 Nut
8 Bolt
9 Rear Parking Brake Cable
10 Brake Disc (Rear Disc Brake Type)
11 Brake Drum (Rear Drum Brake Type)

REPAIR INSTRUCTIONS

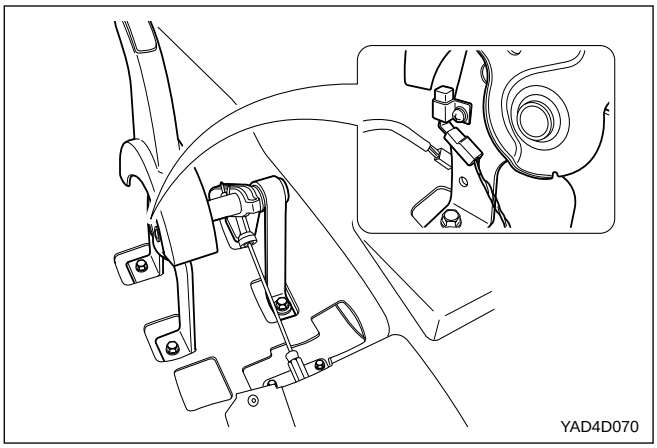

YAD4D060

ON-VEHICLE SERVICE

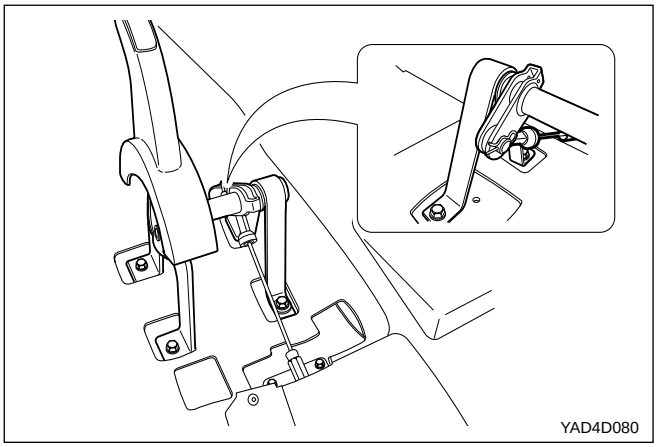
PARKING BRAKE

Removal Procedure

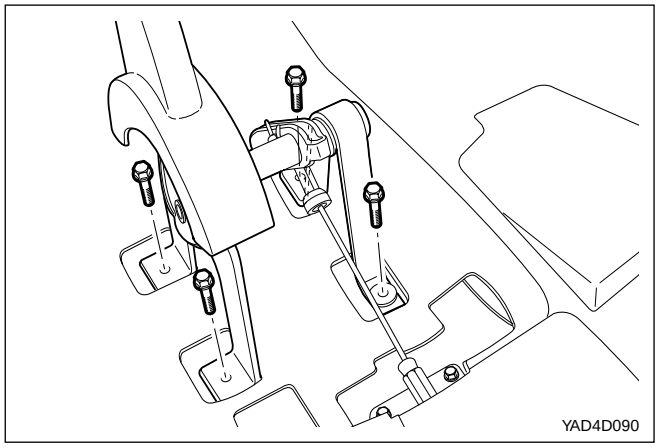
1. Remove the console assembly.


YAD4D070

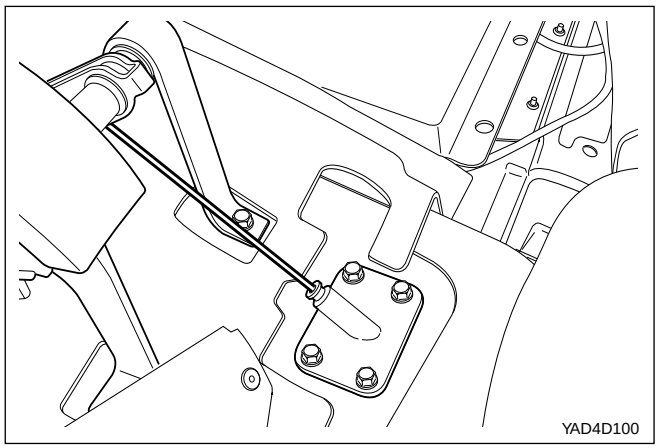
2. Disconnect the parking brake warning lamp connector.


YAD4D080

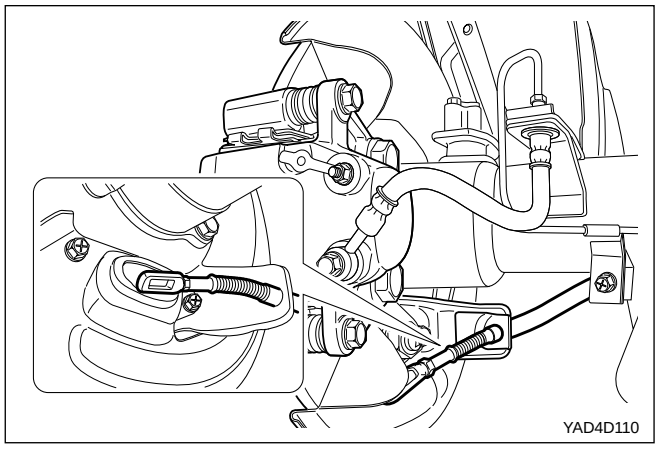
3. Disconnect the cable from the parking brake lever with parking brake released.



4. Remove the parking brake lever bracket mounting bolt and remove the lever assembly.



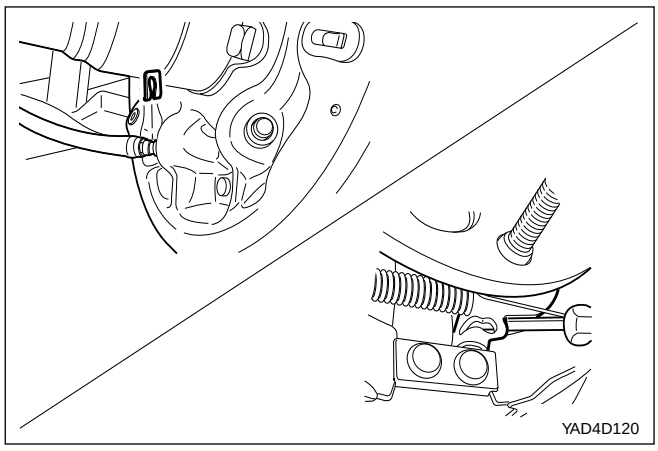
5. Remove the cable plate at the under floor.



6. Disconnect the parking brake cable from the rear brake.

DiscType

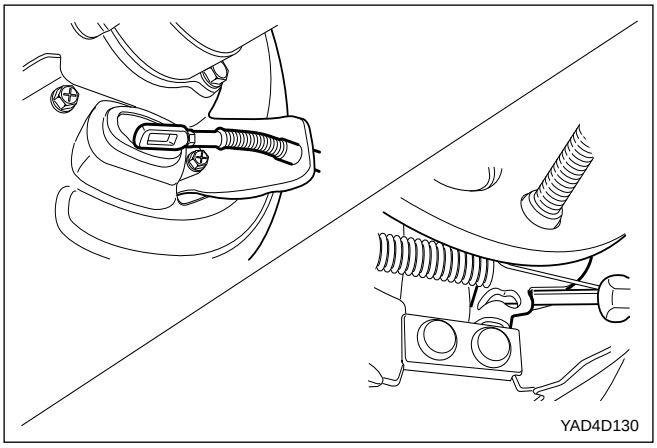
- Disconnect the cable from the parking brake lever.
- Remove the clip from the brake plate.



Drum Type

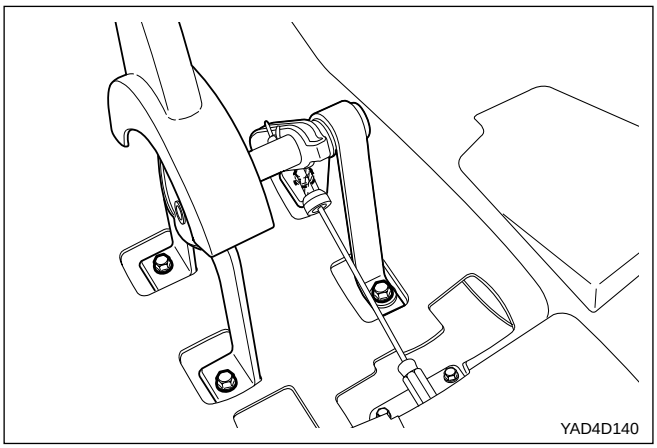
- Remove the clip from the brake plate.
- Move the parking brake lever as shown using driver etc. and then disconnect the cable.

7. Disconnect the cable bracket and the cable.


YAD4D130

Installation Procedure

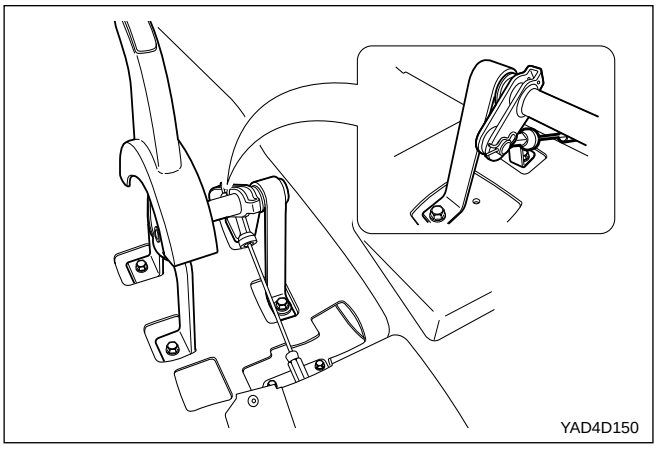
1. Connect the parking brake cable to the parking brake lever.
2. Install the bracket with the parking brake cable to the body.


YAD4D140

3. Install the parking brake lever assembly.

Installation Notice

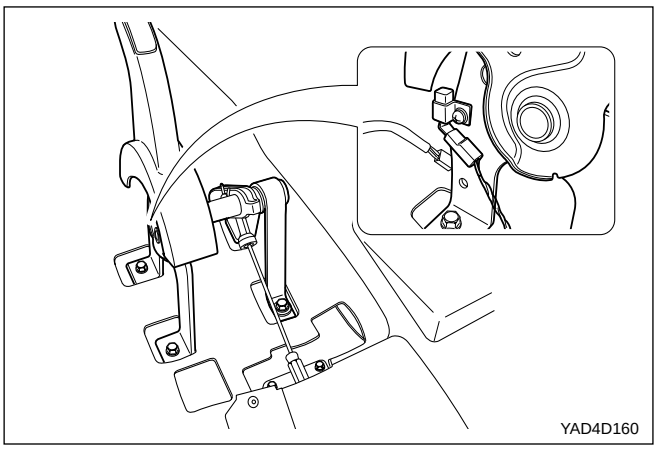
Tightening Torque	22 N•m (16 lb-ft)


YAD4D150

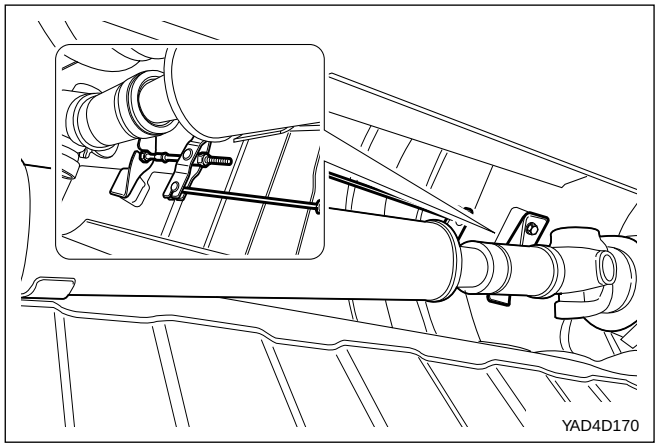
4. Insert the parking brake cable to the lever hole and install the cable plate.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)


YAD4D160

5. Install the parking brake switch and check the warning lamp and brake operation.



6. If there is any operation problem in the parking brake, adjust the cable tension at the equalizer position.
7. Install the console assembly and perform the braking test.

SECTION 4E

ABS SYSTEM AND TRACTION CONTROL SYSTEM

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DESCRIPTION AND OPERATION

ABS(ANTI-LOCK BRAKE SYSTEM)

When wheel slip is noted during a brake application, the ABS enters antilock mode. During antilock braking, hydraulic pressure in the individual wheel circuits is controlled in order to prevent any wheel from slipping. A separate hydraulic line and specific solenoid valves are provided for each wheel. The ABS can decrease, hold or increase hydraulic pressure to each wheel brake. However, the ABS cannot increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During antilock braking, a series of rapid pulsations will be felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as they respond to their desired wheel speed. This pedal pulsation is present during antilock braking and stops when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves rapidly cycle. During antilock braking on dry pavement, the tires may make intermittent chirping noises as they approach slipping. These noises and pedal pulsations should be considered normal during antilock operation.

The vehicle may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking should be no different than previous systems. Maintaining a constant force on the pedal will provide the shortest stopping distance while maintaining vehicle stability.

Basic Knowledge Required

Before using this section, it is important that you have a basic knowledge of the following items. Without this knowledge, it will be difficult to use the diagnostic procedures contained in this section.

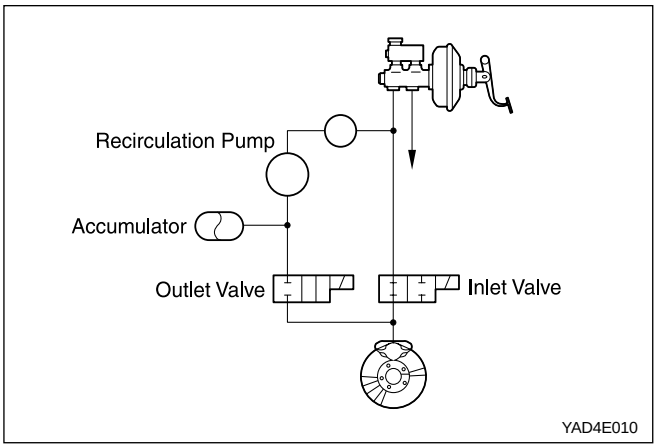
Basic Electrical Circuits - You should understand the basic theory of electricity and know the meaning of voltage, current (amps) And resistance (ohms). You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.

Use of Circuit Testing Tools - You should know how to use a test light and how to bypass components to test circuits using fused jumper wires. You should be familiar with a digital multimeter. You should be able to measure voltage, resistance, and current, and be familiar with the controls and how to use them correctly.

Basic Hydraulic System

Each solenoid valve consists of one inlet valve and one outlet valve in order to become the channel.

The inlet valve and the outlet valve close/open by the electrical signal and control the hydraulic pressure as increase, decrease and hold.



ABS System Components

The ABS 5.3 Antilock Braking System (ABS) consists of a conventional hydraulic brake system plus antilock components. The conventional brake system includes a vacuum booster, master cylinder, front disc brakes, rear disc brakes, interconnecting hydraulic brake pipes and hoses, brake fluid level switch and the BRAKE indicator.

The ABS components include a hydraulic unit, an electronic brake control module (EBCM), two system fuses, four wheel speed sensors (one at each wheel), interconnecting wiring, the ABS indicator, the EBD indicator and the TCS indicator, See “ABS Component Locator” in this section for the general layout of this system.

The basic hydraulic unit configuration consists of hydraulic check valves, two solenoid valves for each wheel, a hydraulic pump, and two accumulators. The hydraulic unit controls hydraulic pressure to the front calipers and rear calipers by modulating hydraulic pressure to prevent wheel lockup.

Units equipped with TCS add two more valves for each drive wheel for the purpose of applying the brake to a wheel that is slipping. This is done with pressure from the hydraulic pump in the unit. There is also a TCS indicator lamp on the instrument panel to alert the driver to the fact that the TCS system is active. The components identified in the drawing are those added to the basic ABS 5.3 system to provide traction control.

Nothing the hydraulic unit or the EBCM is serviceable. In the event of any failure, the entire ABS unit with attached EBCM must be replaced. For more information, refer to “Base Braking Mode” and “Antilock Braking Mode” in the section.

TRACTION CONTROL SYSTEM (TCS) DESCRIPTION

General Information

The traction control system (TCS) is a traction system by means of brake intervention only, available in a low speed range (< 60 kph).

It works on µ-split roads with sidewise different friction coefficients.

The spinning driven wheel is braked and the drive torque can be transferred to the wheel on the high-µ side. During TCS active, the TCS information lamp is blinking.

The temperature of the brakes is calculated by a mathematical model and TCS is switched passive if the calculated temperature is greater than a threshold value (500 °C). TCS is permitted again, when the calculated temperature is less than 350 °C.

Lamp Concepts

The system is equipped with an TCS information lamp, which is blinking during TCS operation.

The activation of the EBD, TCS warning lamp and the TCS info lamp is summarized in the following table:

	Ignition ON	ABS Operation	TCS Operation	System Failure (EBD, ABS or TCS are Not Distinguished)	TCS Passive Due to Temperature Model
ABS Warning Lamp	2 second on for lamp check	OFF	OFF	ON	OFF
TCS Info Lamp	2 second on for lamp check	OFF	Blinking (FLASHING)	OFF	ON
EBD Warning Lamp	2 second on for lamp check	EBD operation/OFF	OFF	ON	OFF

Automatic Brake Differential (ABD)

ABD (Automatic Brake Differential) system is a type of the TCS (ASR) system and substitutes the function of the mechanical LSD (Limited Slip Differential) system.

ABD system operates by controlling the braking forces only under 60km/h.

TCS System Function

Traction control does not have any effect on the operation of the vehicle until the control module detects one or both of the front wheels rotating faster than the rear wheels. At this time, the electronic brake control module (EBCM) requests the powertrain control module to reduce the amount of torque applied to the drive wheels. The powertrain control module does this by retarding timing and selectively turning off fuel injectors. The EBCM applies the front brakes, thus reducing torque to the front wheels. Once the front wheel begins to rotate at the same speed as the rear wheels, the system returns full control to the driver. During traction control mode, if the brake is applied to only one front wheel, most of the torque from the engine is directed to the other front wheel which improves the traction of the vehicle.

Pressure Modulation

Depending on the control deviation and the wheel acceleration of the spinning wheel, pressure increase, hold and decrease are made.

The pressure modulation is done with the conventional control with the valves. Prime valve, inlet valve and outlet valve according to the following table:

	Increase	Hold	Decrease
Prime Valve	Open	Open	Open
Pilot Valve	Closed	Closed	Closed
Inlet Valve	Open	Closed	Closed
Outlet Valve	Closed	Closed	Open

Speed Range

TCS is available in the speed range ≤ 60 kph.

Above 60 kph vehicle speed, TCS is passive.

It is possible to initiate TCS operation up to a vehicle speed of 55 kph.

Control Algorithm

The input signals for the control algorithm are the filtered wheel speed signals from the ABS speed processing.

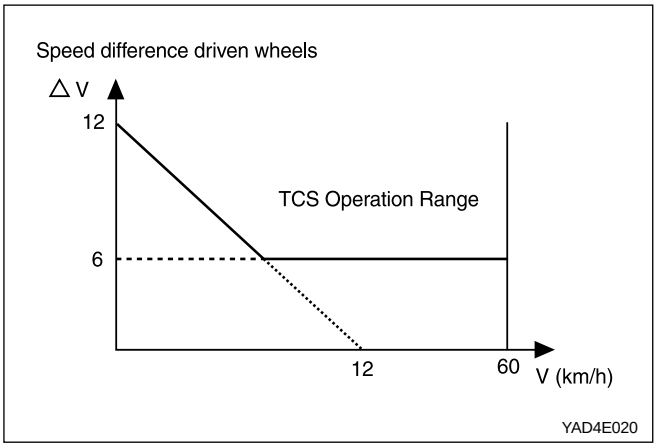
With the speed difference of the driven wheels, the

control deviation is calculated.

If the control deviation exceeds a certain threshold value, the wheel with the greater slip is braked actively.

The threshold value depends on the vehicle speed:

It is reduced with increasing vehicle speed down to a constant value.



△V = Faster rear wheel speed - Slower rear wheel speed

V = Vehicle speed

* TCS is switched passive if the calculated temperature is greater than a threshold value (500 °C).

- TCS (ABD) Indicator turns on but TCS is permitted again, when the calculated temperature is less than 350 °C.

Temperature Model

TCS operation is a high thermal load for the brakes.

To avoid any damages at the brakes, the disk temperature is calculated with a mathematical model for each driven wheel separately, After ignition on, the calculation starts with 30 °C and then three different phases are evaluated separately and added:

TCS operation, braking and cooling phase.

If the temperature is higher than 500 °C, TCS is disabled for this wheel.

It is permitted again, if the model has calculated down the 350 °C.

EBD (ELECTRONIC BRAKE FORCE DISTRIBUTION) SYSTEM

System Description

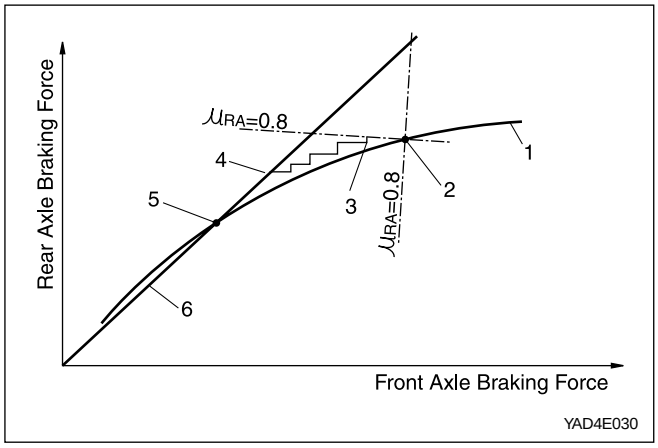
As an add-on logic to the ABS base algorithm, EBD works in a range in which the intervention thresholds for ABS control are not reached yet.

EBD ensures that the rear wheels are sensitively monitored for slip with respect to the front axle. If slip is detected, the inlet valves for the rear wheels are switched to pressure hold to prevent a further increase in pressure at the rear-wheel breaks, thus electronically reproducing a pressure-reduction function at the rear-wheel brakes.

ABS features an enhanced algorithm which includes control of the brake force distribution between the front and rear axles. This is called Electronic Brake Distribution. In an unloading car condition the brake efficiency is comparable to the conventional system but for a fully loaden vehicle the efficiency of the EBD system is higher due to the better use of rear axle braking capability.

The Benefits of EBD

- Elimination of conventional proportioning valve EBD utilizes the existing rear axle wheel speed sensor to monitor rear wheel slip.
- Based on many variables in algorithm a pressure hold, increase and/or decrease pulsetrain may be triggered at the rear wheels insuring vehicle stability.
- Vehicle approaches the ideal brake force distribution (front to rear).
- Constant brake force distribution during vehicle lifetime.
- EBD function is monitored via ABS safety logic (conventional proportioning valves are not monitorable).
- “Keep alive” function.

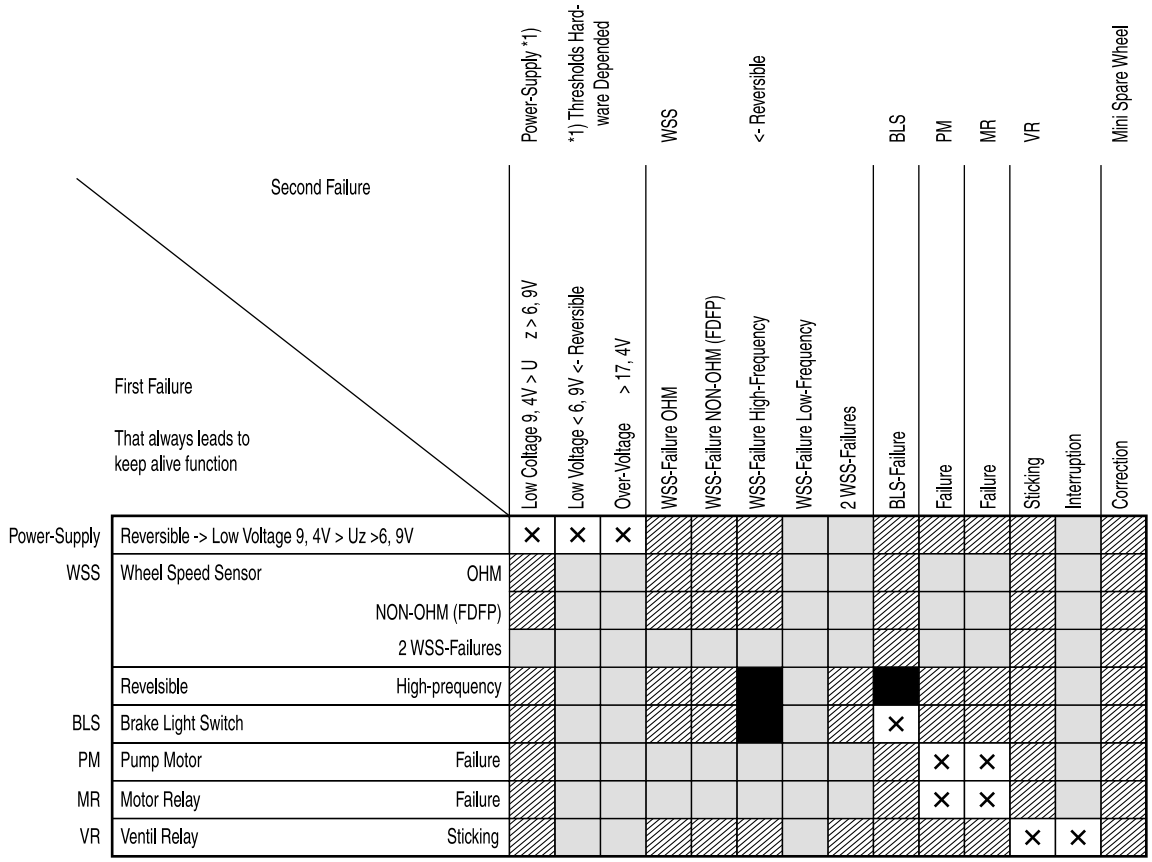


Service Precautions

Observe the following general precautions during any ABS/TCS service. Failure to adhere to these precautions may result in ABS/TCS system damage.

1. Disconnect the EBCM harness connector before performing the electric welding procedures.
2. Carefully note the routing of the ABS/TCS wiring and wring components during removal. The ABS/TCS components are extremely sensitive to EMI (eletromagnetic interference). Proper mounting is critical during component service.
3. Disconnect the EBCM connector with the ignition OFF.
4. Do not hang the suspension components from the wheel speed sensor cables. The cables may be damaged.
5. Do not use petroleum based fluids in the master cylinder. Do not use any containers previously used for petroleum based fluids. Petroleum causes swelling and distortion of the rubber components in the hydraulic brake system, resulting in water entering the system and lowering the fluid boiling point.

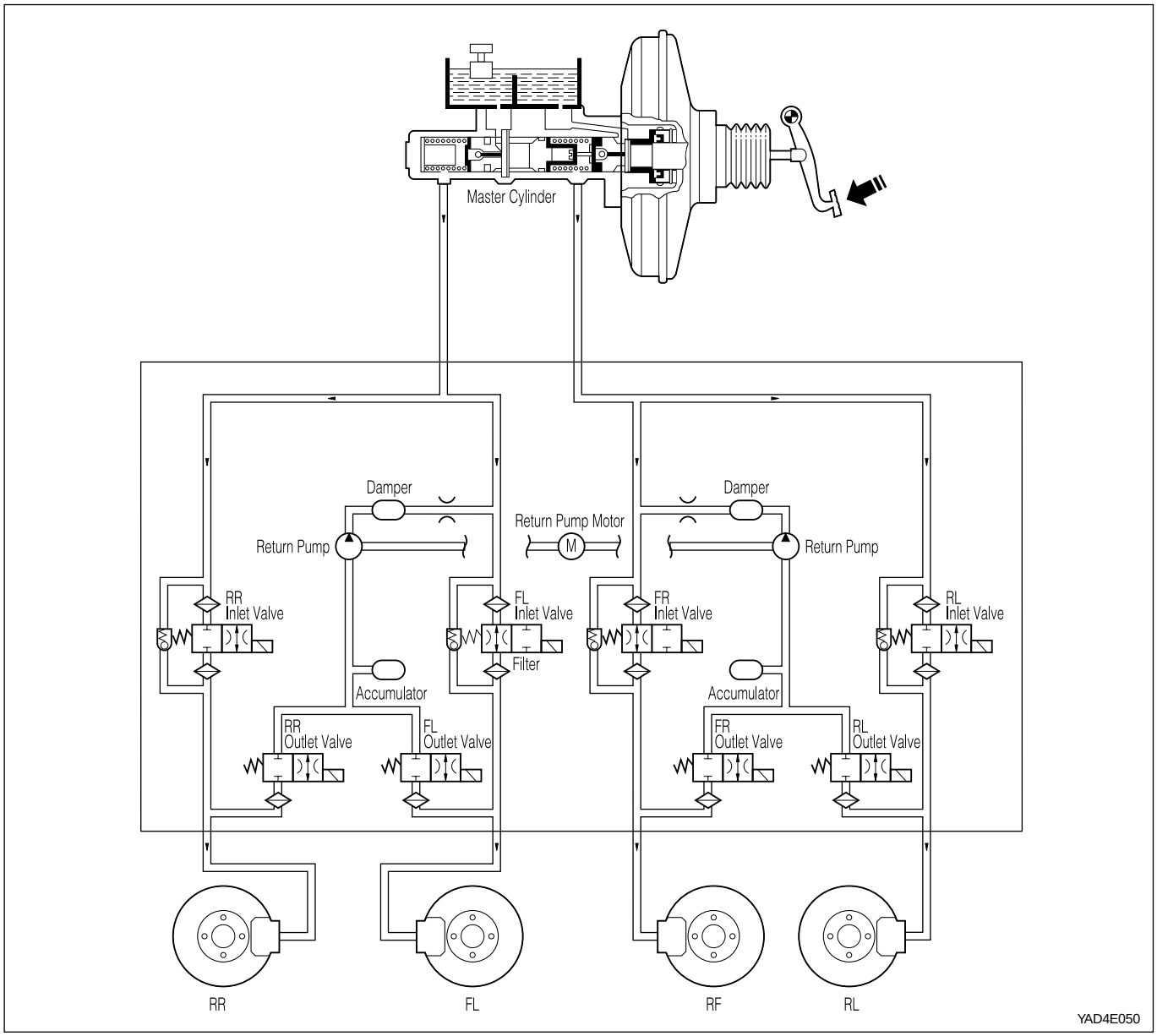
Electronic Brake-Force Distribution (EBD) Failure Matrix



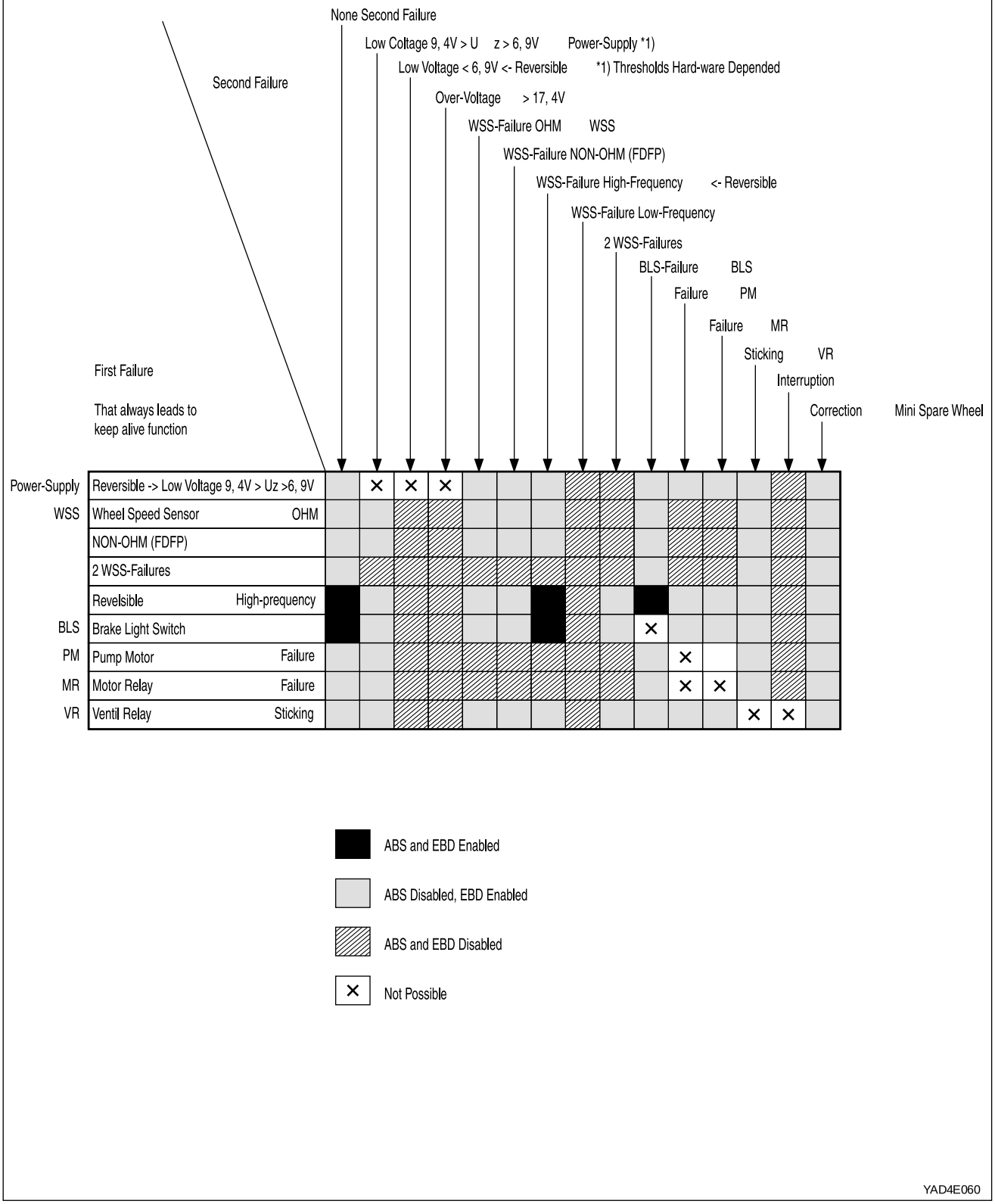
YAD4E040

Hydraulic Fluid Flow Diagrams

For normal brake mode, during non-antilock braking, pressure is applied through the brake pedal and fluid comes from the master cylinder into the hydraulic unit. The normally open isolation cartridge and normally closed dump cartridge would remain in these positions to allow fluid pressure to the calipers and the wheel cylinders. And each wheel begins locking.



Electronic Brake-Force Distribution (EBD) Failure Matrix For Malfunction



TIRES AND ABS/TCS

Replacement Tires

Tire size is important for proper performance of the ABS system. Replacement tires should be the same size, load range, and construction as the original tires. Replace tires in axle sets and only with tires of the same tire performance criteria (TPC) specification number.

The use of any other size or type of tire may seriously affect the ABS operation.

Electronic Brake Control Module (EBCM)

Notice: There is on serviceable or removable EEPROM. The EBCM must be replaced as an assembly (Only ABS). ABS/TCS is separated hydraulic modulator and EBCM.

The EBCM is attached to the hydraulic unit in the engine compartment (ABS). The controlling element of ABS 5.3 is a microprocessor-based EBCM. Inputs to the system include the four wheel speed sensors, the stoplamp switch, the ignition switch, and the unswitched battery voltage. There is an output to a be-directional serial data link, located in pin K of Assembly Line Diagnostic Link (ALDL) for service diagnostic tools and assembly plant testing.

The EBCM monitors the speed of each wheel. If any wheel begins to approach lockup and the brake switch is closed (brake pedal pressed), the EBCM controls the solenoids to reduce brake pressure to the wheel approaching lockup. Once the wheel regains traction, brake pressure is increased until the wheel again begins to approach lockup. This cycle repeats until either the vehicle comes to a stop, the brake pedal is released, or no wheels approach lockup.

Additionally, the EBCM monitors itself, each input (except the serial data link), and each output for proper operation. If it detects any system malfunction, the EBCM will store a DTC in nonvolatile memory (EERPOM) (DTCs will not disappear if the battery is disconnected). Refer to “Self Diagnostics” in this section for more detailed information.

Front Wheel Speed Sensors

The front wheel speed sensors are of a variable reluctance type. Sensor is attached to the steering knuckle, close to a toothed ring. The result, as teeth pass by the sensor, is an AC voltage with a frequency proportional to the speed of the wheel. The magnitude of the voltage and frequency increase with increasing speed. The sensor is not repairable, nor is the air gap adjustable.

Front Wheel Speed Sensor Rings

The toothed ring mentioned above is pressed onto the wheel-side (outer) constant velocity joint. Each ring contains 52 equally spaced teeth. Exercise care during service procedures to avoid prying or contacting this ring. Excessive contact may cause damage to one or more teeth. If the ring is damaged, the wheel-side constant velocity joint must be replaced.

Rear Wheel Speed Sensors And Rings

The rear wheel speed sensors operate in the same manner as the front wheel speed sensor. They incorporate a length of flexible harness with the connector attached to the end of the harness. The rear wheel speed rings are incorporated into the hub assemblies and cannot be replaced separately, require replacement of the rear hub/bearing assembly.

Valve Realy And Pump Motor Relay

The valve relay and the motor pump relay are located inside the electronic brake control module (EBCM) and are not replaceable. If one should fail, replace the EBCM.

Wiring Harness

The wiring harness is the mechanism by which the electronic brake control module (EBCM) is electrically connected to power and to ground, to the wheel speed sensors, the fuses, the switches, the indicators, and the serial communications port. The components, considered part of the wiring harness, are the wires that provide electrical interconnection, and connectors (terminals, pins, contacts, or lugs) that provide an electrical/mechanical interface from the wire to a system component.

Indicators

The electronic brake control module (EBCM) continuously monitors itself and the other ABS components If the EBCM detects a problem with the system, the amber ABS indicator will light continuously to alert the driver to the problem. An illuminated ABS indicator indicates that the ABS system has detected a problem that affects the operation of ABS. On antilock braking will be available. Normal, non-antilock brake performance will remain. In order to regain ABS braking ability, the ABS must be serviced.

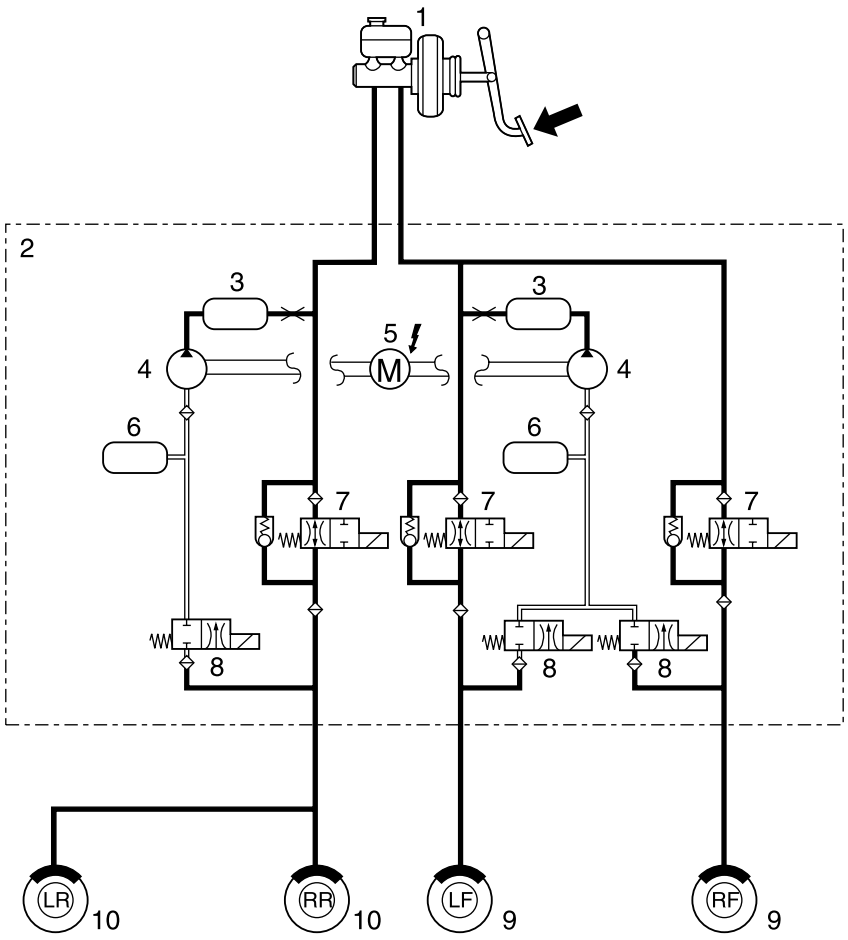
The red BRAKE indicator will be illuminated when the system detects a low brake fluid level in the master cylinder or when the parking brake switch is closed (the parking brake is engaged).

The EBD indicator will light continuously to alert the driver to the problem in the basic brake system. The EBD system must be serviced.

HYDRAULIC CIRCUIT

ABS 5.3

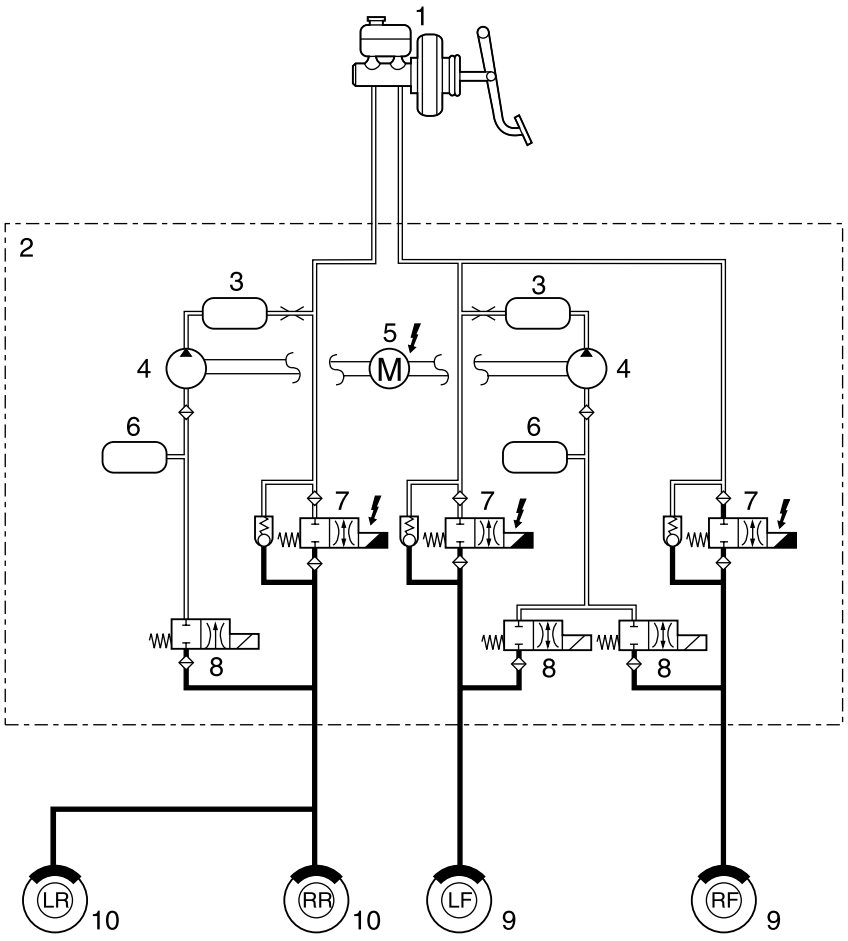
Pressure Increase



YAD4E070

1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Front Wheel
10 Rear Wheel

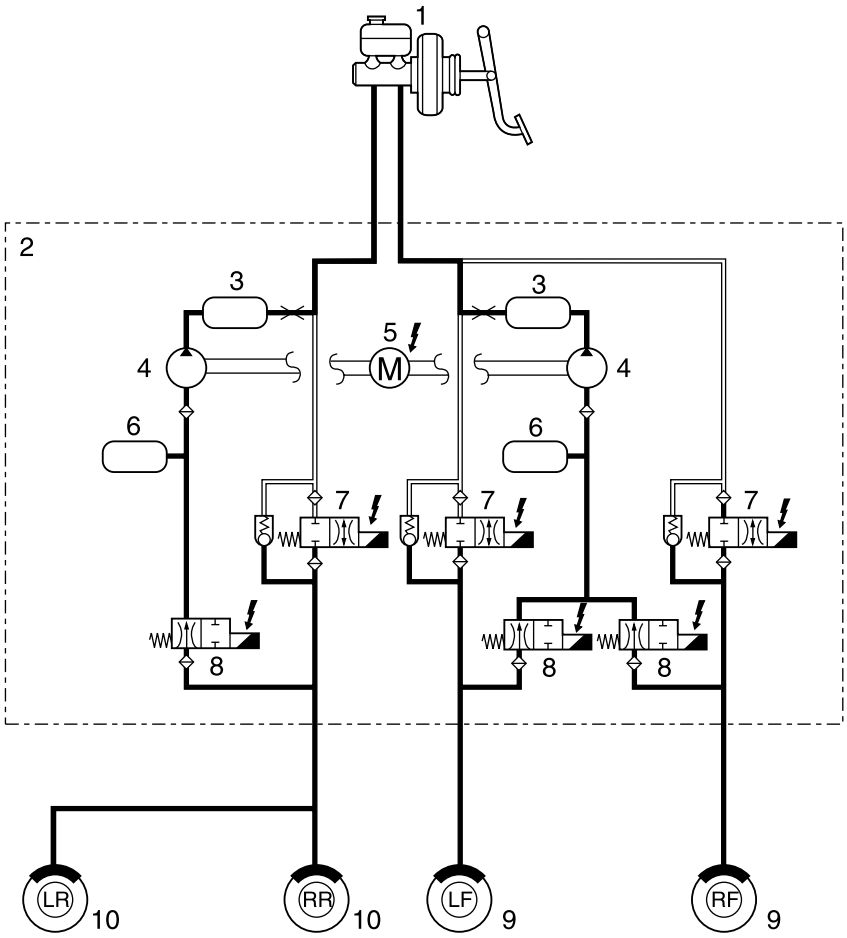
Pressure Hold



YAD4E080

1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Front Wheel
10 Rear Wheel

Pressure Decrease

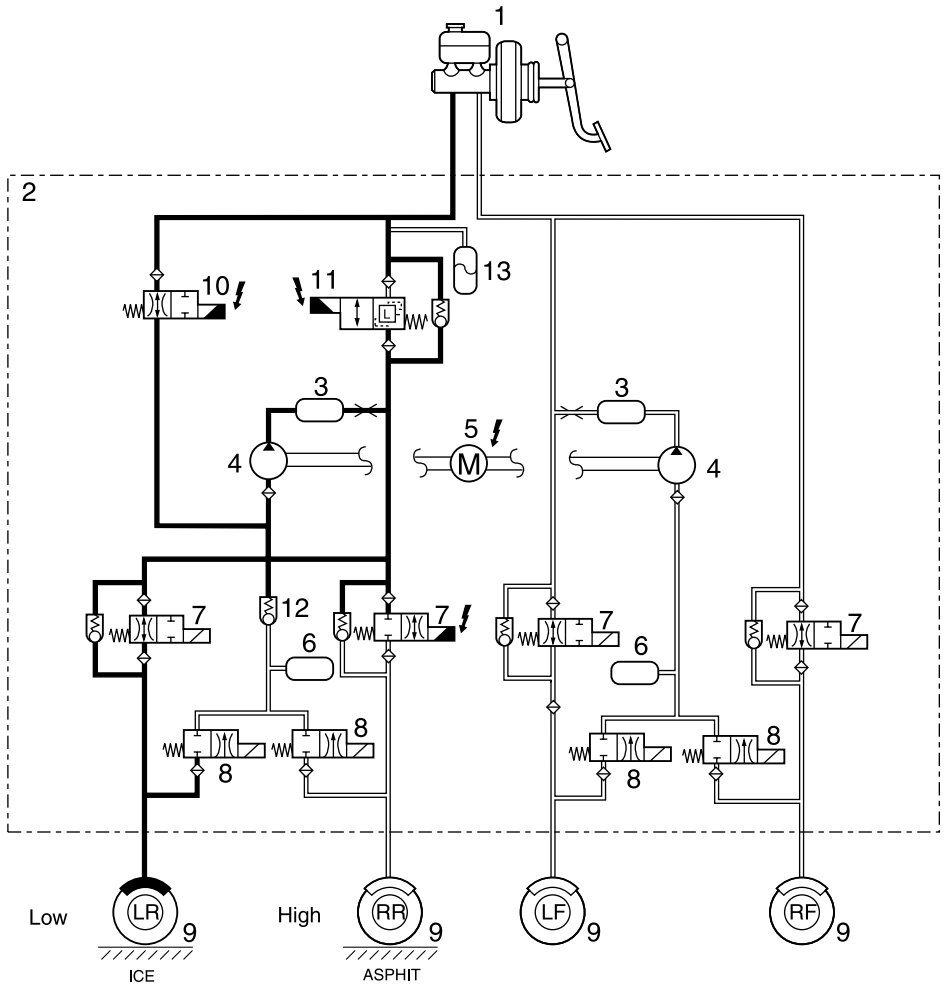


YAD4E090

1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Front Wheel
10 Rear Wheel

ABS/TCS 5.3

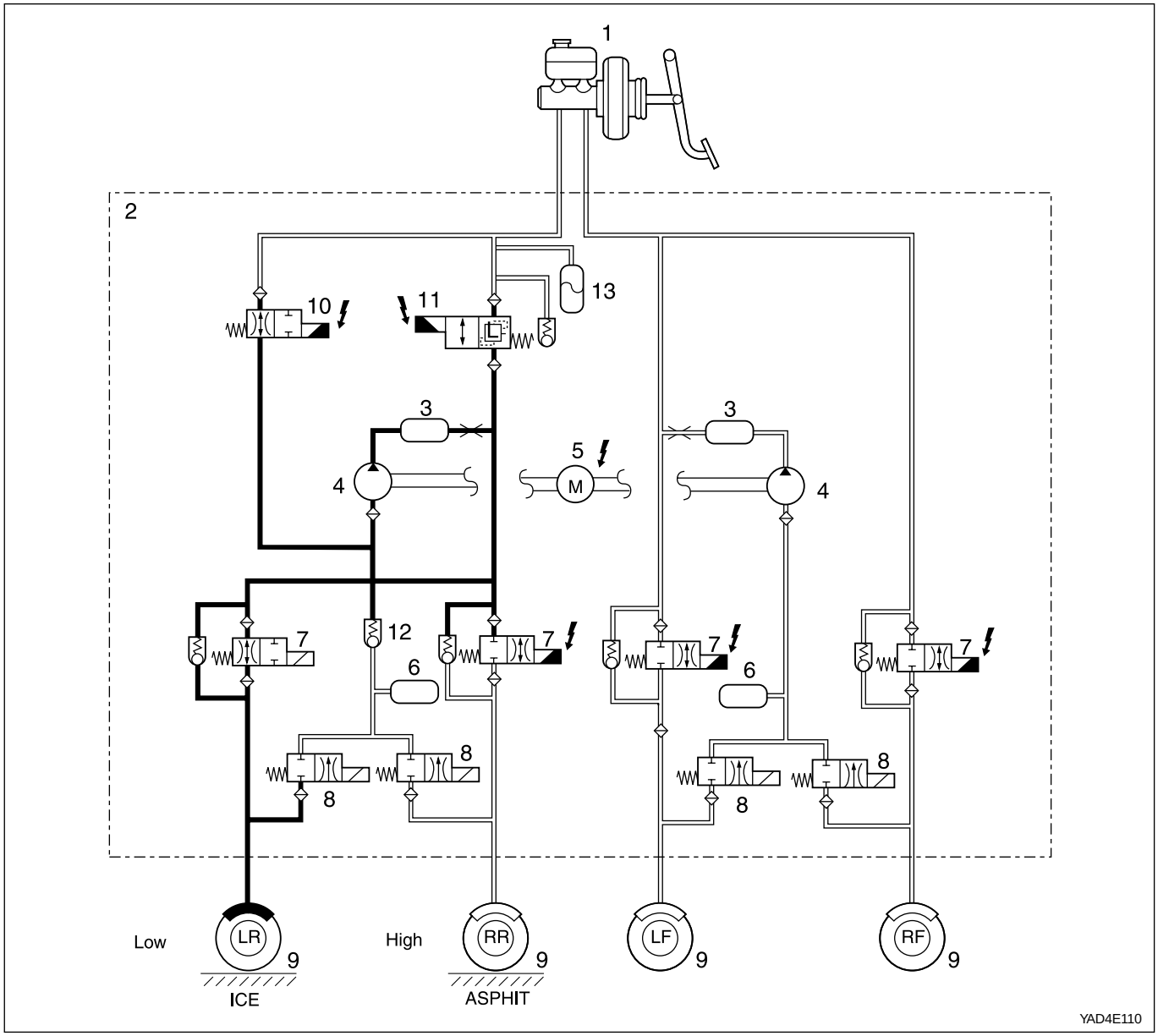
Pressure Increase



YAD4E100

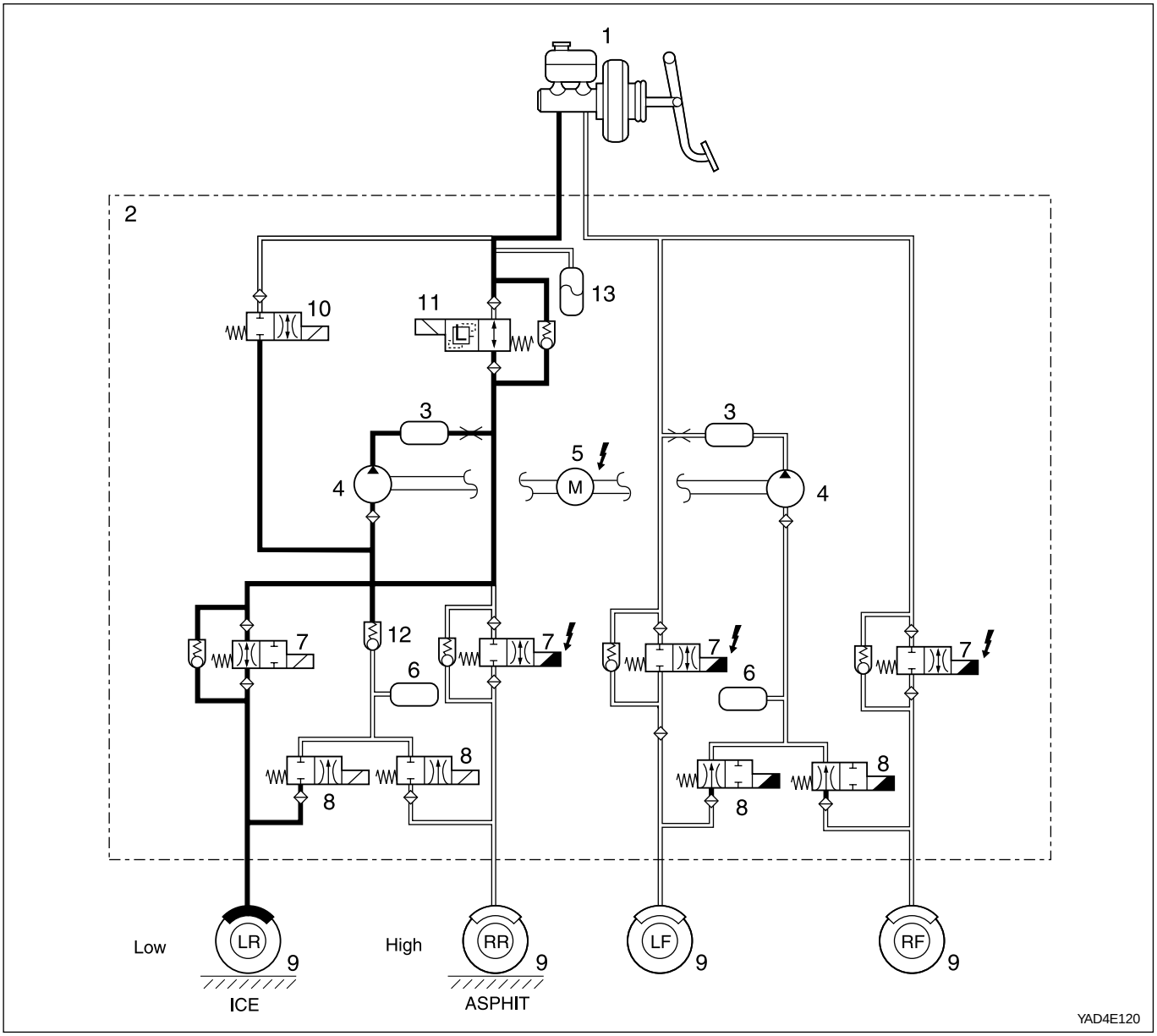
1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Wheel
10 Prime Valve
11 Pilot Valve
12 Check Valve
13 ISD (Integrated Suction Damper)

Pressure Hold



1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Wheel
10 Prime Valve
11 Pilot Valve
12 Check Valve
13 ISD (Integrated Suction Damper)

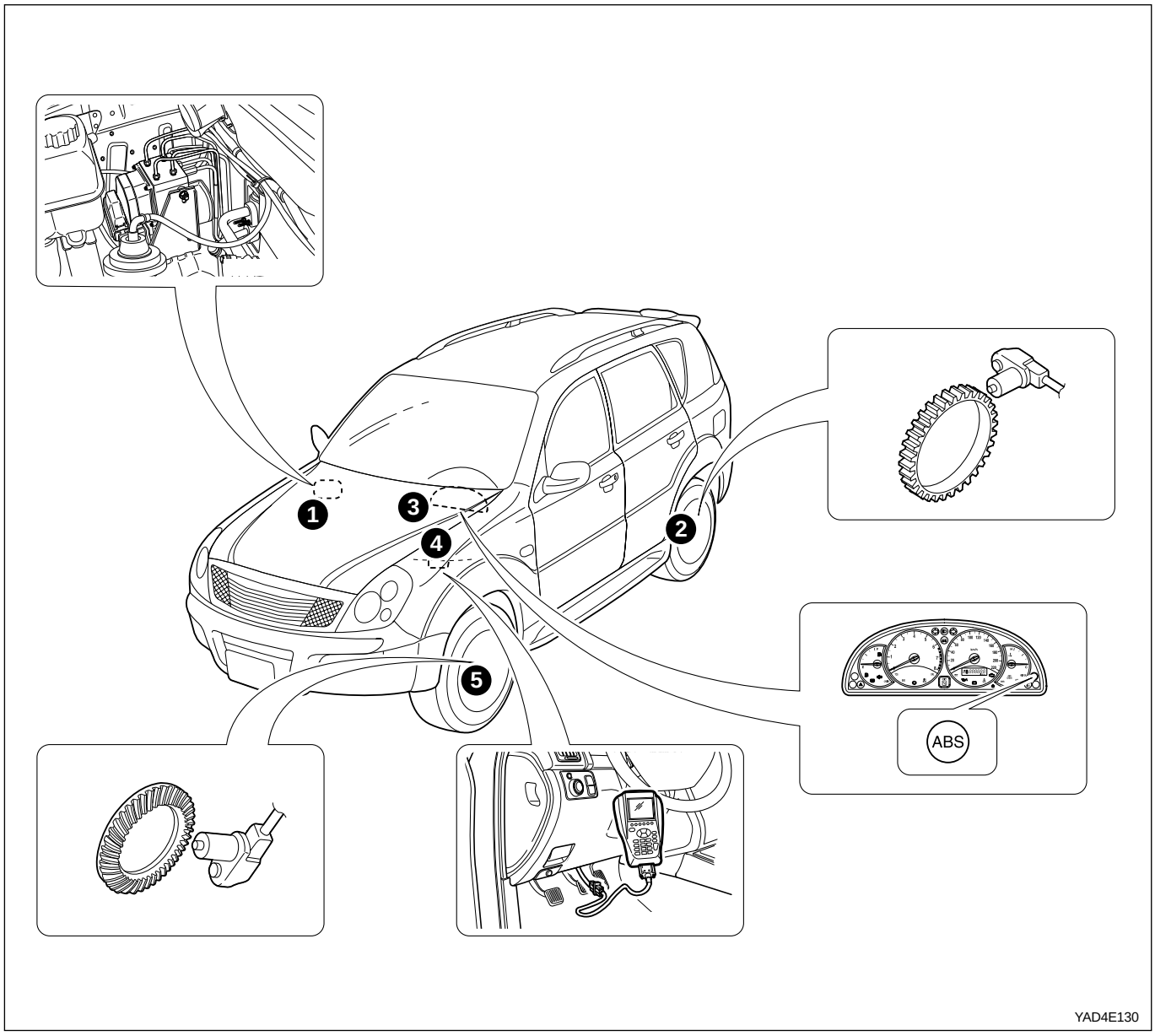
Pressure Decrease



1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Wheel
10 Prime Valve
11 Pilot Valve
12 Check Valve
13 ISD (Integrated Suction Damper)

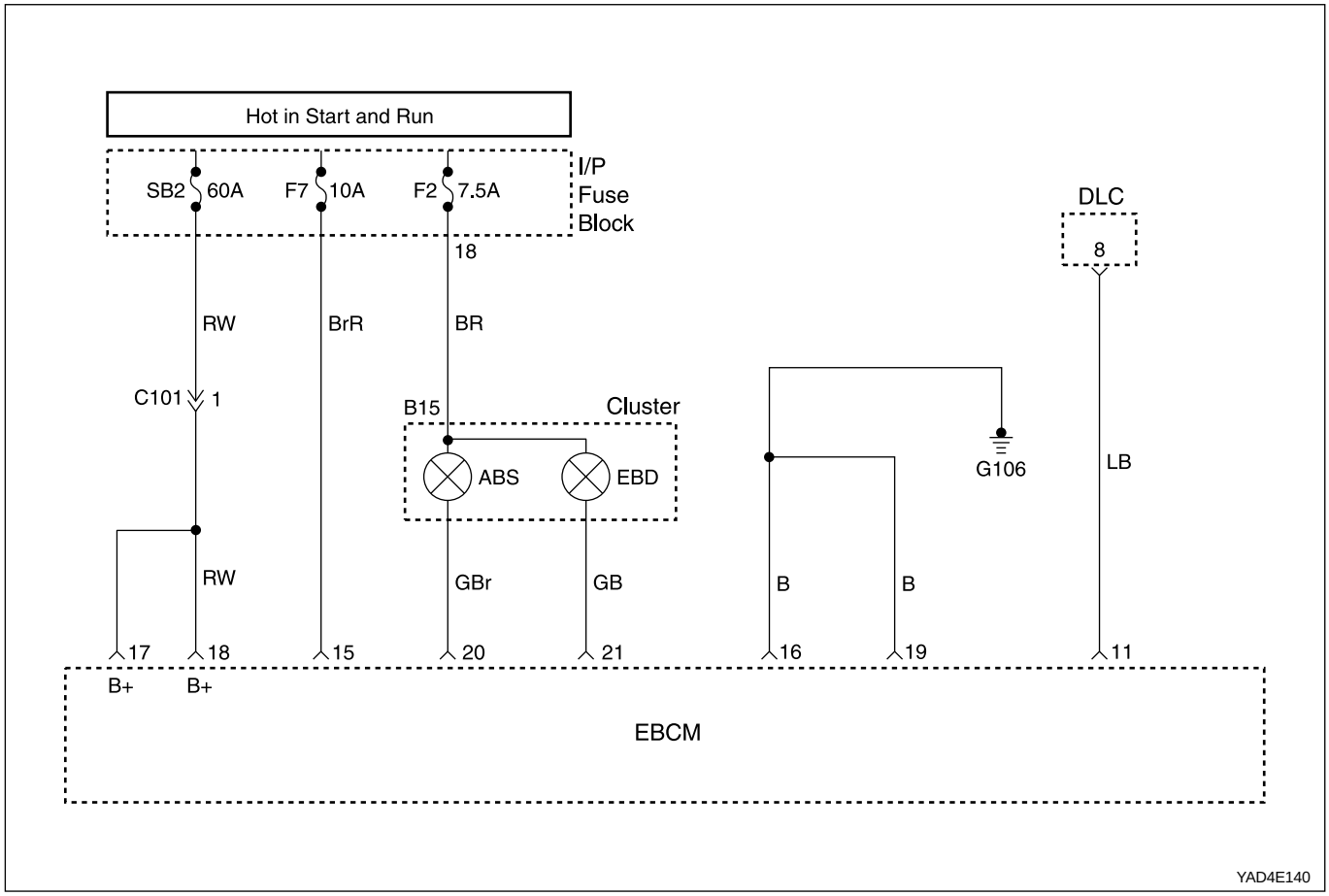
COMPONENT LOCATOR

ABS, ABS/TCS 5.3



1 ABS/TCS Hydraulic Unit and Control Unit
2 Rear Wheel Speed Sensor
3 ABS Warning Indicator
4 Diagnosis connector
5 Front Wheel Speed Sensor

DIAGNOSTIC INFORMATION AND PROCEDURES



DIAGNOSTIC CIRCUIT CHECK

The Diagnostic Circuit Check is an organized approach to identifying a problem created by an antilock brake system (ABS) malfunction. If must be the starting point for any ABS complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

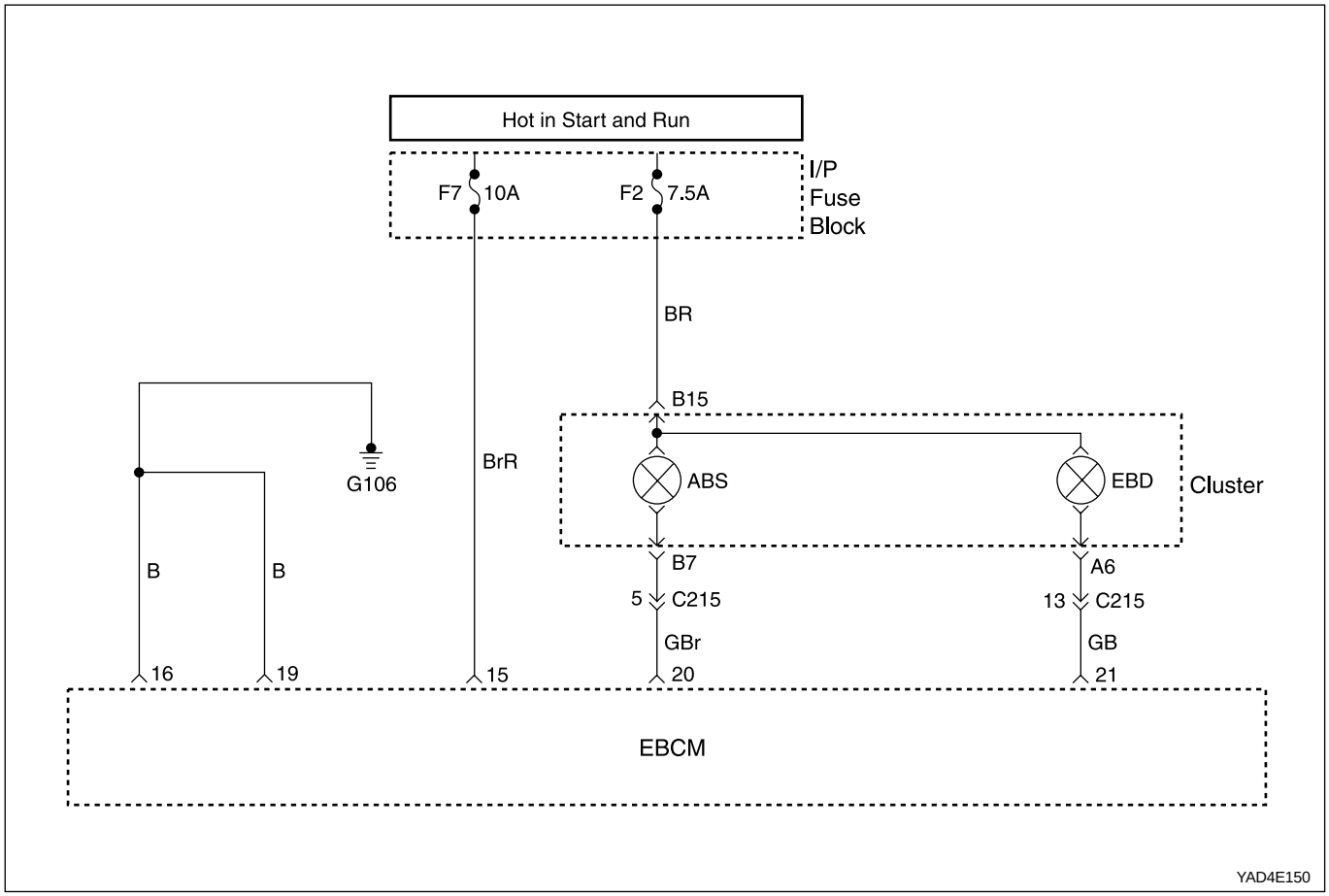
Diagnostic Process

Perform the following steps in order when servicing the ABS/TCS system. Failure to do so may result in the loss of important diagnostic data and may lead to difficulties and time-consuming diagnosis procedures.

1. Perform the tests of the table below.
2. Perform a road test if directed by the table.
   - Test drive the vehicle while using the snapshot feature of the scan tool.
   - Perform normal acceleration, stopping, and turning maneuvers.
   - If this does not reproduce the malfunction, perform an ABS stop or TCS maneuver on a low friction surface such as gravel.
3. Clear the diagnostic trouble codes (DTCs) after all system malfunctions have been corrected.

Diagnostic Circuit Check

Step	Action	Value	Yes	No
1	1. Install the scan tool. 2. Turn ignition switch to ON. 3. Select the Data List mode. Is the scan tool receiving data from the electronic brake control module (EBCM)?	-	Go to Step 2	Go to Step 7
2	Check the display. Are there any current DTCs displayed?	-	Refer to the applicable DTC table	Go to Step 3
3	1. Turn the ignition to LOCK for 10 seconds. 2. Turn the ignition to On and observe the ABS indicator. Does the indicator light for 2 seconds and then go off?	-	Go to Step 5	Go to Step 4
4	Check the ABS indicator. Did the ABS indicator turn on and stay on?	-	Go to “ABS Indicator Lamp Illuminated Constantly”	Go to “ABS Indicator Lamp Inoperative”
5	Check whether the vehicle is equipped with traction control. Is the vehicle equipped with traction control?	-	Go to Step 6	Go to Step 13
6	1. Turn the ignition to LOCK for 10 seconds. 2. Turn the ignition to ON and observe the TCS indicator. Does the indicator light for 2 seconds and then go off?	-	Go to Step 13	Go to “TCS Indicator Lamp Inoperative”
7	1. Turn the ignition to LOCK. 2. Disconnect the EBCM harness connector. 3. Turn the ignition to ON. 4. Use a digital voltmeter (DVM) to measure the voltage from ground to terminal 15 of the EBCM harness connector. Is the voltage equal to the specified valve?	11 - 14 V	Go to Step 8	Go to “Power Supply to Control Module, No DTCs Stored”
8	1. Turn the ignition to LOCK. 2. Use a DVM to measure the resistance from the EBCM harness connector, terminals 16 and 19 to ground. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 10	Go to Step 9
9	Repair the open in the circuit that failed. Is the repair complete?	-	System OK	-
10	Use a DVM to measure the resistance between terminal 11 of the EBCM harness connector and terminal 8 of the data link connector (DLC). Is the resistance below the specified valve?	2 Ω	Go to Step 11	Go to Step 12
11	Replace the ABS unit. Is the repair complete?	-	System OK	-
12	Repair the open or high resistance in circuit between terminal 11 of the EBCM harness connector and terminal 8 of the DLC. Is the repair complete?	-	Go to Step 1	-
13	Perform the road test described above. Are any DTC set?	-	Go to the DTC table	System OK



ABS INDICATOR LAMP INOPERATIVE

Circuit Description

Battery voltage is supplied to the ABS lamp with the ignition switch in the ON or START positions. The warning lamp can be activated only by the ABS control module internally supplying ground to terminal 20 or by the shorting bar in the ABS module connector if the connector in disconnected from the module.

Diagnosis

This procedure checks for a problem in the wiring, a faulty ground, a voltage supply problem, a burned out indicator lamp, or a contact problem in a connector.

Cause

- A fuse has blown.
- The indicator lamp has burned out.
- There is a corroded or broken connector terminal.
- There is a faulty ground connection.
- There is a broken wire in a wring harness.
- The EBCM is faulty.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test checks for any DTCs that may cause the ABS indicator lamp to be inoperative.
2. This test verifies an inoperative lamp condition.
3. This test checks for voltage on the lamp circuit.
4. This begins a series of tests of the circuit from the indicator lamp to the EBCM and ground.

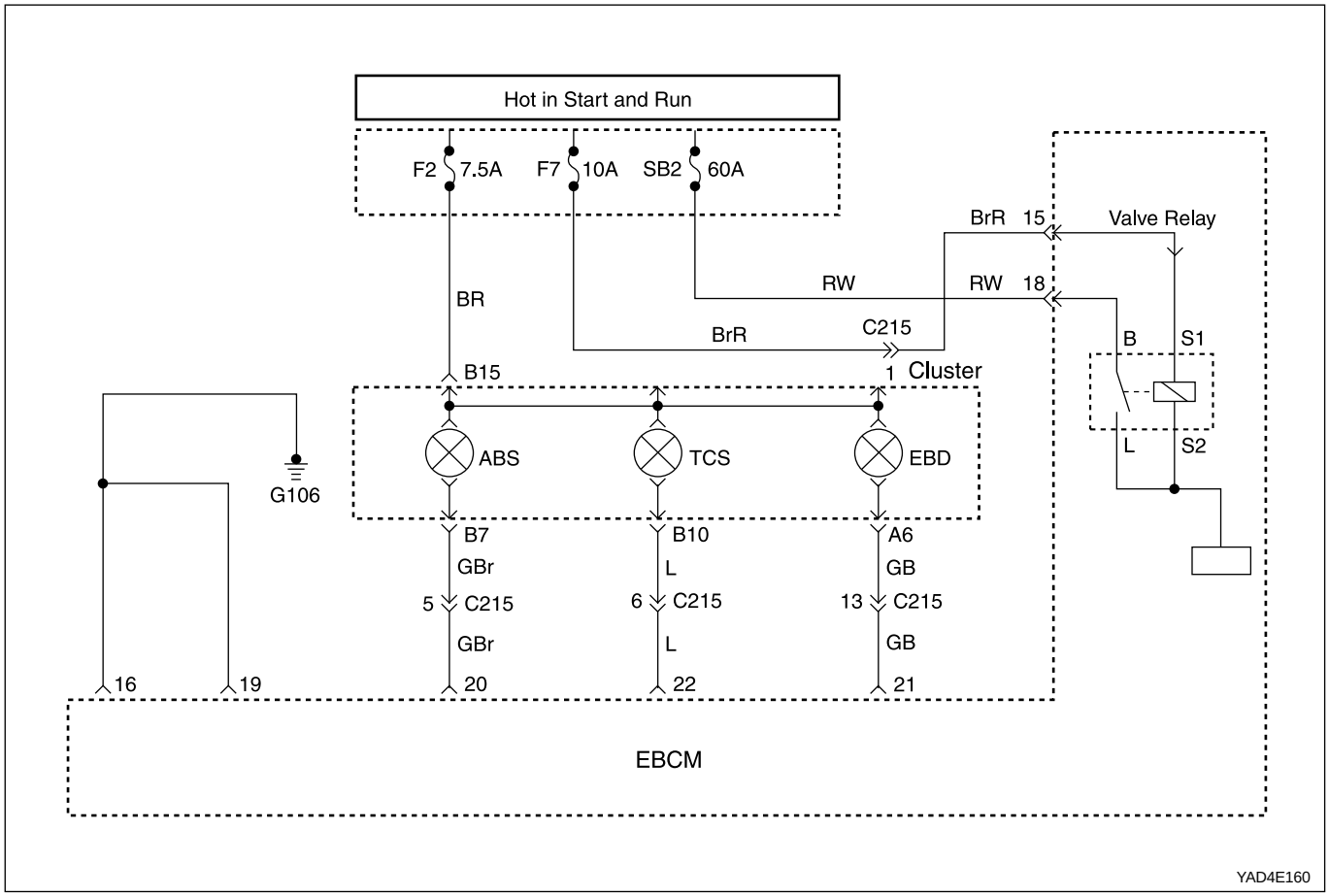
19. This begins a series of tests of the voltage supply circuits that power the indicator lamp.

ABS Indicator Lamp Inoperative

Step	Action	Value	Yes	No
1	Install the scan tool and check for any DTCs. Is any DTC set?	-	Go to the DTC table	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the scan tool. 3. Turn the ignition to ON. 4. Observe the ABS indicator lamp. Does the lamp illuminate for about 2 seconds, then turn off?	-	Go to “Intermittent and Poor Connections”	Go to Step 3
3	With the ignition still ON, observe the oil pressure lamp. Is the oil pressure lamp illuminated?	-	Go to Step 4	Go to Step 19
4	1. Turn the ignition to LOCK. 2. Disconnect the connector from the electronic brake control module (EBCM). 3. Turn the ignition switch to ON. Does the ABS indicator illuminate?	-	Go to Step 5	Go to Step 8
5	1. Turn the ignition to LOCK. 2. Examine terminals 16 and 20 at the EBCM connector on both the ABS wiring harness and on the EBCM. Is there a poor connection at any of these terminals?	-	Go to Step 6	Go to Step 7
6	Repair the faulty terminals or replace the ABS unit, as required. Is the repair complete?	-	System OK	-
7	Replace the ABS unit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Disconnect the wire from the negative battery terminal. 3. Measure the resistance between the negative battery wire, which is attached to ground, and the shorting bar in the EBCM connector. Is the resistance equal to the specified valve?	≈ 0 Ω	Go to Step 10	Go to Step 9
9	Repair the open or high resistance in the circuit from EBCM connector, terminal 16 to ground G106. Is the repair complete?	-	System OK	-
10	1. Remove the I/P cluster. 2. Remove and check the ABS indicator bulb. Is the bulb burned out?	-	Go to Step 11	Go to Step 12
11	1. Replace the ABS indicator bulb. 2. Install the I/P cluster. Is the repair complete?	-	System OK	-
12	Check the continuity at the I/P cluster connector terminal B7. Is the continuity equal to the specified value?	≈ 0 Ω	Go to Step 14	Go to Step 13
13	Repair the contact at the I/P cluster connector terminal B7. Is the repair complete?	-	System OK	-

ABS Indicator Lamp Inoperative (Cont'd)

Step	Action	Value	Yes	No
14	Check the wiring harnesses and the connectors in circuit from the I/P cluster terminal B7 to terminal 20 of the EBCM connector. Is the voltage equal to the specified value?	∞	Go to Step 15	Go to Step 16
15	Repair the open or the resistance found. Is the repair complete?	-	System OK	-
16	Check for continuity between terminal 16 of the EBCM connector and ground G106. Is the continuity equal to the specified value?	≈ 0 Ω	Go to Step 10	Go to Step 9
17	Replace the ABS unit. Is the repair complete?	-	System OK	-
18	Repair the continuity problem between terminal 16 of the EBCM connector and ground G106. Is the repair complete?	-	System OK	-
19	1. Turn the ignition to LOCK. 2. Check fuse F2 in the I/P fuse block. Is fuse F2 blown?	-	Go to Step 20	Go to Step 21
20	Replace fuse F2. Is the repair complete?	-	System OK	-
21	1. Turn the ignition on. 2. Check the voltage at Fuse 2. Is the voltage equal to the specified value?	11 - 14 V	Go to Step 22	Go to Step 21
22	Repair the power supply to Fuse 2. Is the repair complete?	-	System OK	-
23	1. Remove the instrument cluster. 2. Check the circuit from fuse F2 to terminal B15 of the I/P cluster connector. 3. Repair any open or high resistance found in a wiring harness, splice pack, or connector. Is the repair complete?	-	System OK	-



TRACTION CONTROL SYSTEM (TCS) INDICATOR LAMP INOPERATIVE

Circuit Description

Battery voltage is supplied to the TCS warning lamp with the ignition in ON or START. The warning lamp can be activated only by the ABS control module internally supplying ground to terminal 22.

Diagnosis

This procedure checks for a problem in the wiring, a faulty ground, a voltage supply problem, a burned out indicator lamp, or a contact problem in a connector.

Cause

- A fuse has blown.
- The indicator lamp has burned out.
- There is a corroded or broken connector terminal.
- There is a faulty ground connection.
- There is a broken wire in a wiring harness.
- The EBCM is faulty.

Test description

The number(s) below refer to step(s) on the diagnostic table.

1. This test checks for any DTCs that may cause the TCS indicator lamp to be inoperative.
2. This test verifies an inoperative lamp condition.
3. This test checks for voltage on the lamp circuit.
4. This begins a series of tests of the circuit from the indicator lamp to the EBCM and ground.

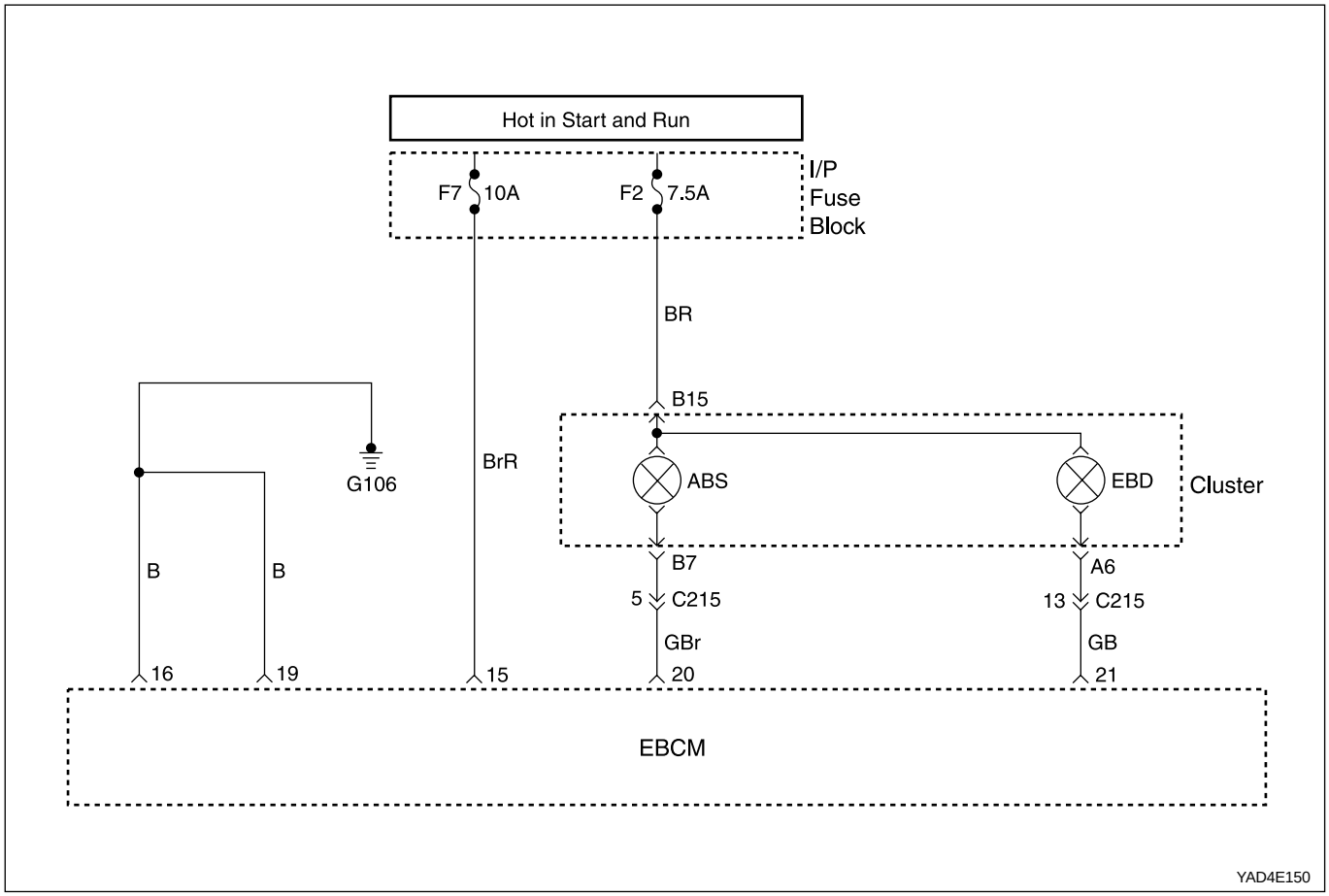
19. This begins a series of tests of the voltage supply circuits that power the indicator lamp.

Traction Control System (TCS) Indicator Lamp Inoperative

Step	Action	Value	Yes	No
1	Install the scan tool and check for any DTCs. Is any DTC set?	-	Go to the DTC table	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the scan tool. 3. Turn the ignition to ON. 4. Observe the TCS indicator lamp. Does the lamp illuminate for about 2 seconds, then turn off?	-	Go to “Intermittent and Poor Connections”	Go to Step 3
3	With the ignition still ON, observe the oil pressure lamp. Is the oil pressure lamp illuminated?	-	Go to Step 4	Go to Step 19
4	1. Turn the ignition to LOCK. 2. Disconnect the connector from the EBCM. 3. Connect a jumper form terminal 22 to the grounding bar in the connector. 4. Turn the ignition to ON. Does the TCS indicator illuminate?	-	Go to Step 5	Go to Step 8
5	1. Turn the ignition to LOCK. 2. Examine terminals 16, 19 at the EBCM connector on both the ABS wiring harness and on the EBCM. Is there a poor connection at any of these terminals?	-	Go to Step 6	Go to Step 7
6	Repair the faulty terminals or replace the ABS unit, as required. Is the repair complete?	-	System OK	-
7	Replace the ABS unit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Disconnect the wire from the negative battery terminal. 3. Measure the resistance between the negative battery wire, which is attached to ground, and the shorting bar in the EBCM connector. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 10	Go to Step 9
9	Repair the open or high resistance in the circuit from EBCM connector, terminal 16, 19 to ground G106. Is the repair complete?	-	System OK	-
10	1. Remove the I/P cluster. 2. Remove and check the TCS indicator bulb. Is the bulb burned out?	-	Go to Step 11	Go to Step 12
11	1. Replace the TCS indicator bulb. 2. Replace the I/P cluster. Is the repair complete?	-	System OK	-
12	Check continuity at the I/P cluster connector terminal B10. Is the continuity equal to the specified value?	≈ 0 Ω	Go to Step 14	Go to Step 13
13	Repair the contact at the I/P cluster connector terminal B10. Is the repair complete?	-	System OK	-

Traction Control System (TCS) Indicator Lamp Inoperative (Cont'd)

Step	Action	Value	Yes	No
14	Check the wiring harnesses and connectors in circuit from the I/P cluster terminal B10 to terminal 22 of the EBCM connector. Is the voltage equal to the specified value?	0 Ω	Go to Step 15	Go to Step 16
15	Repair the open or high resistance. Is the repair complete?	-	System OK	-
16	Check for continuity between terminal 16, 19 of the ABS connector and ground G106. Is the continuity equal to the specified value?	0 Ω	Go to Step 17	Go to Step 18
17	Replace the ABS unit. Is the repair complete?	-	System OK	-
18	Repair the continuity between terminal 16, 19 of the EBCM connector and ground G106. Is the repair complete?	-	System OK	-
19	1. Turn the ignition to LOCK. 2. Check fuse F2 in the I/P fuse block. Is fuse F2 blown?	-	Go to Step 20	Go to Step 21
20	Replace fuse F2. Is the repair complete?	-	System OK	-
21	1. Turn the ignition ON. 2. Check the voltage at fuse F2. Is the voltage equal to the specifies value?	11 - 14 V	Go to Step 22	Go to Step 23
22	Repair the power supply to fuse F2. Is the repair complete?	-	System OK	-
23	1. Remove the I/P cluster. 2. Check circuit from fuse F2 to terminal 15 of the I/P cluster connector. 3. Repair any open or high resistance found in a wiring harness, a splice pack, or a connector. Is the repair complete?	-	System OK	-



ELECTRONIC BRAKE-FORCE DISTRIBUTION SYSTEM (EBD) INDICATOR LAMP INOPERATIVE

Circuit Description

Battery voltage is supplied to the EBD warning lamp with the ignition in ON or START. The warning lamp can be activated only by the ABS control module internally supplying ground to terminal 21.

Diagnosis

This procedure checks for a problem in the wiring, a faulty ground, a voltage supply problem, a burned out indicator lamp, or a contact problem in a connector.

Cause

- A fuse has blown.
- The indicator lamp has burned out.
- There is a corroded or broken connector terminal.
- There is a faulty ground connection.
- There is a broken wire in a wiring harness.
- The EBCM is faulty.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test checks for any DTCs that may cause the EBD indicator lamp to be inoperative.
2. This test verifies an inoperative lamp condition.
3. This test checks for voltage on the lamp circuit.
4. This begins a series of tests of the circuit from the indicator lamp to the EBCM and ground.

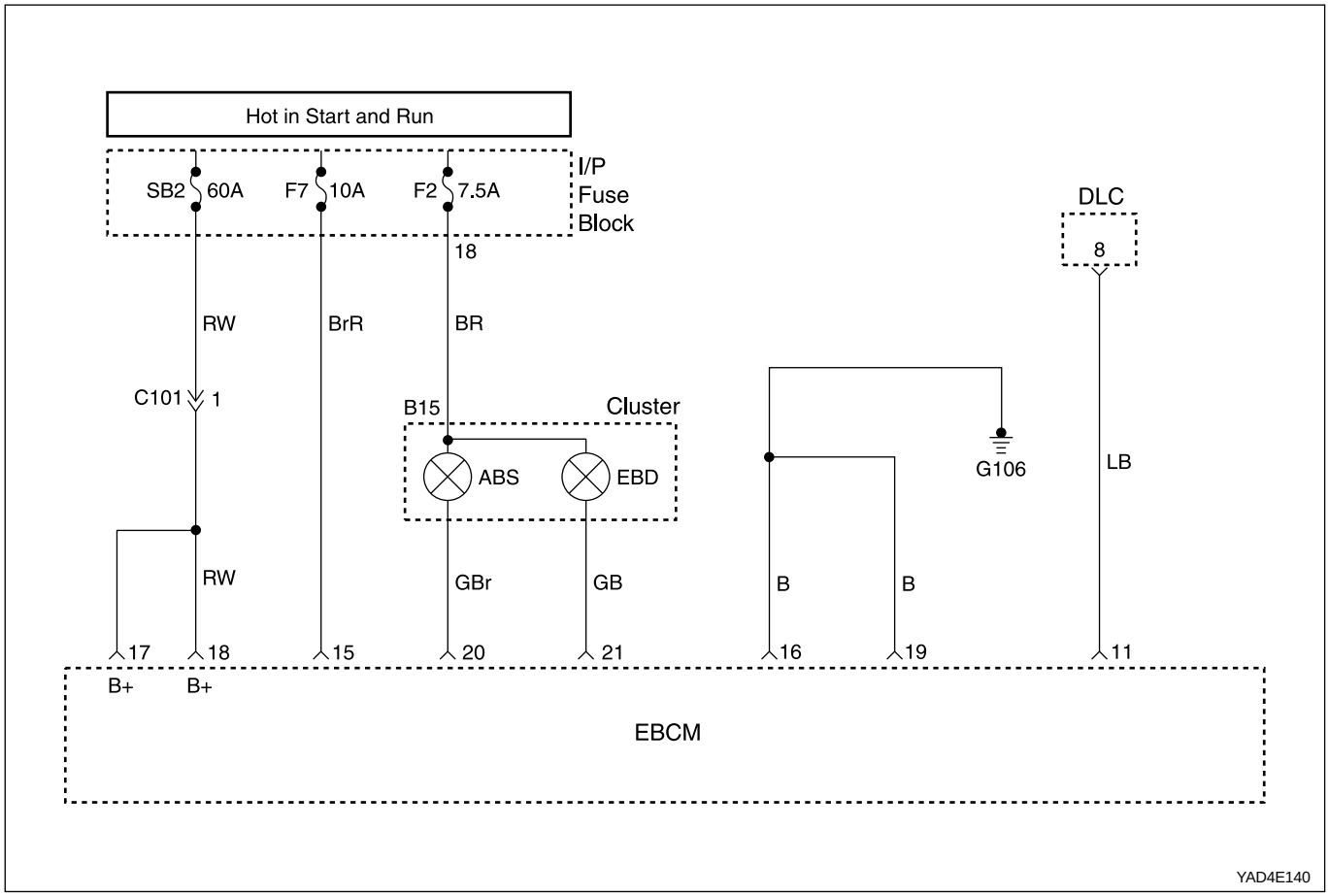
19. This begins a series of tests of the voltage supply circuits that power the indicator lamp.

Electronic Brake-Force Distribution System (EBD) Indicator Lamp Inoperative

Step	Action	Value	Yes	No
1	Install the scan tool and check for any DTCs. Is any DTC set?	-	Go to the DTC table	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the scan tool. 3. Turn the ignition to ON. 4. Observe the EBD indicator lamp Does the lamp illuminate for about 2 seconds, then turn off?	-	Go to “Intermittent and Poor Connections”	Go to Step 3
3	With the ignition still ON, observe the oil pressure lamp. Is the oil pressure lamp illuminated?	-	Go to Step 4	Go to Step 19
4	1. Turn the ignition to LOCK. 2. Disconnect the connector from the EBCM. 3. Connect a jumper form terminal 16, 19 to the grounding bar in the connector. 4. Turn the ignition to ON. Does the EBD indicator illuminate?	-	Go to Step 5	Go to Step 8
5	1. Turn the ignition to LOCK. 2. Examine terminals 16, 19 and 28, 29 at the EBCM connector on both the ABS wiring harness and on the EBCM. Is there a poor connection at any of these terminals?	-	Go to Step 6	Go to Step 7
6	Repair the faulty terminals or replace the ABS unit, as required. Is the repair complete?	-	System OK	-
7	Replace the ABS unit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Disconnect the wire from the negative battery terminal. 3. Measure the resistance between the negative battery wire, which is attached to ground, and the shorting bar in the EBCM connector. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 10	Go to Step 9
9	Repair the open or high resistance in the circuit from EBCM connector, terminal 16, 19 to ground G106. Is the repair complete?	-	System OK	-
10	1. Remove the I/P cluster. 2. Remove and check the EBD indicator bulb. Is the bulb burned out?	-	Go to Step 11	Go to Step 12
11	1. Replace the EBD indicator bulb. 2. Replace the I/P cluster. Is the repair complete?	-	System OK	-
12	Check continuity at the I/P cluster connector terminal A6. Is the continuity equal to the specified value?	≈ 0 Ω	Go to Step 14	Go to Step 13
13	Repair the contact at the I/P cluster connector terminal A6. Is the repair complete?	-	System OK	-

Electronic Brake-Force Distribution System (EBD) Indicator Lamp Inoperative (Cont'd)

Step	Action	Value	Yes	No
14	Check the wiring harnesses and connectors in circuit from the I/P cluster terminal A6 to terminal 21 of the EBCM connector. Is the voltage equal to the specified value?	∞	Go to Step 15	Go to Step 16
15	Repair the open or high resistance. Is the repair complete?	-	System OK	-
16	Check for continuity between terminal 16, 19 of the ABS connector and ground G106. Is the continuity equal to the specified value?	≈ 0 Ω	Go to Step 17	Go to Step 18
17	Replace the ABS unit. Is the repair complete?	-	System OK	-
18	Repair the continuity between terminal 16, 19 of the EBCM connector and ground G106. Is the repair complete?	-	System OK	-
19	1. Turn the ignition to LOCK. 2. Check fuse F2 in the I/P fuse block. Is fuse F2 blown?	-	Go to Step 20	Go to Step 21
20	Replace fuse F2. Is the repair complete?	-	System OK	-
21	1. Turn the ignition ON. 2. Check the voltage at fuse F2. Is the voltage equal to the specifies value?	11 - 14 V	Go to Step 22	Go to Step 23
22	Repair the power supply to fuse F2. Is the repair complete?	-	System OK	-
23	1. Remove the I/P cluster. 2. Check circuit from fuse F2 to terminal 15 of the I/P cluster connector. 3. Repair any open or high resistance found in a wiring harness, a splice pack, or a connector. Is the repair complete?	-	System OK	-



POWER SUPPLY TO CONTROL MODULE, NO DTCS STORED

Circuit Description

Battery voltage is supplied to the electronic brake control module (EBCM) through fuse F3 and F2 in the I/P fuse block, to terminal 15 and 20 of the EBCM connector. The voltage is present when the ignition switch is in ON or START.

Diagnosis

This test checks for battery output, proper grounding, blown fuses, a faulty ignition switch, and problems in the circuitry.

Cause

- The battery is defective.
- There is a defective ground connection.
- A wire is broken or shorted.
- A fuse is blown.
- The ignition switch is malfunctioning.

Action Taken When the DTC Sets

ABS action is disabled during the period of low voltage, and the ABS warning lamp is ON for the remainder of the ignition cycle.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step determines whether there is voltage at the battery and the high current source.
7. This step checks for voltage at the ignition 1 source.

Diagnostic Aids

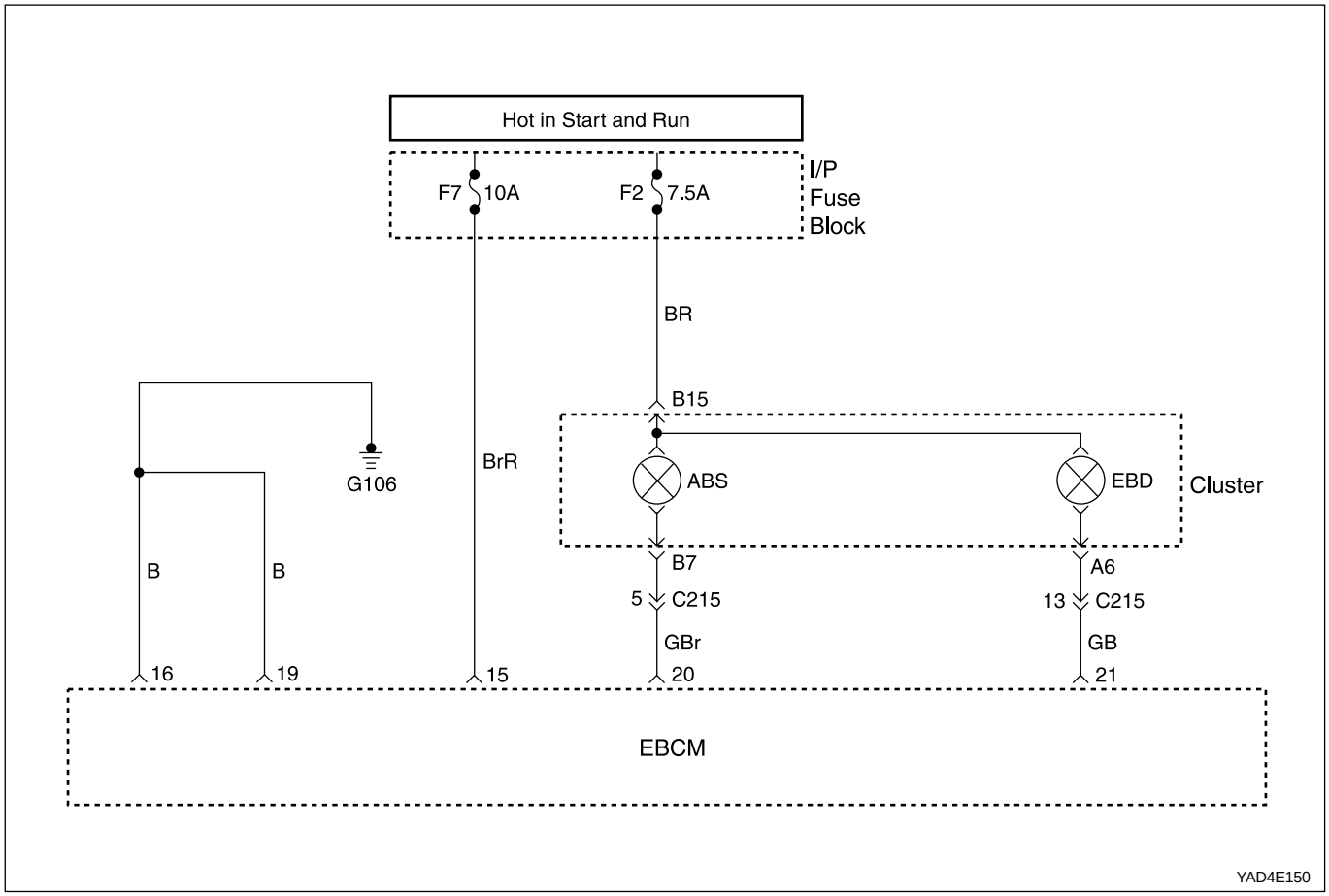
It is very important to perform a thorough inspection of the wiring and the connectors. Failure to do so may result in misdiagnosis, causing part replacement with a reappearance of the malfunction.

Power Supply to Control Module, No DTCs Stored

Step	Action	Value	Yes	No
1	Check the voltage at the battery. Is the voltage equal to the specified value?	11 - 14 V	Go to Step 3	Go to Step 2
2	Charge or replace the battery, as required. Is the repair complete?	-	System OK	-
3	Check fuse F7 in the I/P fuse block. Is the fuse blown?	-	Go to Step 4	Go to Step 8
4	1. Replace fuse F7. 2. Turn the ignition to ON. Does the fuse blow again?	-	Go to Step 6	Go to Step 5
5	Check the ABS function. Is the repair complete?	-	System OK	-
6	1. Turn the ignition to OFF. 2. Remove fuse F7. 3. Disconnect the ABS connector from the EBCM. 4. Measure the resistance to ground at terminals 15. Does the ohmmeter show the specified value?	≈ 0 Ω	Go to Step 7	Go to Step 26
7	Repair the short to ground in circuit between F7 and the ABS harness EBCM connector. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to ON. 2. Check the voltage at fuse F2. Is the voltage equal to the specified value?	11 - 14 V	Go to Step 10	Go to Step 9
9	Repair the power supply to fuse 2. Is the repair complete?	-	System OK	-
10	Check fuse F2 in the I/P fuse block. Is the fuse F2 blown?	-	Go to Step 14	Go to Step 18
11	1. Replace fuse F2. 2. Turn the ignition to ON. Does the fuse blow again?	-	Go to Step 13	Go to Step 12
12	Check the ABS function. Is the repair complete?	-	System OK	-
13	1. Turn the ignition to OFF. 2. Remove fuse F2. 3. Disconnect the ABS connector from the EBCM. 4. Measure the resistance between ground and terminal 20. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 14	Go to Step 13
14	Repair the short to ground in circuit fuse F2 of the I/P fuse block and terminal 20 of the ABS harness EBCM connector. Is the repair complete?	-	System OK	-
15	1. Disconnect the EBCM connector from the EBCM. 2. Turn the ignition to ON. 3. Check for the presence of battery voltage between ground and terminal 17, 18. Is the voltage equal to the specified value?	11 - 14 V	Go to Step 10	Go to Step 9

Power Supply to Control Module, No DTCs Stored (Cont'd)

Step	Action	Value	Yes	No
16	1. Turn the ignition switch to OFF. 2. Trace the RW wires between terminal 15 of the EBCM connector to fuse F7 of the I/P fuse block. 3. Repair the open in this circuit. Is the repair complete?	-	System OK	-
17	Check the voltage between ground and terminal 20 of the EBCM connector. Is the voltage equal to the specified value?	11 - 14 V	Go to Step 19	Go to Step 18
18	1. Turn the ignition switch to OFF. 2. Check the resistance between ground and terminals 16 of the EBCM connector. Is the resistance equal to the specified value?	-	System OK	-
19	1. Turn the ignition to OFF 2. Check the resistance between ground and terminals 16 of the EBCM connector. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 20	Go to Step 23
20	Examine terminals 15, 20, 16 of the EBCM connector. Is there a defective terminal?	-	Go to Step 21	Go to Step 22
21	Repair the defective terminal or replace the connector or wiring harness, as required. Is the repair complete?	-	System OK	-
22	Replace the ABS unit. Is the repair complete?	-	System OK	-
23	Repair the defective ground connection. Is the repair complete?	-	System OK	-



ABS INDICATOR LAMP ILLUMINATED CONTINUOUSLY, NO DTCS STORED

Circuit Description

Battery voltage is supplied to the ABS warning lamp with the ignition in ON or START. The warning lamp should be activated only by the ABS control module internally supplying ground to terminal 20.

Diagnosis

This procedure checks for a short to ground in the wiring or a defective electronic brake control module (EBCM).

Cause

- There is a short to ground in the circuit between the cluster terminal D7 and the EBCM terminal 31.
- The EBCM is faulty.

ABS Indicator Lamp Illuminated Continuously, No DTCs Stored

Step	Action	Value	Yes	No
1	Check the EBCM connector. Is it connected properly?	-	Go to Step 3	Go to Step 2
2	Connect the EBCM connector. Is the repair complete?	-	System OK	-
3	1. Disconnect the EBCM connector. 2. Turn the ignition to ON. 3. Use an insulated tool to push the shorting bar in the connector away from terminal 20. Does the ABS indicator lamp go out?	-	Go to Step 4	Go to Step 5
4	Replace the ABS unit Is the repair complete?	-	System OK	-
5	Repair the short to ground in circuit Lg between I/P cluster connector B7 and terminal 20 EBCM. Is the repair complete?	-	System OK	-

SELF-DIAGNOSTICS

Important: The electronic brake control module (EBCM) turns the valve relay off when a diagnostic trouble code (DTC) is set. The scan tool will indicate that the valve relay is off when it is used to monitor the data list. This is normal and should not be considered a malfunction.

The EBCM performs system self-diagnostics and can detect and often isolate system malfunctions, When it detects a malfunction, the EBCM sets a DTC that represents the malfunction, turns on the ABS and/or the TCS indicators in most instances, and may disable the ABS and/or the TCS function, as necessary, for the duration of the ignition cycle.

Once each ignition cycle, the EBCM performs an automatic test when the vehicle reaches 2.75 km/h (1.7 mph). In the course of this test, the system cycles each valve solenoid and the pump motor, along with the necessary relays, to check component operation. If the EBCM detects any malfunctions, it will set a DTC as described above.

DISPLAYING DTCs

Tools Required

Scan Tool

DTCs can be read through the use of the scan tool.

CLEARING DTCs

Tool Required

Scan Tool

The diagnostic trouble codes (DTCs) in the electronic brake control module (EBCM) memory are erased in one of two ways:

- Use the scan tool “Clear DTCs” selection.
- After 249 DTC-free ignition cycles.

These two methods are detailed below. Be sure to verify the proper system operation and, the absence of DTCs when the clearing procedure is completed.

The EBCM will not permit DTC clearing until all DTCs have been displayed. Also, ETC s cannot be cleared by disconnecting the EBCM, disconnecting the battery cables, or turning the ignition switch to LOCK.

Scan Tool Method

The scan tool can clear ABS/TCS system DTCs using the mess storage cartridge.

1. Install the scan tool and the mass storage cartridge.
2. Select “Fault Memory”.
3. Select “Clear Fault Memory”.

Clearing the fault memory cannot reset a valve relay which was shut down when the fault was recognized. Changes are possible only after the fault has been eliminated and the next ignition cycle has begun.

Ignition Cycle Default

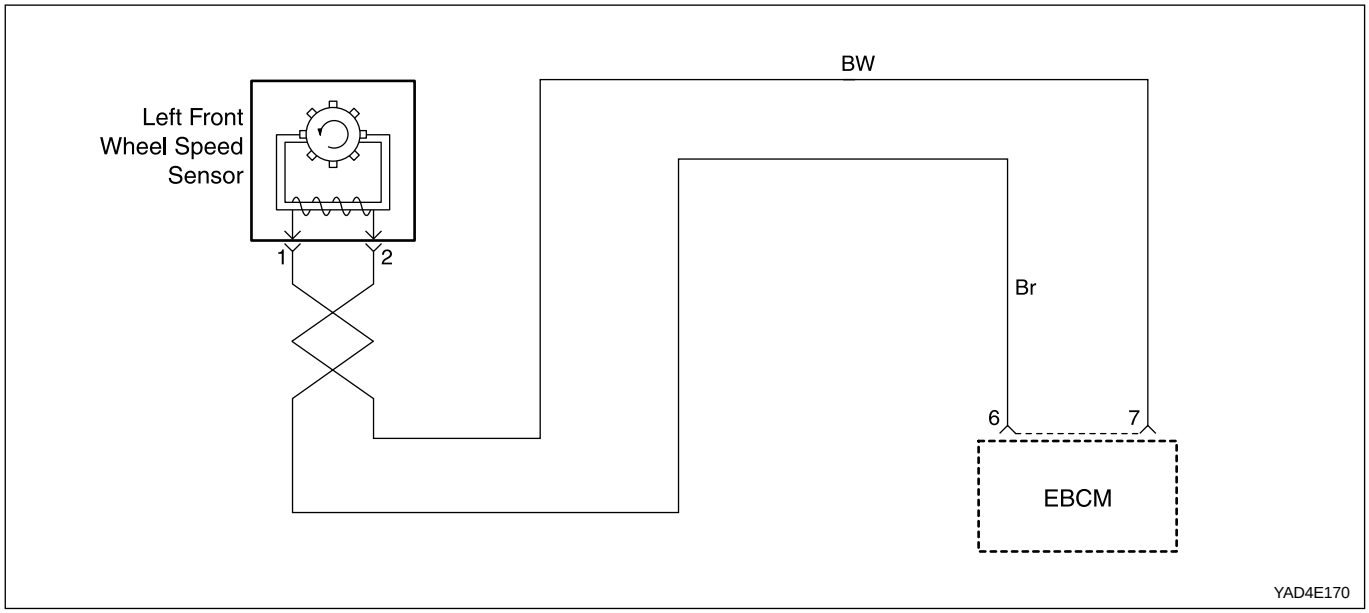
A DTC is erased from memory after 249 ignition cycles without any reappearance of that malfunction.

INTERMITTENT AND POOR CONNECTIONS

As with most electronic systems, intermittent malfunctions may be difficult to diagnose accurately, The following is a method to try to isolate an intermittent malfunction, especially in wheel speed circuitry.

If an ABS malfunction occurs, the ABS indicator will illuminate during the ignition cycle in which the malfunction was detected. If it is an intermittent problem which seems to have corrected itself (ABS indicator OFF), a history DTC will be stored. Also stored will be the history data of the DTC at the time the malfunction occurred. Use the scan tool modular diagnostic system to read ABS history data.

Most intermittents are caused by faulty electrical connections or wiring, although a sticking relay or solenoid can occasionally be at fault.



DIAGNOSTIC TROUBLE CODE (DTC) 035 LEFT FRONT WHEEL SPEED SENSOR FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause

- The wheel speed sensor is defective.
- There is a problem in the wiring.
- There is a problem with a connector.

Action Taken When the DTC Sets

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
6. This step tests the wiring for a short to voltage.
8. This step tests the wiring for a short to ground.
10. This step tests for an open or a high resistance in the wiring.

Diagnostic Aids

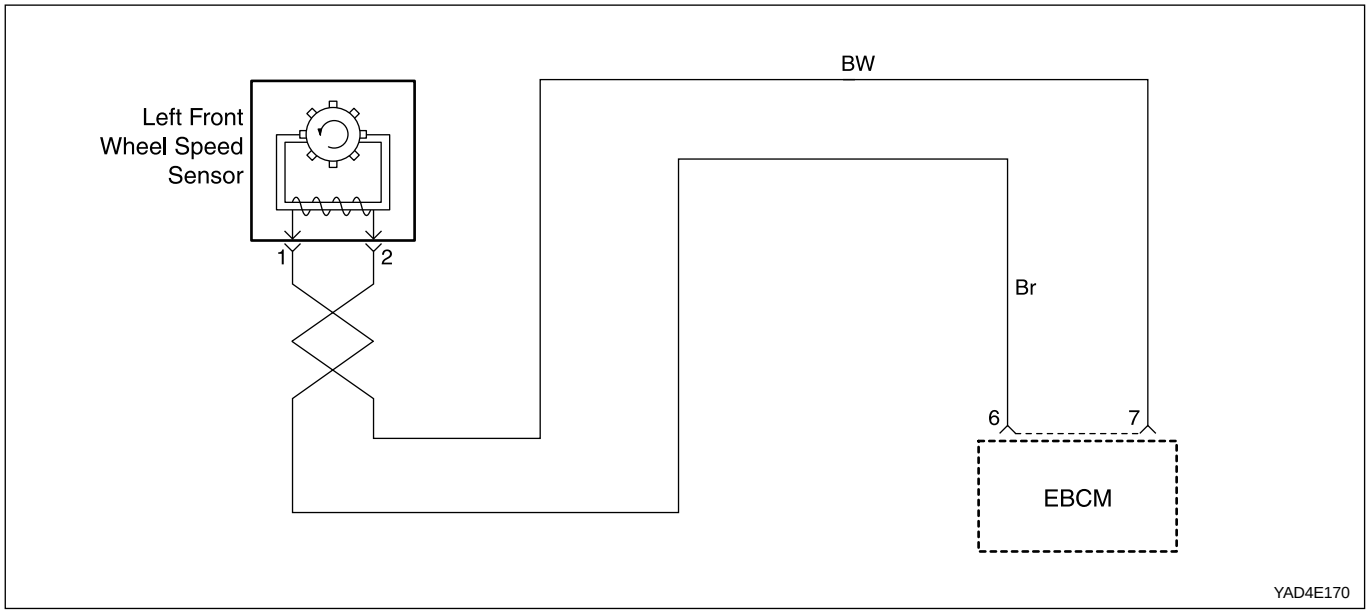
Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

Use the scan tool to monitor wheel speeds during a road test. Watch the wheel speeds being displayed on the scan tool to see if any of the readings are unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and perform a road test, monitoring wheel speeds with the scan tools.

DTC 035 - Left Front Wheel Speed Sensor Fault

Step	Action	Value	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the left front wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure resistance between the sensor terminals. Is the resistance within the specified value at approximately 25 °C (77 °F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Switch the DVM to the AC mV. 2. Measure the voltage output between the wheel speed sensor terminals while rotating the wheel about 1 revolution per second. Is the output within the specified value?	≈ 70 mV	Go to Step 10	Go to Step 9
5	Replace the speed sensor or the toothed wheel, as required. Is the repair complete?	-	System OK	-
6	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	> 1 V	Go to Step 7	Go to Step 8
7	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal 6 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 7 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 9	Go to Step 10
9	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
10	1. Measure the resistance between terminal 7 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 6 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	> 5 Ω	Go to Step 11	Go to Step 12
11	Repair the open or the high resistance in the affected circuit, as required. Is the repair complete?	-	System OK	-
12	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 07 - LEFT FRONT WHEEL SPEED SENSOR CONTINUITY FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause

- The wheel speed sensor is defective.
- There is a problem in the wiring.
- There is a problem with a connector.

Action Taken When the DTC Sets

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
4. This step tests the wiring for a short to voltage.
6. This step tests the wiring for a short to ground.
8. This step tests for an open or high resistance in the wiring.

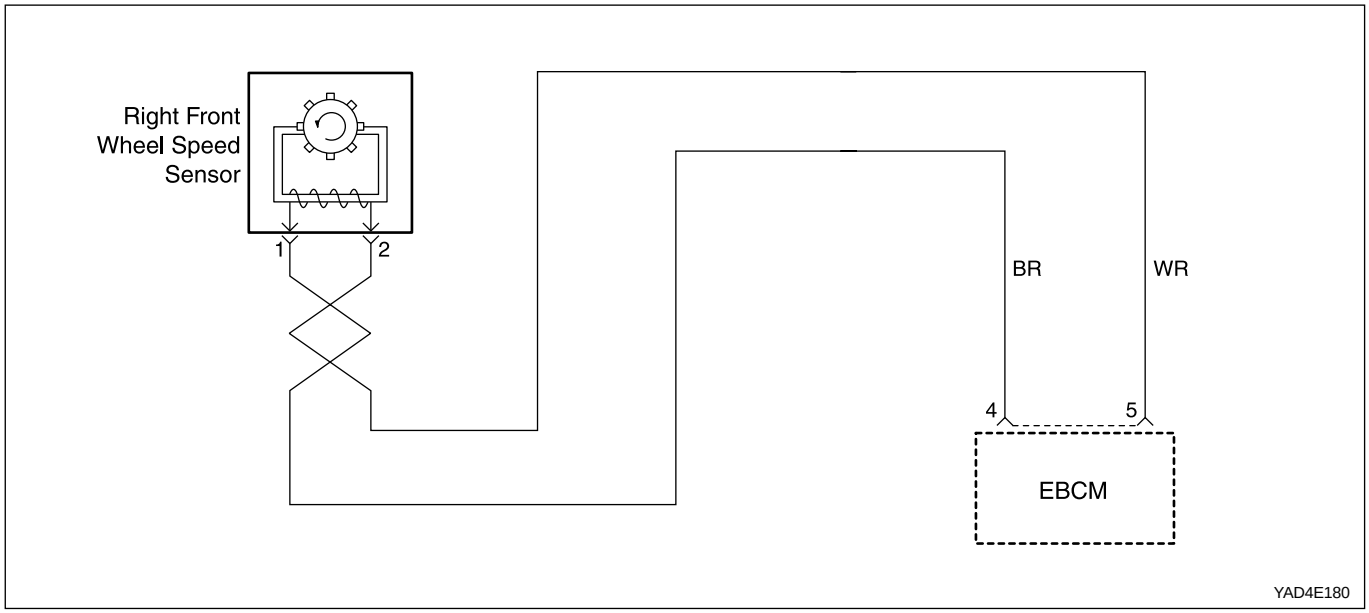
Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

DTC 07 - Left Front Wheel Speed Sensor Continuity Fault

Step	Action	Value	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the left front wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure resistance between the sensor terminals. Is the resistance within the specified value at approximately 25 °C (77 °F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	> 1 V	Go to Step 5	Go to Step 6
5	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
6	1. Turn the ignition go LOCK. 2. Measure the resistance to ground from terminal 6 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 7 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 7	Go to Step 8
7	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Measure the resistance between terminal 6 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 7 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	> 5 Ω	Go to Step 9	Go to Step 10
9	Repair the open or high resistance in the affected circuit as required. Is the repair complete?	-	System OK	-
10	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 040 - RIGHT FRONT WHEEL SPEED SENSOR FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause

- The wheel speed sensor is defective.
- There is a problem in the wiring.
- There is a problem with a connector.

Action Taken When the DTC Sets

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
6. This step tests the wiring for a short to voltage.
8. This step tests the wiring for a short to ground.
10. This step tests for an open or a high resistance in the wiring.

Diagnostic Aids

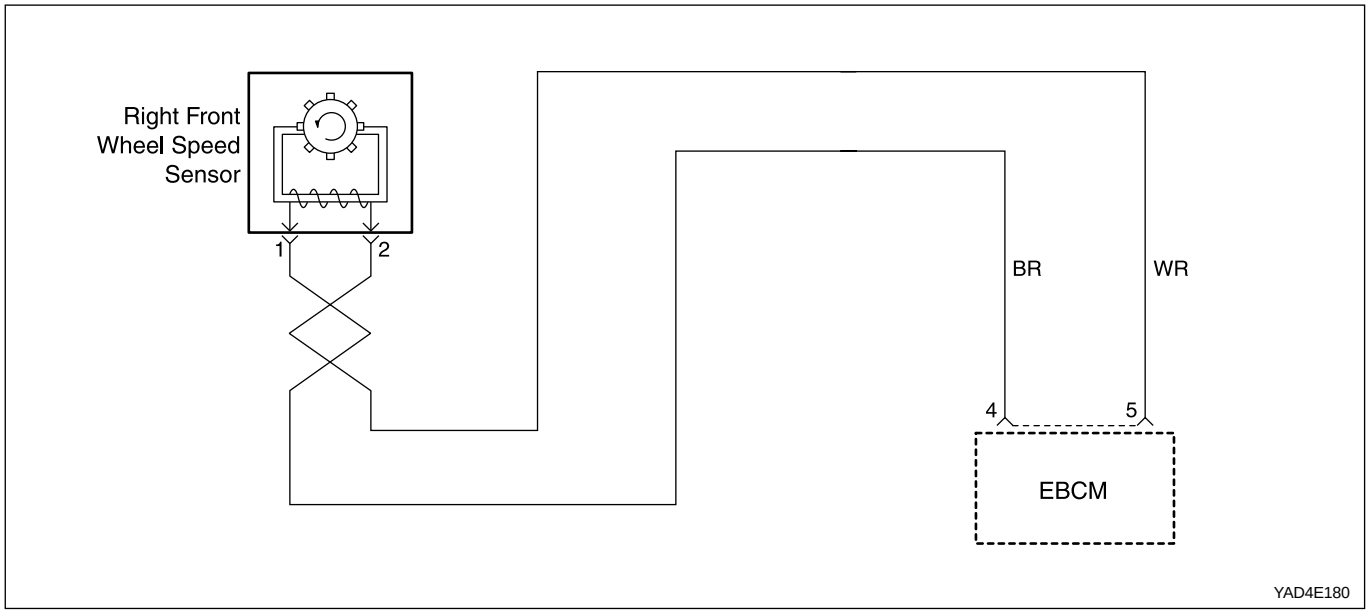
Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

Use the scan tool to monitor wheel speeds during a road test. Watch the wheel speeds being displayed on the scan tool to see if any of the readings are unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and perform a road test, monitoring wheel speeds with the scan tools.

DTC 040 - Right Front Wheel Speed Sensor Fault

Step	Action	Value	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the right front wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure the resistance between the sensor terminals. Is the resistance within the specified value at approximately 25 °C (77 °F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Switch the DVM to the AC mV. 2. Measure the voltage output between the wheel speed sensor terminals while rotating the wheel about 1 revolution per second. Is the output within the specified value?	≈ 70 mV	Go to Step 6	Go to Step 5
5	Replace the speed sensor or the toothed wheel, as required. Is the repair complete?	-	System OK	-
6	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	> 1 V	Go to Step 7	Go to Step 8
7	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal 4 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 5 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	Go to Step 9	Go to Step 9	Go to Step 10
9	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
10	1. Measure the resistance between terminal 4 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 5 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	> 5 Ω	Go to Step 11	Go to Step 12
11	Repair the open or high resistance in the affected circuit, as required. Is the repair complete?	-	System OK	-
12	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 08 - RIGHT FRONT WHEEL SPEED SENSOR CONTINUITY FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause

- The wheel speed sensor is defective.
- There is a problem in the wiring.
- There is a problem with a connector.

Action Taken When the DTC Sets

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
4. This step tests the wiring for a short to voltage.
6. This step tests the wiring for a short to ground.
8. This step tests for an open or high resistance in the wiring.

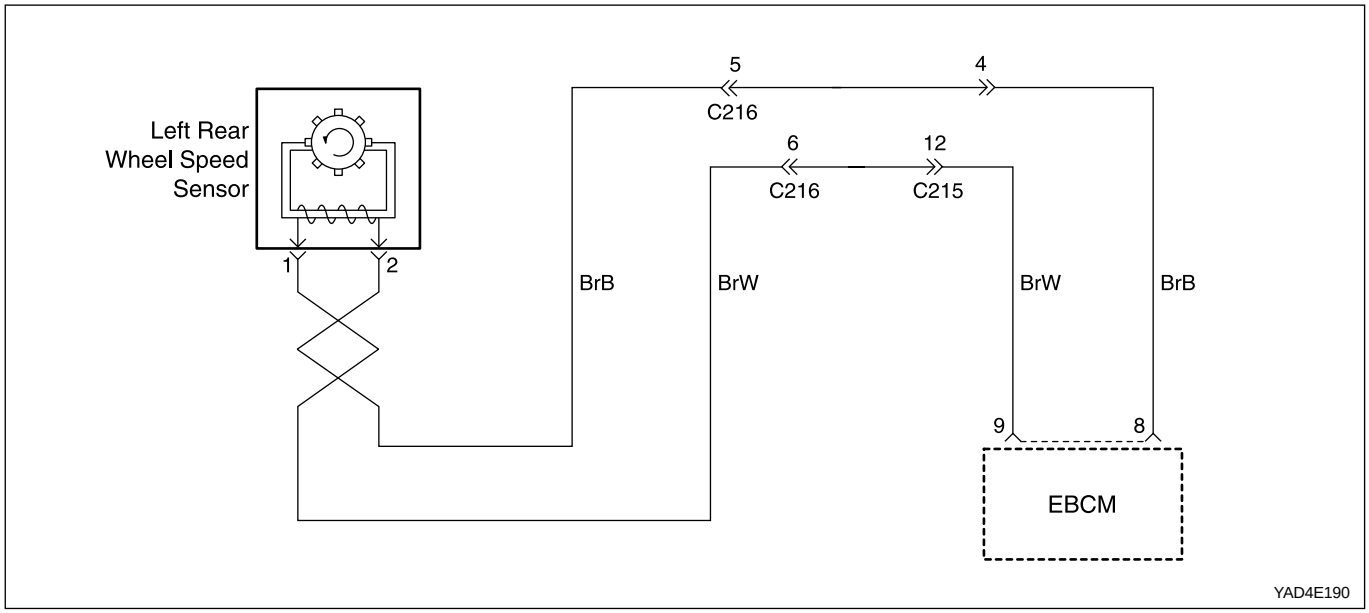
Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

DTC 08 - Right Front Wheel Speed Sensor Continuity Fault

Step	Action	Value	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the right front wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure the resistance between the sensor terminals. Is the resistance within the specified value at approximately 25 °C (77 °F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	> 1 V	Go to Step 5	Go to Step 6
5	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
6	1. Turn the ignition go LOCK. 2. Measure the resistance to ground from terminal 4 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 5 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	System OK	Go to Step 7
7	1. Measure the resistance between terminal 4 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 5 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	> 5 Ω	Go to Step 8	Go to Step 9
8	Repair the open or high resistance in the affected circuit as required. Is the repair complete?	-	System OK	-
9	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 045 - LEFT REAR WHEEL SPEED SENSOR FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause

- The wheel speed sensor is defective or disconnected.
- There is a problem in the wiring.
- There is a problem with a connector.

Action Taken When the DTC Sets

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
4. This step tests the wiring for a short to voltage.
6. This step tests the wiring for a short to ground.
8. This step tests for an open or a high resistance in the wiring.

Diagnostic Aids

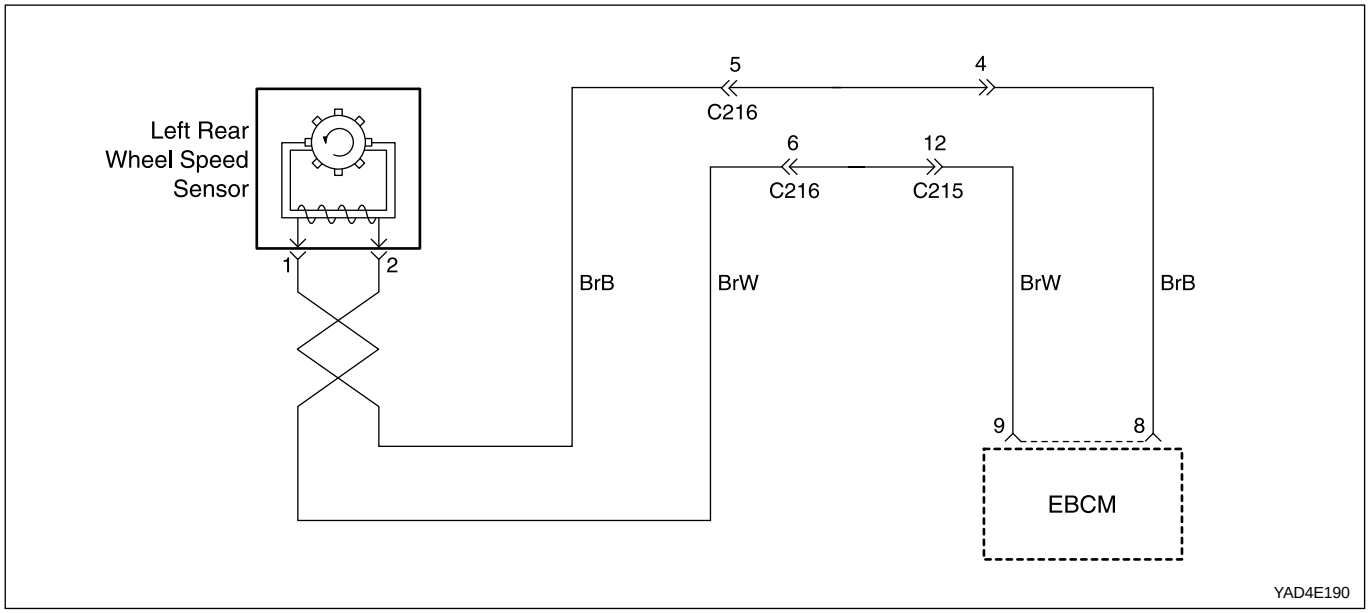
Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

Use the scan tool to monitor wheel speeds during a road test. Watch the wheel speeds being displayed on the scan tool to see if any of the readings are unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and perform a road test, monitoring the wheel speeds with the scan tool.

DTC 045 - Left Rear Wheel Speed Sensor Fault

Step	Action	Value	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the left rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure the resistance between the sensor terminals. Is the resistance within the specified value at approximately 25 °C (77 °F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Switch the DVM to the AC mV. 2. Measure the voltage output between the wheel speed sensor terminals while rotating the wheel about 1 revolution per second. Is the output within the specified value?	≈ 70 mV	Go to Step 6	Go to Step 5
5	Replace the speed sensor or the toothed wheel, as required. Is the repair complete?	-	System OK	-
6	1. Disconnect the from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	> 1 V	Go to Step 7	Go to Step 8
7	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal 8 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 9 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 9	Go to Step 10
9	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
10	1. Measure the resistance between terminal 8 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 9 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	> 5 Ω	Go to Step 11	Go to Step 12
11	Repair the open or high resistance in the affected circuit, as required. Is the repair complete?	-	System OK	-
12	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) - LEFT REAR WHEEL SPEED SENSOR CONTINUITY FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause

- The wheel speed sensor is defective.
- There is a problem in the wiring.
- There is a problem with a connector.

Action Taken When the DTC Sets

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
4. This step tests the wiring for a short to voltage.
6. This step tests the wiring for a short to ground.
8. This step tests for an open or high resistance in the wiring.

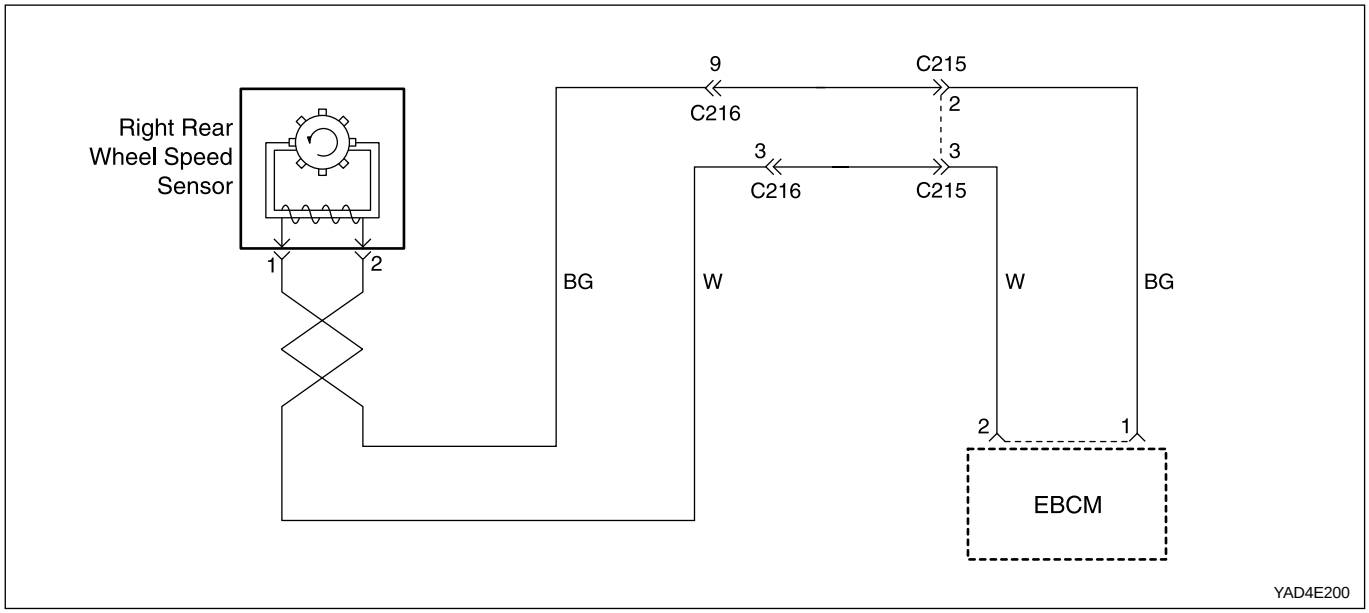
Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

DTC Right Front Wheel Speed Sensor Continuity Fault

Step	Action	Value	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the left rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure the resistance between the sensor terminals. Is the resistance within the specified value at approximately 25 °C (77 °C)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	> 1 V	Go to Step 5	Go to Step 6
5	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
6	1. Turn the ignition go LOCK. 2. Measure the resistance to ground from terminal 8 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 9 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	System OK	Go to Step 7
7	1. Measure the resistance between terminal 8 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 9 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	> 5 Ω	Go to Step 8	Go to Step 9
8	Repair the open or high resistance in the affected circuit as required. Is the repair complete?	-	System OK	-
9	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 050 - RIGHT REAR WHEEL SPEED SENSOR FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause

- The wheel speed sensor is defective or disconnected.
- There is a problem in the wiring.
- There is a problem with a connector.

Action Taken When the DTC Sets

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
6. This step tests the wiring for a short to voltage.
8. This step tests the wiring for a short to ground.
10. This step tests for an open or a high resistance in the wiring.

Diagnostic Aids

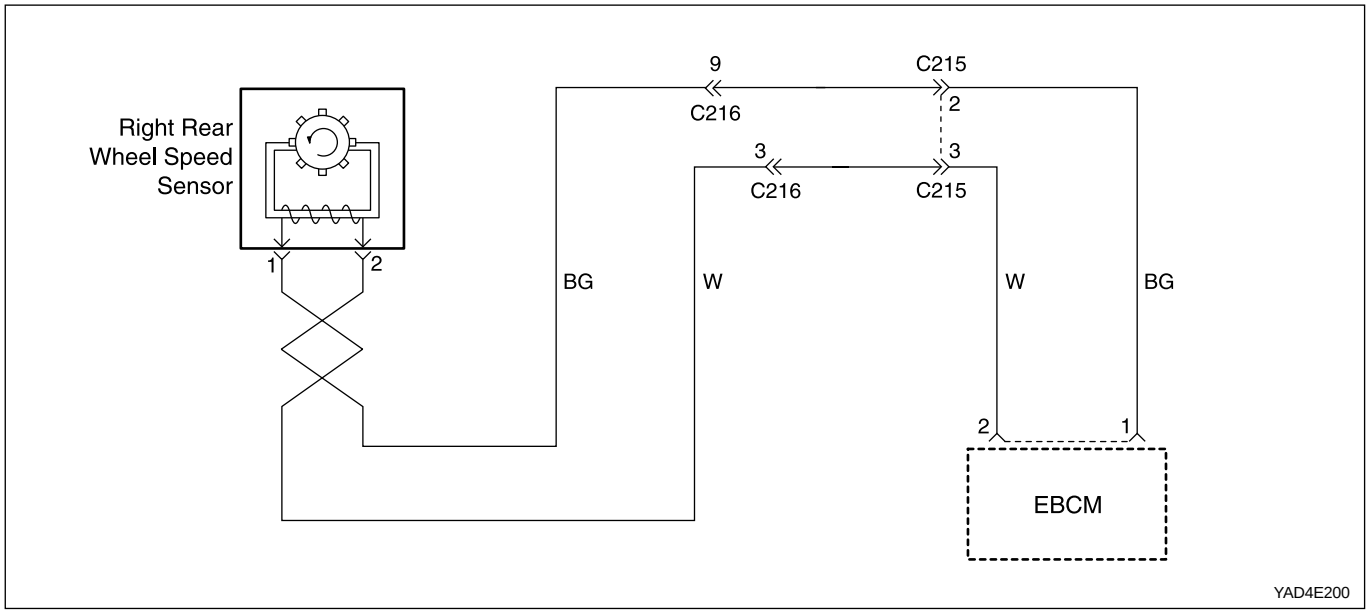
Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

You can use the scan tool to monitor wheel speeds during a road test. Watch the wheel speeds being displayed on the scan tool to see if any of the readings are unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and perform a road test, monitoring the wheel speeds with the scan tool.

DTC 050 - Right Rear Wheel Speed Sensor Fault

Step	Action	Value	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the right rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure the resistance between the sensor terminals. Is the resistance within the specified value at approximately 25 °C (77 °F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Switch the DVM to the AC mV. 2. Measure the voltage output between the wheel speed sensor terminals while rotating the wheel about 1 revolution per second. Is the output within the specified value?	≈ 70 mV	Go to Step 6	Go to Step 5
5	Replace the speed sensor or the toothed wheel, as required. Is the repair complete?	-	System OK	-
6	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	> 1 V	Go to Step 7	Go to Step 8
7	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal 1 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 2 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 9	Go to Step 10
9	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
10	1. Measure the resistance between terminal 1 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 2 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	> 5 Ω	Go to Step 11	Go to Step 12
11	Repair the open or high resistance in the affected circuit, as required. Is the repair complete?	-	System OK	-
12	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) - RIGHT REAR WHEEL SPEED SENSOR CONTINUITY FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause

- The wheel speed sensor is defective or disconnected.
- There is a problem in the wiring.
- There is a problem with a connector.

Action Taken When the DTC Sets

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
6. This step tests the wiring for a short to voltage.
8. This step tests the wiring for a short to ground.
10. This step tests for an open or high resistance in the wiring.

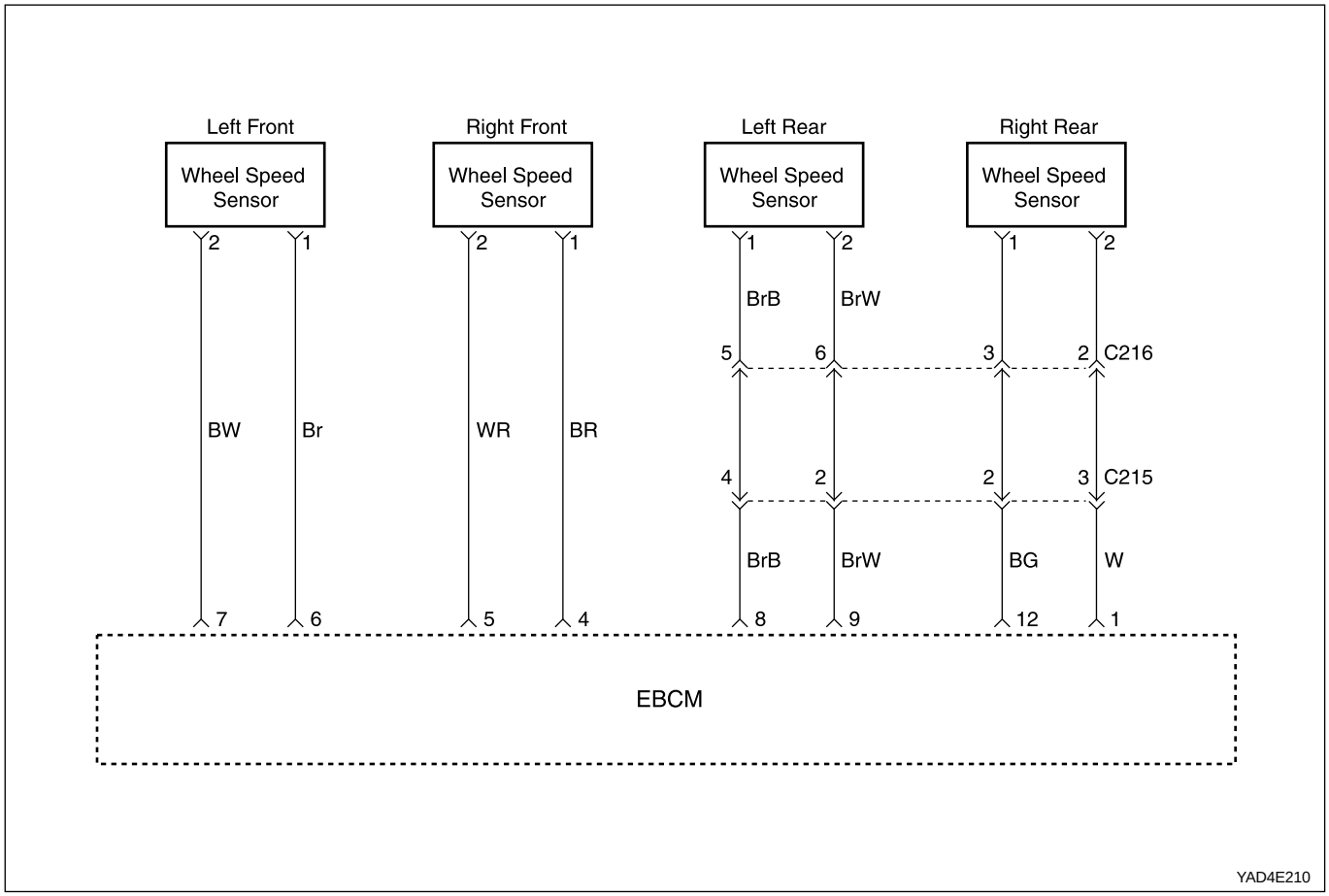
Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

Right Rear Wheel Speed Sensor Continuity Fault

Step	Action	Value	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the right rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure the resistance between the sensor terminals. Is the resistance within the specified value at approximately 25 °C (77 °C)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	> 1 V	Go to Step 5	Go to Step 6
5	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
6	1. Turn the ignition go LOCK. 2. Measure the resistance to ground from terminal 1 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 2 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	System OK	Go to Step 7
7	1. Measure the resistance between terminal 1 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 2 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	> 5 Ω	Go to Step 8	Go to Step 9
8	Repair the open or high resistance in the affected circuit as required. Is the repair complete?	-	System OK	-
9	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE COED (DTC) 245 - WHEEL SPEED SENSOR FREQUENCY ERROR

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the wheel speed sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine wheel speed. The voltage generated depends on the air gap between the wheel speed sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This DTC will set when the EBCM cannot identify which wheel speed sensor is causing the malfunction. It is necessary to check all wheel speed sensors and associated wiring to determine the cause of the DTC.

Cause

- Incorrect number of teeth on the toothed wheel.
- Damaged or broken teeth on the toothed wheel.
- Open or short in speed wheel speed sensor wiring.

Action Taken When the DTC Sets

Antilock brake system (ABS) action is disabled and the ABS warning lamp is ON.

Test Description

The number(s) below refer to Step(s) on the diagnostic table.

1. This step begins the examination of the front wheel speed sensor sensors.
3. This step checks for a problem with one of the front toothed rings.
5. This step checks the front wheel speed sensors.
7. This step checks for shorts in a front wheel speed sensor harness.
9. This step checks for opens in a front wheel speed sensor harness.
11. This step begins a check of the rear wheel speed sensors.
13. This step checks for a problem with one of the rear toothed rings.
15. This step checks the rear wheel speed sensors.
17. This step checks for shorts in a rear wheel speed sensor harness.
19. This step checks for opens in a rear wheel speed sensor harness.

Diagnostic Aids

DTC 11 may be set by running the scan tool auto test if the throttle angle readings are not updating while in the date list mode. If this is the case, clear the DTCs, disconnect the scan tool, and road test the vehicle to at least 25 km/h (15 mph) to see if the DTC resets.

Check the toothed wheels for any large grooves, gouges, marks, etc. that might influence the tooth's signal at the wheel speed sensor. Also, check for a buildup of foreign material in the gaps between the teeth in the toothed wheel, as this material may cause this malfunction.

A badly worn hub/bearing assembly may cause this malfunction. The wheel speed sensor-to-toothed wheel air gap may change excessively due to bearing play.

If an improper rear hub assembly or front outer constant velocity joint is installed, one with a toothed wheel containing the incorrect number of teeth, this DTC can set. Be sure that all the toothed wheels have 52 teeth.

DTC 245 - Wheel Speed Sensro Frequency Error

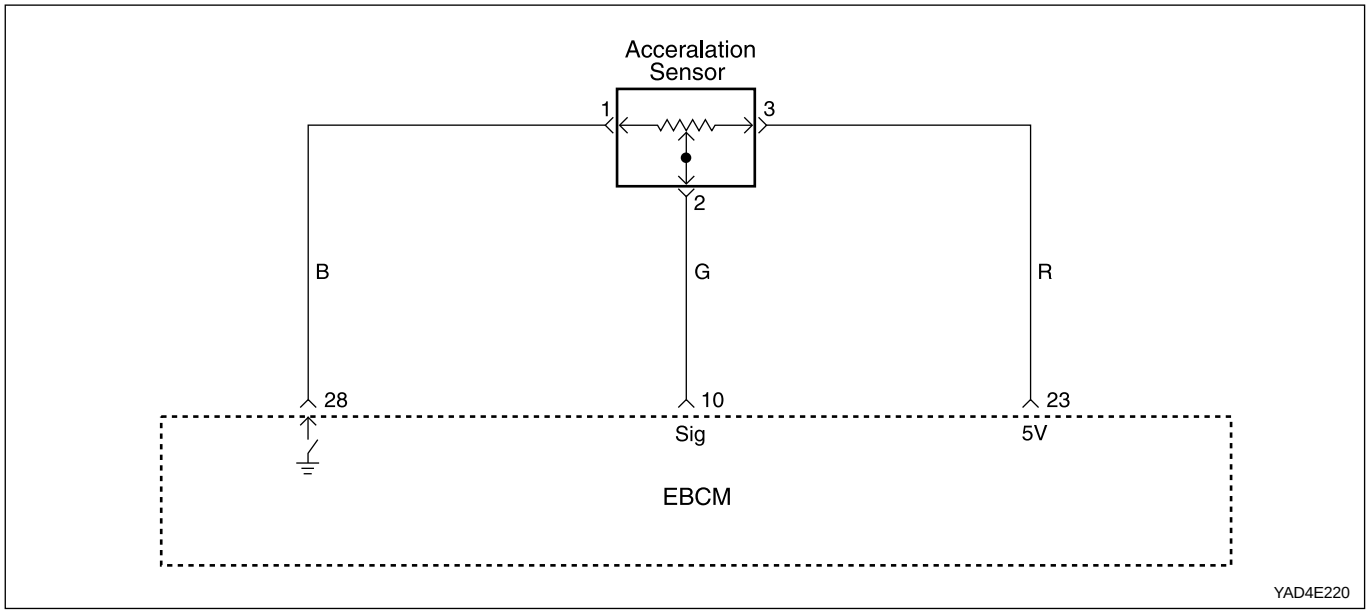
Step	Action	Value	Yes	No
1	Visually inspect the wiring for the front wheel speed sensors. Is there any damage?	-	Go to Step 2	Go to Step 3
2	Repair or replace components, as required. Is the repair complete?	-	System OK	-
3	Check that the correct outer constant velocity (CV) joints are installed on the vehicle, They should have speed rings with 52 teeth. Is one of these incorrect?	-	Go to Step 4	Go to Step 5
4	Replace the incorrect outer CV joint with the proper unit. Is the repair complete?	-	System OK	-
5	1. Disconnect the wheel speed sensor harnesses from the wheel speed sensor connectors. 2. Measure the wheel speed sensor resistance at the wheel speed sensor connector terminals. Does the resistance fall within the specified values for both wheel speed sensors?	1280 - 1920 Ω	Go to Step 7	Go to Step 6
6	Replace the faulty wheel speed sensor. Is the repair complete?	-	System OK	-
7	1. Disconnect the ABS control module connector. 2. Check each wheel speed sensor harness for a short circuit between its wires with a digital ohmmeter attached to the two terminals at the harness side of the wheel speed sensor connector. 3. Also check each wheel speed sensor harness wire for a short to ground from the connector terminals. Is there any short circuit in either wheel speed sensor harness?	-	Go to Step 8	Go to Step 9
8	Repair the short circuit tin the wiring or from a wiring harness to ground. Is the repair complete?	-	System OK	-
9	Check the continuity of the wiring in both front wheel speed sensor circuits between the EBCM connector and the wheel speed sensor connector an each side of the vehicle. • The left side uses terminals 7 and 6 at the EBCM connector. • The right side uses terminals 4 and 5 at the EBCM connector. Is continuity good for both harnesses?	-	Go to Step 11	Go to Step 10

DTC 245 - Wheel Speed Sensro Frequency Error (Cont'd)

Step	Action	Value	Yes	No
10	Repair the discontinuity found in the front wheel speed sensor harness or connector C110. Is the repair complete?	-	System OK	-
11	1. Visually inspect the wiring for the rear wheel speed sensors. 2. Check that the wheel speed sensors are properly mounted and that the retaining belts are properly tightened. Is there any damage?	-	System OK	Go to Step 12
12	Remove each wheel speed sensor from the rear axle and inspect the toothed ring through the wheel speed sensor mounting holes. • Make sure that the toothed ring has 52 teeth. • Check for any damaged or missing teeth. • Check that the ring is properly positioned under the wheel speed sensor. Is there any damage or other fault with either speed ring?	-	Go to Step 13	Go to Step 14
13	Replace the rear wheel hub with the proper unit. Is the repair complete?	-	System OK	-
14	1. Disconnect the rear wheel speed sensor harnesses from the wheel speed sensor connectors. 2. Measure the wheel speed sensor resistance at the wheel speed sensor connector terminals. Does the resistance fall within the specified values for both wheel speed sensors?	1280 - 1920 Ω	Go to Step 16	Go to Step 15
15	Replace the faulty wheel speed sensor. Is the repair complete?	-	System OK	-
16	1. The ABS control module connector should still be disconnected. Disconnect it now if it is not. 2. Check each wheel speed sensor harness for a short circuit between its wires with a digital ohmmeter attached to the two terminals at the harness side of the wheel speed sensor connector. 3. Also, check each wheel speed sensor harness wire for a short to ground from the connector terminals. Is there any short circuit in either wheel speed sensor harness?	-	Go to Step 17	Go to Step 18
17	Repair the short circuit in the wiring or from a wire to ground. Is the repair complete?	-	System OK	Go to Step 19
18	Check the continuity of the wiring in both rear wheel speed sensor circuits between the EBCM connector and the wheel speed sensor connector on each side of the vehicle. • The left side uses terminals 8 and 9 at the EBCM connector. • The right side uses terminals 2 and 1 at the EBCM connector. Is continuity good for both harnesses?	-	Go to Step 20	-

DTC 245 - Wheel Speed Sensro Frequency Error (Cont'd)

Step	Action	Value	Yes	No
19	Repair the discontinuity found in the rear wheel speed sensor harness. Is the repair complete?	-	System OK	-
20	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 930 - ACCELERATION SENSOR FAULT

Circuit Description

The acceleration sensor provides a voltage signal that changes in relation to the acceleration of vehicle. The signal voltage will vary from about 1.95 to 3.45 volt. The electronic brake control module (EBCM) monitor a signal voltage of deceleration in the vehicle.

Diagnosis

This procedure checks for a malfunctioning acceleration sensor, a short to ground or to voltage in the wiring or a contact problem in a connector.

Cause

- The vertical acceleration sensor is defective or disconnected.
- There is a problem in the wiring.
- There is a problem with a connector
- Wrong installed vertical acceleration sensor

Fail Action

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for the voltage reference from the EBCM.
5. This step checks for the voltage signal from the acceleration sensor.

Diagnostic Aids

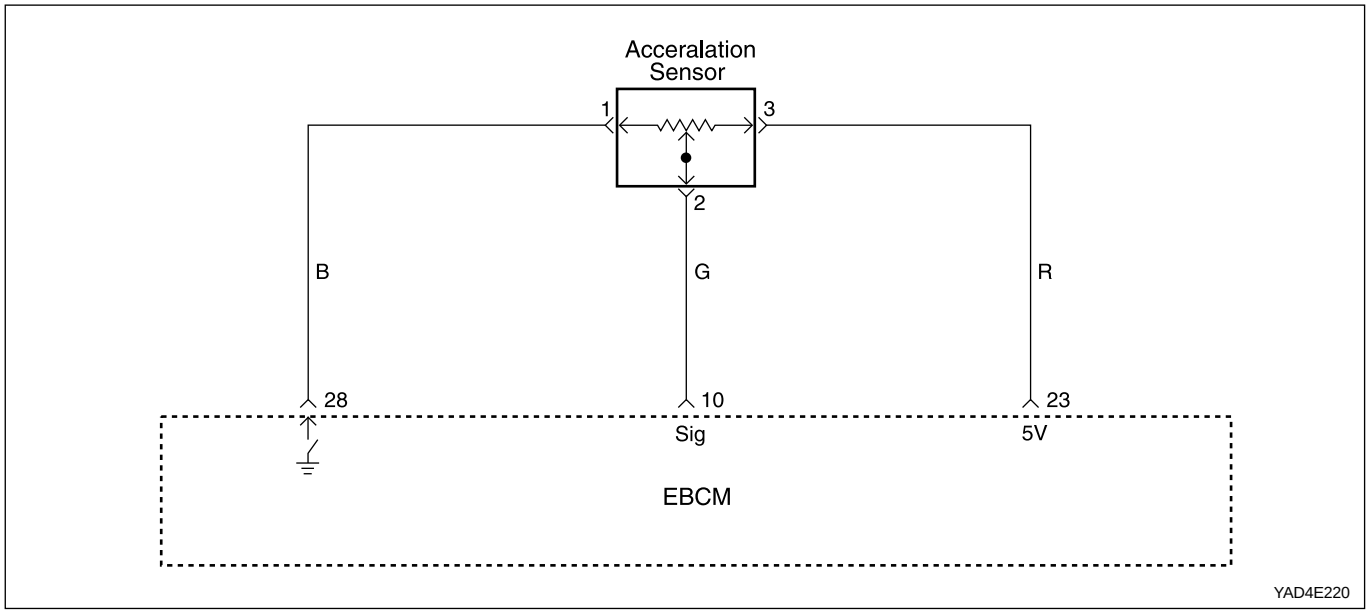
Be sure that the acceleration sensor wiring is properly routed and retained.

It is very important to perform a thorough inspection of the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

You can use the scan tool to monitor acceleration sensor during a road test. Watch the acceleration sensor being display on the scan tool to see if any of the reading is unusual.

DTC 930 - Acceleration Sensor Fault

Step	Action	Value	Yes	No
1	Examine the acceleration sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition switch to ON. 2. Use a digital voltmeter (DVM) to measure the voltage between terminal 28 and 23 of EBCM. Is the voltage within the specified value?	4.75 - 5.25 V	Go to Step 5	Go to Step 4
3	Replace the acceleration sensor. Is the repair complete?	-	System OK	-
4	Repair the open in the affected circuit or replace the acceleration sensor, if necessary. Is the repair complete?	-	System OK	-
5	1. Place the acceleration sensor horizontally and let the acceleration sensor. 2. Turn the ignition switch to ON. 3. Use a digital voltmeter (DVM) to measure the voltage between terminal 28 and 10 of EBCM. Is the voltage within the specified value?	1.95 - 3.45 V	Go to Step 7	Go to Step 6
6	Repair the open in the affected circuit or replace the acceleration sensor, if necessary. Is the repair complete?	-	System OK	-
7	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) - ACCELERATION SENSOR CONTINUITY FAULT

Circuit Description

The acceleration sensor provides a voltage signal that changes in relation to the acceleration of vehicle. The signal voltage will vary from about 1.95 to 3.45 volt. The electronic brake control module (EBCM) monitor a signal voltage of deceleration in the vehicle.

Diagnosis

This procedure checks for a malfunctioning acceleration sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause

- The vertical acceleration sensor is defective or disconnected.
- There is a problem in the wiring.
- There is a problem with a connector
- Wrong installed vertical acceleration sensor

Action Taken When the DTC Sets

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for the voltage reference from the EBCM.
5. This step checks for the voltage signal from the acceleration sensor.

Diagnostic Aids

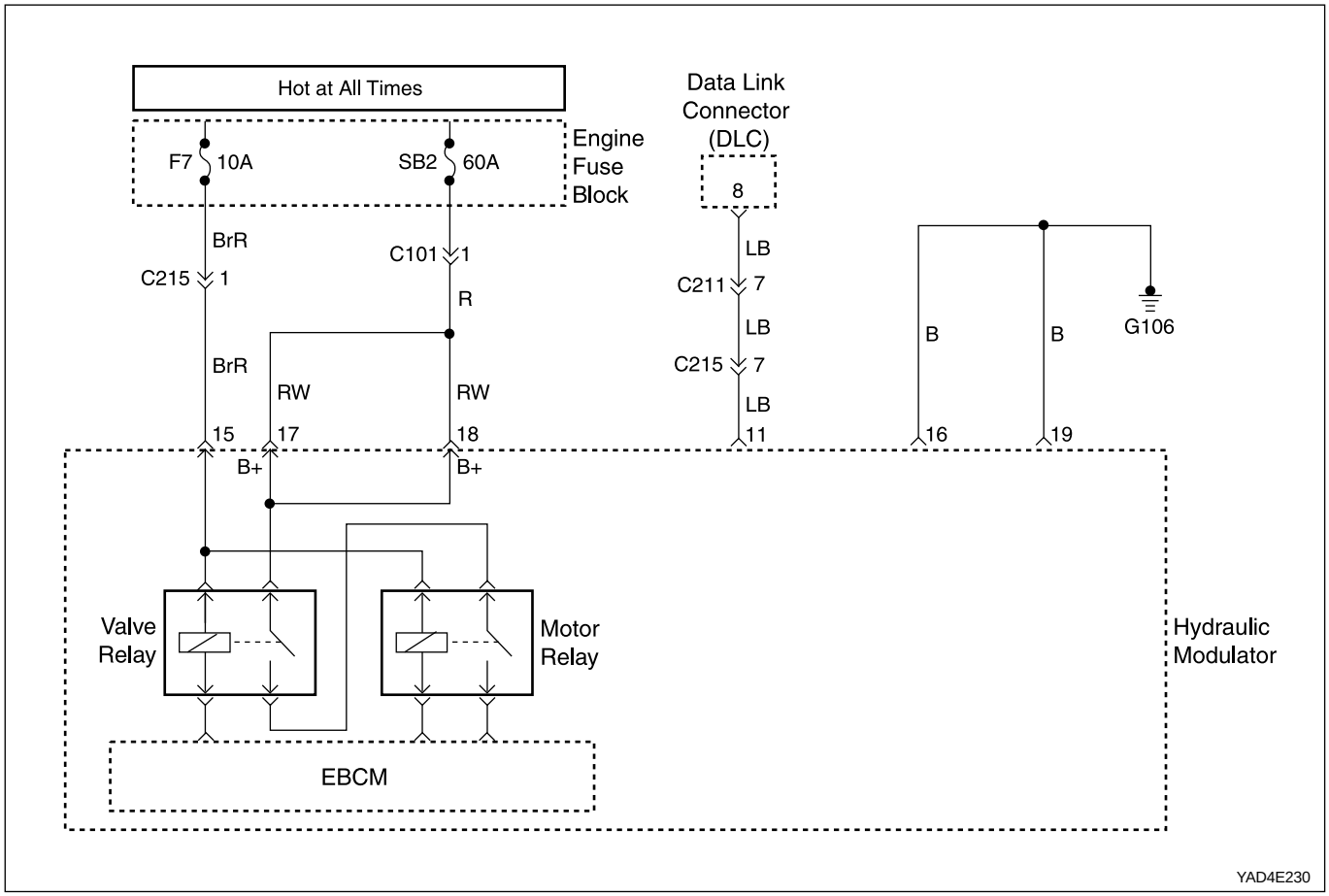
Be sure that the acceleration sensor wiring is properly routed and retained.

It is very important to perform a thorough inspection of the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

You can use the scan tool to monitor acceleration sensor during a road test. Watch the acceleration sensor being display on the scan tool to see if any of the reading is unusual.

DTC - Acceleration Sensor Continuity Fault

Step	Action	Value	Yes	No
1	Examine the acceleration sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition switch to ON. 2. Use a digital voltmeter (DVM) to measure the voltage between terminal 28 and 23 of EBCM. Is the voltage within the specified value?	4.75 - 5.25 V	Go to Step 5	Go to Step 4
3	Replace the acceleration sensor. Is the repair complete?	-	System OK	-
4	Repair the open in the affected circuit or replace the acceleration sensor, if necessary. Is the repair complete?	-	System OK	-
5	1. Place the acceleration sensor horizontally and let the acceleration sensor. 2. Turn the ignition switch to ON. 3. Use a digital voltmeter (DVM) to measure the voltage between terminal 28 and 10 of EBCM. Is the voltage within the specified value?	1.95 - 3.45 V	Go to Step 7	Go to Step 6
6	Repair the open in the affected circuit or replace the acceleration sensor, if necessary. Is the repair complete?	-	System OK	-
7	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE COED (DTC) 060/065 - LEFT FRONT INLET AND OUTLET VALVE SOLENOID FAULT

Circuit Description

The solenoid valve coil circuits are supplied with power from the battery when the valve relay is energized. Switched ground is provided by the electronic brake control module (EBCM) to each coil.

Diagnosis

This procedure checks whether the left front inlet and outlet valves are functioning.

Cause

- A valve has failed.
- A solenoid coil is open or shorted.

Action Taken When the DTC Sets

ABS is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC.

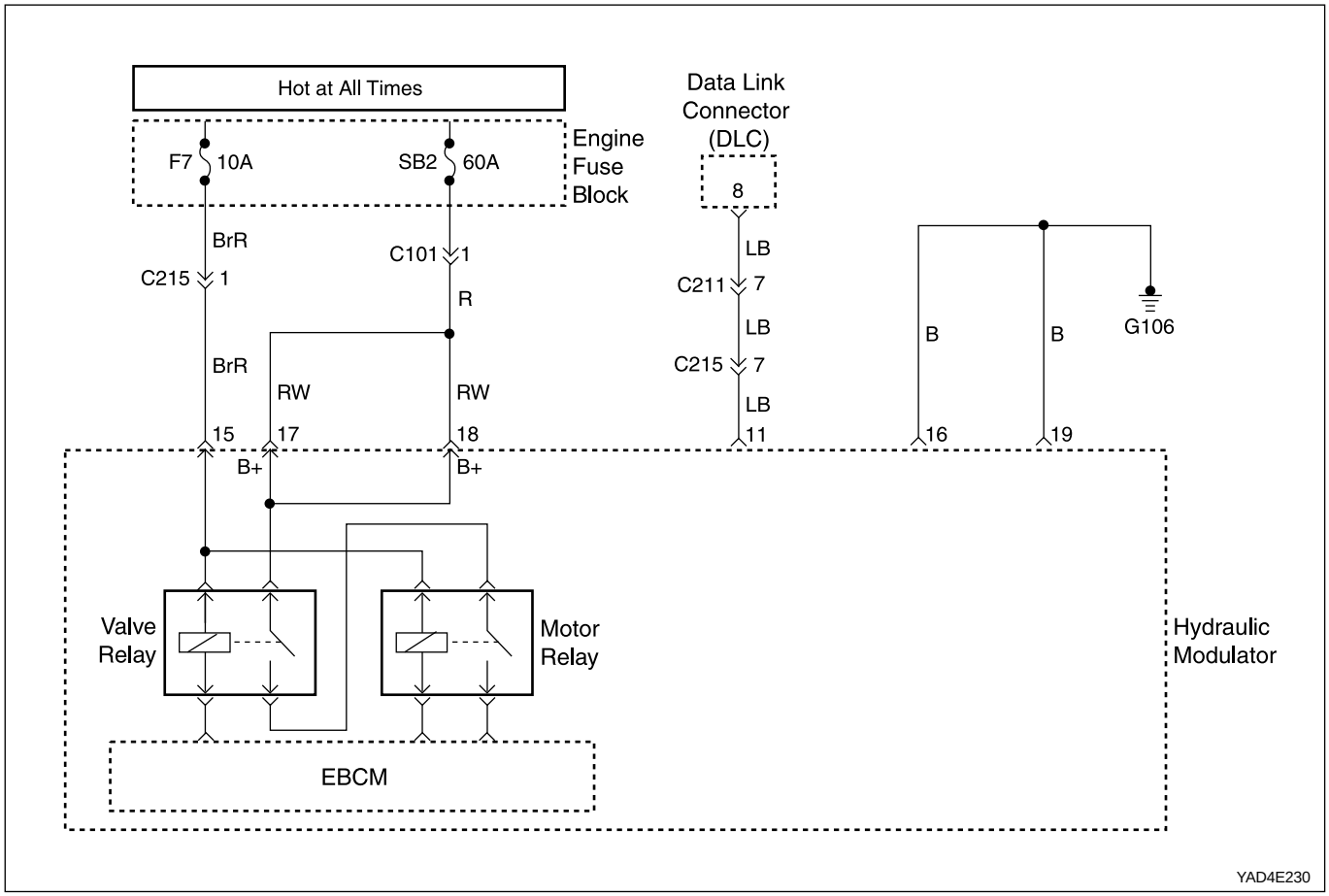
Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins the test of the inlet valve
3. This step tests the outlet valve.

DTC 060/065 - Left Front Inlet and Outlet Valve Solenoid Fault

Step	Action	Value	Yes	No
1	1. Raise and suitably support the vehicle at the corner being tested. 2. Turn the ignition to ON. 3. Install the scan tool to the data link connector (DLC) and select “Wheel front left” to begin the solenoid tests at that wheel. This will test both the inlet and the outlet valves. 4. When the scan tool indicates “Pressure hold,” press and hold the brake pedal until the end of the test. 5. Have an assistant attempt to rotate the wheel. Can the wheel be rotated?	-	Go to Step 2	Go to Step 6
2	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure increase,” have an assistant attempt to rotate the wheel again. Can the wheel be rotated now?	-	Go to Step 6	Go to Step 3
3	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure release on,” have an assistant attempt to rotate the wheel again. Can the wheel be rotated?	-	Go to Step 4	Go to Step 6
4	1. Release brake pedal pressure when the scan tool indicates “Pressure release off” 2. Clear all DTCs. 3. Road test the vehicle. Does the DTC set again?	-	Go to Step 6	Go to Step 5
5	1. Check the wiring harness and connector terminals for an intermittent problem. 2. Repair any problem found. Is the repair complete?	-	System OK	-
6	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE COED (DTC) 070/075 - RIGHT FRONT INLET AND OUTLET VALVE SOLENOID FAULT

Circuit Description

The solenoid valve coil circuits are supplied with power from the battery when the valve relay is energized. Switched ground is provided by the electronic brake control module (EBCM) to each coil.

Diagnosis

This procedure checks whether the right front inlet and outlet valves are functioning.

Cause

- A solenoid coil is open or shorted.

Action Taken When the DTC Sets

ABS is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC.

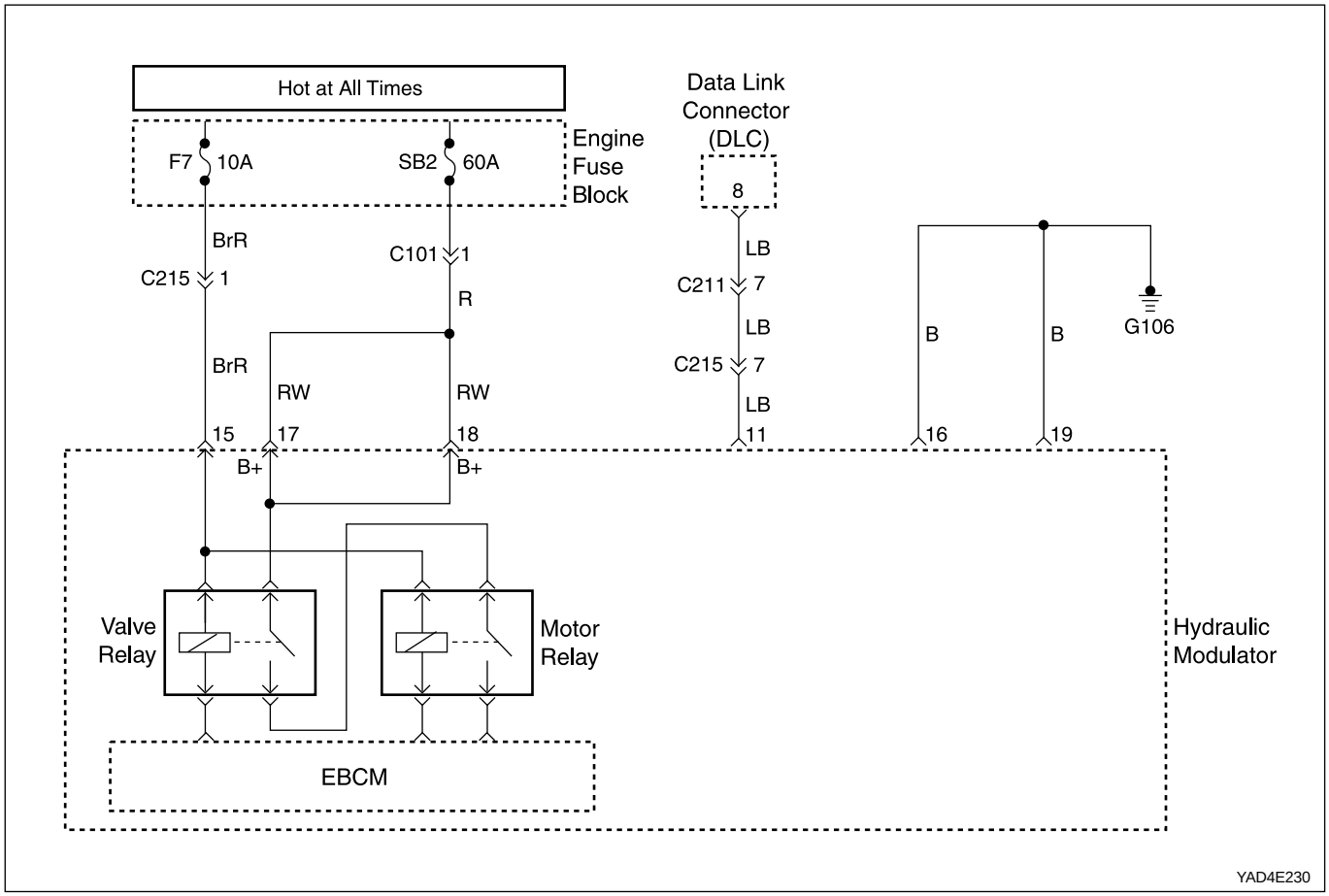
Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This begins the test of the inlet valve
3. This tests the outlet valve.

DTC 070/075 - Right Front Inlet and Outlet Valve Solenoid Fault

Step	Action	Value	Yes	No
1	1. Raise and suitably support the vehicle at the corner being tested. 2. Turn the ignition to ON. 3. Install the scan tool to the data link connector (DLC) diagnostic and select “Wheel front right” to begin the solenoid tests at that wheel. This will test both the inlet and the outlet valves. 4. When the scan tool indicates “Pressure hold,” press and hold the brake pedal until the end of the test. 5. Have an assistant attempt to rotate the wheel. Can the wheel be rotated?	-	Go to Step 2	Go to Step 6
2	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure increase,” have an assistant attempt to rotate the wheel again. Can the wheel be rotated now?	-	Go to Step 6	Go to Step 3
3	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure release on,” have an assistant attempt to rotate the wheel again. Can the wheel be rotated?	-	Go to Step 4	Go to Step 6
4	1. Release brake pedal pressure when the scan tool indicates “Pressure release off” 2. Clear all DTCs. 3. Road test the vehicle. Does the DTC set again?	-	Go to Step 6	Go to Step 5
5	1. Check the wiring harness and connector terminals for an intermittent problem. 2. Repair any problem found. Is the repair complete?	-	System OK	-
6	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE COED (DTC) 080/085 - LEFT REAR INLET AND OUTLET VALVE SOLENOID FAULT

Circuit Description

The solenoid valve coil circuits are supplied with power from the battery when the valve relay is energized. Switched ground is provided by the electronic brake control module (EBCM) to each coil.

Diagnosis

This procedure checks whether the left rear inlet and outlet valves are functioning.

Cause(s)

- A valve has failed.
- A solenoid coil is open or shorted.

Action Taken When the DTC Sets

ABS is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC.

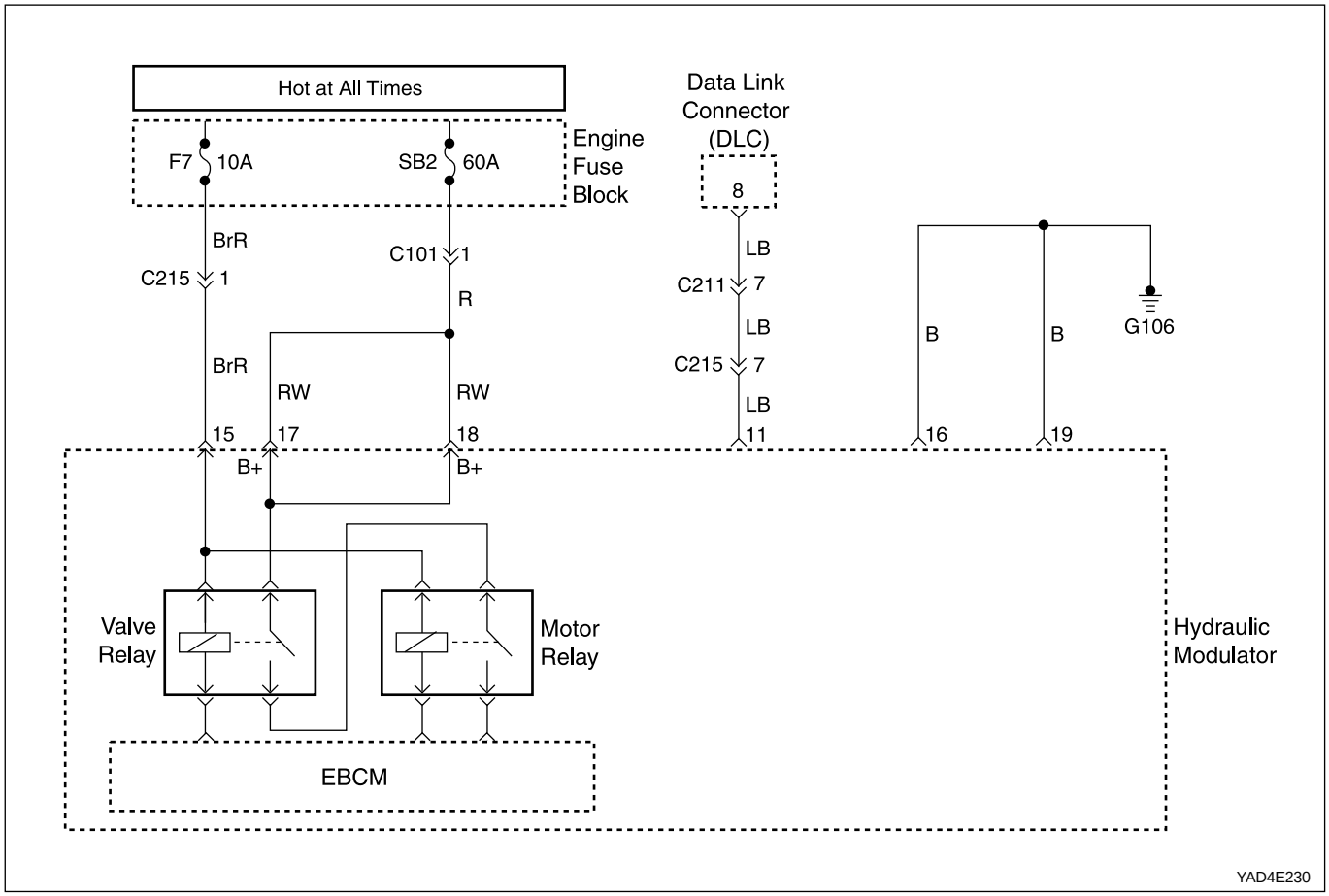
Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This begins the test of the inlet valve
3. This tests the outlet valve.

DTC 080/085 - Left Rear Inlet and Outlet Valve Solenoid Fault

Step	Action	Value	Yes	No
1	1. Raise and suitably support the vehicle. 2. Turn the ignition to ON. 3. Install the scan tool to the data link connector (DLC) and select “Wheel rear left” to begin the solenoid tests at that wheel. This will test both the inlet and the outlet valves. 4. When the scan tool indicates “Pressure hold,” press and hold the brake pedal until the end of the test. 5. Have an assistant attempt to rotate the wheel. Can the wheel be rotated?	-	Go to Step 2	Go to Step 6
2	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure increase,” have an assistant attempt to rotate the wheel again. Can the wheel be rotated now?	-	Go to Step 6	Go to Step 3
3	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure release on,” have an assistant attempt to rotate the wheel again. Can the wheel be rotated?	-	Go to Step 4	Go to Step 6
4	1. Release brake pedal pressure when the scan tool indicates “Pressure release off.” 2. Clear all DTCs. 3. Road test the vehicle. Does the DTC set again?	-	Go to Step 6	Go to Step 5
5	1. Check the wiring harness and connector terminals for an intermittent problem. 2. Repair any problem found. Is the repair complete?	-	System OK	-
6	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE COED (DTC) 090/095 - RIGHT REAR INLET AND OUTLET VALVE SOLENOID FAULT

Circuit Description

The solenoid valve coil circuits are supplied with power from the battery when the valve relay is energized. Switched ground is provided by the electronic brake control module (EBCM) to each coil.

Diagnosis

This procedure checks whether the right rear inlet and outlet valves are functioning.

Cause(s)

- A valve has failed.
- A solenoid coil is open or shorted.

Action Taken When the DTC Sets

ABS is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC.

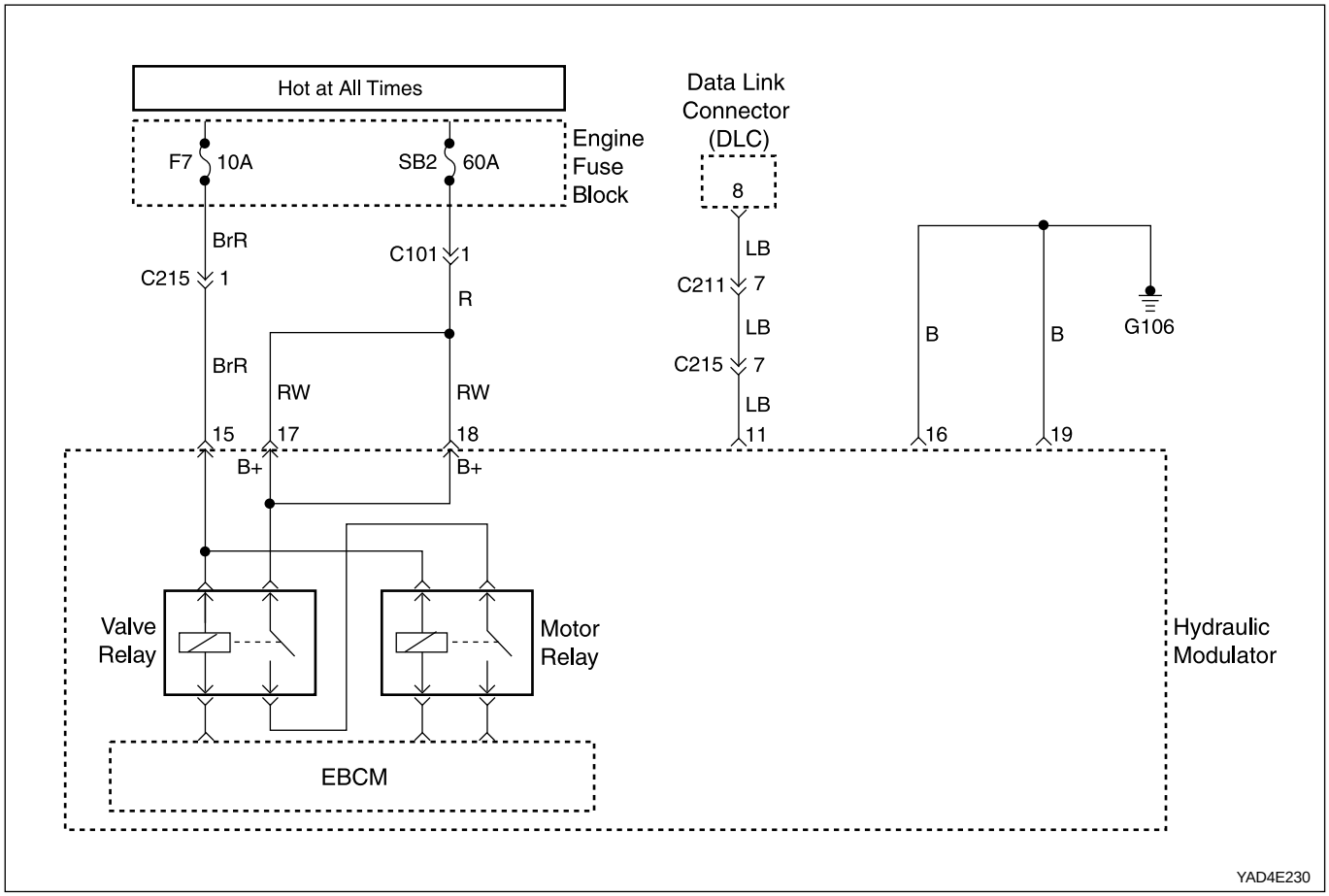
Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This begins the test of the inlet valve
3. This tests the outlet valve.

DTC 090/095 – Right Rear Inlet and Outlet Valve Solenoid Fault

Step	Action	Value	Yes	No
1	1. Raise and suitably support the vehicle. 2. Turn the ignition to ON. 3. Install the scan tool to the data link connector (DLC) and select “Wheel rear right” to begin the solenoid tests at that wheel. This will test both the inlet and the outlet valves. 4. When the scan tool indicates “Pressure hold,” press and hold the brake pedal until the end of the test. 5. Have an assistant attempt to rotate the wheel. Can the wheel be rotated?	-	Go to Step 2	Go to Step 6
2	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure increase,” have an assistant attempt to rotate the wheel again. Can the wheel be rotated now?	-	Go to Step 6	Go to Step 3
3	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure release on,” have an assistant attempt to rotate the wheel again. Can the wheel be rotated?	-	Go to Step 4	Go to Step 6
4	1. Release brake pedal pressure when the scan tool indicates “Pressure release off.” 2. Clear all DTCs. 3. Road test the vehicle. Does the DTC set again?	-	Go to Step 6	Go to Step 5
5	1. Check the wiring harness and connector terminals for an intermittent problem. 2. Repair any problem found. Is the repair complete?	-	System OK	-
6	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE COED (DTC) 141/146 - LEFT REAR PRIME LINE AND TRACTION CONTROL SYSTEM (TCS) PILOT VALVE FAULT

Circuit Description

The solenoid valve coil circuits are supplied with power from the battery when the valve relay is energized. Switched ground is provided by the electronic brake control module (EBCM) to each coil.

Diagnosis

This procedure checks whether the left rear TCS valves are functioning.

Cause(s)

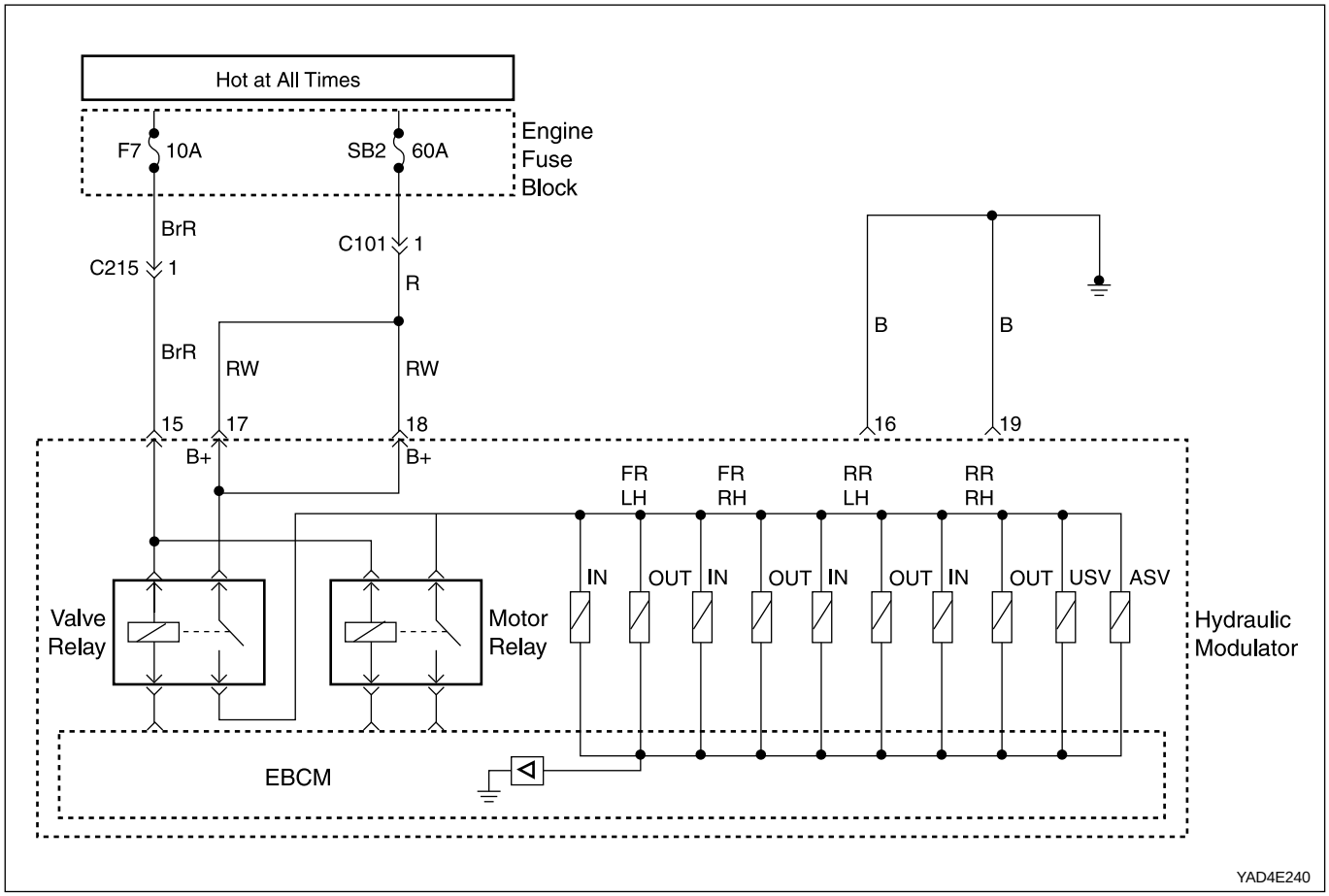
- A solenoid coil is open or shorted.

Action Taken When the DTC Sets

Antilock brake system (ABS) is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC.

DTC 141/146 - Left Rear Prime Line and TCS Pilot Valve Fault

Step	Action	Value	Yes	No
1	1. Raise and suitably support the vehicle at the corner being tested. 2. Turn the ignition to ON. **Important:** Do not step on the brake pedal at any time during this test. 3. Install the scan tool to the data link connector (DLC). 4. Select the TCS function and “Wheel rear left” to begin the solenoid tests at that wheel. This will test both the prime and pilot valves. 5. When the scan tool indicates a pressure increase, attempt to rotate the wheel. Can the wheel be rotated?	-	Go to Step 6	Go to Step 2
2	When the scan tool indicates that the prime valve was turned OFF, attempt to rotate the wheel again. Can the wheel be rotated now?	-	Go to Step 6	Go to Step 3
3	When the scan tool indicates that the pilot valve and the pump motor were switched OFF, attempt to rotate the wheel again. Can the wheel be rotated?	-	Go to Step 4	Go to Step 6
4	1. Clear all DTCs. 2. Road test the vehicle. Does the DTC set again?	-	Go to Step 6	Go to Step 5
5	1. Check the wiring harness and connector terminals for an intermittent problem. 2. Repair any problem found. Is the repair complete?	-	System OK	-
6	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 121 - VALVE RELAY CIRCUIT FAULT

Circuit Description

When the ABS is active, the valve relay provides voltage to actuate the solenoid valves. The valves do not use this voltage unless the ABS control module provides the ground for each solenoid coil.

DTC 12 will set if the valve relay voltage is low or if the relay supply line is at 12 volts when the ABS control module is not requesting it. This DTC will also set if the ABS control module detects three or more solenoid valve circuits are open or shorted during the self-test.

Diagnosis

This procedure checks whether there is a poor ground connection for the electronic brake control module (EBCM).

Cause(s)

- A connector terminal is corroded.
- The wiring harness is damaged.
- The ground terminal is not conducting properly.
- The valve relay is defective.
- The EBCM is defective.

Action Taken When the DTC Sets

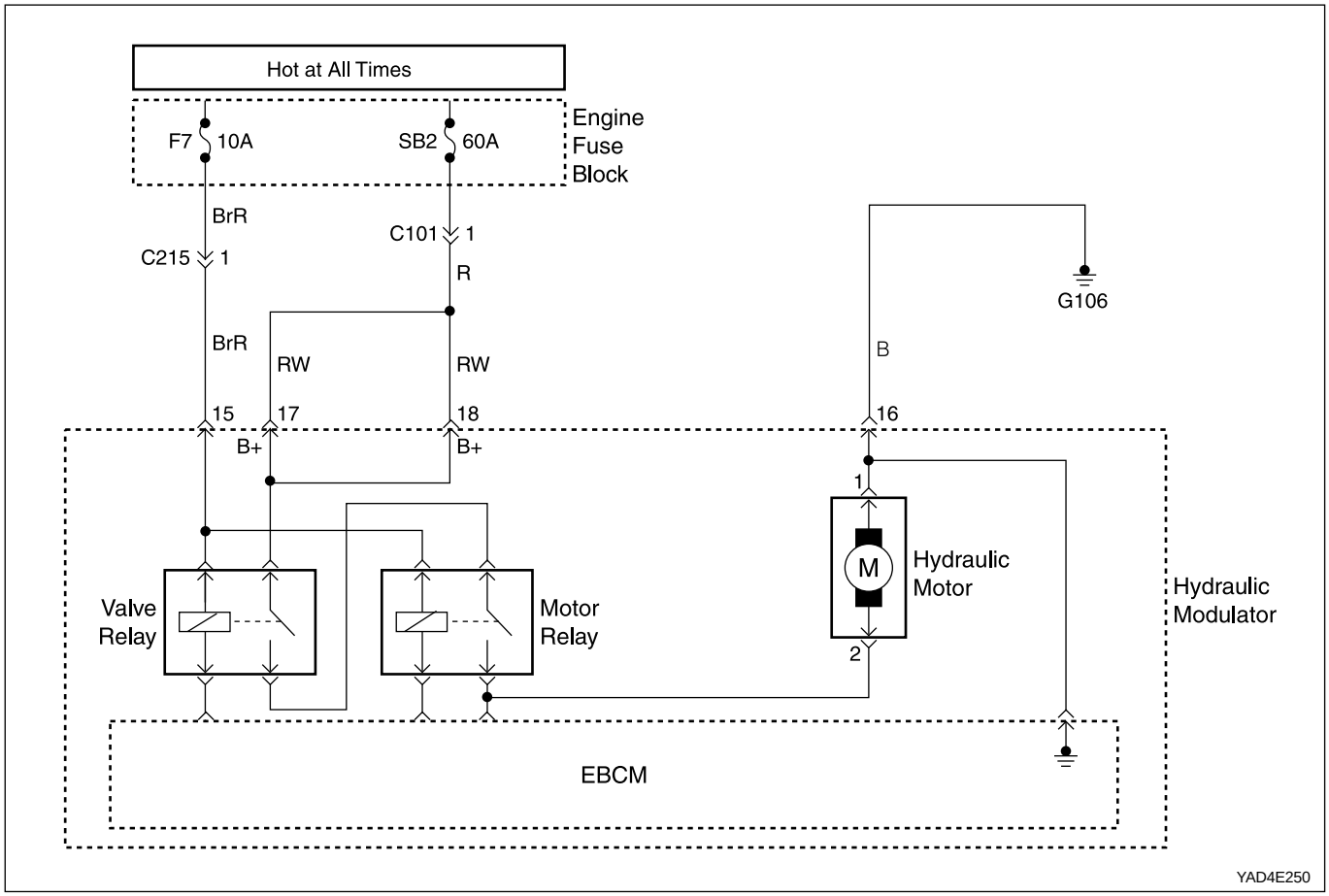
ABS/TCS is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the control module will enable the system at the next ignition cycle and set a history DTC 12.

Diagnostic Aids

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to do so may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

DTC 121 - Valve Relay Circuit Fault

Step	Action	Value	Yes	No
1	1. Use a scan tool to clear all DTCs. 2. Road test the vehicle. Does DTC 121 set again?	-	Go to Step 3	Go to Step 2
2	1. Check all system wiring harness connectors and terminals, especially the electronic brake control module (EBCM), for any problem that could cause an intermittent condition. 2. Repair any intermittent problem found. Is the repair complete?	-	System OK	-
3	Check fuse SB2. Is fuse SB2 blown?	-	Go to Step 4	Go to Step 5
4	1. Check for a short circuit and repair it, if necessary. 2. Replace fuse SB2. Is the repair complete?	-	System OK	-
5	1. Disconnect the valve relay. 2. Check the voltage between the valve relay connector terminal 15 and ground of EBCM. Is the voltage equal to the specified valve?	11 - 14 V	Go to Step 7	Go to Step 6
6	Repair the open circuit between the valve relay connector terminal 15 and terminal SB2 of EBCM. Is the repair complete?	-	System OK	-
7	Replace the hydraulic modulator. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 110 - RETURN PUMP MOTOR CIRCUIT FAULT

Circuit Description

When the electronic brake control module (EBCM) grounds the pump motor relay, it closes and provides battery voltage to the pump motor. The EBCM senses the voltage applied to the pump motor verify motor operation.

Diagnosis

This DTC sets when the EBCM detects B+ without motor relay activation or if the EBCM does not detect B+ after motor relay activation.

Cause

- There is a faulty terminal in the pump motor connector.
- There is faulty terminal in EBCM connector.
- There is high resistance in the chassis ground.
- The EBCM defective.
- There is a problem in the wiring from the pump motor connector to the motor.

Action Taken When the DTC Sets

ABS is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

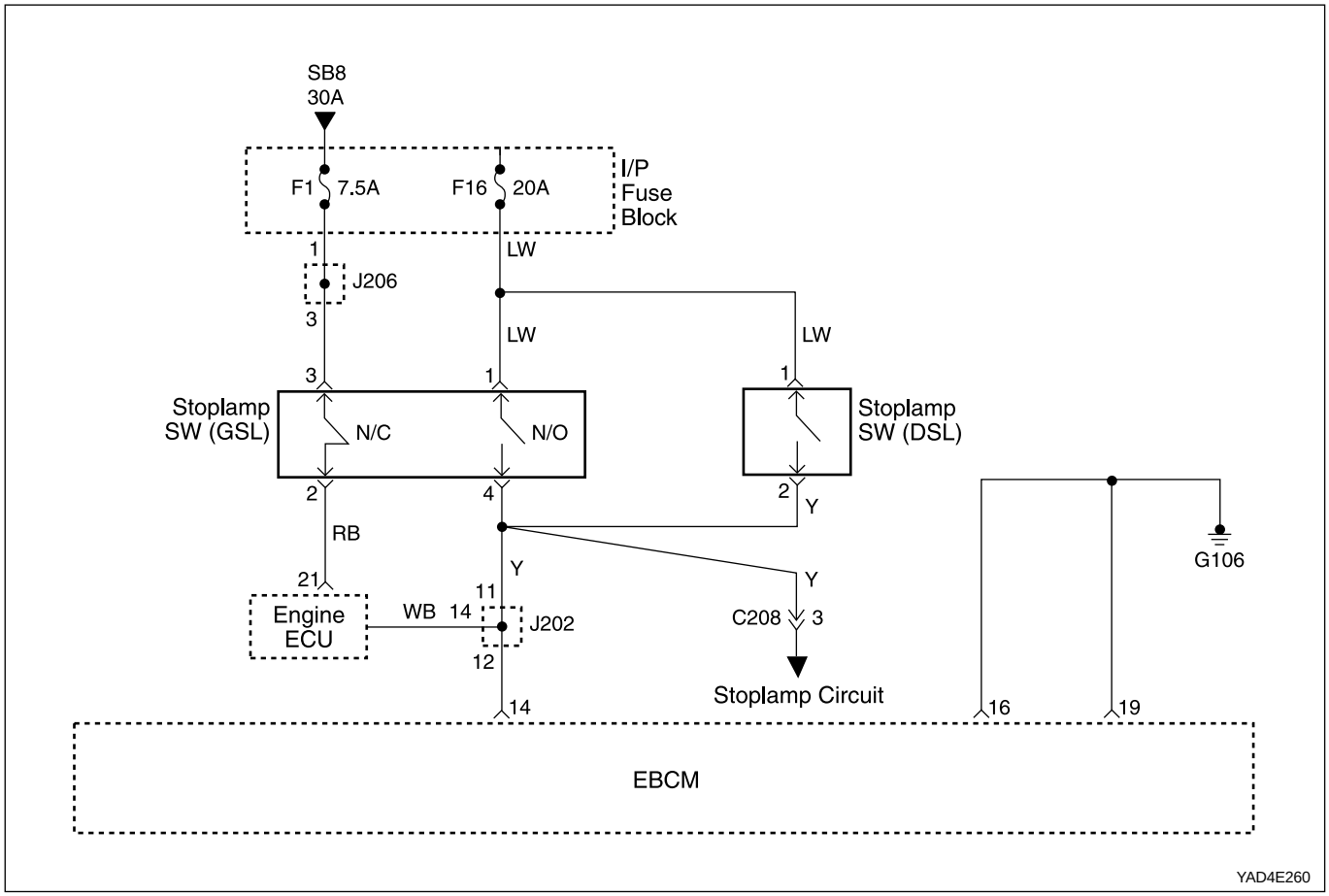
2. This step checks for poor connection.
5. This step checks for the motor relay.
13. This step checks for the hydraulic modulator.

Diagnostic Aids

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to do so may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

DTC 110 - Pump Motor or Pump Motor Relay Fault

Step	Action	Value	Yes	No
1	1. Use a scan tool to clear all DTCs. 2. Road test the vehicle. Does DTC 110 set again?	-	Go to Step 3	Go to Step 2
2	1. Check all system wiring harness connectors and terminals, especially the electronic brake control module (EBCM), for any problem that could cause an intermittent condition. 2 Repair any intermittent problem found. Is the repair complete?	-	System OK	-
3	Check fuse SB2. Is fuse SB2 blown?	-	Go to Step 4	Go to Step 5
4	1. Check for a short circuit and repair it, if necessary. 2. Replace fuse SB2. Is the repair complete?	-	System OK	-
5	1. Disconnect the motor relay. 2. Check the resistance between the motor relay connector terminal 17 and terminal 18 of EBCM. Is the resistance equal to the specified value?	11 - 14 V	Go to Step 7	Go to Step 6
6	Repair the open circuit between the motor relay connector terminal 17 and fuse SB2 of EBCM. Is the repair complete?	-	System OK	-
7	1. Turn the ignition to ON. 2. Check the voltage between the motor relay connector terminal 15 and ground of EBCM. Is the voltage equal to the specified value?	11 - 14 V	Go to Step 9	Go to Step 8
8	1. Repair the open circuit between the motor relay connector terminal 87 and terminal 14 of hydraulic modulator. 2. Road test the vehicle Does DTC 110 clear?	-	System OK	Go to Step 9
9	1. Replace the hydraulic modulator/EBCM. 2. Road test the vehicle Does DTC 110 clear?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 161 - STOPLAMP SWITCH FAULT

Circuit Description

When the brake pedal is pressed, the contacts on the brake light switch close to illuminate the brake lights. Battery voltage is also applied to terminal 14 of the electronic brake control module (EBCM), which signals the ABS controller that the brakes are applied and ABS may be needed. Without this, signals from a wheel speed sensor that may indicate the need for ABS intervention are questionable. When the brake pedal is not pressed, the EBCM terminal 14 is grounded through the stoplamps.

Diagnosis

This procedure will check whether there is no output or constant output from the stoplamp switch and will determine the cause as a faulty switch or a problem in the circuitry.

Cause

- The ground connection or the positive connection at the EBCM has failed.
- There is an open, short to ground, of short to positive in the vehicle wiring.
- The stoplamp switch has failed.

Action Taken When the DTC Sets

The system records a DTC 161. ABS operation is not disabled.

Test description

The number(s) below refer to step(s) on the diagnostic table.

12. This step begins the process of troubleshooting stoplamps that are always on.

Diagnostic Aids

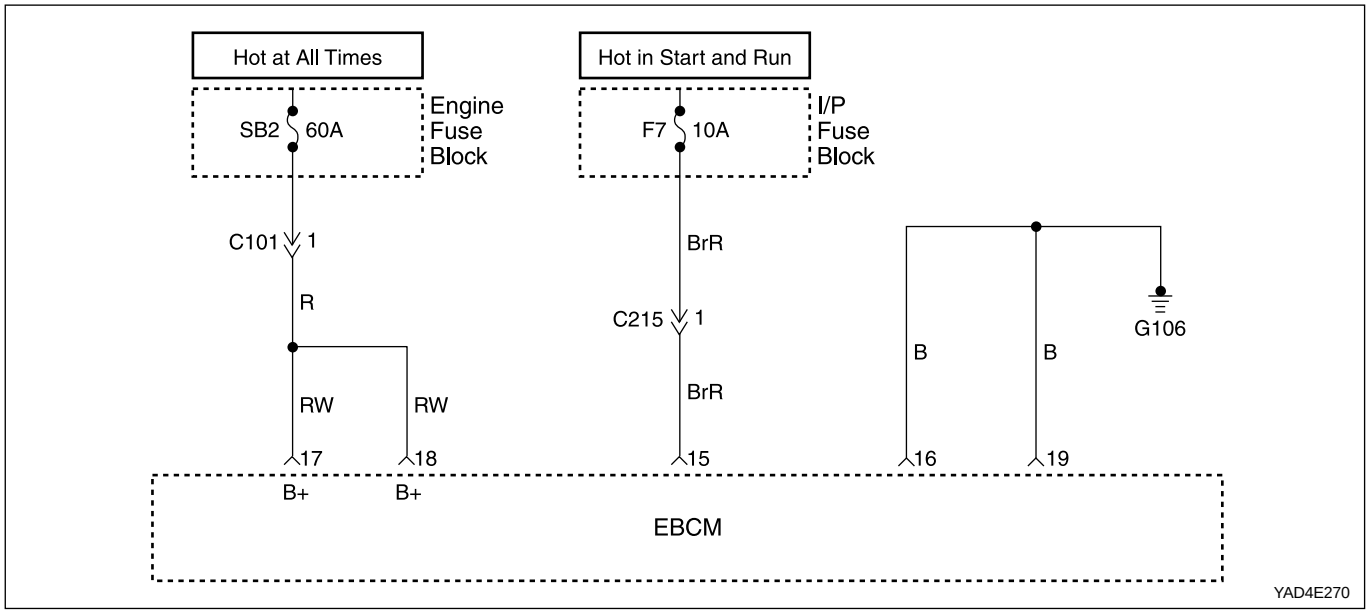
Inspect the wiring and the connectors carefully and thoroughly. Failure to do so could result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

DTC 161 - Stoplamp Switch Fault

Step	Action	Value	Yes	No
1	Observe the stoplamps when the brakes are applied. Do the stoplamps turn on?	-	Go to Step 12	Go to Step 2
2	Check fuse SB8. Is fuse SB8 blown?	-	Go to Step 3	Go to Step 4
3	1. Check for a short circuit and repair it, if necessary. 2. Replace fuse SB8. Is the repair complete?	-	System OK	-
4	Check the voltage at fuse SB8. Is the voltage equal to the specified value?	11 - 14 V	Go to Step 6	Go to Step 5
5	Repair the power supply circuit for fuse SB8. Is the repair complete?	-	System OK	-
6	Check the voltage at fuse F16. Is fuse F16 blown?	-	Go to Step 7	Go to Step 8
7	1. Check for a short circuit between terminal SB8 and fuse F16 in the I/P fuse block and repair it, if necessary. 2. Replace fuse F16. Is the repair complete?	-	System OK	-
8	Check the voltage at terminal 1 of the stoplamps switch. Is the voltage equal to the specified value?	11 - 14 V	Go to Step 10	Go to Step 9
9	Repair the open circuit between fuse F16 and terminal 1 of the stoplamp switch. Is the repair complete?	-	System OK	-
10	With the brakes applied, check the voltage at terminal 2 or 4 of the stoplamp switch. Is the voltage equal to the specified value?	11 - 14 V	Go to Step 12	Go to Step 11
11	Replace the stoplamp switch. Is the repair complete?	-	System OK	-
12	1. Disconnect the electronic brake control module (EBCM) connector. 2. Visually inspect the EBCM and its connector for damaged pins or terminals. Are there any damaged pins or terminals?	-	Go to Step 13	Go to Step 14
13	Repair the damaged pins or terminals. Is the repair complete?	-	System OK	-
14	1. With the EBCM connector disconnected, applied the brake. 2. Check the voltage at terminal 14 of the EBCM. Is the voltage equal to the specified value?	11 - 14 V	Go to Step 16	Go to Step 15
15	Repair the open circuit between 1 of the stoplamp switch and terminal 14 of the EBCM connector. Is the repair complete?	-	System OK	-
16	With the EBCM disconnected, use an ohmmeter to measure the resistance between ground and terminal 16 of the EBCM connector. Is the resistance equal to the specified value?	$\approx$ 0 Ω	Go to Step 18	Go to Step 17

DTC 161 - Stoplamp Switch Fault (Cont'd)

Step	Action	Value	Yes	No
17	Repair the open circuit between ground and terminal 14 of the EBCM. Is the repair complete?	-	System OK	-
18	Replace the ABS unit. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 800 - LOW VOLTAGE FAULT

Circuit Description

Proper operation of the electronic brake control module (EBCM) requires a certain minimum voltage. The EBCM monitors the ignition feed circuit to determine if the voltage falls below a minimum level.

Diagnosis

This test checks for battery output, proper grounding, blown fuses, faulty ignition switch, and problems in the circuitry.

Cause

- The battery is defective.
- There is a defective ground connection.
- A connector is damaged.
- A wire is broken or shorted.
- A fuse is blown.
- The ignition switch is malfunctioning.

Action Taken When the DTC Sets

ABS action is disabled during the period of low voltage, and the ABS warning lamp is ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC 800.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step determines whether there is voltage at the battery and at the high current source.
7. This step checks for voltage at the ignition 1 source.
15. This step begins the check for voltage at the EBCM end of the ABS harness.

Diagnostic Aids

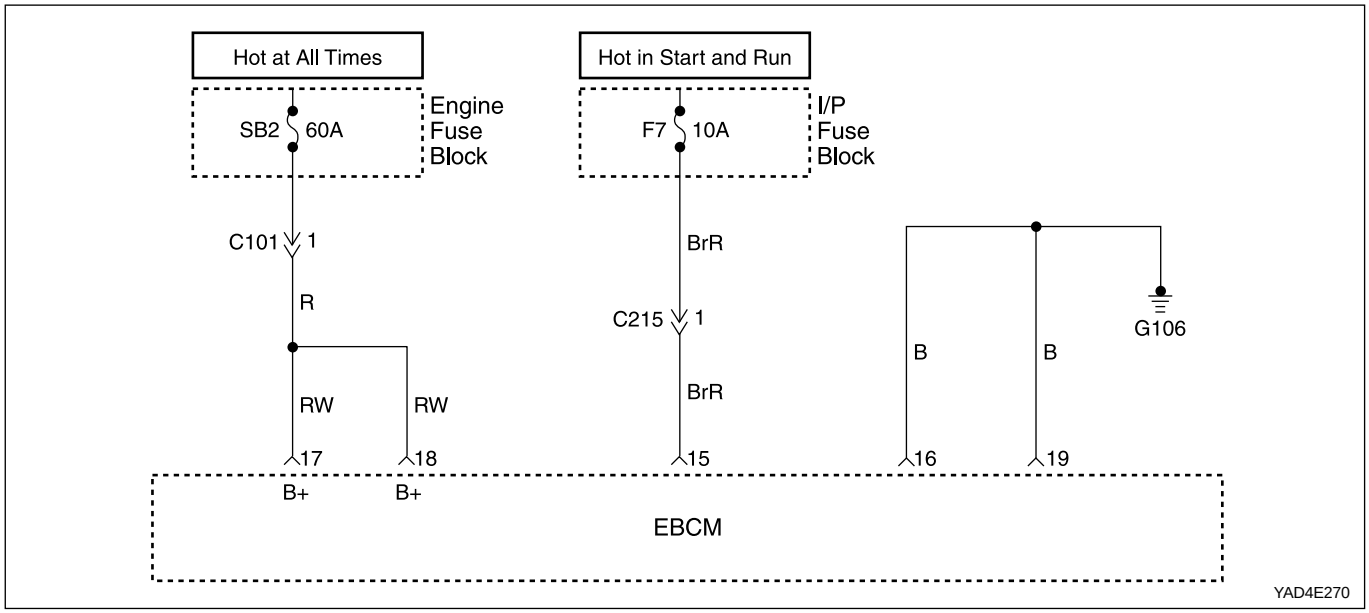
It is very important to perform a thorough inspection of the wiring and the connectors. Failure to do so may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

DTC 800 - Low Voltage Fault

Step	Action	Value	Yes	No
1	Check the voltage at the battery. Is the voltage within the specified value?	11 - 14 V	Go to Step 3	Go to Step 2
2	Charge or replace the battery, as required. Is the repair complete?	-	System OK	-
3	Check fuse SB2 in the engine fuse block. Is the fuse blown?	-	Go to Step 4	Go to Step 7
4	1. Replace fuse SB2. 2. Turn the ignition to ON. Does the fuse blow again?	-	Go to Step 5	Go to Step 6
5	1. Turn the ignition to OFF. 2. Trace the wires in the ABS wiring harness from terminal SB2 at the engine fuse block to the terminal 17, 18 in EBCM. 3. Repair any short circuit found along this path. Is the repair complete?	-	System OK	-
6	1. Turn the ignition to OFF. 2. Install the scan tool. 3. Clear all DTCs. 4. Road test the vehicle. Does DTC 800 reset?	-	System OK	-
7	Check terminal 1 in the C101 connector. Is the connection good?	-	Go to Step 8	Go to Step 10
8	Repair the terminal. Is the repair complete?	-	System OK	Go to Step 9
9	1. Turn the ignition to OFF. 2. Install the scan tool. 3. Clear all DTCs. 4. Rood test the vehicle. Does DTC 800 reset?	-	System OK	-
10	Check fuse F7 in the I/P fuse block. Is fuse F7 blown?	-	Go to Step 11	Go to Step 14
11	1. Replace fuse F7. 2. Turn the ignition to ON. Does fuse F7 blow again?	-	Go to Step 12	Go to Step 13
12	1. Turn the ignition to OFF. 2. Trace the WHT/RED wires in the ABS wiring harness from fuse F7 to terminal 15 of the EBCM connector. 3. Repair any short circuit found along this path. Is the repair complete?	-	System OK	-
13	1. Turn the ignition to OFF 2. Install the scan tool. 3. Clear all DTCs. 4. Rood test the vehicle. Does DTC 800 reset?	-	System OK	-

DTC 800 - Low Voltage Fault (Cont'd)

Step	Action	Value	Yes	No
14	1. Disconnect the connector from the EBCM. 2. Turn the ignition to ON. 3. Check the voltage between ground and terminal 17, and between ground and terminal 18. Is the voltage within the specified value?	11 - 14 V	Go to Step 16	-
15	1. Turn the ignition to OFF. 2. Trace the WHT/RED wires between terminals 17 and 18 of the EBCM connector to fuse F7 and SB2 in the I/P fuse block. 3. Repair the open in this circuit. Is the repair complete?	-	System OK	-
16	1. Turn the ignition ON. 2. Check the voltage at fuse SB2. Is the voltage within the specified value?	11 - 14 V	Go to Step 18	-
17	Repair the power supply circuit for fuse SB2. Is the repair complete?	-	System OK	Go to Step 17
18	1. Turn the ignition to OFF. 2. Check the resistance between ground and terminals 16 and 19 of the ABS harness EBCM connector. Is the resistance equal to the specified value?	0 Ω	Go to Step 19	-
19	Examine terminals 15, 16, 17, 18 and 19 of the EBCM connector. Is there a defective terminal?	-	Go to Step 20	Go to Step 21
20	Repair the defective terminal or replace the connector or wiring harness, as required. Is the repair complete?	-	System OK	Go to Step 22
21	Repair the defective ground connection. Is the repair complete?	-	System OK	-
22	1. Install the scan tool. 2. Clear all DTCs. 3. Road test the vehicle. Does DTC 800 set again?	-	Go to Step 23	Go to Step 24
23	Replace the ABS unit. Is the repair complete?	-	System OK	-
24	1. Examine the wiring harness and connectors for causes of intermittent problems. 2. Repair any intermittent problem found. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 550 - EBCM INTERNAL FAULT

Circuit Description

The ABS control module performs various diagnostic checks on itself. If it finds a problem, it sets DTC 550.

Diagnosis

This procedure checks whether there is a poor ground connection for the electronic brake control module (EBCM).

Cause

- A connector terminal is corroded.
- The EBCM is malfunctioning.

Action Taken When the DTC Sets

ABS is disabled, and the ABS warning lamp is turned ON. If the failure is intermittent, the control module will enable the system at the next ignition cycle and will store a history DTC 550.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step begins the testing for a poor voltage or ground connection.

Diagnostic Aids

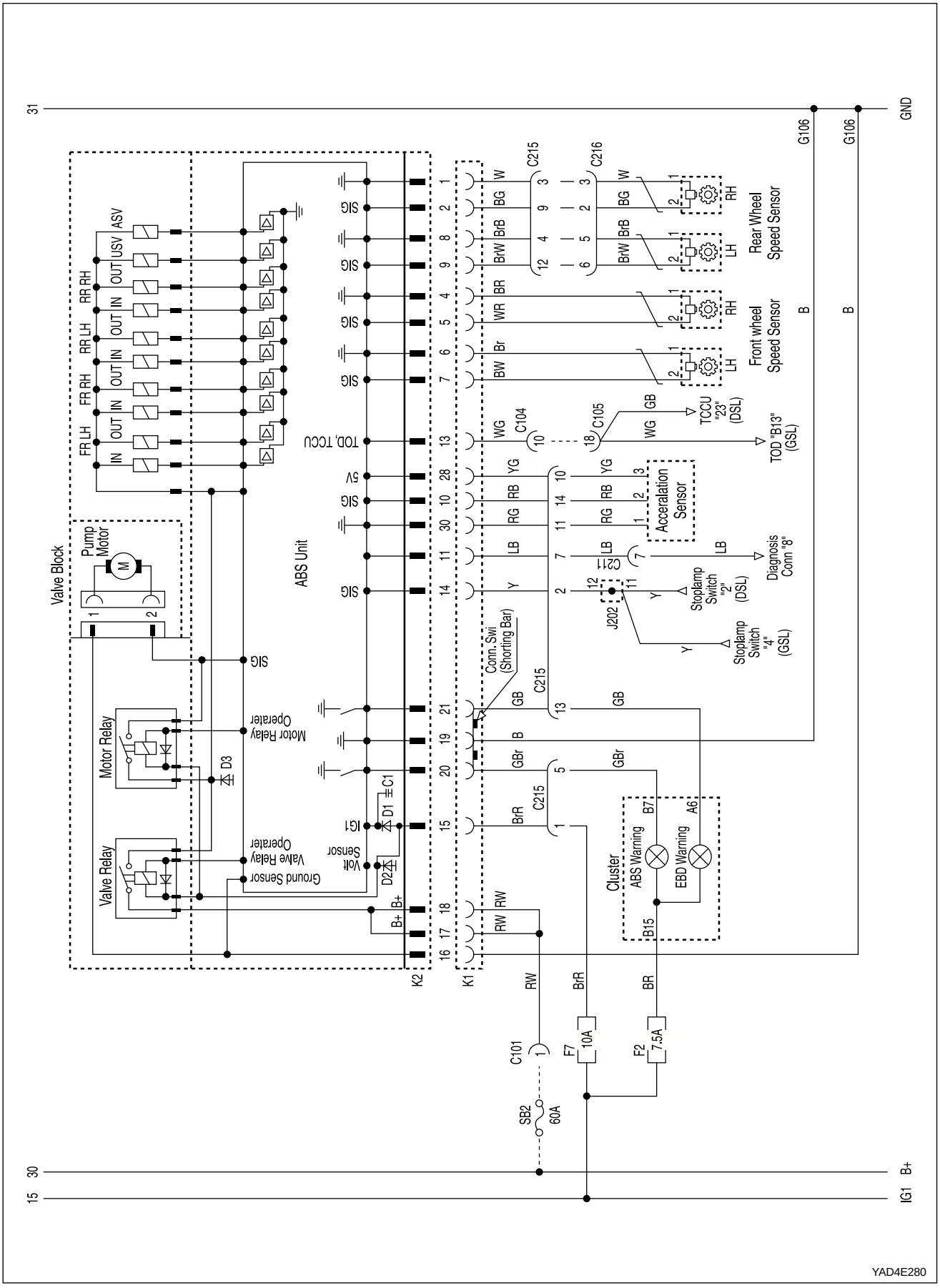
It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

DTC 550 - EBCM Internal Fault

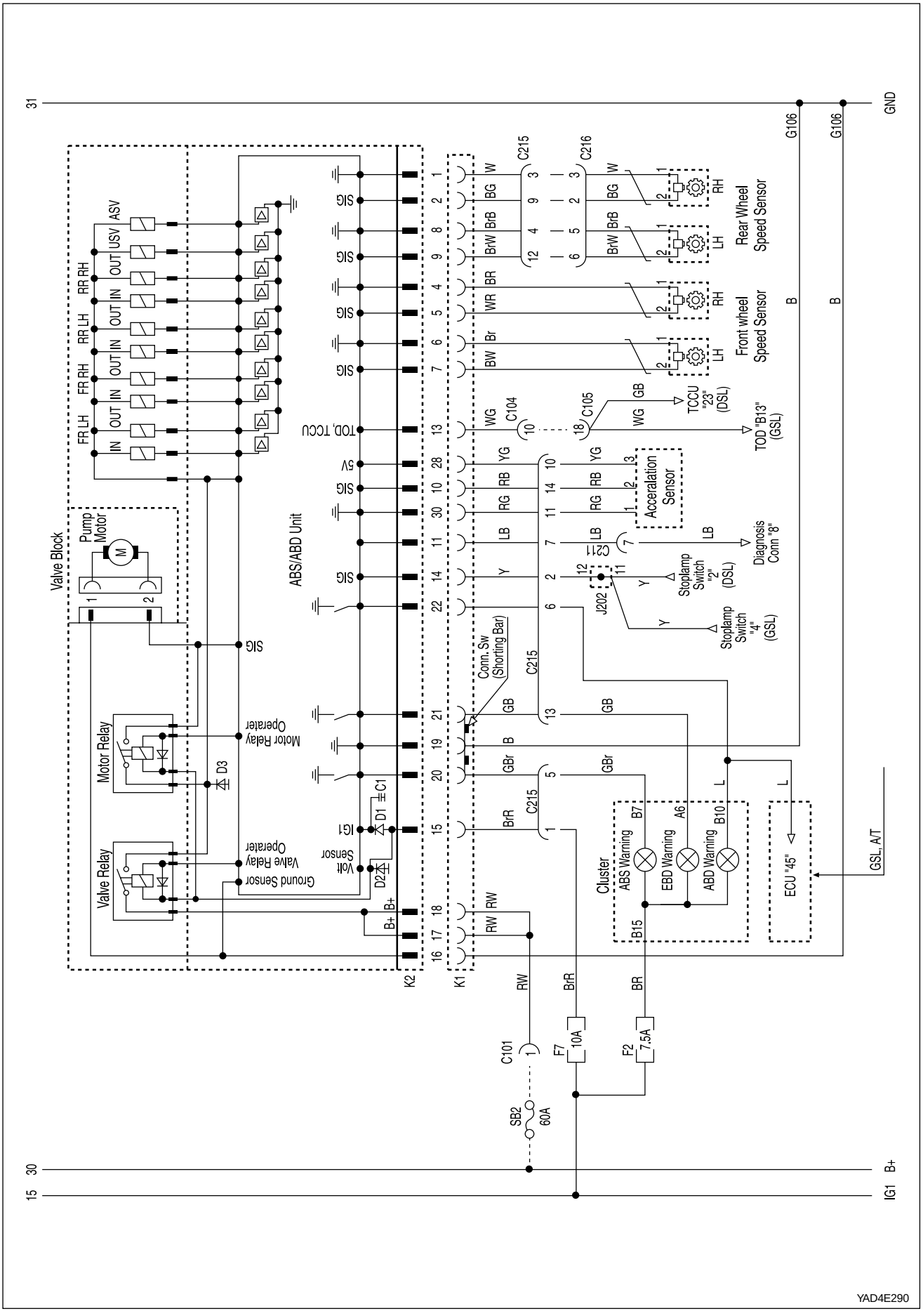
Step	Action	Value	Yes	No
1	Use the scan tool to determine if any other DTCs are set. Are other DTCs set?	-	Go to the applicable Diagnostic Table	Go to Step 2
2	Clear all DTCs and road test the vehicle. Does DTC 550 set again?	-	Go to Step 4	Go to Step 3
3	1. Check all wiring harness connectors and terminals, especially those at the EBCM, for any condition that could cause an intermittent. 2. Repair any problems found. Is the repair complete?	-	System OK	-
4	1. Turn the ignition to OFF. 2. Disconnect the EBCM connector. 3. Turn the ignition to ON. 4. Measure the voltage between ground and terminals 15, 17 and 18 of the EBCM harness connector. Is the voltage equal to the specified value?	11 - 14 V	Go to Step 6	Go to Step 5
5	1. Check the voltage supply and the ground connections to the EBCM. 2. Repair any open or high resistance found. Is the repair complete?	-	System OK	-
6	Check the EBCM connector for any damaged terminals. Are there any problems?	-	Go to Step 7	Go to Step 8
7	Repair any connector problem found. Is the repair complete?	-	System OK	-
8	Clear all DTCs and road test the vehicle. Does DTC 550 set again?	-	Go to Step 9	System OK
9	Replace the EBCM. Is the repair complete?	-	System OK	-

SCHEMATIC AND ROUTING DIAGRAMS

ABS 5.3 CIRCUIT

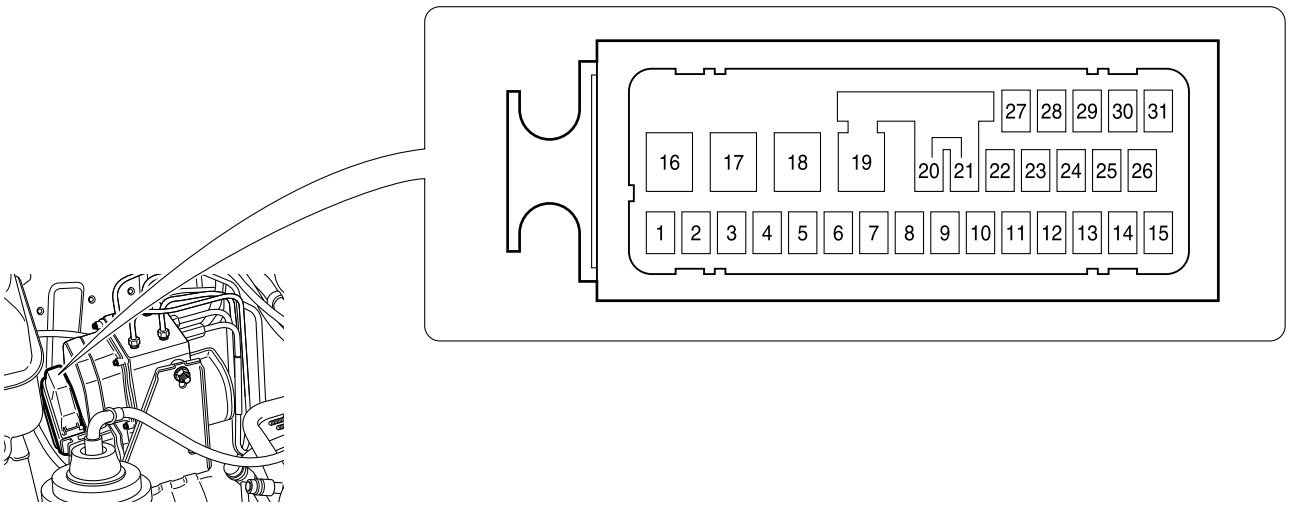


ABD 5.3 CIRCUIT



CONNECTOR END VIEWS

EBCM (HYDRAULIC MODULATOR/UNIT INTEGRATED)



YAD4E300

Pin	Wire Color	Circuit
1	WHT	Right Rear Speed Sensor Ground
2	BLK/GRN	Right Rear Speed Sensor
3	-	Not Used
4	BLK/RED	Right Front Speed Sensor Ground
5	WHT/RED	Right Front Speed Sensor
6	BRN	Left Front Speed Sensor Ground
7	BLK/WHT	Left Front Speed Sensor
8	BRN/BLK	Left Rear Speed Sensor Ground
9	BRN/WHT	Left Rear Speed Sensor
10	RED/BLK	Acceleration Sensor Signal
11	BLU/BLK	Data Link Connector
12	-	Not Used
13	WHT/GRN	TOD
14	YEL	Stoplamp SW
15	BRN/RED	Ignition
16	BLK	Ground

Pin	Wire Color	Circuit
17	RED/WHT	Battery
18	RED/WHT	Battery
19	BLK	Ground
20	GRN/BRN	ABS Warning Lamp
21	GRN/BLK	EBD Warning Lamp
22	BLU	TCS Warning Lamp
23	YEL/GRN	Acceleration Sensor Supply Voltage (5V)
24	-	Not Used
25	-	Not Used
26	-	Not Used
27	-	Not Used
28	RED/GRN	Acceleration Sensor Ground
29	-	Not Used
30	-	Not Used
31	-	Not Used

REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

Caution: Brake Fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.
- Ingestion - consult a physician immediately.

Caution : To help avoid personal injury due to poor braking. DO NOT Tap into the vehicle's brake system to operate a trailer brake system.

Notice : When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread-locking compound will be called out. The correct torque values must be used when installing fasteners that require them. If the above procedures are not followed, parts or system damage could result.

Notice : Use only DOT-3 equivalent hydraulic brake fluid. The use of DOT-5 (silicone) brake fluid is not recommended. Reduced brake performance or durability may result.

Notice : Avoid spilling brake fluid on any the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

Electronic System Service Precautions

Take care to avoid electronic brake control module (EBCM) circuit overloading. In testing for opens or shorts, do not ground or apply voltage to any circuit unless instructed to do so by the diagnostic procedure.

Test circuits only with a high-impedance multi-meter. Never remove or apply power to any control module with the ignition switch in the ON position. Always turn the ignition to the OFF position before removing or connecting battery cables, fuses or connectors.

General Service Precautions

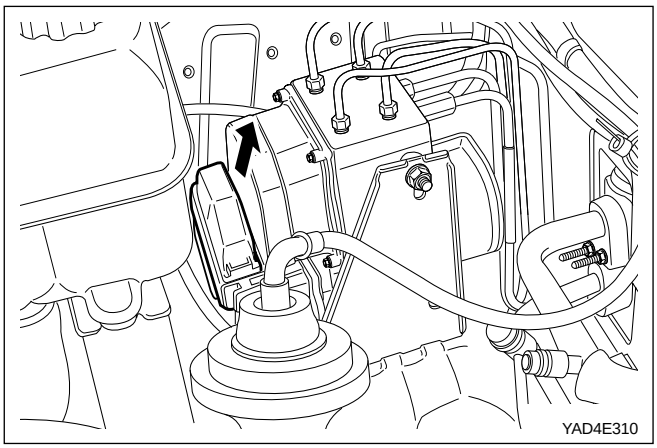
Disconnect the EBCM connector before performing any vehicle welding work using an electric arc welder.

Do not attempt to disassemble any component designated as nonserviceable. The hydraulic modulator and the EBCM can be separated from each other and replaced separately but cannot be serviced. They have no replaceable parts, and there is no replaceable parts, and there is no access to the components they contain.

Bleeding System

Replacement modulators are shipped already filled and bled. In normal procedures requiring removal of the modulator, such as to replace the EBCM, air will not enter the modulator, and normal bleeding will be all that is needed.

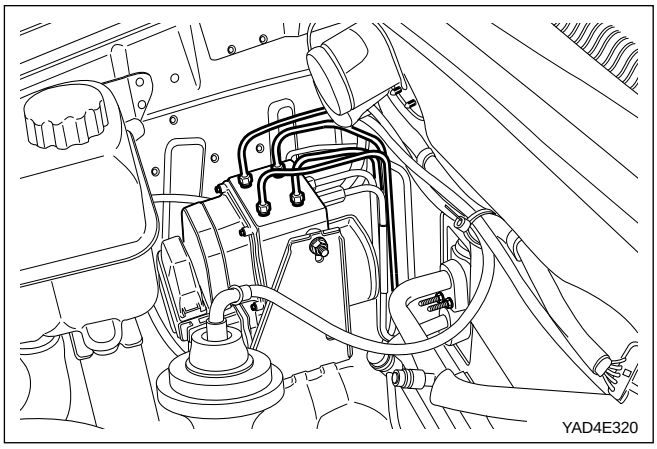
If air enters the hydraulic modulator, or if an unfilled modulator is installed, use the brake bleeding program in the scan tool to bleed the modulator. Manual bleeding of the hydraulic modulator is not possible.


YAD4E310

HYDRAULIC MODULATOR/EBCM ASSEMBLY

Removal & Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the ABS wiring harness connector from its socket on the EBCM.
3. Cover the connector and the socket with shop cloths to protect them from brake fluid.

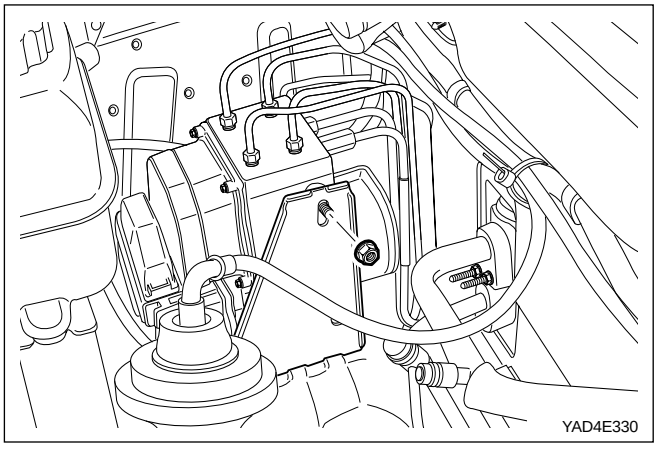

YAD4E320

Notice: Take care not to allow air into the hydraulic modulator. If air gets into the hydraulic unit, it will require a bleeding procedure using a scan tool programmed for the ABS 5.3 system. As long as no air enters the hydraulic unit, a simple bleeding procedure is all the system will require.

4. Remove the brake pipes from the hydraulic modulator.

Installation Notice

Tightening Torque	14 N•m (124 lb-in)


YAD4E330

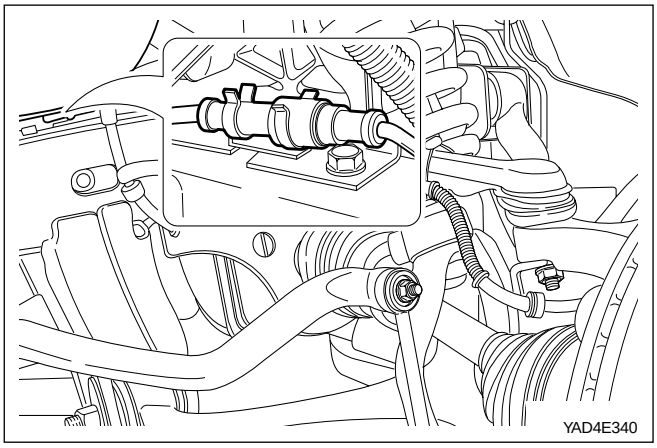
5. Loosen the mounting nuts on the hydraulic unit.
6. Move the brake pipes aside far enough to allow for lifting the ABS 5.3 unit out of the mounting bracket.
7. Cap the brake pipes.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)

- Bleed the hydraulic system.

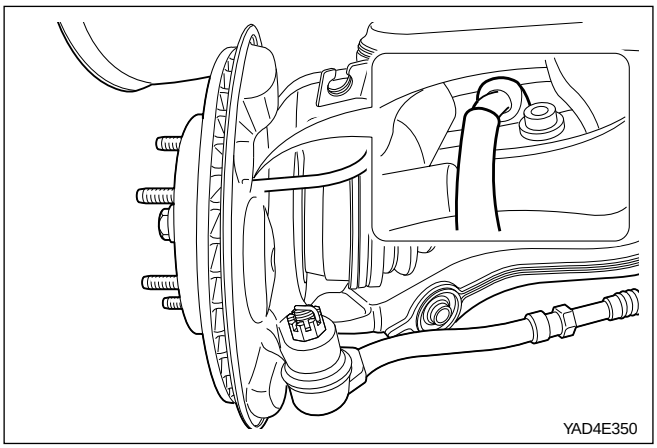
8. Installation should follow the removal procedure in the reverse order.


YAD4E340

FRONT WHEEL SPEED SENSOR

Removal & Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the front wheel speed sensor electrical connector.

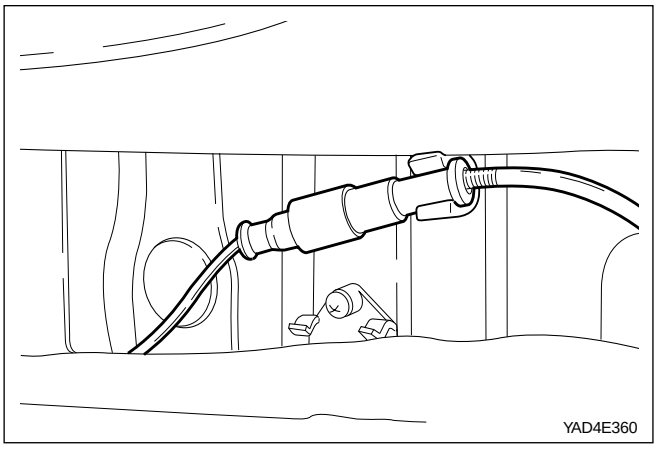

YAD4E350

3. Raise and suitably support the vehicle.
4. Turn the steering wheel to expose the front wheel speed sensor. It is located at the rear of the steering knuckle near tie rod end.
5. Remove the bolt and the front wheel speed sensor from the steering knuckle.

Installation Notice

Tightening Torque	7 N•m (62 lb-in)

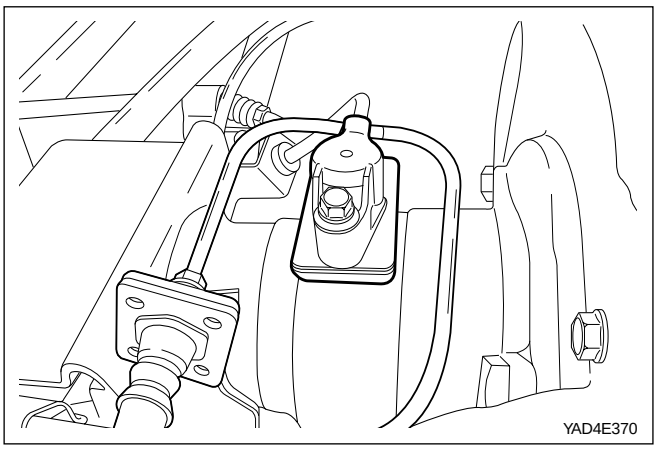
6. Installation should follow the removal procedure in the reverse order.


YAD4E360

REAR WHEEL SPEED SENSOR

Removal & Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the rear wheel speed sensor electrical connector.

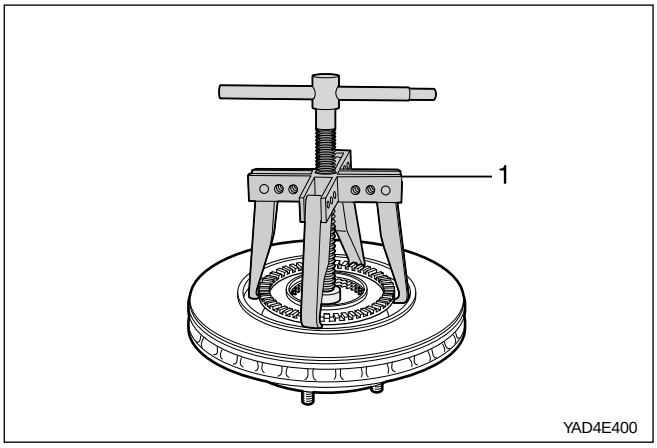

YAD4E370

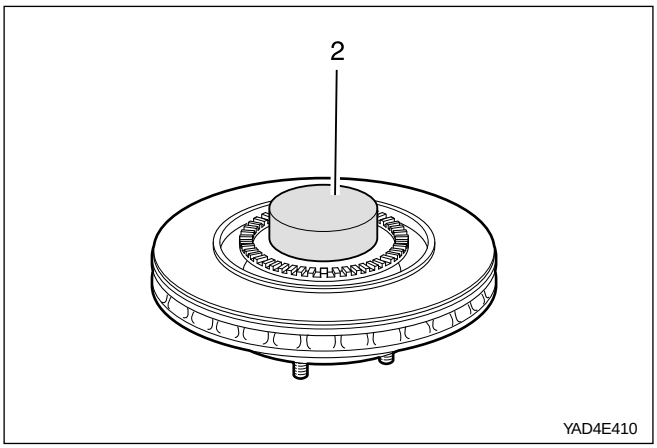
3. Raise and suitably support the vehicle.
4. Remove the rear wheel speed sensor.

Installation Notice

Tightening Torque	7 N•m (62 lb-in)

5. Installation should follow the removal procedure in the reverse order.





UNIT REPAIR

ABS FRONT TOOTH WHEEL

Tool Requires

661 589 16 33 00 ABS Tooth Wheel Puller

Removal Procedure

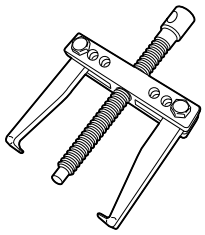
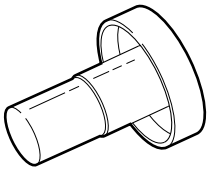
1. Remove the disc brake rotor. Refer to Front Disc Brakes Section.
2. Remove the ABS front toothed wheel using the ABS tooth wheel puller 661 589 16 33 00.

Installation Procedure

1. Install the ABS front toothed wheel using the ABS tooth wheel installer 661 589 17 33 00.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD4E420	**661 589 16 33 00** **ABS Tooth Wheel Puller**
 YAD4E430	**661 589 17 33 00** **ABS Tooth Wheel Installer**

SECTION 5A

AUTOMATIC TRANSMISSION

***CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless* otherwise noted.**

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DESCRIPTION AND OPERATION

BTRA M74 4WD AUTOMATIC TRANSMISSION

The BTR Automotive Model 74 Four Speed Automatic Transmission is an electronically controlled overdrive four speed unit with a lock-up torque converter. The lock-up torque converter results in lower engine speeds at cruise and eliminates unnecessary slippage. These features benefit the customer through improved fuel economy and noise reduction.

	Max. Power (kW)	Configuration
320	160	260 mm Torque Converter-Wide Ratio Gear Set Splined Output for Transfer Case

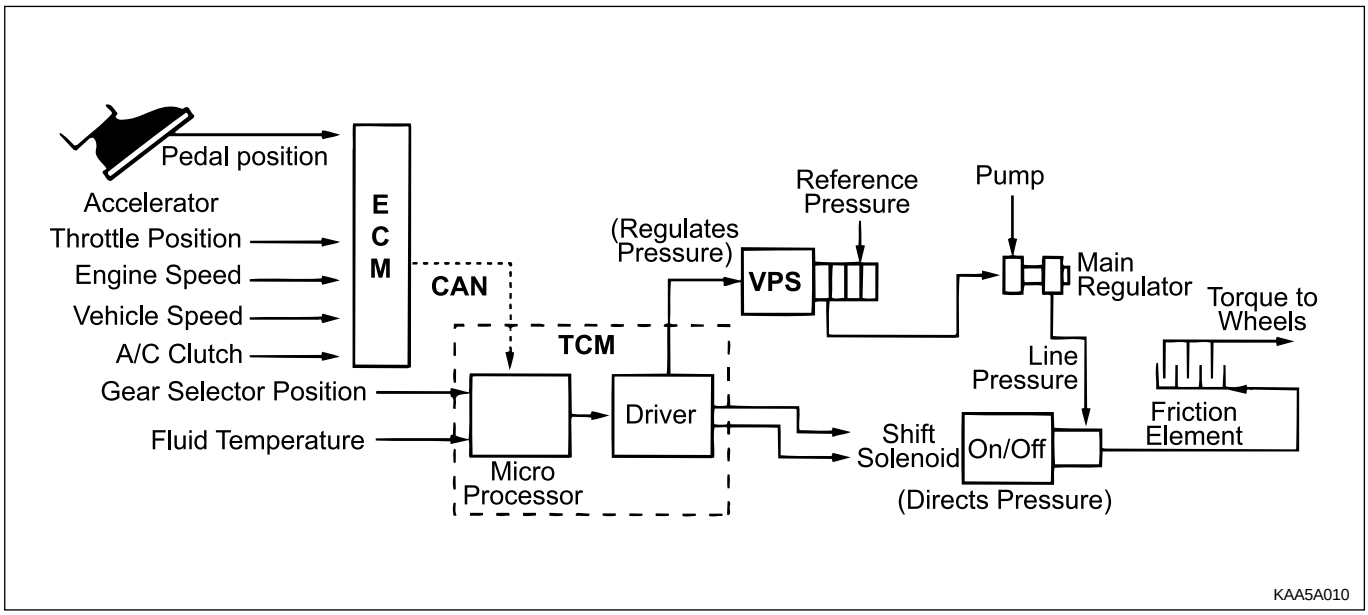
Of primary significance is the Transmission Control Module (TCM) which is a microprocessor based control system.

The TCM utilizes throttle position, rate of throttle opening, engine speed, vehicle speed, transmission fluid temperature, gear selector position and mode selector inputs, and in some applications a Kickdown Switch to control all shift feel and shift schedule aspects.

The TCM drives a single proportional solenoid multiplexed to three regulator valves to control all shift feel aspects. The output pressure of this solenoid is controlled as a function of transmission fluid temperature to maintain consistent shift feel throughout the operating range.

Shift scheduling is highly flexible, and several independent schedules are programmed depending on the vehicle.

Typically the NORMAL schedule is used to maximize fuel economy and driveability, and a POWER schedule is used to maximize performance. WINTER schedule is used to facilitate starting in second gear.



OPERATORS INTERFACES

There are three operator interfaces as the following;

- Gear Shift Control Lever
- Driving Mode Selector
- Indicator Light

Gear Shift Control lever

The transmission uses a conventional shift control lever. The gear shift control lever can be moved from one position to another within the staggered configuration of the shift control lever gate to positively indicate the gear selection.

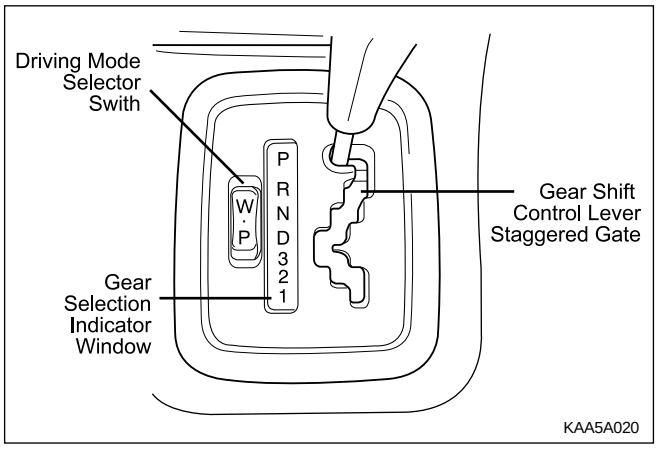
- P - Park position prevents the vehicle from rolling either forward or backward by locking the transmission output shaft. The inhibitor switch allows the engine to be started. For safety reasons, the parking should be used in addition to the park position. Do not select the Park position until the vehicle comes to a complete stop because it mechanically locks the output shaft.
- R - Reverse allows the vehicle to be operated in a rearward direction. The inhibitor switch enables reverse lamp operation.
- N - Neutral allows the engine to be started and operated while driving the vehicle. The inhibitor switch

allows the engine to be started. There is no power transferred through the transmission in Neutral. But the final drive is not locked by the parking pawl, so thewheels are free to rotate.

- D - Overdrive range is used for all normal driving conditions. 4th gear (overdrive gear) reduces the fuel consumption and the engine noise. Engine braking is applied with reduced throttle.

  First to second (1 → 2), first to third (1 → 3), second to third (2 → 3), second to fourth (2 → 4), third to fourth (3 → 4), fourth to third (4 → 3), fourth to second (4 → 2), third to second (3 → 2), third to first (3 → 1) and second to first (2 → 1) shifts are all available as a function of vehicle speed, throttle position and the time change rate of the throttle position.

  Downshifts are available for safe passing by depress-ing the accelerator. Lockup clutch may be enabled in 3rd and 4th gears depending on vehicle type.
- 3 - Manual 3 provides three gear ratios (first through third) and prevents the transmission from operating in 4th gear. 3rd gear is used when driving on long hill roads or in heavy city traffic. Downshifts are available by depressing the accelerator.
- 2 - Manual 2 provides two gear ratios (first and second). It is used to provide more power when climbing hills or engine braking when driving down a steep hill or starting off on slippery roads.
- 1 - Manual 1 is used to provide the maximum engine braking when driving down the severe gradients.



Driving Mode Selector

The driving mode selector consists of a driving mode selector switch and indicator light. The driving mode selector is located on the center console and allows the driver to select the driving mode.

The driving modes available to be selected vary with vehicle types. Typically the driver should have the option to select among NORMAL, POWER and WINTER modes.

When NORMAL mode is selected upshifts will occur to maximize fuel economy. When POWER mode is selected, upshifts will occur to give maximum performance and the POWER mode indicator light is switched ON.

When WINTER mode is selected, starting in second gear is facilitated, the WINTER mode indicator light is switched ON and the POWER mode indicator light is switched OFF.

Indicator Light

The indicator light is located on the instrument panel.

- Auto shift indicator light comes ON when the ignition switch ON and shows the gear shift control lever posi-tion.
- POWER mode indicator light comes ON when the POWER mode is selected and when the kickdown switch is depressed.
- WINTER mode indicator light comes ON when the WINTER mode is selected.

CONTROL SYSTEMS

BTRA M74 4WD automatic transmission consists of two control systems. One is the electronic control system that monitors vehicle parameters and adjusts the transmission performance. Another is the hydraulic control system that implements the commands of the electronic control system commands.

ELECTRONIC CONTROL SYSTEM

The electronic control system comprises of sensors, a TCM and seven solenoids. The TCM reads the inputs and activates the outputs according to values stored in Read Only Memory (ROM).

The TCM controls the hydraulic control system. This control is via the hydraulic valve body, which contains seven electromagnetic solenoids. Six of the seven solenoids are used to control the line pressure, operate the shift valves and the torque converter lock-up clutch, and to turn ON and OFF the two regulator valves that control the shift feel.

The seventh solenoid is the proportional or Variable Pressure Solenoid (VPS) which works with the two regulator valves to control shift feel.

Transmission Control Module (TCM)

The TCM is an in-vehicle micro-processor based transmission management system. It is mounted under the driver's side front seat in the vehicle cabin.

The TCM contains:

- Processing logic circuits which include a central microprocessor controller and a back-up memory system.
- Input circuits.

- Output circuits which control external devices such as the Variable Pressure Solenoid (VPS) driver, On/ Off solenoid drivers, a diagnostics output and the driving mode indicator light.

Processing Logic

Shift schedule and calibration information is stored in an Erasable Programmable Read Only Memory (EPROM).

Throttle input calibration constants and the diagnostics information are stored in Electrically Erasable Programmable Read Only Memory (EEPROM) that retains the memory even when power to the TCM is disconnected. TCM continuously monitors the input values and uses these, via the shift schedule, to determine the required gear state. At the same time it monitors, via the solenoid outputs, the current gear state, whenever the input conditions change such that the required gear state is different to the current gear state, the TCM initiates a gear shift to bring the two states back into line.

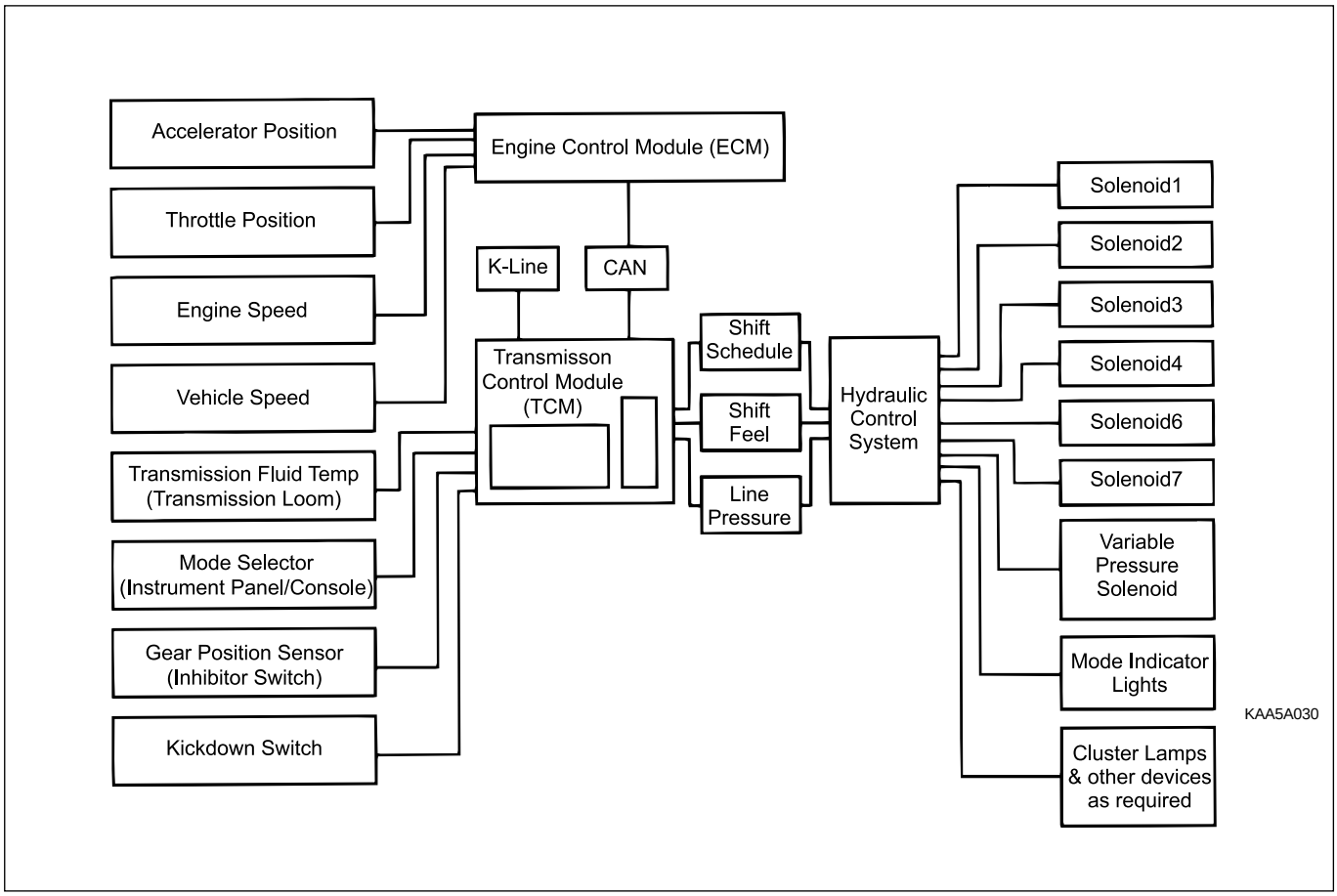
Once the TCM has determined the type of gearshift required the TCM accesses the shift logic, estimates the engine torque output, adjusts the variable pressure solenoid ramp pressure then executes the shift.

The TCM continuously monitors every input and output circuit for short or open circuits and operating range.

When a failure or abnormal operation is detected the TCM records the condition code in the diagnostics memory and implements a Limp Home Mode (LHM).

The actual limp home mode used depends upon the fail-ure detected with the object to maintain maximum drive-ability without damaging the transmission. In general input failures are handled by providing a default value. Output failures, which are capable of damaging the transmission, result in full limp mode giving only third or fourth gear and reverse. For further details of limp modes and memory retention refer to the Diagnostic Trouble Code Diagnosis Section.

The TCM is designed to operate at ambient temperatures between - 40 and 85 °C (- 40 and 185 °F). It is also protected against electrical noise and voltage spikes, however all the usual precautions should be observed, for example when arc welding or jump starting.



TCM Inputs

To function correctly, the TCM requires engine speed, vehicle speed, transmission fluid temperature, throttle position, gear position and Kickdown Switch inputs to determine the variable pressure solenoid current ramp and on/off solenoid states. This ensures the correct gear selection and shift feel for all driving conditions.

The inputs required by the TCM are as follows;

- Engine Speed

  The engine speed signal is derived from the Controller Area Network (CAN) via Engine Control Module (ECM).

- Vehicle Speed

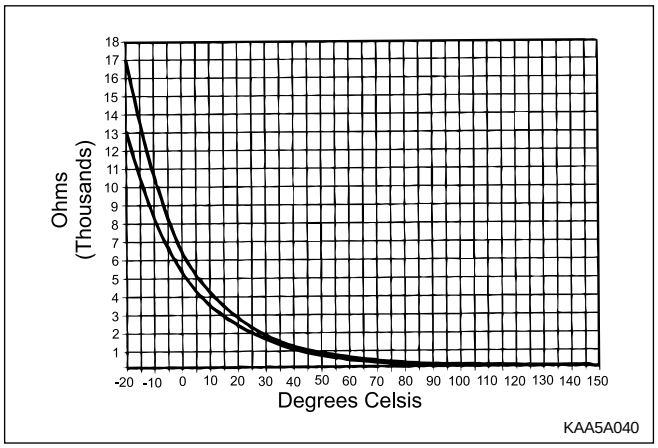
  The vehicle speed sensor, which is located in the transfer case, sends the output shaft speed signal to the Engine Control Module (ECM). The information is then transferred to the TCM via the CAN.

- Transmission Fluid Temperature

  The transmission fluid temperature sensor is a thermistor located in the solenoid wiring loom within the valve body of the transmission. This sensor is a typical Negative Temperature Coefficient (NTC) resistor with low temperatures producing a high resistance and high temperatures producing a low resistance.

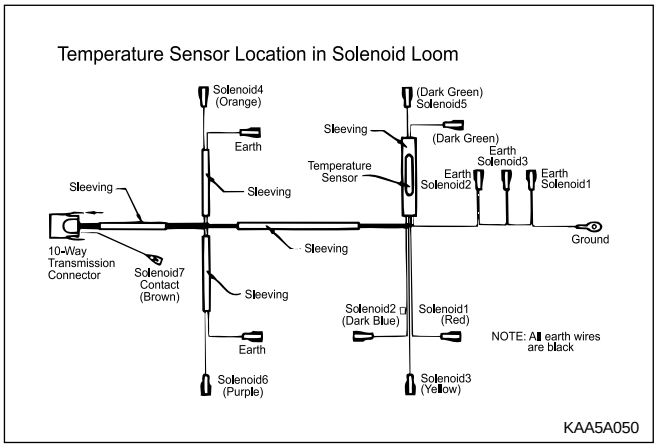
  If the transmission fluid temperature exceeds 135 °C (275 °F), the TCM will impose converter lock-up at lower vehicle speeds and in some vehicles flashes the mode indicator light. This results in maximum oil flow through the external oil cooler and eliminates slippage in the torque converter. Both these actions combine to reduce the oil temperature in the transmission.

Temperature (°C)	Resistance (Ohms)	
	Minimum	Maximum
-20	13,638	17,287
0	5,177	6,616
20	2,278	2, 723
100	117	196
135 (Overheat Mode Threshold)	75	85



Pin No. Codes and colors in Solenoid Loom

Pin No.	Wire Color	Connects to
1	Red	Solenoid 1
2	Blue	Solenoid 2
3	Yellow	Solenoid 3
4	Orange	Solenoid 4
5	Green	Solenoid 5
6	Violet	Solenoid 6
7	Brown	Solenoid 7
8	Green	Solenoid 5
9	White	Temperature Sensor
10	Red	Temperature Sensor



Throttle Position Sensor

Gasoline Engine:

The throttle position signal is sent from the ECM to the TCM via the CAN. Refer to Engine Section for further details.

Diesel Engine:

The throttle position sensor(TPS) is a resistance potentiometer which is installed on the injection pump.

It transmits a signal to the TCU proportional to the throttle plate opening.

The potentiometer is connected to the TCU by three wires: 5 volts positive supply, earth and variable wiper voltage.

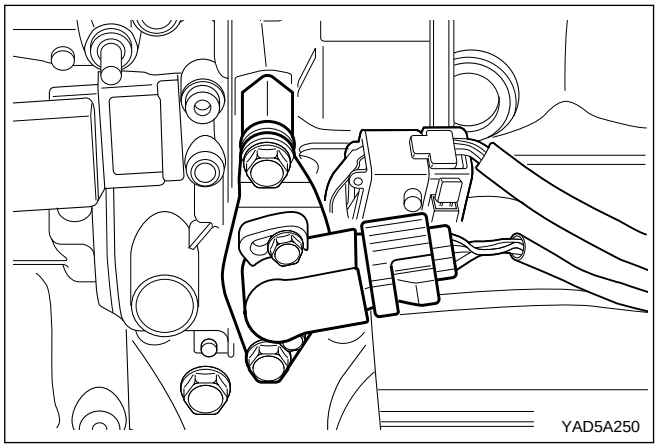
Throttle voltage adjustments are as follows:

- Closed throttle voltage is 0.2 V to 1.0 V.
- Wide open throttle voltage is 3 V to 4.5 V.

These measurements are taken between pins 1 and 3 of the TPS connentor.

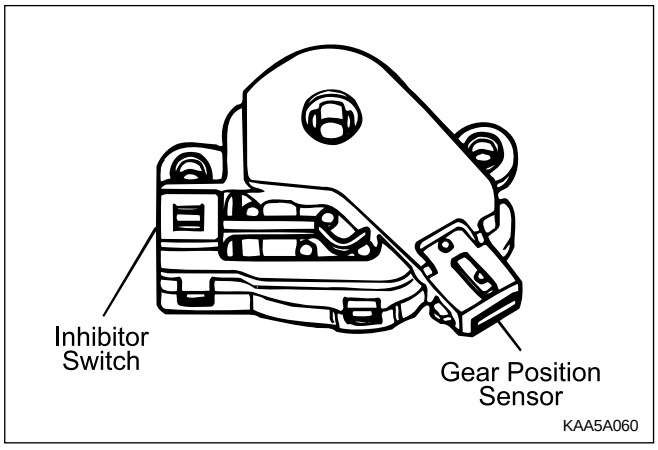
Maintaining good shift feel through the transmission life span is dependant on having an accurate measure of the engine throttle position. To achieve this the TCU continuously monitors the maximum and minimum throttle potentiometer voltages and, if a change occurs, stores the new voltage values.

However these limits will be lost and will require relearning should a new TCU be installed, or the throttle calibration data is cleared by the execution of a particular sequence. This last instance depends on the installation, and reference should be made to the Diagnostics Section of this manual. The relearning will happen automatically.



Gear Position Sensor

The gear position sensor is incorporated in the inhibitor switch mounted on the side of the transmission case.



The gear position sensor is a multi-function switch providing three functions;

- Inhibit starting of the vehicle when the shift lever is in a position other than Park or Neutral
- Illuminate the reverse lamps when Reverse is selected
- Indicate to the TCM which lever position has been selected by way of a varying resistance.

Readings for Resistance / Shift Lever Positions

Shift Lever Position	Resistance (kΩ)
Manual 1	1 ~ 1.4
Manual 2	21.8 ~ 2.2
Manual 3	3 3 ~ 3.4
Drive	4.5 ~ 4.9
Neutral	6.8 ~ 7.2
Reverse	10.8 ~ 11.2
Park	18.6 ~ 19

Kickdown Switch

The Kickdown Switch is used to signal the TCM that the driver has pressed the acclerator to the floor and requires a kickdown shift. When this switch is used, the POWER light comes ON and the POWER shift pattern is used.

Diagnostic Inputs

The diagnostic control input or K-line is used to initiate the outputting of diagnostic data from the TCM to a diagnostic test instrument. This input may also be used to clear the stored fault history data from the TCM's retentive memory. Connection to the diagnostic input of the TCM is via a connector included in the vehicle's wiring harness or computer interface.

Battery Voltage Monitoring Input

The battery voltage monitoring input is connected to the positive side of the battery. This signal is taken from the main supply to the TCM.

If the battery voltage at the TCM falls below 11.3 V, the transmission will adopt a low voltage mode of operating in which shifts into first gear are inhibited. All other shifts are allowed but may not occur because of the reduced voltage. This condition normally occurs only when the battery is in poor condition.

If the battery voltage is greater than 16.5 V, the transmission will adopt limp home mode and all solenoids are turned OFF.

When system voltage recovers, the TCM will resume normal operation after a 30 seconds delay period.

TCM Outputs

The outputs from the TCM are supplied to the components described below;

- Solenoids
- Mode Indicator Light

Solenoids

The TCM controls seven solenoids. Solenoids 1 to 6 (S1 to S6) are mounted in the valve body, while Solenoid 7 (S7) is mounted in the pump cover.

- Solenoid 1 and 2: S1 and S2 are normally open ON/OFF solenoids that set the selected gear. These solenoids determine static gear position by operating the shift valves. Note that S1 and S2 solenoids also send signal pressure to allow or prohibit rear band engagement.
- Solenoid 3 and 4: S3 and S4 are normally open ON/OFF solenoids that combine to control shift quality and sequencing. S3 switches the clutch regulator valve OFF or ON. S4 switches the front band regulator valve OFF or ON. S5 also provides the signal pressure for the converter clutch regulator valve.
- Solenoid 5: S5 is a variable pressure solenoid that ramps the pressure during gear changes. This solenoid provides the signal pressure to the clutch and band regulator, thereby controlling the shift pressures. S5 also provides the signal pressure for the converter clutch regulator valve.
- Solenoid 6: S6 is a normally open ON/OFF solenoid that sets the high/low level of line pressure. Solenoid OFF gives high pressure.
- Solenoid 7: S7 is a normally open ON/OFF solenoid that controls the application of the converter clutch. Solenoid ON activates the clutch.

Solenoid Logic for Static Gear States

Gear	S1	S2
1st	ON	ON
2nd	OFF	ON
3rd	OFF	OFF
4th	ON	OFF
Reverse	OFF	OFF
Neutral	OFF	OFF
Park	OFF	OFF

Solenoid Operation during Gearshifts

Shift	To Initiate Shift	Typical S5 Current Ramp	To Complete Shift
1-2	S1 OFF S4 ON	750mA to 600mA	S4 OFF
1-3	S1 OFF S2 OFF S3 ON S4 ON	850mA to 750mA	S3 OFF S4 OFF
1-4	S2 OFF S3 ON S4 ON	850mA to 750mA	S3 OFF S4 OFF
2-3	S2 OFF S3 ON S4 ON	700mA to 500mA	S3 OFF S4 OFF
3-4	S1 ON S4 ON	750mA to 600mA	S4 OFF
4-3	S4 ON	750mA to 900mA	S1 OFF S4 OFF
4-2	S3 ON	750mA to 950mA	S1 OFF S2 ON S3 OFF
4-1	S3 ON S4 ON	600mA to 1000mA	S2 ON S3 OFF S4 OFF
3-2	S2 ON S4 ON	600mA to 450mA @ 20 kph. 550mA to 400mA @ 60 kph. 800mA to 650mA @ 100 kph.	S4 OFF
3-1	S3 ON S4 ON	700mA to 950mA	S1 ON S2 ON S3 OFF S4 OFF
2-1	S4 ON	800mA to 950mA	S1 ON S4 OFF
Conv. Clutch ON OFF	S7 ON	700mA to 400mA 600mA to 100mA	S7 OFF

Solenoid Valve Symbols

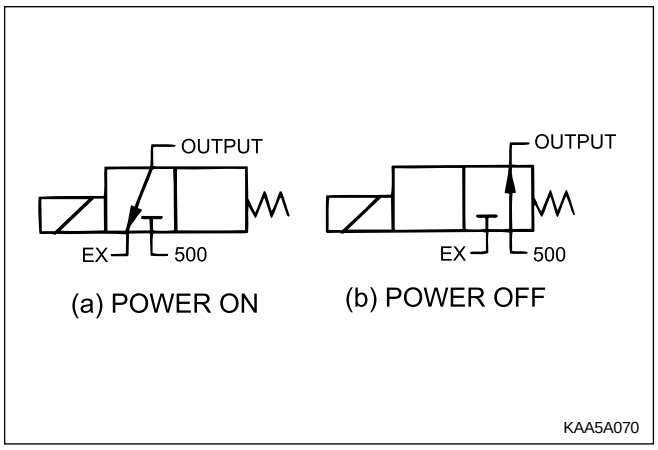
(ON/OFF Solenoids)

The solenoid symbol shown adjacent to each solenoid on the hydraulic system schematics indicates the state of the oil flow through the solenoid valve with the power ON or OFF.

Normally Open (NO) Solenoid

POWER ON: Line 500 port is closed. The output port is open to exhaust at the solenoid valve.

POWER OFF: The exhaust port is closed. The output port is open to line 500.



Variable Pressure Solenoid Multiplexing System

Friction element shifting pressures are controlled by the Variable Pressure Solenoid (VPS).

Line pressure is completely independent of shift pressure and is a function of throttle position, gear state and engine speed.

S5 is a proportional or variable pressure solenoid that provides the signal pressure to the clutch and band regulator valves thereby controlling shift pressures.

VPS pressure is multiplexed to the clutch regulator valve, the band regulator valve and the converter clutch regulator valve during automatic gearshifts.

A variable pressure solenoid produces a hydraulic pressure inversely proportional to the current applied. During a gearshift the TCM applies a progressively increasing or decreasing (ramped) current to the solenoid. Current applied will vary between a minimum oaf 200 mA and a maximum of 1000 mA. Increasing current decreases output (S5) pressure. Decreasing current increases output (S5) pressure.

Line 500 pressure, (approximately 440 to 560 kPa), is the reference pressure for the VPS, and the VPS output pressure is always below line 500 pressure.

When the VPS is at standby, that is no gearshift is taking place, the VPS current is set to 200 mA giving maximum output pressure.

Under steady state conditions the band and clutch regulator valve solenoids are switched OFF.

This applies full Line 500 pressure to the plunger and because Line 500 pressure is always greater than S5 pressure it squeezes the S5 oil out between the regulator valve and the plunger. The friction elements are then fed oil pressure equal to Line 500 multiplied by the amplification ratio.

When a shift is initiated the required ON/OFF solenoid is switched ON cutting the supply of Line 500 to the plunger.

At the same time the VPS pressure is reduced to the ramp start value and assumes control of the regulator valve by pushing the plunger away from the valve. The VPS then carries out the required pressure ramp and the timed shift is completed by switching OFF the ON/ OFF solenoid and returning the VPS to the standby pressure.

This system enables either the band or clutch or both to be electrically controlled for each gearshift.

Mode Indicator Light

Depending on the application, the mode indicator light may be used to indicate the mode that has been selected or if an overheat condition exists. The mode indicator light is usually located on the instrument cluster.

Communication Systems

CAN

The Controller Area Network (CAN) connects various control modules by using a twisted pair of wires, to share common information. This results in a reduction of sensors and wiring. TCM obtains the actual engine speed and throttle position, vehicle speed and accelerator position etc. from ECM via CAN without any additional sensors.

K-Line

The K-line is typically used for obtaining diagnostic information from the TCM. A scan tool with a special interface is connected to the TCM via Data Link Connector (DLC) and all current faults, stored faults, runtime parameters are then available. The stored trouble codes can also be cleared by scan tool.

The K-line can be used for vehicle coding at the manufacturer's plant or in the workshop. This allows for one TCM design to be used over different vehicle mod-els.

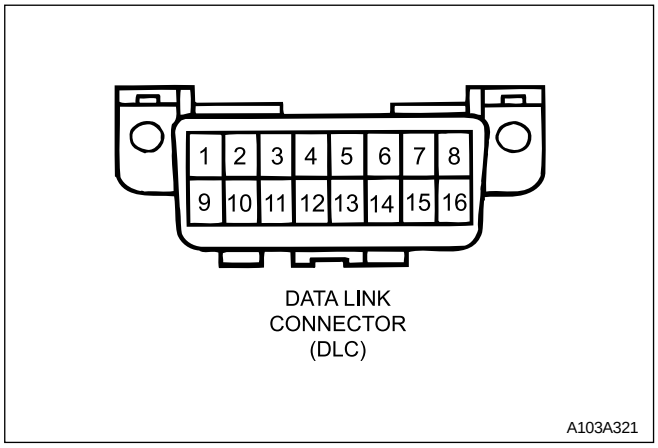
The particular code is sent to the microprocessor via the K-line and this results in the software selecting the correct shift and VPS ramp parameters.

Data Link Connector (DLC)

The Data Link Connector (DLC) is a multiple cavity connector. The DLC provides the means to access the serial data from the TCM.

The DLC allows the technician to use a scan tool to monitor the various systems and display the Diagnostic Trouble Codes (DTCs).

The DLC connector is located within the driver's compartment, directly below the instrument panel on the driver's side.



HYDRAULIC CONTROL SYSTEM

The hydraulic controls are located in the valve body, pump body and main case.

The valve body contains the following;

- Manual valve
- Three shift valves
- Sequence valve
- Solenoid supply pressure regulator valve
- Line pressure control valve
- Clutch apply feed regulator valve
- Band apply feed regulator valve
- Solenoid S1 to S6
- Reverse lockout valve

The pump cover contains the following;

- Primary regulator valve for line pressure
- Converter clutch regulator valve
- Converter clutch control valve
- Solenoid S7

The main case contains the following;

- B1R exhaust valve

All upshifts are accomplished by simultaneously switching on a shift valve(s), switching VPS pressure to the band and/or clutch regulator valve, and then sending the VPS a ramped current. The shift is completed by switching the regulators OFF and at the same time causing the VPS to reach maximum pressure.

All downshifts are accomplished by switching VPS pressure to the band and/or clutch regulator valve and sending a ramped current to the VPS. The shift is completed by simultaneously switching the regulators OFF, switching the shift valves and at the same time causing the VPS to return to stand-by pressure.

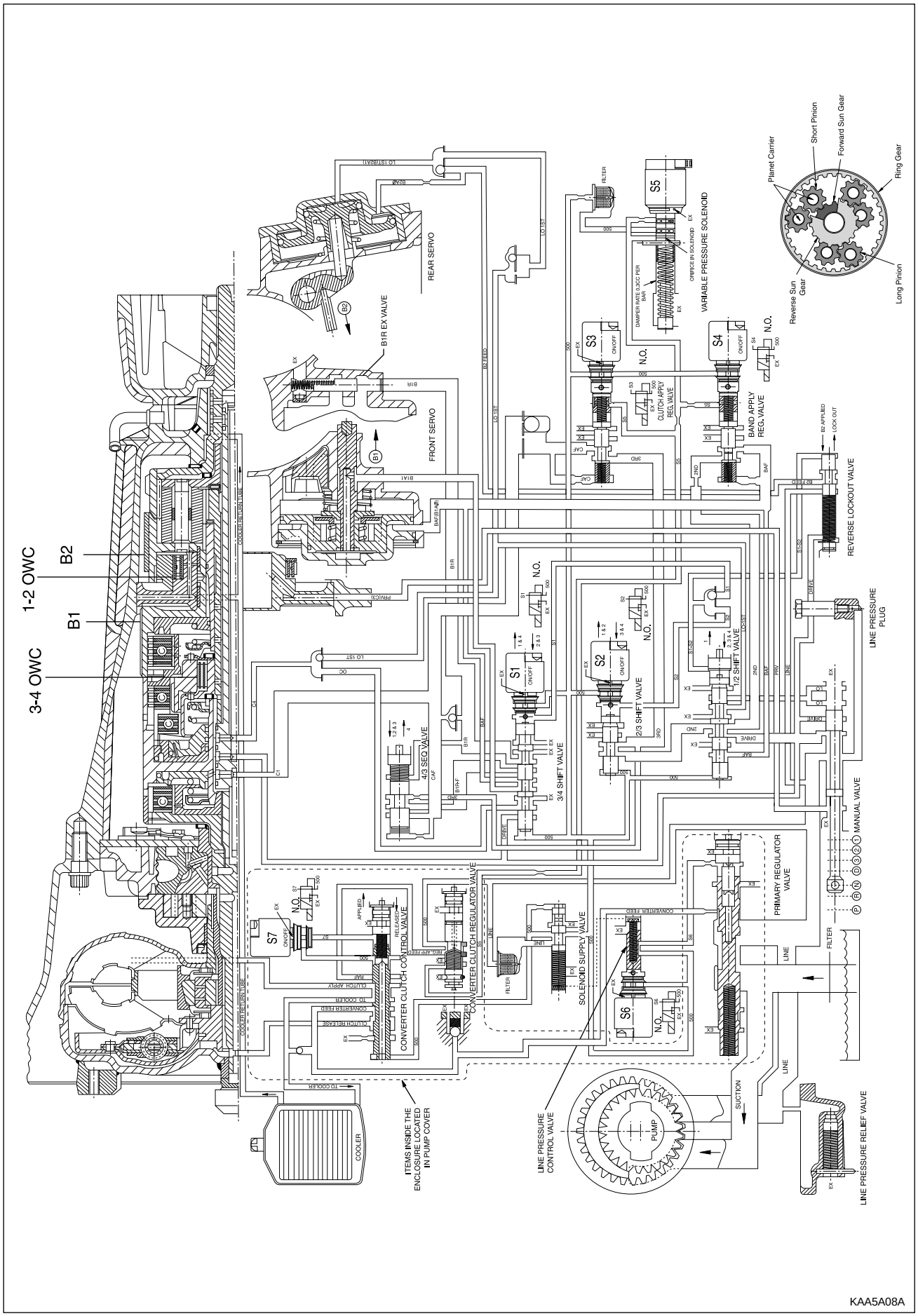
The primary regulator valve is located in the pump cover and supplies four line pressures; high and low for forward gears, and high and low for reverse. This pressure has no effect on shift quality and merely provides static clutch capacity during steady state operation. Low pressure can be obtained by activating an ON/OFF solenoid with high line pressure being the default mode.

Torque converter lock-up is initiated by toggling the converter clutch control valve with an ON/OFF solenoid.

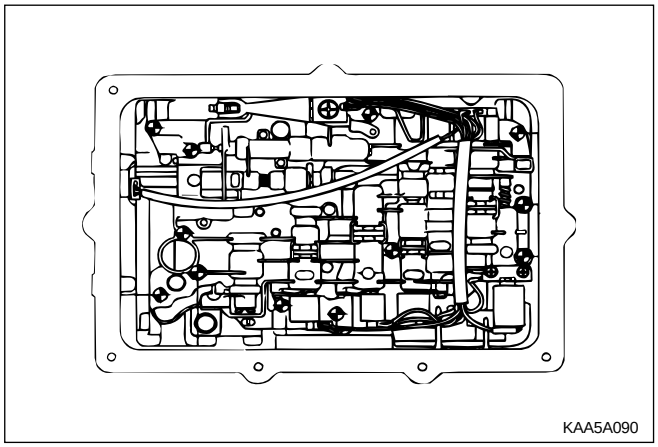
The actual apply and release of the clutch is regulated by the VPS via the converter clutch regulator valve.

The solenoid supply pressure regulator valve provides reference pressure for all the solenoids.

HYDRAULIC CONTROL CIRCUIT

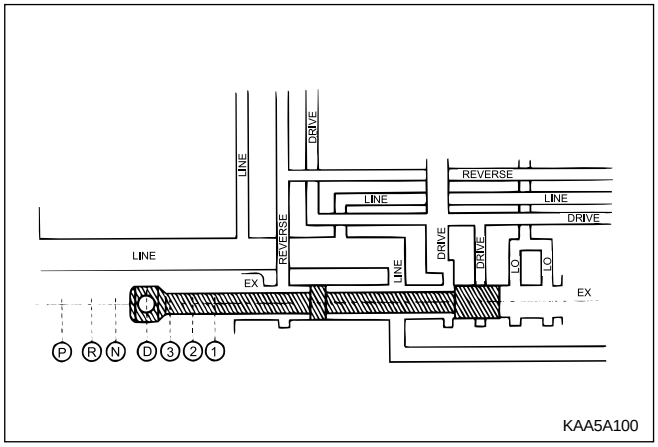


Valve Body


KAA5A090

Manual Valve

The manual valve is connected to the vehicle selector mechanism and controls the flow of oil to the forward and reverse circuits. The manual valve function is identical in all forward gear positions except that in the Manual 1 position an additional supply of oil is directed to the 1-2 shift valve for application of the rear band and the C4 overrun clutch. The manual valve directs the line pressure into the PRND fluid circuits.



KAA5A100

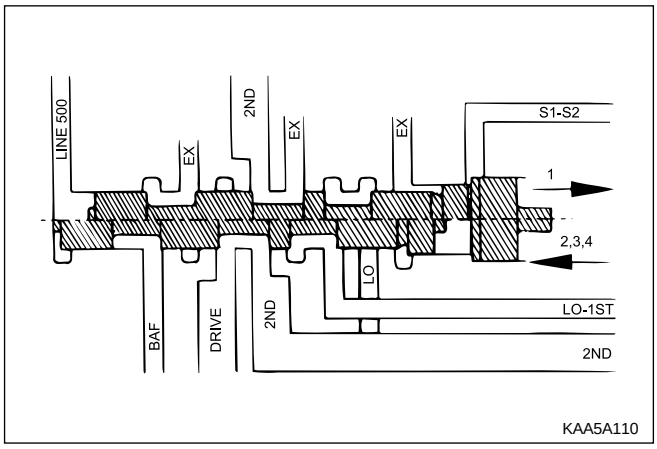
1-2 Shift Valve

The 1-2 shift valve is a two position valve that must be switched to the 2, 3 and 4 position in order to get any forward gear other than first gear. It is used for all 1-2 and 2-1 gearshifts.

The switching of this valve is achieved by using S1 and/ or S2.

During a 1-2 gearshift drive oil from the manual valve passes through to the second gear circuit. During a 2-1 gearshift the band apply feed oil is allowed to exhaust via the 1-2 shift valve.

The 1-2 shift valve works in conjunction with the 3-4 shift valve to disengage the C4 clutch in first gear, and engage C4 in second gear. When Manual 1 is selected the C4 clutch and rear band (B2) are engaged.



KAA5A110

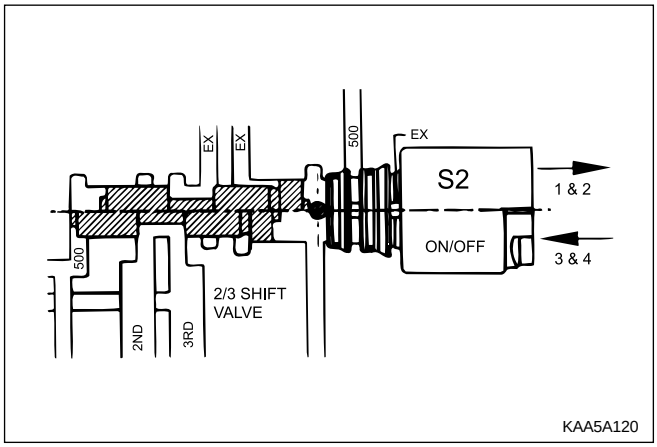
2-3 Shift Valve

The 2-3 shift valve is a two position valve. It is used on all 2-3 and 3-2 gearshifts.

The switching of this valve is achieved by S2 which is located at the end of the valve spool.

In the 1, 2 position, second gear oil from the 1-2 shift valve is prevented from entering the third gear circuit.

When the valve is moved to the 3, 4 position, oil from the second gear circuit is routed to the third gear circuit and the transmission is changed to third gear.



KAA5A120

3-4 Shift Valve

The 3-4 shift valve is a two position valve. It is used for all 3-4 and 4-3 gearshifts.

The switching of this valve is achieved by S1 which is located at the end of the valve spool.

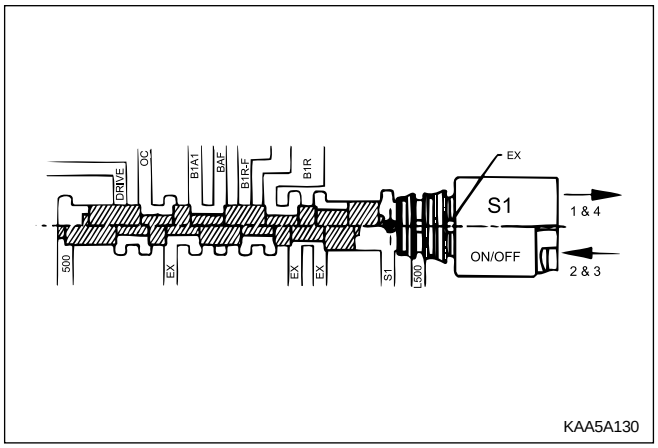
During a 3-4 gearshift the 3-4 shift valve:

- Exhausts the front band release (B1R) circuit thereby allowing the application of the front band (B1).
- Connects the inner apply area of the front servo (B1AI) to the Band Apply Feed (BAF) circuit thus allowing greater apply forces to the front band.
- Exhausts the Overrun Clutch (OC) circuit which allows the C4 clutch to disengage.

During a 4-3 gearshift, the C4 clutch is engaged and the front band (B1) is released. These actions are sequenced by the 4-3 sequence valve.

The 3-4 shift valve also switches during 1-2 and 2-1 gearshifts where its function is to apply the overrun clutch (C4) in second gear but to release it in first gear.

Note that the C4 clutch is applied in Manual 1 by virtue of the manual valve and the 1-2 shift valve. Refer to "1-2 Shift Valve" in this section.

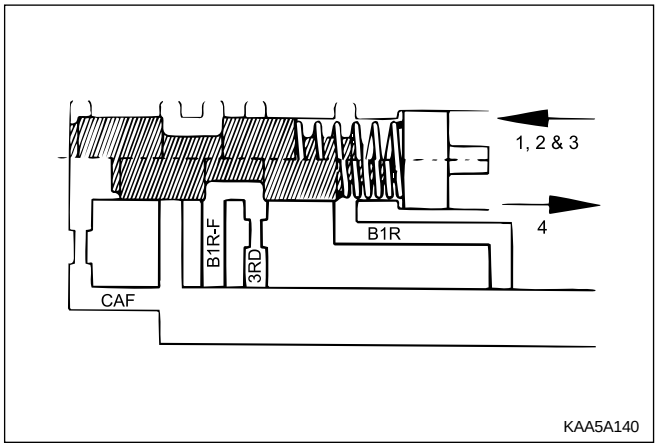


KAA5A130

4-3 Sequence Valve

The 4-3 sequence valve is a two position spring loaded valve. It switches during 3-4 and 4-3 gearshifts although it performs no function during the 3-4 shift.

During the 4-3 shift the 4-3 sequence valve delays the connection of the Clutch Apply Feed (CAF) circuit to the B1R circuit until the B1R circuit has been fully pressurized by using the third gear circuit. This prevents objectionable engine flare on completion of the 4-3 gearshift.



KAA5A140

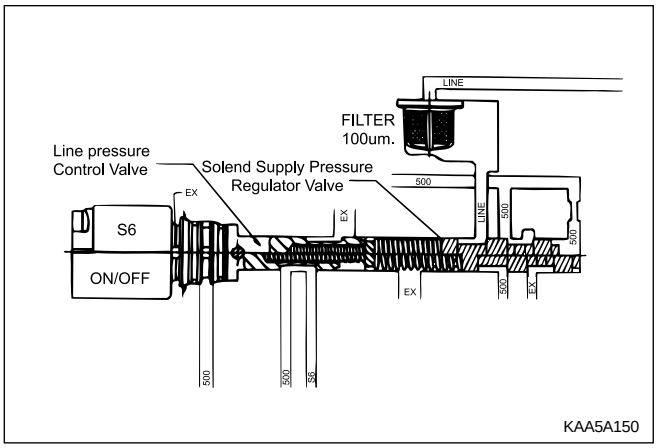
Solenoid Supply Pressure Regulator Valve

The solenoid supply pressure regulator valve supplies a constant pressure to all solenoids (S1 to S7). Line pres-sure is used as the feeding oil to this regulator and the output is termed line 500.

Line Pressure Control Valve

Line pressure is controlled by S6, which acts as the line pressure control valve. When S6 pressure is applied to the end of the Primary Regulator Valve (PRV), it is opposed by spring force and causes LOW line pressure for light throttle application and cruising.

Heavy throttle application causes the normally open S6 to open (switch Off) thus closing line 500 and opening S6 to exhaust. Removal of S6 pressure from the PRV results in HIGH line pressure.

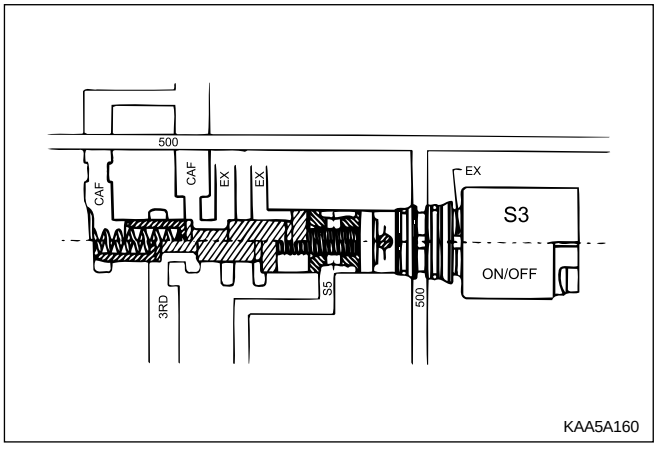


KAA5A150

Clutch Apply Feed Regulator Valve

The clutch apply feed regulator valve is a fixed ratio (2.25:1) valve. This valve provides a regulated pressure to the C1 clutch and controls the change rate of the clutch state to give the desired shift quality.

Third gear oil supplied to the valve is regulated to provide an output pressure, Clutch Apply Feed (CAF) pressure, of 2.25 times the S5 signal pressure when S3 is ON. When S3 is OFF, the output pressure is 2.25 times the line 500 pressure.

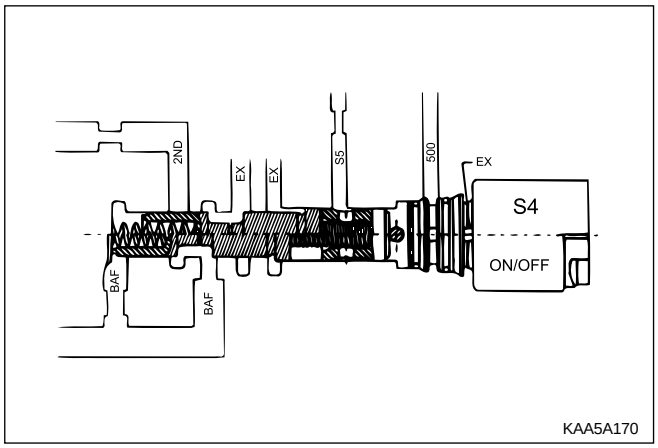


KAA5A160

Band Apply Feed Regulator Valve

The band apply feed regulator valve is a fixed ratio (1.4:1) valve. It provides a regulated pressure to the front servo, and controls the change rate of the front band (B1) state to give the desired shift quality.

Second gear oil supplied to the valve is regulated to provide an output pressure, Band Apply Feed (BAF) pressure, of 1.4 times the S5 signal pressure when S4 is ON. When S4 is OFF the output pressure is 1.4 times the line 500 pressure.

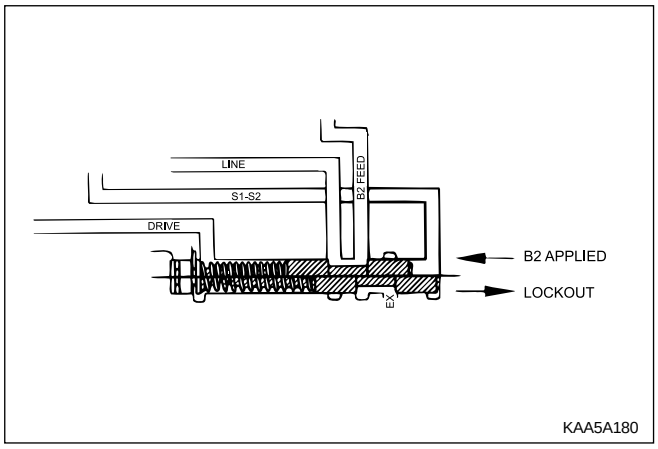


KAA5A170

Reverse Lockout Valve

The reverse lockout valve is a two position valve contained in the upper valve body. This valve uses S1-S2 pressure as a signal pressure and controls the application of the rear band (B2).

While the manual valve is in D, 3, 2 or 1 positions, drive oil is applied to the spring end of the valve, overriding any signal pressures and holding the valve in the lockout position. This prevents the application of B2 in any of the forward driving gears except M1.



KAA5A180

When the manual valve is in P, R or N positions, drive oil is exhausted and the reverse lockout valve may be toggled by S1-S2 pressure.

B2 is applied in P, R, and N if the following conditions are satisfied;

- In P or N, vehicle speed = 3 km/h.
- In R, vehicle speed = 10 km/h.
- Engine speed = 1600 rpm.
- Throttle position = 12 %.

Under these conditions, the TCM switches solenoids S1 and S2 to OFF. The reverse lockout valve toggles under the influence of the S1-S2 pressure, to connect the line pressure to the B2 feed. Oil is fed to both the inner and outer apply areas of the rear servo piston, applying B2.

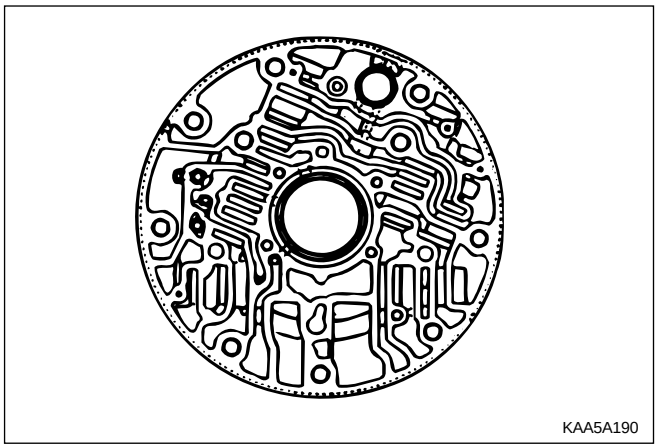
If any of the above conditions are not satisfied, the TCM switches solenoids S1 and S2 to ON.

S1- S2 pressure is exhausted and the valve is held in the lockout position by the spring. In this position, engagement of B2 is prohibited.

This feature protects the transmission from abuse by preventing the undesirable application of B2 at high speed, and by providing a reverse lockout function.

Note that if the transmission is in failure mode, the rear band will be applied at all times in P, R and N.

Pump Cover


KAA5A190

Primary Regulator Valve

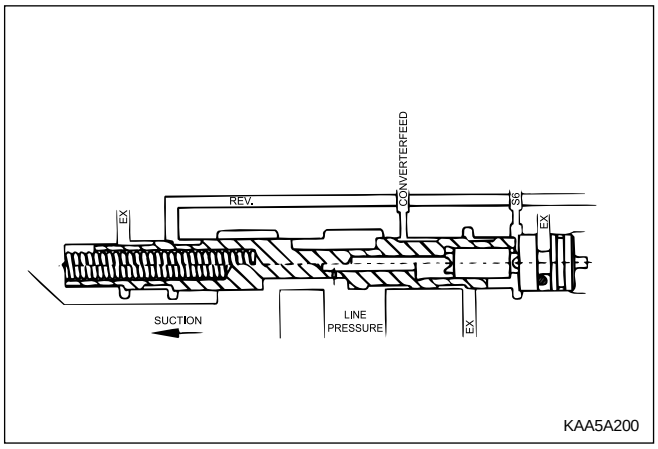
The Primary Regulator Valve (PRV) regulates the transmission line pressure (or pump output pressure). This valve gives either high or low line pressure depending on whether S6 is switched OFF or ON. When S6 is switched ON, S6 pressure is applied to the PRV moving it against spring pressure and opening the line pressure circuit to the pump suction port resulting in reduced line pressure.

Low line pressure is used during light throttle applications and cruising. Heavy throttle will cause S6 to switch OFF and thereby cause high line pressure.

This stepped line pressure control has no detrimental effect on shift feel because all shifting pressures are controlled by separate band and clutch regulator valves, and the output of S5.

When reverse gear is selected, both the low and high line pressure values are boosted to guard against slippage. This is achieved by applying reverse oil line pressure to the PRV to assist the spring load. The other end of the valve contains ports for line pressure feedback and S6 pressure.

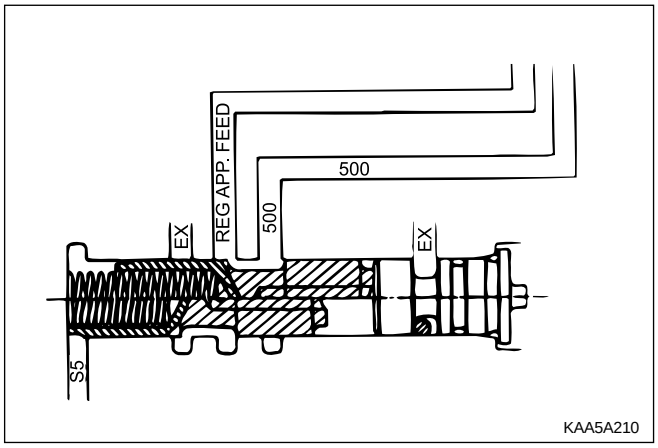
The PRV also regulates the supply of oil to the converter via the converter feed port. The cascade effect of the PRV ensures the first priority of the valve is to maintain line pressure at very low engine speeds. When the engine speed increases and the pump supplies an excess of oil the PRV moves to uncover the converter feed port thereby pressurizing the converter. If there is an excess of oil for the transmission's needs then the PRV moves further to allow oil to return to the suction port.



KAA5A200

Converter Clutch Regulator Valve

The converter clutch regulator valve regulates the pressure of the oil which applies the converter clutch. Input oil from the line 500 circuit is regulated within the valve, with the output pressure being variable according to the signal pressure from the S5 circuit. Converter clutch apply and release application is smoothed by electronically varying the S5 circuit pressure.



KAA5A210

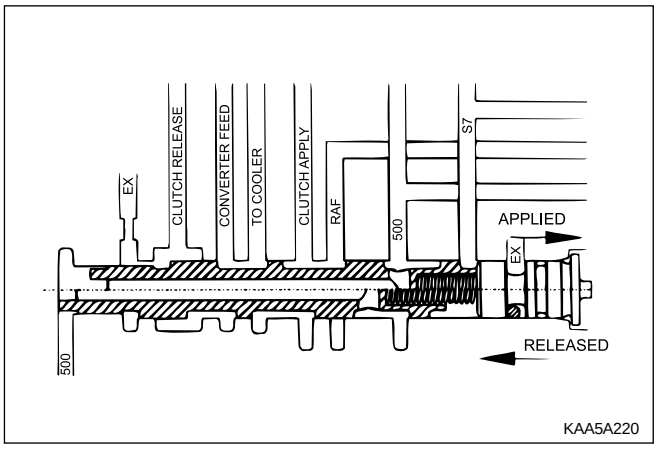
Converter Clutch Control Valve

The converter clutch control valve is a two position valve which applies or releases the converter clutch.

The switching of this valve is governed by the signal pressure from S7.

When the valve is in the OFF or released position, converter feed oil from the PRV is directed to the release side of the converter clutch. After flowing through the converter, oil returns to the converter clutch control valve and is then directed to the oil cooler.

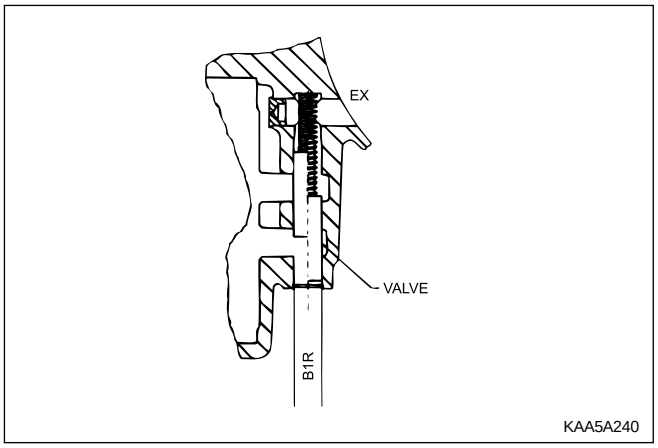
When the valve is in the ON or applied position, regulated oil from the converter clutch regulator valve is directed to the apply side of the converter clutch. This oil remains within the converter because the converter clutch piston is sealed against the flat friction surface of the converter cover. To provide oil flow to the cooler the converter clutch control valve directs converter feed oil from the PRV directly to the cooler circuit.



KAA5A220

B1R Exhaust Valve

The B1R exhaust valve is a two position spring loaded valve located in the transmission case directly adjacent to the front servo. It permits the servo release oil to be rapidly exhausted into the transmission case during application of the front band (B1). This prevents the need to force the oil back from the front servo through the valve body and through the 3-4 shift valve. The spring positions the valve to prevent oil entering the release area of the servo until the B1R circuit oil pressure reaches approximately 100 kPa.



KAA5A240

POWER TRAIN SYSTEM

The Power Train System consists of;

- A torque converter with single face lock-up clutch
- Four multi-plate clutch assemblies
- Two brake bands
- Two one-way clutches
- Planetary gear set
- Parking mechanism

A conventional six pinion Ravigneaux compound planetary gear set is used with overdrive (fourth gear) being obtained by driving the carrier.

The cross-sectional arrangement is very modular in nature.

Four main sub-assemblies are installed within the case to complete the build. These subassemblies are;

- Gear set-sprag-centre support
- C1 -C2 -C3 -C4 clutch sub-assembly
- Pump assembly
- Valve body assembly

One, or a combination of selective washers are used between the input shaft flange and the number 4 bearing to control the transmission end float. This arrangement allows for extensive subassembly testing and simplistic final assembly during production.

A general description of the operation of the Power Train System is detailed below.

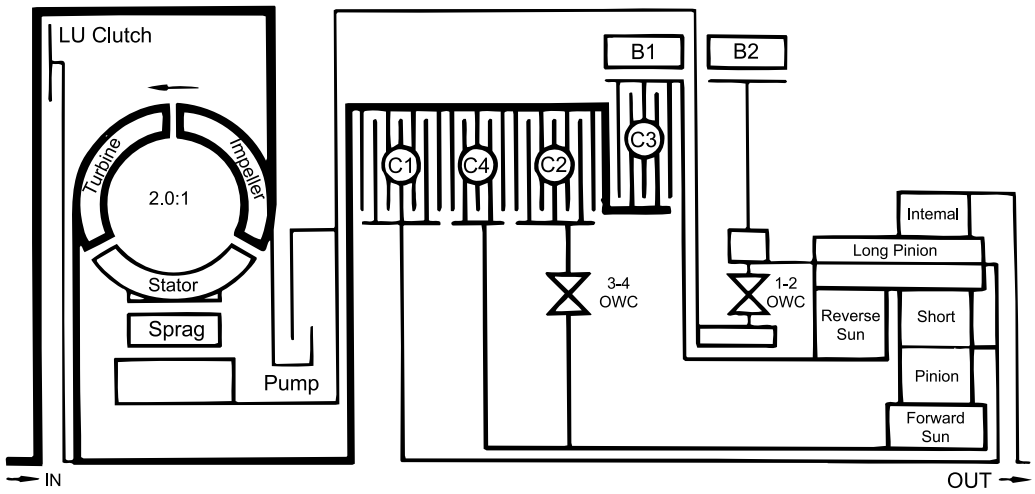
First gear is engaged by applying the C2 clutch and locking the 1-2 One Way Clutch (1-2 OWC). The 1-2 shift is accomplished by applying the B1 band and overrunning the 1-2 OWC. The 2-3 shift is accomplished by applying the C1 clutch and releasing the B1 band. The 3-4 shift is accomplished by re-applying the B1 band and overrunning the 3-4 OWC. Reverse gear is engaged by applying the C3 clutch and the B2 band.

The C4 clutch is applied in the Manual 1, 2 and 3 ranges to provide engine braking. In addition, the C4 clutch is also applied in the Drive range for second and third gears to eliminate objectionable freewheel coasting.

The B2 band is also applied in the Manual 1 range to accomplish the low-overrun shift.

Both the front and rear servos are dual area designs to allow accurate friction element matching without the need for secondary regulator valves. All the friction elements have been designed to provide low shift energies and high static capacities when used with the new low static co-efficient transmission fluids. Non-asbestos friction materials are used throughout.

		ELEMENTS ENGAGED								
Gear	**Gear Ratio**	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
First	2.741		X					X	X	
Second	1.508		X			X			X	
Third	1.000	X	X		X	X			X	X*
Fourth	0.708	X	X		X				X	X
Reverse	2.428			X			X			
Manual 1	2.741		X		X		X		X	
* For Certain Vehicle Applications, Refer to the Owner's Manual.										



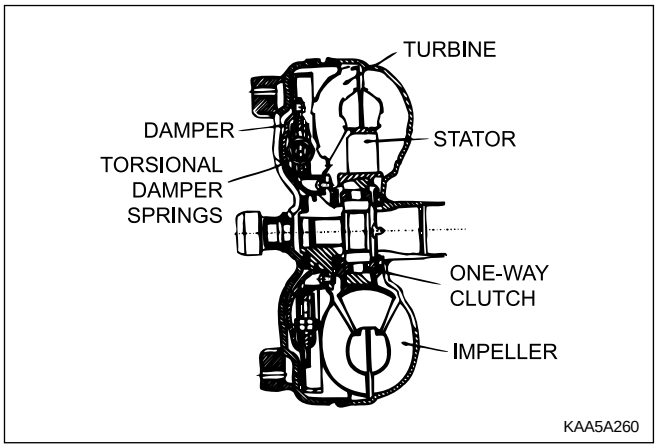
KAA5A250

Torque Converter

The torque converter consists of a turbine, stator pump, impeller and a lock-up damper and piston assembly. As in conventional torque converters, the impeller is attached to the converter cover, the turbine is splined to the input shaft and the stator is mounted on the pump housing via a one way clutch (sprag).

The addition of the damper and piston assembly enables the torque converter to lock-up under favorable conditions. Lock-up is only permitted to occur in third and fourth gears under specified throttle and vehicle speed conditions.

Lock-up is achieved by applying hydraulic pressure to the damper and piston assembly which couples the turbine to the converter cover, locking-up the converter and eliminating unwanted slippage. Whenever lock-up occurs, improved fuel consumption is achieved. Torsional damper springs are provided in the damper and piston assembly to absorb any engine torque fluctuations during lock-up.



Clutch Packs

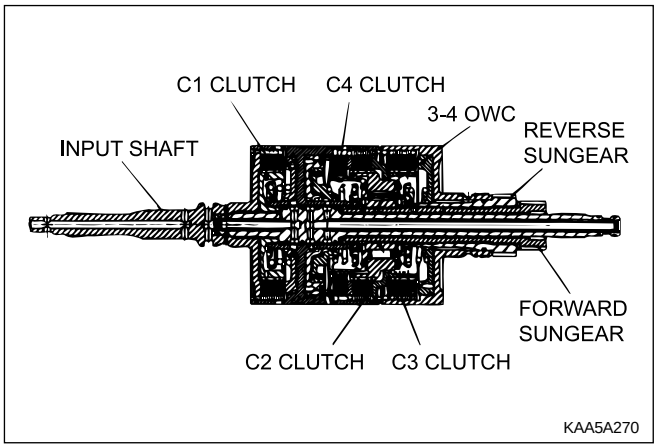
There are four clutch packs. All clutch packs are composed of multiple steel and friction plates.

C1 CLUTCH: When applied, this clutch pack allows the input shaft to drive the planet carrier. This occurs in third and fourth gears.

C2 CLUTCH: When applied this clutch pack allows the input shaft to drive the forward sun gear via the 3-4 OWC. This occurs in all forward gears.

C3 CLUTCH: When applied this clutch pack allows the input shaft to drive the reverse sun gear. This only occurs in reverse gear.

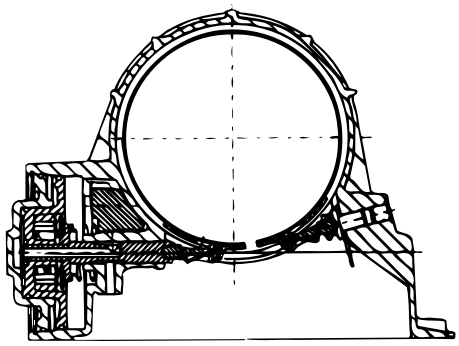
C4 CLUTCH: When applied this clutch provides engine braking on overrun. This occurs in Manual 1, 2 and 3 and also Drive 2 and Drive 3 to prevent objectionable free wheel coasting.



Bands

The transmission utilizes two bands, the B1 band (sometimes known as the 2-4 band), and the B2 band (sometimes known as the low-reverse band).

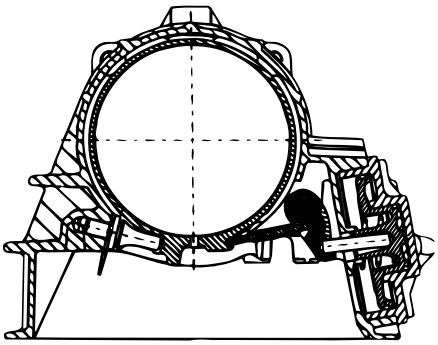
The B1 band is a flexible band which is engaged by the front servo piston. B1 is activated in second and fourth gear. When activated B1 prevents the reverse sun gear from rotating by holding the C3 clutch assembly stationary. In second gear only the outer area of the apply piston is utilized. In fourth gear both areas are utilized for greater clamping force.



FRONT SERVO AND BAND

KAA5A280

The B2 band is a solid band which is engaged by the rear servo piston. B2 is activated in Park, Reverse, Neutral and Manual 1. When activated B2 prevents the planet carrier assembly from rotating. In Manual 1 only the inner area of the apply piston is utilized. In Park, Reverse and Neutral, both areas are utilized for greater clamping force.



REAR SERVO AND BAND

KAA5A290

One Way Clutches

The transmission uses two OWCs, the 1-2 OWC and the 3-4 OWC. (Note that a third OWC is located in the torque converter, also known as a sprag.)

The 1-2 OWC is located between the planetary carrier assembly and the center support. This allows the carrier to rotate around the center support in one direction only. The one way clutch is engaged only in Drive 1.

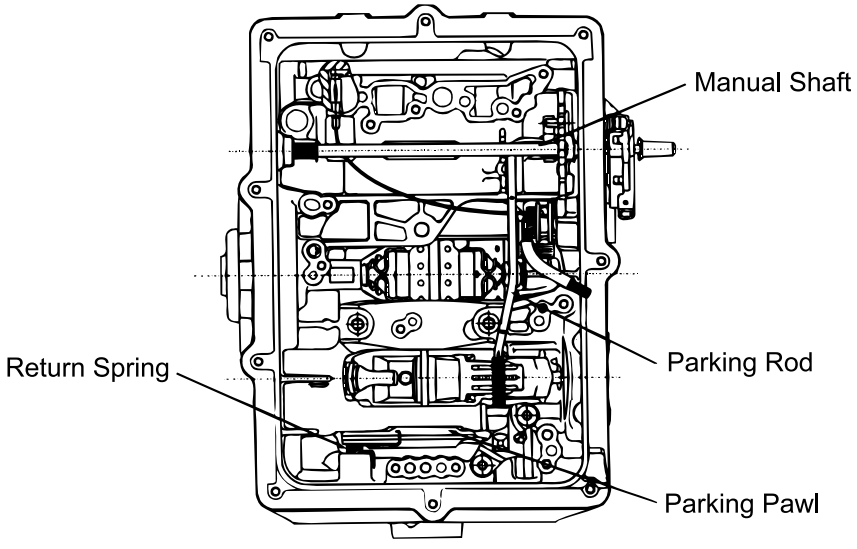
This 3-4 OWC is located between the C4 and the C2 clutch assemblies. This allows the C2 clutch to drive the forward sun gear in first, second and third gears but unlocks in fourth gear and during overrun.

Planetary Gear Set

The planetary gear set used in the transmission is a conventional six pinion Ravigneaux compound gear set.

Parking Mechanism

When Park is selected the manual lever extends the park rod rearwards to engage the parking pawl. The pawl will engage the external teeth on the ring gear thus locking the output shaft to the transmission case. When Park is not selected a return spring holds the parking pawl clear of the output shaft, preventing accidental engagement of Park.



KAA5A300

POWER FLOWS

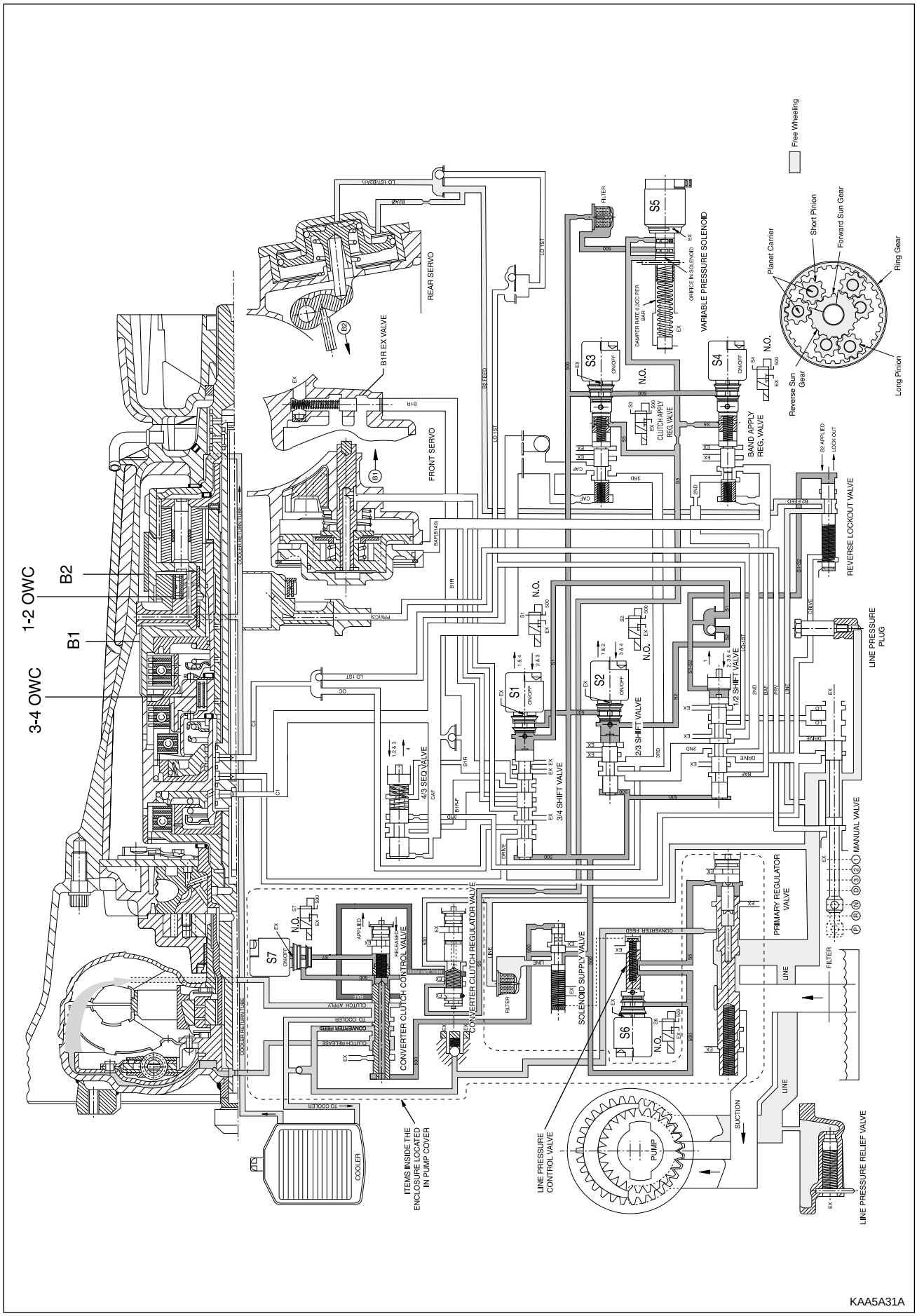
The power flows for the various transmission selections are listed below;

- Power Flow - Neutral and Park
- Power Flow - Reverse
- Power Flow - Manual 1
- Power Flow - Drive 1
- Power Flow - Drive 2
- Power Flow - Drive 3
- Power Flow - Drive 3 Lock Up
- Power Flow - Drive 4 (Overdrive)
- Power Flow - Drive 4 Lock Up

The following table details the engaged elements versus the gear selected for all transmission selections.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Park and Neutral	-	-	-	-	-	X	-	-	-
Reverse	-	-	X	-	-	X	-	-	-
Manual 1	-	X	-	X	-	X	-	X	-
Drive 1	-	X	-	-	-	-	X	X	-
Drive 2 and Manual 2	-	X	-	X	X	-	-	X	-
Drive 3 and Manual 3	X	X	-	X	-	-	-	X	-
Drive 3 Lock Up and Manual 3 Lock Up	X	X	-	X	-	-	-	X	X
Drive 4 Overdrive	X	X	-	-	X	-	-	X	-
Drive 4 Lock Up	X	X	-	-	X	-	-	X	X

PARK AND NEUTRAL



Power Flow - Park and Neutral

In Park and Neutral, there is no drive to the planetary gear set. The rear band is applied to eliminate 'clunk' on engagement of the reverse gear, and to improve the low range engagement for 4WD applications. No other clutches or bands are applied.

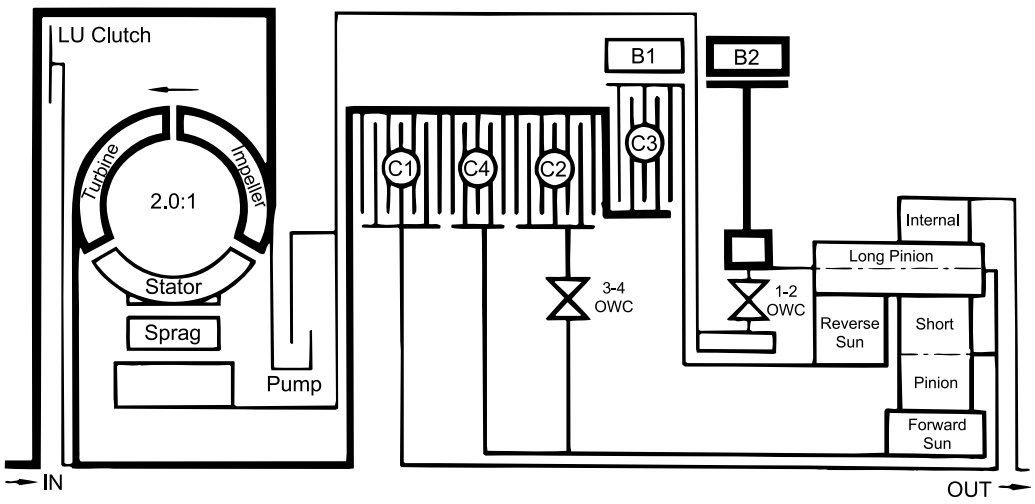
In Park the transmission is mechanically locked by engaging a case mounted pawl with teeth on the output shaft ring gear.

Control

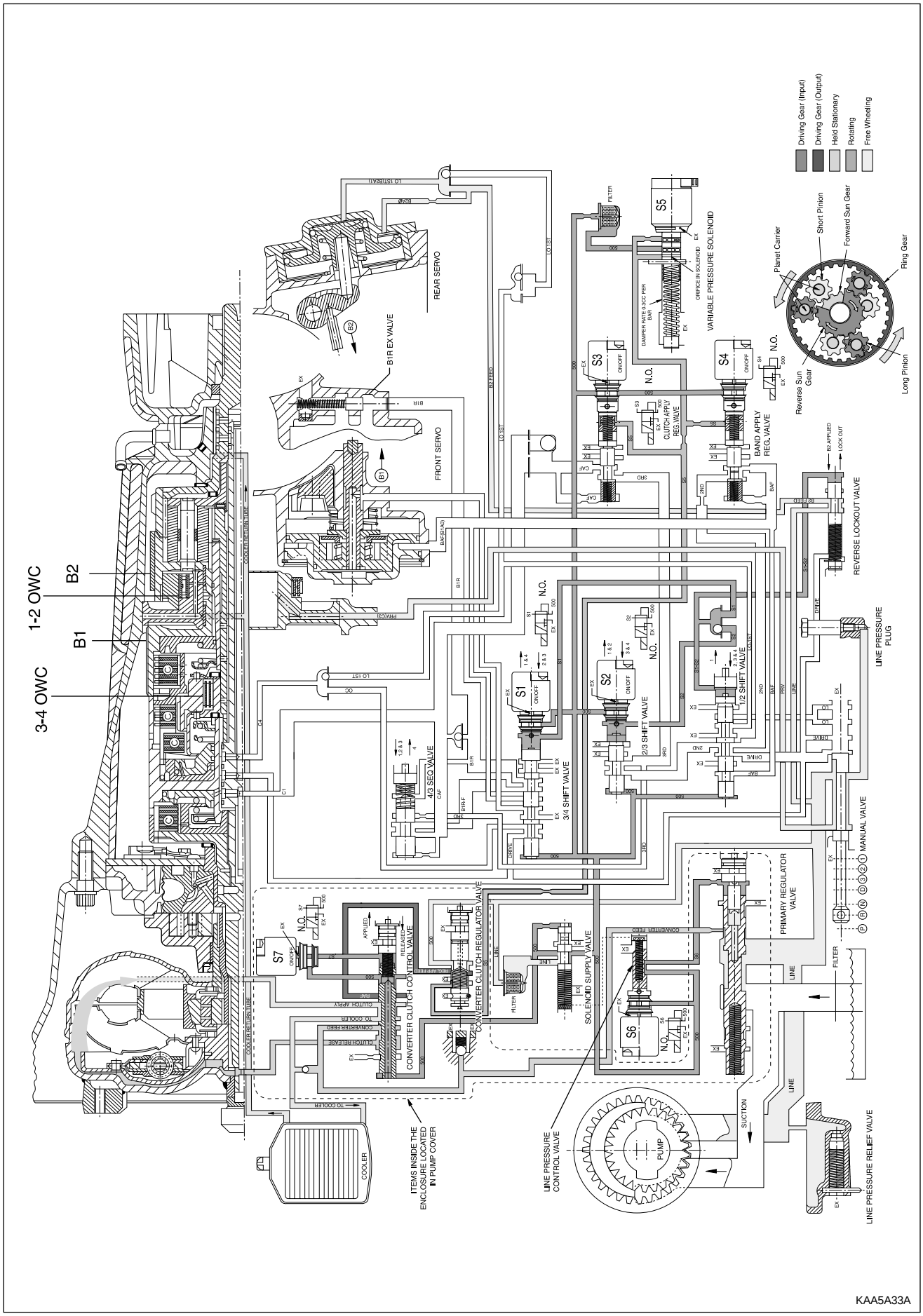
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoids S1 and S2 are switched OFF.
- Line (pump) pressure is applied to the Primary Regulator Valve (PRV) and to the solenoid supply pressure regulator valve.
- The converter, oil cooler, and lubrication circuits are charged from the primary regulator valve.
- The line 500 circuit is charged by the solenoid supply pressure regulator valve.
- The S5 circuit is charged by the variable pressure solenoid (S5).
- Line pressure is prevented from entering the drive circuit by the manual valve.
- The B1 circuit and all clutch circuits are open to exhaust.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Park and Neutral	-	-	-	-	-	X	-	-	-



REVERSE


B2
1-2 OWC
B1
3-4 OWC
Driving Gear (Input)
Driving Gear (Output)
Held Stationary
Rotating
Free Wheeling
Planet Carrier
Short Pinion
Forward Sun Gear
Ring Gear
Reverse Sun Gear
Long Pinion
REAR SERVO
FRONT SERVO
B1R EX VALVE
VARIABLE PRESSURE SOLENOID
ORIFICE IN SOLENOID
DAMPER RATE 0.3CC PER BAR
CLUTCH APPLY REG. VALVE
BAND APPLY REG. VALVE
REVERSE LOCKOUT VALVE
LINE PRESSURE PLUG
1/2 SHIFT VALVE
2/3 SHIFT VALVE
3/4 SHIFT VALVE
4/3 SEQ VALVE
MANUAL VALVE
PRIMARY REGULATOR VALVE
SOLENOID SUPPLY VALVE
CONVERTER CLUTCH REGULATOR VALVE
CONVERTER CLUTCH CONTROL VALVE
LINE PRESSURE CONTROL VALVE
LINE PRESSURE RELIEF VALVE
PUMP
SUCTION
COOLER
ITEMS INSIDE THE ENCLOSURE LOCATED IN PUMP COVER
S1
S2
S3
S4
S5
S6
S7
N.O.
KAA5A33A

Power Flow - Reverse

In Reverse, transmission drive is via the input shaft and the forward clutch cylinder to the hub of the C3 clutch. The elements of the transmission function as follows;

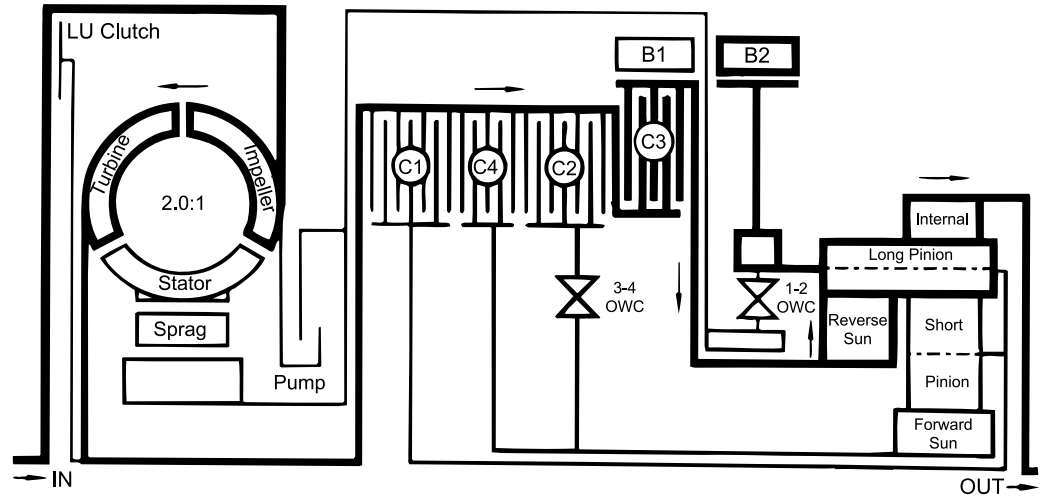
- The C3 clutch is engaged and drives the reverse sun gear in a clock-wise direction.
- The B2 band is engaged and holds the planetary gear carrier stationary causing the long pinion to rotate anti-clockwise about its axis on the pinion shaft.
- The long pinion drives the internal ring gear in the same direction.
- The internal ring being splined to the output shaft drives it in an anti-clockwise or reverse direction.

Control

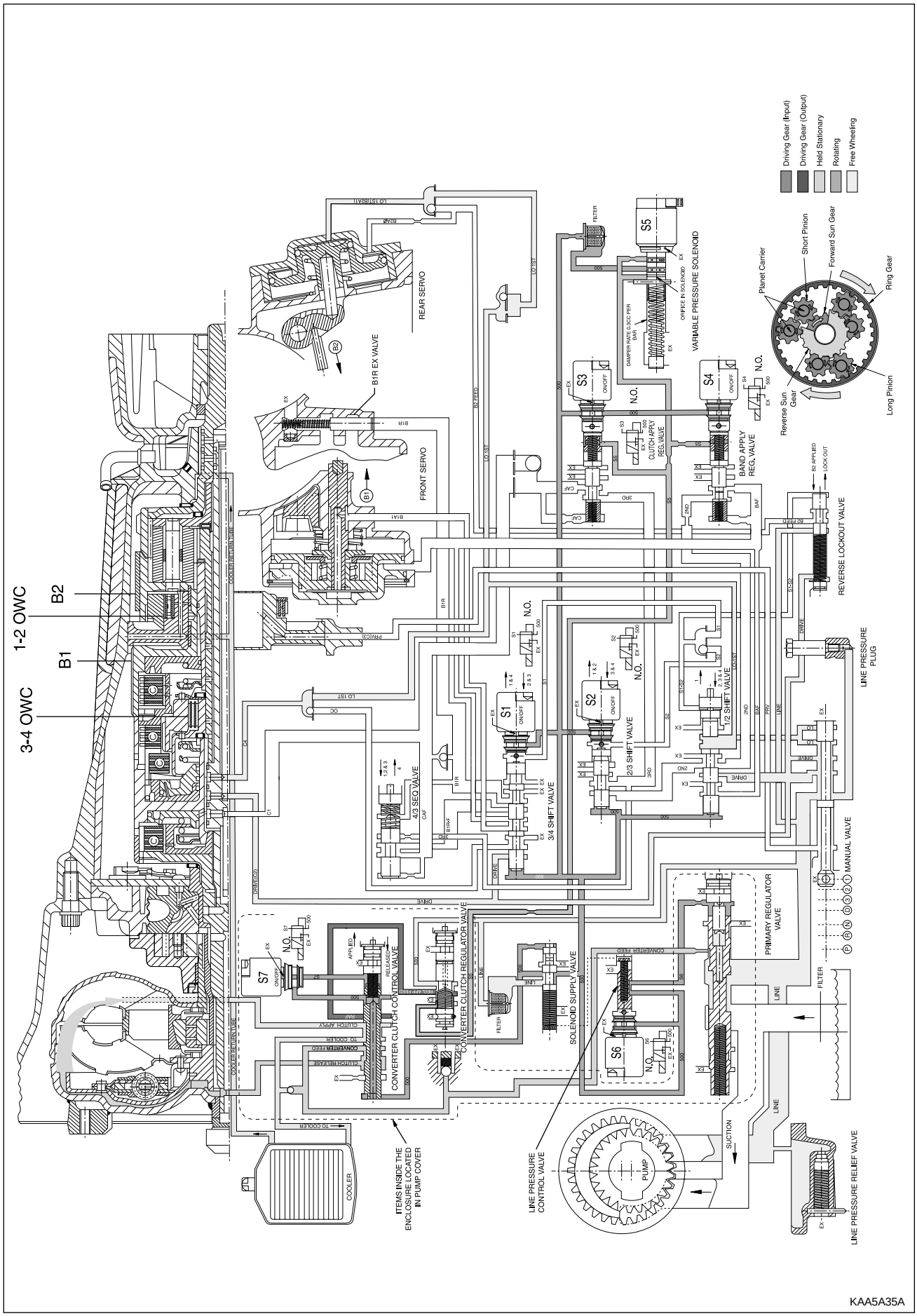
To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- Solenoids S1 and S2 are switched OFF.
- Line pressure is directed through the reverse lockout valve to both the inner and outer apply areas of the rear servo piston for B2 band application.
- Line pressure feeds the reverse oil circuit via the manual valve.
- Reverse oil is routed from the manual valve to the C3 clutch.
- Reverse oil is also applied to the spring end of the primary regulator valve to assist the spring and to boost the line pressure value.
- All other clutch and band apply circuits are open to exhaust.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Reverse	-	-	X	-	-	X	-	-	-



MANUAL 1


Driving Gear (Input)
Driving Gear (Output)
Held Stationary
Rotating
Free Wheeling
Planet Carrier
Short Pinion
Forward Sun Gear
Ring Gear
Reverse Sun Gear
Long Pinion
1-2 OWC
B2
B1
3-4 OWC
REAR SERVO
B1R EX VALVE
FRONT SERVO
VARIABLE PRESSURE SOLENOID
ORIFICE IN SOLENOID
DAMPER RATE ELSCO-PER BAR
CLUTCH APPLY REG. VALVE
BAND APPLY REG. VALVE
REVERSE LOCKOUT VALVE
LINE PRESSURE PLUG
1/2 SHIFT VALVE
2/3 SHIFT VALVE
3/4 SHIFT VALVE
4/3 SEQ VALVE
MANUAL VALVE
PRIMARY REGULATOR VALVE
CONVERTER CLUTCH REGULATOR VALVE
CONVERTER CLUTCH CONTROL VALVE
SOLENOID SUPPLY VALVE
LINE PRESSURE CONTROL VALVE
LINE PRESSURE RELIEF VALVE
PUMP
SUCTION
COOLER
ITEMS INSIDE THE ENCLOSURE LOCATED IN PUMP COVER
KAA5A35A

Power Flow - Manual 1

In Manual 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the trans-mission function as follows;

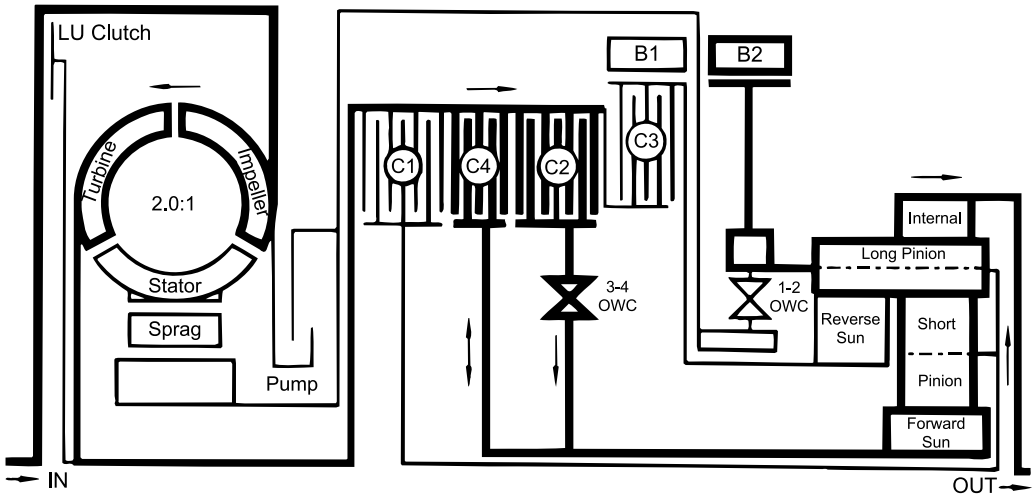
- The C2 clutch is engaged to drive the forward sun gear, via the 3-4 OWC.
- The B2 band is engaged to hold the planetary gear carrier stationary.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The long pinion rotating about its axis drives the inter-nal ring gear and the output shaft in a clockwise or forward direction.
- The C4 clutch provides engine braking through the 3-4 OWC on overrun.

Control

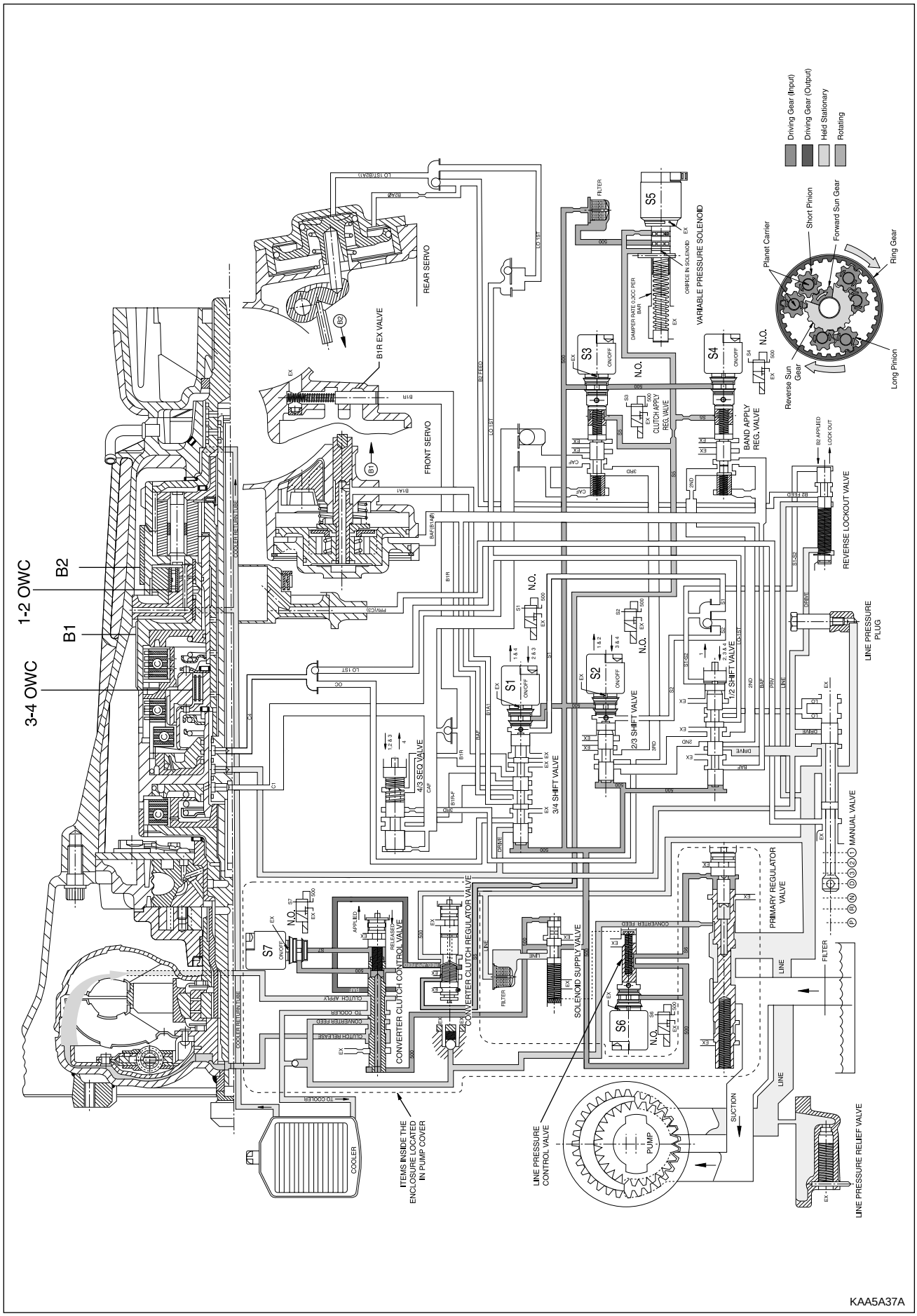
To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- Solenoids S1 and S2 are switched ON.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.
- Lo-1st (line pressure) oil is routed through the 1-2 shift valve to the C4 clutch, and to the inner apply area of the rear servo piston for B2 band application.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Manual 1	-	X	-	X	-	X	-	X	-



KAA5A360


DRIVE 1
1-2 OWC
B2
B1
3-4 OWC
Driving Gear (Input)
Driving Gear (Output)
Held Stationary
Rotating
Planet Carrier
Short Pinion
Forward Sun Gear
Ring Gear
Reverse Sun Gear
Long Pinion
REAR SERVO
B1R EX VALVE
FRONT SERVO
VARIABLE PRESSURE SOLENOID
CLUTCH APPLY REG. VALVE
BAND APPLY REG. VALVE
REVERSE LOCKOUT VALVE
LINE PRESSURE PLUG
1/2 SHIFT VALVE
2/3 SHIFT VALVE
3/4 SHIFT VALVE
4/3 SEQ VALVE
MANUAL VALVE
PRIMARY REGULATOR VALVE
SOLENOID SUPPLY VALVE
CONVERTER CLUTCH REGULATOR VALVE
CONVERTER CLUTCH CONTROL VALVE
LINE PRESSURE CONTROL VALVE
LINE PRESSURE RELIEF VALVE
PUMP
COOLER
ITEMS INSIDE THE ENCLOSURE LOCATED IN PUMP COVER
S1
S2
S3
S4
S5
S6
S7
KAA5A37A

Power Flow - Drive 1

In Drive 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the transmission function as follows :

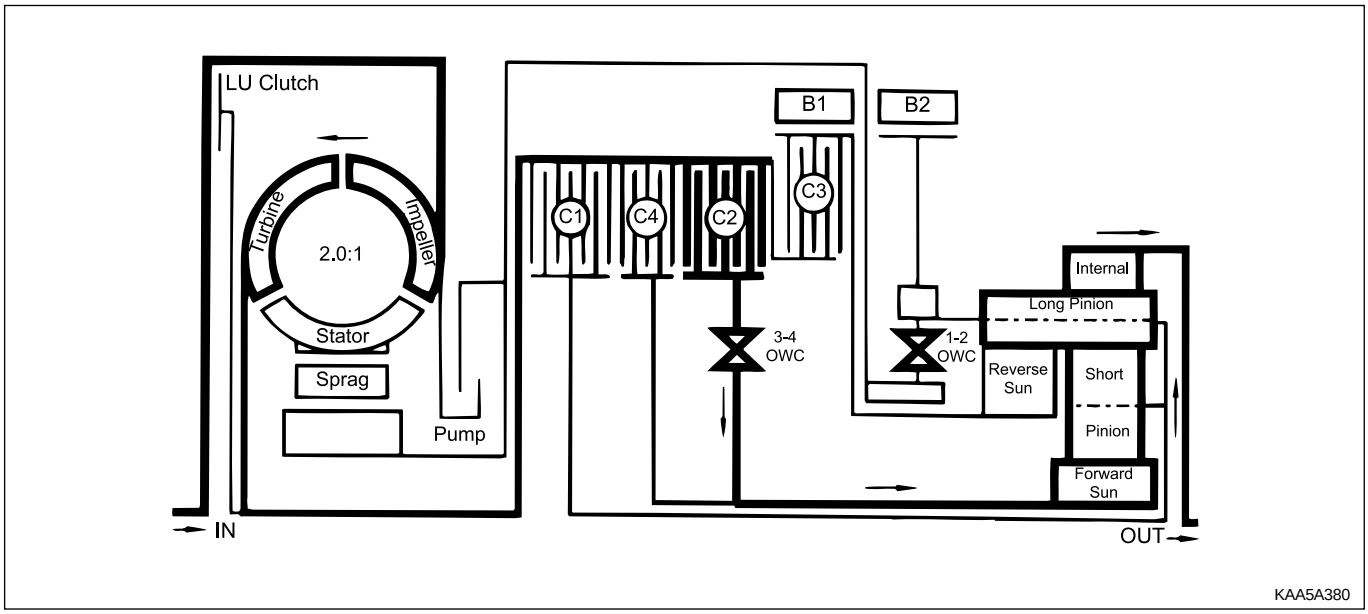
- The C2 clutch is engaged to drive the forward sun gear via the 3-4 OWC.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The 1-2 OWC prevents the planetary gear carrier from rotating under reaction force and the long pinion rotates on its axis driving the internal ring gear and output shaft in a clockwise or forward direction.
- There is no engine braking on overrun.

Control

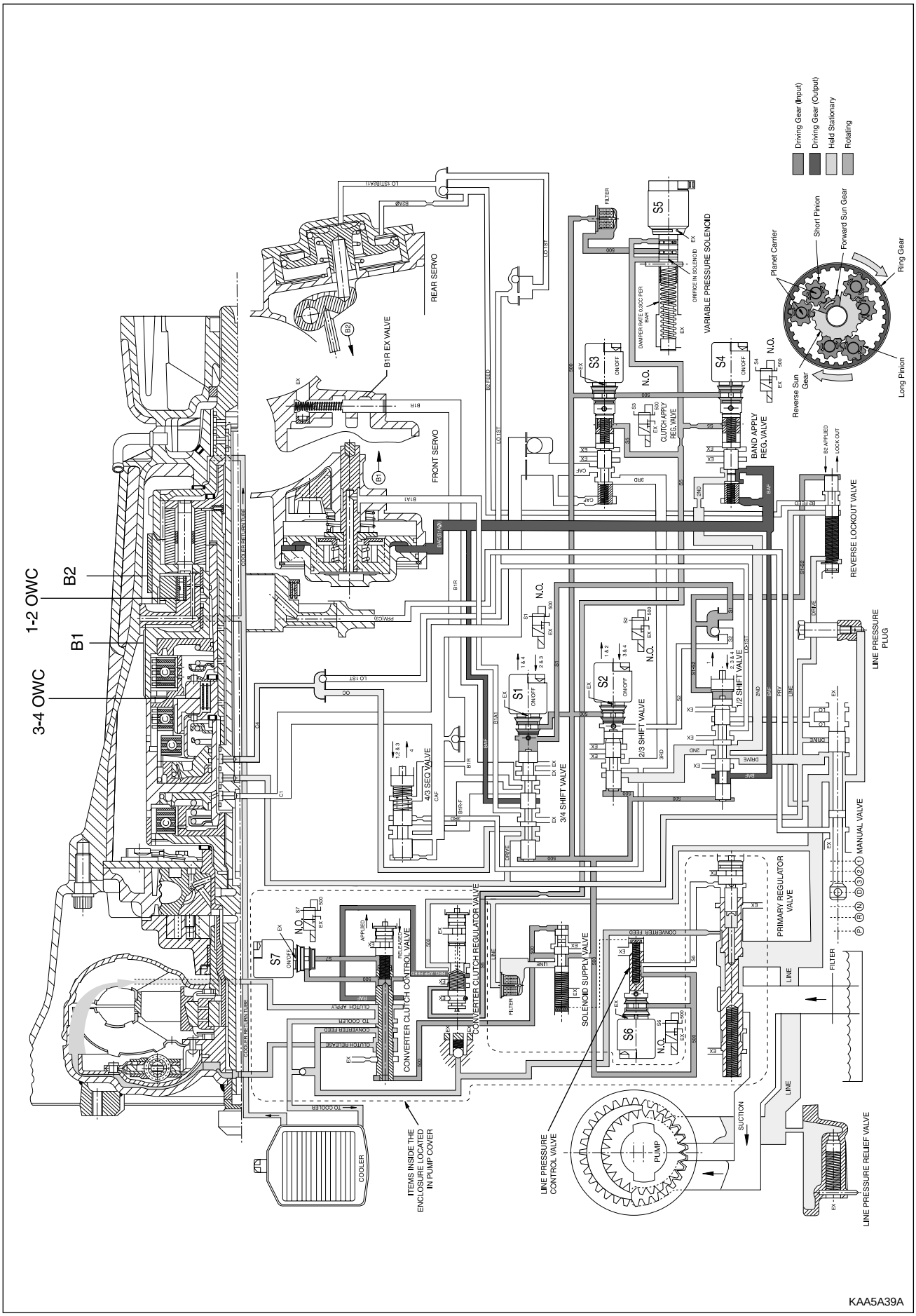
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoids S1 and S2 are switched ON.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 1	-	X	-	-	-	-	X	X	-



DRIVE 2 AND MANUAL 2



Power Flow - Drive 2 and Manual 2

In Drive 2 and Manual 2, transmission drive is via the input shaft and forward clutch cylinder. The elements of the transmission function as follows;

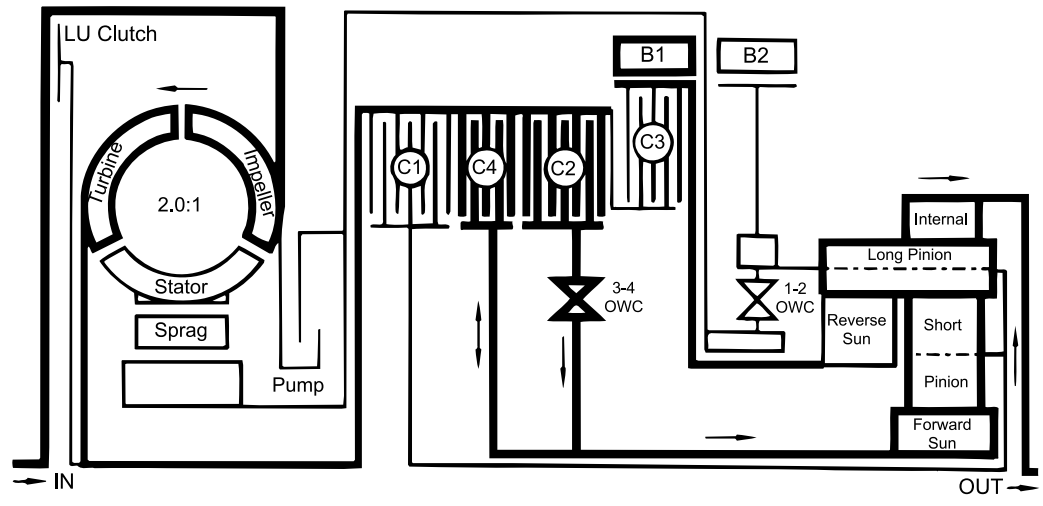
- The C2 clutch is applied to drive the forward sun gear.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The B1 band is applied holding the reverse sun gear stationary therefore the long pinion walks around the reverse sun gear taking the internal ring gear and output shaft with it in a clockwise or forward direction.
- The C4 clutch is applied to bypass the 3-4 OWC and provide engine braking on overrun.

Control

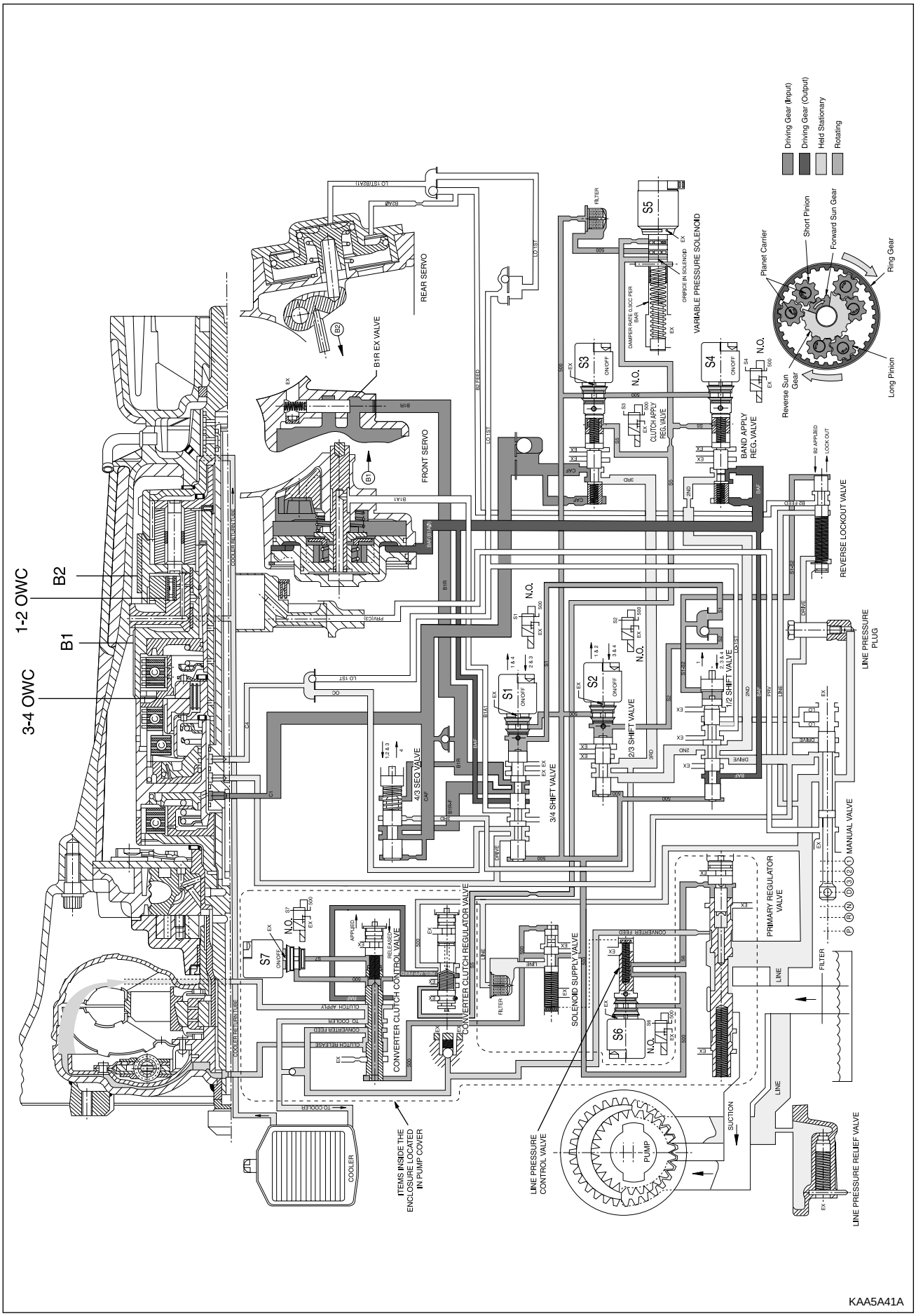
To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- Solenoid S1 is switched OFF. S2 is switched ON.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.
- When S1 switches OFF, S1 oil pressure, which is derived from line 500 pressure, moves the 3-4 shift valve to the left. At the same time S1 oil is directed to the 1-2 shift valve which moves the valve to the second gear position.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply regulator valve, and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ratio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - The outer apply area of the front servo
  - The 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
  - The 3-4 shift valve for use when the transmission is shifted into fourth gear
- Drive (line pressure) is routed through the 3-4 shift valve to apply the C4 clutch.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 2 and Manual 2	-	X	-	X	X	-	-	X	-



DRIVE 3 AND MANUAL 3



Power Flow - Drive 3 and Manual 3

In Drive 2 and Manual 2, transmission drive is via the input shaft and forward clutch cylinder. The elements of the transmission function as follows;

- The C2 clutch is engaged to drive the forward sun gear.
- The C1 clutch is engaged to drive the planet carrier.
- The short pinion drives the long pinion clockwise.
- The forward sun gear and the planet carrier are driven clockwise at the same speed therefore there is no relative motion between the sun gear and the pinions.
- The ring gear and output shaft are driven in a clockwise or forward direction at input shaft speed.
- The C4 clutch is applied to bypass the 3-4 OWC and provide engine braking on overrun.

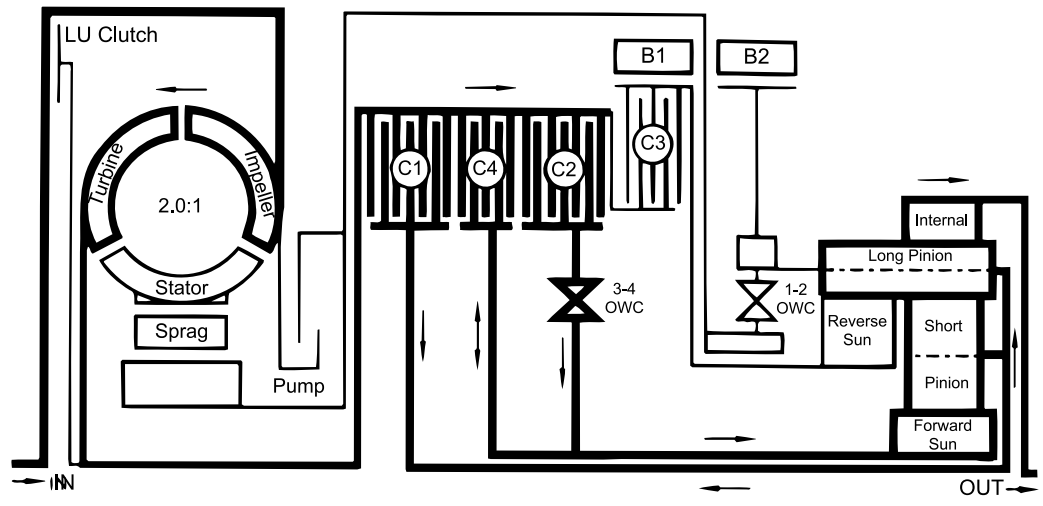
Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoid S1 is switched OFF. S2 is switched OFF.
- With S1 and S2 switched OFF, the 2-3 and 3-4 shift valves are held in the third gear position by line 500 pressure.
- The 1-2 shift valve is held in the third gear position by S1-S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply feed regulator valve and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ra-tio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - The outer apply area of the front servo
  - The 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
  - The 3-4 shift valve for use when the transmission is shifted into fourth gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 sequence valve.
- The clutch apply regulator valve supplies oil (regulated to line 500 pressure multiplied by the valve ratio) to the Clutch Apply Feed (CAF) circuit.

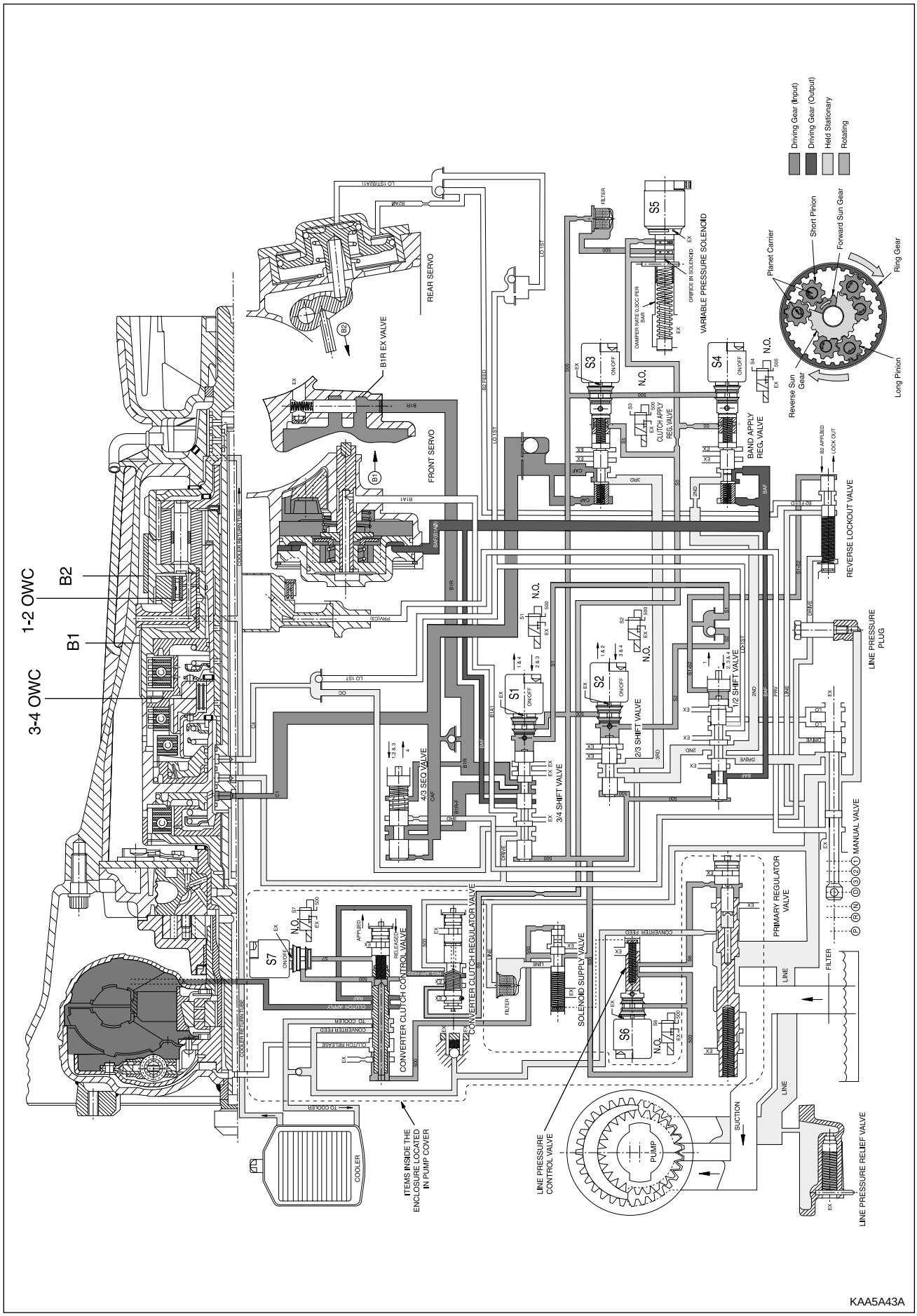
  The CAF oil is directed to;
  - The C1clutch
  - The 4-3 sequence valve
- At the 4-3 sequence valve the CAF oil becomes Band 1 Release Feed (B1R-F) oil, and is directed through the 3-4 shift valve to the spring end of the 4-3 sequence valve, and to the release side of the front servo piston to hold band 1 OFF.
- Drive (line pressure) is routed through the 3-4 shift valve to apply the C4 clutch.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 3 and Manual 3	X	X	-	X	-	-	-	X	-



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DRIVE 3 LOCK UP AND MANUAL 3 LOCK UP



Power Flow - Drive 3 Lock Up and Manual 3 Lock Up

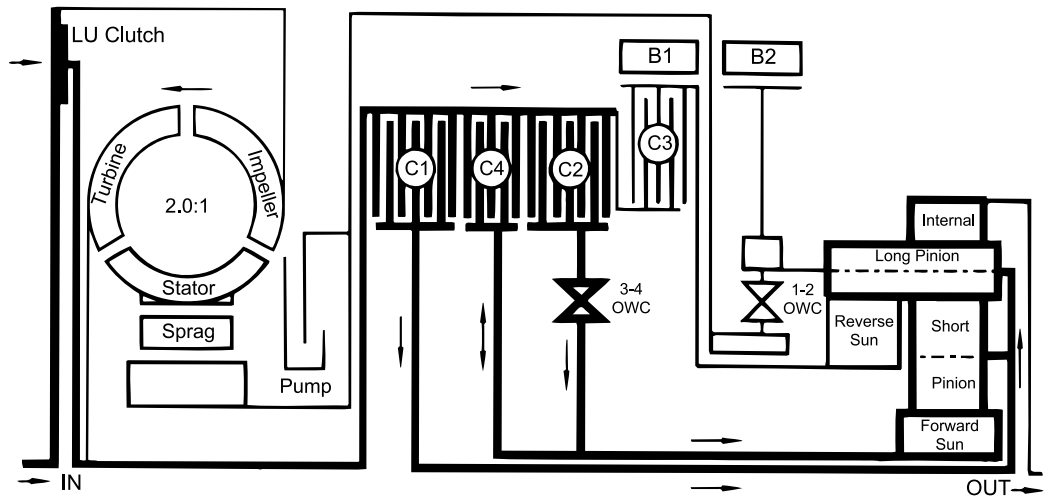
In Drive 3 Lock Up and Manual 3 Lock Up, transmission drive is the same as for Drive 3 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

Control

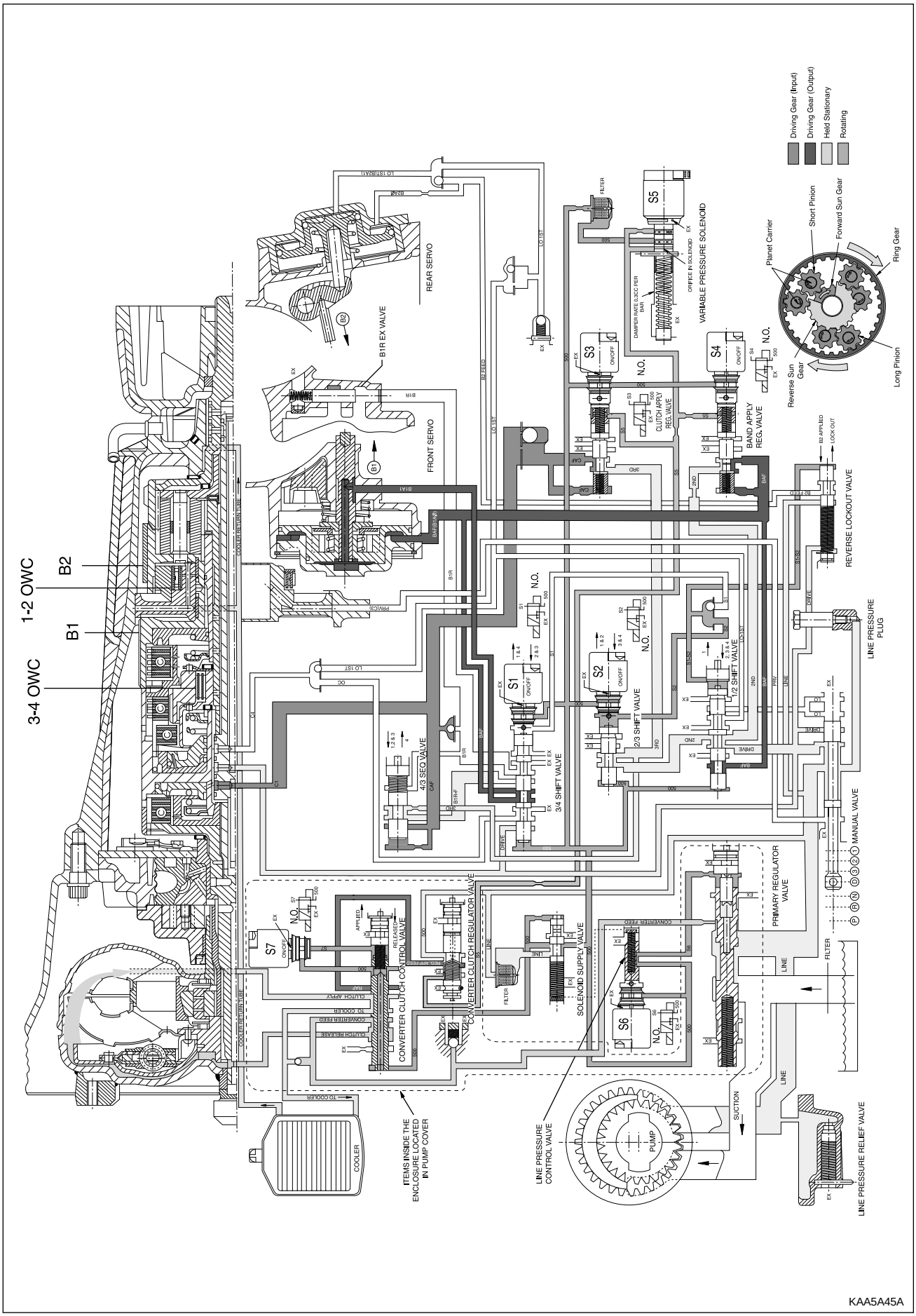
Control for Drive 3 Lock Up and Manual 3 Lock Up is the same as for Drive 3 with the addition of the converter clutch circuit activated by solenoid S7.

- When S7 is switched ON, S7 feed oil to the converter clutch control valve is switched OFF and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, drive oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 3 Lock Up and Manual 3 Lock Up	X	X	-	X	-	-	-	X	X



DRIVE 4 (OVERDRIVE)



Power Flow - Drive 4 (Overdrive)

In Drive 4 (Overdrive), transmission drive is via the input shaft to the forward clutch cylinder.

The elements of the transmission function as follows;

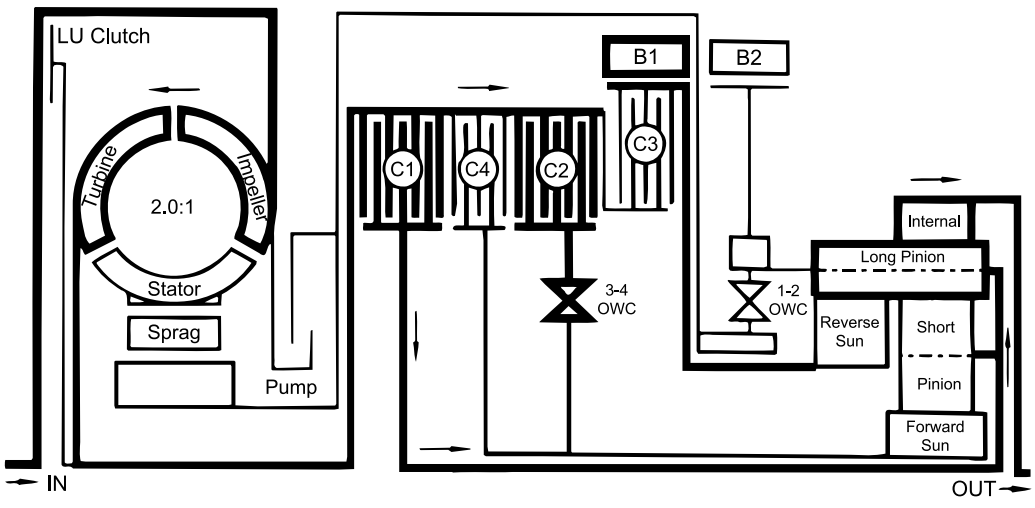
- The C1 clutch is applied to drive the planet carrier clockwise.
- The B1 band is applied to hold the reverse sun gear stationary.
- As the planet carrier tuns, the long pinion walks around the stationary reverse sun gear and rotates around its axis driving the internal ring gear and output shaft in a clockwise or forward direction at a speed faster than the input shaft i.e. in overdrive ratio.
- The forward sun gear is also driven faster than the input shaft and overruns the 3-4 OWC.
- The C2 clutch is engaged to reduce the speed differential across the 3-4 OWC.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

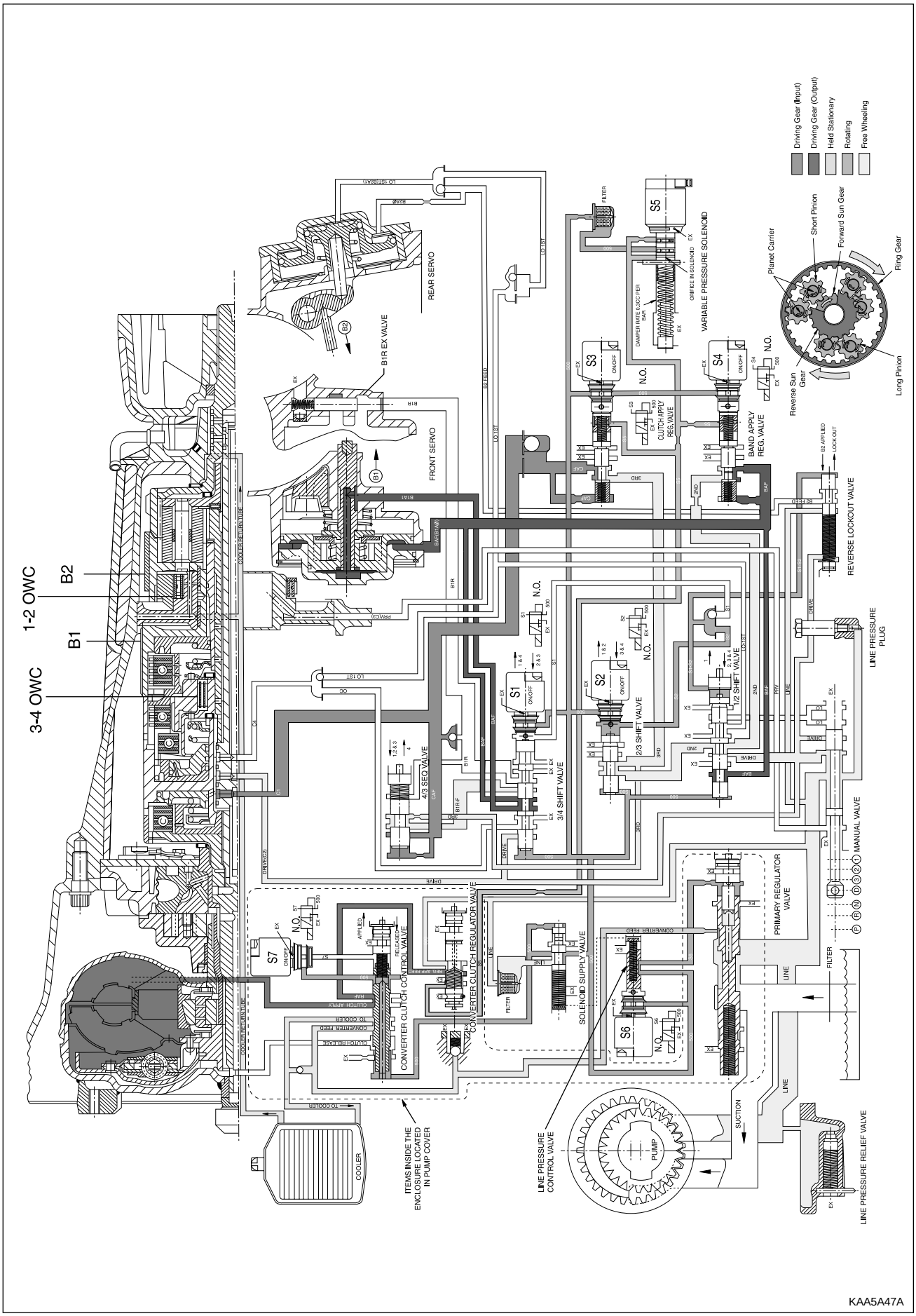
- Solenoid S1 is switched ON. S2 is switched OFF.
- With S1 switched ON, the 3-4 shift valve is held in the fourth gear position by line 500 pressure on the small end of the valve.
- With S2 switched OFF, the 2-3 shift valve is held in the fourth gear position by line 500 pressure on the large end of the valve.
- The 1-2 shift valve is held in the fourth gear position by S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply feed regulator valve, and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ra-tio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - the outer apply area of the front servo
  - the inner apply area of the front servo piston via the 3-4 shift valve
  - the 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 sequence valve.
- The clutch apply regulator valve supplies oil (regulated to line 500 pressure multiplied by the valve ratio) to the Clutch Apply Feed (CAF) circuit.
- The CAF oil is directed to;
  - the C1 clutch
  - the 4-3 sequence valve
- Drive oil (line pressure) from the manual valve engages the C2 clutch.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 4 Overdrive	X	X	-	-	X	-	-	-	-



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DRIVE 4 LOCK UP



Power Flow - Drive 4 Lock Up

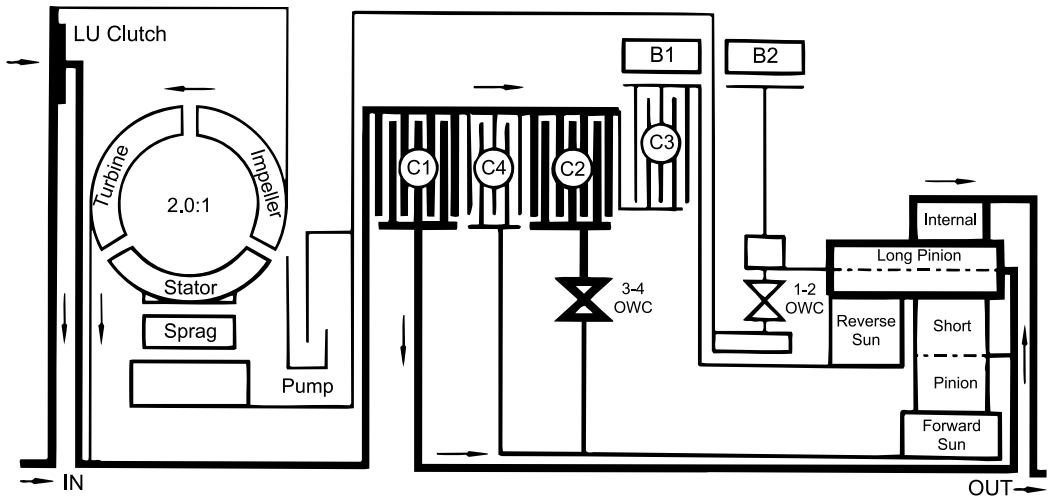
In Drive 4 Lock Up, transmission drive is the same as for Drive 4 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- When S7 is switched ON, S7 feed oil to the converter clutch control valve is switched OFF and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, drived from drive oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 4 Lock Up	X	X	-	-	X	-	-	-	-



KAA5A480

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSIS

BASIC KNOWLEDGE REQUIRED

You must be familliar with some basic electronics to use this section of the Service Manual. They will help you to follow diagnostic procedures.

Notice: Lack of the basic knowledge of this transmission when performing diagnostic procedures could result in incorrect diagnostic performance or damage to transmission components. Do not, under any circumstances, attempt to diagnose a transmission problem without this basic knowledge.

Notice: If a wire is probed with a sharp instrument and not properly sealed afterward, the wire will corrode and an open circuit will result.

Diagnostic test probes are now available that allow you to probe individual wires without leaving the wire open to the environment. These probe devices are inexpensive and easy to install, and they permanently seal the wire from corrosion.

Special Tools

You should be able to use a Digital Volt Meter (DVM), a circuit tester, jumper wires or leads and a line pressure gauge set. The functional check procedure is designed to verify the correct operation of electronic components in the transmission. This will eliminate the unnecessary removal of transmission components.

FUNCTIONAL CHECK PROCEDURE

Begin with the Functional Check Procedure which provides a general outline of how to diagnose automatic transmission. The following functional check procedure will indicate the proper path of diagnosing the transmission by describing the basic checks and then referencing the locations of the specific checks.

- Check the fluid level according to the Fluid Level Service Procedure.
- Check the transmission fluid leak.
- Check if the transmission fluid is not burnt by smell. **Notice:** The specific fluid used in this transmission turns brown during normal operation. Brown fluid does not indicate a transmission fault.
- Ensure that the transmission is not in Limp Home Mode (LHM).
- Check the battery terminals and the earth connections for corrosion or looseness.
- Check that the cooler flow is not restricted.
- Check all electrical plug connections for tightness.
- Use on-board diagnostic tool or a scan tool to see if any transmission trouble codes have been set. Refer to the appropriate “Diagnostic Trouble Code (DTC)” information and repair the vehicle as directed. After repairing the vehicle, perform the road test and verify that the code has not set again.
- Perform the Electrical/Garage Shift Tests.
- Perform the Road Test Procedure in this section.
- Inspect the oil and check for metal or other contaminants in the oil pan.

TRANSMISSION FLUID LEVEL SERVICE PROCEDURE

This procedure is to be used when checking a concern with the fluid level in a vehicle. A low fluid level will result in slipping and loss of drive/ reverse or delay on engagement of drive/ reverse when the vehicle is cold.

The vehicle is first checked for transmission diagnostic messages on the scan tool. If the oil level is low, it is possible to register a vehicle speed signal fault.

The vehicle is to be test driven to determine if there is an abnormal delay when selecting drive or reverse, or loss of drive. One symptom of low fluid level is a momentary loss of drive when driving the vehicle around a corner. Also when the transmission fluid level is low, a loss of drive may occur when the transmission fluid temperature is low.

If there is no loss of drive when the vehicle is driven warm and a vehicle speed signal fault is registered, then fluid should be added to the transmission.

When adding or changing transmission fluid use only Castrol TQ 95 automatic transmission fluid. The use of incorrect fluid will cause the performance and durability of the transmission to be severely degraded.

Fluid Level Diagnosis procedure

1. If the vehicle is at operating temperature allow the vehicle to cool down for two hours, but no greater than four hours. Or if the vehicle is at cool status, start the engine and allow the engine to idle for approximately 5 minutes or, if possible, drive the vehicle for a few kilometers. This will allow the transmission to be within the correct temperature range. Transmission fluid level should be checked at temperature 50 - 60 °C (82 - 140 °F).

Caution: Removal of the fluid filler plug when the transmission fluid is hot may cause injury if fluid drains from the filler hole.

2. With the brake pedal pressed, move the gear shift control lever through the gear ranges, pausing a few seconds in each range. Return the gear shift control lever to P (Park). Turn the engine OFF.

3. Park the vehicle on a hoist, inspection pit or similar raised level surface. The vehicle must be control level to obtain a correct fluid level measurement.
4. Place a fluid container below the fluid filler plug.
5. Clean all dirt from around the fluid filler plug. Remove the fluid filler plug. Clean the filler plug and check that there is no damage to the 'O' ring.
   - If fluid drains through the filler hole the transmission may have been overfilled. When the fluid stops draining the fluid level is correct. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
   - If fluid does not drain through the filler hole, the transmission fluid level may be low. Install the filler pump into the filler hole. Lower the vehicle with the filler pump still connected and partially fill the fluid through the filler hole.

     Start the vehicle in P (Park) with the parking brake and the brake applied. With the engine idling, move the gear shift. control lever through the gear ranges, pausing a few seconds in each range and adding the fluid until gear application is felt.

     Return the gear shift lever to P (Park).

     Turn the engine OFF and raise the vehicle. When the three minutes passed after the engine stopped, remove the filler pump.

     Check if the fluid level is aligned with the bottom of the filler hole. If not, add a small quantity of fluid to the correct level. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
   - If fluid does not drain through the filler hole although adding a total of 1.5 liters, the transmission should be inspected for fluid leaks and any leaks should be fixed before setting the transmission fluid level.
6. When the fluid level checking procedure is completed, wipe any fluid around the filler plug with a rag or shop towel.

Fluid Level Set After Service

1. Depending on the service procedure performed, add the following amounts of fluid through the filler plug hole prior to adjusting the fluid level:

Converter empty	8.0 liters (8.5 quarts)
Converter full	3.8 liters (4.0 quarts)

2. Follow steps 1 through 4 of the Fluid Level Diagnosis Procedure.
3. Clean all dirt from around the fluid filler plug. Remove the fluid filler plug. Clean the filler plug and check that there is no damage to the 'O' ring.
4. Lower the vehicle with the filler pump still connected and start the vehicle in P (Park) with the parking brake and the brake applied. With the engine idling, move the gear shift control lever through the gear ranges, pausing a few seconds in each range and adding the fluid until gear application is felt.

   Then add an additional 0.5 litres of fluid. Return the gear shift lever to P (Park). Turn the engine OFF and raise the vehicle. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
5. Drive the vehicle at 3.5 to 4.5 kilometers with light throttle so that the engine does not exceed 2500 rpm.

   This should result in the transmission temperature being in the range 50 - 60 °C (82 - 140 °F). With the brake applied, move the shift lever through the gear ranges, pausing a few seconds in each range at the engine idling.
6. Return the gear shift lever to P (Park).

   Turn the en-gine OFF and raise the vehicle on the hoist, if applicable, ensuring the vehicle is level. When the three minutes passed after the engine stopped, remove the filler plug.

   Check if the fluid level is aligned with the bottom of the filler hole. If not, add a small quantity of fluid to the correct level. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
7. Wipe any fluid around the filler plug with a rag or shop towel.

FLUID LEAK DIAGNOSIS AND REPAIR

The cause of most external leaks can generally be located and repaired with the transmission in the vehicle.

Methods for Locating Leaks

General Method

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Drive the vehicle for approximately 25 km (15 miles) or until the transmission reaches normal operating temperature (88 °C, 190 °F).
4. Park the vehicle over clean paper or cardboard.
5. Turn the engine OFF and look for fluid spots on the paper.
6. Make the necessary repairs to correct the leak.

Powder Method

1. Thoroughly clean the suspected leak area.
2. Apply an aerosol type powder (foot powder) to the suspected leak area.
3. Drive the vehicle for approximately 25 km (15 miles) or until the transmission reaches normal operating temperature (88 °C, 190 °F).
4. Turn the engine OFF.
5. Inspect the suspected leak area and trace the leak path through the powder to find the source of the leak.

6. Make the necessary repairs.

Dye and Black Light Method

1. Add dye to the transmission through the transmission fluid filler plug. Follow the manufacturer's recommen-dation for the amount of dye to be used.
2. Use the black light to find the fluid leak.
3. Make the necessary repairs.

Repairing the Fluid Leak

Once the leak point is found the source of the leak must be determined. The following list describes the potential causes for the leak:

- Fasteners are not torqued to specification.
- Fastener threads and fastener holes are dirty or corroded.
- Gaskets, seals or sleeves are misaligned, damaged or worn.
- Damaged, warped or scratched seal bore or gasket surface.
- Loose or worn bearing causing excess seal or sleeve wear.
- Case or component porosity.
- Fluid level is too high.
- Plugged vent or damaged vent tube.
- Water or coolant in fluid.
- Fluid drain back holes plugged.

ELECTRICAL / GARAGE SHIFT TEST

This preliminary test should be performed before a hoist or road test to make sure electronic control inputs are connected and operating. If the inputs are not checked before operating the transmission, a simple electrical condition could be misdiagnosed as a major transmission condition.

A scan tool provides valuable information and must be used on the automatic transmission for accurate diagnosis.

1. Move gear shift control lever to P (Park) and set the parking brake.
2. Connect scan tool to Data Link Connector (DLC) terminal.
3. Start engine.
4. Turn the scan tool ON.
5. Verify that the appropriate signals are present. These signals may include:
   - ENGINE SPEED
   - VEHICLE SPEED
   - THROTTLE POSITION
   - ACCEL. PEDAL POSITION
   - TRANSMISSION GEAR STATE
   - GEAR SHIFT LEVER POSITION
   - TRANSMISSION FLUID TEMPERATURE
   - CLOSED THROTTLE POSITION LEARN
   - OPEN THROTTLE POSITION LEARNT
   - CLOSED ACCEL. PEDAL POSITION LEARNT
   - OPEN ACCEL. PEDAL POSITION LEARNT
   - A/C COMPRESSOR STATUS
   - KICKDOWN SWITCH STATUS
   - 4WD STATUS
   - MODE SWITCH
   - THROTTLE POSITION VOLTAGE
   - GEAR SHIFT LEVER POSITION VOLTAGE
   - TRANS. FLUID TEMPERATURE VOLTAGE
   - A/C SWITCH
   - KICKDOWN SWITCH VOLTAGE
   - 4WD LAMP LOW VOLTAGE
   - 4WD LAMP HIGH VOLTAGE
   - MODE SWITCH VOLTAGE
   - BATTERY VOLTAGE
6. Monitor the A/C COMPRESSOR STATUS signal while pushing the A/C switch.
   - The A/C COMPRESSOR STATUS should come ON when the A/C switch is pressed, and turn OFF when the A/C switch is repushed.
7. Monitor the GEAR SHIFT LEVER POSITION signal and move the gear shift control lever through all the ranges.
   - Verify that the GEAR SHIFT LEVER POSITION value matches the gear range indicated on the instrument panel or console.
   - Gear selections should be immediate and not harsh.
8. Move gear shift control lever to neutral and monitor the THROTTLE POSITION signal while increasing and decreasing engine speed with the accelerator pedal.
   - THROTTLE POSITION should increase with engine speed.

ROAD TEST PROCEDURE

- Perform the road test using a scan tool.
- This test should be performed when traffic and road conditions permit.
- Observe all traffic regulations.

ELECTRONIC ADJUSTMENTS

Idle Speed Adjustments

Carry out the adjustments to the idle speed as detailed in the workshop manual.

Vehicle Coding

The vehicle coding is integrated as part of the diagnostic software. A scan tool has the function to code the ve-hicle through the K-line.

Throttle Clearing

The leant throttle clearing routine uses the mode switch and gear lever. Carry out the following steps to complete the automated throttle clearing procedure:

1. Switch ignition 'ON' with handbrake applied and engine 'OFF'.
2. Select the selector lever to 1st gear and 'WINTER' mode.
3. Move the selector lever to 2nd gear and 'ECONO' or 'POWER' mode.
4. Move the selector lever to 3rd gear and 'WINTER' mode.

Throttle Position Calibration

Should the throttle position data stored in the TCU be lost or be out of specification, as indicated by a diagnostic trouble message, it may be re-established by the following procedure.

- Check that the hot engine idle speed is within specfication.
- Allow the engine to idle in 'Drive' for 60 seconds with the air conditioner (if fitted) turned off. The closed throttle reference point in the TCU has now been set.
- Switch the engine off but leave the ignition on. Hold the accelerator pedal on the floor for 60 seconds. The wide open throttle reference point in the TCU has now been set.

SYMPTOM DIAGNOSIS

DRIVE FAULTS

Condition	Possible Causes	Action
No Drive in D	• Insufficient auto transmission fluid.	• Check the fluid level. Top up as necessary.
	• Blocked feed in C1/C2 cylinder.	• Inspect and clean C1/C2 feed.
	• 'Z' link displaced.	• Reinstall/renew the 'z' link.
	• Primary Regulator Valve (PRV) jammed open.	• Remove, clean and re-install the PRV.
	• Overdrive shaft or input shaft seal rings failed.	• Inspect and replace as necessary.
	• 3-4 or 1-2 One Way Clutch (OWC) installed backwards or failed.	• Inspect and replace as necessary.
	• C2 piston broken or cracked.	• Inspect and replace as necessary.
No Drive in Reverse No engine braking in Manual 1 Engine braking in Manual 1 is OK	• Rear band or servo faulty.	• Check servo adjustment or replace rear band as necessary.
	• Failure in C3, C3 hub or C1/C2 cylinder.	• Check for failure in C3, C3 hub or C1/C2 cylinder. Repair as necessary.
	• Damaged input shaft sealing rings.	• Inspect and replace as necessary.
No drive in Drive and Reverse	• Jammed Primary Regulator Valve (PRV).	• Inspect and clean PRV.
	• Damaged/broken pump gears.	• Inspect and replace pump gears as necessary.
	• Dislodged output shaft snap ring.	• Inspect and repair as necessary.

FAULTY SHIFT PATTERN

Condition	Possible Causes	Action
2-3 shift only (no 4th or 1st)	• S1 always OFF.	• Inspect S1. Repair or replace as necessary. • Check for 12 Volts applied to S1 at all times or for wiring fault.
1-4 shift only1-3-4 (Delayed 1-2 shift)	• S1 always ON.	• Inspect S1. Repair or replace as necessary. • Check for 12 Volts applied to S1 at all times or for wiring fault.
4-3 shift only	• S2 always OFF.	• Inspect S2. Repair or replace as necessary. • Check for open circuit or wiring fault.
1-2-Neutral (1st over run)	• S2 always ON.	• Inspect S2. Repair or replace as necessary. • Check for open circuit or wiring fault.
1-3 shift only	• B1 failed. • Loose band adjustment. • Front servo piston or seal failed. • S1/S2 ball misplaced,	• Inspect and repair as necessary. • Inspect and adjust as necessary. • Inspect and repair as necessary. • Inspect and replace or refit as necessary
1-3-4 only	• Smaller 'O' ring on front servo piston failed or missing. • 2-3 shift valve jammed.	• Inspect 'O' ring. Refit or replace as necessary. • Inspect the 2-3 shift valve. Repair or replace as necessary.
1-2-1 only	• C1 clutch failed or slipping in 3rd and 4th. (Gives 1st in 3rd and 2nd in 4th.)	• Inspect C1 clutch. Repair or replace as necessary.
No manual 4-3, 3-2 or 2-1	• Over-run Clutch (OC) /low ball misplaced.	• Inspect ball. Refit or replace as necessary.
No manual 1st	• Rear band slipping when hot. • Reverse/Low-1st ball misplaced. • Rear servo inner 'O' ring missing.	• Inspect rear band adjustment. Adjust as necessary. • Inspect ball. Refit or replace as necessary. • Inspect 'O' ring. Refit or replace as necessary.
1st gear only or 2nd,3rd, and 4th only	• 1-2 shift valve jammed.	• Inspect the 1-2 shift valve. Repair or replace as necessary.
1st and 2nd only or 1st, 3rd and 4th only	• 2-3 shift valve jammed.	• Inspect the 2-3 shift valve. Repair or replace as necessary.
1st, 2nd and 4th only or 1st, 2nd, and 3rd (tied up in 3rd)	• Inhibitor switch fault, 1-2-3 only. • 3-4 shift valve jammed.	• Inspect inhibitor switch. Repair or replace as necessary. • Inspect the 3-4 shift valve. Repair or replace as necessary.

Condition	Possible Causes	Action
Harsh 2-3 shift	• Jammed band 1 release valve.	• Inspect the release valve. Repair or replace as necessary.
	• Faulty S3 or S2 solenoid.	• Inspect S3 or S2. Repair or replace as necessary.
	• Faulty clutch apply regulator valve.	• Inspect the regulator valve. Repair or replace as necessary.
	• Missing or damaged clutch apply feed ball.	• Inspect the ball. Refit or replace as necessary.
	• Damaged input shaft sealing rings.	• Inspect the sealing rings. Refit or replace as necessary.
	• Damaged C1 piston 'O' rings.	• Inspect the 'O' rings. Refit or replace as necessary.
	• Damaged or dislodged C1 piston bleedball.	• Inspect the bleed ball. Refit or replace as necessary.
Harsh 3-4 shift	• Faulty S1 or S4 solenoid.	• Inspect S1 or S4. Repair or replace as necessary.
	• Jammed band 1 release valve.	• Inspect the release valve. Repair or replace as necessary.
	• Incorrect front band adjustment.	• Inspect the band. Adjust as necessary.
	• Damaged front servo piston 'O' rings.	• Inspect the 'O' rings. Refit or replace as necessary.
	• Faulty or damaged variable pressure solenoid (S5).	• Inspect S5. Repair or replace as necessary.
	• Faulty band apply regulator valve.	• Inspect the regulator valve. Repair or replace as necessary.

SHIFT QUALITY FAULTS

Condition	Possible Causes	Action
All Shifts Firm	• Incorrect auto transmission fluid (ATF). • S5 faulty won, or incorrectly fitted. • Band apply and clutch apply regulator springs misplaced.	• Drain and fill with specified ATF. • Check that S5 is fitted correctly, or replace S5. • Inspect band apply and clutch apply regulator springs. Refit or replace as necessary
Manual 4-3-2-1 is soft delayed or missing	• Over-run Clutch (OC) /Low-1st ball misplaced. • C4 clutch worn or burnt. • C4 wave plate not lined up with the holes in the piston.	• Inspect the ball. Refit or replace as necessary. • Inspect C4 clutch. Replace or repair as necessary. • Check the alignment. Realign as necessary.
Firm 1-2 Hot	• S5 worn.	• Inspect S5 and replace as necessary.
4th Tied up	• Incorrect C4 pack clearance. • Damaged C4 clutch. • Cracked C2 piston (leaking into C4).	• Check the clearance and adjust as necessary. • Inspect C4. Repair or replace as necessary. • Inspect piston. Repair or replace as necessary.
Tied up on 2-3	• Incorrect band adjustment • Front servo plastic plug missing • B1R spring broken.	• Inspect and adjust band as necessary. • Replace the plug. • Replace the spring.
Flare on 2-3	• B1R spring/plug left out. • C1/B1R ball misplaced. • C1 clutch damaged. • Restriction in C1 feed. • C1 piston check ball jammed. • Overdrive or input shaft sealing rings damaged.	• Replace the spring/plug. • Refit the ball. • Inspect the clutch. Repair the clutch as necessary. • Inspect and clean C1 feed. • Replace the piston. • Inspect and replace the sealing rings and/or shaft as necessary.
Slips in 4th	• C1/B1R ball misplaced. • Overdrive or input shaft sealing rings damaged. • C1 clutch damaged.	• Inspect and replace the ball. • Inspect and replace the sealing rings and/or shaft as necessary. • Inspect and repair the C1 clutch as necessary.
Slips in reverse, no manual 1st	• Rear band incorrectly adjusted or damage • Low-1st check ball misplaced.	• Inspect and adjust or replace rear band. • Inspect and re-fit the ball.
Flare on 4-3, Flare on 3-2	• 4-3 sequence valve in backwards.	• Refit the valve.
Firm Manual low shift-high line press.	• Low-1st check ball misplaced.	• Replace the ball.

Condition	Possible Causes	Action
Harsh 1-2 shift	• Faulty inhibitor switch.	• Check the resistance. Replace the inhibitor switch as necessary.
	• Faulty throttle position sensor.	• Inspect and replace the sensor as necessary.
	• Incorrect front band adjustment.	• Inspect and adjust the band as necessary.
	• Damaged front servo piston 'O' rings.	• Inspect and replace the 'O' rings as necessary.
	• Faulty or damaged variable pressure solenoid (S5).	• Inspect, repair or replace S5 as necessary.
	• Faulty S1 or S4 solenoid.	• Inspect, repair or replace S1 or S4 as necessary.
	• Faulty Band Apply Regulator (BAR) valve.	• Inspect, repair or replace the BAR as necessary.
	• Misassembled front servo return spring.	• Inspect and repair as necessary.
Stalls when Drive Or Reverse	• Jammed Converter Clutch Control Valve (CCCV).	• Inspect and clean CCCV.
Selected Shudder on Rolldown	• Faulty solenoid 7.	• Inspect, repair or replace as necessary.

AFTER TEARDOWN FAULTS

Condition	Possible Causes	Action
C2 burnt	• Gear shift lever linkage out of adjustment.	• Inspect, repair C2 and adjust the linkage as necessary.
	• S6 foiled - stuck low.	• Repair C2. Inspect, repair or replace S6 as necessary.
	• Overdrive/output shaft sealing rings damaged.	• Repair C2. Inspect, replace the sealing rings and/or shaft as necessary.
	• C2 piston cracked.	• Repair C2. Inspect, repair or replace the C2 piston as necessary.
C4 burnt	• Incorrect C4 pack clearance.	• Inspect C4 and repair as necessary. • Inspect and adjust the C4 pack clearance as necessary.
	• C4 wave plate not lined up properly.	• Repair C4. Inspect and realign the wave plate as necessary.
	• Overdrive or output shaft sealing rings damaged.	• Repair C4. Inspect and realign the sealing rings and/or shaft as necessary.
	• C2 piston cracked.	• Repair C4. Inspect and replace the C2 piston as necessary.
	• Over-run Clutch (OC) /low-1st ball misplaced.	• Repair C4. Inspect and refit the ball as necessary.
B1 burnt	• B1R spring broken.	• Inspect and repair B1 and replace the spring as necessary.
	• Input shaft sealing ring cut.	• Replace sealing ring.
	• C1/B1R ball misplaced.	• Repair B1. Refit the ball as necessary.
C1 burnt	• B1R spring left out.	• Inspect and repair C1 and replace the spring.
	• Overdrive or input shaft sealing rings damaged.	• Repair C1. Inspect and replace the sealing tongs and/or shaft as necessary.
	• C1 piston cracked.	• Repair C1. Inspect and replace the C1 piston as necessary.
	• Ball capsule jammed.	• Repair C1. Inspect and refit the capsule as necessary.
	• 4-3 sequence valve in backwards.	• Repair C1. Inspect and refit the valve as necessary.
	• Clutch Apply Feed (CAF) /B1R ball left out.	• Repair C1. Inspect and replace the ball as necessary.
B2 burnt (Slips in reverse - no manual 1st)	• Rear band incorrectly adjusted or damaged.	• Inspect and adjust the band as necessary.
	• Reverse-low/first ball misplaced.	• Inspect and refit the ball as necessary.

Condition	Possible Causes	Action
Firm converter lock or unlock	• Input shaft 'O' ring missing or damaged. • Converter clutch regulator valve in backwards.	• Inspect and replace the 'O' ring as necessary. • Inspect and refit the valve as necessary.
No lock up at light throttle	• Input shaft 'O' ring missing or damaged. • C1 bias valve in backwards.	• Inspect and replace the 'O' ring as necessary. • Inspect and refit the valve as necessary.

TROUBLE CODE DIAGNOSIS - GASOLINE VEHICLE

TCM DIAGNOSTIC SYSTEM OVERVIEW

Notice: To prevent Transmission Control Module (TCM) damage. The ignition key must be OFF when disconnection or reconnection the power to the TCM (for example bttery cable, TCM pigtail connector, TCM fuse, jumper cables, etc.).

When the TCM detects a system fault, a Diagnostic Trouble Code (DTC) is set in the TCM. This code is present while the fault conditions are met and is stored as a 'History DTC' until cleared. Condition for setting and clearing each TCM DTC are provided in the relevant sections.

In the case where the vehicle type is certified for Eure On-Board Diagnostic (EOBD) compliance, the Engine Control Module (ECM) provides the communication link to the EOBD scan tool to pass on any EOBD relevant codes from the TCM. The table below contains a list of all supported DTCs and the classification of each for EOBD purposes. Where a type B DTC has been set in an EOBD vehicle, the response to the fault may include action by the ECM, including the illumination of the Malfunction Indicator Lamp (MIL). Refer to *Section 1F, Engine Control,* for details on EOBD system function, checks and fault clearing.

CLEARING TROUBLE CODES

TCM DTCs should be cleared after repairs have been completed. Some diagnostic tables will tell you to clear the codes before using the chart, which will help to find the cause of the problem more quickly. Always note the DTCs present before clearing - this information may be helpful in the diagnostic process."

DIAGNOSTIC TROUBLE CODES

DTC	Description	Type
P0706	Transmission Range Sensor Circuit Range/Performance	B
P0707	Transmission Range Sensor Circuit Low input	B
P0708	Transmission Range Sensor Circuit High input	B
P0710	Transmission Fluid Temperature Sensor Circuit Malfunction	D
P0790	Normal/Performance Switch Circuit Malfunction	D
P1703	Engine Speed Signal Error	D
P1704	Shaft Speed Signal Error	D
P1708	TCM Supply Voltage Low	D
P1709	TCM Supply Voltage High	D
P1712	Kickdown Switch Circuit Malfunction	D
P1713	Pedal Signal Error	D
P1714	EEPROM Vehicle Code Error	D
P1715	VPS Offset Error	D
P1717	RAM Error	D
P1718	ROM Error	D
P1719	CAN Bus Error	D
P1720	EEPROM Error	D
P1721	Throttle Signal Error	D
P1722	Vehicle Type Determination Error	D
P1733	Solenoid 1 Circuit Open	D
P1734	Solenoid 2 Circuit Open	D
P1735	Solenoid 3 Circuit Open	D
P1736	Solenoid 4 Circuit Open	D
P1737	Solenoid 5 Circuit Open	D

DIAGNOSTIC TROUBLE CODES (Cont'd)

DTC	Description	Type
P1738	Solenoid 6 Circuit Open	D
P1739	Solenoid 7 Circuit Open	D
P1741	Solenoid 1 Circuit Short	D
P1742	Solenoid 2 Circuit Short	D
P1743	Solenoid 3 Circuit Short	D
P1744	Solenoid 4 Circuit Short	D
P1745	Solenoid 5 Circuit Short	D
P1746	Solenoid 6 Circuit Short	D
P1747	Solenoid 7 Circuit Short	D

DTC Types

Each DTC is directly related to a diagnostic test. The Diagnostic management system sets DTCs based on the failure of the tests during a driving cycle or cycles. The following are the two types of DTCs and the characteristics of those codes;

Type B

- Emissions related.
- EOBD system "Armed" after one driving cycle with a fail.
- EOBD system "Disarmed" after one driving cycle with a pass.
- Illuminates the MIL on the second con-secutive driving cycle with a fail.
- TCM stores a history DTC on the first driving cycle with a fail.
- EOBD system stores a history DTC on the second consecutive driving cycle with a fail, (the DTC will be armed after the first fail).
- EOBD system stores a freeze frame on the second consecutive driving cycle with a fail, (if empty).

Type D

- Non-Emissions related.
- Does not request illumination of any lamp.
- Stores a history DTC on the first driving cycle with a fail.
- EOBD system does not store a freeze frame.

TROUBLE CODE DIAGNOSIS - DIESEL VEHICLE

TCM DIAGNOSTIC SYSTEM OVERVIEW

Notice: To prevent Transmission Control Module (TCM) damage. The ignition key must be OFF when disconnection or reconnection the power to the TCM (for example bttery cable, TCM pigtail connector, TCM fuse, jumper cables, etc.).

When the TCM detects a system fault, a Diagnostic Trouble Code (DTC) is set in the TCM. This code is present while the fault conditions are met and is stored as a 'History DTC' until cleared. Condition for setting and clearing each TCM DTC are provided in the relevant sections.

CLEARING TROUBLE CODES

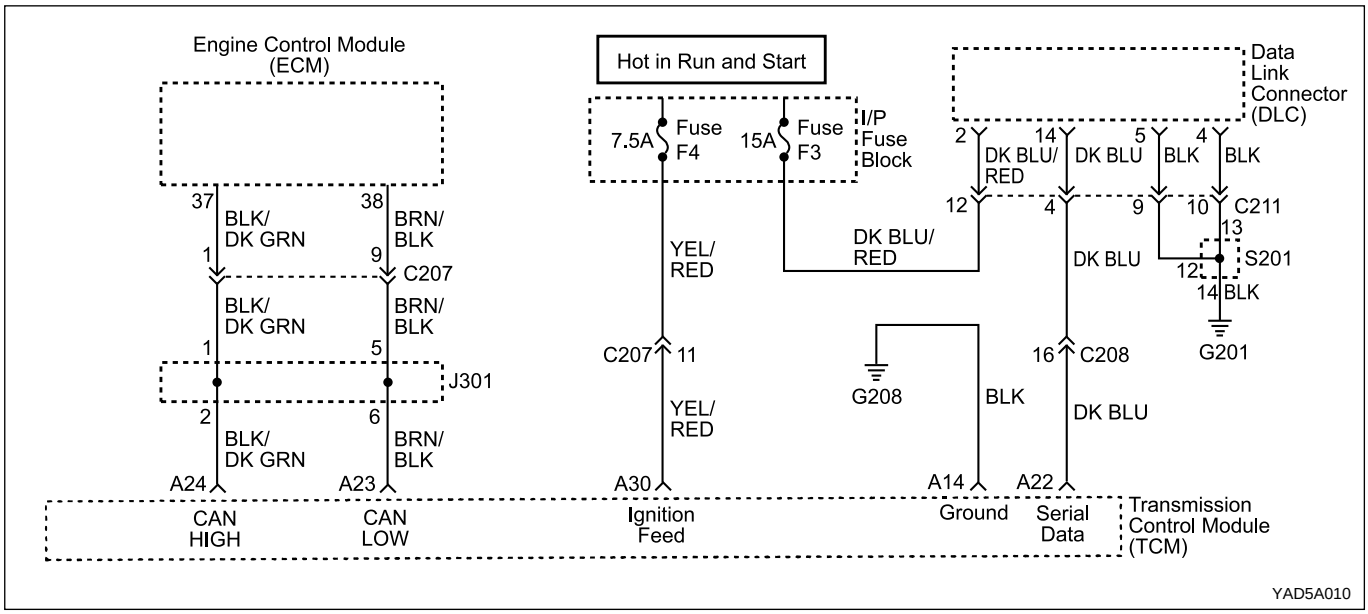
TCM DTCs should be cleared after repairs have been completed. Some diagnostic tables will tell you to clear the codes before using the chart, which will help to find the cause of the problem more quickly. Always note the DTCs present before clearing - this information may be helpful in the diagnostic process."

DIAGNOSTIC TROUBLE CODES

DTC	Description
P0707	Transmission Range Sensor Circuit Low Input
P0708	Transmission Range Sensor Circuit High Input
P0710	Transmission Fluid Temperature Sensor Circuit Malfunction
P0790	Normal/Performance Switch Circuit Malfunction
P1703	Engine Speed Signal Error
P1704	Shaft Speed Signal Error
P1708	TCM Supply Voltage Low
P1709	TCM Supply Voltage High
P1710	Air Conditioning Switch Circuit Malfunction
P1712	Kickdown Switch Circuit Malfunction
P1714	EEPROM Vehicle Code Error
P1715	VPS Offset Error
P1716	Throttle Not Learnt Error
P1717	RAM Error
P1718	ROM Error
P1720	EEPROM Error
P1721	Throttle Signal Error
P1722	Vehicle Type Determination Error
P1733	Solenoid 1 Circuit Open
P1734	Solenoid 2 Circuit Open
P1735	Solenoid 3 Circuit Open
P1736	Solenoid 4 Circuit Open
P1737	Solenoid 5 Circuit Open
P1738	Solenoid 6 Circuit Open
P1739	Solenoid 7 Circuit Open
P1741	Solenoid 1 Circuit Short
P1742	Solenoid 2 Circuit Short
P1743	Solenoid 3 Circuit Short
P1744	Solenoid 4 Circuit Short

DIAGNOSTIC TROUBLE CODES (Cont'd)

DTC	Description
P1745	Solenoid 5 Circuit Short
P1746	Solenoid 6 Circuit Short
P1747	Solenoid 7 Circuit Short



TCM DIAGNOSTIC SYSTEM CHECK

Circuit Description

The Transmission Control Module (TCM) Diagnistic System Check is the starting point for any driveability complaint diagnosis. Before using this procedure, perform a careful visual/ physical check of the Transmission Control Module (TCM) and the transmission grounds for cleanliness and tightness.

The TCM Diagnostic System Check is an organized approach to identifying a problem created by an electronic transmission control system malfunction.

Diagnostic Aids

An intermittent fault may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the TCM harness and connections for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

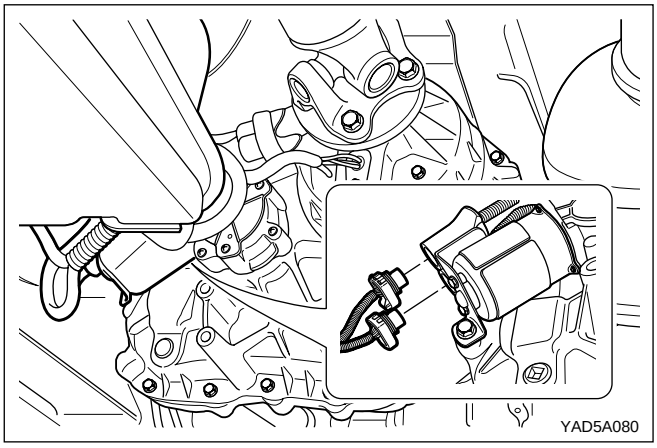
TCM Diagnostic System Check

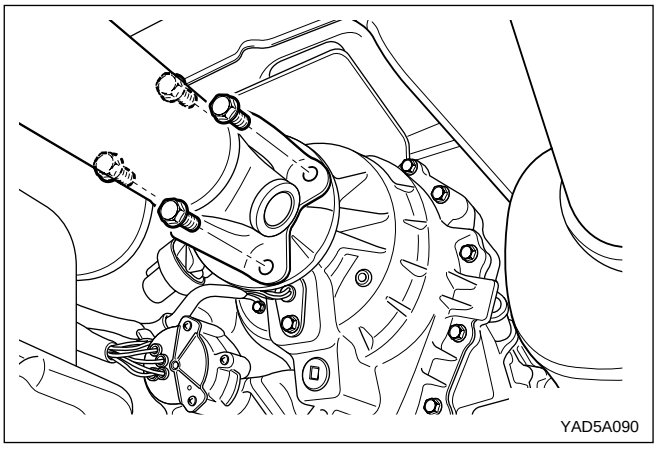
Step	Action	Value(s)	Yes	No
1	1 Turn the ignition OFF. 2. Install the scan tool. 3. Turn the ignition ON, with the engine OFF. 4. Attempt to display the Transmission Control Module (TCM) Data List with the scan tool. Does the scan tool display the TCM data?	-	Go to Step 2	Go to Step 3
2	Select the Trouble Code with the scan tool. Are any Diagnostic Trouble Codes (DTCs) stored?	-	Go to applicable DTC table	System OK, Check Complete

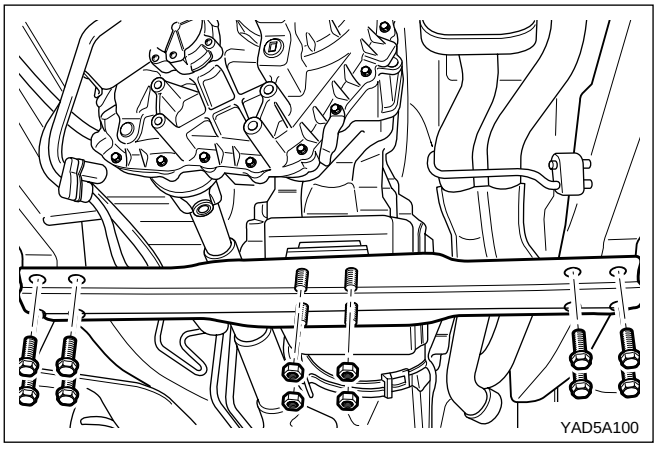
TCM Diagnostic System Check (Cont'd)

Step	Action	Value(s)	Yes	No
3	1. Turn the ignition OFF. 2. Disconnect the TCM connector B. 3. Turn the ignition ON. 4. Check the serial data line from TCM connector terminal A22 to Data Link Connector (DLC) connector terminal 14 for an open, short to ground, or short to voltage. Also, check the DLC ignition feed circuit for an open or short to ground and the DLC ground circuit for an open. Is a problem found?	-	Go to Step 4	Go to Step 5
4	Repair the open, short to ground or short to voltage in the serial data circuit or the DLC ignition feed circuit or the DLC ground circuit. Is a repair complete?	-	Go to Step 1	-
5	Check the TCM ignition feed circuit for an open or short to ground and the TCM ground circuit for an open.	-	Go to Step 6	Go to Step 7
6	Is a problem found? Repair the open or short to ground in the TCM ignition feed circuit or the TCM ground circuit.	-	Go to Step 1	-
7	Is a repair complete? 1. Turn the ignition OFF. 2. Disconnect the TCM connector.	-	Go to Step 1	-

REPAIR INSTRUCTIONS







ON-VEHICLE SERVICE

TRANSMISSION

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the connectors from transfer case.
3. Disconnect the speedometer connector from transfer case.
4. Disconnect the inhibitor connector, gear position sensor connector and transmission case connector.
5. Remove the rear propeller shaft bolts.

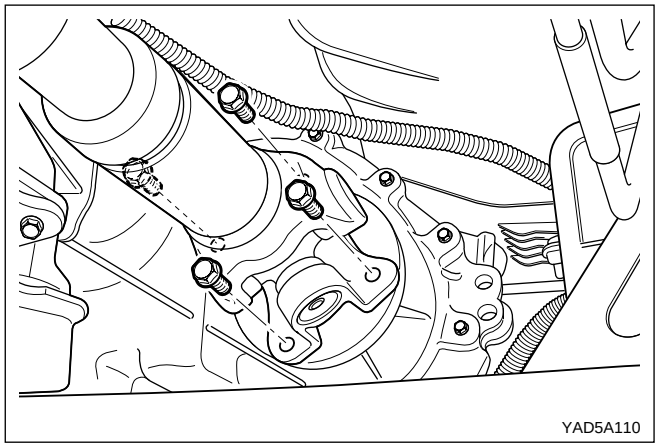
Installation Notice

Tightening Torque	70-80 N•m (52-59 lb-ft)

6. Remove the cross member bolts and nuts.

Installation Notice

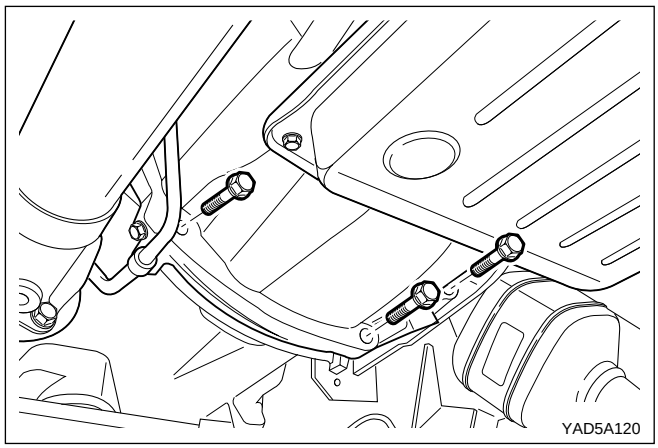
Tightening Torque	70-80 N•m (52-59 lb-ft)



7. Remove the front propeller shaft bolts from transfer case.

Installation Notice

Tightening Torque	70-80 N•m (52-59 lb-ft)

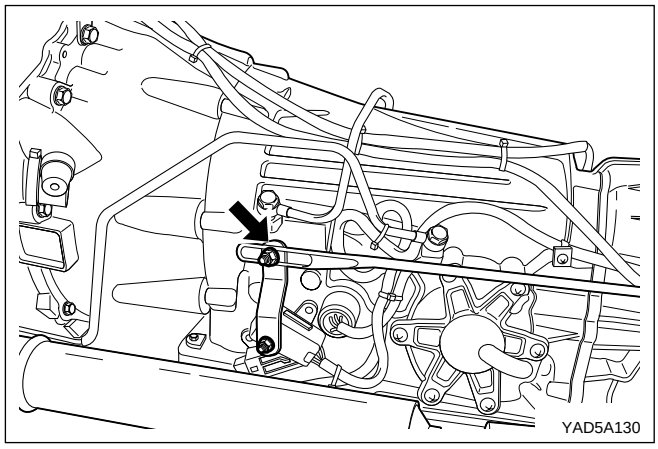


8. Remove the transfer case-to-transmission housing bolts and remove the transfer case.

Installation Notice

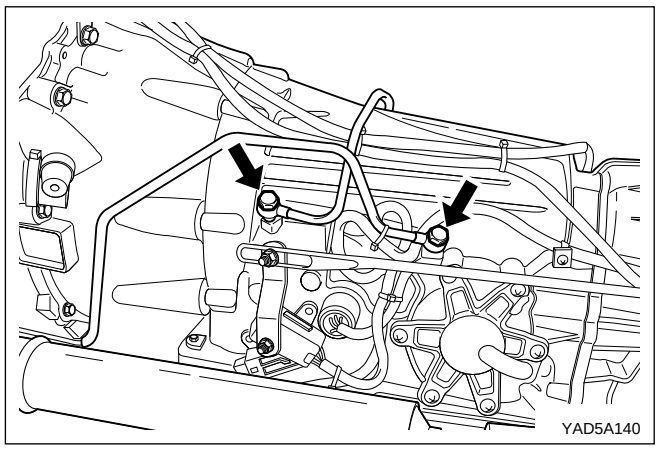
Tightening Torque	44 N•m (33 lb-ft)

9. Disconnect the 10-Pins Plug connector from transmission.



10. Separate the locking clip on shift lever and remove the shift rod.

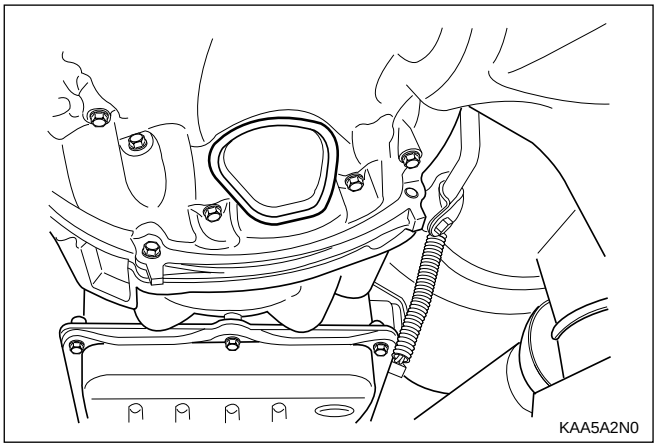
Notice: Removal and installation performed when the shift procedure should be lever is in 'D' range.



11. Remove the oil cooler pipes.

Installation Notice

Tightening Torque	25-35 N•m (18-26 lb-ft)

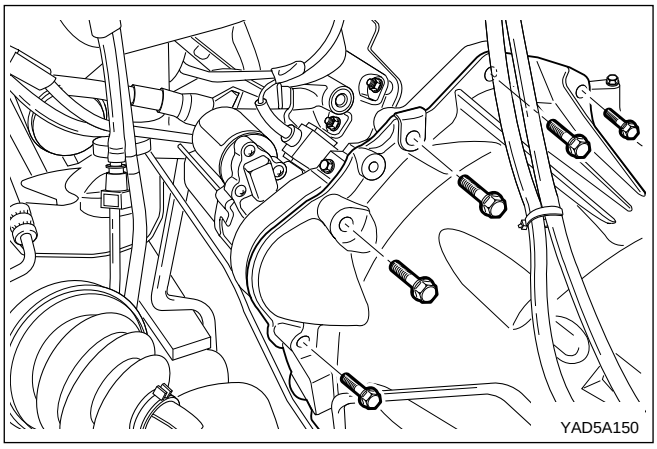


12. Remove the service hole cover in the engine block.
13. Put the alignment mark for installation, and remove the six mounting bolts for torque converter from drive plate through the service hole by rotating the engine and remove the torque converter.

    Installation Notice

Tightening Torque	42 N•m (31 lb-ft)

    - Screw the six bolts mounting the torque converter through the service hole by using a mirror and rotating the engine.
14. Remover the starter. Refer to Section *1E, Engine Electrical*.



15. Remove the extension housing to case bolts and remove the transmission assembly.

    Installation Notice

Tightening Torque	55-65 N•m (41-48 lb-ft)

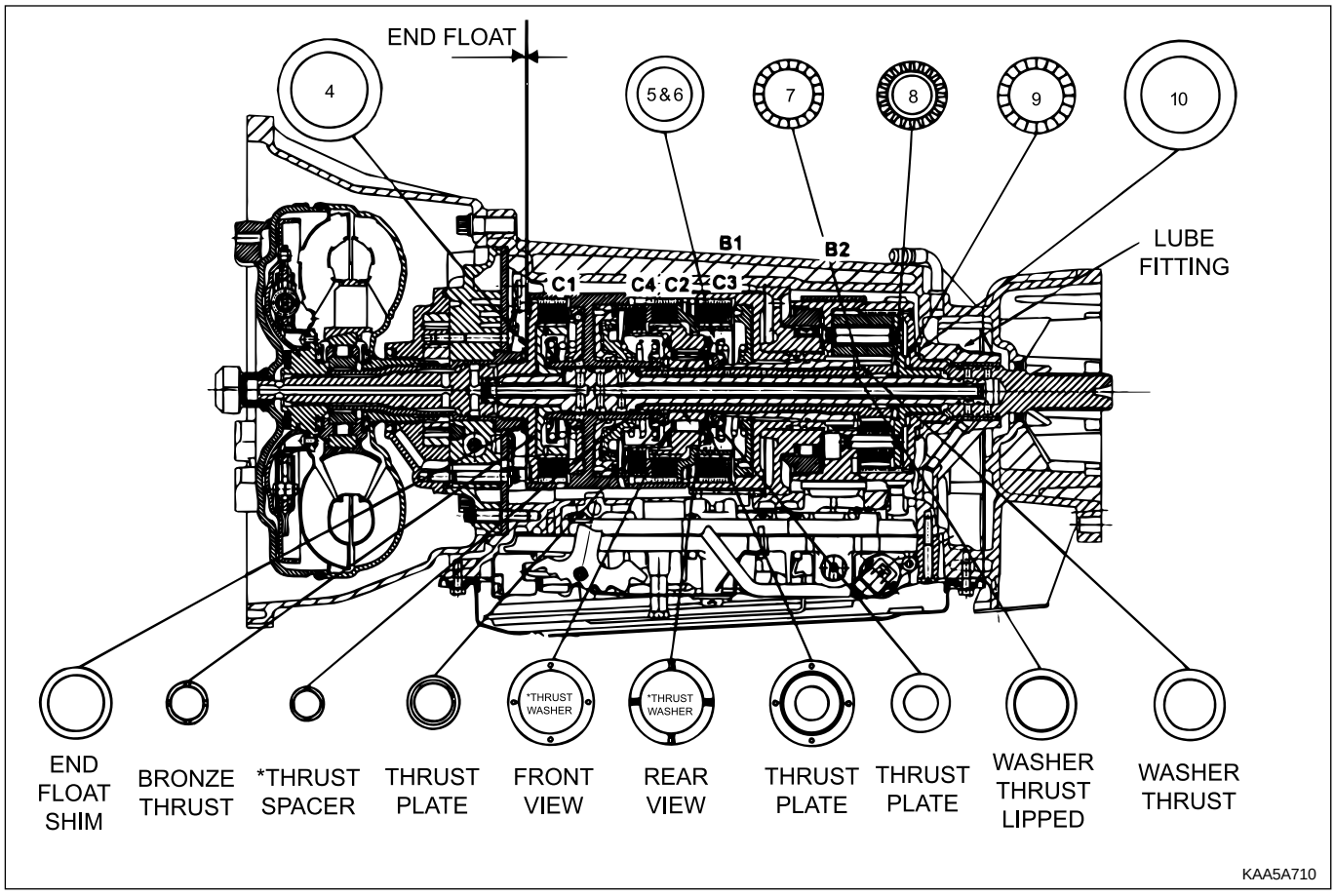
    - Be careful not to drop the torque converter while removing the transmission.
16. Installation should follow the removal procedure in the reverse order.

UNIT REPAIR

REBUILD WARNINGS

Prior to rebuilding a transmission system, the following warnings are to be noted.

- Ensure that, before replacing a transmission the cooler lines are flushed out to remove any debris. This can be done by applying compressed air to the rear cooler line forcing oil and any contaminants out of the front cooler line.
- The cooler flow should be checked after the transmission has been fitted. With the front cooler line connected and the rear line run into a suitable container, measure the flow over 15 seconds with the vehicle idling in park.
- The flow rate should exceed 1 liter in 15 seconds.
- Be wary of any situation where water enters the transmission. This may result in fluid foaming and leaking through the breather.
- Ensure that both earth straps (one at the battery terminal and one on the vehicle body) are connected in the vehicle before connecting the positive side of the battery.
- Follow the throttle position calibration procedure in this manual if the engine control module/ transmission control module (ECM/TCM) is swapped.



DISASSEMBLY PROCEDURE

Transmission

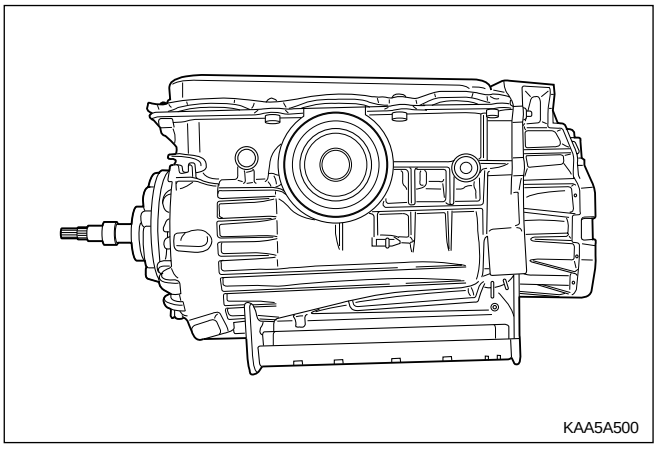
Tools Required

0555-336256 Transmission Bench Cradle

0555-336257 Pump Puller

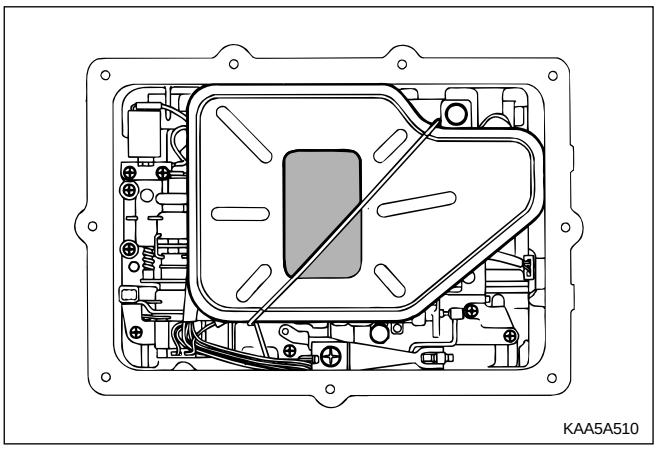
Notice:

- Remove the inhibitor switch before washing the transmission in solvent or hot wash.
- It is assumed that the transmission fluid has been drained when the transmission was removed from the vehicle and that the 'special tools' quoted are available.
- The transmission is dismantled in a modular fashion, and the details of disassembly for each module are given under the appropriate subject. Refer to Special Tools Table in this chapter for details of all special tools required when performing disassembly procedures.
- Technicians overhauling these transmissions will also require a selection of good quality Torx bit sockets, in particular numbers 30, 40 and 50, and an 8mm, 10mm and 12 mm double hex socket.



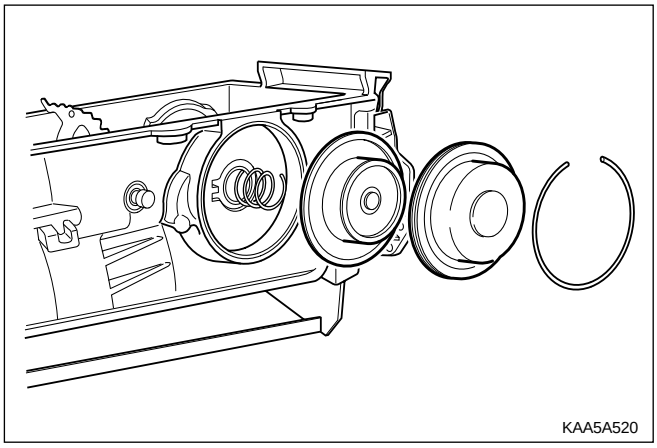
KAA5A500

1. Remove the converter and the converter housing.
2. Mount the transmission on the transmission bench cradle 0555-336256.
3. Remove the oil pan and the oil pan seal.



KAA5A510

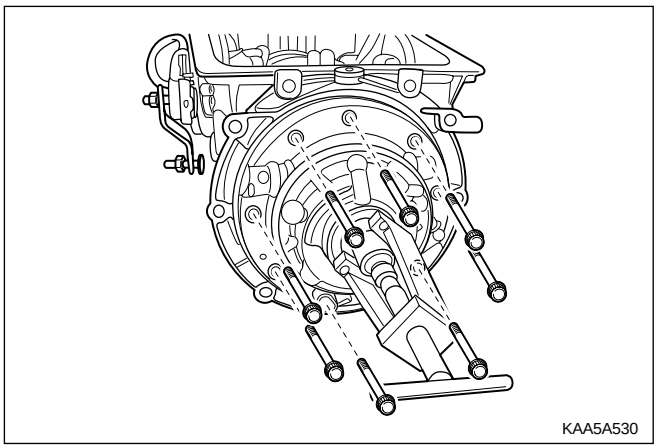
4. Remove each end of the filter retaining clip from the valve body and remove the filter.
5. Disconnect the wires from each solenoid and ground and lay the wiring to one side.
6. Remove the valve body securing screws and remove the valve body from the case.


KAA5A520

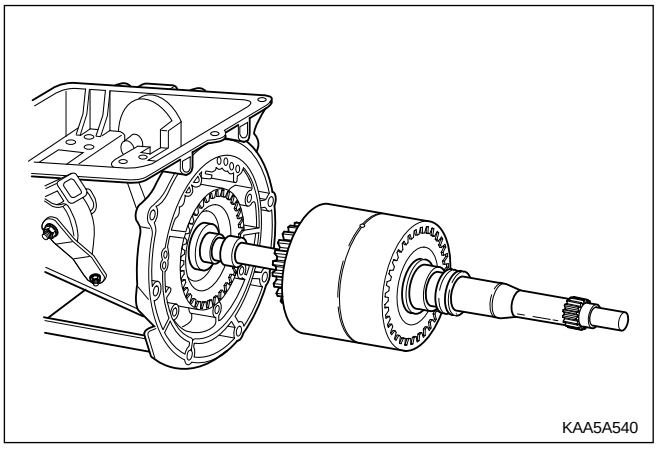
7. Remove the front servo cover circlip.
8. Remove the front servo cover, piston and spring.

   Notice: The plastic servo block is retained by the piston return spring only.

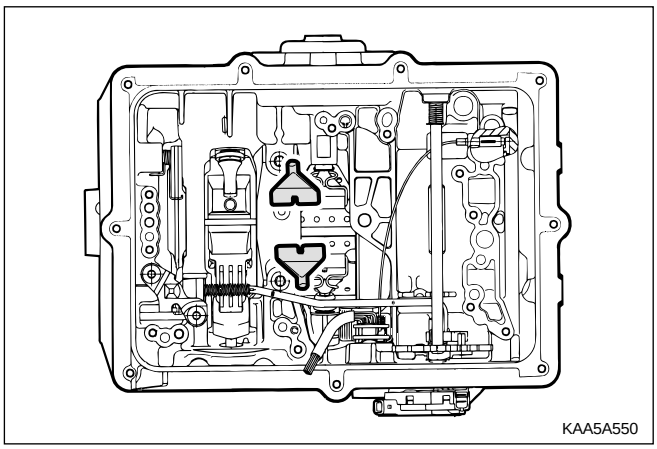
9. Remove the adaptor housing bolts and adaptor housing.


KAA5A530

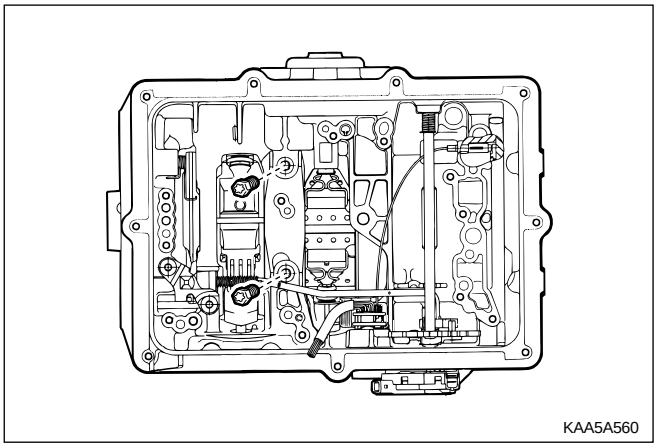
10. Remove the pump to case bolts using a multi-hex 8 mm spanner.
11. Using the pump puller 0555-336257, remove the pump and pump cover.


KAA5A540

12. Remove the input shaft, forward clutch cylinder, and the overdrive shaft as an assembly, withdrawing them through the front of the case.
13. Remove the C3 clutch cylinder and sun gears.


KAA5A550

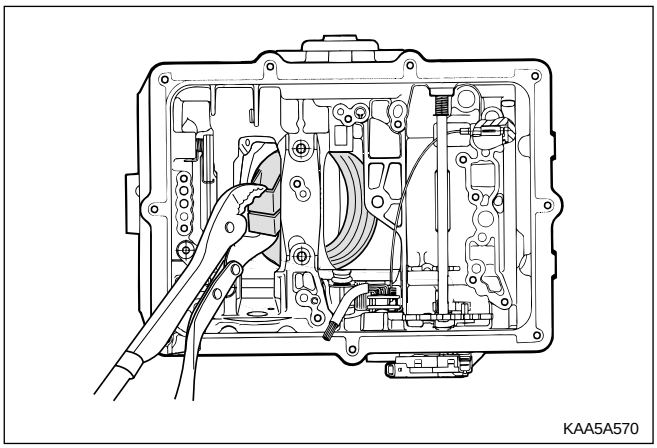
14. Remove the front band struts. Remove the front band.


KAA5A560

15. Remove the two centre support retaining bolts using a T50 Torx bit.
16. Remove the centre support retaining circlip.

    Notice: Do not hammer the output shaft to remove the centre support as this will cause permanent damage to the thrust bearing surfaces.

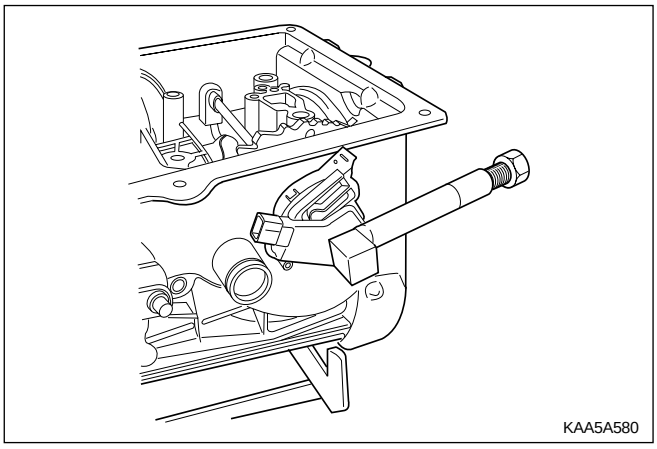
17. Remove the centre support, 1-2 one way clutch, and planetary gear set as an assembly.
18. Remove the parking rod cam plate using a T40 Torx bit.


KAA5A570

19. Remove the rear band struts and remove the band.

    Notice: Vise the both end of rear band using the plier and lean forward about 15 degrees

20. Remove the output shaft assembly.


KAA5A580

Transmission Case

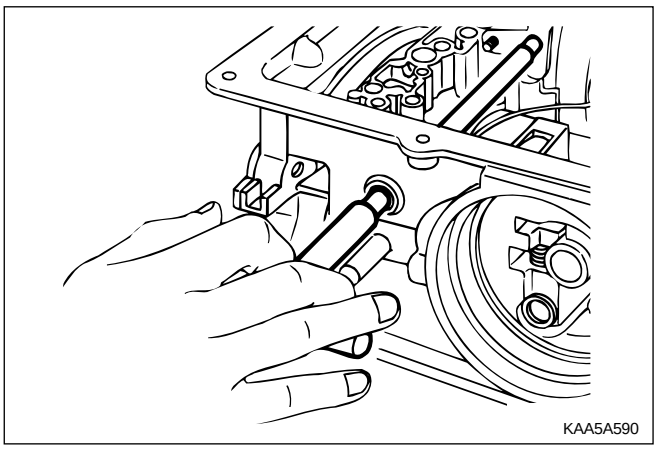
Tools Required

0555-336258 Cross Shaft Pin Remover/Installer (Detent Lever)

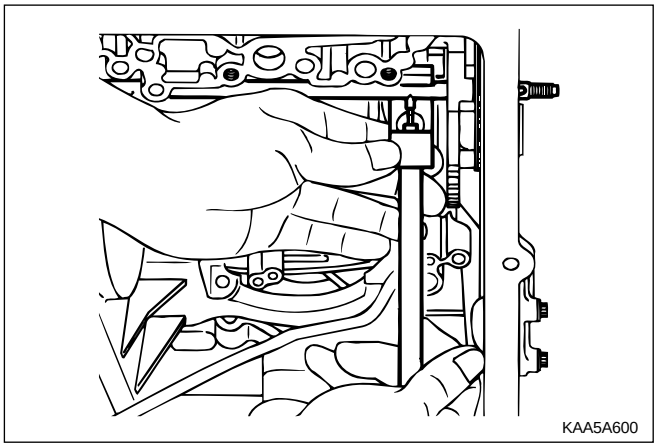
0555-336261 Cross Shaft Seal Remover

0555-336265 Cross Shaft Pin Remover/Installer (Inhibitor Switch)

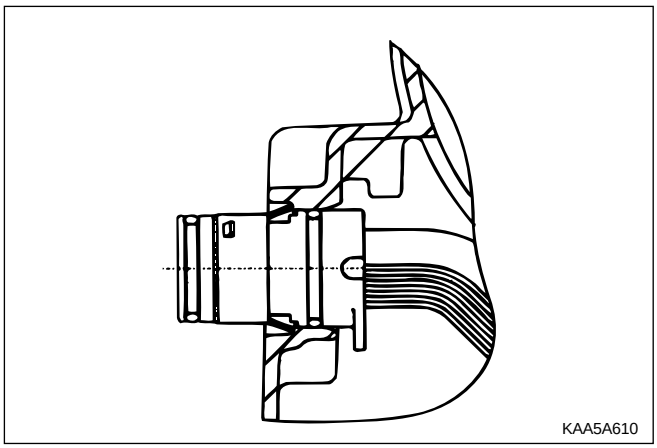
1. Remove the pin from the side of cross shaft inhibitor switch using cross shaft pin remover/ installer (inhibitor switch) 0555-336265.
2. Remove the inhibitor switch bolts and inhibitor switch from the case.


KAA5A590

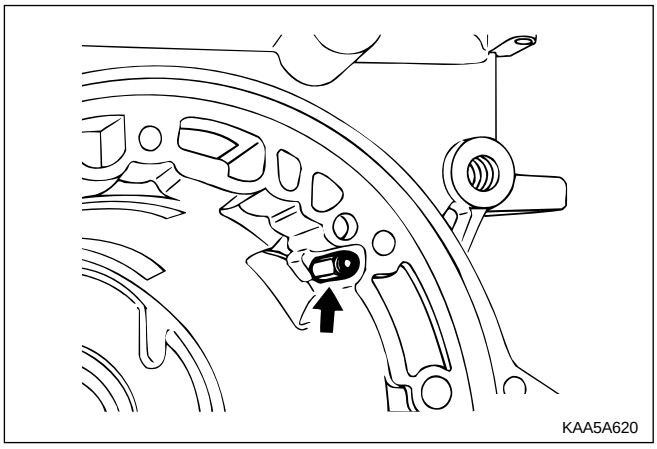
3. Remove the cross shaft seals with cross shaft seal remover 0555-336261.
4. Remove the circlip from the cross shaft. Pull the shaft to release the drive pin from the selector quadrant.


KAA5A600

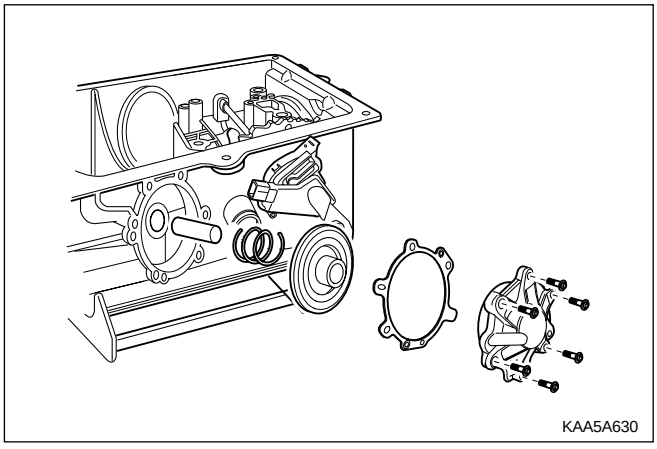
5. Using cross shaft pin remover/installer (detent lever) 0555-336258, press the pin from the cross shaft and withdraw the shaft from the case.
6. Remove the cross shaft pin and spring.
7. Remove the manual valve lever and the park rod.


KAA5A610

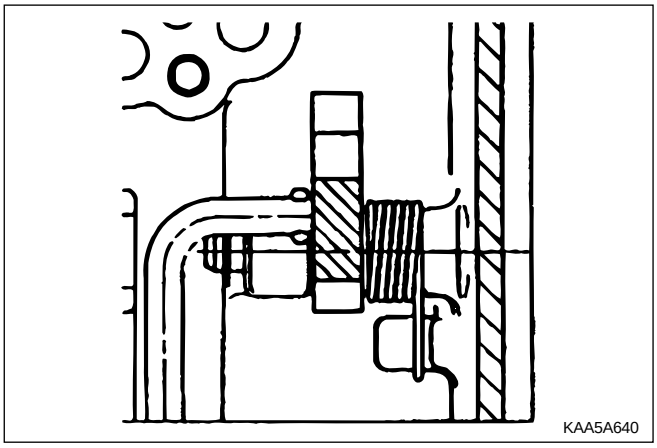
8. Depress the tangs and withdraw the 10 pin connector into the case. Remove the wiring loom assembly.


KAA5A620

9. Detach the No.7 solenoid wire from the front of the case.
10. Remove the parking pawl pivot pin and the pawl and spring from the case.
11. Remove the shaft and the rear servo lever.

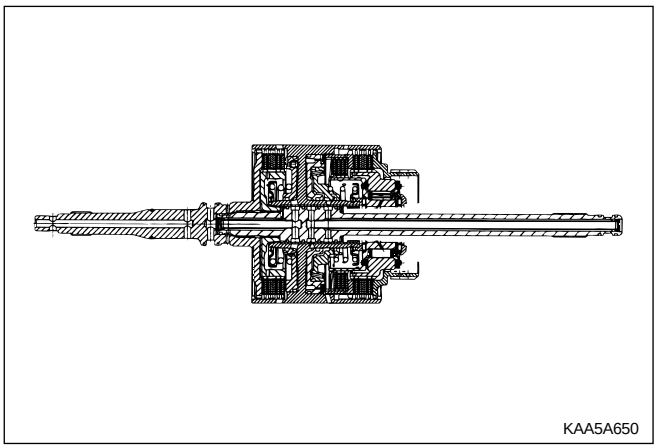

KAA5A630

12. Remove the rear servo cover and piston assembly.
13. Remove the B1R circlip, valve and spring.
14. Remove both band adjustment shims.
15. Inspect the output shaft bushing in the case and replace if necessary.
16. Inspect cooler line fittings and replace as necessary.
17. Inspect the case for damage.


KAA5A640

18. To remove the park rod lever: Remove the circlip from the inner end of the pivot shaft and tap the outer end of the shaft until it moves free from the case, then using a wide shallow tapered drift as a wedge, drive the pin out from the inside of the case and remove the lever and spring.

    Notice: Do not remove the park rod lever unless absolutely necessary.

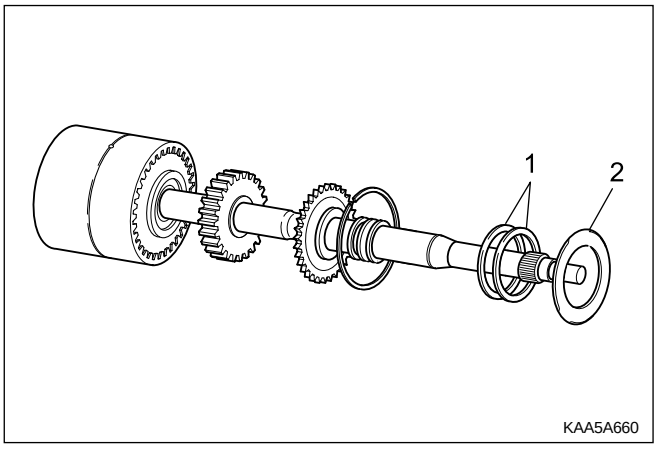

KAA5A650

Forward Clutch Cylinder

Tools Required

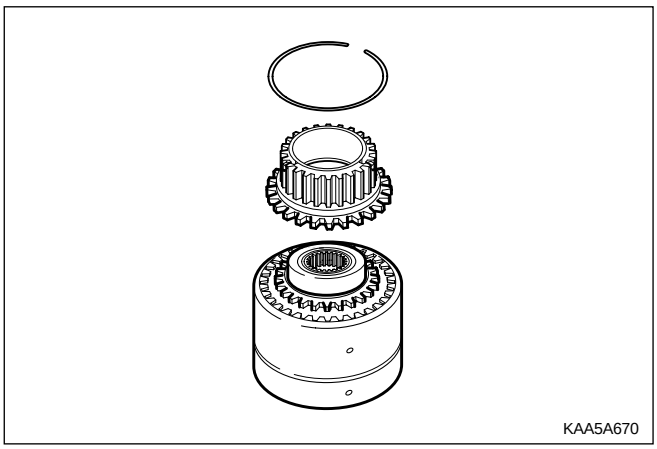
0555-336259 Clutch Spring Compressor

1. Place the assembly in a horizontal position.

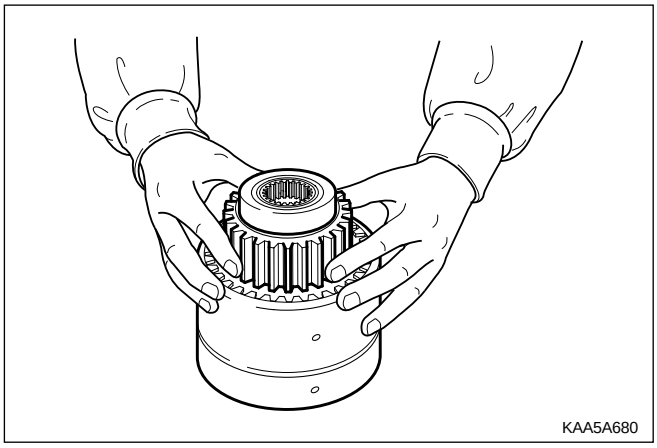


KAA5A660

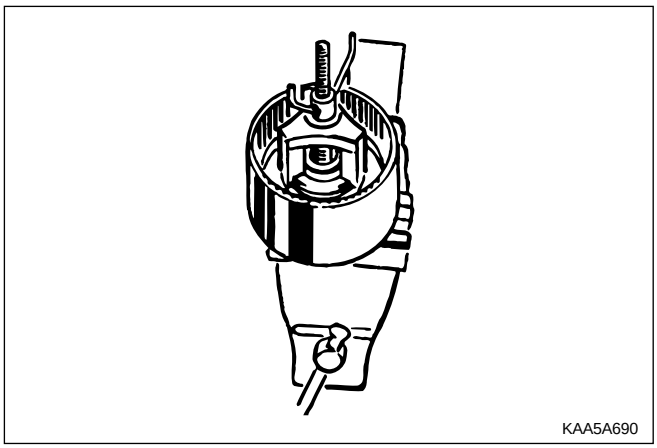
2. Remove the No. 4 needle bearing (2) and adjustment shims (1) from the input shaft.
3. Remove the circlip from the front of the clutch cylinder and remove the input shaft.
4. Remove the overdrive shaft and the C1 clutch hub assembly from the clutch cylinder.
5. Remove the C1 clutch plates from the cylinder.


KAA5A670

6. Remove the circlip retaining the C3 clutch hub in the rear of the clutch cylinder and remove the hub.
7. Remove the C2/C4 clutch hub assembly and remove the No. 5 needle bearing from the C4 hub.
8. Removethe C2 clutch plates.


KAA5A680

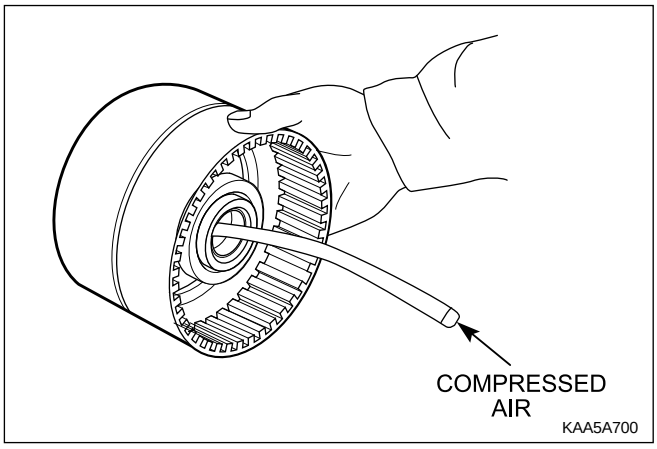
9. Invert the clutch cylinder and remove the C4 clutch sleeve, clutch plates and the two wave washers. The 3-4 one way clutch is located between the C2 and C4 clutch hubs, and the hubs may be separated by rotating one hub clockwise and withdrawing it from the other.
10. Remove the thrust block from the C4 clutch cylinder hub.


KAA5A690

11. Mount the clutch cylinder on clutch spring compressor 0555-336259 with the C2/C4 end uppermost and compress the piston return spring. Remove the spring retaining circlip. Release the tool and remove the circlip, keeper and spring.

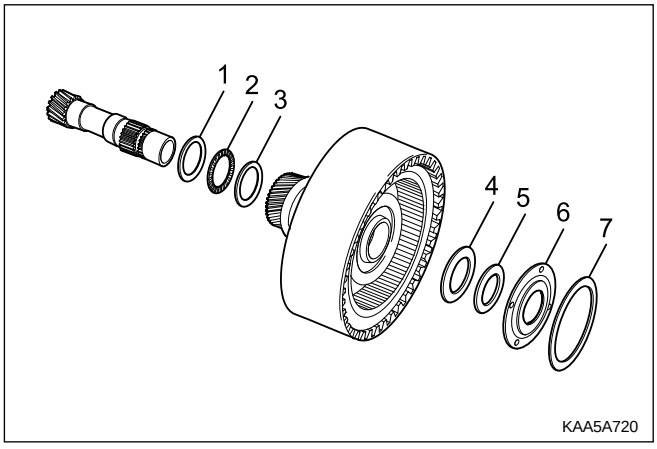
    Notice: Make sure that the spring keeper is not caught in the circlip groove, and that all the spring pressure is released, before removing the tool.

12. Invert the clutch cylinder on the compressor tool and removethe C1 clutch piston return spring in asimilar manner.



KAA5A700

13. To remove the clutch pistons from the clutch cylinder, apply air pressure to the apply ports in the bore of the cylinder.



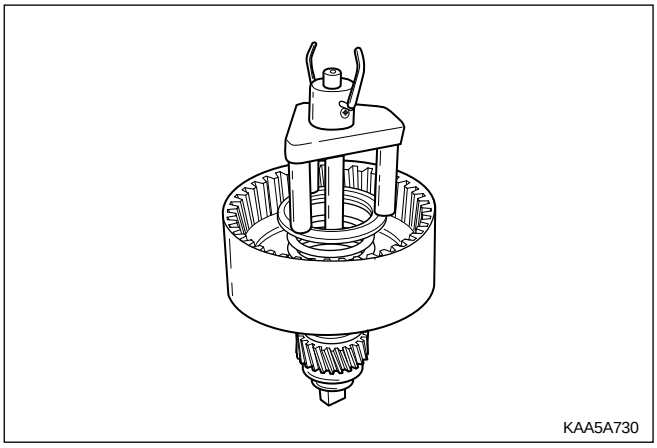
KAA5A720

C3 Clutch Cylinder

Tools Required

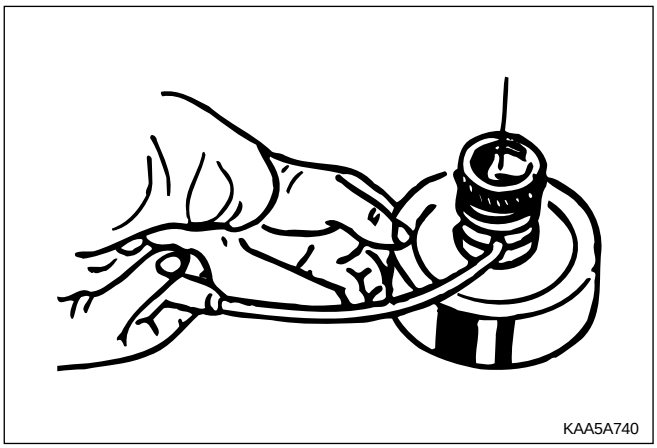
0555-336259 Clutch Spring Compressor

1. Remove the forward sun gear, No.7 needle bearing (2) thrust washer (1) and lipped thrust washer (3) from the C3 clutch cylinder.
2. Remove the thrust plate (4), No.6 needle bearing (5), thrust plate (6) and nylon thrust plate (7) from the clutch cylinder hub.
3. Remove the clutch plate retaining circlip and remove the clutch plates.

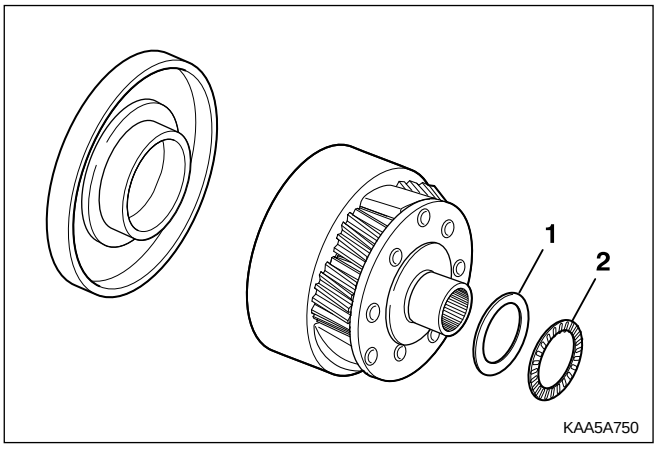

KAA5A730

4. Mount the clutch assembly on clutch spring compressor 0555-336259 and compress the piston return spring.
5. Remove the circlip and release the spring.
6. Remove the tool, circlip, keeper and spring.

   Notice: Make sure that the spring keeper has not been caught in the circlip groove, and that all spring pressure has been released, before removing the tool.


KAA5A740

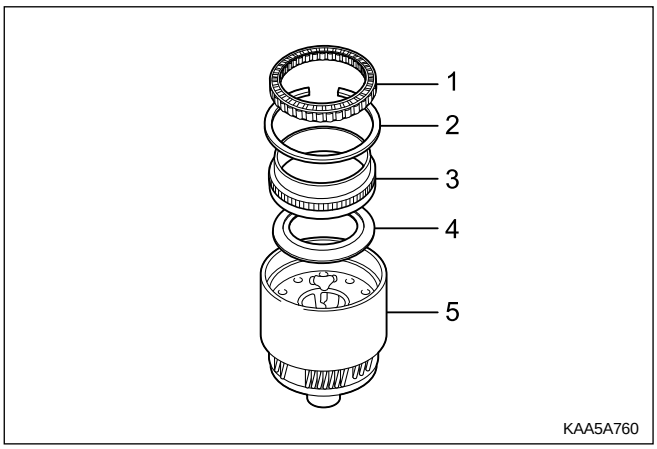
7. Remove the sealing rings from the C3 clutch cylinder.
8. To remove the clutch piston from the clutch cylinder, apply air pressure to the port between the iron sealing rings on the bearing journals of the cylinder.
9. Remove the reverse sun gear and C3 washer from the cylinder.



KAA5A750

Planet Carrier Assembly and Centre Support

1. Remove the No. 9 (2) needle bearing and washer (1) from the output shaft and the planet carrier.
2. Separate the centre support from the planet carrier by rotating it anti-clockwise.



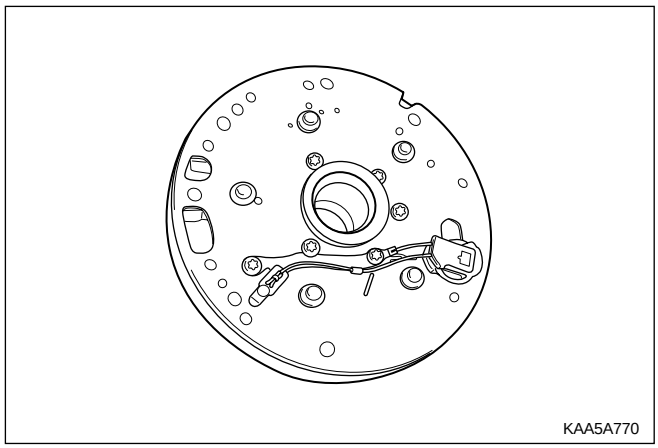
KAA5A760

3. Lift the one way clutch (1) from the planet carrier (5).
4. Remove the circlip (2) retaining the one way clutch outer race (3) in the planet carrier and remove the race.
5. Remove the one way clutch retainer (4) from the planet carrier.

Pump

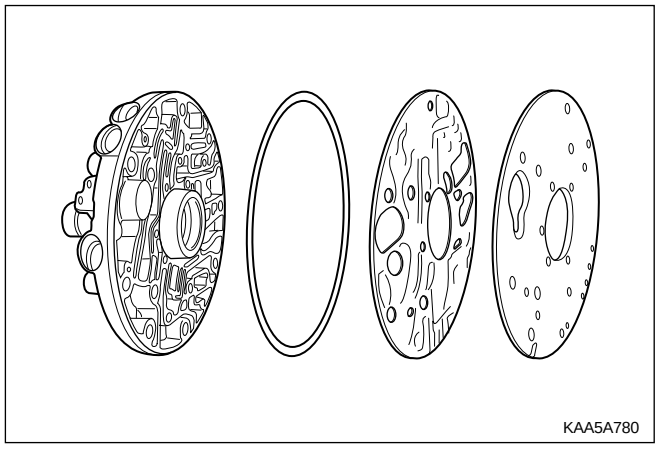
Notice: The following valves are housed in the pump cover:

- Solenoid 7
- Converter clutch control valve
- Converter clutch regulator valve
- Primary regulator valve

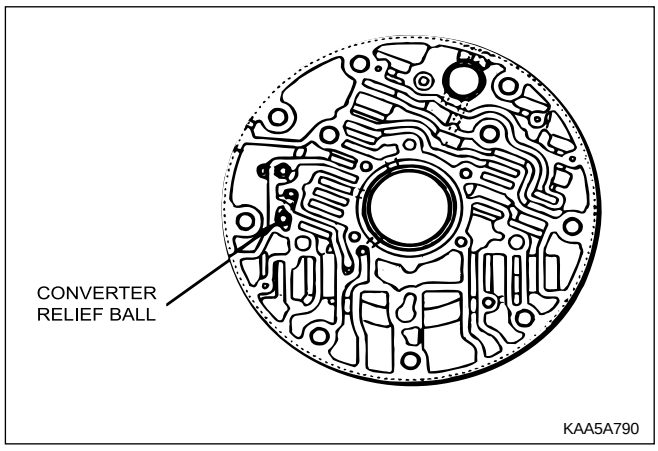

KAA5A770

1. Remove the wiring loom retainer plate and remove solenoid 7 with a T30 Torx bit.
2. Remove the five washer head bolts from the cover plate using a multi-point 8 mm socket.
3. Remove the five Torx head screws from the cover plate with T30 Torx bit. Note that the long screw holds the pump body to the pump body cover.

   Notice: Do not strike the converter support tube to loosen the pump body.

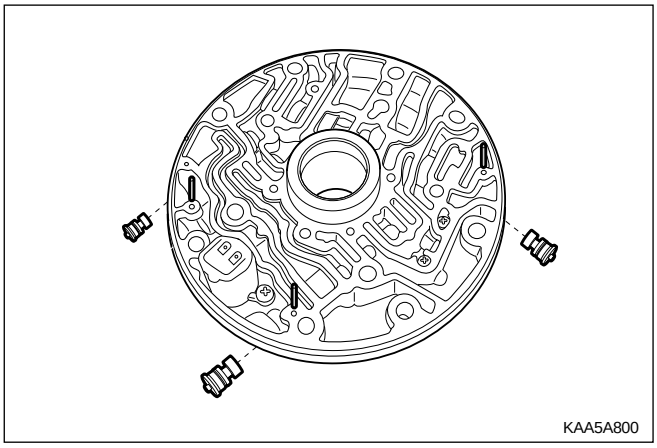

KAA5A780

4. Separate the pump body from the pump cover.
5. Remove the cover plate, gasket and seal from the cover.



KAA5A790

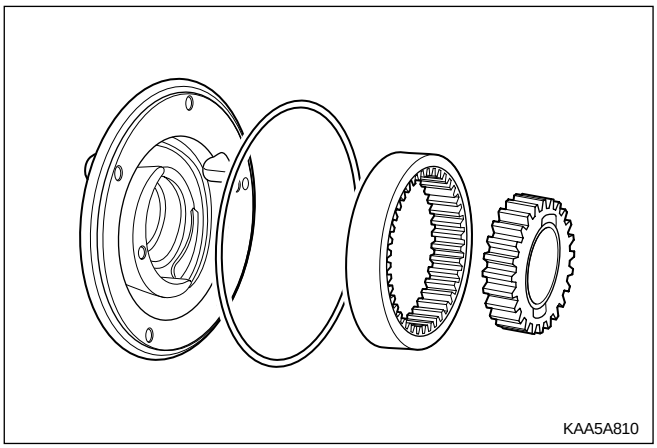
6. Remove the ball check valve and one spring from the pump cover.


KAA5A800

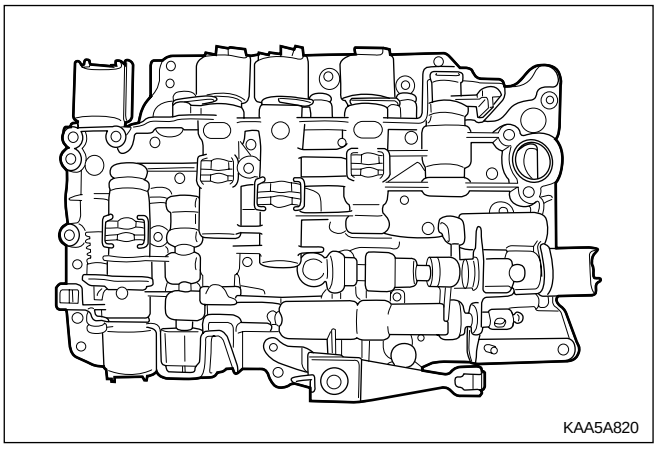
7. Depress the plug inward and remove the retaining pin for each of the three valves.

   Notice: Some of the valves and plugs are preloaded by springs and may unexpectedly fall out of the cover when the pins are removed.

8. Remove the four valves, plugs and springs.


KAA5A810

9. Remove the pump gears from the pump body.
10. Remove the lip seal from the front of the pump body.


KAA5A820

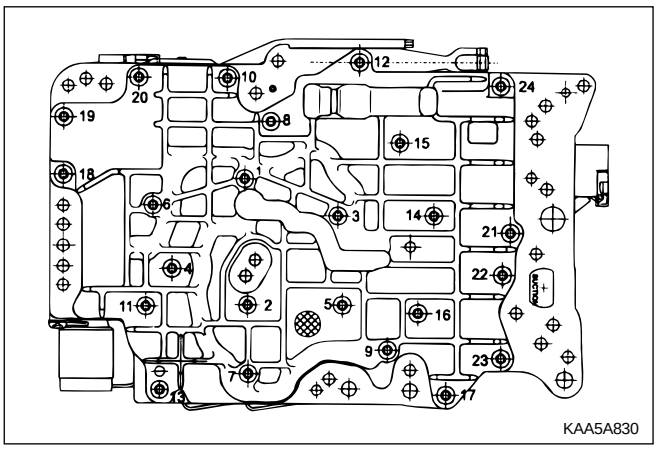
Valve Body

1. Remove the manual valve detent spring and retainer plate using a T40 Torx bit.
2. Slide the manual valve out of the lower valve body.

   Notice: Be aware that the manual valve will fall out of the valve body.

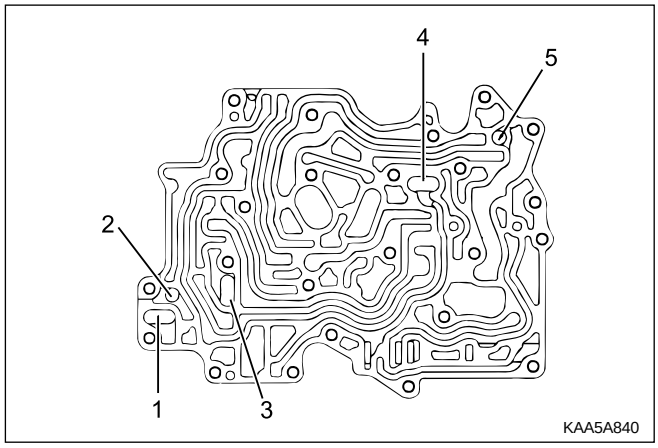
3. Take note of the angular relationship of the solenoid terminals to the valve body and remove the solenoids 1, 2, 3, 4, 5, 6 and valve assemblies.

   Notice: Take care that the bracket is not separated from the solenoid.

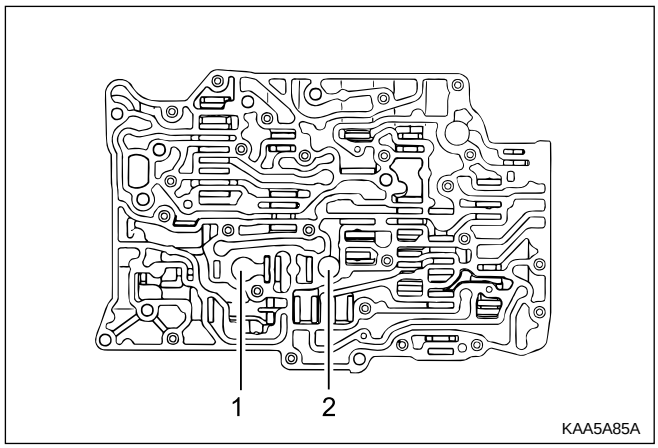


KAA5A830

4. Place the valve body assembly on the bench with the upper body uppermost.
5. Remove the 24 clamping screws with a No. 30 Torx bit. Separate the upper and lower valve bodies by lifting the upper body and the separator plate togeth-er.
6. Turn the upper body over and place it on the bench with the separator plate uppermost.



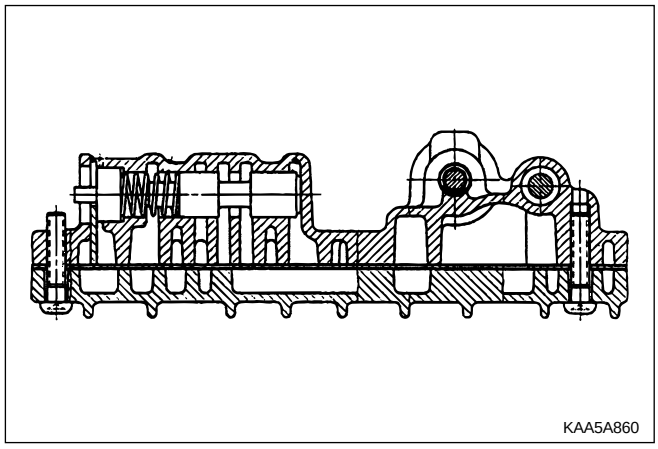
7. Lift the separator plate and gaskets from the upper valve body.
8. Remove the five nylon check balls exposed in the valve body.
9. Remove the retaining plate, plug, spring and reverse lockout valve.



10. Remove the filter (1) and the large nylon check ball (2) from the lower valve body.
11. Remove the retaining plates and pins from the 1-2, 2-3, 3-4, BAR and CAR valves. The pins can be removed with a magnet.

    Notice: Once the pins are removed, the plates are loose in the valve body and will drop out when the valve body is turned over.

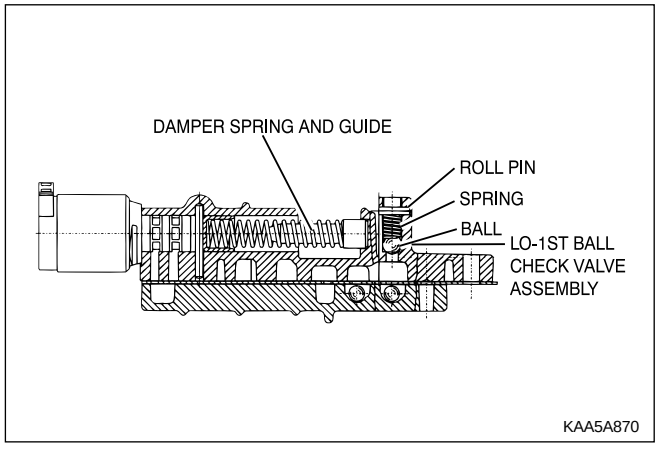
12. Remove the 1-2, 2-3 and 3-4 shift valves.



13. Depress the 4-3 sequence valve plug and remove the retaining plate.

    Notice: The plug is preloaded by the spring and may unexpectedly fall out of the valve body.

14. Remove the plug, spring and valve



15. Depress the solenoid 5 valve. Remove the retaining in and remove the valve, damper guide and spring.

    Notice: The valve is preloaded by the spring and may unexpectedly fall out of the valve body.

16. Depress the line pressure release valve, remove the retaining pin, disc (if fitted), spring and valve.
17. Drive out the retaining pin and remove the spring and ball check valve adjacent to the BAR valve.

ASSEMBLY PROCEDURE

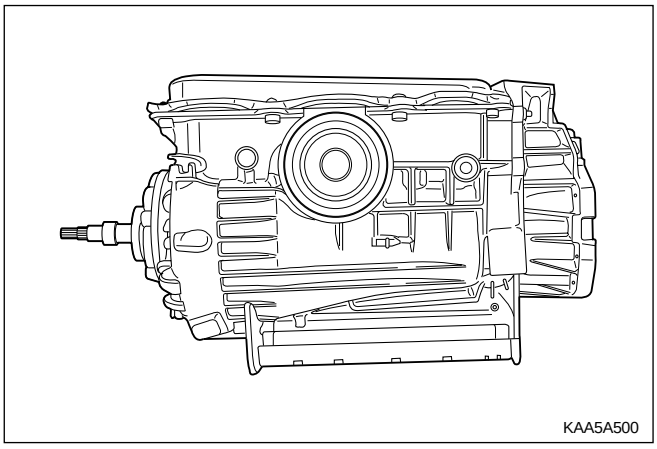
Transmission

Tools Required

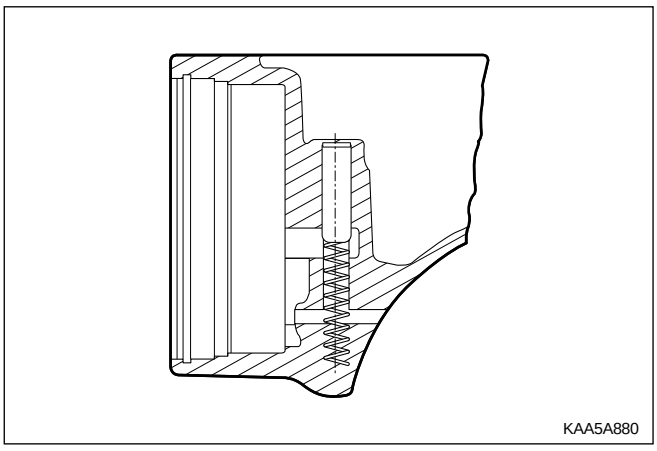
0555-336256	Transmission Bench Cradle
0555-336258	Cross Shaft Pin Remover/Installer (Detent Lever)
0555-336262	Cross Shaft Seal Installer
0555-336263	Cross Shaft bullet
0555-336265	Cross Shaft Pin Remover/Installer (Inhibitor Switch)

Notice:

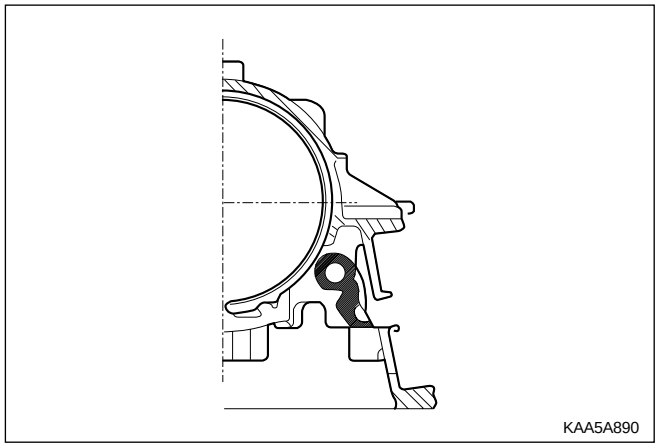
- The transmission is assembled in modular fashion and details of assembly for each module are given under the appropriate subject.
- Technicians overhauling these transmissions will also require a selection of good quality Torx bit sockets, in particular numbers 30, 40 and 50, and an 8 mm, 10 mm and 12 mm double hex socket.
- Ensure that the B1R circlip is fitted to the case. (If this is not fitted, the valve will peen its way into and through the separator plate)
- Ensure that the 'E'clip is fitted to the cross shaft.
- Ensure that all aspects of the parking mechanism are working.


KAA5A500

1. Turn the transmission case upside down on the bench and mount it to the transmission bench cradle 0555-336256.
2. Install all fittings, plugs and the breather, applying a sealant where applicable, Tighten the fittings to specifications. Ensurethatthebreatheris clear, andcheckthat the lube fitting in the rear of the case is fittedand clear of obstruction.

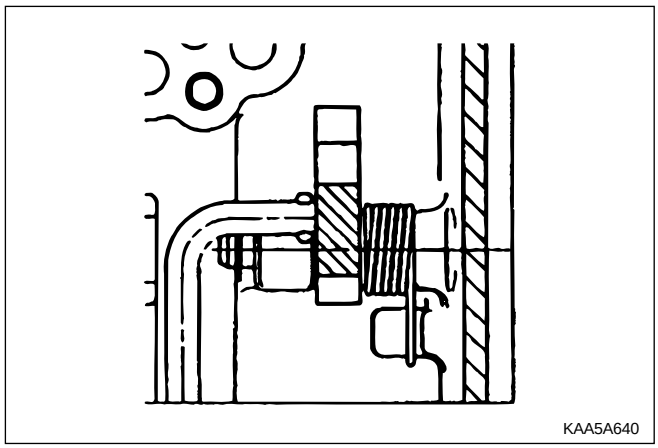

KAA5A880

3. Assemble the B1R valve and spring, and secure with the circlip. Ensure that the circlip is completely seated in its groove.


KAA5A890

4. Install the rear servo lever and pivot pin.

   Notice: The lever must pivot freely on its pin.

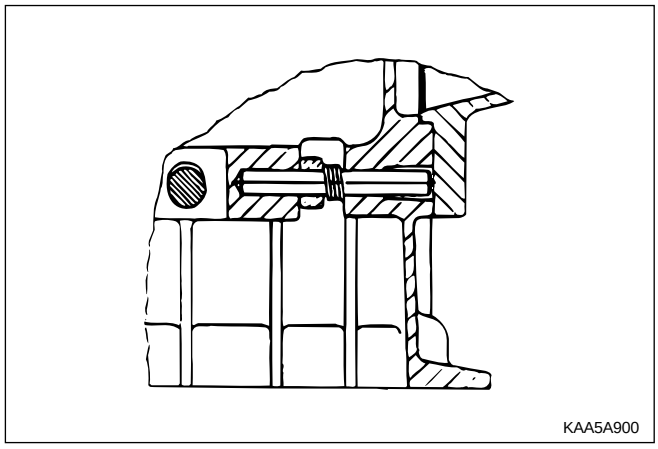

KAA5A640

5. Assemble the park rod lever, complete with the return spring and pivot pin, applying a small amount of sealant to the outer end of the pivot pin.

   Notice: Care must be taken when applying sealant to ensure that it is not applied between the pin and the lever.

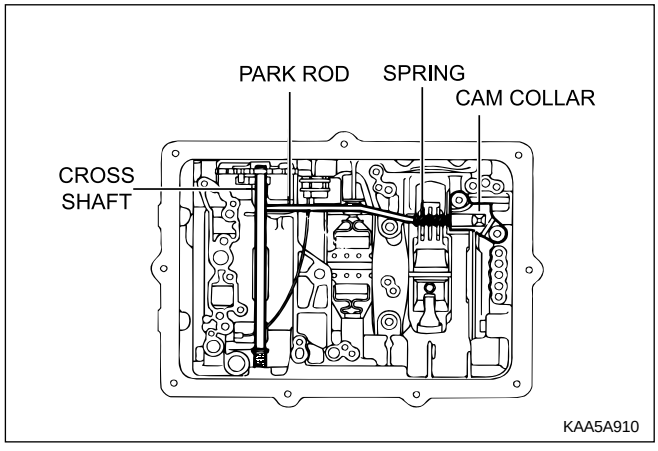
6. Secure the pivot pin with the circlip.

   Notice: The lever must pivot freely on its pin and the spring must return the park rod lever to its correct location.


KAA5A900

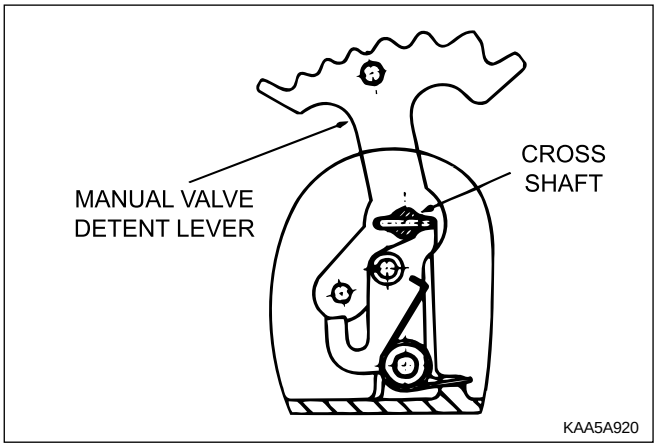
7. Install the parking pawl pivot pin and spring.

   Notice: The pawl must pivot freely on its pin.

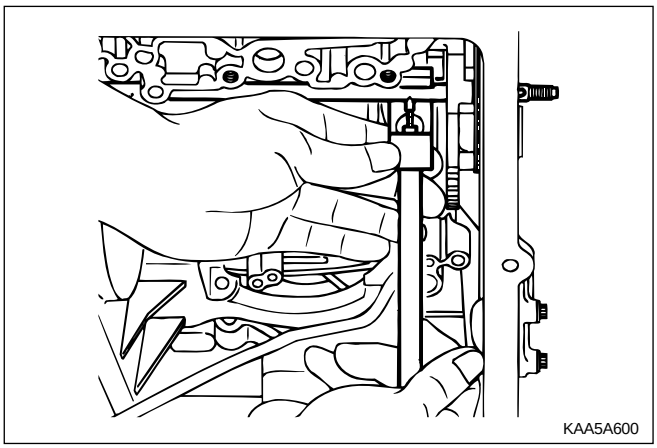


KAA5A910

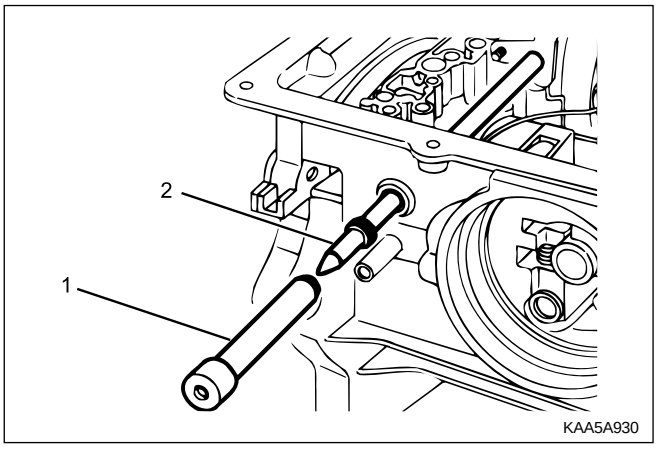
8. Connect the park rod to the manual valve detent lever. Ensure the spring and cam collar is firmly installed on the rod.
9. Check that the cam collar slides freely on the rod.
10. Insert the cross shaft into the case, from the side opposite to the inhibitor switch, then install the antirattle spring on the shaft.



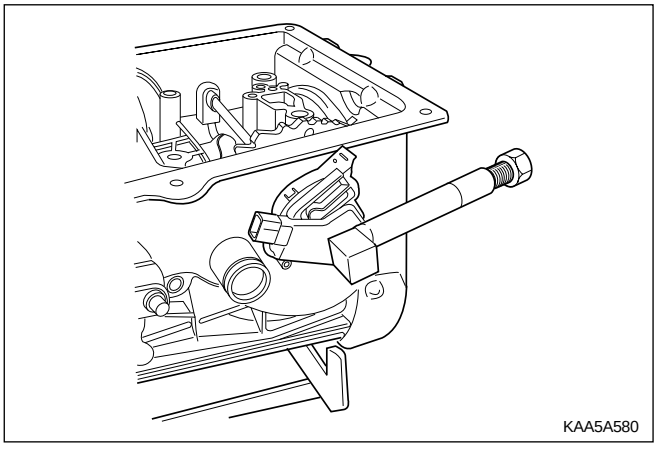
11. Poition the manual valve detent lever, aligning it with the cross-shaft bore in the case.
12. Push the shaft through the detent lever until it starts in the detent lever side of the case.



13. Install the detent lever drive pin in the shaft using cross shaft pin remover/installer (detent lever) 0555-336258 with the adaptor over the pin.
14. Press the pin into the shaft until the tool bottoms.
15. Remove the tool and fit the spring retaining circlip to the shaft.



16. Install the new cross shaft seals using cross shaft seal installer 0555-336262 (1) and cross shaft bullet 0555-336263 (2).

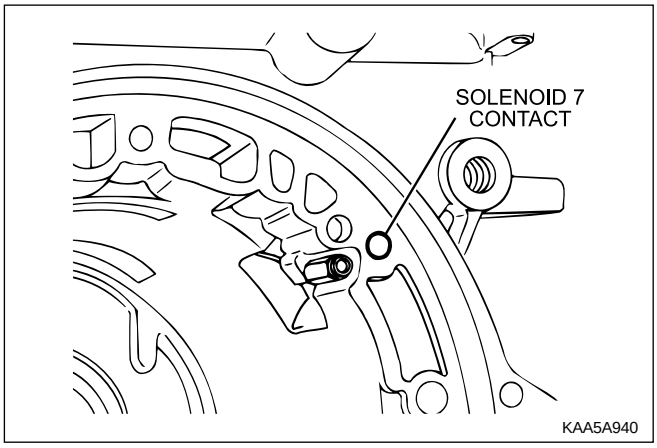


17. Install the inhibitor switch on the case. Torque the bolts as per specifications. Press the pin into the shaft until the tool bottoms using cross shaft pin installer/ remover (inhibitor switch) 0555-336265.

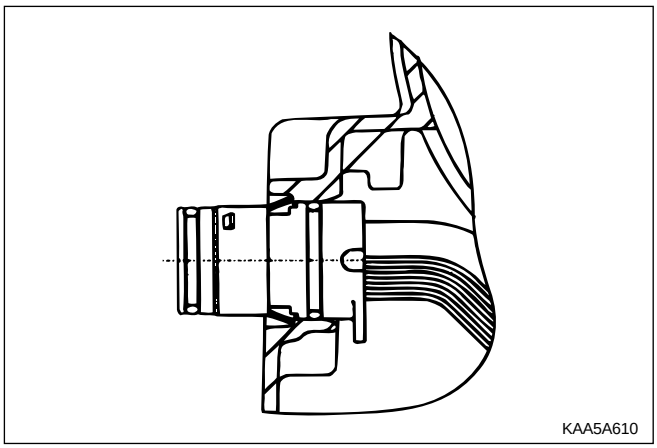
Installation Notice

Tightening Torque	4-6 N•m (35-53 lb-in)

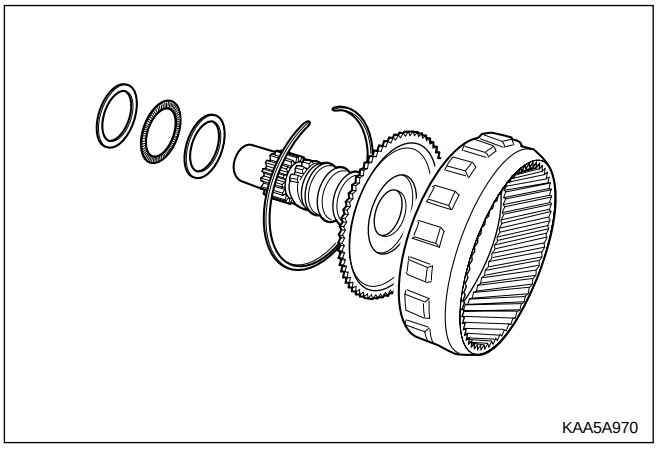
18. Thoroughly check the terminal wiring loom for condition and continuity.



19. Position the wiring loom and locate the solenoid 7 contact and terminal in the pump mounting flange at the front of the case. The solenoid 7 wire is routed under the park rod and cross shaft in the case.

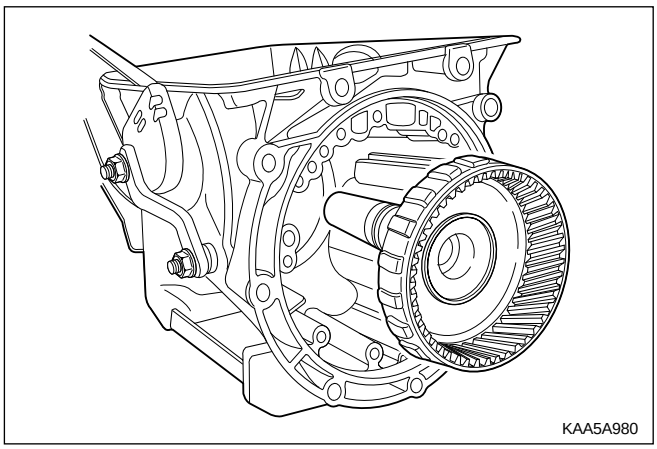


20. Install the 10 pin connector in the case engaging the tangs on the connector in the notches in case.

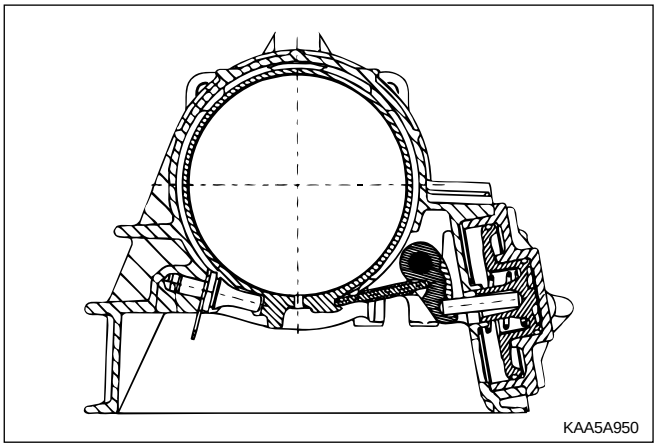


Output Shaft and Gear Assembly

1. Check that the output shaft bush is not worn or damaged. Replace if necessary.
2. Check for damage to parking pawl teeth on the ring gear. Replace if necessary.
3. Check that the sealing ring grooves have not been damaged.
4. Lubricate the sealing rings with automatic transmission fluid.
5. Assemble the sealing rings to the output shaft with the scarf cut uppermost.



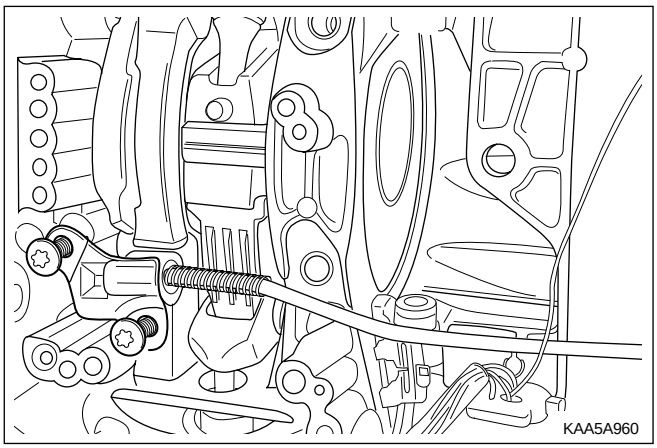
6. If previously dismantled, assemble the ring gear to the output shaft and secure with circlip. Ensure that the circlip is firmly seated in its groove.
7. Install the No. 10 needle bearing assembly onto the output shaft using petroleum jelly.
8. Carefully install the output shaft assembly in the case to prevent damage to the sealing rings.



Rear Band Assembly

1. Check the rear band for any cracks or damage along the lining and metal backing.
2. Install the reaction anchor strut into the main case, without shims.
3. Carefully install the rear band into the transmission case and ensure that it is properly fitted in the case.

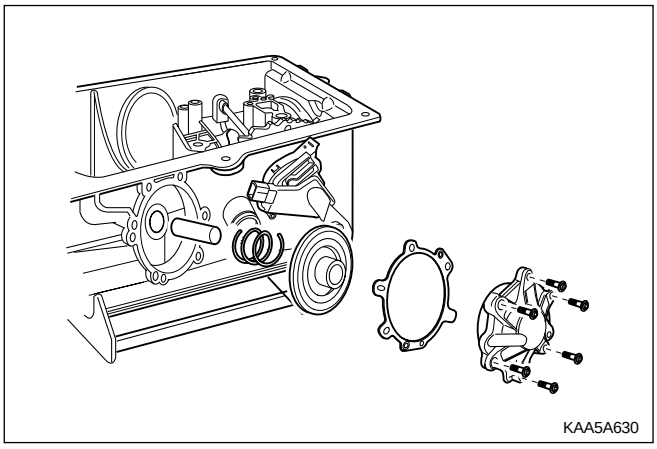
   Notice: If fitting a new band, soak the new band in automatic transmission fluid for a minimum of five minutes prior to assembly.



4. Position the apply strut on the rear band then engage the apply strut in the servo lever.
5. Install the cam plate and tighten the screws to specification.

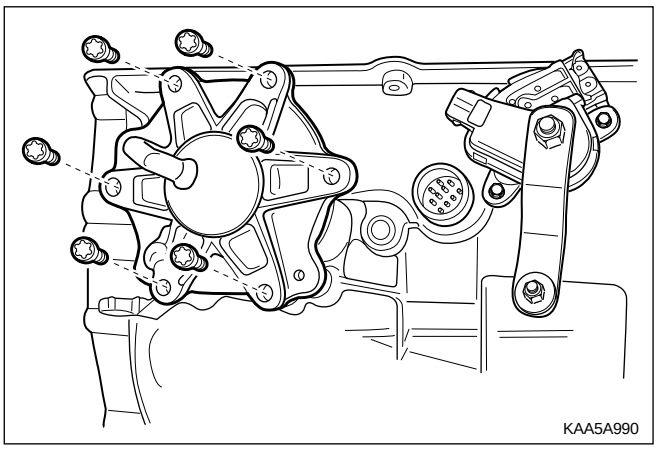
   Installation Notice

Tightening Torque	16-22 N•m (12-16 lb-ft)



Rear Servo Assembly

1. Check the servo piston ‘O’ rings and gasket for any damage.
2. Lubricate the servo piston ‘O’ rings with automatic transmission fluid, and fit the ‘O’ rings to the piston grooves.
3. Assemble the piston to the cover, ensuring that ‘O’ ring compression is adequate but not excessive.
4. Align the spring on the piston spigot, then position the rear servo rod into the spigot.



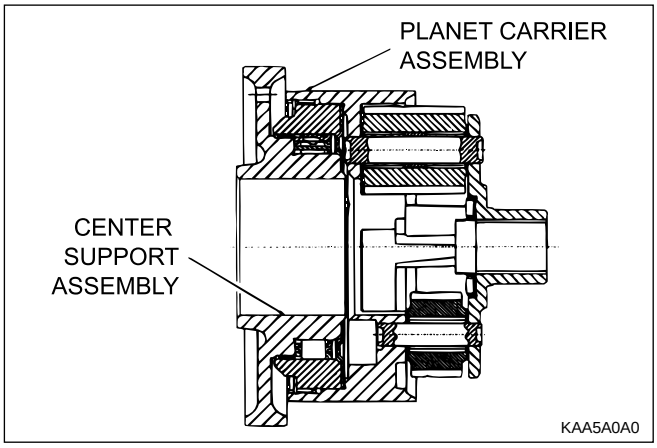
5. Assemble the gasket to the cover and fit the assembly to the case.

   Notice: Do not use petroleum jelly on the gasket.

6. Apply additional Loctite 202 or equivalent as required to the rear servo to case bolts. Install the bolts and tighten to specification.

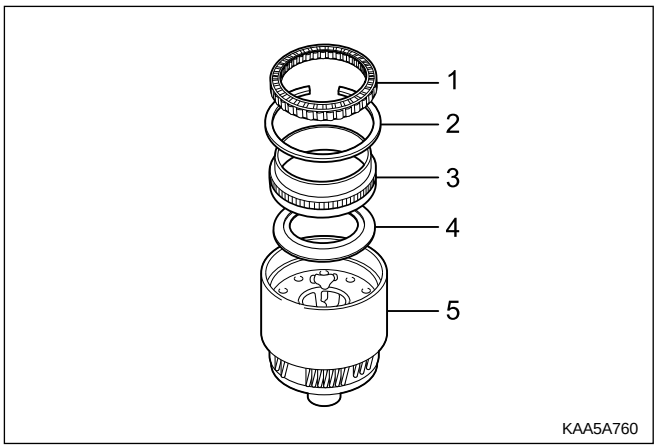
   Installation Notice

Tightening Torque	30-35 N•m (22-26 lb-ft)

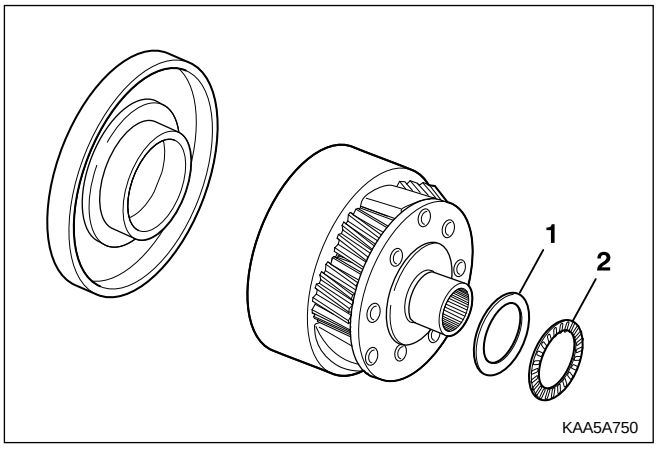


Planet Carrier Assembly and Centre Support

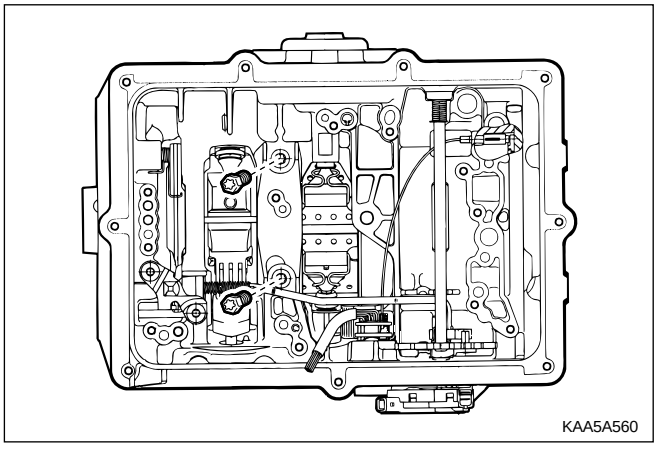
1. Check the carrier and planet assembly for any damage or irregularity and ensure that all pinions rotate freely and that the pinion end float is within 0.10 mm - 0.50 mm.



2. Install the One Way Clutch (OWC) retainer (1) to the planet carrier with the inner edge pointing downwards. Inspect the OWC race and the sprag assemblies for wear or damage. Replace if necessary.
3. Install the outer (3) race in the drum. Press the race to the bottom of the drum and install the retaining circlip (2). Ensure the circlip is firmly seated in its groove.
4. Install the OWC (1) into the outer race with the lip edge uppermost. Lubricate the sprags with automatic transmission fluid.



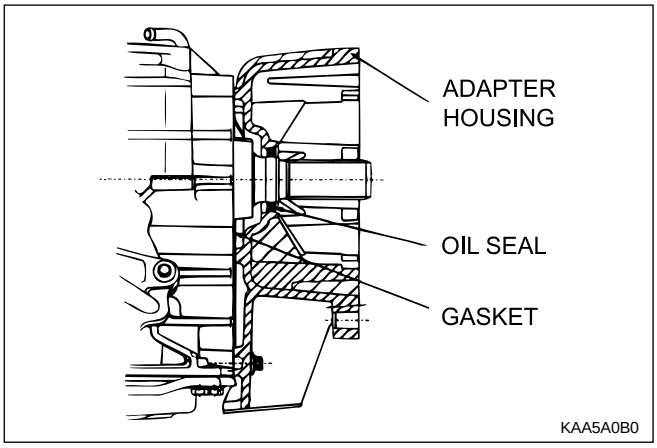
5. Check that the plugs are fitted to the centre support, then assemble the centre support into the OWC, ensuring that the support will rotate in an anti-clock-wise direction only.
6. Lubricate the No. 9 needle bearing and washer with petroleum jelly and fit them to the rear face of the planet carrier.



7. Install the planet assembly and the centre support into the case, and align the centre support mounting bolt holes.
8. Install the centre support bolts finger tight.
9. Install the circlip retainer ensuring that the circlip is completely seated in the groove of the case.
10. Remove the centre support bolts and apply Loctite 222 or equivalent to the threads. Install the bolts and torque to specifications.

Installation Notice

Tightening Torque	20-27 N•m (15-20 lb-ft)



Adaptor Housing Assembly

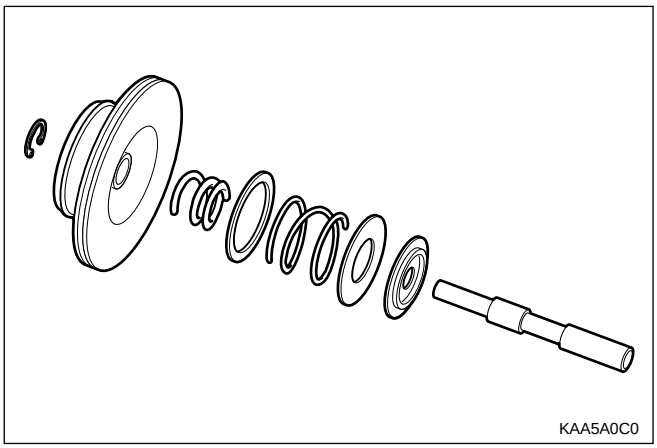
1. Install a new seal to the adaptor housing.
2. Position a new gasket onto the adaptor housing.

   Notice: Do not use petroleum jelly to hold the gasket in position.

3. Apply additional Loctite 202 or equivalent as required to the adapter housing bolts. Install the adaptor housing and torque the bolts to specification.

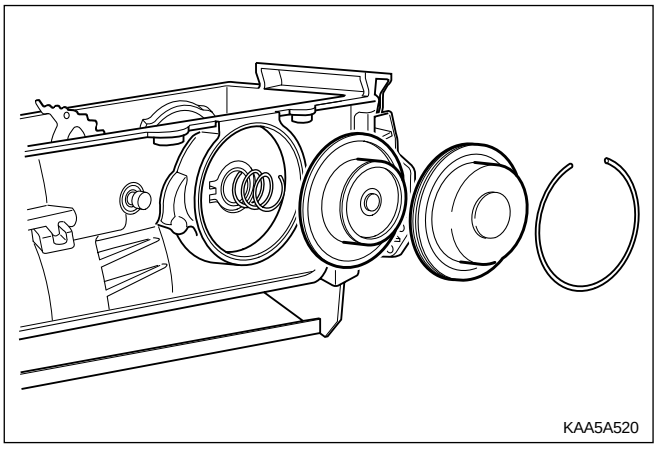
   Installation Notice

Tightening Torque	30-35 N•m (22-26 lb-ft)

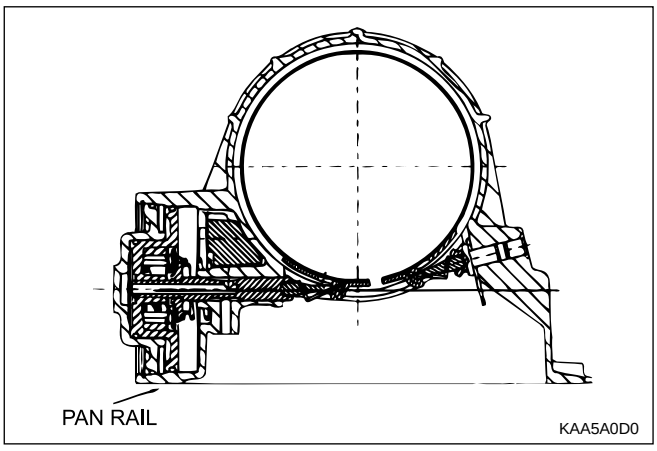


Front Servo Assembly

1. Lubricate the cover 'O' ring with automatic transmission fluid and fit to the cover.
2. Lubricatethepiston'O' rings with automatic transmission fluid and fit to the piston.
3. Assemble the piston, push rod, spring, belleville washer, seat and retaining ring.
4. Fit the piston push rod assembly into the front servo cover.

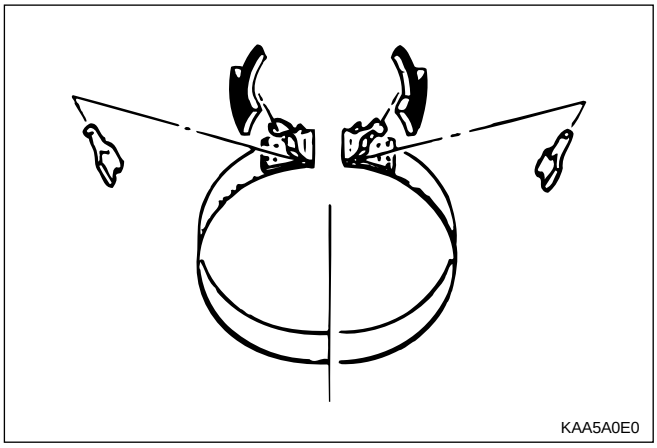


5. Install the front servo block and spring into the case.
6. Install the front servo assembly into the case.



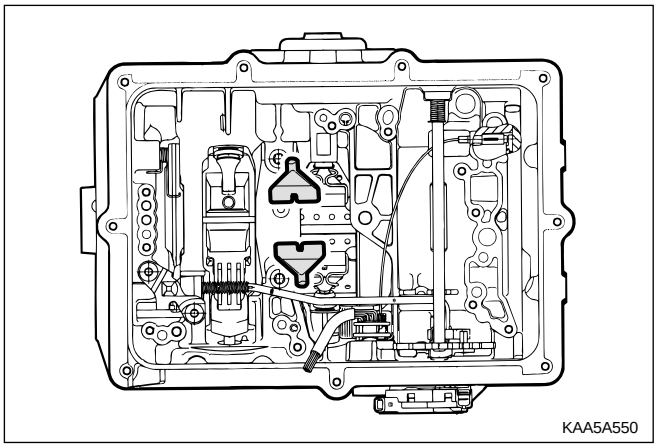
7. Compress the servo cover and fit the servo cover retaining circlip, aligning the gap with the pan rail, and ensuring that it is completely seated in its groove.

   Notice: Ensure that the front servo snap ring is installed correctly. Orient the circlip with the gap at the bottom, near the pan rail.


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Front Band Assembly

1. Install the reaction anchor strut to the case.
2. Check the band for all cracks or damage along its lining and metal backing.
3. Position the strut retainers on the band.


KAA5A550

4. Install the front band into the transmission case, ensuring that it is properly seated in place.

   Notice: If fitting a new band, soak the band in automatic transmission fluid for a minimum of 5 minutes prior to assembly.

5. Position the reaction strut in its retaining clip and engage it with the band and anchor strut.
6. Position the apply strut in its retaining clip and engage it with the band and the servo piston rod.

C2/C4 Clutch Assembly

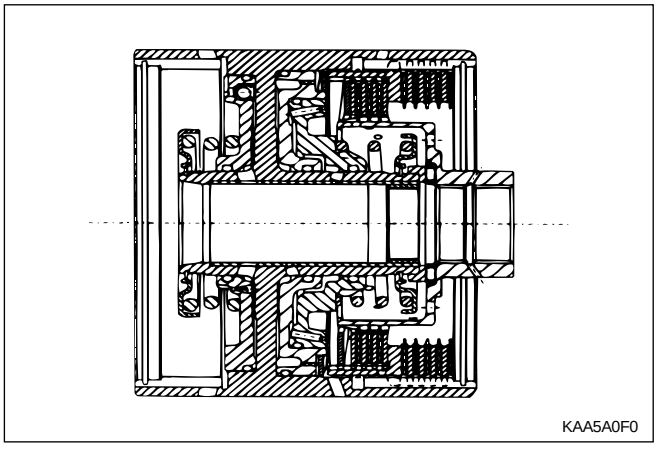
Tools Required

0555-336259 Clutch Spring Compressor

0555-336260 Clutch Pack Clearance Kit

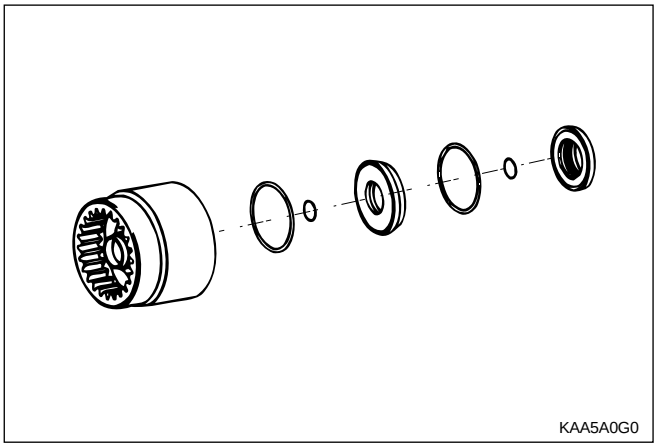
Notice:

- Check pistons for cracks.
- Do not mix the clutch piston return springs.
- Ensure that the snap rings are fitted correctly.

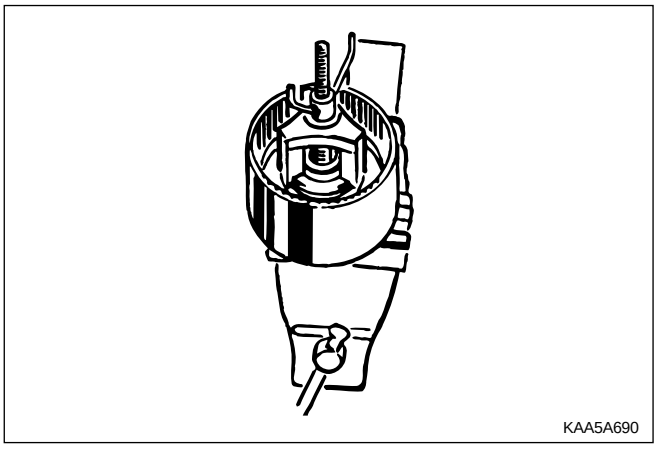

KAA5A0F0

1. Check the feed orifices in the cylinder bore are clear of obstructions.
2. Check the C2 piston bleed orifices are clear of obstructions.
3. Lubricate the ‘O’ rings with Automatic Transmission Fluid (ATF)
4. Fit the small ‘O’ ring onto the inner groove, and the large ‘O’ ring onto the outer groove of the piston.

   Notice: ‘O’ rings must not be twisted in the grooves.


KAA5A0G0

5. Check the C4 piston bleed orifices are clear of obstructions.
6. Lubricate the ‘O’ rings with ATF.
7. Fit the small ‘O’ rings onto the inner groove and the large ‘O’ rings onto the outer groove of the piston.
8. Position the clutch cylinder with the C2/C4 cavity facing upwards.
9. Fit the C4 piston into the C2 piston with the bleed orifices in alignment.
10. Install the C2/C4 piston assembly into the cylinder, with the piston bleed orifices aligned with the holes on the outside of the cylinder, until the outer diameter of the C2 piston enters the inner diameter of the cylinder.

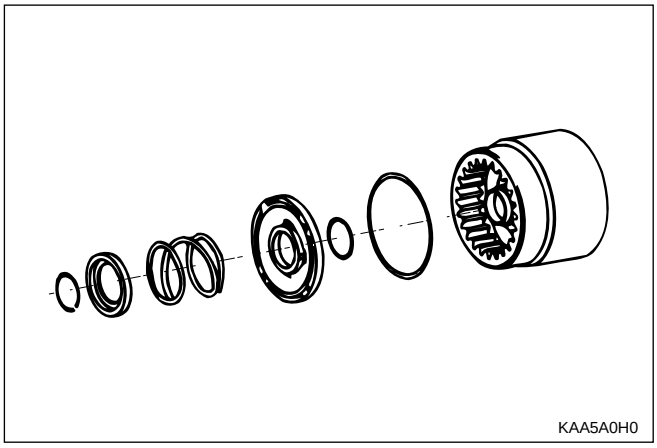

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11. Assemble the piston return spring to the piston, and fit the spring retainer over the spring.
12. Using 0555-336259 clutch spring compressor, compress the spring sufficiently to enable the installation of the retaining circlip ensuring that the circlip is firmly seated in its groove, then remove the tool.

    Notice: The wire diameter of this spring is 4.3 mm.

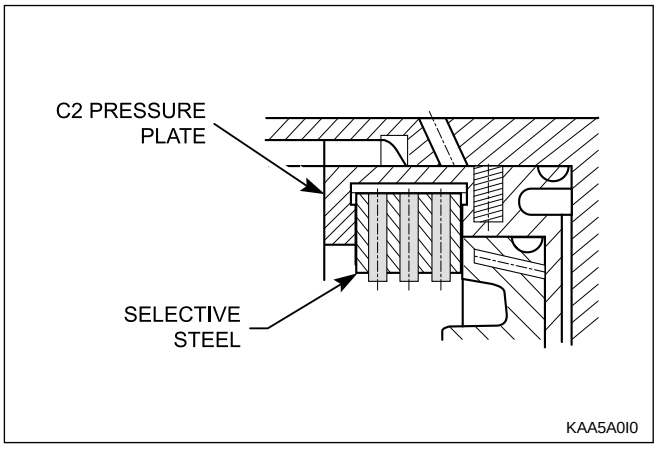
13. Check the C1 piston check valves are not damaged and are free to move, and that the cylinder feed orifices are clear of obstructions.
14. Lubricate the ‘O’ rings with ATF and fit them to their respective grooves.

    Notice: ‘O’ rings must not be twisted in the grooves.


KAA5A0H0

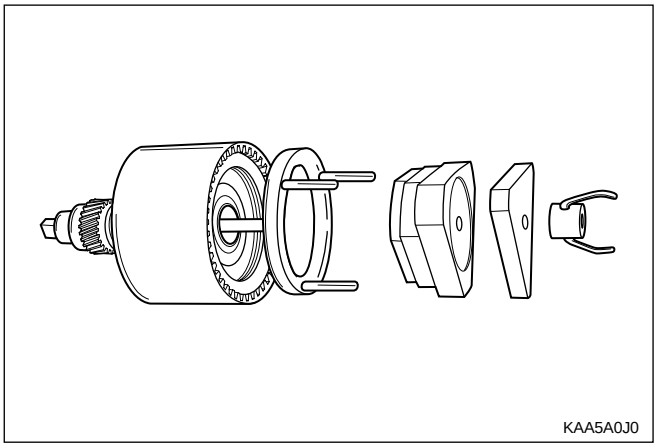
15. Position the cylinder with the C1 cavity upwards. Install the piston into the cylinder until the outer diameter of the piston enters the inner diameter of the cylinder.
16. Install the spring and spring retainer onto the piston.
17. Using 0555-336259 clutch spring compressor, compress the spring sufficiently to enable the installation of the retaining circlip ensuring that the circlip is firmly seated in its groove, then remove the tool.

    Notice: The wire diameter of this spring is 5.26 mm.
18. Install the C2 wave washer into the cylinder with the crest of one wave covering one of the bleed orifices inthe C2 piston.

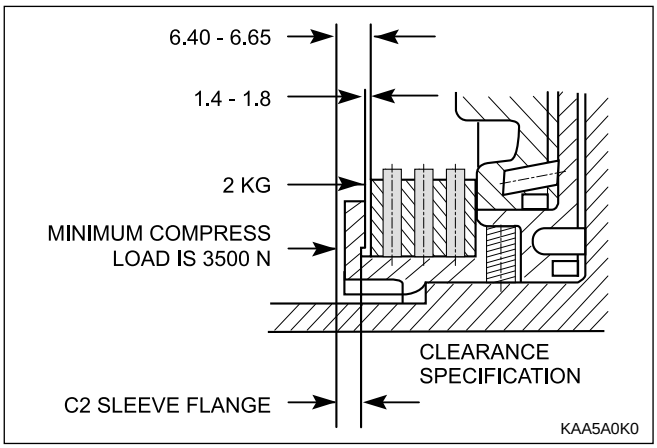


KAA5A0I0

19. Measure and record the thickness of the flange of the C2 sleeve.
20. Install the C4 clutch plates and wave washer into the C2 actuating sleeve, with the rounded edge of the steel plates down, in the following sequence:
    - Steel plate (selective)
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Wave washer


KAA5A0J0

21. Holding the cylinder horizontal, install the sleeve and clutch plate assembly into the cylinder, with the crest of one wave of the washer in line with one of the holes in the outside of the cylinder, until the sleeve contacts the C2 wave washer.
22. Check the C4 clutch pack clearance using 0555-336260 clutch pack clearance kit.

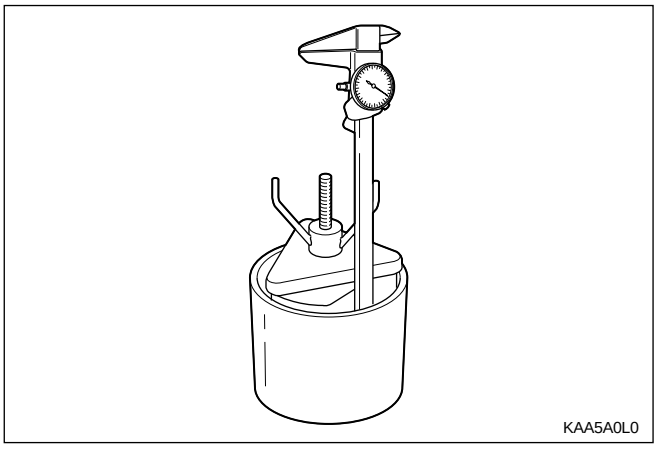


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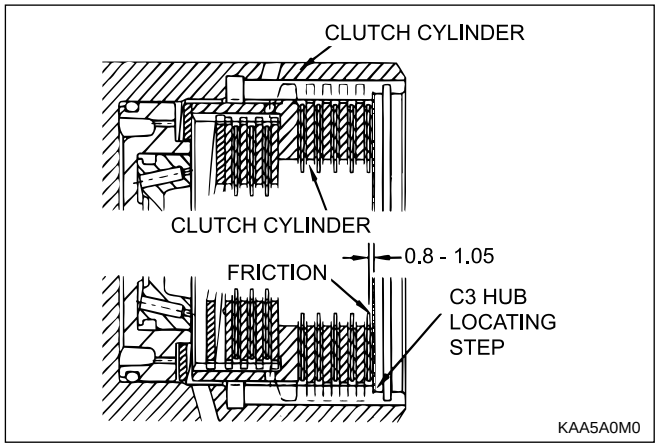
Notice: With the C2 wave spring compressed, and the clutch Pack supporting a 2 kg weight, the dimension from the underside of the C2 pressure plate to the selective steel is to be between 1.4 - 1.8 mm. If the clutch is to be gauged from the top of the pressure plate, then the dimension is to be the actual thickness of the pressure plate plus 1.4 - 1.8 mm.

23. Use selective plates to achieve the correct specification. If new friction plates are being fitted, remove the clutch pack and soak the friction plates in ATF for a minimum of 5 minutes prior to reassembly.

    Notice: The clutch pack clearance must be taken before the elements are soaked in ATF.


KAA5A0L0

24. Reassemble the sleeve and clutch pack into the cylinder. Observe the alignment of the wave washer to the hole in the cylinder.
25. Install the C2 clutch plates in the cylinder in the following sequence:
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Steel plate (0574-000013, `014, `015, `016, `019, `022), or Friction disc (0574-000012 & `017)
    - Steel plate (selective)
    - Friction disc
    - Steel plate (selective)
    - Friction disc



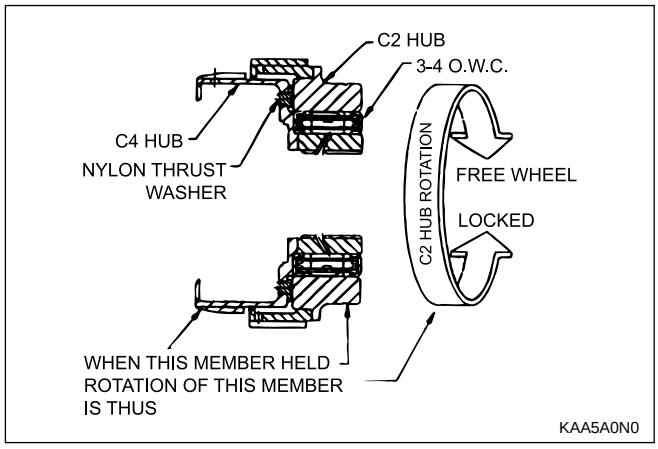
26. Check the clutch pack clearance using only the weight from 0555-336260 clutch pack clearance kit.

    Notice: With the clutch pack supporting a 2 kgweight, the dimension from the C3 clutch hub locating step to the friction plate is to be between 0.80 - 1.05 mm.

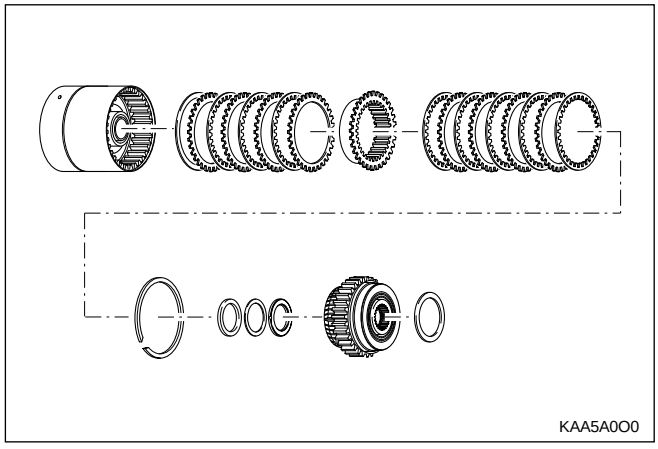
27. Use selective plates to achieve the correct specifica-tion. If new friction plates are being fitted, remove the clutch pack and soak the friction plates in ATF for a minimum of 5 minutes prior to reassembly.

    Notice: The clutch pack clearance must be taken before the elements are soaked in ATF.

28. Lubricate and fit the 3-4 OWC and end caps to the C2 hub.



29. Align the tangs and fit the nylon thrust washer onto the C4 hub.
30. Align and fit the C4 hub to the C2 clutch and the OWC assembly.
31. Check the rotation of the C2 hub. While holding the C4 hub, the C2 hub should rotate in the clockwise direction and lockup in the anti-clockwise direction when viewed from the C2 hub.



32. Apply petroleum jelly to the No. 5 needle bearing and fit it to the C4 hub.
33. Remove the C2 clutch plates from the clutch cylin-der.
34. Fit the thrust plate over the cylinder inner hub.
35. Engage the C2/C4 clutch hub assembly in the C4 clutch plates.
36. Install the C2 clutch plates.
37. Install the C3 hub and secure it with the circlip, ensuring that the circlip is firmly seated in its groove.

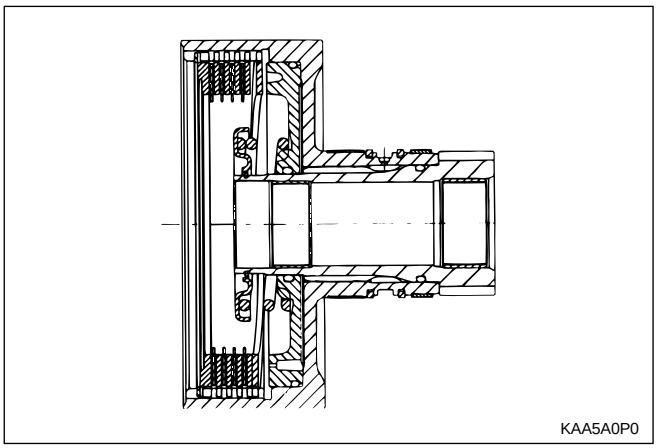
C3 Clutch and Reverse Sun Gear Assembly

Tools Required

0555-336259 Clutch Spring Compressor

0555-336260 Clutch Pack Clearance Kit

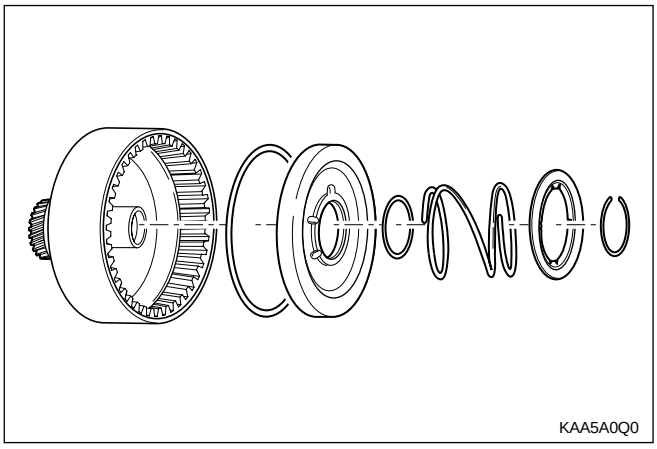
1. Check the orifices in the cylinder are clear of obstructions.
2. Check the C3 cylinder bush outside diameter and the centre support inside diameter are in good condition and not damaged. Coat the sealing rings with automatic transmission fluid and fit into the C3 cylinder grooves.



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3. Check the reverse sun gear splines, grooves and thrust face for condition. Coat the 'O' ring with automatic transmission fluid and fit it to the groove of the reverse sun gear.
4. Lubricate the C3 washer with petroleum jelly and fit to the inner face of the reverse sun gear.
5. Install the reverse sun gear in the C3 cylinder, ensuring that the 'O' ring compression is adequate but not excessive.

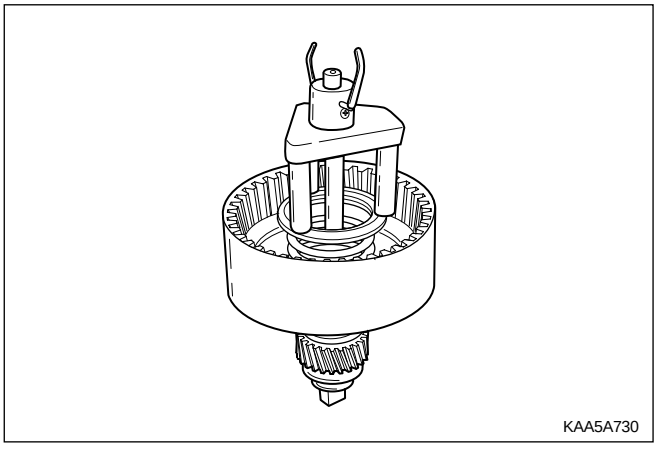
   Notice: 'O' rings must not be twisted in the grooves.



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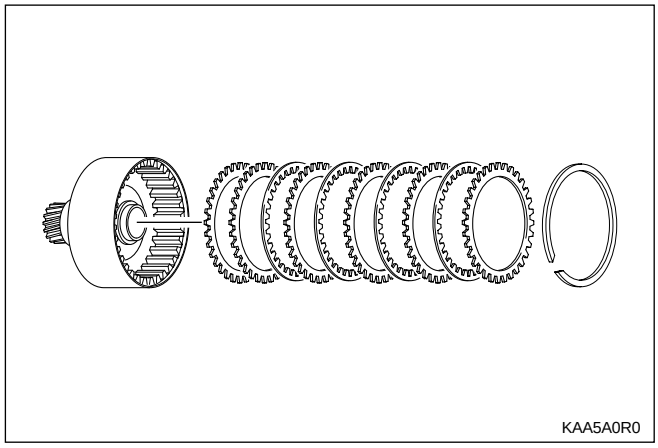
6. Coat the C3 piston 'O' rings with automatic transmission fluid and fit the small 'O' ring onto the inner ring and the large 'O' ring onto the outer ring of the C3 piston.
7. Check that the bleed orifices of the piston are clean and clear of obstructions.
8. Install the C3 piston in the cylinder until the outside diameter of the piston enters the inside diameter of the cylinder.

   Notice: Take care not to cut the 'O' ring.

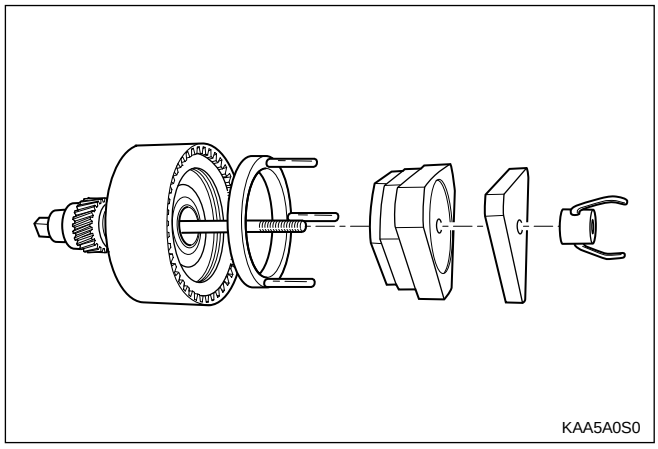


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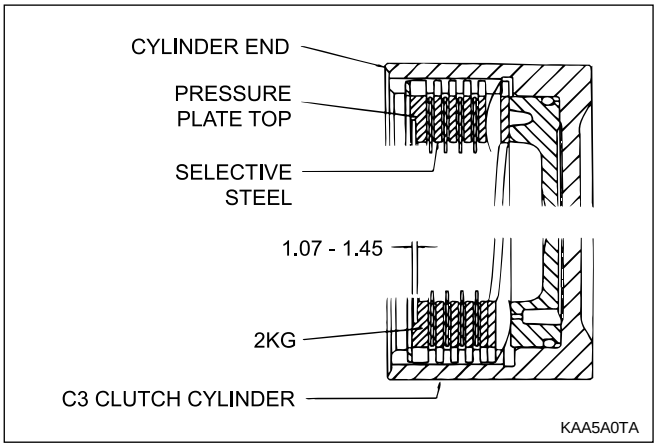
9. Assemble the spring and spring retainer on the piston. Using 0555-336259 clutch spring compressor compress the spring sufficiently to enable the installation of the retaining circlip, ensuring that the circlip is firmly seated in the groove, and remove the tool.
10. Fit the C3 wave plate to the C3 piston face, ensuring that one crest of the wave plate of the C3 piston face is aligned over one of the piston orifices.


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11. Assemble the clutch plates and discs into the cylinder in the following sequence :
    - Steel plate
    - Friction disc
    - Steel plate
    - Steel plate (0574-000013, `014, `015, `016, `019, `022), or Friction disc (0574-000012, `017)
    - Steel plate (selective)
    - Friction disc
    - Steel plate (selective)
    - Friction disc
12. Align and fit the pressure plate with the counterbore facing away from the clutch plates.


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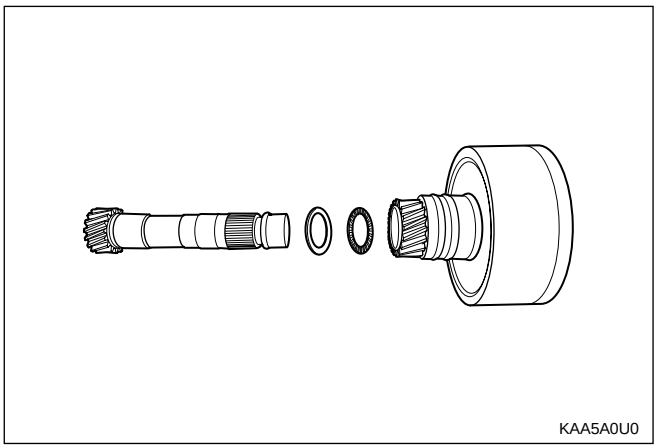
13. Install the circlip.
14. Check the C3 clutch clearance using 0555-336260 clutch pack clearance kit in the following manner (weight only).
    a. Place the weight on the pressure plate and measure the distance from the end of the cylinder to the top of the pressure plate.
    b. Record this figure.
    c. Remove the weight.
    d. Lift the pressure plate up against the circlip and measure the distance from the end of the cylinder to the top of the pressure plate.
    e. Record this figure.
    f. Subtract the second reading from the first reading to obtain the clutch pack clearance.



Notice: With the clutch pack supporting a weight of 2kg, the clearance between the snap ring and the top of the pressure plate is to be between 1.07 - 1.45 mm.

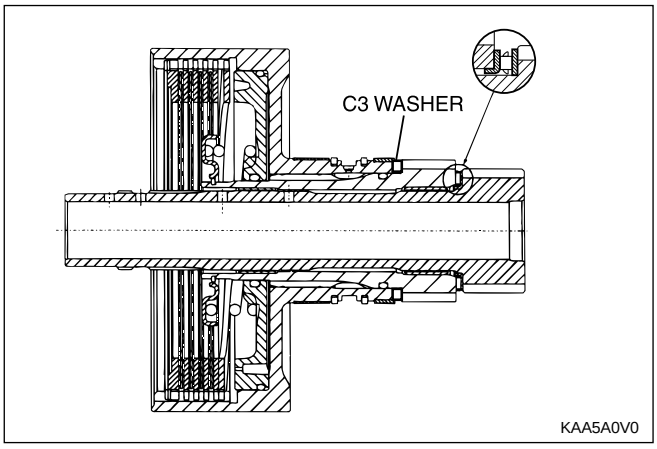
15. If new friction plates are being fitted, remove the clutch pack and soak the friction elements in automatic transmission fluid for a minimum of five minutes prior to reassembly.

    Notice: The clutch pack clearance must be taken before the elements are soaked in automatic transmission fluid.

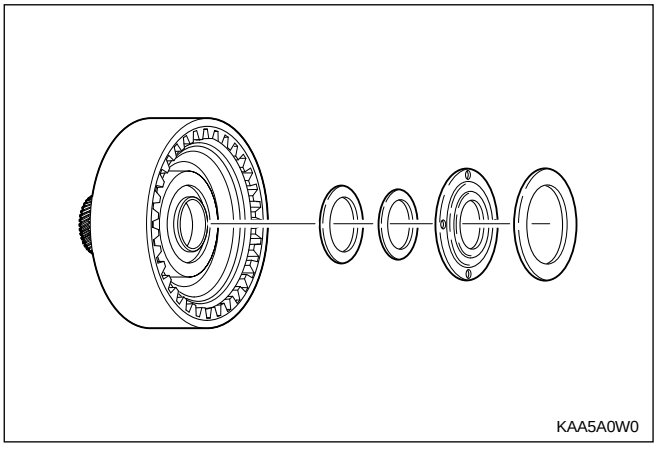


Forward Sun Gear and C3 Clutch Pack Assembly

1. Fit the No.7 needle bearing assembly over the forward sun gear, ensuring that the thrust washer is between the bearing and the sun gear.
2. Lubricate the lipped thrust plate with petroleum jelly and fit the thrust plate onto the reverse sun gear.



3. Align and fit the C3 clutch assembly over the forward sun gear.



4. Lubricate the No.6 needle bearing with petroleum jelly and fit it to the thrust plate. Ensure the lugs on the outside diameter of the bearing fit in the thrust plate counterbore.
5. Align and fit the plastic thrust washer to the thrust plate with petroleum jelly.
6. Install the assembly over the forward sun gear shaft against the No. 6 needle bearing.
7. Place the assembly to one side.

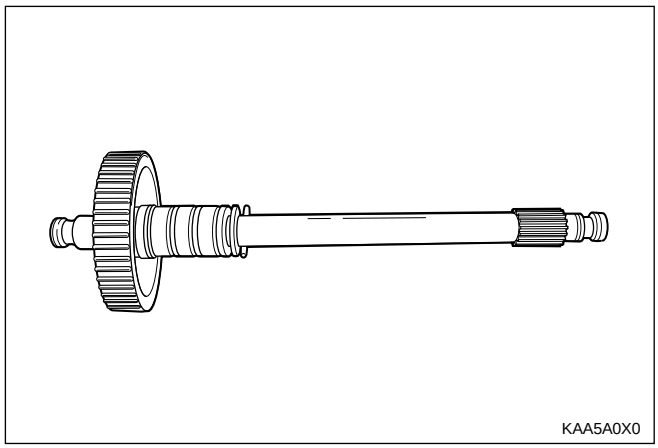
C1 Clutch Overdrive Shaft and Input Shaft Assembly

Tools Required

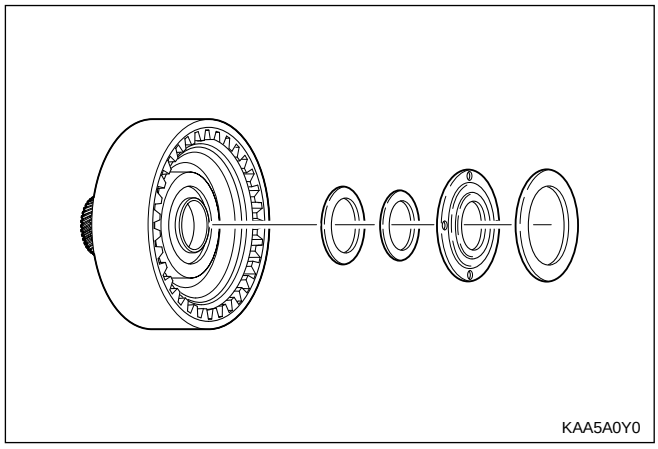
0555-336260 Clutch Pack Clearance Kit

Notice:

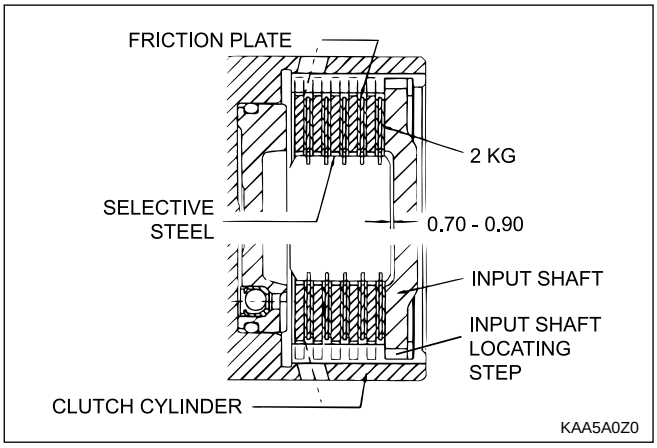
- Ensure that the snap rings are fitted correctly.
- Check pistons for cracks, especially the C1 piston.
- Do not mix clutch piston return springs.
- If the C1/C2 clutch packs separate from the C3 clutch pack, make sure the No. 6 bearing doesn't drop out of the bearing retainer.


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1. Check the overdrive shaft grooves for any defect.
2. Coat the sealing rings, large and small, with petroleum jelly and fit them to the overdrive shaft. The sealing rings may be held in place with a small amount of petroleum jelly.


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3. Assemble the clutch plate and disc into the cylinder in the following sequence:
   - Steel plate
   - Friction disc
   - Steel plate
   - Friction disc
   - Steel plate
   - Steel plate (0574-000013, `014, `015, `016, `019, `022), or friction disc (0574-000012 & `017)
   - Steel plate (selective)
   - Friction disc
   - Steel plate (selective)
   - Friction disc

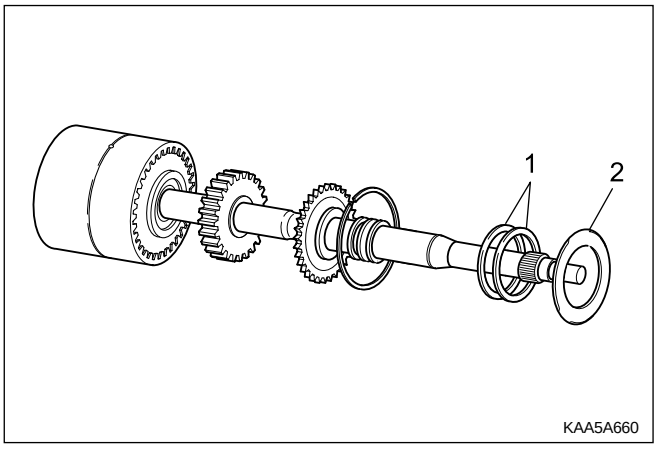


4. Check the clutch pack clearance using 0555-336260 clutch pack clearance kit.
5. Use selective plates to achieve the correct specification.

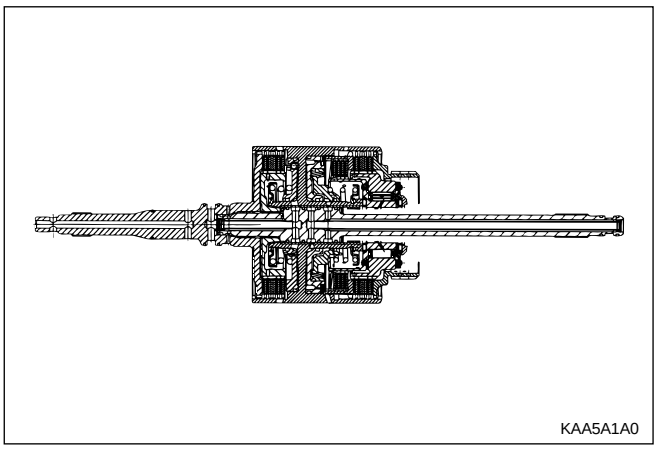
   Notice: With the clutch pack supporting a 2 kg weight, the dimension from the input shaft locating stop to the friction disc must be 0.70 - 0.90 mm.

6. If new friction plates are being fitted, remove the clutch pack and soak the friction elements in automatic transmission fluid for a minimum of five minutes prior to assembly.

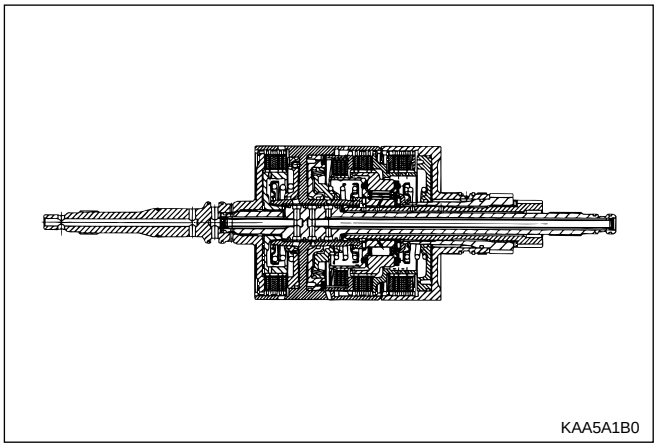
   Notice: The clutch pack clearance must be taken before elements are soaked in automatic transmission fluid.



7. Check the fit of the C1 clutch hub on the overdrive shaft. If it is loose, the hub and shaft assembly must be replaced.
8. Coat the small nylon thrust spacer with petroleum jelly and install it over the overdrive shaft.
9. Carefully fit the overdrive shaft into the C1 cylinder so as not to damage the sealing ring.
10. Fit the small bronze C1 hub thrust washer in place with petroleum jelly.
11. Check the input shaft for any defect. Fit the input shaft into the cylinder and secure it with the circlip, ensuring that the circlip is completely seated in the groove.



12. Coat the sealing rings with petroleum jelly and fit onto the input shaft.

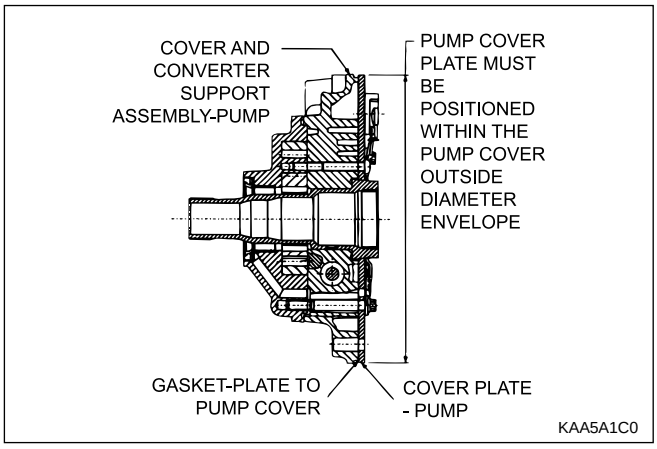

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13. Assemble the C1/C2/C4 clutch assembly to the C3 clutch and sun gear assembly.
14. Install this assembly in the transmission case.

Pump Cover and Converter Support

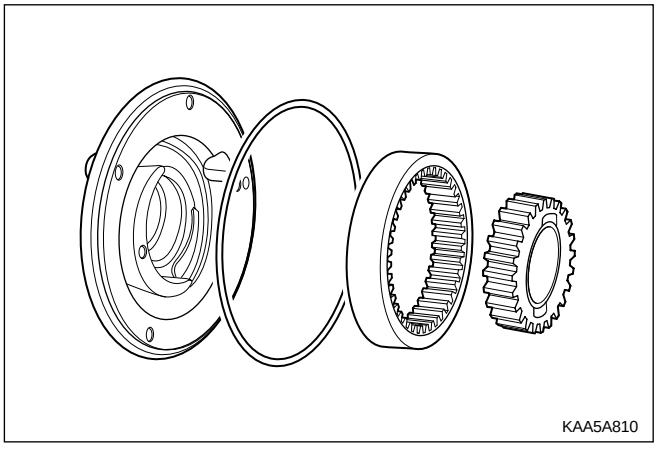
Notice:

- Do not wash the nose of solenoids in solvent.
- Ensure that the correct ‘O’ ring is fitted for the application.
- Be careful not to damage the needle bearings on the assembly. Avoid any axial impact loads during assembly.
- Check the transmission end float. This will help to detect any missing parts or incorrect assembly.

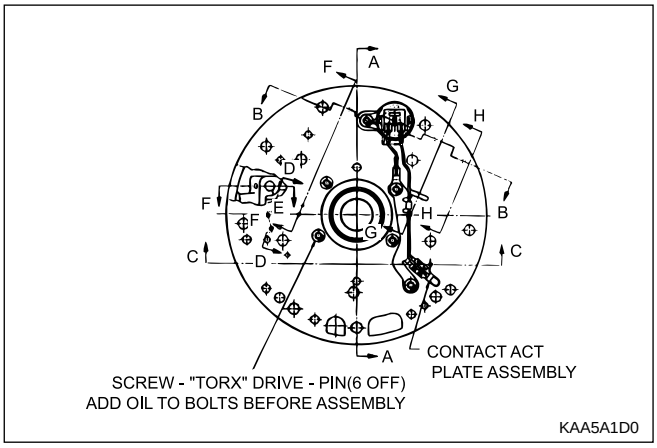


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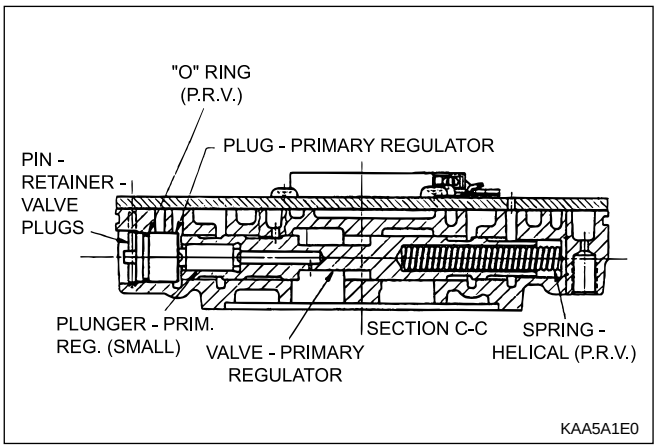
1. Check the pump body for any damage, chips or irregularity. Check that the bush is firmly staked in the drive gear.
2. Install the seal flush with the front face of the pump body.
3. Lubricate the pump bush, and the drive and driven gears, with automatic transmission fluid.


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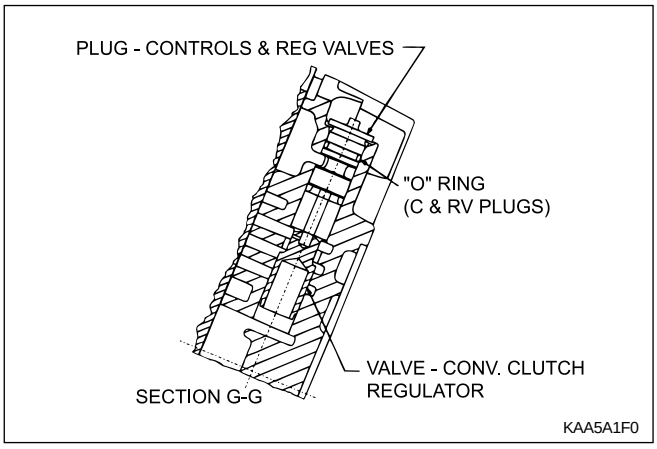
4. Install the pump driven gear and the pump drive gear into the pump body.
5. Using a straight edge and thickness gauge, check that the clearance between pump face and gears is 0.04 - 0.018 mm.
6. Lubricate the pump body ‘O’ ring with automatic transmission fluid and fit it to the pump body. Put the pump body to one side.



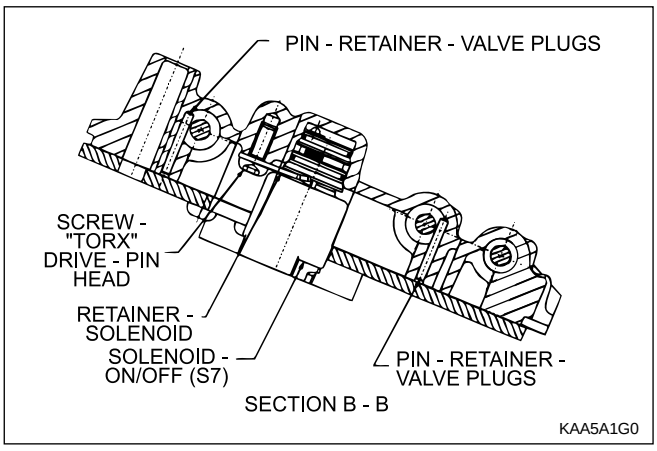
7. Ensure that the pump cover cavities, ports and holes are clean and free of any obstruction.
8. Lubricate all loose parts with automatic transmission fluid prior to assembly.



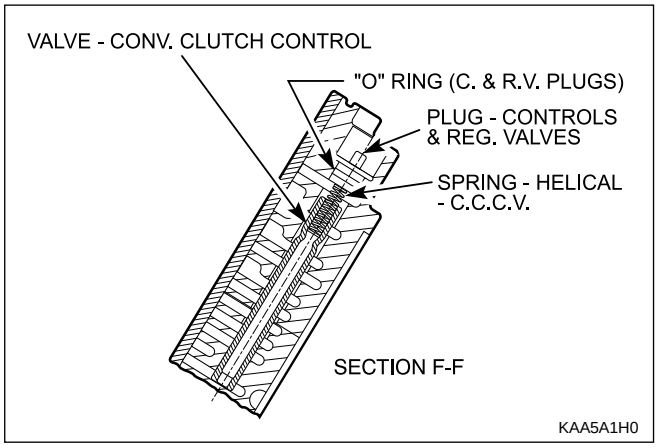
9. Assemble the primary regulator valve, spring and plunger to the pump cover, ensuring that the regulator valve slides freely, then fit the regulator valve plug and ‘O’ ring.
10. Install the retaining pin.



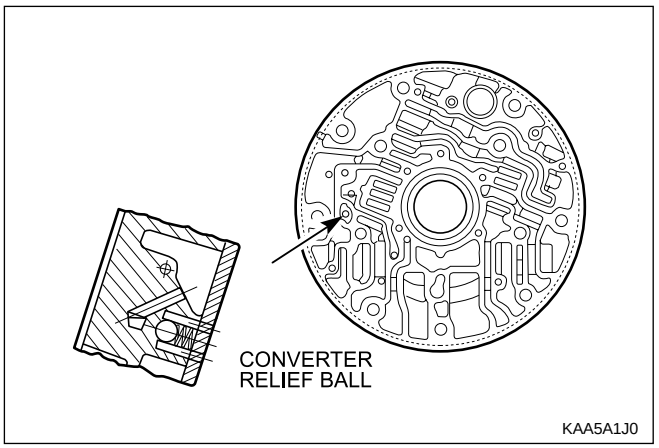
11. Install the converter clutch regulator valve, plug, spring and ‘O’ ring.



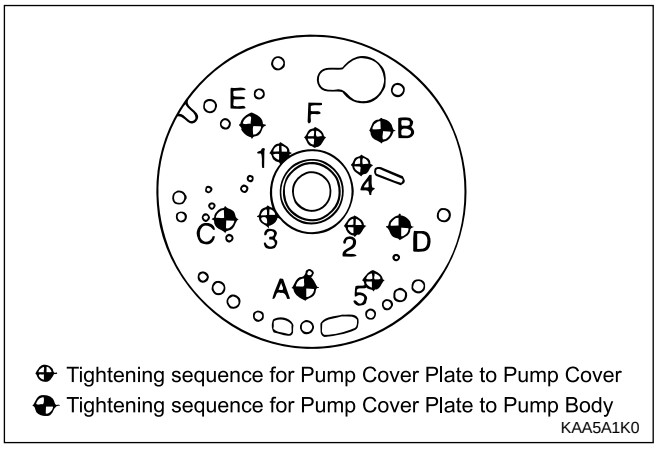
12. Install the retaining pin.



13. Install the converter clutch control valve, spring, plug, and 'O' ring.
14. Install the retaining pin.



15. Install the converter release check ball and spring.
16. Install the gasket on the pump cover.



17. Install the cover plate, solenoid 7 with the retainer and the solenoid wiring retainer to the pump cover, ensuring that the periphery of the cover plate is flush with the periphery of the pump cover.
18. Tighten the screws to specification in the order. (1-5)

Installation Notice

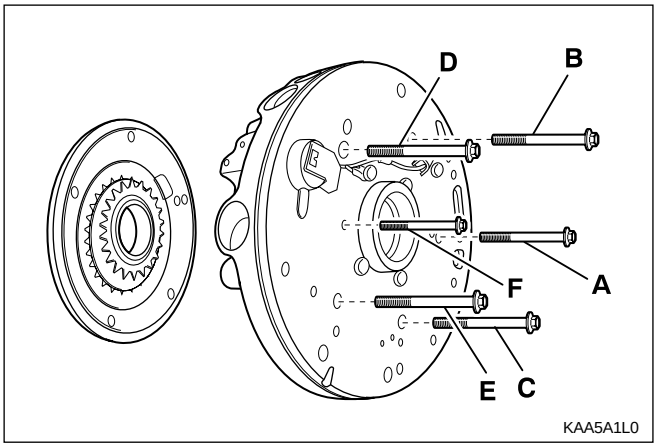
Tightening Torque	13-16 N•m (10-12 lb-ft)

19. Tighten the solenoid 7 screw.

Installation Notice

Tightening Torque	13-16 N•m (10-12 lb-ft)

- Check that neither the wiring nor the connector protrudes excessively, in order that at assembly neither the wiring and the connector contacts or rubs on the input shaft or the C1/C2 clutch cylinder.

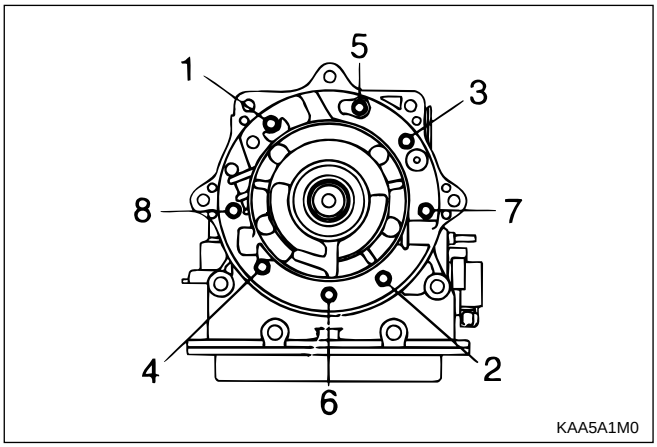


20. Assemble the pump to the pump cover.
21. Tighten all bolts and the crescent screw finger tight, ensuring that the pump is flush against the pump cover. Tighten the bolts and the screw to specification in the order. (A-F)

Installation Notice

Tightening Torque	Bolt (A-E) : 24-27 N•m (18-20 lb-ft)
	Screw (F) : 13-16 N•m (10-12 lb-ft)

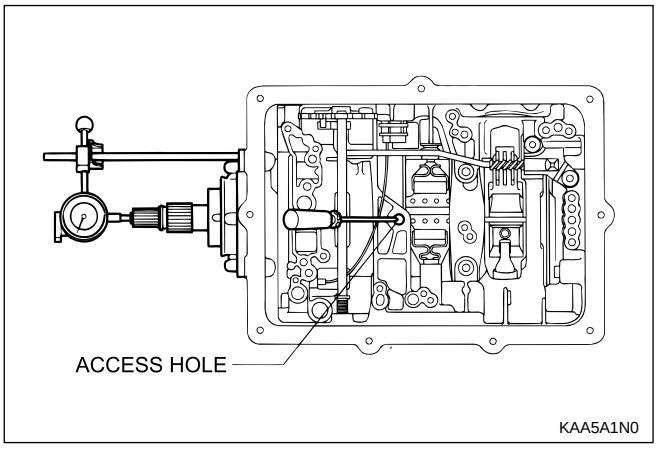
22. Install the pump to transmission case gasket onto the case.
23. Fit the 'O' ring to the pump cover outer diameter.



24. Install the pump and cover assembly over the input shaft being careful not to damage the sealing rings. Apply additional Loctite 202 or equivalent as required to the pump cover to case bolts. Install and tighten bolts to specification.

Installation Notice

Tightening Torque	24-34 N•m (18-25 lb-ft)

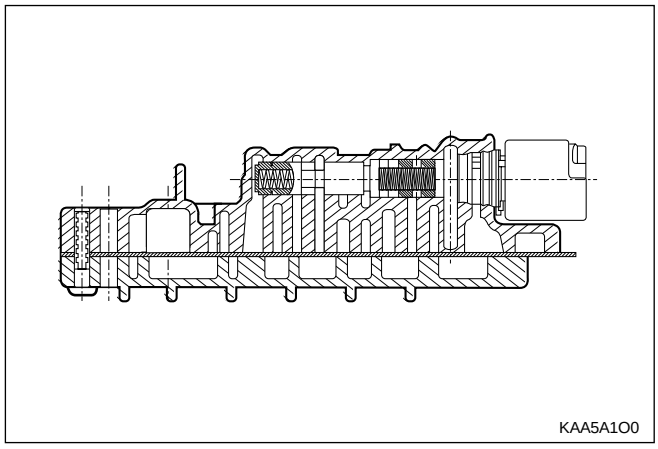


25. Check that the transmission end float is 0.50 - 0.65 mm. If the unshimmed end float clearance is greater than specification, shims are to be placed between the No. 4 bearing and the input shaft bearing surface. If the end float clearance is less than 0.5 mm then the transmission has been assembled incorrectly or the parts are out of specification.
26. Perform the following steps to check the end float :
    a. Attach a dial indicator to the front of the transmission case with the stylus resting on the end of the input shaft.
    b. Apply a force of approximately 250 N or 25 kg to the input shaft.
    c. Zero the dial indicator.
    d. Place a small lever behind the forward clutch cylinder and lever the cylinder forward.
    e. The measurement recorded on the dial indicator is the transmission end float or clearance between the No.4 bearing and the converter support tube.
27. On completion of this procedure, adjust the front and rear bands to specifications. Refer to "Front and Rear Band Adjustment" in this section.

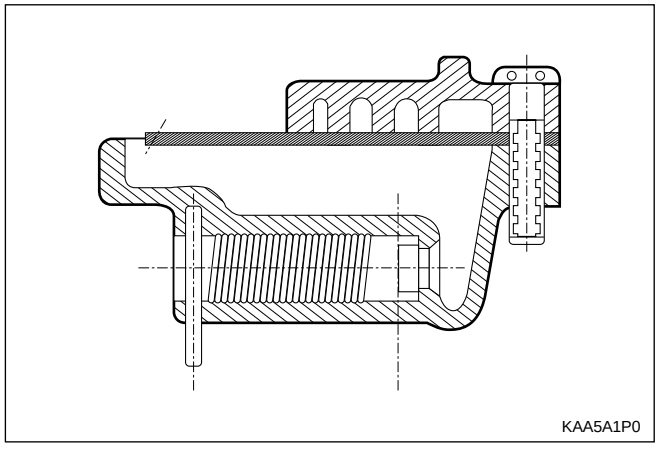
Valve Body

Notice:

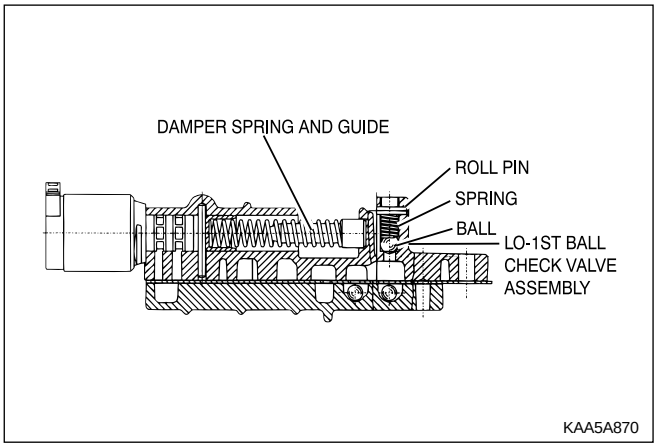
- Do not wash the nose of solenoids in solvent.
- Be aware of ball positions in the upper valve body.
- Be aware of 1-2 and 3-4 shift valve positions, they can be swapped.
- Check the 4-3 sequence valve and spring orientation.
- Check that the 12 mm ball is in the lower body.
- Check the line pressure relief valve for swarf, and be aware of replacing the shims.
- When servicing the transmission, ensure that the solenoid 5 damper spring is not broken.
- Locate the detent spring central to the detent lever.
- Wash the upper and lower valve bodies thoroughly with cleansing solvent and blow dry.
- Check the valve body cavities, ports and holes for damage or obstructions.
- The orifices in the valve body are for stability and safeguard. Do not drill them larger.
- Thoroughly wash all loose components.
- Check that all valves slide freely in their location.


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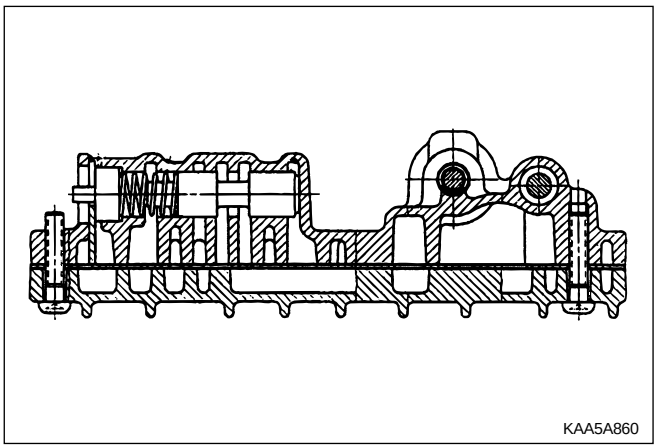
1. Install the detent lever locating pin
2. Install the Band Apply Regulator (BAR) valve, springs, plunger and retaining pin.


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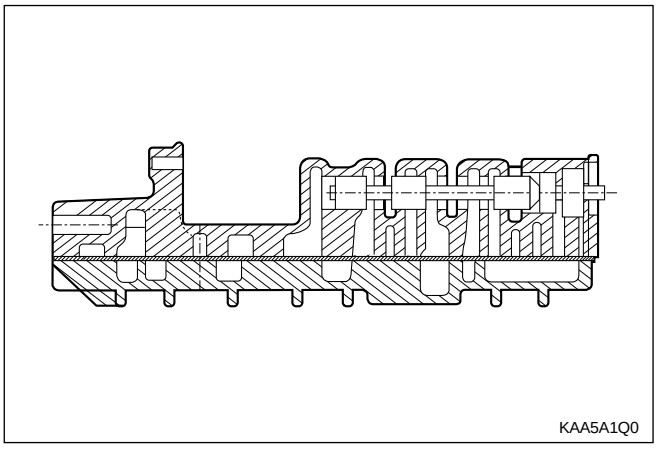
3. Install the line pressure relief valve, tapered end first, spring and disc. Secure with the retaining pin.



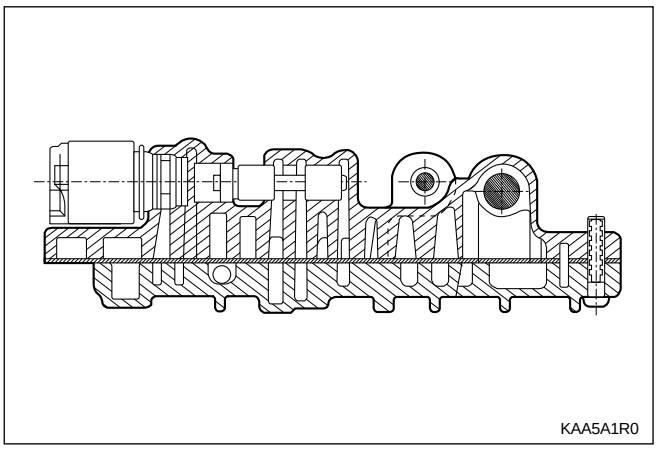
4. Install the solenoid 5 damper guide and spring, piston and retaining pin.



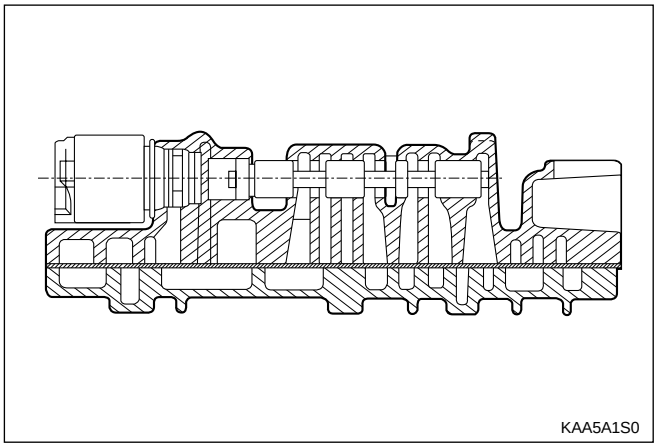
5. Install the 4-3 sequence valve, spring, plug and retaining plate.



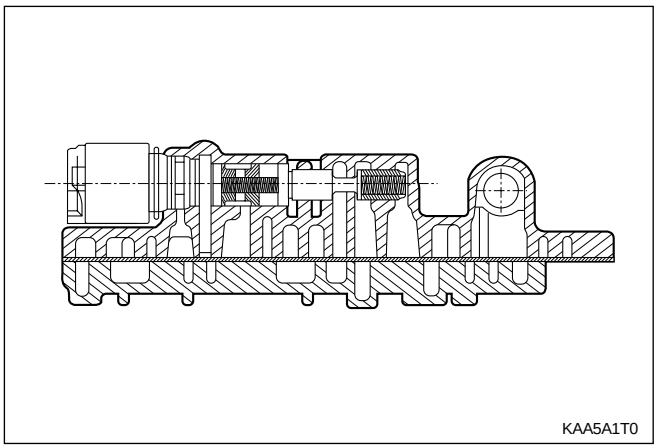
6. Install the 1-2 shift valve, plug and retaining pin.



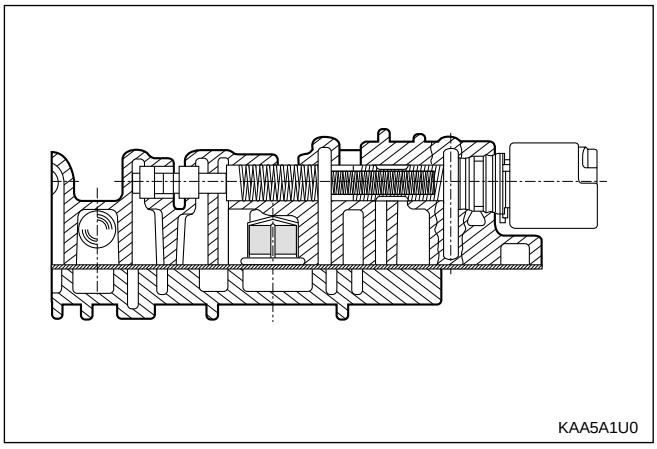
7. Install the 2-3 shift valve and retaining pin.


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8. Install the 3-4 shift valve and retaining pin.


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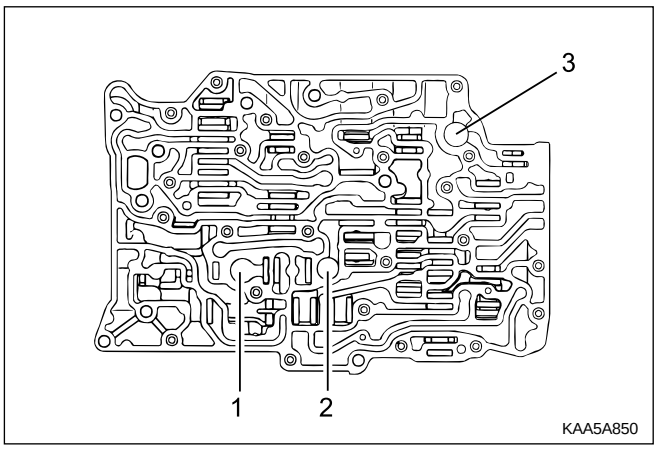
9. Install the Clutch Apply Regulator (CAR) valve, springs, plunger and retaining pin.


KAA5A1U0

10. Install the solenoid supply valve, spring and retaining plate.

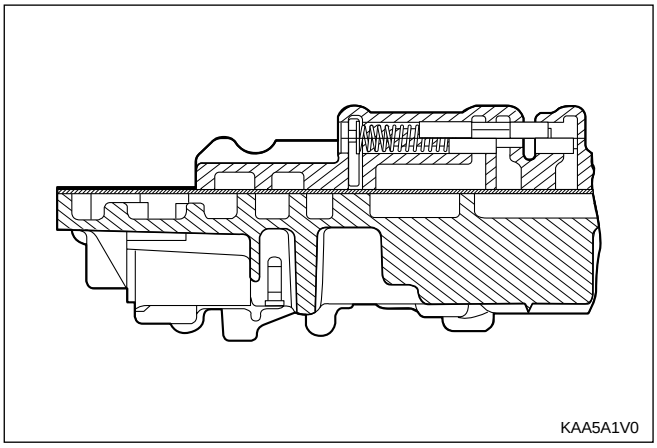
    Notice: This aluminum valve is easily damaged.

11. Install solenoid 6 plunger, spring and retaining pin.

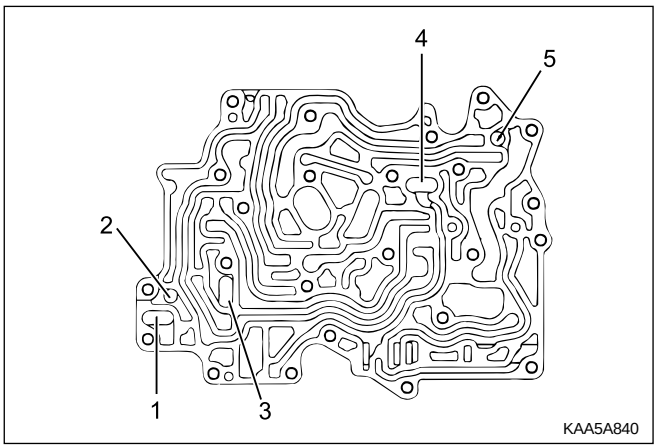


KAA5A850

12. Position the third feed ball (large nylon) in the valve body and install the solenoid 6 filter.
13. Check the separator plate for burrs and damage. Repair or replace the separator plate as necessary.
14. Check the upper and lower valve body gaskets for damage. Replace the gaskets as necessary.
15. Install the lower valve body gasket on the lower valve body.

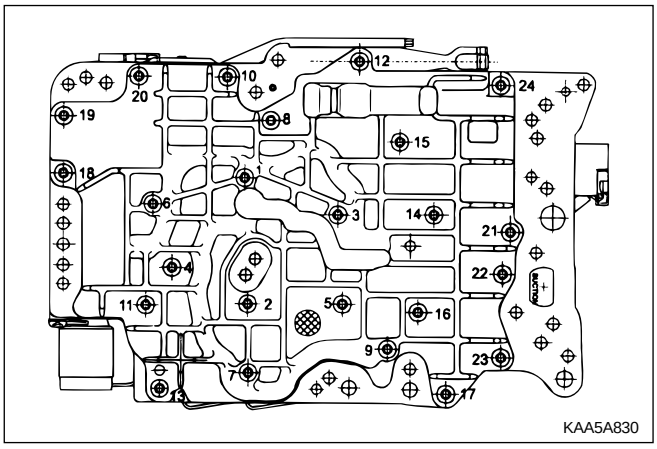

KAA5A1V0

16. Install the reverse lockout valve, spring, plug and retaining plate. Ensure that the valve is correctly oriented.



KAA5A840

17. Position the five nylon ball checks in the upper valve body.
18. Fit the upper valve body gasket. Install the separator plate over the upper valve body.



KAA5A830

19. Holding the separator plate to the upper valve body to prevent the check balls from falling out, install the upper valve body on the lower valve body. Install all screws finger tight then tighten the screws to specification in the prescribed sequence.

Installation Notice

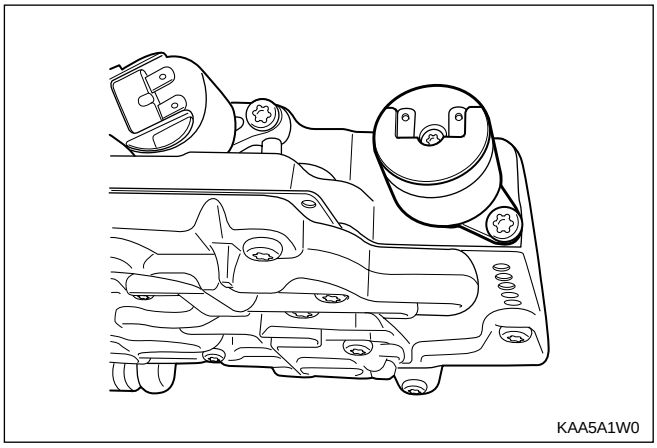
Tightening Torque	11-16 N•m (8-12 lb-ft)

20. Install solenoids 1, 2, 3, 4 and 6. Ensure the solenoid is firmly secured by the retainer and that the screw is tightened to specification.

Installation Notice

Tightening Torque	8-12 N•m (71-106 lb-in)

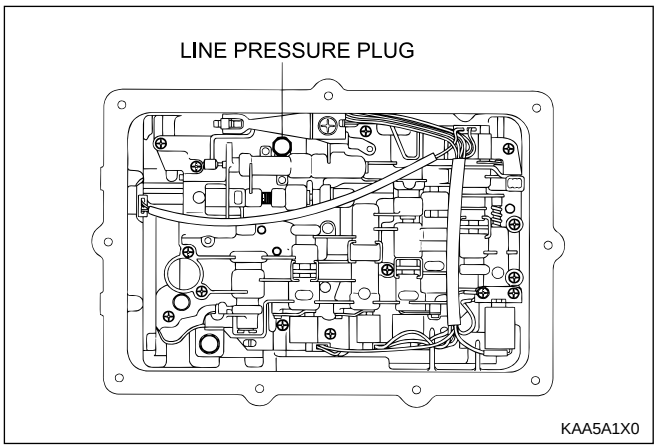
- The wiring loom ground wire eyelet terminal is secured beneath the solenoid 1 retainer.


KAA5A1W0

21. Install solenoid 5. Ensure that the solenoid is pushed firmly into the valve body by the retainer and that the screw is tightened to specification.

Installation Notice

Tightening Torque	8-12 N•m (71-106 lb-in)

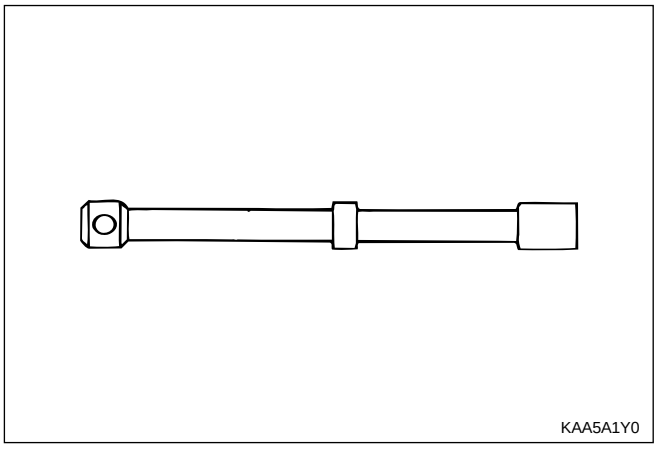


KAA5A1X0

22. Install the detent spring assembly (spring, support plate and screw), ensuring that the screw is tightened to specification. Check the spring for wear or damage.

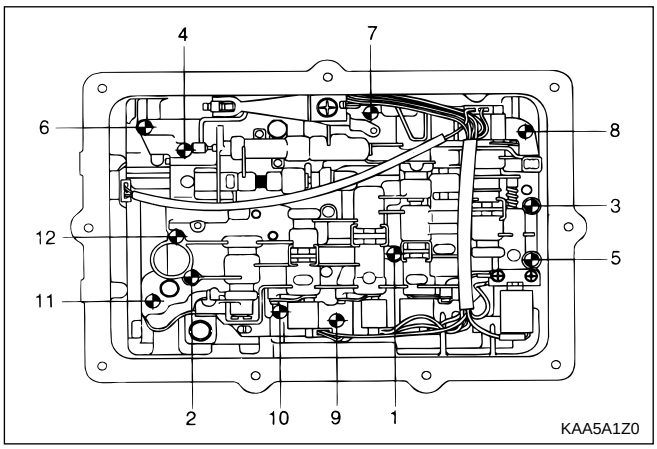
Installation Notice

Tightening Torque	20-22 N•m (15-16 lb-ft)


KAA5A1Y0

23. Install the manual shift valve.

Notice: Be aware that the manual valve will fall out of the valve body.

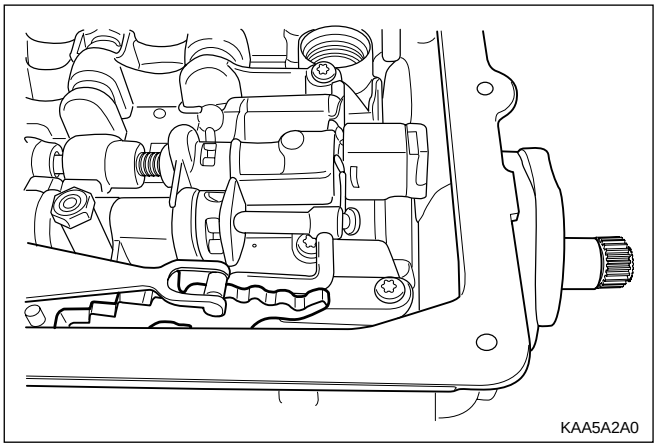


KAA5A1Z0

24. Align the valve body assembly on the transmission case and install the manual valve lever to manual valve link. Fit the long end of the link to the manual valve first. Install the securing bolts and tighten to specification in the specified sequence.

Installation Notice

Tightening Torque	8-13 N•m (71-115 lb-in)


KAA5A2A0

25. Check the alignment of the detent roller and the manual lever quadrant.
26. Connect the solenoid wiring as detailed below:

    Solenoid 1 - red

    Solenoid 2 - blue

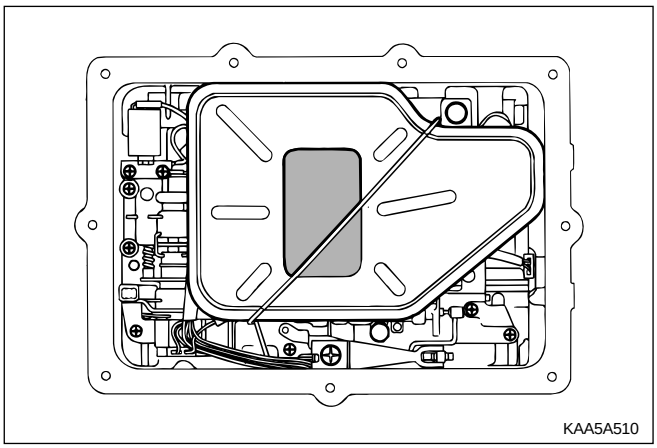
    Solenoid 3 - yellow

    Solenoid 4 - orange

    Solenoid 5 - green

    Solenoid 6 - violet

    Notice: All hardware must be correctly installed and torqued to specification.

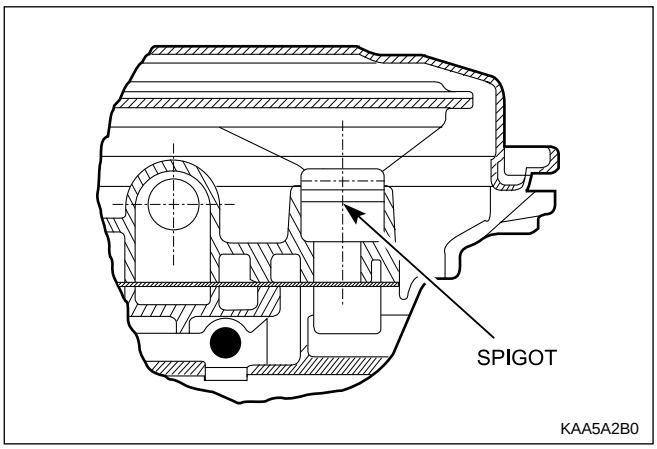

KAA5A510

Oil Filter and Pan Assembly

Notice:

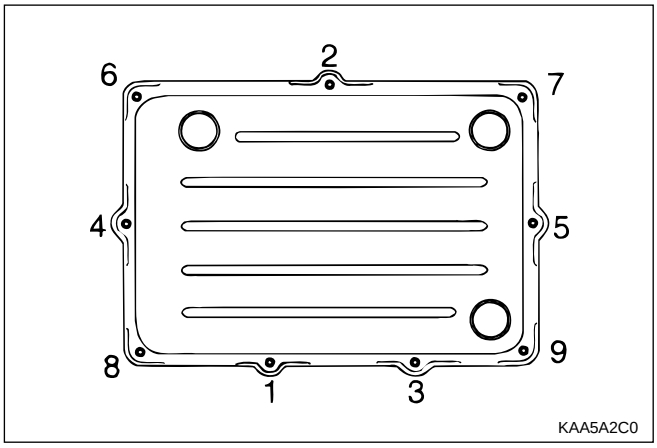
- Replace the filter whenever rebuilding a transmission where a significant amount of mechanical damage has occurred.
- To aid the assembly of the pan gasket, use a small amount of Vaseline at the pan/gasket interface. This ensures that the gasket remains on the pan ridge. Do not over torque pan bolts as this may distort the pan and cause leaks.
- Ensure that the internal line pressure plus in the valve body is fitted.

1. Lubricate the oil filter sealing ring with automatic transmission fluid.



KAA5A2B0

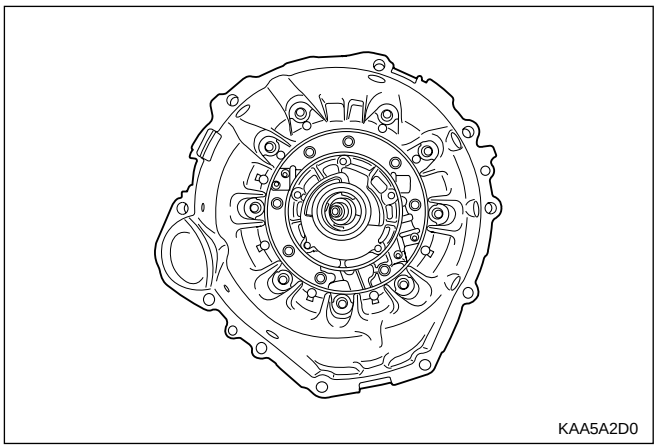
2. Carefully assemble the oil filter to the valve body. The spigot must not lean on one side while being fitted.
3. Secure the oil filter assembly with the retainer.
4. Check that the magnet is located in the dimple in the corner of the oil pan.
5. Assemble the gasket on the pan lip. The gasket must be free of any distortion when installed.



6. Fit the oil pan assembly to the transmission case and tighten the securing bolts to specification and sequence Do not over torque.

Installation Notice

Tightening Torque	4-6 N•m (35-53 lb-in)



Torque Converter and Housing Assembly

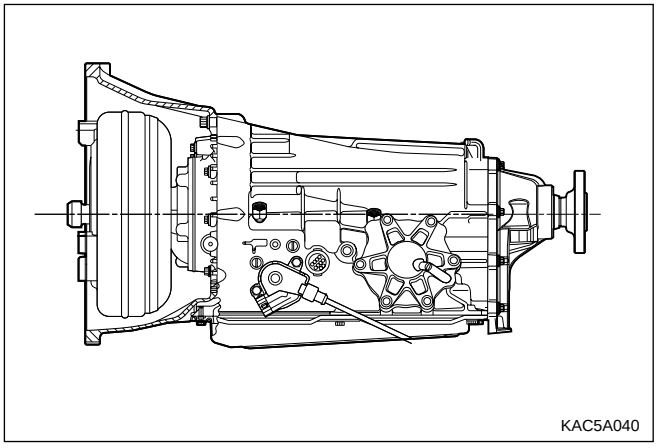
1. Locate the torque converter housing on the transmission main case.
2. Apply additional Loctite 202 or equivalent as required to the converter housing to case bolts. Install and tighten bolts to specification.

Installation Notice

Tightening Torque	54-68 N•m (40-50 lb-ft)

- All the hardware must be correctly installed and torqued to specification.

3. Fit the converter ensuring that the tangs are engaged in the pump gear. Ensure that the tangs do not contact the pump seal.



Output Flange Assembly (2WD Mode)

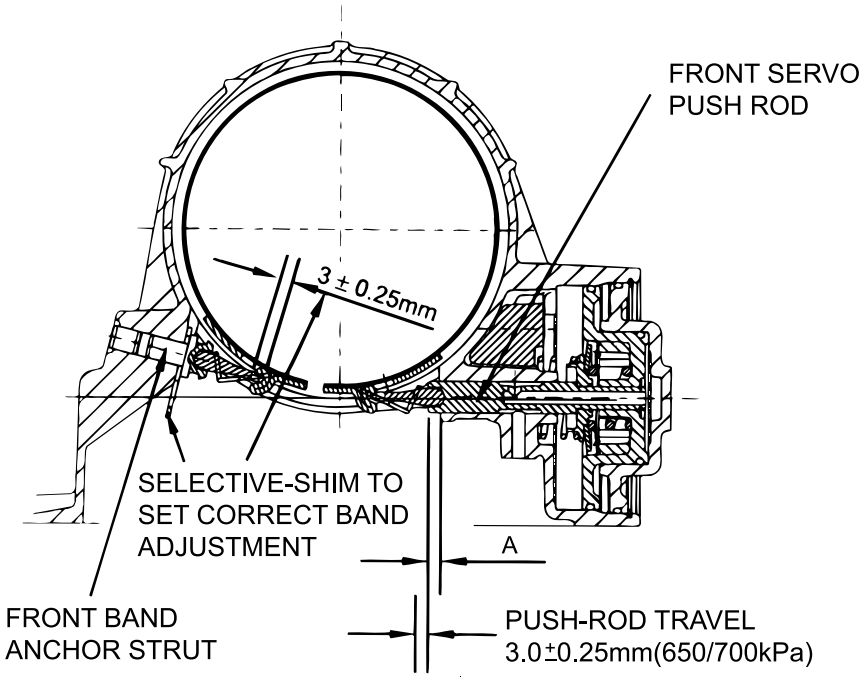
1. Position the transmission detent lever into the park position and lock the output shaft.
2. Clear the threads on the output shaft and apply Loctite 243 or equivalent as required to threads.
3. Install the flange, ‘O’ ring and torque the nut to specification.

Installation Notice

Tightening Torque	35 N•m (26 lb-ft)

FRONT AND REAR BAND ADJUSTMENT

Front Band Setting Procedure



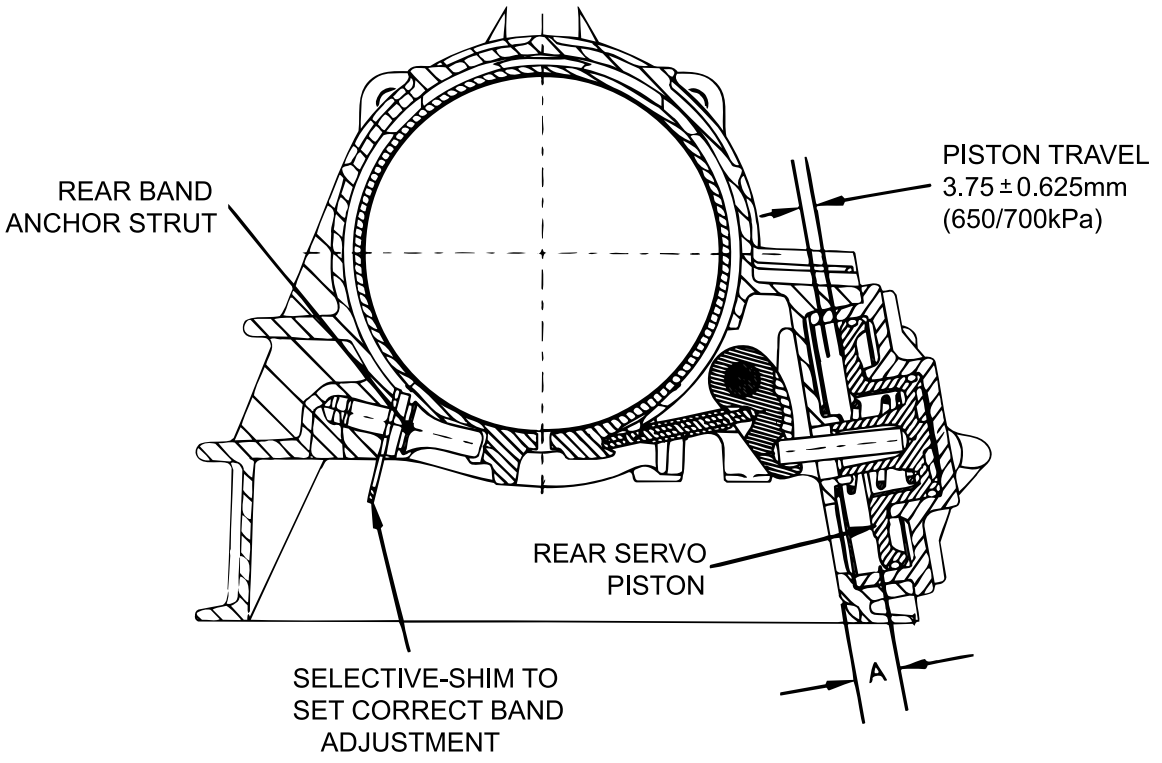
1. Measure the projection of the front servo push rod from the transmission case dimension 'A'.
   a. Apply air at 650/700 kPa to the front servo apply area (B1 outer)
   b. Measure the travel of the push rod and subtract 3 mm to find the shim size required.
   c. Release the air.

   Notice: A minimum of one shim is required at all times - minimum shim size is 1 mm. The thickness of available shims are listed in the table below.

Thickness(mm)	Part Number
0.95/1.05	0574-037017
1.15/1.25	0574-037018
1.44/1.56	0574-037019
1.73/1.87	0574-037020
1.93/2.07	0574-037021
2.12/2.28	0574-037022
2.42/2.58	0574-037023
2.61/2.79	0574-037024

2. Fit the selected shim(s) to the shank of the anchor strut as follows:
   a. Inspect the shim(s) for damage, wear or corrosion. Replace as necessary.
   b. The shim(s) are to be installed between the case abutment face and the anchor strut flange.
   c. The shim(s) are to be fitted by hand and under no circumstances to be hammered or forced.
   d. Shim(s) are to be pressed on by hand until an audible click is heard. The click indicates that the shim is clipped home correctly.
3. Re-check that the push rod travel. (3mm ±0.25mm)

Rear Band Setting Procedure

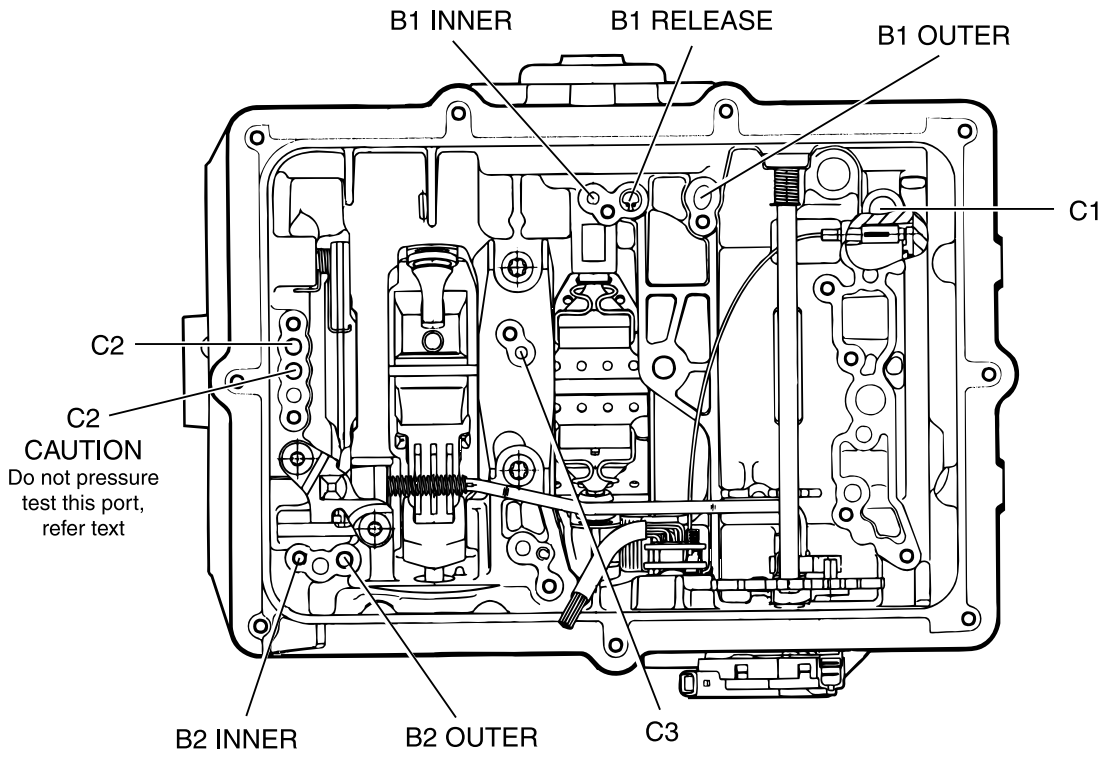


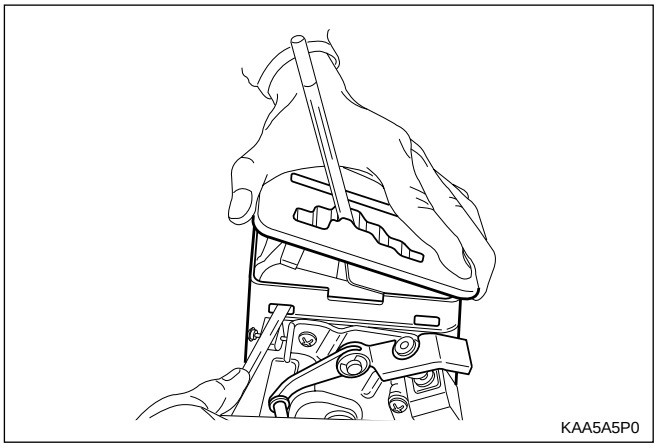
1. Measure distance'A' from the rear servo piston to the inner face of the transmission case using vernier calipers.
   a. Apply air at 650/700 kPa to the rear servo apply area (B2 outer)
   b. Measure the travel of the piston, subtract 3.75 mm and divide the remainder by 2.5 to find shim size.
   c. Release the air.

   Notice: A minimum of one shim is required at all times - minimum shim size is 1 mm. The thickness of available shims are listed in the table below.

Thickness(mm)	Part Number
0.0.95/1.05	0574-037017
1.15/1.25	0574-037018
1.44/1.56	0574-037019
1.73/1.87	0574-037020
1.93/2.07	0574-037021
2.12/2.28	0574-037022
2.42/2.58	0574-037023
2.61/2.79	0574-037024

2. Fit the selected shim(s) to the shank of the anchor strut as follows.
   a. Inspect the shim(s) for damage, wear or corrosion and replace as necessary. The shim(s) are to be installed between the case abutment face and the anchor strut flange.
   b. The shim(s) are to be fitted by hand and under no circumstances to be hammered or forced
   c. The shim(s) are to be pressed on by hand until an audible click is heard. The click indicates that the shim is clipped home correctly.
3. Re-check that the piston travel.
   (3.75 mm ± 0.625 mm)

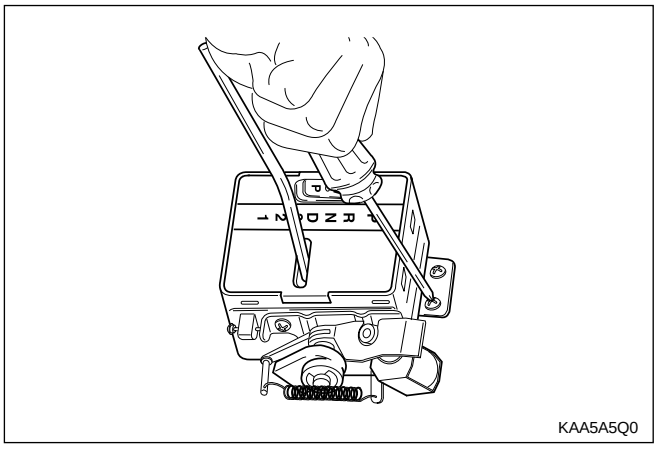

B1 INNER
B1 RELEASE
B1 OUTER
C1
C2
C2
CAUTION
Do not pressure test this port, refer text
B2 INNER
B2 OUTER
C3
KAA5A2G0


KAA5A5P0

GEAR SHIFT CONTROL LEVER

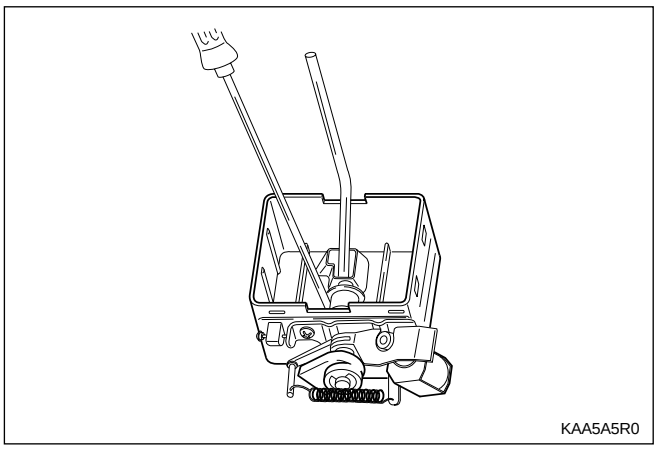
Disassembly and Assembly Procedure

1. Disconnect the negative battery cable.
2. Remove the gear shift control lever assembly. Refer to *Section 9G, interior Trim.*
3. Remove the gear shift control lever knob.
4. Separate the upper and middle housing from the gear shift control lever assembly by unlocking the lock.
5. Remove the upper housing.
6. Disconnect the P position lamp by turning it from the middle housing.

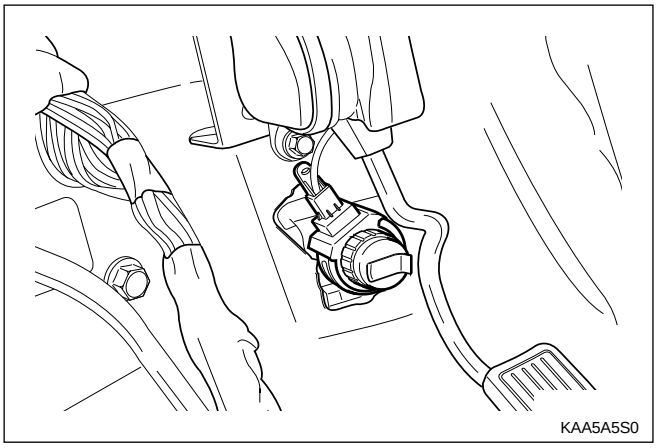

KAA5A5Q0

7. Remove the P position switches assembly bolts.
8. Remove the middle housing with the mode selector switch wiring harness from the gear shift control lever assembly.
9. Separate the P position switches assembly with the P position lamp wiring harness from the gear shift control lever assembly.

   Notice: Adjust the brake transmission shift interlock ease the operation well.

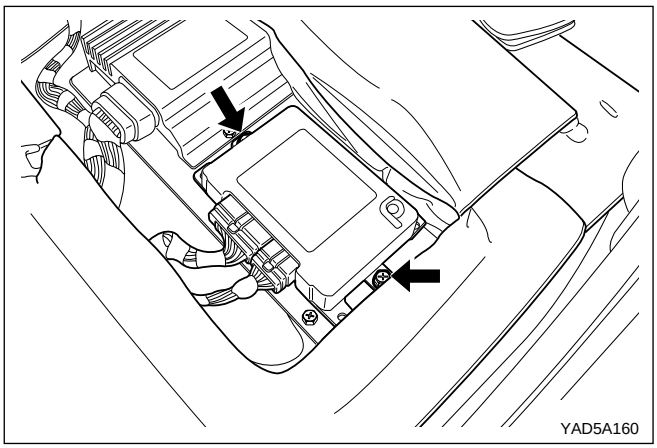

KAA5A5R0

10. Remove the clips supporting the springs and bushes from the pin of the pin of the gear shift control lever.
11. Remover the spring and bushes from the pin of the gear shift control lever.
12. Remove the gear shift control lever by pushing the pin.
13. Installation should follow the removal procedure in the reverse order.


KAA5A5S0

KICKDOWN SWITCH

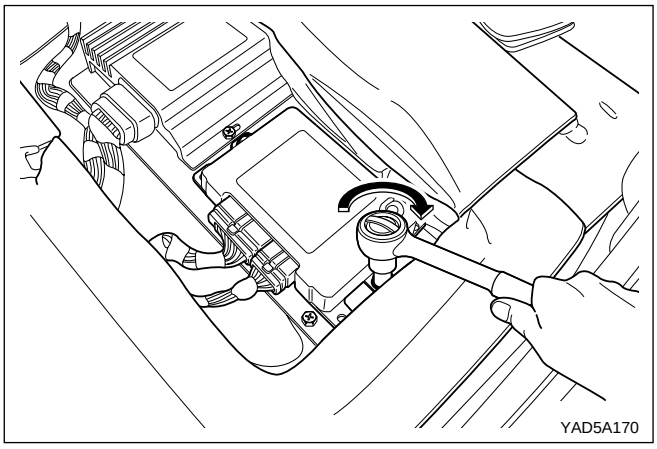
1. Separate the Kickdown Switch from the Kickdown Switch bracket by pushing the lock.
2. Disconnect the Kickdown Switch connector.
3. Installation should follow the removal procedure in the reverse order.


YAD5A160

TRANSMISSION CONTROL MODULE

Removal and Installation Procedure

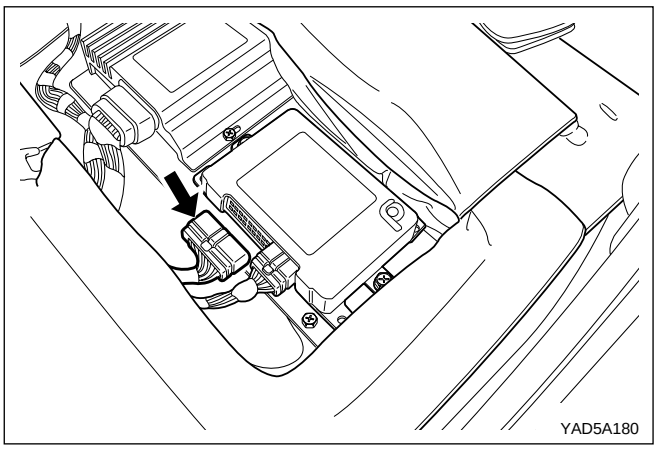
1. Disconnect the negative battery cable.
2. Push the driver's seat and disconnect the transmission control module connector.


YAD5A170

3. Removal the TCM mounting bolts and TCM.

Installation Notice

Tightening Torque	10 N•m (89 lb-ft)


YAD5A180

4. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

GENERAL SPECIFICATION

Model Part Numbers And Applications

SYMC P/NO	Transmission	Engine Version	Torque Converter
36100-05442	0574-000013	E23	179K
36100-05432	0574-000012	E32	150K
36100-05412	0574-000014	662LA	150K

Model Specifications

Application	Descriprtion
Torque Converter	
Mean Diameter of Fluid Circuit Description	260 mm (10.2 in.)
Maximum Torque Multiplication	2.0 : 1
Gear Ratios	
First	2.741 : 1
Second	1.508 : 1
Third	1.000 : 1
Fourth	0.708 : 1
Reverse	2.429 : 1
Lubricant	
Type	Castrol TQ95
Capacity	
Dry System	9.0 Liters (approx.)
Service Refill	4.5 Liters (approx.)
Gear Train End Float	0.50 - 0.65 mm (0.020 - 0.026 in.)
Gear Set Pinion End Float	0.10 - 0.50 mm (0.004 - 0.020 in.)

Clutch Pack Details

	0574-000012	0574-000013 (14)
C1		
Composition	5	4
Steel	5	6
C2		
Composition	5	4
Steel	4	5
C3		
Composition	4	3
Steel	4	5
C4		
Composition	3	3
Steel	4	4

Model Part Numbers and Applications

E23 Gasoline Engine

MODE	THROTTLE OPENING	SHIFT (km/h)									
		1/2	2/3	3/4	4/3	3/2	2/1	UNL3	LCK3	UNL4	LCK4
NORMAL MODE	0 %	10.1	19.3	36.4	20.8	8.9	9.2	50.7	79.1	71.7	79.1
	16 %	10.1	19.3	36.4	20.8	8.9	9.2	50.7	79.1	71.7	79.1
	31 %	13.9	30.9	47.0	28.4	12.4	9.2	50.7	79.1	71.7	79.1
	49 %	22.3	46.1	70.5	41.8	18.9	9.3	50.7	90.3	74.2	90.3
	50 %	22.8	46.4	71.7	42	19.2	9.3	50.7	58.1	75.4	91.5
	58 %	27.2	53.2	89.0	52.7	24.7	10.9	59.4	66.8	81.6	100.2
	64 %	30.9	59.4	94.0	60	28.4	12.1	66.8	74.2	86.6	106.4
	71 %	34.1	66.5	103.3	69.3	32.6	18.6	71.7	76.7	95.8	115.0
	100 % (WOT)	47.4	91.9	147.2	98.9	45.5	34.6	81.6	95.1	134.3	147.2
	Kidkdowm	47.9	94.0	149.6	139.7	86.9	45.4	90.7	95.5	147.2	149.6
POWER MODE	0 %	11.9	22.8	42.0	20.8	8.9	9.2	73.0	75.4	73.0	75.4
	16 %	11.9	22.8	42.0	20.8	8.9	9.2	73.0	75.4	73.0	75.4
	31 %	22.5	42.0	70.0	33.4	17.3	9.2	73.0	79.1	73.0	79.1
	49 %	27.2	56.9	87.2	42.0	24.7	9.2	73.6	94.0	73.6	94.0
	50 %	30.7	64.3	96.5	49.5	29.7	10.4	76.2	103.9	76.2	103.9
	58 %	35.1	73.2	110.8	60.6	37.8	15.1	81.6	110.8	81.6	110.8
	64 %	37.6	77.4	116.3	68	42.5	18.1	86.6	116.3	87.8	116.3
	71 %	40.1	81.1	121.2	77.7	47.7	20.8	86.6	121.2	97.7	121.2
	100 % (WOT)	47.4	91.9	147.2	115.0	66.7	33.0	86.6	136.0	142.2	147.2
	Kickdown	47.9	94.0	149.6	139.7	86.9	45.4	90.7	95.5	147.2	149.6

E32 Gasoline Engine

MODE	THROTTLE OPENING	SHIFT (km/h)									
		1/2	2/3	3/4	4/3	3/2	2/1	UNL3	LCK3	UNL4	LCK4
NORMAL MODE	0 %	11.7	20.2	39.5	24.6	10.2	10.5	37.4	81.9	73.1	81.9
	15 %	11.7	22.8	39.5	24.6	10.2	10.5	37.4	81.9	73.1	81.9
	25 %	13.3	30.4	67.3	32.2	14.6	10.5	37.4	81.9	73.1	81.9
	32%	16.8	36.6	76.0	38.0	19.7	11.0	39.5	83.4	73.1	83.4
	35 %	18.6	40.1	80.4	40.9	21.9	11.7	40.9	62.9	74.6	86.3
	45 %	24.0	49.7	93.6	52.6	27.8	13.9	46.8	70.2	81.9	93.6
	55 %	31.9	66.1	114.1	70.2	32.2	17.3	54.1	79.0	102.4	114.1
	70 %	42.1	85.4	146.2	90.7	39.5	21.9	64.3	93.6	128.7	146.2
	100 % (WOT)	56.7	110.0	170.4	119.9	46.8	26	93.6	114.1	152.1	170.4
	Kidkdowm	57.0	110.6	175.5	163.8	104.7	50.3	116.4	119.3	166.7	175.5
POWER MODE	0 %	12.3	24.6	40.9	24.6	10.2	10.5	76.0	81.9	76.0	81.9
	15 %	14.0	27.8	43.9	29.2	10.2	10.5	76.0	81.9	76.0	81.9
	25 %	23.4	43.9	65.8	39.5	17.5	11.0	76.0	81.9	76.0	81.9
	32 %	24.6	49.1	76.6	46.1	24.9	11.6	81.9	90.7	81.9	90.7
	35 %	26.3	52.6	81.9	51.2	27.8	12.0	84.8	96.5	84.8	96.5
	45 %	32.2	65.8	105.3	67.3	37.3	15.4	102.4	117.0	102.4	117.0
	55 %	38.6	76.9	125.8	87.7	51.2	21.4	111.1	125.8	114.1	125.8
	70 %	46.7	90.8	146.2	113.3	66.5	28.7	111.1	146.2	128.7	146.2
	100 % (WOT)	56.7	110.0	170.4	148.4	89.9	42.4	111.1	170.4	152.1	170.4
	Kickdown	57.0	110.6	175.5	163.8	104.7	50.3	116.4	119.3	166.7	175.5

662LA Diesel Engine

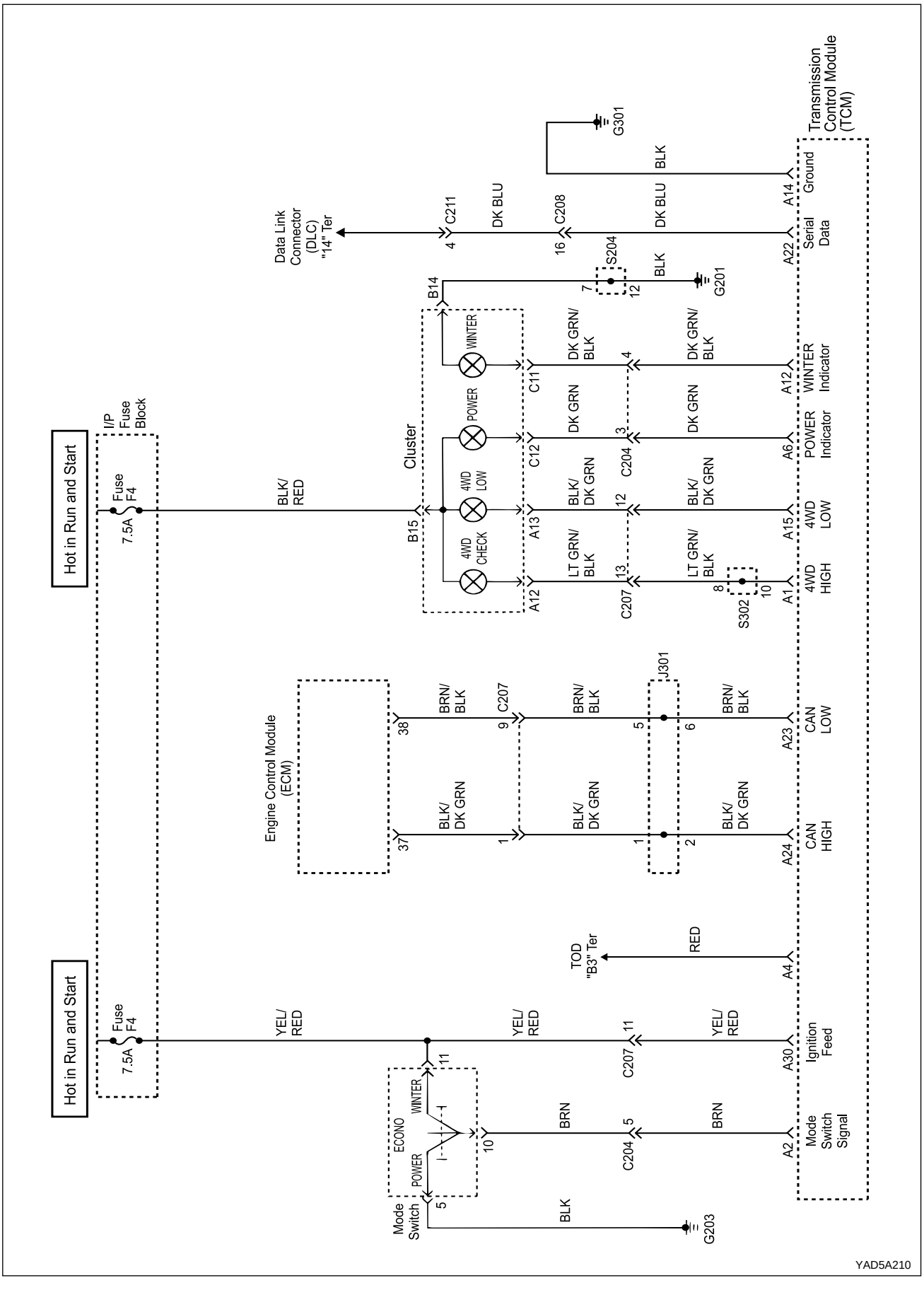
MODE	THROTTLE OPENING	SHIFT (km/h)									
		1/2	2/3	3/4	4/3	3/2	2/1	UNL3	LCK3	UNL4	LCK4
NORMAL MODE	0 %	11.4	20.4	35.4	26.7	9.3	9.5	47.6	76.2	72.1	76.2
	25 %	11.4	20.4	35.4	27.2	9.3	9.5	47.6	76.2	72.1	76.2
	40 %	12.2	25.4	40.8	29.9	13.6	9.5	47.6	76.2	72.1	76.2
	60 %	14.7	36.5	61.8	38.1	21.8	9.5	47.6	76.2	72.1	76.2
	61 %	14.7	36.7	62.0	38.4	22.0	9.5	47.6	50.3	72.1	76.2
	70 %	16.6	40.0	70.7	43.5	25.9	12.2	47.6	51.7	72.1	77.0
	75 %	18.2	43.3	76.2	49.0	28.6	13.6	47.6	54.4	72.1	81.6
	80 %	21.8	51.7	84.4	54.4	31.3	15.0	49.0	57.7	75.1	89.0
	100 % (WOT)	28.6	62.6	104.5	69.4	38.1	19.6	57.1	62.6	92.5	104.5
	Kidkdowm	34.8	68.0	110.2	100.7	63.9	31.3	61.2	68.0	100.7	110.2
POWER MODE	0 %	11.7	21.8	38.1	26.7	9.3	9.5	61.2	76.2	72.1	76.2
	25 %	11.7	21.8	38.1	31.3	9.3	9.5	61.2	76.2	72.1	76.2
	40 %	14.1	27.5	43.5	32.7	16.3	10.2	61.2	76.2	72.1	76.2
	60 %	21.8	44.6	69.4	47.6	27.2	12.8	61.2	76.2	72.1	76.2
	61 %	28.0	57.1	88.7	54.4	35.4	14.4	61.2	88.7	72.1	88.7
	70 %	29.9	59.9	93.9	61.2	40.8	15.8	61.2	93.9	72.1	93.9
	75 %	31.3	61.8	96.6	65.3	46.3	17.4	61.2	96.6	75.1	96.6
	80 %	32.7	64.8	100.4	70.7	50.3	20.4	61.2	100.4	81.6	100.4
	100 % (WOT)	34.0	67.8	105.3	83.0	54.4	23.1	61.2	105.3	92.5	105.3
	Kickdown	34.8	68.0	110.2	100.7	63.9	31.3	61.2	68.0	100.7	110.2

FASTENER TIGHTENING SPECIFICATIONS

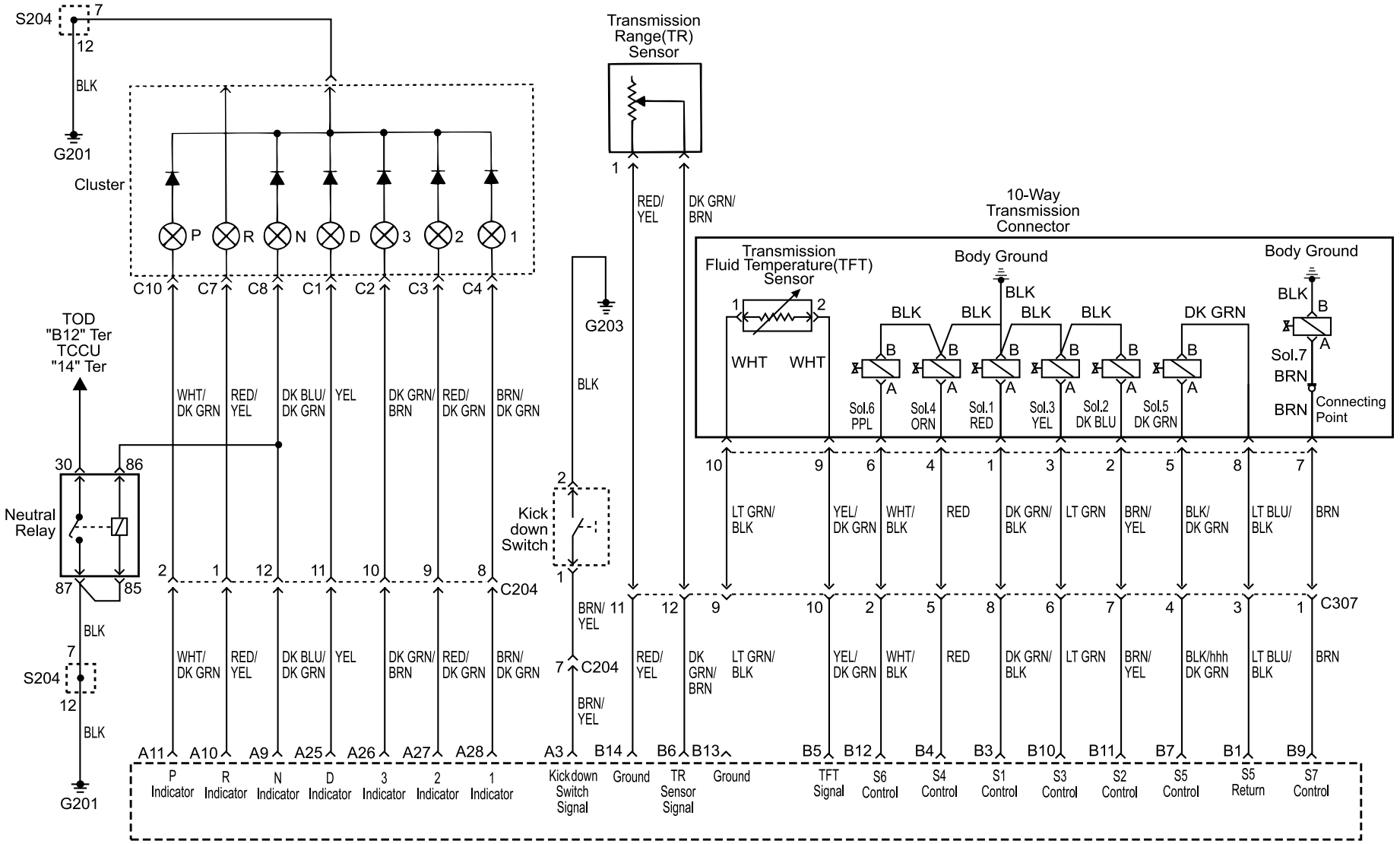
Application	N•m	Lb-Ft	Lb-Ft
Adaptor Housing to Case Bolts	30 - 35	22 - 26	
Cam Plate to Case (Parking Pawl) Screws	16 - 22	12 - 16	
Centre Support to Case Bolts	20 - 27	15 - 20	
Detent Spring Screw	20 - 22	15 - 16	
Extension Housing to Case Bolts	54 - 68	40 - 50	
Front Propeller Shaft Bolts	70 - 80	52 - 59	
Inhibitor Switch to Case Bolts	4 - 6	-	
Oil Cooler Pipes	40 - 45	29 - 33	
Oil Pan to Case Bolts	4 - 6	-	
On/Off Solenoid Retainer Screws	8 - 12	-	
Output Flange Nuts	35	26	
Pump Cover Plate to Crescent Screw	13 - 16	10 - 12	
Pump Cover Plate to Pump Cover Screws	13 - 16	10 - 12	
Pump Cover to Case Bolts	24 - 34	18 - 25	
Pump to Pump Cover Bolts	24 - 27	18 - 20	
Rear Propeller Shaft Bolts	70 - 80	52 - 59	
Rear Servo Cover to Case Bolts	30 - 35	22 - 26	
TCM Mounting Bolt	10	-	
Torque Converter Housing to Case Bolts	54 - 68	40 - 50	
Torque Converter Mounting Bolts	42	31	
Transfer Case to Transmission Housing Bolts	35 - 60	26 - 44	
Transmission Filler Plug	30 - 35	22 - 26	
Upper Valve Body to Lower Valve Body Screws	11 - 16	8 - 12	
Valve Body To Case Bolts	8 - 13	-	
Variable Pressure Solenoid (S5) Retainer Screw	8 - 12	-	

SCHEMATIC AND ROUTING DIAGRAMS

TCM WIRING DIAGRAM (GASOLINE ENGINE-1 OF 2)

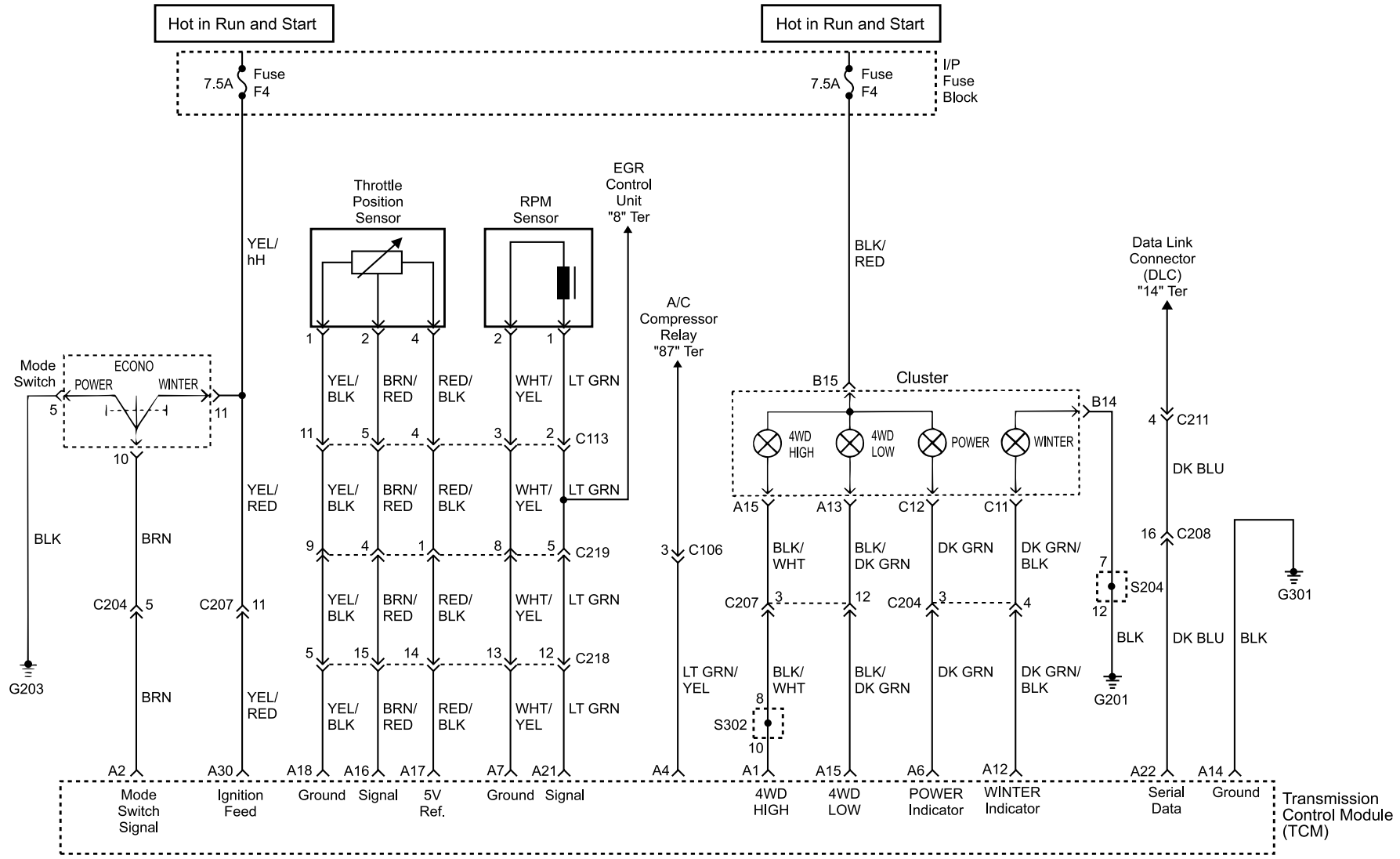


TCM WIRING DIAGRAM (GASOLINE ENGINE-2 OF 2)



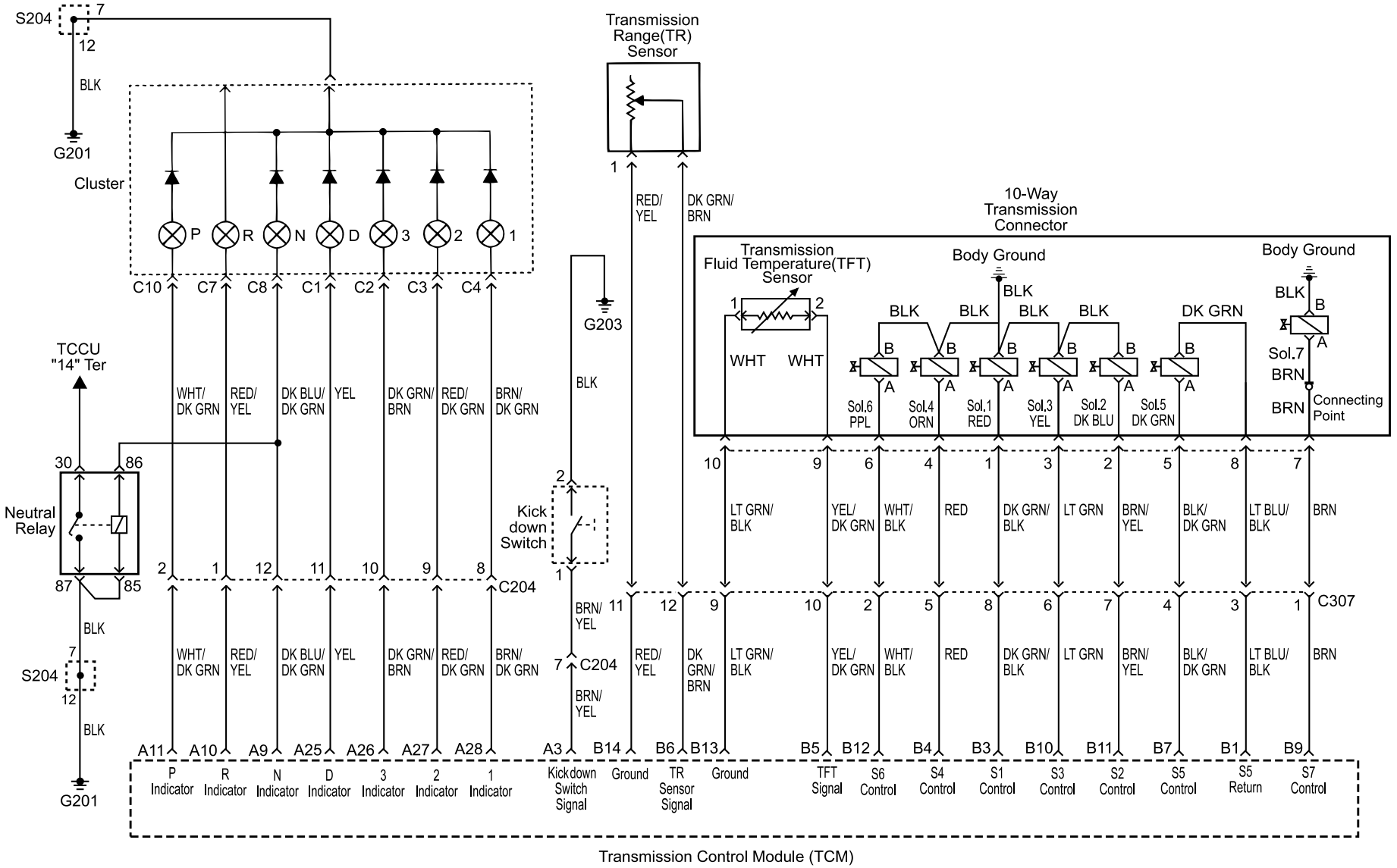
YAD5A220

TCM WIRING DIAGRAM (DIESEL ENGINE-1 OF 2)



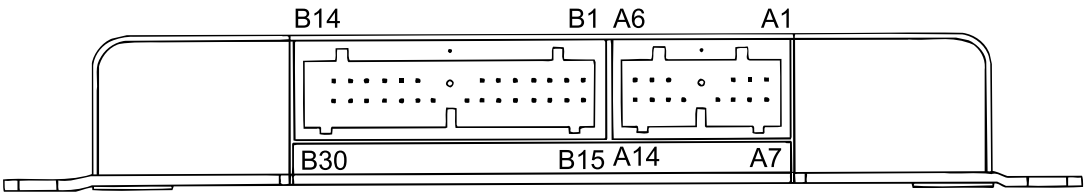
YAD5A230

TCM WIRING DIAGRAM (DIESEL ENGINE-2 OF 2)

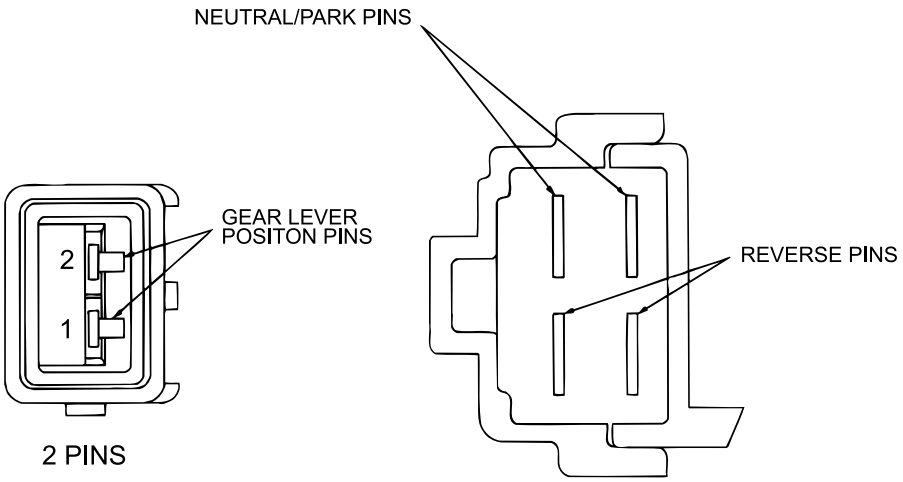


YAD5A240

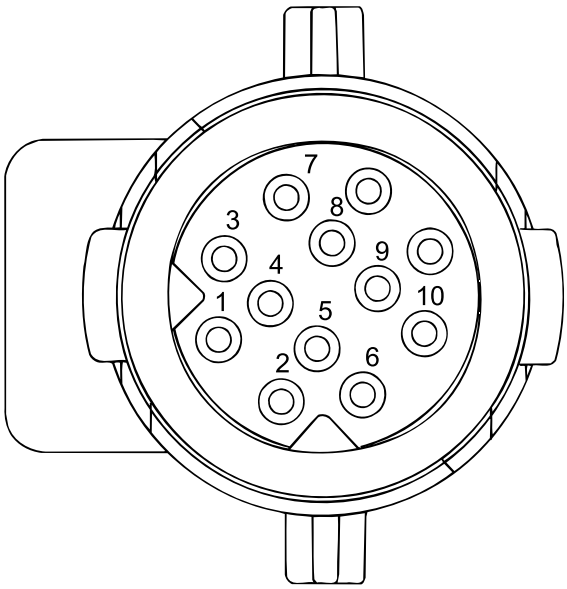
CONNECTOR END VIEW



Transmission Control Module (TCM) Pin Numbers



Inhibitor Switch Pins

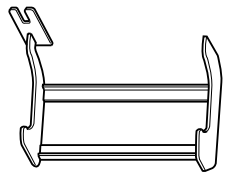
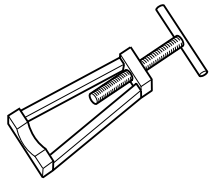
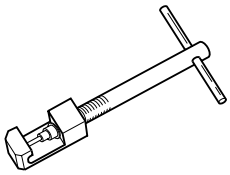
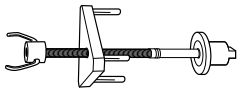
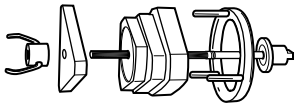
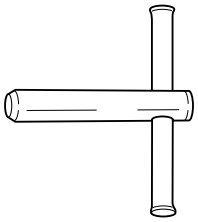
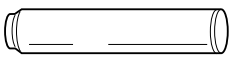
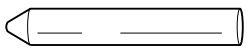


10-Way Transmission Connector

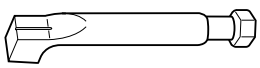
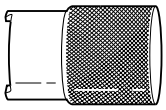
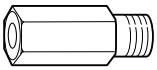
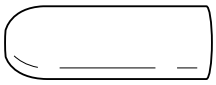
KAA5A5O0

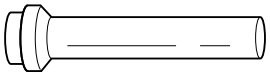
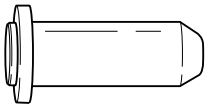
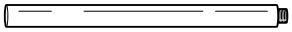
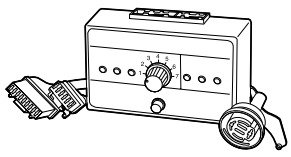
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

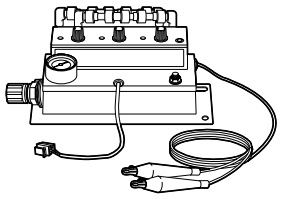
 KAA5A2P0	**0555 - 336256 Transmission Bench Cradle**	 KAA5A2Q0	**0555 - 336257 Pump Puller**
 KAA5A2R0		 KAA5A2S0	**0555 - 336259 Clutch Spring Compressor**
 KAA5A2T0	**0555 - 336260 Clutch Pack Clearance Kit**	 KAA5A2U0	**0555 - 336261 Cross Shaft Seal Remover**
 KAA5A2V0	**0555 - 336262 Cross Shaft Seal Installer**	 KAA5A2W0	**0555 - 336263 Cross Shaft Bullet**

SPECIAL TOOLS TABLE (Cont'd)

 KAA5A2X0	**0555 - 336265 Cross Shaft Pin Remover / Installer (Inhibitor Switch)**
 KAA5A2Z0	**0555 - 336267 Pump Alignment Tool**
 KAA5A3B0	**0555 - 336269 End Float Measuring Adaptor**
 KAA5A3D0	**0555 - 336302 Output Shaft Bullet**

 KAA5A2Y0	**0555 - 336266 Adaptor Housing Seal Installer**
 KAA5A3A0	**0555 - 336268 Pump Seal Installer**
 KAA5A3C0	**0555 - 336270 End Float Measuring Shaft**
 KAC5A050	**0555 - 336045 Solenoid Bench Tester**

SPECIAL TOOLS TABLE (Cont'd)

 KAC5A060	**0555 - 332083** **Solenoid /Thermistor** **Electronic Tester**

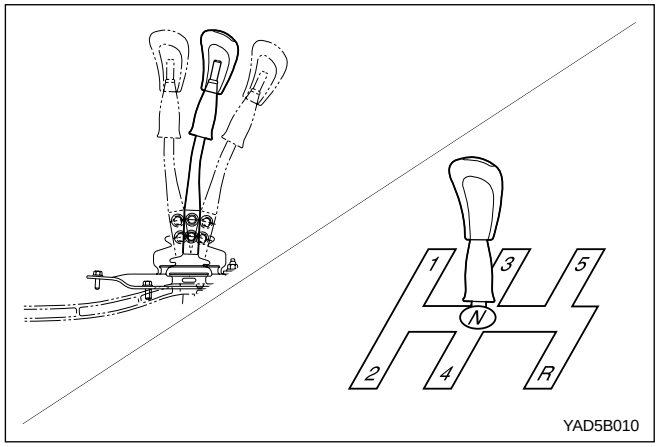
SECTION 5B

MANUAL TRANSMISSION

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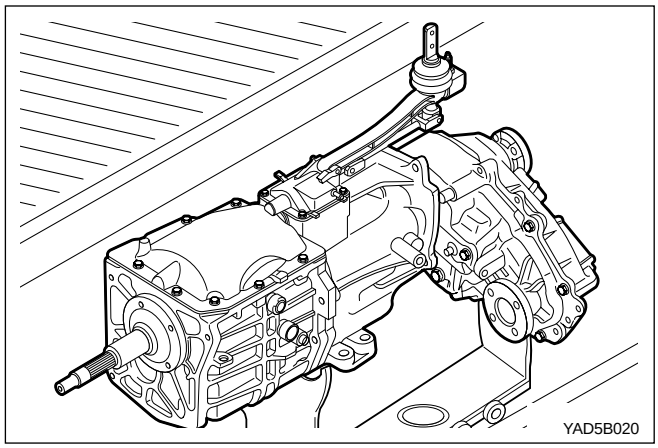
GENERAL DESCRIPTION AND OPERATION



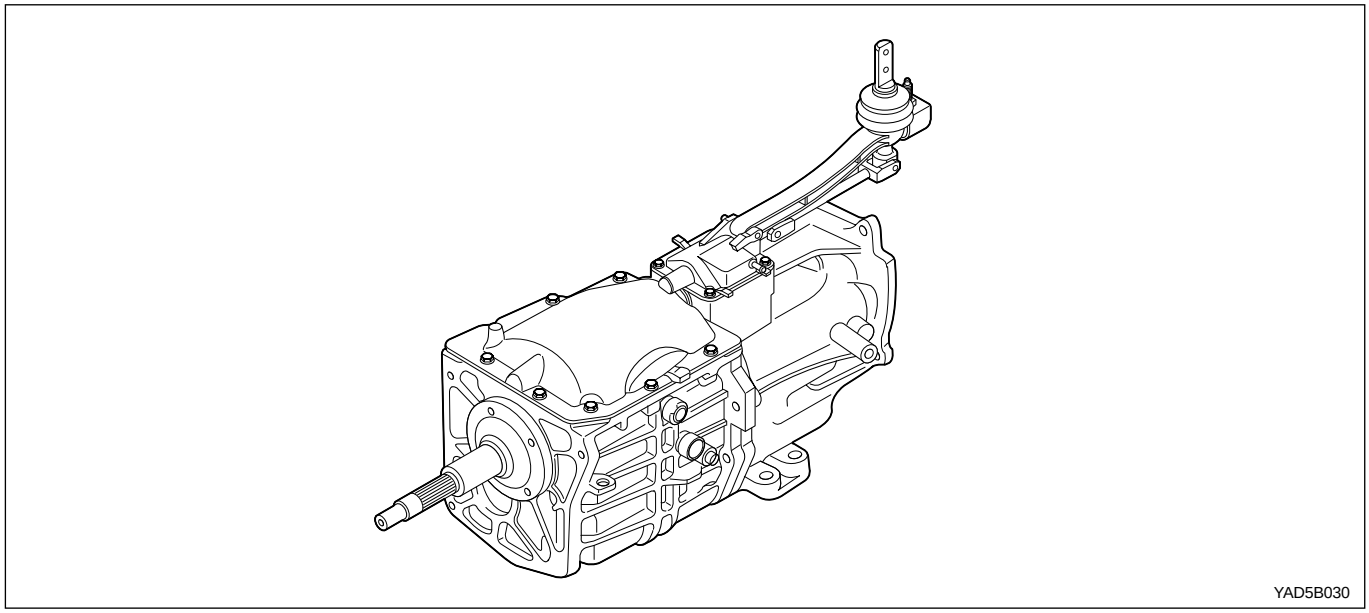
YAD5B010

SHIFT LEVER

The shift lever is a type of linkage connected directly and lock shifting from 5th to reverse. This unit decreases the possibility of any blown, wear etc.


YAD5B020

TRANSMISSION ASSEMBLY


YAD5B030

SPECIFICATIONS

Application		Description
Model		T5WC
Type		Floor Change
Gear Ratio	1st	3.969 : 1
	2nd	2.341 : 1
	3rd	1.457 : 1
	4th	1.000 : 1
	5th	0.851 :1
	Reverse	3.710 : 1
Oil	Specification	ATF DEXRON II / III
	Capacity(litre)	3.4 L
	Change Interval	Check : Every 15,000 km, Replace : Every 50,000 km
Weight (Dry)		33kg

Notice: Add LUBRIZOL (280cc) in oil after overhauling.

DIAGNOSTIC INFORMATION AND PROCEDURES

Applicatio	Check	Action
Will not shift (control lever moves)	Control lever assembly broken or damaged.	Replace control lever and housing assembly.
	Damaged offset lever, shift fork, selector place or selector arm.	Remove extension, adapter or case cover. Check or replace damaged parts.
Hard shift or control lever will not move into gear	Clutch not releasing.	Adjust or replace clutch.
	Improper or low transmission oil.	Add or replace with specified oil.
	Shift or shift rail binding.	Remove extension, adapter or case cover. Check or replace damaged parts.
	Binding of sliding synchronizers or gears.	Remove extension, adapter or case cover. Check synchronizers and gears and replace damaged parts.
	If reverse only, faulty backup switch.	Check or replace backup switch.
	Worn or damaged flywheel pilot bushing.	Replace pilot bushing.
Gears crash when shifting	Engine idle speed too high.	Adjust idle speed to specified speed.
	Damaged or faulty clutch.	Adjust or replace clutch.
	Pilot bearing between input shaft and output shaft binding.	Replace or check roller bearings.
	Damaged synchronizer.	Check or replace synchronizer parts.
	Bell housing misaligned.	Align bell housing and bore.
	Damaged gear(s).	Check or replace gear(s).
	Worn or damaged flywheel pilot bushing.	Replace pilot bushing.
Transmission jumps out	Loosened transmission or flywheel housing bolts, improper alignment.	Tighten bolts to specified value. Realign if necessary.
	Synchronizer damaged or excessively worn.	Check or replace synchronizer parts.
	Blocking ring damaged, worn index slots or friction surfaces worn or damaged.	Check or replace blocking ring.
	Excessive countershaft end play.	Check worn or damaged parts. Adjust shim thickness using roller bearings if necessary.
	Worn or damaged fork due to loosened shaft, rail or shifting fork.	Check for wear or damaged. Replace worn or damaged parts.
Transmission locked in one gear	Fork or offset lever loose on shaft or rail.	Replace extension, adapter or case cover. Check or replace loose parts on shaft or rail. Replace roll pin(s).
	Worn or damaged forks, offset lever, shaft or rail.	Remove extension, adapter or case cover. Check for wear or damaged. Replace damaged parts.

Applicatio	Check	Action
Transmission locked in one gear	Worn or damaged synchronizer.	Check worn or damaged synchronizer parts and replace if necessary.
	Worn or damaged gears.	Check worn or damaged gears and replace if necessary.
Transmission noise	Improper or low transmission oil.	Add or drain and replace with proper oil.
	Loose bolts or other attaching parts.	Tighten as specified.
	Improper flywheel housing to engine crankshaft alignment.	Realign correctly.
	Noisy transmission bearing.	Check bearings, bearing rollers and parts for wear or damage. Replace if necessary.
	Noisy gears.	Check for worn or damaged gears(including speedometer gear). Replace if necessary.
Transmission leakage	Leakage from transmission.	Clean all exposed surfaces, then check for leaks.
	Vent or breather clogged.	Clean or replace vent or breather.
	Too much oil.	Check oil level.
	Loose bolts at sealing faces.	Tighten as specified.
	Improperly applied sealant.	Clean leaking surfaces. Reapply sealant.
	Worn or damaged oil seal.	Replace oil seal.

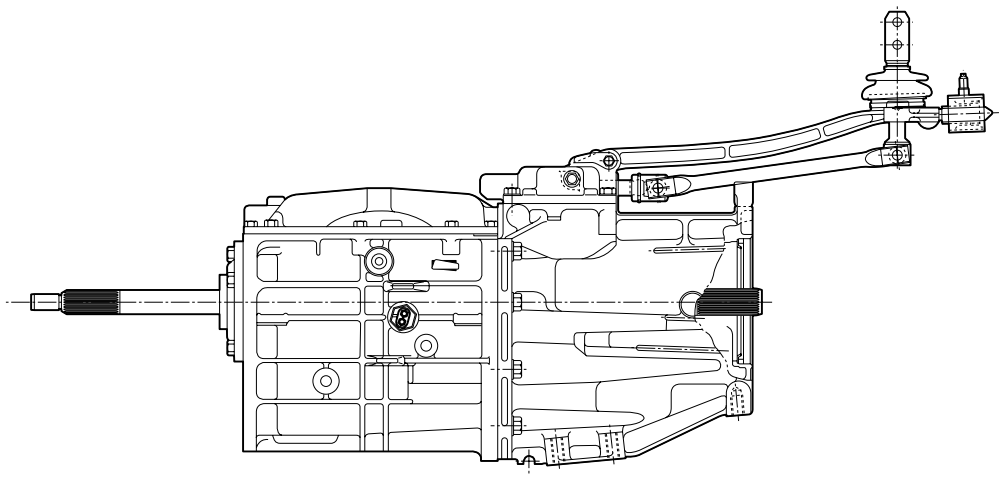
DIAGNOSIS TABLE

Applicatio													
1 Shift Hop-out													
	2 Shift Gear Crash												
		3 Shift Block-out											
			4 Hard Shift										
				5 Noise in Reverse Gear									
					6 Noise in 5th Gear								
						7 Noise in 4th Gear							
							8 Noise in 3rd Gear						
								9 Noise in 2nd Gear					
									10 Noise in 1st Gear				
										11 Noise in All Speeds			
											12 Leak at Transmission Rear Part		
												13 Leak at Transmission Center Part	
													14 Leak at Transmission Front
													Possible Faulty Part
												●	● Transmission Case
											●	●	Extension Housing
●			●								●	●	Shift Cover / Shift Shaft
●			●							●			Shift Control Lever
			●									●	Input Bearing Retainer
									●				Input Gear Set
●							●		●				3rd Speed Gear Set
●								●	●				2nd Speed Gear Set
				●									Reverse Speed Gear Set
●								●	●				1st Speed Gear Set
●									●				5th Speed Gear Set
			●						●				Clutch Housing and Release Derive
			●						●				Crankshaft Pilot Bushing and Release Bearing
									●				Input Bearing
									●				Main Shaft Input Bearing
●									●				Main Shaft Thrust Bearing
							●		●				3rd Speed Gear Bearing
								●	●				2nd Speed Gear Bearing
									● ●				1st Speed Gear Bearing
				●									Reverse Idler Gear Bushing
									●				Counter Shaft Front Bearing
									●				Counter Shaft Rear Bearing
●		●							●				Counter Shaft Thrust Bearing
					●				●				5th Speed Drive Gear Bearing
										●			Slip Yoke Bushing
										●			Slip Yoke Seal
										●			Speedometer Drive / Driven Gears
										●			Speedometer Driven Gear Housing
												●	Input Shaft Seal
●	●	●						●	●	●			1 - 2 Synchronizer Assembly
●	●	●				●	●			●			3 - 4 Synchronizer Assembly
●	●	●				●				●			5th Synchronizer Assembly

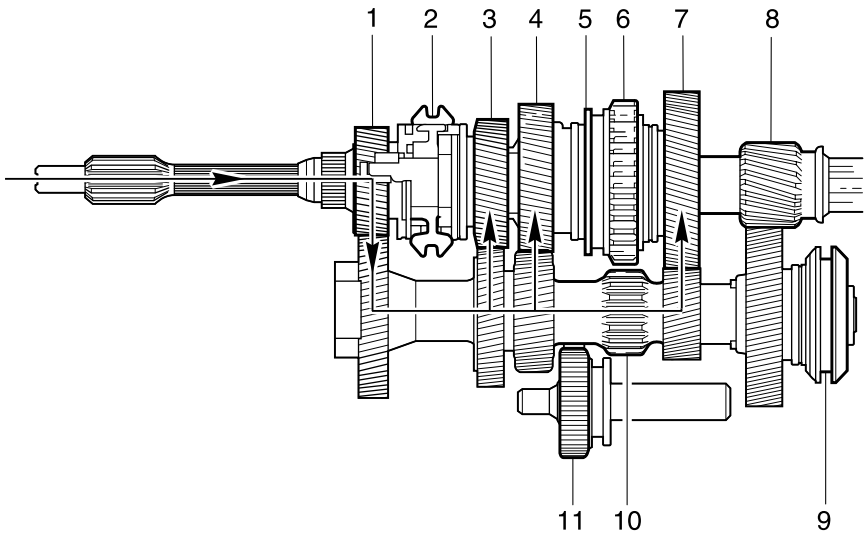
COMPONENT LOCATOR

CROSS-SECTIONAL VIEW

External View



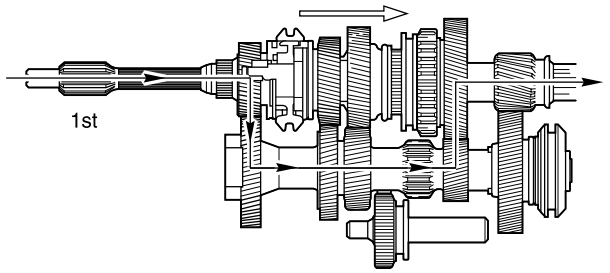
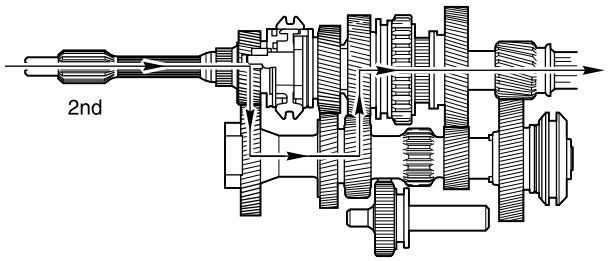
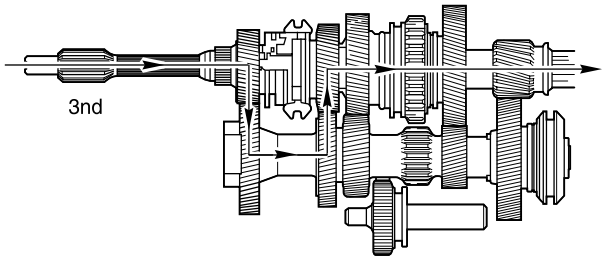
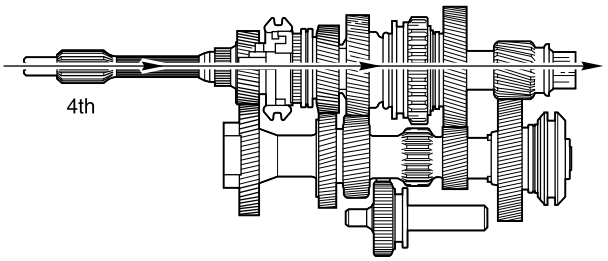
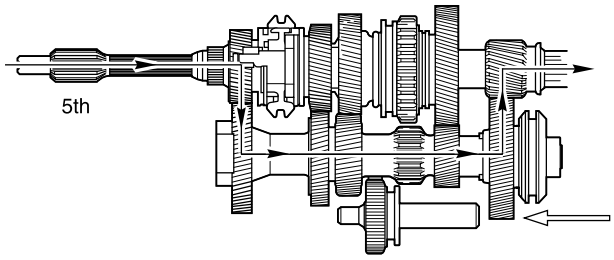
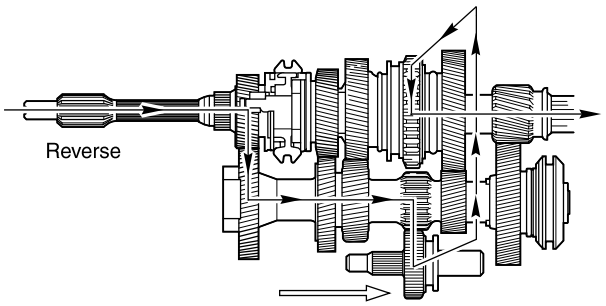
Internal View



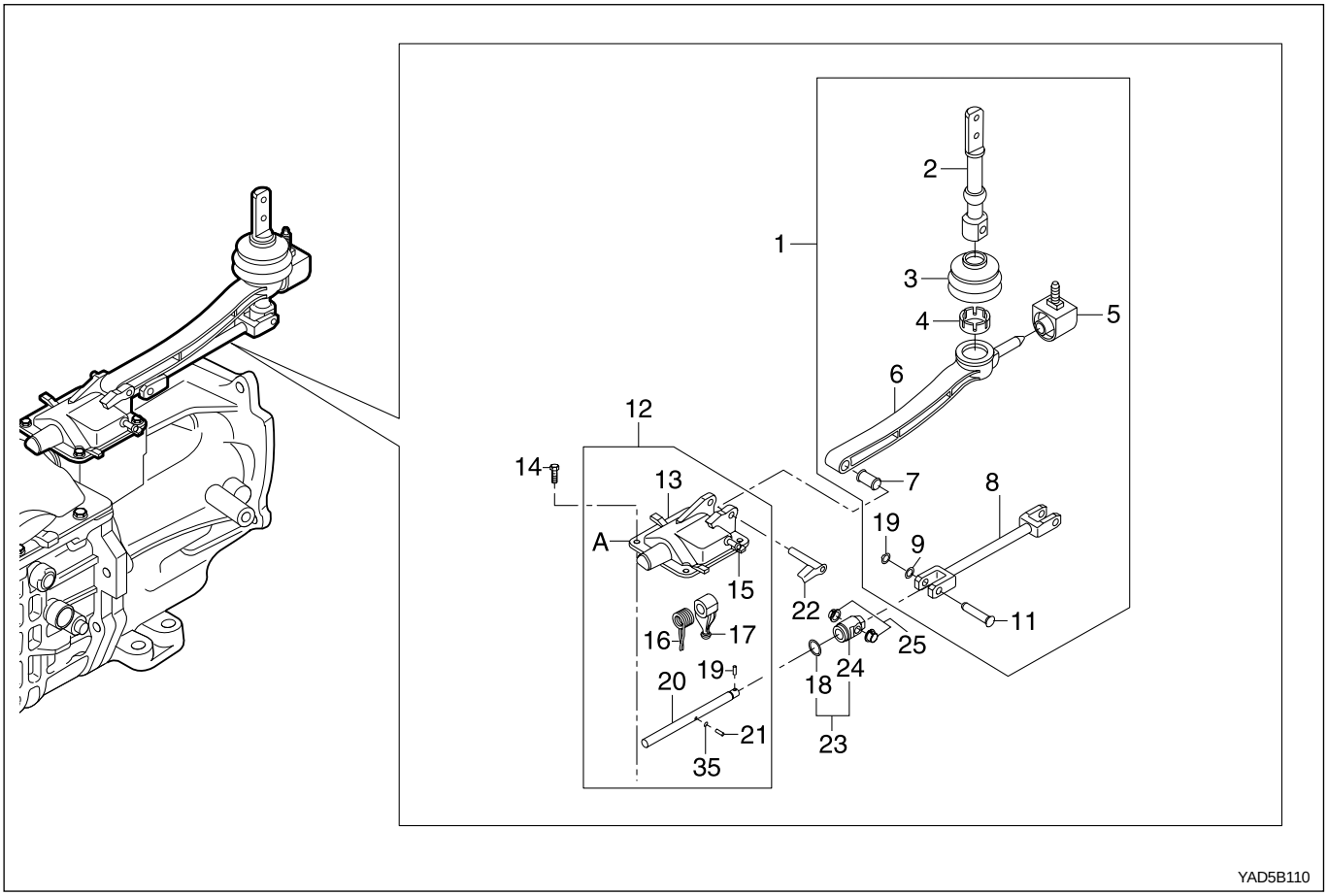
YAD5B040

1 4th Gear
2 3rd-4th Synchronizer
3 3rd Gear
4 2nd Gear
5 1st-2nd Synchronizer
6 Reverse Gear
7 1st Gear
8 5th Gear
9 5th Synchronizer
10 Counter Shaft
11 Reverse Idler

POWER FLOW

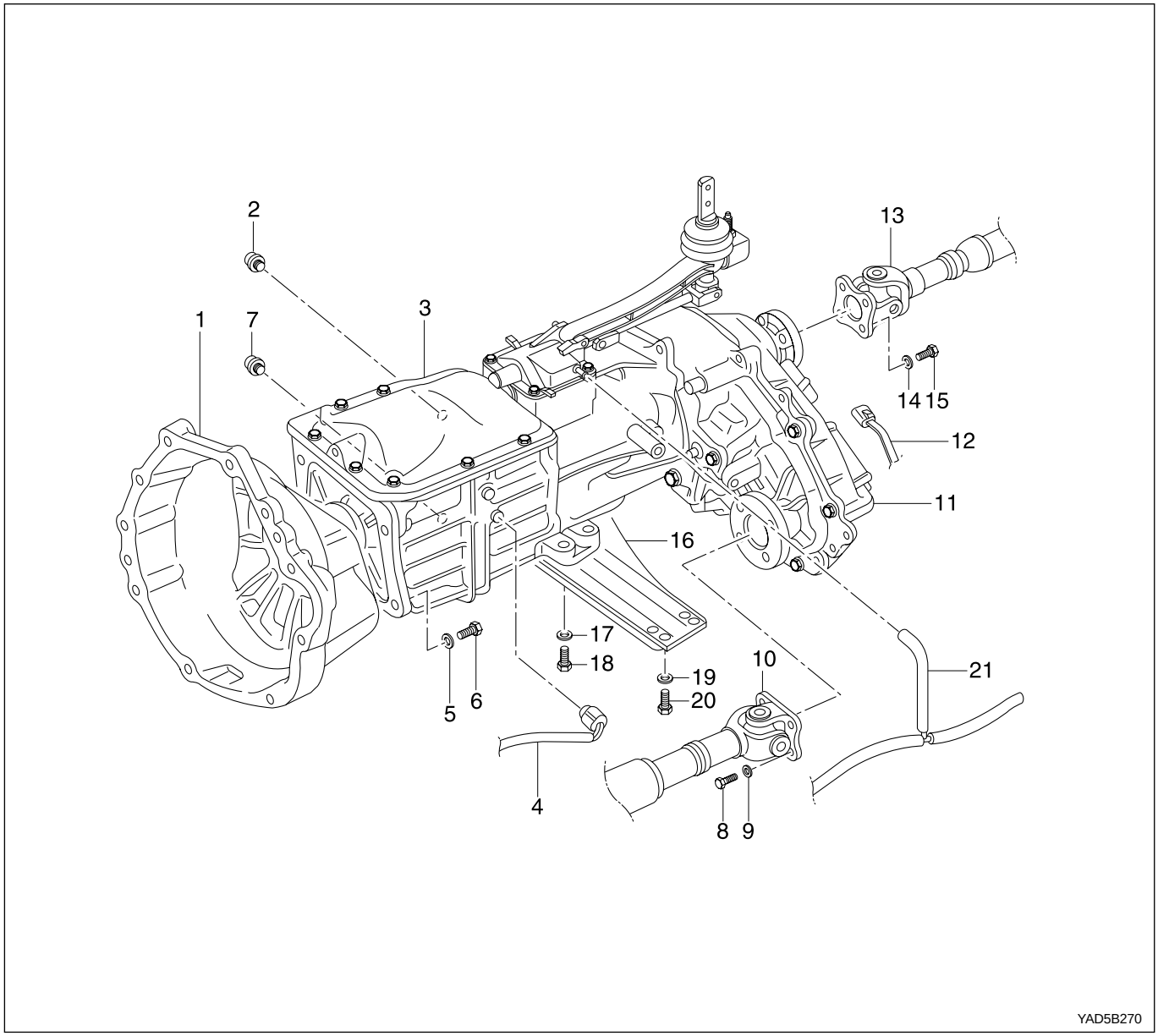
1st	2nd
 YAD5B050	 YAD5B060
3rd	**4th**
 YAD5B070	 YAD5B080
5th	**Reverse**
 YAD5B090	 YAD5B100

SEMI-REMOTE KIT DISASSEMBLY AND ASSEMBLY



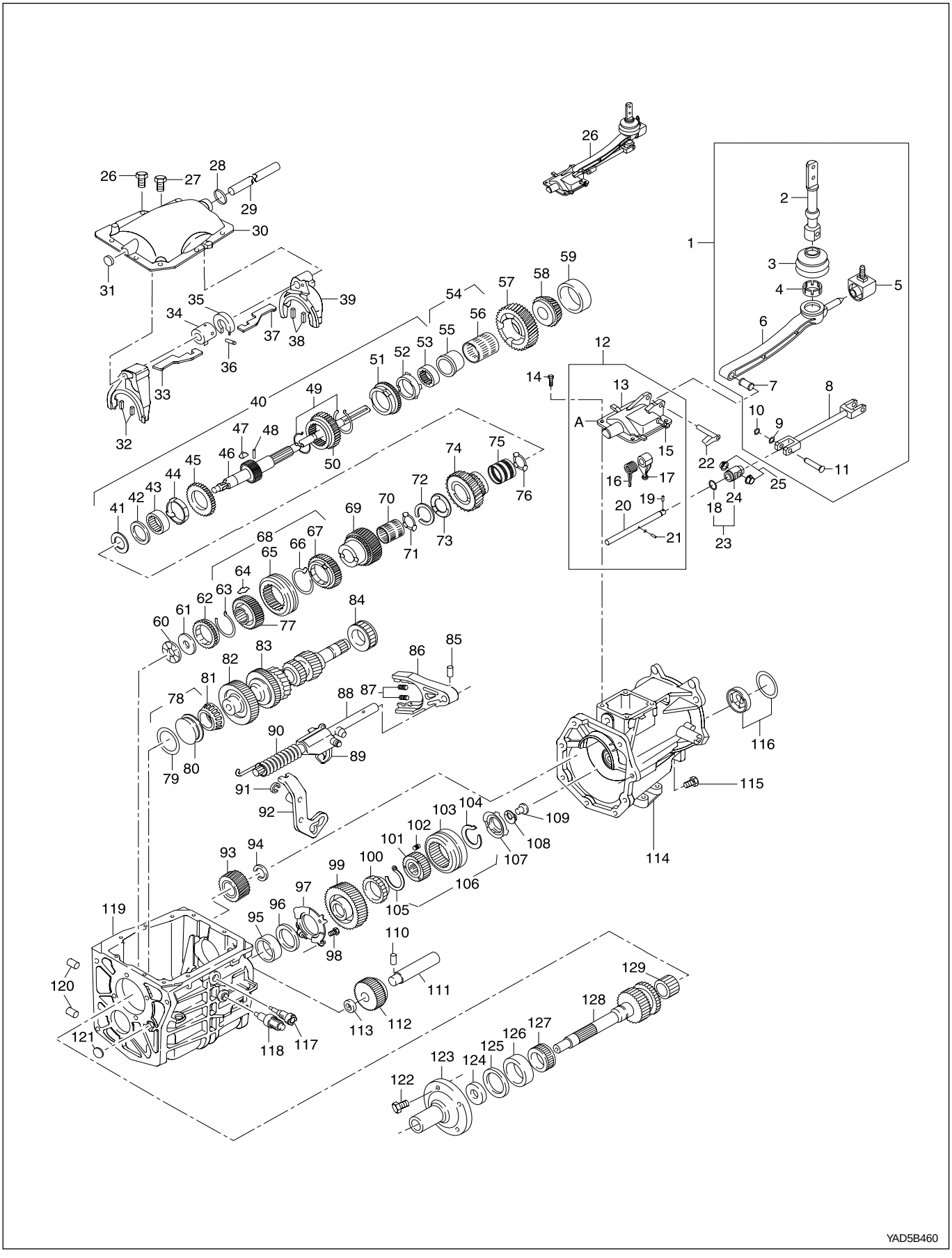
1 Remote Shift
2 Shift Lever
3 Shift Inner Boot
4 Lining Shift Socket
5 Control Housing Arm Insulator
6 Control Housing Arm
7 Bushing
8 Shift Rod Link
9 Washer
10 Clip
11 Shift Rod Pin
12 Cover Assembly
13 Shift Tower Cover
14 Bolt
15 Breather Hose Bar
16 Control Shift Spring
17 Offset Control Lever
18 Retainer Ring
19 Pin
20 Shift Rail
21 Grove Pin
22 Pin & Clip
23 Joint Assembly
24 Joint Housing
25 Bushing

TRANSMISSION ASSEMBLY



1 Clutch Housing
2 Oil Filler Plug ..... 25 N•m
3 Transmission Assembly
4 Back-up Switch
5 Washer
6 Bolt ..... 77-87 N•m
7 Oil Drain Plug ..... 25 N•m
8 Bolt ..... 81-89 N•m
9 Washer
10 Front Propeller Shaft
11 Transfer Case Assembly
12 Speedometer Cable
13 Rear Propeller Shaft
14 Washer
15 Bolt ..... 70-80 N•m
16 Cross Member
17 Washer
18 Bolt ..... 21-35 N•m
19 Washer
20 Bolt ..... 62-93 N•m
21 Breather Hose

TRANSMISSION ASSEMBLY DISASSEMBLED VIEW



1 Remote Shift
2 Shift Lever
3 Shift Inner Boot
4 Lining Shift Socket
5 Control Housing Arm Insulator
6 Control Housing Arm
7 Bushing
8 Shift Rod Link
9 Washer
10 Clip
11 Shift Rod Pin
12 Cover Assembly
13 Shift Tower Cover
14 Bolt
15 Bleeder Hose Barb
16 Control Shift Spring
17 Offset Control Lever
18 Retainer Ring
19 Pin
20 Shift Rail
21 Groove Pin
22 Pin and Clip
23 Joint Assembly
24 Joint Housing
25 Bushing
26 Bolt
27 Bolt
28 O-ring
29 Shaft Rail
30 Case Cover
31 Cap Plug
32 Insert
33 Selecter Plate
34 Selecter Arm
35 Inlockter Plate
36 Selecter Arm Pin
37 Selecter Plate
38 Insert
39 Shift Fork
40 Output Shaft
41 Retainer Ring
42 Washer
43 Inner Corn
44 Outer-Race
45 1-2nd Blocking-Ring
46 Output Shaft Assembly
47 Insert
48 Ball
49 Spring
50 Reverse Sliding Gear
51 1-2nd Blocking-Ring
52 Outer Corn Race
53 Inner Corn
54 Sleeve Bearing
55 Sleeve
56 Needle Bearing
57 1st Speed Driven Gear
58 Bearing Corn
59 Bearing Cup
60 Thrust Bearing
61 Thrust Race
62 Blocking-Ring
63 Spring
64 Insert
65 Synchronizer Sleeve
66 Spring
67 Blocking-Ring
68 Synchronizer
69 3rd Speed Gear
70 Needle Bearing
71 Spacer
72 Snap Ring
73 Washer
74 2nd Speed Gear
75 Needle Bearing
76 Spacer
77 Synchronizer Sleeve
78 Bearing
79 O-Ring
80 Bearing
81 Corn Bearing
82 Shaft Gear
83 Counter Shaft Gear
84 Corn Bearing
85 Roll Pin
86 Shift 5th Fork
87 Insert
88 Shift Rail
89 Reverse Fork
90 Spring
91 Retainer Ring
92 Shift Lever
93 5th Speed Driven Gear
94 Snap Ring
95 Bearing Cap
96 Shim
97 Rear Retainer
98 Bolt
99 5th Speed Driven Gear
100 Blocking 5th-Ring
101 Hub Bearing
102 Insert
103 Sleeve
104 Spring
105 Spring
106 Synchronizer
107 5th Synchronizer Retainer
108 Snap Ring
109 Oil Ring Funnel
110 Roll Pin
111 Reverse Idler Shaft
112 Reverse Idler Gear
113 O-Ring
114 Cross member Mounting Hole

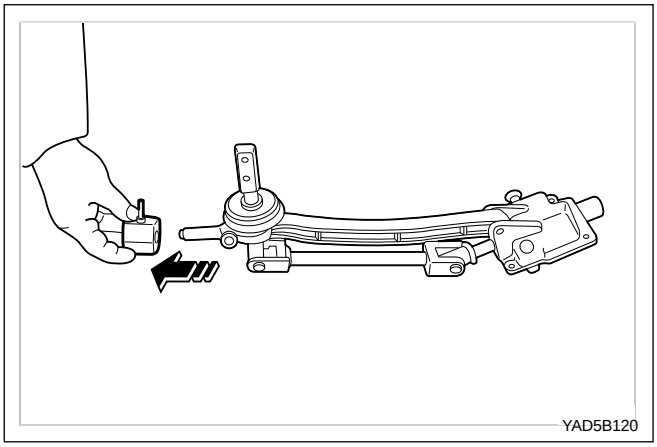
115 Bolt
116 Spacer Seal and O-ring
117 Pivot Pin
118 Back-up Switch
119 Transmission Case
120 Filler/Drain Plug
121 Plug
122 Bolt
123 Input Bearing Retainer
124 Oil Seal
125 Shim
126 Bearing Cap
127 Bearing Corn
128 Input Drive Shaft
129 Roller Bearing

MAINTENANCE AND REPAIR

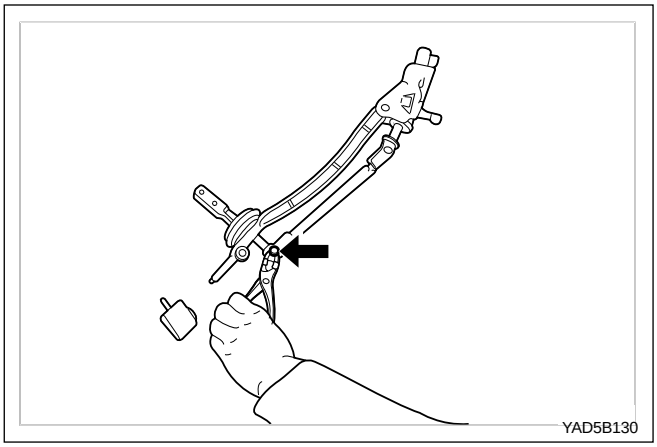
ON-VEHICLE SERVICE

SEMI-REMOTE KIT

Removal Procedure

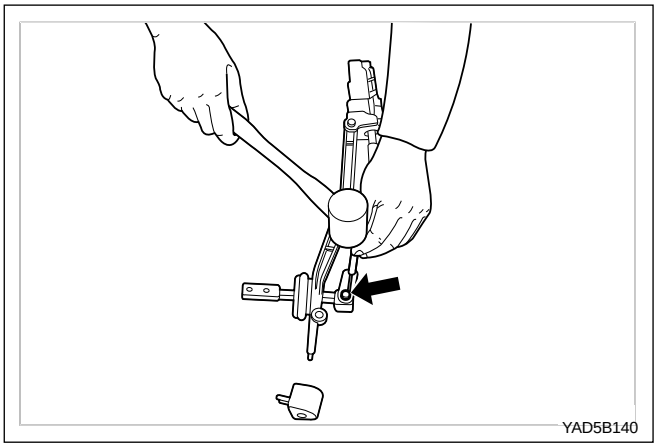

YAD5B120

1. Remove the control housing arm insulator from the semi-remote kit.

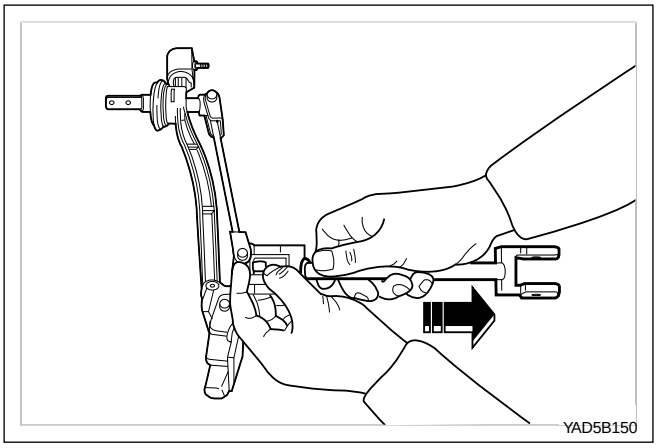

YAD5B130

2. Remove two snap rings and two screws using the snap ring plier.

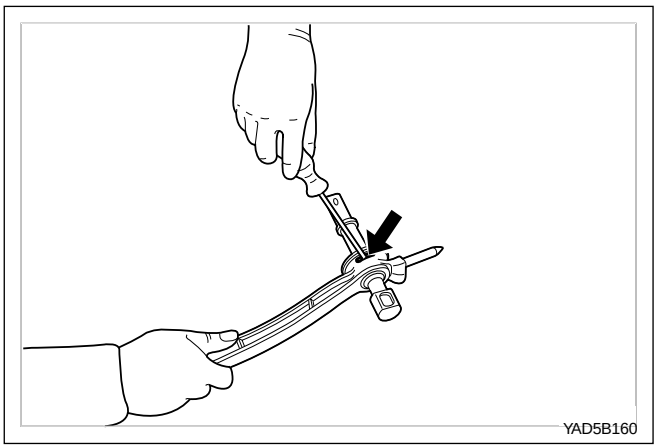
   Notice: Do not reuse the damaged snap ring.


YAD5B140

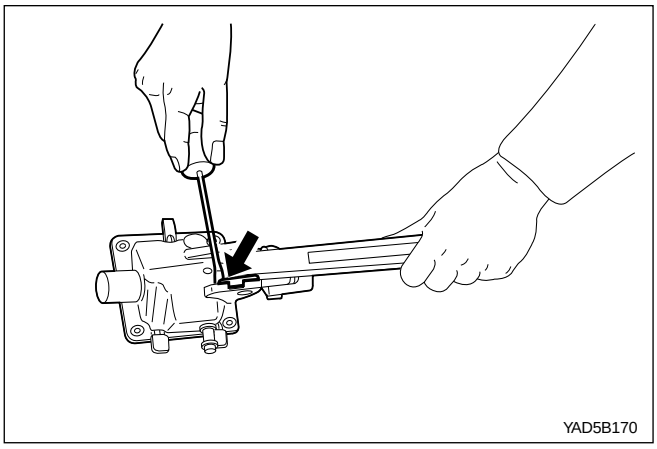
3. Disconnect the shift rod pin using the punch.


YAD5B150

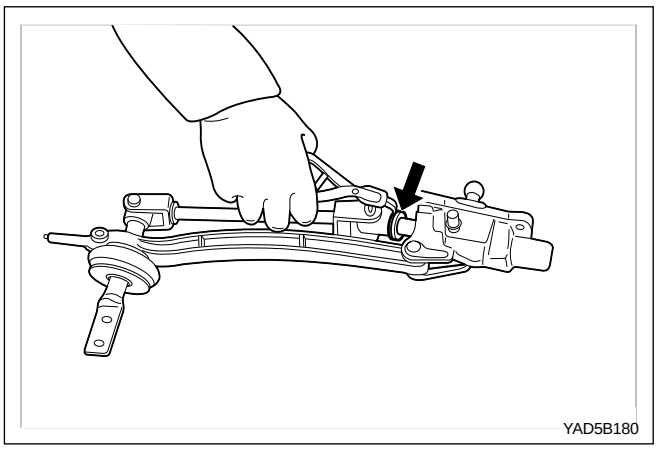
4. Remove the shift rod link from the semi-remote kit.
5. Remove four metal bushing from the shift rod.


YAD5B160

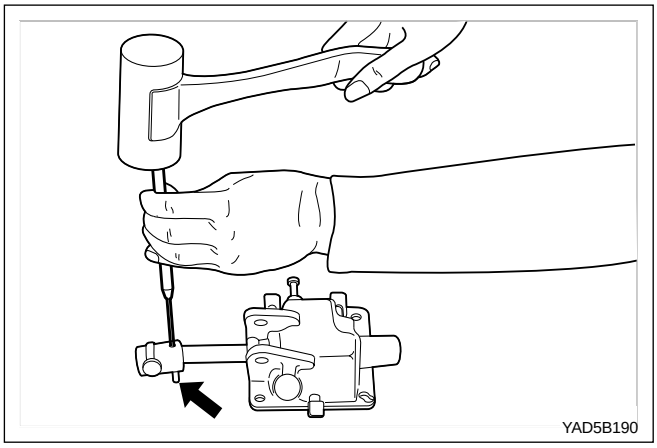
6. Push down the socket lining's wing from the control housing arm and disconnect the socket lining and shift lever from the semi-remote kit.


YAD5B170

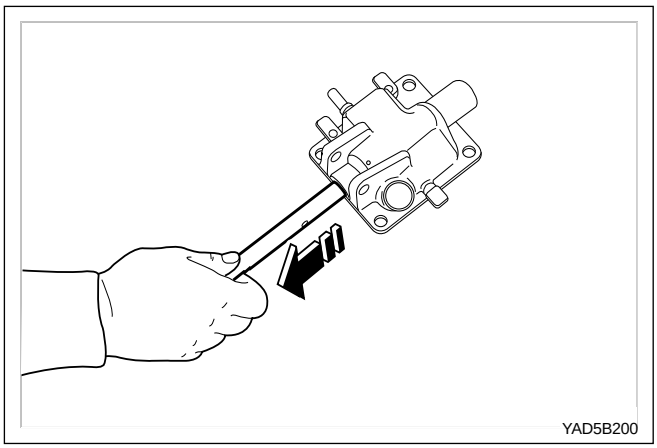
7. Remove the control housing arm by rotating the clip pin.


YAD5B180

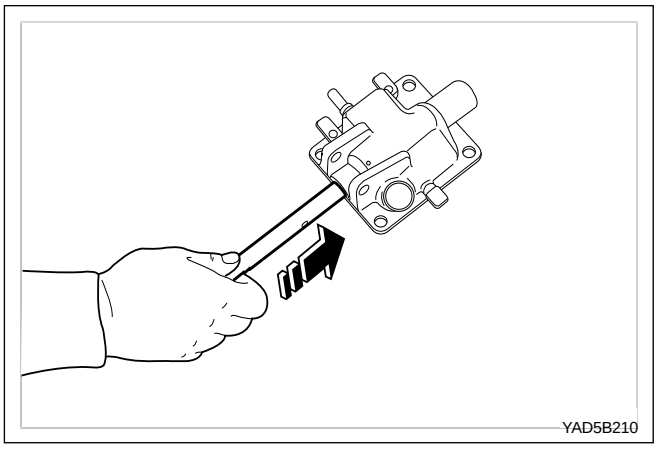
8. Remove the retainer-ring from the U-joint assembly using the snap ring plier.


YAD5B190

9. Remove the pin from the U-joint assembly using the punch.
10. Remove the U-joint assembly from the cover assembly.

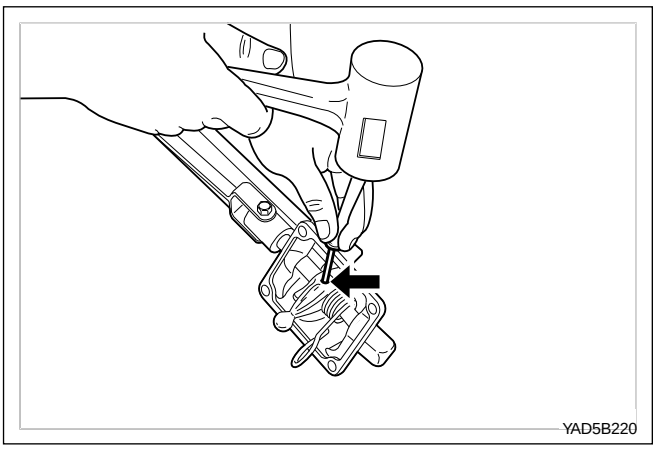

YAD5B200

11. Remove the shift rail from the cover assembly using the punch.
12. Pull out the shift rail from the cover assembly.
13. Inspect and clean all of the disassembled parts and replace as needed.

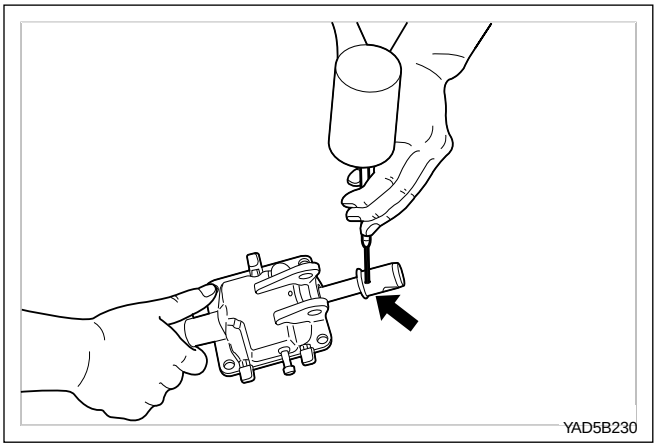

YAD5B210

Installation Procedure

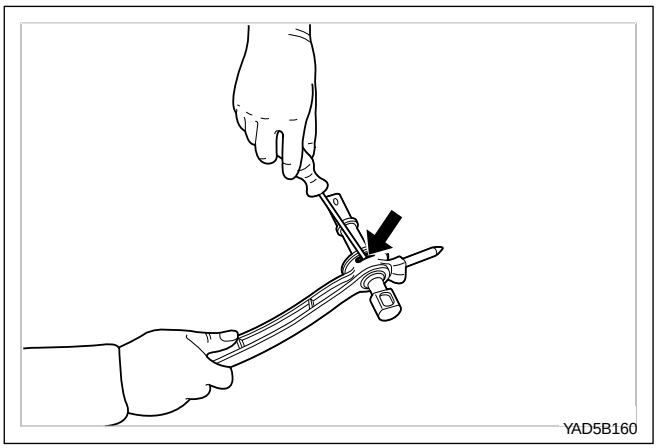
1. Insert the shift rail to the cover.


YAD5B220

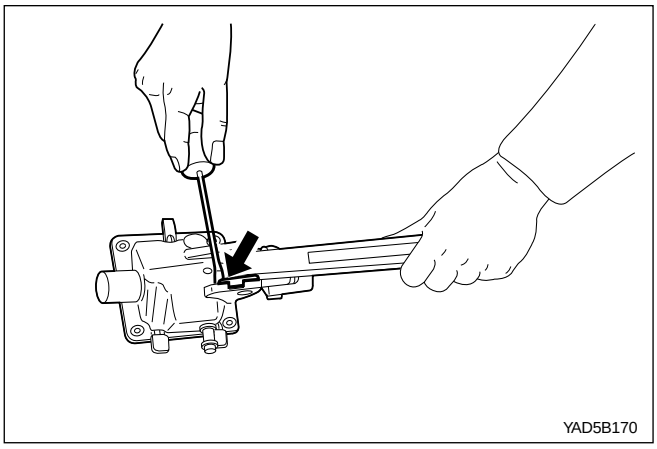
2. Pull the shift rail to the offset lever using the punch and assemble them.



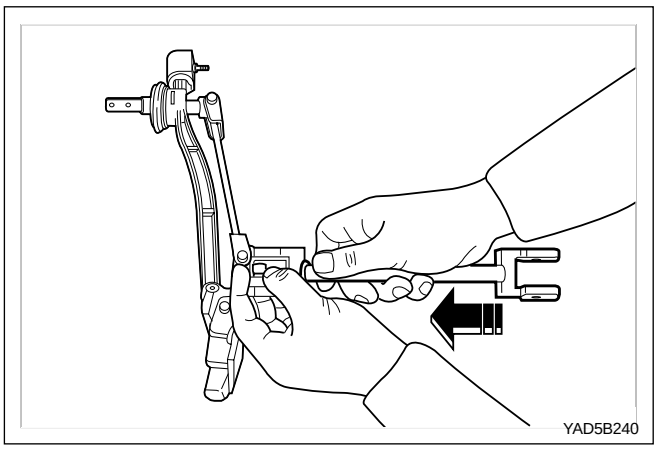
3. Insert the rail to U-joint assembly and assemble the retainer ring using the snap ring plier.



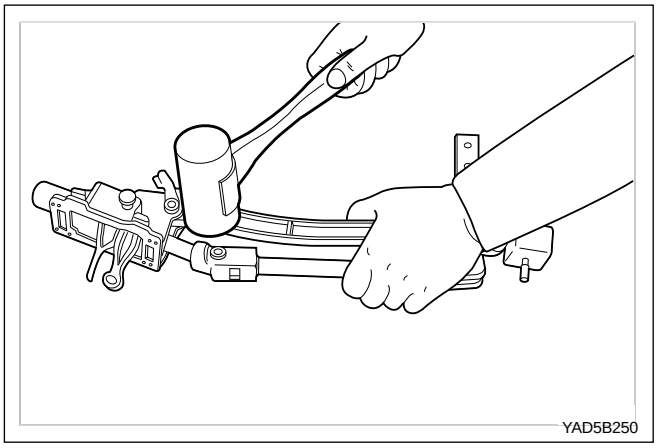
4. Push down the shift lever and the lining shift socket from the control housing arm.



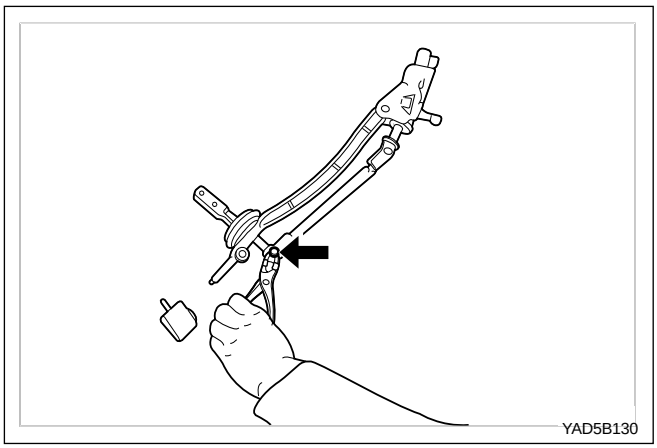
5. Insert the clip pin to fix the cover assembly and the control housing arm.



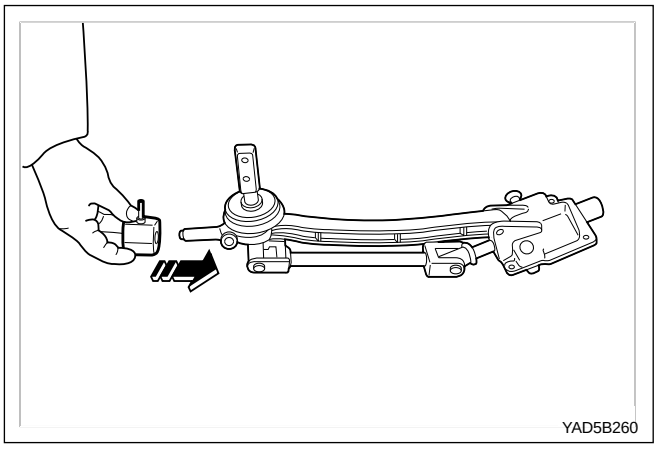
6. Insert the metal bushing to the shift rod.



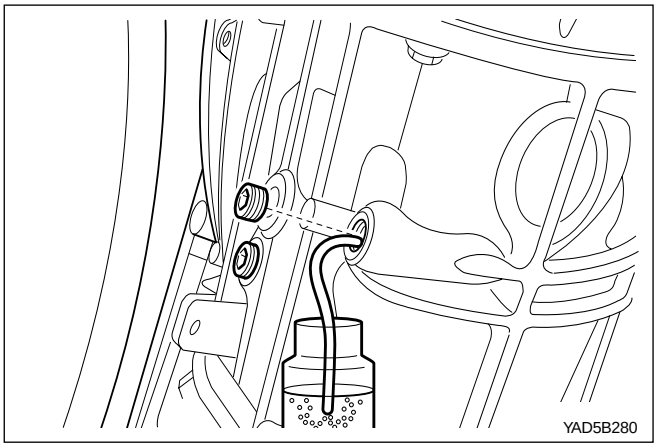
7. Assemble the shift rod, the shift rail and U-joint using the pin.



8. Insert the washer and assemble the snap ring.



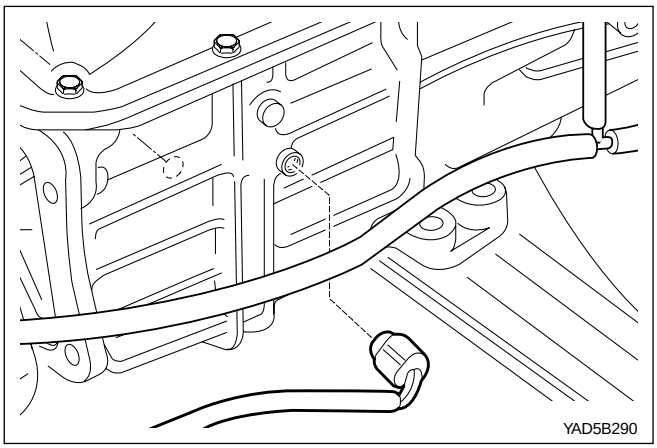
9. Insert the control housing arm insulator to the semi-remote kit.



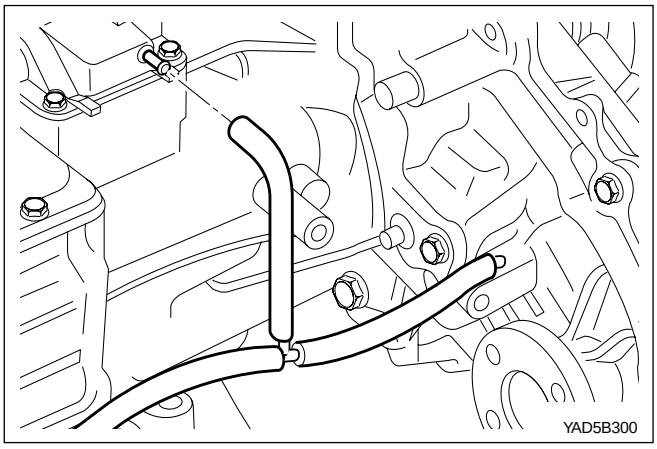
TRANSMISSION

Removal Procedure

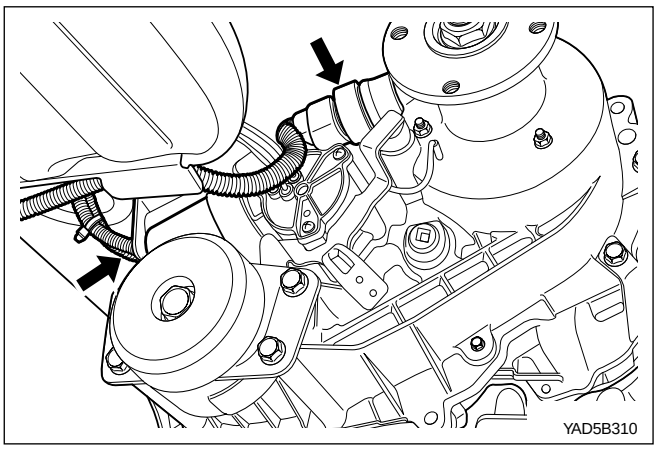
1. Disconnect the negative terminal from the battery.
2. Lift up the vehicle and fix it safely.



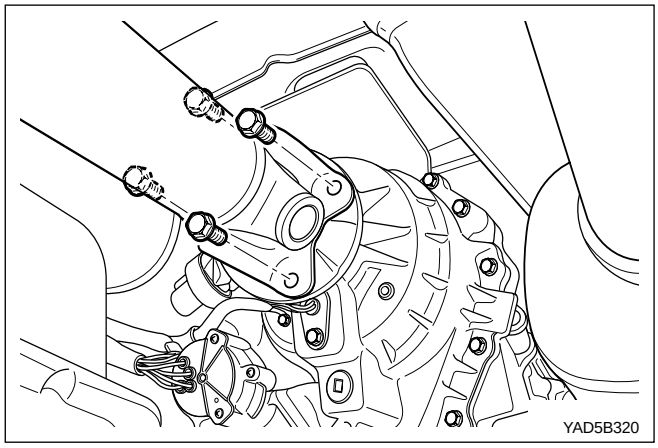
3. Remove the drain plug from the transmission housing and drain the oil. Reinstall the drain plug.
4. Disconnect the back-up switch connector.



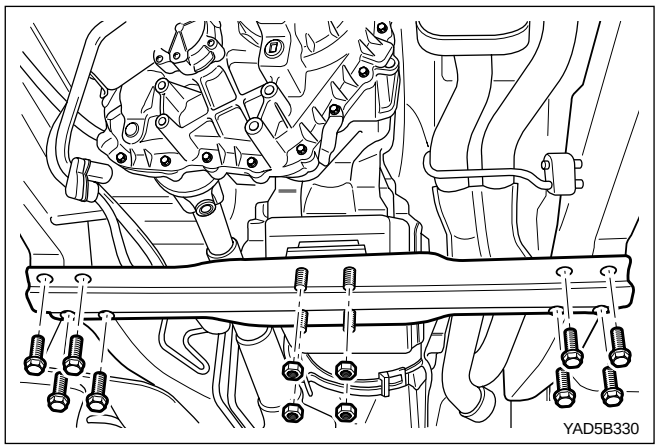
5. Remove the breather hose.



6. Remove the speedometer connector and other wiring harnesses and connectors.

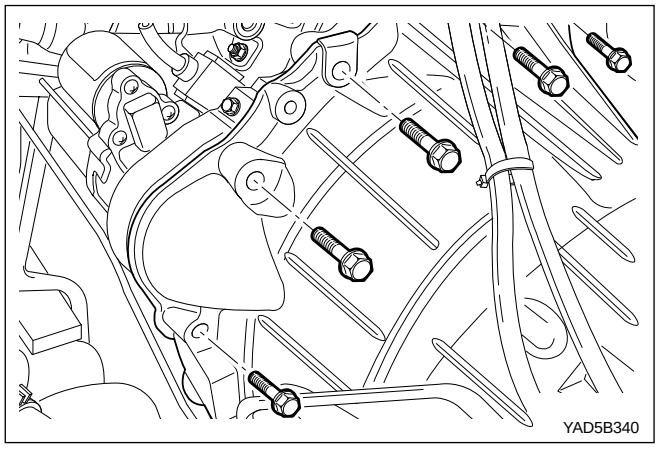


7. Remove the front and rear propeller shafts from the transfercase.



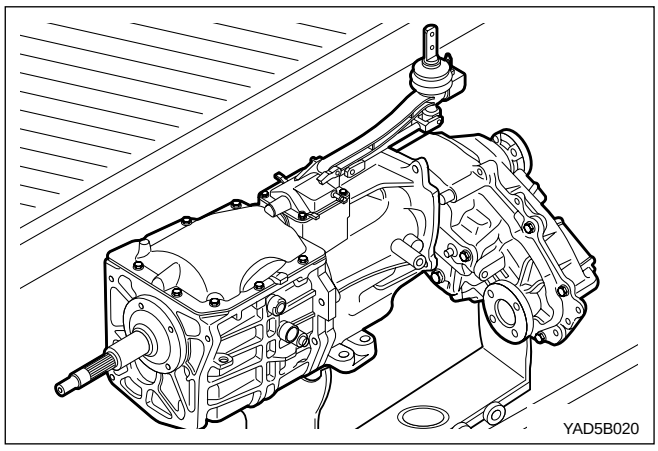
8. Support the transmission on an suitable jack.

   Unscrew the center mounting nuts and each sides mounting bolts and remove the cross member.



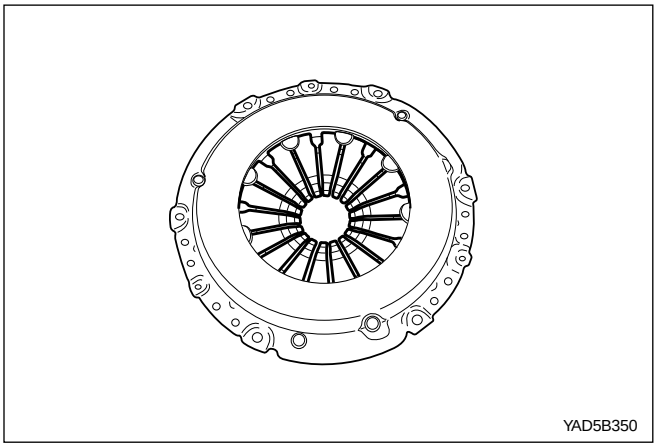
9. Remove the transmission mounting bolts.

   Notice: For removing the transmission, there may be any damage in the clutch housing inside CSC. Thus remove the transmission with the clutch housing.



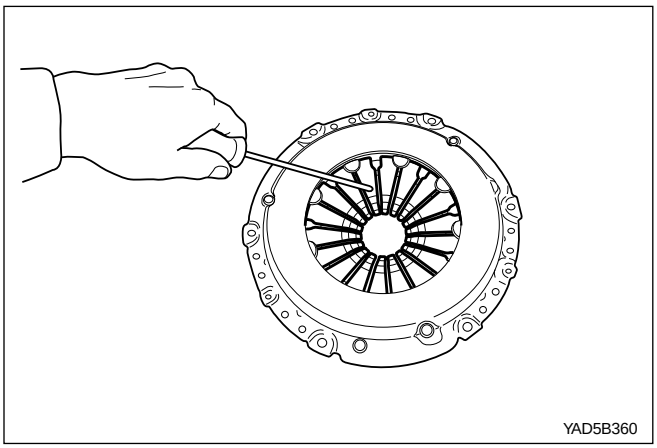
10. Move the transmission jack backward careful and disengage the transmission input shaft from the engine.

    Remove the transmission.


YAD5B350

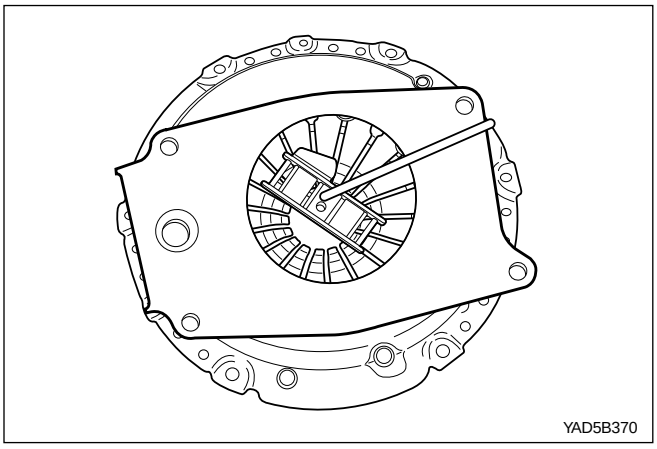
Pre-Installation Checks Checking Procedure

1. Separate the clutch release fork from the pivot and remove the pivot from the clutch housing.
2. Check the pivot. Fork and release bearing.
3. Check the pressure plate spring.

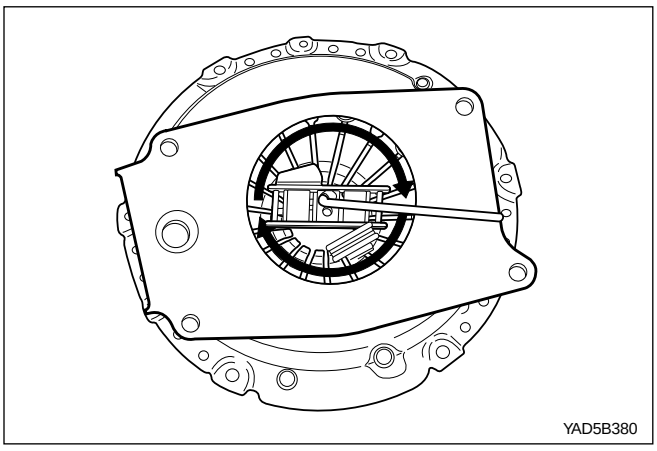

YAD5B360

Notice: Inspect each parts and replace the excessively worn parts.

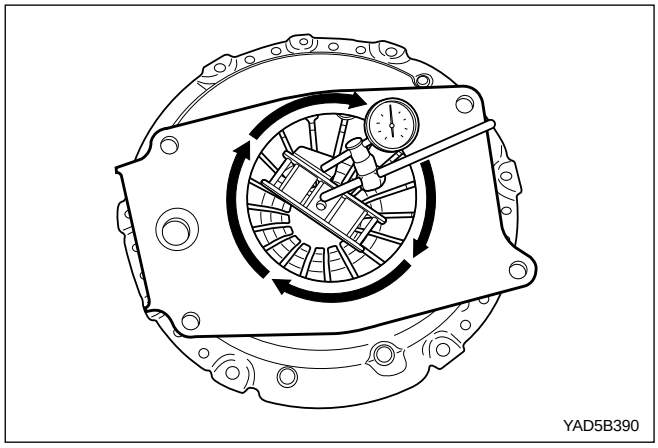
4. Check the clutch housing alignment as follows :


YAD5B370

- Place the magnetic base on the pressure plate spring.
- Check the housing bore alignment.

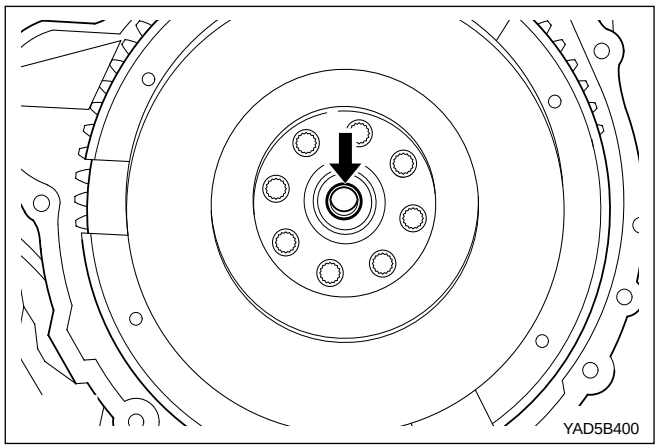

YAD5B380

- Place the dial indicator on the bore.
- By rotating the crankshaft one revolution, record the dial indicator reading.



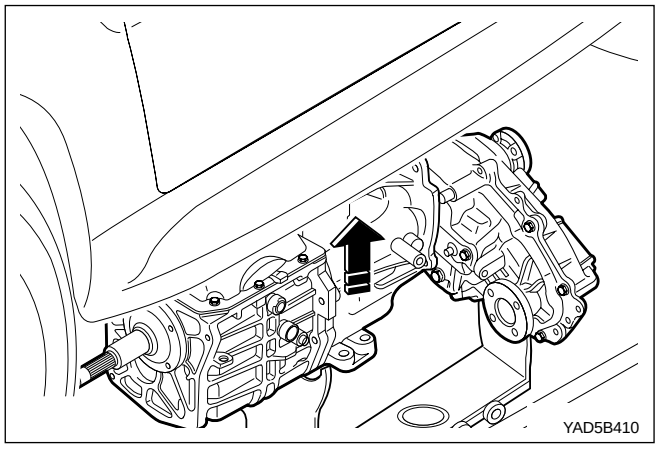
- Check the housing face alignment.
  - Place the dial indicator on the housing face.
  - By rotating the crankshaft one revolution, record the dial indicator reading.

Notice: If the reading is greater than 0.010 inch, insert the shim between the engine and clutch housing and adjust the alignment.



5. Check the following parts :
   - Pressure plate spring assembly
   - Disc
   - Flywheel
   - Input shaft pilot bearing

   Notice: Replace the excessively worn parts.
6. Lubricate the clutch release bearing bore, fork pivot head during assembly.

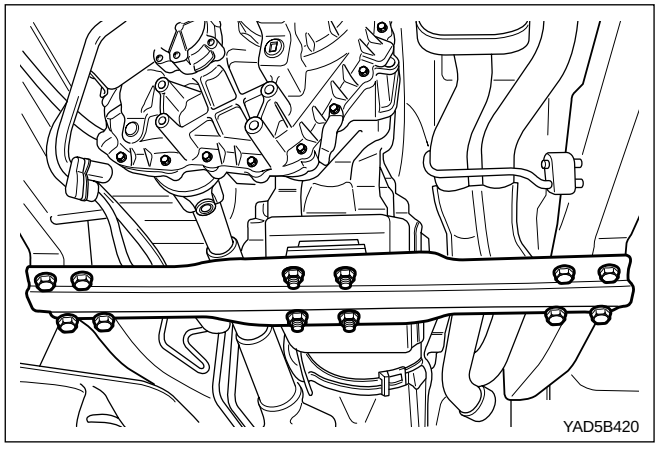


Installation Procedure

1. Install the transmission to the vehicle. At this time, seat correctly the input shaft of the transmission on the pilot bearing of the flywheel.
2. Tighten the transmission mounting bolts as the specified torque on the vehicle.

   Installation Notice

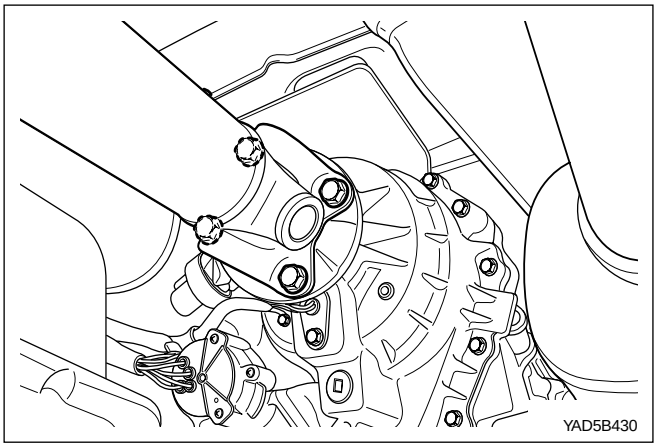
Tightening Torque	77 - 87 N•m (57 - 64 lb-ft)



3. Install the cross member and tighten as the specified torque by supporting the suitable jack.

   Installation Notice

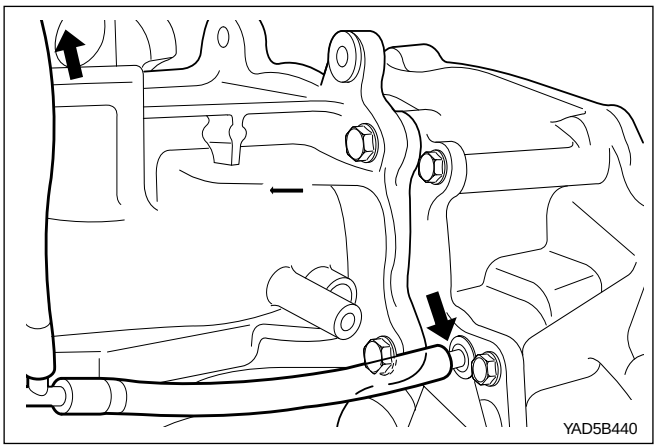
Tightening Torque	Left/Right	62 - 93 N•m (45 - 69 lb-ft)
	Center	21 - 35 N•m (15 - 26 lb-ft)



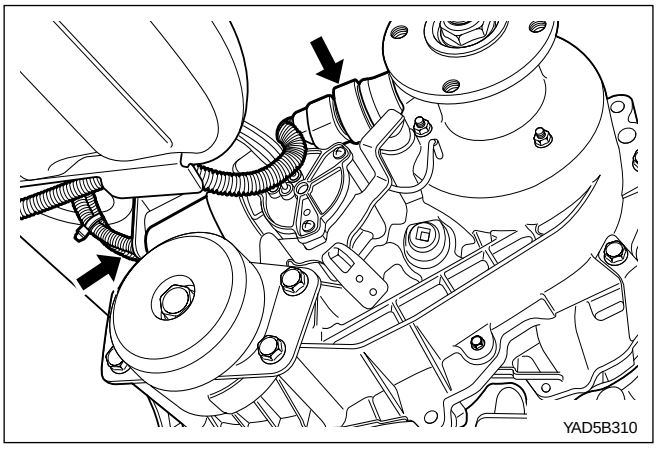
4. Install the front and rear propeller shafts to the transmission.

Installation Notice

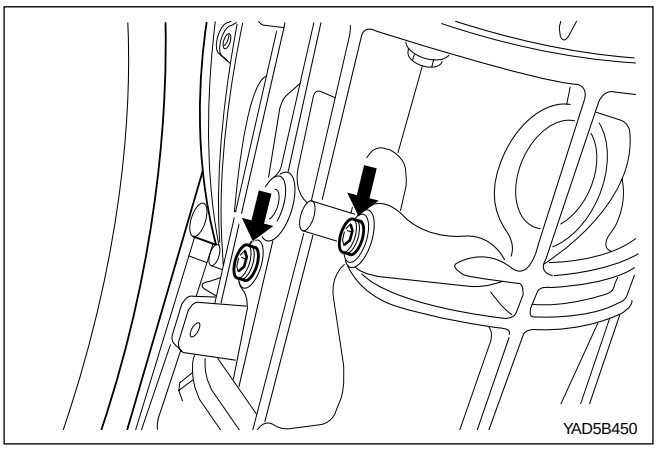
Tightening Torque	Front	81 - 89 N•m (60 - 66 lb-ft)
	Rear	70 - 90 N•m (52 - 66 lb-ft)



5. Connect the cable, the harness and the bleeder.
6. Install the back lamp switch.



7. Install the speedometer cable.



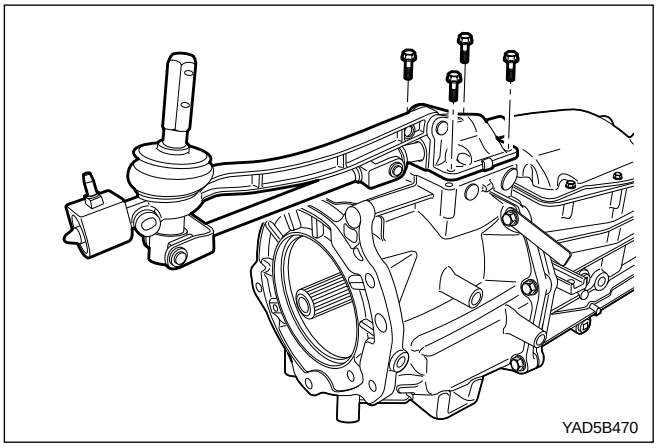
8. Charge the approved oil in the transmission housing and tighten the drain plug and the filler plug.

Installation Notice

Tightening Torque	Filler Plug	25 N•m (18 lb-ft)
	Drain Plug	25 N•m (18 lb-ft)

- Oil

Spec.	ATF Dexron II	
Capacity	4WD	3.4L
	2WD	2.0L

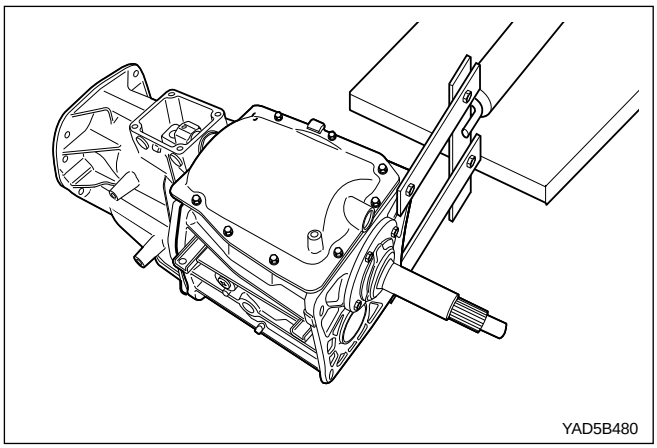

YAD5B470

UNIT REPAIR

MAJOR UNIT

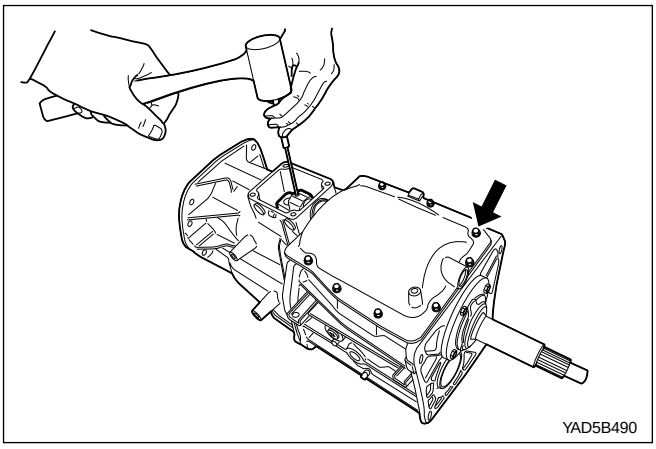
Disassembly Procedure

1. Remove the shift lever from the extension housing.

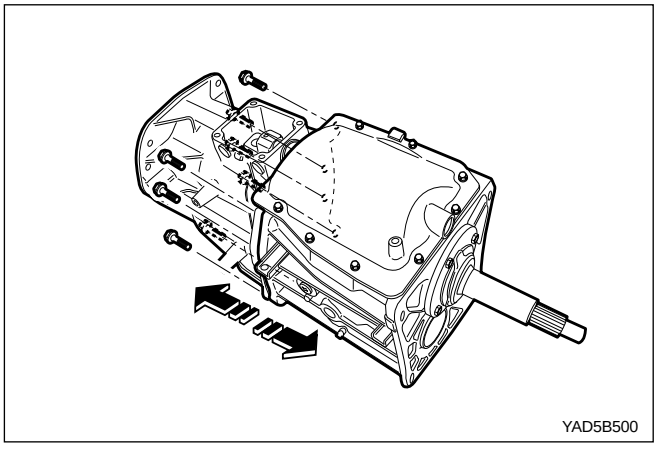

YAD5B480

2. Install the removed transmission into a fixture.
3. Remove the drain plug and drain the oil. Using a 10 mm wrench, remove the clamp bolt and position the offset lever in the 3-4 position of neutral.

   Notice: Removal of the offset lever in a position other than 3-4 of neutral will be difficult.


YAD5B490

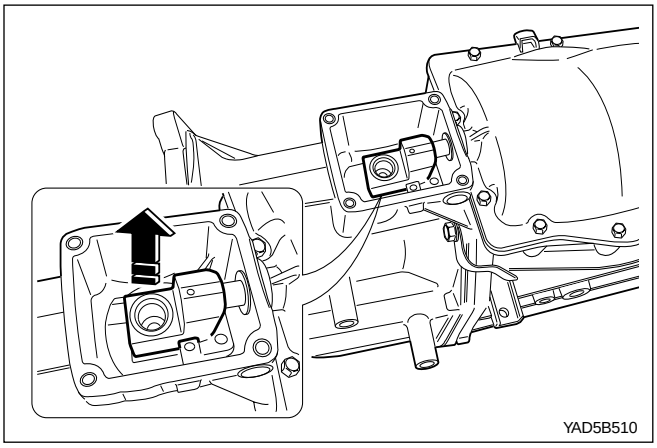
4. Using a pin punch and a hammer, remove the roll pin to remove the shift lever from the offset lever.
5. Using a 15 mm wrench, remove the 8 bolts from the extension housing.


YAD5B500

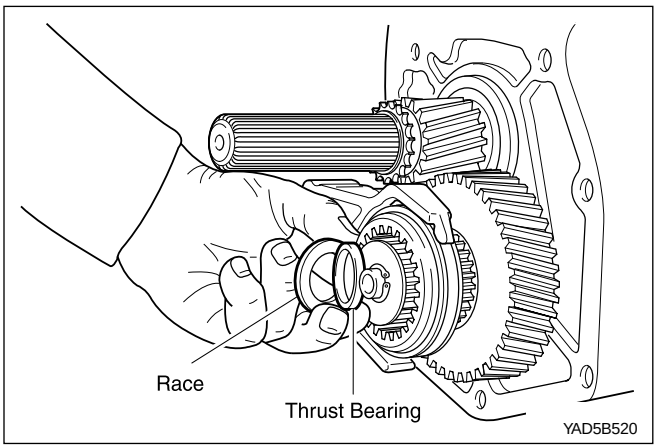
6. Separate the extension housing from the case and shift cover.

   Separate the offset lever from the shift.

   Notice: Do not remove the offset lever while the extension housing is still assembled to the case.

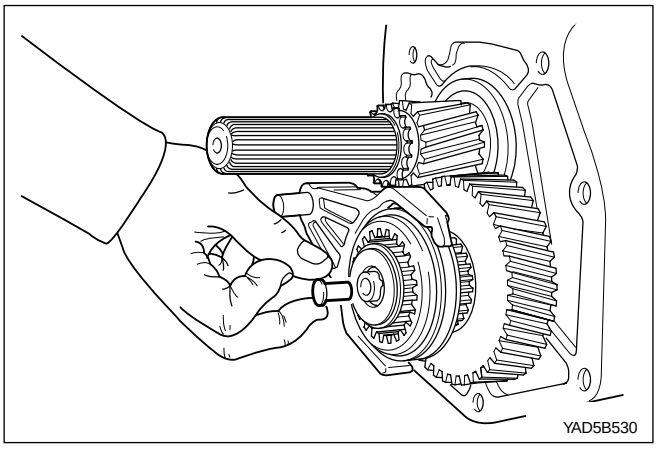

YAD5B510

7. Remove the offset lever from the extension housing with the detent ball and spring.
8. Remove the roll pin from either the offset lever or extension housing.

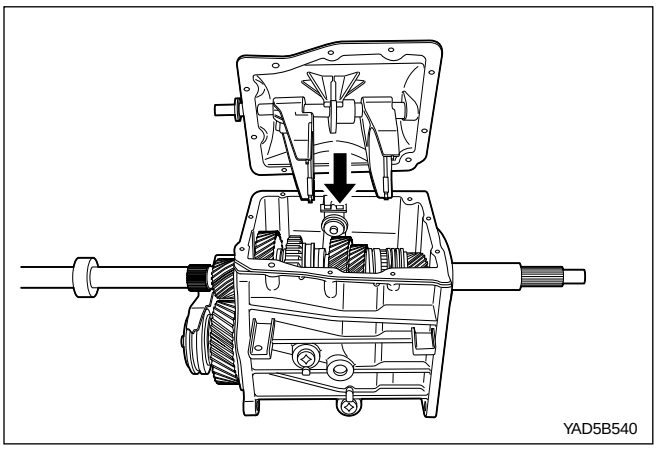


YAD5B520

9. Remove the counter shaft thrust race and bearing.


YAD5B530

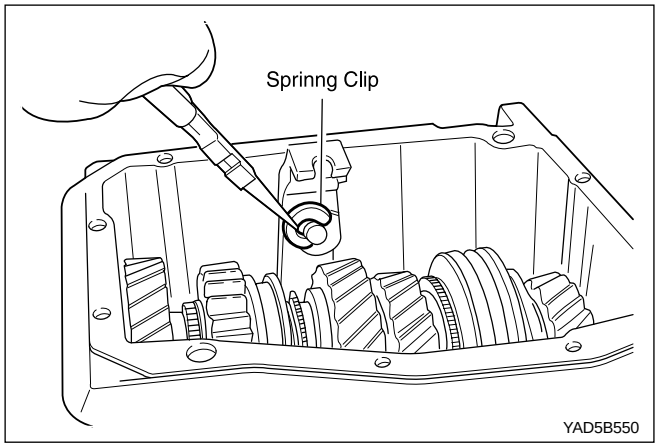
10. Carefully remove the oiling funnel from the end of the counter shaft.


YAD5B540

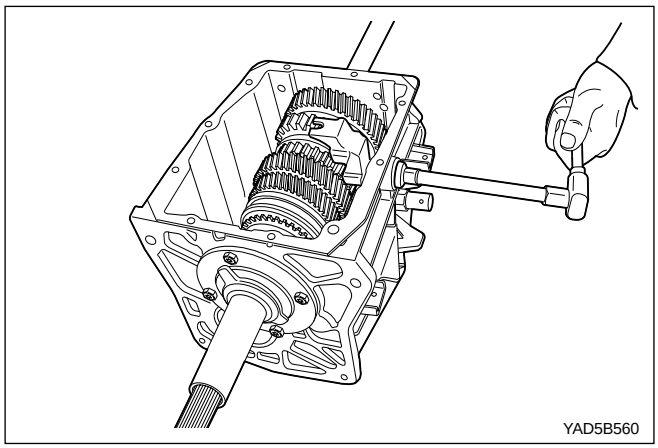
11. Using a 10 mm wrench, remove the 10 bolts from the shift cover.

    Notice: For assembly, note the location of the two bolts.

12. Lift up the shift cover after sliding it toward the drain plug about 3 cm. At this time remove sealer bond.

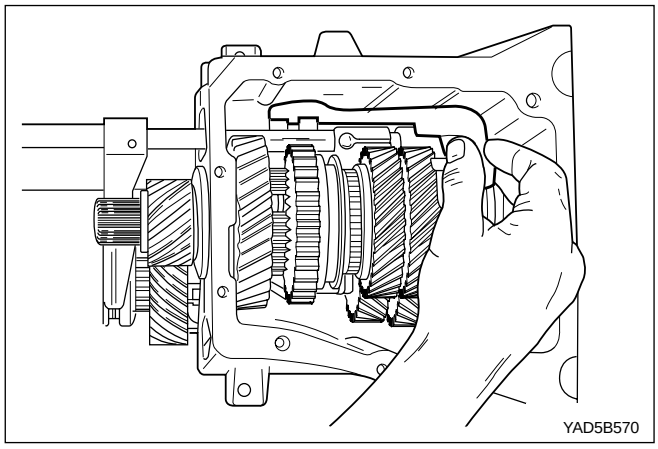


13. Using a needle nose pliers, remove the 5th-R lever clip.



14. Using a 21 mm wrench or a T-50 bit, remove the 5th-R lever pivot bolt.

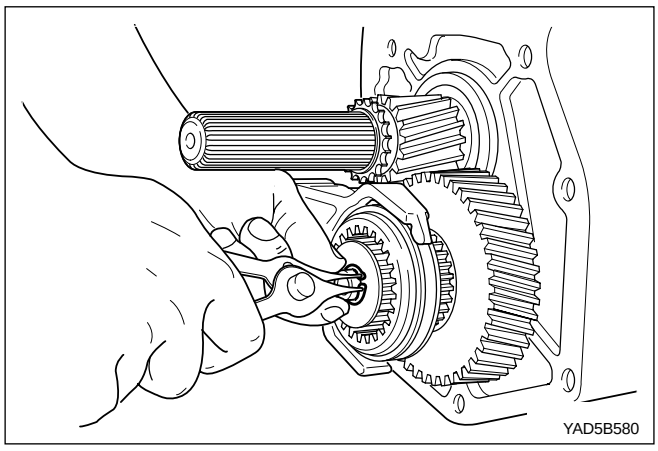
    Notice: Apply sealer bond to this bolt during assembly.



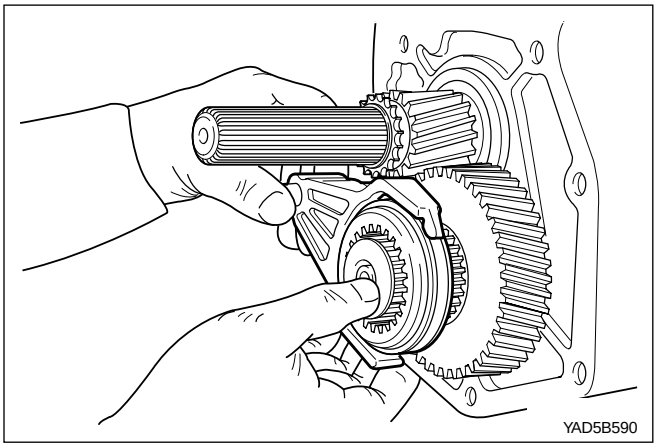
15. Using a 22 mm wrench, remove the back-up lamp switch from the 5-R lever side.

    Notice: Apply sealer to the threads.

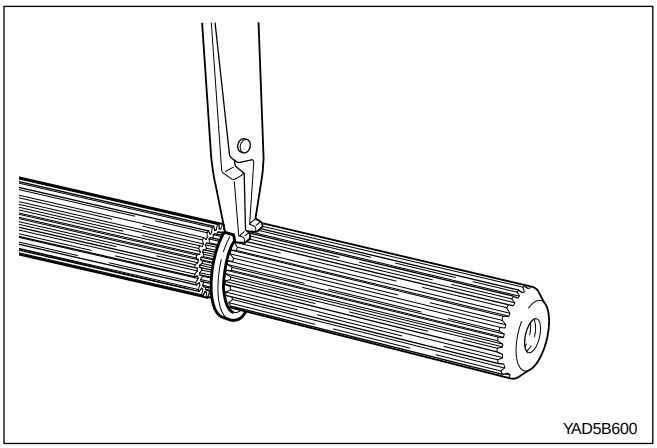
16. Pull out the 5th-R lever out of the transmission.



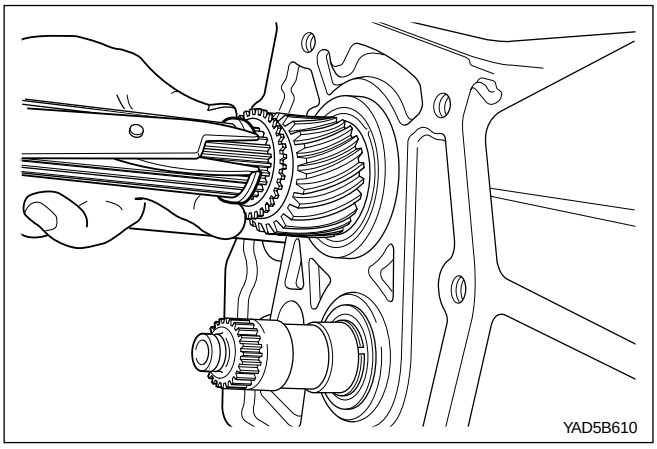
17. Using a snap ring pliers, remove the 5th synchronizer snap ring from the end of the counter shaft.


YAD5B590

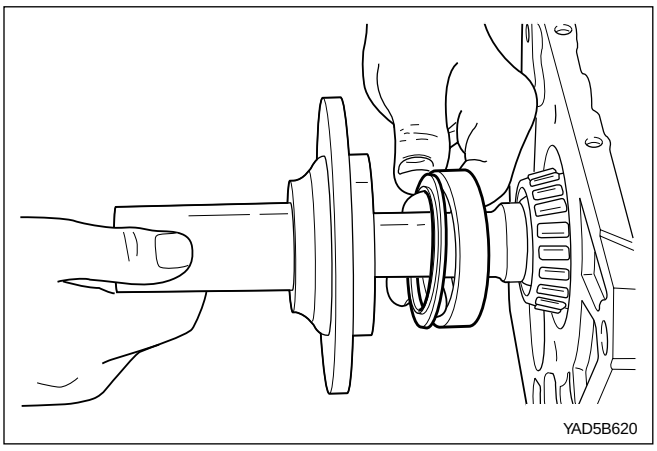
18. Remove the 5th synchronizer assembly with its fork and rail assembly from the counter shaft.


YAD5B600

19. Remove the slip yoke snap ring from the main shaft.


YAD5B610

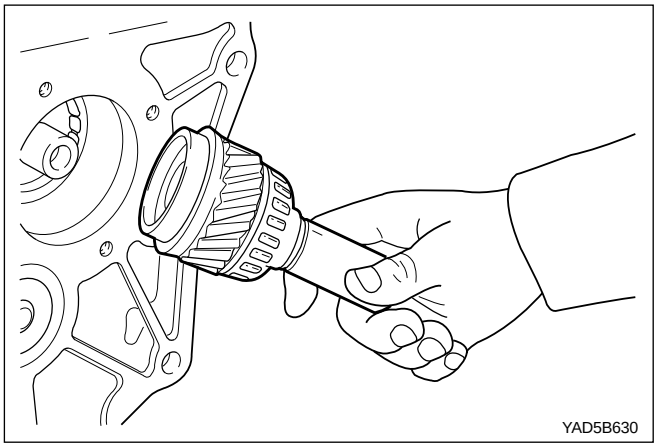
20. Remove the 5th speed drive gear snap ring from the main shaft.


YAD5B620

21. Make alignment marks on the case and input bearing retainer and remove the 4 input shaft bearing retainer bolts, using a 13 mm wrench.

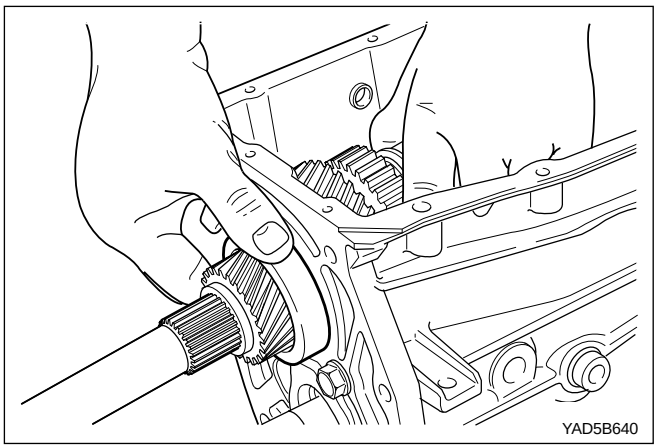
    Remove the input bearing retainer with the bearing outer race and shim.

    Notice: Apply sealer on these bolts during assembly.

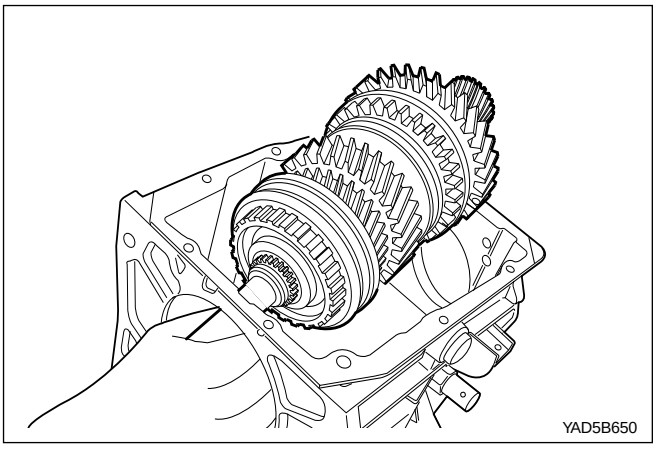

YAD5B630

22. Remove the input shaft from the case by rotating it until the flat surface appears.
23. Remove the following parts from the input shaft.
    - 4th speed gear blocking ring.
    - Main shaft thrust race and bearing.
    - Main shaft pilot bearing rollers (15 rollers).

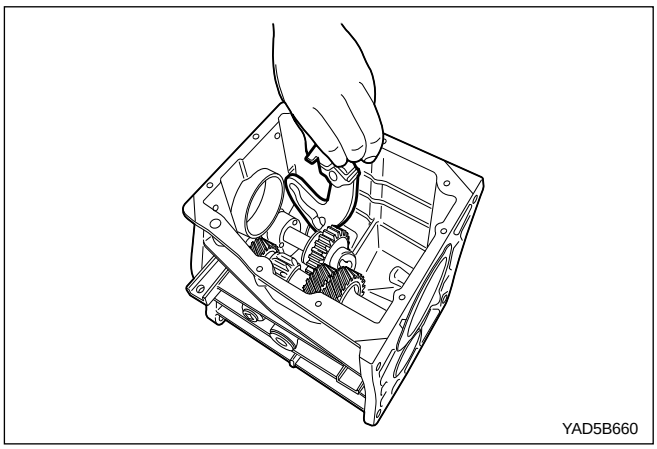
    Notice: Be careful not to dissipate the pilot bearing rollers.


YAD5B640

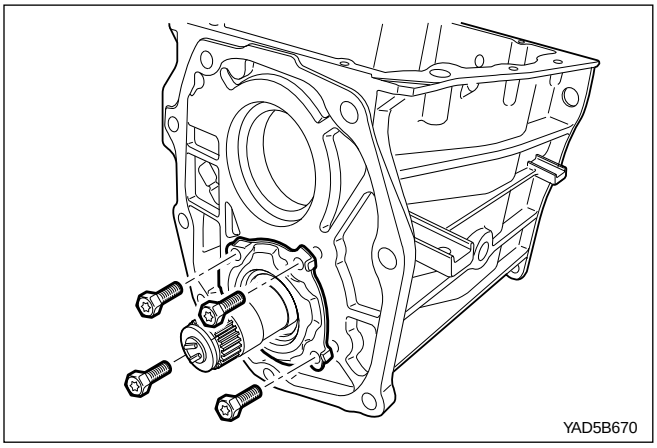
24. Remove the main shaft in 2 steps.
    - To remove the rear bearing outer race, push the main shaft rearward.


YAD5B650

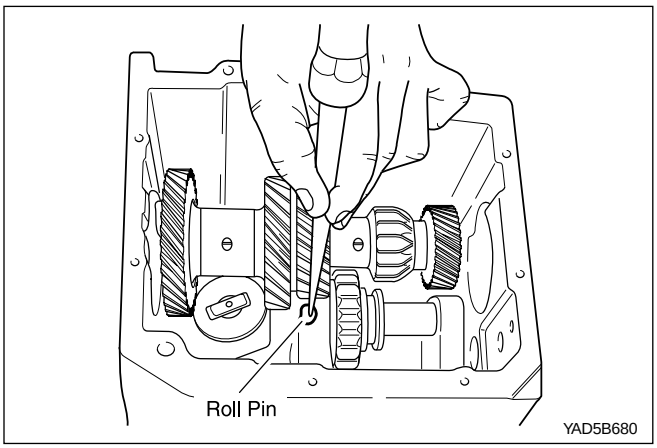
    - Tilt and lift the main shaft from the case.


YAD5B660

25. Remove the reverse fork and spring from the case.

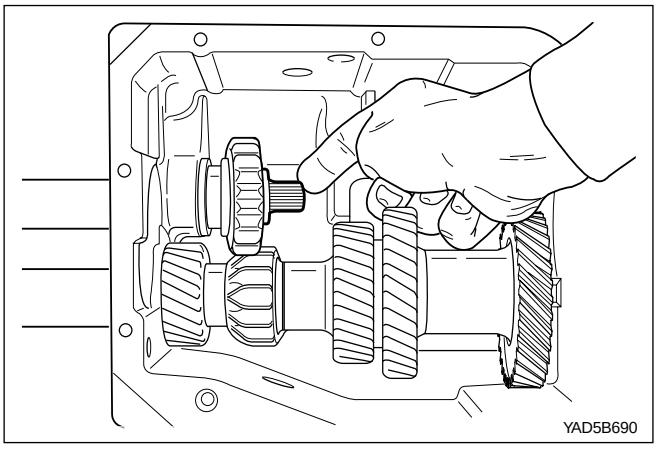

YAD5B670

26. Remove the counter shaft as follows:
    - Using a punch and hammer, pry up the lock tabs.
    - Using a 13 mm wrench or T-40 bit, remove the 4 bolts.
    - Remove the retainer and shim from the case.
    - Push the counter shaft rearward to remove the rear bearing outer race.

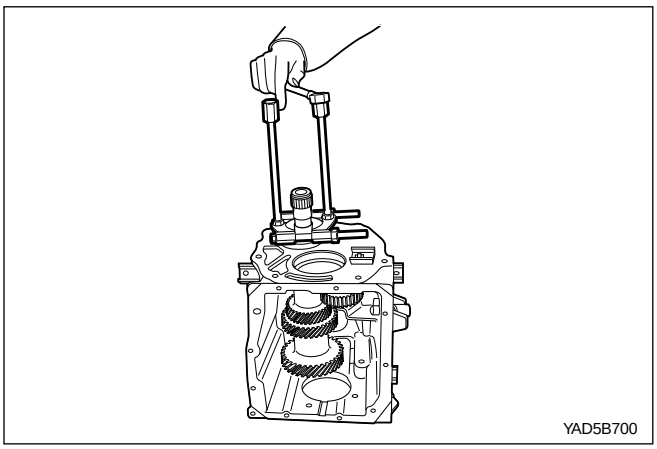


YAD5B680

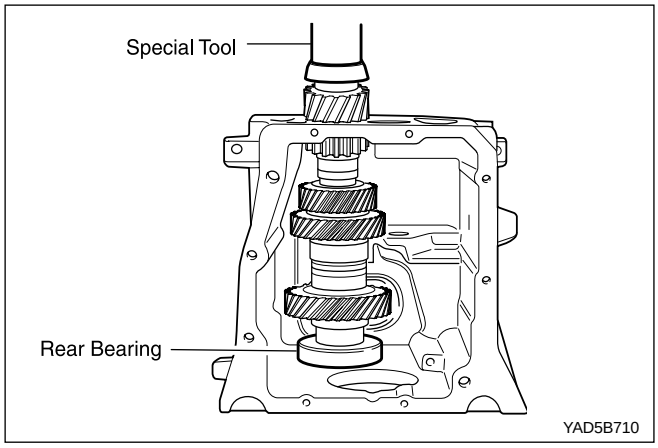
27. Using a pin punch and a hammer, remove the roll pin fixed on the reverse idler shaft.


YAD5B690

28. By pushing the reverse idler shaft rearward and out of the case, remove the reverse idler gear and O-ring.

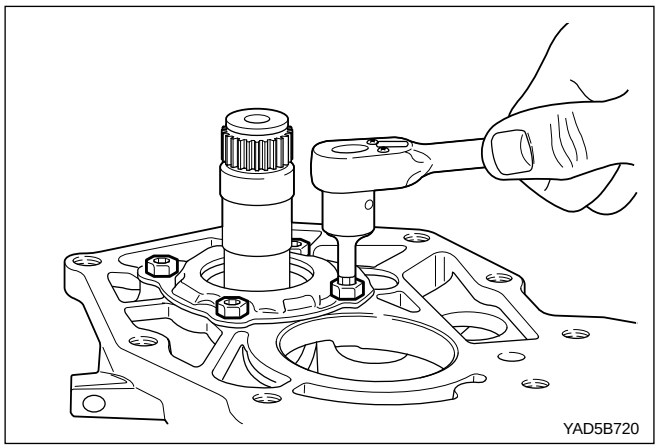

YAD5B700

29. Using a puller, remove the rear bearing assembly from the counter shaft.



Assembly Procedure

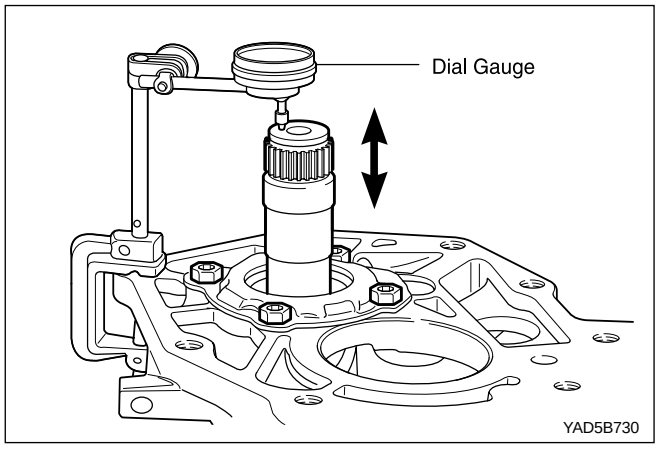
1. Using a hydraulic press and a supporting tool, press the counter shaft rear bearing into the case. Be sure that the supporting tool inside of the case should support the counter shaft.



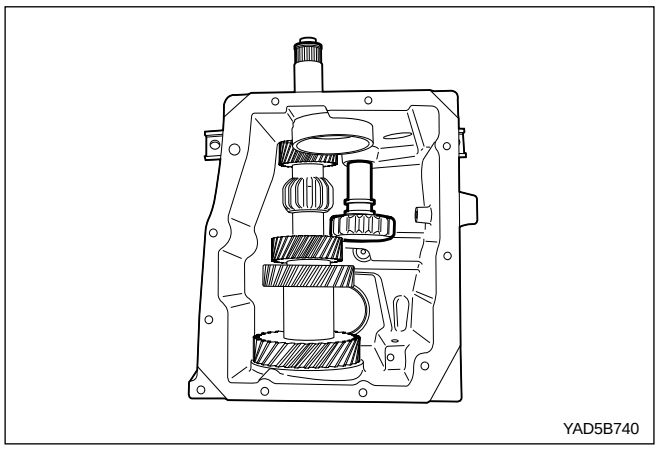
2. Without the shim, install the retainer and counter shaft rear bearing outer race. Tighten the 4 retainer bolts.

Installation Notice

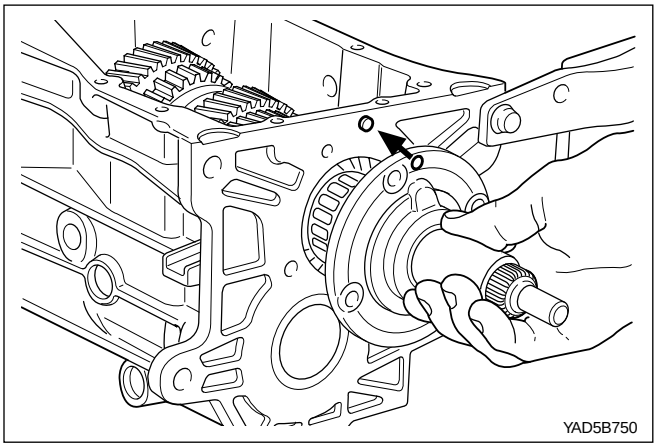
Tightening Torque	20 N•m (15 lb-ft)



3. Place a dial indicator on the case and measure counter shaft end play by moving up and down.



4. Select a shim which is the same thickness as the indicator rearing (up to 0.004 inch) and assemble it.
5. When the end play is correctly adjusted, remove the counter shaft rear bearing retainer and outer race.
6. Using a pin punch and rubber hammer, install the reverse idler shaft, gear and O-ring.

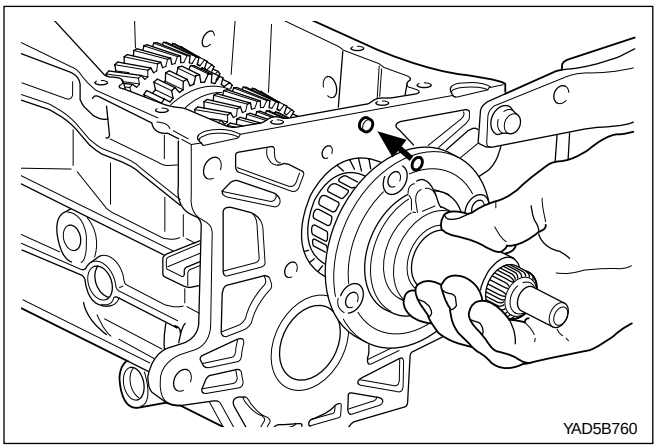

YAD5B750

7. Install the counter shaft rear bearing outer race, shim and retainer.

Installation Notice

Tightening Torque	20 N•m (15 lb-ft)

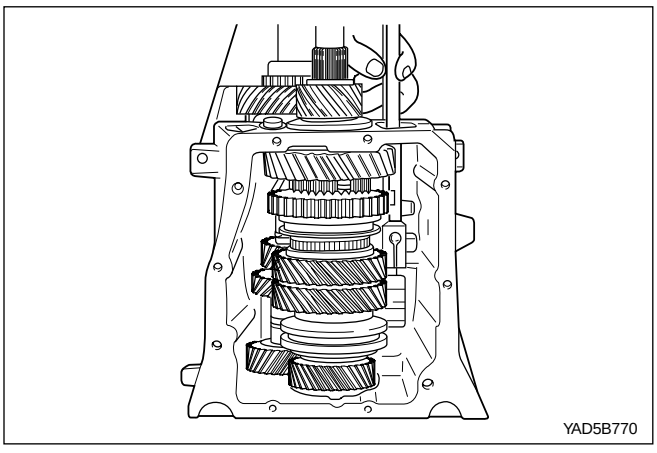
Notice: Using a punch and hammer, bend the lock tabs on the retainer.


YAD5B760

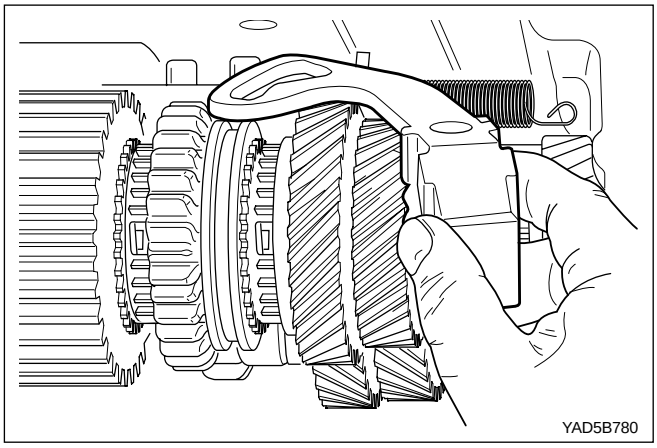
8. Install the following parts :
   - Install the main shaft into case.
   - Install the main shaft rear bearing outer race into the rear of the case.
   - Install the 4th speed blocking ring onto the front of the main shaft.
   - Install the input shaft onto the front of the main shaft.
   - Install the input bearing retainer without shim onto the front of the case.
   - Using a torque wrench, tighten the 4 bolts.

Installation Notice

Tightening Torque	20 N•m (15 lb-ft)


YAD5B770

9. Install the 5th speed drive gear and blocking ring on the counter shaft.
10. Install the 5th synchronizer and rail/fork.
11. Install the 5th synchronizer snap ring and oiling funnel.

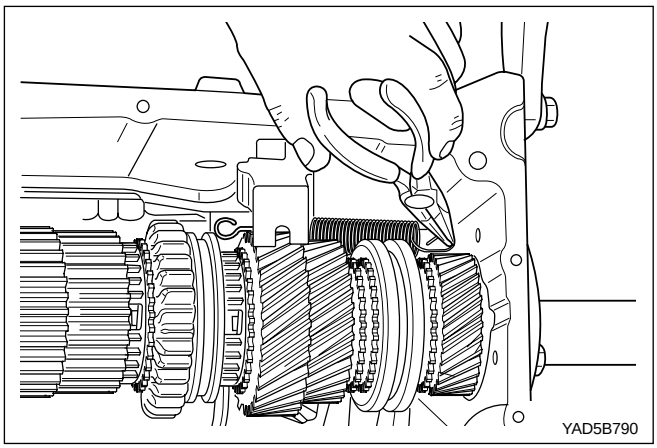


12. Align the slots of the lever with the rollers of the reverse fork and 5th shift rail. Apply sealer on the 5-R lever pivot bolt and install it into the case.

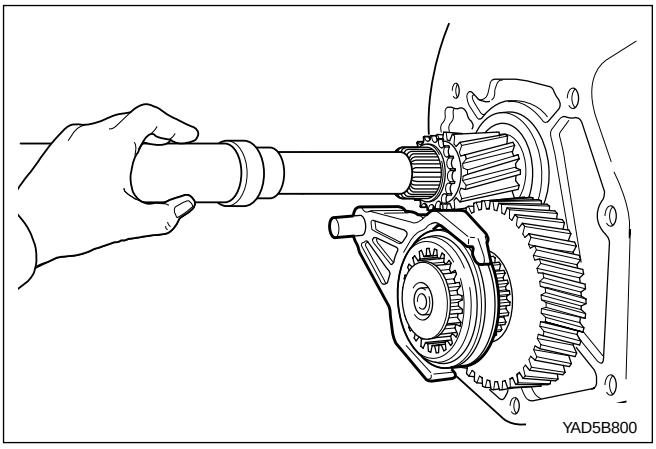
    Installation Notice

Tightening Torque	28 N•m (21 lb-ft)

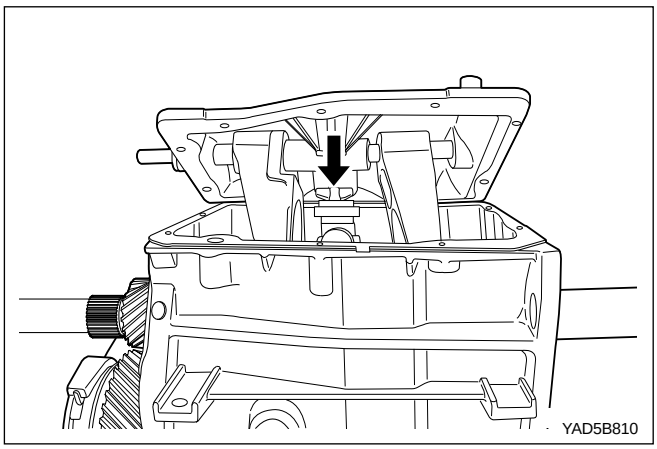
13. Using a needle nose pliers, install the 5-R lever clip.



14. Using a needle nose pliers, install the reverse fork spring to its pin inside the case. Check the operation of the 5-R shift mechanism at this time.



15. Using a snap ring piers, install the slip yoke snap ring onto the end of the main shaft.
16. Make sure that the 1-2 and 3-4 synchronizer sleeves and 5-R shift lever are in neutral position.

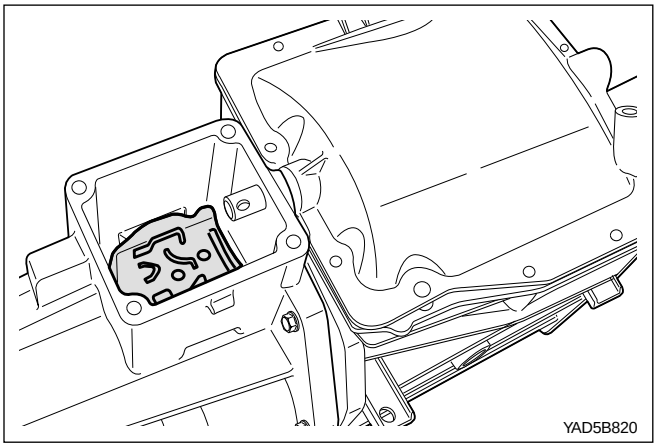


17. Align the holes the case and cover with alignment-type bolts. Tighten the 10 bolts.

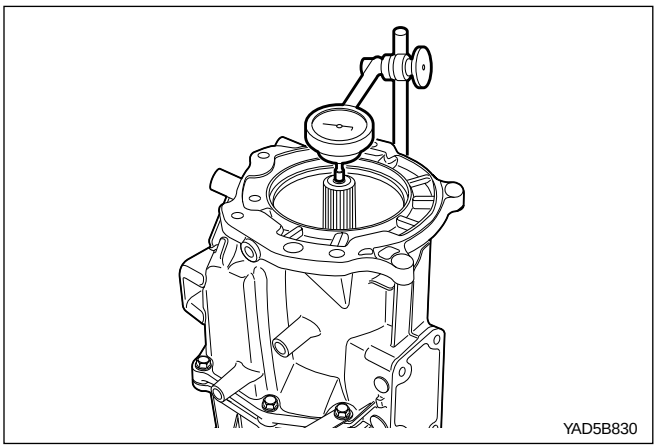
    Installation Notice

Tightening Torque	15 N•m (11 lb-ft)

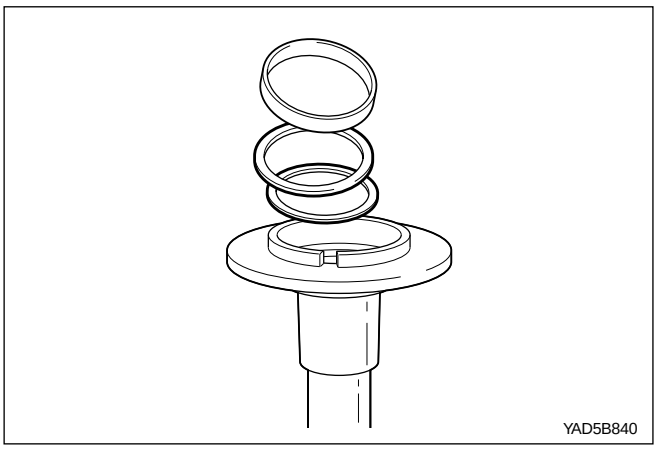
18. Apply RTV sealant on the sealing surface of the extension housing.
19. Apply grease on the detent/guide plate in the extension housing. Install the detent ball in the 3-4 position.


YAD5B820

20. Place the detent spring and offset lever in the extension housing and push the extension against the case and shift cover.

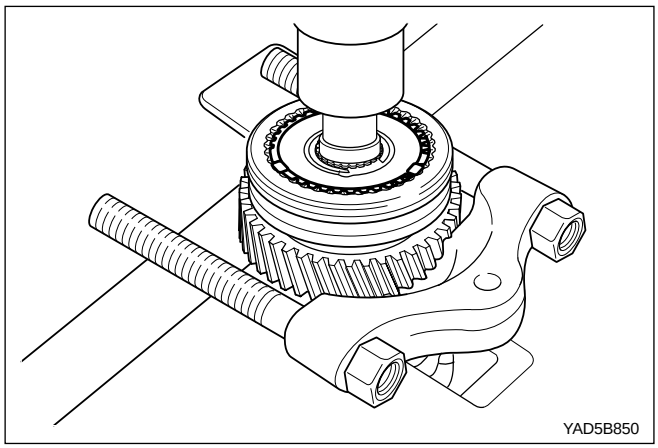

YAD5B830

21. Completely compress the detent spring.
22. To install the extension housing to the case, apply sealer to the top two bolts and tighten them and tighten the 6 bolts.
23. Apply sealer to the back-up lamp switch and drain plug and tighten them.
24. Using a hammer, install the offset lever-to-shift roll pin.
25. Turn the transmission case reversely and place a dial indicator on the extension housing. Move the input and main shift up and down and measure end play. Select a shim which is the same thickness as the measurement (0.001 inch). After shim installation, the end play should be “0”.


YAD5B840

26. Remove the input bearing retainer and do the following :
    - Install the adjusting shim behind the input bearing outer race in the retainer and if 2 shims are used, install the thinner one in first.
    - Install the retainer to the case and tighten the bolts.
    - If end play is not 0change the shim again.
    - Apply RTV sealant to the sealing surface of the retainer.
    - Apply sealer to the 4 retainer bolts and tighten them.

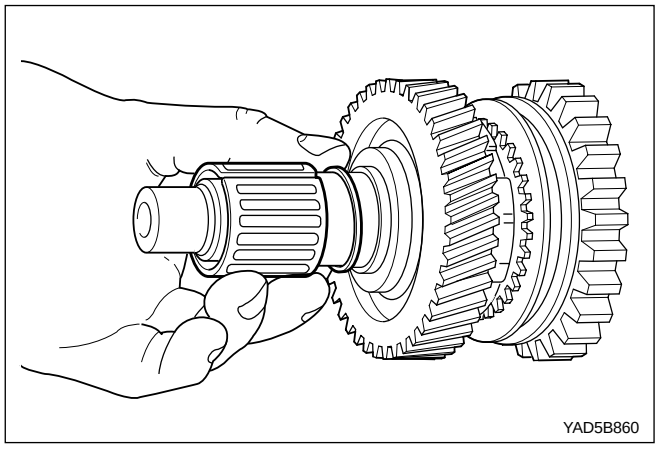
27. Remove the fill plug.
28. Remove the transmission from the holding fixture and install it to the vehicle.
29. Clean the sealing surface of the shift control lever.
30. Install the control cables to the shift lever.


YAD5B850

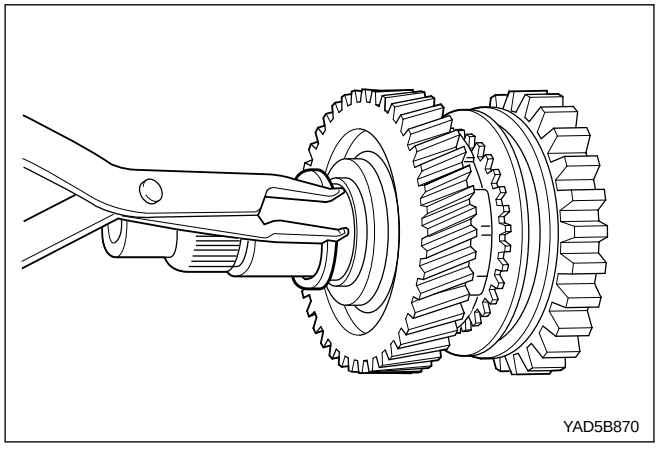
MAIN SHAFT

Disassembly Procedure

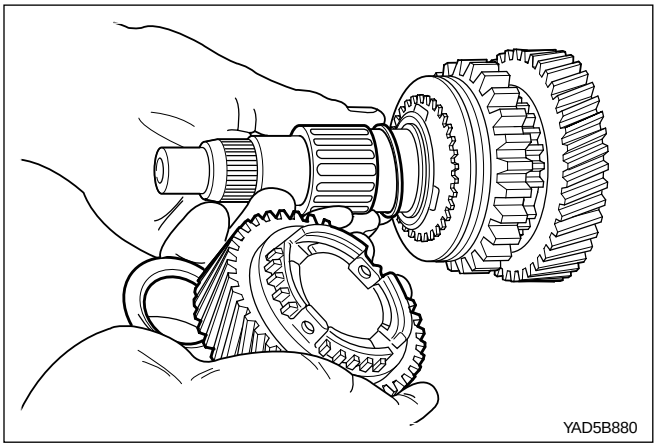
1. For correct reassemble, place an alignment mark on the 3-4 Synchronizer hub and sleeve.
2. Using a hydraulic press and puller plate, remove the 3-4 Synchronizer assembly and the 3rd speed gear.


YAD5B860

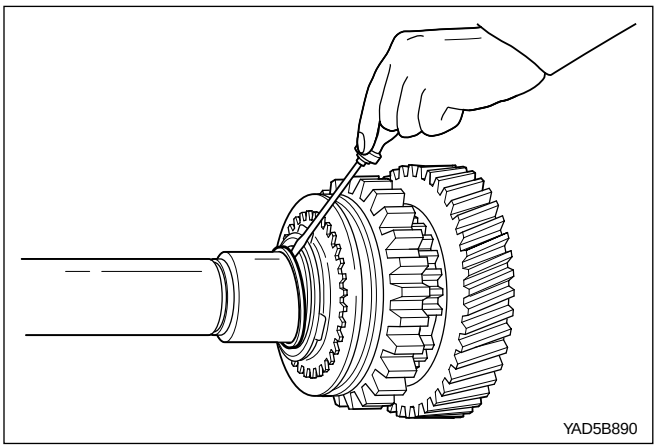
3. Remove the 3rd speed gear bearing and spacer.


YAD5B870

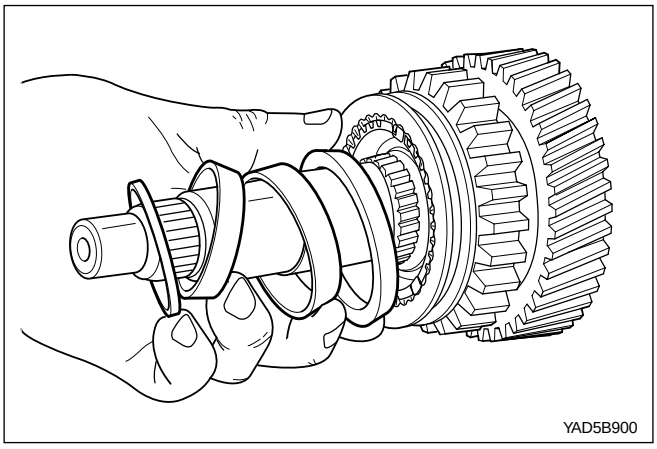
4. Using a snap ring pliers, remove the 2nd speed gear snap ring.
5. Remove the 2nd speed gear thrust washer.


YAD5B880

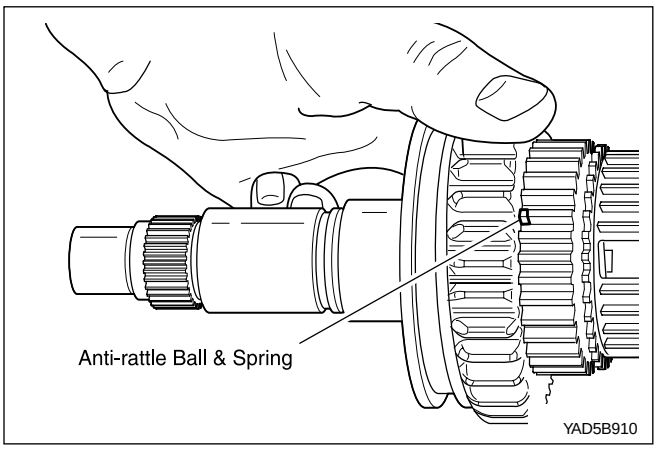
6. Remove the 2nd speed gear, bearing and spacer.


YAD5B890

7. Using a screwdriver, remove the spiral retaining ring.

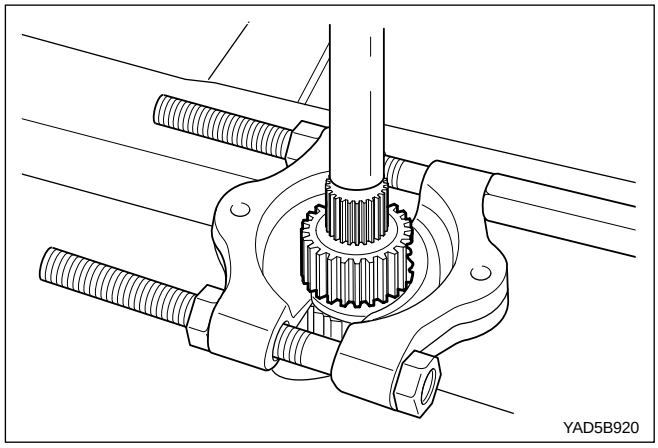

YAD5B900

8. Remove the thrust washer and three-piece 2nd speed blocking ring assembly.

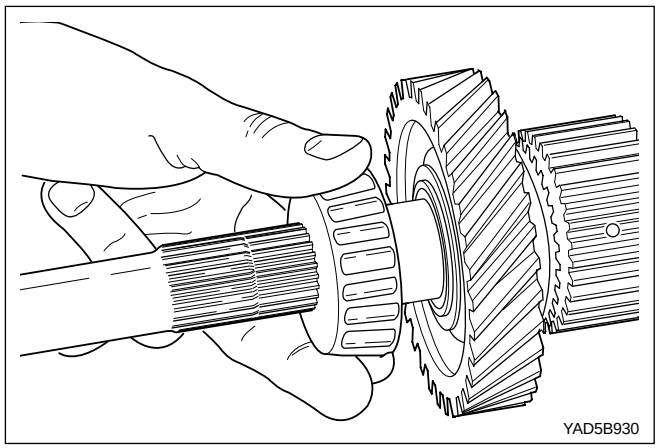


YAD5B910

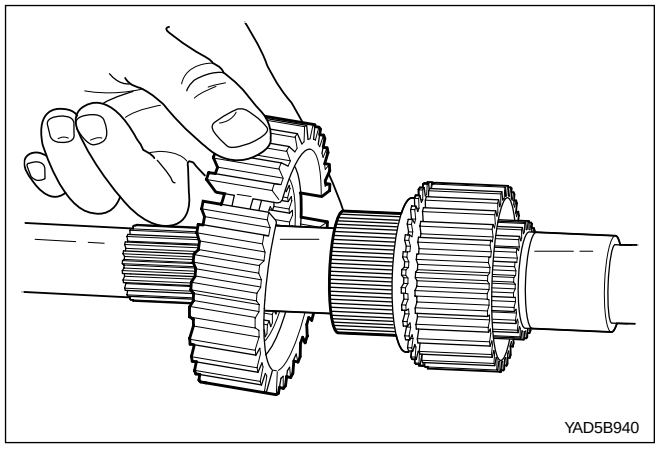
9. For correct reassembly, place an alignment mark on the 1-2 synchronizer hub and sleeve.
10. Remove the 1-2 synchronizer sleeve from the hub with following parts :
    - The anti-rattle ball and spring.
    - The three keys.
    - One of the 3 springs.



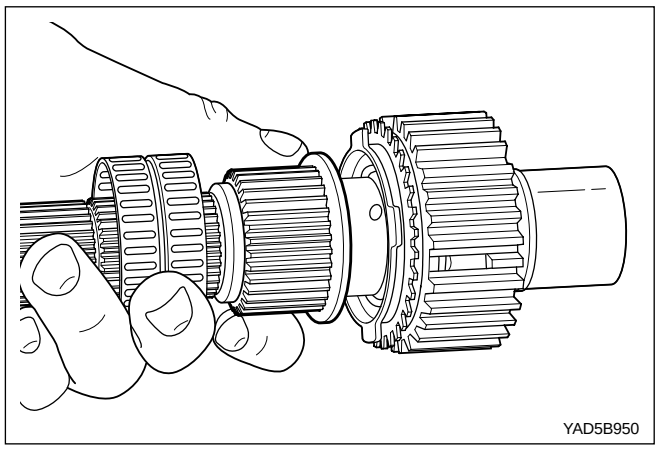
11. Using a hydraulic press and puller plate, remove the 5th speed driven gear from the main shaft.



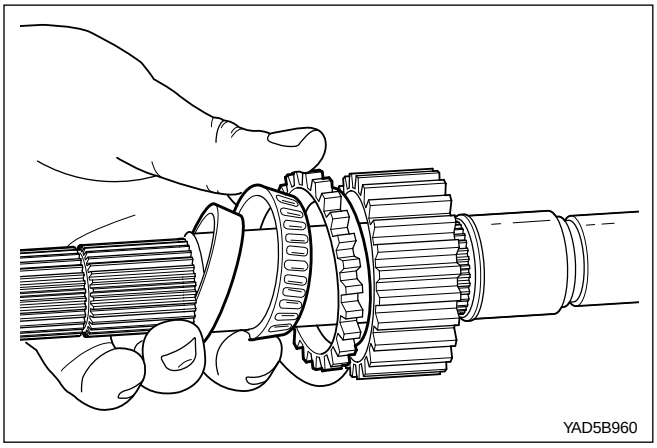
12. Remove the main shaft rear bearing assembly from the shaft.



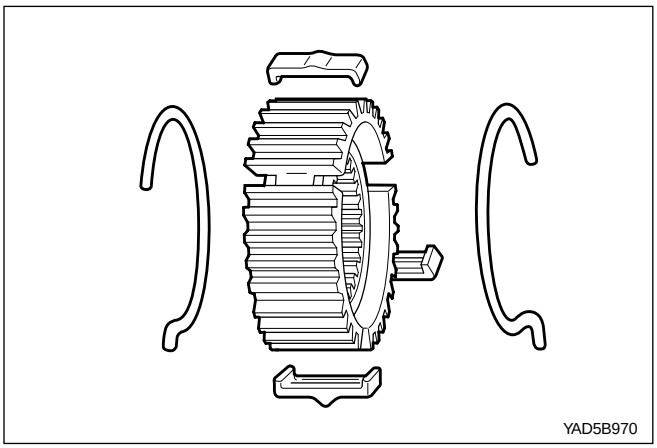
13. Remove the 1st speed gear and bearing.



14. Remove the inner race.


YAD5B960

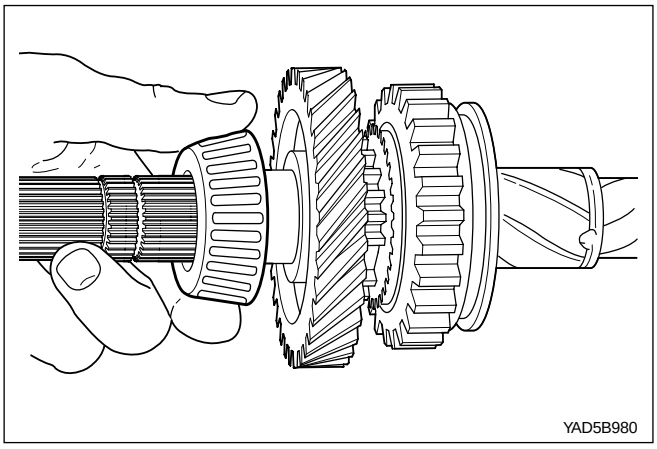
15. Remove the tree-piece 1st speed blocking ring assembly and remaining synchronizer spring.
16. Check and clean all removed parts and replace if necessary.


YAD5B970

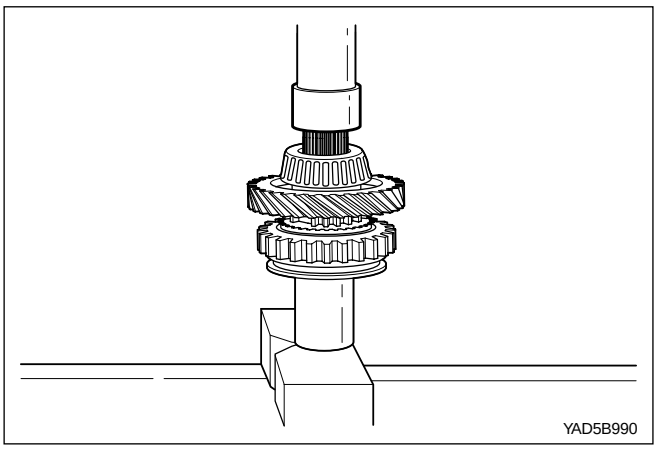
Assembly Procedure

1. When assemble the synchronizer, make sure that the hubs and sleeves are matched and the 3 keys are installed properly. Also align blocking rings with keys during installation.

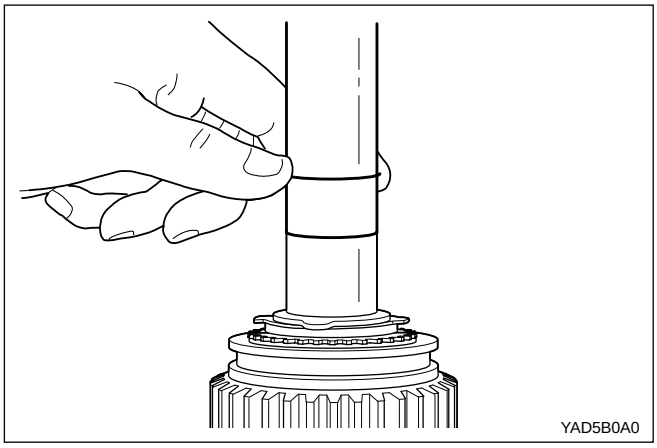
   Notice: Before assembly, coat all parts with lubricant. In case of the paper-lined blocking rings, soak them in DexronII/III before installation.


YAD5B980

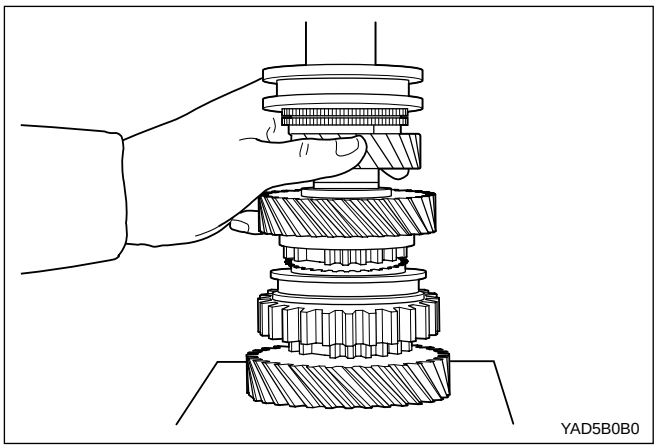
2. Assemble the following parts :
   - 1st speed blocking ring.
   - Alignment pin and 1st speed gear bearing race.
   - 1st speed gear and its bearing.
3. Install the rear bearing assembly to the main shaft.


YAD5B990

4. Using a hydraulic press and installer, press the 5th driven gear onto the main shaft. While the main shaft is still on the press bed, install the 5th driven gear snap ring. If the snap ring does not fit completely, continue pressing the 5th driven gear.

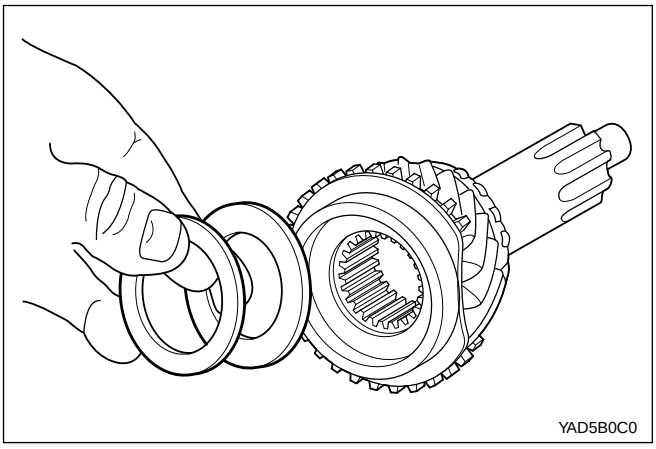

YAD5B0A0

5. Install the following parts :
   - 2nd speed blocking ring assembly.
   - Thrust washer for the blocking ring inner cone.
   - Spiral retaining ring (Use special tools).
   - 2nd speed gear spacer, bearing and gear.
   - 2nd gear thrust washer and snap ring.
   - 3rd speed gear spacer, bearing and gear.
   - 3rd speed blocking ring.


YAD5B0B0

6. Using a hydraulic press and installer, install the 3-4 synchronizer hub onto the main shaft.

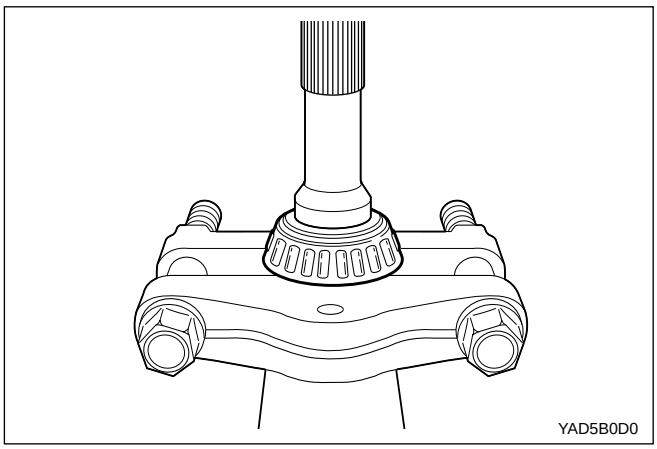
   Notice: Align the blocking ring with the synchronizer keys while installing the hub.


YAD5B0C0

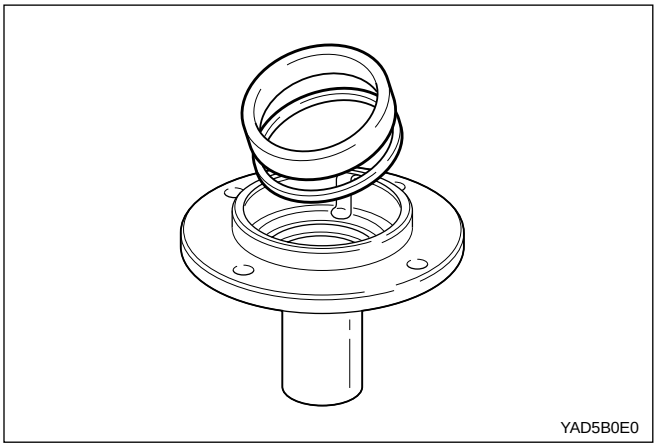
INPUT SHAFT

Disassembly Procedure

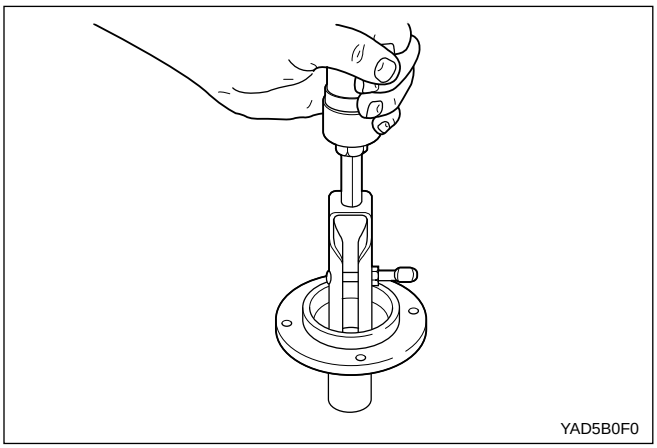
1. Remove the following parts from the input shaft :
   - Main shaft thrust race and bearing.
   - Main shaft pilot bearing rollers (15 rollers).


YAD5B0D0

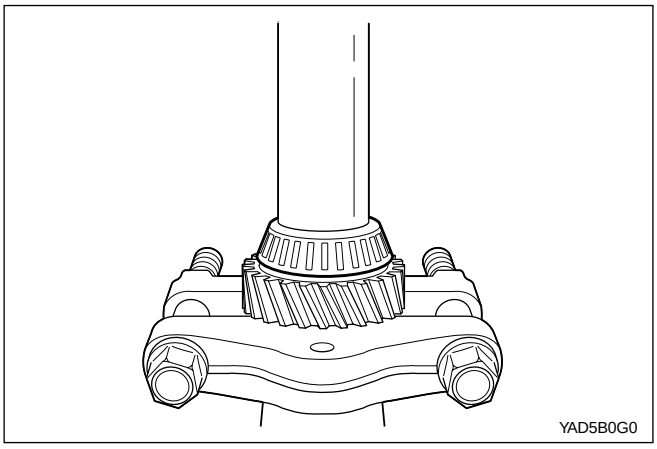
2. Using a hydraulic press and puller plate, remove the input shaft bearing assembly from the shaft.


YAD5B0E0

3. Remove the input bearing.

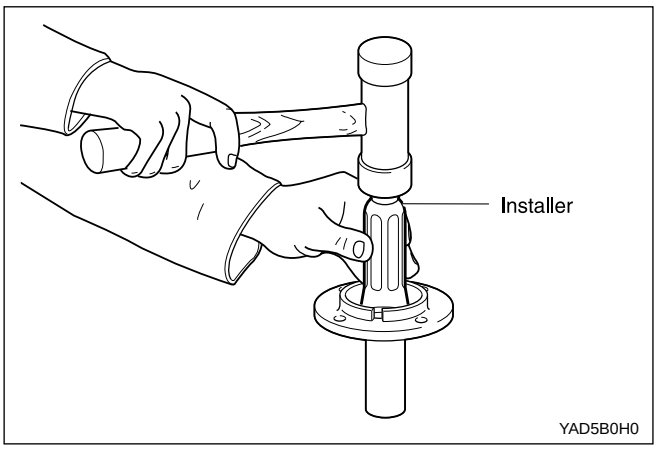

YAD5B0F0

4. Remove the input shaft seal.
5. Check and clean all removed parts and replace if necessary.


YAD5B0G0

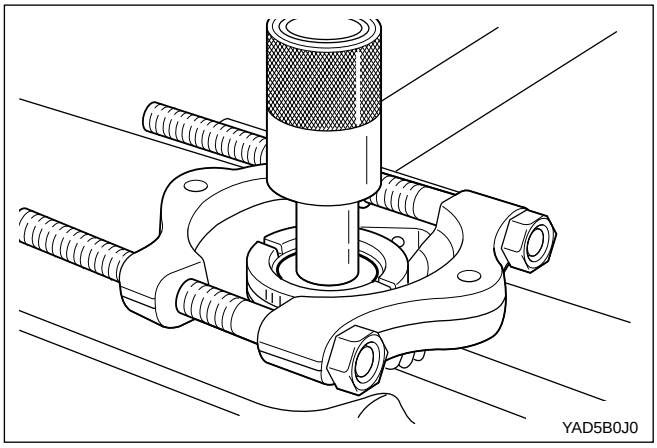
Assembly Procedure

1. Using a hydraulic press and installer, press the input shaft bearing onto the input shaft.
2. Apply grease to the thrust bearing inner roller (15 rollers) and install the main shaft thrust bearing and its race in the rear of the input shaft.



YAD5B0H0

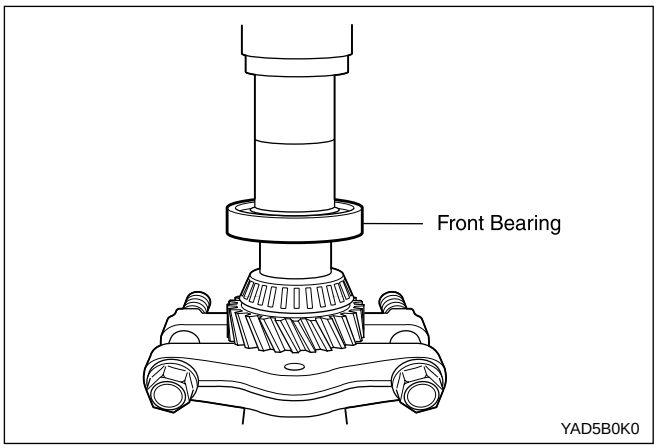
3. Using a rubber hammer and installer, install the input bearing retainer and input shaft seal after applying grease.
4. Install the bearing outer race to the retainer without end play adjusting shim.


YAD5B0J0

COUNTER SHAFT

Disassembly Procedure

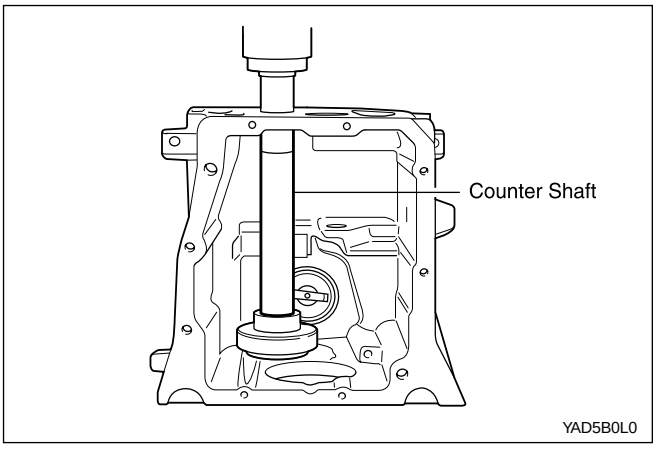
1. Using a hydraulic press and special tool, remove the front bearing assembly from the counter shaft.
2. Check and clean all removed parts and replace if necessary.



YAD5B0K0

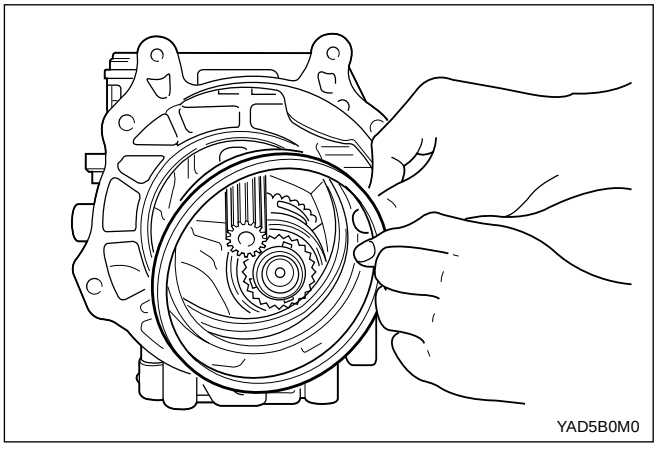
Assembly Procedure

1. Using a hydraulic press and installer, press the front bearing assembly onto the counter shaft.



YAD5B0L0

2. Install is as follows :
   - Install a new O-ring on the counter shaft outer race and lubricate it.
   - Using a installer, lightly tap the race into its bore until the O-ring is compressed.
   - Install the race to be fully seated on the inside of the case.


YAD5B0M0

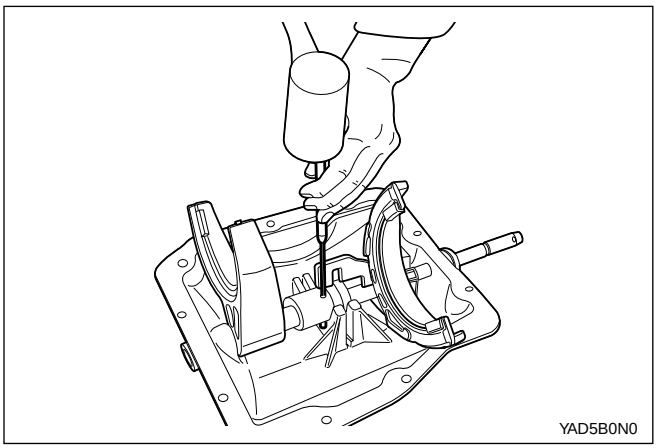
EXTENSION HOUSING

Disassembly Procedure

1. Remove the vent from the extension housing.
2. Remove the O-ring and steel ring from the rear of the extension housing.
3. Check and clean all removed parts and replace if necessary.

Assembly Procedure

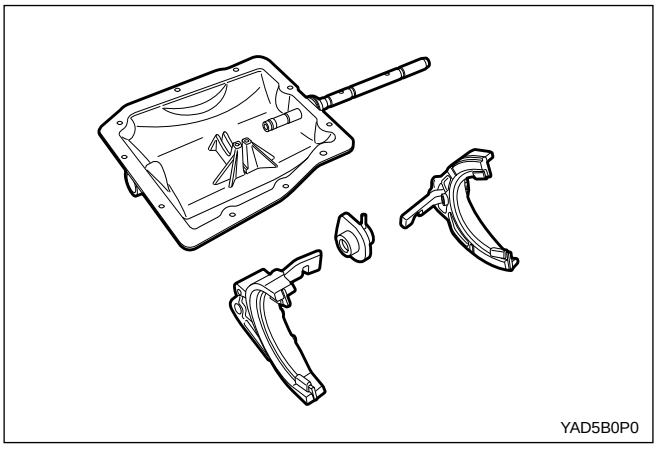
1. Install the O-ring and steel ring to the rear of the extension housing.
2. Install the vent to the extension housing.


YAD5B0N0

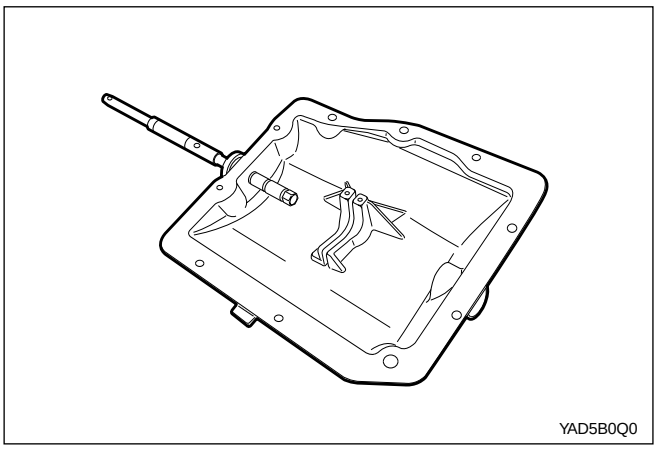
SHIFT COVER

Disassembly Procedure

1. Using a hammer and a pin punch (3/16) remove the selector arm roll pin.

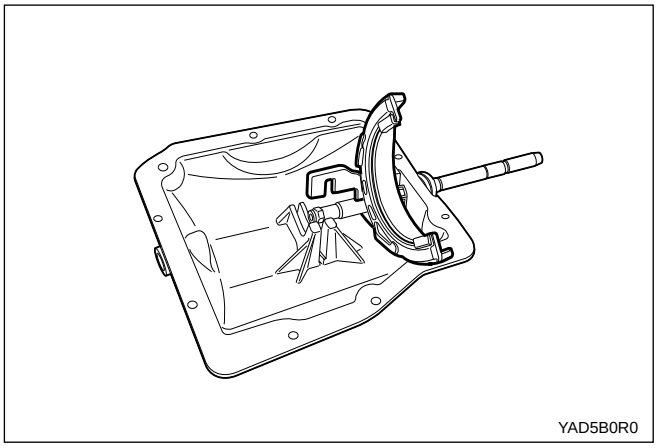

YAD5B0P0

2. Before removal, note the correct position of the interlock plate and selector arm and remove the shift shaft.
3. Check and clean all removed parts and replace if necessary.

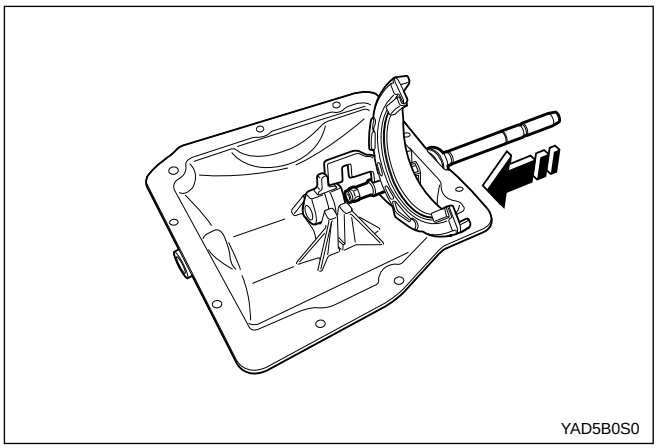

YAD5B0Q0

Assembly Procedure

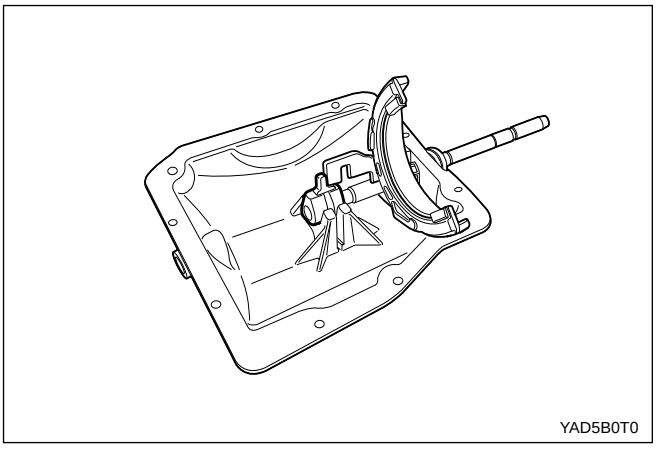
1. If the shaft cup plug was removed, apply plug outer surface with sealer and install it into the cover.
2. Install the fork pads and selector plates onto the 1-2 and 3-4 shift forks.
3. Assemble the sift cover parts as follows :
   - Push the shift shaft into the cover until the front of the shaft is at the inside of the cover.


YAD5B0R0

- Install the 1-2 shift fork and its selector plate.

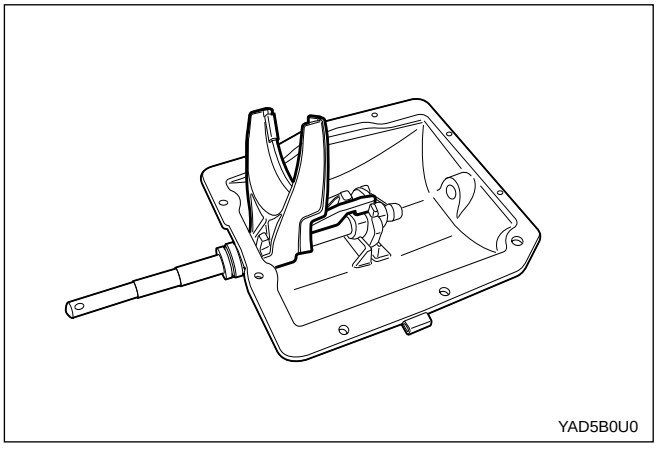

YAD5B0S0

- Push the shift shaft through the 1-2 shift fork.

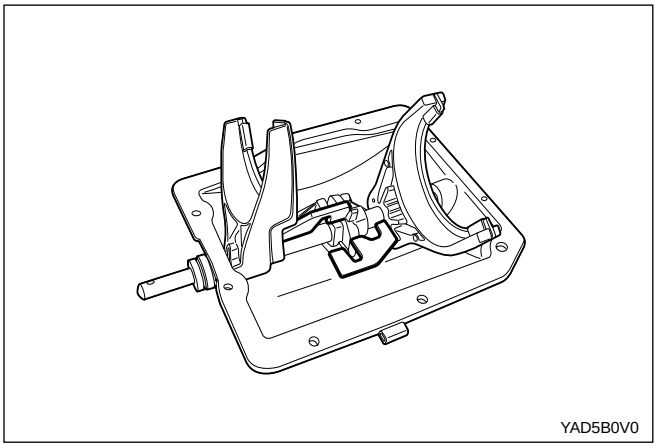

YAD5B0T0

- Place the selector arm and interlock plate in the cover.

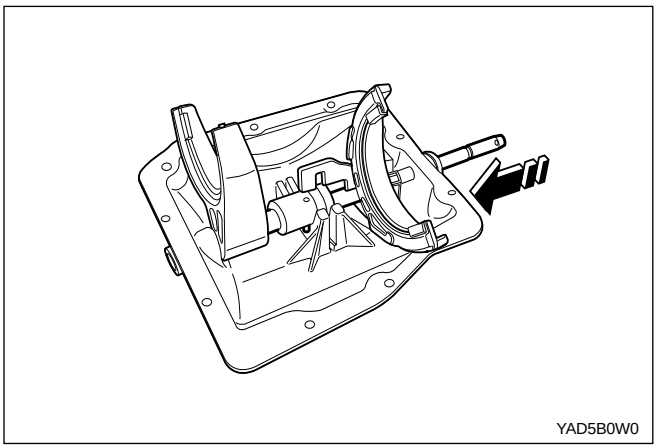
  Note the position of the interlock plate and selector arm.


YAD5B0U0

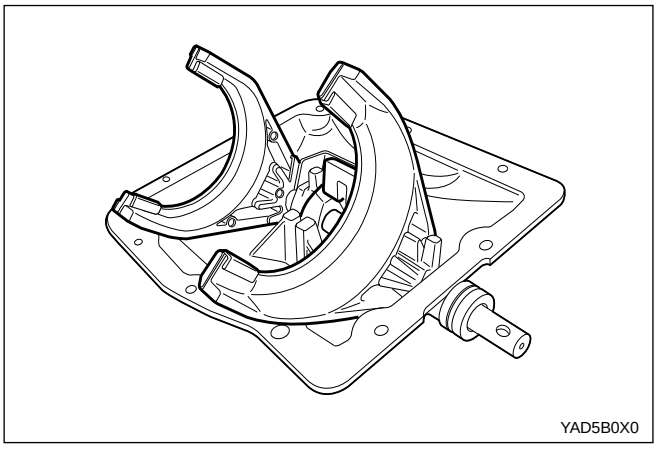
- Push the shift shaft through the 3-4 shift fork.


YAD5B0V0

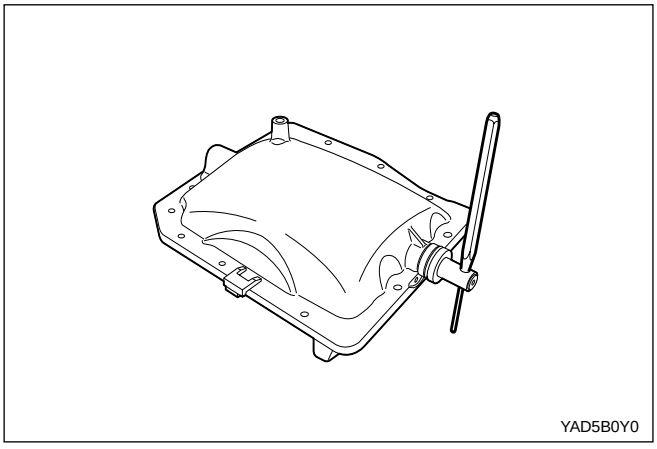
- Install the 3-4 shift fork and its selector plate.


YAD5B0W0

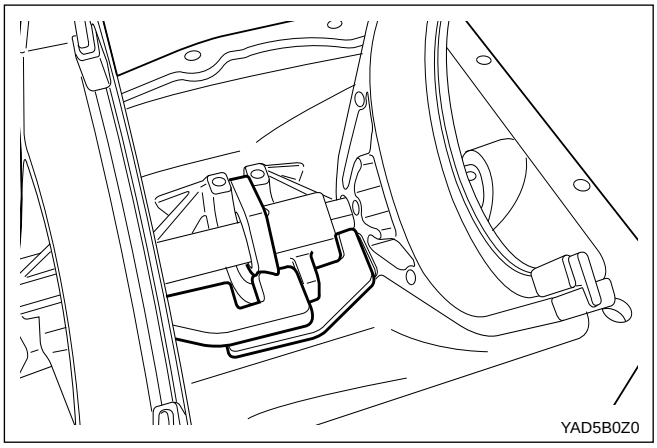
- Push the shift shaft through the 3-4 shift fork.


YAD5B0X0

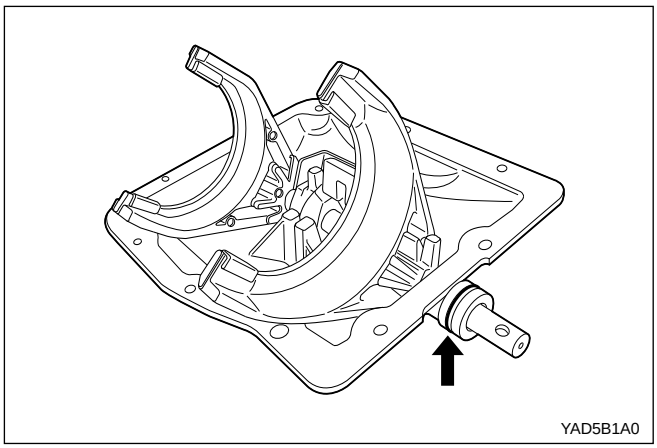
- Install the roll pin that fixes the selector arm to the shift shaft.


YAD5B0Y0

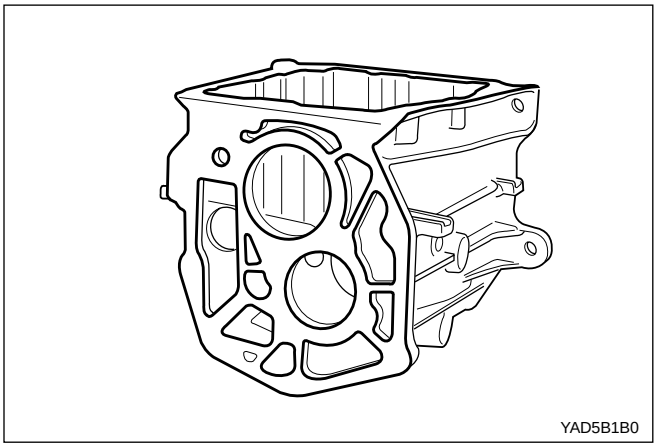
4. Check the shift cover parts for proper assembly as follows :
   - Insert a pin punch (3/16) into the offset lever hole of the shift shaft.
   - Place the shift cover to the flat ground and rotate the shift shaft so that the punch is vertical.



- Selector arm should be aligned with the 3/4 shift fork selector plate.



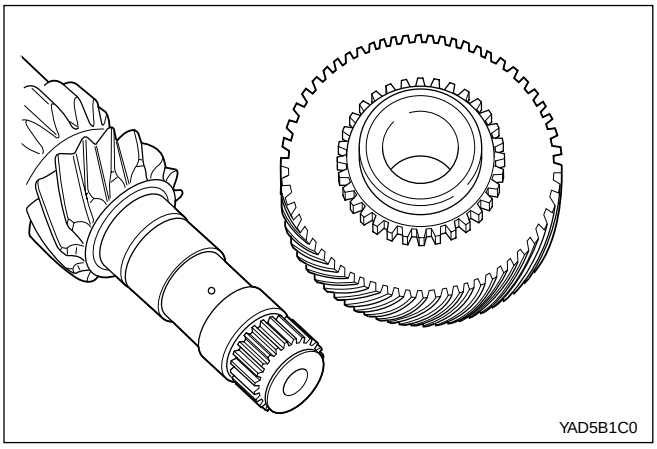
5. Lubricate and install the O-ring on the rear of the shift cover.


YAD5B1B0

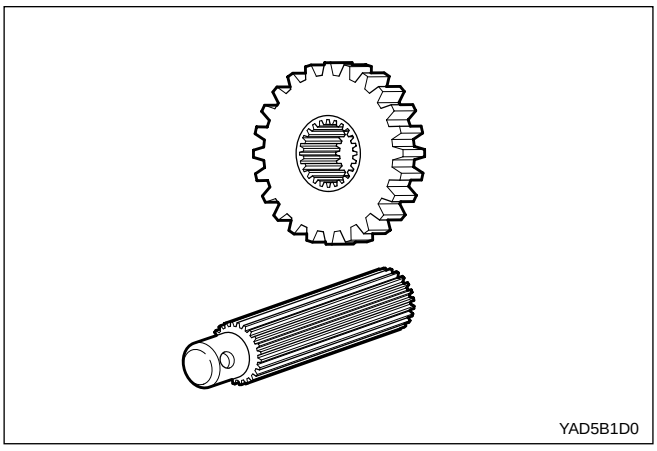
INSPECTION OF COMPONENTS

Inspection Procedure

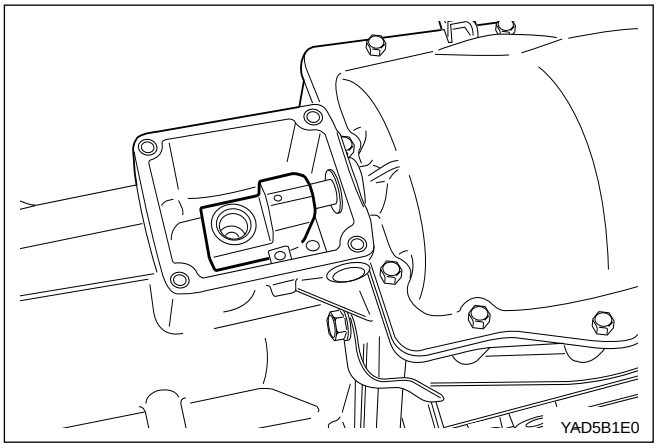
1. Clean all parts with solvent and dry them with compressed air. Check the following parts for cracks and damaged sealing surfaces.
   - Case
   - Extension housing
   - Shift Cover
   - Input bearing retainer
   - Counter shaft rear bearing retainer
2. Check the parts which support bearings and shafts for excessive wear and replace them if necessary.


YAD5B1C0

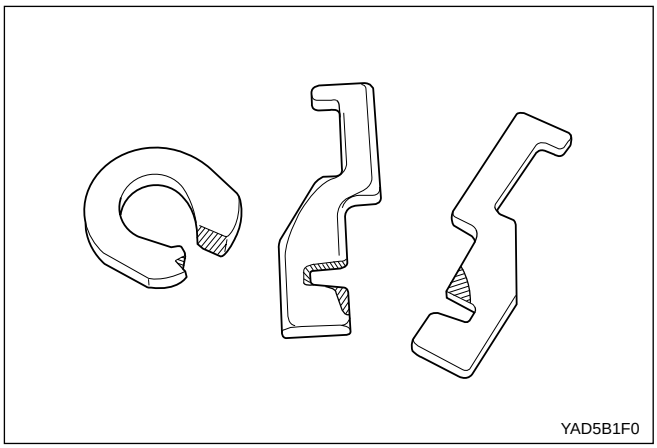
3. Check the bearing surfaces of the following parts ;
   - Input shaft
   - Main shaft and its gears
   - Counter shaft and 5th drive gear
4. Check the reverse idler shaft and its gears.


YAD5B1D0

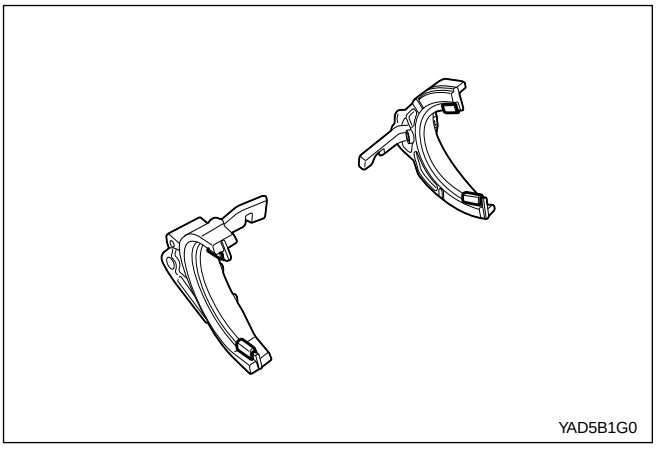
Notice: Replace excessive wear parts and do not file on the hardened surface and precision ground.



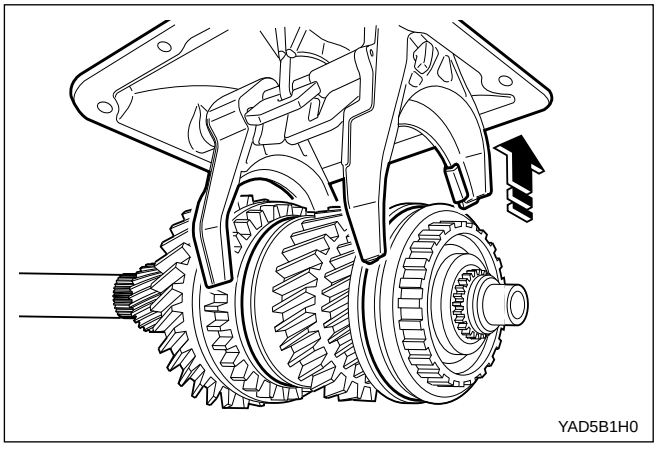
5. Check the shift mechanism parts as follows :
   - Wear of the shift shaft.
   - Wear of the detent/guide plate and offset lever.



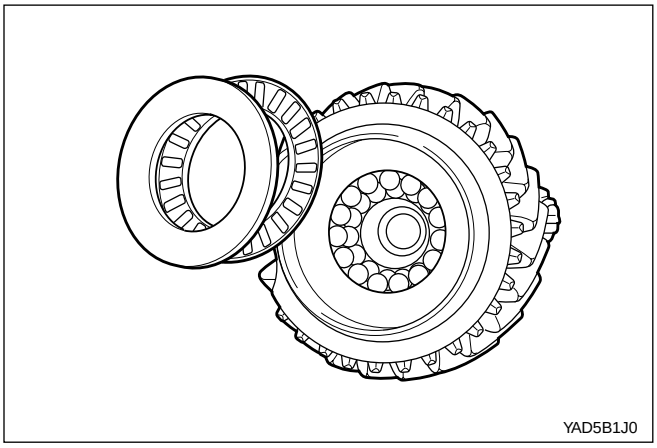
6. Check worn edges on the following parts :
   - Selector arm.
   - Interlock plate.
   - Selector plates for the 1-2 and 3-4 shift forks.



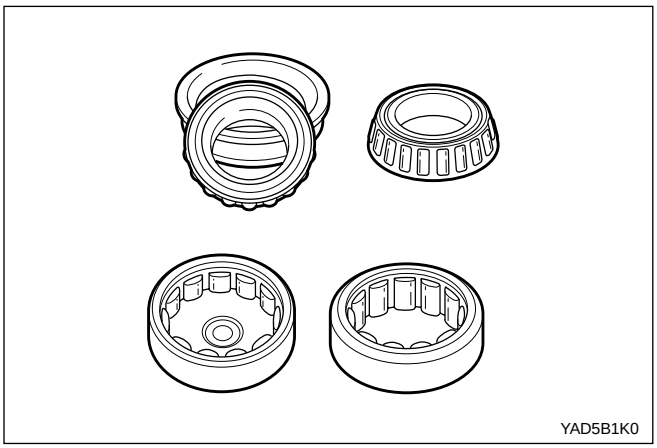
   - 5-R shift lever and the rollers on the reverse fork and the 5th shift rail/fork.



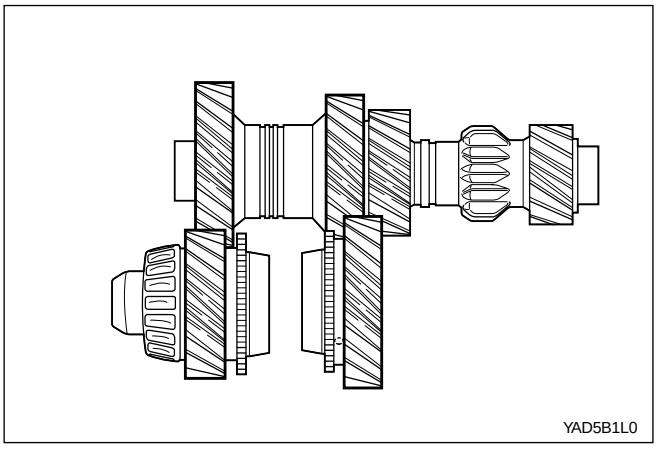
7. Check worn mating surfaces on the following parts :
   - 1-2 shift fork, pads and synchronizer sleeve.
   - 3-4 shift fork, pads and synchronizer sleeve.
   - 5th shift rail/fork pads and synchronizer sleeve.
   - Reverse fork and reverse idler gear sleeve.


YAD5B1J0

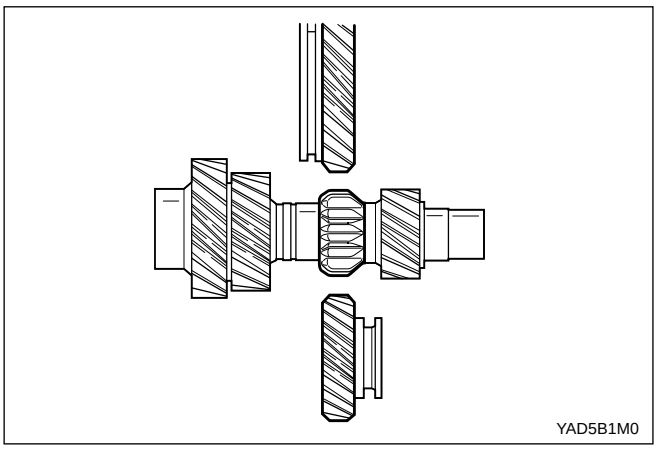
8. Check the following Bearing for excessive war:
   - Crankshaft pilot bushing for the front of the input shaft.
   - Clutch release bearing.
   - Input shaft bearing.
   - Main shaft pilot bearing rollers.
   - Main shaft thrust Bearing and its surfaces.


YAD5B1K0

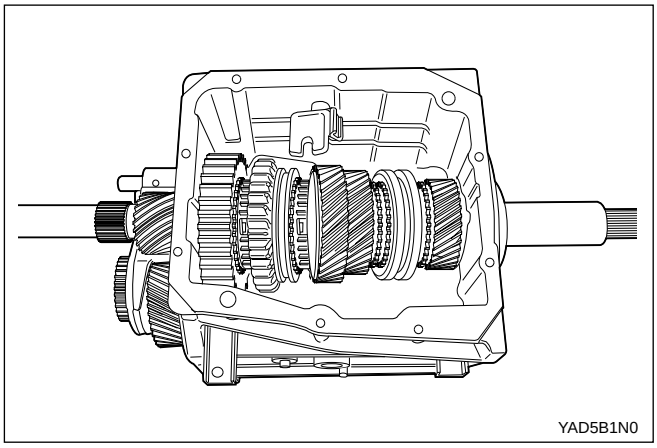
   - Speed gear roller bearing on the main shaft.
   - Main shaft rear bearing.
   - Counter shaft front and rear bearings.


YAD5B1L0

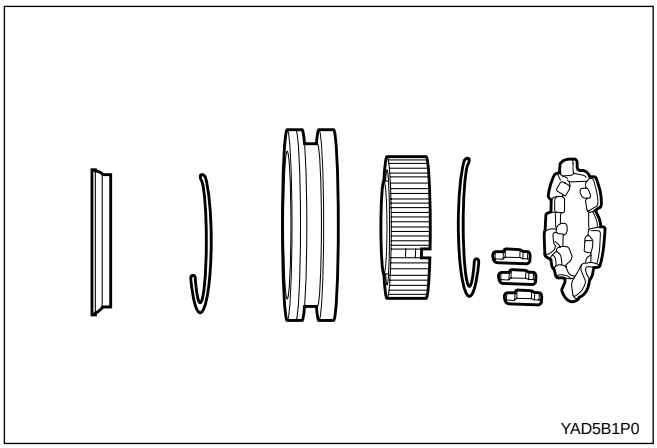
9. Check the gear tooth surfaces of all gear sets.


YAD5B1M0

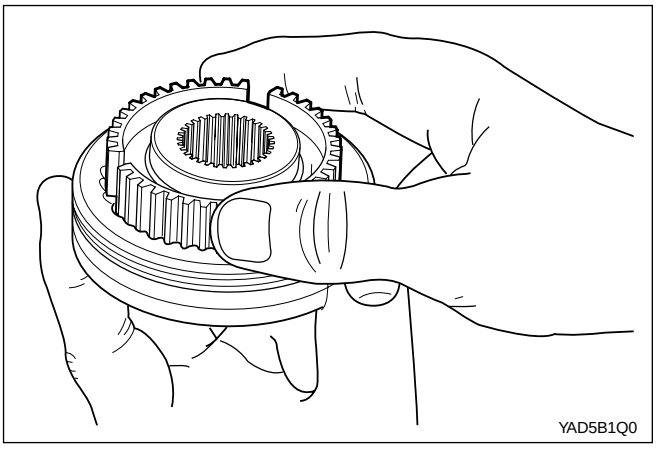
10. Check the reverse gear set surfaces. Check the surfaces of gear teeth for excessive wear, pitting, scoring and spalling and replace if necessary.


YAD5B1N0

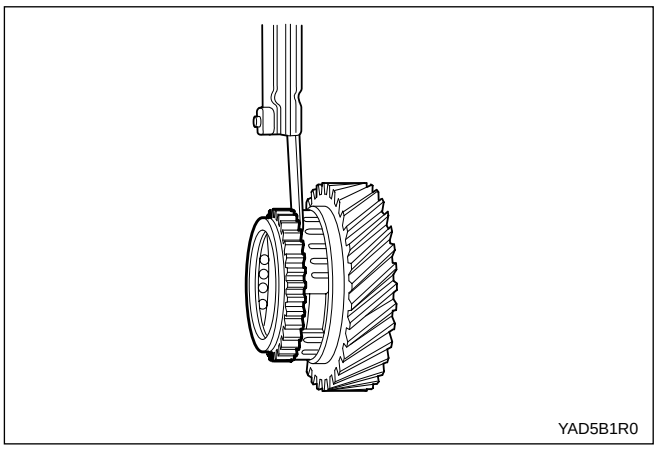
11. Take apart the three synchronizer assemblies and check :
    - The 1-2 synchronizer.


YAD5B1P0

- The 5th blocking ring.

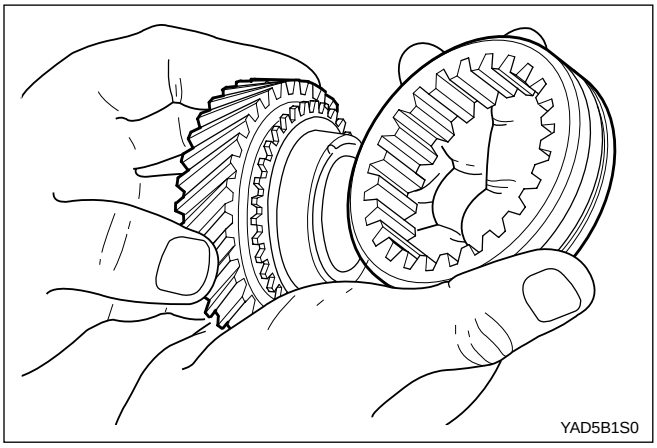

YAD5B1Q0

12. Check the fit between the hub and sleeve of each synchronizer
    - Excessively tight or loose hub-to-sleeve fit.
    - Wear of the cone clutch surfaces of brass blocking rings and gears.


YAD5B1R0

13. Measure the clearance between the blocking ring and the speed gear
    - New 1-2 blocking ring : 0.87 - 1.4mm
    - New 3-4 blocking ring : 0.88 - 1.5mm

    Notice: Excessive wear of the blocking ring or the speed gear cone surface will cause shift block-out gear clash.



14. Check for gear clash on the synchronizer sleeve teeth or the clutch teeth on the speed gear.
15. Check the synchronizer sleeve and gear clutch tooth for hop-out.

SECTION 5C

CLUTCH

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GENERAL DESCRIPTION AND OPERATION

GENERAL DESCRIPTION

Driving members

The driving members consist of two flat surfaces machined to a smooth finish. One of these is the rear face of the engine flywheel and the other is the pressure plate. The pressure plate is fitted into a steel cover, which is bolted to the flywheel.

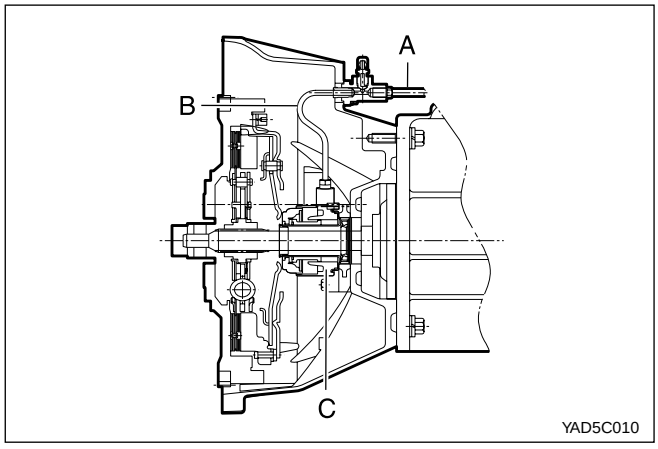
Driven members

The driven member is the clutch disc with a splined hub which is free to slide lengthwise along the splines of the input shaft, but which drives the input shaft through these same splines.

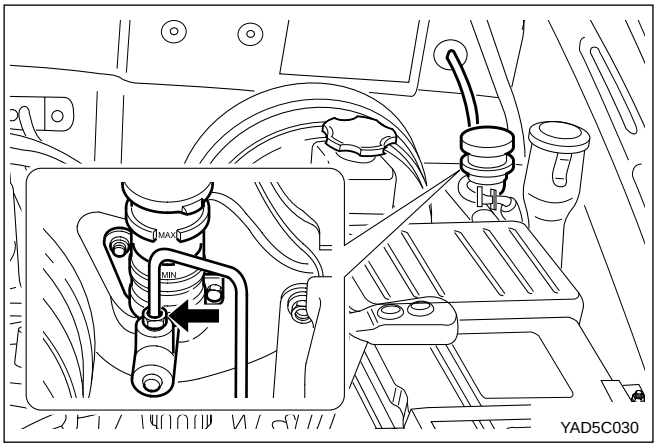
The driving and driven members are held in contact by spring pressure. This pressure is exerted by a diaphragm spring in the pressure plate assembly.

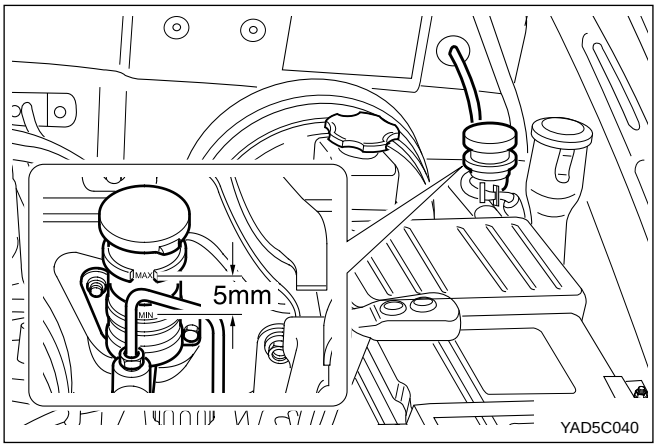
Operating members

The clutch release system consists of the clutch pedal, the clutch release shaft, the clutch cable, the release arm and the release bearing. When pressure is applied to the clutch pedal, the clutch release shaft pushes against the release bearing by rotating. The bearing then pushes against the diaphragm spring in the pressure plate assembly, thereby releasing the clutch.



A. Clutch Release Cylinder Pipe (W/ transmission case)
B. Clutch Release Cylinder Pipe (W/ transmission case)
C. Concentric Slave Cylinder





BLEEDING OF CLUTCH SYSTEM

Notice: Keep the fluid level over MAX in reservoir during bleeding operation.

Do not let fluid contact a painted surface.

1. Remove the air bolt cap of the release cylinder. Connect a vinyl tube to the bolt.
2. Insert the other end of the tube in a vacant container.
3. Slowly depress the clutch pedal several times.
4. With clutch pedal fully depressed, open the air bolt and release air rind fluid in the fluid line,
5. Repeat this procedure until there are no more air bubbles in the fluid flows.

SPECIFICATIONS

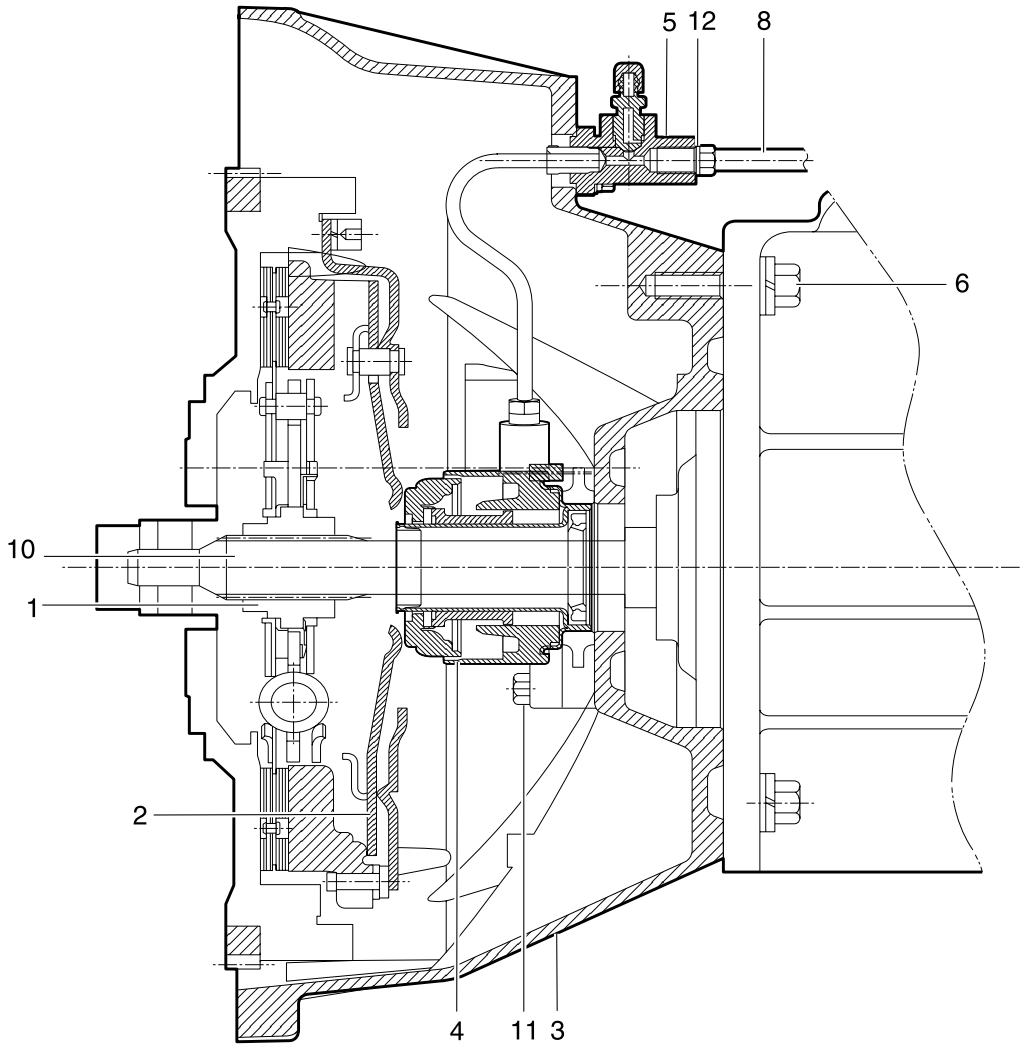
Type		Hydraulic	
Clutch Pedal	Type	Suspended	
	Max. Pedal Stroke	DSL	148 mm
		GSL	150 mm
	Pedal Free Play	5 - 10 mm	
Clutch Disc	Type	Single Dry Diaphragm	
	Facing O.D. × I.D. × Thickness	240 × 155 mm	
	Facing and Quantity	22 cm^2 × 1	
	Thickness of Disc	Free	9.85 - 10.2 mm
		With Load	9.2 mm
Clutch Cover Assembly Setting Weight		610 kg	
Clutch Master Cylinder	Stroke	28.4 mm	
	Inner Diameter	Ø15.87 mm	
Clutch Fluid		DOT3 or DOT4	

DIAGNOSTIC INFORMATION AND PROCEDURES

Check		Possible Cause	Action
Clutch slips		Excessive Wear of Facing	Replace
		Hard or Oily Facing	Repair or Replace
		Damaged Pressure Plate or Flywheel	Replace
		Damaged or Burnt Diaphragm Spring	Replace
		Clutch Pedal Free play Insufficient	Adjust
		Faulty Operation of Clutch Pedal	Repair or Replace
		Worn or Damaged Clutch Disc	Replace
Poor disengagement		Vibration or Excessive Run-out of Disc	Replace
		Rust or Wear of Disc Spline	Repair or Replace
		Oily Facing	Repair or Replace
		Damaged Diaphragm Spring	Replace
		Excessive Clutch Pedal Free play	Adjust
Hard to shift or will not shift		Excessive Clutch Pedal Free play	Adjust Pedal Freeplay
		Faulty Clutch Release Cylinder	Repair Release Cylinder
		Worn Disc, Excessive Run-out, Damaged Lining	Repair or Replace
		Dirty or Burred Splines on Input Shaft or Clutch Disc	Repair as Necessary
		Damaged Clutch Pressure Plate	Replace
Clutch chatters when starting		Oily Facing	Repair or Replace
		Hard or Faulty Facing	Replace
		Burnt Torsion Spring	Replace
		Faulty Pressure Plate	Replace
		Bent Clutch Diaphragm Spring	Replace
		Hard or Bent Flywheel	Repair or Replace
		Engine Mounts Loose or Burnt Lever	Tighten or Replace
Difficult pedal operation		Poor Lubrication on Clutch Cable	Lubricate or Replace
		Poor Lubrication on Pedal Shaft	Lubricate or Replace
		Poor Lubrication on Clutch Pedal	Repair
Clutch Noisy	Not Using the Clutch	Insufficient Clutch Pedal Free play	Adjust
		Excessive Wear of Facing	Replace
	After Disengagement	Worn or Damaged Release Bearing	Replace
		Poor Lubrication Contact Surface of Bearing	Replace
	When Disengaging	Faulty Installation of Clutch Assembly or Bearing	Repair
	Clutch Pedal is Partially Depressed and Vehicle Speed is Reduced	Damaged Pilot Bushing	Replace

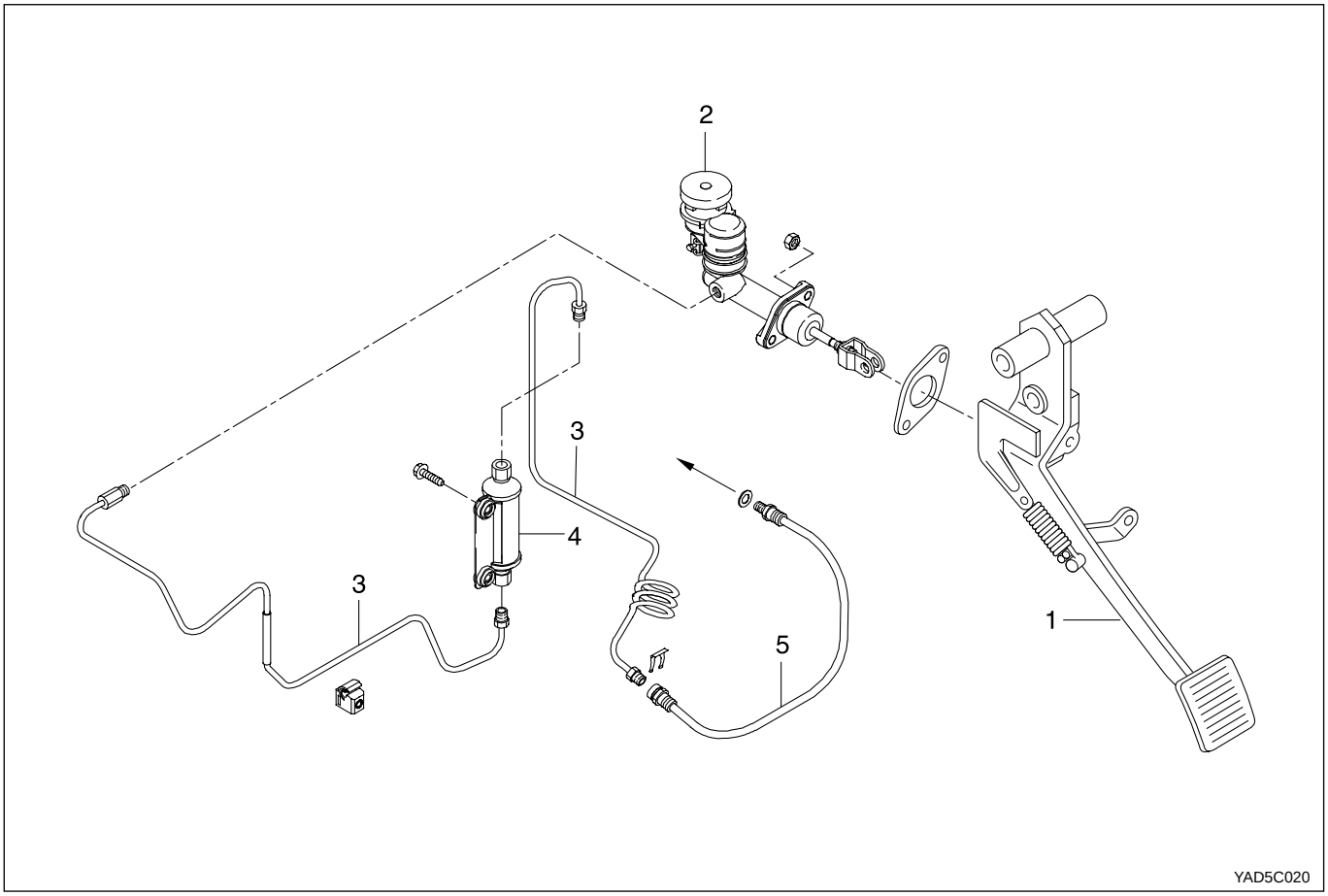
COMPONENT LOCATOR

CROSS SECTIONAL VIEW



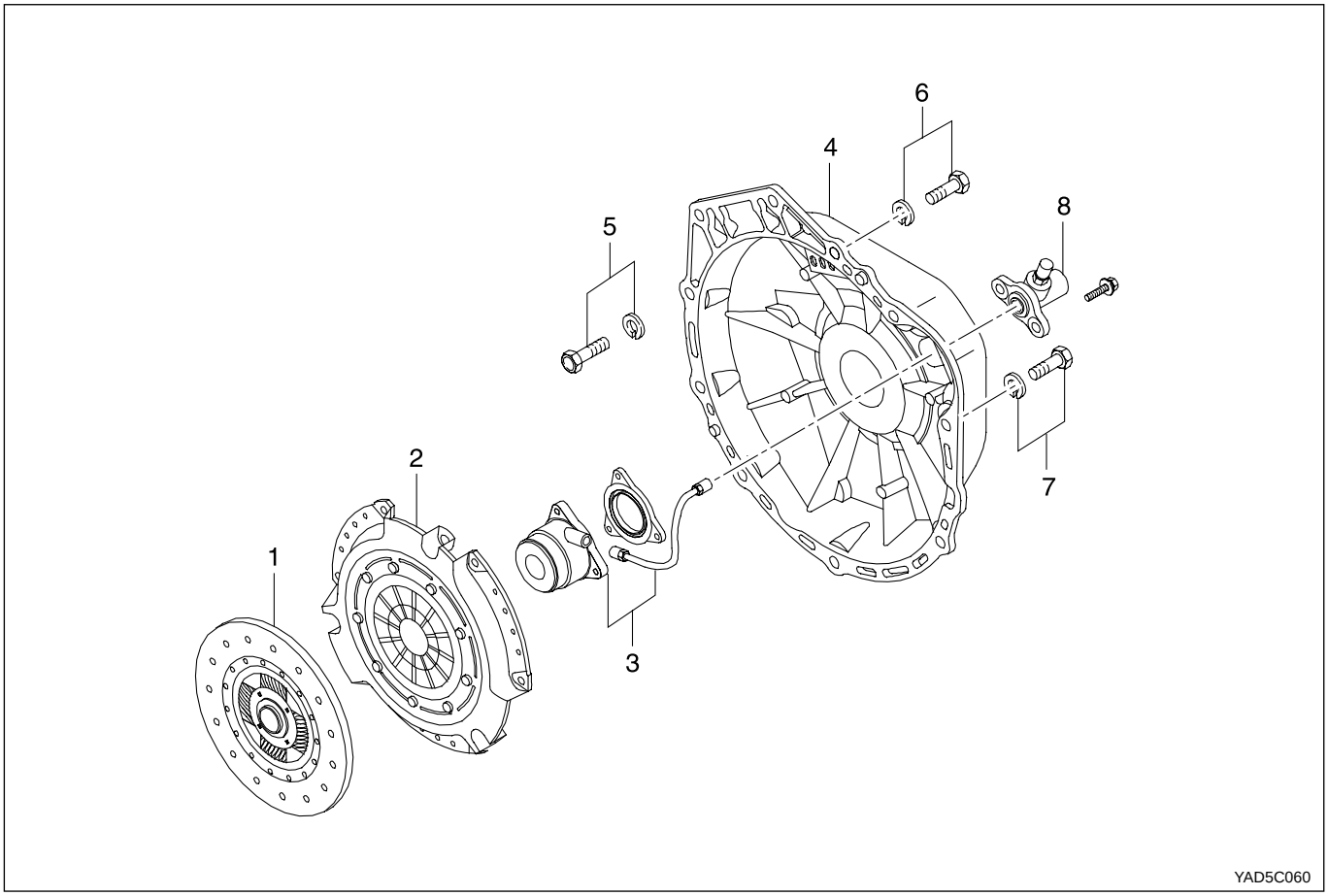
1 Clutch Disc
2 Clutch Cover
3 Clutch Housing
4 Concentric Slave Cylinder
5 Adapter
6 Bolt
7 Bolt
8 Hose
9 Spring Lock Washer
10 Transmission Input Spline
11 Bolt
12 Gasket

CLUTCH HYDRAULIC LINES



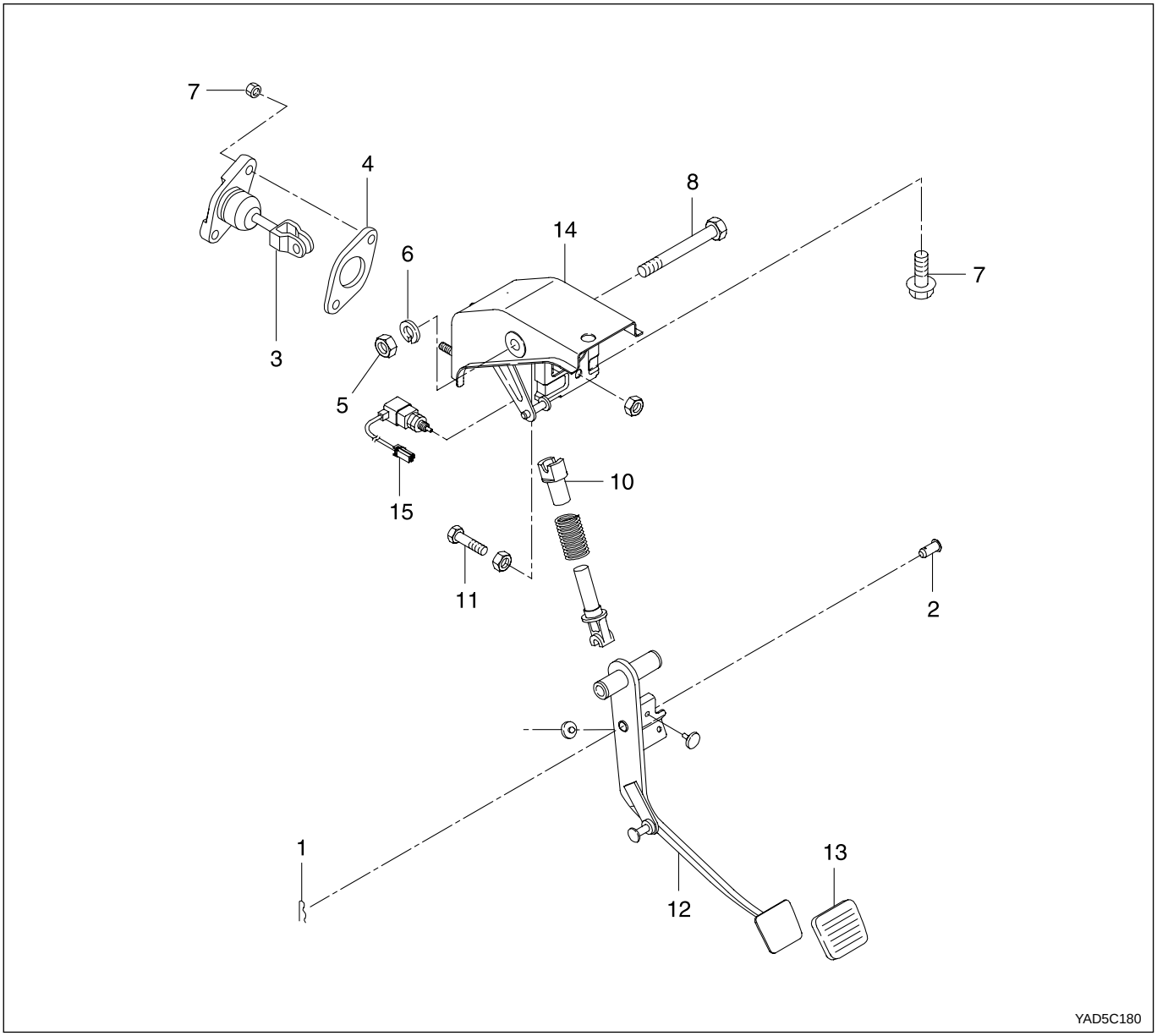
1 Clutch Pedal
2 Clutch Master Cylinder
3 Clutch Hydraulic Line
4 Clutch Oil Chamber
5 Clutch Hydraulic Hose

CLUTCH DISC ASSEMBLY



1 Clutch Disc
2 Clutch Cover
3 Concentric Slave Cylinder
4 Clutch Housing
5 Bolt and Washer ..... 35 N•m (26 lb-ft)
6 Bolt and Washer ..... 47 N•m (35 lb-ft)
7 Bolt and Washer ..... 47 N•m (35 lb-ft)
8 Adapter

CLUTCH PEDAL ASSEMBLY

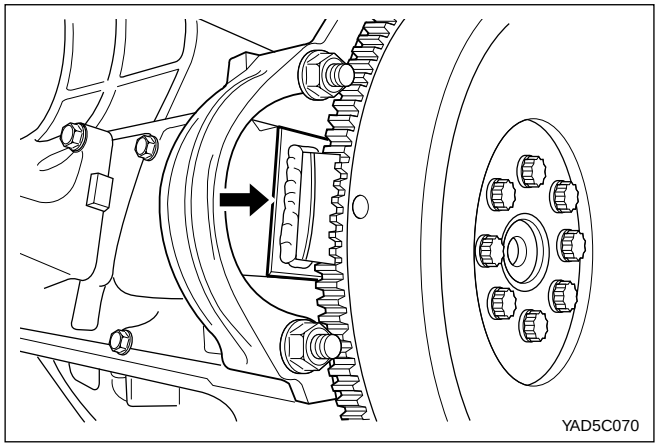


1 Snap Pin ..... Replace
2 Clevis Pin ..... Apply Grease
3 Master Cylinder Push Rod
4 Gasket
5 Nut ..... 16-22 N•m (12-16 lb-ft)
6 Spring washer
7 Nut ..... 8-18 N•m
8 Fulcrum Pin
9 Turn Over Spring ..... Apply Grease
10 Bushing ..... Replace, Apply Grease
11 Full Stroke Stopper Contact Pad
12 Interlock Switch Stopper Pad
13 Clutch Pedal
14 Pedal Pad
15 Pedal Mounting Bracket
16 Stopper Bolt ..... 16-22 N•m (12-16 lb-ft)

Notice: Assembly should follow the disassembly procedure in the reverse order.

- Grease specification : Long - term grease (T/Mn DBL6611.00)

MAINTENANCE AND REPAIR

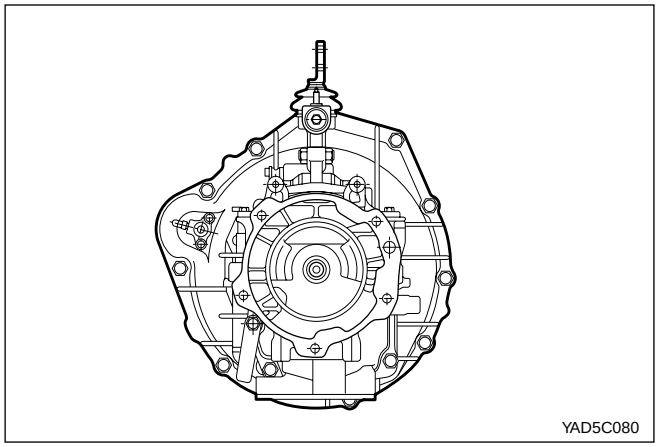

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ON-VEHICLE SERVICE

CLUTCH DISC

Removal & Installation Procedure

1. Remove the starter motor. Install the special tool to the flywheel through the starter motor mounting holes.

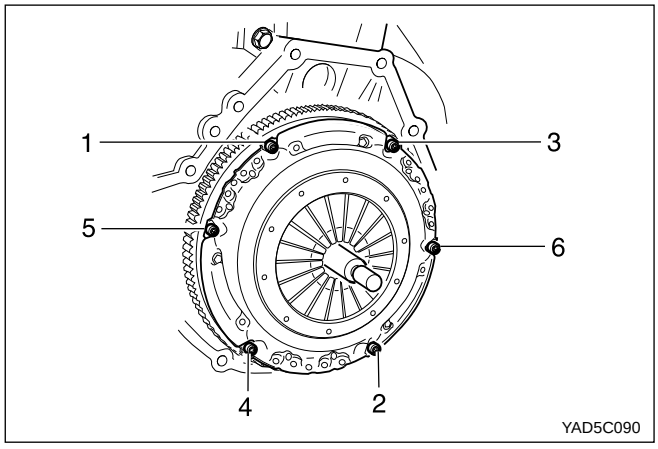

YAD5C080

2. Unscrew the release cylinder mounting bolts and remove the release cylinder.

   Installation Notice

Tightening Torque	30 - 40 N•m (22 - 30 lb-ft)

Notice: When the clutch housing and the transmission is removed, it may be possible any damage in the concentric slave cylinder.



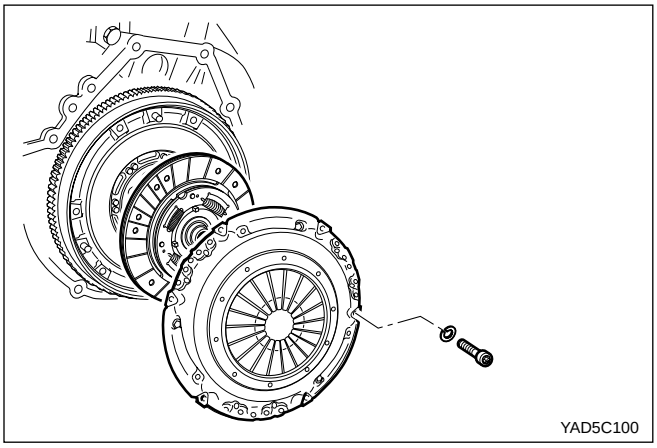
YAD5C090

3. Unscrew the clutch housing bolts and remove the clutch housing, release fork and release bearing.

   Insert the centering pin into the clutch spline.

   Loosen the clutch cover bolts 1/2 turn in crisscross sequence until the spring tension is released.

   Notice: Do not remove the bolts at a time, or clutch cover can be damaged or deformed.

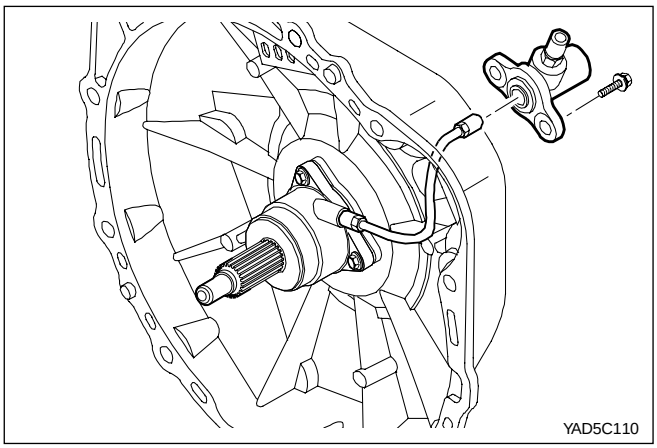

YAD5C100

4. Unscrew the bolts and remove the clutch cover, pressure plate and clutch disc.

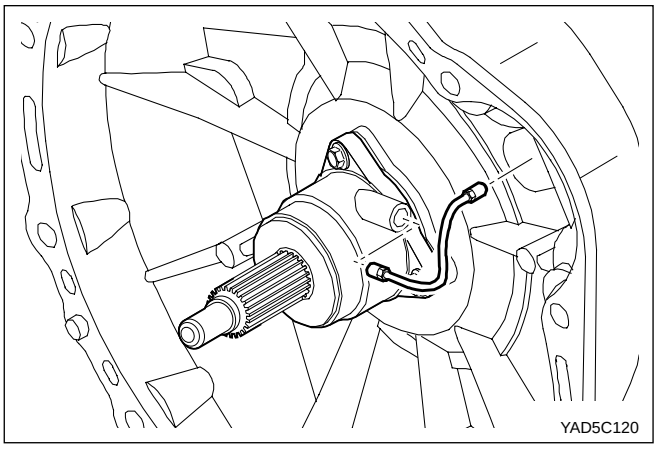
   Notice: Be careful not to drop the pressure plate and clutch disc.

   Installation Notice

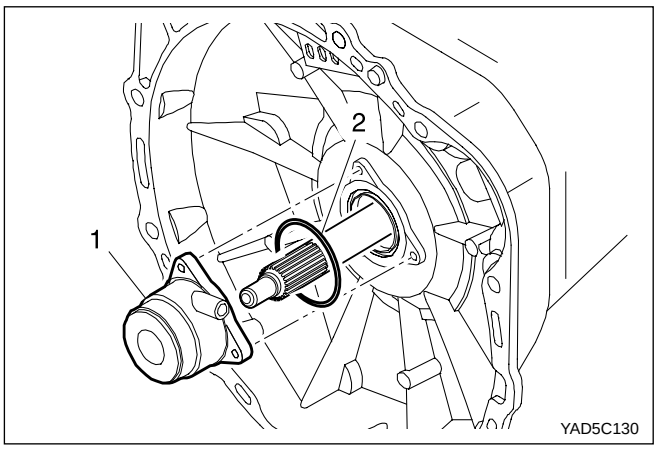
Tightening Torque	21 - 27 N•m (15 - 20 lb-ft)


YAD5C110

5. Remove the oil pipe and the adapter from the clutch housing.

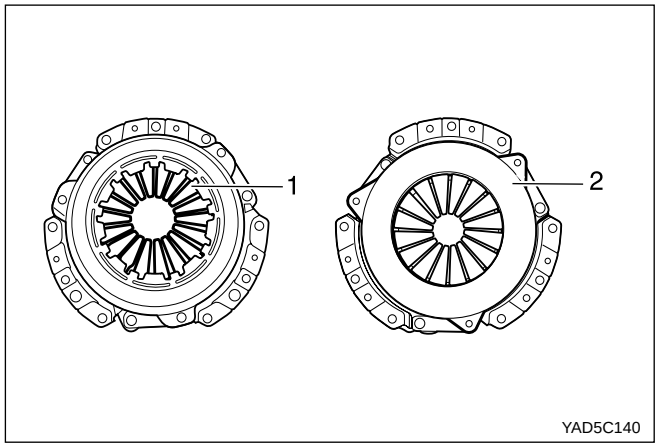

YAD5C120

6. Remove the oil pipe nut at the clutch housing inside.



YAD5C130

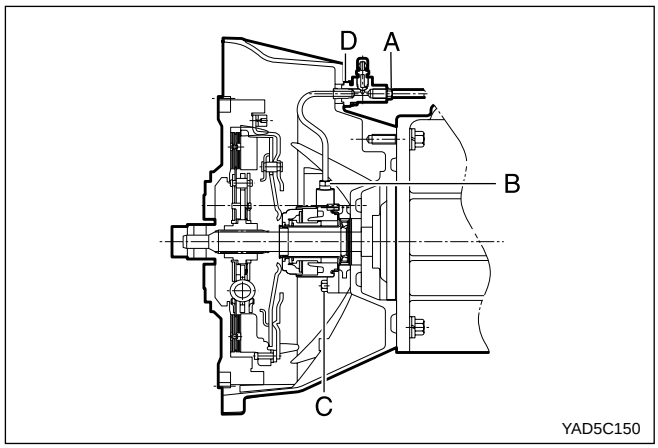
7. Remove the concentric slave cylinder mounting bolt and remove the concentric slave cylinder from the input shaft.
8. Remove the spacer from the input shaft.



9. Installation should follow the removal procedure in the reverse order.

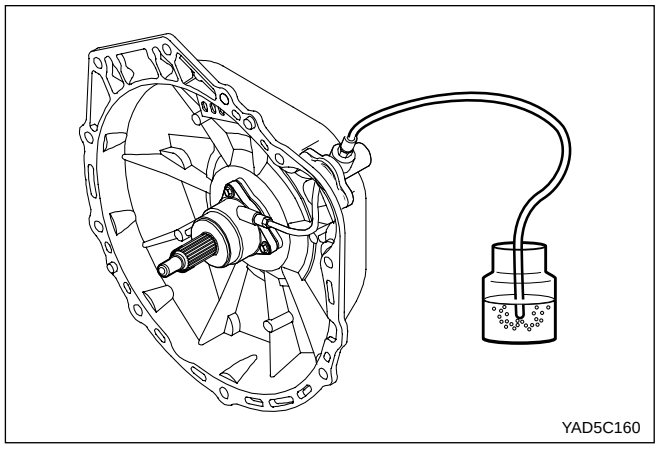
   Notice:

   - Before installation, clean oil and grease on the flywheel surface.
   - Do not clean the clutch disc and release bearing in solvent.



10. Tighten the pipe nut and the cylinder mounting bolt as the specified torque.

Hose Nut	A: 1.5 ~ 1.8 kgf.m
Pipe Nut	B: 1.5 ~ 1.8 kgf.m
Cylinder mounting bolt	C: 1.5 ~ 1.8 kgf.m
Adapter Nut	D: 1.5 ~ 1.8 kgf.m



MASTER CYLINDER

Removal & Installation Procedure

1. Draw out the fluid.
2. Pull out the snap pin and clevis pin from the clutch pedal connection.
3. Remove the clutch tube.

   Installation Notice

Tightening Torque	15 - 18 N•m (11 - 13 lb-ft)

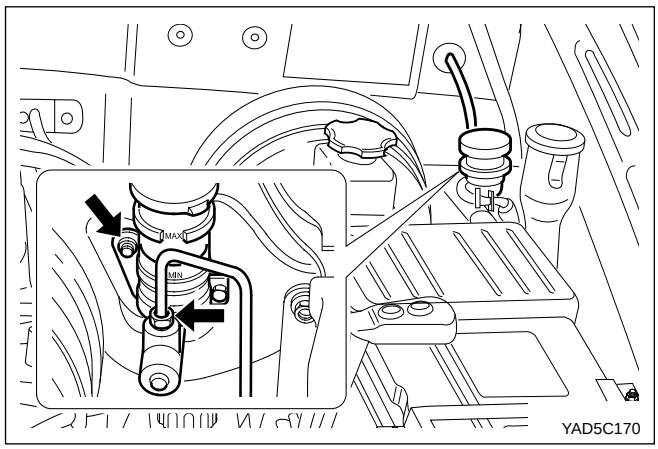
   Notice: Be careful not the fluid contact a painted surface.

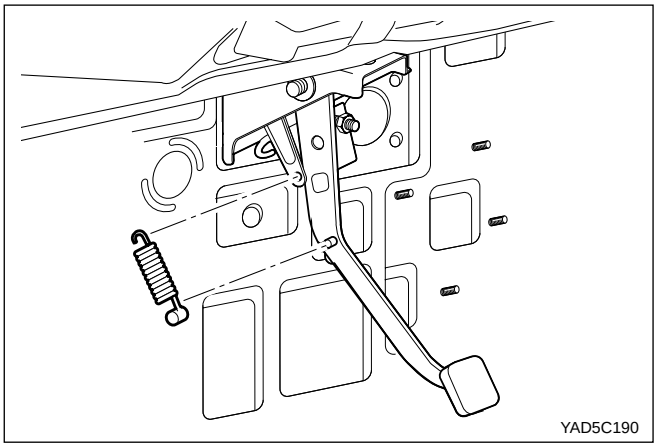
4. Remove the master cylinder mounting nuts and pull off the master cylinder.

   Installation Notice

Tightening Torque	15 - 18 N•m (11 - 13 lb-ft)

5. Check the clutch pedal operation.
6. Bleed the clutch system.
7. Installation should follow the removal procedure in the reverse order.

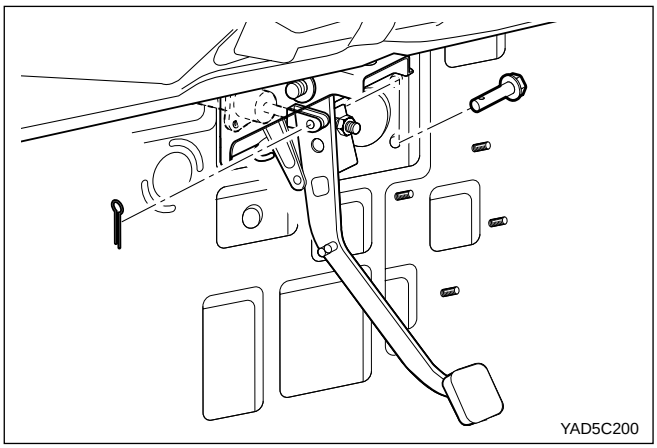




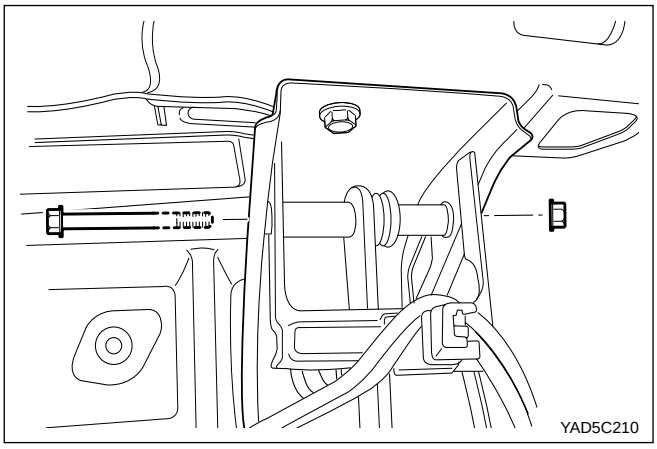
CLUTCH PEDAL

Removal & Installation Procedure

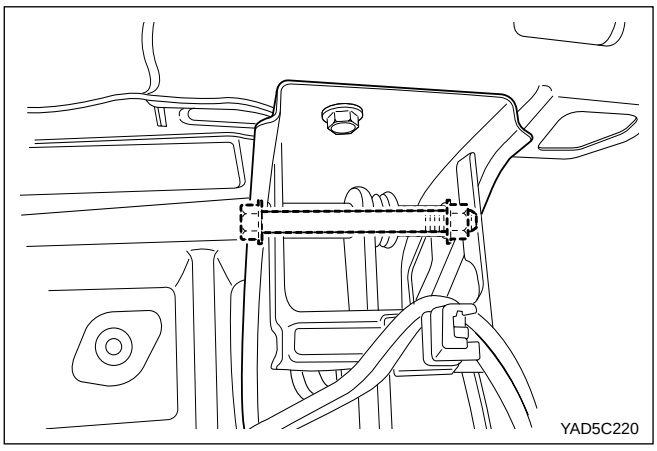
1. Remove the turn over spring from the clutch pedal.



2. Remove the snap pin and the clevis pin from the clutch master cylinder push rod and separate the push rod and the clutch pedal.



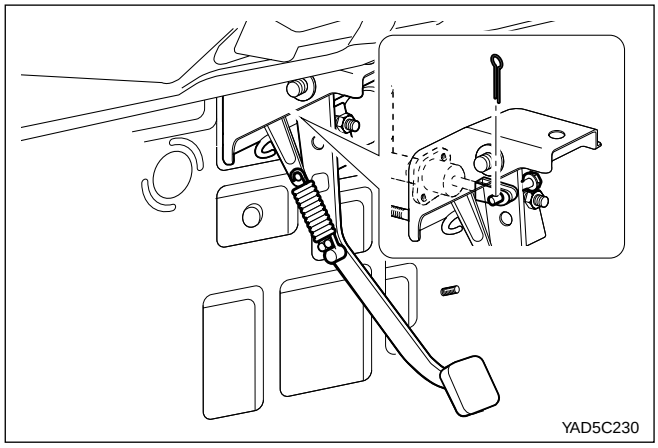
3. Remove the pedal mounting and nut from the clutch pedal bracket and remove the pedal from the bracket.



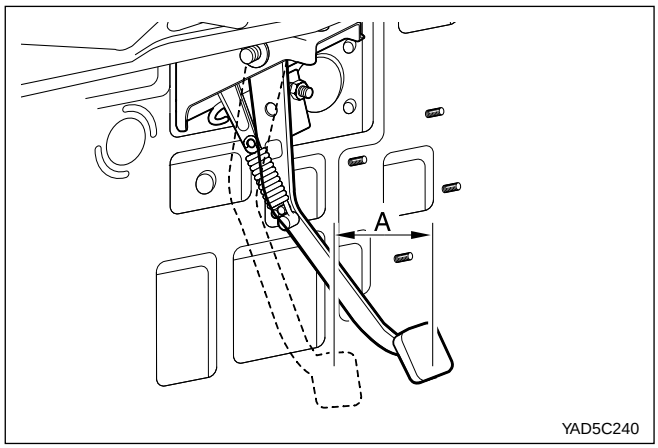
4. Installation should follow the removal procedure in the reverse order.

   Perform the following procedure for installation.

   - Apply the grease to the clutch pedal clevis pin and pedal bushing.

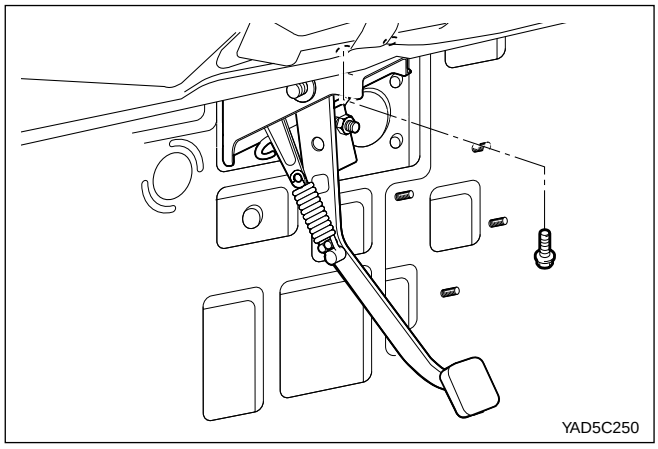

YAD5C230

- Apply the grease to the connecting portion between the clevis pin and the turnover spring.



YAD5C240

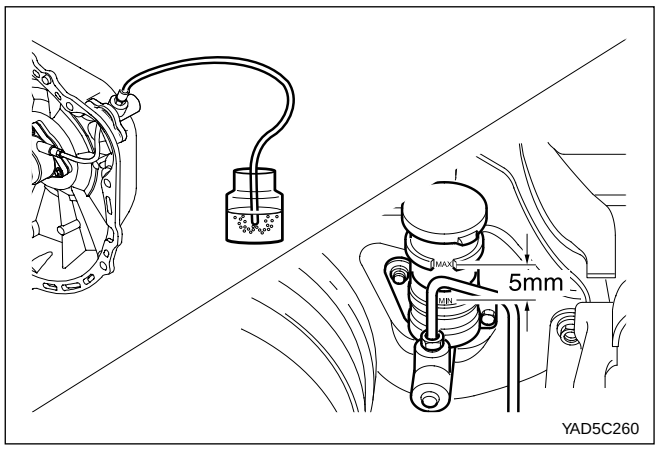
- Check the clutch pedal height after connecting the pedal and the push rod. Align the height according to the “A” free play of the push rod.


YAD5C250

CLUTCH PEDAL BOX

Removal & Installation Procedure

1. Remove the clutch master cylinder.
2. Remove the upper bolt from the clutch pedal box and remove the clutch pedal assembly.

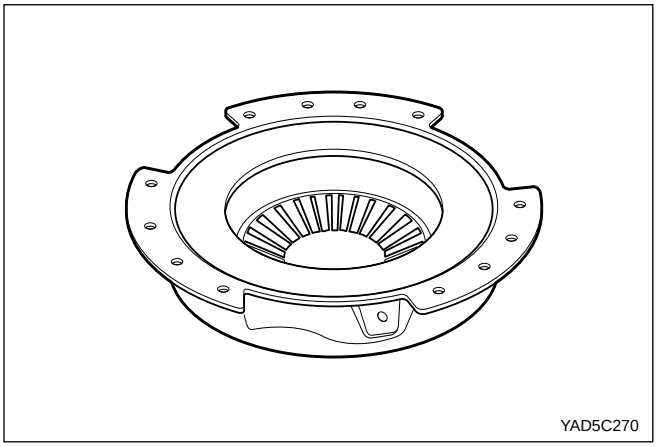


YAD5C260

3. Installation should follow the removal procedure in the reverse order.

   Notice: Charge the clutch oil as specified and then bleed the system.

INSPECTION PROCEDURE

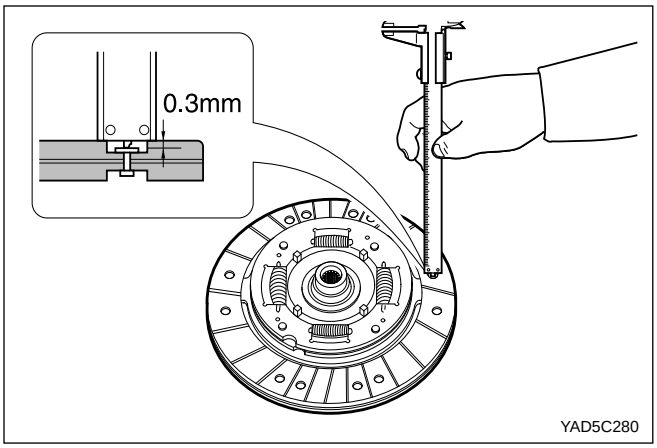

YAD5C270

CLUTCH DISC

1. Clutch Cover
   - Check the diaphragm spring tip for wear and height unevenness.

Unevenness Limit	0.8 mm

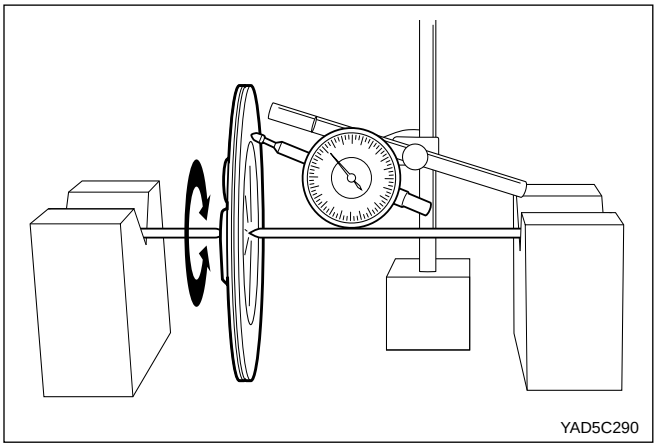
   - Check the pressure plate surface for wear, crack and discoloration.
   - Check the strap plate rivet for looseness and replace the clutch cover if loosened.



YAD5C280

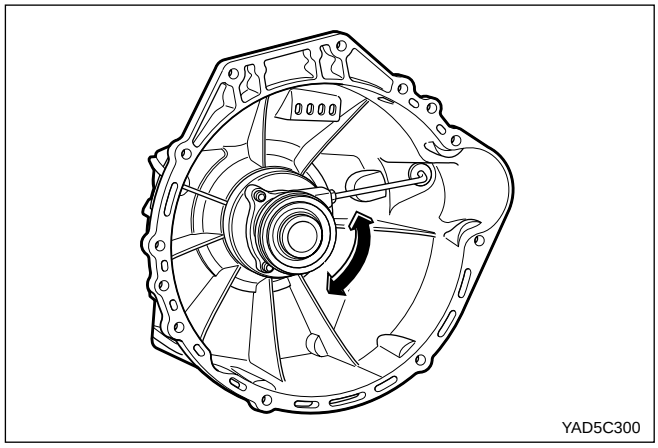
2. Clutch Disc
   - Check the facing for rivet looseness, excessive runout, sticks, oil and grease.
   - Measure the rivet head depth. If out limit, replace the disc.

Wear Limit	0.3 mm

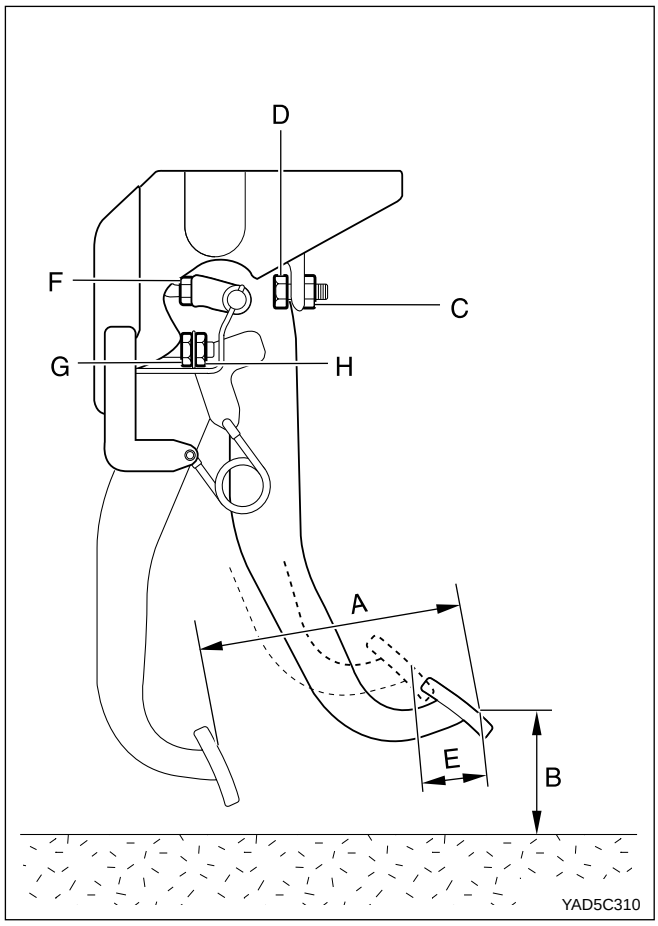

YAD5C290

3. Clutch Disc Plane Rate
   - Measure the clutch disc plane rate and replace the disc as needed.

Limit Value	0.7 mm


YAD5C300

4. Concentric Slave Cylinder
   - Check any heat damage, abnormal noise, poor rotation and wear of the concentric slave cylinder bearing.



YAD5C310

CLUTCH PEDAL

1. Pedal Stroke (A).

Max. Stroke	GSL	158 mm
	DSL	148 mm

Notice: To adjust the pedal stroke, loosen the lock nut (H) of the interlock switch (G) and turn the two lock auto until the stroke is correct.

2. Pedal Height (B).

Height (From the Floor Carpet)	182 ± 5 mm

Notice: To adjust the pedal height, loosen the lock nut (C) of the stopper bolt(D) and turn the stopper bolt until the height is correct.

3. Pedal Free Play (E).

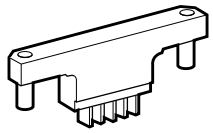
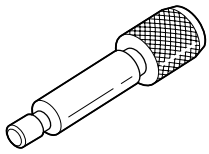
Free Play	5 - 10 N•m

Notice: To adjust the pedal free play, loosen the lock nut (F) of the master cylinder and turn the push rod until the free play is correct.

4. Check the fulcrum pin and the bushing for wear, the pedal for bending and the spring for damage.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD5C320	**602 589 00 40 00** **Engine Lock**
 YAD5C330	**661 589 00 15 00** **Centering Pin**

SECTION 5D1

PART TIME - T/C

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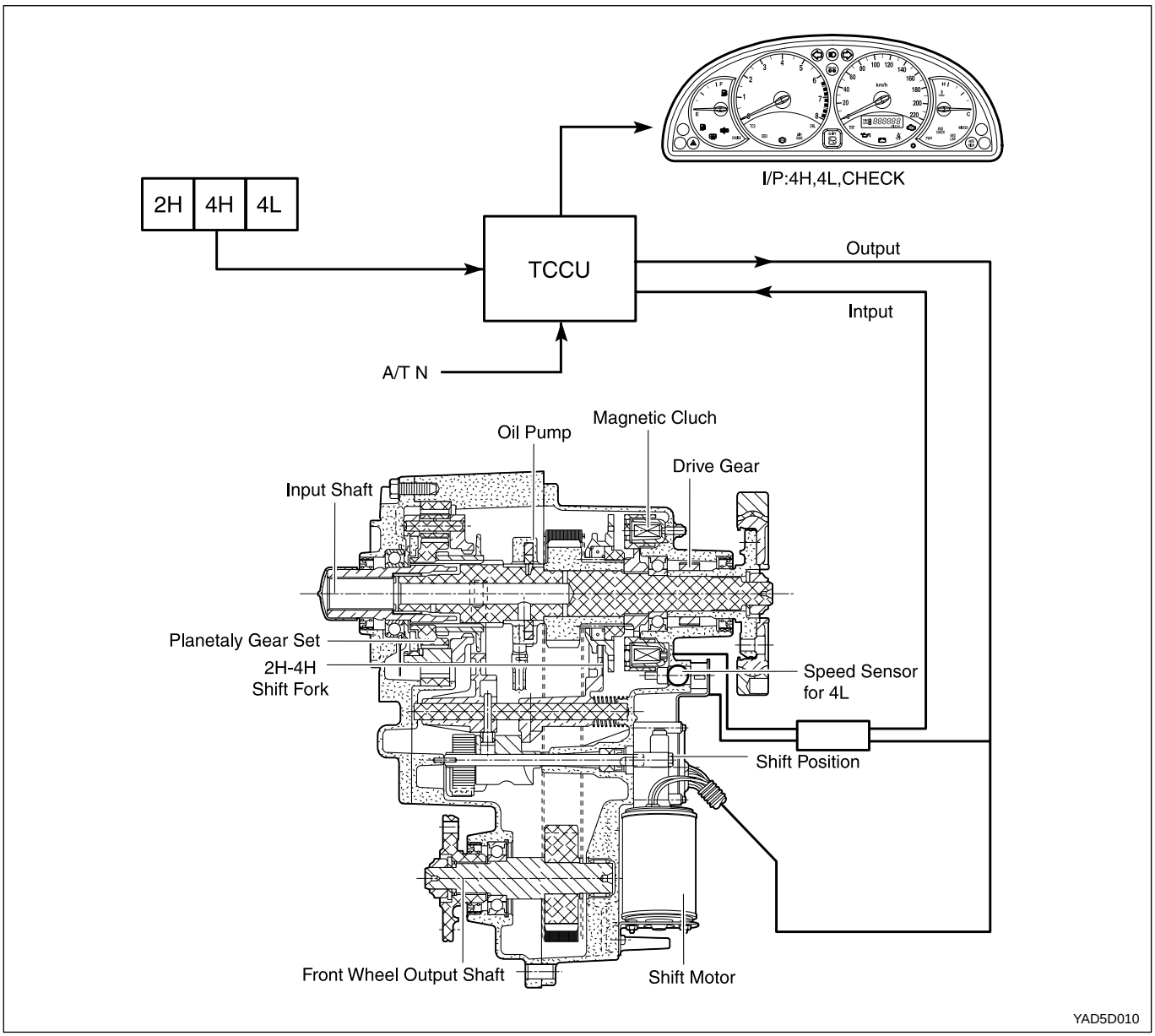
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GENERAL INFORMATION AND OPERATION

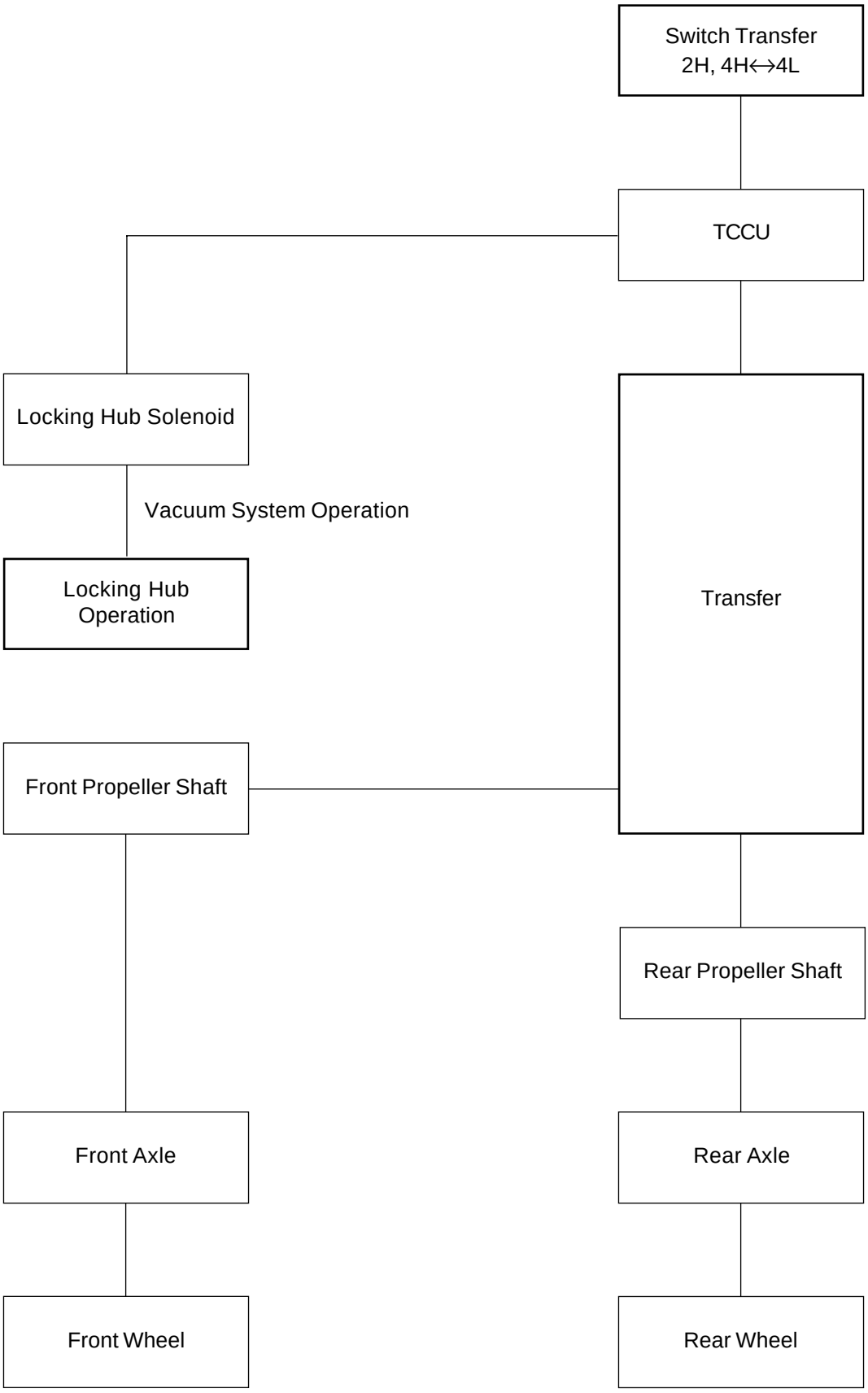
4WD OPERATION OVERVIEW

Application	Mode Position		Operation Condition
Driving Type	2H	2WD Drive(Rear Wheel Drive)	• Normal Driving on the normal road or highway, or high speed driving
	4H	4WD Drive(High Speed)	• Slipped road such as snow, rainy, sand, mud etc.
	4L	4WD Drive(Low Speed)	• Max driving force requiring condition such as towing, rough road. • When a vehicle is driven in turning at low speed on the paved road, a vibration and a noise may be occurred by tight corner braking.
Transferring	2H ↔ 4H	2WD Drive ↔ 4WD Drive(High Speed)	• 2WD ↔ 4WD transfer is possible below 70 km without operating the clutch.
	2H, 4H ↔ 4L	2WD Drive, 4WD Drive(High Speed) ↔ 4WD Drive(Low Speed)	• Manual Transmission Transfer starts after the vehicle stops and the clutch is applied • Automatic Transmission Transfer starts after the vehicle stops and the shift lever is shifted [N] position. **Notice:** After the vehicle stops and the mode switch is selected with applying the brake pedal, shifting [N-R-N] makes the mode transfer easier.

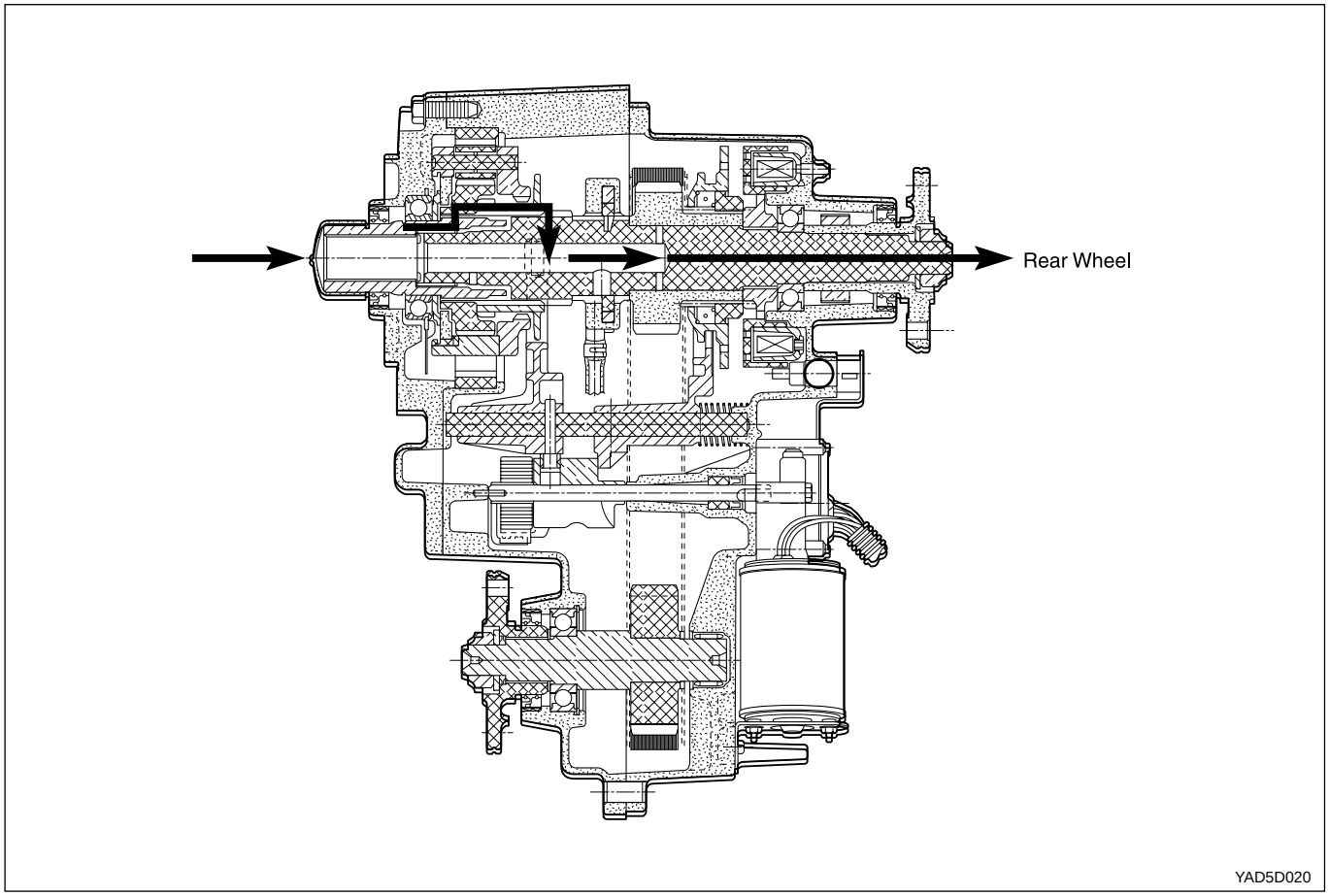
SYSTEM STRUCTURE



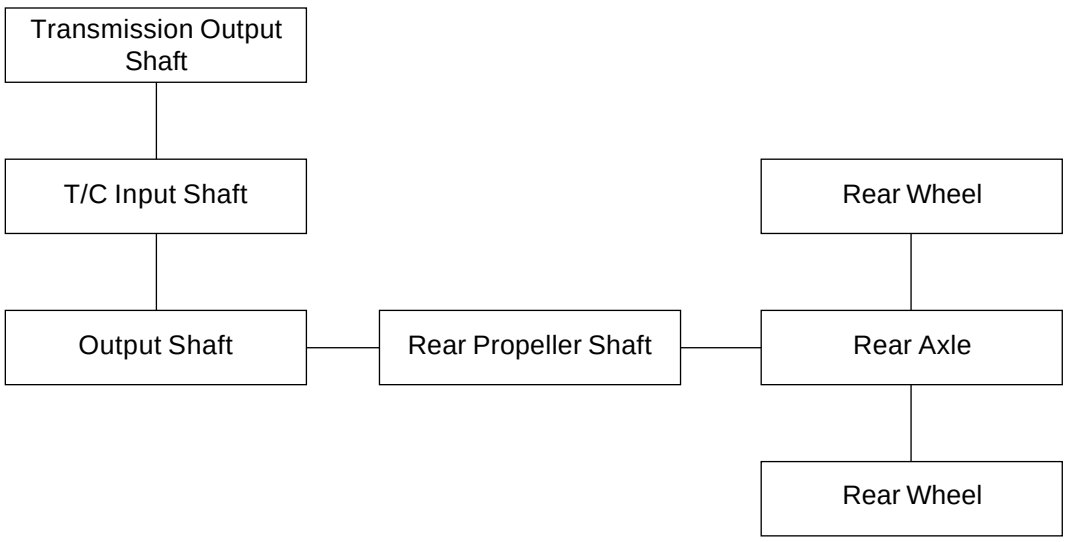
Power Flow


Switch Transfer
2H, 4H↔4L
TCCU
Locking Hub Solenoid
Vacuum System Operation
Locking Hub
Operation
Transfer
Front Propeller Shaft
Rear Propeller Shaft
Front Axle
Rear Axle
Front Wheel
Rear Wheel

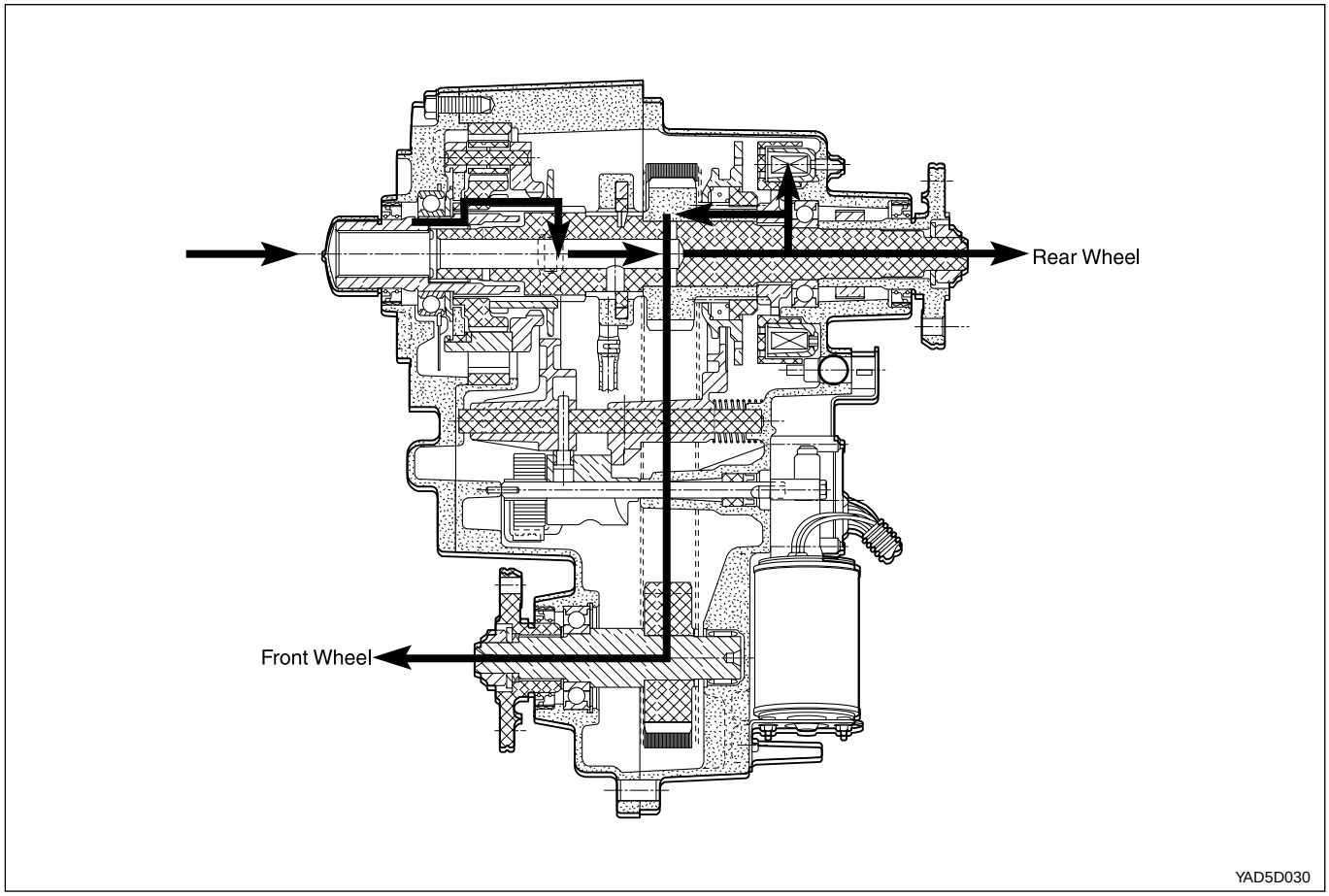
2H MODE(REAR WHEEL DRIVE)



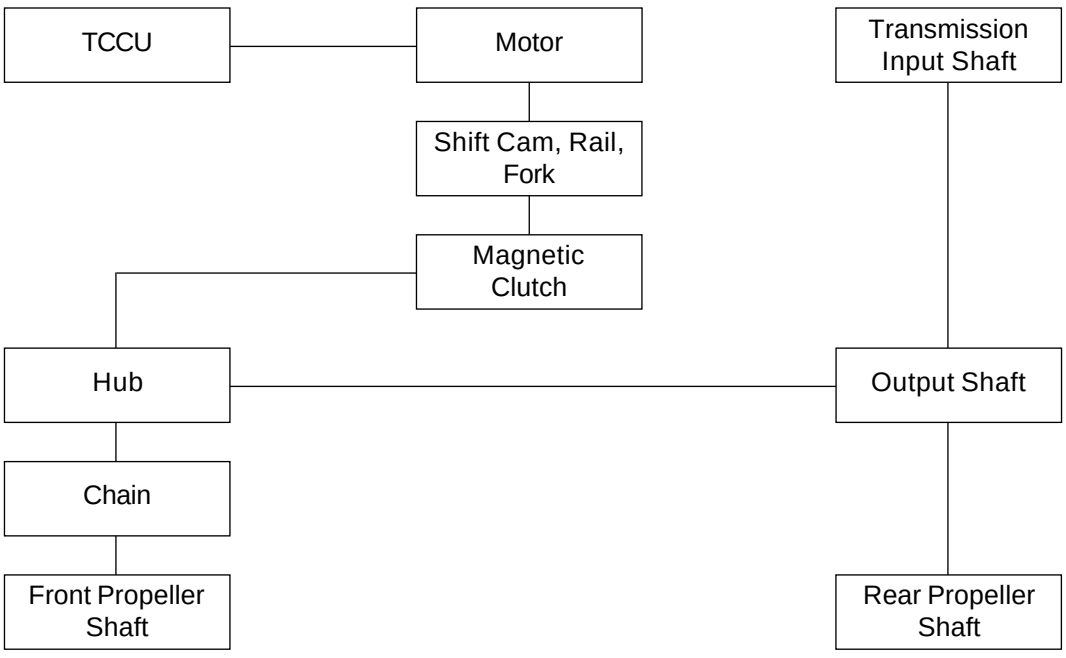
Power Flow



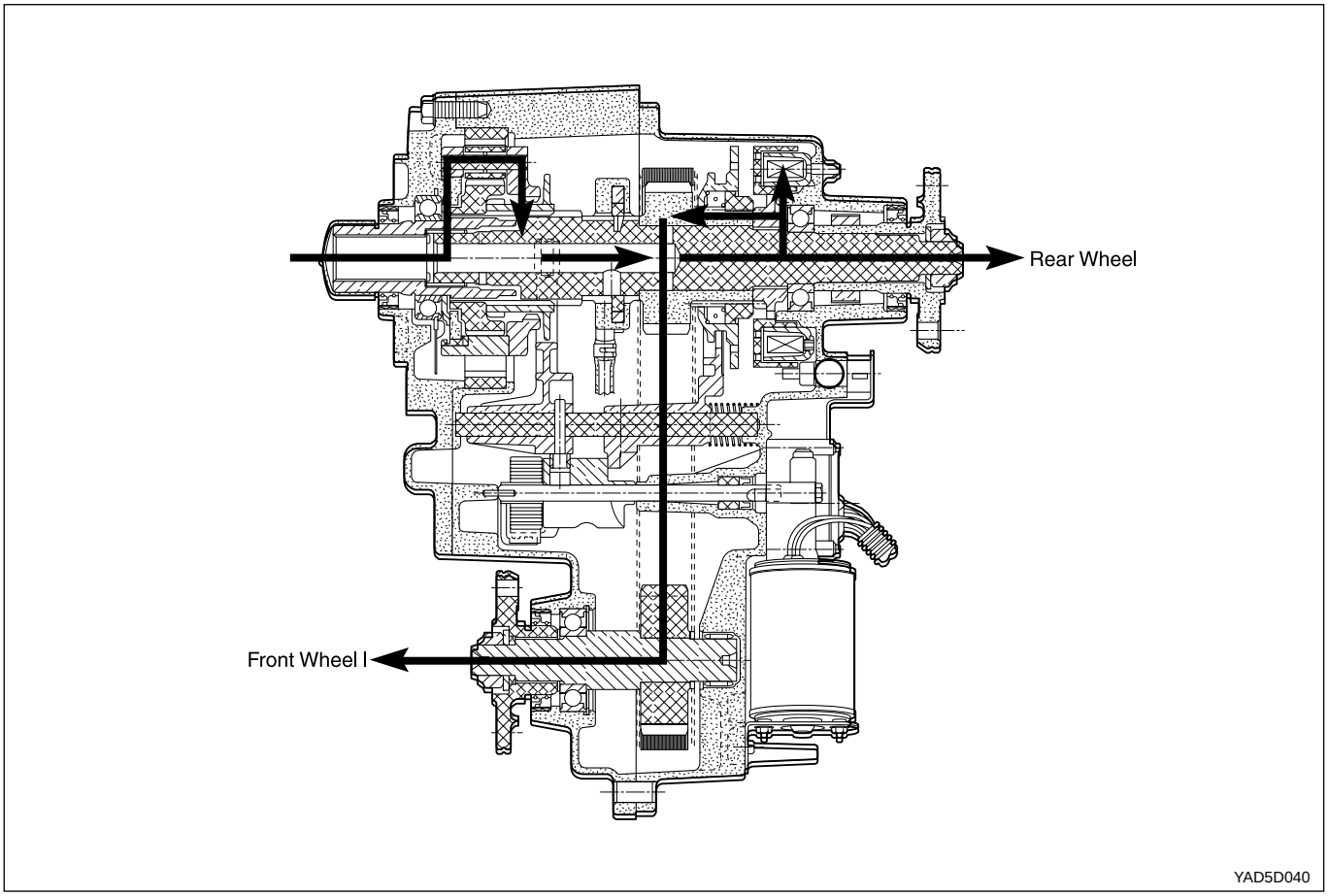
4H MODE(4WD DRIVE - HIGH SPEED)



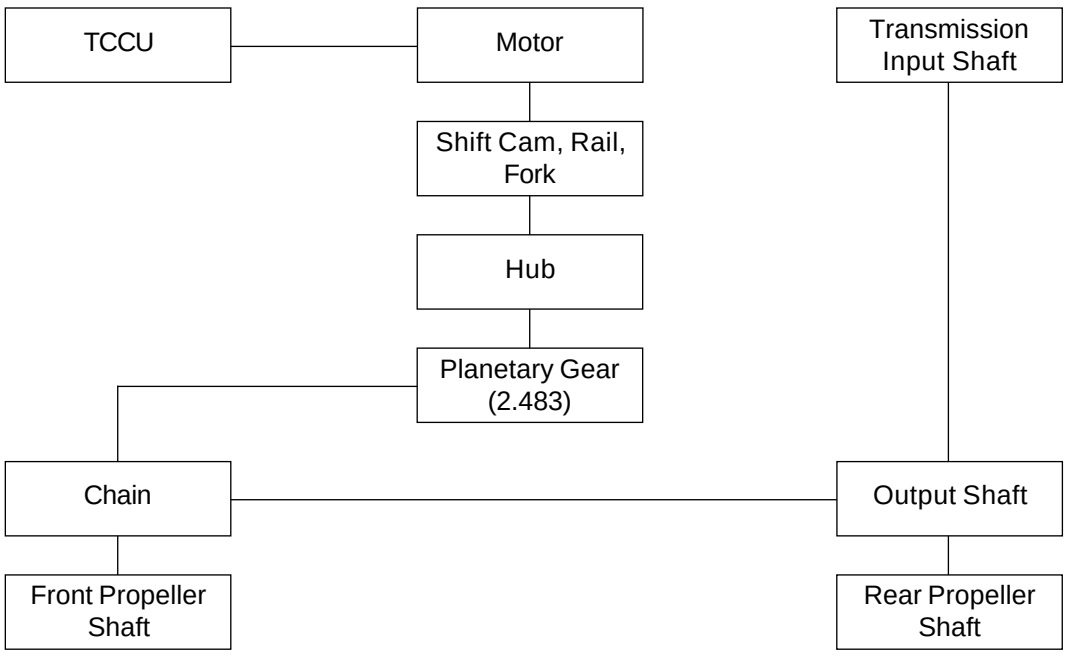
Power Flow

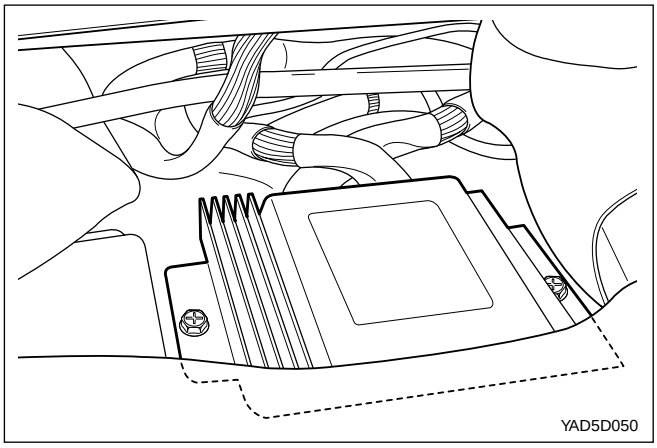


4L MODE(4WD DRIVE - LOW SPEED)



Power Flow

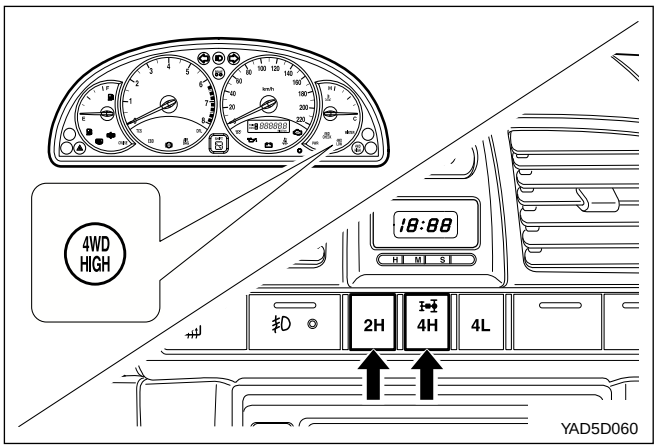



YAD5D050

SYSTEM DESCRIPTION

Transfer Case Control Unit (TCCU)

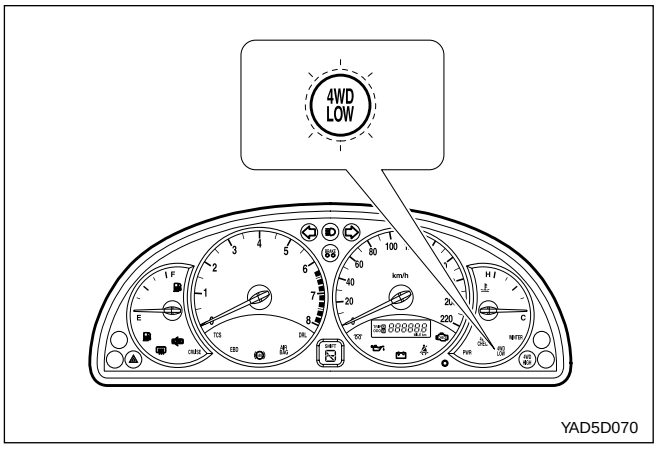
TCCU is located under the front left handed seat and permits the vehicle to shift from two-wheel drive to four-wheel drive (and back shift) according to drivers switch operation during driving (For the shifting between 4WD HIGH and 4WD LOW, stop the vehicle).



YAD5D060

1. Shifting from 2H to 4H
   - Position the transfer case switch from '2H' to '4H'.
   - Shifting is possible during driving.
   - '4WD HI' indicator light will turn on.

2. Shifting from 4H to 2H
   - Position the transfer case switch from '4H' to '2H'.
   - Shifting is possible during driving.
   - 4WD HI' indicator light will turn off.



YAD5D070

3. Shifting between 4H and 4L
   - Shifting is possible when the vehicle is almost stopped (below approx. 2 km/h), so it would be better stop the vehicle.
   - In case of manual transmission equipped vehicle, apply clutch pedal.
   - In case of auto transmission equipped vehicle, put the lever position into 'N'.
   - Position the transfer case switch '4H' to '4L' or '4L' to '4H'.
   - According to the shifted position, indicator light will turn on.

   Notice: If there are malfunctions during shifting, '4H' or '4L' indicator light will blink.

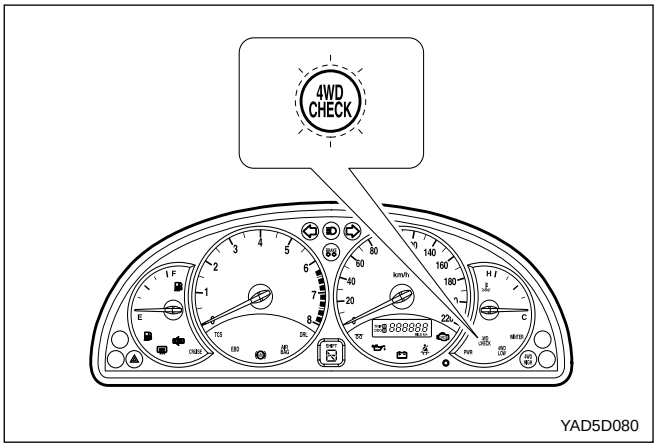
SPECIFICATIONS

Model		Part-Time 4408 (E)
Type		E.S.O.F. Type
Gear Ratio	High	1 : 1
	Low	2.48 : 1
Oil	Specification	ATF S-3, S-4 or DEXRON II, III
	Capacity	1.2 L
	Lubrication	Check : Every 15,000 km
		Replace : Every 50,000 km
Manufacturer		Borg Warner
Weight		30 kg

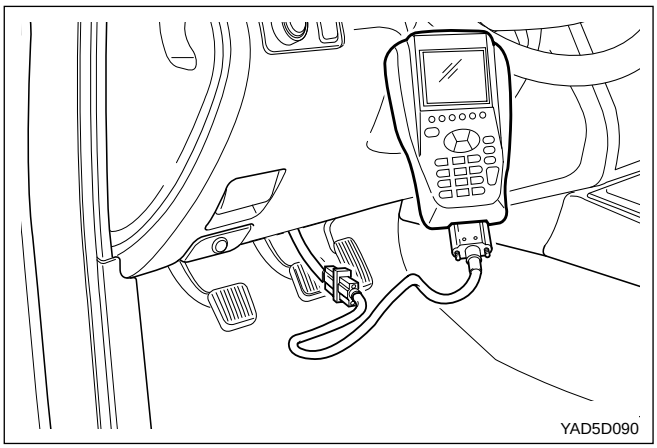
DIAGNOSTIC INFORMATION AND PROCEDURES

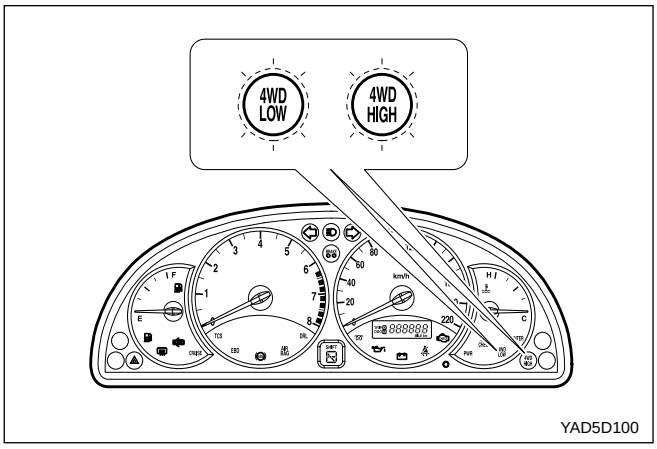
GENERAL DIAGNOSIS

Symptoms	Check	Action
Electric shift problems	• Faulty or damaged TCCU, speed sensor, motor, clutch or internal wirings • Damaged or worn shift cam, hub, fork and rail shift	• Overhaul and check, replace if necessary. • Overhaul and check for wear and damage.
	• Binding shift fork, hub collar or gear	• Replace if necessary.
Cannot front wheel drive when shifted 4H,4L	• Broken drive chain	• Check sliding parts, replace if necessary.
Noise in 4WD operation	• Improper or low oil • Loosened bolts or mounted parts • Noisy T/C bearing	• Drain and replace with specified oil. • Retighten as specified. • Disassemble bearings and parts and check for wear or damage. Replace if necessary.
	• Gear abnormal noise	• Check for wear and damage including speedometer gear, replace if necessary.
Noise in 4H or 4L	• Worn or damaged sprockets or drive chain • Incorrect tire pressure	• Disassemble and check for wear and damage, replace if necessary. • Adjust tire pressure.
Transfer case oil leakage	• Cracked transfer case	• Replace the case.
	• Leakage from other parts	• Clean case and parts and check for leakage.
	• Breather clogging • Improper or too much oil	• Remove breather hose and clean, replace if necessary. • Use specified oil and adjust oil level.
	• Loosened sealing bolts	• Retighten
	• Improperly applied sealant • Worn or damaged oil seal	• Use specified sealant and retighten. • Replace

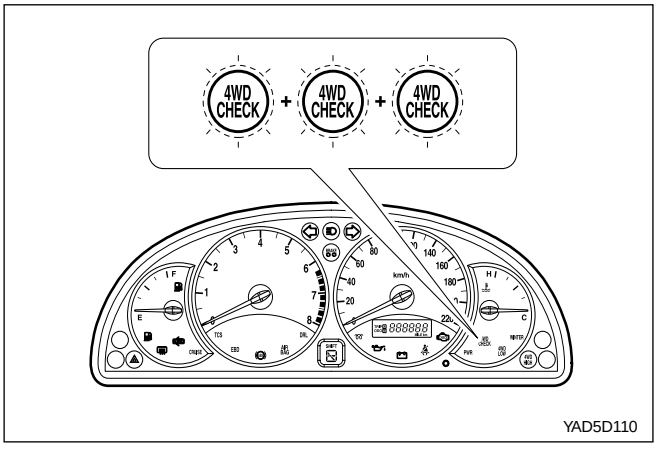


YAD5D080


YAD5D090



YAD5D100



YAD5D110

SELF-DIAGNOSIS TEST

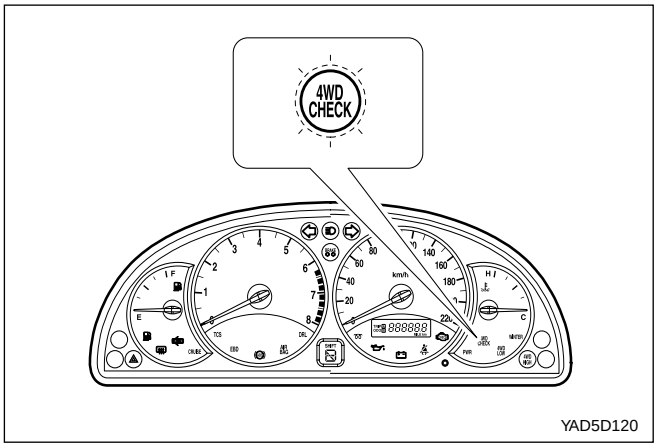
System Description

1. TCCU detects transfer case system malfunctions and indicates malfunctioning part(s) through flashing 4H,4L indicator lights.

   Using a service connector, connect it to the diagnosis box in the engine room and read the flashing of the “4WD CHECK” indicator light.

   The flashing indicator light will show you defective code(s).
2. Identify 7 defective codes after reading the flashing indicator light.
   - TCCU
   - Shift motor
   - Magnetic synchronizer clutch
   - Speed sensor
   - Hub solenoid
   - Selector switch
   - Motor position sensor
3. Transfer case system is malfunctioning when:
   - 4H, 4L indicator lights are remain on after 0.6 second when turning the ignition switch ON
   - 4H, 4L indicator lights are continuously come on during driving.
4. If only 1 part is malfunctioning, 4WD CHECK indicator light will display defective code 3 times continuously.
5. If more then 2 part is malfunctioning, the first malfunctioning part will be displayed 3 times and following malfunctioning parts will be displayed .
6. To read defective code, connect the service connector and turn the ignition switch ‘ON’.
7. After repairing, eliminate the defective code stored in the TCCU.

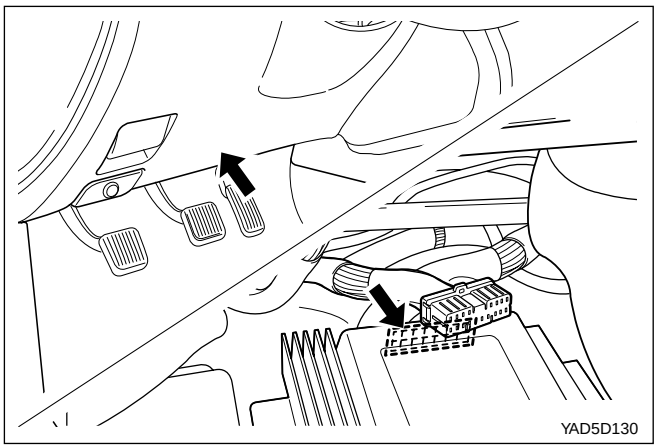
   Notice: Before replacing the malfunction parts with defective code, check the wires and connectors for proper condition.



YAD5D120

Defective Code Reading

1. Position the ignition switch to OFF
2. Using a service connector, connect the No.2 pin (Ignition) and No.13 pin (TCCU) of the diagnosis socket in the engine room.
3. Position the ignition switch to ON.
4. Read the flashing 4WD CHECK indicator light and identify the malfunctioning part(See Diagnosis Table).

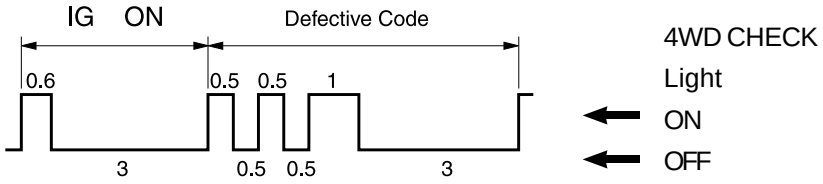
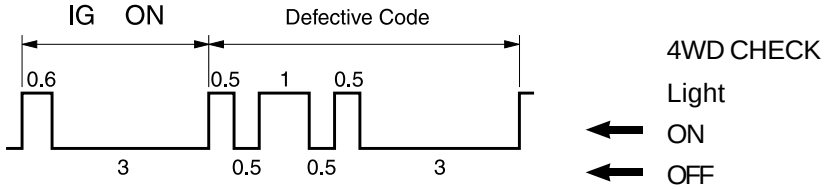
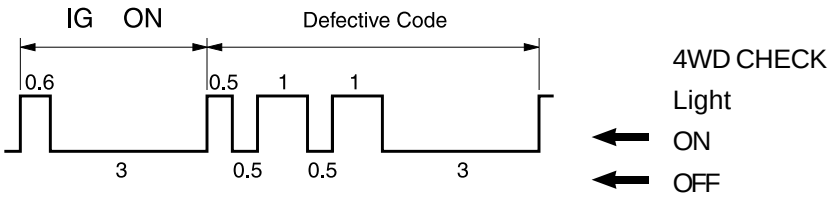
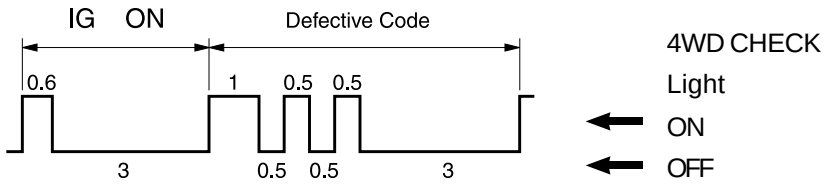
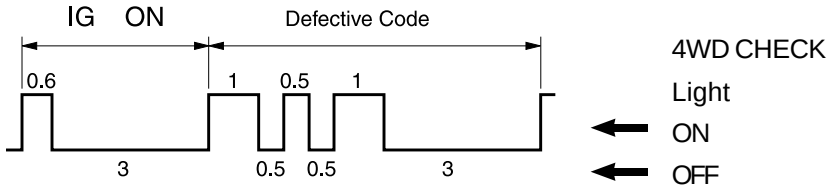

YAD5D130

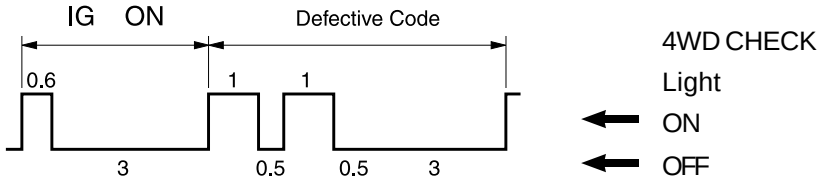
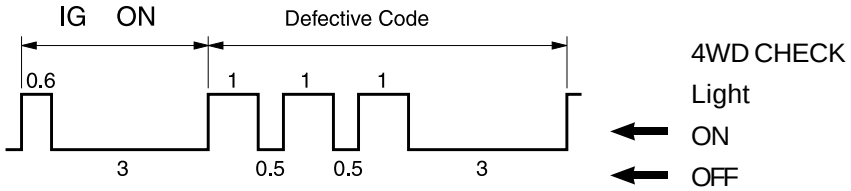
How to Clear the Fault Code

1. Position the ignition switch to OFF.
2. Using a service connector, connect the No.2 pin (GND) and No.13 pin (TCCU) of the diagnosis socket in the engine room.
3. Position the ignition switch to ON over 5 seconds.
4. Do defective code reading and make sure that all defective codes are eliminated.

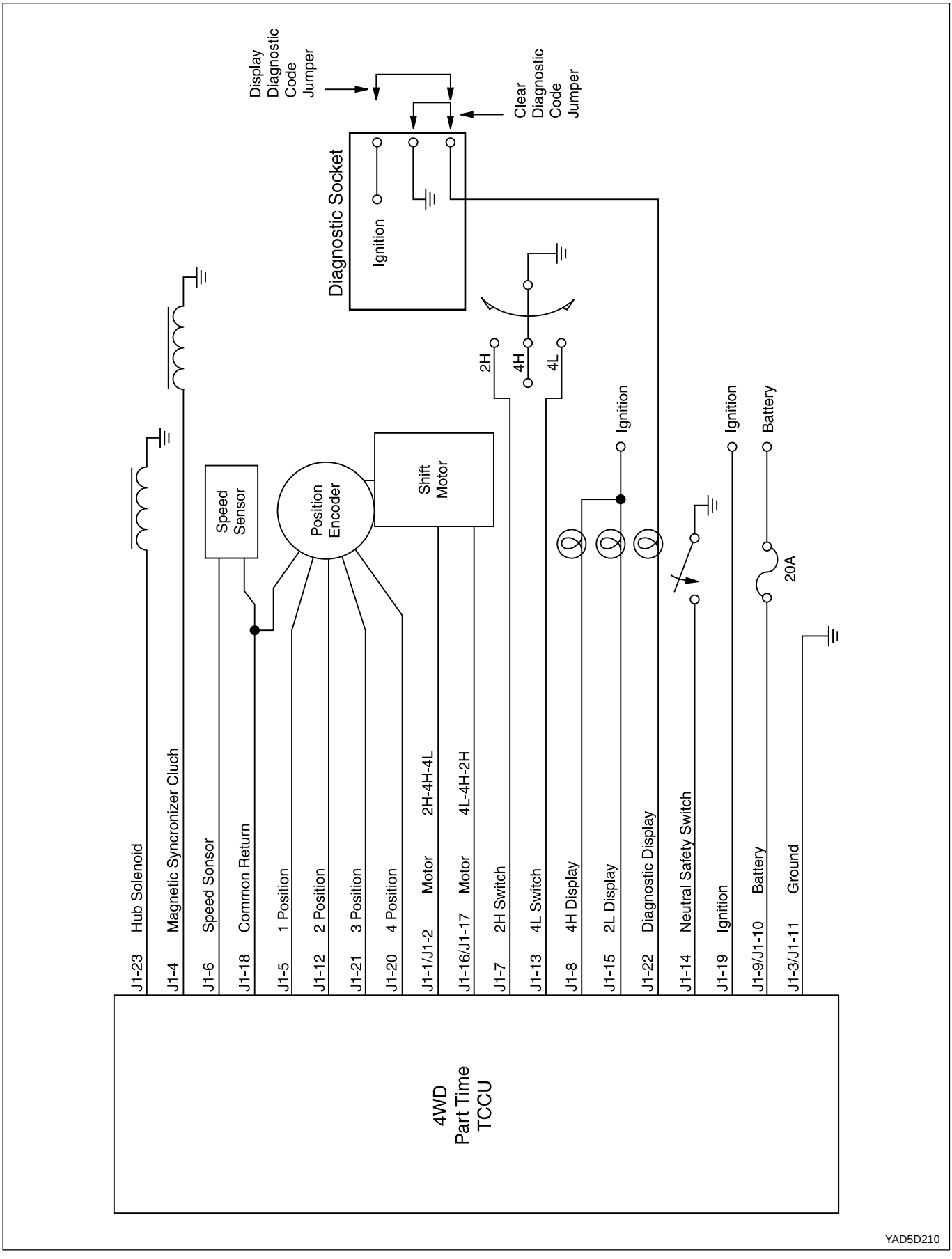
Diagnostic Table

Connect a service connector. If turn the ignition switch "ON" "4WD CHECK" indicator light will come on for 0.6 second and turn off for 3 seconds and then display a defective code 3 times continuously.

No.	Defective Code	Malfunctioning Part
1	 YAD5D140	TCCU
2	 YAD5D150	Shift Motor
3	 YAD5D160	Synchronizer Clutch
4	 YAD5D170	Speed Sensor
5	 YAD5D180	Locking Hub Solenoid

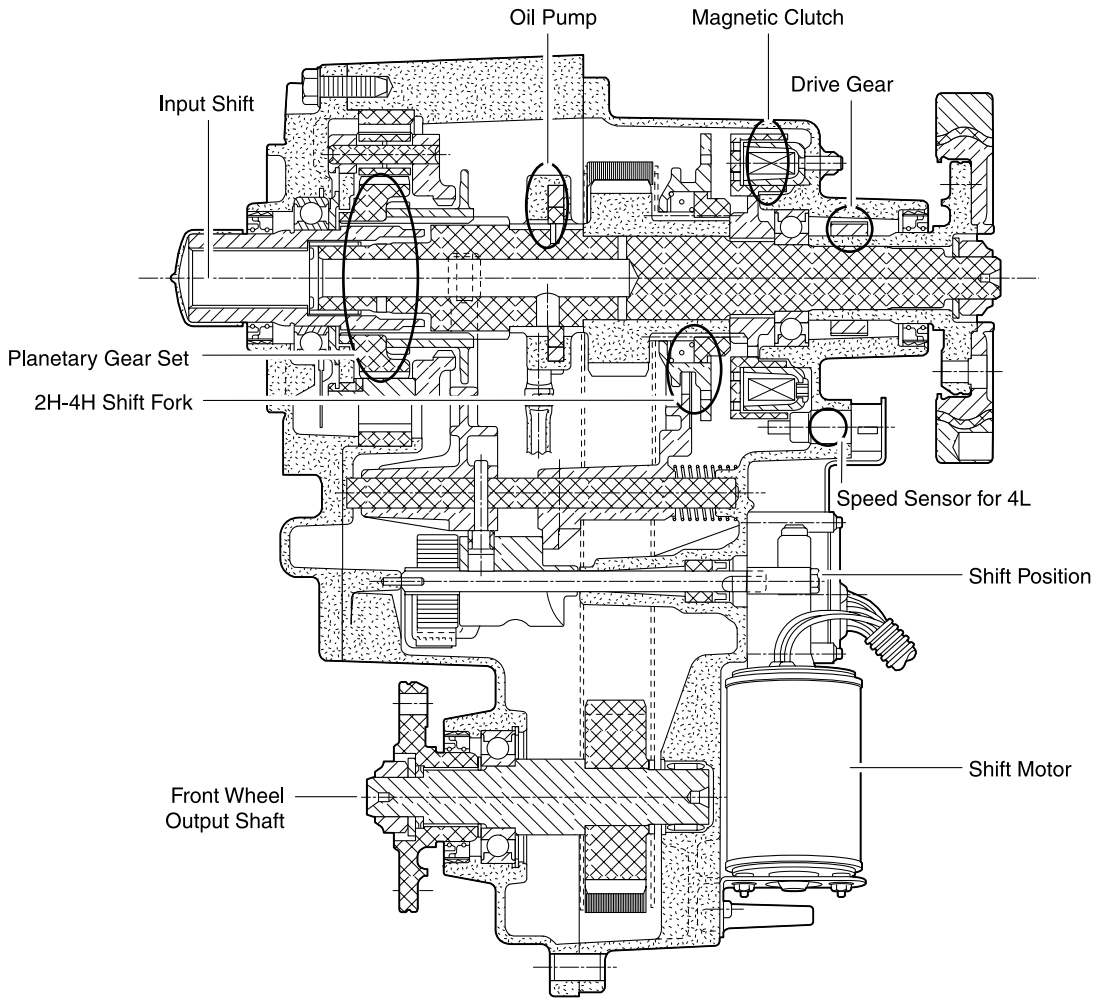
No.	Defective Code	Malfunctioning Part
6	 YAD5D190	Selector Switch
7	 YAD5D200	Motor Position Sensor

DIAGNOSTIC DIAGRAM

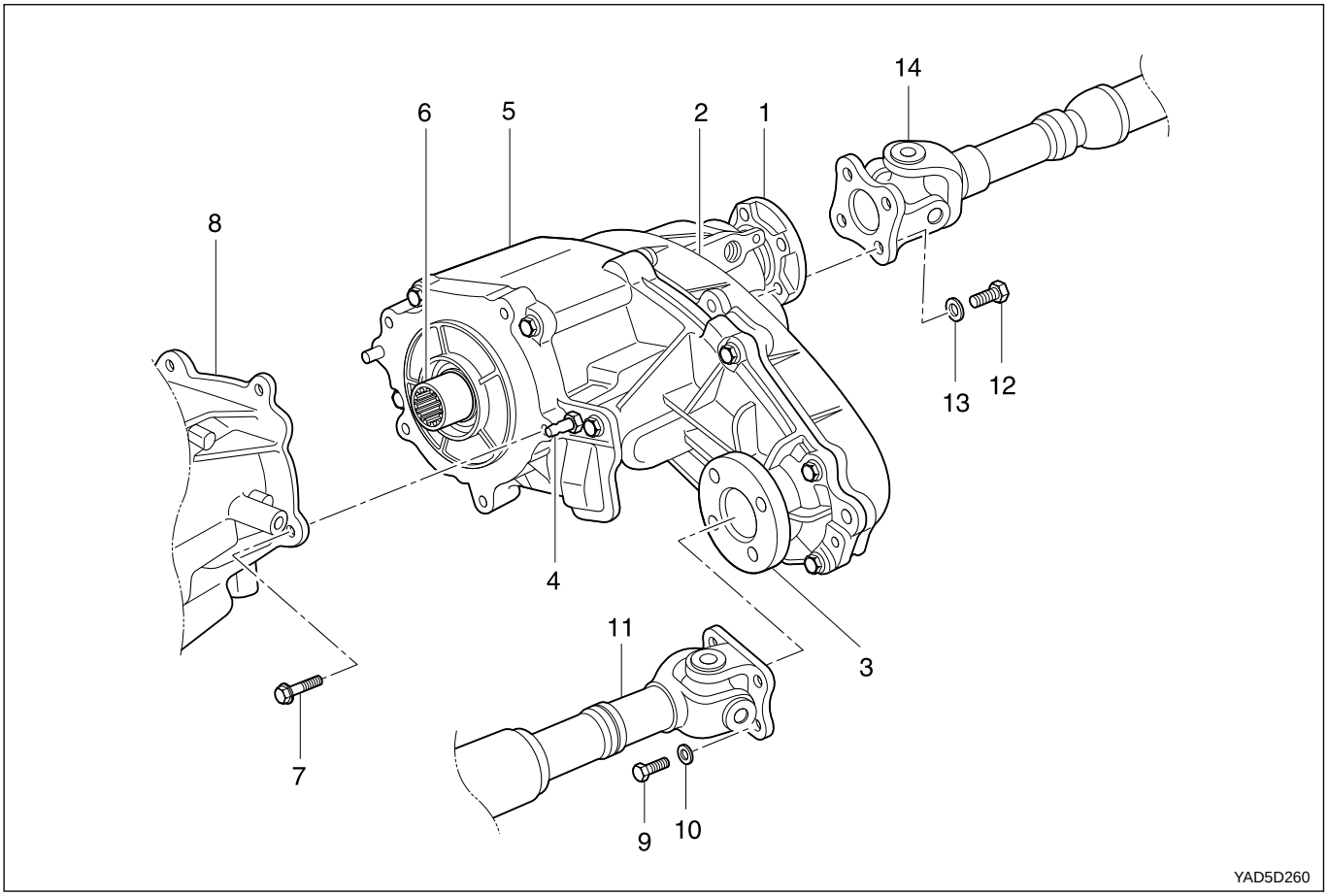


COMTONENT LOCATOR

CROSS SECTIONAL VIEW

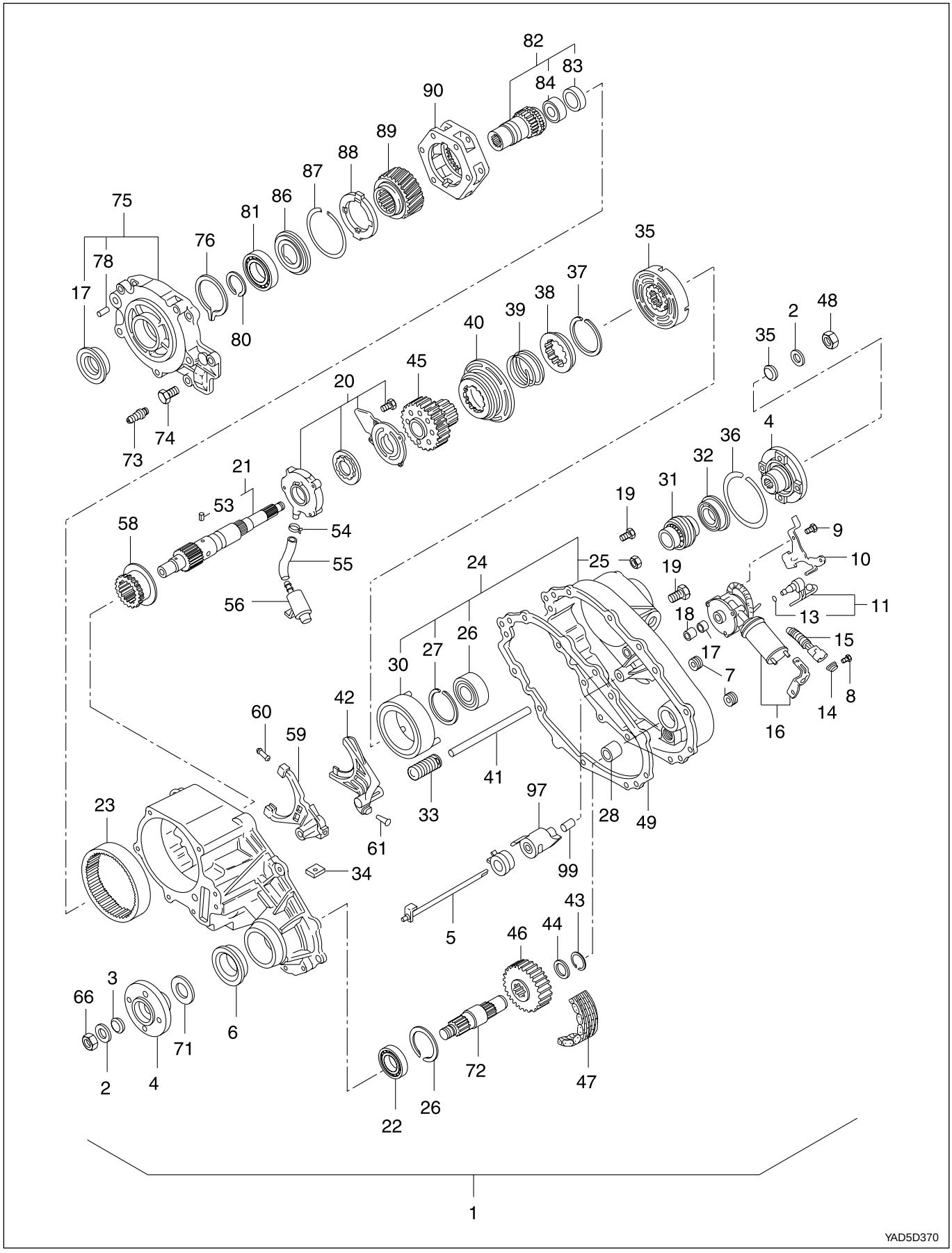


TRANSFER CASE ASSEMBLY



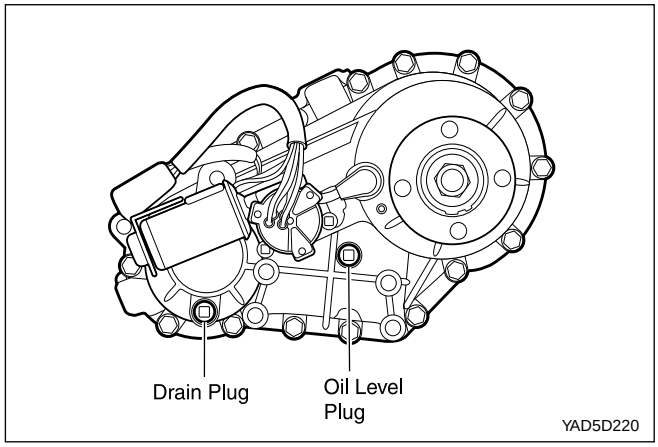
1 Rear Companion Flange
2 Case Cover
3 Front Companion Flange
4 Breather Plug
5 Transfer Case
6 Input Shaft
7 Mounting Bolt
8 Transmission Extension Housing
9 Bolt
10 Washer
11 Front Propeller Shaft
12 Bolt
13 Washer
14 Rear Propeller Shaft

DISASSEMBLY AND ASSEMBLY



1 Transfer Case
2 Spring Washer
3 Oil Seal
4 Companion Flange
5 Shift shaft
6 Oil Seal
7 Pipe Plug
8 Screw
9 Bolt
10 Speed Sensor and Harness Bracket
11 Speed Sensor Assembly
12 Speed Sensor
13 O-Ring
14 Locking Clip
15 Connector
16 Motor Assembly
17 Oil Seal
18 Bearing
19 Bolt
20 Pump Assembly
21 Output Shaft Assembly
22 Bearing
23 Ring Gear
24 Cover Assembly
25 Nut
26 Snap Ring
27 Bearing
28 Needle Bearing
30 Clutch Coil Assembly
31 Speed Gear
32 Oil Seal
33 Return Spring
34 Magnet
35 Clutch Housing
36 Snap Ring
37 Snap Ring
38 Lock-up Hub
39 Sleeve Return Spring
40 Lock-up Collar
41 Rail Shaft
42 Lock-up Fork
43 Snap ring
44 Spacer
45 Driven Sprocket
46 Driving Sprocket
47 Drive Chain
48 Nut
49 Gasket
53 Spring Pin
54 Hose Clamp
55 Hose Coupling
56 Oil Strainer
58 Reduction Hub
59 Shift Fork Assembly
60 Shift Fork Facing
61 Roller and Retainer
66 Nut
67 Plane Washer
68 Oil Seal
71 Spacer
72 Front Output Assembly
73 Breather
74 Bolt
75 Front Adapter Assembly
76 Snap Ring
80 Snap Ring
81 Bearing
82 Input Shaft Assembly
83 Sleeve Assembly
84 Needle Bearing
86 Thrust Washer
87 Retaining Ring
88 Thrust Plate
89 Sun Gear
90 Gear Carrier Assembly
97 Electric Shift Cam
99 Spacer

MAINTENANCE AND REPAIR



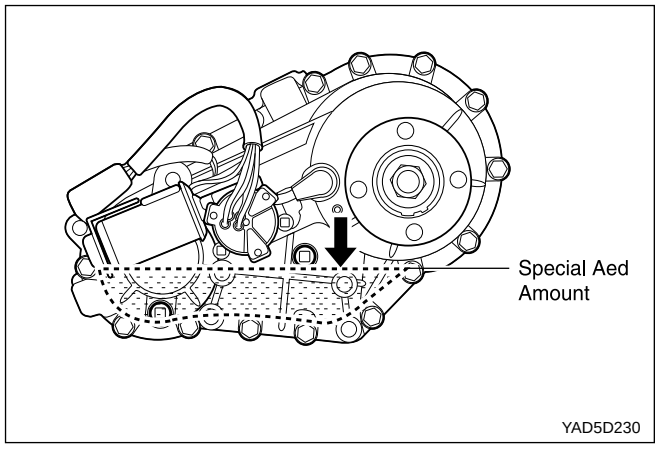
ON-VEHICLE SERVICE

MAINTENANCE OF TRANSFER CASE LUBRICANT

1. Oil Level Check
   - Clean the oil level plug and surrounding area.
   - Remove the oil level plug and check whether oil is drip out or not.
   - Tighten the oil level plug.

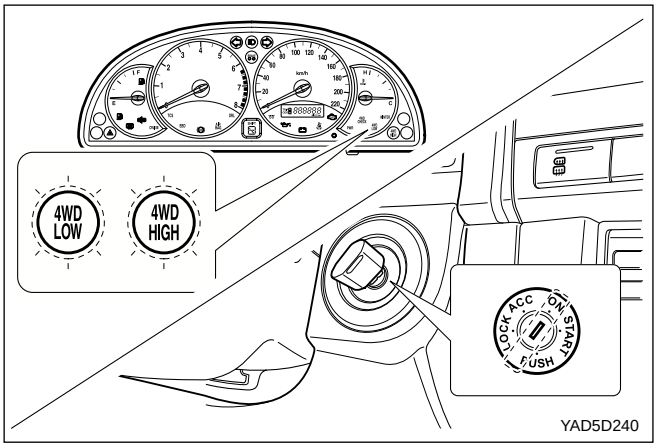
Installation Notice

Tightening Torque	20 - 30 N•m (15 - 22 lb-ft)



2. Oil Change
   - Clean the oil level plug and surrounding area
   - Place a suitable container under the transfer case.
   - Remove the oil and tighten the drain plug.
   - Fill the oil through the oil level plug until oil begins to drip out.
   - Tighten the oil level plug.

3. Cautions for oil level check and plugs tightening
   - Do not use an impact wrench to remove or tighten the oil level plug or drain plug since this will damage the threads in the transfer case.



4H AND 4L INDICATOR

When the ignition switch turns on, 4H and 4L indicators turn on for 0.6 seconds and turn off.

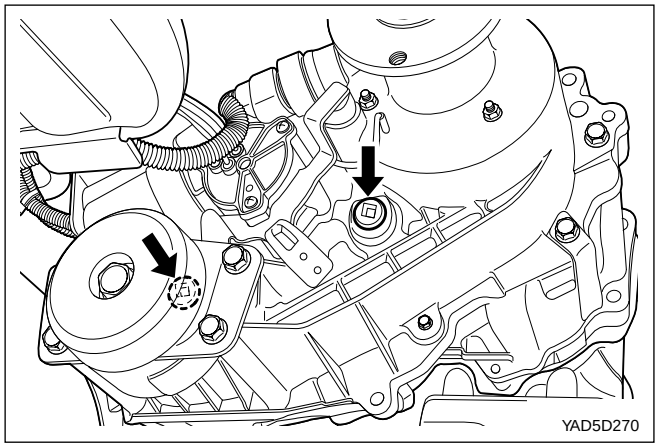
Notice: If 4H and 4L indicators do not turn on, check the related bulb, the wiring harness and TCCU.

TCCU INSPECTION

Pin No.	Operation Condition	Voltage(V)
J1 - 7	4H or 4L	4.75 - 5.35
	2H	0 - 0.50
J1 - 8	4H indicator light ON	< 1.00
	4H indicator light OFF	> 11.00
J1 - 13	2H or 4H	4.75 - 5.35
	4L	0 - 0.50
J1 - 14	Clutch pedal applied	< 0.50
	Clutch pedal released	> 11.00
J1 - 15	4L indicator light ON	< 1.00
	4L indicator light OFF	> 11.00
J1 - 16	Motor OFF	< 1.00
	Motor ON	> 11.00
J1 - 17	Motor OFF	< 1.00
	Motor ON	> 11.00
J1 - 23	Auto locking hub ON	> 11.00
	Auto locking hub OFF	< 1.00

Notice:

- DC 12V for the TCCU operation should be maintained.
- In case of J1-8 and J1-15, indicator light will turn on for 0.6 second when turn the ignition switch ON.
- If 4H and 4L indicator lights remain turned on when turn the ignition switch on or during driving, perform the TCCU diagnosis.

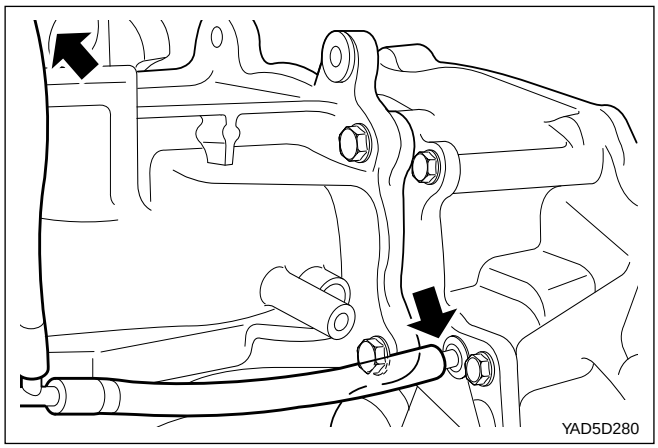


TRANSFER CASE ASSEMBLY

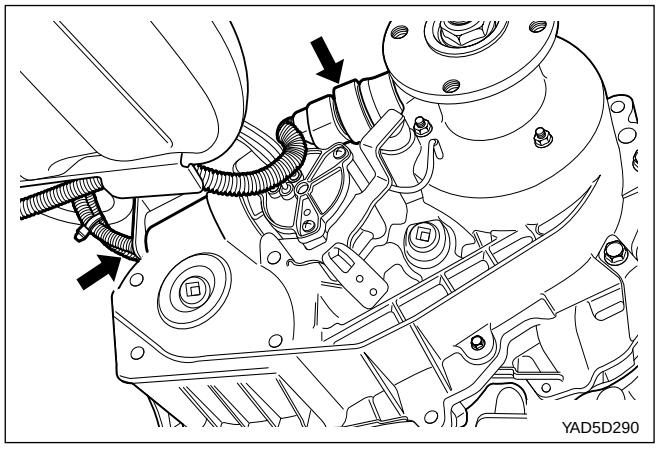
1. Disconnect the negative terminal from the battery.
2. Lift up the vehicle and fix it safely.
3. Remove the damper mounting bolt.
4. Remove the drain plug and drain the oil.
   Reinstall the drain plug.

Installation Notice

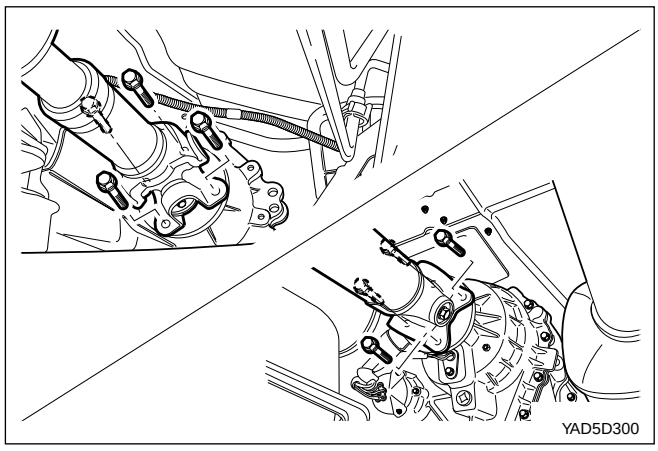
Tightening Torque	19 - 30 N•m (14 - 22 lb-ft)



5. Remove the breather hose.



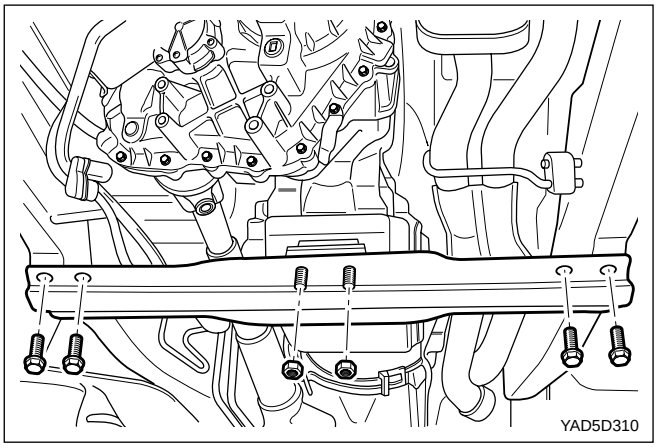
6. Disconnect the speedometer cable connector and other cable connectors and wiring harnesses.



7. Support the transfer case with jack and remove the front and rear propeller shafts from the transfer case.

Installation Notice

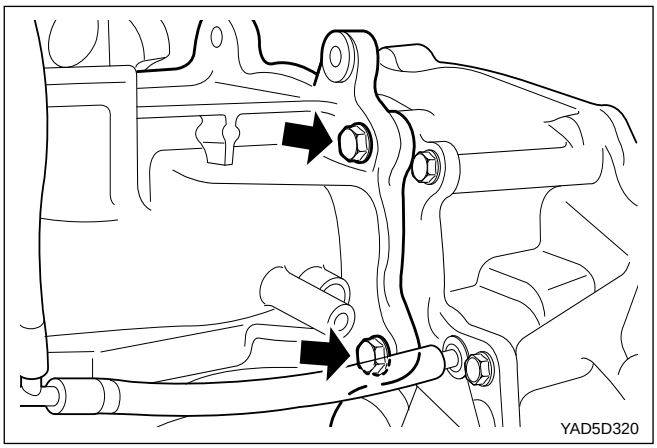
Tightening Torque	Front	81 - 89 N•m (60 - 66 lb-ft)
	Rear	70 - 90 N•m (52 - 66 lb-ft)



8. Remove the center mounting nuts and end sides mounting bolts of the cross member and then remove the cross member.

Installation Notice

Tightening Torque(1)	12 - 23 N•m (9 - 17 lb-ft)
Tightening Torque(2)	6 - 8 N•m (53 - 71 lb-in)



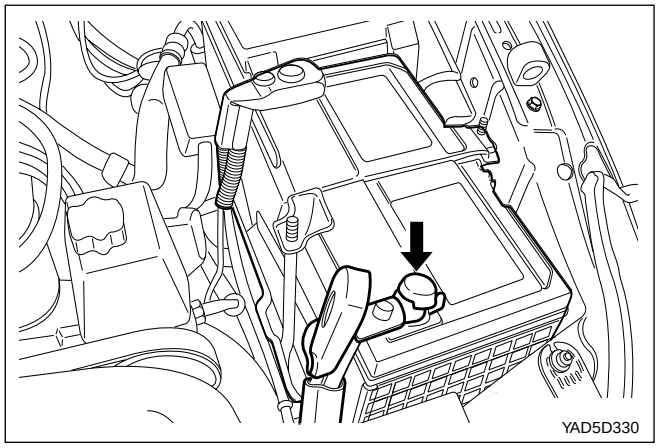
9. Remove the transfer case by removing the bolts attaching the transfer case to the transmission.

Installation Notice

Tightening Torque	35 - 60 N•m (26 - 44 lb-ft)

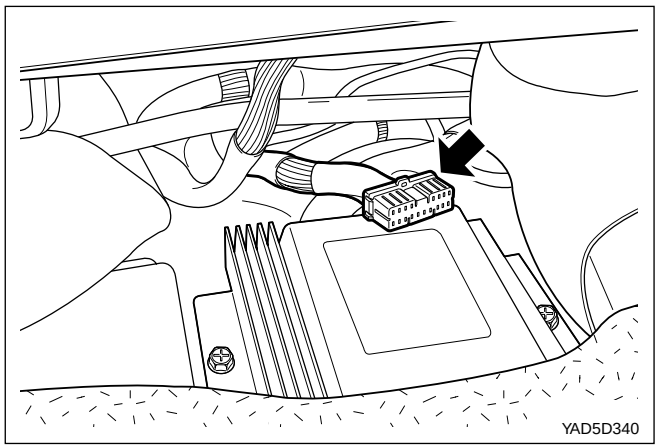
Notice: Apply long-term grease to the inner spline of the transfer case input shaft.

10. Installation should follow the removal procedure in the reverse order.

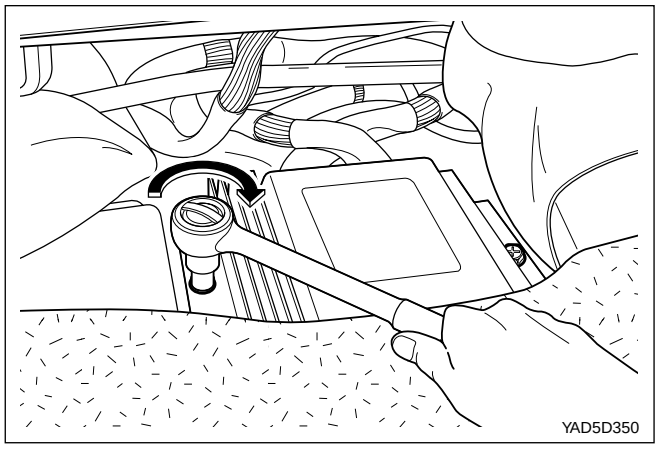


TCCU

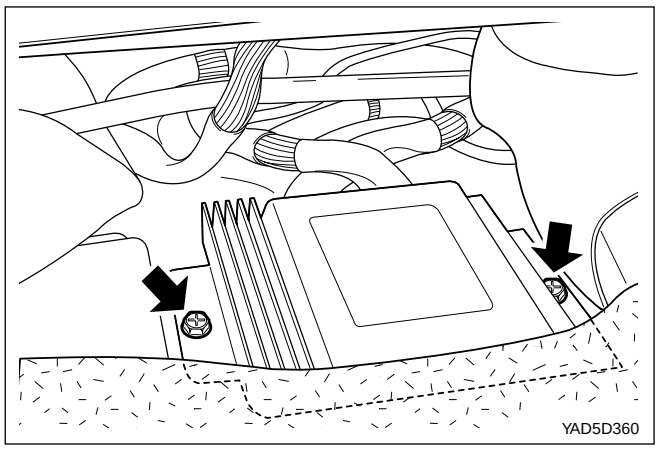
1. Disconnect the negative terminal from the battery.



2. Remove the TCCU connector.



3. Remove the TCCU mounting bolt and remove the TCCU.
   - TCCU installation position : Under the driver's seat

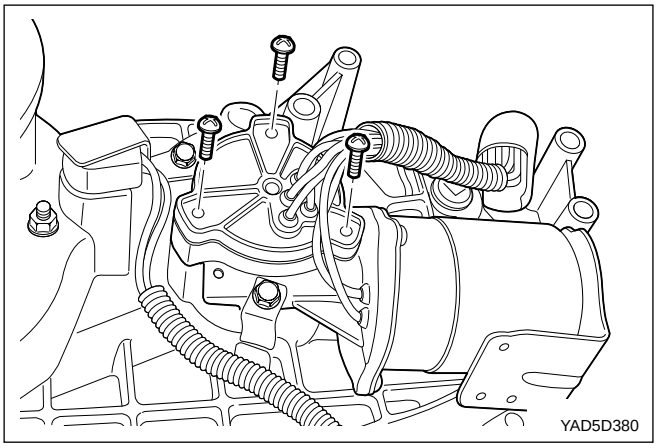


4. Installation should follow the removal procedure in the reverse order.

   Notice: Be careful not to give any impact to the TCCU body.

Installation Notice

Tightening Torque	10 N•m (89 lb-ft)

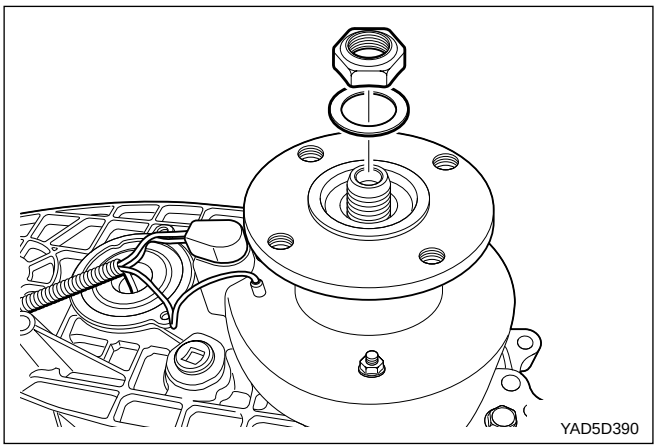


UNIT REPAIR

DISASSEMBLY PROCEDURE

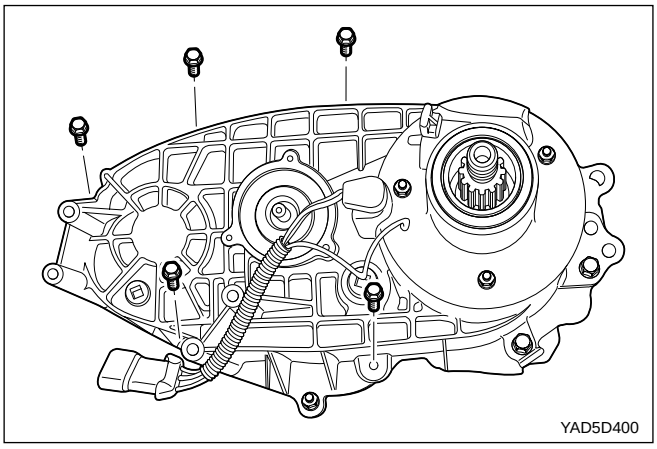
Shift Motor Assembly

1. Separate the harness bracket.
2. Remove the shift motor mounting bolt and remove the shift motor assembly.



Companion Flange

1. Holding the companion flange, remove the nut and washer and then remove the companion flange.
2. Remove the oil seal.
3. Remove the companion flange from the case cover.

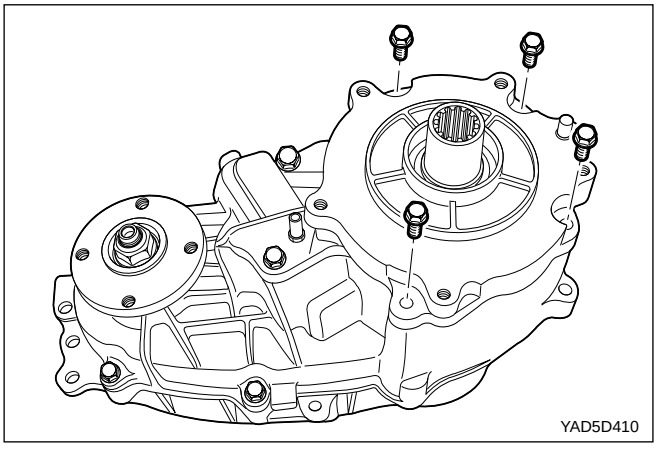


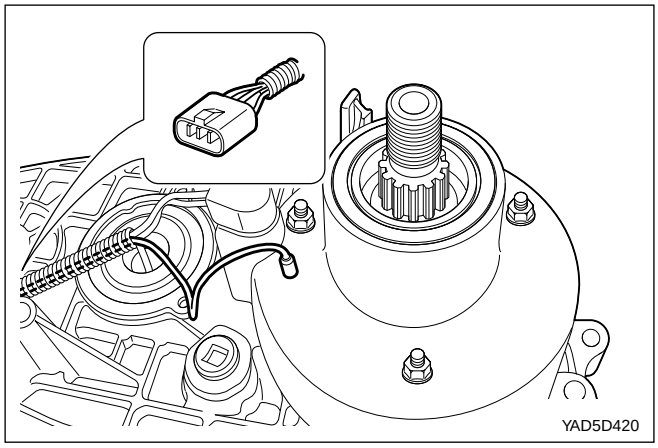
Case Cover Assembly

1. Remove the cover mounting bolts(9), and the case mounting bolts(5).

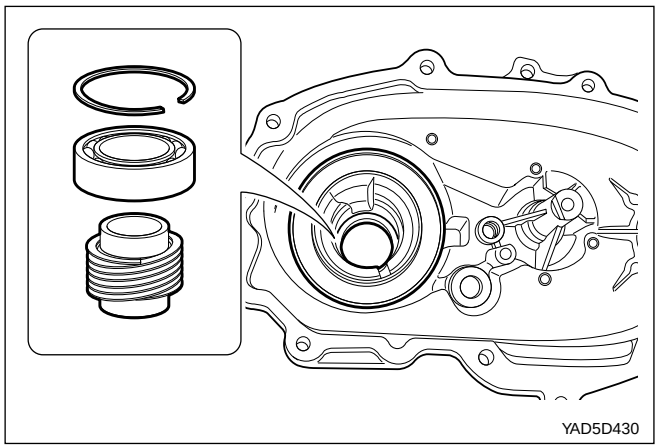
   Notice: Identification tag has information required for ordering replacement parts, so be careful not to lose it.

2. Using a driver, pry and disconnect the sealant bond of the cover and required case.

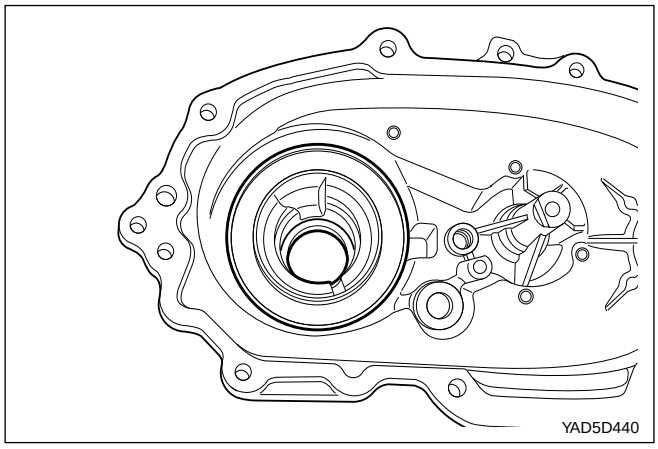




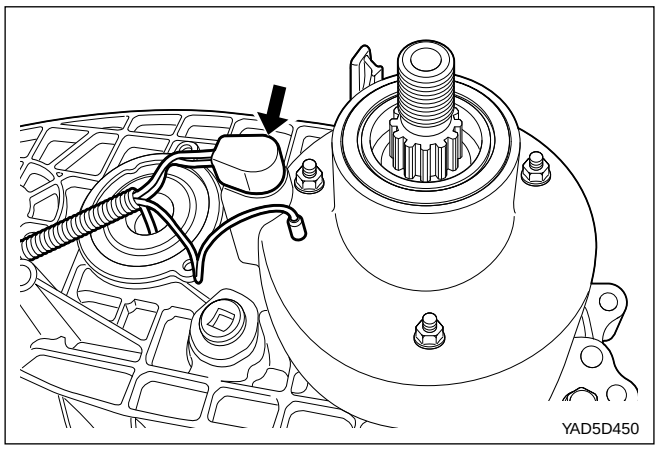
3. Remove the clutch coil wiring from the connector.
4. Remove the clutch coil assembly mounting nut.



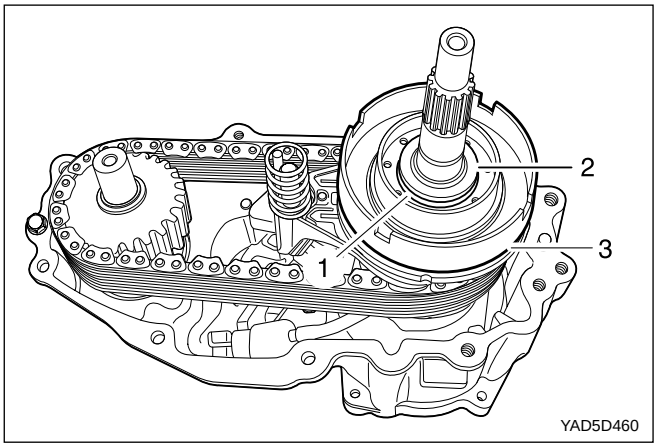
5. Remove the snap ring and pull out the ball bearing from the cover to remove the speed gear.



6. Remove the clutch coil assembly and the oil seal from the cover.

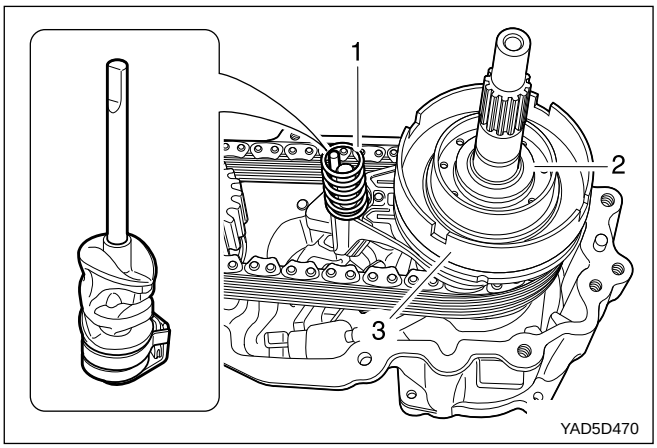


7. Remove the speed sensor and the O-ring from the case cover.

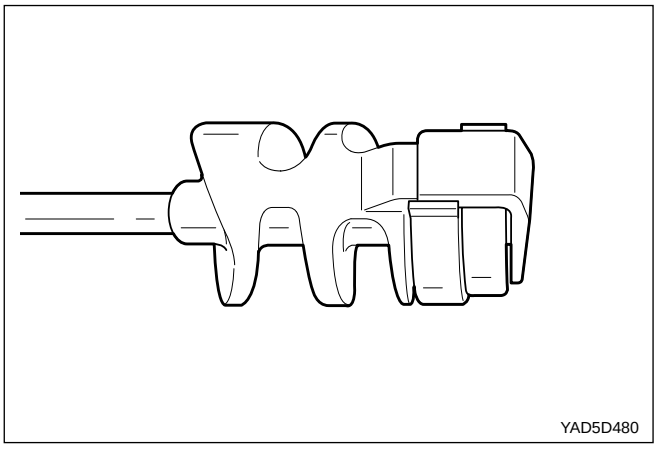


Transfer Case Assembly

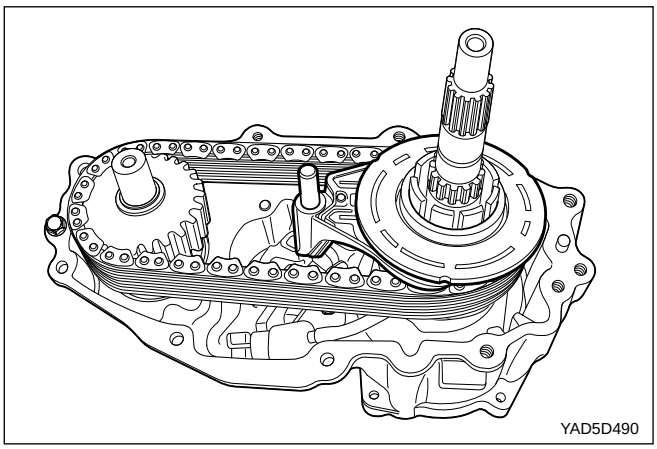
1. Separate the shift motor shaft cam assembly and the spring(1).



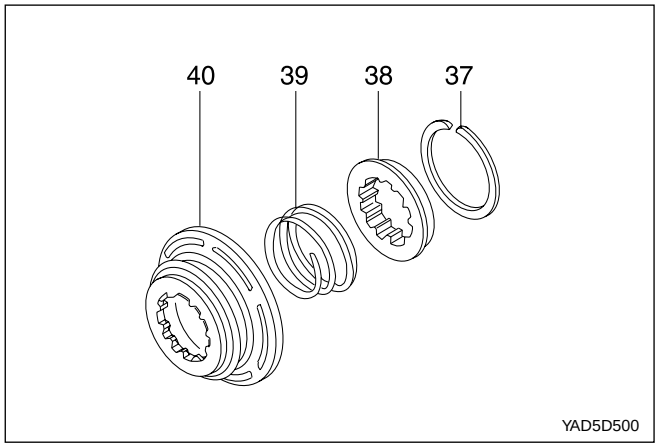
2. Remove the clutch housing assembly from the output shaft.
   - Clutch Housing Component
     (1) Retaining Ring
     (2) Shift collar Hub
     (3) Clutch Housing



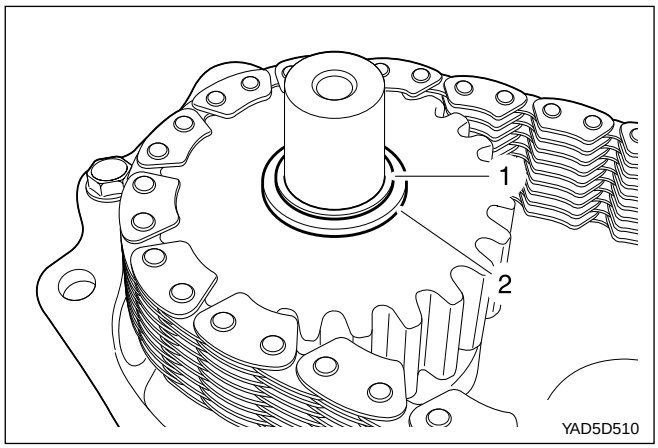
   - Remove the shift cam from the shaft.
   - Fix the shaft at the vise with the cam removed and remove the torsion bar using a driver.



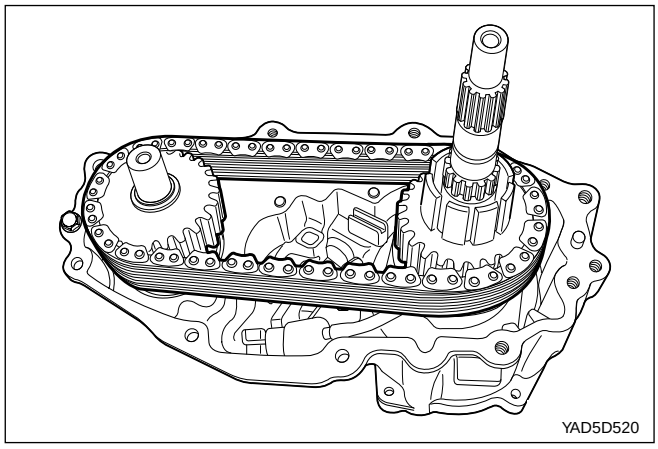
3. Remove the 2WD/4WD lock up assembly, the lock up fork and rail shaft from the output shaft.



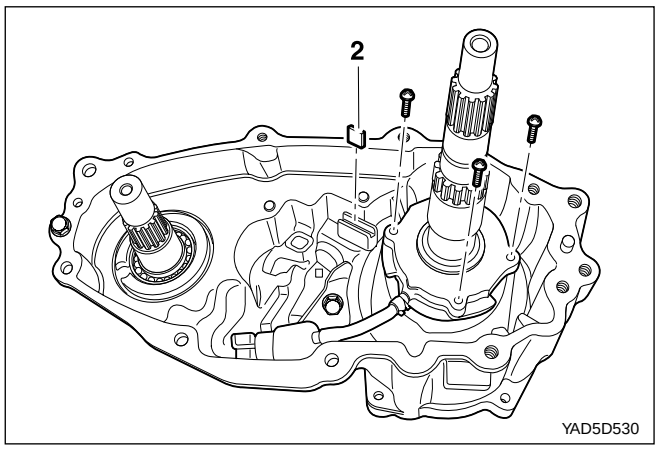
- 2WD/4WD Lock Up Assembly Component
  (37) Snap Ring
  (38) Lock up Hub
  (39) Return Spring
  (40) Lock up Collar



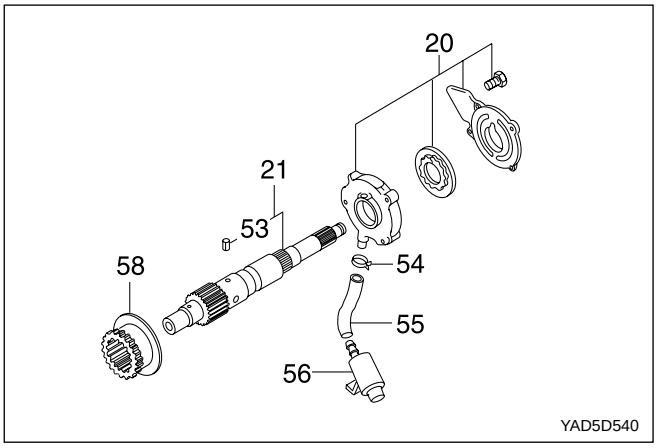
4. Remove the snap ring from the front output driven sprocket and separate the snap ring and the spacer.



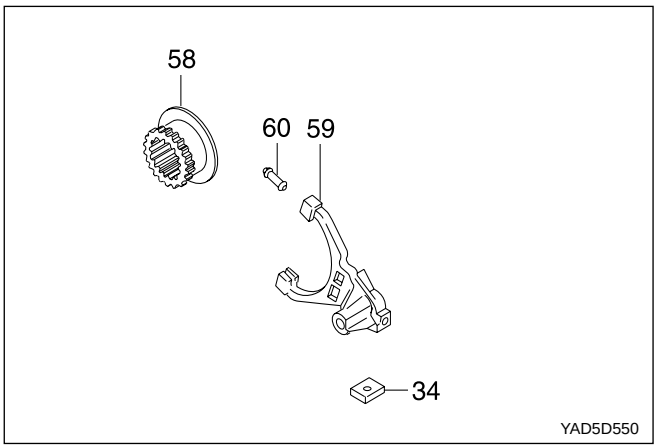
5. Remove the driving sprocket, the driven sprocket and the driving chain from the front/rear output shaft.



6. Remove the oil pump assembly and the magnetic from the output shaft.

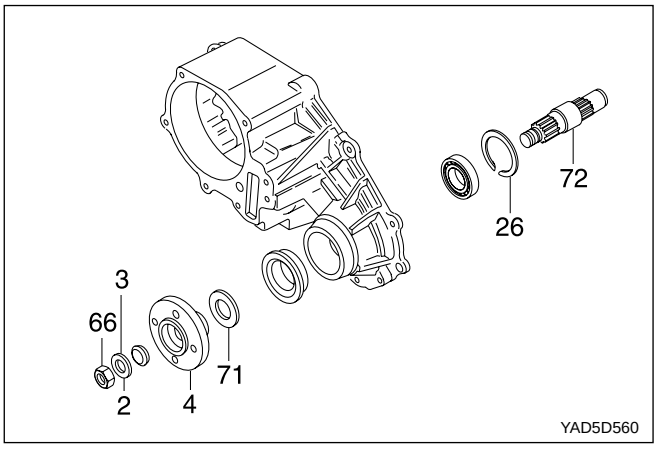


- Remove the bolt and the retainer. Separate the output shaft and rear pump cover.
- Remove the hose clamp and remove the hose coupling cover from the pump housing.
- Remove the hose clamp, the hose coupling and the strainer.
- Remove two pump pins and the spring from the output shaft.
- Separate the front pump and remove the output shaft.



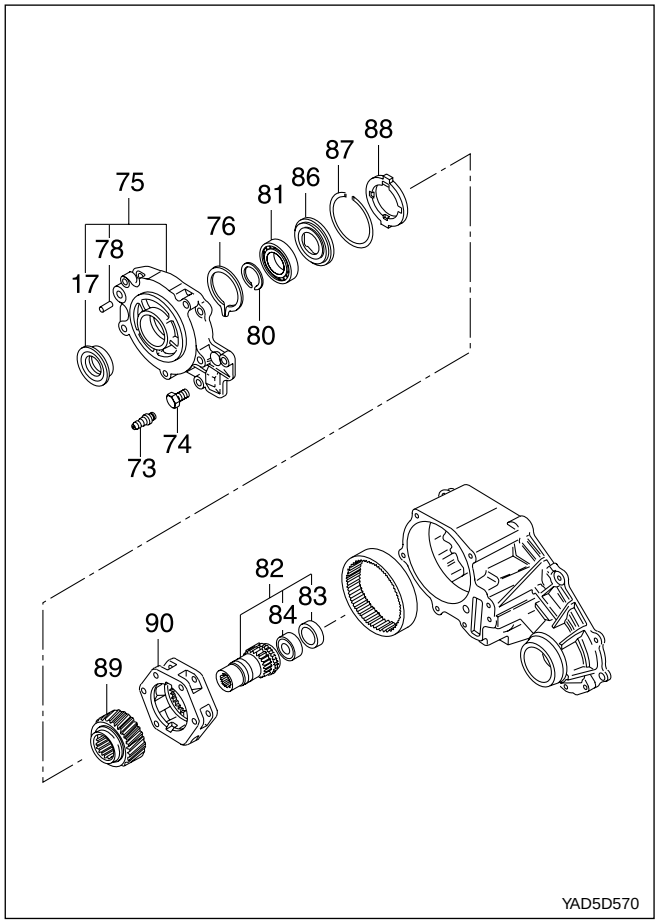
Reduction Shift Parts

1. Remove the reduction hub and reduction shift fork assembly from the case.
2. Remove the 2 shill fork facings from the shift fork assembly.
3. To remove the roller cam and pin, cut elf the plastic retainer when disassembling the fork assembly.



Front Output Assembly

1. Holding the companion flange, remove the nut and washer and then remove the companion flange and oil seal.
2. Remove the output shaft.



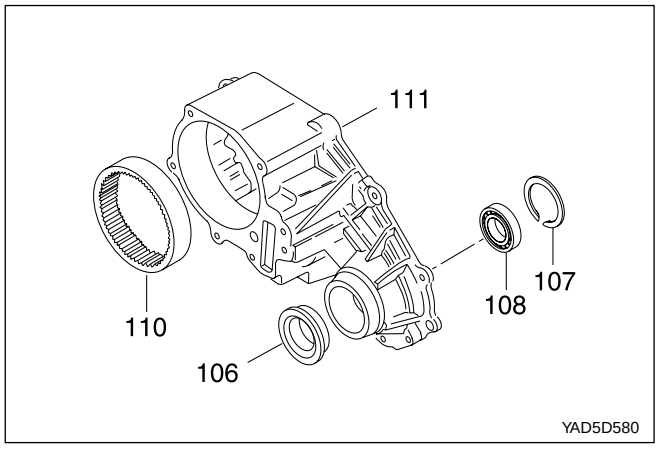
Adapter, Input Shaft and Carrier Gear

1. Remove the breather.
2. After removing 6 bolts, remove the front adopter by separating the adapter sealer bond from the case using a screw driver.

   Notice: Be careful not to damage the contacting surface of the case and adapter.

3. Remove the adapter assembly, input shaft assembly and carrier gear assembly.
4. Remove the snap ring and oil seal from the front adapter.
5. After removing snap ring, pull out the bearing and thrust washer from the input shaft assembly and separate the input shaft assembly from the carrier gear assembly.
6. Remove the needle bearing and sleeve bearing from the input shaft assembly.
7. Remove the retaining ring, thrust plate rind sun gear from the planet carrier assembly.

   Notice: Do not disassemble the planet carrier assembly.



Transfer Case Assembly(Front)

1. Remove the oil seal.
2. Remove the retaining ring and the ball bearing.
3. Remove the pin from the transfer case.

   Notice: Be careful not to give any damage to the case for removing the pin.

4. Remove the ring gear from the case using the press.

   Notice: Replace new part for installation.

Cleaning Procedure

Notice: Before cleaning, check the magnet for the presence of metal particles which indicate internal chipping of the transfer case.

1. Using cleaning solvent, clean the residual oil and dirt deposits.

   Notice: During cleaning, be careful not to damage the metal surfaces.

2. After cleaning, dry the parts with low pressure(Max. 20 psi) compressed air.
3. Lubricate the ball bearings and needle bearings with transfer case oil after cleaning.

   Notice: Protect the lubricated bearings from dust.

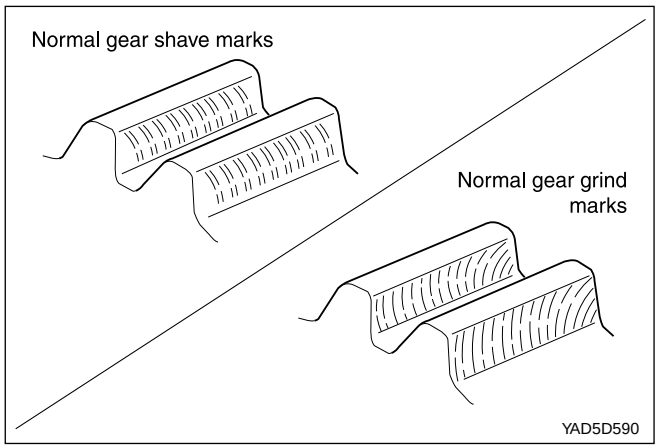
Inspection Procedure

1. Visually check the all removed parts.

   Notice: Always replace the hose coupling, O-ring and oil seal with new parts.

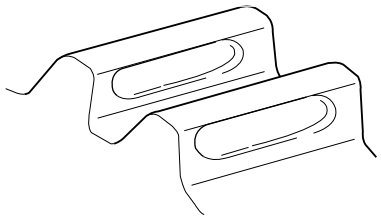
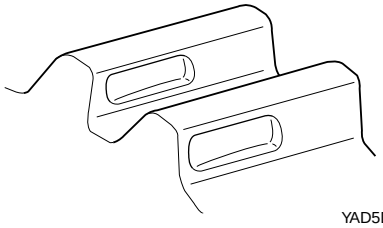
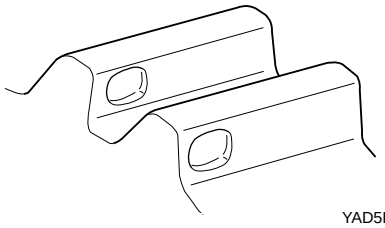
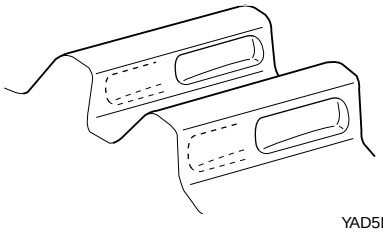
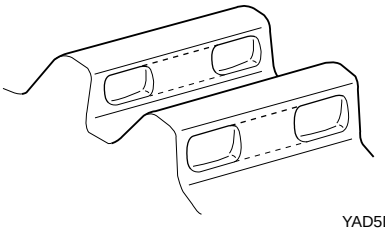
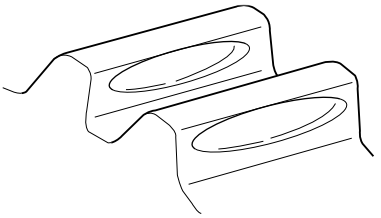
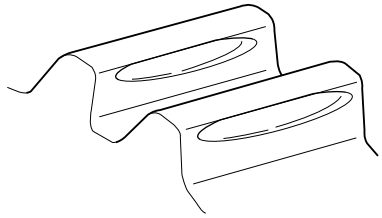
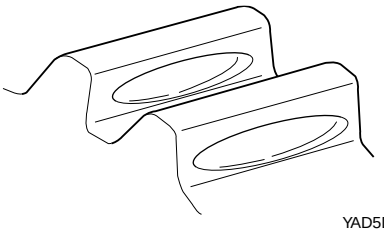
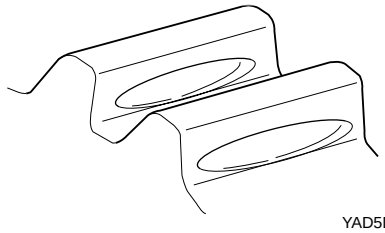
2. Inspection Terms
   - Burr : Local rise of material forming protruding sharp edge
   - Chip : An area from which a small fragment has been broken off or cut
   - Crack : Surface break of line nature indicating partial or complete separation of material.
   - Excessive wear : Heavy or obvious wear beyond expectations considering conditions of operation.
   - Indentation : Displacement of material caused by localized heavy contact.
   - Galling : Breakdown of metal surface due to excessive friction between parts. Particles of the softer material are torn loose and welded to the harder material.
   - Nick : Local break or notch, usually displacement of material rather than loss.
   - Scoring : Tear or break in metal surface from contact under abnormal pressure.

- Step wear : Heavy wear that produces a step that can be seen or felt between adjacent contact and non-contact surfaces.
- Uneven wear : Condition of localized, unevenly distributed wear Includes hollows, shiny spots, uneven polish and other visual indications.

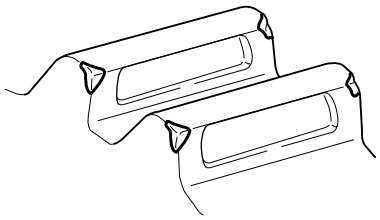
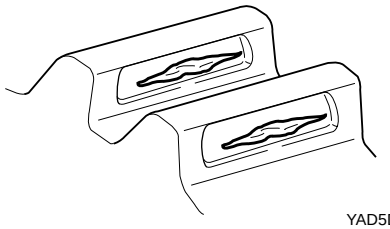
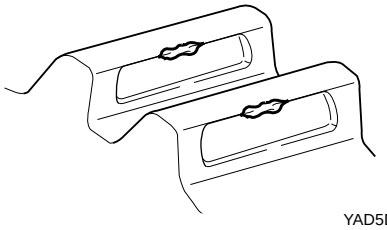
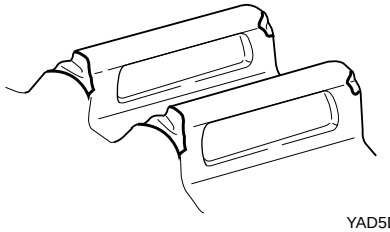
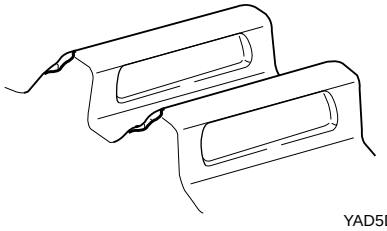
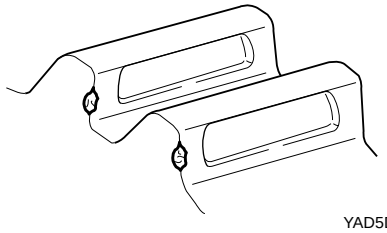


3. Specific Inspection
   - Referring to normal gear tooth face, specifically inspect the uneven wear and chips of gear tooth. Replace or repair if necessary.

4. Inspection of contact patterns

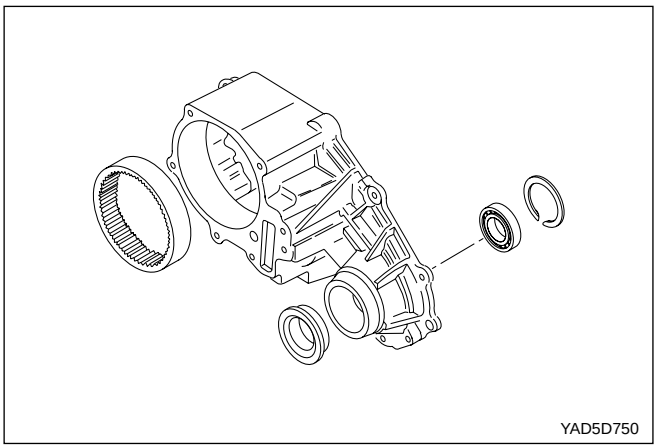
Description	Normal	Abnormal
Normal Wear	 YAD5D600	
End Face Wear	 YAD5D610	 YAD5D620
Traveling Face Wear	 YAD5D630	 YAD5D640
Upper Face Wear	 YAD5D650	 YAD5D660
Lower Face Wear	 YAD5D670	 YAD5D680

5. Chip pattern of the gear face

Description	Patterns	Action
Corner chip at drive face	 YAD5D690	Repair
Edge chip at drive face	 YAD5D700	Repair
Corner chip at coast face	 YAD5D710	Repair
Chip within contact pattern	 YAD5D720	Replace
Chip completely through tooth	 YAD5D730	Replace
Side edge chip at drive face	 YAD5D740	Replace

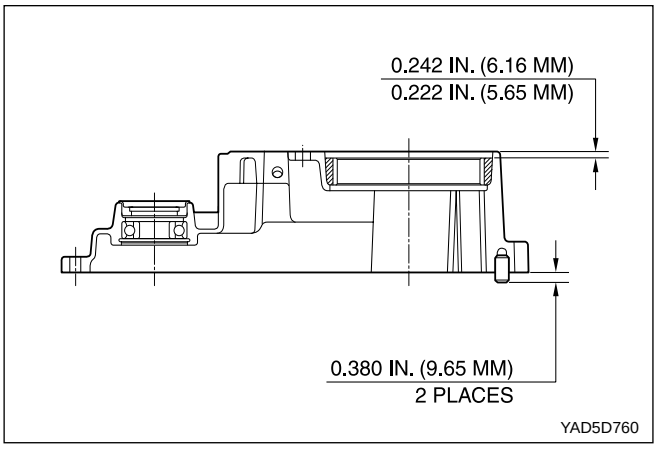
ASSEMBLY PROCEDURE

- Use special tools during assembly of oil seals and bearings.
- Lubricate bearings, oil seals and bushings before assembly.

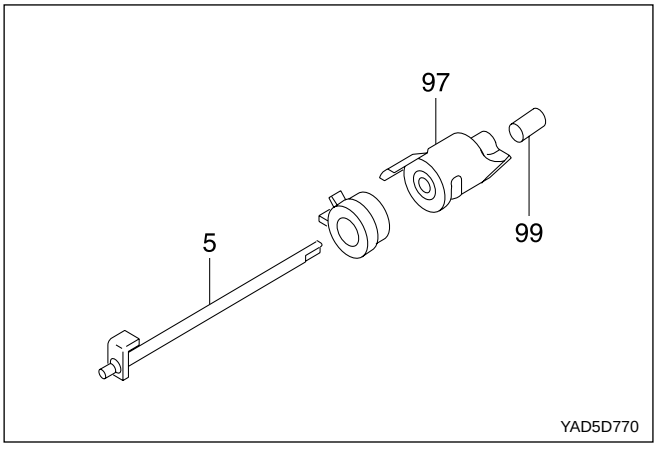


Transfer Case Assembly

1. If the ring gear was removed, align the outer diameter of the new replaced ring gear with transfer case and assemble it.
2. Insert the pin.
3. Insert the ball bearing to the case and install the retaining ring.
4. Install the new oil seal by pressing into the case.

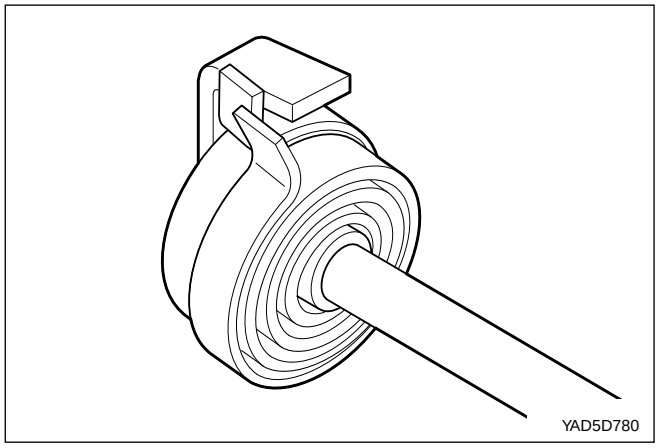


5. Make sure that all parts are correctly and firmly installed into the case.

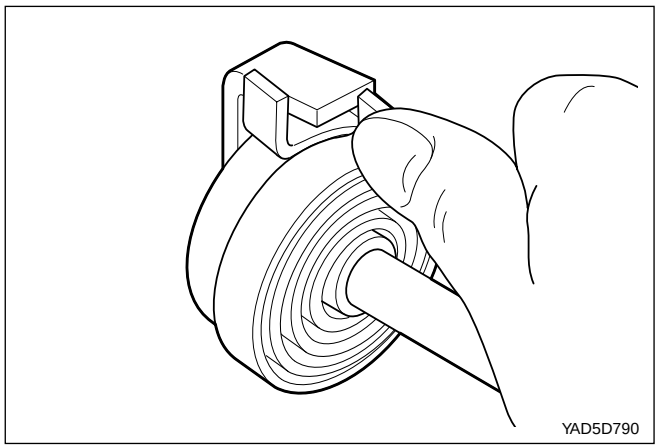


Electric Shift Cam Parts

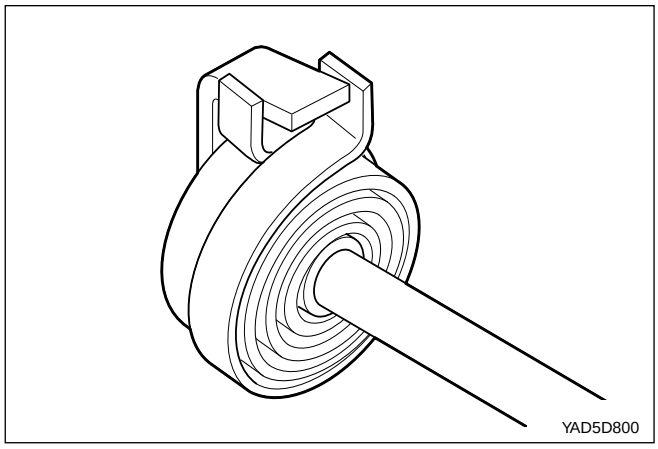
1. Insert the spacer into torsion spring.
2. Insert the end of the shift shaft into the spacer smoothly.



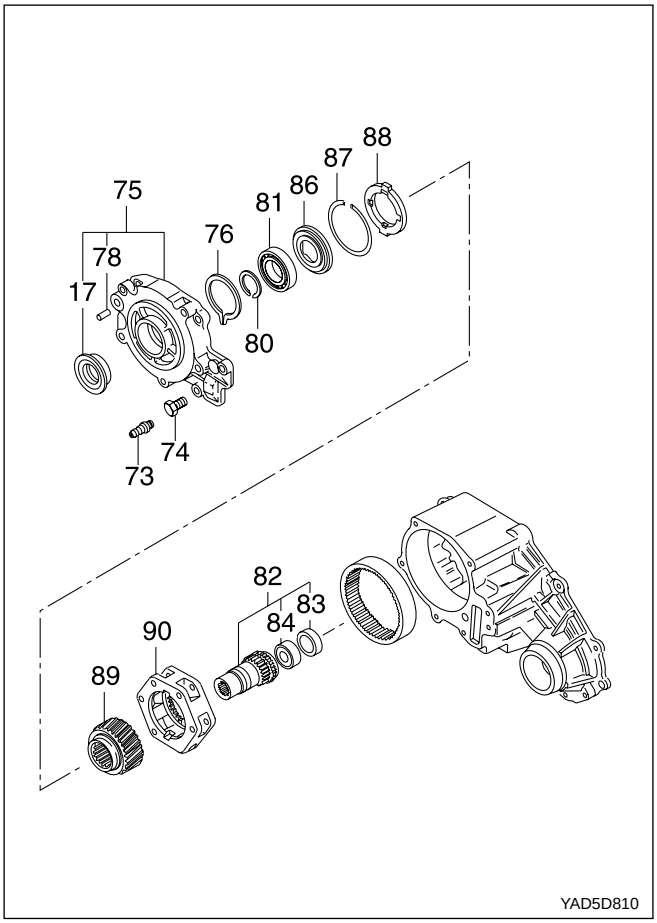
3. Slide the torsion spring and spacer to the left of the shift shaft and position the end of the first spring to fix on the drive tang.



4. Push the end of the second spring to right and fix it on the drive tang.



5. Push the torsion spring and spacer together back them completely.
6. Slide the electric shift cam onto the shift shaft.
7. Install the electric shift cam assembly into the transfer case after installation of the shift fork.



Adapter, Input Shaft and Carrier

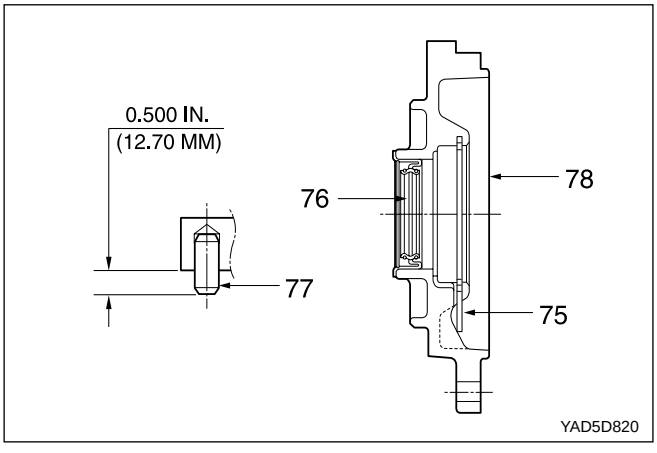
1. Place the planet carrier assembly on work bench to be the retaining ring mounting groove upward.
2. Install the sun gear with the hub end up into the planet carrier assembly and rotate the sun gear to make sure that gears are fully engaged.
3. Align the tabs and install the thrust plate into the planet carrier assembly.
4. Install the retaining ring to the planet carrier assembly.
5. Press the needle bearing into the input shaft and press the new sleeve bearing into the input shaft assembly.
6. Install the planet carrier assembly onto the input shaft and install the thrust washer. Press the bearing over input shaft.
7. After pressing the bearing, install the retaining ring.
8. Press the pin into the front adapter.
9. Slowly press the oil seal into the front adapter.
10. Install the front adapter assembly.

    Notice: After installation, make sure that snap ring is correctly installed into the groove.

11. Position the input shaft assembly over front cover and engage into the bearing groove by expanding the ends of snap ring.
12. Apply 1.6mm bead of sealant on the mounting face for the transfer case and tighten the 6 bolts.
13. Install the breather.

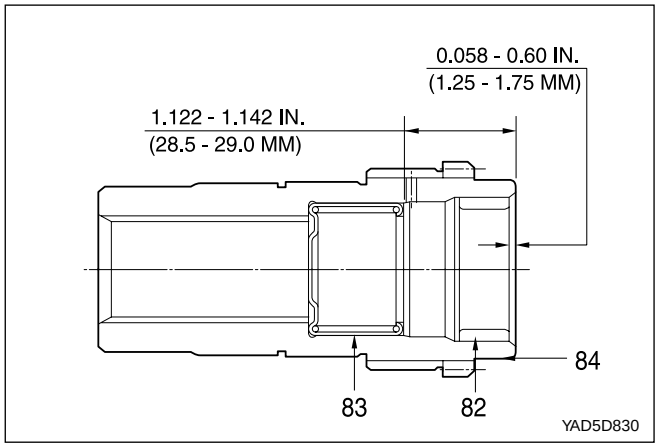
Installation Notice

Item	Tightening Torque
6 Bolts	28 - 48 N•m (21 - 35 lb-ft)
Breather	8 - 15 N•m



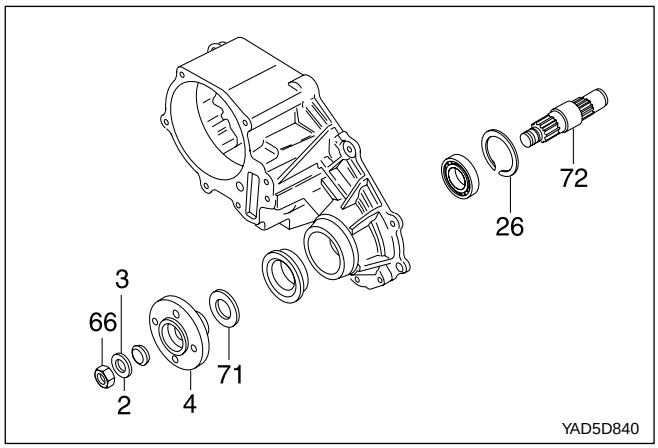
Front Output Shaft

Cross Sectional View



Input Shaft

Cross Sectional View

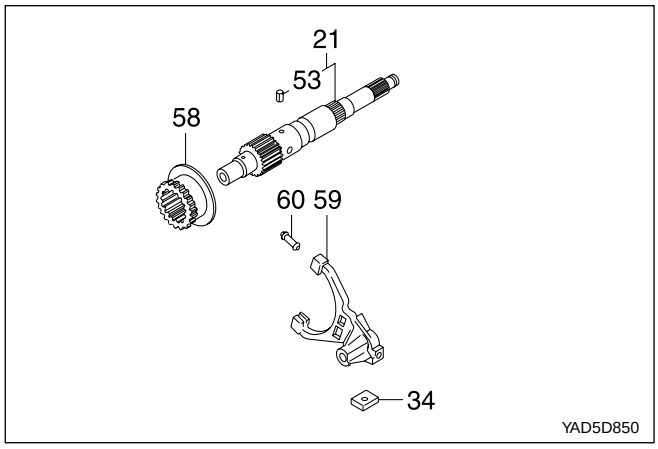


Front Output Shaft

1. Install the deflector on the yoke.
2. Position the output shaft in transfer case and install the companion flange assembly, oil seal, washer and nut.
3. Holding the companion flange, tighten the nut.

Installation Notice

Tightening Torque	346 - 380 N•m



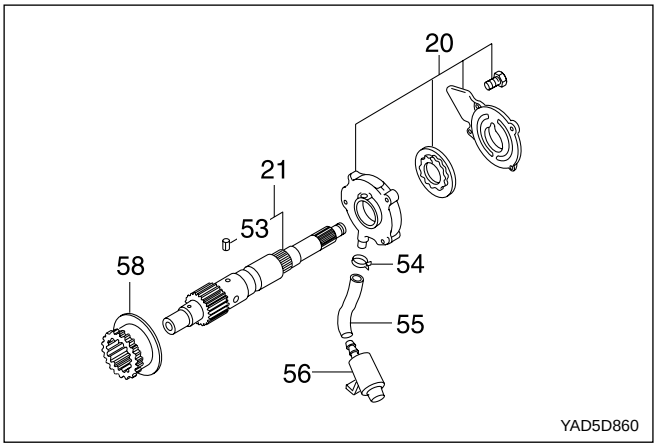
Reduction Shift Parts

1. Install the new pin, roller and retainer into the reduction shift fork.
2. Press the pin, roller and retainer into the reduction spilt fork bore completely.

   Notice: Make sure that the cam roller turns freely.

3. Install the 2 fork facing on the reduction shift fork assembly.
4. Install the reduction shift fork onto the previously installed reduction hub in the transfer case.
5. Install the output shaft spline into the reduction hub and engage the output shaft end with input shaft bearing.

   Notice: For installation of the output shaft, assemble the oil pump temporarily.



Oil Pump

1. Install the pump front cover to be the “TOP” mark down and turn the cover to be the “TOP” mark up when installed in vehicle.
2. Install the 2 pump pins and spring to the output shaft.

   Notice: Flat surface of the pins must point out and align the center line of pins and spring.

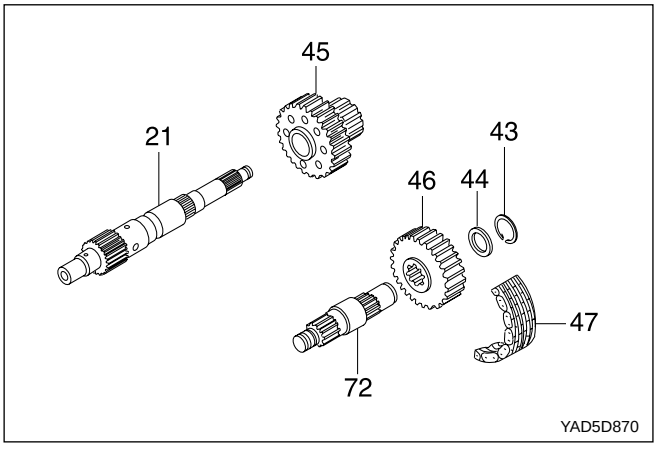
3. Connect the hose coupling to the strainer coupling and install the strainer foot into the transfer case slot.

   Notice: The hose coupling must face the pump assembly.

4. Install the pump housing to be the ‘REAR’ mark up and seat the 2 pump pins inside of the pump housing by moving pump pins inward and compressing the spring.
5. Tighten the hose to pump housing by hose clamp.
6. Position the pump rear cover to be the TOP REAR mark up and located at the top of transfer case when installed in vehicle. Position the pump retainer on the cover so that tab on the retainer is in notch in the transfer case. Apply Loctite to the bolts and tighten the bolts with turning the output shaft by hand to make the pump pins move freely.

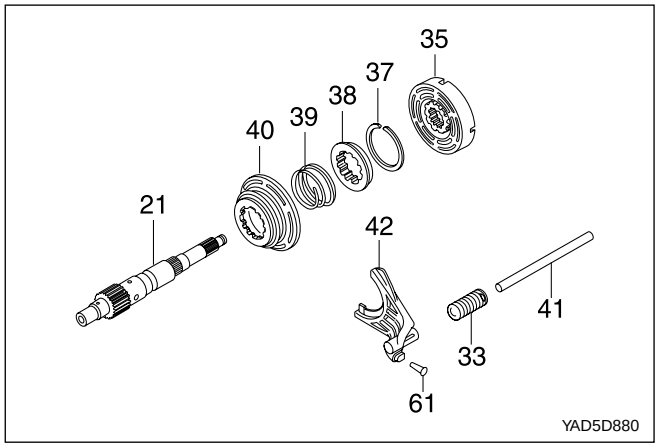
   Installation Notice

Tightening Torque	4 - 8.5 N•m (35 - 75.5 lb-in)



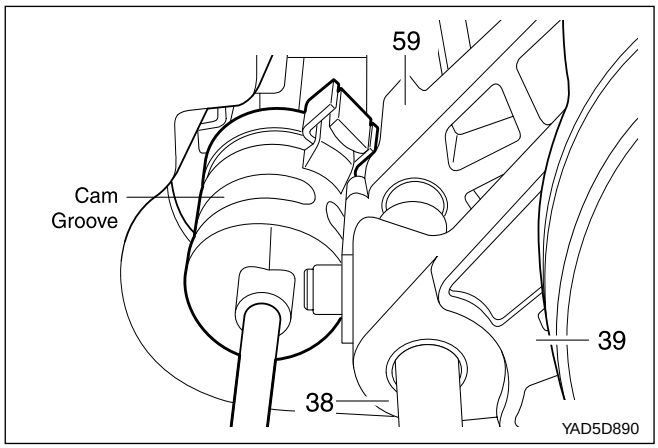
Drive Chain

1. Position the drive sprocket to the rear output shaft end and driven sprocket to the front output shaft end.
2. Install the drive chain onto the sprocket.
3. Holding each sprocket to be the drive chain tight and parallel with transfer case, install the drive chain assembly to the output shafts.
4. Rotate the driven sprocket slightly to engage splines on the front output shaft.
5. Install the spacer to the front output shaft and insert the snap ring into the shaft groove over spacer.



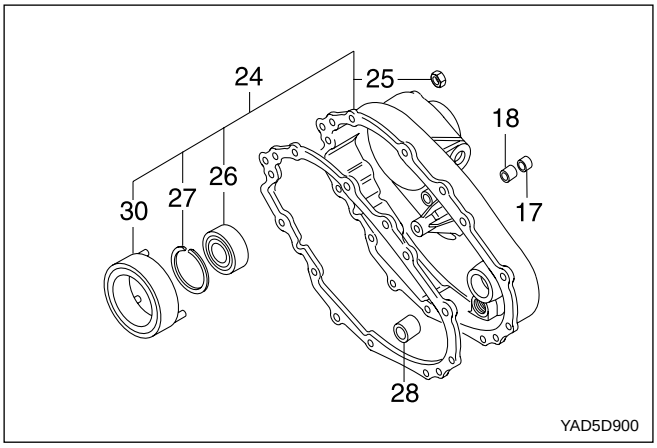
Lockup Shift

1. Install the lockup hub and return spring to the lockup collar and insert the snap ring.
2. Install the rail shaft through reduction shift fork assembly previously installed and into the blind hole in case.
3. Engage the lockup fork into the 2WD/4WD groove and check operation.
4. Install the shift collar hub to the output shaft spline.



5. Install the previously assembled electric shift cam and assemble the clutch housing as follows.
   - Rotate the shift cam assembly to right so that the end of the torsion spring contacts with reduction shift fork side.
   - Holding the rail shaft, lift up the fork assembly slightly.

     Adjust electric shift cam assembly so that the roller on reduction shift fork assembly is in groove in shift cam and button on lockup fork is on cam end.
   - Install the clutch housing over shift collar hub and insert the retaining ring into the clutch collar hub groove.



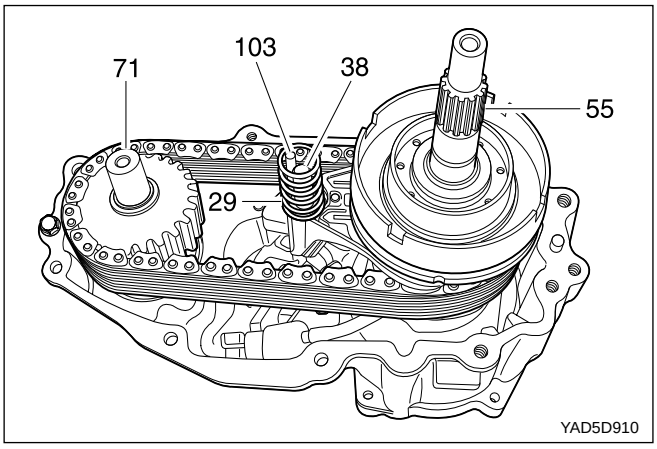
Cover

1. Position the cover to be the open end up on the work table.
2. Position the end of needle bearing to be identification mark up and press into the cover until upper end of bearing is 40.47 - 40.97 mm below cover face that contacts with transfer case.
3. Press the ball bearing into the cover and install the snap ring .
4. Install remaining parts as follows.
   - Install the 4 O-rings on the stud bolts of the clutch coil assembly.
   - Install the clutch coil assembly inside the cover and tighten 3 nuts.

   Installation Notice

Tightening Torque	8 - 11 N•m (71 - 97 lb-in)

   - Install the bearing and motor bearing into the cover.

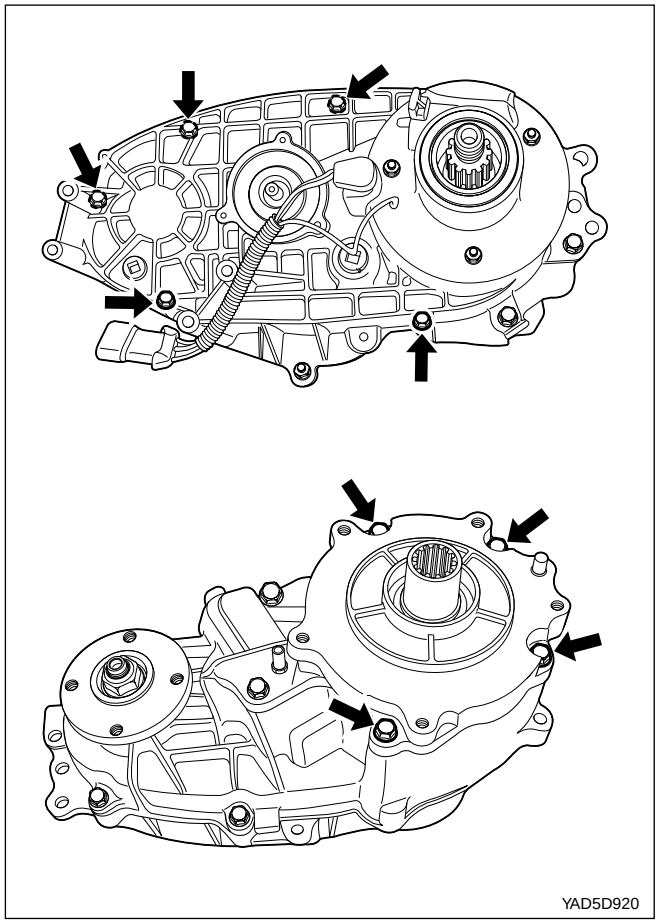


Cover Assembly

1. Install the return spring over rail shaft in the transfer case.
2. Insert the magnet into the transfer case slot.
3. Apply 1.6mm bead of Loctite RTV 598 to the transfer case mounting surface.

   Notice: For installation of cover, align the transfer case with cover not to use excessive force.

4. Install the cover onto the transfer case as follows:
   - Align the cover bores with transfer case pins.
   - Align the cover bearings with output shafts.
   - Align the cover blind hole with rail shaft and make sure that return spring is not cocked.

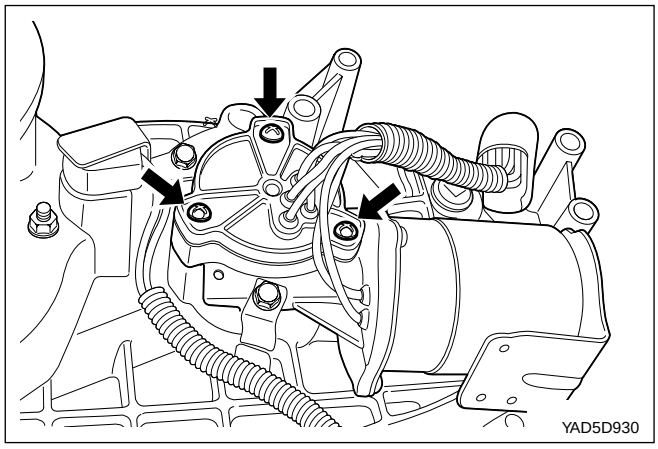


5. Tighten 9 bolts positioning identification tag and wiring clip.

Installation Notice

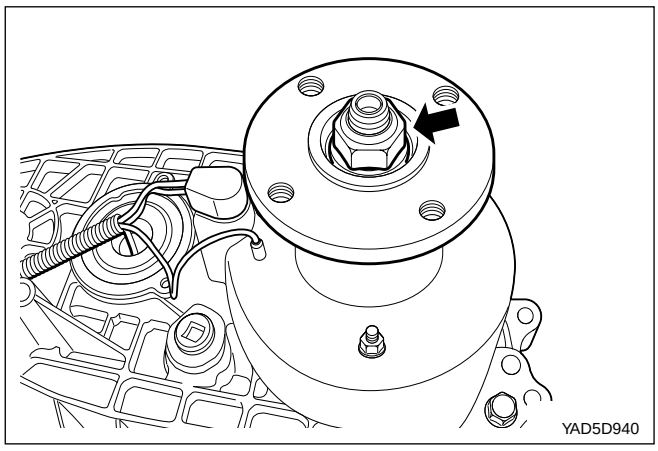
Tightening Torque	28 - 48 N•m (21 - 35 lb-ft)

6. Install the speed gear over output shaft spline in the cover assembly.
7. Press the new oil seal into the cover assembly.



External Electric Shift

1. Align the motor with shift shaft and position the motor assembly onto the cover.
2. Install the motor to the shift shaft and contact cover and rotate the motor clockwise direction to check correct engagement.



3. Insert the 0-ring on the speed sensor assembly to the cover.
4. Install the bracket to the motor assembly and tighten 3 bolts.

Installation Notice

Tightening Torque	8 - 11 N•m (71 - 97 lb-in)

Companion Flange

1. Install the 2 plugs to the cover.
2. Install the companion flange, oil seal and washer.
3. Holding the companion flange, tighten the nut.

Installation Notice

Tightening Torque	346 - 380 N•m

Notice: Apply Loctite #262 to nut before installation.

SECTION 5D2

TRANSFER CASE - TOD

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Special Tools and Equipment 5D2-89
Special Tools Table 5D2-89

GENERAL INFORMATION AND OPERATION

TOD system means the full time 4WD system and the registered trade mark of Borg Warner. TOD is an abbreviation of Torque On Demand.

TOD control unit automatically tailors torque distribution to road, offering full time four wheel drive. TOD distributes electronically-controlled power into front and rear wheels whose ratio change from 0 : 100 to 50 : 50 complying with wheel speed differences.

Also TOD control unit analyzes data from wheel speed sensor and engine output then changes pressure of electromagnetic clutch. This pressure controls front propeller shaft and power to front wheel. Power to front wheel depends on degree of pressure corresponding clutch slip.

TOD is designed to distribute the power to front and rear axle by operation of 4H/4L switch and shift motor. Shifting 4WD high (4H) to 4WD low (4L) is performed towards reducing high-low collar by means for connection high-low shift fork with output shaft in order to join with planetary gear. Torque transmits input shaft then sun gear rotating front planetary gear. Front planetary gear joins with output shaft and drives at low position.

The TOD system has 2 selectable mode, 4H and 4L. 4H is the normal operating mode when drive of which gear ratio is 1:1 and 4L mode distributes power to front and rear wheels 50 : 50 of which gear ratio is 2.48:1.

TOD SYSTEM FUNCTION

4H Mode

The TOD system transfer case controls the clutch mechanism to comply with rotation in front and rear propeller shaft and if its difference exceeds the permissible range, corresponding power is distributed into front wheel through electromagnetic clutch (EMC).

Hall effect speed sensors are located front and rear propeller shafts, send signals to TOD transfer case control unit (TCCU). The EMC coil is activated by variable current on exceeding difference of speed in front and rear propeller shafts.

4L Mode

When select 4L mode, EMC is locked to apply maximum torque into front and rear propeller shafts. Shift motor rotates also 4L position by rotation of cam thus propeller shaft torque changes from 1:1 to 2.48:1 by planetary gear set.

Transfer Case Control Unit (TCCU)

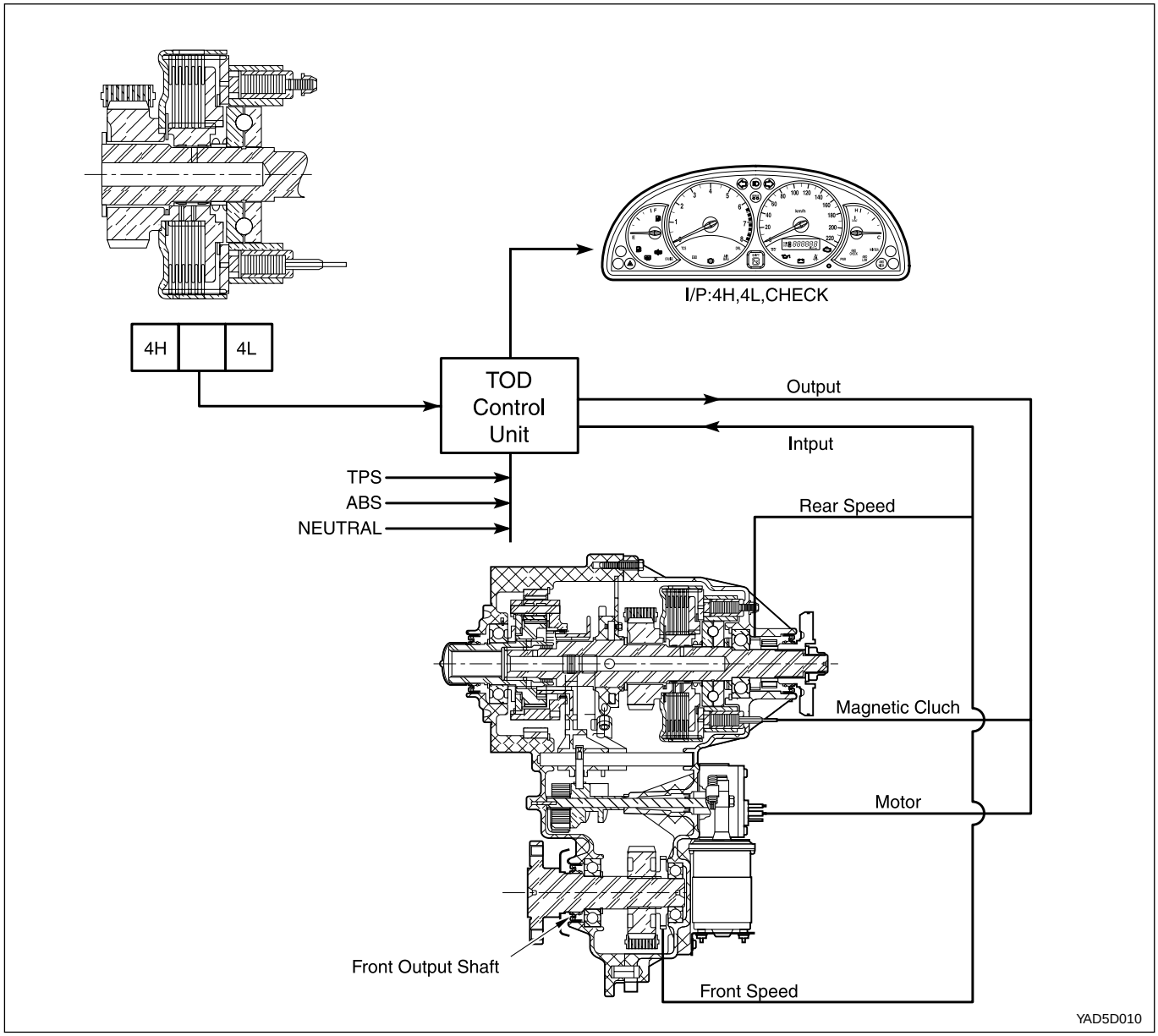
Transfer case control unit (TCCU) receives, front and rear propeller shaft speed, shift motor position and 4H/4L switch signals and controls electromagnetic clutch (EMC), shift motor. TCCU communicates with scan tool with K-line for diagnosis. It located under the front LH seat.

4WD OPERATION OVERVIEW

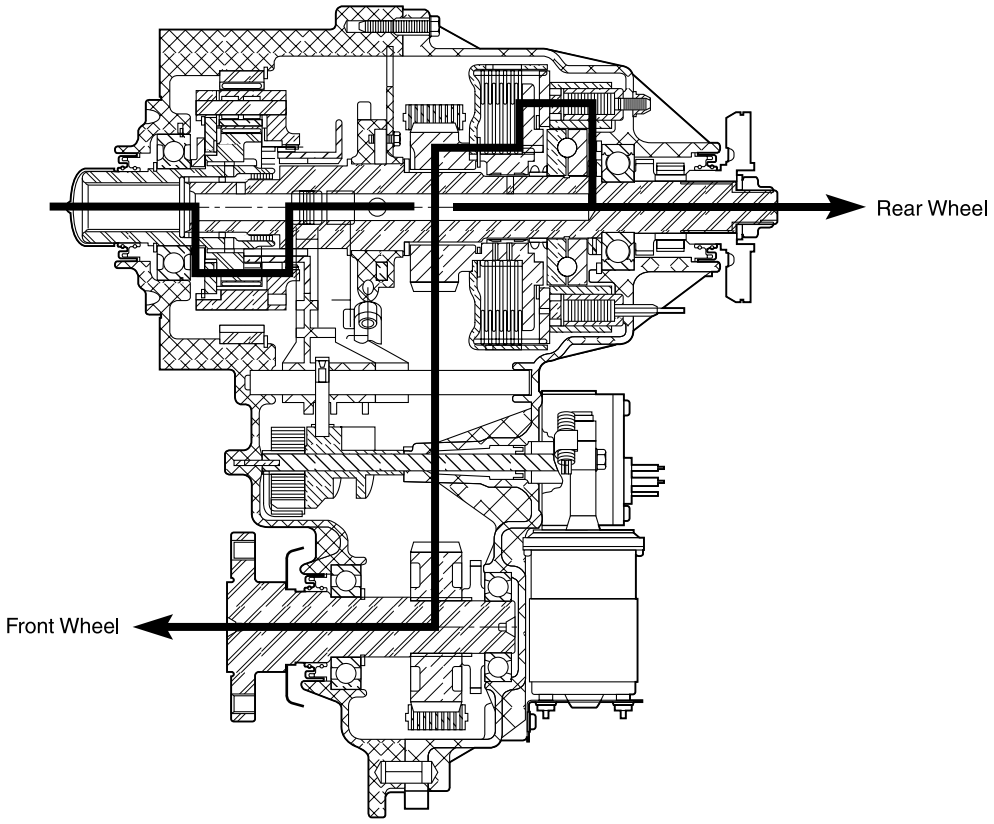
Application	Mode Position		Operation Condition
Driving Type	4H	4WD Drive(High Speed)	Normal Driving on the normal road or highway, or high speed driving Slipped road such as snow, rainy, sand, mud etc.
	4L	4WD Drive(Low Speed)	Max driving force requiring condition such as towing, rough road. Same function as part time transfer case 4L.
Transferring	4H ↔ 4L	4WD Drive High Speed ↔ Low Speed	A vehicle should stop for transfer. Manual Transmission • Transfer starts after the vehicle stops and the clutch is applied Automatic Transmission • Transfer starts after the vehicle stops and the shift lever is shifted [N] position.

Notice: After the vehicle stops and the mode switch is selected with applying the brake pedal, shifting [N-R-N] makes the mode transfer easier.

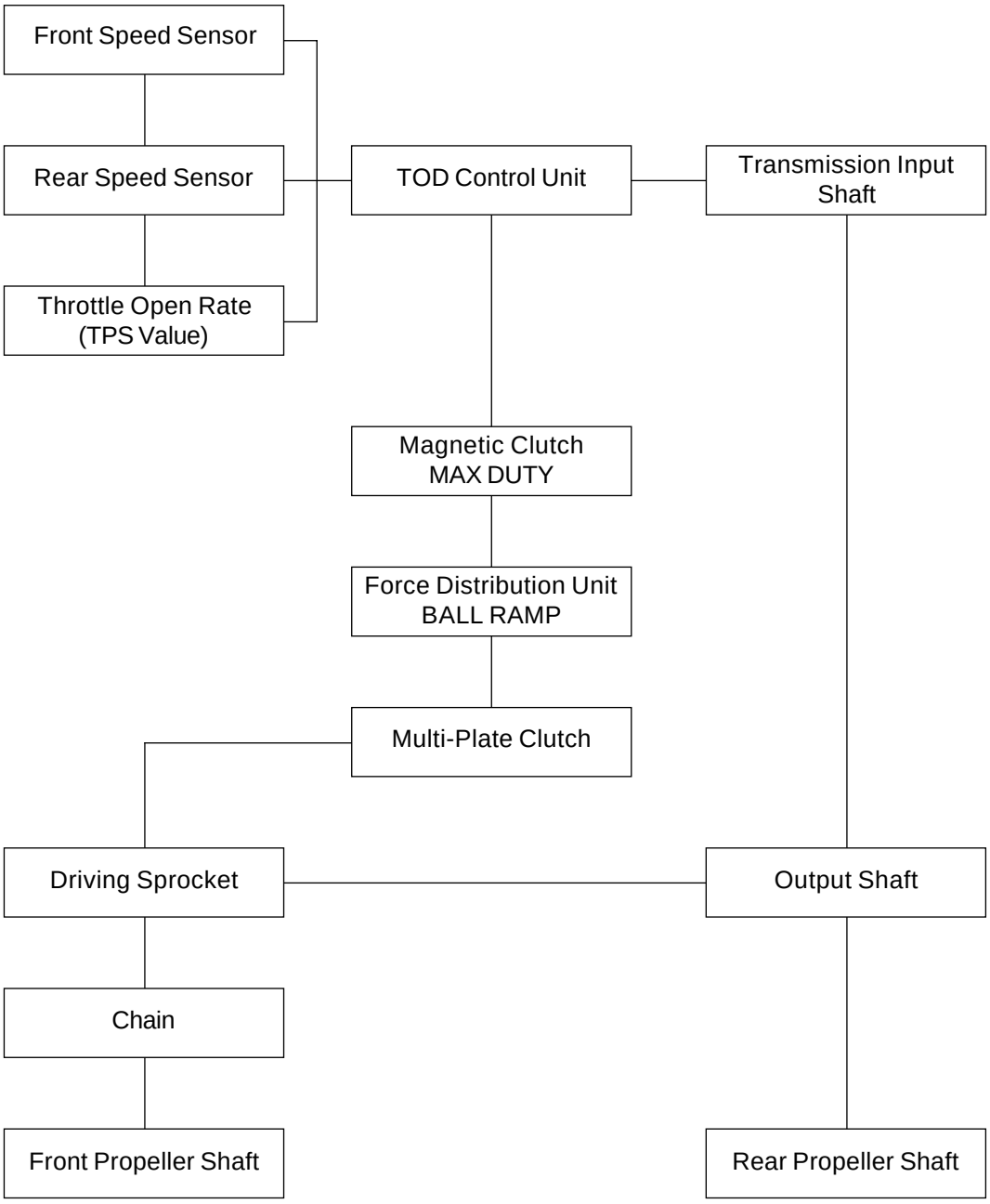
SYSTEM STRUCTURE



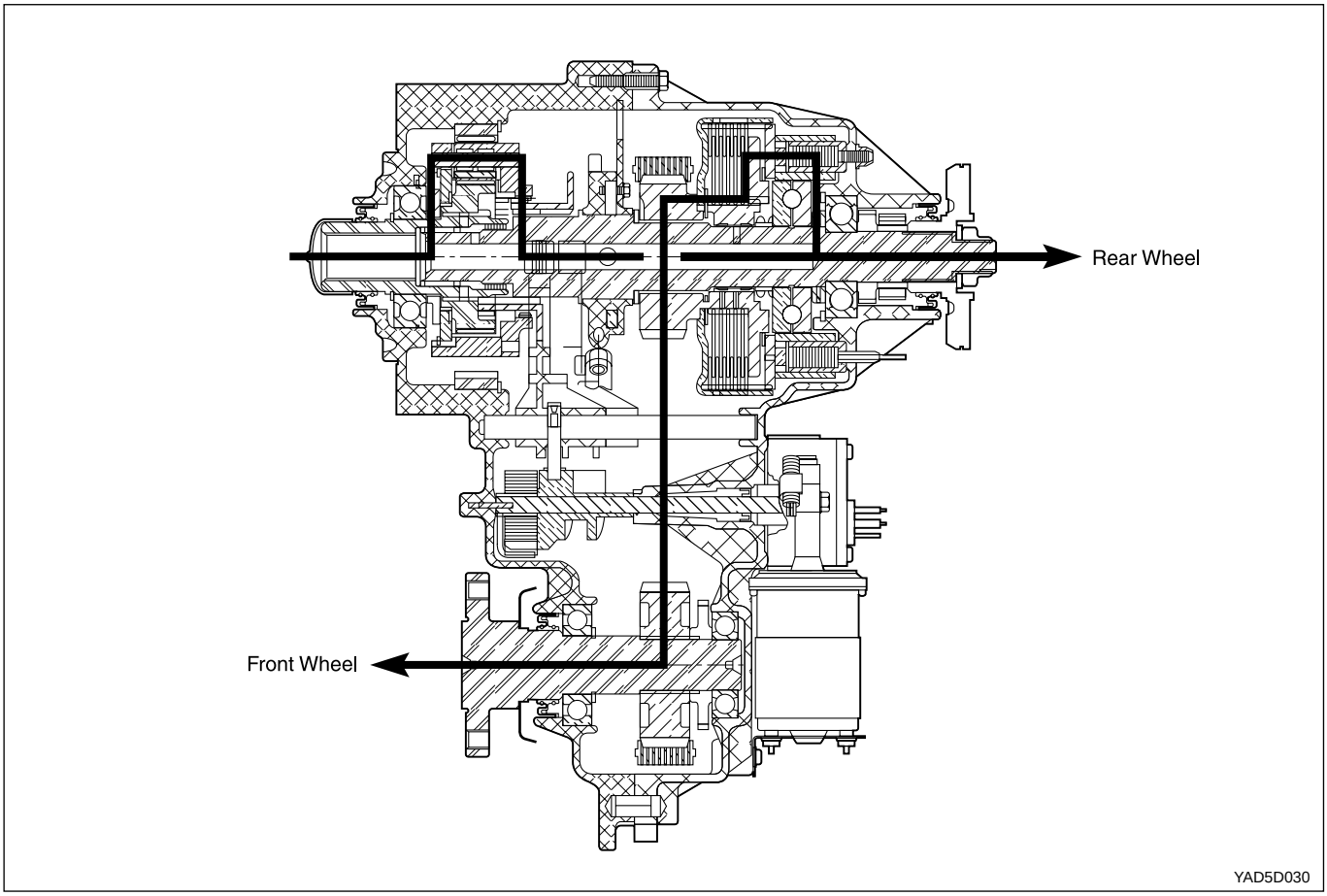
4H MODE (4WD DRIVE - HIGH SPEED)



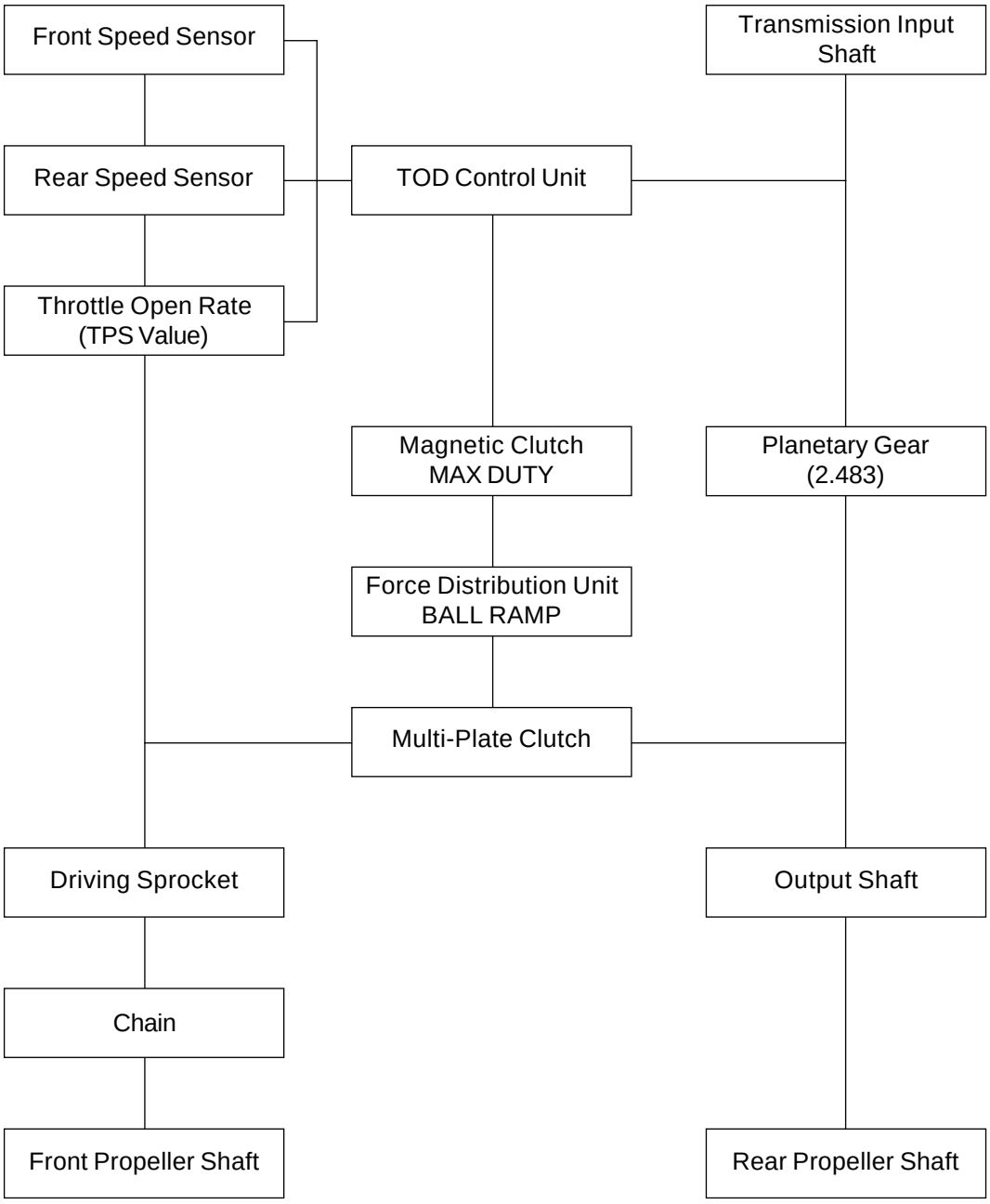
Power Flow


Front Speed Sensor
Rear Speed Sensor
Throttle Open Rate (TPS Value)
TOD Control Unit
Transmission Input Shaft
Magnetic Clutch MAX DUTY
Force Distribution Unit BALL RAMP
Multi-Plate Clutch
Driving Sprocket
Output Shaft
Chain
Front Propeller Shaft
Rear Propeller Shaft

4L MODE (4WD DRIVE - LOW SPEED)



Power Flow


Front Speed Sensor
Transmission Input Shaft
Rear Speed Sensor
TOD Control Unit
Throttle Open Rate (TPS Value)
Magnetic Clutch MAX DUTY
Planetary Gear (2.483)
Force Distribution Unit BALL RAMP
Multi-Plate Clutch
Driving Sprocket
Output Shaft
Chain
Front Propeller Shaft
Rear Propeller Shaft

SPECIFICATIONS

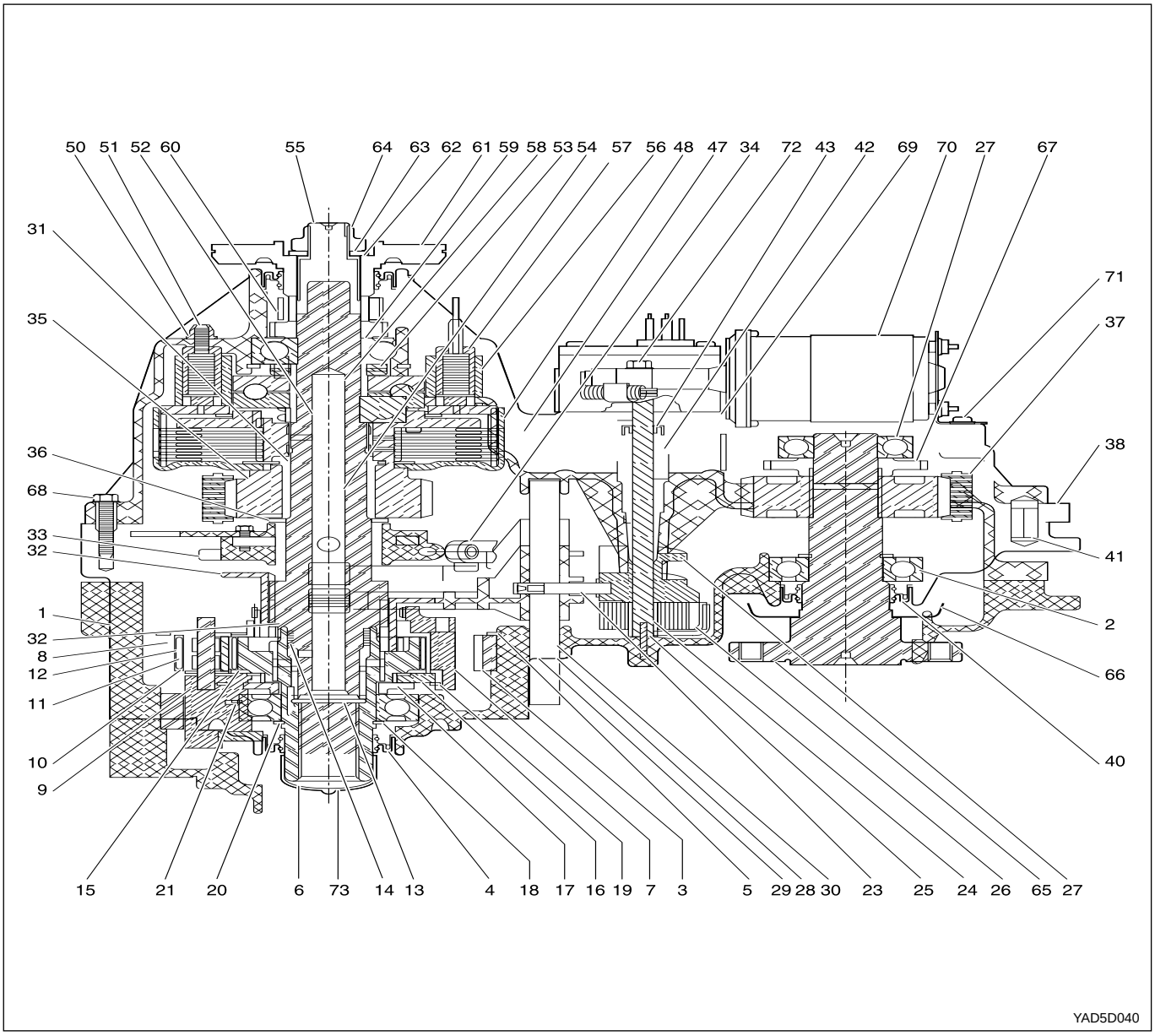
Check			Action
TOD	Model		TOD (Torque On Demand) Transfer Case (4423E)
	Length		343.0 mm
	Weight (w/oil)		37.9 kg
	Shift Mode		4H and 4L
	Gear Ratio	High	1 : 1
		Low	2.48 : 1
	Oil	Specification	ATF S-3, S-4 or Dexron II, III
		Capacity	1.4 L
		Interval	Inspect Every 15,000km,
	Max. Torque		Replace Every 50,000km
			550 lb ft (76kg cm)
TOD Control Unit	Voltage	Normal Range	9-16 V
		CAN Comm.	6-16 V
	Current(Below Max. Operation Voltage)	Ignition Switch OFF	2 mA
		Ignition Switch ON	1 A
	Max. Operation Current	Motor OFF	7 A
		Motor ON	20 A

TIGHTENING SPECIFICATIONS

Application	N•m	Kgf.m
Clutch Coil Retaining Bolt	10	1.0
Drain Plug	25	2.5
Filter Plug	25	2.5
Front Case - Rear Case Mounting Bolt	31	3.1
Front Propeller Shaft - Front Output Shaft/Flange Mounting Bolt	85	8.6
Planner Damper - Transfer Case Mounting Bolt	35	3.6
Rear Output Shaft Flange Mounting Nut	167	17.0
Rear Propeller Shaft - Rear Output Shaft/Flange Mounting Bolt	85	8.7
Shift Motor Adjusting Nut	5	0.5
Shift Motor Bracket Bolt	10	1.0
Shift Motor Mounting Bolt	10	1.0
Speed Sensor Retaining Bolt	5	0.5
Transfer Case Control Unit (TCCU) Retaining Bolts	10	1.0
Transfer Case - Transmission Adapter Housing Mounting Bolt	48	4.9

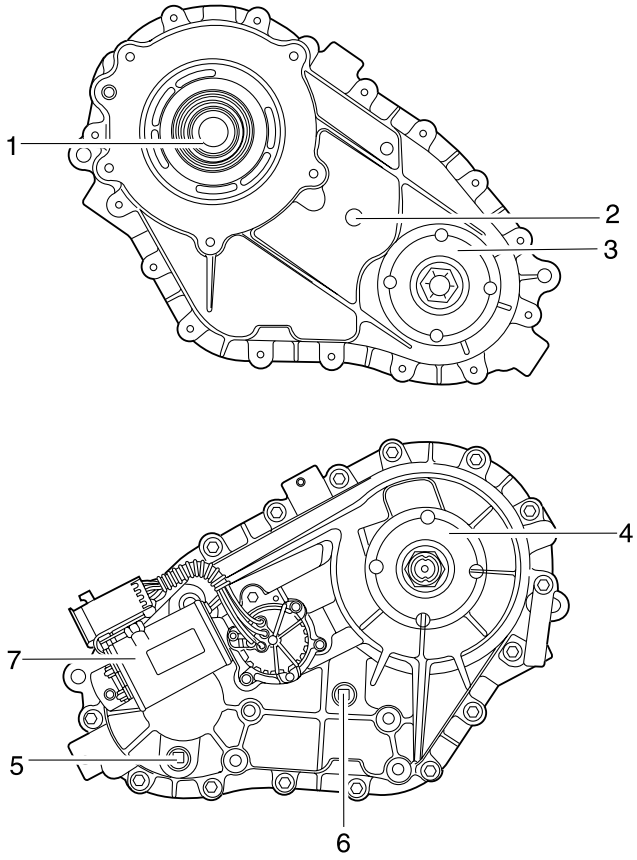
COMPONENT LOCATOR

TRANSFER CASE CROSS SECTIONAL VIEW



1 Case
2 Bearing
3 Ring Gear
4 Oil Seal
5 Retaining Ring
6 Input Shaft
7 Carrier
8 Pinion Gear
9 Pinion Shaft
10 Thrust Washer
11 Needle Roller
12 Spacer
13 Bearing
14 Bushing
15 Sun Gear
16 Thrust Plate
17 Hub
18 Bearing
19 Snap Ring
20 Snap Ring
21 Snap Ring
22 Hub Reduction
23 Shift Fork
24 Spacer
25 Shaft Shift
26 Spring
27 Cam
28 Breather Hose
29 Breather Plug
30 Shift Rail
31 Intermediate Shaft
32 Thrust Washer
33 Pump
34 Clamp Hose
35 Upper Sprocket
36 Thrust Washer
37 Chain
38 Cover
39 Bearing
40 Oil Seal
41 Dowel Pin
42 Bearing Sleeve
43 Seal
44 Snap Ring
45 Center Bearing Support
46 Ball Bearing
47 Dowel Pin
48 Viscous Coupling
49 Pinion Gear
50 Thrust Washer
51 Pinion Shaft
52 Thrust Washer
53 Thrust Washer
54 Bushing
55 Output Shaft
56 Ring Gear
57 Retaining Ring
58 Needle Bearing
59 Ball Bearing
60 Speed Gear
61 Flange
62 Oil Seal
63 Washer
64 Nut
65 Flange
66 Dust Deflector
67 Tone Wheel
68 Bolt
69 Motor
70 Bolt
71 Cap Screw

TRANSFER CASE ASSEMBLY



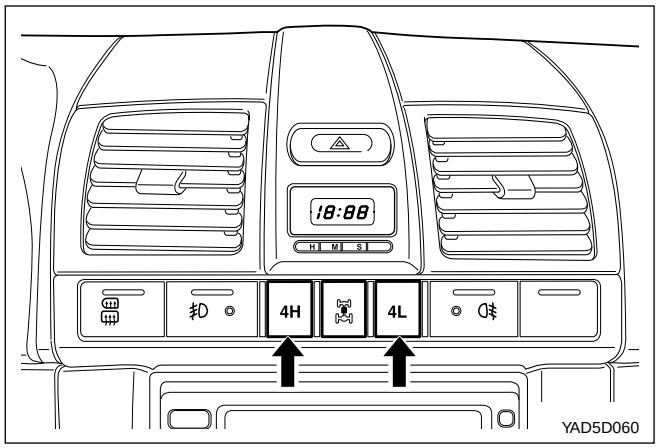
YAD5D050

1 Input Shaft
2 Air Control Cap
3 Front Companion Flange
4 Rear Companion Flange
5 Drain Plug
6 Filler Plug
7 Shift Cam Driving Motor

FUNCTION DESCRIPTION

TOD SYSTEM SELECT MODE

4H is the mode when drive normally of which gear ratio is 1 : 1 and 4L mode distributes power to front and rear wheels 50 : 50 of which gear ratio is 2.48 : 1.



TOD system controls clutch mechanism to comply with rotation in front and rear propeller shaft and if its difference exceeds the permissible range, corresponding power is distributed into front wheel through EMC (Electro-Magnetic Clutch). Hall effect sensor signals speed on front and rear propeller shafts going through with TOD control unit.

Transfer case clutch coil is activated by variable current on exceeding difference of speed in front and rear propeller shafts.

Select 4L Mode

When select 4L mode, EMC is locked to apply maximum torque into front and rear propeller shafts. Shift motor rotates also 4L position by rotation of cam thus propeller shaft torque changes from 1 : 1 to 2.48 : 1 by planetary gear set.

Deselect 4L Mode

When select 4H mode, the 4WD mode is deselected and returns the 4WD - high speed mode.

- "4H" switch : Slef-return Type
- "4L" switch : Push Lock Type

COMPONENT FUNCTION

Shift Motor

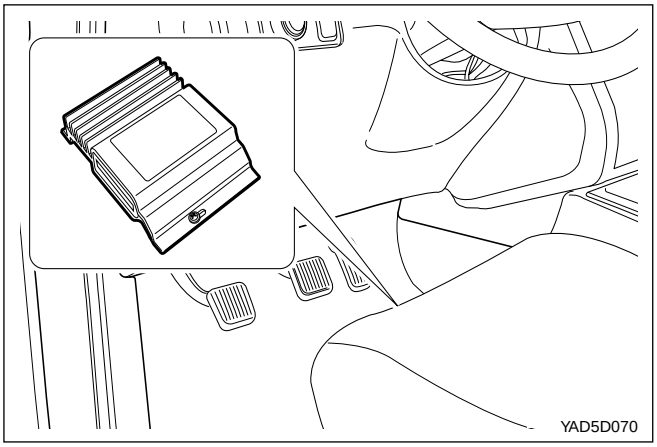
It locates backside transfer case, which drives rotary helical cam. When mode select switch changes to 4L, shift fork is on position for 2.48:1 by rotation of helical cam.

Transfer Case

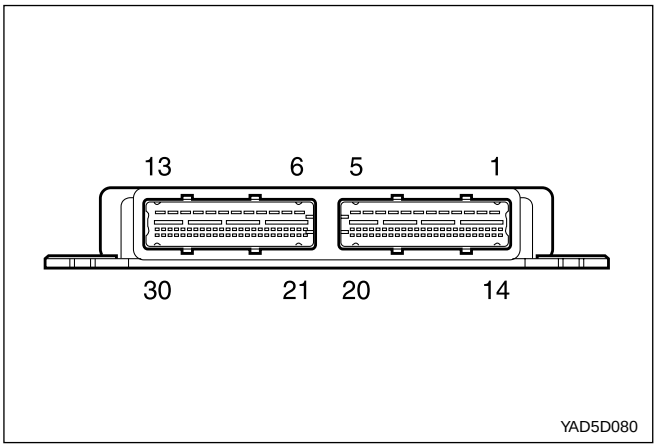
TOD transfer case distributes power into front and rear axle by operation of 4H/4L switch and shift motor. Shifting 4H to 4L, is performed towards reducing HI-LO collar by means for connection HI-LO shift fork with output shaft in order to join with planetary gear. Torque transmits input shaft then sun gear rotating front planetary gear. Front planetary gear join with output shaft and drives LO position.

TOD Control Unit

TOD control unit is located on the floor under the driver seat.



Shape and function of TOD Control Unit

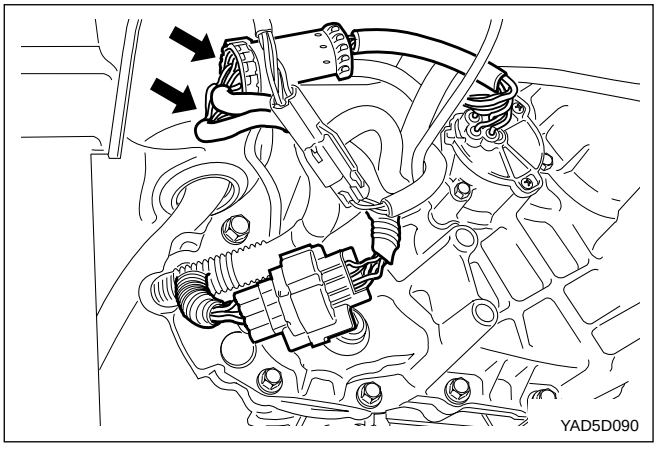


Pin	Function	Pin	Function
1	Motor HI-LO	16	Speed Reference
2	Motor LO-HI	17	Ground
3	EMC	18	Ground
4	Battery (+)	19	Battery (+)
5	Ignition	20	K-LINE
6	Position Return	21	4L Illumination
7	Diagnosis Display	22	CAN-H
8	-	23	CAN-L
9	HI / LO Switch	24	Auto T/M, Neutral
10	Position 2	25	ABS Input
11	Front Speed	26	Brake Switch
12	TPS Supply (Diesel)	27	Position 1
13	Speed/TPS Return	28	Position 3
14	Motor HI-LO	29	Rear Speed
15	Motor LO-HI	30	Position 4

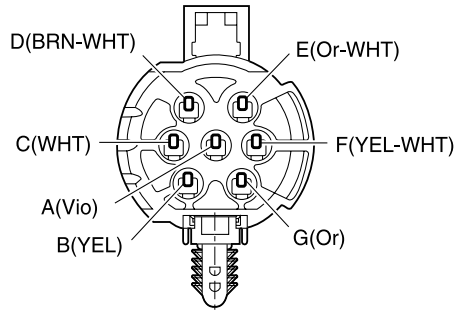
Speed Sensor, Clutch Coil, Motor Connector

Speed Sensor, Clutch Coil and Motor Connector are located at the upper & rear side of the transfer case (upper shift motor) as shown.

- Shift Motor Connector : Black (upper arrow as shown)
- Speed Sensor and Clutch Coil Connector : White (lower arrow as shown)



Shift Motor Connector

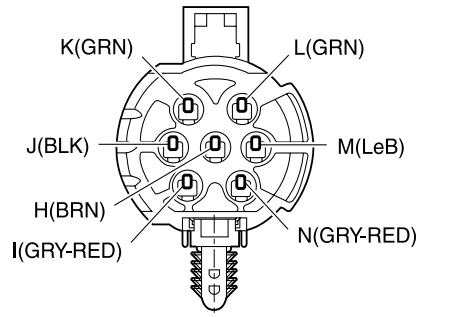


Connector Rear Section View

YAD5D100

Pin	Function
A	Motor HI-LO (clockwise)
B	Motor HI-LO (counter-clockwise)
C	Position Return
D	Position 1
E	Position 2
F	Position 3
G	Position 4

Speed sensor, clutch coil connector

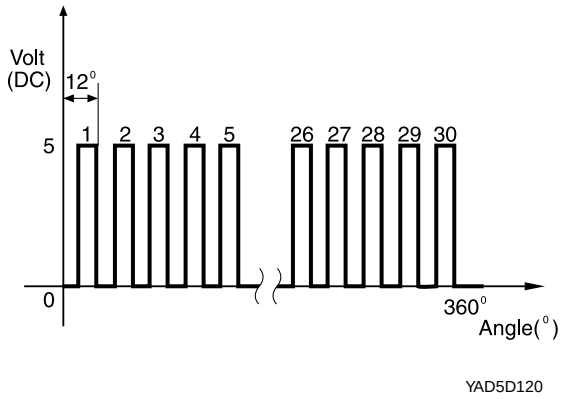


Connector Rear Section View

YAD5D110

Pin	Function
H	Clutch Coil
I	Front Speed Return
J	Front Speed
K	Front Speed Sensor Voltage Supply
L	Rear Speed Sensor Voltage Supply
M	Rear Speed
N	Rear Speed Return

DEFINITION OF TERMINOLOGY

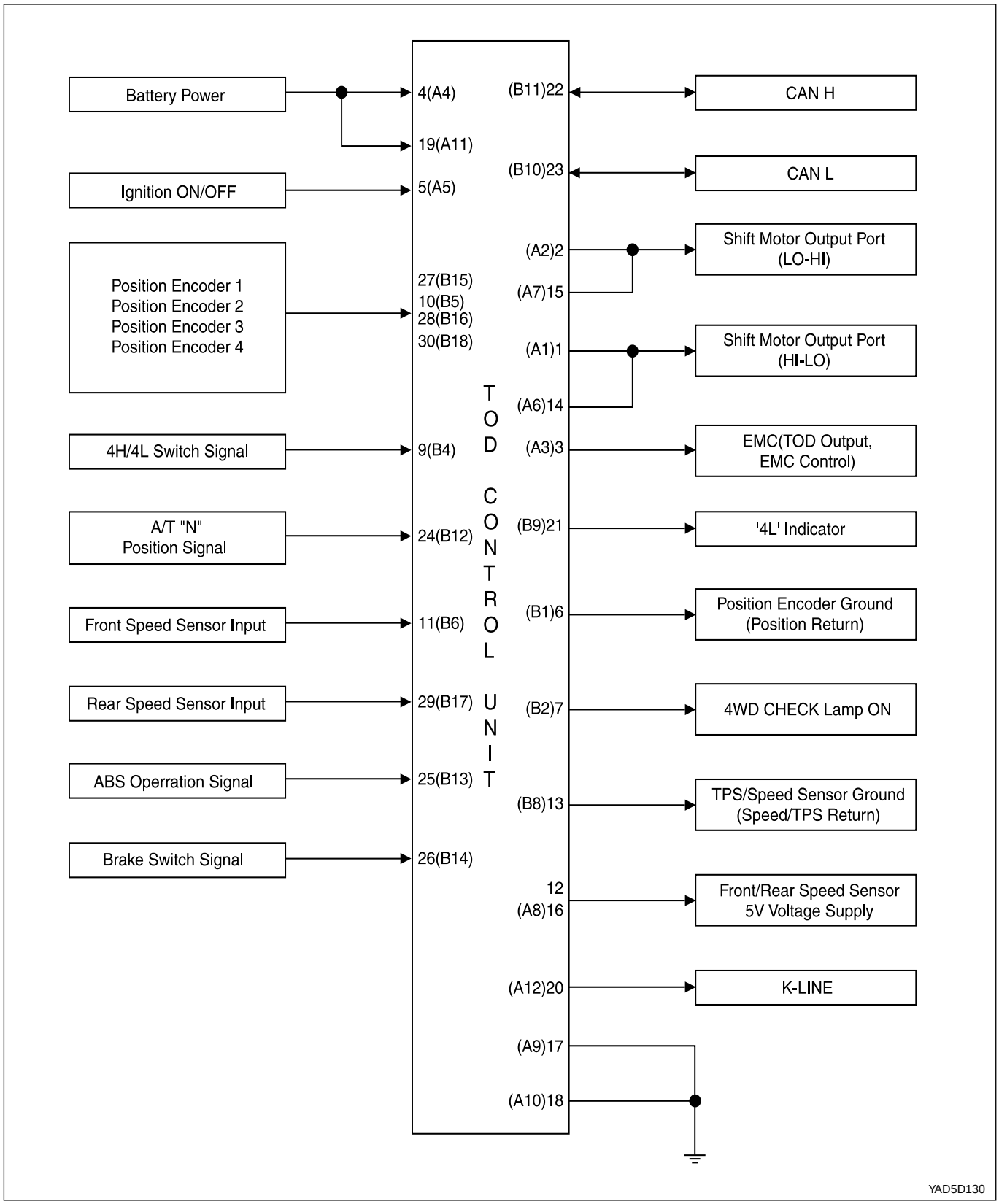
Definitions	Description
Rear Speed Sensor	A Hall Effect speed sensor which produces a square wave. 0-5Vdc signal in response to a rotating 30 tooth wheel coupled to the rear propeller shaft inside the Transfer Case. Each rotation of the rear propeller shaft will result in 30 speed sensor pulse.  YAD5D120
Front Speed Sensor	A Hall Effect speed sensor which produces a square wave. 0-5Vdc signal in response to a rotating 30 tooth wheel coupled to the front propeller shaft inside the Transfer Case.
EMC (Electromagnetic Clutch)	Each rotation of the front propeller shaft will result in 30 speed sensor pulse. An Electromagnetic clutch used to control the amount of torque applied to the front propeller shaft.
TOD	TOD is an abbreviation of Torque On Demand and means that the torque is transferred according to the operating condition.
TPS (Throttle Position Sensor)	TPS is an abbreviation of Throttle Position Sensor. For MSE engine, the potentiometer in the throttle actuator acts as TPS.
PWM	PWM is an abbreviation of Pulse Width Modulation and is a type of output value control by adjusting pulse width.
Duty Cycle	Duty Cycle is the time the EMC is on divided by the period in which it is being modulated.
Touch-off	A minimum amount of duty cycle applied to the EMC.
Front Overrun	A condition where the front propeller shaft is turning at a rate which is faster than the rear propeller shaft.
Rear Overrun	A condition where the rear propeller shaft is turning at a rate which is faster than the front propeller shaft.
High Range	The highest (numerically lowest = 1 : 1) gear ratio between the input and outputs of the Transfer Case.
Low Range	The lowest (numerically highest = 2.48 : 1) gear ratio between the input and outputs of the Transfer Case.

Definitions	Description
4H/4L Switch	A switch which selects the desired gear ratio. Electric motor which changes the Transfer Case range.
Shift Motor	A set of 4 Gray code switches which provide feedback to the TOD indicating the position of the Shift Motor.
Position Encoder	A switch on vehicles equipped with a manual transmission which indicates that the clutch pedal is depressed.
Neutral Safety Switch	A switch on vehicles equipped with an automatic transmission which indicates that the transmission is in neutral.
Shift Inhibit Speed	The vehicle speed above which Transfer Case shifts are disallowed. Vehicle speed is indicated by propeller shaft speed measurement.

CONTROL UNIT

Input/Output diagram

TOD control unit and main wiring harness is linked by 30 pin connector. Each pin joins with switch and actuator whose details refer to the below diagram.



Classification	Pin No.	Pin Name	Description
Power Supply	17,18	Ground	TOD control unit ground
	4,19	Input	TOD control unit battery supply : (Fuse No 13,20A)
Signal Input	5	Ignition	Ignition ON / OFF
	27	Position 1	Position encoder 1 : check of shift motor position
	10	Position 2	Position encoder 2 : check of shift motor position
	28	Position 3	Position encoder 3 : check of shift motor position
	30	Position 4	Position encoder 4 : check of shift motor position
	9	4H/4L Switch	Transfer case mode input
	24	Auto T/M Neutral	Check of neutral gear position in Auto T/M
	12, 16	Speed Voltage Supply	5V supply (TPS / speed sensor)
	11	Front Speed	Front speed sensor signal input
	29	Rear Speed	Rear speed sensor signal input
	25	ABS Operation	ABS ON / OFF
	26	Brake Switch	Brake Switch ON/OFF Signal Input
	22	CAN-L	CAN bus low line
	23	CAN-H	CAN bus high line
	20	K-LINE (1)	Connect to Diagnostic Connector No. 15
Signal Output		Motor LO-HI	Motor output port - LO to HI : join with battery - HI to LO (or motor brake) : join with ground
		Motor HI-LO	Motor output port - HI to LO : join with battery - LO to HI (or motor brake) : join with ground
	3	EMC	TOD Output
	21	4L Illumination	When the transfer case is in “4L” mode, illuminates “4L” indicator.
	6	Position Return	Position encoder ground
	7	Self Diagnosis Display	Illuminates “4L” indicator “4WD check lamp” turns ON Upon defect ; Ground circuit
	13	Speed	Ground for speed sensor / TPS

(1) K-LINE : It means that Communication line for coding and diagnosis with diagnostic scanning tool.

SYSTEM OPERATION

Initial Operation of TOD Control Unit

When ignition “ON”, “4L” and “4WD check” lamps illuminates for 0.6 second to check bulb in instrument panel, then perform diagnosis of system (See 3F-19 Self-Diagnosis Condition).

Position Encoder

The Position Encoder is used by the TOD to determine the position of the Shift Motor. Each motor position is identified by a position code below.

Notice:

- All other position codes are invalid
- Position

  Input Open Circuit (> 4.5V) = 1
- Position Input shorted to Speed/Position Return (< 0.5V) = 0

Position Code 1/2/3/4	Motor Position	Position Code 1/2/3/4	Motor Position
1110	Left Stop	1001	Neutral
1010	Left of High	0001	Zone 2
0010	High	0101	Low
0000	Right of High	0100	Right Stop
1110	Zone 1	-	-

Position Sensor Interpretation

When the module powers up, it will read the position sensor and the 4H/4L switch input and respond to the possible codes as follows.

4H/4L Switch Input	Motor Position	System Response (Action)
4H	Left Stop	No action required. 4L bulb off.
4H	Left of High	No action required. 4L bulb off.
4H	High	No action required. 4L bulb off.
4H	Right of High	Blink 4L bulb. After the shift conditions are met, attempt a shift to 4H under conditions of below 87 rpm in front and rear propeller shaft and “Neutral” position. After successfully shifting into 4H, stop blinking 4L bulb.
4H	Zone 1	Same as above
4H	Neutral	Same as above
4H	Zone 2	Same as above
4H	Low	Blink 4L bulb. After the shift conditions are met, attempt a shift to 4L. After successfully shifting into 4L, stop blinking 4L bulb.
4H	Right Stop	Same as above
4L	Left Stop	Blink 4L bulb. After the shift conditions are met, attempt a shift to 4L. After successfully shifting into 4L, stop blinking 4L bulb.
4L	Left of High	Same as above
4L	High	Same as above
4L	Right of High	Same as above
4L	Zone 1	Same as above
4L	Neutral	Same as above
4L	Zone 2	Same as above
4L	Low	No action required. 4L bulb on.
4L	Right Stop	No action required. 4L bulb on.

A command to shift will only be acted upon if the TOD is reading a valid code at the time the command to shift is made.

After a shift has started, the TOD will power the shift motor until the code for the requested position is read. If an invalid code is read, the TOD will go into a default mode.

During a shift attempt, the shift motor will be energized for a maximum of 5 seconds.

Electric Shift System Operation

The Electric Shift System is responsible for changing the Transfer Case gear ratio by controlling the electric shift motor. The TOD monitors the 4H/4L switch, neutral switch, speed sensors, position encoder, and ignition switch.

A range change is initiated when ;

1. The 4H/4L Switch is changed from 4H to 4L or from 4L to 4H.
2. The motor position (as indicated by the position encoder) does not match the 4H/4L Switch immediately after the ignition is turned on.

Shift criteria

When a range change is initiated a Diagnostic Test will be completed on the motor, speed sensors, and position encoder. If the Diagnostic Test fails, the shift will not be attempted. If all components are operating properly, the TOD will attempt a range change after the following shift criteria are met:

1. The transmission is in neutral for 2 seconds after the shift is requested.
2. Both propeller shaft speeds are below 87 rpm (2580 pulses/minute).

If the transmission is taken out of neutral before 2 seconds has elapsed, or either propeller shaft speed increases above the limit, the shift will be suspended and the 4L Indicator will continue to blink until the criteria are met again or the 4H/4L Switch is returned to the original position.

Range change

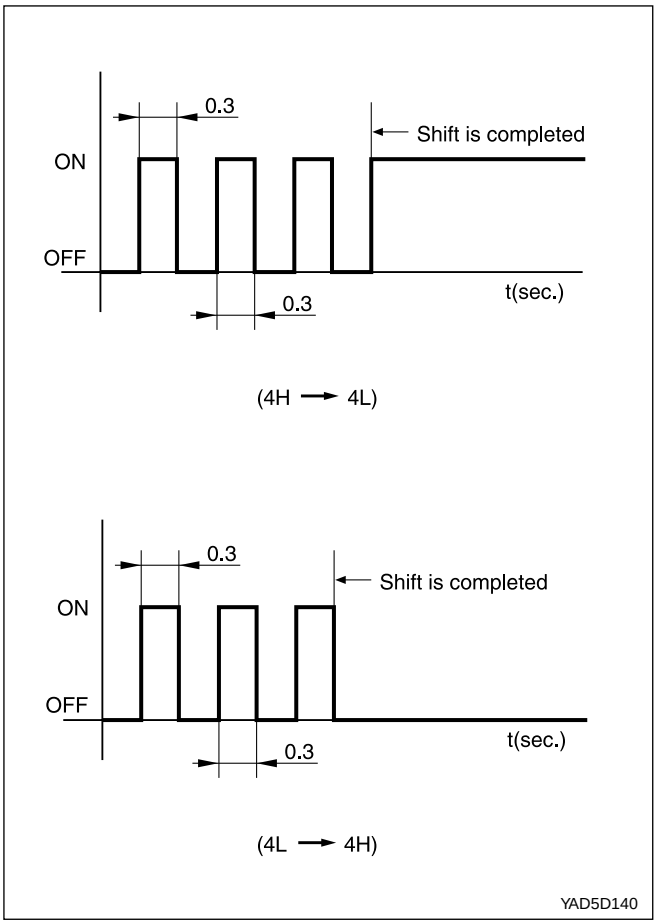
When the shift criteria are met, the motor is rotated in the appropriate direction (as determined by the selector switch) until one of the following occurs:

1. The motor reaches its destination.
2. The motor is on for 5 seconds without reaching its destination. The shift has failed and the TOD will respond as default mode.
3. A fault occurs with either the motor or position encoder. Refer to the diagnosis requirement.

When the motor is energized, the Ignition, 4H/4L Switch, propeller shaft speeds, and transmission neutral inputs are ignored.

Indicator function on shifting

Once a range change has been initiated the 4L Indicator will begin to blink at a rate of 0.3 seconds on, 0.3 seconds off until the shift is completed or canceled.



If a successful shift has been completed, the 4L Indicator will be illuminated if the motor is in Low and it will be turned off if the motor is in High.

4L Indicator illuminates as below figure.

Electric shift default mode

If the motor fails to reach its destination, the TOD will attempt the following (in order):

1. The TOD will wait 3 seconds then attempt the shift again.
2. If the second attempt to reach the destination fails the TOD will wait 3 seconds then attempt to rotate the motor back to the original position. If successful, all future shifts will be inhibited until the Ignition is cycled.
3. If the attempt to return to the original position fails, the TOD will wait 3 seconds then attempt to rotate the motor to the original position again. If the second attempt to return to the original position is successful, the 4WD CHECK lamp will be illuminated, and all future shifts will be inhibited until the Ignition is cycled.

4. If the second attempt to return to the original position fails the motor will be turned off, the “4WD CHECK” lamp will be illuminated, and all future shifts will be inhibited until the Ignition is cycled.

TOD TM System operation

The TODTM System is responsible for distributing torque between the front and rear axles. The TOD monitors the propeller shaft speeds, operating range (High/Low), and ABS activity and then applies a calculated amount of torque to the front axle by Pulse Width Modulating the current applied to the EMC.

1. Touch-off Torque

   The minimum EMC Duty Cycle is based on the vehicle speed and throttle position.

   The TOD receives the TPS signal from the following sources:

   On vehicles equipped with CAN, the TOD receives the TPS signal from the CAN bus.
2. When Slip Detection

   The TOD continuously monitors the front and rear propeller shaft speeds to detect wheel slip.
3. Wheel Slip Control

   When wheel slip is detected the TOD controls the EMC duty cycle as necessary until the wheel slip is reduced below the allowable limit. The EMC Duty Cycle will then be reduced to the Touch-Off value.
4. Brake/ABS Strategy

   When the ABS System is active, the EMC Duty Cycle is set to a fixed duty cycle (30 %) to aid in braking without counteracting the ABS System.
5. 4L Strategy

   When the system is operating in 4L, the TOD continues TODTM (operation provided that the propeller shaft speed is below 175 rpm (5220 pulses/minute)). When the speed increases above 175 rpm, the EMC Duty Cycle is set to the maximum value (88 %) which applies the maximum available torque to the front axle.

DIAGNOSIS

While the TOD is active it periodically monitors its inputs and outputs. If a fault is detected the “4WD CHECK” lamp is illuminated and a fault code is stored in the TOD memory.

When requested, fault codes are downloaded to a diagnostic connector (K-line) serial communications using SCAN-100.

DIAGNOSTIC TESTS

TOD Internal Function

When the Ignition is turned on the TOD tests its ROM and RAM. If there is a fault, the TOD immediately resets itself and re-tests the ROM and RAM. If the fault persists the TOD continues to reset and re-test until the fault is corrected or the ignition is turned off. All TOD functions are inhibited until the fault is corrected. The 4WD CHECK lamp is not illuminated if there is a ROM or RAM fault.

If the ROM/RAM passes the EEPROM memory is tested. If there is a fault the 4WD CHECK lamp is illuminated and the TOD continues to operate using the default calibration data stored in ROM. Fault codes are not stored when there is an EEPROM fault.

An EEPROM fault can only be cleared by cycling ignition off-on.

Shift Motor Assembly Test

If the TOD detects a shift motor or position encoder fault continuously for one second the “4WD CHECK” lamp is turned on and the appropriate fault code is stored in memory.

1. A shift motor fault when the motor is off is defined as follows:
   - Motor H-L shorted to Ground
   - Motor L-H shorted to Ground
   - Motor open circuit
2. A shift motor fault when the motor is energized is defined as follows:
   - Motor H-L shorted to Ground
   - Motor L-H shorted to Ground
   - Motor H-L shorted to Motor L-H
   - Motor open circuit
3. A position encoder fault is defined as follows:
   - Any position code which does not correspond to the valid 9 codes.
   - A short to ground on any of the encoder lines.
4. If no shifts are in progress when a failure occurs the TOD will not respond to any shift commands.
5. If a shift command has been received, but not acted upon when a failure occurs the TOD will cancel the command and not respond to any subsequent shift commands.
6. If a shift command is in progress when an invalid position code is confirmed it will be halted and the TOD will turn the motor toward the high position. Afterwards the TOD will not respond to any shift commands.
7. If the shift motor/position encoder assembly failure (other than a motor failure which occurs when the motor is energized) recovers continuously for one second the TOD will function normally. The “4WD CHECK” lamp is turned off but the fault code will remain in memory.
8. A motor failure (i.e. open or short circuit) which occurs when the motor is energized can only be cleared by cycling the ignition off-on.

Front Speed Sensor Test

If a Front Speed Sensor fault is detected continuously for 0.5 second the 4WD CHECK lamp is illuminated. The TOD then responds as follows:

1. If the system is in High Range the TOD uses the Rear Speed Sensor to determine the EMC Touch Off level and wheel slip control is suspended.
2. If the system is in Low Range, the EMC Duty Cycle is set to maximum (independent of vehicle speed) until the system is shifted out of 4L.
3. All Electric Shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

If the Front Speed Sensor recovers continuously for O.5 second the TOD will function normally. The 4WD CHECK lamp is turned off but the fault code will remain in memory.

Rear Speed Sensor Test

If a Rear Speed Sensor fault is detected continuously for 0.5 second the 4WD CHECK lamp is illuminated. The TOD then responds as follows:

1. If the system is in High Range the TOD uses the Front Speed Sensor to determine the EMC Touch Off level and wheel slip control is suspended.
2. If the system is in Low Range, the EMC Duty Cycle is set to maximum (independent of vehicle speed) until the system is shifted out of 4L.
3. All Electric Shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

If the Rear Speed Sensor recovers continuously for 0.5 second the TOD will function normally. The “4WD CHECK” lamp is turned off but the fault code will remain in memory.

Both Speed Sensor Faulty

If both the Front and Rear Speed Sensors are faulty continuously for 0.5 seconds the “4WD CHECK” lamp is illuminated. The TOD then responds as follows:

1. If the system is in High Range the TOD sets the EMC Touch off level based on a vehicle speed of 0 and wheel slip control is suspended.
2. If the system is in Low Range, the EMC Duty Cycle is set to maximum until the system is shifted out of 4L.
3. All Electric Shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

If both Speed Sensors recover continuously for 0.5 second the TOD will function normally. The “4WD CHECK” lamp is turned off but the fault code will remain in memory.

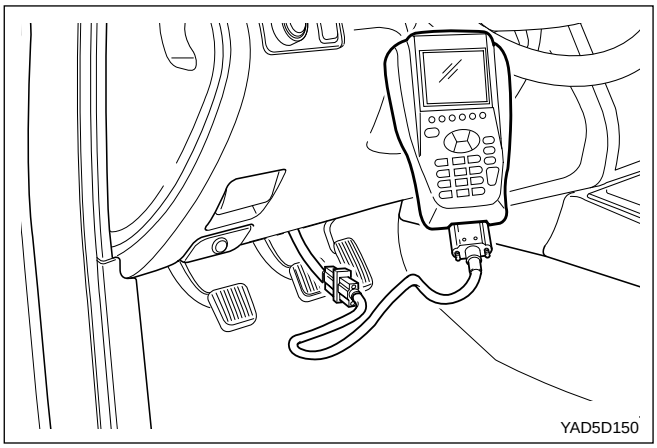
EMC Test

The EMC is tested for open circuit or short circuit to ground. If a fault is detected continuously for 0.8 second the “4WD CHECK” lamp is turned on and all TODTM activity is halted.

If the EMC recovers continuously for 0.8 second the TOD will function normally. The “4WD CHECK” lamp is turned off but the fault code will remain in memory.

CODING ON TOD

Connection of Coding Tool



Construct SCANNER into diagnosis connector (20 pins) near fuse box in engine room as below figure.

1. Diagnosis Connector
2. SCANNER

Notice: Coding ; An input activity of data for the proper performance by matching specification, devices and system with control unit.

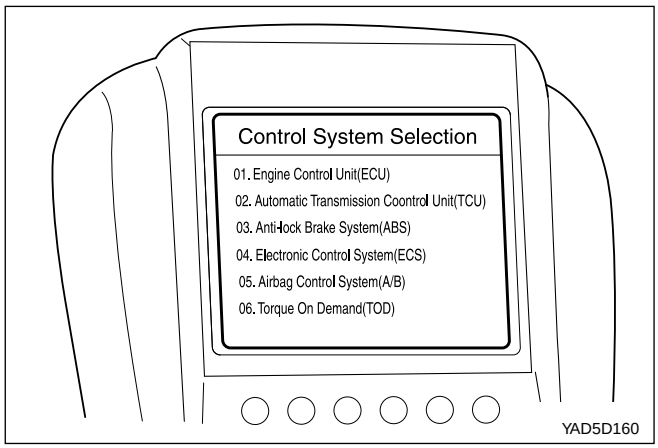
Coding required

1. Replacement of TOD control unit.
2. Adjustment by input error.
3. Change of tire specification.

Coding method

1. Check and record engine type, axle ratio and tire size.
2. Ignition “OFF”.
3. Connect SCANNER with diagnosis connector in engine room.
4. Ignition “ON”.
5. Read the current memorized specification in TOD control unit.

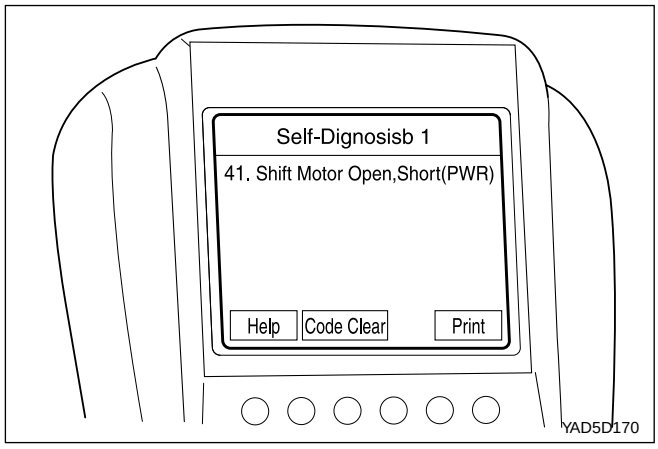
6. Compare memorized specification with the checked record. If not matched, perform a coding.
7. Read again memorized coding specification in TOD control unit for confirmation of coding.
8. Check coding specification whether it matches with vehicle or not. If not, perform a coding again.



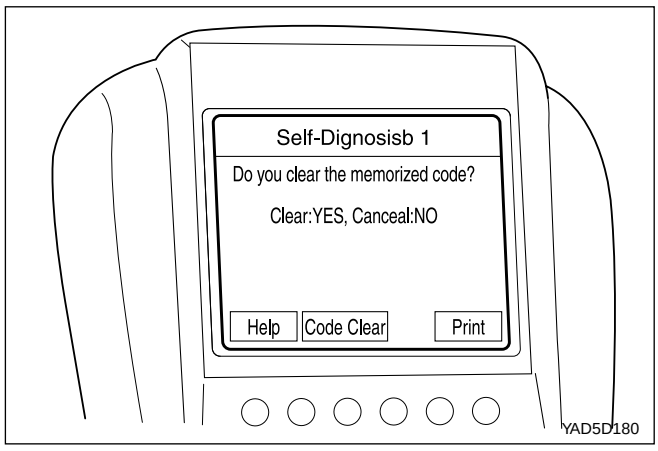
Eliminate the Memorized Fault Code

When diagnose by SCANNER, it is required that you make adequate service on defects against all fault codes. And then you should delete the memorized fault codes in TOD control unit using SCANNER as follows;

1. Connect SCANNER with diagnosis connector.
2. Ignition turns “ON”.
3. Select “Vehicle Type” and press “ENTER” key.
4. Select “Model Type” and press “ENTER” key.
5. Select “Control System” and then select “06 Transfer Case (TOD)”. Press “ENTER” key.

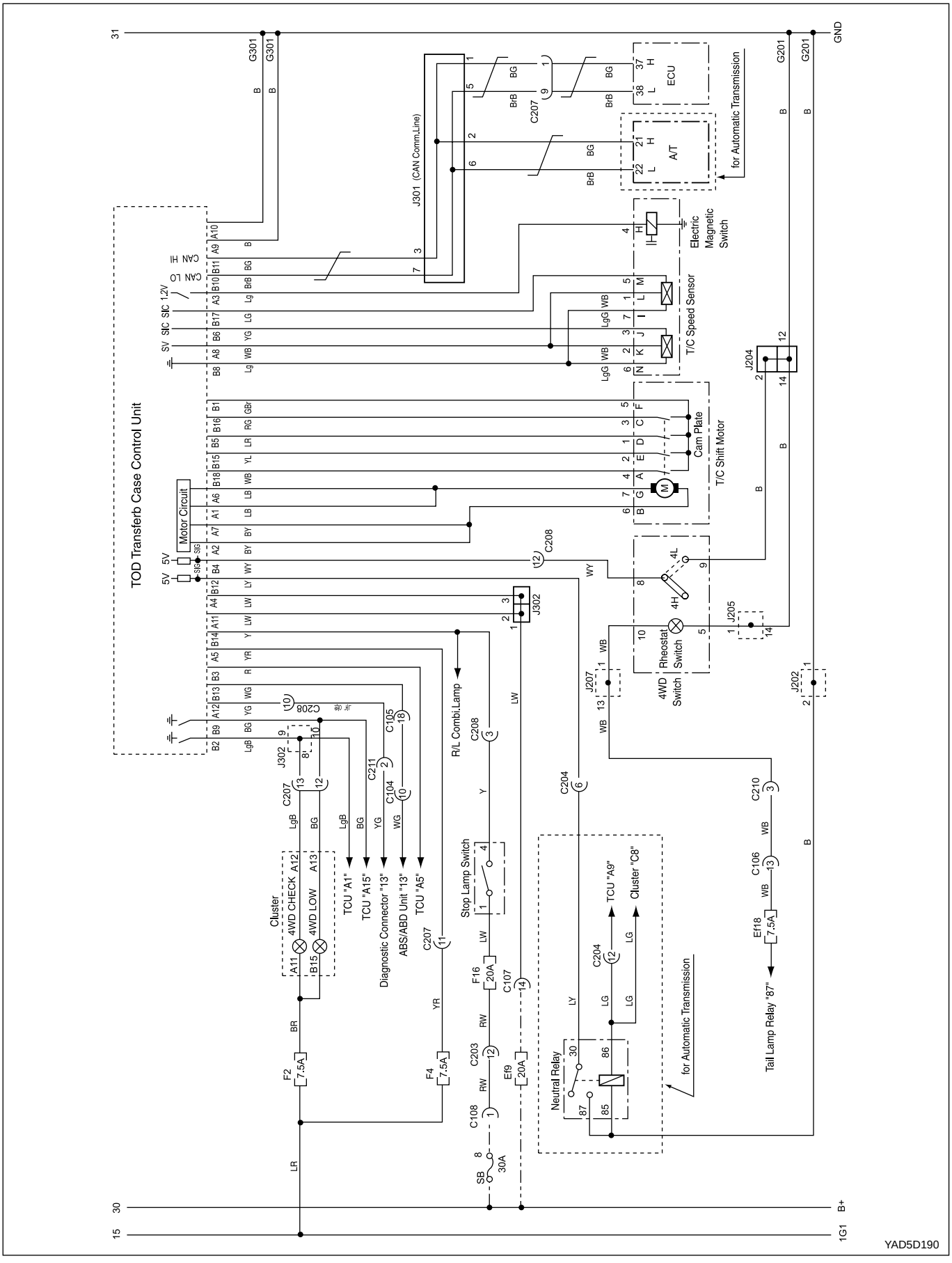


6. When system confirmation screen displays, press “ENTER” key.
7. If there is any fault in the system, it displays as shown.



8. Press the function key “F2”.
9. Press “Yes”.
10. If the memorized fault code is cleared successfully, it appears on the screen as following; “Self Diagnosis Result is Normal”.

SCHEMATIC WIRING DIAGRAM



TOD CONTROL UNIT DIAGNOSTIC SYSTEM CHECK

Circuit Description

The diagnostic system check is an organized approach to identifying a problem created by a transfer case control unit (TOD) malfunction. It must be starting point for any derivability complaint diagnosis because it directs the technician to the next logical step in diagnosing the complaint. Understanding the table and using it correctly will reduce diagnostic time and prevent the unnecessary replacement of parts.

Step	Action	Value	Yes	NO
1	Verify the customer's complaint. Does it verify the customer's complaint?	-	Go To Step 2	-
2	Turn the ignition ON. Does "4WD CHECK" lamp turns on continuously?	-	Go To Step 4	Go To Step 3
3	Jump between the terminal A2 of the TOD and ground. Does "4WD CHECK" lamp turns on? 1. Turn the ignition OFF.	-	Go To Step 4	Repair the bulb and circuit
4	2. Connect the data diagnosis connector to scan tool and follow the manual instruction. 3. Turn the ignition ON. Does the scan tool communicate with TOD?	-	Go To Step 9	Go To Step 5
5	Check whether the scan tool communicates with other control units. Does the scan tool communicate with other control units?	-	Go To Step 6	Go To Step 7
6	Repair the diagnostic line between the TOD terminal A12 and DLC connector 13. Is the repair complete?	-	Go To Step 4	-
7	Change the scan tool. Does the scan tool communicate with other control units?	-	Go To Step 4	Go To Step 8
8	1. Replace the TOD. 2. Connect the data diagnosis connector to scan tool. 3. Request the DTC. Does any DTC display?	-	Go To Step 11	Go To Step 10
9	Request the DTC with the scan tool. Does any DTC display?	-	Go To Step 11	Go To Step 10
10	1. Perform the road test. 2. Recheck any DTC. Does any DTC display?	-	Go To Step 11	System OK
11	Refer to applicable DTC table. Start the lowest DTC and move another DTC. Does the DTC identify as a valid DTC?	-	Go To the applicable DTC table	-

DIAGNOSTIC TROUBLE CODES (DTC's)

Diagnostic Trouble Code Retention

The first time a fault is detected a DTC is stored in the TOD's Non-Volatile memory. This DTC will remain in memory until the TOD is instructed to erase DTC's by SCAN-100. DTC's will not be erased by disconnecting power to the TOD.

Diagnostic Trouble Code Assignments

Classification	Fault Code	Description
TOD	1714	EEPROM Checksum Fault
	1715	TPS Loss of Signal
	1716	TPS Out of Range
EMC	1721	EMC Open / Short to Battery
	1722	EMC Short to ground
Speed Sensor	1731	Front Speed Sensor Voltage Low
	1732	Front Speed Sensor Voltage High
	1733	Rear Speed Sensor Voltage Low
	1734	Rear Speed Sensor Voltage High
	1735	Speed Sensor Reference Voltage Low
	1736	Speed Sensor Reference Voltage High
Shift Motor	1741	Motor Open / Shorted to Battery
	1742	Motor Output Shorted to Ground
	1743	Shift System Timeout
Position Encoder	1750	General Position Encoder Fault (Invalid Code)
	1751	Position 1 Shorted to Ground
	1752	Position 2 Shorted to Ground
	1753	Position 3 Shorted to Ground
	1754	Position 4 Shorted to Ground

4WD CHECK INDICATOR STAYS ON WITH IGNITION SWITCH ON

Circuit Description

When the ignition switch turns to ON the transfer case control unit (TOD) illuminates 4WD CHECK and 4WD LOW indicator to check bulb operation and turns off after 0.6 seconds. Then TOD starts self-diagnosis and illuminate 4WD CHECK indicator when TOD detects any fault.

Diagnostic Aids

- If the 4WD CHECK indicator illuminates steadily the TOD may detect some fault. TOD should be checked by scan tool to solve the problem.
- The 4WD CHECK indicator also illuminates steadily if the terminal B2 of TOD connector is shorted to ground. The shorted wire or terminals should be repaired.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step, along with step 4, checks the short to ground condition of the wire or terminals.

Step	Action	Value	Yes	No
1	1. Turn the ignition switch to OFF. 2. Connect the scan tool to the data link connector (DLC). 3. Turn the ignition switch to ON and request the DTC. Does the scan tool display any DTC?	-	Go to the specific DTC diagnostic table	Go to Step 2
2	1. Turn the ignition switch to OFF. 2. Disconnect the 18-pin connector from transfer case control unit (TOD). 3. Turn the ignition switch to ON and check the 4WD CHECK bulb operation. Does the 4WD CHECK indicator come on steadily?	-	Go to Step 3	Go to Step 4
3	Repair any short to ground circuit between terminal A2 of TOD connector and terminal 31 of cluster. Is the repair complete?	-	System OK	-
4	1. Turn the ignition OFF. 2. Check the pin or terminals for damage or improper connection. 3. Reconnect all the connectors. 4. Turn the ignition ON. Does the 4WD CHECK indicator come on steadily?	-	Go to Step 5	System OK
5	Replace the TOD. Is the repair complete?	-	System OK	-

4WD LOW INDICATOR STAYS ON WITH IGNITION SWITCH ON

Circuit Description

When the ignition switch turns to ON the transfer case control unit (TOD) illuminates 4WD CHECK and 4WD LOW indicator to check bulb operation and turns off after 0.6 seconds. Then TOD starts self-diagnosis and illuminate 4WD CHECK indicator when TOD detects any fault.

Diagnostic Aids

- If the 4WD LOW indicator illuminates steadily the transfer case in 4WD low range and 4H/4L switch set to 4L. It is normal condition.
- The 4WD LOW indicator also illuminates steadily if the terminal B9 of TOD connector is shorted to ground. The shorted wire or terminals should be repaired.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for the normal bulb operation.

Step	Action	Value	Yes	No
1	Check the position of 4H/4L switch. Does the 4H/4L switch set on 4L?	-	Go to Step 2	Go to Step 3
2	1. Turn the ignition switch to ON. 2. Set the shift lever to N (neutral). 3. Turn the 4H/4L switch to 4H. Does the 4WD LOW indicator go off?	-	System OK	-
3	1. Turn the ignition switch to ON. 2. Set the shift lever to N (neutral). 3. Turn the 4H/4L switch to 4L. Does the 4WD LOW indicator go off?	-	Go to Step 4	Go to Step 5
4	The wiring of 4H/4L switch is reversed. Repair the wiring. Is the repair complete?	-	System OK	-
5	1. Turn the ignition OFF. 2. Check the pin or terminals for damage or improper connection. 3. Reconnect all the connectors. 4. Turn the ignition ON. Does the 4WD LOW indicator come on steadily?	-	Go to Step 6	System OK
6	Repair any short to ground circuit between terminal B9 of TOD connector and terminal A13 of cluster. Is the repair complete?	-	System OK	Go to Step 7
7	Replace the TOD. Is the repair complete?	-	System OK	-

NO 4WD CHECK OR 4WD LOW INDICATOR WITH IGNITION SWITCH ON

Circuit Description

When the ignition switch turns to ON the transfer case control unit (TOD) illuminates 4WD CHECK and 4WD LOW indicator to check bulb operation and turns off after 0.6 seconds. Then TOD starts self-diagnosis and illuminate 4WD CHECK indicator when TOD detects any fault.

Diagnostic Aids

If the both of the 4WD CHECK and 4WD LOW indicator were not illuminating there would be some problems with fuse, power supply line, improper connection of connector or transfer case control unit (TOD).

If one of the indicators illuminates, the fuse and power supply line is good and the connector or TOD may be the cause of problems.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step checks for the normal bulb operation.
5. This step checks voltage supply condition.

Step	Action	Value	Yes	No
1	Check the bulb operation when the ignition switch turns to ON. Does the only 4WD LOW indicator come on and goes after 0.6 seconds?	-	Go to Step 2	Go to Step 5
2	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connector from the transfer case control unit (TOD). 3. Using test lamp check the continuity between terminal B2 of TOD and ground. Does the test lamp come on?	-	Go to Step 3	Go to Step 4
3	1. Turn the ignition OFF. 2. Check the pin or terminals for damage or improper connection. 3. Reconnect all the connectors. 4. Turn the ignition ON. Do the two indicators come on go after 0.6 seconds?	-	System OK	Go to Step 7
4	Repair or replace of following components: • 4WD CHECK indicator bulb. • Open circuit between terminal A12 of cluster and terminal B2 of TOD connector. Is the repair complete?	-	System OK	Go to Step 7
5	1. Check the fuse F2 and indicator bulbs. 2. Check the continuity for following terminals: • Fuse F2 to B2 (TOD) • A2 (Cluster) to B2 (TOD) • B15 (Cluster) to B9 (TOD) Are there any problems?	-	Go to Step 6	Go to Step 7
6	Repair open circuit or replace damaged parts. Is the repair complete?	-	System OK	Go to Step 7
7	Replace the TOD. Is the repair complete?	-	System OK	-

4WD LOW INDICATOR BLINK STEADILY

Circuit Description

When the 4H/4L switch turned from 4H (4L) to 4L (4H) electric shift starts and 4WD LOW indicator begin to blink until the shifting is completed or canceled. If 4H to 4L shifting is completed the 4WD LOW indicator will illuminated and 4L to 4H shifting is completed it will be turned off.

If shifting fails the 4WD LOW indicator will blink steadily until the shifting is completed or canceled.

Diagnostic Aids

The 4WD LOW indicator shows that the transfer case is operating in low range. And the indicator will blink while shifting from low to high range or high to low range. If the indicator blinks steadily it warns the shifting command and real position of the shift motor or position encoder are not matched.

Step	Action	Value	Yes	No
1	1. Stop the vehicle. 2. Turn the 4H/4L switch to original position. Does the 4WD LOW indicator stop blinking?	-	Go to Step 2	Go to Step 3
2	1. Make sure the vehicle stopped completely. 2. Set the shift lever to N (neutral) and wait more than 2 seconds. 3. Turn the 4H/4L switch. Does the 4WD LOW indicator blink and stop after complete shifting? • 4H —> 4L: 4WD LOW indicator illuminates. • 4L —> 4H: 4WD LOW Indicator turns off.	-	System OK	Go to Step 3
3	1. Starts TOD Diagnostic System Check. 2. If there were no trouble code, replace TOD. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1714

EEPROM Checksum Fault

Circuit Description

When the ignition is turned on the transfer case control unit (TOD) receives battery voltage and ignition voltage and illuminates the 4WD CHECK and 4WD LOW indicators for 0.6 seconds. Then it starts self diagnosis to check itself.

Conditions for Setting the DTC

DTC 1714 is an indication of a potential internal transfer case control unit (TOD) malfunction. It will set if any of following conditions is detected.

- The calculated checksum for internal memory does not match the stored value.
- The permanent memory storage area is malfunctioning.

Action Taken When the DTC Sets

The TOD will illuminates 4WD CHECK indicator and DTC is stored in TOD.

Diagnostic Aids

- Check for poor connections, fuse and power supply wiring.
- Check for ground condition.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks the battery supply voltage.
4. This step checks the ground condition.
6. This step checks the connection status.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go To “TOD Control Unit Diagnostic System Check”
2	1. Turn the ignition switch OFF. 2. Disconnect the 12-pin connector from transfer case control unit (TOD). 3. Turn the ignition switch to ON. 4. Connect a digital voltmeter between each of the following TOD connector terminal and ground. • A4 (Battery supply) • A11 (Battery supply) • A5 (Battery supply) Does the voltage of the all circuits measure within the value specified?	11 ~ 14 V	Go to Step 4	Go to Step 3
3	1. Check the fuse EF9 and voltage supply circuit. 2. Repair or replace any open or damaged circuit or fuse. Is the repair complete?	-	Go to Step 4	-
4	Connect a digital ohmmeter between each of the following TOD connector terminal and ground. • B9 (Ground). • B2 (Ground). Does the resistance of the all circuits measure within the value specified?	0 Ω	Go to Step 6	Go to Step 5
5	Repair or replace any open or damaged circuit. Is the repair complete?	-	Go to Step 6	-

Step	Action	Value	Yes	No
6	1. Check the terminals for damages and loose connection. 2. Replace or repair the faulty connector, wire, or terminals. 3. Connect the TOD connector. 4. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 5. Turn the ignition switch to ON. 6. Delete and request DTC with scan tool. Is DTC 1714 still present?	-	Go to Step 7	System OK
7	1. Replace the TOD. 2. Turn the ignition switch to OFF. 3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 4. Turn the ignition switch to ON. 5. Delete DTC with scan tool. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1715

TP Sensor Loss of Signal

Circuit Description

The transfer case control unit (TOD) receives throttle position (TP) sensor signals from engine control module (ECM) through CAN bus line.

Conditions for Setting the DTC

The transfer case control unit (TOD) can not receive throttle position (TP) sensor signal from engine control module (ECM). There is a bad communication between TOD and ECM.

- TOD is malfunction.
- ECM is malfunction.

Action Taken When the DTC Sets

The TOD will illuminates 4WD CHECK indicator and DTC is stored in TOD.

Diagnostic Aids

- Check for poor connections of CAN bus line.
- Check for ECM and TP sensor.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step decides the causal parts of the problem.
4. This step checks the ground condition.
6. This step checks the connection status.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON and request engine DTC. Are there any engine DTC related throttle position (TP) sensor?	-	Go to “TOD Diagnostic System Check” Refer to Section Engine	Go to Step 3
3	1. Turn the ignition switch to OFF. 2. Disconnect the 18-pin connector from the transfer case control unit (TOD). 3. Disconnect the gray connector from engine control module (ECM). 4. Connect a digital ohmmeter between the following TOD connector terminal and gray ECM connector terminal. • B11 (TOD) and 37 (ECM) • B10 (TOD) and 38 (ECM) • B11 (TOD) and 24 (ECM) • B10 (TOD) and 23 (ECM) Does the resistance of the all circuits measure within the value specified?	0 Ω	Go to Step 5	Go to Step 4
4	Repair or replace any open wires, faulty connector, or terminal. Is the repair complete?	-	System OK	-

Step	Action	Value	Yes	No
5	1. Replace the TOD. 2. Connect all connectors. 3. Request DTC with scan tool. Is the repair complete?	-	System OK	Go to Step 6
6	Replace the ECU. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1716

TP Sensor Out of Range

Circuit Description

The transfer case control unit (TOD) receives throttle position (TP) sensor signals from engine control module (ECM) through CAN bus line.

Conditions for Setting the DTC

D The transfer case control unit (TOD) receives throttle position (TP) sensor signal from engine control module (ECM), but the signal is out of the range.

There is a bad communication between TOD and ECU.

- TOD is malfunction.
- ECU is malfunction.

Action taken When the DTC Sets

The TOD will illuminates 4WD CHECK indicator and DTC is stored in TOD.

Diagnostic Aids

Check for poor connections of CAN bus line.

Check for ECU and TP sensor.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step decides the causal parts of the problem.
4. This step checks the ground condition.
6. This step checks the connection status.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-		Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON and request engine DTC. Are there any engine DTC related throttle position (TP) sensor?	-	Go to Step 2 Go to “TOD Diagnostic System Check” Go to specific engine DTC diagnosis.	Go to Step 2
3	1. Turn the ignition switch to OFF. 2. Disconnect the 18-pin connector from the transfer case control unit (TOD). 3. Disconnect the gray connector from engine control module (ECU). 4. Connect a digital ohmmeter between the following TOD connector terminal and gray ECU connector terminal. • B11 (TOD) and 38 (ECU) • B10 (TOD) and 37 (ECU) • B11 (TOD) and A24 • B10 (TOD) and A23 • B11 (TOD) and ground • B10 (TOD) and ground Does the resistance of the all circuits measure within the value specified?	0 Ω	Go to Step 4	Go to Step 5
4	Repair or replace any short wires, faulty connector, or terminal. Is the repair complete?	-	System OK	-

Step	Action	Value	Yes	No
5	1. Replace the TOD. 2. Connect all connectors. 3. Request DTC with scan tool. Is the repair complete?	-	System OK	Go to Step 6
6	Replace the ECU. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1721

Electromagnetic Clutch Open / Short to Battery

Circuit Description

To control the distribution of the torque to front propeller shaft, the transfer case control unit (TOD) sends a signal to the electromagnetic clutch (EMC). Then the clutch disc is compressed or released by the EMC.

Conditions for Setting the DTC

Even the TOD send signal for controlling the EMC, it receives uncontrolled propeller shaft speed signal.

- The wiring circuit to EMC opened.
- The wiring circuit is shorted to battery.

Action Taken When the DTC Sets

The TOD will illuminates 4WD CHECK indicator and DTC is stored in TOD.

Diagnostic Aids

- Check for poor connections of the circuit.
- Check for EMC.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks poor connection or damage on the pin.
3. This step, along with step 4, checks the voltage supply condition.
5. This step checks the ground condition.
7. This step checks the continuity of the wire and short to battery condition.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 3. Inspect the terminals for damage or improper connection. 4. Repair any damaged pins or terminals on the wiring harness and TOD. 5. Reconnect the connectors and make sure it is seated properly. 6. Connect a scan tool to the data link connector (DLC). 7. Turn the ignition ON. 8. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 3	System OK
3	1. Turn the ignition switch to OFF. 2. Disconnect the 12-pin connector from transfer case control unit (TOD). 3. Turn the ignition switch to ON. 4. Connect a digital voltmeter between each of the following TOD connector terminal and ground. • A4 (Battery supply). • A11 (Battery supply). Does the voltage of the all circuits measure within the value specified?	11 ~ 14 V	Go to Step 5	Go to Step 4

Step	Action	Value	Yes	No
4	1. Check the fuse EF9, F10 and voltage supply circuit. 2. Repair or replace any open or damaged circuit or fuse. Is the repair complete?	-	Go to Step 5	-
5	Connect a digital ohmmeter between each of the following TOD connector terminal and ground. • A9 (Ground) • A10 (Ground) Does the resistance of the all circuits measure within the value specified?	0 Ω	Go to Step 7	Go to Step 6
6	Repair or replace any open or damaged circuit. Is the repair complete?	-	Go to Step 7	-
7	1. Disconnect the 7-pin connector under the body. 2. Measure the voltage between terminal 4 and ground. Is the resistance within the value specified?	12	Go to Step 9	Go to Step 8
8	Repair open or short to battery circuit. Is the repair complete?	-	System OK	-
9	Measure the resistance between the clutch coil terminal H and ground. Is the measurement within the value specified?	2.2 ~ 2.8 Ω	Go to Step 11	Go to Step 10
10	1. Replace EMC (Electronic Magnetic Clutch). 2. Connect all the connectors. 3. Connect a scan tool to the DLC. 4. Turn the ignition switch to ON. 5. Delete and request DTC. Is the repair complete?	-	System OK	-
11	Replace TOD. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1722

Electromagnetic Clutch Short to Ground

Circuit Description

To control the distribution of the torque to front propeller shaft, the transfer case control unit (TOD) sends a signal to the electromagnetic clutch (EMC). Then the clutch disc is compressed or released by the EMC.

Conditions for Setting the DTC

Even the TOD send signal for controlling the EMC, it receives uncontrolled propeller shaft speed signal.

- The wiring circuit to EMC is shorted to ground.

Action Taken When the DTC Sets

The TOD will illuminates 4WD CHECK indicator and DTC is stored in TOD.

Diagnostic Aids

- Check for poor connections of the circuit.
- Check for EMC.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks poor connection or damage on the pin.
3. This step, along with step 4, checks the voltage supply condition.
5. This step checks the ground condition.
7. This step checks the continuity of the wire and short to battery condition.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 3. Inspect the terminals for damage or improper connection. 4. Repair any damaged pins or terminals on the wiring harness and TOD. 5. Reconnect the connectors and make sure it is seated properly. 6. Connect a scan tool to the data link connector (DLC). 7. Turn the ignition ON. 8. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 3	System OK
3	1. Turn the ignition switch to OFF. 2. Disconnect the 12-pin connector from transfer case control unit (TOD). 3. Turn the ignition switch to ON. 4. Connect a digital voltmeter between each of the following TOD connector terminal and ground. • A4 (Battery supply). • A11 (Battery supply). Does the voltage of the all circuits measure within the value specified?	11 ~ 14 V	Go to Step 5	Go to Step 4
4	1. Check the fuse EF9, F10 and voltage supply circuit. 2. Repair or replace any open or damaged circuit or fuse. Is the repair complete?	-	Go to Step 5	-

Step	Action	Value	Yes	No
5	Connect a digital ohmmeter between each of the following TOD connector terminal and ground. • A9 (Ground) • A10 (Ground) Does the resistance of the all circuits measure within the value specified?	0 Ω	Go to Step 7	Go to Step 6
6	Repair or replace any open or damaged circuit. Is the repair complete?	-	Go to Step 7	-
7	1. Disconnect the 7-pin connector under the body. 2. Measure the voltage between terminal 4 and ground. Is the resistance within the value specified?	0 Ω	Go to Step 9	Go to Step 8
8	Repair open or short to battery circuit. Is the repair complete?	-	System OK	-
9	Measure the resistance between the clutch coil terminal H and ground. Is the measurement within the value specified?	2.2 ~ 2.8 Ω	Go to Step 11	Go to Step 10
10	1. Replace EMC (Electronic Magnetic Clutch). 2. Connect all the connectors. 3. Connect a scan tool to the DLC. 4. Turn the ignition switch to ON. 5. Delete and request DTC. Is the repair complete?	-	System OK	-
11	Replace TOD. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1731

Front Speed Sensor Voltage Low

Circuit Description

The transfer case control unit (TOD) supplies 5 volts reference voltage to the front speed sensor and receives speed signals generated by Hall effect speed sensor.

Conditions for Setting the DTC

- The wiring circuit for speed sensor shorted to ground or opened.
- The reference voltage circuit is shorted to ground or opened.

Action Taken When the DTC Sets

The TOD will illuminates 4WD CHECK indicator and DTC is stored in TOD.

The TOD then responds as follows:

- If the system is in high range the TOD uses the rear speed sensor to determine the EMC touch off level and wheel slip control is suspended.
- If the system is in low range, the EMC duty cycle is set to maximum, independent of vehicle speed, until the system is shifted out of low range.
- All electric shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

Diagnostic Aids

- Check for short to ground or open circuit.
- Check for front propeller speed sensor.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity.
5. This step checks the speed sensor.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1735 also shown?	-	Go to “DTC 1735 – Speed Sensor Reference Voltage Low”	Go to Step 3
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 3. Measure the resistance between terminals B6 and terminals of the 7-pin connector. 4. Measure the resistance between terminals B6 and ground. Is measured value equal to specified range?	0 Ω ∞	Go to Step 5	Go to Step 4

Step	Action	Value	Yes	No
4	1. Repair any damaged pins, terminals, open or short to ground circuit. 2. Reconnect the connectors and make sure it is seated properly. 3. Connect a scan tool to the data link connector (DLC). 4. Turn the ignition ON. 5. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 5	System OK
5	Measure the resistance between terminals of the male white 7-pin connector. Is the measurement within specified range? • Terminal 6 and terminal 3 • Terminal 6 and terminal 2 • Terminal 3 and terminal 2	 5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 MΩ	 Go to Step 7	 Go to Step 6
6	Replace front propeller shaft speed sensor. Is the repair complete?	-	System OK	-
7	1. Replace the TOD. 2. Turn the ignition switch to OFF. 3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 4. Turn the ignition switch to ON. 5. Delete and request DTC with scan tool. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1732

Front Speed Sensor Voltage High

Circuit Description

The transfer case control unit (TOD) supplies 5 volts reference voltage to the front speed sensor and receives speed signals generated by Hall effect speed sensor.

Conditions for Setting the DTC

- The wiring circuit for speed sensor shorted to voltage.
- The reference voltage circuit is shorted to voltage.

Action Taken When the DTC Sets

The TOD will illuminates 4WD CHECK indicator and DTC is stored in TOD.

The TOD then responds as follows:

- If the system is in high range the TOD uses the rear speed sensor to determine the EMC touch off level and wheel slip control is suspended.
- If the system is in low range, the EMC duty cycle is set to maximum, independent of vehicle speed, until the system is shifted out of low range.
- All electric shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

Diagnostic Aids

- Check for short to ground or open circuit.
- Check for front propeller speed sensor.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity.
5. This step checks the speed sensor.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1736 also shown?	-	Go to “DTC 1736 – Speed Sensor Reference Voltage High”	Go to Step 3
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 3. Measure the voltage between terminals B6 and ground. Is measured value below the specified value?	0 Ω	Go to Step 5	Go to Step 4

Step	Action	Value	Yes	No
4	1. Repair any damaged pins, terminals, short to battery circuit. 2. Reconnect the connectors and make sure it is seated properly. 3. Connect a scan tool to the data link connector (DLC). 4. Turn the ignition ON. 5. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 5	System OK
5	Measure the resistance between terminals of the male white 7-pin connector. Is the measurement within specified range? • Terminal B and terminal C • Terminal B and terminal D • Terminal C and terminal D	 5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ	 Go to Step 7	 Go to Step 6
6	Replace front propeller shaft speed sensor. Is the repair complete?	-	System OK	-
7	1. Replace the TOD. 2. Turn the ignition switch to OFF. 3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 4. Turn the ignition switch to ON. 5. Delete and request DTC with scan tool. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1733

Rear Speed Sensor Voltage Low

Circuit Description

The transfer case control unit (TOD) supplies 5 volts reference voltage to the front and rear speed sensor and receives speed signals generated by Hall effect speed sensor.

Conditions for Setting the DTC

- The wiring circuit for speed sensor shorted to ground or opened.
- The reference voltage circuit is shorted to ground or opened.

Action Taken When the DTC Sets

The TOD will illuminates 4WD CHECK indicator and DTC is stored in TOD.

The TOD then responds as follows:

- If the system is in high range the TOD uses the front speed sensor to determine the EMC touch off level and wheel slip control is suspended.
- If the system is in low range, the EMC duty cycle is set to maximum independent of vehicle speed until the system is shifted out of low range.
- All electric shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

Diagnostic Aids

- Check for short to ground or open circuit.
- Check for front propeller speed sensor.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity.
5. This step checks the speed sensor.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1736 also shown?	-	Go to “DTC 1735 – Speed Sensor Reference Voltage Low”	Go to Step 3
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 3. Measure the resistance between terminals 17 of TOD and terminals in female white 7-pin connector. Is measured value equal to specified range? 4. Measure the resistance between terminals B17 of TOD and ground. Is measured value equal to specified range?	0 Ω ∞	Go to Step 5	Go to Step 4

Step	Action	Value	Yes	No
4	1. Repair any damaged pins, terminals, open or short to ground circuit. 2. Reconnect the connectors and make sure it is seated properly. 3. Connect a scan tool to the data link connector (DLC). 4. Turn the ignition ON. 5. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 5	System OK
5	Measure the resistance between terminals of the male white 7-pin connector. Is the measurement within specified range? • Terminal 7 and terminal 5 • Terminal 7 and terminal 1 • Terminal 5 and terminal 1	 5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ	 Go to Step 7	 Go to Step 6
6	Replace rear propeller shaft speed sensor. Is the repair complete?	-	System OK	-
7	1. Replace the TOD. 2. Turn the ignition switch to OFF. 3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 4. Turn the ignition switch to ON. 5. Delete and request DTC with scan tool. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1734

Rear Speed Sensor Voltage High

Circuit Description

The transfer case control unit (TOD) supplies 5 volts reference voltage to the front speed sensor and receives speed signals generated by Hall effect speed sensor.

Conditions for Setting the DTC

- The wiring circuit for speed sensor shorted to voltage.
- The reference voltage circuit is shorted to voltage.

Action Taken When the DTC Sets

The TOD will illuminates 4WD CHECK indicator and DTC is stored in TOD.

The TOD then responds as follows:

- If the system is in high range the TOD uses the front speed sensor to determine the EMC touch off level and wheel slip control is suspended.
- If the system is in low range, the EMC duty cycle is set to maximum independent of vehicle speed until the system is shifted out of low range.
- All electric shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

Diagnostic Aids

- Check for short to ground or open circuit.
- Check for front propeller speed sensor.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity.
5. This step checks the speed sensor.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1736 also shown?	-	Go to “DTC 1736 - Speed Sensor Reference Voltage High”	Go to Step 3
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 3. Measure the voltage between terminals B17 of TOD and ground. Is measured value below the specified value?	0 Ω	Go to Step 5	Go to Step 4

Step	Action	Value	Yes	No
4	1. Repair any damaged pins, terminals, open or short to ground circuit. 2. Reconnect the connectors and make sure it is seated properly. 3. Connect a scan tool to the data link connector (DLC). 4. Turn the ignition ON. 5. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 5	System OK
5	Measure the resistance between terminals of the male white 7-pin connector. Is the measurement within specified range? • Terminal 7 and terminal 5 • Terminal 7 and terminal 1 • Terminal 5 and terminal 1	 5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ	 Go to Step 7	 Go to Step 6
6	Replace rear propeller shaft speed sensor. Is the repair complete?	-	System OK	
7	1. Replace the TOD. 2. Turn the ignition switch to OFF. 3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 4. Turn the ignition switch to ON. 5. Delete and request DTC with scan tool. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1735

Speed Sensor Referance Voltage Low

Circuit Description

The transfer case control unit (TOD) provides reference voltage to front and rear propeller-shaft speed sensor.

Conditions for Setting the DTC

If the system is in high range the TOD sets the EMC touch off level based on a vehicle speed of 0 and wheel slip control is suspended.

- If the system is in low range, the EMC duty cycle is set to maximum until the system is shifted out of low range.

Diagnostic Aids

- Check for short to ground or open circuit.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step, along with step 3, checks the voltage supply condition.
5. This step checks the continuity of ground line.
7. This step checks the speed sensors.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Disconnect white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 2. Turn the ignition switch to ON. 3. Measure the voltage between following terminals of male white 7-pin connector: Terminal D/E and terminal B/G Is measured value within the specified range?	4.5 ~ 5.5 V	Go to Step 7	Go to Step 3
3	Measure the resistance between terminal A8 and terminals B8 of transfer case control unit (TOD). Is measured value within the specified range?	4.5 ~ 5.5 V	Go to Step 5	Go to Step 4
4	1. Turn the ignition switch to OFF. 2. Check two connectors of the TOD and white 7-pin connector. 3. Repair any damaged pins, connector or wires. 4. Reconnect all the connectors and make sure it is seated properly. 5. Connect a scan tool to the data link connector (DLC). 6. Turn the ignition switch to ON. 7. Request DTC Is the DTC still current?	-	Go to Step 5	System OK
5	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the TOD and white 7-pin connector under the body. 3. Measure the resistance between following terminals: • A8 (TOD) and 1/2 (7-pin connector) • B8 (TOD) and 6/7 (7-pin connector) Is the resistance equal to specified value? 4. Measure the resistance between A8 and B8 of TOD connector and ground Is the resistance equal to specified value?	0 Ω ∞	Go to Step 7	Go to Step 6
6	Repair any open or short to ground circuit. Is the repair complete?	-	System OK	Go to Step 7

Step	Action	Value	Yes	No
7	Measure the resistance between terminals of the male white 7-pin connector. • Terminal 6 and terminal 3 • Terminal 6 and terminal 2 • Terminal 3 and terminal 2 • Terminal 7 and terminal 5 • Terminal 7 and terminal 1 • Terminal 5 and terminal 1 Is the measurement within specified range?	 5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ 5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ	Go to Step 9	Go to Step 8
8	Replace front or rear propeller shaft speed sensor. Is the repair complete?	-	System OK	-
9	1. Replace the TOD. 2. Turn the ignition switch to OFF. 3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 4. Turn the ignition switch to ON. 5. Delete and request DTC with scan tool. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1736

Speed Sensor Reference Voltage High

Circuit Description

The transfer case control unit (TOD) provides reference voltage to front and rear propeller-shaft speed sensor.

Conditions for Setting the DTC

If the reference voltage supply line is shorted to battery, then the 4WD CHECK indicator will illuminated and the diagnostic trouble code (DTC) will stored to the TOD.

- If the system is in high range the TOD sets the EMC touch off level based on a vehicle speed of 0 and wheel slip control is suspended.
- If the system is in low range, the EMC duty cycle is set to maximum until the system is shifted out of low range.

Diagnostic Aids

- Check for short to ground or open circuit.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step, along with step 3, checks the voltage supply condition.
5. This step checks the continuity of ground line.
7. This step checks the speed sensors.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Disconnect white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 2. Turn the ignition switch to ON. 3. Measure the voltage between following terminals of male white 7-pin connector: • Terminal D/E and terminal B/G Is measured value within the specified range?	4.5 ~ 5.5 V	Go to Step 7	Go to Step 3
3	Measure the resistance between terminal A8 and terminals B8 of transfer case control unit (TOD). Is measured value within the specified range?	4.5 ~ 5.5 V	Go to Step 5	Go to Step 4
4	1. Turn the ignition switch to OFF. 2. Check two connectors of the TOD and white 7-pin connector. 3. Repair any damaged pins, connector or wires. 4. Reconnect all the connectors and make sure it is seated properly. 5. Connect a scan tool to the data link connector (DLC). 6. Turn the ignition switch to ON. 7. Request DTC. Is the DTC still current?	-	Go to Step 5	System OK

Step	Action	Value	Yes	No
5	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the TOD and 7-pin connector under the body. 3. Measure the resistance between following terminals: • A8 (TOD) and 1/2 (7-pin connector) • B8 (TOD) and 6/7 (7-pin connector) Is the resistance equal to specified value? 4. Measure the voltage between A8 and B8 of TOD connector and ground. Is the resistance below the specified value?	0 Ω ∞	Go to Step 7	Go to Step 6
6	Repair any short to circuit. Is the repair complete?	-	System OK	Go to Step 7
7	Measure the resistance between terminals of the male white 7-pin connector. • Terminal 6 and terminal 3 • Terminal 6 and terminal 2 • Terminal 3 and terminal 2 • Terminal 7 and terminal 5 • Terminal 7 and terminal 1 • Terminal 5 and terminal 1 Is the measurement within specified range?	 5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ 5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ	Go to Step 9	Go to Step 8
8	Replace front or rear propeller shaft speed sensor. Is the repair complete?	-	System OK	-
9	1. Replace the TOD. 2. Turn the ignition switch to OFF. 3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 4. Turn the ignition switch to ON. 5. Delete and request DTC with scan tool. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1741

Motor Output Open / Shorted to Battery

Circuit Description

The transfer case control unit (TOD) sends current to move the shift motor upon the position of the 4H/4L switch.

Conditions for Setting the DTC

If the TOD detects a shift motor fault continuously for one seconds, the 4WD CHECK indicator will illuminated and the diagnostic trouble code (DTC) will stored to the TOD.

- Motor HI-LO circuits are shorted to battery.
- Motor LO-HI circuits are shorted to battery.
- Motor HI-LO circuits are shorted to motor LO-HI circuits.
- Motor circuits are open.

Diagnostic Aids

Check for short to battery or open circuit.

Check for the shift motor.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks the connector and connection status.
3. This step, along with step 3, checks the voltage supply condition.
5. This step checks the continuity of ground line.
7. This step checks the shift motor.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the transfer case control unit (TOD) and 7-pin connector under the body. 3. Inspect the terminals for damage or improper connection. 4. Repair any damaged pins or terminals on the wiring harness and TOD. 5. Reconnect the connectors and make sure it is seated properly. 6. Connect a scan tool to the data link connector (DLC). 7. Turn the ignition ON. 8. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 3	System OK
3	1. Disconnect the black 7-pin connector for shift motor under the body. 2. Turn the ignition switch to ON. 3. Position shift lever to N (neutral). 4. Connect the voltmeter between terminal 7 of female 7-pin connector and ground. 5. Measure the voltage while switching the 4L/4H switch from 4H to 4L. Is the voltage within the specified value? 6. Connect the voltmeter between terminal 6 of female 7-pin connector and ground. 7. Measure the voltage while switching the 4L/4H switch from 4L to 4H. Is the voltage within the specified value?	11 ~ 14 V 11 ~ 14 V	Go to Step 7	Go to Step 4

Step	Action	Value	Yes	No
4	1. Connect terminal A1/A6 and terminal A9/A10 with digital voltmeter. 2. Measure the voltage while switching the 4L/4H switch from 4H to 4L. Is the voltage within the specified value? 3. Connect terminal A2/A7 between terminals A9/A10 with digital voltmeter. 4. Measure the voltage while switching the 4L/4H switch from 4L to 4H. Is the voltage within specified range?	 11 ~ 14 V 11 ~ 14 V	 Go to Step 5	 Go to Step 9
5	1. Disconnect 12-pin connector from transfer case control unit (TOD) and black 7-pin connector. 2. Measure the resistance between following terminals. • A2 (TOD) and 6 (7-pin connector) • A7 (TOD) and 6 (7-pin connector) • A1 (TOD) and 7 (7-pin connector) • A6 (TOD) and 7 (7-pin connector) Is the resistance equal to specified value? 3. Measure the voltage between following terminals: • A2/A7 (TOD) and ground • A1/A6 (TOD) and ground Is the voltage below specified value?	 0 Ω 1 V	 Go to Step 7	 Go to Step 6
6	Repair any open or short to battery circuit. Is the repair complete?	 -	 System OK	 Go to Step 7
7	1. Turn the ignition switch to OFF. 2. Disconnect the black 7-pin connector, for shift motor, under the body. 3. Measure the resistance between terminal G and terminal B. Is the resistance within the specified value?	 1 ~ 250 Ω	 Go to Step 9	 Go to Step 8
8	Replace the shift motor. Is the repair complete?	 -	 System OK	 -
9	Replace the TOD. Is the repair complete?	 -	 System OK	 Go to Step 7

DIAGNOSTIC TROUBLE CODE (DTC) 1742

Motor Output Shorted to Ground

Circuit Description

The transfer case control unit (TOD) sends current to move the shift motor upon the position of the 4H/4L switch.

Conditions for Setting the DTC

If the TOD detects a shift motor fault continuously for one second, the 4WD CHECK indicator will illuminated and the diagnostic trouble code (DTC) will stored to the TOD.

- Motor HI-LO circuits are shorted to ground.
- Motor LO-HI circuits are shorted to ground.
- Motor HI-LO circuits are shorted to motor LO-HI circuits.

Diagnostic Aids

- Check for short to ground circuit.
- Check for the shift motor.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks the connector and connection status.
3. This step, along with step 3, checks the voltage supply condition.
5. This step checks the continuity of ground line.
7. This step checks the shift motor.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to "TOD Diagnostic System Check"
2	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the transfer case control unit (TOD) and black 7-pin connector under the body. 3. Inspect the terminals for damage or improper connection. 4. Repair any damaged pins or terminals on the wiring harness and TOD. 5. Reconnect the connectors and make sure it is seated properly. 6. Connect a scan tool to the data link connector (DLC). 7. Turn the ignition ON. 8. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 3	System OK
3	1. Disconnect the black 7-pin connector for shift motor under the body. 2. Turn the ignition switch to ON. 3. Position shift lever to N (neutral). 4. Connect the voltmeter between terminal 7 of female 7-pin connector and ground. 5. Measure the voltage while switching the 4L/4H switch from 4H to 4L. Is the voltage within the specified value? 6. Connect the voltmeter between terminal 6 of female 7-pin connector and ground. 7. Measure the voltage while switching the 4L/4H switch from 4L to 4H. Is the voltage within the specified value?	11 ~ 14 V 11 ~ 14 V	Go to Step 7	Go to Step 4

Step	Action	Value	Yes	No
4	1. Connect terminal A1/A6 and terminal A9/A10 with digital voltmeter. 2. Measure the voltage while switching the 4L/4H switch from 4H to 4L. Is the voltage within the specified value? 3. Connect terminal A2/A7 between terminals A9/A10 with digital voltmeter. 4. Measure the voltage while switching the 4L/4H switch from 4L to 4H. Is the voltage within specified range?	11 ~ 4 V 11 ~ 4 V	Go to Step 5	Go to Step 9
5	1. Disconnect 12-pin connector from transfer case control unit (TOD) and 7-pin connector. 2. Measure the resistance between following terminals. • A2/A7 (TOD) and 6 (7-pin connector) • A1/A6 (TOD) and 7 (7-pin connector) • A1/A6 (TOD) and ground. • A2/A7 (TOD) and ground. Is the resistance equal to specified value?	0 Ω	Go to Step 6	System OK
6	Repair any short to ground or short between circuit. Is the repair complete?	-	System OK	Go to Step 7
7	1. Turn the ignition switch to OFF. 2. Disconnect the black 7-pin connector, for shift motor, under the body. 3. Measure the resistance between terminal G and terminal B. Is the resistance within the specified value?	1 ~ 205 Ω	Go to Step 9	Go to Step 8
8	Replace the shift motor. Is the repair complete?	-	System OK	-
9	Replace the TOD. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1743

Shift System Timeout

Circuit Description

The transfer case control unit (TOD) sends current to move the shift motor upon the position of the 4H/4L switch.

Conditions for Setting the DTC

- Shifting to other drive range is failed within specified range.

Diagnostic Aids

- Check for short to ground circuit.
- Check for the shift motor.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the connector and connection status.
4. This step checks the shift motor.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1741 or 1742 also shown?	-	Go to Applicable DTC Table	Go to Step 3
3	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the transfer case control unit (TOD) and black 7-pin connector under the body. 3. Inspect the terminals for damage or improper connection. 4. Repair any damaged pins or terminals on the wiring harness and TOD. 5. Reconnect the connectors and make sure it is seated properly. 6. Connect a scan tool to the data link connector (DLC). 7. Turn the ignition ON. 8. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 4	System OK
4	1. Remove the shift motor. 2. Connect the black 7-pin connector to shift motor. 3. Check the motor operation by turning the 4H/4L switch. Is the motor run?	-	Go to Step 5	Replace shift motor and Go to Step 3
5	Replace the TOD. Is the repair complete?	-	System OK	Go to Step 6
6	Repair any problems in transfer case assembly. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1750

General Position Encoder Fault (Invalid Code)

Circuit Description

The transfer case control unit (TOD) receives position encoder signals from position encoder.

Conditions for Setting the DTC

If the TOD detects a shift motor fault continuously for one second, the 4WD CHECK indicator will illuminated and the diagnostic trouble code (DTC) will stored to the TOD.

- Any position code which does not correspond to the valid 9 codes.
- A short to ground on any of the encoder lines.

Diagnostic Aids

- Check for short to ground circuit.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity of the position encoder line.

5. This step checks the connector and connection status.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1751, 1752, 1753, or 1754 also shown?	-	Go to Step 3	Go to Step 5
3	1. Disconnect 18-pin connector from the transfer case control unit (TOD). 2. Measure the resistance between following terminals: • B15 (TOD) and ground • B5 (TOD) and ground • B16 (TOD) and ground • B18 (TOD) and ground Is any of the resistance equal to specified value?	0 Ω	Go to Step 4	Go to Step 5
4	Repair all of the short to ground circuit. Is the repair complete?	-	System OK	-
5	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the transfer case control unit (TOD) and 7-pin connector under the body. 3. Inspect the terminals for damage or improper connection. 4. Repair any damaged pins or terminals on the wiring harness and TOD. 5. Reconnect the connectors and make sure it is seated properly. 6. Connect a scan tool to the data link connector (DLC). 7. Turn the ignition ON. 8. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 6	System OK

Step	Action	Value	Yes	No
6	Replace the shift motor with position encoder. Is the repair complete?	-	System OK	Go to Step 7
7	Replace the TOD. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1751

Position 1 Shorted to Ground

Circuit Description

The transfer case control unit (TOD) receives position encoder signals from position encoder.

Conditions for Setting the DTC

- Position 2 code does not correspond to the specific codes.
- A short to ground on any of the encoder lines.

Diagnostic Aids

- Check for short to ground circuit.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity of the position encoder line.
5. This step checks the connector and connection status.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to "TOD Diagnostic System Check"
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1751 only current trouble code?	-	Go to Step 3	Go to "DTC 1750 General Position Encoder Fault (Invalid Code)"
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connector from the transfer case control unit (TOD). 3. Measure the resistance between terminal A15 of TOD connector and ground. Is the resistance equal to specified value?	0 Ω	Go to Step 4	Go to Step 5
4	Repair short to ground circuit. Is the repair complete?	-	System OK	-
5	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the transfer case control unit (TOD) and 7-pin connector under the body. 3. Inspect the terminals for damage or improper connection. 4. Repair any damaged pins or terminals on the wiring harness and TOD. 5. Reconnect the connectors and make sure it is seated properly. 6. Connect a scan tool to the data link connector (DLC). 7. Turn the ignition ON. 8. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 6	System OK
6	Replace the shift motor. Is the repair complete?	-	System OK	Go to Step 7
7	Replace the TOD. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1752

Position 2 Shorted to Ground

Circuit Description

The transfer case control unit (TOD) receives position encoder signals from position encoder.

Conditions for Setting the DTC

- Position 2 code does not correspond to the specific codes.
- A short to ground on any of the encoder lines.

Diagnostic Aids

- Check for short to ground circuit.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity of the position encoder line.
5. This step checks the connector and connection status.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1752 only current trouble code?	-	Go to Step 3	Go to “DTC 1750 General Position Encoder Fault (Invalid Code)”
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connector from the transfer case control unit (TOD). 3. Measure the resistance between terminal A10 of TOD connector and ground. Is the resistance equal to specified value?	0 Ω	Go to Step 4	Go to Step 5
4	Repair short to ground circuit. Is the repair complete?	-	System OK	-
5	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the TOD and black 7-pin connector under the body. 3. Inspect the terminals for damage or improper connection. 4. Repair any damaged pins or terminals on the wiring harness and TOD. 5. Reconnect the connectors and make sure it is seated properly. 6. Connect a scan tool to the data link connector (DLC). 7. Turn the ignition ON. 8. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 6	System OK
6	Replace the shift motor. Is the repair complete?	-	System OK	Go to Step 7
7	Replace the TOD. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1753

Position 3 Shorted to Ground

Circuit Description

The transfer case control unit (TOD) receives position encoder signals from position encoder.

Conditions for Setting the DTC

- Position 3 code does not correspond to the specific codes.
- A short to ground on any of the encoder lines.

Diagnostic Aids

- Check for short to ground circuit.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity of the position encoder line.
5. This step checks the connector and connection status.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to "TOD Diagnostic System Check"
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1753 only current trouble code?	-	Go to Step 3	Go to "DTC 1750 General Position Encoder Fault(Invalid Code)"
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connector from the transfer case control unit (TOD). 3. Measure the resistance between terminal A28 of TOD connector and ground. Is the resistance equal to specified value?	0 Ω	Go to Step 4	Go to Step 5
4	Repair short to ground circuit. Is the repair complete?	-	System OK	-
5	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the TOD and black 7-pin connector under the body. 3. Inspect the terminals for damage or improper connection. 4. Repair any damaged pins or terminals on the wiring harness and TOD. 5. Reconnect the connectors and make sure it is seated properly. 6. Connect a scan tool to the data link connector (DLC). 7. Turn the ignition ON. 8. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 6	System OK
6	Replace the shift motor. Is the repair complete?	-	System OK	Go to Step 7
7	Replace the TOD. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 1754

Position 4 Shorted to Ground

Circuit Description

The transfer case control unit (TOD) receives position encoder signals from position encoder.

Conditions for Setting the DTC

- Position 4 code does not correspond to the specific codes.
- A short to ground on any of the encoder lines.

Diagnostic Aids

- Check for short to ground circuit.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

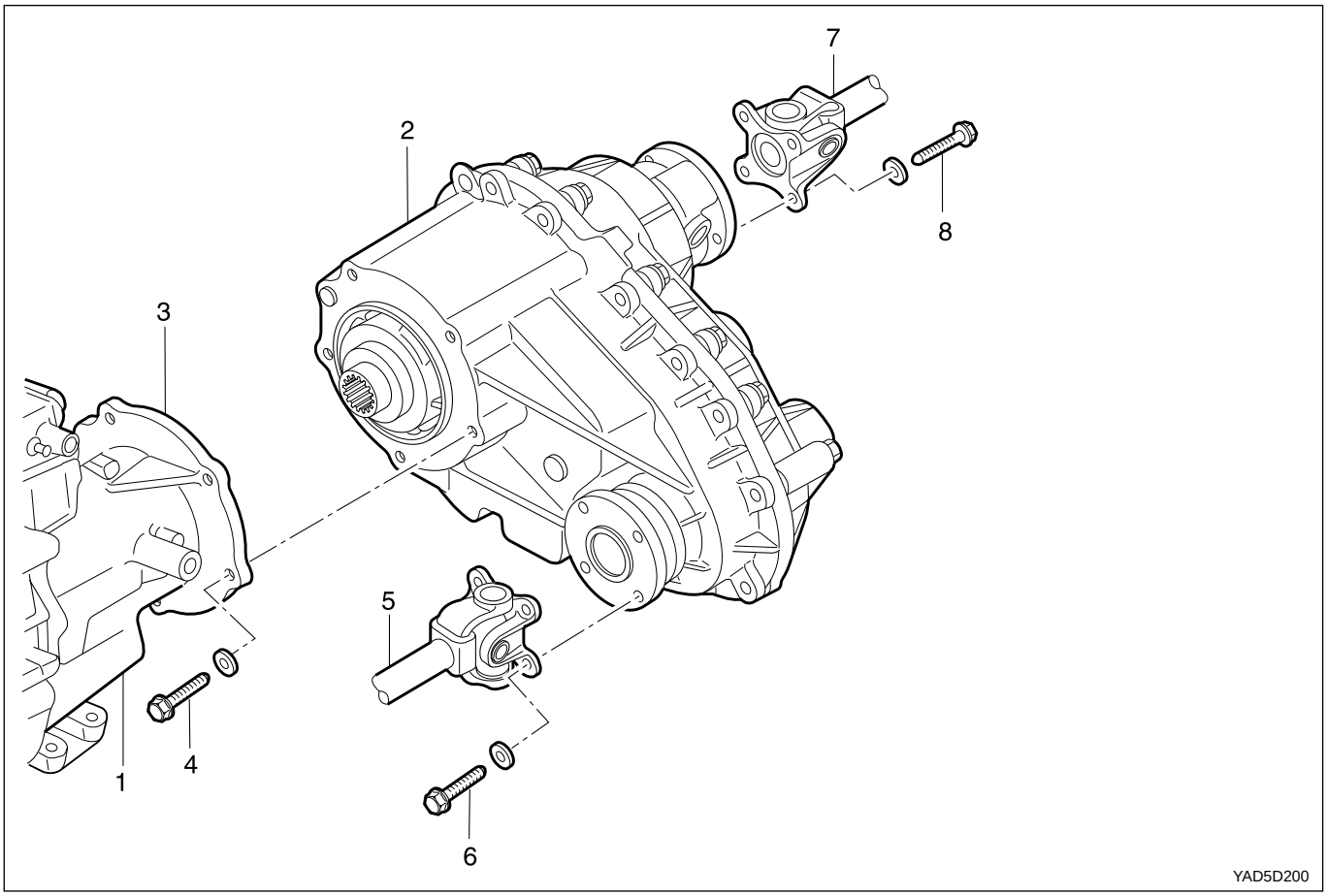
3. This step checks the continuity of the position encoder line.
5. This step checks the connector and connection status.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to “TOD Diagnostic System Check”
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1754 only current trouble code?	-	Go to Step 3	Go to “DTC 1750 General Position Encoder Fault(Invalid Code)”
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connector from the transfer case control unit (TOD). 3. Measure the resistance between terminal A30 of TOD connector and ground. Is the resistance equal to specified value?	0 Ω	Go to Step 4	Go to Step 5
4	Repair short to ground circuit. Is the repair complete?	-	System OK	-
5	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the TOD and black 7-pin connector under the body. 3. Inspect the terminals for damage or improper connection. 4. Repair any damaged pins or terminals on the wiring harness and TOD. 5. Reconnect the connectors and make sure it is seated properly. 6. Connect a scan tool to the data link connector (DLC). 7. Turn the ignition ON. 8. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 6	System OK
6	Replace the shift motor. Is the repair complete?	-	System OK	Go to Step 7
7	Replace the TOD. Is the repair complete?	-	System OK	-

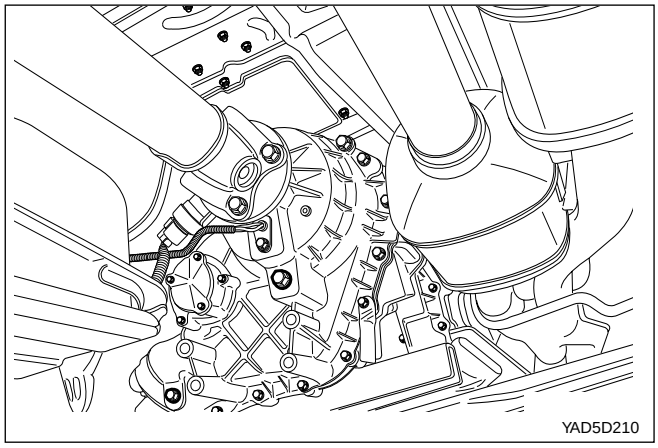
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

TRANSFER CASE (TOD) COMPONENT LOCATOR



1 Transmission (A/T)
2 TOD Transfer Case
3 Extension Housing
4 Bolt ..... 35 - 60 N•m
5 Front Propeller Shaft
6 Bolt (M14, 4) ..... 81 - 89 N•m
7 Rear Propeller Shaft
8 Bolt (M14, 4) ..... 81 - 89 N•m


YAD5D210

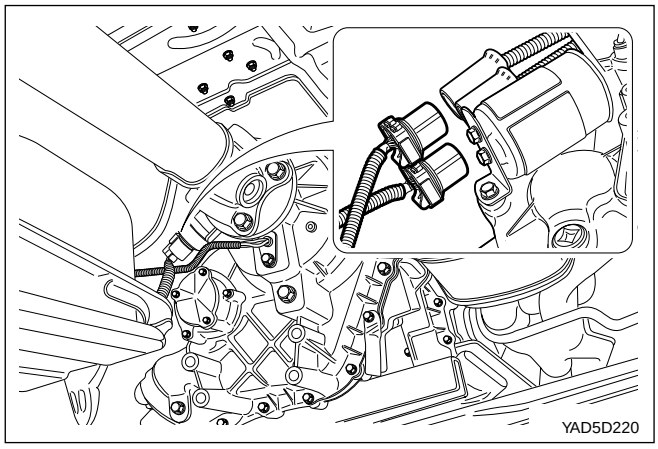
Removal & Installation Procedure

1. Disconnect (-) cable from battery.
2. Lift on vehicle and make sure on safety.

   Notice: Be careful for catalytic converter due to high temperature after driving or engine running.
3. Prepare a vessel to drain transfer case and manual transmission oil.
4. Release drain plug and drain transfer case and manual transmission oil.

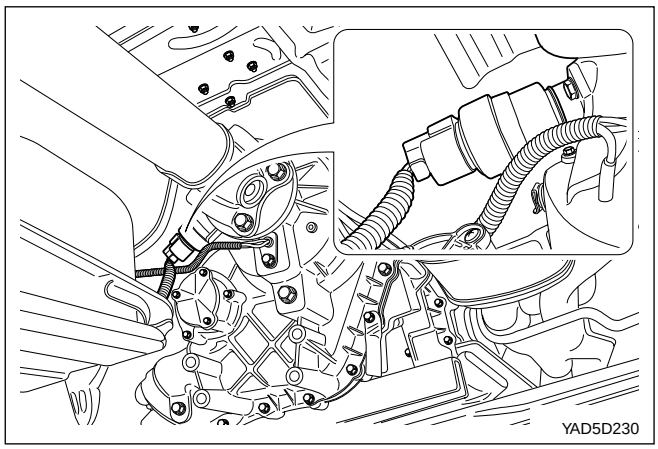
   If planar damper is installed, unscrew 4 bolts and remove the planar damper.

   Notice: Oil drain should be along with whole transfer case disassembly and assembly.

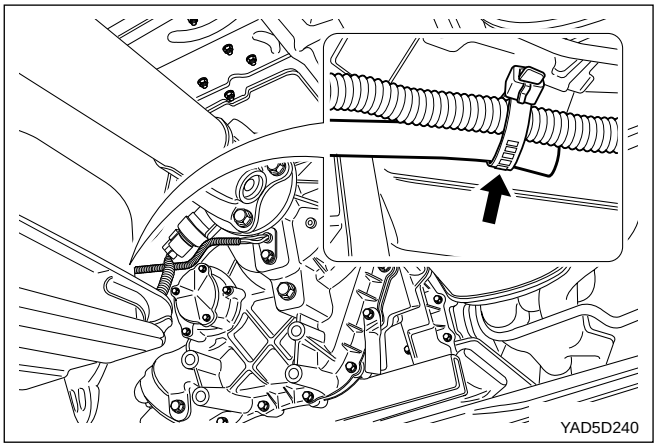

YAD5D220

5. Disconnect transmission extension wiring connector back side transfer case.

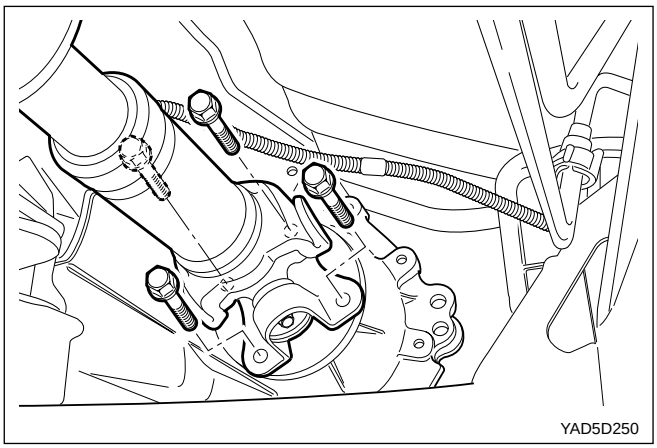
   Notice: When disconnect connector, make sure on direction of locking tab towards inside.
6. Disconnect shift motor/clutch coil connect (Black 7 pin) connector upper backside.
7. Disconnect front and rear speed sensor connector (white 7 pin).


YAD5D230

8. Disconnect speedometer sensor connector right upper side.



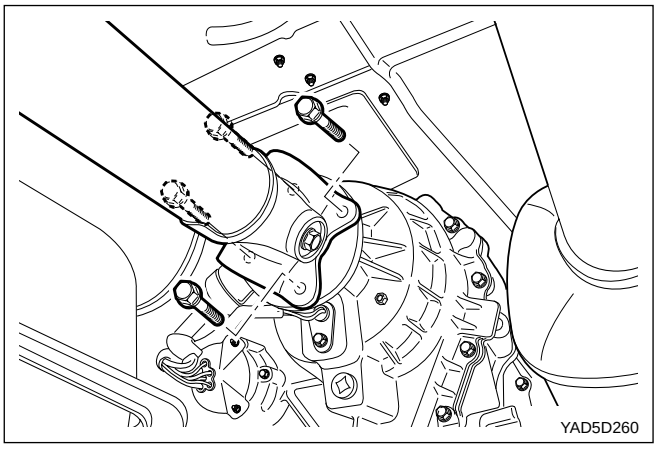
9. Disconnect breather tube front upper side transfer case (Upper connecting point of transfer case and front propeller).
10. Prepare hydraulic jack and support transfer case assembly.



11. Unscrew 4 units of M12 bolts from case flange then disconnect front propeller shaft from transfer case.

Installation Notice

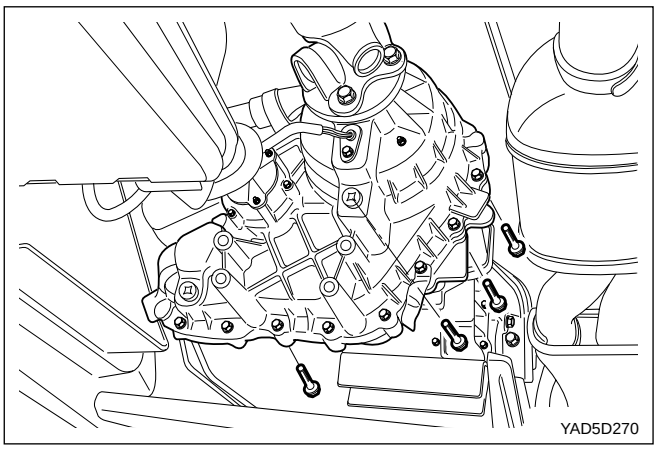
Tightening Torque	81 - 89 N•m (60 - 66 lb-ft)



12. Unscrew 4 units of M12 bolts from case flange then disconnect rear propeller shaft from transfer case.

Installation Notice

Tightening Torque	81 - 89 N•m (60 - 66 lb-ft)



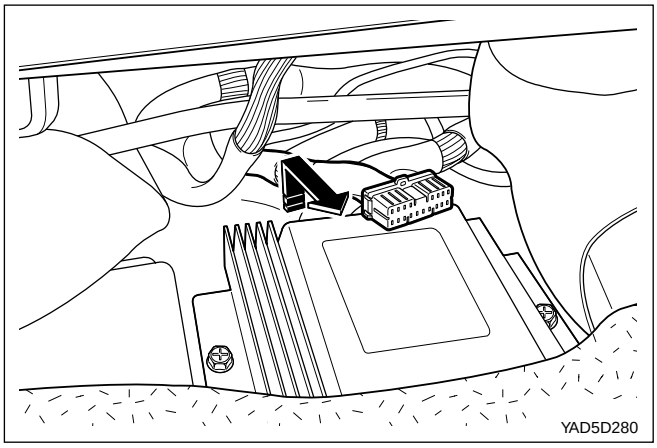
13. Unscrew 5 units of mounting bolt (M12) from extension housing in transmission.

Installation Notice

Tightening Torque	35 - 60 N•m (26 - 44 lb-ft)

Notice: Make sure the connecting surface is clean. Applying long-life grease spline inside transfer case input shaft.

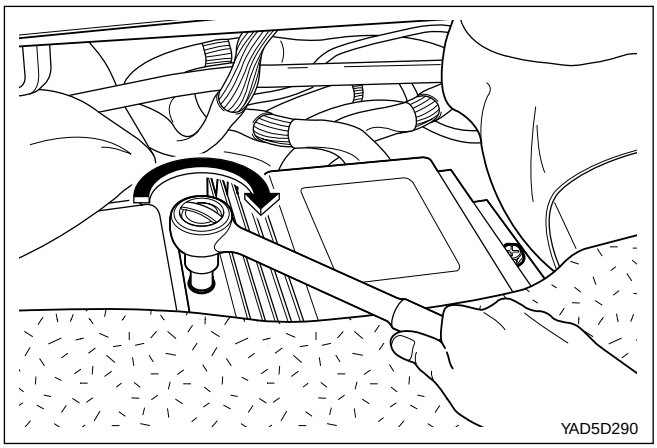
14. Installation should follow the removal procedure in the reverse order.


YAD5D280

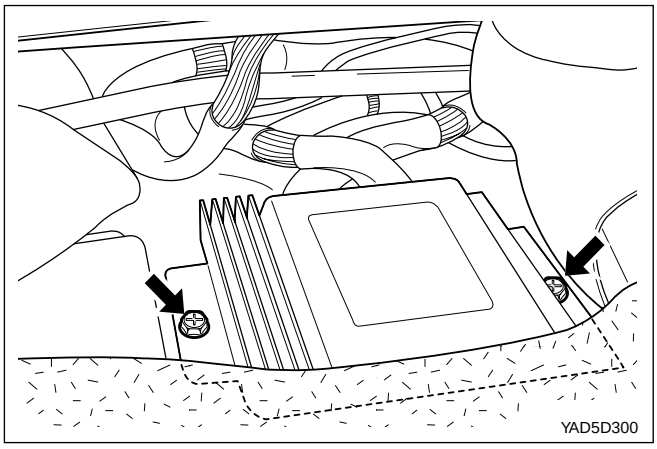
TOD CONTROL UNIT

Removal & Installation Procedure

1. Disconnect (-) cable from battery.
2. Pull toward the driver seat and disconnect the 30 pin connector from TOD control unit.


YAD5D290

3. Unscrew 2 bolts.

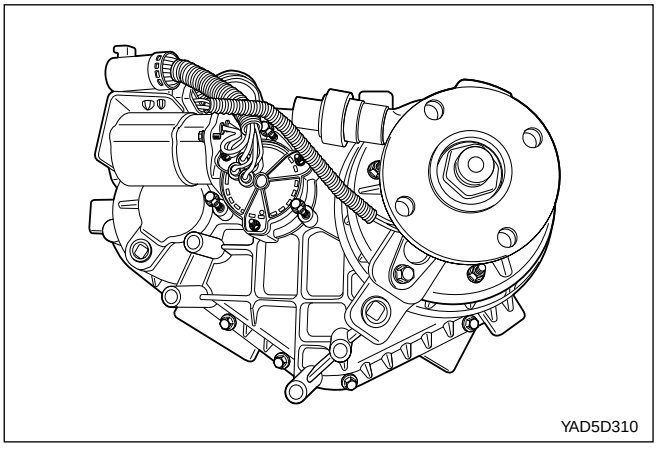

YAD5D300

4. Installation should follow the removal procedure in the reverse order.

   Notice: When replace TOD control unit, it is required to make a coding correspondent with vehicle specification.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

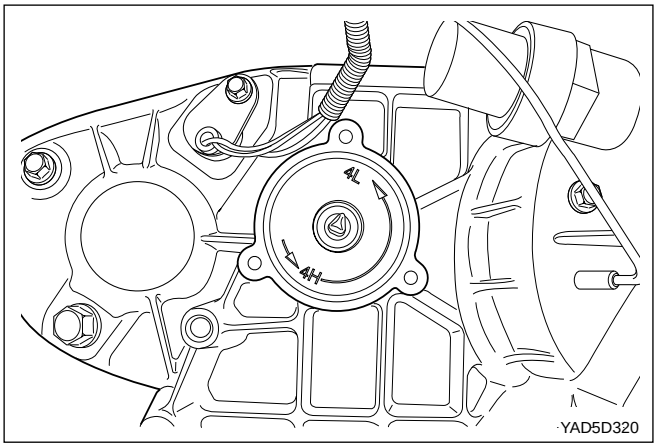

YAD5D310

SHIFT MOTOR

Removal & Installation Procedure

1. Disconnect (-) cable from battery.
2. Disconnect shift motor/magnetic clutch coil connector (black pin7) upper backside.
3. Unscrew 3 shift motor mounting bolts (M10).
4. Unscrew a bracket mounting bolt (M10).

   Notice: When disconnecting shift motor and mounting bracket, it is required to unscrew 2 units of adjusting bolts (M10) form motor and bracket.



5. Keep shift motor even then pull rearward.
6. Clean connection surface of transfer case and shift motor.
7. If necessary, make a test by SCANNER with shift motor assembly.

   Notice: Do not disassemble shift motor. If necessary, replace by shift motor assembly unit.

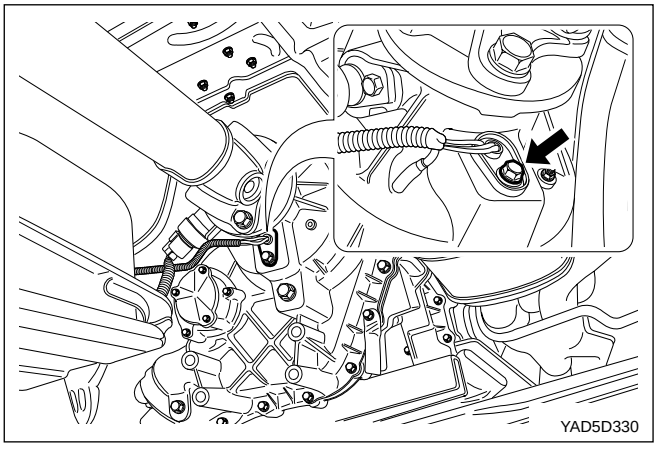
8. Applying sealant into connecting surface for new shift motor.
9. Installation should follow the removal procedure in the reverse order. Before installation, make sure that motor position match with mode of 4H/4L switch.

   Notice: When accord position of motor with 4H/4L switch and transfer case match position of the disconnected motor and new one.

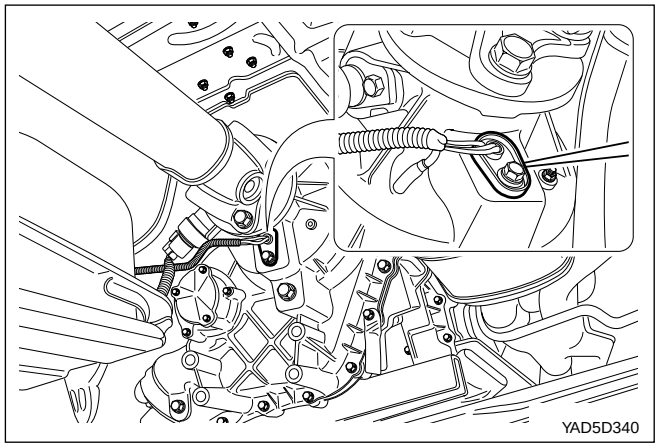
SPEED SENSOR IN FRONT AND REAR PROPELLER SHAFT

Replacement Procedure

1. Disconnect (-) cable from battery.
2. Detach shift motor assembly.
3. Disconnect front and rear speed sensor connector (white 3 pin) upper backside transfer case.
4. Disconnect speed sensor connect from locking sleeve by pushing.
5. Disconnect wire stick cap from the detached connector.



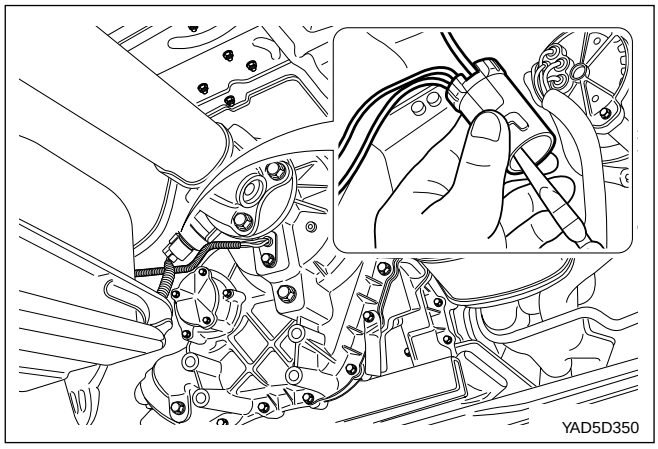
6. Unscrew rear speed sensor mounting bolt (M10) from upper side of rear case flange.



7. Detach sensor from transfer case by lifting up using tool.

   Notice: When disconnect sensor, make sure on adequate pressure due to sensitiveness with shock.

8. Disconnect taping from both protection tube ends that wrap 3 wires of speed sensor and 1 wire of clutch coil.
9. Disconnect tube.



10. Disconnect pin and wire from speed sensor connector by pulling sticking long-nose plier into “L” pin in connector.
11. On the same way, disconnect pin and wire “M” and “N” from connector.

    Notice: Do not touch the wires related with EMC.

12. Prepare new speed sensor.
13. Connect 3 pins with wires of speed sensor to coincide with each connection position.
14. Using long-nose plier, connect tightly by pulling pins.
15. Apply rubber cap into connector using long-nose plier not to detach.
16. Connect protection tube with wire.
17. Tape both ends of tube.
18. Putting rear speed sensor into hole, connect exactly pushing both ends.
19. Screw 1 unit of bolt (M10).

Installation Notice

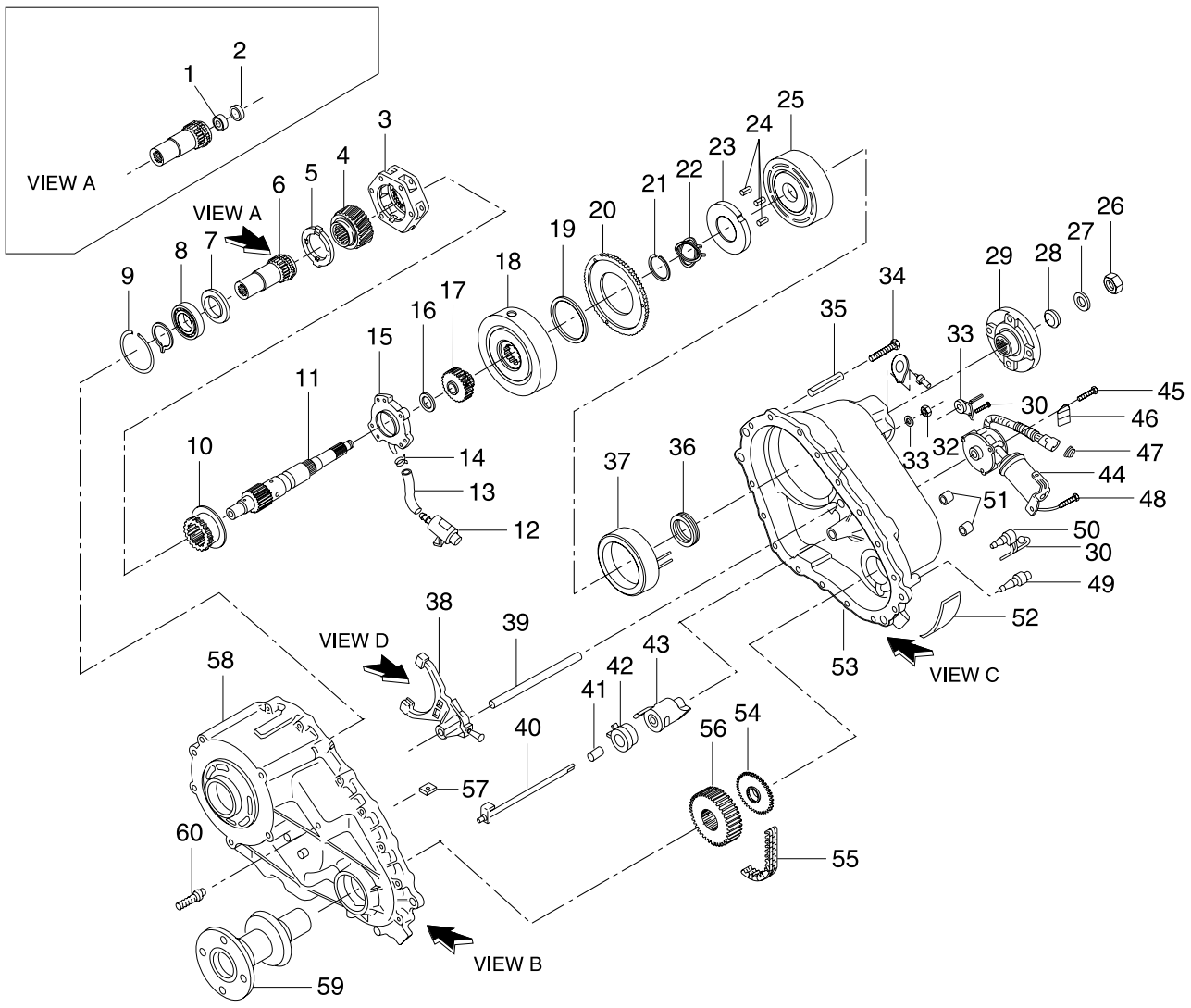
Tightening Torque	3 - 6 N•m (27 - 53 lb-in)

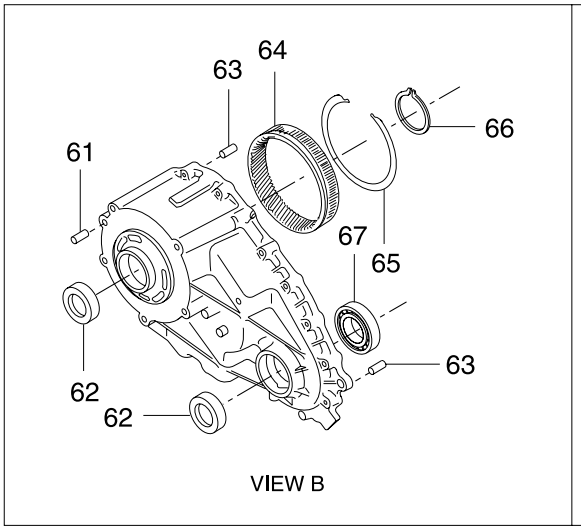
20. Connect speed sensor connector, then locking sleeve.

    Notice: Front propeller shaft should be premised by removal of shift motor.
    After disconnecting shift motor, procedure of replacement on sensor assembly of accords with one of rear speed sensor.

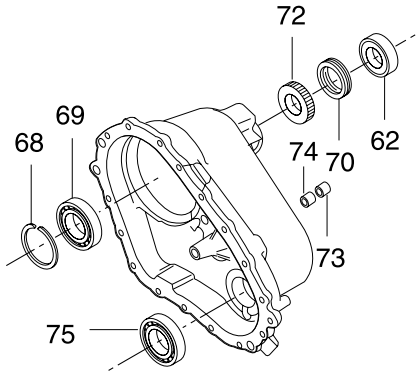
UNIT REPAIR

TRANSFER CASE, DISASSEMBLED VIEW

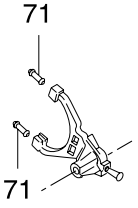




VIEW B



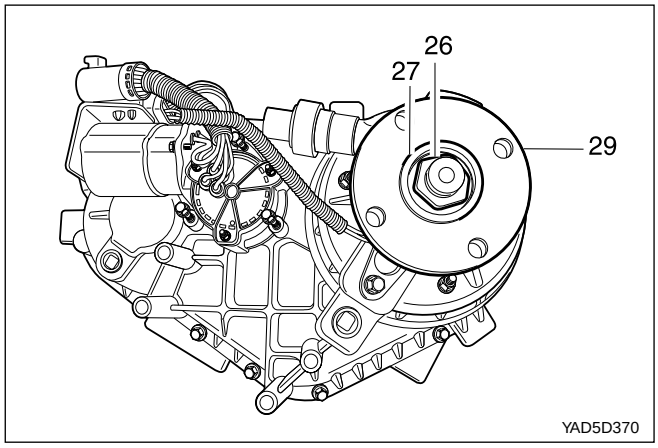
VIEW C



VIEW D

YAD5D360

1 Bearing
2 Bushing
3 Carrier Assembly
4 Sun Gear
5 Thrust Plate
6 Input Shaft
7 Output Shaft Thrust Washer
8 Bearing
9 Snap Ring
10 High-low Collar
11 Rear Output Shaft
12 Oil Strainer
13 Coupling Hose
14 Hose Clamp
15 Pump Assembly
16 Thrust Washer
17 Sprocket, Drive (24T)
18 Clutch Pack Assembly
19 Insulator Washer
20 Armature
21 Snap Ring
22 Wave Washer
23 Apply Cam
24 Ball
25 Cam and Coil Assembly
26 Nut (2)
27 Output Shaft Yoke Washer
28 Oil Seal
29 Case Flange
30 Bolt
31 Upper Speed Sensor (Rear)
32 Nut
33 Washer
34 Bolt (M10 X 105 X 30)
35 Tag, Identification
36 Thrust Bearing
37 Clutch Coil Assembly
38 Fork, Reduction Shift
39 Shift Rail
40 Shaft, Shift
41 Spacer
42 Torsion Spring
43 Electric Shift Cam
44 Transfer Case Shift Motor
45 Bolt
46 J-clip
47 Connector Retainer
48 Bolt
49 Support Stud
50 Lower Speed Sensor (Front)
51 Plug
52 Identification Decal
53 Cover
54 Tone Wheel, Lower
55 Chain, Drive
56 Sprocket, Driven (24T)
57 Magnet, Oil Pan
58 Case
59 Case Flange and Output Shaft
59 Case Assembly
60 Breather Bar
61 Spiral Pin
62 Oil Seal
63 Pin, Dowel
64 Ring Gear
65 Retaining Ring
66 Snap Ring
67 Bearing
68 Snap Ring
69 Bearing
70 Speedometer Drive Gear
71 Facing, Shift Fork
72 Upper Tone Wheel
73 Oil Seal
74 Bearing Sleeve
75 Bearing

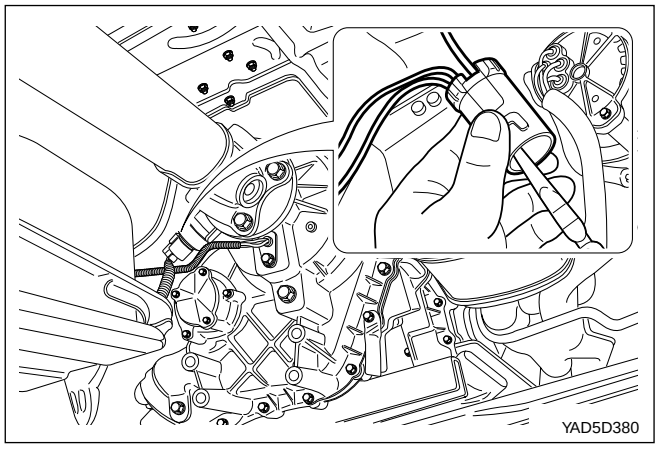


DISASSEMBLY PROCEDURE

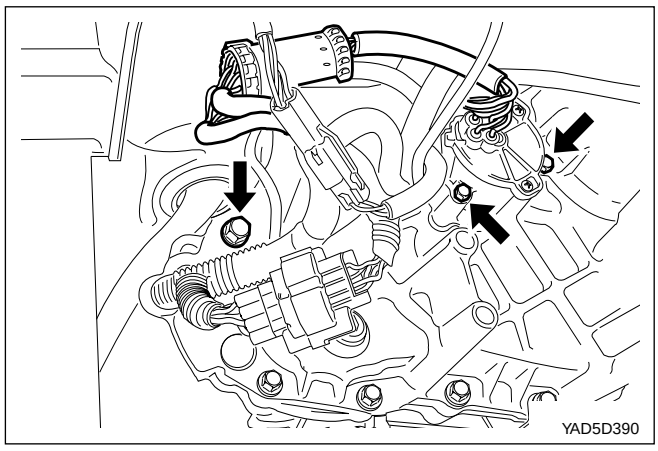
1. Disconnect transfer case from vehicle
2. Using a 30 mm thin-wall socket, first remove the rear output nut, output shaft yoke washer, oil seal then the case flange.
3. Disconnect shift motor/clutch coil connector and speed sensor connector from upper bracket of transfer case.

   Notice: When disconnect connector, pull forwards grasping connector housing.

4. Remove outer tube on speed sensor connector.
5. Remove wire supporting cape back side of speed sensor connector.

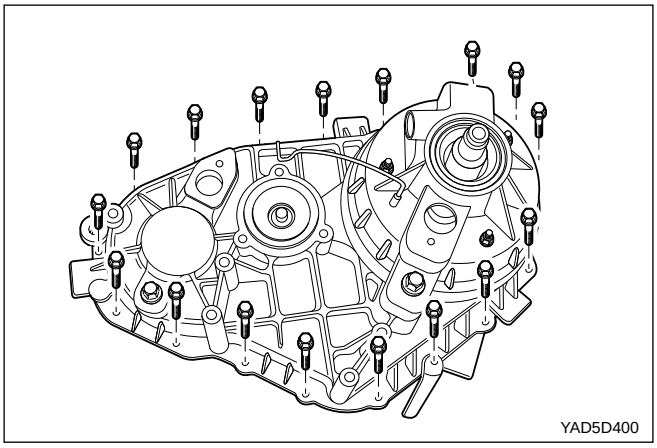


6. Disconnect pin of clutch coil wire (yellow) from speed sensor connector (7 pin) using long-nose plier.

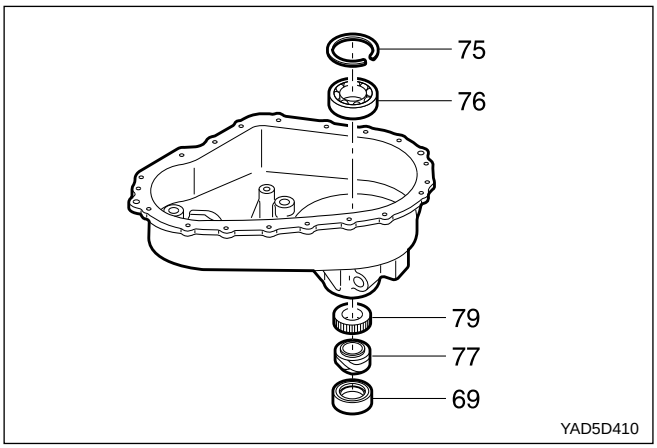


7. Remove shift motor.

   Notice: When remove shift motor, pay attention to the location of triangular slot and shaft in transfer case inside motor.


YAD5D400

8. Disconnect front and rear speed sensor as needed.
9. Remove the 17 bolts that retain the front case to the rear case.

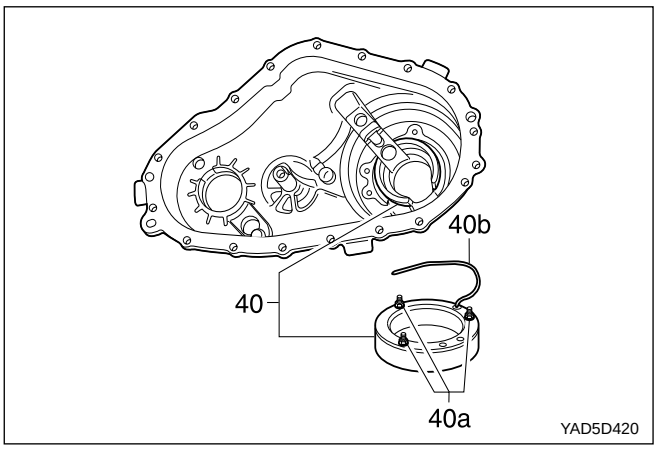


YAD5D410

10. Make sure that the front case is facing downward so that the rear cover is facing upwards.
11. Remove the rear front case from the rear case.
12. Remove all traces of gasket sealant from the mating surfaces of the front case and rear case.
13. If the speedometer drive gear is to be replaced, first remove the flange seal by prying and pulling the curved-up lip of the flange seal.

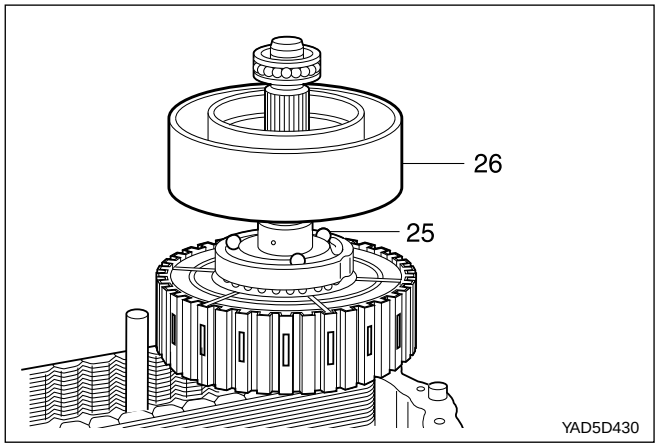
    Notice: Be careful not to damage the bearing, bearing cage or case. Remove and discard the flange seal.

14. Remove the speedometer drive gear and upper tone wheel.
15. If the rear output shaft bearing requires replacing, remove the internal snap ring that retains the bearing in the bore.
16. From the outside of the case, drive out the bearing using the driver.

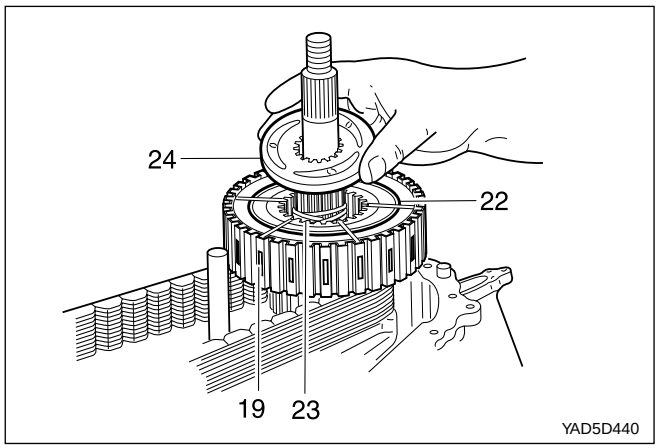


YAD5D420

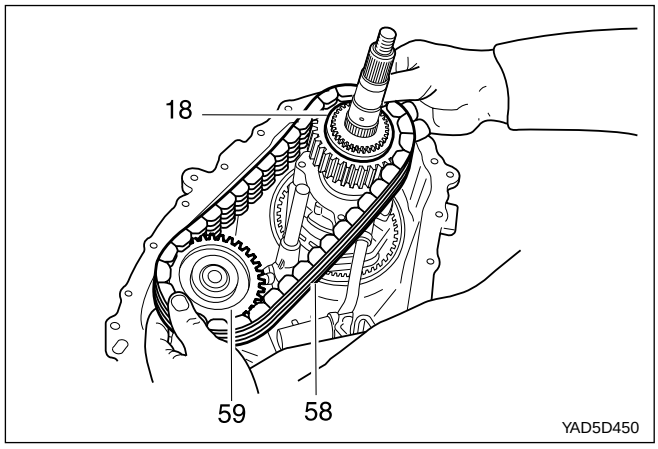
17. Remove the three nuts and washers retaining the clutch coil assembly to the rear case.
18. Pull the assembly, along with the O-ring and wire, from the case.



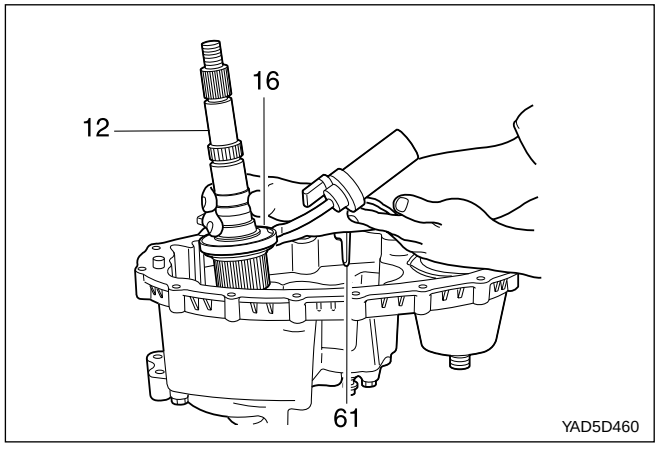
19. Remove bearing assembly from output shaft.
20. Remove the clutch housing from the output shaft.



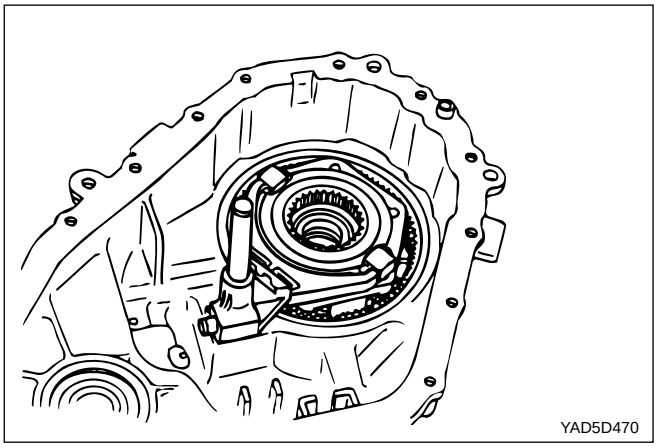
21. Remove the balls and apply cam and wave washer from the output shaft.
22. Remove snap ring from output shaft.
23. Remove clutch pack assembly from output shaft.



24. Remove the chain, driven sprocket and drive sprocket as an assembly.
25. Remove thrust washer from output shaft.



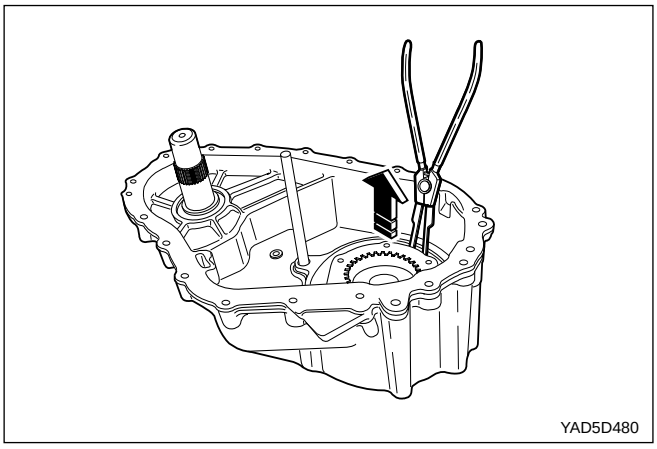
26. Remove the magnet from the slot in the front of the case bottom.
27. Remove the output shaft and oil pump as an assembly.
28. If required, to remove the pump from the output shaft, rotate the pump to align.
29. Pull out the shift rail.
30. Remove the helical cam from the front case.
31. If required, remove the helical cam, torsion spring and sleeve from the shaft.


YAD5D470

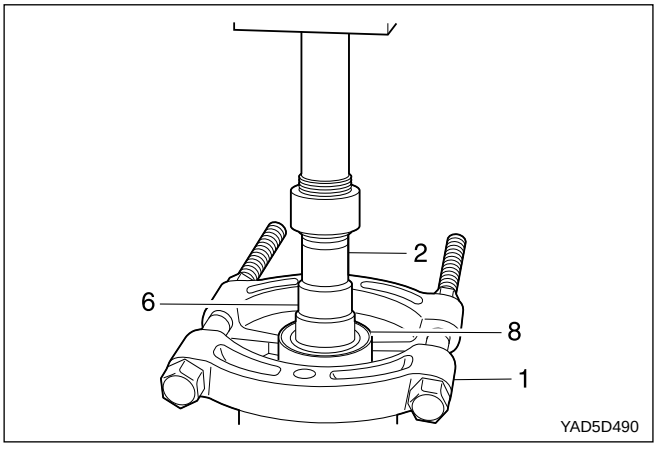
32. Remove the high-low range shift fork and collar as an assembly.
33. Expand the tangs of the large snap ring in the case.
34. With the input shaft against a bench, push the case down and slide the main drive gear bearing retainer off the bearing.
35. Lift the input shaft and front planet from the case.
36. If required, remove the oil seal from the case by prying and pulling on the curved-up lip of the oil seal.

    Notice: Be careful not to damage the bearing, bearing cage or case.

37. Remove the internal snap ring from the planetary carrier.
38. Separate the front planet from the input shaft.
39. Remove the external snap ring from the input shaft.


YAD5D480

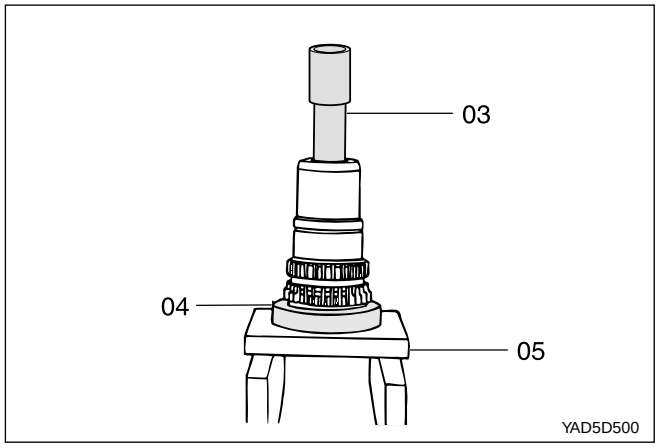
40. Place the input shaft in a vise and remove the bearing.
41. Remove the thrust washer, thrust plate and the sun gear off the input shaft.



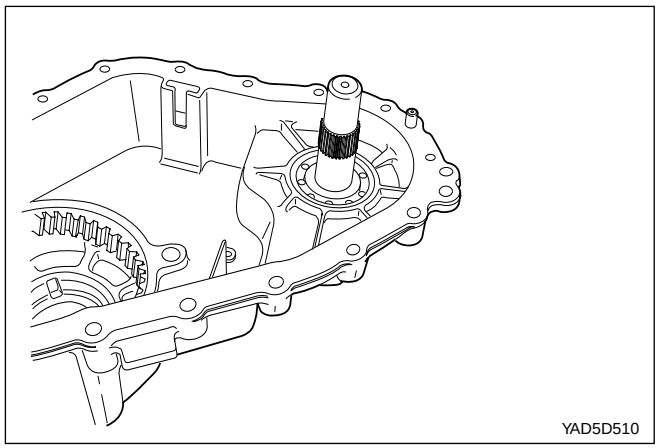
YAD5D490

42. Inspect the bushing and needle bearing in the end of the input shaft for wear or damage.

    Notice: Under normal use, the needle bearing and bushing should not require replacement. If replacement is required, the bushing and needle bearing must be replaced as a set.



43. If replacement of the needle bearing and bushing is required, press the bearing and bushing is required, press the bearing and bushing out as follows:
    - Position the input shaft on Axle Bearing/Seal plate, and using Pinion Bearing Cone Replacer as a spacer.
    - Insert Input Shaft Bearing Remover into the input shaft so it is resting on top of the bearing cage.
    - Tighten the actuator pin until it stops, then press the bearing and bushing out together.



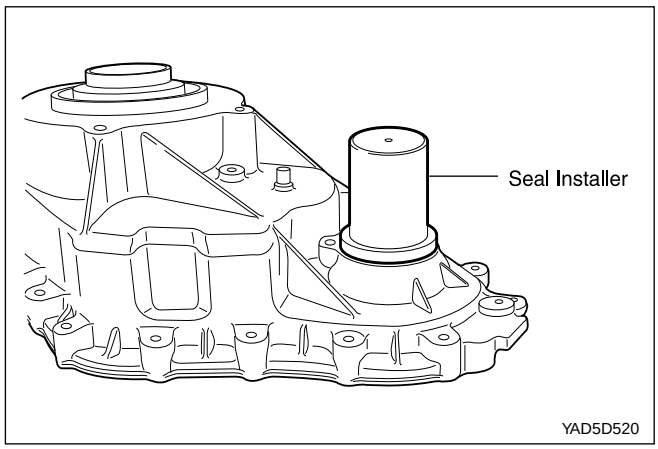
44. If required, remove the front yoke to flange seal by prying and pulling on the curved-up lip of the yoke to flange seal.

    Notice: Be careful not to damage the bearing, bearing cage or case.

45. If required, remove the internal snap ring retaining the front output shaft ball bearing and remove the bearing.

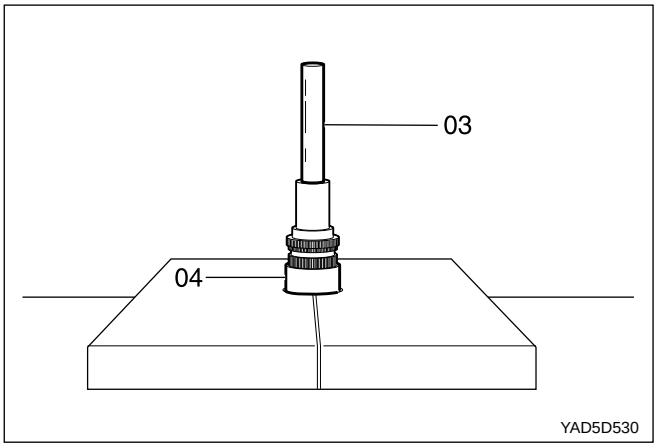
Assembly Procedure

1. Before assembly, lubricate all parts with Automatic Transmission Fluid or equivalent.
2. If removed, drive the bearing into the front output case bore.



Notice: Drive the bearing in straight, making sure it is not cocked in the bore.

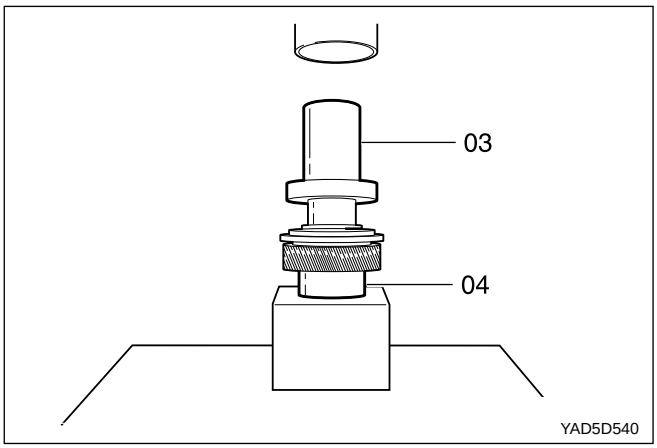
3. Install the internal snap ring that retains the bearing to the front case.
4. If removed, install the front yoke to flange seal in the front case bore.
5. If removed, install the yoke to flange seal into the mounting adapter bore.



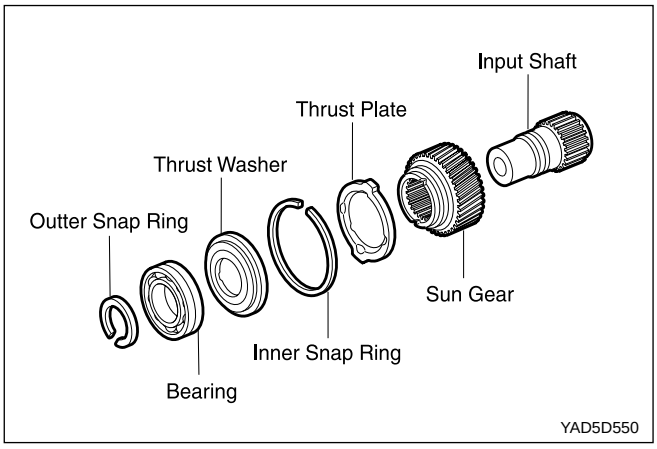
6. If the input shaft needle bearing and bushing were removed, install a new bearing and bushing as detailed in the following steps:

   Press a new needle bearing, then a new bushing in the input shaft as follows:

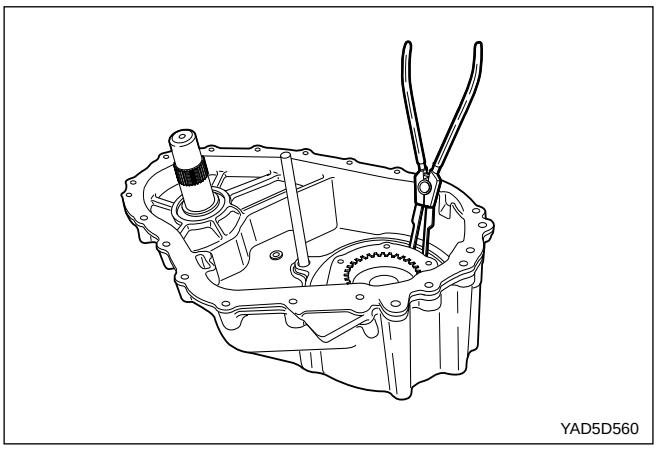
   - Position the input shaft on Axle Bearing/Seal Plate or equivalent, and Pinion Bearing Cone Replacer as a spacer.
   - Press a new needle bearing into the end of the input shaft until it seats in the input shaft.



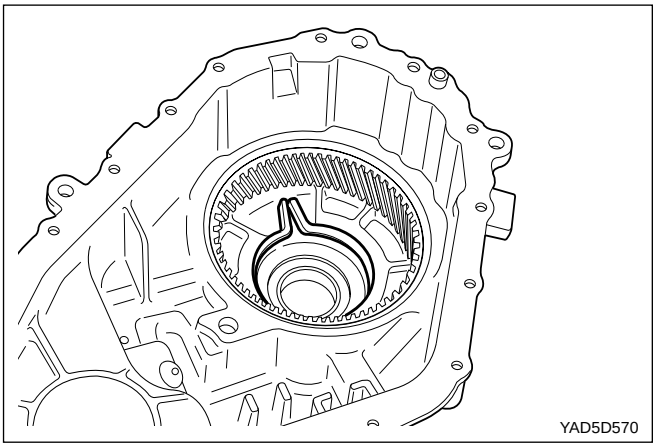
   - Press in a new bushing.



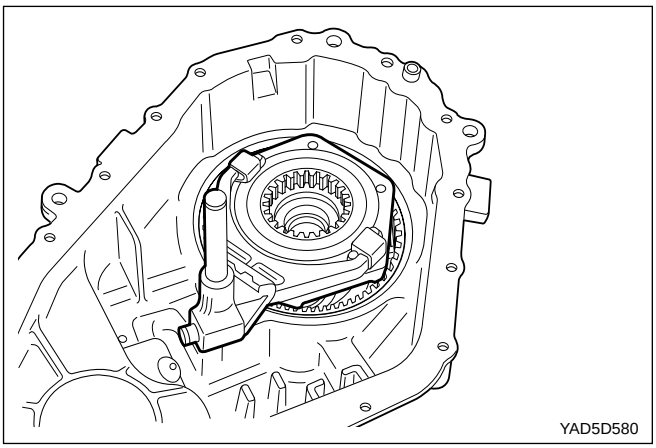
7. The recessed face of the sun gear and the snap ring groove on the bearing outer race should be toward the rear of the transfer case.
8. The stepped face of the thrust washer should face toward the bearing.
9. Slide the sun gear, thrust plate and thrust washer into position on the input shaft.
10. Press the bearing over the input shaft.
11. Install the external snap ring to the input shaft.



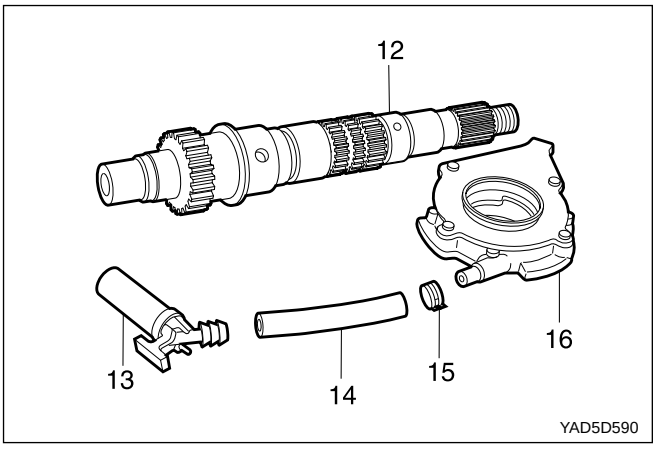
12. Install the front planet to the sun gear and input shaft.
13. Install the internal snap ring to the planetary carrier.


YAD5D570

14. Place the tangled snap ring in the case. Expand snap ring with snap ring pliers and install planetary carrier assembly. Check installation by holding the case and carefully tapping the face of the input shaft against a wooden block to make sure the snap ring is installed.
15. Remove all traces of gasket sealant from the front case and mounting adapter mating surfaces. Install a bead of gasket sealant on the surface of the front case.

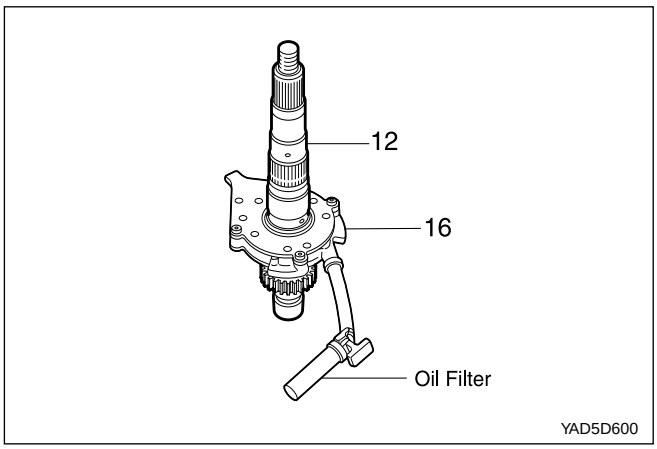

YAD5D580

16. Install the high-low shift fork and high-low collar as an assembly into the front planet.
17. If new pump is used, align the flat of the output shaft and the flat of the pump. Slide the pump onto the output shaft.



YAD5D590

18. Inspect the outside surfaces and bore of the oil pump.

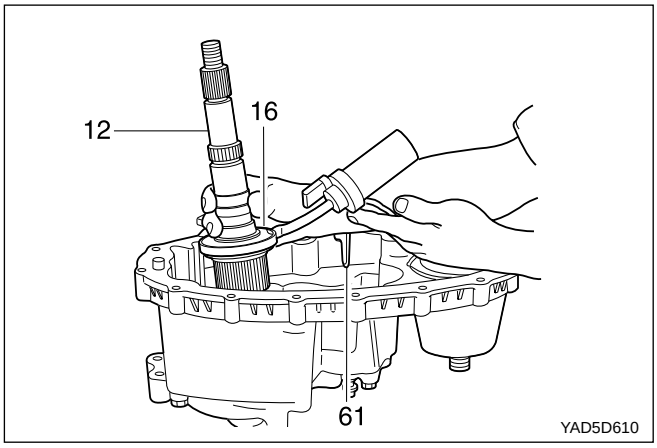


YAD5D600

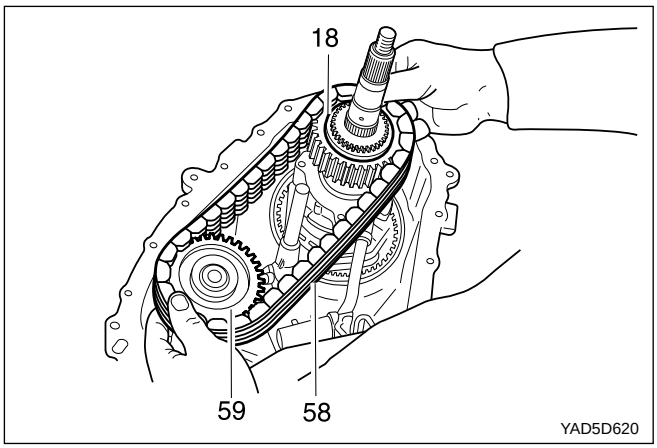
19. Install the output shaft and oil pump in the input shaft.

    Make sure that the internal splines of the ouput shaft engage the internal splines of the high-low shift collar.

    Make sure that the oil pump retainer arm and oil filter leg are in the groove and slot of the front case.

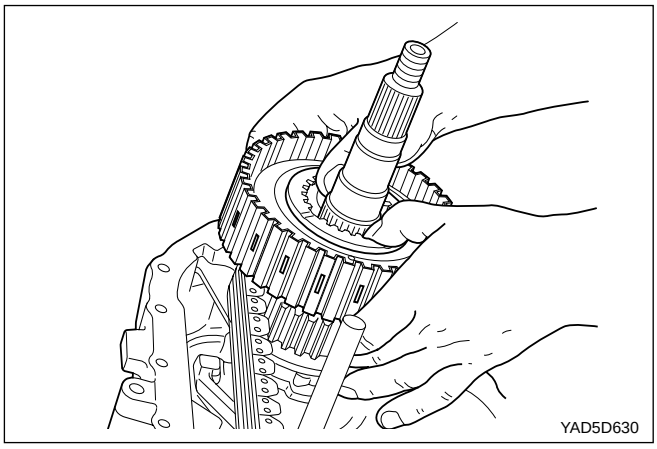


20. Install the magnet in the slot in the front case just above the oil filter leg.
21. Install the front output shaft in the front case.
22. Install the thrust washer on the rear output shaft.

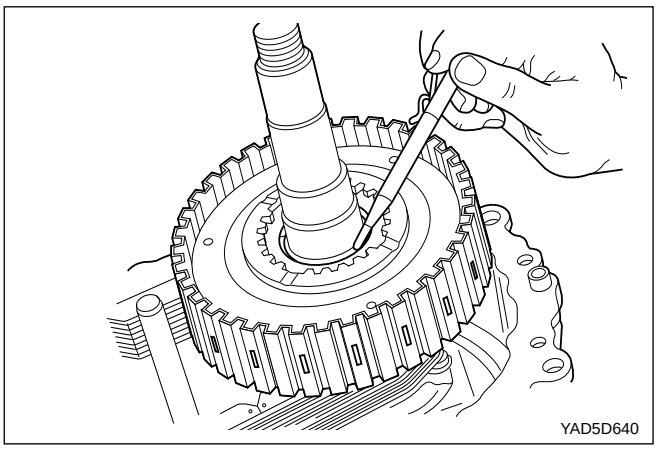


23. Install the chain, drive sprocket and driven sprocket as an assembly over the output shaft.

    Notice: The driven sprocket (on the front output shaft) must be installed with the marking REAR facing toward the rear case, if so marked.
    Drive sprocket has a bushing pressed into it.



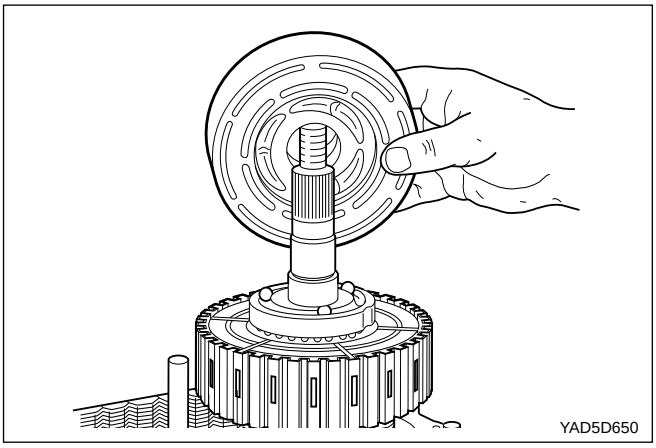
24. Install tone wheel onto the front output shaft. Make sure the spline on the tone wheel engages the spline on the front output shaft.
25. Install clutch pack assembly onto the rear output shaft. Make sure the spline of the clutch pack engages to the spline of the sprocket.



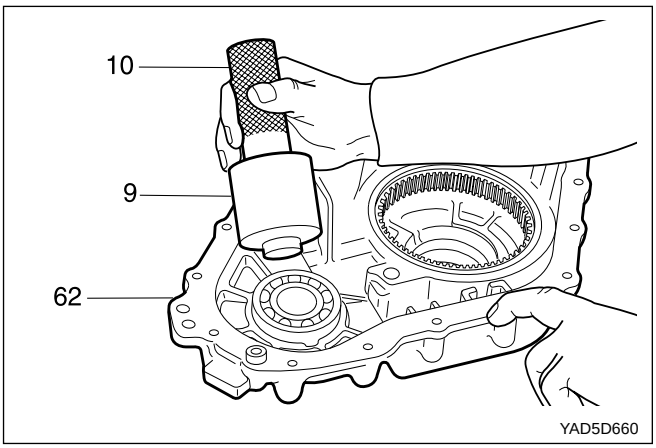
26. Install snap ring onto the rear output shaft. Start the snap ring over the spline and use the wave spring to seat the snap ring in the snap ring groove.

    If the snap ring will not install, the thrust washer inside the clutch pack may not be seated properly.
27. Install wave spring, insulator washer and armature. (Three offset slots must align with housing to be installed)

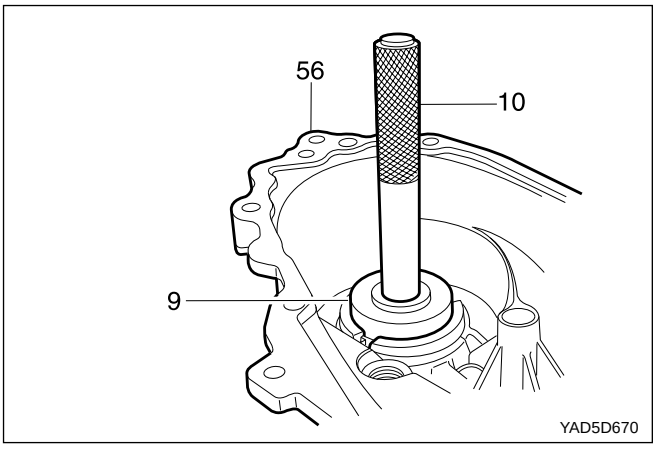
    Notice: Three slots on the thrust washer must be aligned with the three tabs on the clutch pack housing.



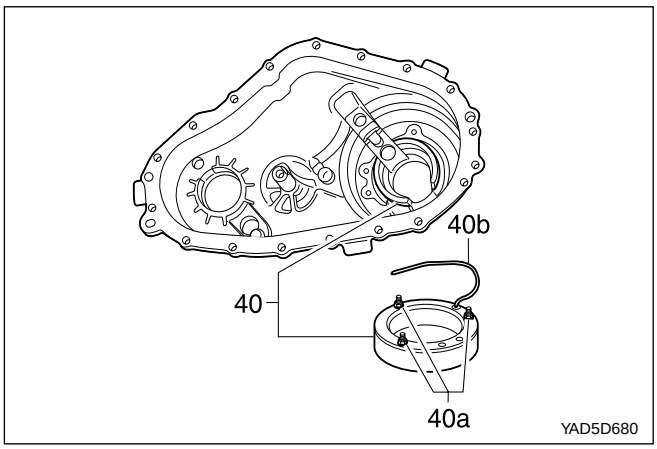
28. Install apply cam onto the rear output shaft,
29. Install three balls into the apply cam.
30. Install cam and coil housing assembly onto rear output shaft.
31. Install thrust bearing assembly onto output shaft.



32. If removed, drive the front output shaft ball bearing into the rear cover bore with Front Shaft Needle Bearing Replacer and Driver Handle.



33. If removed, install the rear output bearing in the rear case bore. Drive the bearing into the rear case bore with Output Shaft Bearing Replacer and Driver Handle. Make sure that the bearing is not cocked in the bore.
34. Install the internal snap ring that retains the bearing to the rear case.



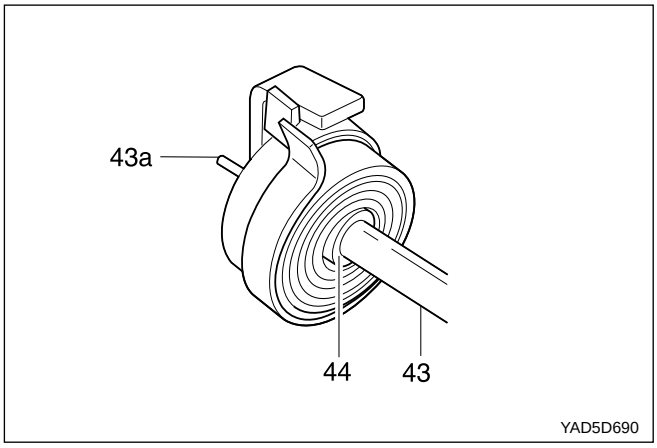
35. Install the clutch coil from inside the rear case until the wire and studs extend through the cover.

    Notice: Do not kink or trap the wire while seating the clutch coil to the case.

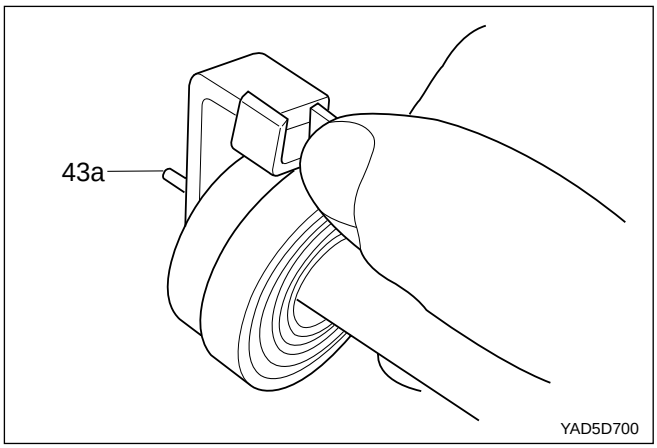
36. Install the washers and nuts and tighten.

Installation Notice

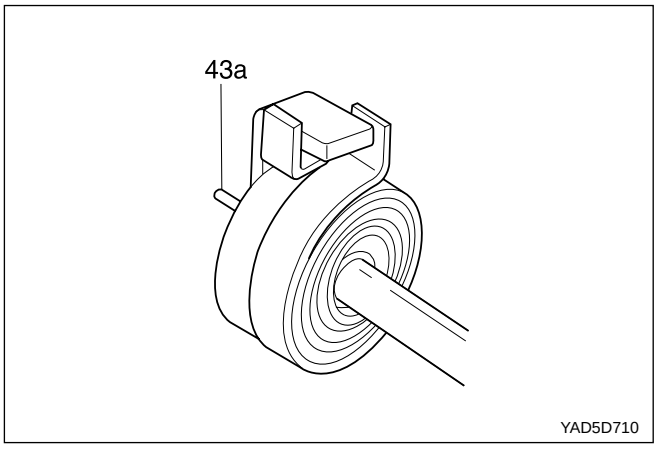
Tightening Torque	8 - 11 N•m (71 - 97 lb-in)



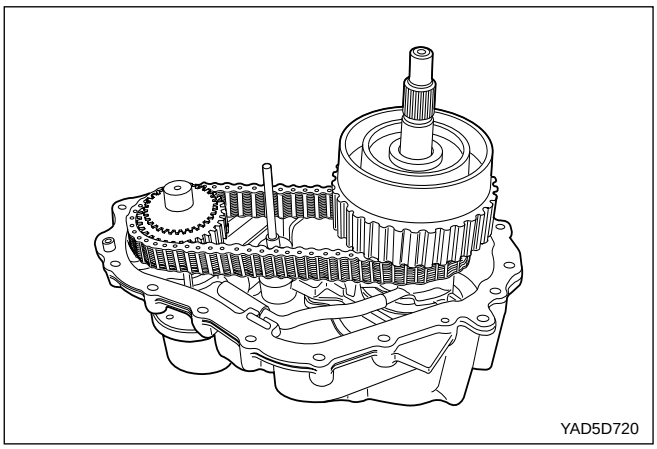
37. Slide the spring spacer on the camshaft and position it beneath the drive tang.
38. Place the torsion spring on the camshaft. Position the first spring tang to the left of the camshaft drive tang.



39. Rotate the second spring tang clockwise past the drive tang.



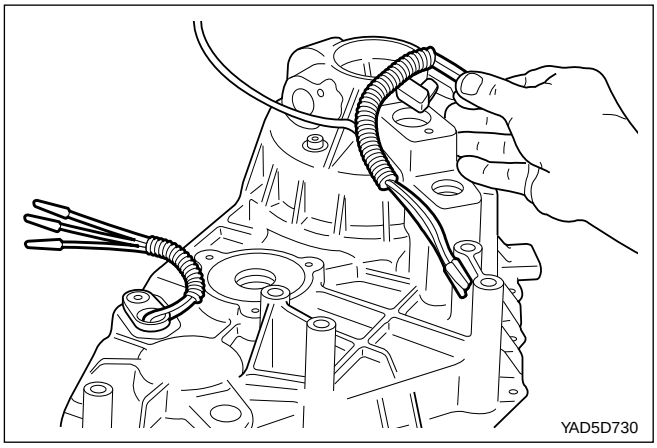
40. Push the torsion spring and sleeve in as far as it will go.
41. Install the helical cam and slide the drive tang between the torsion spring tangs as far as it will go.



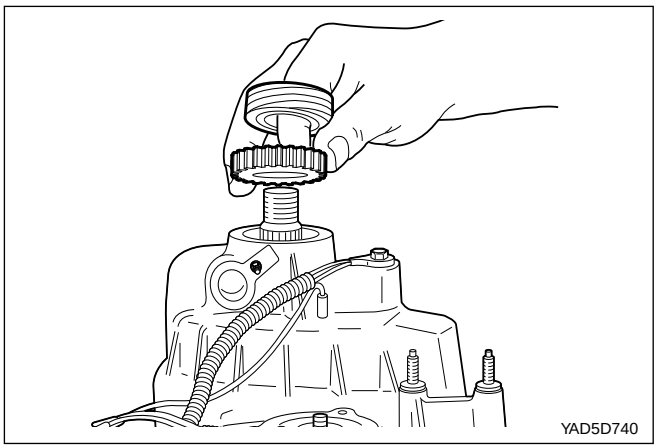
42. Install the pin on the tang end of the helical cam into the hole in the front case. Position the torsion spring tangs so that they are pointing toward the top side of the transfer case and just touching the high-low shift fork.

    Notice: Do not bend the helical cam during installation to the front case because of possible damage to the pin at the tang end of the motor shaft.

43. Install the shift rail through the high-low shift fork and make sure that the reverse gear shift rail is seated in the front case bore.

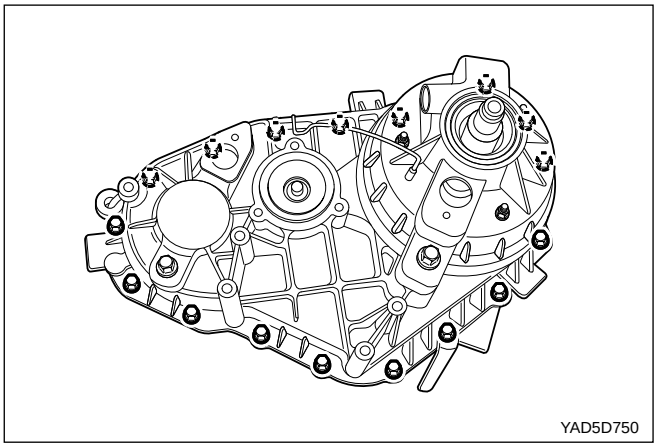


44. Install upper and lower speed sensors into the cover. Feed the coil wire through the upper speed sensor wire shield.



45. Install upper tone wheel, speedometer gear and rear output seal. Use Output Shaft Seal Replacer and Driver or equivalent to install seal.

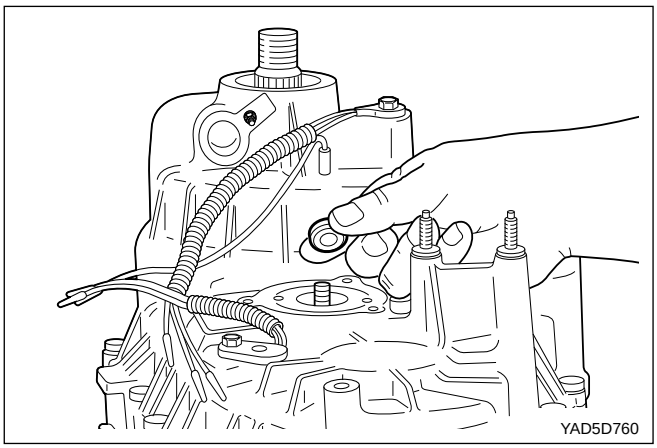
46. Coat the mating surface of the front case with a bead of Black Non-Acid Cure Silicone Rubber or equivalent.
47. The following procedure must be followed prior to installing the rear case onto the front case half:
    - Align the output shaft with the rear case output shaft bore.
    - Align the helical cam with the rear case motor bore.
    - If difficulty is encountered with seating the rear case, tap the rear output shaft with a sharp blow using a rubber mallet in a direction away from the triangular shaft while pushing down on the rear case.


YAD5D750

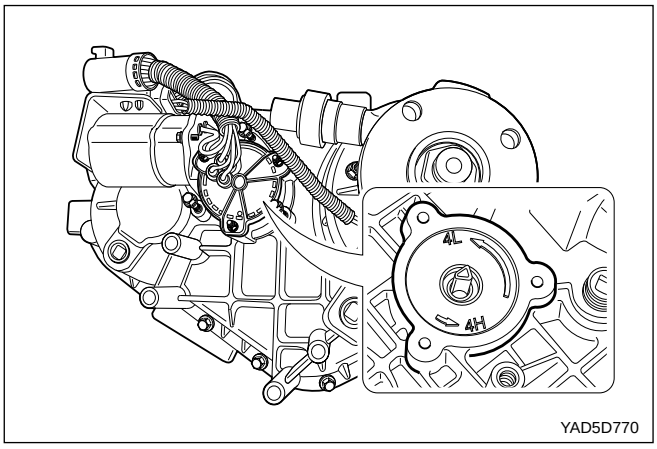
48. Install the bolts retaining the case halves and tighten.

Installation Notice

Tightening Torque	25 - 37 N•m (8 - 27 lb-ft)


YAD5D760

49. Install shift shaft oil seal if it is not installed.



YAD5D770

50. Using pliers equipped with soft jaws, rotate the triangular shaft so it is aligned with the triangular slot in the transfer case shift motor.

Notice: If triangular shaft will not rotate, rotate the rear output shaft.

51. Tighten manually the two nuts that attach the slotted support bracket to the end of the motor house.
52. Apply Black Non-Acid Cure Silicone Rubber or equivalent to motor housing base and install on transfer case.
53. Install the transfer case shift motor and three bolts along with speed sensor wire harness bracket and tighten.

Installation Notice

Tightening Torque	8 - 11 N•m (71 - 97 lb-in)

54. Holding the slotted support bracket tight against the motor housing end, secure the bracket to the transfer case, tightening the bolt with lock washer.

Installation Notice

Tightening Torque	8 - 11 N•m (71 - 97 lb-in)

55. Retighten the two nuts that attach the slotted support bracket to the end of the motor.

Installation Notice

Tightening Torque	3 - 6 N•m (27 - 53 lb-in)

56. Install the clutch coil wire terminal(brown) and other shift motor wires to the 7-pin connector(black).
57. Install the connector retainer at the connector end.
58. Connect the front and rear speed sensors wiring to the 7-pin connector(white).
59. Install the rear case flange on the output shaft.
60. Install the rubber seal, output shaft yoke washer and nut. Tighten the nut.

Installation Notice

Tightening Torque	137 - 196 N•m

61. Install the drain plug and tighten.

Tightening Torque	19 - 30 N•m (14 - 22 lb-ft)

62. Fill the transfer case with 1.4 liters of Automatic Transmission Fluid or equivalent.
63. Install the fill plug and tighten.

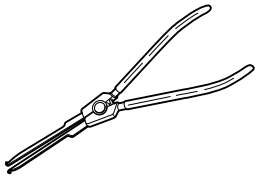
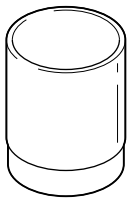
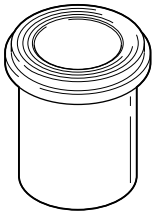
Installation Notice

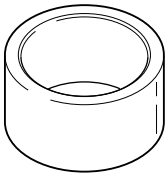
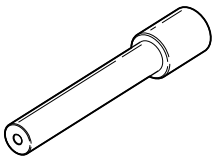
Tightening Torque	19 - 30 N•m (14 - 22 lb-ft)

64. Install the transfer case as outlined in removal and Installation.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD5D780	**Snap Ring Plier**
 YAD5D800	**Bearing Installer**
 YAD5D820	**Seal Installer**

 YAD5D790	**Input Shaft Support**
 YAD5D810	**Bearing Removal/ Installer**

SECTION 6A

POWER STEERING

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GENERAL DESCRIPTION AND OPERATION

SPECIFICATIONS

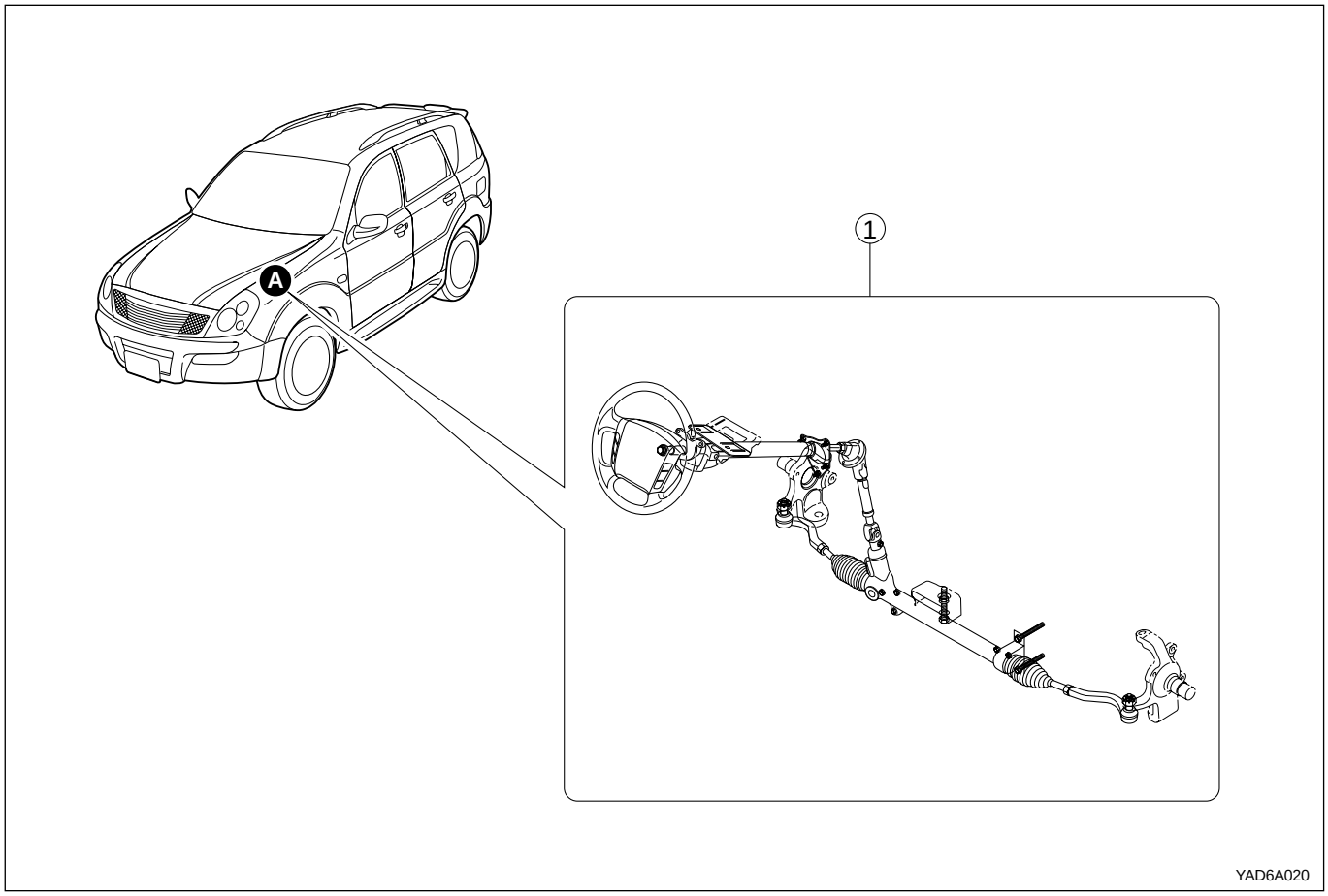
Steering Wheel	Number of spoke		4-Spoke Type
	Outer Diameter		390 mm
Steering Gear Box	Type		Rack and pinion
	Gear Ratio		∞
	Steering Angle	Inner	36° 17´
		Outer	32° 40´
Oil pump	Type		Vane
	MAX. Pressure		82 ~ 92 kgf/cm²
	Outlet		10.5L/min
	Size		124mm
Tilt column Angle	Upper		4°
	Lower		4°
	Turning Radius		5.7 m
Oil	Type		ATF DEXRON II
	Capacity		1 L

DIAGNOSTIC INFORMATION AND PROCEDURES

Phenomena	Checks	Action
Hard Steering	Lack of Lubrication	Lubricate
	Abnormal Wear or Binding of Steering Ball Joint	Replace
	Damaged or Faulty Steering Gear	Replace gear assembly
	Improper Preload of Steering Pinion	Adjust
	Faulty Steering Shaft Joint	Replace
	Steering Fluid Leaks	Repair or replace
	Lack of Fluid or Air-in System	Replenish or bleed
	Faulty Steering Oil Pump	Replace
Steering Pulls to One Side	Damaged or Loosened Pump Drive Belt	Adjust or replace
	Clogging Oil Line	Repair or replace
	Damaged Wheel or Tire	Repair or replace
	Faulty Suspension System	Repair or replace
	Damaged Steering Linkage	Repair
	Damaged Wheel and Tire	Repair or replace
	Faulty Brake System	Repair or replace
	Faulty Suspension System	Repair or replace
Excessive Wheel Play	Worn Steering Gear	Replace gear assembly
	Worn or Damaged Steering Ball Joint	Replace
	Loosened Steering Gearbox Bolts	Retighten
Poor Return of Steering Wheel	Damaged or Binding Steering Ball Joint	Replace
	Improper Preload of Steering Pinion	Replace gear assembly
	Damaged Wheel or Tire	Repair or replace
	Faulty Suspension System	Repair or replace
Steering Wheel Shimmy	Damaged Steering Linkage	Replace
	Loosened Steering Gearbox Mounting Bolt	Retighten
	Damaged or Binding Steering Ball Joint	Replace
	Worn or Damaged Front Wheel Bearing	Replace
	Damaged Wheel or Tire	Repair or replace
	Faulty Suspension System	Repair or replace
Abnormal Noise From Steering System	Loosened Steering Gearbox Mounting Bolt	Retighten
	Faulty Steering Gear	Replace gear assembly
	Steering Column Linterference	Replace
	Loosened Steering Linkage	Retighten
	Damaged or Loosened Oil Pump Drive Belt	Adjust or replace
	Loosened Oil Pump Bracket	Retighten
	Loosened Oil Pump Mounting Bolt	Retighten
	Air-in System	Bleed
	Faulty Oil Pump	Replace

COMPONENT LOCATOR

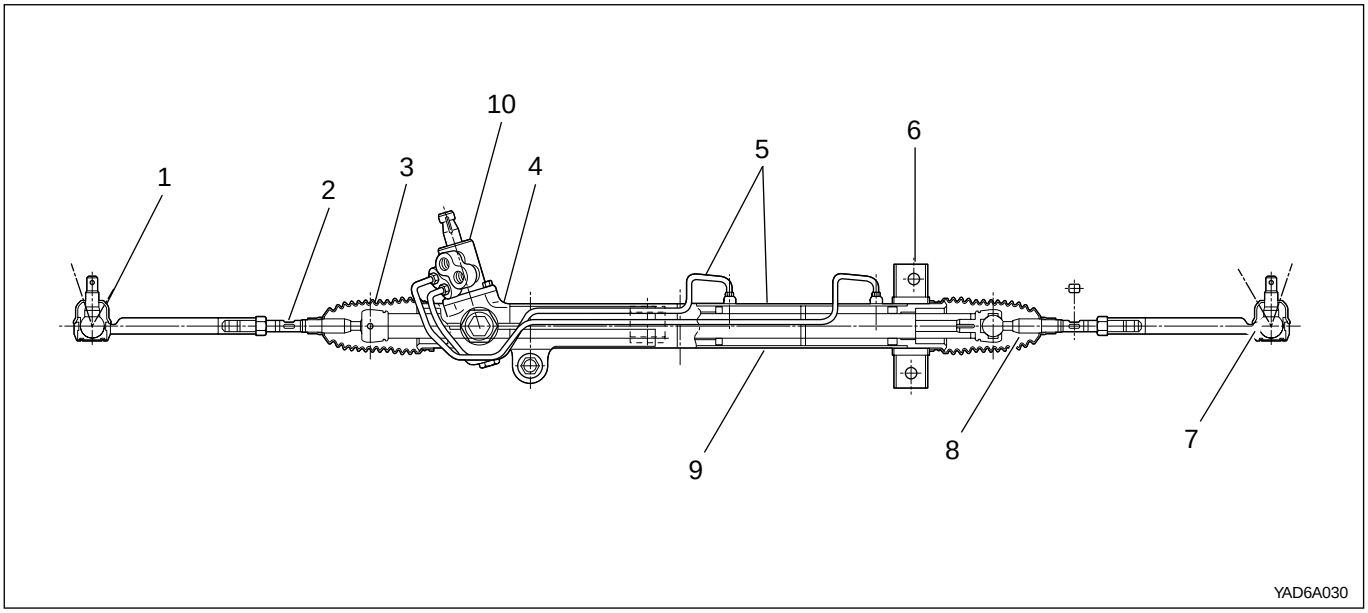
POWER STEERING SYSTEM LOCATOR



A Mounting Position

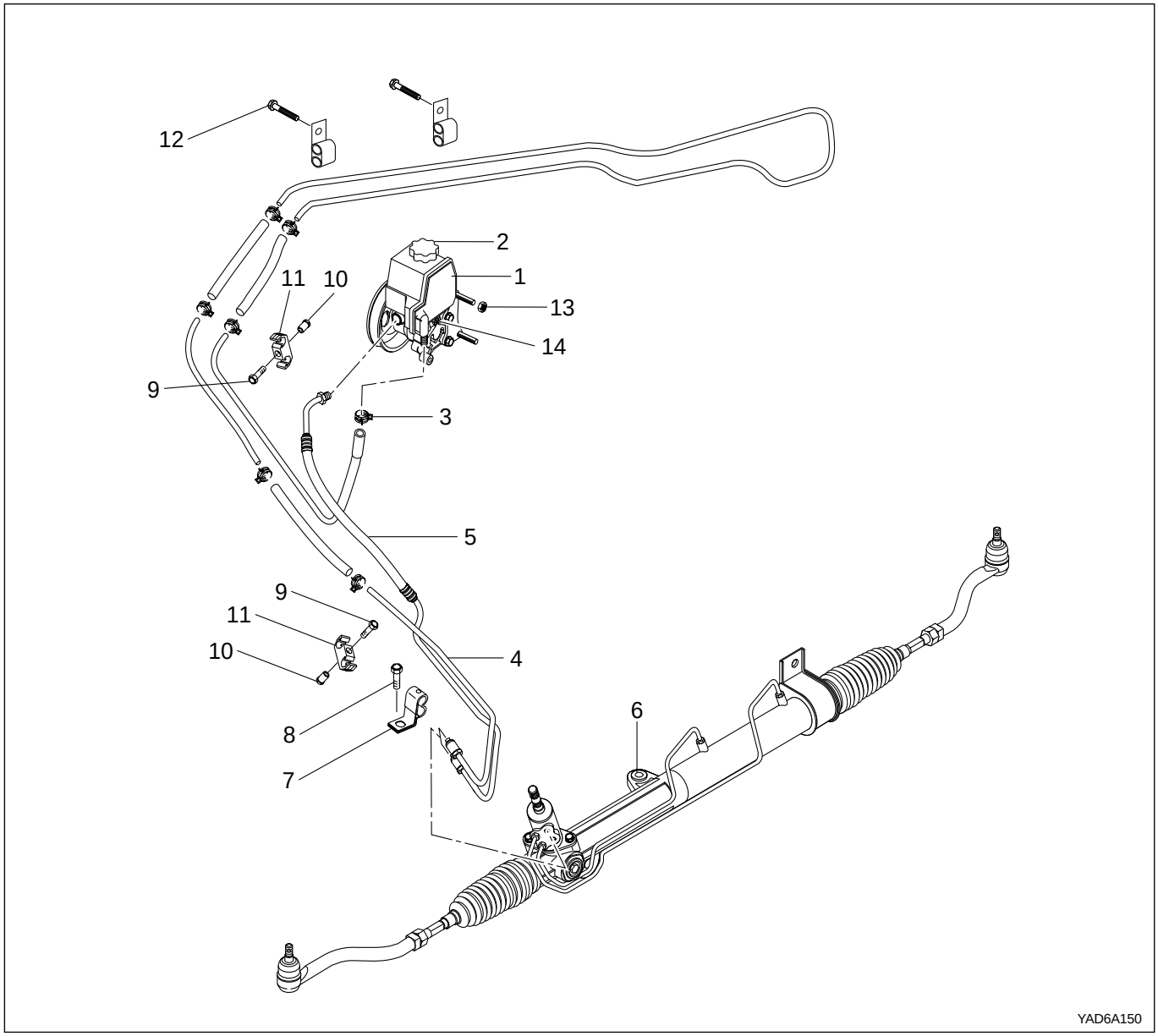
1 Steering Component

STEERING GEAR BOX CROSS SECTION



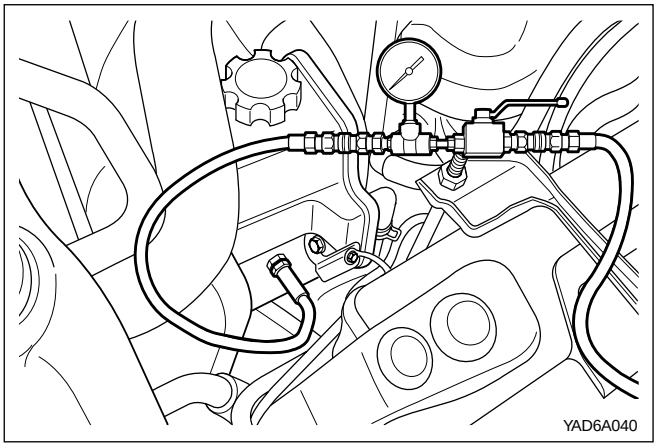
1 Tie Rod End
2 Tie Rod
3 Bellows
4 Rack Housing
5 Feed Tube
6 Mounting Bracket
7 Tie Rod End
8 Tie Rod End
9 Cylinder Tube
10 Valve Assembly

POWER STEERING ASSEMBLY



1 Power Steering Pump Reservoir Assembly
2 Power Steering Pump Cap Assembly
3 Clip
4 Return Line
5 Pressure Line
6 Power Steering Gear
7 Power Steering Pipe Mounting Bracket Clip.
8 Hexagon Bolt
9 Fan Screw (M5)
10 Welded Nut
11 Pipe Clamp
12 Hexagon Bolt
13 Nut
14 Bolt

GENERAL INSPECTION



OIL PUMP PRESSURE

Do the pressure checking followed to check the defect of power steering pump.

Notice: Before checking, check the power steering oil level and belt tension. When tightening of removing the fitting, prepare the oil container because the oil may drop down.

1. Remove the pressure line fitting of power steering pump.
2. Install the pressure check gauge between the power steering pump and power steering oil pressure line.
3. Put the transmission in neutral position.
4. Pull the lever of parking brake.
5. Open the installed pressure check gauge valve completely.
6. Start the engine and keep it to the idling.
7. Turn the steering wheel several times until the oil temperature is up to the normal operating temperature.
8. Close the pressure check gauge valve completely and then measure the oil pressure.

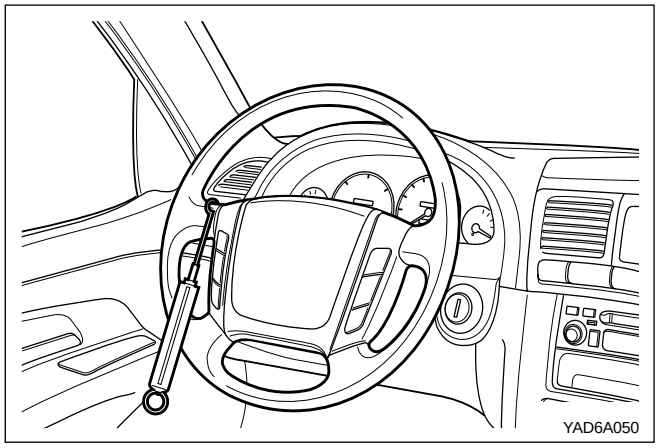
   Notice: Do not keep the valve closed for more than 10 seconds to protect the damage of pump.

A	53 - 58 kgf/cm²

9. Open the gauge valve completely and then measure the oil pressure.

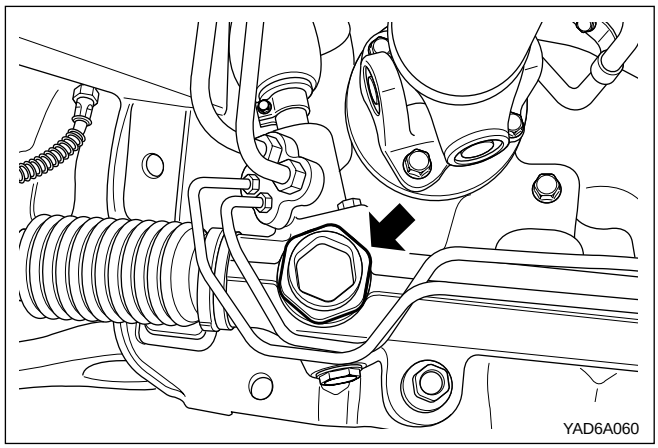
A	3 - 5 kgf/cm²

10. If the pressure is within specified value, the pump is normal. If not, replace the power steering pump.

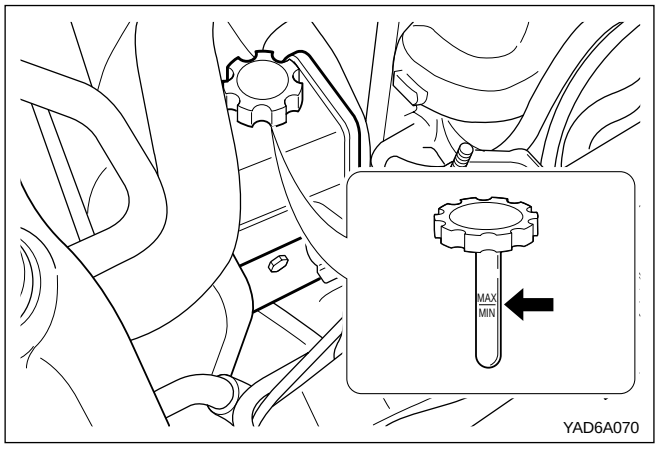


POWER STEERING GEAR PRELOAD ADJUSTMENT

1. Place the steering wheel in front direction.
2. Lift the vehicle using the lifter safely.
3. Remove the adjustment plug lock nut.
4. Measure the torque of adjustment plug.

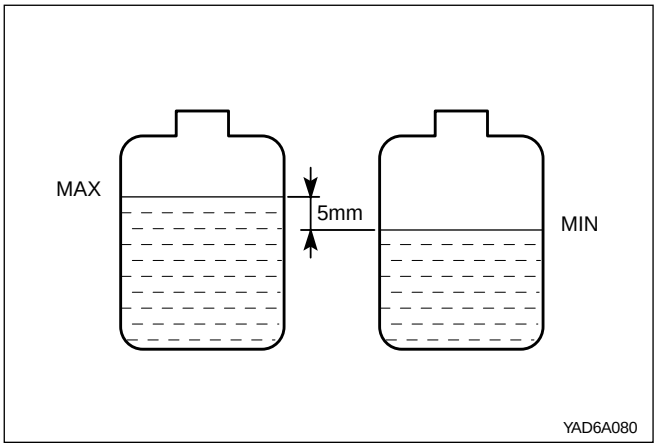


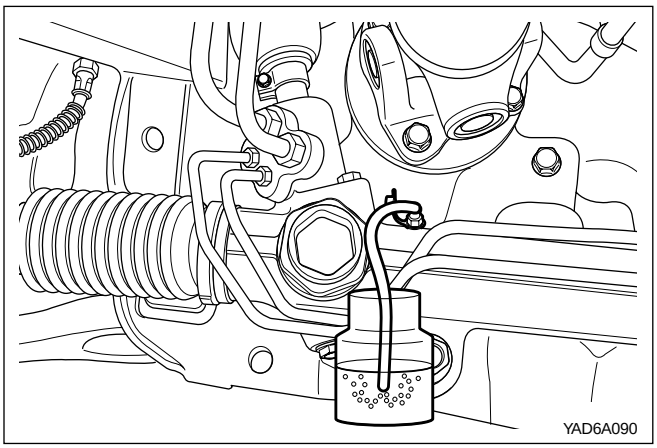
5. If torque is excessive or too little, adjust it as specified value.
   - Place the rack gear in center position.
   - Tighten the adjustment plug by 100 kg.cm
   - Turn the pinion gear in order that rack gear move to the left/right end five times.
   - Remove the adjustment plug.
   - Tighten the adjustment plug by 45 - 55 kg.cm
   - Tighten the adjustment plug by 67.5° to C.C.W direction.
6. Tighten the adjustment plug lock nut.



OIL CHANGE

1. Lift the vehicle slightly using the lifter.
2. Separate the oil supply hose from the power steering pump.
3. Discharge the oil in the oil tank.
4. Connect the oil supply hose with the power steering pump.
5. Separate the oil return line from the oil tank.
6. Remove the high pressure cable in the ignition coil.
7. Operating the ignition motor periodically, turn the steering wheel from lock to lock and discharge the oil through the return line.
8. Connect the return line with the oil tank.
9. Charge the oil in the oil tank as specified quantity.
10. Do bleeding procedure.





OIL QUANTITY CHECK AND AIR BLEEDING

Oil Quantity Check

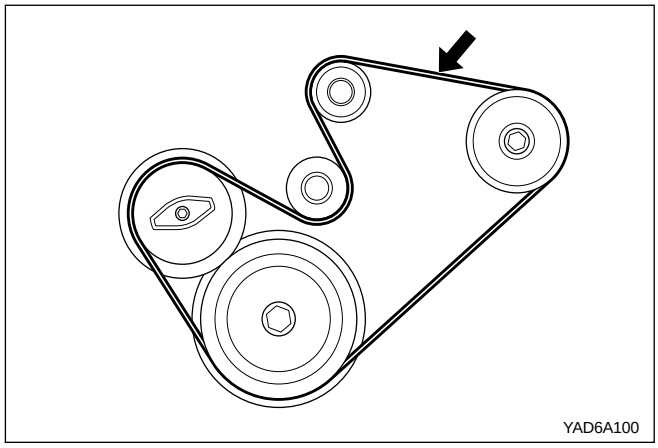
1. Place the vehicle on flat road and start the engine and keep it idling.
2. Turn the steering wheel from lock to lock several times until the oil temperature gets to the normal operating condition.
3. The oil level should be placed between MAX and MIN.

Air Bleeding

1. Disconnect the fuel line. Using a starter motor, crank the engine and turn the steering wheel from lock to lock several times.
2. Connect the fuel feed line and start the engine at idle steed.
3. Turn the steering wheel from lock to lock until there is no more air in oil reservoir.
4. Connect the oil lever is within specification.
5. By turning the steering wheel left to right, check the oil level change.

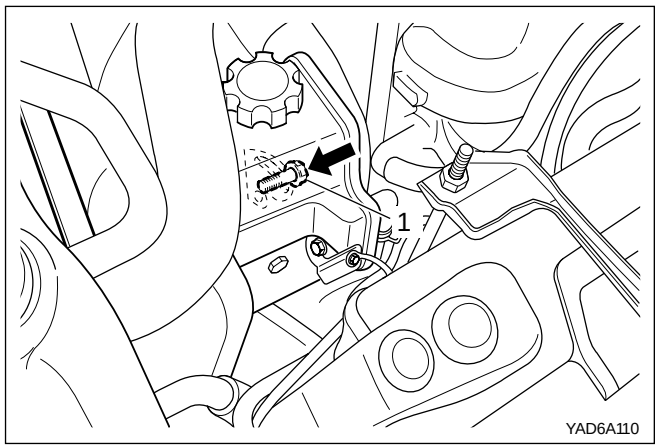
Notice:

- Do bleeding with engine cranking. If bleed with idling, there con be a air contact with oil.
- If oil is not changes more than 5mm, do bleeding again.
- If oil level rises suddenly when stopped engine, do bleeding again.

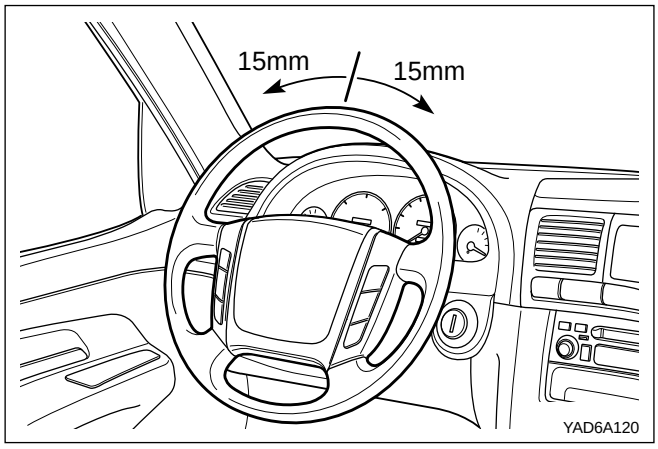


Belt tension Check/Adjustment

1. Check the wear, crack and damage of belt, and if necessary, replace it.
2. Push the center position of belt (10 kg) and then check the deflection of belt.



3. If the measurement value is not within the specified value, remove the bolt of power steering pump. Adjust the belt tension as moving the pump assembly.

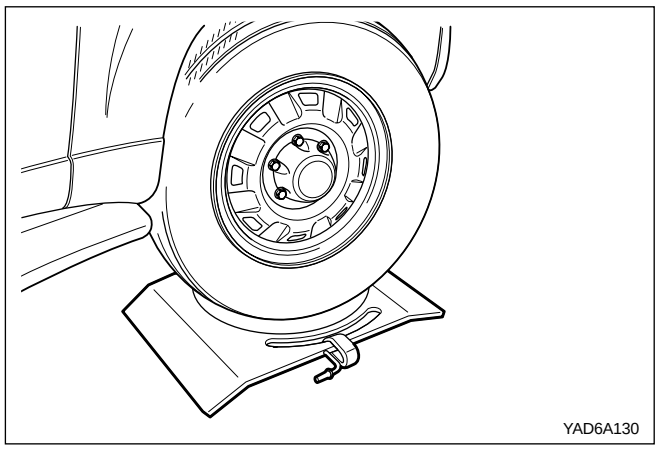


Power steering wheel Freeplay Check

1. Start the engine and place the wheels in straight ahead position.
2. Slightly move the steering wheel to the left/right and measure the steering wheel free play when the front wheel is start to move.

Standard	Max. 30 mm

Notice: If exceeds standard, the steering column shaft and steering linkage clearance. Replace or repair if necessary.

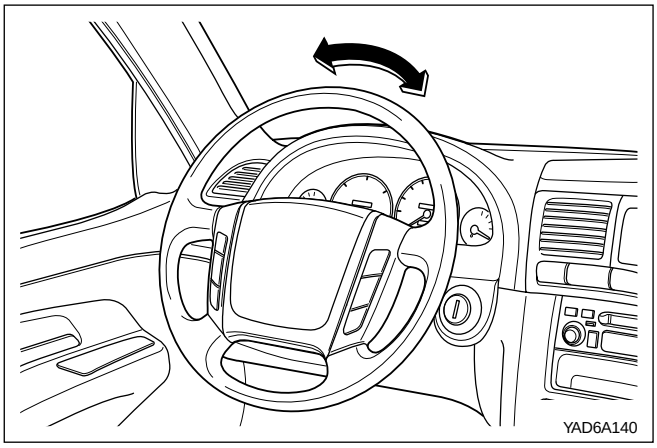


Steering Angle Check

1. Place the front wheel on a measuring tool.
2. Rotate steering wheel to the left/right direction and measure steering angle.

Standard	Inner	36° 17´
	Outer	32° 40´

Notice: If out of standard, check or adjust toe-in.



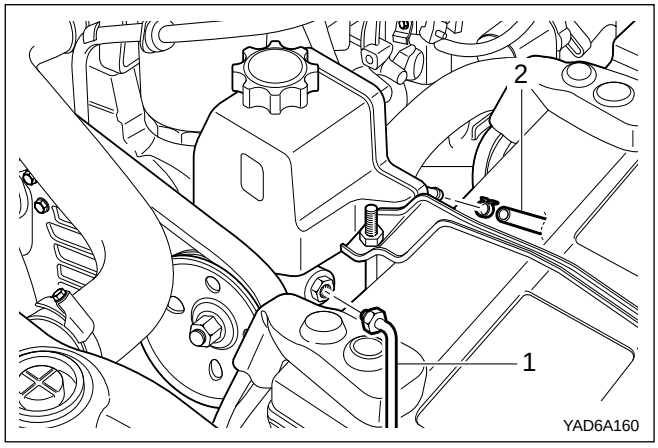
Steering Effort Check

1. Place a vehicle on the paved flat ground with front wheels In a straight ahead position.
2. Start the engine and run it at 1,000 rpm.
3. Using a scale, measure the steering effort in both directions.

Standard	Max. 3.0 kg

Notice: The difference in steering effort of left/ right should be within 0.6 kg.

MAINTENANCE AND REPAIR



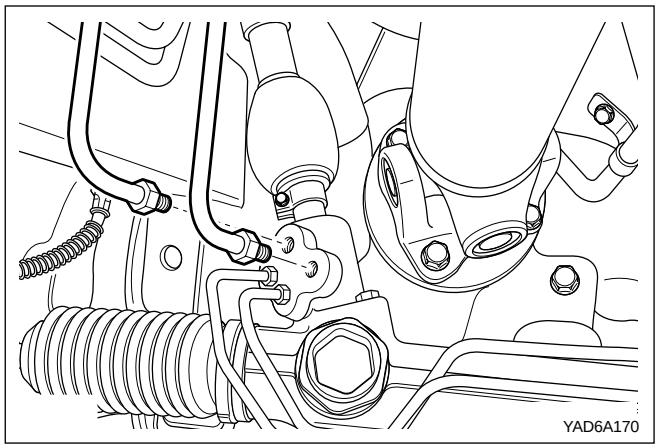
ON-VEHICLE SERVICE

POWER STEERING PIPE/HOSE

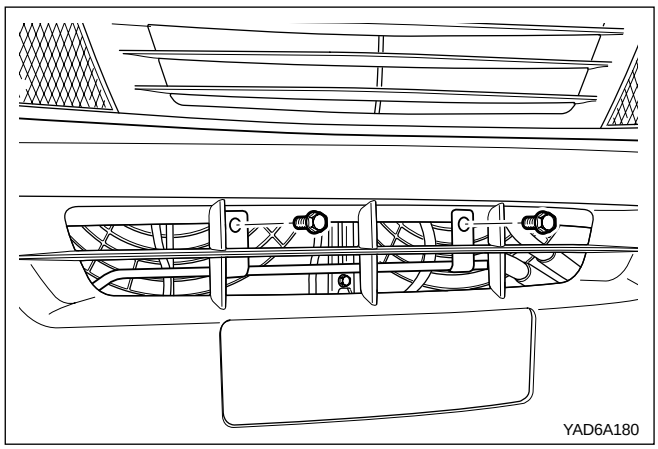
Removal

1. Remove the supply pipe (1) and return hose (2) which is installed in power steering pump.

   Notice: When removing/installing the pipe and hose, prepare the oil container in order that the oil may not drop down.

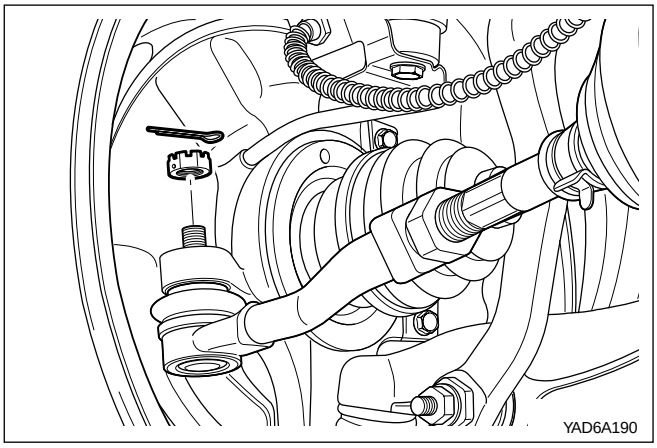


2. Remove the supply/return pipe installed in power steering gear box.



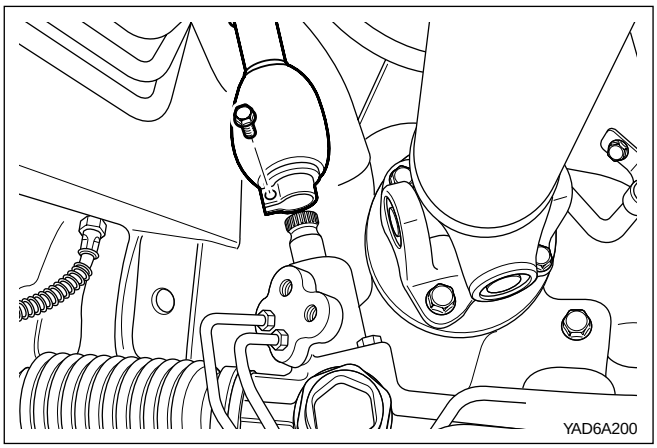
3. Remove the oil pipe bracket bolt installed in front bumper and pull off the oil pipe.

   Notice: First, remove the pipe from the pipe clamp installed in front panel and then pull off the pipe.

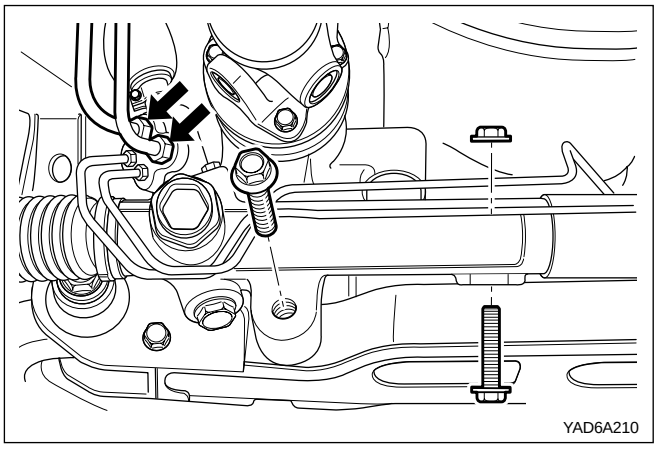


POWER STEERING GEAR BOX ASSEMBLY

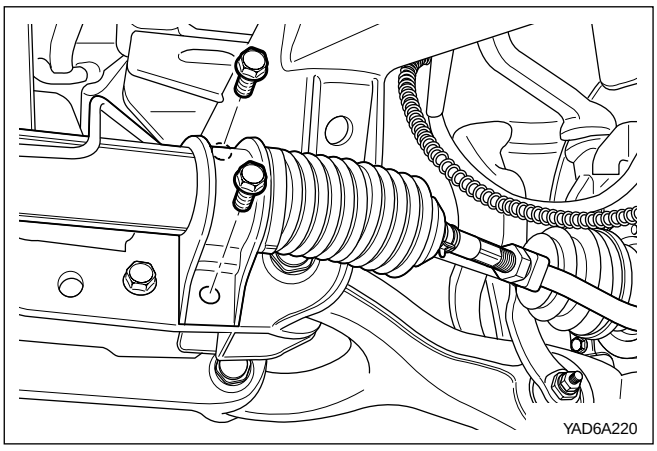
1. Remove the tie rod installed in steering knuckle. Disassembly the split pin and sloted nut in tie rod end and pull off the tie rod using the special tool.



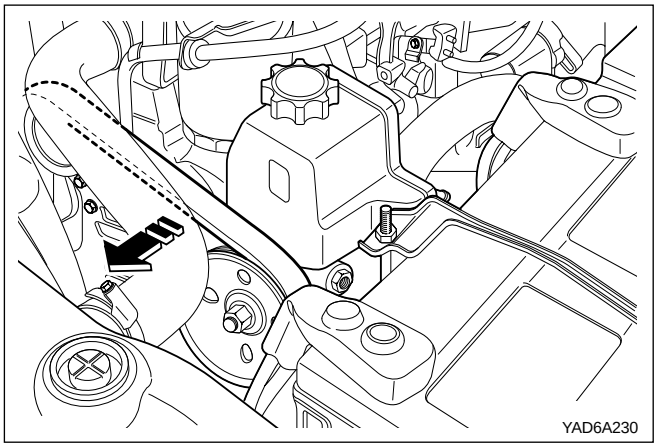
2. Remove the joint blot of steering lower shaft and separate the lower shaft from the gear box.



3. Remove the center bolt in gear box and left mounting bolt. Remove the supply/return pipe connection bolt.

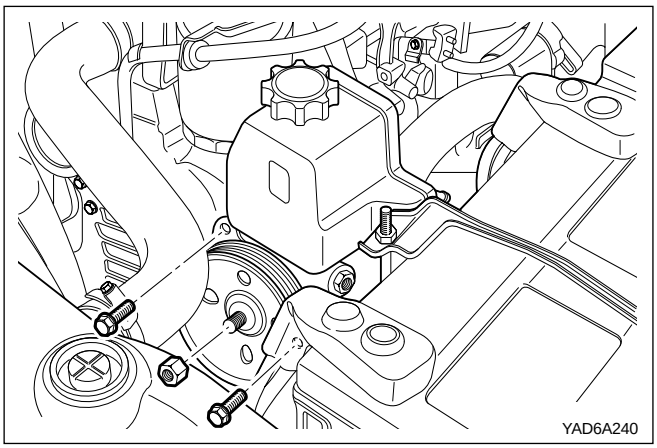


4. Remove the clamping bolt and pull off the steering gear box assembly.

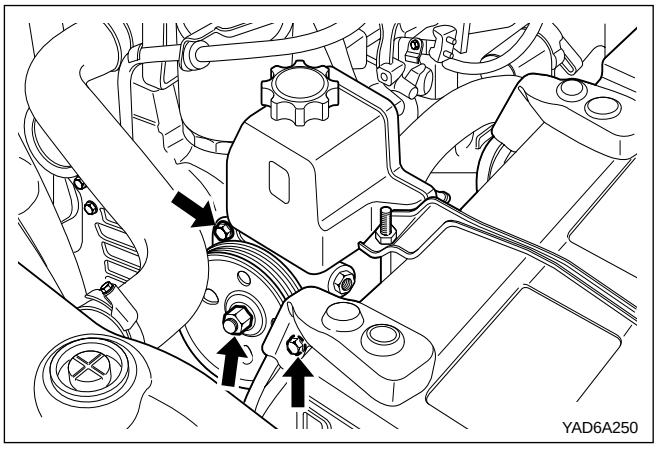


STEERING GEAR PUMP

1. Separate the drive belt from pump pulley after each pipe and hose is removed.



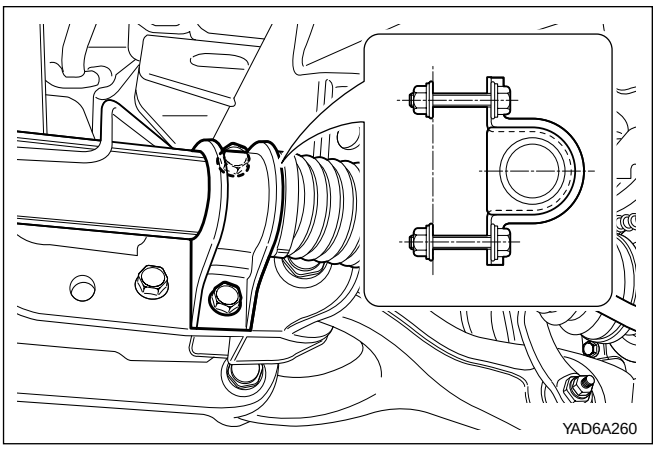
2. Remove the bolts/nuts in pump and pull off the pump assembly from engine.



ASSEMBLY INSTALLATION

1. Install the power steering pump in engine and tighten the bolt/nut as specified torque.

Nut		Torque
Bolt	Upper	23 N•m (17 lb-ft)
	Lower	23 N•m (17 lb-ft)

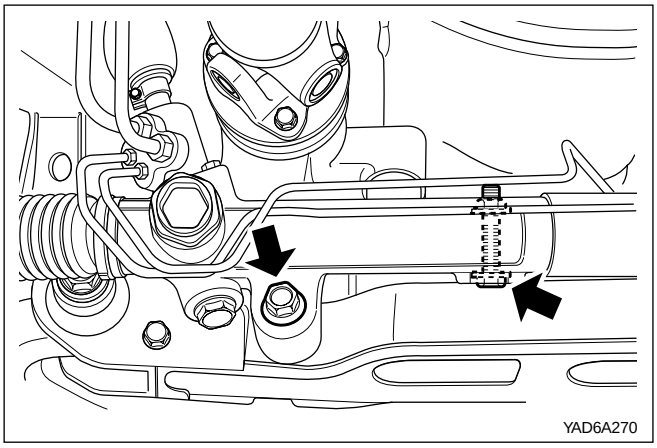


2. Install the power steering gear box in frame. Tighten the mounting bolts slightly and then install the gear box clamp in left. Tighten the bolt/nut as specified torque.

   Notice: Because the length of bolt is same, install them after checking.

   Installation Notice

95 mm Bolt/Nut (Upper)	70 - 90 N•m (52 - 66 lb-ft)
95 mm Bolt/Nut (Lower)	70 - 90 N•m (52 - 66 lb-in)

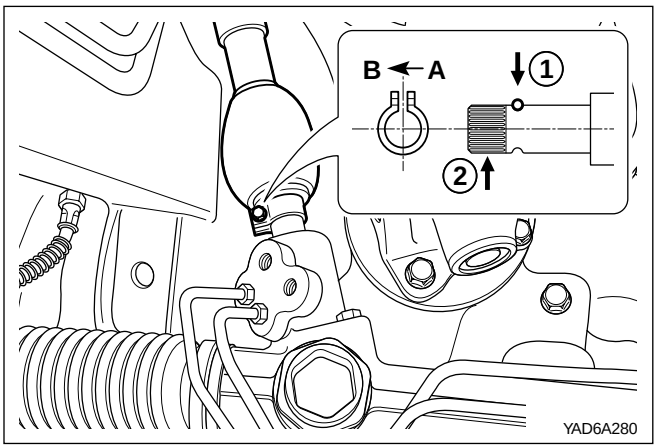


3. Completely tighten the mounting bolt/nut which is tightened slightly.

   Notice: First tighten the center bolt/nut and then tighten bolt/nut as specified torque.

   Installation Notice

Center Bolt/Nut	70 - 90 N•m (52 - 66 lb-ft)
Left Bolt/Nut	70 - 90 N•m (52 - 66 lb-in)

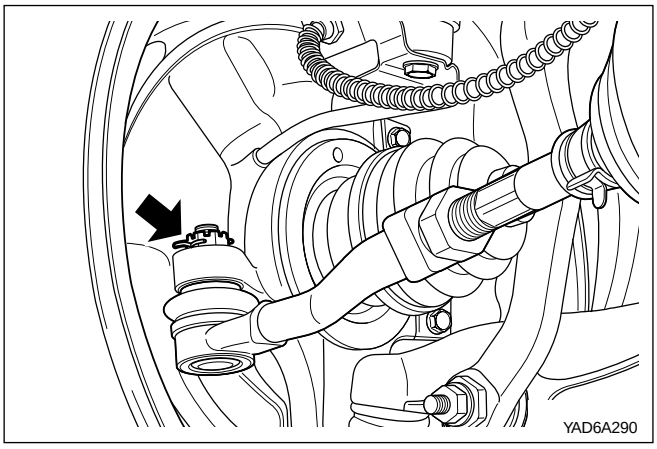


4. Install the steering lower shaft to the gearbox. The joint bolt on the lower shaft should be tightened toward ‘B’ (threaded) from ‘A’ (non-threaded).

   Installation Notice

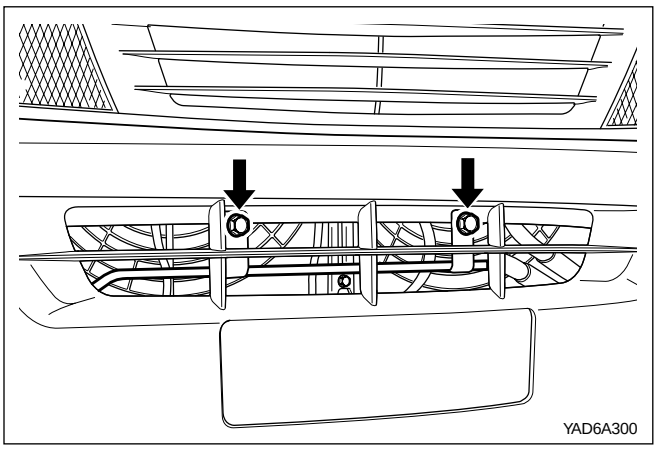
Tightening Torque	25 - 30 N•m (18 - 22 lb-ft)

   Notice: When installing the lower shaft to the gear box, the joint bolt (1) should be installed anto the gearbox pinion shaft splines.



5. Install the tie rod end in steering knuckle. Tighten the sloted nut and then insert the new split pin.

Tightening Torque	35 - 45 N•m (26 - 33 lb-ft)

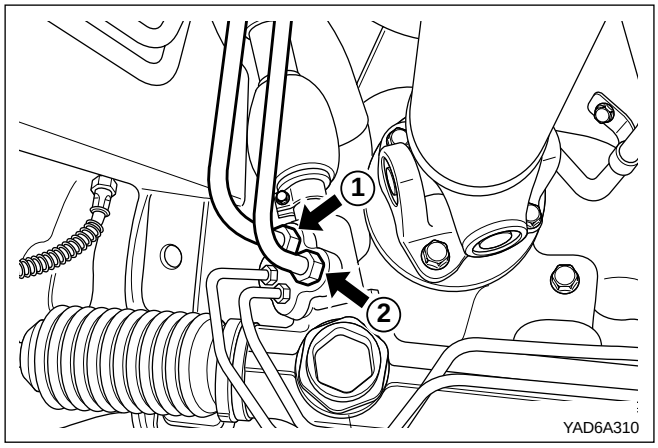


Installation Notice

6. Install the clamp of return pipe in front end panel.

Installation Notice

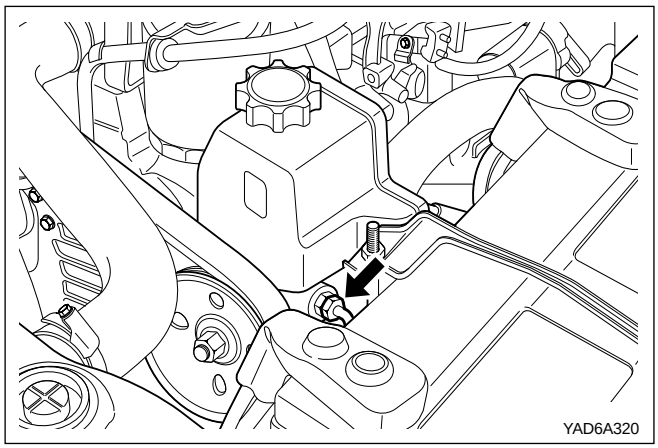
Tightening Torque	7 - 10 N•m (62 - 89 lb-in)



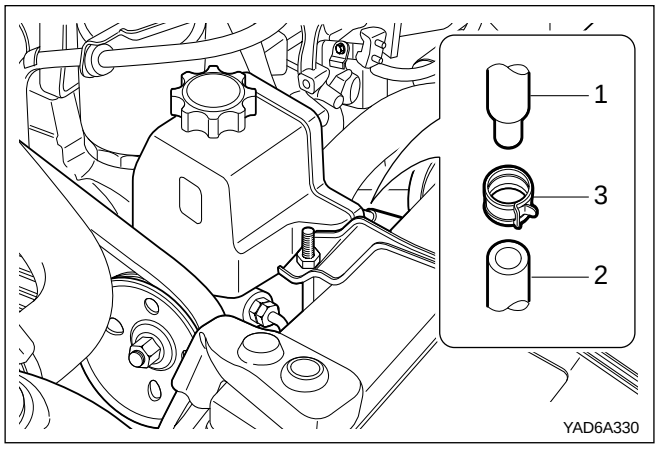
7. Install the supply/return pipe in gear box housing.

   Installation Notice

Supply Pipe ②	12 - 18 N•m (9 - 13 lb-ft)
Return Pipe ①	12 - 18 N•m (9 - 13 lb-ft)



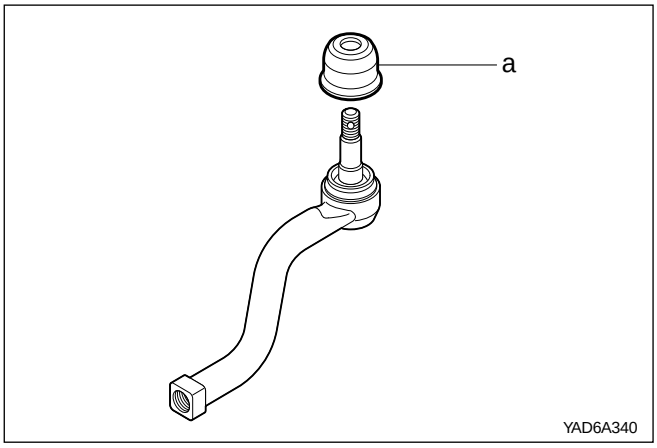
8. Install the supply pipe in steering gear pump.



9. Insert the return hose (2) Into the reservoir tank (1) and then insert the spring clamp (3) as like the picture.

   Notice: After inserting the hose into the reservoir tank completely, install in order that the spring clamp is placed in the center of nipple.

10. After installing completely, do bleeding.

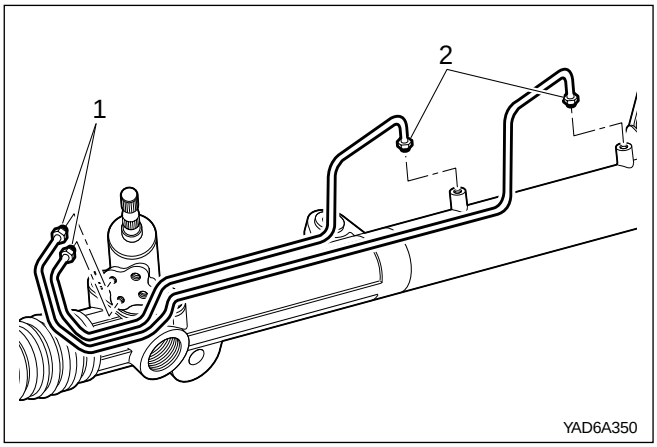


UNIT REPAIR

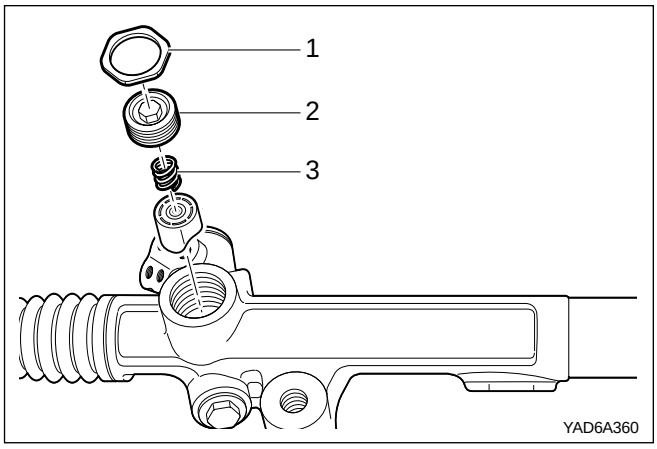
STEERING GEAR BOX

Disassembly

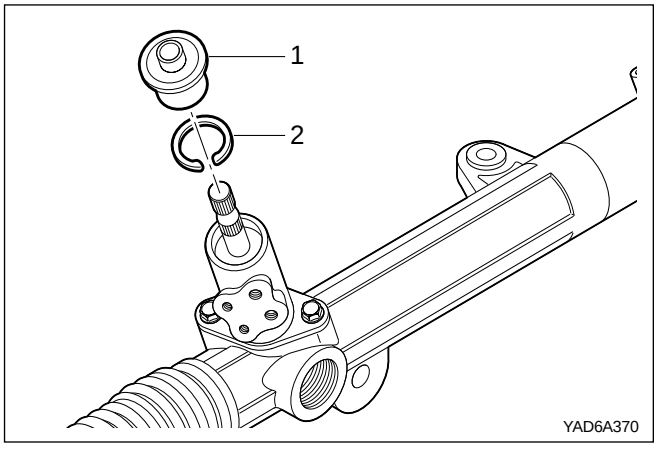
1. Disassembly the tie rod end boot (a).



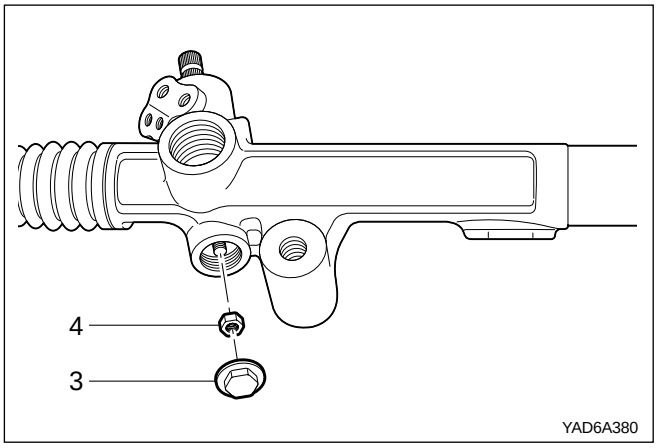
2. Remove the cylinder tube (2) in gear box.
3. Remove the valve tube (1) in gear box.



4. Remove the lock nut (1) and separate the plug (2) and spring (3).

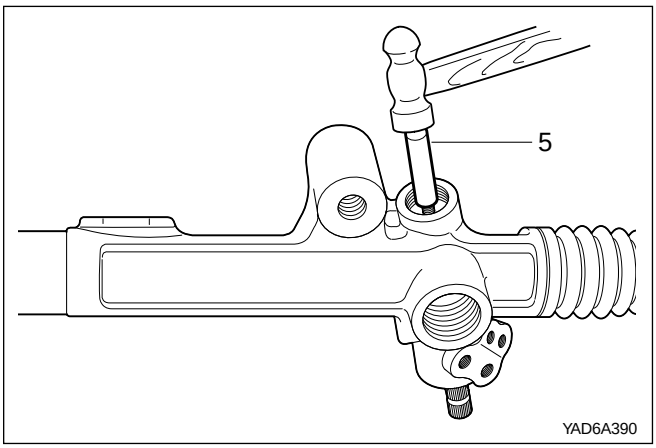


5. Remove the dust cover (1) and pull off the retainer ring (2).



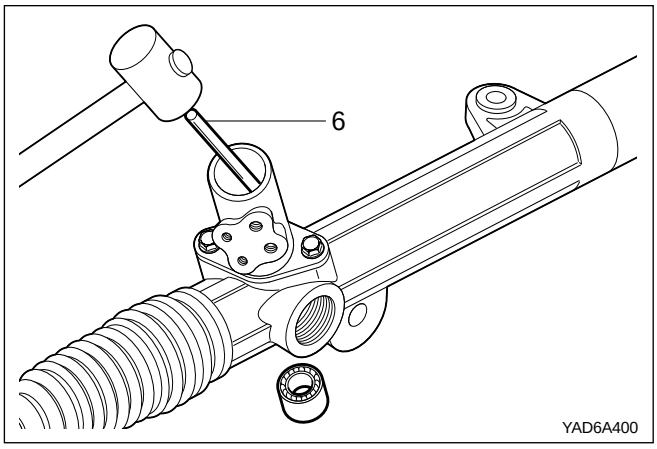
6. Remove the pinion dust cover (lower) (3) and remove the pinion lock nut (4).

   Notice: When removing the steering pinion lock nut, be sure to fix the pinion gear n order to protect the damage of pinion gear.

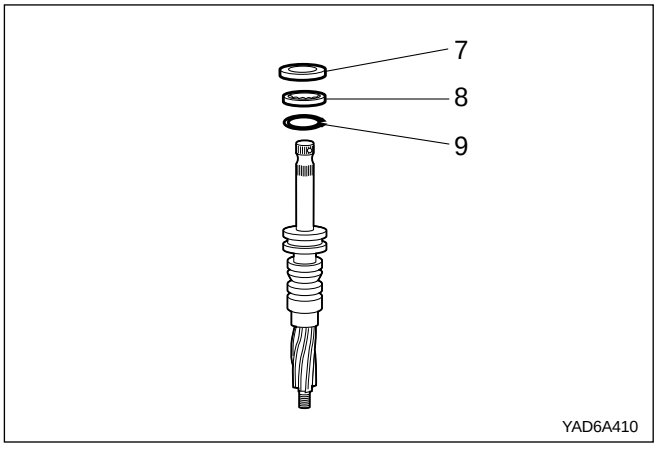


7. Tapping the pinion lower part carefully using the plane draft and hammer, remove the steering pinion (5) from the pinion bearing.

   Notice: Tap the draft using the hammer as lik the picture.

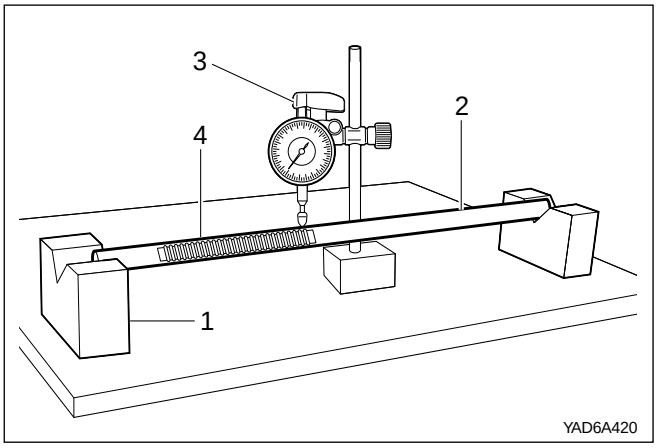


8. Tapping the pinion bearing softly using the plane and long draft and rubber hammer, remove the bearing.



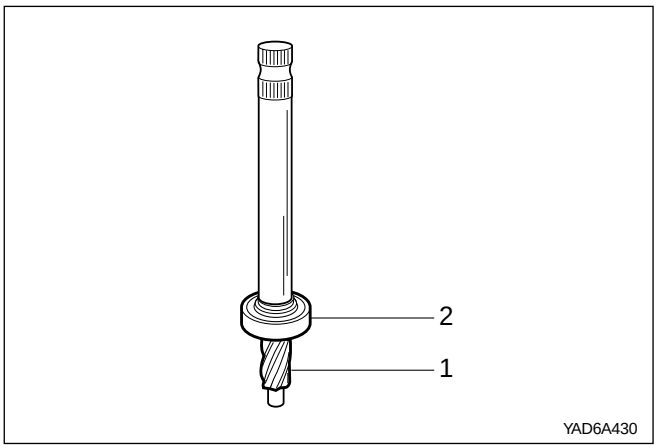
9. Remove the pinion shaft seal (7), needle bearing (8), retainer ring (9).

   Notice: Do not overhaul the power steering gear housing and rack gear, if the damage happened, replace them with assembly.

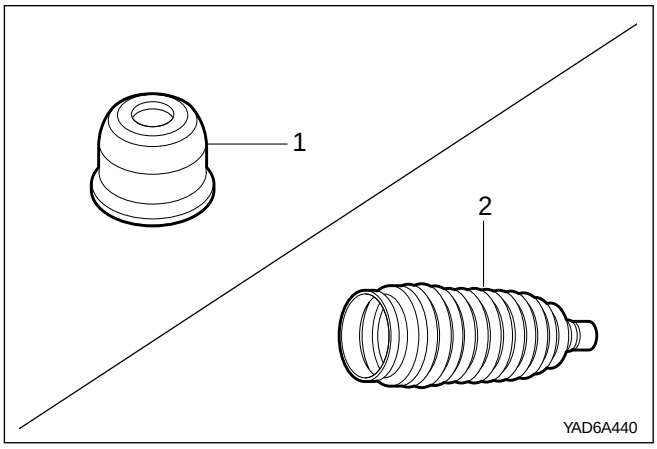


Rack Gear Shaft Checks

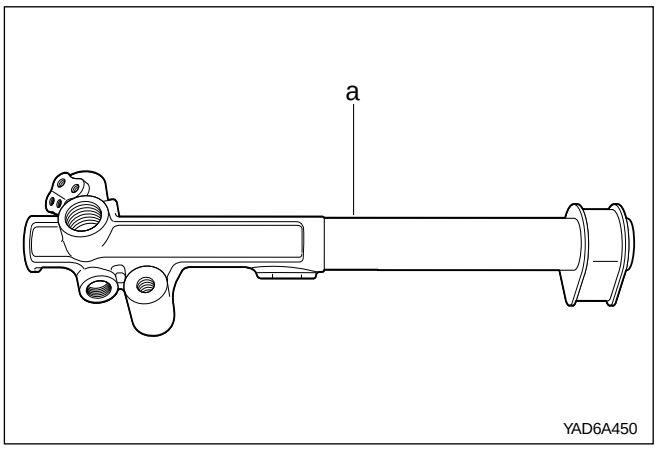
1. Check the rack gear damage.
   - Set up the v-block (1) on the plane table.
   - Put the rack gear (2, 4) on the V-block.
   - Measure the straightness of rack gear using the dial gauge (3).
   - Check the rack gear for the wear or damage.



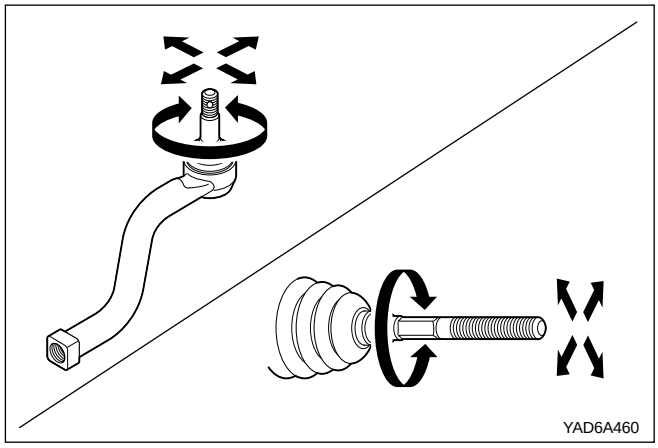
2. Check the steering pinion gear for the damage.
   - Check the pinion gear (1) for the wear or damage.
   - Check the looseness and normal operating of bearing (2).



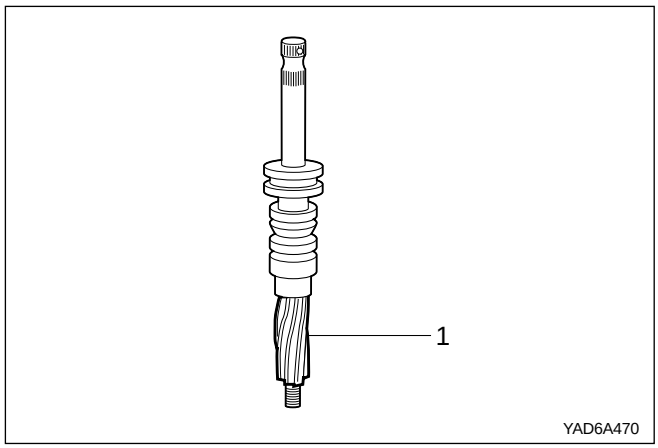
3. Check the tie rod end, rack and pinion bellows for the damage.
   - Check the tie rod end boot (1) for the crack or wear.
   - Check the rack and pinion boot for the crack or wear.



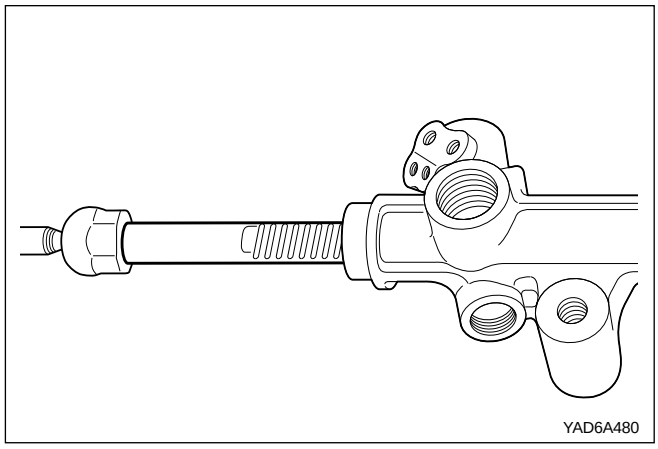
4. Check the steering gear housing for the crack, deformation and wear.



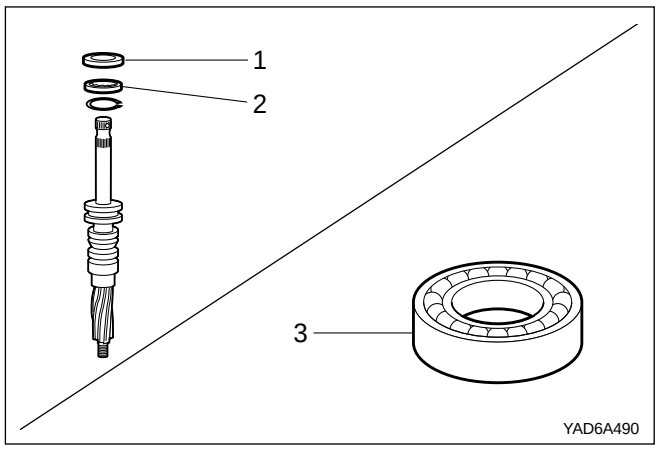
5. Check the tie rod end and ball joint for the damage.
   - Check the tie rod end ball joint for the normal operating,
   - Check the tie rod ball joint for the normal operating and the deflection by the self-weight of tie rod.
6. After checking, if out of specified value or damaged, replace them with the new one.



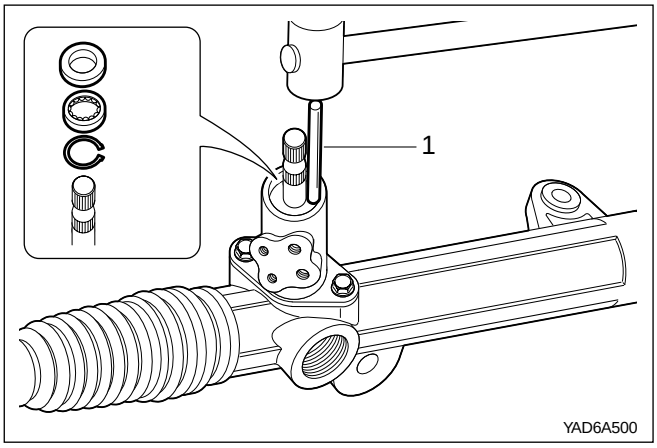
7. Check the tie rod end and the rotation part of ball joint for the damage.



8. Check the tie rod end and rack/pinion boot for the crack and wear.
9. Check the metal part for the damage.
   - Check the pinion gear for the damage or wear.
   - Check the rack gear for the damage or wear.
   - Check the steering gear housing for the damage or wear.

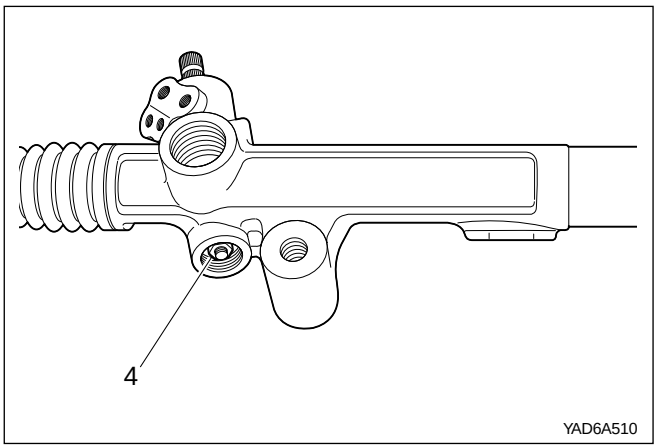


10. Check the bearing and oil seal for the damage.
    - Check the pinion shaft seal for the wear or leakage.
    - Check the needle bearing for the wear.
    - Check the steering pinion bearing for the wear.
11. After checking, if out of specified value or damaged, replace them with the new one.



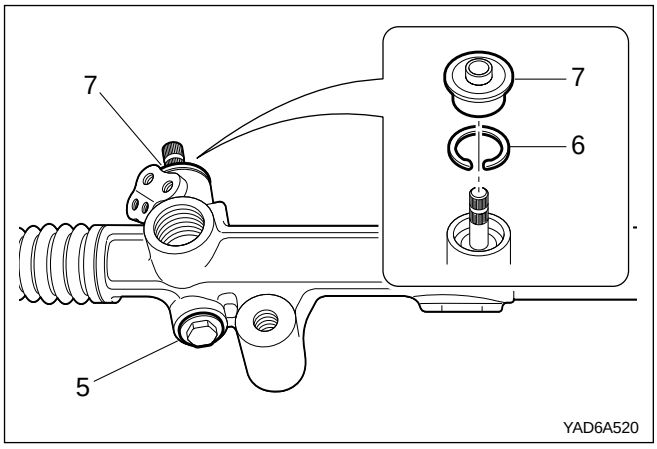
Assembly

1. Install the steering pinion assembly gear.
   - Install the retaining ring.
   - Install the needle bearing.
   - Tapping the pinion shaft seal carefully in diagonal direction using the thin draft (1), assemble them.

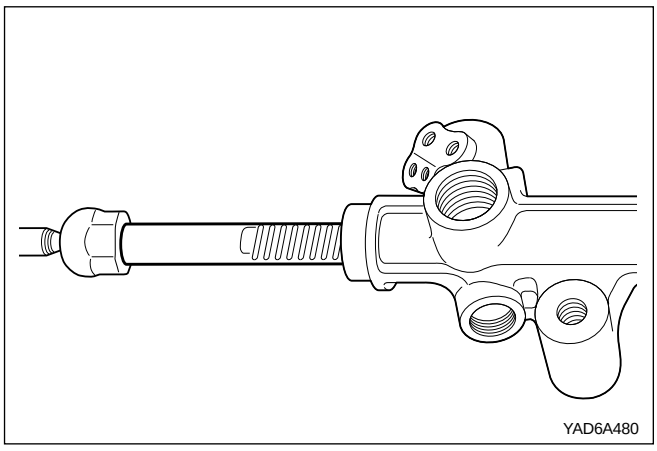


2. Tighten the steering pinion lock nut (4) as specified torque.

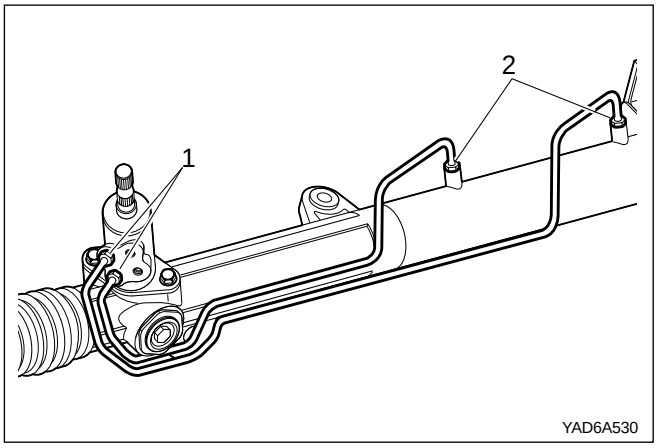
   Notice: Because the pinion bearing is inserted into the pinion lock nut by force, be careful not to be eccentric.



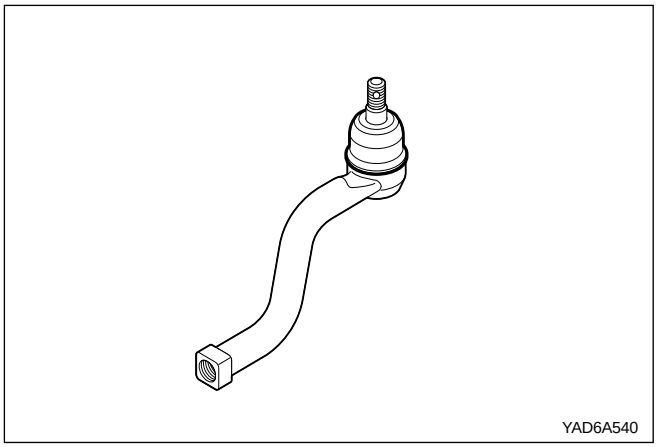
3. Tighten the steering pinion dust cover (5) as specified torque.
   - Install the retaining ring (6).
   - Install the plastic dust cover (7).



4. Install the rack bearing.
   - Install the adjustment spring.
   - Tighten the adjustment plug as specified torque.
   - Tighten the adjustment plug lock nut.
   - Adjust the steering gear preload.



5. Install the fluid pressure line in power steering gear and tighten them as specified torque.
   ① Tighten the fitting to the piston side.
   ② Tighten the fitting to the cylinder side.

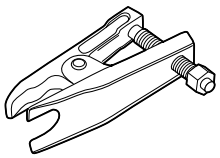


6. Assemble the tie rod end boot.

   Notice: Apply the grease to the tie rod end ball joint and boot.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD6A550	**Tie Rod End Remover**

SECTION 6E

STEERING COLUMN

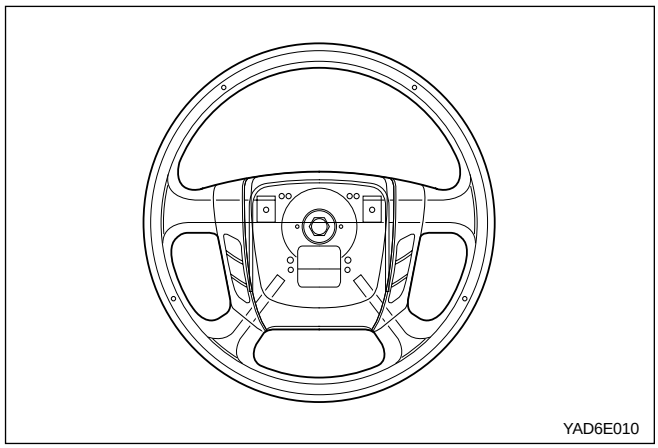
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Special Tools Table 6E-16

GENERAL DESCRIPTION AND OPERATION

The steering wheel and column have the function of steering. When collidings they soften the impact by the steering wheel and also are designed in order that the steering column shaft may be folded or absorb the impact. The ignition switch and lock cylinder is installed in steering column. If pulling the ignition switch in “LOCK” position and draw out the key, as the lock cylinder installed in column operates, you cannot steer the vehicle.

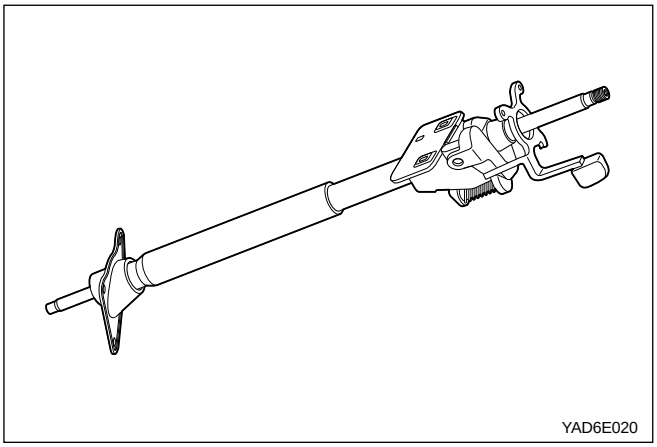
STEERING WHEEL


YAD6E010

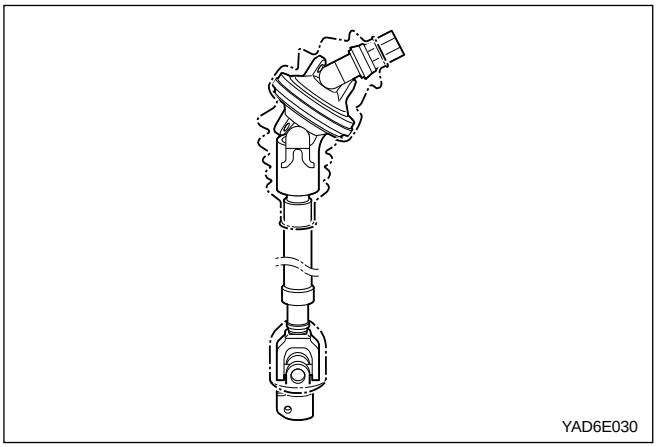
Type	4 Spoke Type
Outer Diameter	390 mm

The vibration absorbing damper is mounted in steering wheel in order that the vibration may be minimized.

COLUMN & SHAFT ASSEMBLY


YAD6E020

LOWER SHAFT


YAD6E030

Type	4 Spoke Type
Angle	390 mm

Because the lower shaft uses the constant velocity joint which the angular belocity change is not, torque fluctuation is very little.

TIGHTENING TORQUE

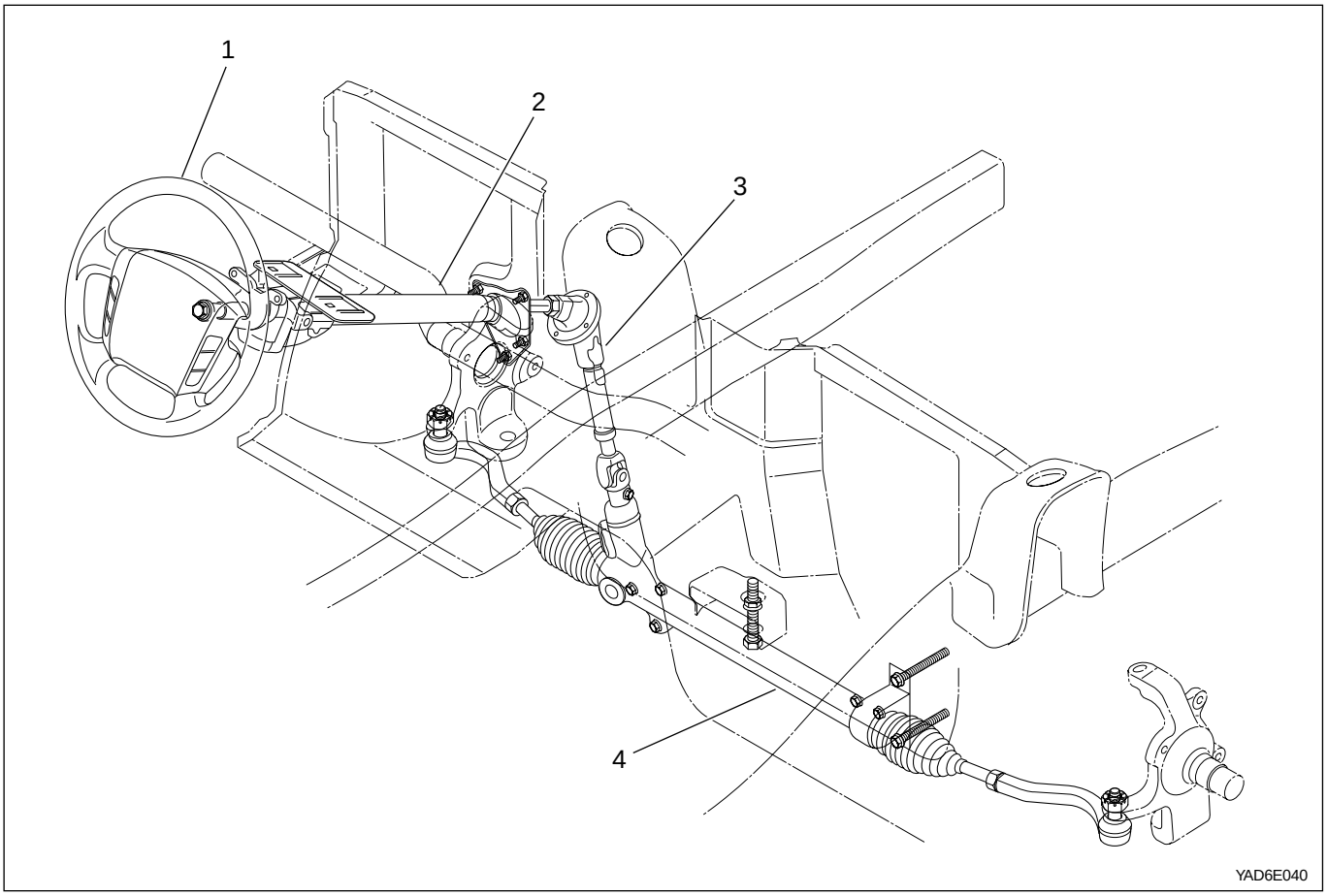
Item		Torque
Steering Column Shaft	Steering Column Mounting Bolt (upper)	20 - 25 N•m (15 - 18 lb-ft)
	Steering Column Mounting Bolt (lower)	20 - 25 N•m (15 - 18 lb-ft)
	Steering Wheel and Steering Column shaft Lock Nut	40 - 60 N•m (30 - 44 lb-ft)
	Steering Column and Airbag Module Connection Bolt	7 - 11 N•m (62 - 97 lb-in)
	Steering Column and Lower Shaft Connection Bolt	25 - 30 N•m (18 - 22 lb-ft)
Power Steering Gear Box	Steering Gear Box and Gear Box Cross Member Mounting Bolt	70 - 90 N•m (52 - 66 lb-ft)
	Steering Gear Box and Lower Shaft Connection Bolt	25 - 30 N•m (18 - 22 lb-ft)
	Tie Rod End and Steering Lock Connection Nut	35 - 45 N•m (26 - 33 lb-ft)
	Tie Rod End Lock Nut	65 - 80 N•m (48 - 59 lb-ft)
	Steering Gear Box and Pressure Hose Connection Nut	15 - 20 N•m (11 - 15 lb-ft)
	Steering Gear Box and Return Line Connection Nut	15 - 20 N•m (11 - 15 lb-ft)
Power Steering Pump	Power Pump Bracket and Timing Gear Case Cover Mounting Bolt	20 - 23 N•m (15 - 17 lb-ft)
	Power Pump and Pressure Hose Connection Nut	40 - 50 N•m (30 - 37 lb-ft)
Power Steering Line	Return Line and Cilp Connection Bolt	9 - 14 N•m (80 - 124 lb-in)

DIAGNOSTIC INFORMATION AND PROCEDURES

Phenomena	Checks	Action
Noise (When operating the steering wheel)	Loosened or Poor Tightening Steering Column Nut	Retightening
	Worn or Damaged Steering Shaft Bearing	Replace steering column
	Lossened or Poor Interm shaft Pinch Bolt	Retightening
Excessive Steering Force	Worn or Damaged Steering Shaft Bearing	Replace steering column
Poor Operating of Ignition Switch	Inner Defect of Lock Cylinder	Replace steering column
	Inner Defect of Ignition Switch	Replace ignition switch

COMPONENT LOCATOR

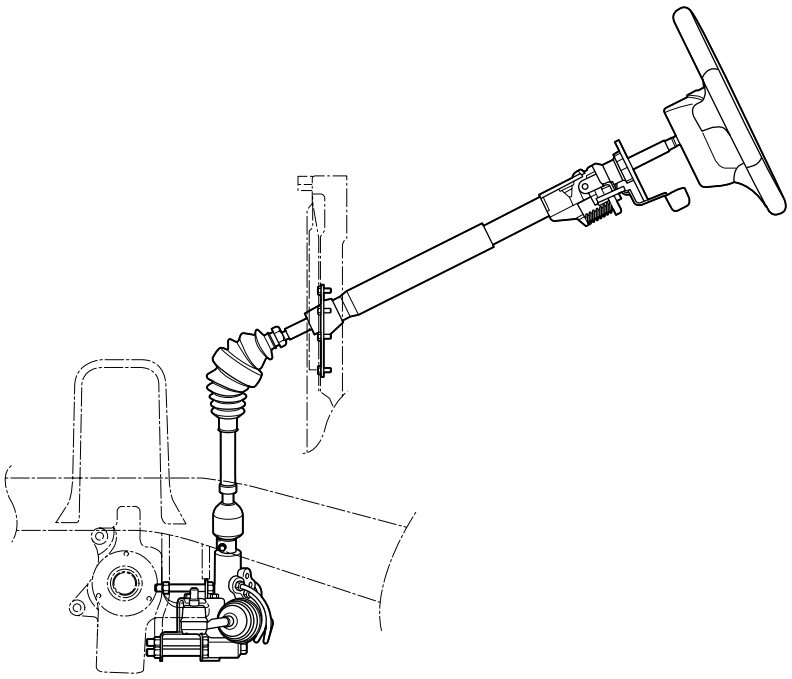
STEERING COLUMN ASSEMBLY



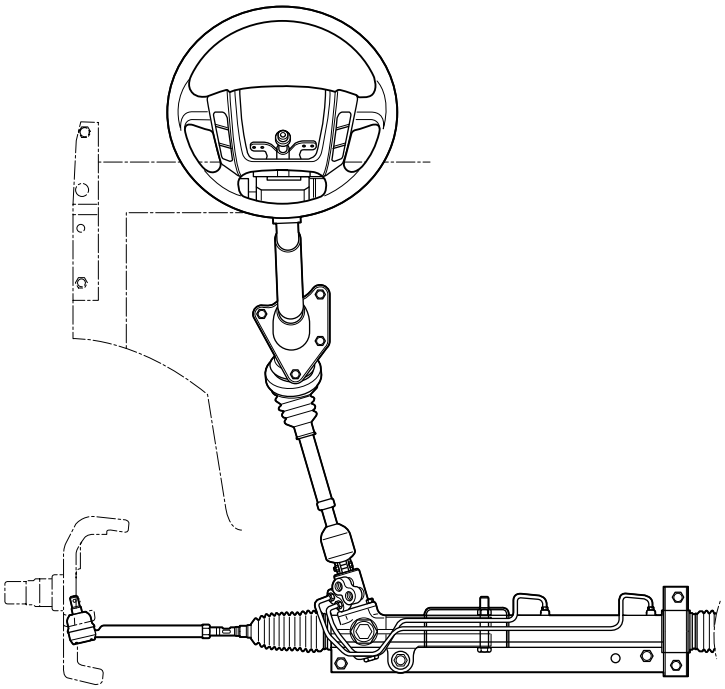
1 Steering Wheel
2 Column Shaft Assembly
3 Lower Shaft Assembly
4 Steering Gear Assembly

STEERING ASSEMBLY CROSS SECTION

Side

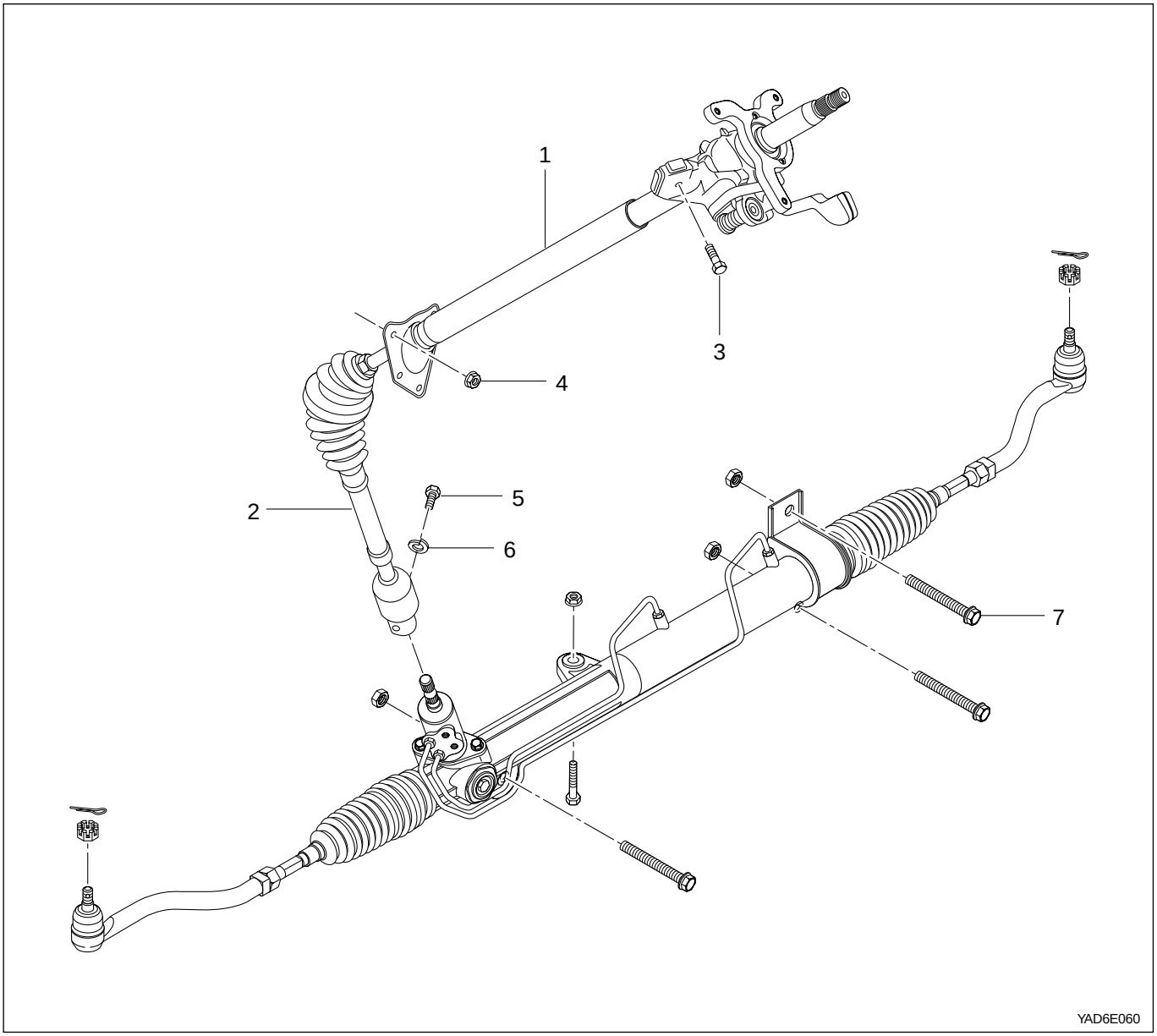


Rear



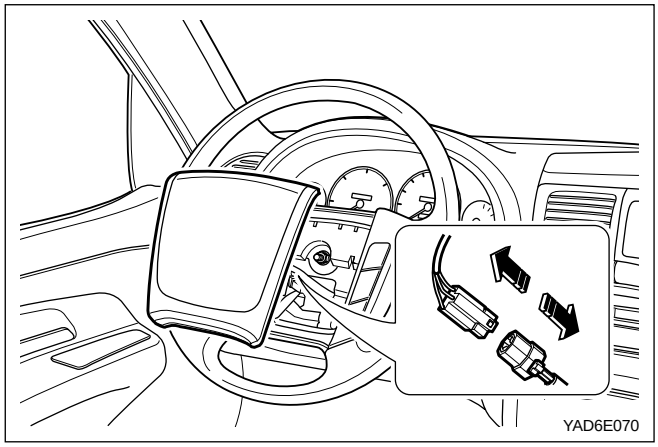
YAD6E050

STEERING COLUMN & WHEEL



1 Steering Column shaft
2 Lower Shaft
3 Bolt
4 Nut
5 Bolt
6 Washer
7 Bolt

MAINTENANCE AND REPAIR



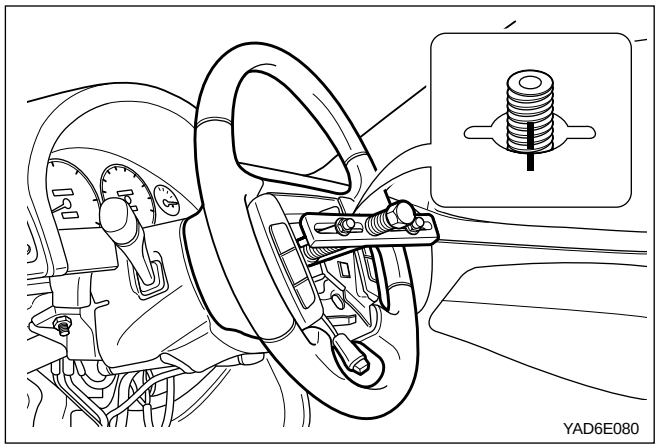
ON-VEHICLE SERVICE

STEERING COLUMN

Removal

1. Disconnect the negative terminal of battery and place the tires in front straight direction.
2. Untighten the fixing screw in the left/right of steering wheel and remove the horn pad (airbag module assembly) in the wheel.

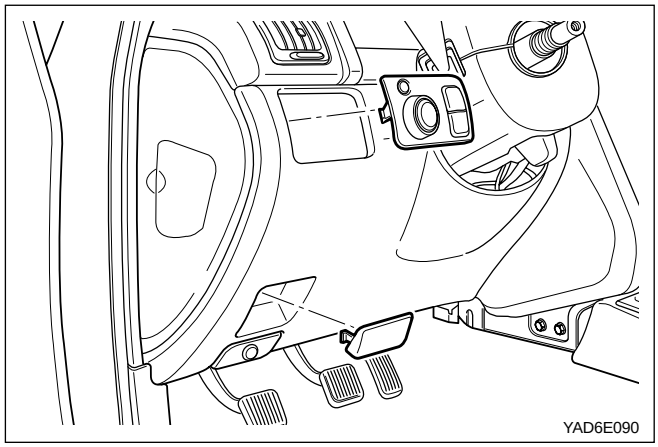
   At this time, remove the airbag module connector simultaneously.



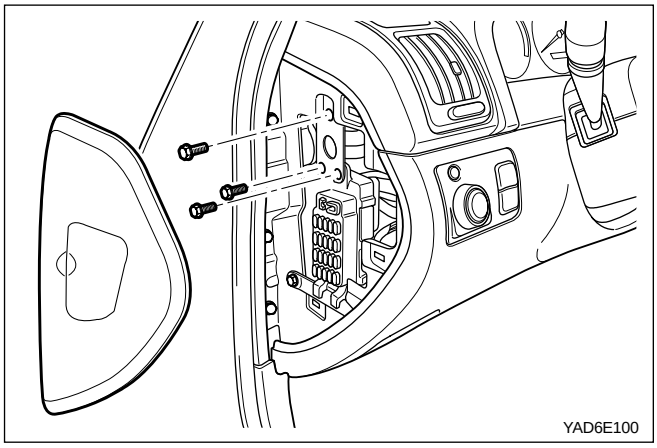
3. Untighten the wheel fixing nuts and remove the steering wheel using the special tool.

   Notice:

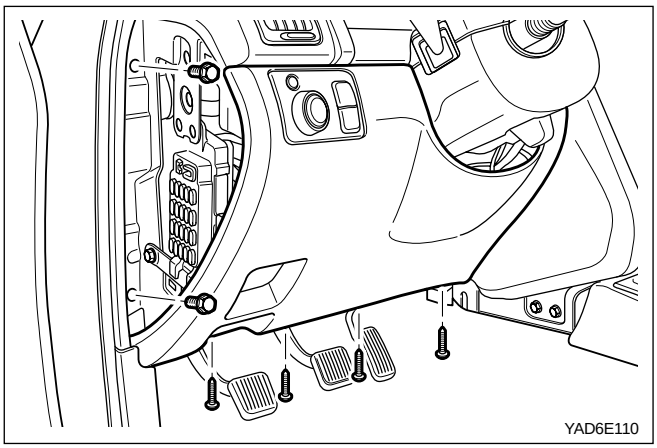
   - When you remove the wheel, be sure to do alignment mark in column shaft and wheel.
   - Remove the remote control switch connector (airbag connector, horn connector)



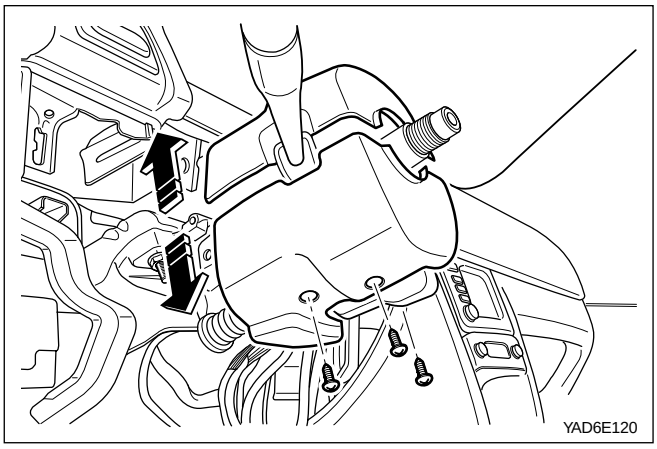
4. Remove the fuel filler door release cable, hood release cable, side mirror switch.



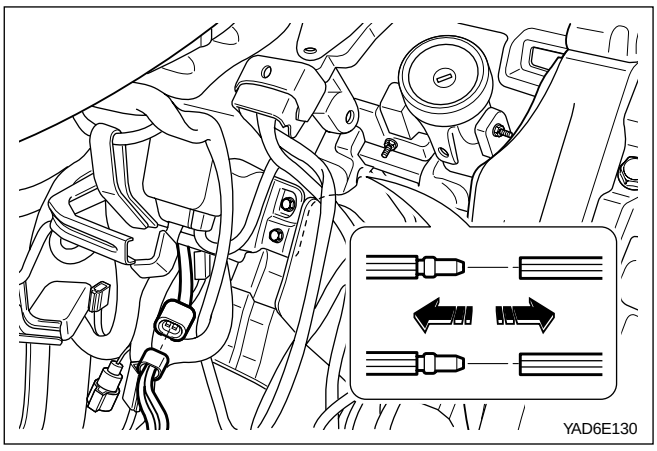
5. Remove the instrument panel side cover and untighten the fixing bolts of inner fuse box.



6. Untighten the side fixing bolts/screws of instrument panel and then remove the panel.

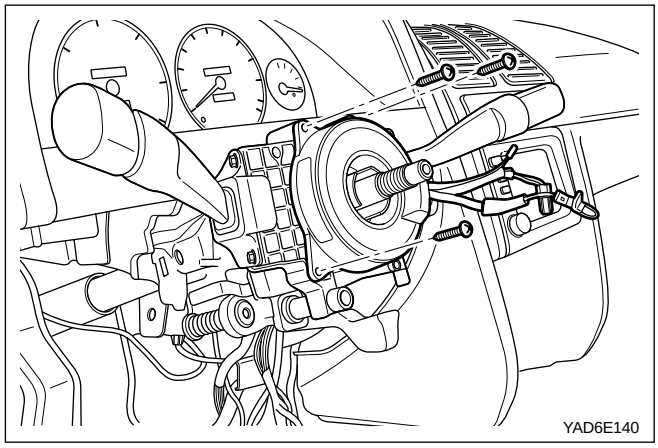


7. Ntighten the column fixing bolts from the steering column shaft and then remove the upper/lower column cover.

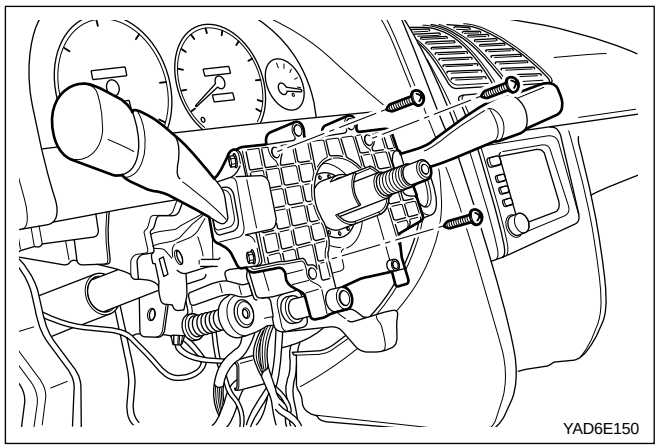


8. Disconnect the connector connected with the combination switch and the fuel cut vacuum hose.

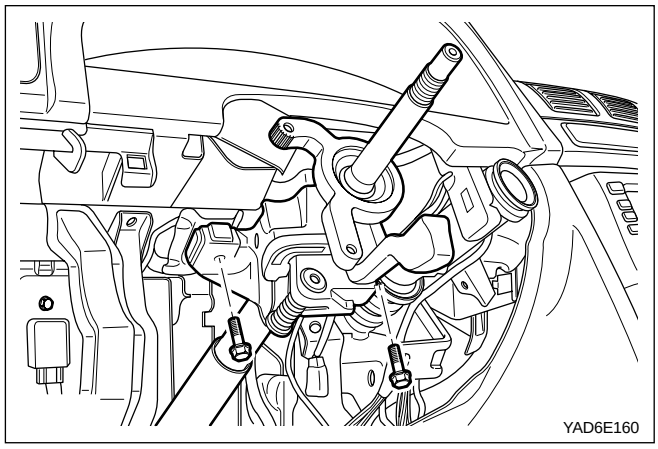
   Notice: Be sure to check the fuel cut hose because the identification color is marked.


YAD6E140

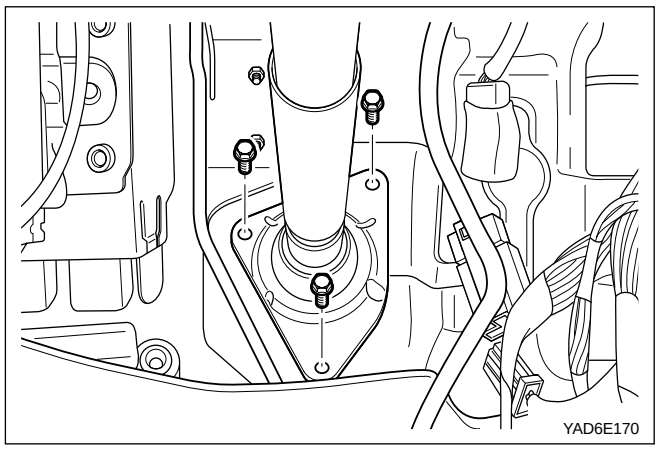
9. Remove the contact coil from the steering column shaft.


YAD6E150

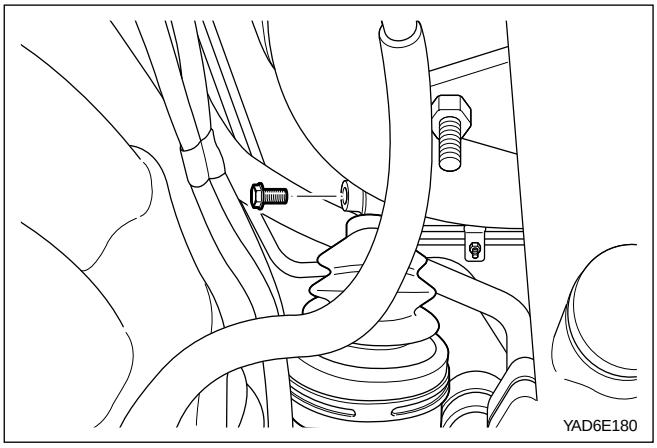
10. Remove the combination switch assembly from the column shaft which the airbag module is separated.


YAD6E160

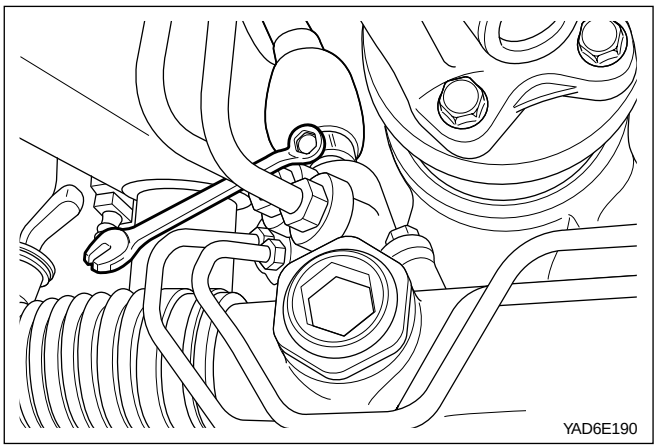
11. Mark the assembly marking on the column shaft and lower shaft and then untighten the upper fixing bolt of column shaft.


YAD6E170

12. Untighten the housing floor fixing bolts of steering column shaft.



13. Untighten the upper fixing bolts (2EA) of steering column shaft and then remove the steering column assembly.

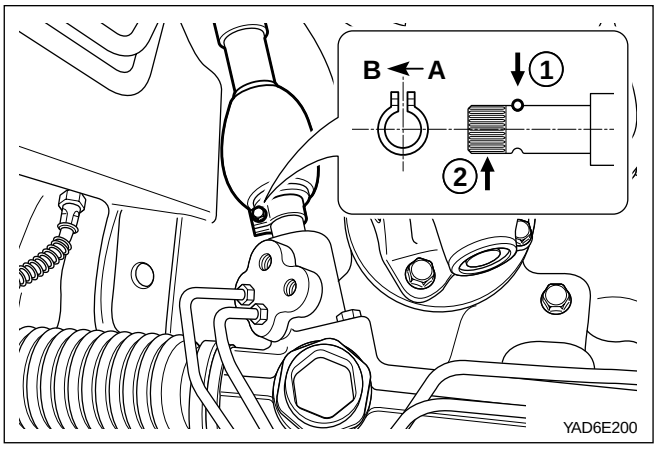


STEERING WHEEL & SHAFT

Removal

1. Remove the upper bolt of lower shaft.
2. Remove the bolt of lower shaft and steering gear box coupling and then remove the lower shaft

   Notice: Mark the assembly marking.



Installation

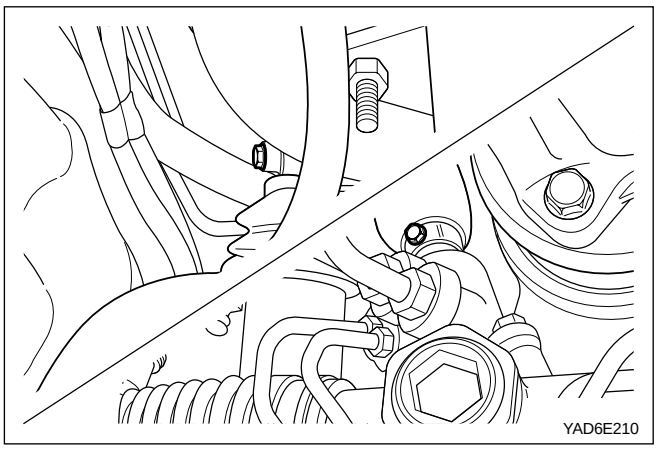
1. Insert the lower shaft into the gear box (spline part) and then tighten the blots as specified torque.

   Notice:

   - Install the lower shaft to tighten the bolt in non-spline part of upper spline part
   - Install to align the assembly marking

   Installation Notice

Tightening Torque	30 - 40 N•m (22 - 30 lb-ft)



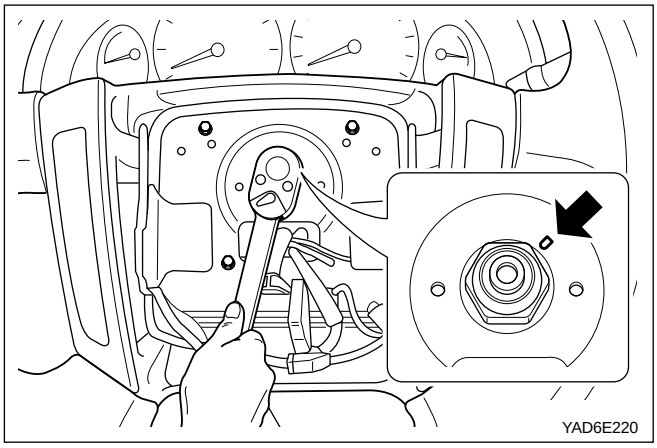
2. Install the steering column shaft in the lower shaft to align the assembly marking and then tighten the bolt.

   Notice:

   - Install the lower shaft to tighten the bolt in non-spline part of upper spline part
   - Install to align the assembly marking

   Installation Notice

Tightening Torque	30 - 40 N•m (22 - 30 lb-ft)



3. Tighten the floor bolt of steering column as specified torque.

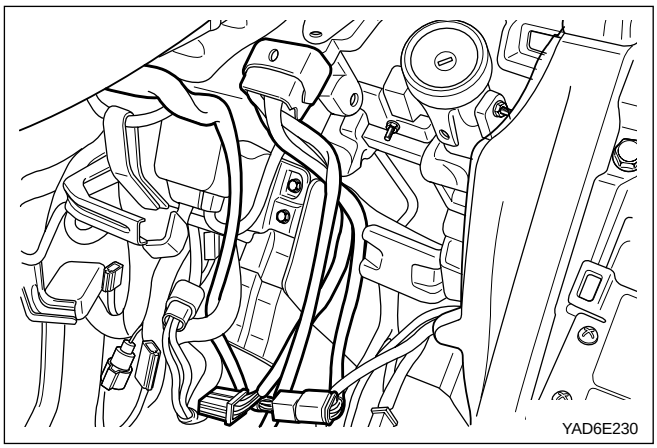
   Installation Notice

Tightening Torque	20 - 25 N•m (15 - 18 lb-ft)

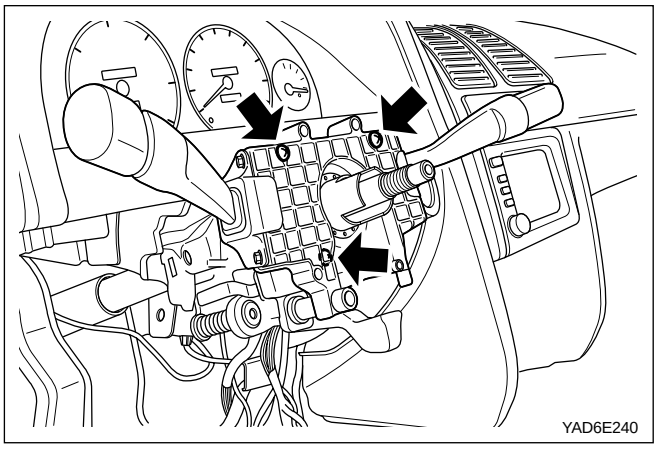
4. Tighten the upper bolt of steering column shaft as specified torque.

   Installation Notice

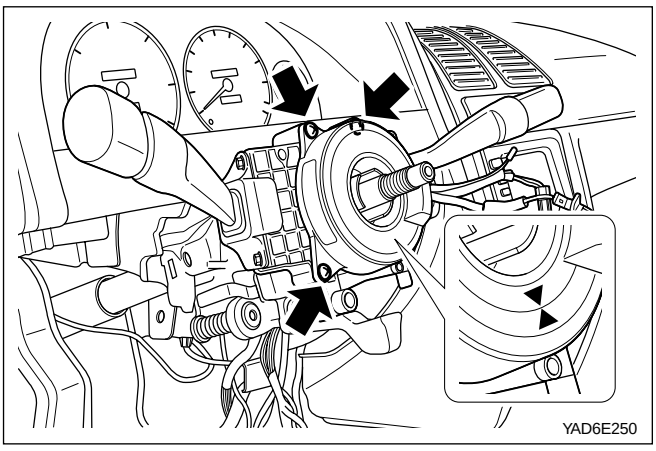
Tightening Torque	20 - 25 N•m (15 - 18 lb-ft)



5. Connect each wiring connector of steering column.

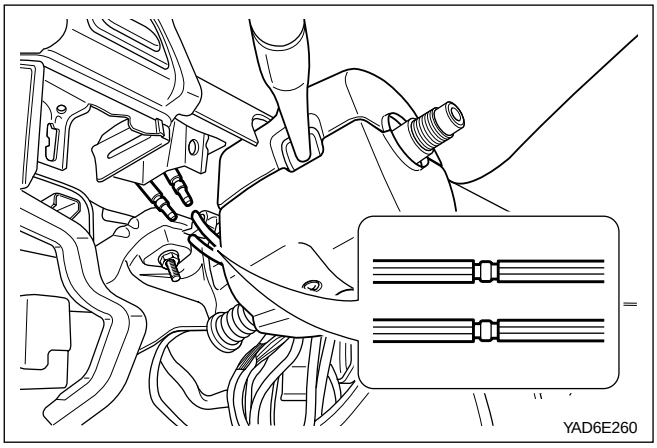


6. Install the combination switch assembly in steering column shaft.



7. Install the contact coil in steering column shaft which the combination switch is installed.

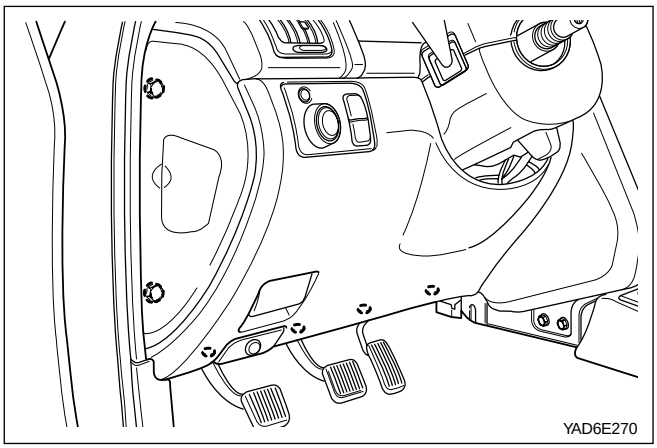
   Notice: When you adjust the neutral position of contact coil, rotate the contact coil to C.W. direction until it stops and then again rotate it by 2.9 ±0.2 to C.C.W. direction. Align the mark (▶ ◀) Which is marked in contact coil.



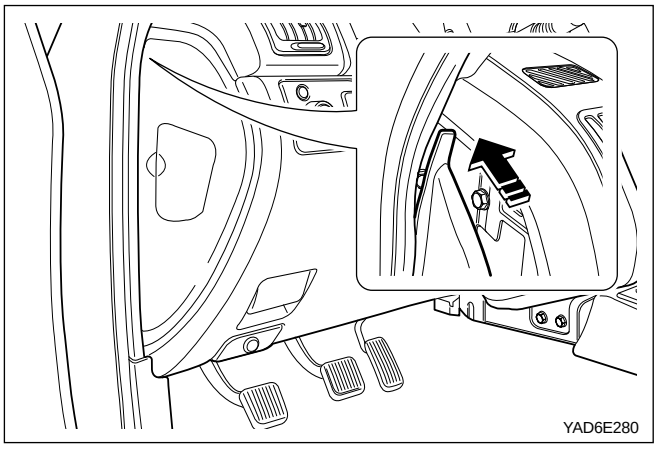
8. Connect the fuel cut vacuum hose with the connector.

   Notice: The identification color is marked in fuel cut vacuum hose.

Classification	Color
Fuel Cut Vacuum Hose-Inlet	Green
Fuel Cut Vacuum Hose-Outlet	Blue

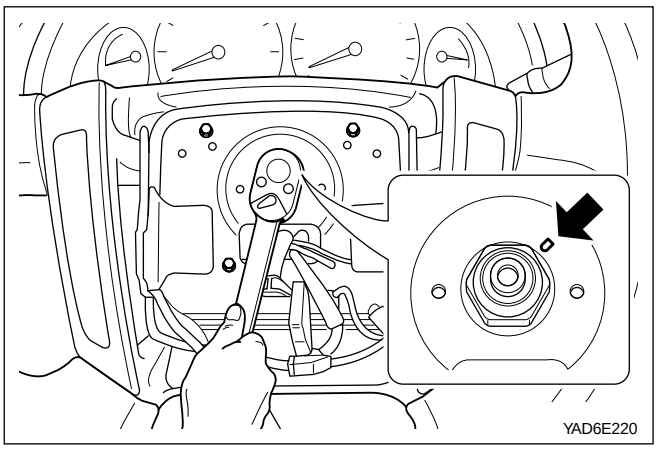


9. Install the steering column cover and instrument panel.



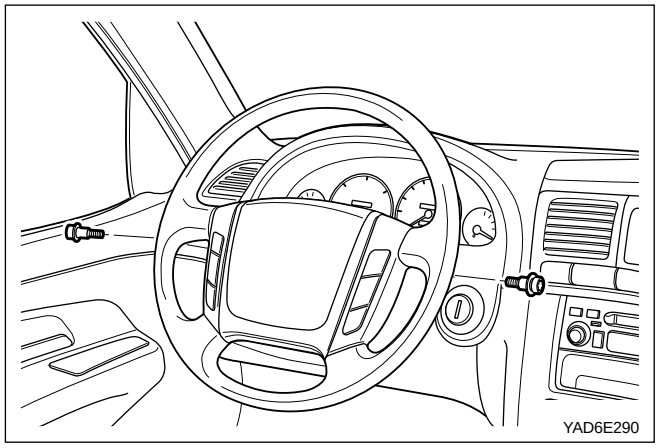
10. Install the fuse box in the panel, each cable and switch. Insert the panel side cover.

    Notice: The panel side cover should be inserted to the inside of molding and then installed.



11. Install the steering wheel in order that it is aligned to the assembly marting of column shaft.

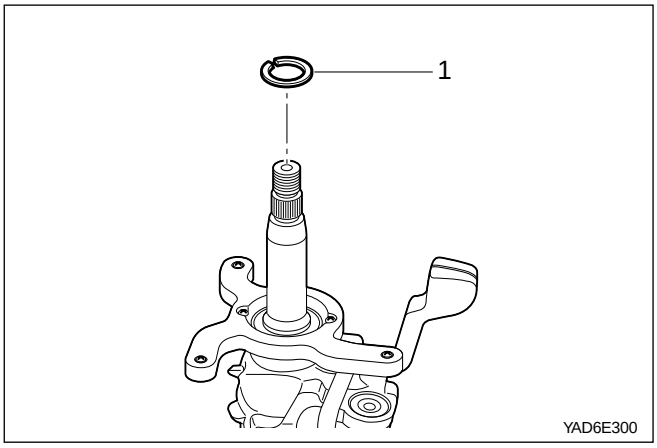
    Notice: Apply the grease to the shaft spline part in order that the wheel is installed easily.



12. Before installing the horn pad in steering wheel, first install each connector and then install the horn pad.

    Notice: When installing the pad, insert the safety pin to the wheel hold and align the shaf end part with the pad groove.

13. Tighten the left/right screw of steering wheel and connect the negative terminal of battery.



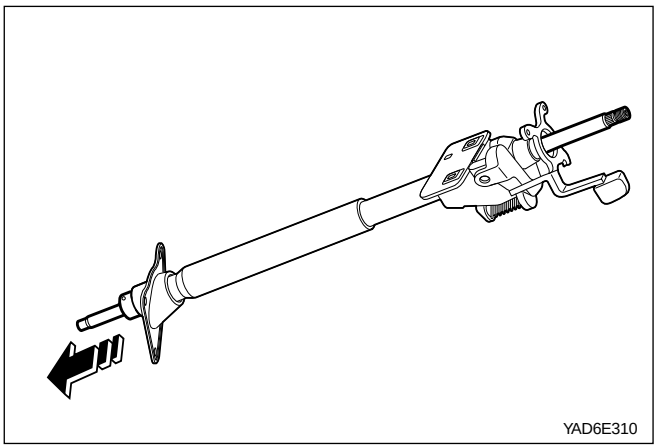
UNIT REPAIR

STEERING GEAR BOX

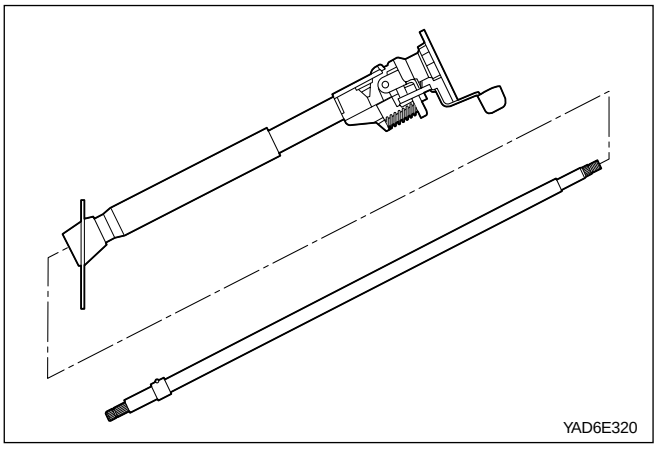
Disassembly

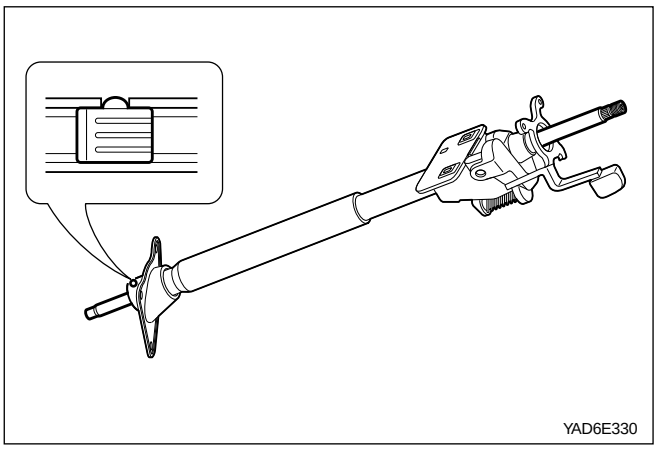
1. Remove the steering column assembly from the vehicle.

   Notice: Be careful so that the steering column/ steering column shaft is not gotten the impact. If being gotten the impact, in case of the frontal collision, the plastic sleeve may be broken.



2. Remove the steering column shaft from the steering column.
   - Remove the retainer ring.
   - Push the steering column shaft strongly downward.



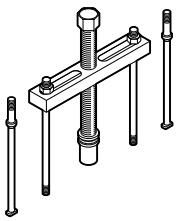


Assembly

1. Assemble in reverse order of disassembly.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD6E340	**SteeringWheel Remover**

SECTION 7A

HEATING AND VENTILATION SYSTEM

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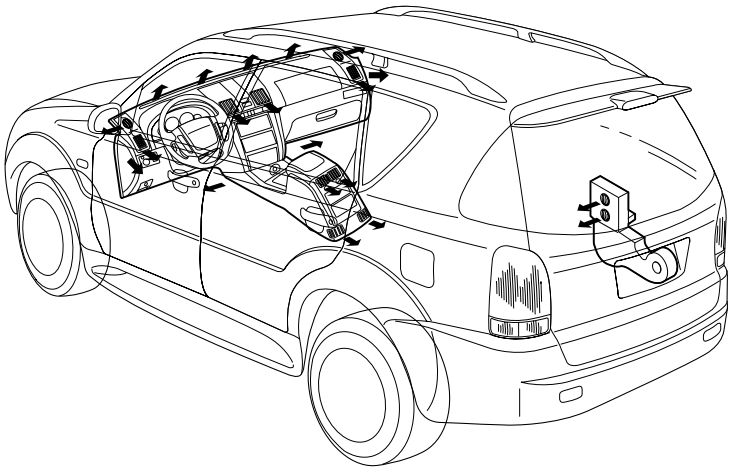
DESCRIPTION AND OPERATION

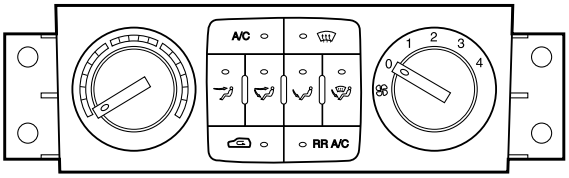
GENERAL

Heater is the system that circulate the suction air through the heater core to deliver the heat of engine coolant to the suction air and designed for heating and defrosting in the passenger room.

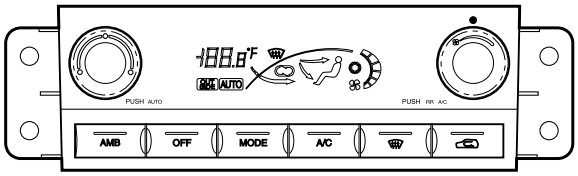
Heater system is consist of heater hose, heater module, blower motor and adjustment system.

The control switch assembly (adjustment system) equipped with the instrument panel can control the temperature, the amount and the direction of the outlet. Also this system can use the suction air as separation between ambient air and intake air on the vehicle.

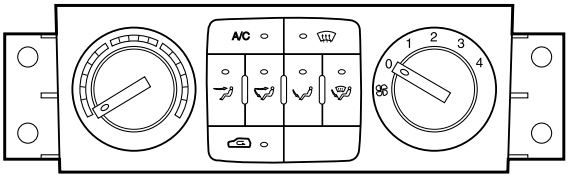




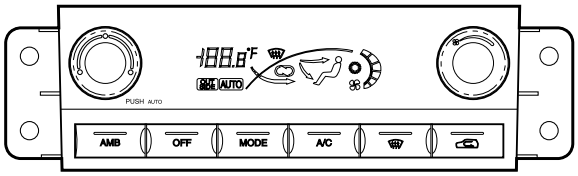
Manual Switch (Option)



Auto Switch (Option)



Manual Switch (Standard)



Auto Switch (Standard)

YAD7A010

SPECIFICATIONS

Engine Type		GSL	GSL
Blower Motor	Max. Capacity	7.425 - 9.075 kcal/h	←
Heater Core	Fin Pitch	1.52 mm	←
	Size (L x H x W)	194.6 x180 x 35 mm	←
	Heating Capacity	8,250 (Min. 4,700) kcal/h	←
Blower Motor Resistance	1st Mode	3.25 Ω	←
	2nd Mode	1.45 Ω	←
	3rd Mode	0.35 Ω	←
	4th Mode	Ω	←
Front A/C and Heater Unit	Type	Heater+Evaporator and Blower (2 pieces)	
	Heating Capacity	Min. 4600 kcal/h (5.5 m^3/Min)	
	Cooling Capacity	Min. 4700 kcal/h (7.5 m^3/Min)	
	Expansion Valve	Block Type	
	Input Power	Max. 250 W	
Rear Cooler	Type	Evaporator and Blower (only Cooler)	
	Cooling Capacity	Min. 2700 kcal/h (5 m^3/Min)	
	Expansion Valve	ANGLE Type	
	Input Power	Max. 180 W	

AIR DELIVERY AND FUNCTION

Mode Door Motor

Installation Location

It's located at the left side of heater case.

Function

It controls the open/close of the outlet at Vent, Foot or Def by the control command of automatic temperature control and then can set up the outlet mode of Vent, Bi-level, Foot, Foot/Def or Def.

Intake Door Motor

Installation Location

It's located at the upper and right side of blower housing.

Function

It operates ambient/intake door motor by the control command of automatic temperature control to set up the inlet mode of ambient/intake door.

Air Mix Door Motor

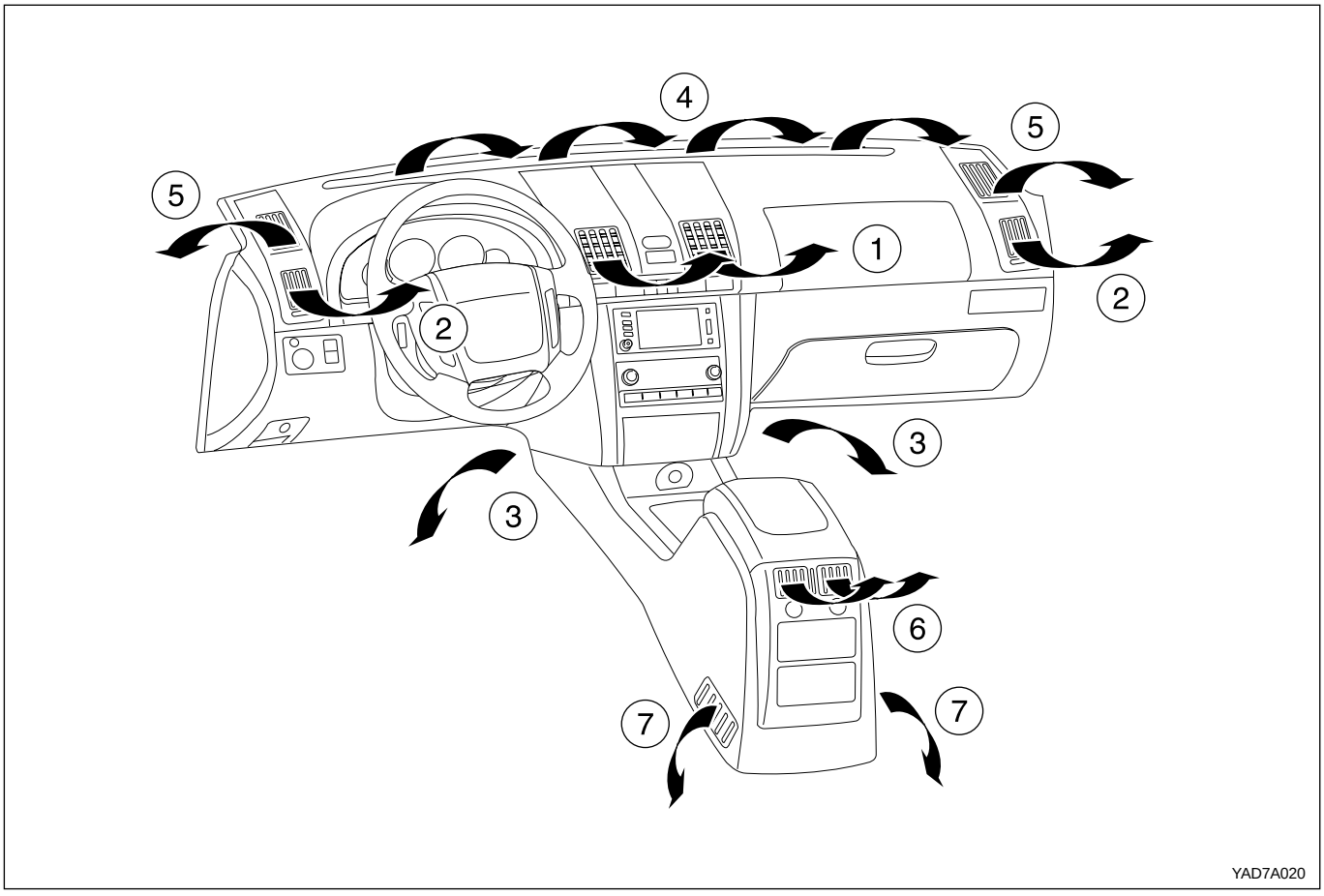
Installation Location

It's located at the lower side of heater housing

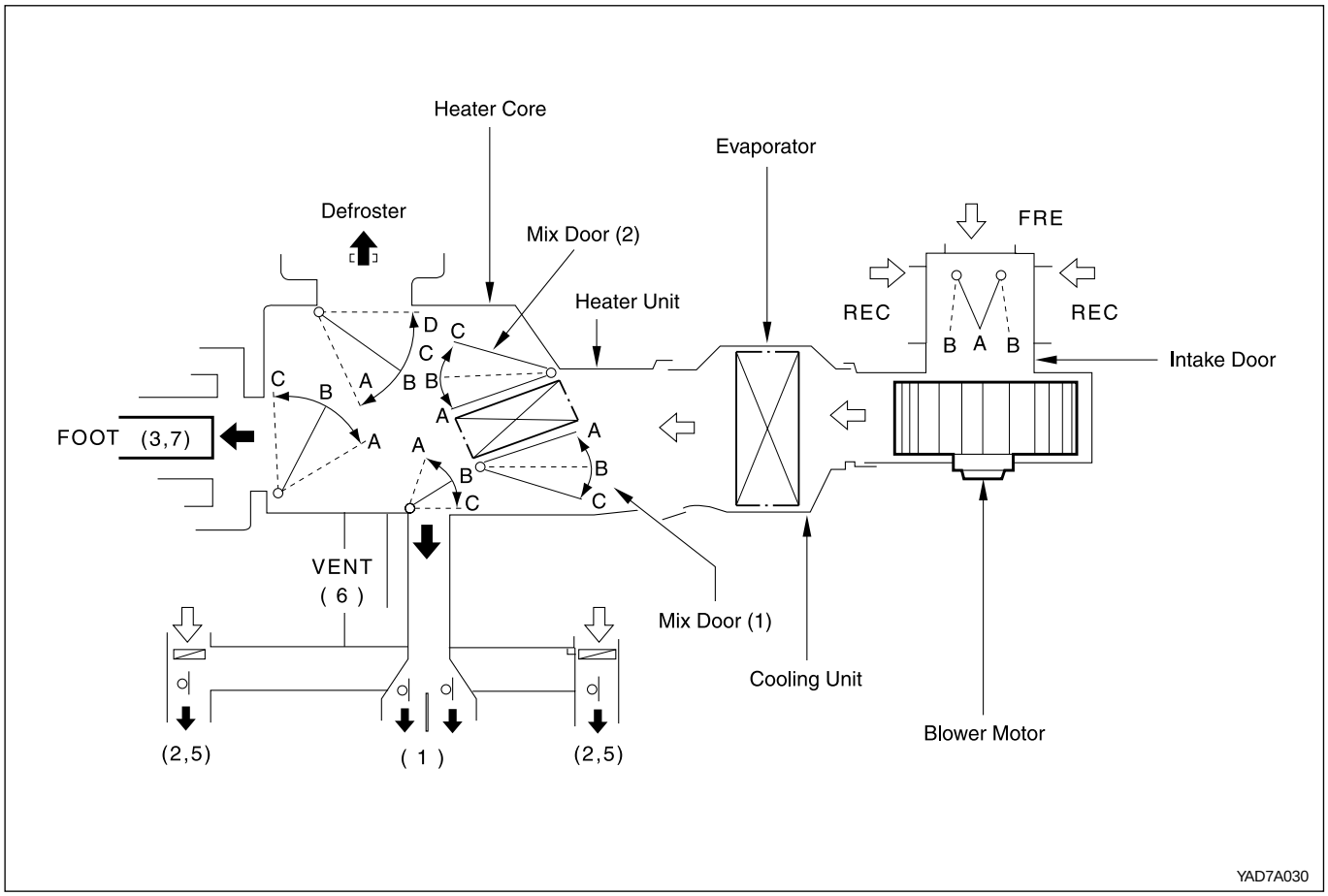
Function

It controls the open/close of damper by the control command of automatic temperature control to adjust the temperature of outlet air.

Airflow Through Vents

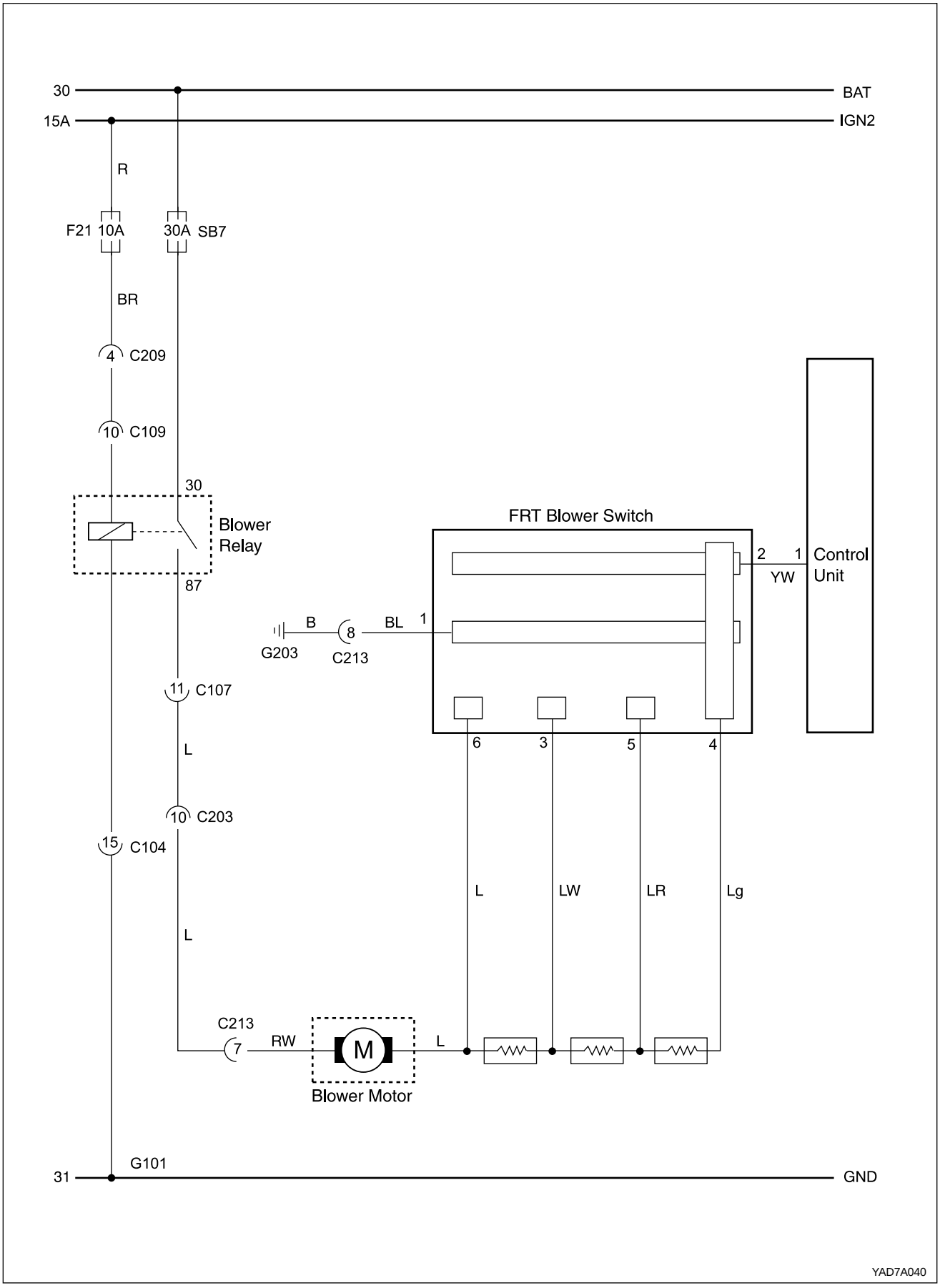


MODE		VENT	BI-LEVEL	FOOT	FOOT/DEF	DEF	Recirculation Switch		Temperature Control Lever
							REC	FRE	
Front	CENTER VENT (1)	A	B	–	–	–	–	–	–
	SIDE VENT (2)	A	B	B	B	B	–	–	–
	FOOT (3)	–	C	B	C	–	–	–	–
	DEFROSTER (4)	–	–	D	C	B	–	–	–
	SIDE DEF (5)	–	–	D	D	C	–	–	–
Rear	VENT* (6)	B	C	–	–	–	–	–	–
	FOOT (7)	–	C	B	D	–	–	–	–
INTAKE Door							(A)	(B)	–
AIR MIX Door							–	–	A B C



SCHEMATIC & ROUTING DIAGRAM

BLOWER MOTOR DIAGRAM



DIAGNOSTIC INFORMATION AND PROCEDURES

INSUFFICIENT HEATING OR DEFROSTING

Step	Action	Yes	No
1	Check the coolant level, the serpentine accessory drive belt for tension or damage, coolant hoses for leaks or kinks, coolant reservoir cap. Is the repair complete?	System OK	Go to Step 2
2	1. Set the temperature control switch to full hot. 2. Set the blower motor switch on 4. 3. Turn the ignition ON. 4. Check for the airflow from the vent outlet. Is there a heavy airflow from the vent outlet?	Go to Step 4	Go to Step 3
3	Recheck the Heater system and then repair as needed. Does the system operate properly?	System OK	Go to Step 7
4	Check for change in the airflow at various blower speeds. Does the blower speed increase as the switch is turned from 1 to 4?	Go to Step 5	Go to “Blower Electrical”
5	With the engine idle, remove the coolant reservoir cap and watch the flow of the coolant. Is the coolant flow visible?	Go to Step 6	Go to Step 8
6	1. Check for a restriction in the cooling system, failed water pump impeller, faulty thermostat. 2. Make repairs to the cooling system, as needed. Is the repairs complete?	System OK	-
7	Check the airflow from the Defrost and vent outlets. Is there a heavy airflow from there?	System OK	Go to Step 9
8	1. Check the vehicle for cold air leaks at the Instrument panel, Heater case and Vents. 2. Repair and replace any leaks or obstructions. Are the repairs complete?	System OK	Go to Step 15
9	Set all the selection switches to Defrost. Is there a heavy airflow from any step?	Go to Step 10	Go to Step 11
10	Check the vent outlets and repair as needed. Is the repair complete?	System OK	-
11	Check for change in the airflow at various blower speeds and then repair as needed. Is the repair complete?	Go to Step 12	Go to “Blower Electrical”
12	Check for obstructions in the system at the blower inlet and repair as needed. Is the repair complete?	System OK	Go to Step 13
13	1. Set the blower motor switch on 4. 2. Slide the temperature control knob from full hot to full cold. 3. Listen for an airflow change. Does the airflow change?	Go to Step 14	Go to Step 19
14	1. Repair the temperature door travel, cables and linkage as required. 2. Verify the accuracy of the temperature controls at full hot. Is the repair complete?	System OK	-
15	1. Turn the ignition “LOCK”. 2. Turn the temperature control knob to full cold, then rapidly to full hot. 3. Listen for the sound of the temperature door slam. Did the door slam?	Go to Step 16	Go to Step 20

Insufficient Heating or Defrosting (Cont'd)

Step	Action	Yes	No
16	1. Set the temperature switch to full hot. 2. Start the vehicle. 3. Check the temperature of the heater inlet and outlet hose by feel. Is the heater inlet hose hot and the heater outlet hose warm?	Go to Step 17	Go to Step 21
17	Inspection the heater inlet and outlet hose for proper installation. Are the heater inlet and outlet hose reserved?	Go to Step 18	Go to Step 22
18	1. Back flush the heater core. 2. Drain the cooling system. 3. Replace the coolant. 4. Warm the engine to an average operating temperature. 5. Feel the heater inlet and outlet hose. Is the heater inlet hose hot and outlet hose warm?	System OK	Go to Step 23
19	Check the system for any obstruction between blower, heater case and airflow delivery outlet and then repair or replace as required. Is the repair complete?	System OK	-
20	1. Repair the temperature door travel, cables and linkage as required. 2. Verify the accuracy of the temperature control at full hot and full cold, and then repair as required. Is the repair complete?	System OK	-
21	Check thermostat and then repair or replace as required. Is the repair complete?	System OK	-
22	Reinstall heater hose properly. Is the replace complete?	System OK	-
23	Replace heater core. Is the replace complete?	System OK	-

BLOWER ELECTRICAL

Step	Action	Yes	No
1	1. Disconnect the power connector from the blower motor. 2. Check the resistance between the 2 terminal of the blower motor connector and each step with the blower switch place each position. Is the resistance within the specified value?	Go to Step 2	Go to Step 3
2	Replace the blower motor. Is the repair complete?	System OK	-
3	Check the fuse SB7 (30A) in the engine compartment fuse block. Is the fuse blown?	Go to Step 4	Go to Step 5
4	Replace the fuse. Is the repair complete?	System OK	-
5	1. Turn the ignition ON. 2. Use the short detector to locate the following possible short: From the fuse SB7 (30A) in engine compartment fuse block to the blower motor. From the blower motor to the blower resister block. From the blower resister block to the blower speed switch. Is there any short in the above positions?	Go to Step 6	Go to Step 7
6	Repair any short. Is the repair complete?	System OK	-
7	1. Disconnect the power connector from the blower motor. 2. Use the test lamp to locate a possible short between the terminal 1 of the blower switch connectors and the terminals 6, 3, 5, 4 of the blower switch connectors sequentially. Does the test lamp light on at any terminal?	Go to Step 8	Go to Step 9
8	Replace the A/C controller switch. Is the repair complete?	System OK	-
9	Replace the blower resistor. Is the repair complete?	System OK	Go to Step 10
10	Check the ground of the blower motor and then repair as needed. Is the repair complete?	System OK	-

IMPROPER AIR DELIVERY OR NO MODE SHIFT

This procedure provides a test of all functions of the heater/defroster unit.

1. Warm the vehicle and keep the engine running.
2. Perform the following diagnostic procedure.

Check		Action	
Check connection and the attachment of the door cable	Is the cable connected and retained properly?	Yes	Check the range of the door travel and the effort required to move it.
		No	Connect and attach the cable properly. Check the operation of the temperature control switch.
	Does the door operate properly?	Yes	If required, repair.
		No	Recheck the system using “Control setting/Correct Results” test.
	Is there a problem with the temperature control switch or wiring?	Yes	Repair or replace the temperature control switch or the cable.
		No	System OK
	Is the system OK after the repair complete?	Yes	Check the airflow from the defroster or the vent outlets.
		No	System OK
	Is the heavy airflow?	Yes	Switch the mode knob to defrost.
		No	Remove the heater outlet and then remove any obstructions in the heater outlet.
	Is the airflow proper?	Yes	Check the blower speed for change in the airflow as the control is turned 1 to 4.
		No	Repair or replace any obstructions at heater and air delivery case.
	Does the blower motor speed increase?	Yes	Go to “Blower Electrical”
		No	System OK
	Is the system OK after the repair complete?	Yes	Set the blower switch to 4th. Rotate the temperature control from full cold to full hot.
		No	Listen to an airflow change.
	Does the airflow change?	Yes	Repair or replace any obstruction between the blower and the system outlets.
		No	Check and repair the door adjustments, the cables, the linkage and the control.

TOO MUCH HEAT

Check		Action	
Mode switch to the floor position	Is there too much heat when the mode switch is in the floor position?	Yes	Set the temperature control switch to defrost position.
		No	Set the mode switch to the vent position.
	Is the airflow proper?	Yes	Set the blower speed to 4th. Set the temperature control switch to full hot. Turn the ignition “ON”. Check the airflow and attachment at the foolr outlet.
		No	Check the door travel, the cables, the controls and the linkage for the defrost position and then repair or replace as needed.
	Is the heavy airflow?	Yes	Check the door travel, the cables, the controls and the linkage for the full hot, full cold position and then adjust as needed.
		No	Check for a change in the airflow at different blower speed. Check the change.
	Does the airflow change?	Yes	System OK
		No	Go to “Blower Electrical”
	Is the airflow proper?	Yes	Turn the ignition “OFF”. Turn the temperature control knob to full hot, then rapidly to full cold.
		No	Check the system case for leaks and check the floor outlet attachment.
	Can you hear the sound of the temperature door slam?	Yes	Adjust the vent door to vent mode.
		No	Check the door travel, the cables, the controls and the linkage for the full hot, full cold position and then adjust as needed.

HEATER CONTROLS

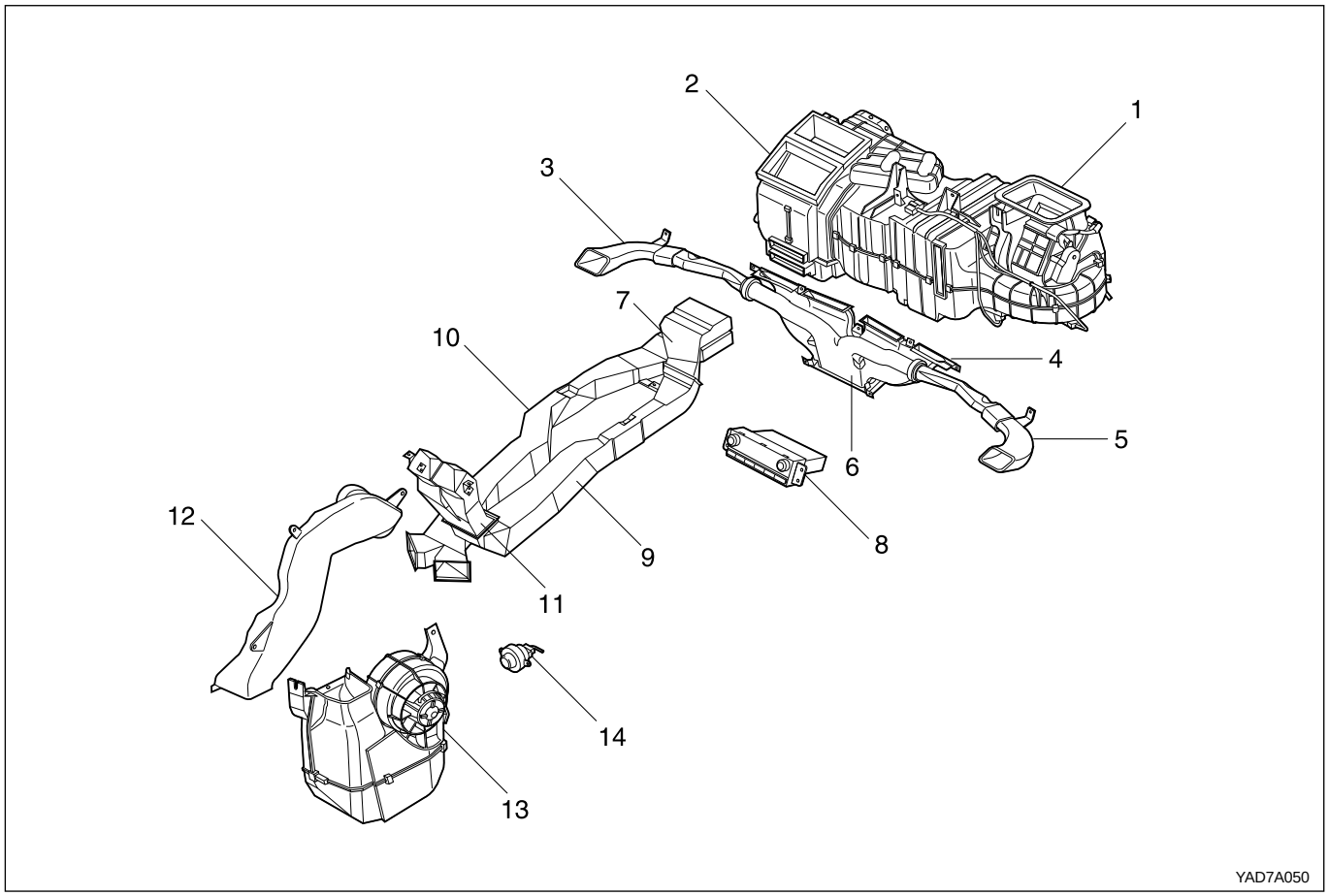
Check		Action	
Turn the temperature control switch	Is excessive effort required to move the control?	Yes	Check the cable for improper routing, kinks, wiring interference or other instrument panel interference.
		No	Set the blower switch to 4th. Repeat to turn the temperature control knob to full hot, then rapidly to full cold
	Does the control operate properly?	Yes	Remove the cable from any door that binds on the cable. Cycle the door manually. Check the door binding.
		No	Repair or replace the problem.
	Is there any door binding?	Yes	Check the door seal for proper installation.
		No	Check the control for binding.
	Does the control bind?	Yes	Reinstall the cable to the door. Repair the instrument panel interference with the cable.
		No	Remove the cable from the control. Check the control for binding.
	Does the control bind?	Yes	Replace the control switch.
		No	Replace the cable.
	Is excessive effort required to move the control?	Yes	Remove the cable from the control. Operate the control switch.
		No	System OK
	Does the control operate properly without any interference?	Yes	System OK
		No	Replace the control switch.
	Is the installation good condition?	Yes	Check a binding door for the shaft alignment, a bent shaft, a bent door or warped case and then repair as needed.
		No	Repair the door seal or replace as needed.

BLOWER NOISE

Check		Action	
Cycle through the blower speeds, the modes and the temperature settings in order to find the noise. -Close all of the doors and windows. -Turn the ignition "ON". -Set the blower switch to 4th. -Set the control switch to full hot position.	Is the blower noise constant at high blower speeds or certain modes, but absent at lower speeds or in other modes?	Yes	Remove any obstruction or foreign material of the duct. Check floor/defroster door seals. Repair or replace as needed.
		No	Check for the vibration from the blower motor and fan assembly at each blower speed by feeling the blower motor housing. Check for the foreign materials at the opening of the blower inlet.
	Did you find the excessive vibration and any foreign material?	Yes	Remove all foreign materials and repair or replace the blower motor and fan assembly.
		No	Set the blower switch to 4th. Check any noise from full hot to full cold temperature positions in the defroster, floor and vent modes.
	Is the noise constant?	Yes	Remove any obstruction or foreign material of the duct. Check the floor/defroster door seals. Repair or replace as needed.
		No	Check any noise in the floor mode.
	Is the noise constant?	Yes	Remove any obstruction or foreign material of the duct. Check the floor/defroster door seals. Repair or replace as needed.
		No	Check any noise in the vent mode.
	Is the noise constant?	Yes	Remove any obstruction or foreign material of the duct. Check the vent door seals. Repair or replace as needed.
	Is the blower noise constant at any modes but absent at all modes of temperature control lever?	Yes	Check the temperature door seals
		No	Check the system for obstructions, foreign materials between the fan and the temperature door and then repair or replace the fan as required.

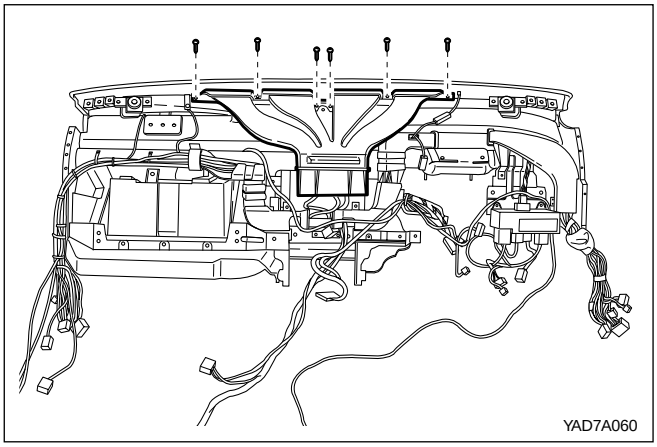
COMPONENT LOCATOR

AIRFLOW THROUGH VENTS WITH REAR HEATING DUCT



1 Blower and Evaporator Assembly
2 Heater Assembly
3 Side Defroster Duct (LH)
4 Main Defroster Nozzle
5 Side Defroster Duct (RH)
6 Side Defroster Joint
7 Console Front Ventilation Duct
8 A/C Controller
9 Console Middle Ventilation Duct
10 Console FOOT Duct
11 Console Rear Ventilation Duct
12 Rear cooler Duct
13 Rear cooler Assembly
14 Rear cooler Controller

REPAIR INSTRUCTIONS

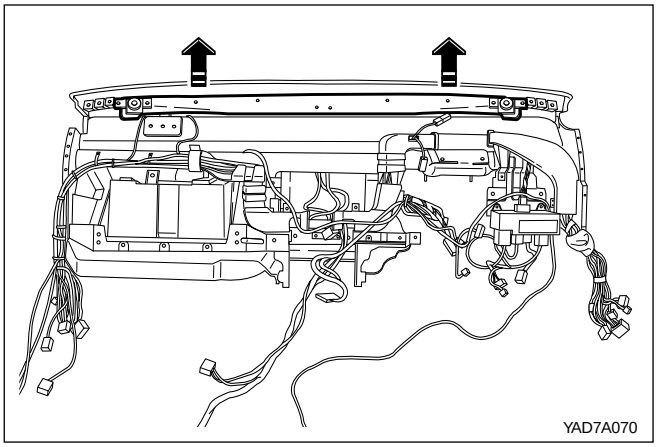


ON-VEHICLE SERVICE

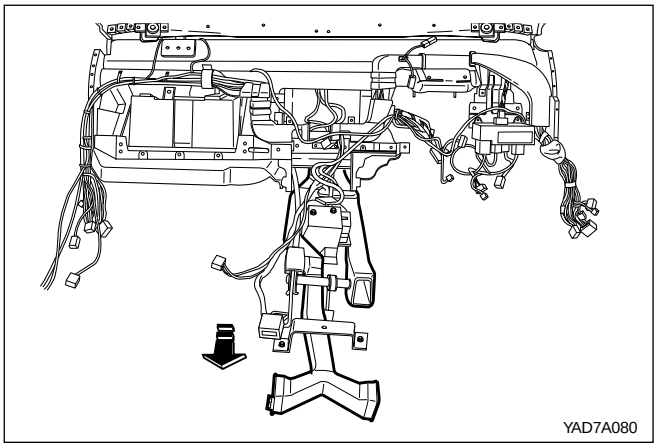
AIR DUCT ASSEMBLY

Removal & Installation Procedure

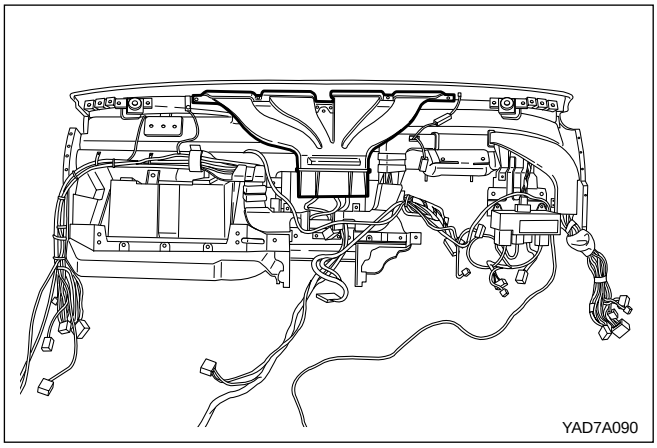
1. Remove the instrument assembly.
2. Remove the defroster nozzle retaining screws and the defroster nozzle assembly.



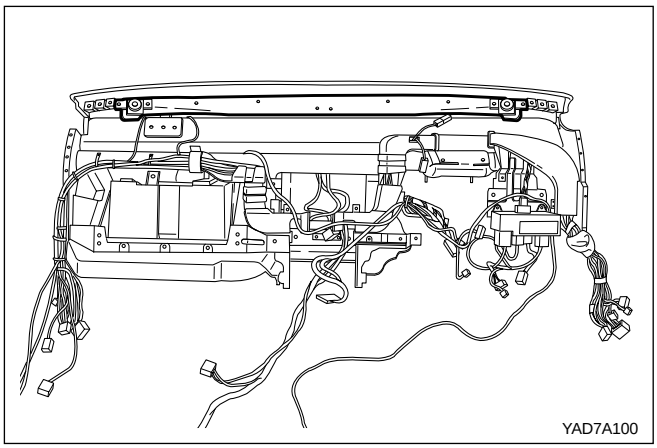
3. Remove the ventilation duct.



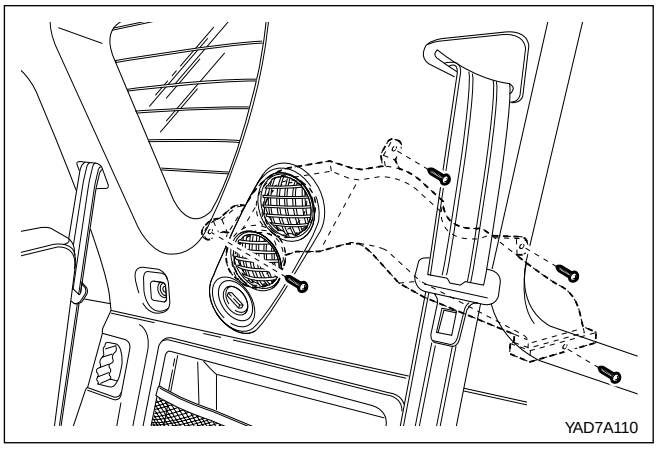
4. Remove the air distributor at console side.
   - Remove the center console.
   - Remove the parking brake lever assembly.
   - Remove the middle duct retaining bolt.
5. Remove the middle duct and the lower duct.



6. Installation should follow the removal procedure in the reverse order.
   - Install the nozzle and the ventilation duct to the instrument panel.



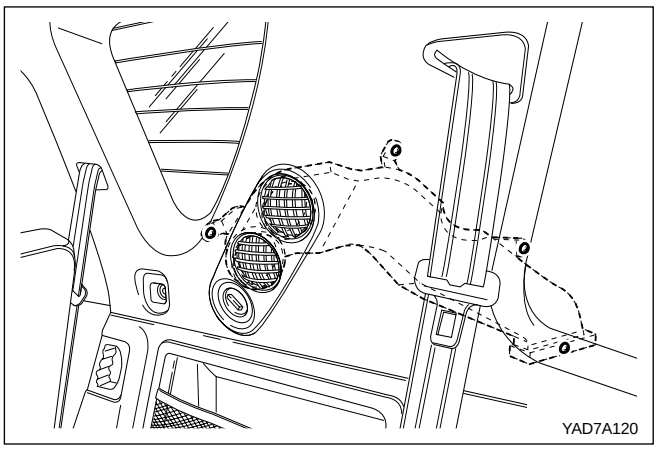
- Install the duct at console side with air duct.



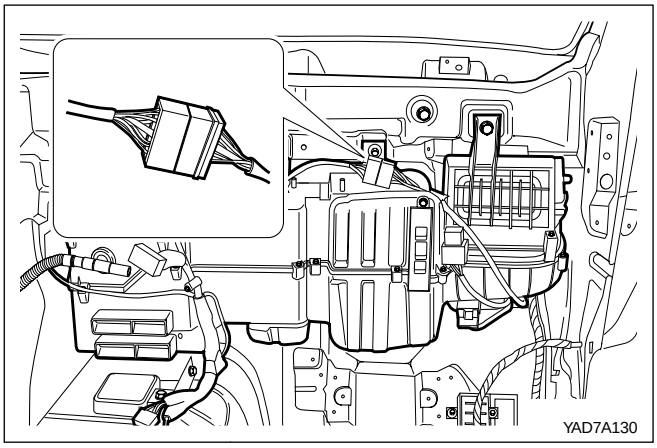
REAR COOLER DUCT

Removal & Installation Procedure

1. Remove the rear quarter inner panel.
2. Remove the tapping screw and hex screw at the duct.
3. Remove the duct.



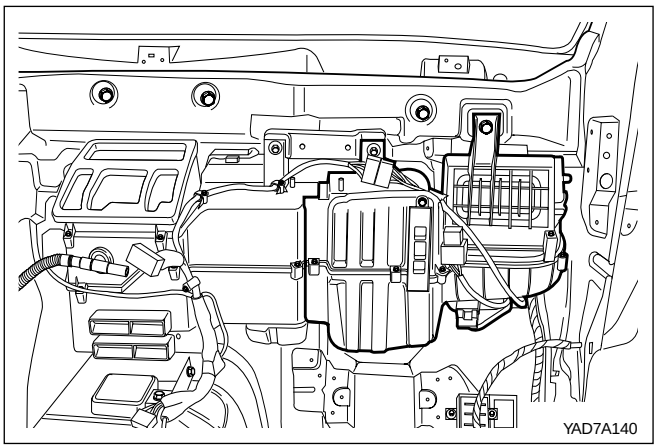
4. Installation should follow the removal procedure in the reverse order.



HEATER AND BLOWER MODULE ASSEMBLY

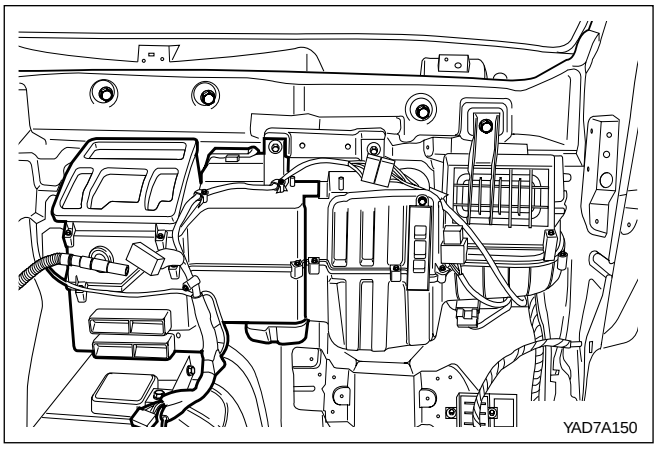
Removal & Installation Procedure

1. Disconnect the blower motor connecter.



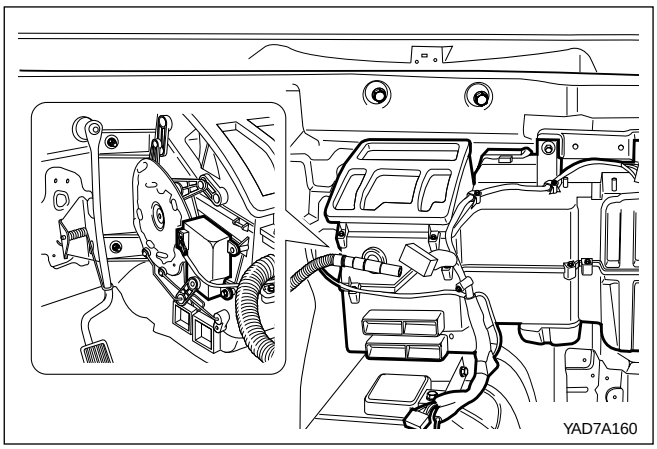
2. Remove the retaining bolts of the blower module and evaporator and then remove the blower module.

   Notice: A/C pipe should be removed previously.



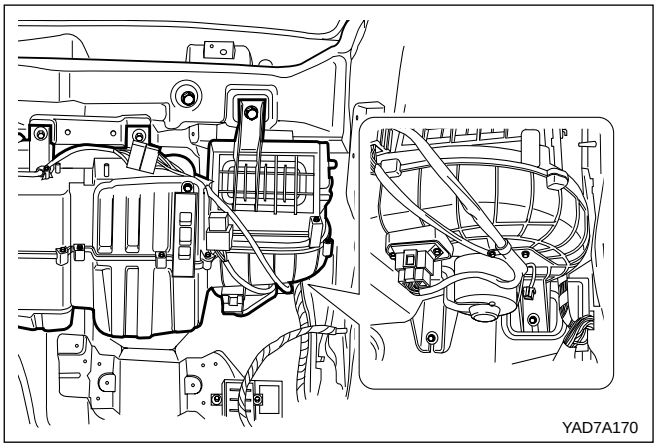
3. Remove the heater module retaining bolts and heater module assembly.

   Notice: Note that it is possible to remove the heater module only when you remove the heater hose previously.



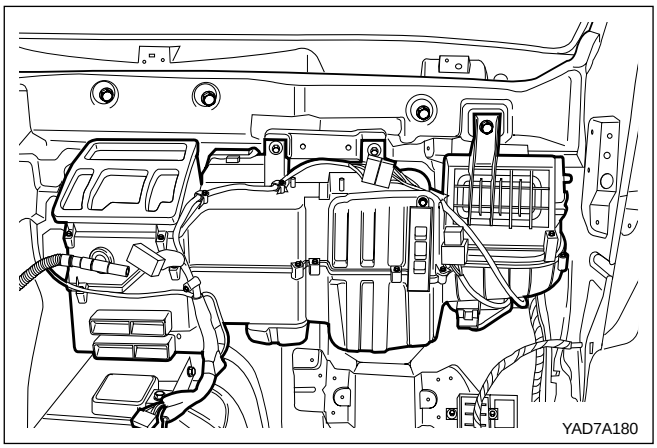
4. Installation should follow the removal procedure in the reverse order.
   - Tighten the heater module with the retaining bolts.

Retaining Bolt	5 N•m (44 lb-in)

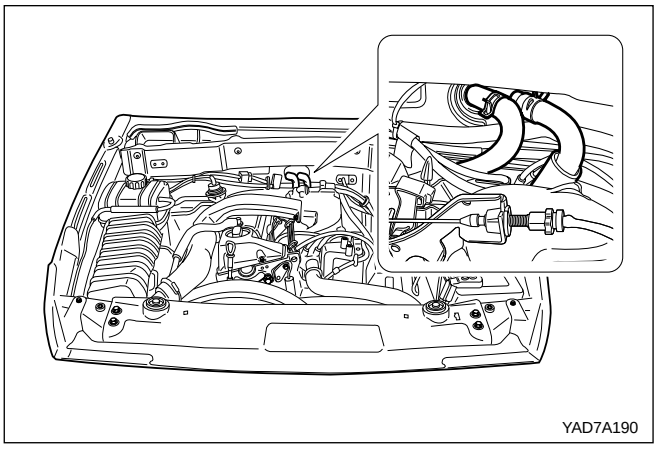


- Tighten the blower module assembly with retaining nuts.

Retaining Bolt	5 N•m (44 lb-in)



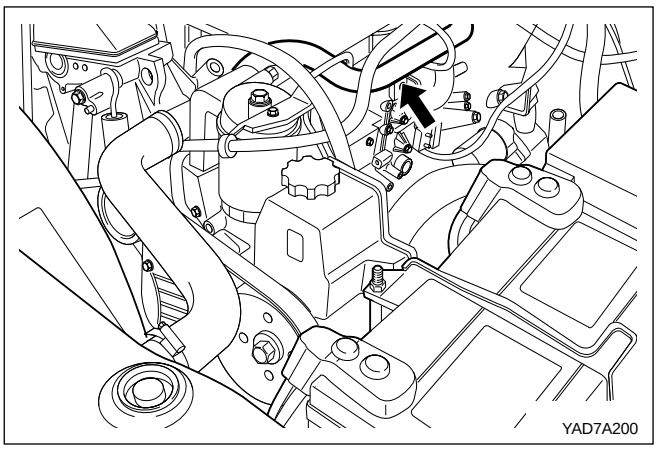
- Connect the blower motor connector and install the heater hose and A/C pipe.



HEATER SUCTION AND DISCHARGE HOSE

Removal & Installation Procedure

1. Drain the coolant.
2. Remove the clips and push back the suction heater hose clamp near the fire wall.
3. Twist the hose slowly from the left side to the right side to loosen the connection between the hose and the tube.
4. Remove the hose end from the tube.



5. Remove the clip and push back the heater suction hose at engine block side.
6. Remove the heater suction hose and discharge hose on the vehicle.
7. Installation should follow the removal procedure in the reverse order.

SECTION 7B

GENERAL HVAC (HEATING, VENTILATION AND AIR CONDITIONING) SYSTEM

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DESCRIPTION AND OPERATION

SPECIFICATIONS

Component	Application	Specifications	
Compressor	Model	V 5	V 7
	Type	Variable Displacement	←
	Displacement	9.8 - 151 cc/rev	9.8 - 179 cc/rev
	PCD	Ø130	←
	Cylinder	5	7
	Oil (Synthetic Oil)	265 ml	←
Condenser	Type	MFC (6-PASS)	
	Size	620 w x 479 h x 20 t	
Receiver-Dryer	Capacity	250 cc	
	Desiccant	XH-9 (35 g)	
	Pressure Switch	DSL : Dual Pressure, GSL: Triple Pressure	
Refrigerant	Type	R-134a	
	Refrigerant Capacity	Single: 850 ± 50 g, Dual: 1200 ± 50 g	

REPAIR INSTRUCTIONS

Air Conditioning

Vehicle air conditioning is the cooling (refrigerant), heating and ventilation of the air in the passenger compartment. Refrigerant is accomplished by making practical use of the three laws of nature. These laws of nature and their practical application are as follows:

- Heat transfer
- Latent heat of vaporization
- Effect of pressure on boiling or condensation

Heat Transfer

The principle of heat transfer are that the heat always flow from hot to cold, the rate of heat transfer will increase as the difference in temperature between two objects increases, and the mass of an object remains the same regardless of its heat contents.

Latent Heat of Vaporization

Everything in the world is composed of matter and the matter exists in one of following states;

- Solid
- Liquid
- Vapor

When a liquid boils, it changes to vapor and absorbs heat without raising the temperature of the resulting vapor.

When the vapor condenses, it changes back to a liquid and gives off heat without lowing the temperature of the resulting liquid.

Effect of Pressure on Boiling or Condensing

When the pressure on the liquid or vapor changes, the boiling point changes. Increasing the pressure increases the boiling point, while the boiling point decreased by decreasing the pressure on the liquid or vapor.

Another effect of the compression is an increase in temperature even through heat has not been added. For example, if you compress the refrigerant R-134a from 206kPa (30 psi) to 1206kPa (175 psi) the temperature of vapor will increase from 0 °C (32 °F) to 54 °C (130 °F) and boiling point increase. Condensing point also will increase.

Testing the refrigerant system

1. Check the outer surfaces of the radiator and the condenser cores to be sure that the airflow is not blocked by dirt leaves or other foreign material. Check between the condenser and the radiator as well as all outer surfaces.
2. Check for any restrictions or kinks inthe condenser core, the hoses and the pipes.
3. Check the operation of the blower fan.
4. Check all the air ducts for leaks or restrictions. Low airflow rate may indicate a restricted evaporator core.
5. Check for slippage of the compressor clutch.
6. Check the drive belt tension.

Handling O-Ring

1. Even though O-rings may look identical, it is extremely important that only recommended service replacement air conditioning O-rings be used, or excessive leakage of the refrigerant may occur.
2. Always O-ring and installation area should be kept clean. Any foreign material and dust may result in excessive refrigerant leakage.
3. Before installation, verify that both O-ring and fittings have not been nicked or deformed. Deformed or nicked parts must be replaced.
4. Failure to use the proper service replacement parts and procedures may result in excessive refrigerant leakage.

Handling Refrigerant

1. Always work in a well-ventilated area.
2. If you have difficulty breathing, seek medical attention immediately. If refrigerant comes in contact with any part of your body, flush the exposed area with water. If a rush or pain develops seek medical attention.

Handling of Refrigerant Lines and Fittings

1. Using too low or too high a torque when tightening a fitting can result in loose joints or deformed joint parts.
2. Back up the opposing fitting to prevent the distortion of the connecting lines or the components. Back up both the swaged fitting on the flexible hose connections and the coupling to which it is attached two wrenches to prevent turning the fitting and damaging the ground seat.

Maintaining Chemical Stability In the Refrigeration System

The efficient operation and life of the air conditioning system is dependent upon the chemical stability of the refrigeration system.

When foreign materials, such as dirt, air or moisture, contaminate the refrigeration system, they will change the stability of the refrigeration and the polyalkalene glycol (PAG) compressor oil. They will also affect the pressure-temperature relationship, reduce efficient operation and can possibly cause interior corrosion and abnormal wear of moving parts.

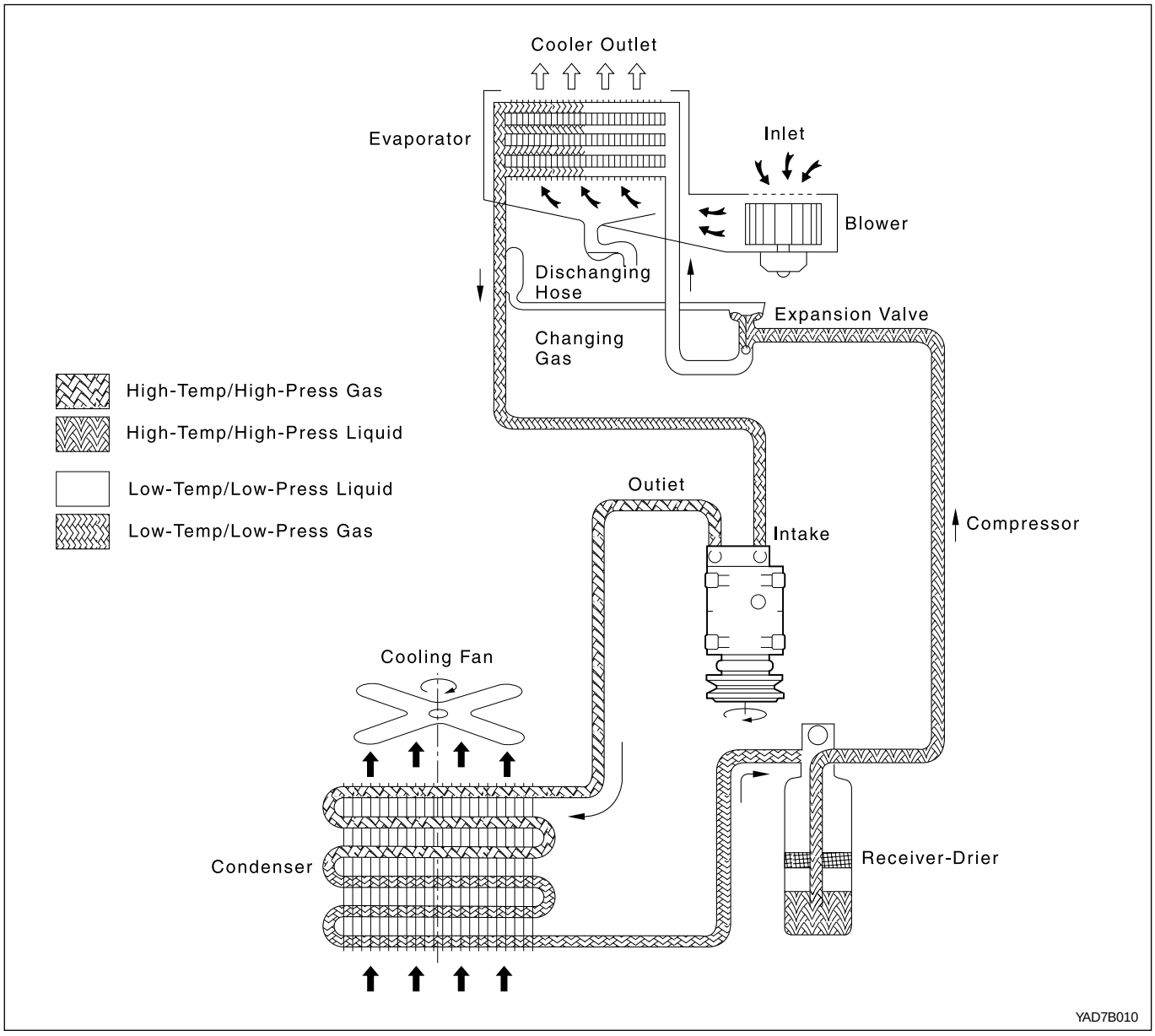
Observe the following practices to ensure chemical stability in the system:

1. Wipe away dirt or oil at and near any connection before opening that connection. This will reduce the chance of dirt entering the system.
2. Cap, plug or tape both sides of a connection as soon as possible after opening the connection. This will prevent the entry of dirt, foreign material and moisture.
3. Keep all tools clean and dry including the manifold gauge set and all replacement parts.
4. Use a clean and dry transfer device and container to add PAG refrigerant oil. This will ensure that the oil remains as moisture-free as possible.
5. When opening an A/C system, have everything needed to perform all operations ready. Do not leave the A/C system open any longer than necessary.
6. Evacuate and recharge any A/C system that has been opened.

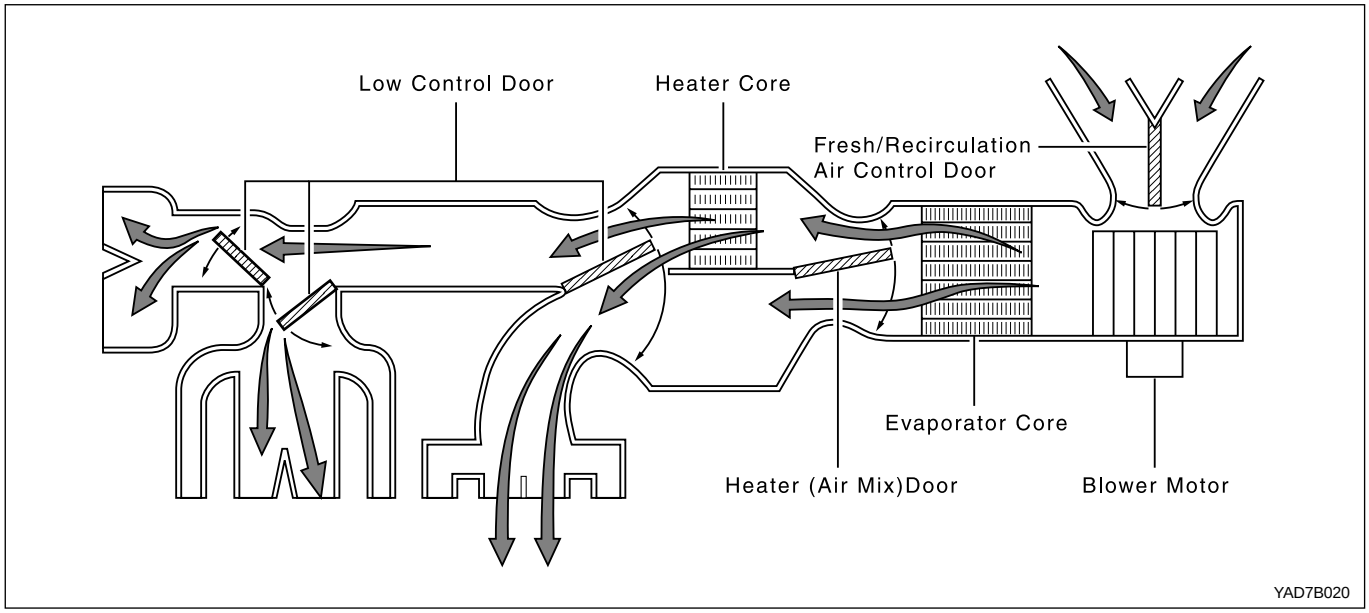
BASIC A/C SYSTEM FUNCTION

A/C System consists of the following component basically.

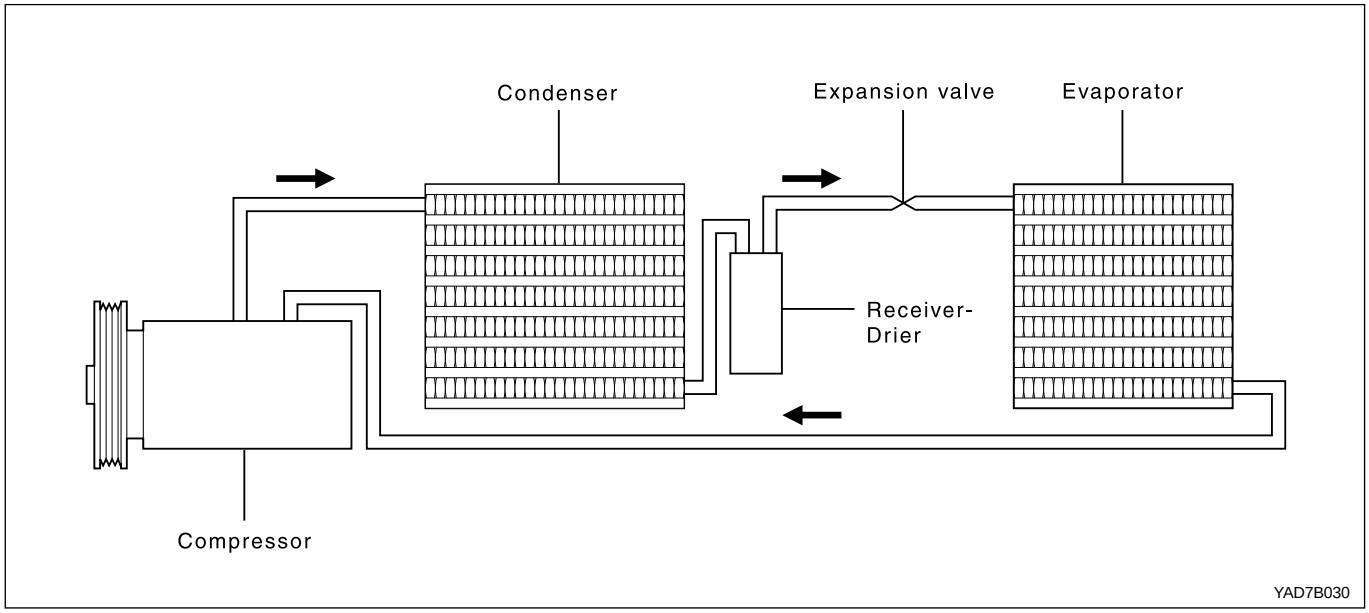
The refrigerant continues to change the phase, liquid → gas → liquid to maximize the cooling effect.



Airflow - Typical

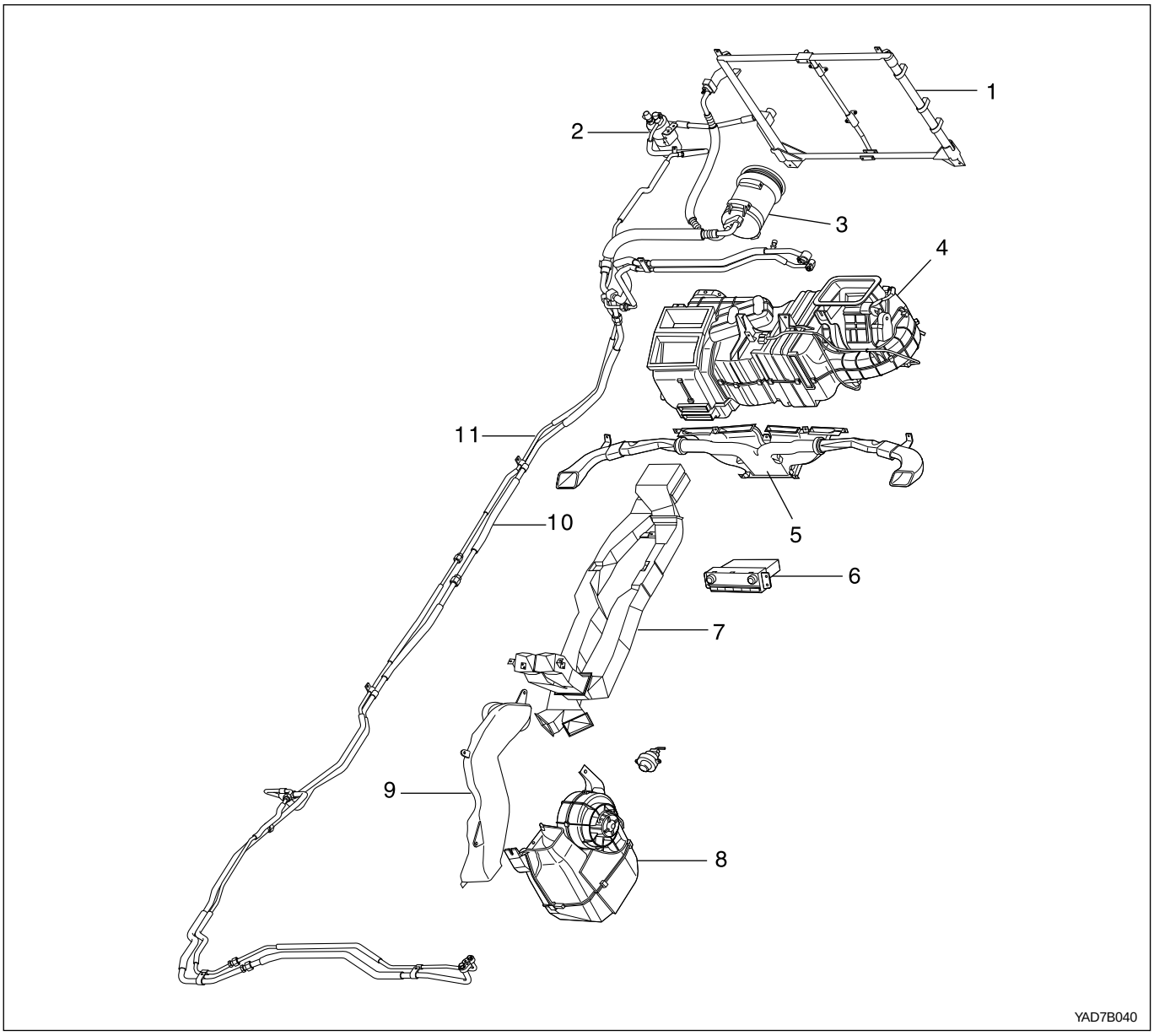


A/C System - Typical



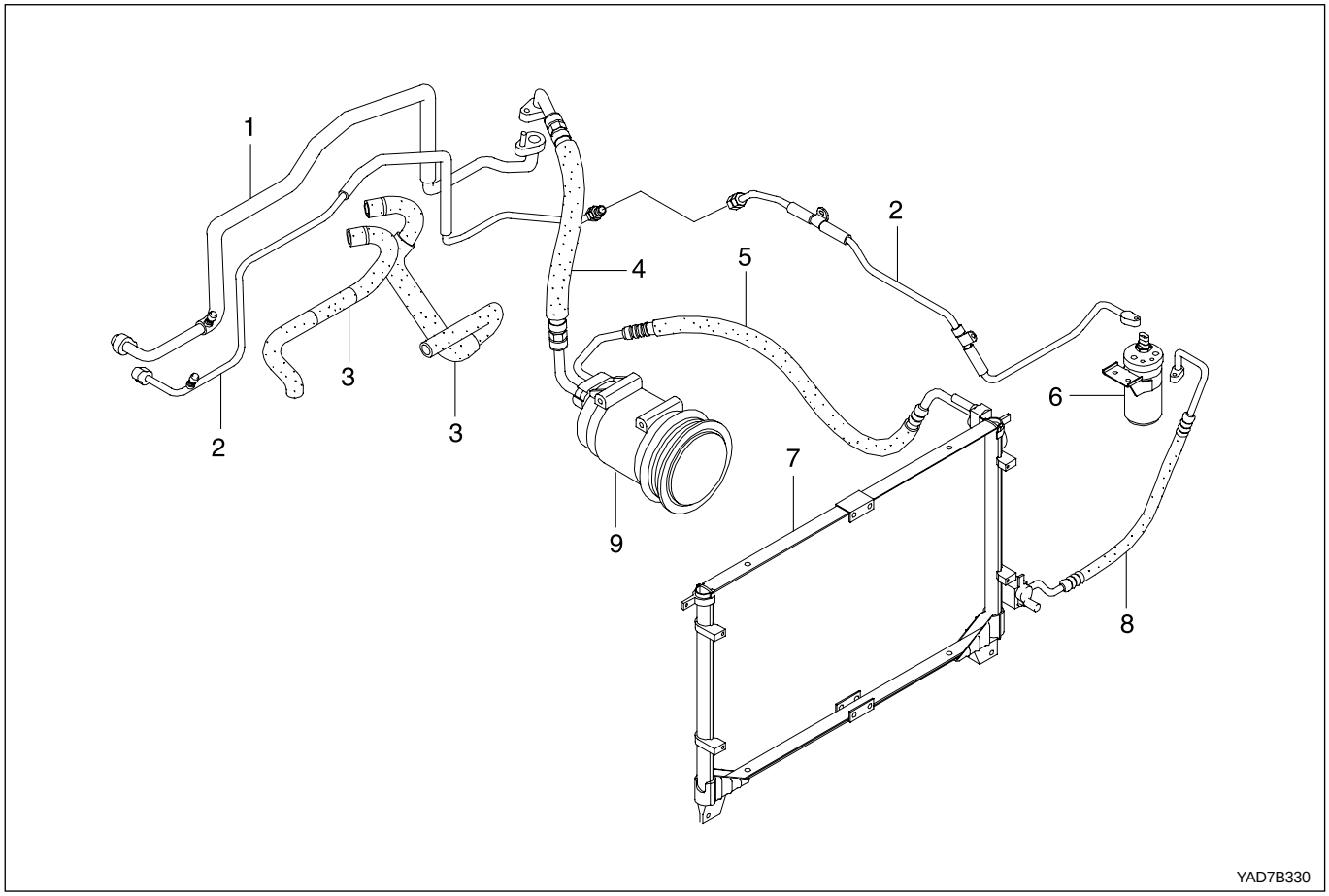
COMPONENT LOCATOR

A/C SYSTEM COMPONENT



1 Condenser
2 Receiver-Drier
3 Compressor
4 A/C & Heater (Blower) Module
5 Defrost Nozzle/Duct
6 Front A/C Controller
7 Rear Duct
8 Rear Cooler Assembly
9 Rear Cooler Duct
10 Suction Rear Pipe Line
11 Liquid Rear Pipe Line
12 Rear Cooler Controller

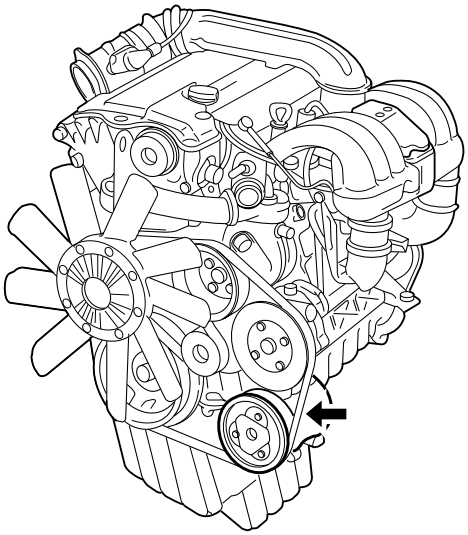
A/C SYSTEM PIPE LINE



1 High Pressure Pipe
2 Low Pressure Pipe
3 Heater Hose
4 High Pressure Hose And Pipe
5 High Pressure Hose
6 Receiver-Drier
7 Condenser
8 Liquid Hose
9 Compressor

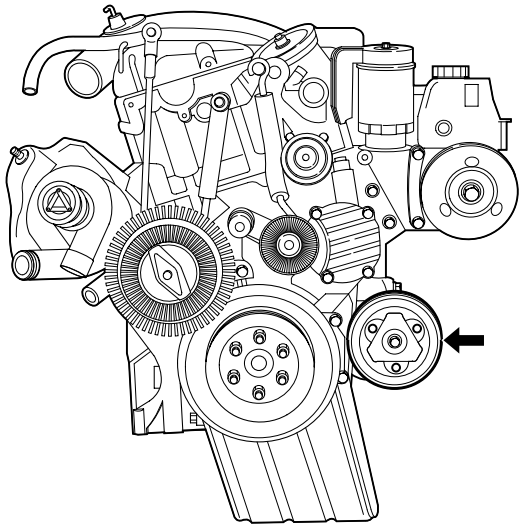
COMPRESSOR LOCATION

Gasoline Engine



YAD7B050

Diesel Engine



YAD7B060

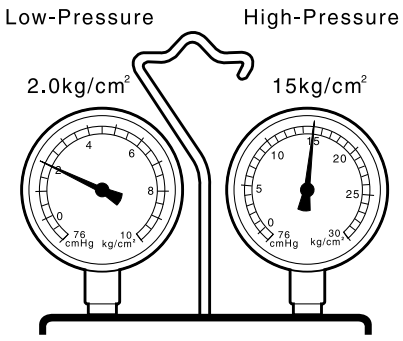
DIAGNOSTIC INFORMATION AND PROCEDURES

GENERAL DIAGNOSIS

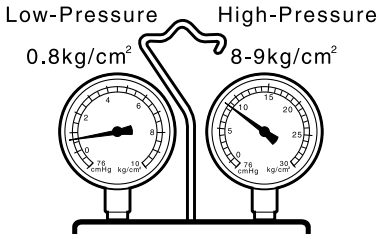
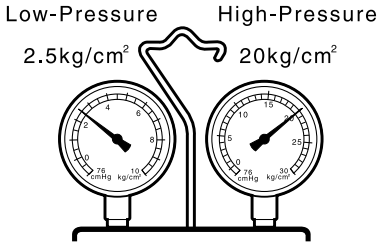
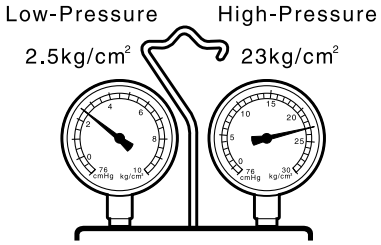
Symptom		Check	Action
Airflow not cold.	Magnetic clutch switch don't turn ON.	Check the fuse	Replace
		Check the A/C switch	Replace
		Check the triple switch (DSL: Dual switch)	Replace
		Check the thermo switch (GSL)	Replace
		Check the compressor relay	Replace
		Check the magnetic clutch	Replace
		Check the A/C control unit	Replace
	Insufficient refrigerant	Check the refrigerant capacity	Adding refrigerant
	Faulty receiver-drier	Check the receiver-drier	Replace
	Abnormal rotating of compressor	Check the drive belt's tension, slip of the compressor and clutch	Adjusting belt
	Abnormal compression of compressor	Check the compressor	Replace
	Faulty expansion valve	Check the expansion valve	Replace
Airflow is cold but insufficient.	Duct joint leak	Check the Duct joint	Replace
	Evaporator frozen	Check the intake air temperature switch	Replace
	Faulty blower motor	Check the blower motor	Replace
	Blower 1th - 3th inoperative, 4th operative	Check the resistor, connector	Replace
Airflow is not continuous.	There is air in the refrigerant	Measure the pressure	Evacuating and charging refrigerant
	Faulty expansion valve	Check the expansion valve	Replace
Insufficient cooling.	Insufficient refrigerant	Check the refrigerant capacity	Adding refrigerant
	Faulty receiver-drier	Check the receiver-drier	Replace
	Faulty condenser	Check the fin's surface and crack of the tube, tank	Cleaning surface, Replace
	Excessive refrigerant in the system	Check the refrigerant capacity (Verify the capacity higher than high pressure)	Recharging refrigerant
	Abnormal rotating of compressor	Check the drive belt's tension	Adjusting belt
	Insufficient compression of compressor	Check the compressor	Replace
	There is air in the unit.	Check the pressure	Evacuating and charging refrigerant
	Faulty expansion valve	Check the expansion valve	Replace

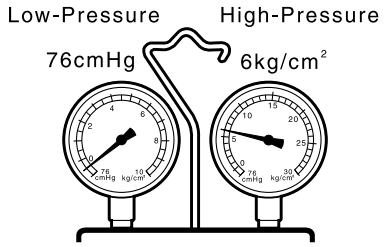
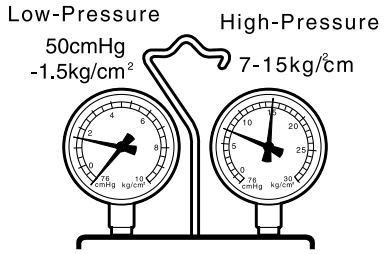
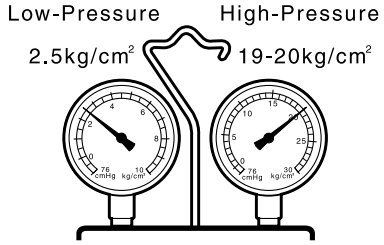
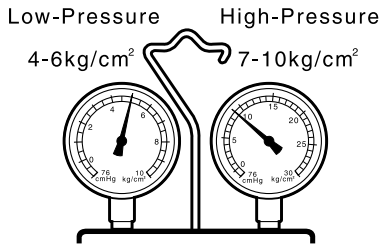
DIAGNOSIS USING THE MANIFOLD GAUGE

On normal operation during the cooling cycle, the manifold gauge must indicate approximately 1.5 - 2.0 kg/cm^2 at low pressure side and 14.5 - 15 kg/cm^2 at high pressure side, on condition that the temperature at the cooler inlet, 30 °C - 35 °C, 2,000 rpm of the engine rpm , full cold and maximum blower speed.

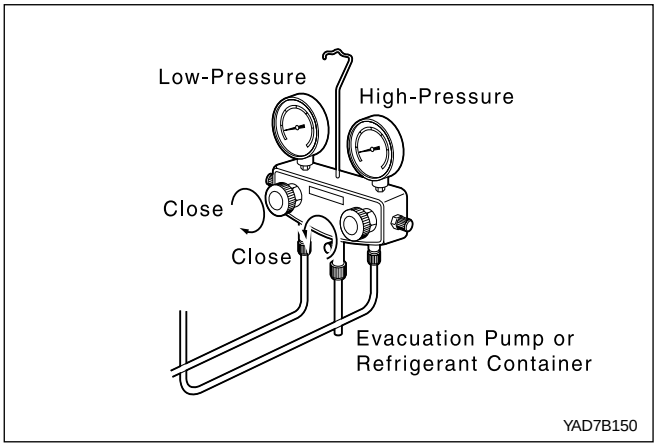


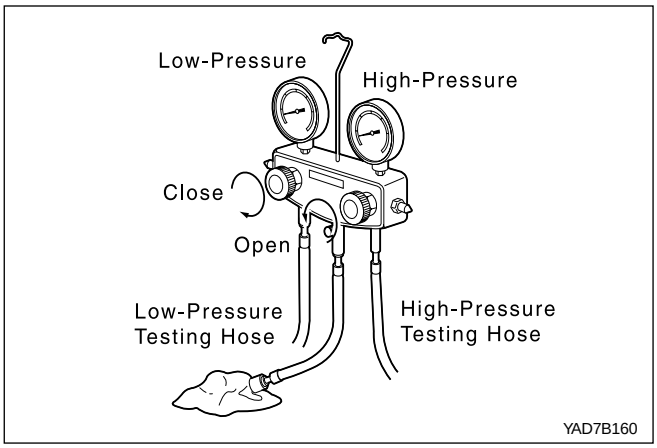
YAD7B070

Symptom	Cause	Action
1. High and low pressure are abnormally low. 2. Air at cooler outlet is not cold.  YAD7B080	• There is a gas leak in the cooling system.	• Check the oil leak, repair • Add the refrigerant
1. High and low pressure are abnormally high.  YAD7B090	• Insufficient cooling and faulty condenser cooling by excessive refrigerant.	• Keep the specified amount of the refrigerant, Clean the condenser • Repair the belt
1. High and low pressure are abnormally high. 2. Connection at the low pressure is not cold.  YAD7B100	• Belt is slipped • There is an air in the cooling system	• Clean and repair the receiver-drier • Check the oil contamination etc.

Symptom	Cause	Action
1. The low-pressure side indicates excessive high and high-pressure indicates excessive low. 2. There is a moisture in the connection of the receiver-drier and the front/back of the expansion valve.  YAD7B110	• The dust and moisture etc. are frozen at the expansion valve • A gas leak in the heat reducer	• Repair the receiver-drier • Replace the expansion valve for the faulty heat reducer
1. The low-side pressure is high or normal intermittently.  YAD7B120	• The mixed moisture is frozen at the expansion valve	• Repair the receiver-drier and perform the bleeding
1. The low-pressure and high-pressure are excessive high. 2. There are a lot of moistures in the connection of the low-side pressure  YAD7B130	• The faulty expansion valve, the improper installation of the heat reducer • Fail to control the flow rate	• Repair the receiver-drier • Check the oil contamination etc.
1. The low-pressure is excessive high and high-pressure is excessive low.  YAD7B140	• There is an oil leak in the compressor	• Replace the compressor

MAINTENANCE AND REPAIR





REFRIGERANT CHARGING

Installation of Manifold Gauge

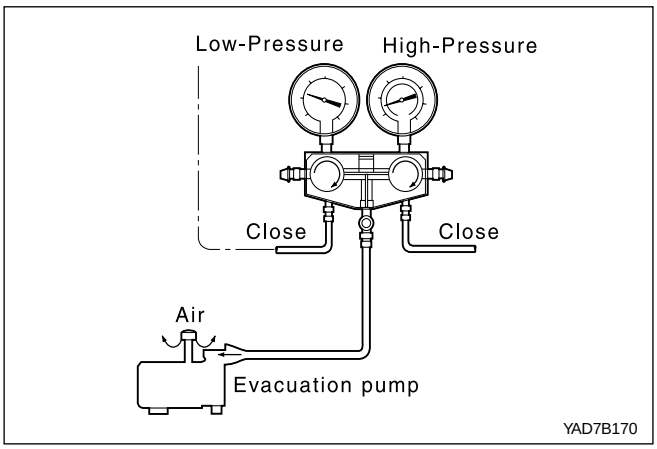
1. Close both high/low pressure hand valves of manifold gauge before installation of gauge to the charging valve.
2. Both high/low pressure hand valves of manifold gauge connect the appropriate charging valve. Tighten the hose nuts by hand.
   - high pressure hand valve → high pressure charging valve
   - low pressure hand valve → low pressure charging valve

Discharging Refrigerant

1. Connect the manifold gauge to the charging valve.
2. Place the free end of the center hose in a shop towel.
3. Slowly open the high pressure hand valve and discharge refrigerant.

   Notice: If refrigerant is allowed to escape too fast, compressor oil will be drawn out of the system.

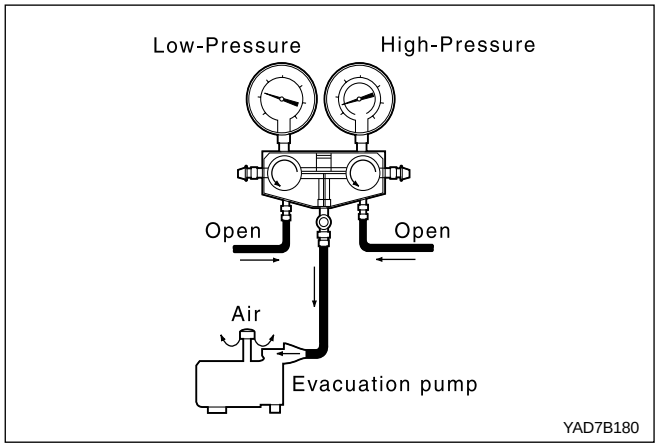
4. Check whether the shop towel gets wet in oil and if wet, close the hand valve.
5. After the high pressure gauge reading drops below 3.5 kg/cm^2, slowly open the low pressure valve.
6. When both high and low pressure gauges reading drops to 0 kg/cm^2, discharging is completed.



Evacuating Refrigeration System

Notice: The unit tank must contain a sufficient amount of R-134a refrigerant for charging. Check the amount of refrigerant in the tank. If there is less than 3.6 kg (8 pounds) of refrigerant, add new refrigerant to the tank.

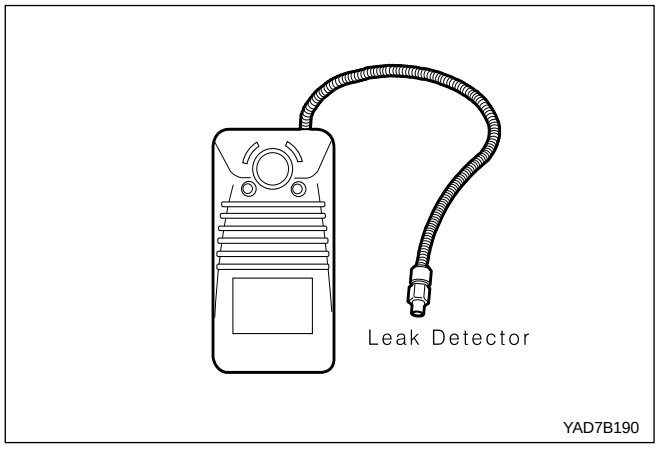
1. Verify that the high-side and the low-side hoses are connected to the A/C system. Open both the high-side and the low-side valves on the unit's control panel.
2. Open both the gas and the liquid valves on the tank.



Important: Refer to the manufacturer's instructions for the charging station in use. It is necessary to evacuate the system before recharging it with new or recycled refrigerant.

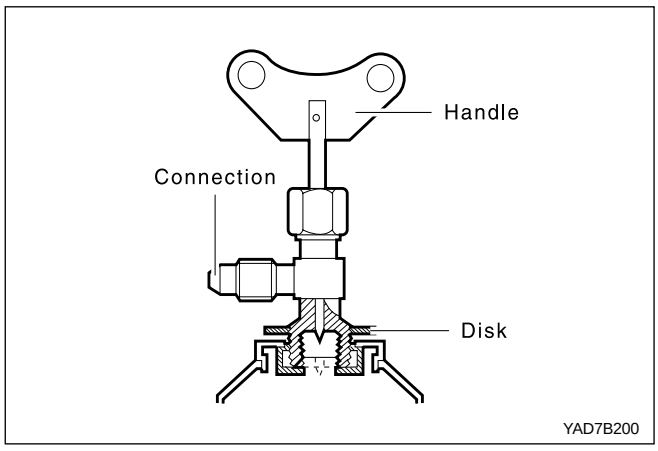
3. Start the vacuum pump and begin the evacuation process. Non-condensable gases (mostly air) are vented from the tank automatically during the recycling process. The pressure being released may be heard.
4. Check for leaks in the system. Refer to the manufacturer's instructions for the charging station in use.

Important: Change the vacuum pump oil frequently. Refer to the manufacturer's instructions for the charging station in use.



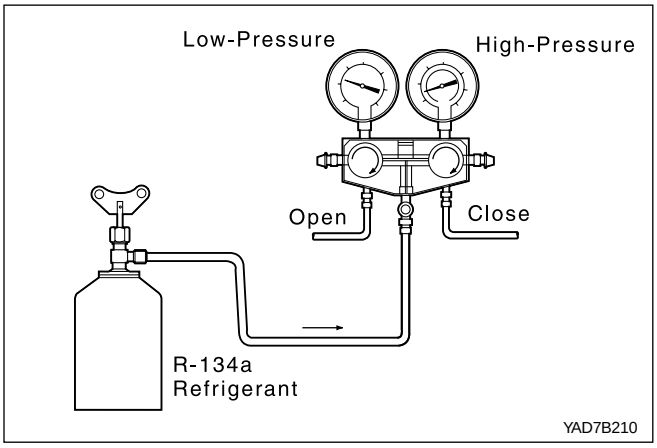
Check for Refrigerant Leaks

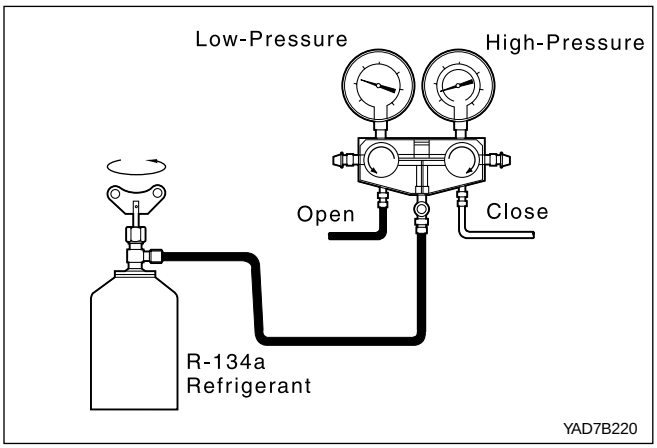
1. Connect the center hose of the gauge to the refrigerant tank.
2. Open the high pressure valve of the gauge to charge with refrigerant gas.
3. Charge until the low pressure gauge reads 1.0 kg/cm^2 and close the valve.
4. Using a gas leak detector, check the system for leaks.
5. If any leak is found, replace O-ring or repair the faulty connection.



How to Use the Tap Valve

1. Rotate the handle counterclockwise fully before connecting the valve to the refrigerant tank.
2. Rotate the disk counterclockwise fully.
3. Connect the center hose to the valve fitting and then rotate the disk clockwise fully by hand.
4. Rotate the handle clockwise to drill the sealed hole.
5. Remove the hose nut securing the center fitting of the manifold gauge and then tighten the nut again in a few seconds.





Charging Refrigerant

Charging for Gas

1. Connect the tap valve to the refrigerant tank.
2. Open the low pressure and adjust the low-side reading below 4.2 kg/cm^2.
3. Place the refrigerant tank in the warm water (40 °C) and keep the gas pressure in the refrigerant tank higher than the gas pressure in the charging valve.
4. Run the engine at high speed and operate A/C system.

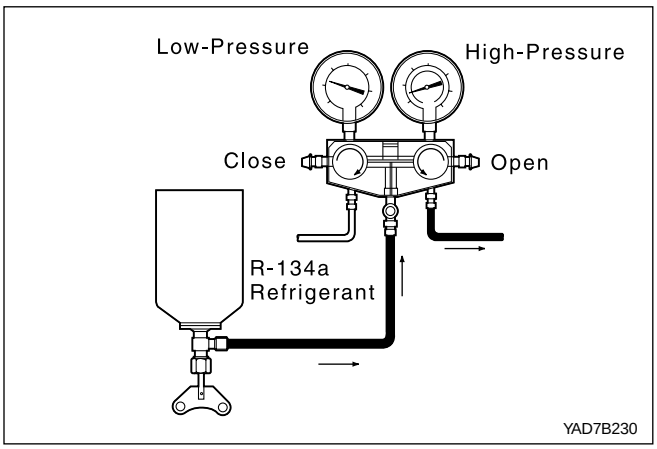
   Notice: Place the refrigerant tank on the flat floor to protect the liquid refrigerant from coming through the suction inlet resulting in the compressor's damage.

5. Charge the specified amount to the charging valve and close the low pressure valve.

Specified amount	Single: 850 ± 50 g
	Dual: 1200 ± 50 g

Notice:

- If the charging speed is low, it's more efficient to place the refrigerant tank in the warm water (40 °C). But the temperature should keep below (52 °C) at any situation.
- Be careful not to contact the heating device or material.



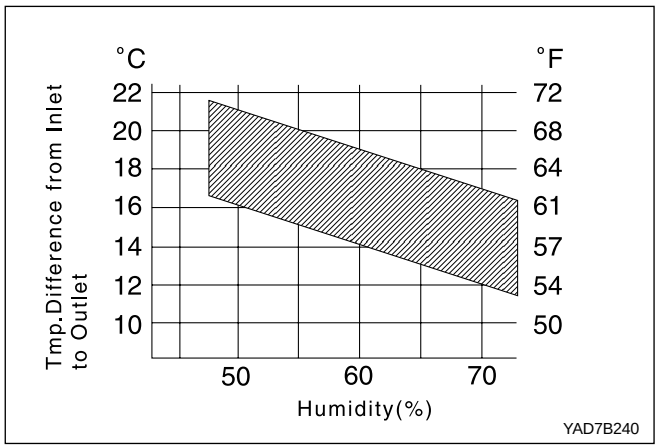
Charging for Liquid

Notice:

- Do not operate when charging the system through the high-side rpessure.
- Do not open the low pressure valve when charging the system by the liquid refrigerant.

1. Tighten both high pressure and low pressure completely before evacuating the charging valve.
2. Connect the tap valve of the refrigerant tank.
3. Open the high pressure valve and turn the refrigerant tank upside down.

4. The discharging pressure increases when the charging valve charges excessively, so charge the charging valve to the specified amount with measuring the weight of the refrigerant before closing the high pressure valve.
5. Charge the specified amount of the refrigerant and then close the valve of the manifold gauge. Check the system for any leak.



Operation Check

Notice: Operation Check is recommended before removing the manifold gauge.

1. Install the manifold gauge set.
2. Run the engine at 2,000 rpm and set the blower switch at 'HI' and A/C switch 'ON'. Set the temperature control lever at 'COOL'.
3. Keep opening all of the window and door.
4. Place a dry bulb thermometer to the front duct.
5. Place a psychrometer close to the inlet of the cooling unit.
6. Check the high pressure gauge reading within 14 - 16 kg/cm^2

   If the reading indicates high excessively, spray the water to the condenser.

   If the reading indicates low excessively, cover the condenser with the towel.
7. Check the temperature of air inlet within 25 - 35 °C.
8. Calculate the relative humidity from the psychrometic graph comparing the wet/dry temperature at the air inlet.
9. Measure the wet/dry temperature at the cold air outlet and calculate the temperature difference of the dry bulb between the inlet and the outlet.
10. Check the cross point of the relative humidity and check the temperature difference between the black line. If the cross point is located between the black line, the cooling performance is normal.

COMPRESSOR OIL REPLACEMENT

Before Oil Replacement

When any part is replaced or there are a lot of gas leaks in the A/C system, you should add the specified amount of the oil to keep the approval oil capacity because the oil for lubricating the compressor circulates through the A/C system during operating the compressor.

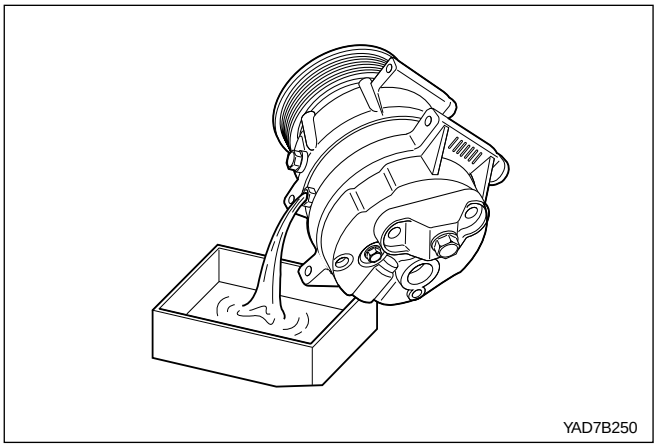
Total Oil Capacity	265 cc

Handling Oil

- Be careful that moistures, dusts etc. must not flow into the oil.
- Do not mix with any other material.
- If the oil leaves outside for long time, it's possible to mix it with the moistures and so keep the oil sealed with a container.

Circulating Oil

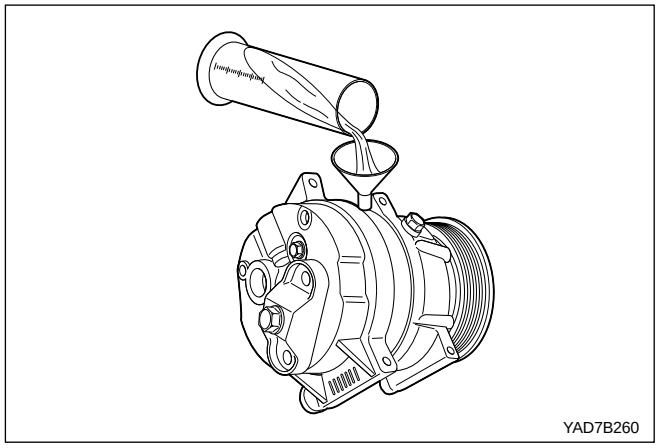
For checking or adjusting the oil level, set the control unit to full cold and max blower speed with keeping the engine run at idle for 20 - 30 minutes in order to circulate the oil through the compressor.


YAD7B250

Replacement Oil

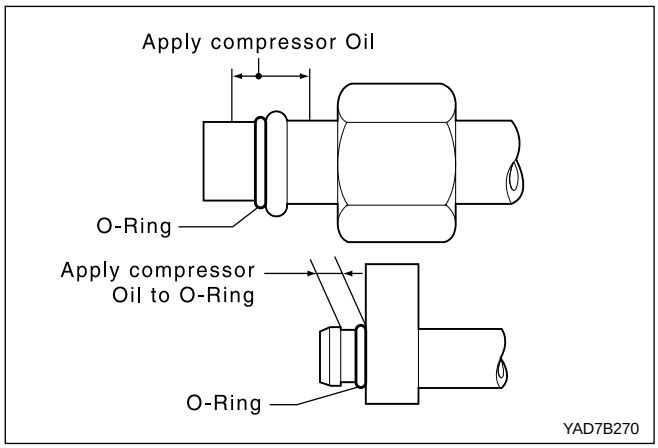
1. Perform the oil circulation and stop the engine. Remove the compressor on the vehicle.
2. Drain the oil at the position of the system line connection.

   Notice: It may be difficult to discharge the oil when the compressor is cold. At this time warm the compressor (40 - 50 °C) before discharging the oil.


YAD7B260

3. Measure the amount of the discharged oil. If the the amount of the discharged oil is below 70 cc, it means the oil leak. Check the connections of the system and repair or replace as needed.
4. Check the oil contamination and add the oil or adjust the oil level.

   Notice: For contaminating the oil by the dust or the foreign material, charge the refrigerant in the system and clean the receiver-drier.

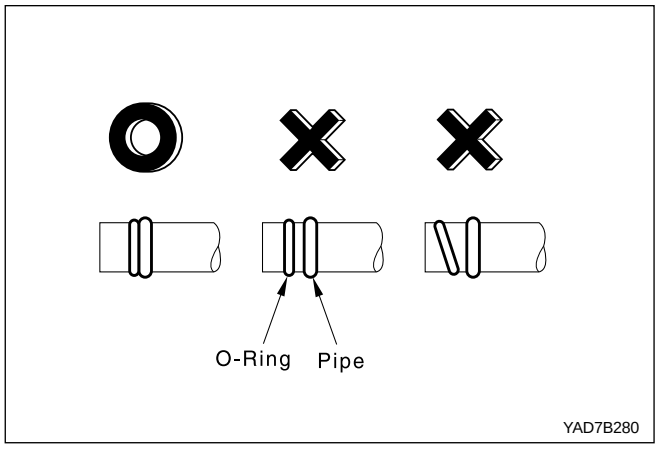


YAD7B270

REPLACEMENT OF REFRIGERANT CONNECTION

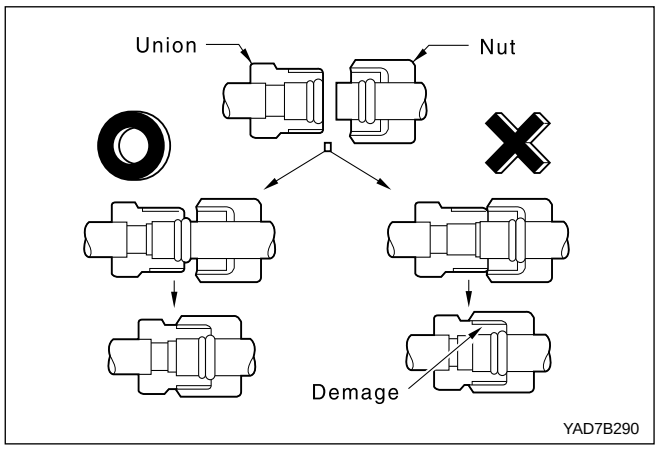
1. When connecting a O-ring type, apply compressor oil to portions shown in illustration. Be careful not to apply oil to threaded portion.

   Notice: Use the approval compressor oil.



YAD7B280

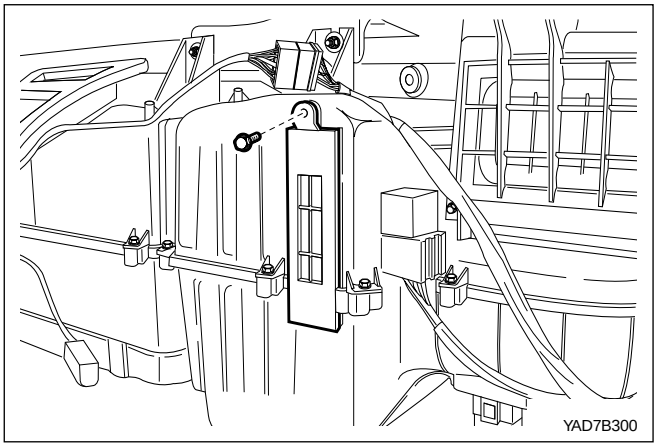
2. O-rings must be closely attached to inflated portion of pipe and always replace used O-rings.



YAD7B290

3. After inserting the pipe to the union, tighten the nut by hand as much as possible and tighten the nut with the specified torque.

REPAIR INSTRUCTIONS

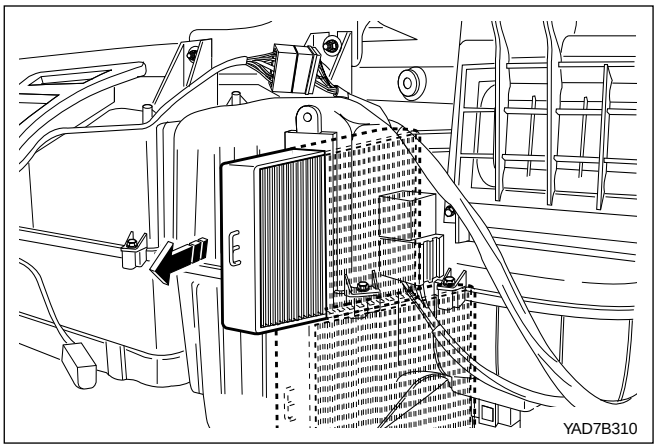

YAD7B300

ON-VEHICLE SERVICE

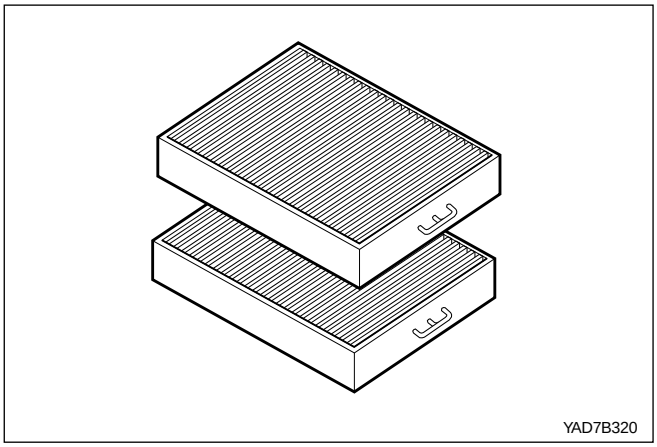
AIR FILTER (AUTO A/C)

Removal & Installation Procedure

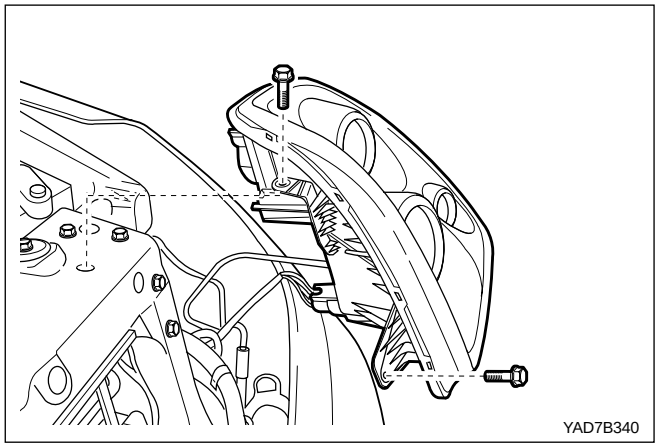
1. Remove the glove box.
2. Remove the lower bracket of crash pad.
3. Remove the air filter.


YAD7B310

4. For replacing the air filter, verify that the flowing direction mark of the air filter face toward the evaporator core.


YAD7B320

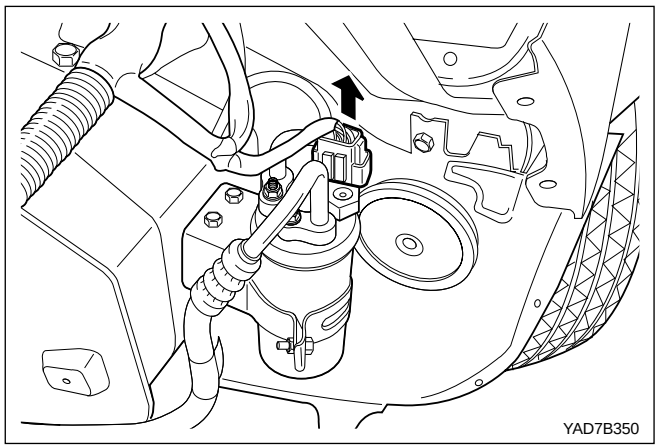
Notice: Installation should follow the removal procedure in the reverse order.


YAD7B340

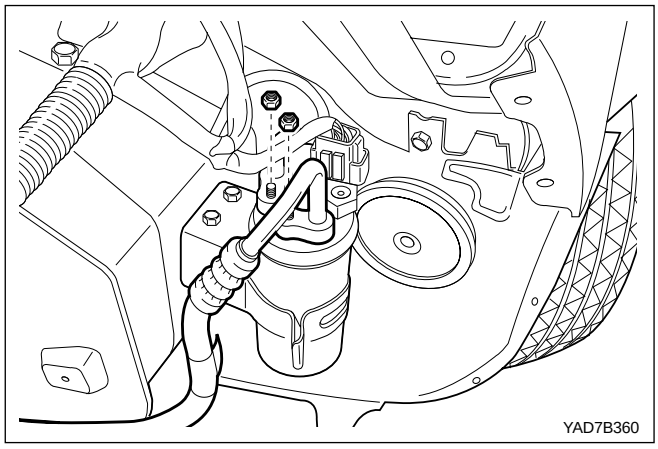
RECEIVER-DRIER

Removal & Installation Procedure

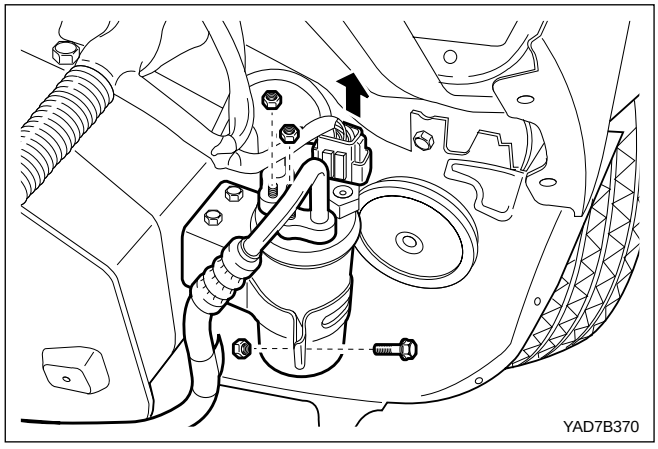
1. Discharge and recover the refrigerant from the system.
2. Remove the head lamp assembly.


YAD7B350

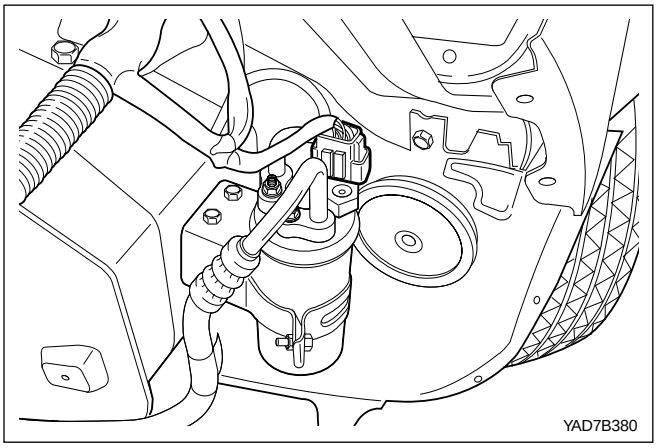
3. Disconnect refrigerant pressure sensor connector.


YAD7B360

4. Remove the receiver-drier.
   - Remove two flange nuts.
   - Remove the O-ring

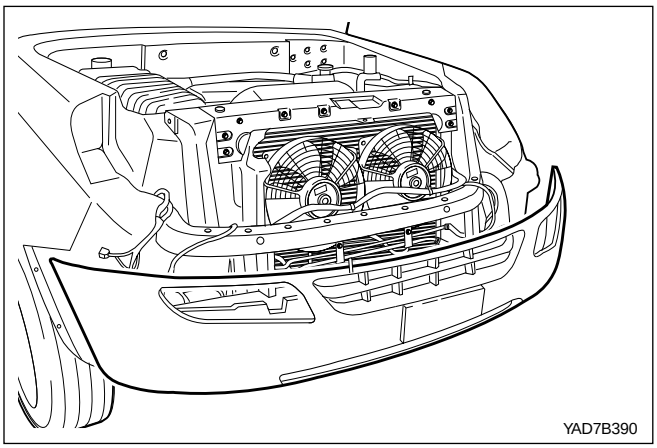

YAD7B370

   - Remove the bracket bolt retaining the receiver-drier and then remove the receiver-drier.


YAD7B380

5. Installation should follow the removal procedure in the reverse order.
   - Tighten the two flange nuts.
   - Evacuate and recharge the A/C system.

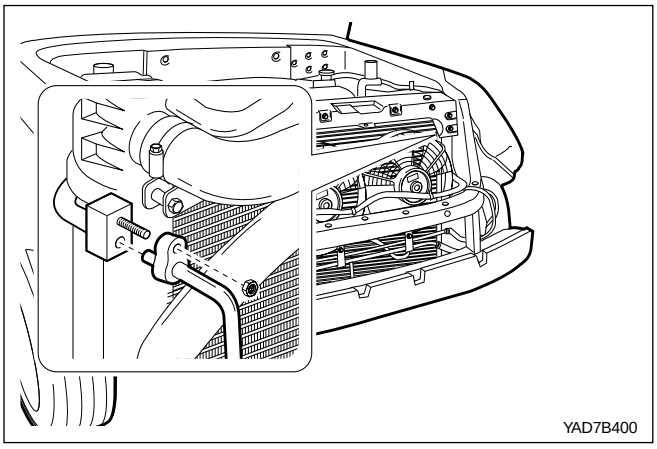
   Notice: Before installing, check the O-ring and apply the compressor oil.


YAD7B390

CONDENSER

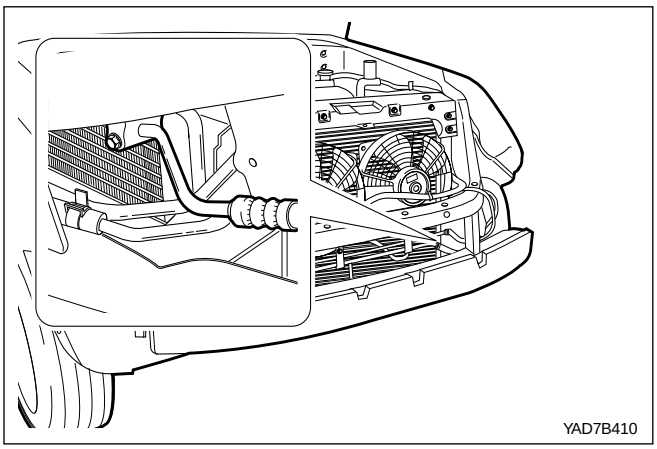
Removal & Installation Procedure

1. Discharge and recover the refrigerant from the system.
2. Remove the radiator grill and front bumper.

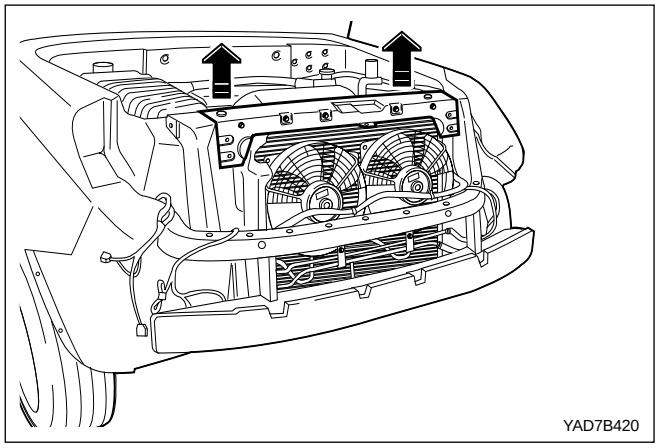

YAD7B400

3. Remove the inlet pipe.

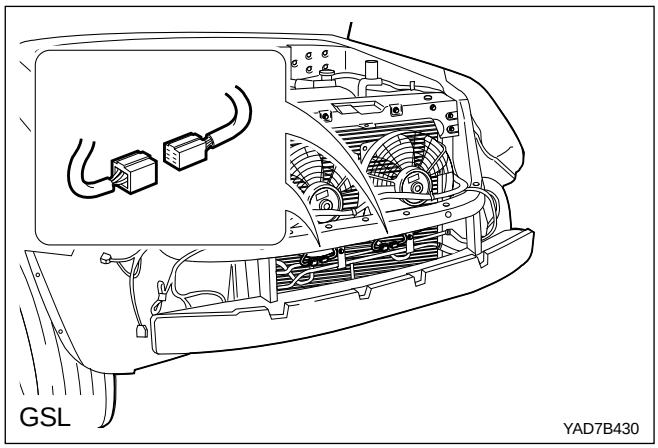
   Remove the O-ring at the same time.


YAD7B410

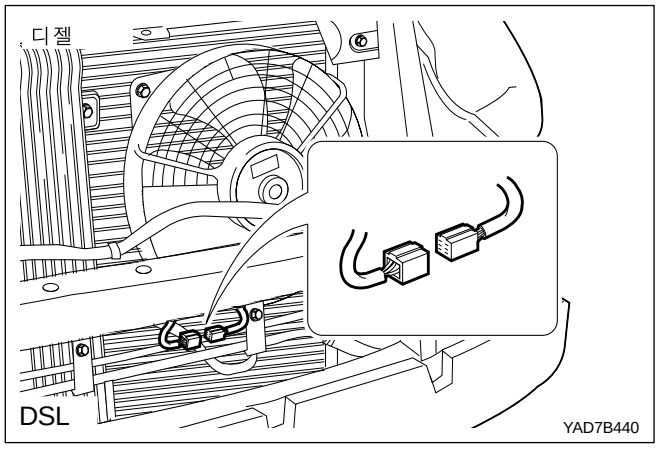
4. Remove the outlet pipe (at the bottom side) with O-ring.

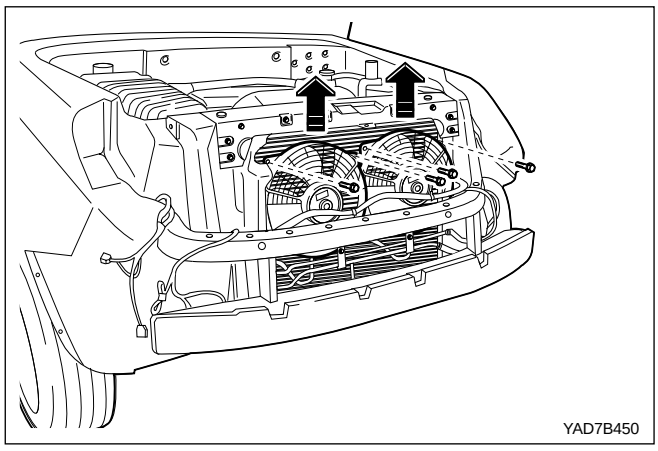


5. Remove the radiator grill plate.



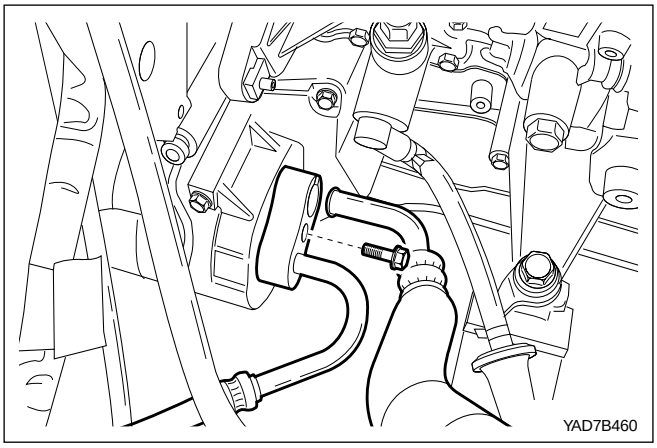
6. Remove the fan bolts.
7. Disconnect the fan connector and then remove the condenser fan from the condenser.





8. Remove the bolts and nuts retaining condenser and then remove the condenser from the vehicle.
9. Installation should follow the removal procedure in the reverse order.

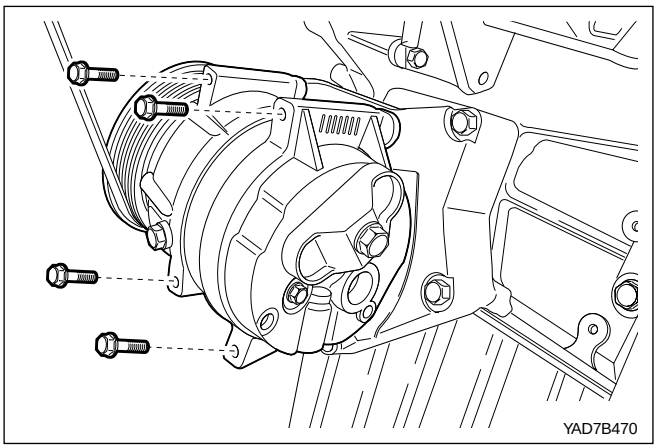
   Notice: The used O-ring must be replaced by the new part.



COMPRESSOR

Removal & Installation Procedure

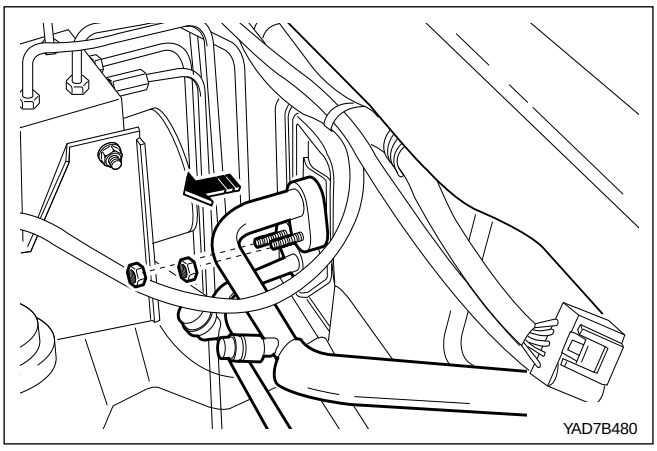
1. Discharge and recover the refrigerant from the system.
2. Remove the fan belt.
3. Disconnect suction/discharge hose from the compressor.
   - Remove the flange bolt retaining the hoses.
   - Disconnect the hoses.
   - Remove two sealing washer.



4. Lift the vehicle and support safely.
5. Remove the skid plate.
6. Remove the compressor.
   - Disconnect the connector of the compressor.
   - Remove three front bracket bolts retaining compressor.

   Notice: Discard the used sealing washer.

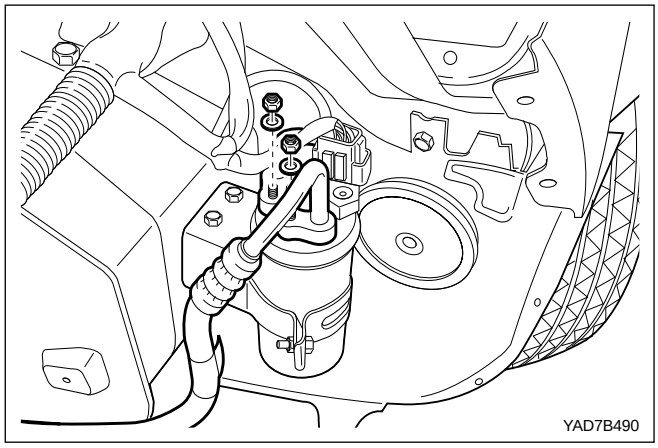
7. Installation should follow the removal procedure in the reverse order.
   ① Tighten the bolts with the specified torque.
   ② Evacuate and recharge the A/C system.



A/C HIGH/LOW PRESSURE LINE

Removal Procedure

1. Discharge and recover the refrigerant from the system.

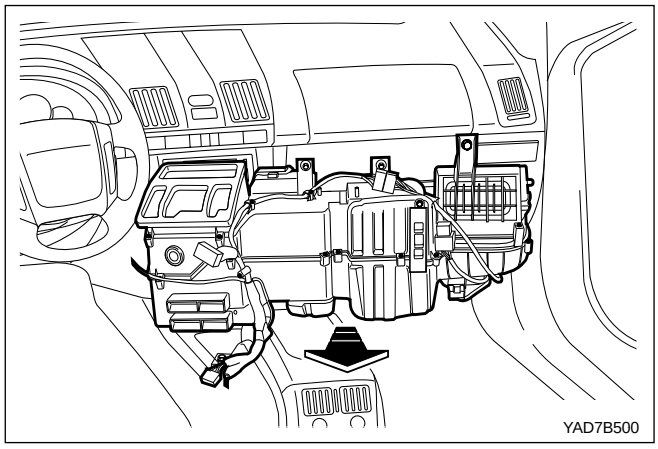


2. Remove the high/low pressure pipe lines.
3. Remove the high/low pressure pipe lines from the evaporator.

Installation Procedure

Notice: Discard the used O-ring and sealing washer.

1. Installation should follow the removal procedure in the reverse order.
2. Tighten the flange nut securing the high pressure line with the specified torque.
   - flange nut at compressor
   - flange nut at evaporator
3. Evacuate and recharge the A/C system.



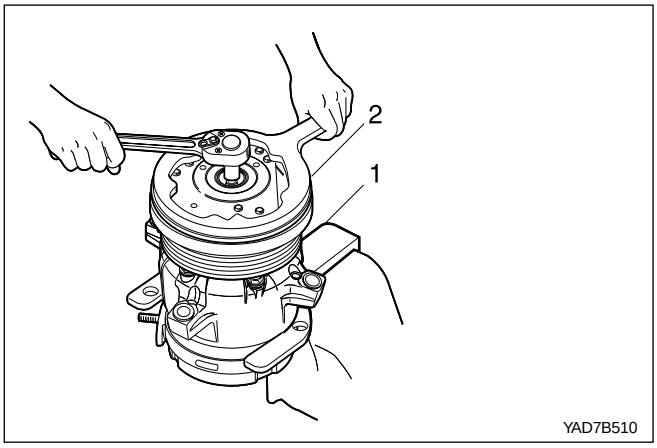
A/C MODULE ASSEMBLY

Removal Procedure

1. Discharge the coolant from the system.
2. Discharge and recover the refrigerant from the system.
3. Disconnect the inlet and outlet hose of the heater.
4. Disconnect the high/low pressure pipe from the evaporator core.
5. Remove five bolts securing the A/C module.
   - two bolts at evaporator
   - two bolts at heater core
   - a bolt at I/P
6. Remove the instrument panel.
7. Remove the fiber panel.
8. Remove the A/C module assembly.

Installation Procedure

1. Installation should follow the removal procedure in the reverse order.
2. Tighten five bolts securing A/C module with the specified torque.
3. Recharging the coolant.
4. Evacuate and recharge the A/C system.

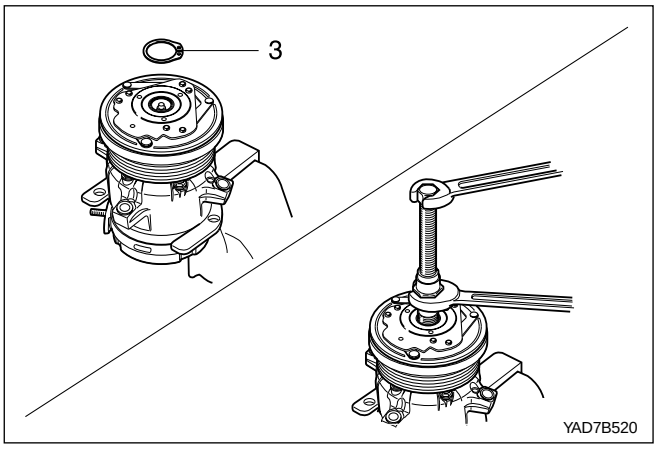


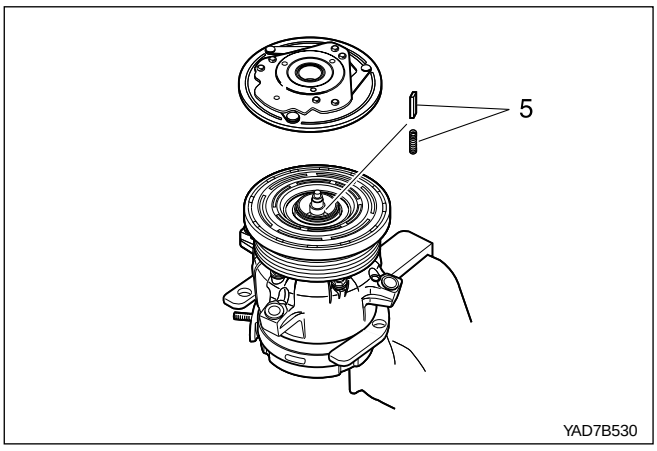
UNIT REPAIR

COMPRESSOR

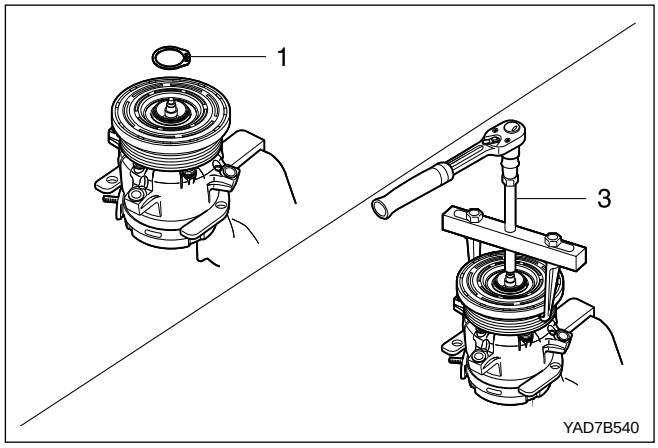
Disassembly and Assembly Procedure

1. Remove the compressor.
2. Remove the clutch driver.
   - Install the compressor holding fixture to the compressor and hold the compressor holding fixture using a bench vise.
   - Use the clutch hub holding tool to keep the clutch drive plate and the hub assembly from turning to remove the shaft nut.
   - Remove the snap ring using the ring plier.
   - Remove the clutch drive using the special tool.

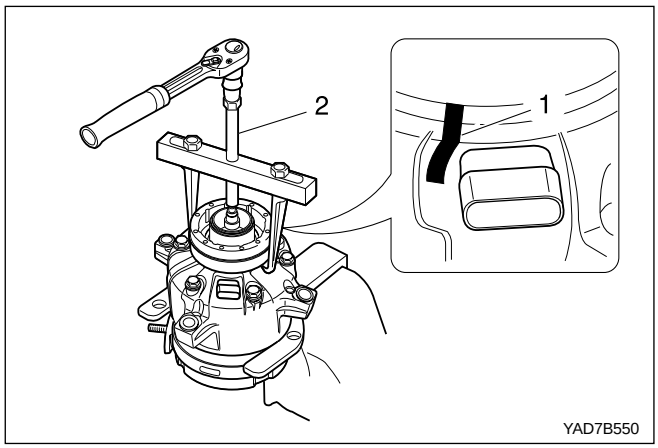




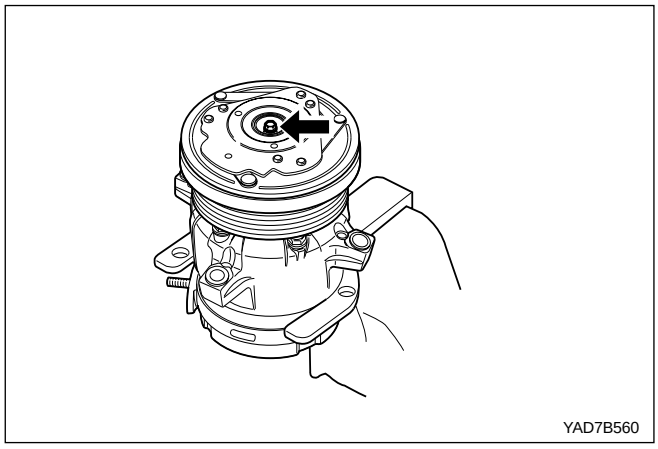
   - Remove the clutch shaft key and spring.



3. Remove the compressor pulley.
   - Remove the snap ring using the ring plier.
   - Remove the compressor pulley using the special tool.



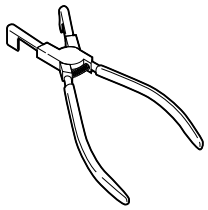
4. Remove the clutch coil.
   - Mark the location of the clutch coil connector at the clutch housing.
   - Remove the clutch coil using the special tool.



5. Assembly should follow the disassembly procedure in the reverse order.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD7B570	**DW 100-010** **Spring Clamp Remover & Installer**

SECTION 7C

MANUAL CONTROL HEATING, VENTILATION AND AIR CONDITIONING SYSTEM

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Control Switch Assembly 7C-8

DESCRIPTION AND OPERATION

SYSTEM COMPONENTS-FUNCTIONAL

Compressor

All compressor are belt-driven from the engine crankshaft through the compressor clutch pulley. The compressor pulley rotates without driving the compressor shaft until an electromagnetic clutch coil is energized. When voltage is applied to energize the clutch coil, the clutch plate and hub assembly is drawn rearward toward the pulley. The magnetic force locks the clutch plate and pulley together as one unit to drive the compressor shaft.

As the compressor shaft driven, it compresses the low pressure refrigerant vapor from evaporator into high pressure, high temperature vapor. The refrigerant oil that is used to lubricate the compressor is carried with the refrigerant.

Magnetic Clutch

The magnetic clutch is assembled in front of the compressor and controls to stop or operate the compressor.

The center piece is inserted to the compressor crankshaft and rotate the only the pulley when it doesn't operate the compressor. When the A/C switch is turned ON, the current flows into the wrapped coil of the stator and the stator is converted to the powerful electromagnet. Therefore, the compressor can rotate with the pulley together because the stator can pull the center piece tightly.

V-5 Compressor-General

Description

Vehicle using the V5 compressor may have differences between installations in the mounting brackets, the drive system, the pulleys, the connections and the system capacities. Basic overhaul procedures are similar between the compressors used on different vehicles.

When serving the compressor, keep dirt and foreign material from getting on or into the compressor parts and the system. Clean tools and a clean work area are important for proper service. The compressor connections and outside of the compressor should be cleaned before performance of any on-vehicle repairs and before removal of the compressor. The parts must be kept clean at all times and any parts that are to be reassembled should be cleaned with trichloroethane, naphtha, stoddard solvent, kerosene or equivalent solvents and dried with dry air. Use only lint-free cloths to wipe the parts.

The operations described are based on bench overhaul with the compressor removed from the vehicle, except as noted. They have been prepared in the order of accessibility of the components. When a compressor is removed from the vehicle for servicing, the amount of oil remaining the compressor should be drained, measured and recorded. This should then be discarded and new polyalkaline glycol (PAG) refrigerant oil added to the compressor.

Important: The oil drain plug must be removed and the oil drained through the plug opening to insure complete draining of oil from the compressor.

V-5 Compressor-Operation

The V5 is a variable displacement compressor that can match the automotive air conditioning demand under all conditions without cycling. The basic compressor mechanism is a variable angle wobble-plate with seven axially oriented cylinders. The center of the control of the compressor displacement is a billows-actuated control valve located in the rear head of the compressor that senses compressor suction pressure.

The wobble-plate angle and the compressor displacement are controlled by the crankcase suction pressure differential. When the A/C capacity demand is high, the suction pressure will be above the control point. The valve will maintain a bleed from crankcase to suction. With no crankcase suction pressure differential, the compressor will have maximum displacement.

When the A/C capacity demand is lower and the suction pressure reaches the control point, the valve will bleed discharge gas in the crankcase and close off a passage from the crankcase to suction plenum. The angle of the wobble-plate is controlled by a force balance of seven pistons. A slight elevation of the crankcase suction pressure differential creates total force on the piston resulting in a movement about the wobble-plate pivot pin that reduces the plate angle.

The compressor has a unique lubrication system. The crankcase suction bleed is routed through the rotating wobble-plate for lubrication of wobble-plate bearing.

The rotation acts as an oil separator that removes some of the oil from the crankcase where it can lubricate the compressor mechanism.

Condenser Core

The condenser assembly in front of the radiator consists of coils, which carry the refrigerant and cooling fins that provide the rapid transfer of heat. The air passing through the condenser cools the high-pressure refrigerant vapor and causes it to condense it to condense into a liquid.

Receiver-Drier

The sealed receiver-drier assembly is connected between the condenser and evaporator. It acts as a refrigerant storing container, receiving liquid and some vapor and refrigerant oil from the condenser.

At the bottom of the receiver-drier is the desiccant, which acts as drying agent for the moisture that may have entered the system. An oil bleed hole is located near the bottom of the receiver-drier outlet pipe to provide an oil return path to the compressor. The receiver drier is serviceable as an assembly.

Expansion Valve

The expansion valve can fall in three different positions: open, closed or restricted.

An expansion valve that fails in open position will result in a noisy A/C compressor or no cooling. The cause can be a broken spring, a broken ball or excessive moisture in the A/C system. If the spring or the ball are found to be defective, replace the expansion valve. If excessive moisture is found in the A/C system recycle the refrigerant.

A restricted expansion valve will result in low suction pressure and no cooling. This may be caused by debris in the refrigerant system. If debris is believed to be the cause, recycle the refrigerant, replace the expansion valve and replace the receiver-drier.

Evaporator

The evaporator is a device which cools and dehumidifies the air before it enters the vehicle. High pressure liquid refrigerant flows through the expansion tube (orifice) and becomes a low pressure gas in the evaporator. The heat in the air passing through the evaporator core is transferred to the cooler surface or the core, which cools the air.

As the process of heat transfer from the air the evaporator core surface is taking place, any moisture (humidity) in the air condenses on the outside surface of the evaporator core and is drained off as water.

Pressure Relief Valve

The compressor is equipped with a pressure relies valve which is placed in the system as a safety factor. Under certain conditions, the refrigerant on the discharge side may exceed the designed operating pressure at approximately at 3,171 to 4,137 kPa (460 to 600 psi) in an R-134a system. Conditions that might cause this valve to open, such as a defective pressure transducer, an inoperative cooling fan, etc., should be corrected. The refrigerant oil and the refrigerant should be replaced as necessary.

Controller

The operation of the A/C system is controlled by the switches and knob on the control head. This console-mounted controller contains following control knobs.

Rotary Temperature Control Knob

- Actuates by cable.
- Raise the temperature of the air entering the vehicle by sliding to the right or the red portion of the knob.
- Varies the mix of the fresh air from outside the vehicle with the heated air from inside the vehicle to suit individual performance.

Rotary Mode Control Knob

- Actuates by cable.
- Regulates the air distribution between the windshield, the instrument panel and the floor vents.

Rotary Blower Control Knob

- Turn on to operate the blower motor at four speeds.
- Turn OFF to stop the blower.
- Operates completely independently from both the mode control knob and temperature control knob.
- Changes the fan speed in any mode and at any speed.

SPECIFICATIONS

Component			Description	
Compressor		Type	Variable Displacement	
		Model	Single	V-5 Compressor
			Dual	V-7 Compressor
			Gasoline	10PAIRC
		Displacement	Single	9.8 - 151 cc/rev
			Dual	179 cc/rev
			Gasoline	170.5 cc/rev
		Max. RPM	6,000 - 7,500 rpm	
Refrigerant		Type	R-134a	
		Capacity	Single	850 ± 50 g
			Dual	1200 ± 50 g
Oil		Type	Synthetic PAG Oil	
		Capacity	260 cc	
Receiver-Drier		Material	Aluminum	
		Capacity	260 cc	
A/C Condenser		Max. Capacity	11,400 Kcal/h	
Evaporator		Size	263.0 x 228.6 x 88.9 mm	
		Capacity	6,500 Kcal/h	
A/C Pressure Sensor	High Pressure	A/C ON/OFF	305/425 psi	
	Low Pressure	A/C ON/OFF	39/30 psi	
A/C Cutoff Pressure		High Pressure	32 Kgf/cm^2	
		Low Pressure	4 Kgf/cm^2	

DIAGNOSTIC INFORMATION AND PROCEDURES

INSUFFICIENT COOLING DIAGNOSIS

Step	Action	Yes	No
1	1. Check the A/C fuse. 2. Check the operation of the blower motor and cooling fan. 3. Check the accessory belt. 4. Check the A/C condenser for restricted air flow. 5. Check the engagement of the compressor clutch. 6. Check the discharge air temperature with the A/C turned ON. Are all above the operations normal?	System OK	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Connect the high/low pressure gauges. Are both pressures within the specified value?	Go to Step 4	Go to Step 3
3	1. If it's above the specified value, discharge the refrigerant. 2. If it's below the specified value, add 0.45kg (1 pound) of the refrigerant and repair any leaks as needed. 3. Recover, evacuate and recharge the A/C system. Is the repair complete?	System OK	-
4	1. Start the engine and allow it to run at idle. 2. Turn the A/C switch to ON. 3. Set the blower motor switch to 4th. 4. Set the temperature control lever to full cold. Does the A/C compressor clutch engage?	Go to Step 8	Go to Step 5
5	1. Turn the ignition to LOCK. 2. Check the open or short in the compressor wiring. Is there any open or short in the wiring?	Go to Step 6	Go to Step 7
6	Repair the faulty wiring as needed. Is the repair complete?	System OK	-
7	Replace the compressor clutch coil. Is the replacement complete?	System OK	-
8	Check for a knocking noise from the A/C compressor. Cycle the A/C compressor ON and OFF in order to verify the source of the noise. Do you hear a loud knocking noise?	Go to Step 9	Go to Step 10
9	1. Recover the A/C system refrigerant. 2. Replace the A/C compressor. 3. Evacuate and recharge the A/C system. 4. Check the A/C system for leaks. Is the compressor running normally?	System OK	-
10	1. Close all of the windows and doors. 2. Set the A/C switch to ON position. 3. Set the intake air control switch to "Fresh Air". 4. Set the blower motor switch to 4th. 5. Set the temperature control switch to full cold. 6. Keep it to run at idle for 5 minutes. 7. Check the temperature at the inlet/outlet of the evaporator. Is there a noticeable difference in the temperature of the evaporator inlet/outlet pipes?	Go to Step 11	Go to Step 13

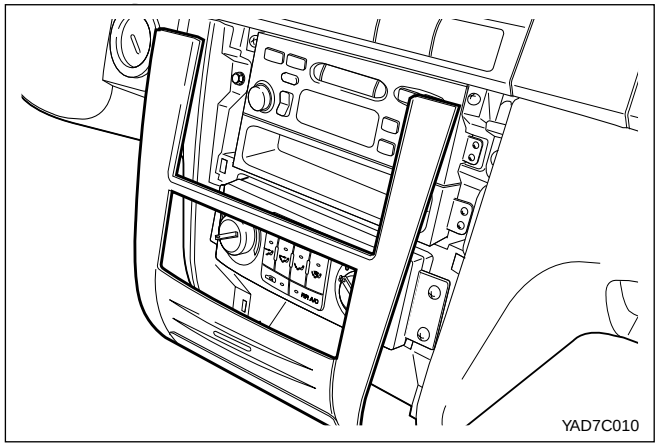
Insufficient Cooling Diagnosis (Cont'd)

Step	Action	Yes	No
11	1. Recover the A/C system refrigerant. 2. Replace the expansion valve as needed. 3. Evacuate and recharge the A/C system. 4. Check the A/C system for leaks. 5. Operate the A/C system. Is the discharge temperature normal?	Go to Step 13	Go to Step 12
12	1. Recover the refrigerant of the A/C system. 2. Evacuate and recharge the A/C system. 3. Check the A/C system for leaks. Does the A/C system operate normally?	System OK	-
13	Feel the liquid pipe between the condenser and the expansion valve. Is the pipe cold?	Go to Step 15	Go to Step 14
14	1. Repair any restriction in high pressure side. 2. Check the A/C system for leaks. Does the A/C system operate normally?	System OK	-
15	1. Run the engine at 3,000 rpm. 2. Close all of the windows and doors. 3. Set the A/C switch to ON. 4. Set the blower motor switch to 4th. 5. Set the temperature control switch to full cold. 6. Turn the A/C switch ON and OFF every 20 seconds for 3 minutes. 7. Measure the compressor high and low pressure. Are both pressures within the specified value?	Go to Step 17	Go to Step 16
16	Add the specified amount of the refrigerant to the A/C system. Is the amount within the specified value?	System OK	-
17	1. Turn the ignition to LOCK. 2. Set the A/C switch to OFF position. Can you turn the compressor clutch freely by hand?	Go to Step 18	Go to Step 19
18	1. Check the A/C system for leaks. 2. Repair any leaks as needed. 3. Evacuate and recharge the A/C system. Does the A/C system operate normally?	System OK	-
19	1. Recover the refrigerant of the A/C system. 2. Evacuate and recharge the A/C system. 3. Check the A/C system for leaks. 4. Replace the compressor as needed. Is the repair complete?	System OK	-

ABNORMAL REFRIGERANT PRESSURE

Step	Action	Yes	No
1	1. Verify whether airflow and excessive refrigerant. 2. Check any restriction at the condenser or radiator. 3. Check the condenser or cooling fan for proper operation. 4. Check any restriction of the refrigerant lines. Is the high-side refrigerant pressure high abnormally?	Go to Step 2	Go to Step 3
2	1. Recover, evacuate and recharge the A/C system according to the specified value. 2. Clean the condenser or radiator core. 3. Check the voltage, rpm, direction of the cooling fan. 4. Repair or replace the appropriate parts as needed. Is the high-side pressure within the specified value?	System OK	-
3	1. Check the amount of the refrigerant. 2. Check the internal faulty of the compressor. 3. Check the faulty of the expansion valve. 4. Check the moisture mix into the system. Is the high-side refrigerant pressure low abnormally?	Go to Step 4	Go to Step 5
4	1. Replace the compressor and the expansion valve as needed. 2. Recover, evacuate and recharge the A/C system according to the specified value. 3. Repair any leaks as needed. Is the repair complete?	System OK	-
5	1. Check the freezing/clogging of the expansion valve. 2. Check the clogging of the receiver-drier. 3. Check the amount of the refrigerant. Is the low-side refrigerant pressure low abnormally?	Go to Step 6	Go to Step 7
6	1. Clean the expansion valve and replace it as needed. 2. Replace the receiver-drier as needed. Is the repair complete?	System OK	-
7	1. Check the expansion valve and the compressor for any faulty. 2. Check the excessive amount of the refrigerant. Is the low-side refrigerant pressure high abnormally?	Go to Step 8	Go to Step 9
8	1. Replace the expansion valve and the compressor as needed. 2. Add the specified amount of the refrigerant. Is the repair complete?	System OK	-
9	1. Check the tightening condition of the refrigerant line coupling and bolts. 2. Check the faulty O-ring. 3. Check the faulty gasket or seal of the compressor. Is there any refrigerant leak?	Go to Step 10	System OK
10	1. Tighten the bolts. 2. Replace the faulty O-ring. 3. Replace the faulty compressor. Is the repair complete?	System OK	-

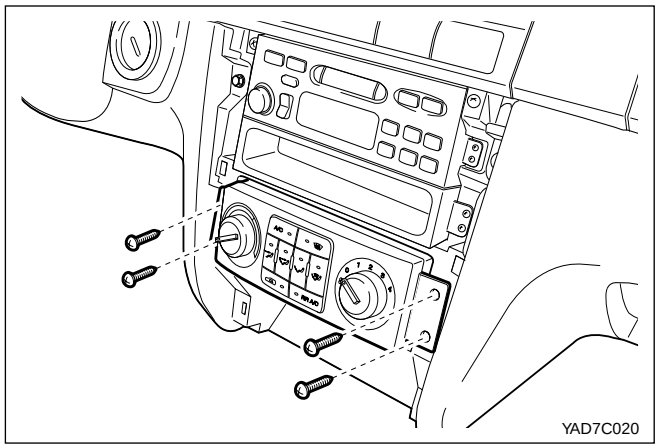
REPAIR INSTRUCTIONS



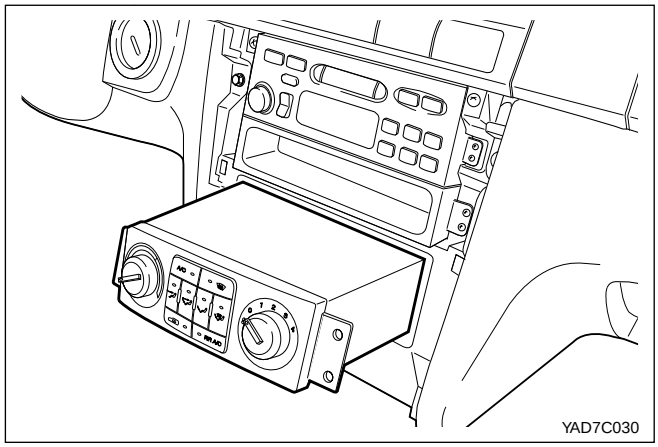
ON-VEHICLE SERVICE

CONTROL SWITCH ASSEMBLY

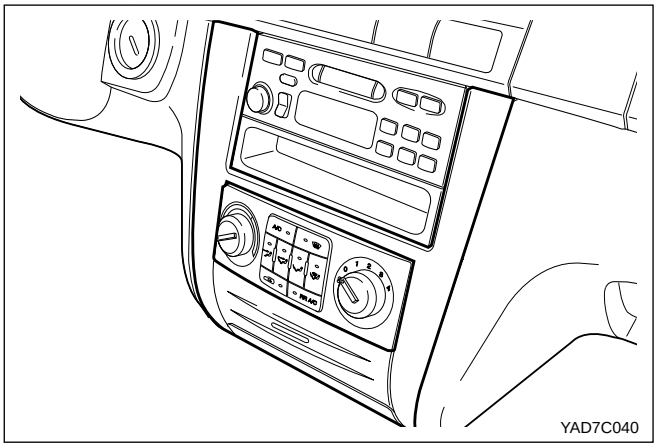
1. Remove the center instrument panel.



2. Remove four screws securing the A/C control switch assembly.



3. Remove the A/C control switch assembly from the instrument panel.



4. Installation should follow the removal procedure in the reverse order.

   Notice: Insert connector to the switch and then assembly the

SECTION 7D

AUTOMATIC CONTROL HEATING, VENTILATION AND AIR CONDITIONING SYSTEM

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DESCRIPTION AND OPERATION

GENERAL

THE V5 FULL AUTOMATIC TEMPERATURE CONTROL (FATC) SYSTEM

The full automatic temperature control (FATC) uses the integrated control panel as the driver's interface to the system. The FATC receives driver's input signal and various input signal from sensors and controls the actuators to maintain driver's desired room temperature.

Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System for general Information details for the following:

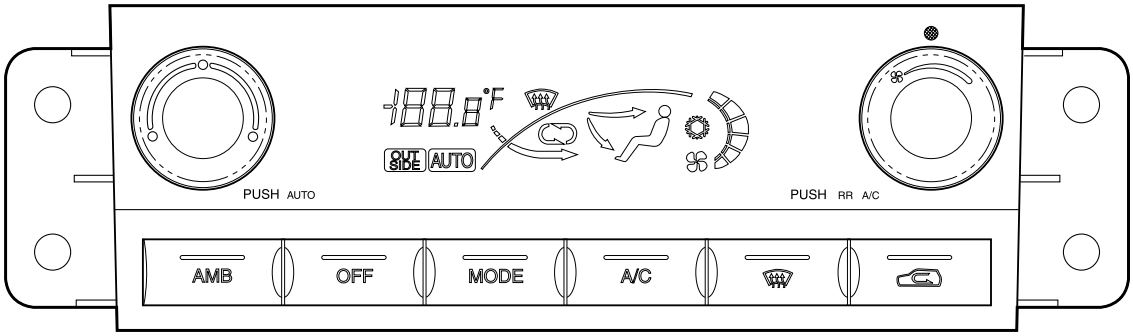
- System Components – Functional.
- The V5 A/C System.
- V5 Compressor – Operation.
- V5 Compressor – General Description.

Vacuum Fluorescent Display panel provides system operating information for the driver. With the system in OFF mode, the outside temperature is displayed continuously.

The driver may display the current temperature setting by selecting any mode except OFF or adjusting the temperature control.

Also, it provides the convenience to the driver by indicating the ambient air temperature. If it occurs the faulty in the FATC system, the MICOM informs the driver or mechanics of the results of the self-diagnostic check and controls the system by

FATC CONTROL

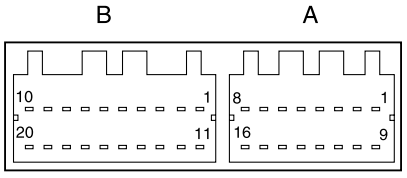


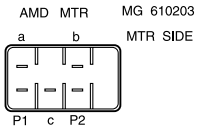
PIN NO. ASSIGNMENT

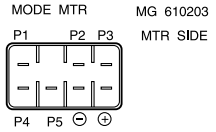
A1 : POWER GND
A2 : AMD(C)
A3 : ILL(-)
A4 : ILL(+)
A5 : IGNITION
A6 : REAR BLOWER RLY
A7 : BLOWER REQ
A8 : AMD(H)
A9 : TXD
A10 : MAX HI RELAY
A11 : A/C REQ. (GSL)
A12 : A/C REQ. (DSL)
A13 : SENSOR GND
A14 : BATTERY
A15 : 1/3 FRE.
A16 : INCAR SENSOR

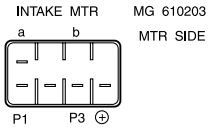
B1 : BLR CONTROL
B2 : Vss
B3 : RXD
B4 : PBR(+5V)
B5 : PBR(SENSING)
B6 : PBR(GND)
B7 : WIPER SIGNAL Lo
B8 : AMB SENSOR
B9 : WATER SENSOR
B10 : SUN SENSOR
B11 : POWER GND
B12 : BLR SENSING
B13 : FRE
B14 : REC
B15 : WIPER SIGNAL HI
B16 : MODE MOTOR(P5)
B17 : MODE MOTOR(P4)
B18 : MODE MOTOR(P3)
B19 : MODE MOTOR(P2)
B20 : MODE MOTOR(P1)

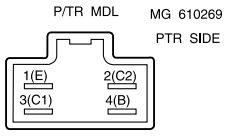
MOLEX 53874-3615 (CONTROLLER SIDE)





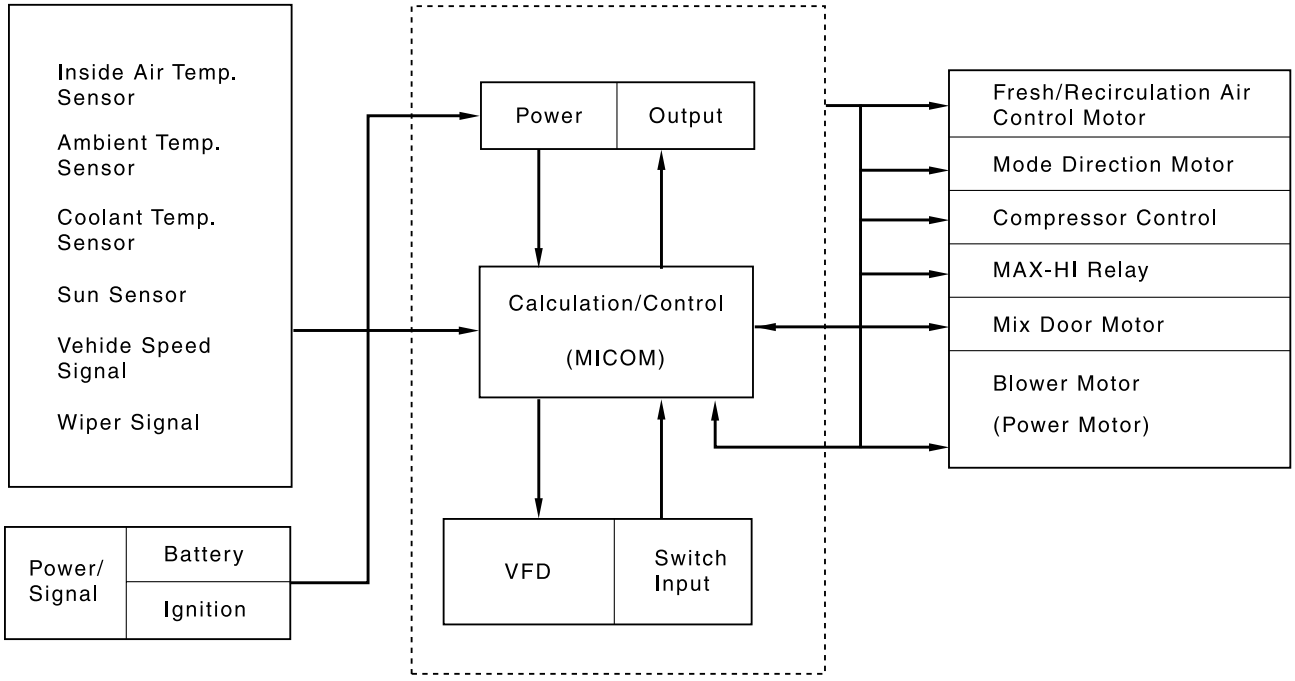






YAD7D010

FATC INPUT/OUTPUT ROUTING DIAGRAM



FATC SYSTEM CHARACTERISTIC

Display Performance Enhancement

It allows VFD (Vacuum Fluorescent Display) to develop the effect of the visible.

Airflow Control Enhancement

It allows MICOM to control the temperature and perform the control automatically of the heating operation, the cooling operation and the Mild operation. Also, MICOM enable to control the amount of the airflow and the direction of the vent outlet in order to keep the inside air fresh.

Self-Diagnostic Circuit Check

The full automatic temperature control (FATC) air conditioning controller contains a self-diagnosis function to aid in finding any problem with the system. If the FATC detects some errors it will blink the temperature display screen for 5 seconds when the ignition switch is ON.

To enter the diagnostic mode, perform the following procedure.

1. Turn the ignition switch ON.
2. Set the temperature control to 26 °C (79 °F).
3. Within 3 seconds, push the AUTO and the OFF switches simultaneously, more than three times.
4. Check the diagnostic trouble code (DTC) in the temperature indicator screen blinks. If there are no diagnostic trouble code (DTC) set, the screen will display 00.
5. When the FATC controller indicates a DTC, proceed to the table for the DTC.
6. Push the OFF switch to return the controller to its normal function.

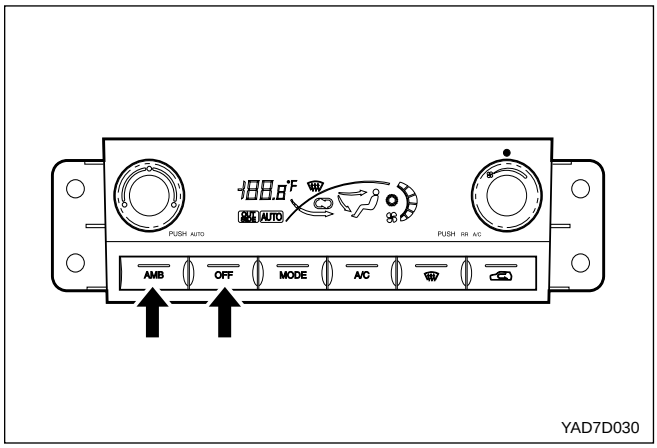
DTC	Description
0	Normal (No Error)
1	Inside Air Temperature Sensor Error
2	Ambient Air Temperature Sensor
3	Error
4	Coolant Temperature Sensor Error
5	Air Mix Door Error
6	Sun Sensor Error
7	Power Transistor Error

Action Taken When the Faulty Occurred

When any faulty is occurred in the automatic temperature control system, it's sign is informed to the driver by flashing the set temperature display for 5 seconds at initial starting.

How to Verify Faulty Code

When the temperature is set to 26 °C and then within 3 second, push the AMB switch and the OFF switch simultaneously at three times, the FATC controller temperature display indicates the faulty code after performing the self-diagnosis by MICOM.



YAD7D030

Condition For Clearing the Faulty Code

1. When the vehicle restarts
2. When push the OFF switch after indicating the faulty code
3. When pass over 32 seconds after indicating the faulty code

Fault Safety Function

FATC air conditioner not only performs self-diagnosis but also has safety function against faults. If there is open or short in the sensors or potentiometer of temperature door some specific value will be substitute.

Error	Fault Safety Function
Inside air Sensor Error	25 °C will be substituted as temperature of inside of vehicle.
Ambient Temperature Sensor Error	25 °C will be substituted as ambient temperature.
Coolant Temperature Sensor Error	Sensor ON. 50 °C will be substituted as coolant temperature.
Sun Sensor Error	Zero (0) will be substituted as sun load.

SYSTEM BASIC FUNCTION

Set Temperature Control

When you set the setting temperature using the temperature control switch, the FATC receives the various input signals from sensors including the information of inside air temperature, ambient temperature, coolant temperature and sun loads etc.. The FATC uses this signals to control automatically the A/C compressor, the mode door, the I/A door, air mix door and blower motor etc.

Airflow Control

For setting at Full AUTO, it is possible to control the blower motor operation both manually and automatically in order to adjust the airflow according to the set temperature.

Manual Control

When you push the blower switch, you can control the blower motor manually and it increases or decreases each step by moving the switch to HI/LO. (with the ignition ON)

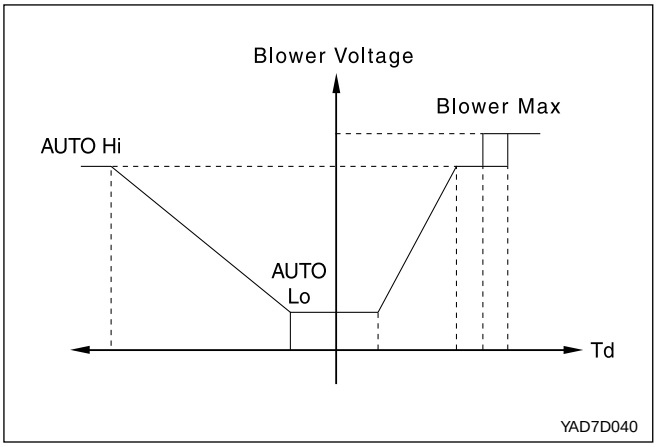
Step	Blower Voltage
1	4.5 V
2	6.0 V
3	7.5 V
4	9.0 V
5	11.0 V
6	Max Hi

* The voltage of the blower motor may increase or decrease (0.5 V) according to power voltage.

Automatic Control

Td value can be determined by the set temperature value and Td value is set to the target voltage of the blower motor simultaneously. The blower motor can shift without step.

Abbreviation: Td (Thermal Demand) : Td value is the default for automatic control of the automatic temperature control and allows it to control the set temperature calculating the differences between inside air temperature and ambient temperature.



Blower Step	Blower Motor Voltage
1	4.0 - 5.5 V
2	5.5 - 7.5 V
3	7.5 - 8.5 V
4	8.5 - 9.5 V
5	9.5 - 10.5 V
6	10.5 - 13.5 V

Vent Rate Control By Heating Operation

When the temperature of the engine coolant is low or it's difficult to obtain the desired hot air in winter, the system controls to prevent the cold airflow from the outlet due to the cold air give a negative effect to the heating performance.

Therefore vent step is fixed 1st on blower AUTO step until the coolant sensor detects above 20 °C and also the blower step increases gradually according to going up the coolant temperature. When the coolant temperature goes up above 40 °C, the heating operation stops.

Vent Rate Control By Cooling Operation

When the air inside the resonance duct is hot in summer, after the system keeps the low vent rate (1st) operating for 5 seconds and discharges the hot air to the windshield side (Def Mode), the system starts to control normally in order to avoid for the passengers contacting the hot air.

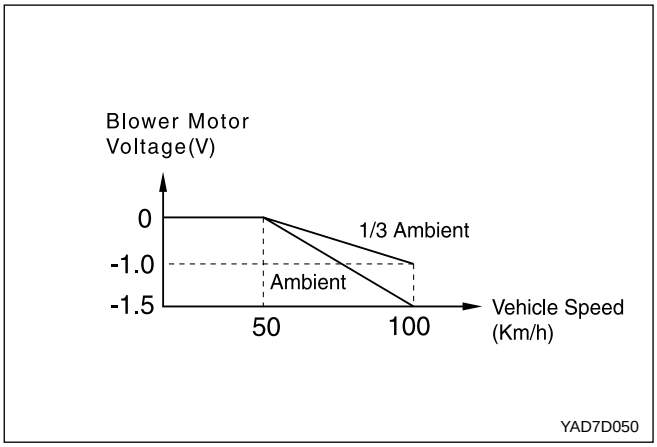
Defroster Calibration

On the blower AUTO step, when the passenger sets to Defroster (Def), the system increases the blower voltage by 2 V for some intervals comparing AUTO voltage. But it is excluded the condition when the blower voltage is above 11.0 V. Also, the voltage increasing by defroster calibration is limited up to 10.5 V.

Vehicle Speed Calibration

On the Ambient or the 1/3 Ambient and the blower AUTO, the blower decreases the voltage with the vehicle speed 100 Km/h such as 1.5 V for the Ambient, 1.0 V for the 1/3 Ambient.

But it is the exception for the blower max.



Ambient Temperature Display

It indicates the ambient temperature as 0.5 °C increment in the set temperature digit by ambient temperature sensor.

- When you push the AMB key it indicates the ambient temperature for 5 seconds and return back the set temperature.
- If you push the AMB key again during indicating in 5 seconds, it returns back.
- The ambient temperature sensor is securing in the front of radiator and may be influenced easily to the heat of the engine compartment in parking. Therefore the ambient temperature sensor indicates the ambient temperature accurately on the condition of above 40 km/h running.

Delivery Condition

For the initial installation (the initial current draw), the initial mode follows;

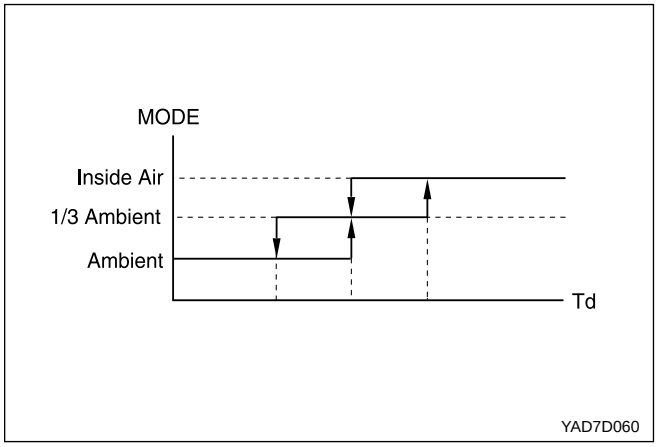
Actuator	Mode	Suction Air	A/C	Blower	Mix
Condi-tion	FOOT/ DEF	FRESH	OFF	OFF	Td Basic Control

Vent inlet Control

Manual Control

When you push the I/A control switch, you can control the I/A door manually and the I/A door changes between the recirculation air and the fresh air flow alternately by the control switch. For changing the fresh air step (FRE) to the recirculation air step (REC), the blower voltage decrease 15% and for changing the recirculation air step (REC) to the fresh air step (FRE), the blower voltage return back.

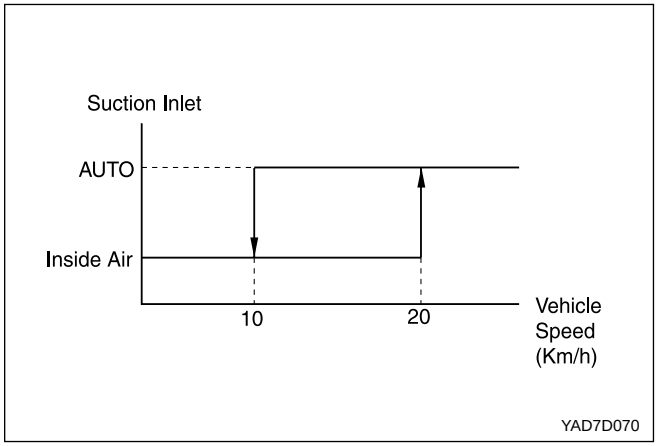
AUTO Control



Control by the Vehicle Speed

The system controls the vent inlet according to the vehicle speed in order to prevent the exhaust gas of the preceding vehicle from flowing inside with the vehicle stopping or driving at low speed. The operation and control condition is following as;

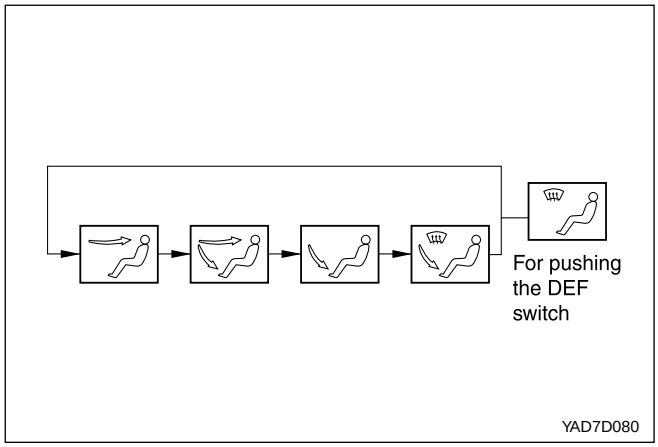
1. When the vent inlet mode is AUTO and the A/C “ON”.
2. When the vehicle keeps to drive at below 10 km/h for 10 seconds and changes the REC mode at stop.
3. If 10 minutes passes after changing the REC mode, it returns back to the AUTO mode.



Vent outlet Control

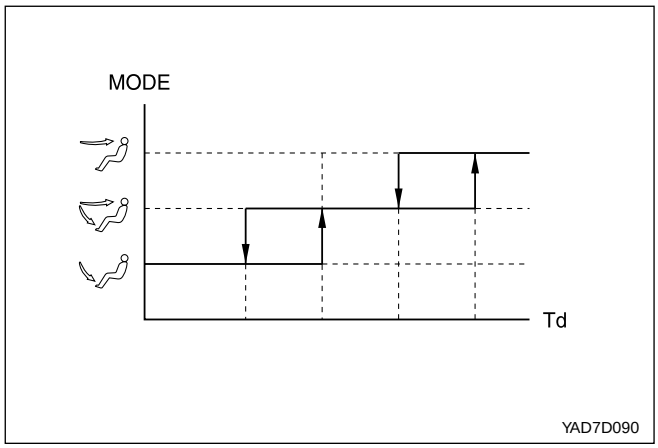
Manual Control

For pushing the mode switch of AUTO temperature control, you can select four type of the vent outlets.



When you push the Def switch, it keeps to change to the defroster mode regardless of the sequence.

AUTO Control



A/C Control

Manual Control

When you pushed the A/C switch “ON” or the Def switch “ON”, A/C starts to operate.

AUTO Control

Basic Control: A/C “ON” has the priority for the initial operation.

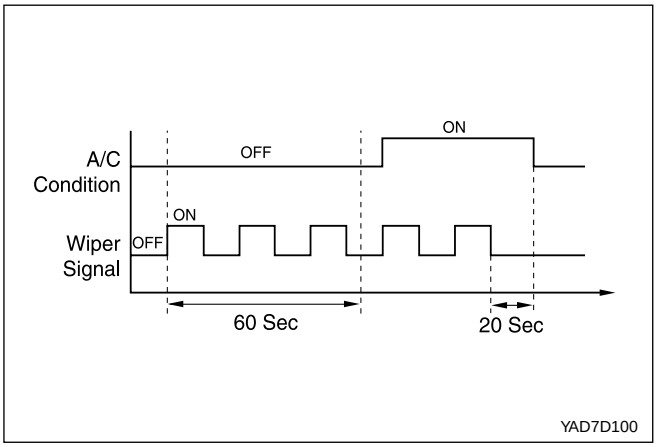
Full Cold/Hot Control

When you sets the set temperature to full cold (LO) or full hot (HI), the system controls the temperature to full cold or full hot regardless of sensor’s detection. For LO, it becomes A/C “ON”, front vent mode, recirculation air, max blower speed, air mix door close and for HI, A/C “OFF”, floor vent mode, ambient mode, air mix door open.

Wiper Calibration Control

It is possible to generate the frost on the windshield in the rainy days. At this time, FATC controller allows the mode to change the AUTO defroster mode.

- Operation Condition: When the passenger operates the wiper on AUTO mode, the system controls the wiper on the A/C AUTO mode after sending the wiper signal and controlling the delay for 1 minutes.



FATC Controller Illumination Control

When the tail lamp is ON, ATC Controller illumination lamp turns on.

SYSTEM COMPONENTS - CONTROL

Controller Assembly

The operation of the A/C system is controlled by the switched on the control head. This console-mounted controller consist of control knobs and a vacuum fluorescent display (VFD) indicating the status of the control settings selected.

Sensors and Motors

- Inside air sensor, ambient sensor, coolant temperature and sun sensor
- Door mode motor, intake air control door motor, air mix door motor

Inside Air Sensor

Inside air sensor located in left side of full automatic temperature control (FATC) controller, is a sensor that detects the interior air temperature and a thermistor that decreases its resistance when temperature up and increases when temperature down. If there is open or short in the sensors, 25 °C (77 °F) will be substitute.

Inspection

When the inside air temperature sensor error displays, check the followings;

1. Remove the inside air temperature sensor and measure the resistance between the sensor connectors.

   (approximately 2.2 KΩ at 25 °C) Replace the inside air temperature sensor when the resistance value is excessive low or high.
2. Replace the inside air temperature sensor for outside the specified value and check the followings for within the specified value;
3. Turn the ignition ON.
4. Measure the voltage between A13 and A16 terminal of the AUTO temperature control connector. (approximately 2.2 V at 25 °C)
5. Verify the open circuit of the wiring harness when you can not measure the voltage value and replace the AUTO temperature control when it's normal.

Ambient Sensor

Ambient sensor is a thermistor (NTC resistance) that decreases its resistance when temperature up and increases when temperature down and it detects ambient air temperature. If there is open or short in the sensors, 25 °C (77 °F) will be substitute. The sensor is located in the left back side of front bumper.

Inspection

When the ambient temperature sensor error displays, check the followings;

1. Remove the ambient temperature sensor and then measure the resistance between the sensor connectors.

   (approximately 2.2 KΩ at 25 °C) Replace the ambient temperature sensor when the resistance value is excessive low or high.
2. Replace the ambient temperature sensor for outside the specified value and check the followings for within the specified value;
3. Turn the ignition ON.
4. Measure the voltage between A13 and B8 terminal of the AUTO temperature control connector. (approximately 2.2 V at 25 °C)
5. Verify the open circuit of the wiring harness when you can not measure the voltage value and replace the AUTO temperature control when it's normal.

Coolant Temperature Sensor

Coolant temperature sensor is a thermistor that decreases its resistance when temperature up and increases when temperature down. It detects coolant temperature to operate the blower speed at low when the coolant temperature is less than 50 °C (122 °F). If the coolant temperature sensor is open or short, 100 °C (212 °F) will be substitute.

Inspection

When the coolant temperature sensor error displays, check the followings;

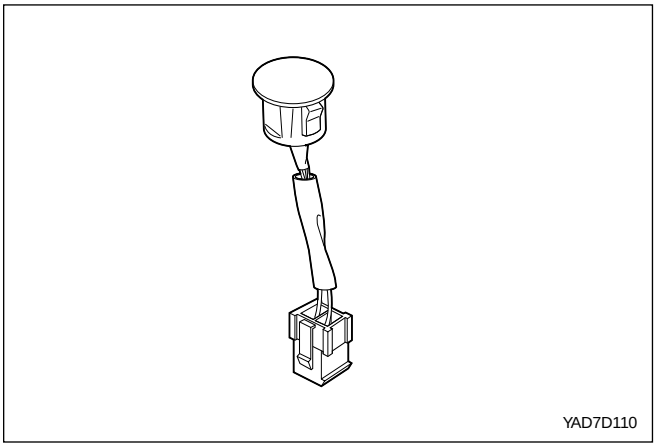
1. Measure the resistance between the sensor connectors. (approximately 2.2 KΩ at 25 °C)
2. Replace the coolant temperature sensor for outside the specified value and check the followings for within the specified value;
3. Turn the ignition ON.
4. Measure the voltage between A13 and B9 terminal of the AUTO temperature control connector. (approximately 2.2 V at 25 °C)
5. Verify the open circuit of the wiring harness when you can not measure the voltage value and replace the AUTO temperature control when it's normal.

Sun Sensor

Sun sensor is a photo diode that detects lights. Resistance of the diode can be measured as current by using voltmeter according to increasing sun loads. If the sun sensor is error, no sun load will be substitute.

Photo Diode

It is used to the circuit converting the sun light loads to the electric signals.



Inspection

When the sun sensor error displays, check the followings;

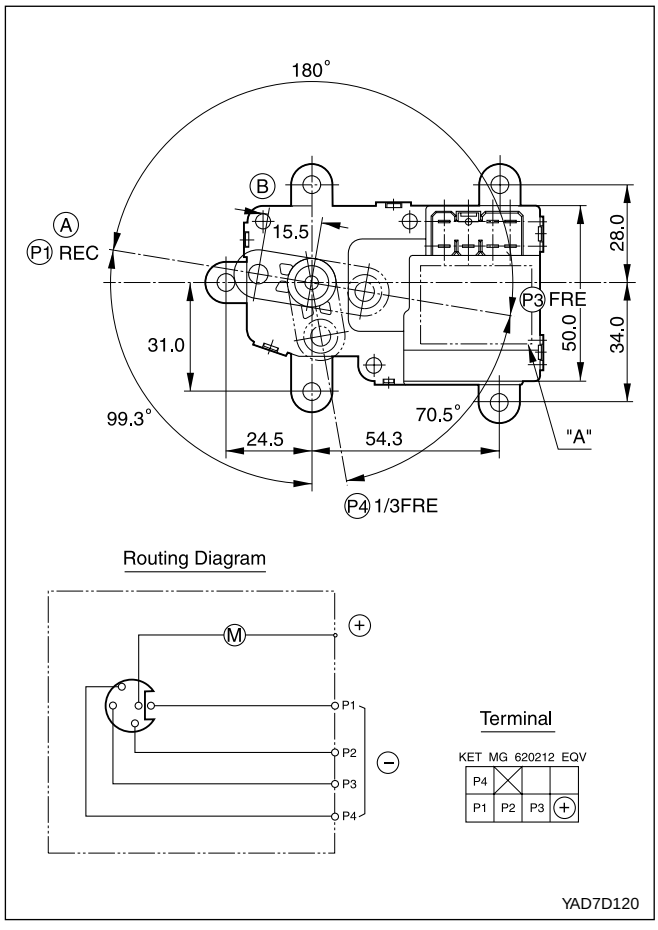
1. Remove the sensor to place it under the sun light and measure the current between the connector terminals.
2. Place the sun sensor under the shadow place and measure the current between the connector terminals. If the value is lower than the value under the sun light, it's normal.
3. Turn the ignition ON.
4. Measure the voltage between A13 and B10 terminal of the AUTO temperature control connector. (Sun light; 2.5 V, Shadow; 4.8 V)
5. Verify the open circuit of the wiring harness when you can not measure the voltage value and replace the AUTO temperature control when it's normal.

Intake Control Door Motor

The mode motor set the I/A mode by the control signal of the AUTO temperature control.

When the mode displayed in the AUTO temperature control is different from the actual mode, check the followings;

- Turn the ignition ON.
- Measure the voltage between the (+) terminals at each mode and verify that changes from 0V before the mode selection to 12V after the mode selection.
- If the value is the specified value, check the open or short circuit.
- If the wiring is normal, replace the AUTO temperature control.
- If the voltage value is outside the specified value, replace the I/A mode motor.
- Check the motor operation connecting the (+) terminal to No.4 of the motor connector and connecting No.5 and No.7 to (-) terminal sequentially using 12 V power.



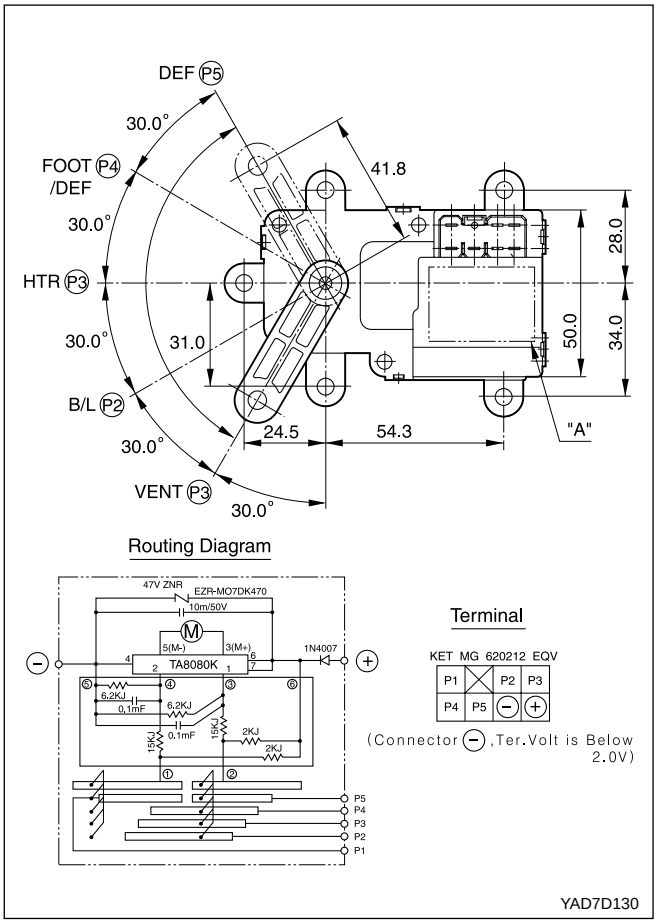
Inspection

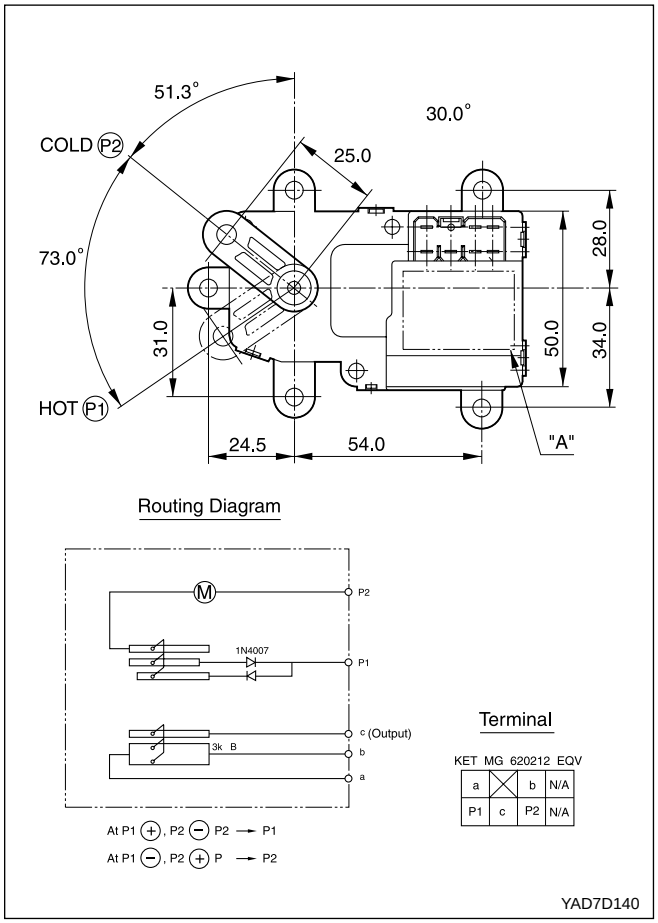
When the vent inlet mode displayed in the AUTO temperature control is different from the actual mode, check the followings;

1. Turn the ignition ON.
2. Measure the voltage between positive terminal and negative terminal of the Mtr-Act, AI connector. (Specified value; 12 V)
3. Measure the voltage between P1, P2, P3 and (+) terminal. (If it changes from 0V before the mode selection to 12 V after the mode selection, it's normal)
4. If the value is outside the specified value, check the open or short circuit.
5. If the wiring is normal, replace the AUTO temperature control.
6. If the value is the specified value, replace the Mtr-Act, AI.
7. Check the motor operation connecting the (+) terminal to No.4 of the motor connector and connecting No.5 and No.7 to (-) terminal sequentially using 12 V power.

Mode Control Motor

The control motor sets the mode of Vent, Bi-level, Foot, Foot/Def or Def by opening/closing the outlet damper at the outlet of Vent, Foot or Def according to control signal of the AUTO temperature control.





Inspection

When the vent inlet mode displayed in the AUTO temperature control is different from the actual mode, check the followings;

1. Turn the ignition ON.
2. Measure the voltage between P1 - P5 and (+) terminal. (If it changes from 0V before the mode selection to 12 V after the mode selection, it's normal)
3. If the value is outside the specified value, check the open or short circuit.
4. If the wiring is normal, replace the AUTO temperature control.
5. If the value is the specified value, replace the Mtr-Act, AI.
6. Check the motor operation connecting the (+) (-) terminal to the Mtr-Act mode and each terminal P1 - P5 to (-) terminal sequentially using 12 V power.

Air Mix Door Motor

The air mix door motor is located on left side of heater module. The air mix door motor controls the exhaust air temperature by the signal of the FATC.

Inspection

When the air mix door motor error displays, check the followings;

1. Turn the ignition ON.
2. Measure the voltage within P1, P2 terminals (specified value; 12 V) and a,b (specified value; 5).
3. If the value is outside the specified value, check the open or short circuit.
4. If the wiring is normal, replace the Mtr-Act, Temp.
5. If the (+) (-) terminal connects to P1 and P2 of the Mtr-Act, Temp alternately, the output by the each mode is following;

AMD	Mode	Bc Resistance
Cool	P1 (-), P2 (+)	Below 300 Ω
Hot	P1 (+), P2 (-)	Above 2.4 KΩ

Power Transistor

Power transistor controls the blower airflow and it receives the airflow control signal from the AUTO temperature control in order to for blower motor to shift the speed without step by adding the current to the power transistor basic current.

Inspection

When the power transistor error displays, check the followings.

1. Turn the ignition ON.
2. Measure the voltage between blower connectors by changing the step from 1st to 6th.
3. The voltage value by each step is the followings; (specified value; 0.5)
4. If the value is outside the specified value, check the open or short circuit.

1st	2nd	3rd	4th	5th	6th
4.5 V	6.0 V	7.5 V	9.0 V	11.0 V	Relay Hi

5. When there is no problem in the wiring harness, replace the power transistor.

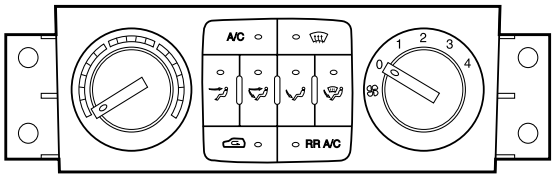
SPECIFICATIONS

Component			Description
Compressor		Type	Variable Displacement
		Model	V-5 Compressor
		Displacement	9.8 - 151 cc/rev
		Max. RPM	6,000 - 6,500 rpm
Receiver-Drier		Material	AL R/DRIER
		Capacity	210 cc
Refrigerant		Type	R-134a
		Capacity	750 ± 20 g
Oil		Type	Synthetic PAG Oil
		Capacity	220 cc
Condenser		Max. Capacity	11,400 Kcal/h
A/C Pressure Sensor	High (Gauge Pressure)	A/C ON	305 psi
		A/C OFF	425 psi
	Low (Gauge Pressure)	A/C ON	39 psi
		A/C OFF	30 psi
Blower Motor		Max. Capacity	7,475 - 9,075 Kcal/h
Heater Core		Fin Pitch	1.52 mm
		Size	200.5 x 168.2 x 25.0 mm
		Capacity	8,250 Kcal/h

DIAGNOSTIC INFORMATION AND PROCEDURES

GENERAL DIAGNOSIS

The full automatic temperature control (FATC) air conditioning controller contains a self-diagnosis function to aid in finding any problem with the system.



YAD7D150

If the FATC detects some errors it will blink the temperature display screen for 5 seconds when the ignition switch is ON.

When there are some errors in the automatic temperature control system without displaying the faulty code, perform the diagnostic test using the applicable table.

General A/C Diagnosis

Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System for details of the following procedures:

- A/C Performance Test.
- Insufficient Cooling “Quick Check” Procedure.
- Insufficient Cooling Diagnosis.
- Leaking Testing the Refrigerant System.
- Low-and High-Side Pressure Relationship Chart.
- Pressure-Temperature Relationship of R-134a.
- Testing the refrigerant system.
- Pressure Test Chart (R-134a System).

INSUFFICIENT COOLING DIAGNOSIS

Step	Action	Yes	No
1	1. Check the A/C fuse. 2. Check the operation of the blower motor and cooling fan. 3. Check the accessory belt. 4. Check the A/C condenser for restricted air flow. 5. Check the engagement of the compressor clutch. 6. Check the discharge air temperature with the A/C turned ON. Are all above the operations normal?	System OK	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Connect the high/low pressure gauges. Are both pressures within the specified value?	Go to Step 4	Go to Step 3
3	1. If it's above the specified value, discharge the refrigerant. 2. If it's below the specified value, add 0.45 kg (1 pound) of the refrigerant and repair any leaks as needed. 3. Recover, evacuate and recharge the A/C system. Is the repair complete?	System OK	-
4	1. Start the engine and allow it to run at idle. 2. Turn the A/C switch to ON. 3. Set the blower motor switch to 4th. 4. Set the temperature control lever to full cold. Does the A/C compressor clutch engage?	Go to Step 8	Go to Step 5
5	1. Turn the ignition to LOCK. 2. Check the open or short in the compressor wiring. Is there any open or short in the wiring?	Go to Step 6	Go to Step 7
6	Repair the faulty wiring as needed. Is the repair complete?	System OK	-
7	Replace the compressor clutch coil. Is the replacement complete?	System OK	-
8	Check for a knocking noise from the A/C compressor. Cycle the A/C compressor ON and OFF in order to verify the source of the noise. Do you hear a loud knocking noise?	Go to Step 9	Go to Step 10
9	1. Recover the A/C system refrigerant. 2. Replace the A/C compressor. 3. Evacuate and recharge the A/C system. 4. Check the A/C system for leaks. Is the compressor running normally?	System OK	-
10	1. Close all of the windows and doors. 2. Set the A/C switch to ON position. 3. Set the intake air control switch to "Fresh Air". 4. Set the blower motor switch to 4th. 5. Set the temperature control switch to full cold. 6. Keep it to run at idle for 5 minutes. 7. Check the temperature at the inlet/outlet of the evaporator. Is there a noticeable difference in the temperature of the evaporator inlet/outlet pipes?	Go to Step 11	Go to Step 13

Insufficient Cooling Diagnosis (Cont'd)

Step	Action	Yes	No
11	1. Recover the A/C system refrigerant. 2. Replace the expansion valve as needed. 3. Evacuate and recharge the A/C system. 4. Check the A/C system for leaks. 5. Operate the A/C system. Is the discharge temperature normal?	Go to Step 13	Go to Step 12
12	1. Recover the refrigerant of the A/C system. 2. Evacuate and recharge the A/C system. 3. Check the A/C system for leaks. Does the A/C system operate normally?	System OK	-
13	Feel the liquid pipe between the condenser and the expansion valve. Is the pipe cold?	Go to Step 15	Go to Step 14
14	1. Repair any restriction in high pressure side. 2. Check the A/C system for leaks. Does the A/C system operate normally?	System OK	-
15	1. Run the engine at 3,000 rpm. 2. Close all of the windows and doors. 3. Set the A/C switch to ON. 4. Set the blower motor switch to 4th. 5. Set the temperature control switch to full cold. 6. Turn the A/C switch ON and OFF every 20 seconds for 3 minutes. 7. Measure the compressor high and low pressure. Are both pressures within the specified value?	Go to Step 17	Go to Step 16
16	Add the specified amount of the refrigerant to the A/C system. Is the amount within the specified value?	System OK	-
17	1. Turn the ignition to LOCK. 2. Set the A/C switch to OFF position. Can you turn the compressor clutch freely by hand?	Go to Step 18	Go to Step 19
18	1. Check the A/C system for leaks. 2. Repair any leaks as needed. 3. Evacuate and recharge the A/C system. Does the A/C system operate normally?	System OK	-
19	1. Recover the refrigerant of the A/C system. 2. Evacuate and recharge the A/C system. 3. Check the A/C system for leaks. 4. Replace the compressor as needed. Is the repair complete?	System OK	-

FULL AUTOMATIC TEMPERATURE CONTROL (FATC) DOES NOT OPERATE WHEN THE IGNITION IS ON

Step	Action	Yes	No
1	Check the fuse F18. Are the fuses blown?	Go to Step 3	Go to Step 2
2	Replace the fuse. Is the repair complete?	System OK	-
3	1. Remove the controller with connecting ATC wiring connector. 2. Turn the ignition switch to ON. 3. Measure the voltage between terminal A1 and A5 of the connectors Is the voltage within specified value?	Go to Step 15 11 - 14 V	Go to Step 4
4	Replace the controller. Is the repair complete?	System OK	-
5	Measure the voltage between terminal A5 of the connector and ground. Is the voltage within specified value?	Go to Step 6	Go to Step 7
6	Repair the faulty circuit between fuse F18 and terminal A5 of the ATC wiring connector. Is the repair complete?	System OK	-
7	Repair the faulty circuit between the ground G203 and terminal A1 of the ATC wiring connector. Is the repair complete?	System OK	-

CONTROLLER DOES NOT ILLUMINATE WHEN LIGHT SWITCH IS ON

Step	Action	Yes	No
1	1. Remove the controller with connecting ATC wiring connector. 2. Turn the ignition switch to ON. 3. Measure the voltage between terminal A4 and A3 of the controller. Is the voltage within the specified value?	Go to Step 3 11 V - 14 V	Go to Step 2
2	Repair the wiring harness between splice S206 and terminal A3 of the controller connector or between splice S206 and terminal A4 of the controller connector. Is the repair complete?	System OK	-
3	Check the illumination bulb. Is the bulb burned out?	Go to Step 4	Go to Step 5
4	Check the illumination bulb. Is the repair complete?	System OK	-
5	Replace the controller. Is the repair complete?	System OK	-

NO HOT AIR FROM BLOWER

Step	Action	Yes	No
1	Check the coolant level. Is the coolant level within the specified value?	Go to Step 3	Go to Step 2
2	Add coolant as needed. Is the repair complete?	System OK	-
3	1. Turn the ignition to ON. 2. Observe the temperature indication screen of the controller. Does the digit flash?	Go to Step 6	Go to Step 4
4	Observe the blower motor operation. Is the blower motor functioning at all?	Go to Step 5	Go to “Blower Motor Does Not Run At All”
5	Use the blower push switch to cycle the blower through its different speeds. Does the motor function at different speeds?	Go to Step 7	Go to “the Applicable Diagnostic Table”
6	Run a self diagnosis circuit check. Does the display indicate a defect code?	Go to Step 7	Go to “the Applicable Diagnostic Table”
7	Check the airflow of the ducts at each mode. Is the airflow normal?	Go to Step 9	Go to Step 8
8	Check inside the heater duct for obstructions and repair as needed. Is the repair complete?	System OK	-
9	Observe the air mix door motor while changing the temperature setting from LO to HI and then from HI to LO. Is the air mix door actuator functioning properly?	Go to Step 10	Go to “the Applicable Diagnostic Table”
10	Check the coolant hoses for leaks or kinks. Are the coolant hoses in good condition?	Go to Step 12	Go to Step 11
11	Replace the coolant hoses. Is the repair complete?	System OK	-
12	Check the coolant reservoir cap. Is the coolant tank cap in hood condition?	Go to Step 14	Go to Step 13
13	Replace the coolant reservoir cap. Is the repair complete?	System OK	-
14	1. Turn the A/C switch to ON. 2. Set the temperature control to full hot (HI). 3. Set the blower motor speed to full high. 4. Remove the coolant reservoir cap (all segments illuminated on the display). 5. Start the vehicle and run the engine at idles. 6. Watch for the flow of the coolant when the thermostat opens. Does the coolant flow normally?	Go to Step 16	Go to Step 15
15	1. Check for • faulty thermostat. • failed coolant pump impeller. • restriction in the cooling system. 2. Make repairs, as needed. Is the repair complete?	System OK	-

No Hot Air From Blower (Cont'd)

Step	Action	Yes	No
16	Check the temperature of the heater inlet and outlet hoses by feel. Is the heater inlet hose hot and the outlet hose warm?	Go to Step 18	Go to Step 17
17	Back flush or replace the heater core. Is the repair complete?	System OK	-
18	Check the vehicle for cold air leaks the • Dash. • Heater cases. • Vents. Are any leaks found?	Go to Step 20	Go to Step 19
19	Repair any cold air leaks. Is the repair complete?	System OK	-
20	Check the coolant temperature sensor using the tests in "DTC Coolant Temperature Sensor Error." Is there a problem indicated in the sensor, the sensor wiring or the controller?	Go to Step 21	Go to Step 22
21	Repair, or replace the sensor, the wiring, or the controller as required. Is the repair complete?	System OK	-
22	Replace the controller. Is the repair complete?	System OK	-

BLOWER MOTOR DOES NOT RUN AT ALL

Step	Action	Yes	No
1	1. Turn the ignition switch to ON. 2. Observe the temperature indication screen of the controller. Dose the digit on and off?	Go to "the Applicable Diagnostic Table"	Go to Step 2
2	Check the fuses. Are the fuses blown?	Go to Step 3	Go to Step 4
3	Replace the fuse. Is the repair complete?	System OK	-
4	1. Turn the ignition switch to ON. 2. Measure the voltage between ground and terminal 87 of blower relay. Is the voltage within the specified value?	Go to Step 7 11 - 14 V	Go to Step 5
5	1. Measure the voltage between ground and terminal 86 of blower relay. Is the voltage within the specified value?	Go to Step 9 11 - 14 V	Go to Step 6
6	1. Check the circuit between terminal 86 of the blower relay and fuse SB7 in the I/P fuse block. 2. Repair any problem found in the wiring or terminals at the relay socket or connectors. Is the repair complete?	System OK	-
7	1. Turn the ignition to OFF. 2. Disconnect the wiring connector of the blower motor. 3. Turn the ignition to ON. 4. Measure voltage between the wiring connector of the blower motor and ground. Is the voltage within the specified value?	Go to Step 11 11 - 14 V	Go to Step 10

Blower Motor Does Not Run At All (Cont'd)

Step	Action	Yes	No
8	Repair the faulty circuit between the wiring connector of the blower relay, wiring, blower motor, connector C203, C107. Is the repair complete?	System OK	-
9	Measure voltage between terminal 30 of the blower relay and ground. Is the voltage within the specified value?	Go to Step 9 11 - 14 V	Go to Step 10
10	1. Repair the circuit between terminal 86 of the blower relay and fuse SB7 in the I/P fuse block. 2. Repair the wiring connector of the blower relay, wiring, blower motor, connector C203, C107. Is the repair complete?	System OK	-
11	1. Turn the ignition switch to OFF. 2. Using an ohmmeter, measure the resistance between terminal 85 of the blower relay and ground. Does the measured resistance indicate 0 Ω?	Go to Step 13	Go to Step 12
12	Repair the faulty circuit between terminal 85 of the blower relay, C104 and ground G101. Is the repair complete?	System OK	-
13	Replace the blower motor relay. Is the repair complete?	System OK	-
14	Measure the resistance of the blower motor. Does the measured resistance indicate 0.5 Ω?	Go to Step 15	Go to Step 16
15	Replace the blower motor. Is the repair complete?	System OK	-
16	Measure the open or short of the circuit between terminal 1 of the blower connector and terminal 30 of the blower high relay and terminal 6 of the power transistor. Is there any open or short circuit?	Go to Step 17	Go to Step 18
17	Repair the problem in the circuit. Is the repair complete?	System OK	-
18	Measure the resistance of the circuit from terminal 3 of the power transistor connector and ground. Does the measured resistance indicate 0 Ω?	Go to Step 19	Go to Step 20
19	Replace the controller. Is the repair complete?	System OK	-
20	1. Repair the faulty circuit from terminal 3 of the power transistor connector and terminal 87 of the high blower relay to ground. 2. Repair the faulty in the wiring, connector, C109, C209, C104 or ground G104. Is the repair complete?	System OK	-

NO COOL AIR FROM BLOWER

Step	Action	Yes	No
1	1. Turn the ignition switch to ON. 2. Observe the temperature indication screen of the controller. Does the digit flash?	Go to Step 2	Go to Step 3
2	Run a self-diagnosis circuit check. Does the display indicate a defect code?	Go to "the Applicable Diagnostic Table"	Go to Step 4
3	Observe the blower motor operation. Is the blower motor functioning at all?	Go to Step 4	Go to "Blower Motor Does Not Run At All"
4	Use the blower push switch to cycle the blower through its different speeds. Does the motor function at different speeds?	Go to Step 5	Go to "the Applicable Diagnostic Table"
5	Check the airflow of the ducts at each mode. Is the airflow normal?	Go to Step 8	Go to Step 6
6	Check inside the heater duct for obstructions and repair as needed. Is the repair complete?	System OK	-
7	Observe the air mix door motor while changing the temperature setting from LO to HI and then from HI to LO. Is the air mix door actuator functioning properly?	Go to Step 8	Go to "the Applicable Diagnostic Table"
8	Perform the checks found in "Insufficient Cooling Diagnosis." Is the system operating normally now?	System OK	Go to Step 9
9	Place the controller in the AUTO mode. Is smoke taken into the intake port of the inside air sensor?	Go to Step 11	Go to Step 10
10	Replace the intake hose. Is the repair complete?	System OK	-
11	Check the each sensor and sensor wiring using the Diagnostic Table. Is there a problem indicated in the sensor, the sensor wiring or the controller?	Go to Step 12	Go to Step 13
12	Repair, or replace the sensor, the wiring, or the controller as required. Is the repair complete?	System OK	-
13	Replace the controller. Is the repair complete?	System OK	-

MODE CONTROLS DOES NOT WORK

Step	Action	Yes	No
1	Measure the voltage between terminal 4 of the blower motor and mode door motor ground. Is the voltage within the specified value?	Go to Step 3 11 - 14 V	 Go to Step 17
2	Repair the connector and the circuit for any wiring or terminal problems. Is the repair complete?	System OK	-
3	1. Using the Motor Control Table, measure the voltages at the specified terminals of the specified motor connectors. 2. Change the mode settings and observe the voltage changes. Is the voltage within the specified value?	Go to Step 5	Go to Step 4
4	Repair or replace the wiring harness or the defective terminal. Is the repair complete?	System OK	-
5	1. Measure the voltages of the connector terminal. 2. Change the mode settings and observe the voltage changes. Is the voltage within the specified value?	Go to Step 7	Go to Step 6
6	Replace the fuel filter or the fuel line.	System OK	-
7	Check the connector at the controller. Is there a defective terminal?	Go to Step 8	Go to Step 9
8	Repair the terminal and replace as needed. Is the repair complete?	System OK	-
9	Replace the controller. Is the repair complete?	System OK	-

MODE CONTROLS DOES NOT WORK

Step	Action	Yes	No
1	Measure the voltage between terminal 4 of the intake control door motor and ground. Is the voltage within the specified value?	Go to Step 3 11 - 14 V	 Go to Step 2
2	Repair the connector and the circuit for any wiring or terminal problems. Is the repair complete?	System OK	-
3	1. Measure the voltages at the specified terminals of the specified motor connectors. 2. Change the mode settings and observe the voltage changes Is the voltage within the specified value?	Go to Step 5	Go to Step 4
4	1. Repair the wiring harness or the defective terminal. 2. Replace the fuel filter or the fuel line as needed. Is the repair complete?	System OK	-
5	Check the connector at the controller. Is there a defective terminal?	Go to Step 6	Go to Step 7
6	Repair the terminal and replace as needed. Is the repair complete?	System OK	-
7	Replace the controller. Is the repair complete?	System OK	-

ABNORMAL REFRIGERANT PRESSURE

Step	Action	Yes	No
1	1. Verify whether airflow and excessive refrigerant. 2. Check any restriction at the condenser or radiator. 3. Check the condenser or cooling fan for proper operation. 4. Check any restriction of the refrigerant lines. Is the high-side refrigerant pressure high abnormally?	Go to Step 2	Go to Step 3
2	1. Recover, evacuate and recharge the A/C system according to the specified value. 2. Clean the condenser or radiator core. 3. Check the voltage, rpm, direction of the cooling fan. 4. Repair or replace the applicable parts as needed. Is the high-side pressure within the specified value?	System OK	-
3	1. Check the amount of the refrigerant. 2. Check the internal faulty of the compressor. 3. Check the faulty of the expansion valve. 4. Check the moisture mix into the system. Is the high-side refrigerant pressure low abnormally?	Go to Step 4	Go to Step 5
4	1. Replace the compressor and the expansion valve as needed. 2. Recover, evacuate and recharge the A/C system according to the specified value. 3. Repair any leaks as needed. Is the repair complete?	System OK	-
5	1. Check the freezing/clogging of the expansion valve 2. Check the clogging of the receiver-drier. 3. Check the amount of the refrigerant. Is the low-side refrigerant pressure low abnormally?	Go to Step 6	Go to Step 7
6	1. Clean the expansion valve and replace it as needed. 2. Replace the receiver-drier as needed. Is the repair complete?	System OK	-
7	1. Check the expansion valve and the compressor for any faulty. 2. Check the excessive amount of the refrigerant. Is the low-side refrigerant pressure high abnormally?	Go to Step 8	Go to Step 9
8	1. Replace the expansion valve and the compressor as needed. 2. Add the specified amount of the refrigerant. Is the repair complete?	System OK	-
9	1. Check the tightening condition of the refrigerant line coupling and bolts. 2. Check the faulty O-ring. 3. Check the faulty gasket or seal of the compressor. Is there any refrigerant leak?	Go to Step 10	System OK
10	1. Tighten the bolts. 2. Replace the faulty O-ring. 3. Replace the faulty compressor. Is the repair complete?	System OK	-

COMPRESSOR MAGNETIC CLUTCH DOES NOT ENGAGE

Step	Action	Yes	No
1	1. Remove the controller with connecting the connector. 2. Turn the ignition switch to ON. 3. Set the A/C switch to ON. 4. Measure the voltage between the controller connector A12 (or all for GSL) and the ground. Is the voltage within the specified value?	Go to "Insufficient Cooling Diagnosis" 11 - 14 V	Go to Step 2
2	Replace the defective motor. Is the repair complete?	System OK	-

INSIDE AIR TEMPERATURE SENSOR ERROR

Step	Action	Yes	No
1	1. Put the smoke of the cigarette near the air inlet and verify that the smoke come into the air inlet properly. 2. Remove the controller with connecting the connector. 3. Turn the ignition switch to ON. 4. Measure the voltage between the connector terminals of the inside air sensor. Does the measured voltage indicate 2 - 3 V at 25 °C?	Go to Step 3	Go to Step 2
2	Repair the open or short of the wiring harness. Is the repair complete?	System OK	-
3	1. Remove the inside air temperature sensor. 2. Measure the resistance between the inside air sensor connector terminals. Does the measured resistance indicate 2.2 kΩ at 25 °C?	Go to Step 5	Go to Step 4
4	Replace the inside air sensor. Is the repair complete?	System OK	-
5	Replace the controller. Is the repair complete?	System OK	-

AMBIENT AIR TEMPERATURE SENSOR ERROR

Step	Action	Yes	No
1	1. Remove the ambient air temperature sensor. 2. Measure the resistance between the ambient air temperature sensor connector terminals. Does the measured resistance indicate 2.2 kΩ at 25 °C?	Go to Step 3	Go to Step 2
2	Replace the ambient air temperature sensor. Is the repair complete?	System OK	-
3	1. Remove the controller with connecting the connector. 2. Turn the ignition switch to ON. 3. Measure the voltage between terminal B8 and connector A13. Does the measured voltage indicate 2.2 V at 25 °C?	Go to Step 5	Go to Step 4
4	Repair the open or short of the wiring harness. Is the repair complete?	System OK	-
5	Replace the controller. Is the repair complete?	System OK	-

COOLANT TEMPERATURE SENSOR ERROR

Step	Action	Yes	No
1	1. Disconnect the coolant temperature sensor connector from the FATC harness. 2. Measure the resistance between the coolant temperature sensor connector terminals.. Does the measured resistance indicate 2.2 kΩ at 25 °C?	Go to Step 3	Go to Step 2
2	Replace the coolant temperature sensor. Is the repair complete?	System OK	-
3	1. Remove the controller with connecting the connector. 2. Turn the ignition switch to ON. 3. Measure the voltage between terminal B9 and connector A13. Does the measured voltage indicate 2.2 V at 25 °C?	Go to Step 5	Go to Step 4
4	Repair the open or short of the wiring harness. Is the repair complete?	System OK	-
5	Replace the controller. Is the repair complete?	System OK	-

AIR MIX DOOR ERROR

Step	Action	Yes	No
1	1. Disconnect the I/P wiring harness connector form the air mix door motor. 2. Use an ohmmeter to measure the resistance between terminals 5 and 7 on the air mix door motor. Is the resistance within the specified value?	Go to step 3 open : ∞ short : 0 Ω	Go to Step 2
2	Replace the air mix door motor. Is the repair complete?	System OK	-
3	Use an ohmmeter to measure the resistance between terminals 2 and 3 on the air mix door motor. Does the measured resistance indicate approximately 3 kΩ?	Go to Step 5	Go to Step 4
4	Replace the air mix door motor. Is the repair complete?	System OK	-
5	Use an ohmmeter to measure the resistance between terminals 6 and 3, 6 and 2 on the air mix door motor. Does the measured resistance indicate approximately 3 kΩ?	Go to Step 7	Go to Step 6
6	Replace the air mix door motor. Is the repair complete?	System OK	-
7	Check the connector terminals at the air mix door motor and the wiring in the FATC harness. Is there a problem with any terminal on either the harness connector or the motor connector or the wiring?	Go to Step 9	Go to Step 8
8	1. Remove the FATC controller from the instrument panel. 2. Disconnect the harness connectors of the controller. 3. Examine the connector terminals on the harness connectors and the controller connectors and the harness wiring. Is there a problem with any of these connectors or the wiring?	Go to Step 9	Go to Step 10
9	Repair the problem found with a connector terminal or wiring. Is the repair complete?	System OK	-

Air Mix Door Error (Cont'd)

Step	Action	Yes	No
10	Check continuity in the harness between the controller connectors and the air mix door motor connector. Is there a problem with the wiring?	Go to Step 11	Go to Step 12
11	Repair the problem found with the wiring and replace as needed. Is the repair complete?	System OK	-
12	1. Reconnect the FATC harness connectors to the controller. 2. Reconnect the air mix door motor to the FATC harness. 3. Turn the ignition to ON. 4. Measure the voltage between ground and terminal B5 at the controller by backprobing the connector. Is the voltage within the specified value?	Go to Step 14 0 - 5 V	Go to Step 13
13	Repair the problem found between the controller connector wiring and air mix door connector wiring. Is the repair complete?	System OK	-
14	1. Set the temperature controller to LO. 2. Measure the voltage between ground and terminal A15 at the controller by backprobing the connector. (Specified voltage : 12 V) 3. Raise the temperature setting on the controller to HI and measure the voltage. (Turn to 0V) 4. Measure the voltage between ground and terminal A9 at the controller. (Specified voltage : 12 V) 5. Change the temperature setting on the controller to LO and measure the voltage. (0 V) Is the voltage within the specified value?	Go to Step 15	Go to Step 17
15	Recheck all wiring circuits between the controller and the air mix door motor with changing the temperature setting. Does the air mix door operate normally?	System OK	Go to Step 6
16	Replace the air mix door motor. Is the repair complete?	System OK	-
17	Recheck all wiring circuits between the controller and the air mix door motor. Is there a problem in the wiring or the connectors?	Go to Step 18	Go to Step 19
18	Repair the problem in the wiring between the FATC controller and the air mix door motor. Is the repair complete?	System OK	-
19	Recheck the air mix door motor. Is there a problem in the air mix door motor?	Go to Step 16	Go to Step 21
20	Replace the air mix door motor. Is the repair complete?	System OK	-
21	1. Install the components. 2. Perform the diagnostic test of the controller. Does the DTC reset?	Go to Step 16	System OK

SUN SENSOR ERROR

Step	Action	Yes	No
1	1. Disconnect the Sun sensor connector. 2. Place the sun sensor under the sun light and measure the current between the connector terminals. 3. Place the sun sensor under the shadow place and measure the current between the connector terminals. Is the measured current lower at the shadow place?	Go to Step 3	Go to Step 2
2	replace the sun sensor. Is the repair complete?	System OK	-
3	1. Remove the controller with connecting the connectors. 2. Turn the ignition switch to ON. 3. Measure the voltage terminal A13 and B10 by backprobing the connectors. (Sun light: 2.5 V, Shadow: 4.8 V) Is the voltage equal to the specified value?	Go to Step 5	Go to Step 4
4	Repair open or short circuit. Is the repair complete?	System OK	-
5	Replace the FATC controller. Is the repair complete?	System OK	-

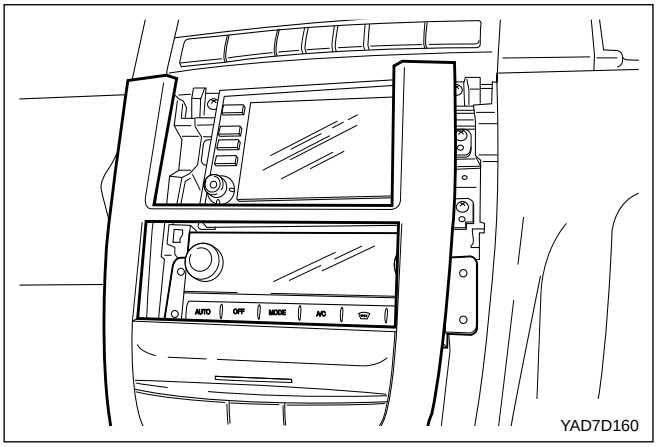
POWER TRANSISTOR ERROR

Step	Action	Yes	No
1	1. Remove the controller and disconnect the controller connector. 2. Disconnect power transistor connector. 3. Examine the open or short circuit between controller connector and power transistor connector. Is there a problem in the wiring or the connectors?	Go to Step 2	Go to Step 3
2	Repair the faulty wiring and replace as needed. Is the repair complete?	System OK	-
3	1. Reconnect power transistor connector and FATC connectors. 2. Turn the ignition switch to ON. 3. Measure the voltage between ground and terminal B12 of the FATC controller while changing the blower speed from 1 to 6 manually. 1st : 4.5 V 4th : 9.0 V 2rd : 6.0 V 5th : 11.0 V 3th : 7.5 V 6th : 12.5 V Is the resistance equal to the specified value?	Go to Step 5	Go to Step 4
4	Replace the power transistor. Is the repair complete?	System OK	-
5	Replace the FATC controller. Is the repair complete?	System OK	-

MAX-HIGH RELAY ERROR

Step	Action	Yes	No
1	1. Remove the controller with connecting the connectors. 2. Turn the ignition switch to ON. 3. Set the blower speed for 5th speed manually. 4. Measure the voltage at terminal A10 and ground. Does the measured voltage indicate 0V?	Go to Step 3	Go to Step 2
2	Replace the FATC controller. Is the repair complete?	System OK	-
3	1. Check the wiring harness associated with blower high relay and terminals. 2. Repair any defects found. 3. Install the component. Is DTC retrieved as a current DTC?	Go to Step 4	System OK
4	Replace blower high relay. Is the repair complete?	System OK	-

REPAIR INSTRUCTIONS

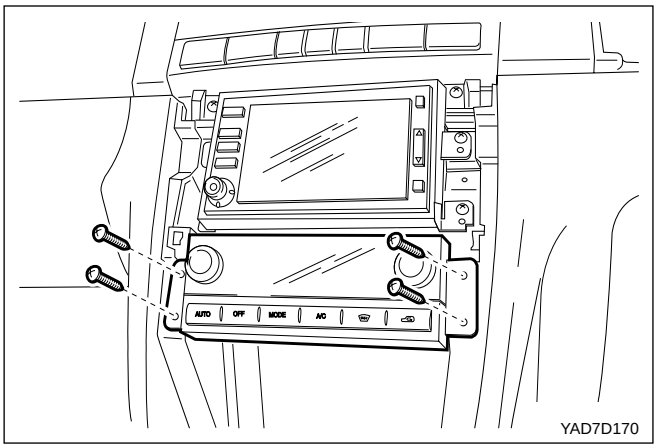


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ON-VEHICLE SERVICE

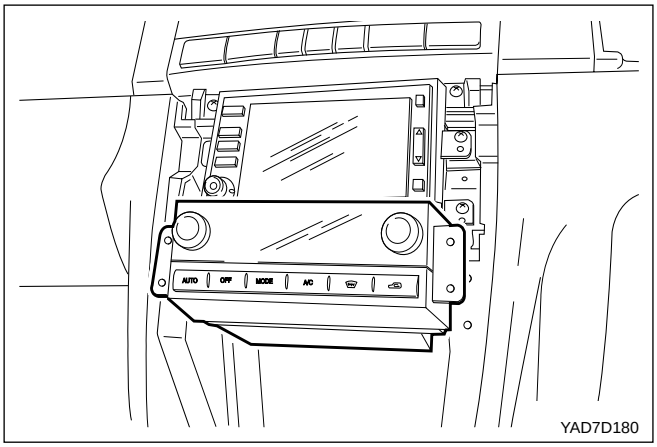
CONTROL SWITCH ASSEMBLY

1. Remove the center instrument panel.



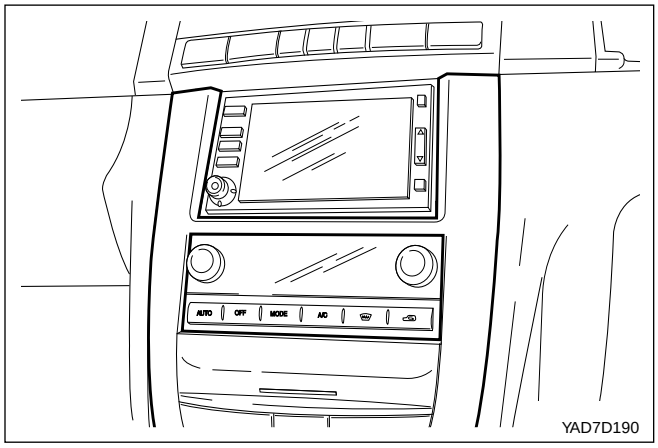
YAD7D170

2. Remove the four screws securing the control switch assembly.



YAD7D180

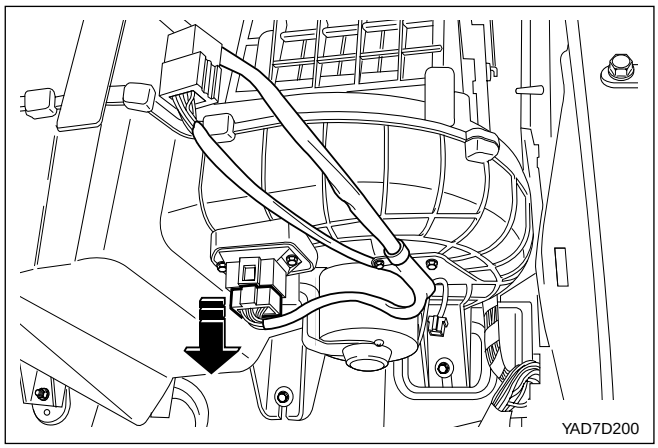
3. Remove the control switch assembly from the instrument panel.



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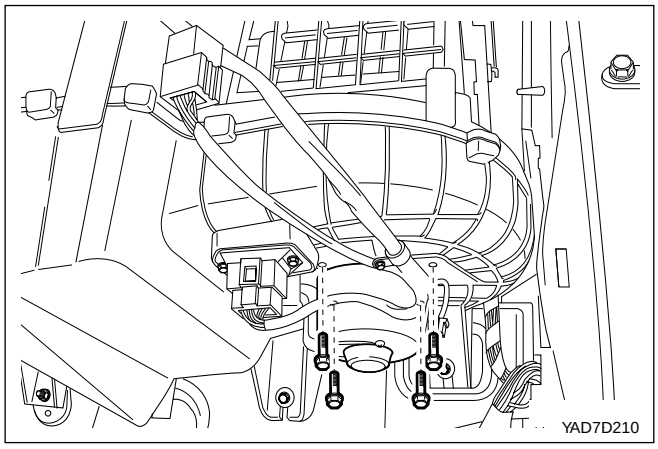
4. Installation should follow the removal procedure in the reverse order.

   Notice: Insert the connectors to the switch and then assemble the control switch completely.

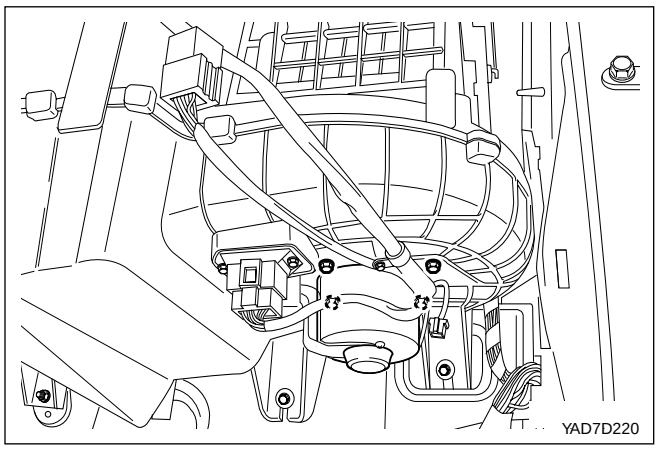

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BLOWER MOTOR

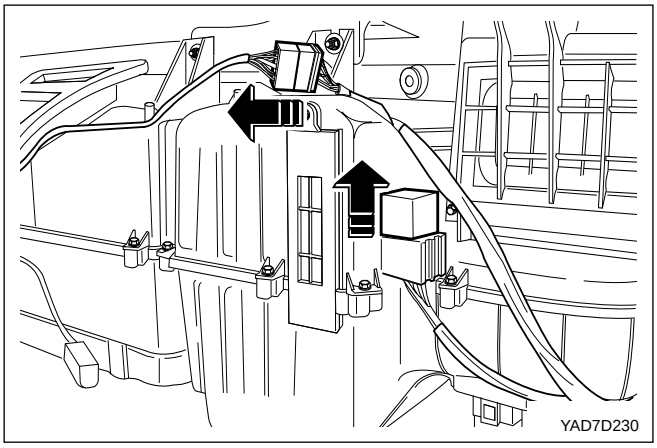
1. Remove the glove box and put the floor mat aside.
2. Disconnect the connectors connecting the blower motor.


YAD7D210

3. Remove four bolts securing the blower motor and remove the motor assembly.

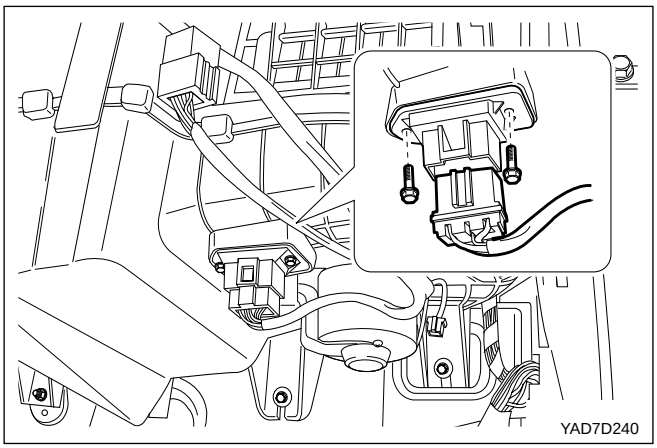

YAD7D220

4. Installation should follow the removal procedure in the reverse order.



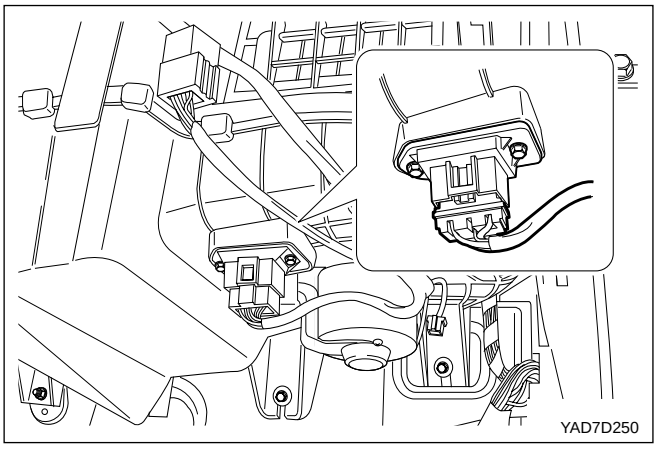
HIGH BLOWER RELAY

1. Remove the high relay connector of the blower motor.
2. Remove the bolt securing the high relay.
3. Installation should follow the removal procedure in the reverse order.



BLOWER MOTOR RESISTANCE (POWER TRANSISTOR)

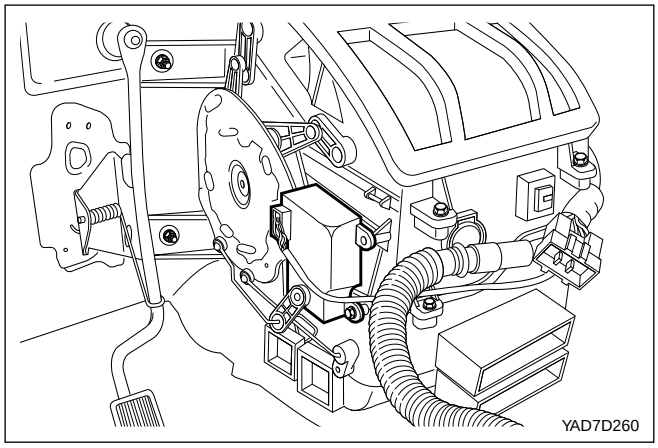
1. Remove the connector of the power transistor.
2. Remove two bolts securing the power transistor.
3. Remove the power transistor assembly.



4. Installation should follow the removal procedure in the reverse order.

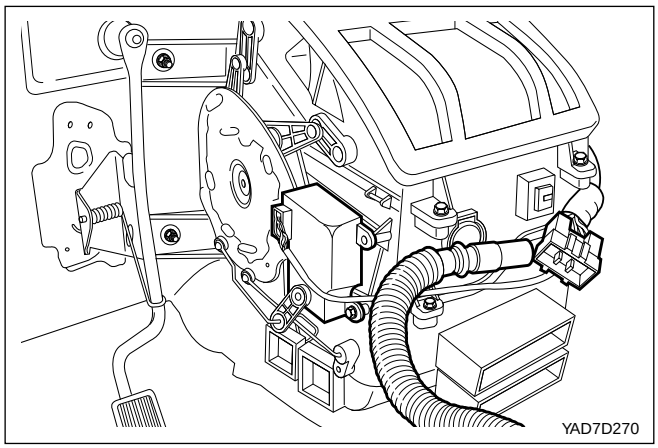
AIR MIX DOOR ACTUATOR

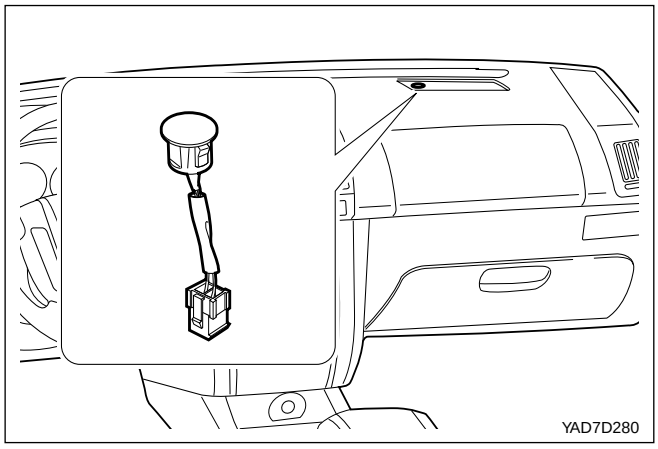
1. Disconnect the negative battery cable.
2. Remove the glove box.
3. Disconnect the connectors of the air mix door actuator.
4. Remove three screws securing the mode control door actuator and heater/air distributor case.
5. Remove the mode control actuator slowly and then remove the air mix door actuator.
6. Installation should follow the removal procedure in the reverse order.



MODE CONTROL DOOR ACTUATOR

1. Disconnect the negative battery cable.
2. Remove the driver's knee bolster or lower cover.
3. Disconnect the connector to mode control door actuator.
4. Remove three screws securing the mode control door actuator and heater/air distributor case.
5. Remove the mode control actuator slowly and then remove the mode control door actuator.
6. Installation should follow the removal procedure in the reverse order.

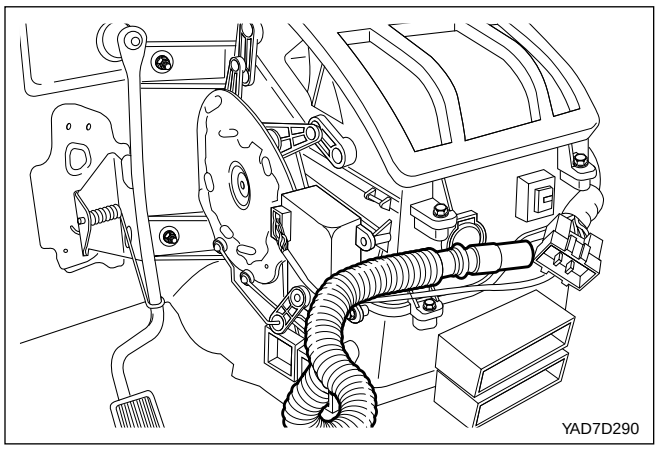




SUN SENSOR

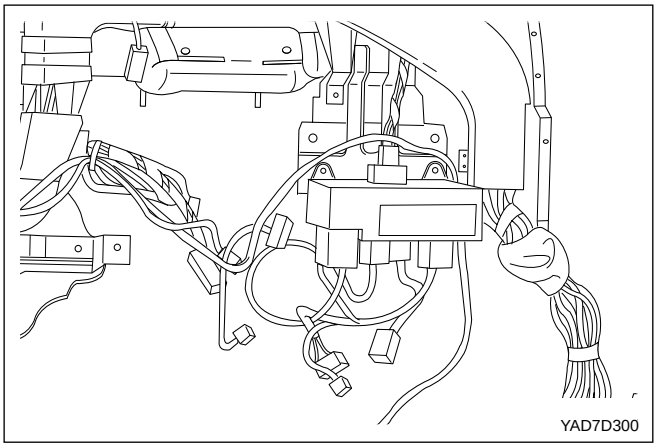
1. Remove the sun sensor from the instrument panel.
2. Disconnect the sensor connector and remove the sun sensor.
3. Installation should follow the removal procedure in the reverse order.

Notice: For disconnecting the connector from the sun sensor, be careful that the wiring must not come into the instrument panel.

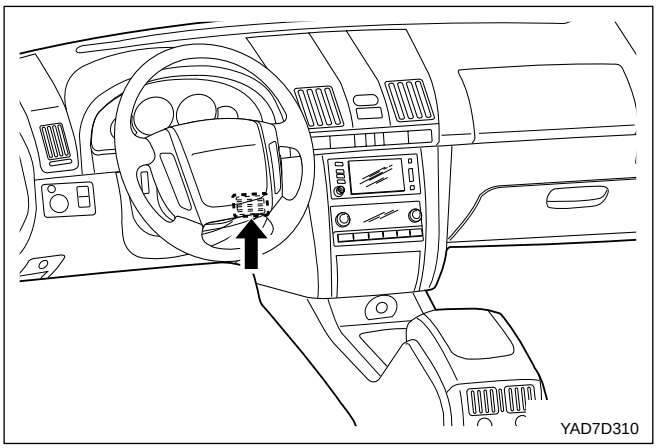


INSIDE AIR TEMPERATURE SENSOR

1. Remove the instrument panel.
2. Disconnect the sensor connector, remove the inside air temperature sensor with the tube.

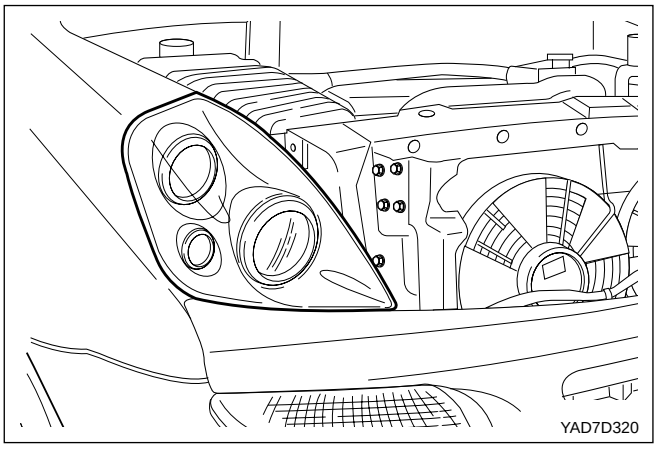


3. Remove the inside air temperature sensor sub from the instrument panel.

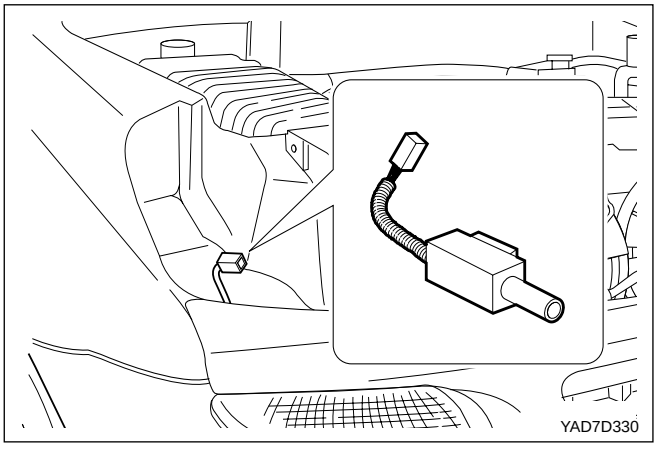


4. Installation should follow the removal procedure in the reverse order.

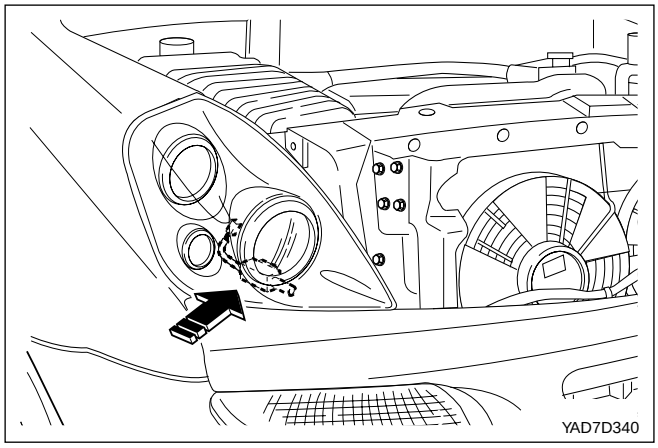
AMBIENT AIR TEMPERATURE SENSOR



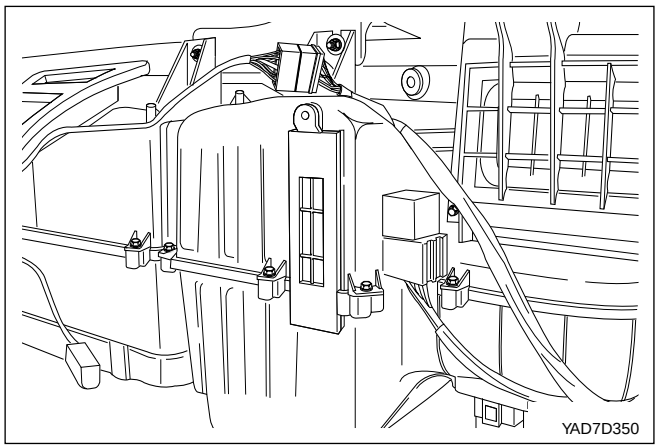
1. Remove the left headlamp assembly.



2. Disconnect the ambient air temperature sensor at the clip hole of the headlamp support outer panel and then disconnect the connector.



3. Installation should follow the removal procedure in the reverse order.



COOLANT TEMPERATURE SENSOR

1. Disconnect the coolant temperature sensor at the side of the heater core (at left bottom of the glove box).
2. Installation should follow the removal procedure in the reverse order.

SECTION 8A

SEAT BELTS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must be in B unless otherwise noted.

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3rd-Row Seat Belt 8A-8

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application		N•m	Lb-Ft	Lb-In
Front Seat Belt	Adjuster Mounting Bolt	30 - 40	22 - 30	-
	Retractor Mounting Bolt	30 - 45	22 - 33	-
	Upper Bolt	30 - 45	22 - 33	-
	Lower Bolt	30 - 45	22 - 33	-
	Belt Buckle Bolt	30 - 45	22 - 33	-
2nd-Row Seat Belt	Retractor Mounting Bolt	30 - 45	22 - 33	-
	Upper Bolt	30 - 45	22 - 33	-
3rd-Row Seat Belt	Upper Bolt	30 - 45	22 - 33	-
	Lower Bolt	30 - 45	22 - 33	-
	Retractor Bolt	30 - 45	22 - 33	-

DIAGNOSIS

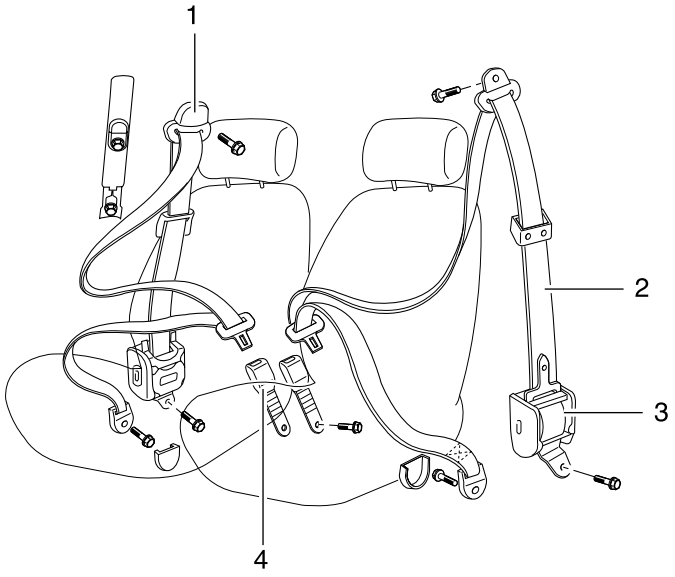
SEAT BELT WARNING LAMP IS INOPERATIVE

Condition	Probable Cause	Correction
Seat belt warning lamp is inoperative	Seat belt warning lamp wiring harness is open circuit or a short circuit.	Repair the wiring harness.
	The continuity between the two terminals at the switch side of the connector is fail.	Replace the seat belt switch.
	The continuity between the terminal for the BLK wire and ground is fail.	Repair the open ground.
	The warning lamp bulb in the instrument cluster is blown.	Replace the warning lamp bulb.

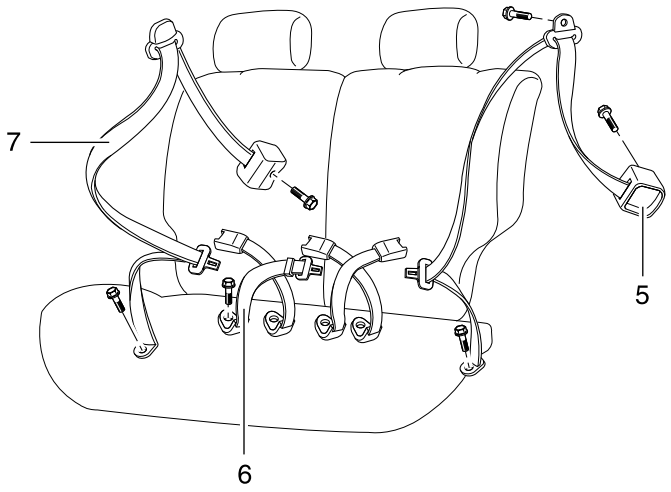
COMPONENT LOCATOR

SEAT BELT ASSEMBLY

[Front Seat Belt]



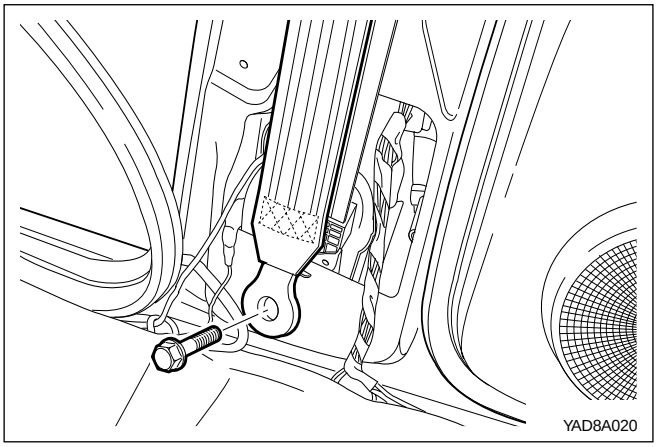
[Rear Seat Belt]



YAD8A010

1 Upper anchor plate
2 Seat Belt
3 Retractor
4 Buckle
5 Retractor
6 Rear Seat Belt
7 Seat Belt

MAINTENANCE AND REPAIR

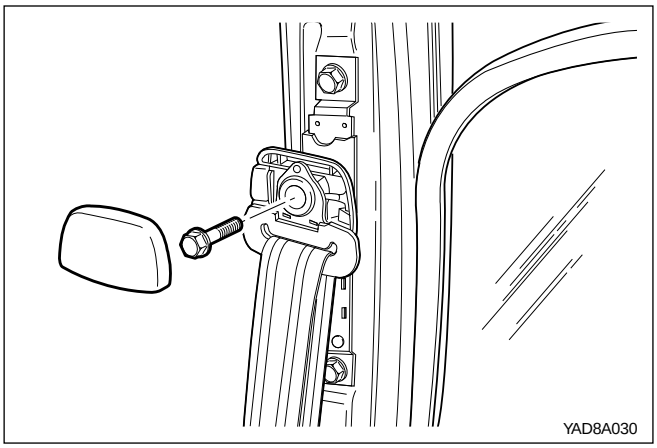


ON-VEHICLE SERVICE

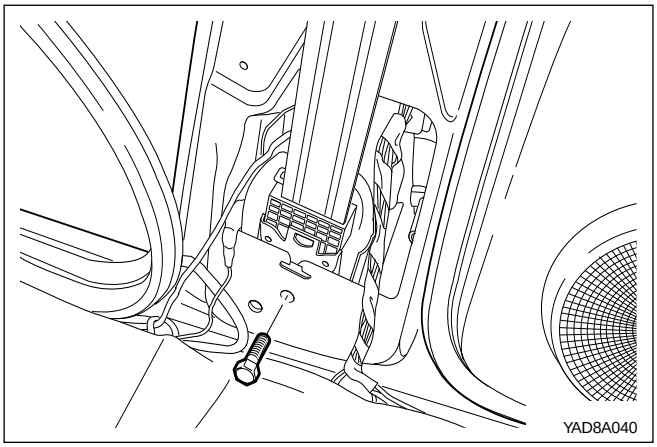
FRONT SEAT BELT

Removal Procedure

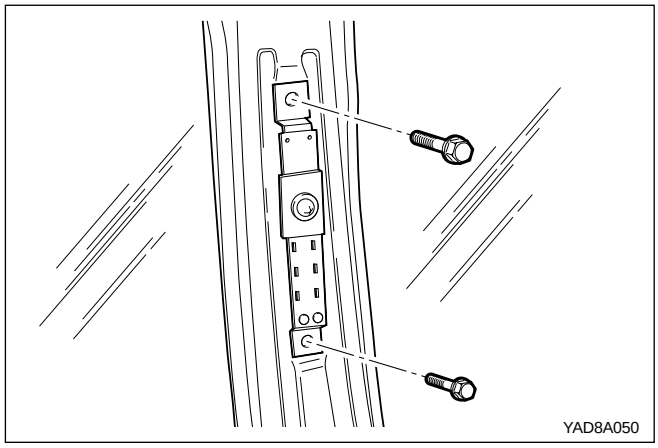
1. Push to slide the front seat toward and push down the seatback.
2. Pry off the bolt cap of the seat belt and remove the lower bolt.



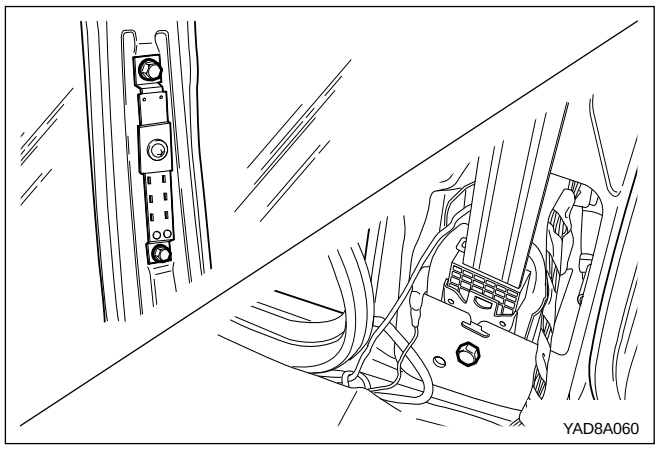
3. Pry off the upper bolt cap using the special tool and remove the upper bolt.



4. Pry off the lower B-pillar trim.
5. Disconnect the connector in the front seat belt retractor and remove the mounting bolt.
6. Separate the front seat belt and the retractor assembly.



7. Remove the upper B-pillar trim and remove the bracket mounting bolt of the height adjuster to remove the adjuster assembly.

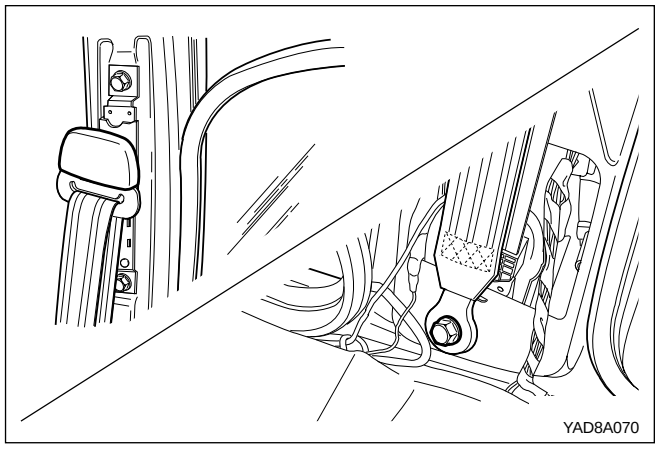


Installation Procedure

1. Tighten the adjuster and the seat belt retractor bolt as specified torque.

Installation Notice

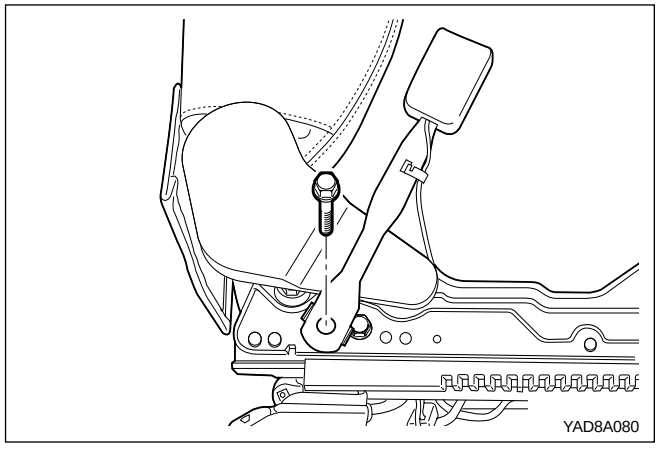
Adjuster Mounting Bolt (1)	30 - 40 N•m (22 - 30 lb-ft)
Retractor Mounting Bolt (2)	30 - 45 N•m (22 - 33 lb-ft)



2. Tighten the upper/lower bolt as specified torque.

Installation Notice

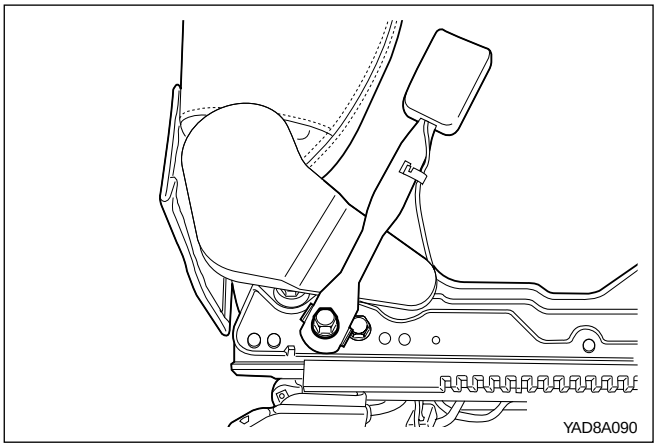
Upper Bolt (1)	30 - 45 N•m (22 - 33 lb-ft)
Lower Bolt (2)	30 - 45 N•m (22 - 33 lb-ft)



FRONT SEAT BELT BUCKLE

Removal and Installation Procedure

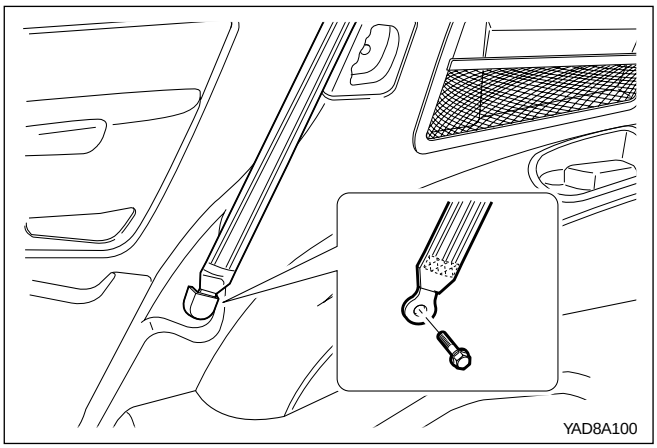
1. Remove the seat and seat belt buckle mounting bolt to remove the buckle assembly.



2. Installation should follow the removal procedure in the reverse order. Tighten the mounting bolt as specified torque.

Installation Notice

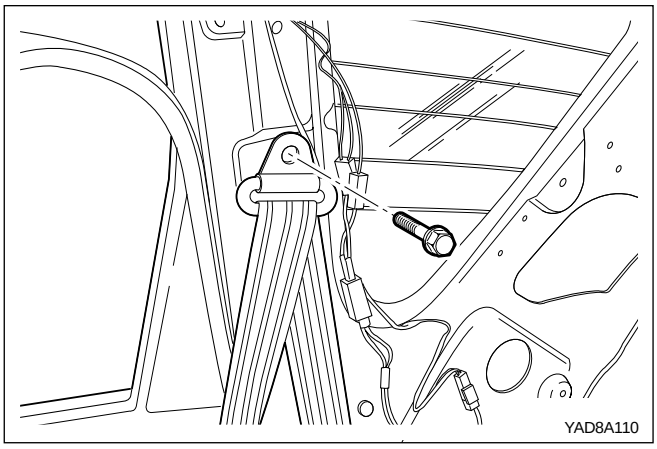
Tightening Torque	30 - 45 N•m (22 - 33 lb-ft)



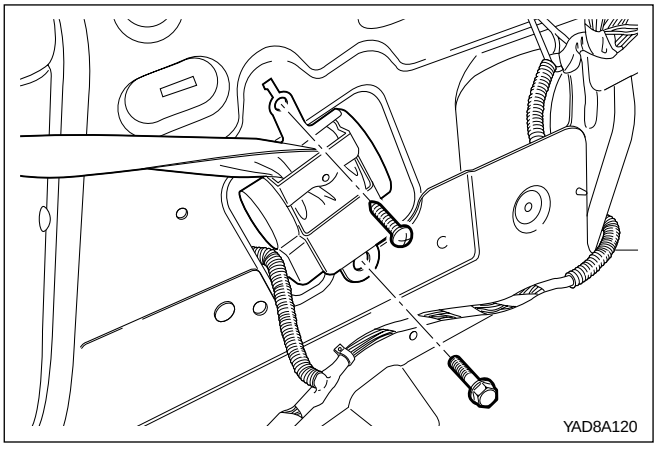
2ND-ROW SEAT BELT

Removal and Installation Procedure

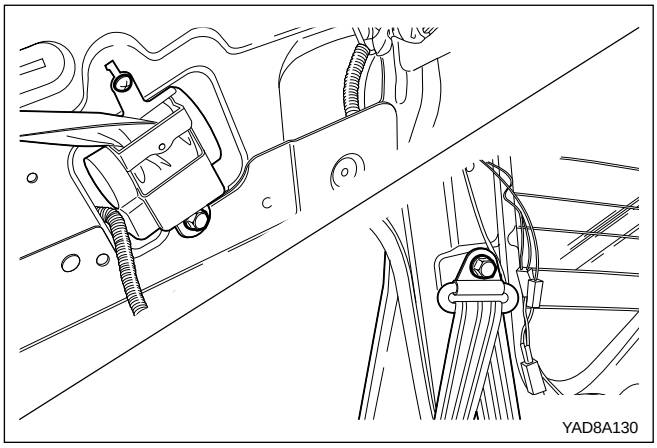
1. Pry off the lower bolt cap of the seat belt and remove the lower bolt.



2. Remove the lower quarter trim.
3. Remove the upper quarter trim.



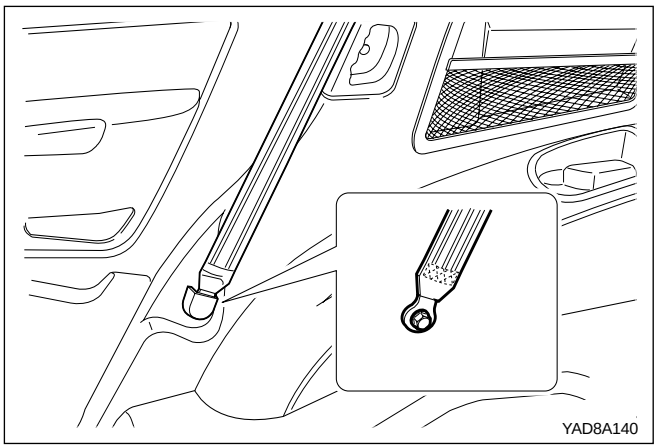
4. Remove the seat belt upper bolt.
5. Remove the retractor bolt and screw. Remove the seat belt assembly.



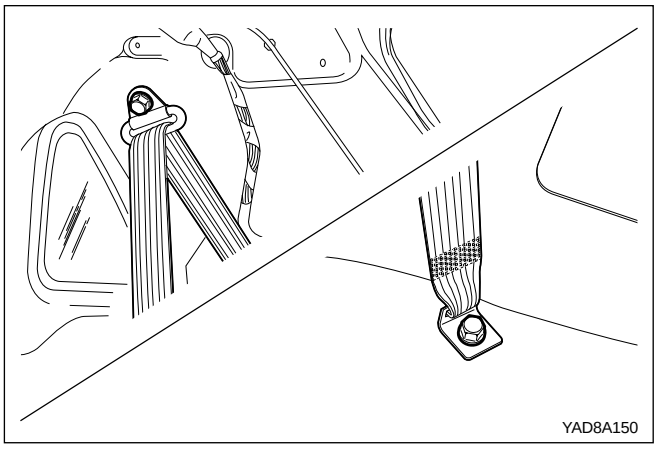
6. Installation should follow the removal procedure in the reverse order.
   - Tighten the seat belt retractor bolt and the upper bolt as specified torque.

Installation Notice

Retractor Mounting Bolt (1)	30 - 45 N•m (22 - 33 lb-ft)
Upper Bolt (2)	30 - 45 N•m (22 - 33 lb-ft)



- Tighten seat belt lower bolt as specified torque.

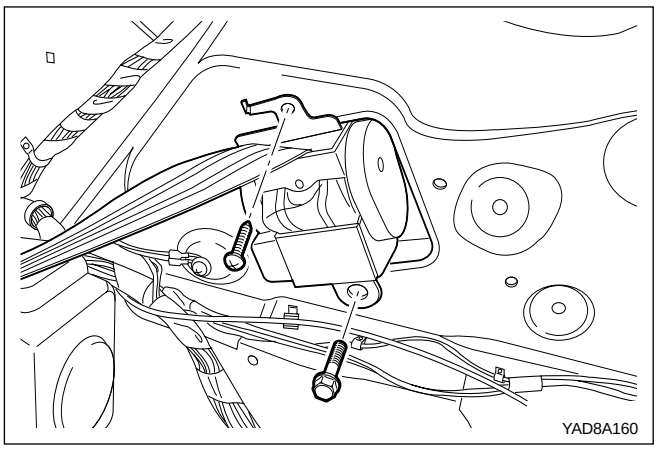


3RD-ROW SEAT BELT

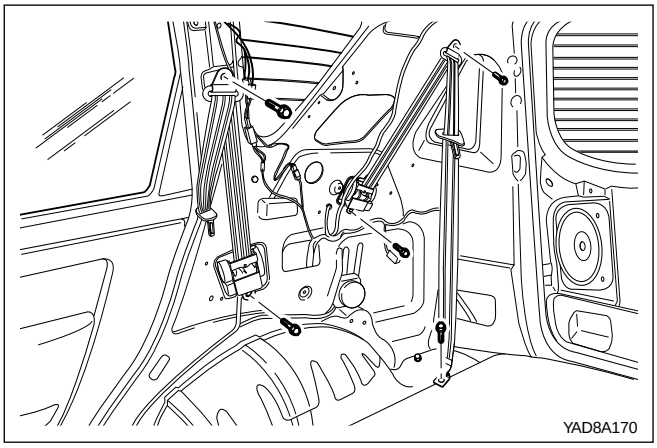
Removal and Installation Procedure

1. Remove the upper/lower bolt of the seat belt.

   Notice: Push the 3rd row seat down and perform the work with the upper quarter trim removed.



2. Remove the retractor bolt and screw of the 3rd row seat and then remove the seat belt assembly.



3. Installation should follow the removal procedure in the reverse order. Tighten each bolt as specified torque.

Installation Notice

Upper Bolt (1)	30 - 45 N•m (22 - 33 lb-ft)
Lower Bolt (2)	30 - 45 N•m (22 - 33 lb-ft)
Retractor Bolt (3)	30 - 45 N•m (22 - 33 lb-ft)

SECTION 8B

RESTRAINTS

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GENERAL DESCRIPTION AND OPERATION

GENERAL PRECAUTIONS

When the ignition is switched ON, the supplemental inflatable restraints (SIR) warning lamp must blink at seven times for 7 seconds and then turn off.

There is a fault in the airbag system if the warning lamp does not turn OFF or the warning lamp illuminates while the vehicle is in operation. If the warning lamp indicates there is a fault in the airbag system, assume that the SIR system may not be functional.

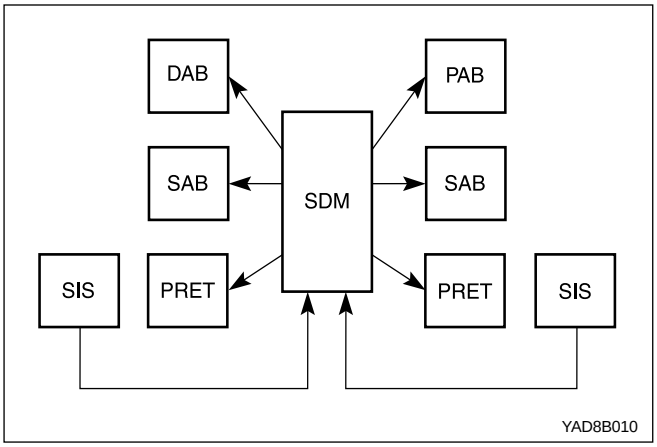
Notice: Failure to follow all service procedures in the correct sequence can cause the airbag system to deploy unexpectedly and possibly cause a serious injury.

- Only trained personnel at franchised SsangYong dealers and authorized SsangYong service dealerships may service the airbag system.
- Never attempt to disassemble, repair or reuse the following component;
  - Airbag modules
  - Clock spring
  - Sensing and diagnostic module
  - Wiring harness
- When repairing SIR component, follow the service notice;
  - Inspect any SIR part before it is installed.
  - Use only new parts.
  - Do not install used SIR parts from other vehicles.
  - Do not install any part that has been dropped or that has dents, cracks or other defects.
- Before testing, disconnect the negative battery cable. Wait one minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

SIR SYSTEM

SIR system consists of 6-Loop (DAB, PAB, 2*SAB, 2*PRET) fully and the block diagram is as shown below.

On this diagram, SDM sends the output signal to DAB, PAB, 2*SAB, 2*PRET and receives the input of side impact from 2*SIS (Side Impact Seasor).

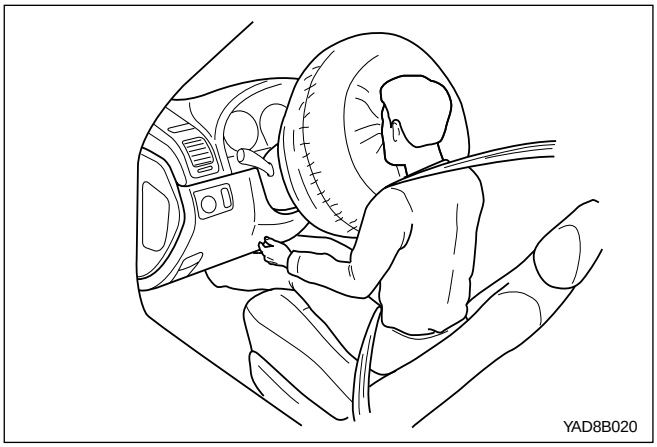


Abbreviation

1	SDM	Sensing and Diagnostic Module (SDM)
2	DAB	Driver-side Airbag Module
3	PAB	Passenger-side Airbag Module
4	SAB	Side Airbag Module (Driver, Passenger)
5	PRET	Seatbelt Pretensioner (Driver, Passenger)
6	SIS	Side Impact Sensor (Driver, passenger)

SIR SYSTEM OPERATION

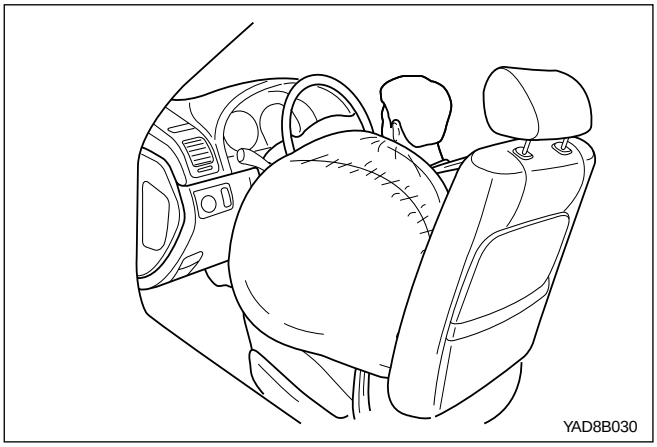
The supplemental inflatable restraints (SIR) system is a safety device used in conjunction with the seat belts. The airbag does not replace the function of the seat belt. The driver and the passengers must always fasten their seat belts and adjust them for a proper fit.



Deployment Condition

Airbag is designed to protect the driver and the front seat passenger in the event of a significant frontal impact to the vehicle. The airbags deploy if the force is applied from a direction within 30 degrees of the vehicle's centerline and above 25 km/h (15 mph) speed. In case of the 0 degree frontal concrete barrier, airbag may deploy above 25 km/h (15 mph) speed.

The side airbag deploys if the side impact is applied above 30 km/h.



Condition That Deployment may not be Occurred

- Rear Impact
- Slight impact or partial impact
- Incline impact
- Overturn and fall accident
- Impact on the material that may be possible to absorb a lot of impact energy (styrofoam, empty drum can, etc.)

AIRBAG MODULE DISCARD

Airbag Module Deployment (Inside Vehicle)

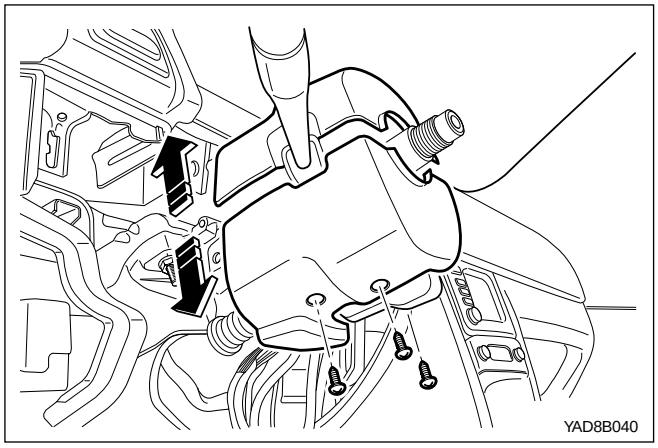
Deploy the airbag before disposing of them. If a vehicle to be scraped, the airbag may be deployed inside the vehicle.

- Before deploying the airbags, remove all loose objects from the airbag's expansion area.
- Deploy the airbags with the vehicle doors closed and the side windows open.
- Deploy the airbags only in an evacuated area. Service personnel who must be present during the deployment should be at least 10 meters (33 feet) in front of the vehicle.
- Do not connect the voltage source until after having completed all other preparations for the deployment of the airbags.
- Allow a deployed airbag module or pretensioner to cool for at least 30 minutes before handling.
- If the deployment fails, disconnect the voltage source and wait 5 minutes before approaching the vehicle.

Airbag Module Discard (Driver)

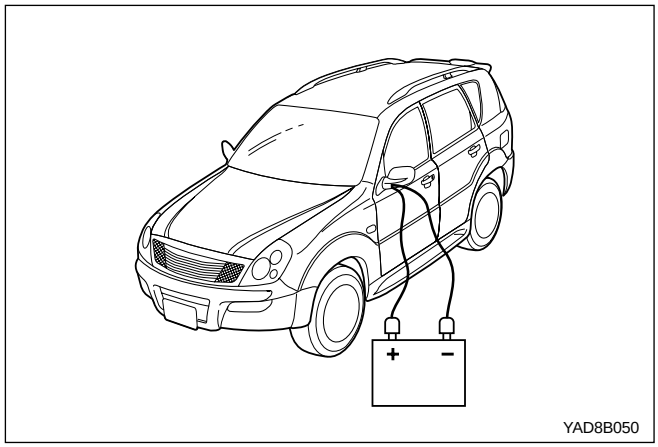
1. Disconnect the battery cable and place the vehicle battery at least 10 meters (33 feet) away from the airbag module.

   Notice: If the airbags are not disconnected, service cannot begin until one minute has passed after disconnecting power to the SDM. If the airbags are disconnected, service can begin immediately without waiting for one-minute time period to expire. Failure to temporarily disable the SRS during service result in unexpected deployment, personal injury and otherwise unneeded SRS repair.
2. Remove the lower cover of the steering column.



3. Cut two wires between the airbag and the contact coil.
4. Strip 13 mm (0.5 inch) of the insulation from the end of the wires leading to the contact coil.

5. Use two additional wires, each at least 10 meters (33 feet) long, to reach from the deployment battery to the airbag module.
6. Strip 13 mm (0.5 inch) of the insulation from the ends of these two additional wires.
7. Twist the two wires together at one end.
8. Place the twisted ends of the two wires near the deployment battery. Do not connect the wires to the battery at this time.
9. Using the free ends of the 10 meters (33 feet) wires leading to the airbag module, make two splices, one at each wires from the airbag module.
10. Wrap the splices with insulating tape.
11. Now that the free ends of the 10 meters (33 feet) wires are spliced to the airbag module wires and the ends that are twisted together are near the deployment battery, clear the area.
12. Untwist the wires that near the deployment battery.



13. Touch one wire to the positive battery terminal and touch the other wire to the negative battery terminal. The airbag module will deploy.
14. Refer to “DEPLOYED AIRBAG MODULE DISPOSAL PROCEDURE” in this section.

Airbag Module Discard (Passenger)

The passenger airbag deployment is the same procedure of the driver’s. Remove the glove box instead of the contact coil and cut two passenger airbag wires.

Refer to “AIRBAG MODULE DISCARD (DRIVER)” in this section for more information.

Airbag Module Deployment (Outside Vehicle)

Deploy airbag modules in following situations:

- If the airbag module is removed in the discarded vehicle.
- If the airbag module is replaced due to any fault.
- If an airbag module is damaged during transfer, storage or servicing.

Observe following precaution if the airbag is deployed:

- Deploy the airbags only in an evacuated area. Service mechanics should be at least 10 meters (33 feet).
- Do not connect the voltage source until after having completed all other preparations for the deployment of the airbags.
- Allow a deployed airbag module or pretensioner to cool for at least 30 minutes before handling.
- If the deployment fails, disconnect the voltage source and wait 5 minutes before approaching the vehicle.
  1. Position the airbag module face up, on flat ground outdoors, at least 10 meters (33 feet) from any obstacle or people.
  2. Place a vehicle battery at least 10 meters (33 feet) away from the airbag module.
  3. Deploy the airbag module using the deployment tool. If you do not have deployment tool, cut the two additional wires to the airbag module and strip 13 mm (0.5 inch) of the insulation from the end of the wires leading to the airbag module.
  4. Refer to “DEPLOYED AIRBAG MODULE DISPOSAL PROCEDURE” in this section.

Deployed Airbag Module Disposal Procedure

After deployment, a powdery residue may be on the surface of the airbag. The powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a by-product of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate also known as baking soda}. Therefore, it is unlikely that sodium hydroxide will be present after deployment. Wear gloves and eye protection during the disposal procedure.

After deployment, the metal surfaces of the airbag module will be hot. In order to avoid the risk of an injury or a fire, do not place the deployed airbag module near any flammable objects, and allow the airbag module to cool for 30 minutes before handling. Deploy an airbag or pretensioner before disposing of it.

This includes those in a whole vehicle being scrapped. If the vehicle is still within the warranty period contact the SsangYong regional service manager for approval or special instructions before deploying an airbag module or pretensioner.

COMPONENT FUNCTION

Back (Cushion)

- The airbag system performance is influenced on the cushion size, shape and position.
- The cushion strength is a important parameter on the impact absorb effect.
- Therefore, the control of the airbag performance depends on cushion size, shape, inflator characteristic and vent hole size for the gas discharge.
- The cushion's material and folding function to control the cushion deployment direction and the performance to protect passenger's face.

Module Cover/Housing

- It is a type of a container that includes the cushion and the inflator.
- The module housing functions to deliver the reaction force between the body structure and the airbag (The airbag reaction is absorbed generally to the steering wheel or instrument panel).
- The module cover must be considered in a viewpoint of protection between exterior, internal units and cushion. Also the module cover should be designed not to cause any personal injury for deployment.

Inflator

- The inflator is a type of the direct gas generated device.
- The inflator with initial low pressure provides negative restraint effect regarding passengers moving and time.

  On the contrary, the inflator with initial high pressure allows other components of the airbag to make a excessive impact resulting in any personal injury.

  Thus, the inflator output must be optimized according to the characteristic of the vehicle and passenger moving.
- The discharge gas has no toxicity or inflammability and also it is the important parameter to control the high temperature for gas firing.

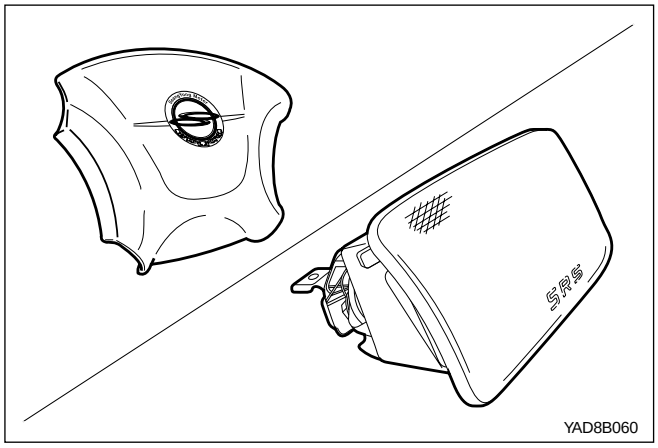
Airbag Module

The driver airbag module is under the center pad of the steering wheel.

The passenger airbag module is installed in the instrument panel at passenger side.

The driver and passenger side airbag is inside each seat.

Notice: Do not disassemble the airbag module because unintentional deployment of the airbags resulting from any damage or interference of the module can cause injury.



YAD8B060

SDM (Sensing and Diagnostic Module)

1. The airbag system consists of the module section (driver, passenger and side), seat belt section and SDM.
2. The SDM has no user-serviceable parts and monitors the system components continuously. The SDM also records any faults which are discovered.
3. The SDM allows the fault codes to be retrieved with a scan tool and illuminates a warning lamp that alerts the driver to any faults.

The SDM located on floor beneath the floor console assembly. The SDM performs the following functions:

- Impact decision processor function.

  Determine the airbag deployment through the impact signal of the accelerometer sensor and the safety sensor.
- Malfunction detection and recording any faults that are detected.

  Monitor the supplemental restrain system electrical components and set a diagnostic trouble code when malfunction is detected.
- Display airbag fault codes

  Display airbag fault codes and system status information when connected to a scan tool.
- Self-diagnosis function

  Illuminate the AIRBAG indicator to alert the driver to any fault.
- Power supply function

  Provide a reserve power source to deploy the airbags and pretensioners if an accident has disabled the normal power source.

Acceleromenter Sensor

The accelerometer sensor electronically represents the acceleration or deceleration of the vehicle during a frontal impact.

In this electronic representation, the electrical signal is proportional to the acceleration or deceleration of the vehicle.

Safety Sensor

The safety sensor is safety device made up of a dual-contact, electro-mechanical switch that:

1. Acts independently of the electronic components.
2. Connects the acceleration sensor in series in order to make up for the weak points in the current electronic sensor.

Micro Controller

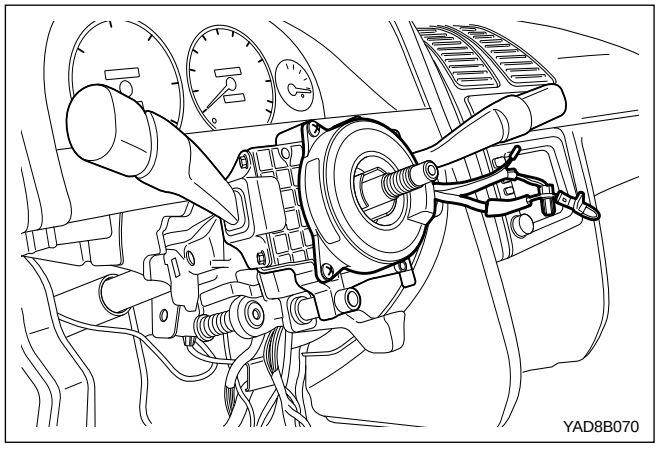
This device receives the impact signal from the sensor for vehicle impact and identifies whether the current condition is necessary for airbag deployment or not. And then the controller sends the specified currents to the airbag ignition circuit as needed.

This device always monitors the airbag system in conduction with the diagnostic circuit. When it is detected any problem, it illuminates the airbag warning indicator to inform driver of the fault and stores the fault information.

Contact Coil

The contact coil is installed between the steering wheel and the steering column and contains a coil that enables to contact electrically between the airbag wiring harness, the driver airbag module and the horn switch.

Notice: Turning the steering wheel more than three and one-quarter turns may damage the clock spring. The contact coil should never be disassembled and must be replaced if the airbag have been deployed.


YAD8B070

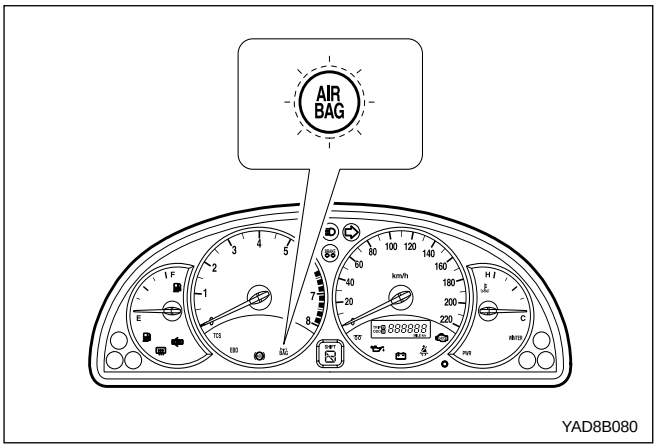
Notice: Turn the label of the clock spring clockwise to lock and turn the label of the clock spring counterclockwise approximately 2.9 ± 0.2 turns to the neutral positions with the front wheels ahead.

Align the pointed marks " ▸ ◂ ".

Airbag Warning Lamp

The instrument cluster contains an airbag warning indicator bulb to verify the operation of the AIRBAG indicator and sensing and diagnostic module (SDM).

The SDM performs a turn-on test when the ignition is turned ON. The SDM flashes the AIRBAG indicator seven tomes by supplying an intermittent ground to the indicator lamp circuit. After flashing seven times, the AIRBAG indicator will turn off if no more malfunctions have been detected.



YAD8B080

Warning lamp status	Fault contents
Flash at seven times for 7 seconds and then turn off	System OK
Warning lamp stays ON	System fault Internal SDM fault
No turn on	Power supply circuit open and fuse open Warning lamp circuit open SDM fault

Wiring Harness Connectors

If the sensing and diagnostic module (SDM) electrical connector is not attached properly, a built in shorting bar will connect the wire from airbag warning lamp with the SDM ground wire. This turns on the AIRBAG indicator.

To prevent deployment during servicing, additional shorting bars are located in following locations:

- Driver airbag module connector
- Passenger airbag module connector
- Driver and passenger side airbag module connector
- SDM wiring harness connector
- Contact coil connector to airbag wiring harness

The shorting bar is only a backup safety device. Always disable the supplemental restraints system (SRS) before beginning any service procedure.

Belt Pretensioner

The belt pretensioner enables to retract the driver and the passenger seat belt webbing to reduce any personal impact when accounted a frontal collision.

FRONT AIRBAG

General Description

- The frontal airbag system is a safety device used in conjunction with the seat belts.

  The airbag does not replace the function of the seat belt. The driver and the passengers must always fasten their seat belts and adjust them for a proper fit.

  The front seat airbag is designed to protect the driver and the front seat passenger in the event of a significant frontal impact to the vehicle.
- The driver airbag is installed on the steering wheel and the passenger airbag is in the instrument panel.

Airbag Component

Cover

It is a part of the airbag steering section and is made by injection molding.

Door Assembly

It is a part of the airbag steering and is made by vacuum bubble, PSM, injection.

Cushion

- Cushion is made mainly of nylon 66 material.
- It is made by assembling various panel pieces and sometimes, some surfaces of these panel pieces handled by coating. The coating material is used as silicon rubber generally.

Inflator

- The inflator generates gas to fill the cushion with it. There are two type of ALL-PYRO TECHNIC TYPE and HYBRID TYPE according to gas generated type.
- Now, the driver airbag uses the “all-pyro technic type” and the passenger airbag uses both “all-pyro technic type” and “hybrid type”.
- The inflator has the ignitor at one side of the inflator.

  The ignitor receives a electrical signal from the sensor and ignites powders continuously.

Housing

It is a part of airbag steel plate structure.

SIDE AIRBAG

The side airbag receives each of the side airbag sensor signal to deploy the airbag when the vehicle crashes at side impact. The side airbag module is installed inside the seat. When the airbag is deployed, replace the deployed front seat assembly.

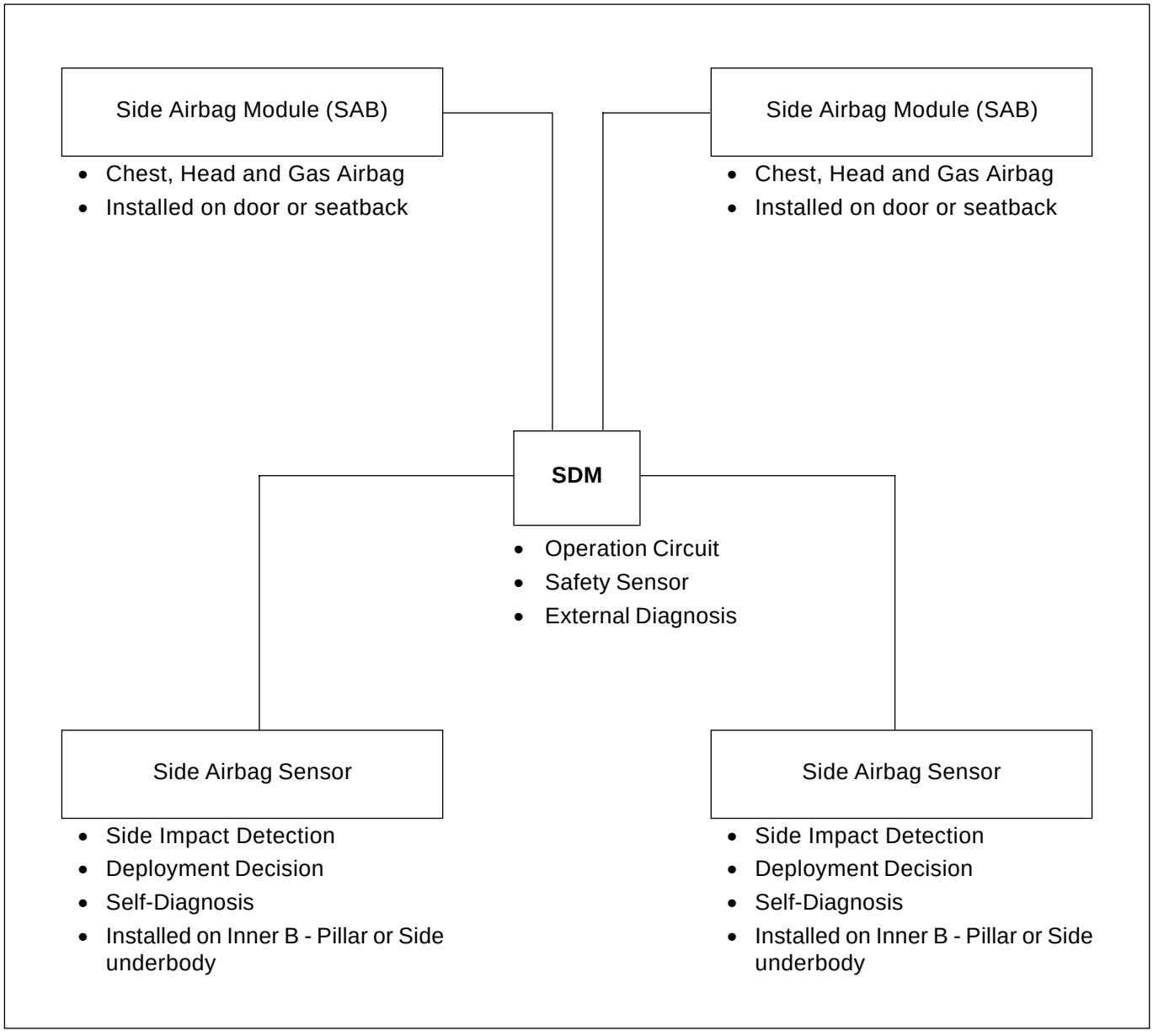
System Structure

Related System

1 Vehicle Structure and B/W
2 Seat System
3 Seat Belt System
4 Door Trim and Door Structure
5 B - Pillar Trim and Structure
6 Airbag Wiring Harness

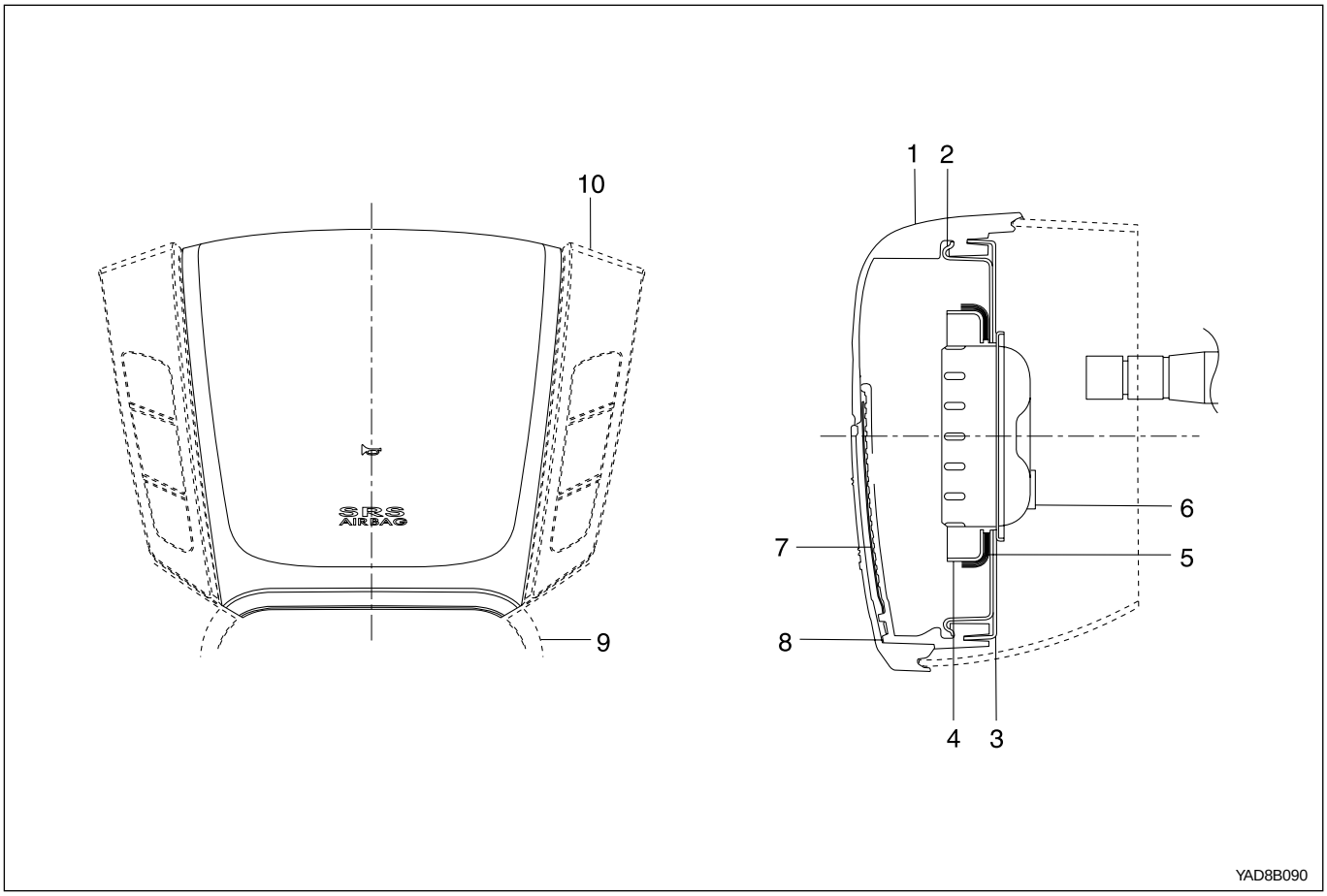
Component

1 Side Airbag Module (LH/RH)
2 Side Airbag Sensor (LH/RH)
3 SDM (Common use the SDM for frontal airbag)



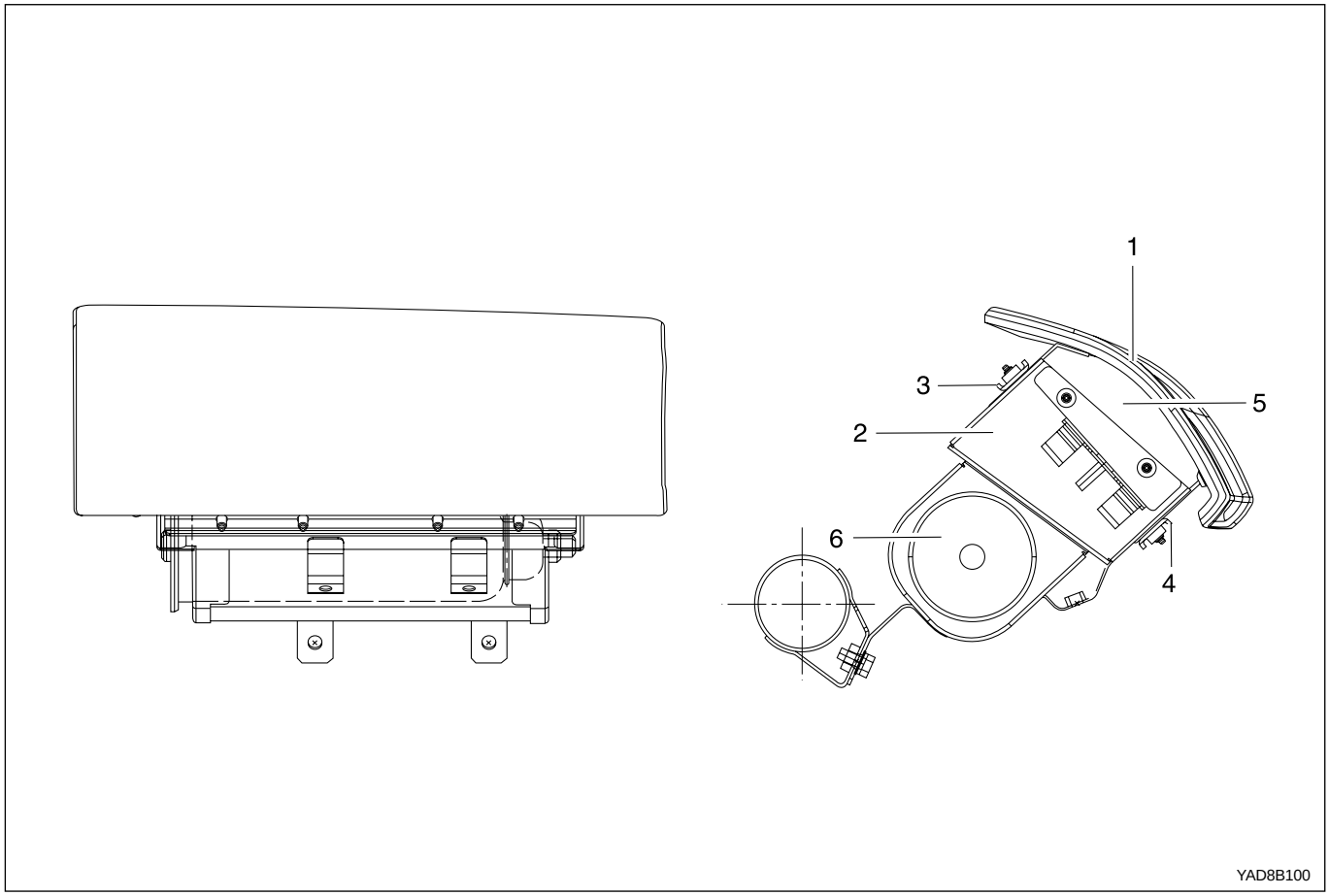
FRONTAL AIRBAG CROSS SECTIONAL VIEW

DRIVER AIRBAG ASSEMBLY



1 Cover
2 Carrier
3 Retainer cover assembly
4 Retainer cushion assembly
5 Cushion assembly
6 Inflator assembly
7 Membrane switch assembly
8 Reaction plate
9 Steering wheel
10 Remote control switch

PASSENGER AIRBAG ASSEMBLY



1 Cover assembly
2 Housing assembly
3 Upper Door Retainer
4 Lower Door Retainer
5 Cushion assembly
6 Inflator assembly

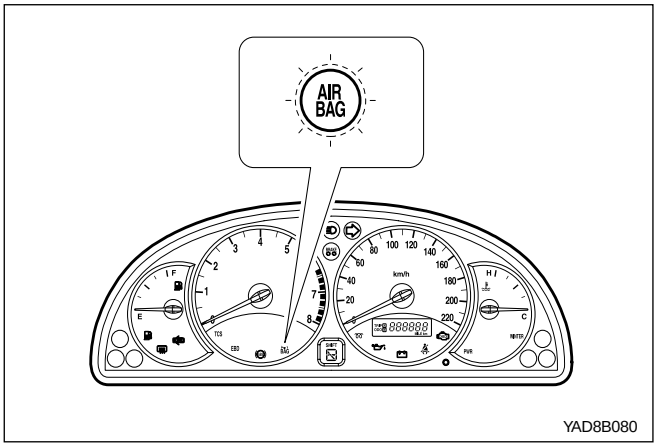
DIAGNOSTIC INFORMATION AND PROCEDURES

GENERAL DIAGNOSIS

Warning Lamp Check

As soon as the opening voltage is applied to the sensing and diagnostic module (SDM) ignition input, the SDM activates the warning lamp for a bulb check. The SDM allows the lamp to blink at seven times for 7 seconds and then turn off.

During the bulb check, the SDM is not ready to detect a crash or deploy the supplemental inflatable restraints.



Fault Indication

The sensing and diagnostic module records the system's faults in two categories:

- Active Fault

  Current detected faults and the "C" appears the first digit of the fault code on the scan tool display (example: "C16").

- History Fault

  These faults that were detected in the past, but are no longer active. The "H" appears the first digit of the fault code on the scan tool display (example: "H17").

Diagnosis by Using Warning Lamp

- The warning lamp flashes for 7 seconds at seven times and turn off : Normal Status - There is not any history or current fault code.
- The indicator turns on for 7 seconds and then turn off : Normal Status - A fault has been detected previously but now there is not any more of the same detected fault. Clear the fault using the scan tool.
- The indicator turns on for 7 seconds and turns off for 1 second and then turn on again: Abnormal Status - It has detected a current fault or has been occurred same fault more than five times, or has been occurred more than five types of faults. Perform the diagnosis using the scan tool.
- Warning lamp stays ON : Connection fault between the SDM wiring harness connector and the SDM connector, or the airbag wiring harness fault.
- No the indicator turn ON : Power supply malfunction, indicator circuit open, bulb fault, SDM internal defect.

Diagnosis by Using Scan Tool

- Check the fault code by connecting the diagnostic (ALDL) connector.
- Receive serial data from terminal 9 of the ALDL connector.
- Receive the ground signal from terminal 4 or 5 of the ALDL connector.

Clearing Fault Codes

When the sensing and diagnostic module (SDM) receives the "CODE ERASE" command from the scan tool, the SDM:

- Clears the entire fault memory.
- Turns OFF the warning lamp.
- When it is removed the scan tool after clearing the fault code, the SDM rechecks the airbag system to detect the SDM's fault.

External Fault

Service personnel can reset the SDM and turn OFF the warning lamp if the fault is an external fault.

Internal Fault

An internal fault of the SDM or a CRASH RECORDED fault code cannot be reset.

In the case of an internal fault of the SDM or a CRASH RECORDED fault code, the SDM must be replaced.

Microprocessor-Independent Lamp Activation

If the sensing and diagnostic module (SDM) electrical connector is not properly attached, the SDM cannot function and cannot control the warning lamp.

If this fault is present, the warning lamp will operate independently from the SDM through the use of shorting bars that are built into the SDM connector.

Notice: Do not measure the resistance of the airbag module because the multimeter's battery may deploy the air bag causing any personal injury.

DIAGNOSIS

Possible Cause		Action	
Ignition “ON” Check warning lamp on I/P	Does the warning lamp blink at seven times for 7 seconds and then turn off?	Yes	System OK
		No	Connect the scan tool to diagnostic connector (ALDL). Select the fault code display menu and clear code menu.
	Does the fault code display on the scan tool display?	Yes	Perform “Diagnostic System Check”.
		No	Check any fuse open.
	Is there any open in fuse?	Yes	Replace fuse.
		No	Disconnect wiring connector. Check any wiring short between fuse and wiring connector.
	Is there any short in fuse?	Yes	Repair wiring.
		No	Disconnect SDM wiring connector. Check wiring short between connector terminal and SDM connector terminal.
	Is there any short in wiring?	Yes	Replace airbag wiring.
		No	Check any open between ALDL connector No.4, No.5 terminal and ground.
	Is there any open in wiring?	Yes	Repair wiring
		No	Ignition “ON” Measure voltage at the cigar lighter socket.
	Does the voltage indicate 11~14V?	Yes	Check any open or short between ALDL connector terminal and wiring connector terminal.
		No	Repair the wiring of the cigar lighter socket.
	Is there any open or short in wiring?	Yes	Repair wiring
		No	Check any open or short between SDM connector terminal and wiring connector terminal.
	Is there any open or short in wiring?	Yes	Replace the airbag wiring.
		No	Replace the SDM.

DIAGNOSTIC TROUBLE CODES

Code	Fault Contents	Check
01h	Driver airbag circuit, resistance too high	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
02h	Driver airbag circuit, resistance too low	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
03h	Driver airbag circuit, short to ground	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
04h	Driver airbag circuit, short to battery voltage	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
05h	Passenger airbag circuit, resistance too high	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
06h	Passenger airbag circuit, resistance too low	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
07h	Passenger airbag circuit, short to ground	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
08h	Passenger airbag circuit, short to battery voltage	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
09h	Driver pretensioner circuit, resistance too high	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Ah	Driver pretensioner circuit, resistance too low	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Bh	Driver pretensioner circuit, short to ground	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Ch	Driver pretensioner circuit, short to battery voltage	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.

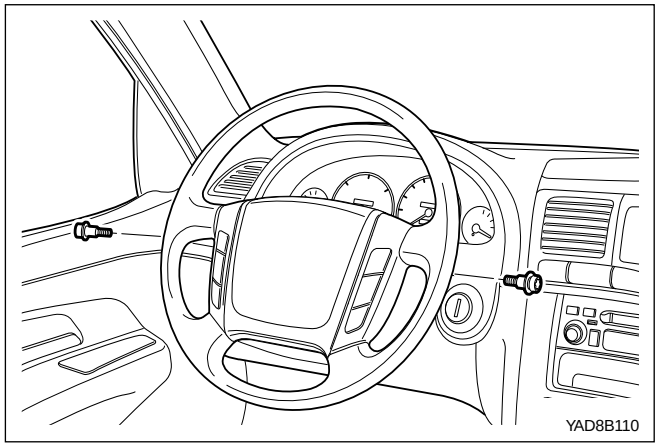
Code	Fault Contents	Check
0Dh	Passenger pretensioner circuit, resistance too high	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
0Eh	Passenger pretensioner circuit, resistance too low	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
0Fh	Passenger pretensioner circuit, short to ground	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
10h	Passenger pretensioner circuit, short to battery voltage	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
34h	Driver side airbag circuit, resistance too high	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
35h	Driver side airbag circuit, resistance too low	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
36h	Driver side airbag circuit, short to ground	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
37h	Driver side airbag circuit, short to battery voltage	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
38h	Passenger side airbag circuit, resistance too high	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
39h	Passenger side airbag circuit, resistance too low	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
3Ah	Passenger side airbag circuit, short to ground	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
3Bh	Passenger side airbag circuit, short to battery voltage	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
50h	Driver side airbag sensor, open/ short to battery voltage	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.

Code	Fault Contents	Check
51h	Passenger side airbag circuit, short to ground	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
52h	Communication malfunction of the driver side airbag	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
53h	Internal fault of the driver side airbag sensor	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
54h	Passenger side airbag sensor, open/short to battery voltage	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
55h	Passenger side airbag sensor, short to ground	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
56h	Communication malfunction of the passenger side airbag	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
57h	Internal fault of the passenger side airbag sensor	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
17h	Battery voltage too high	Check generator output voltage. Check the battery voltage. Check the bending of the airbag terminal.
18h	Battery voltage too low	Check generator output voltage. Check the battery voltage. Check the bending of the airbag terminal.
1Eh	SDM internal fault (Initialization fault)	Replace the SDM.
1Fh	SDM internal fault	Replace the SDM.

Caution:

- ***Use only the scan tool to check the airbag module and the sensing and diagnostic module (SDM). Never measure the resistance of an airbag module with an ohmmeter. An ohmmeter's battery can deploy the airbag and cause injury.***
- ***Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.***
- ***Do not attempt to repair the supplemental inflatable restraints (SIR) wiring harness. An SIR repair can create a high-resistance connection which can keep the airbags from deploying when needed, resulting in injury.***

MAINTENANCE AND REPAIR

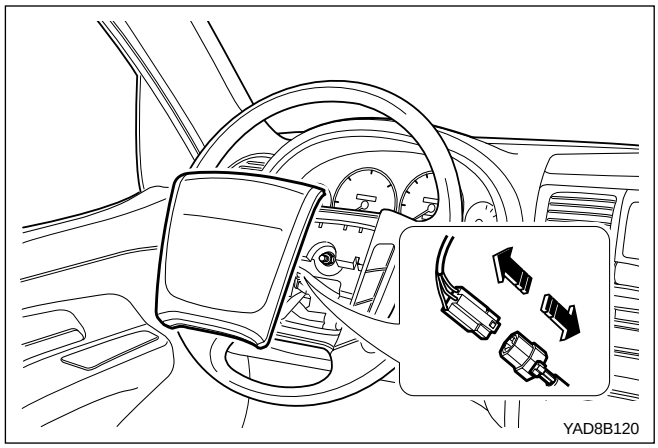


ON-VEHICLE SERVICE

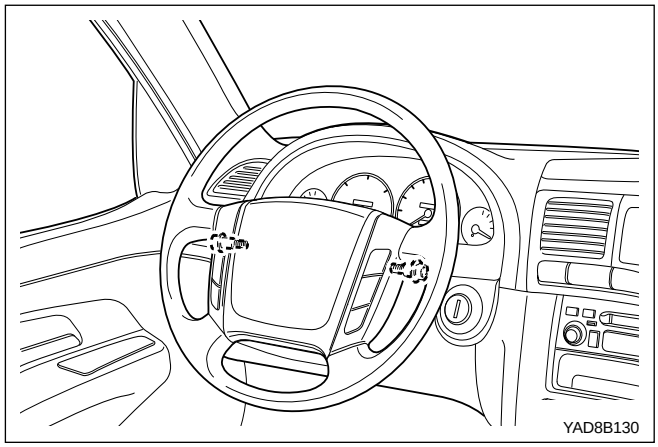
AIRBAG MODULE (DRIVER)

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Place the steering wheel at the straight driving direction.
3. Remove the screw of the airbag module.

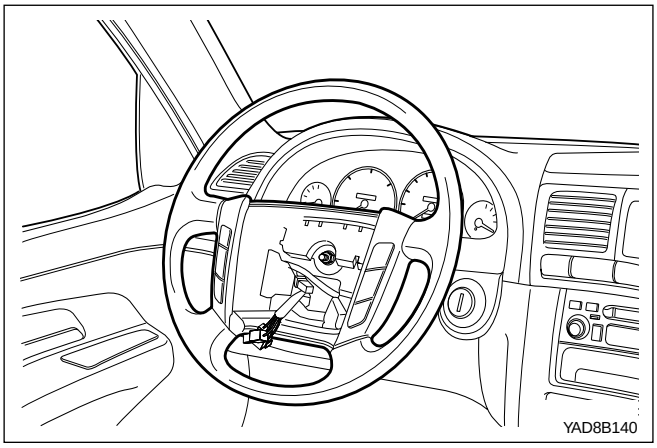


4. Disconnect the airbag module connector, the horn connector and then remove the airbag module.



5. Verify to tighten all of the module and each connector.

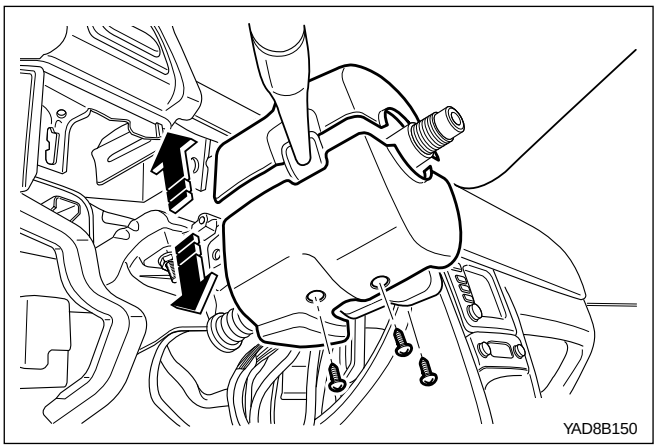
   Installation should follow the removal procedure in the reverse order.



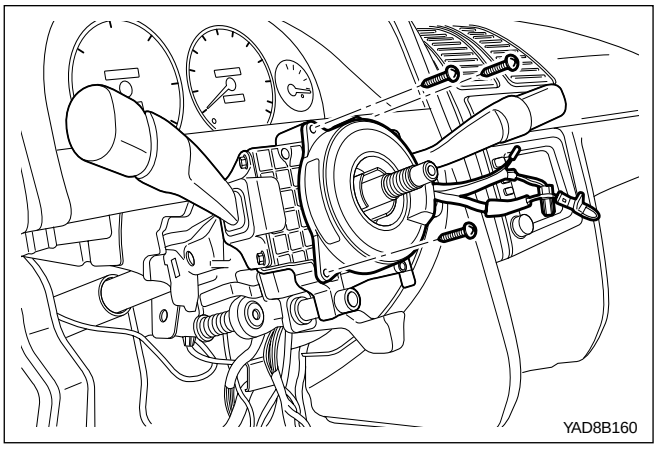
CONTACT COIL

Removal and Installation Procedure

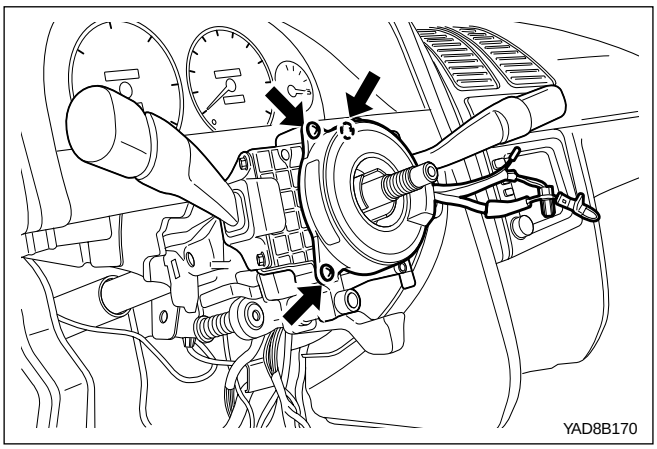
1. Remove the steering wheel, the lower panel at the driver side.



2. Remove the upper and lower cover of the steering column.



3. Disconnect the contact coil connector and remove the contact coil mounting screw. Remove the contact coil assembly.

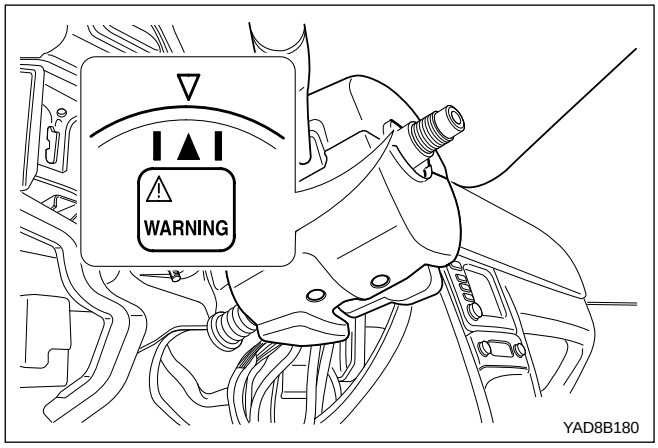


4. Tighten the contact coil mounting screw as the specified torque.

   Installation should follow the removal procedure in the reverse order.

Installation Notice

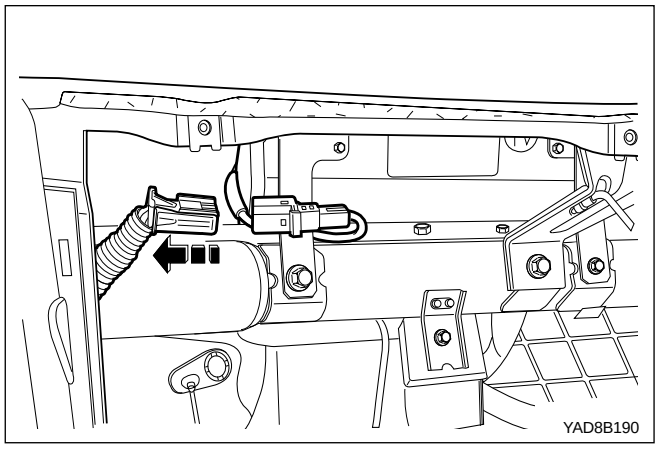
Tightening Torque	3 N•m (27 lb-in)



5. Fix the contact coil to the center position.

   Notice: If the clock spring is not properly aligned, the steering wheel may not be able to rotate completely during a turn. Restricted turning ability can cause the vehicle to crash. Improper alignment of the clock spring also may make the supplemental inflatable restraints (SIR) system inoperative, preventing the airbags from deploying during a crash. Both of these outcomes can result in injury.

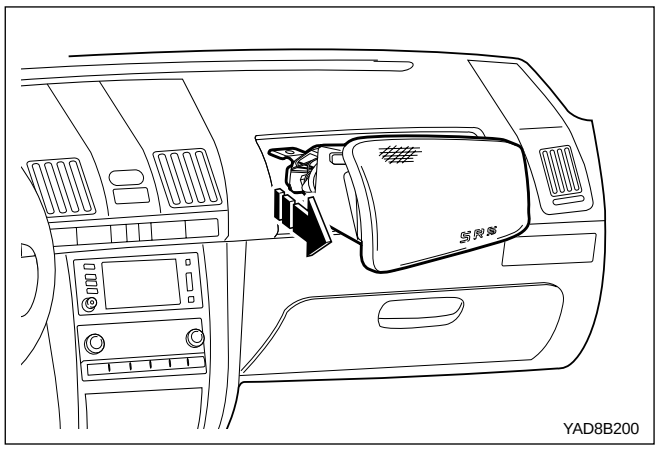
   Notice: Turn the label of the clock spring clockwise to lock and turn the label of the clock spring counterclockwise approximately 2.9 ¡¾ 0.2 turns to the neutral positions with the front wheels ahead. And also Align the pointed marks " ▸ ◂ ".



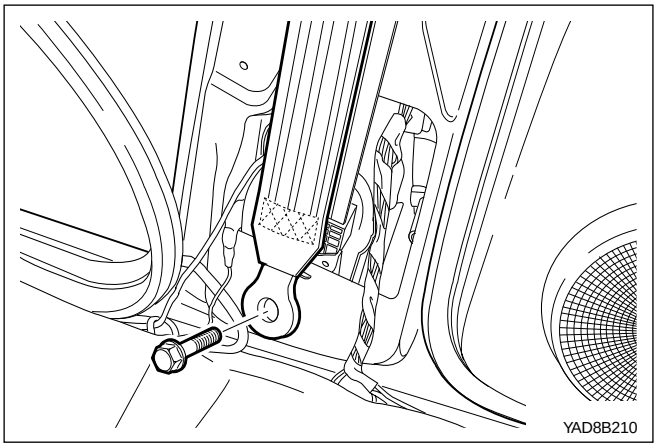
AIRBAG MODULE (PASSENGER)

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the glove box.
3. Disconnect the airbag module connector.



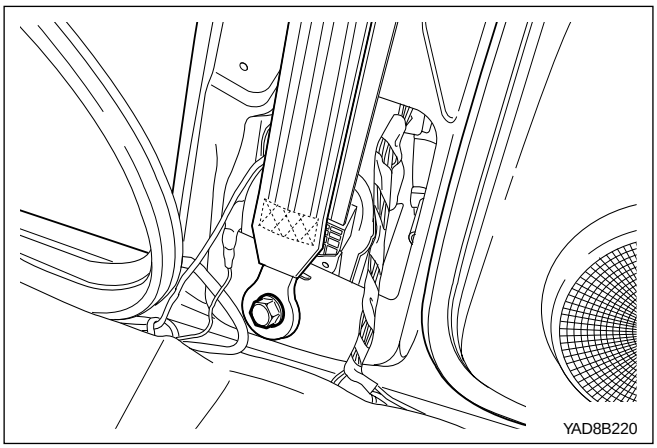
4. Remove the airbag module.
5. Installation should follow the removal procedure in the reverse order.



BELT PRETENSIONER

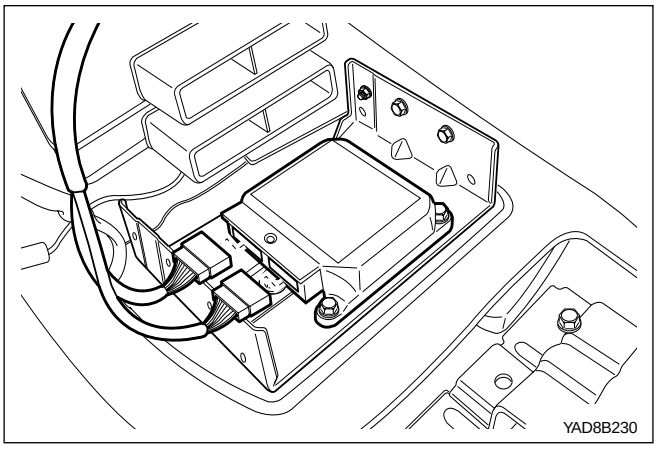
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the upper belt bolt and disconnect the panel.
3. Disconnect the airbag wiring connector.
4. Remove the mounting bolt of the belt pretensioner and remove the belt assembly.



5. Tighten the pretensioner mounting bolt as the specified torque.

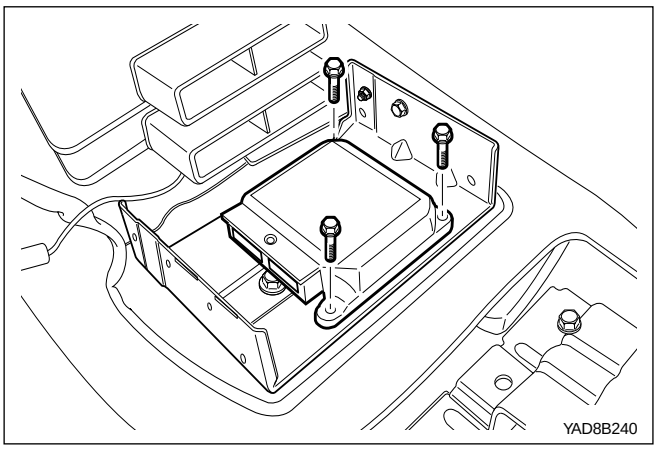
   Installation should follow the removal procedure in the reverse order.



SENSING AND DIAGNOSTIC MODULE (SDM)

Removal and Installation Procedure

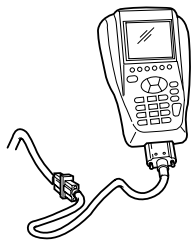
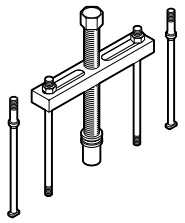
1. Disconnect the negative battery cable.
2. Remove the I/P center panel and the console panel.
3. Remove the SDM connector.



4. Remove the SDM mounting bolt and remove the SDM assembly.
5. Installation should follow the removal procedure in the reverse order.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD8B250	**Scan Tool**
 YAD8B260	**Wheel Wrench**

SECTION 9A

GENERAL BODY

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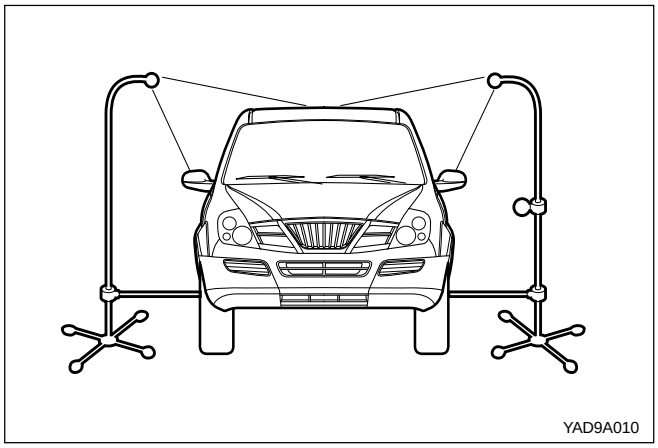
Special Tool and Equipment 9A-9

Special Tools Table 9A-9

SPECIFICATION

Application			Specification
Hood	Type		Rear Hinge and Type of Front Opening, Gas Lifter
Front Door	Structure		Front Hinge and Frame Door
	Type of Regulator		Wire and Drum
	Lock System		Pin and Fork
Rear Door	Structure		Front Hinge and Frame Door
	Type of Regulator		Wire and Drum
	Lock System		Pin and Fork
Tail Gate Thickness of Glass	Type		Internal Hinge, Gas Lifter
	Wind Shield		5 mm
	Front Door Glass		4.0 mm
	Rear Door Glass		4.0 mm
	Rear Fix Glass		4.0 mm
	Glass of Tail Gate	Fixing Type	4.0 mm
		Opening Type	5.0 mm
Specification of Test Water Leaking	Type of Nozzle		Spray Nozzle of #1/2 GG-25 or Nozzle with Sloping Angle 60° Equivalent
	Height of Nozzle		Keep Distance 1,600 mm from Ground
	Quantity of Injecting		14L Per Mir
	Pressure		155kPa(22.5 psi): Checking Pressure from nozzle
	Position of a Piller Test Stand and Wing Shield		Keep Injecting Water, 30° of Lower Direction and 45° of Backwards, Approximately at the corner of Wind-shield
	Position of “B” Piller Test Stand		Keep Injecting Water, 30° of Lower Direction and 45° of Backwards, Approximately at the corner Line of Rear Door.
	Position of Rear Decklid Test and Tail Gate Glass		Keep Injecting Water, 30° of Lower Direction and 45° of Forwards, Approximately at Distance of 60mm to the Corner of Rear Door

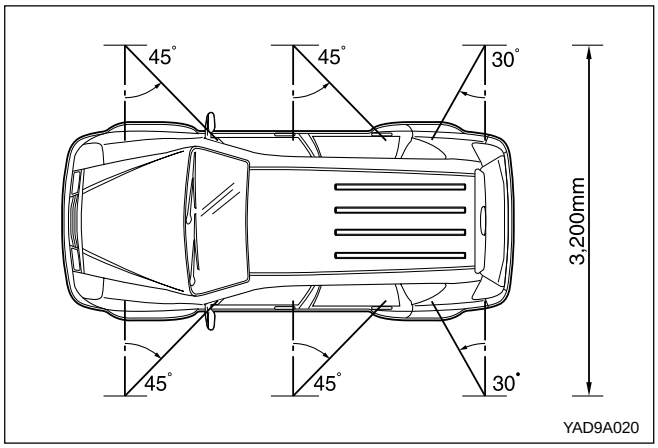
CHECK AND REPAIR


YAD9A010

CHECK

General Checking Leaking Water

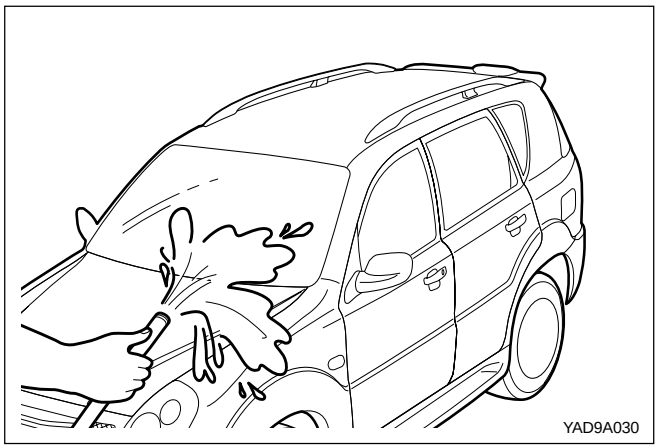
1. Install checking equipment
2. Check leaking water.
3. If water pressure is getting below regulated water pressure, to inject water overlapping, technician keeps vehicle close to stand of each side.



YAD9A020

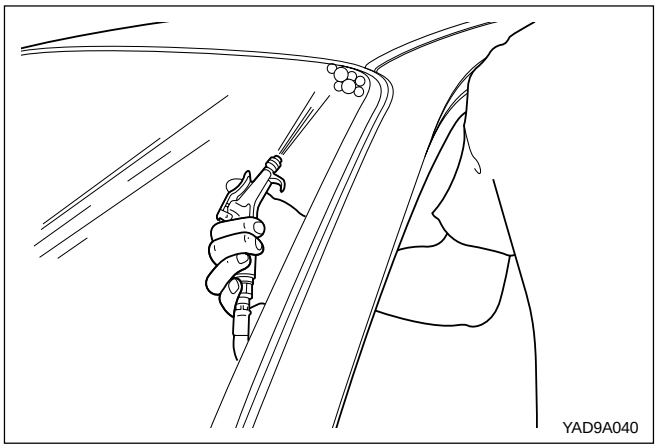
Check Local Section of Leaking Water

1. Test local section of leaking water by using water hose or air hose
2. First of all, test dubious section of leaking water by injecting water or air, until technician detect section of leaking water, point of checking is moving from the low of vehicle to the upper of vehicle.


YAD9A030

Check the Water Hose

1. In order to detect section of leaking water, another technician, is moving into the internal of vehicle.
2. Use water hose not having a nozzle.
3. First of all, test dubious section of leaking water by injecting water or air,until technician detect section of leaking water, point of checking is moving from the low of vehicle to the upper of vehicle.



Check Air Hose

1. Soap bubbles is fed on the dubious section of leaking water.
2. Inject air from the internal of the vehicle, not to keep compressing air, over 205 kPa (29.7 psi).
3. Check whether bubble of soap is occurred on the dubious section of leaking water, or not and then make sure section of leaking water.

Dignosis of Wind Noise

Notice: If technician diagnose the vehicle wind noise, another technician is driving the diagnosed vehicle for the prevention of vehicle unsafe.

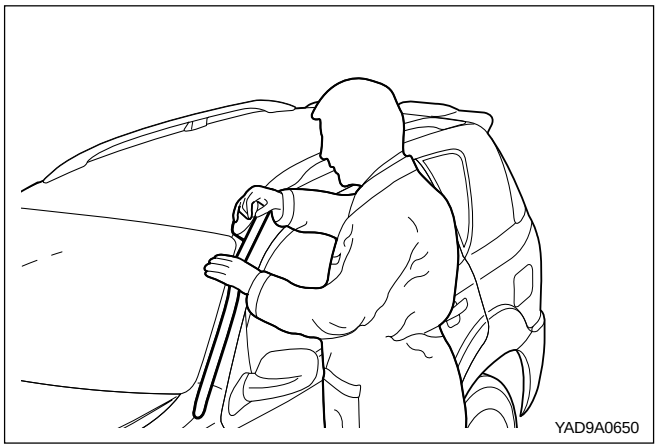
It is necessary for technician to drive vehicle in order to analyse position of wind noise, accurately, wind noise is occurred by first leaking and second, if all the leaking section is not repaired, wind noise will be reduced little bit, but wind noise will not be reduced completely

For technician to diagnose position of wind nose with driving test, following description should be provided

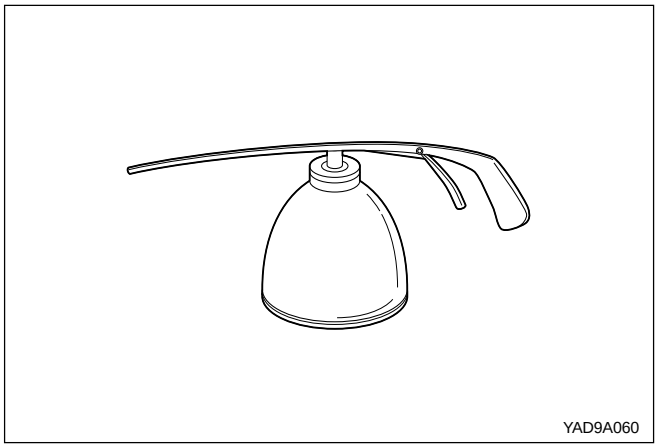
- vacuum hose
- vinyl tape
- scrip cork
- pencil indicating
- screw driver

Driving test should be observed as followings.

1. Select straight and even road which is available to East,West,South, and North.
2. Select road not preventing test which has no noise or traffic obstacle.
3. Drive the vehicle when wind noise is occurred Keep in mind within specified vehicle speed.
4. If following condition happen, each one is defined, as external wind noise.
   - wind noise is occurred by wind
   - wind noise happen on the lower side of door glass under vehicle is driving
   - wind noise is removed by taping of moulding

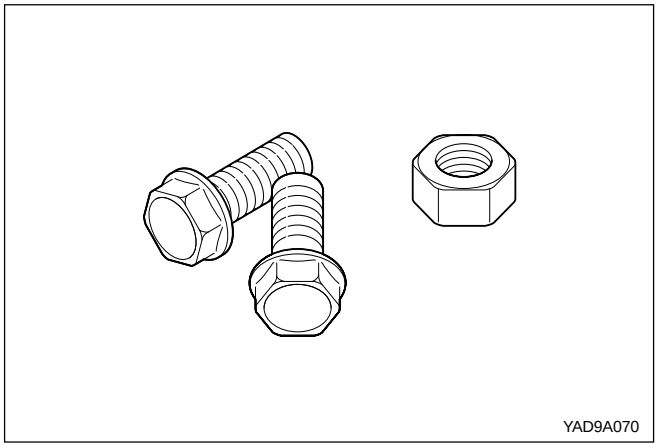

YAD9A0650

5. Internal wind noise is repaired following description
   - Leaking section is detected by using stethoscope or vacuum hose is repaired by using vinyl tape temporarily.
   - Keep driving test to check whether wind noise is removed or not if leaking section is checked.
   - Wind noise will be completely repaired by proper equipment, tool of sealing.


YAD9A060

Body

Periodically hood and locking system should be fed for operating smoothly, specially feeding oil to the section of closing and opening is depending on operation smooth and prevention of noise.


YAD9A070

Bolt and Nut

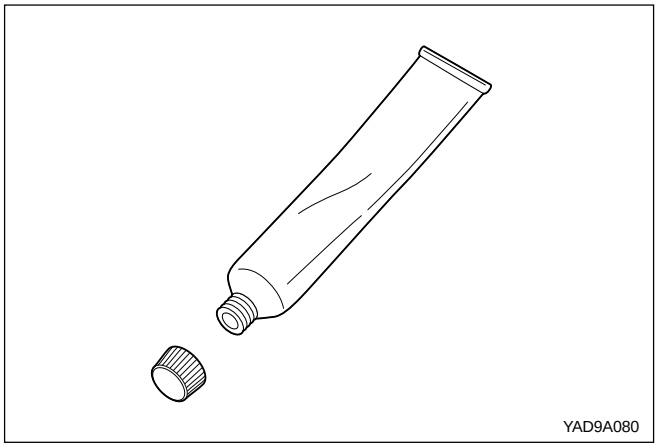
Notice: Contacting surface to the non-characteristic of each metal cause each metal to corrode so, for prevention of early corrosion, use specified bolt and nut

Alloy of aluminium is using currently most vehicle

Contacting between steel and aluminium cause to corrode if those are ,not hardening.

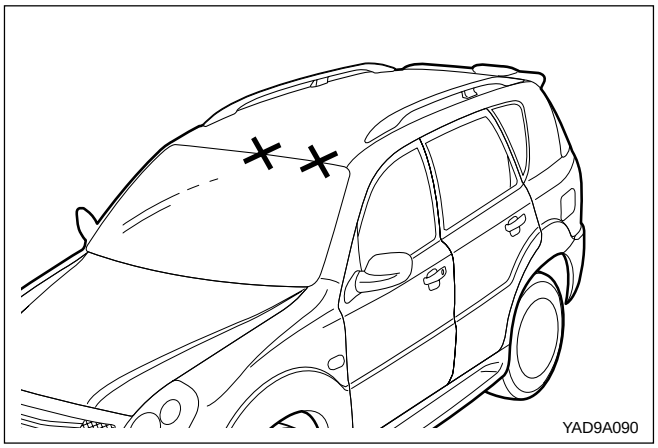
Special bolt and nut are using for prevention of corrosion in the vehicle.

If bolt and nut are replaced, same specification of bolt and nut should be, used or similar material of bolt and nut.


YAD9A080

The Prevention of Corrosion

In order not to corrode body, surface of internal panels of metal is added, material of anti-corrosion. If those panel are replaced, spread material of anti- corrosion on the panels with proper quantity


YAD9A090

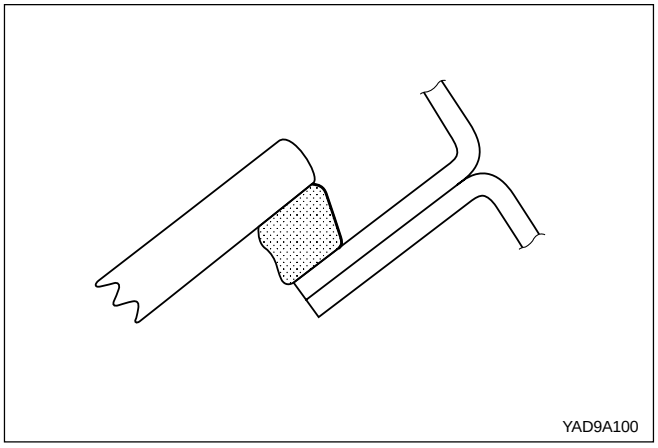
REPAIR

Repair Leaking Water

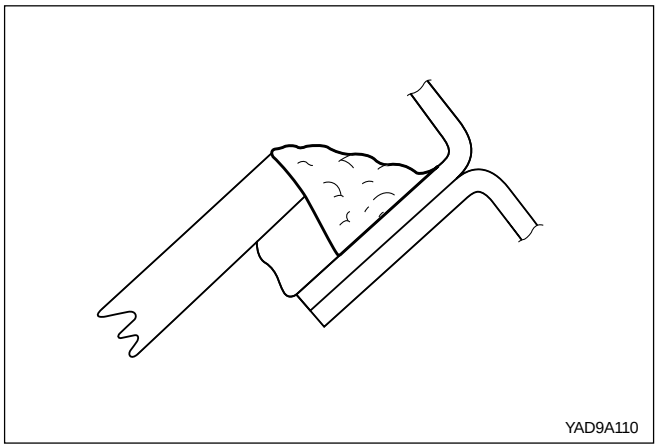
Leaking water on the section of glass can be repaired without removal of glass.

Notice: Method to repair of following description is applied on the equipped glass of urethane sealing.

1. Remove leaking moulding and section of trim, to detect position of leaking water it is necessary for technician to remove trim and garnish moulding
2. During injecting water on the leaking section, to detect quantity of leaking water, carefully push the glass external area.
3. Mark accurate position of leaking water.
4. Wash section of leaking water and dry up air hose.


YAD9A100

5. Remove ununiform section of cohesive material on the distance of 75 - 100 mm to leaking section
6. Spread prima on the uniform section leaking


YAD9A110

7. Wait approximately 5 minutes, until drying up prima.
8. Spread cohisive material on the distance of 75 - 100 mm to leaking section.
9. After spreading cohisive material, using the flat stick and similar equipment, keep body and cohisive material uniform in order not to leak water.
10. To make sure to finish repairing leaking water, inject warm water or, hot water on the section of leaking water.
11. Install parts removed to repair leaking section.

    Notice: After repairing section of leaking water completely, using stand for leaking. test, check the section of leaking water again, if abnormal pressure is checked, repaired cohesive material may get out of position itself. So leaking water test should not check on local section of leaking .

Method to Repair Wind Noise

Method to repair wind noise is similar to method to repair leaking water.

Wind noise of around door opening weather strip is not proper installed.

Weather but depends on adjusting door and window.

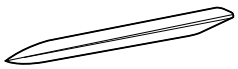
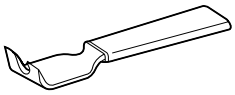
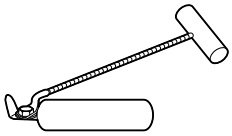
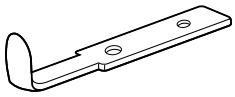
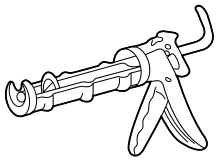
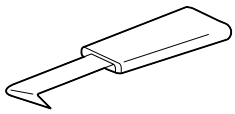
Method to Repair Body Noise

Due to not properly installed parts of body, body noise is occurred, in order not to make a noise, proceed the following description.

- Install completely relative moving parts under vehicle's moving.
- Repair clearance of moving parts under vehicle's moving.
- In order not to cause body noise about moving parts, separate, moving parts, treat soundproof.
- Uniform surface of friction can prevent harding state.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD9A120	**09793-21000** **Adjusting Wrench of Door Wrench**
 YAD9A130	**09800-21000** **Ornament Remover**
 YAD9A140	**09853-31000** **Remover of Headlning Clip**
 YAD9A150	**09861-31100** **Cutting Tool of Sealant**
 YAD9A160	**09861- 31200** **Cuttibg Knife of Sealant**
 YAD9A170	**09861-31300** **Sealant Gun**
 YAD9A180	**09861-31400** **Glass Holder**
 YAD9A190	**09861-31000** **Remover of Wind Shield Molding**

SECTION 9B

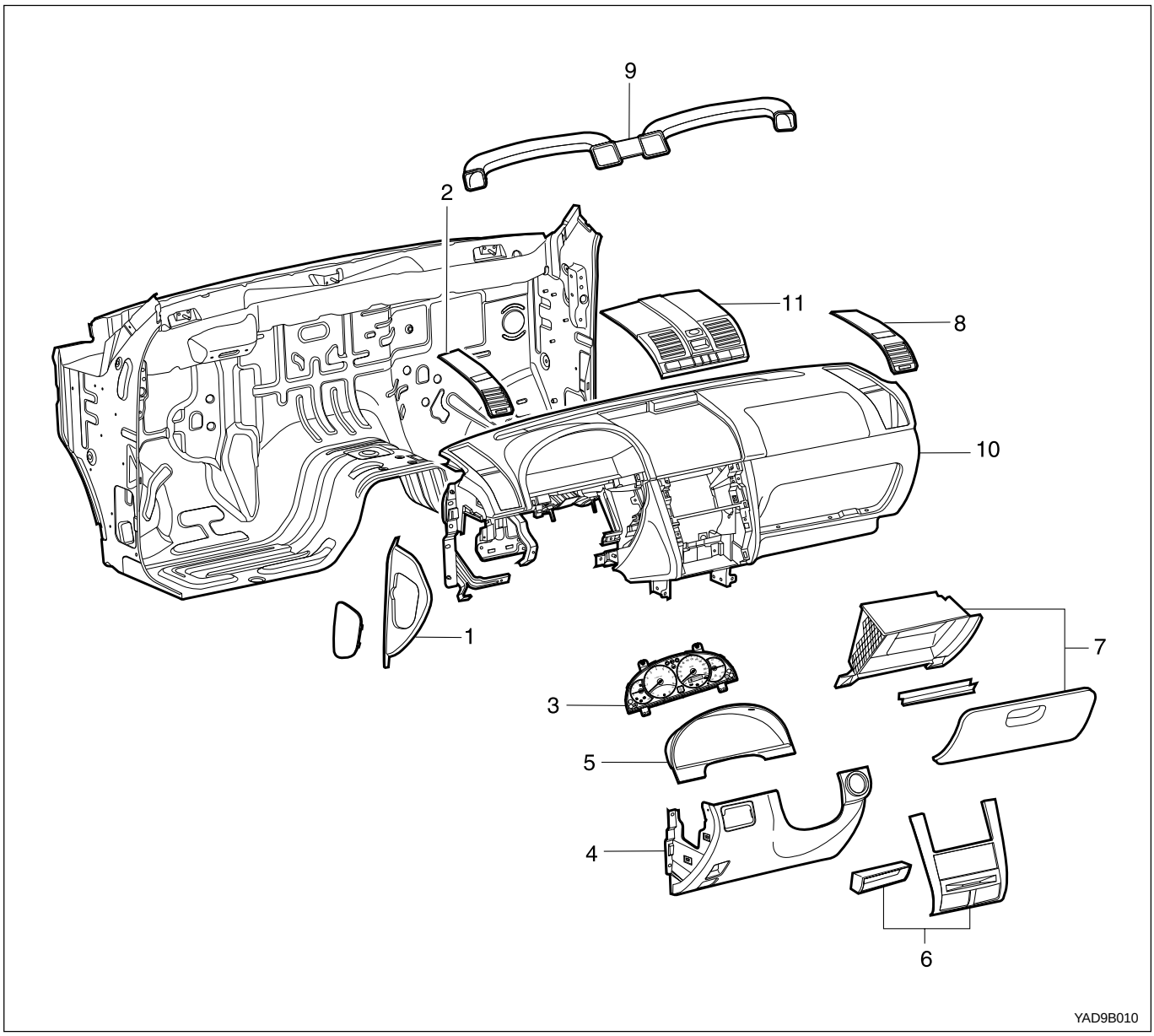
BODY INTERIOR

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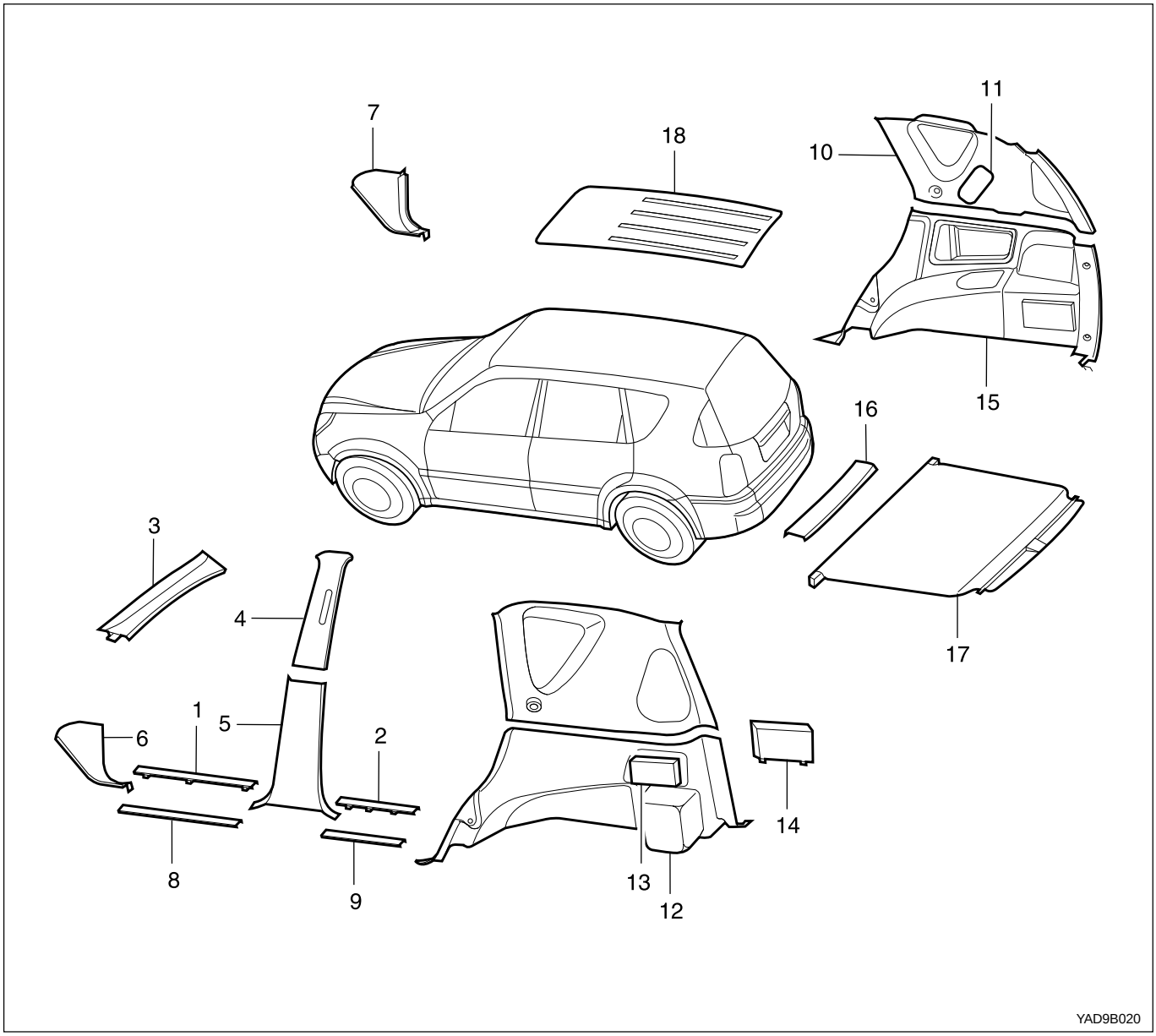
COMPONENTS LOCATION

INSTRUMENTS ASSEMBLY



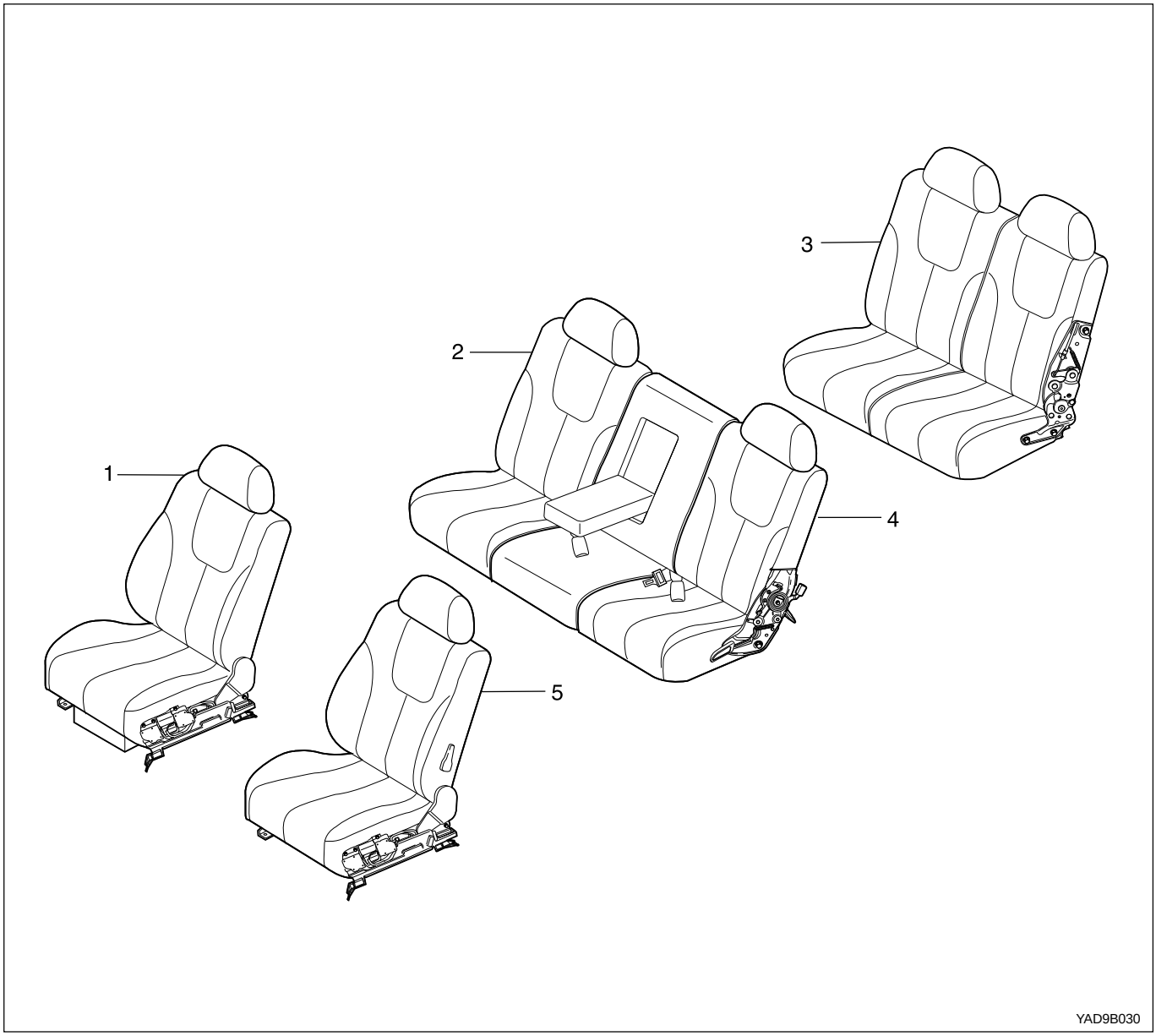
1 Fuse Box Cover
2 Side Facia Panel
3 Instrument Panel
4 Instrument Lower Main Panel
5 Cluster Facia Panel
6 Center Facia Lower Panel
7 Groove Box
8 Side Facia Panel
9 Duct
10 Instrument Assembly
11 Center Facia Upper Panel

SIDE TRIM AND ROOF ASSEMBLY



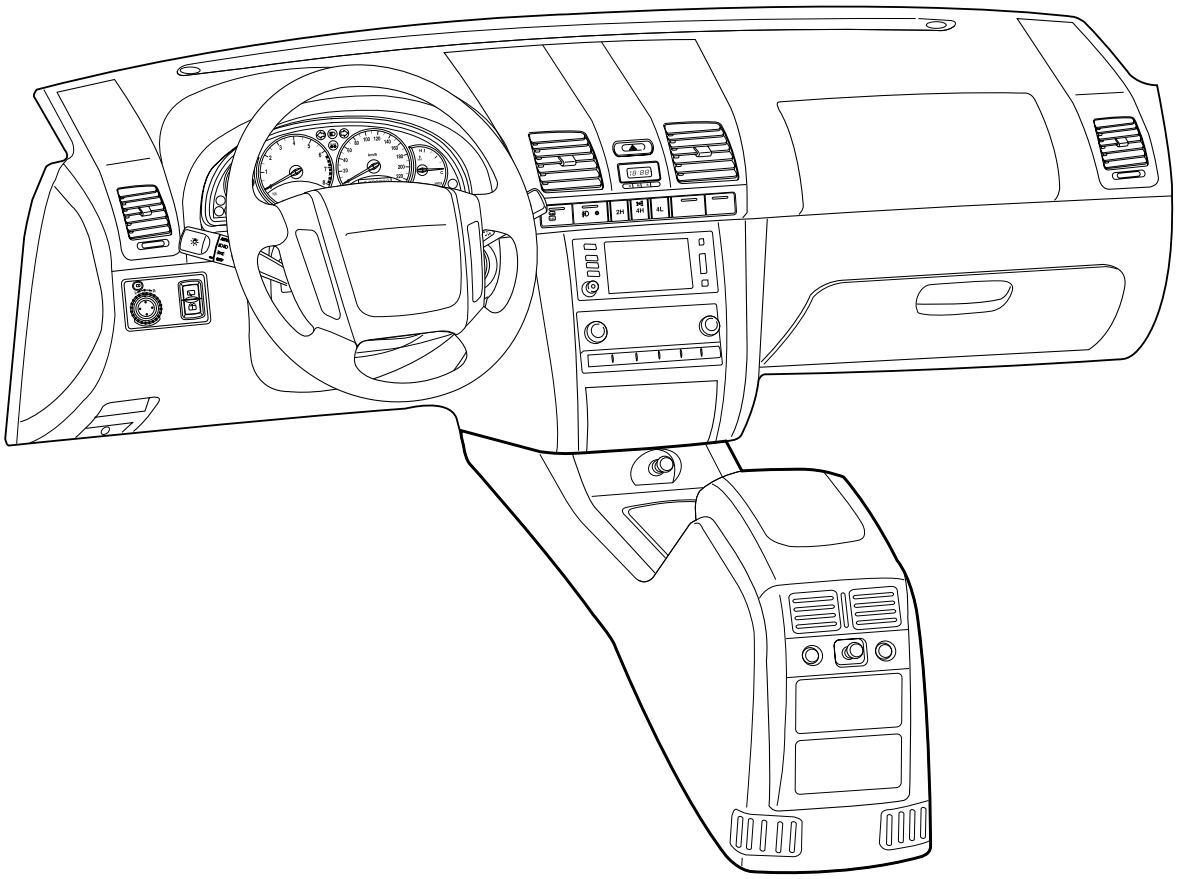
1 Door Scuff Front
2 Door Scuff Rear
3 A-Pillar
4 B-Upper Pillar
5 B-Lower Pillar
6 Side Cowl
7 Side Cowl
8 Out Side Step Front
9 Out Side Step Rear
10 Upper Quarter
11 Rear Aircon (Facia)
12 Lower Quarter
13 Jack Cover
14 Lower Quarter (Cover)
15 Lower Quarter
16 Rear Transverse Trim
17 Baggage Room Cover
18 Roof Panel

SEAT



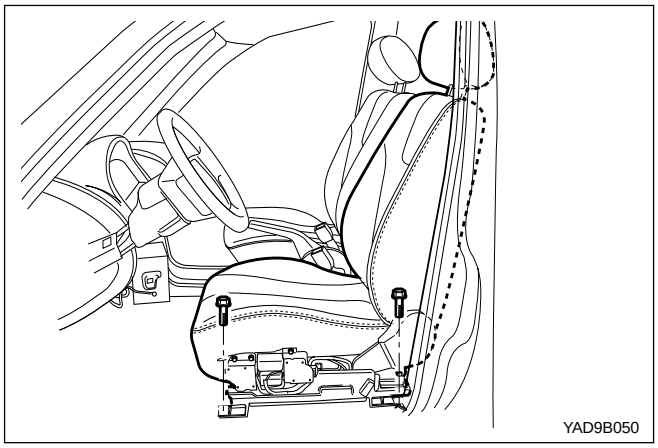
1 Front Seat - Right Side
2 Rear Seat - Right Side
3 3 Row Seat
4 Rear Seat - Left Side
5 Front Seat - Left Side

CONSOLE



YAD9B040

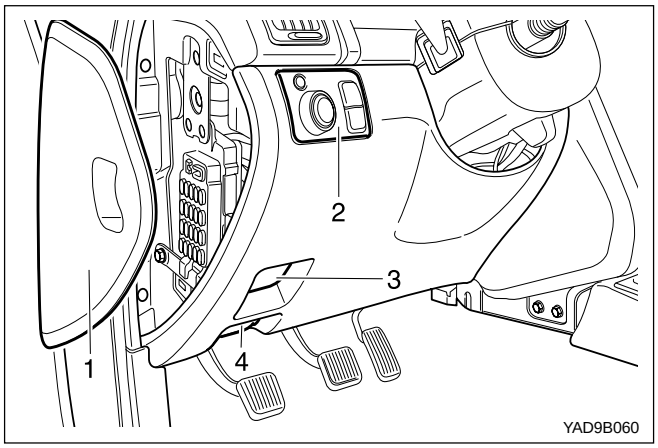
REMOVAL AND INSTALLATION



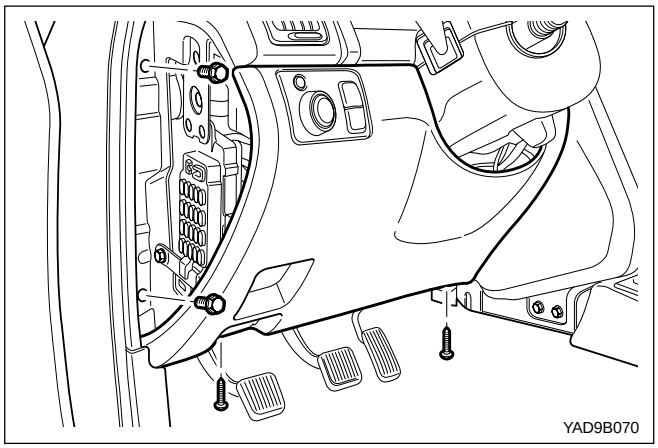
INSTRUMENT

Removal / Installation

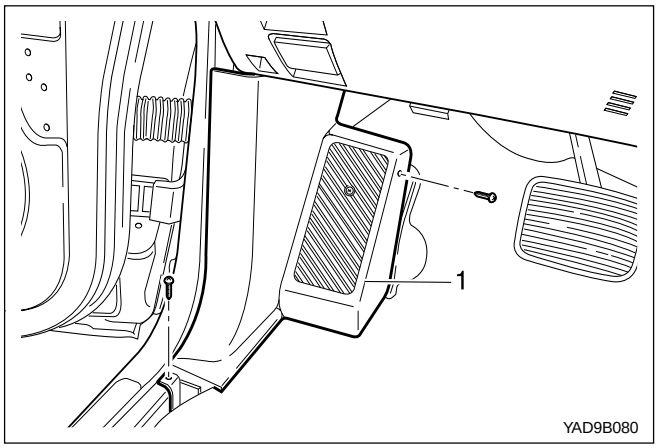
1. Remove negative terminal(-) from battery.
2. Remove seat of passenger to remove easily panel of instrument.



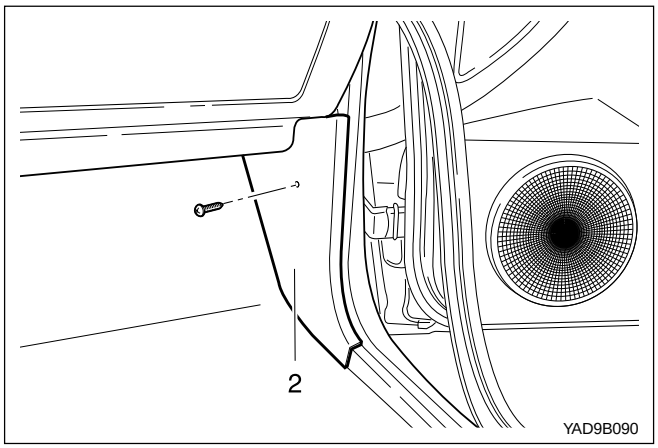
3. Remove cover(1) of fuse box, switch panel(2) of side mirror, release lever(3) of fuel tank cover.



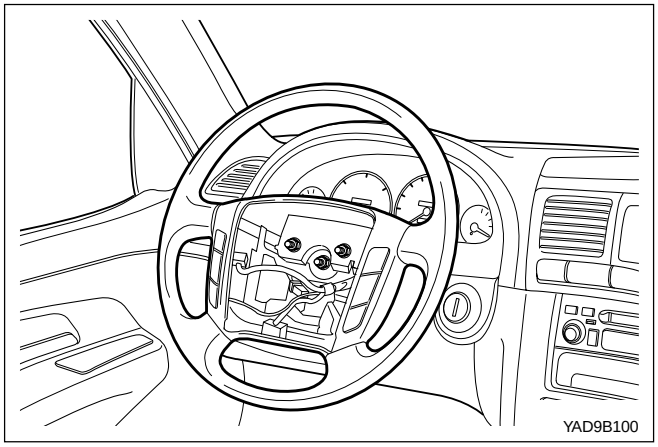
4. Remove lower panel of driver seat in the instrument panel.



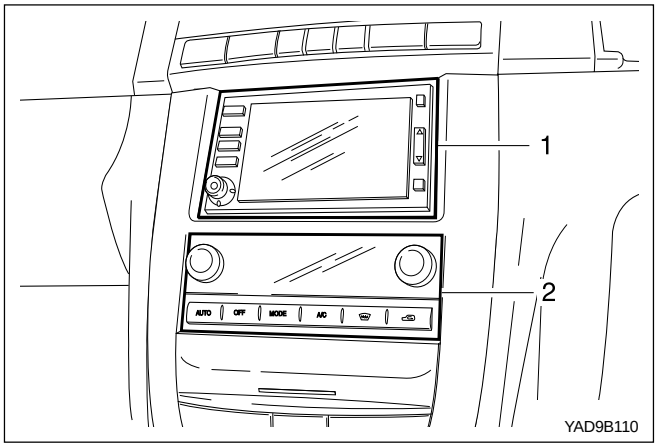
5. Remove side cowl in the left side/ right side.
   1) Remove front trim of door scuff in the left side / right side.
   2) Removing screw of side of foot-board, side of door in the side cowl and then come to removal of side cowl.



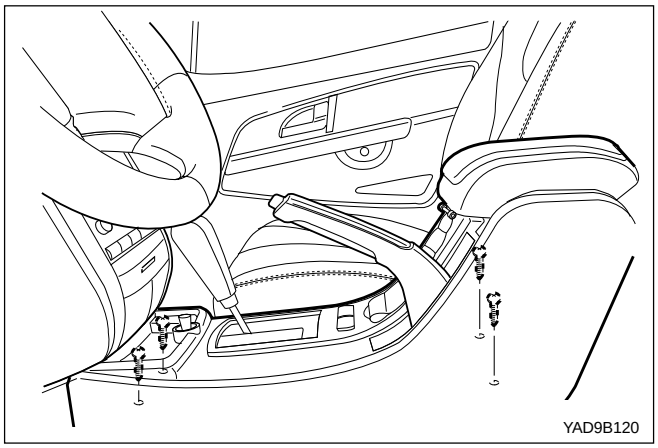
   3) After driver put clearance between pillar and panel, remove side cowl.



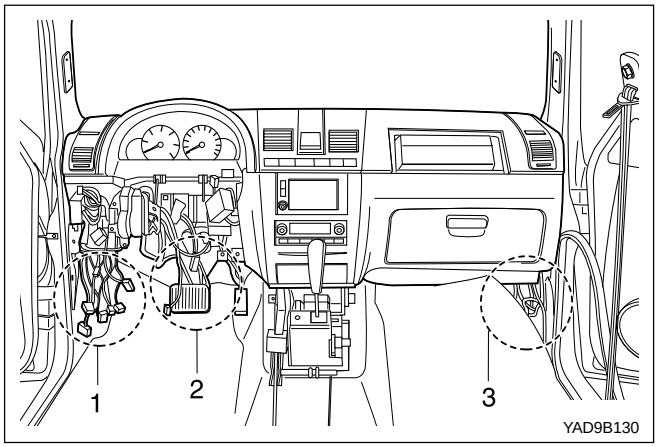
6. Separating connector and vacuum hose from steering column assembly, remove steering column shaft assembly.



7. Removing center facia panel , remove Audio(1), Aircon controller Assembly(2).

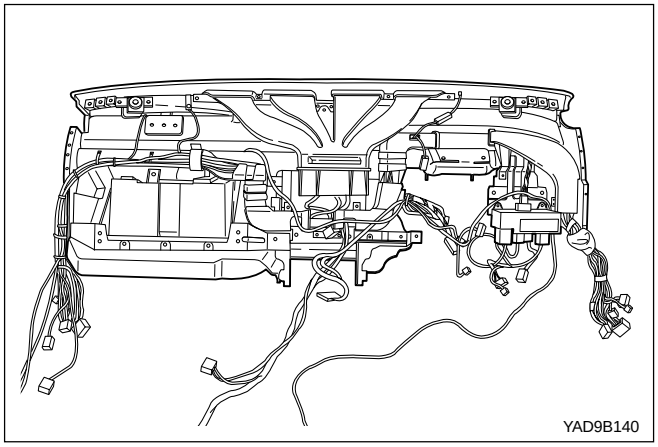

YAD9B120

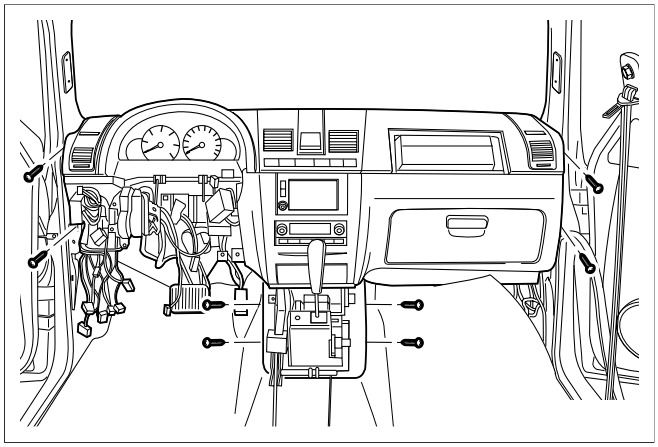
8. Remove the console box.



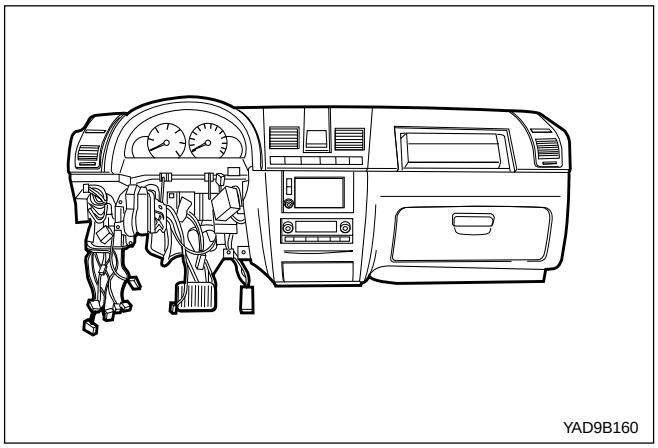
YAD9B130

9. Remove connector of main harness linking to center and right side /left in the instrument panel.
   1) Connector linking to left side
   2) Connector linking to right side
   3) Connector linking to center

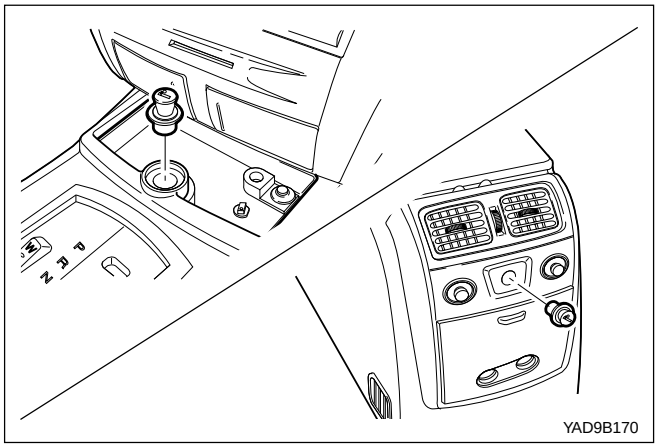

YAD9B140



10. After releasing fixing bolt and nut in the instrument panel, remove panel assembly.


YAD9B160

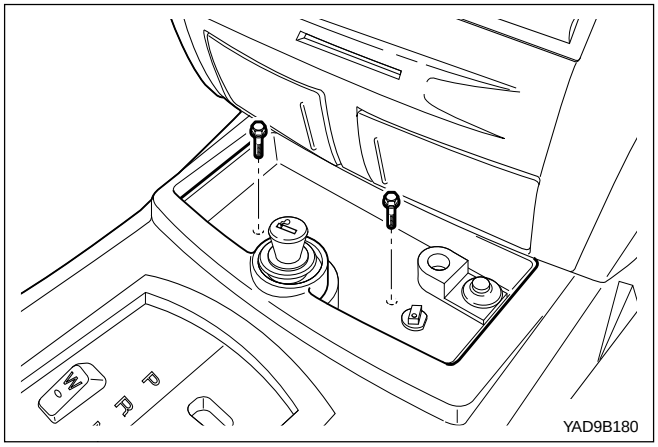
11. Installing the reverse of removal, insert each connectors tightly.


YAD9B170

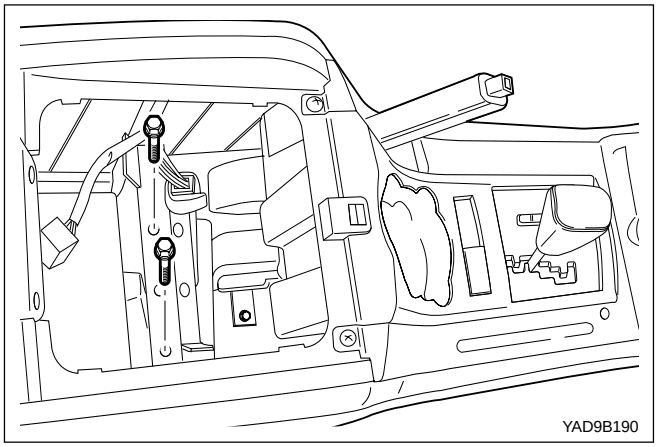
COSOLE BOX

Removal / Installation

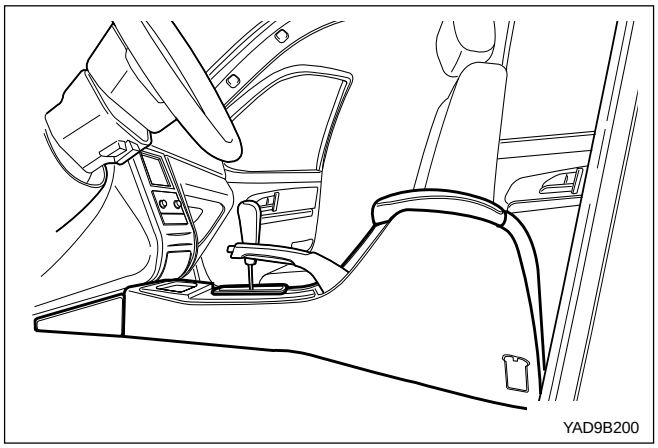
1. Separate front console cover and console tray.


YAD9B180

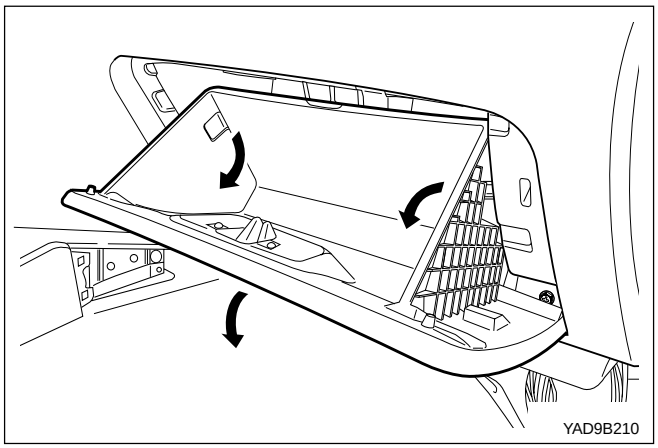
2. After removing front console cover , separate fixing bolts(2).


YAD9B190

3. Separate fixing bolts from console tray internal in the console box of rear side.



4. Separate cigar lighter, connectors of seat warmer (right/ light).
5. Remove console assembly.

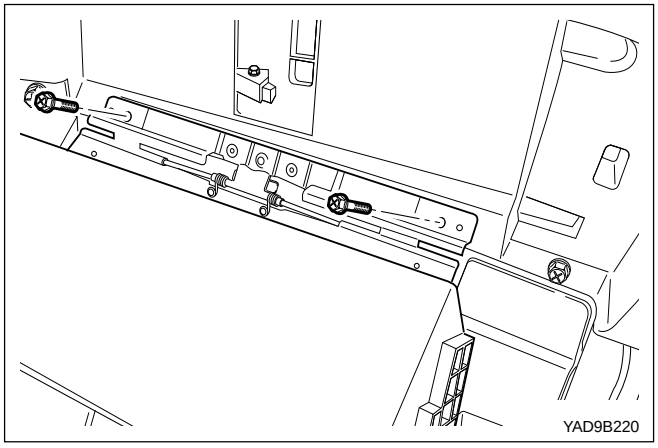


GROOVE BOX

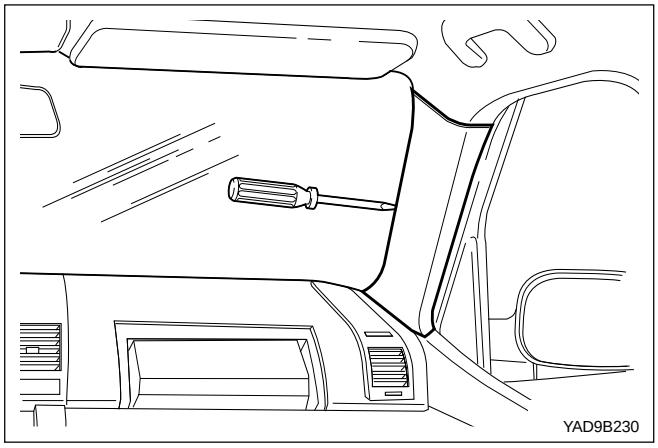
Removal / Installation

1. Remove hook of left/right side in the groove box from instrument.

   Notice: If excessive force is put on hook, hook may be broken.



2. While the groove box is opened completely, release fixing bolt of bracket, and then remove groove box assembly.



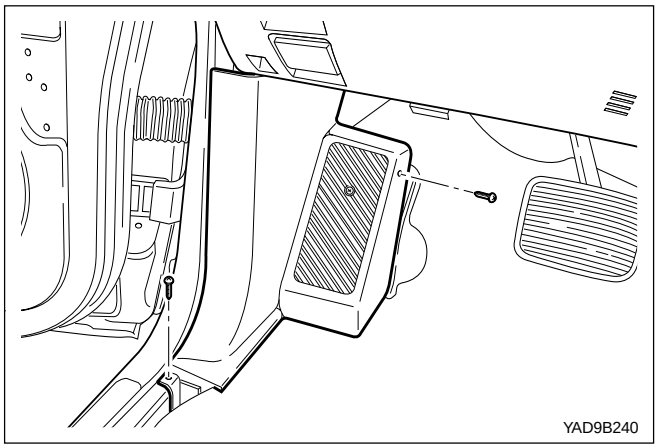
TRIM AND ROOF

Removal / Installation

Notice: Installation proceed reverse order of removal.

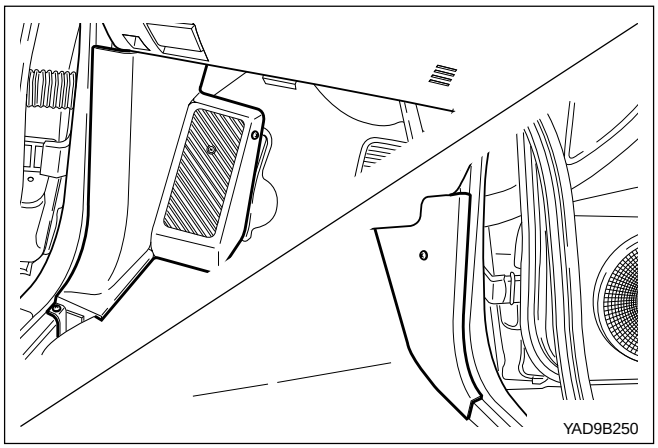
A-pillar

1. Remove trim of A-pillar
   - Pull key of A-pillar trim out of key home.

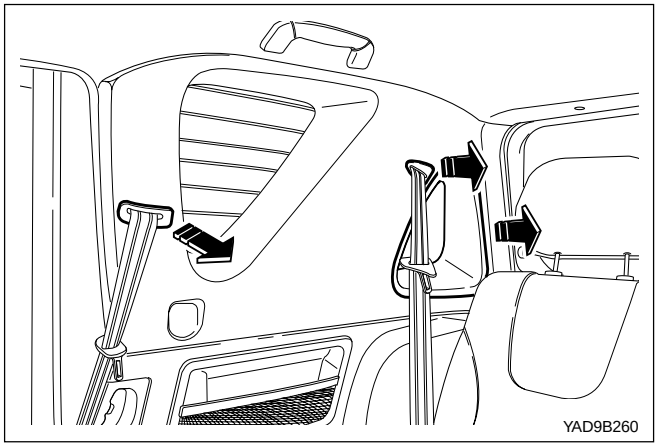


Side cowl trim

1. Separate fixing screw of door side and fixing screw of foot board of side cowl-trim in the driver seat.

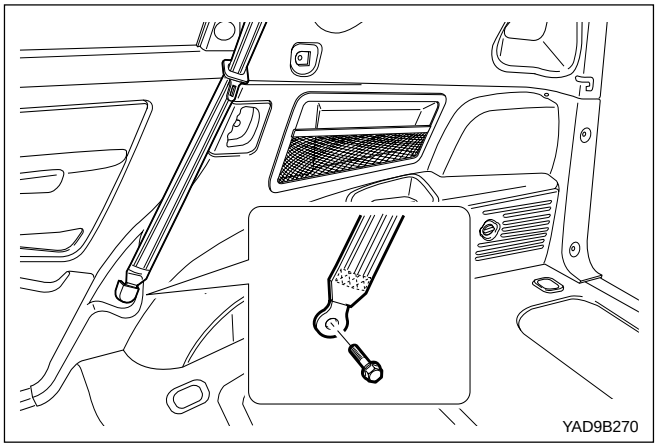


2. Remove trim of side cowl (right/left).

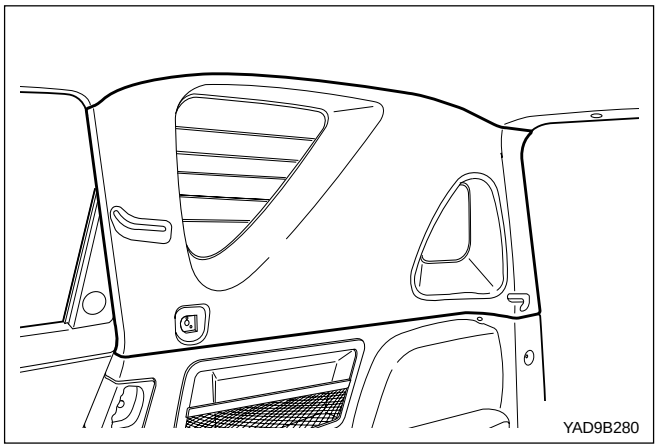


Upper / lower quarter

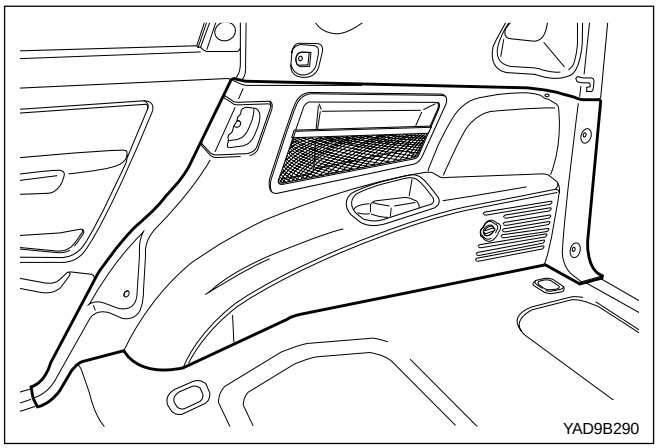
1. Remove rear window cover ,seat belt cover of upper quarter trim.



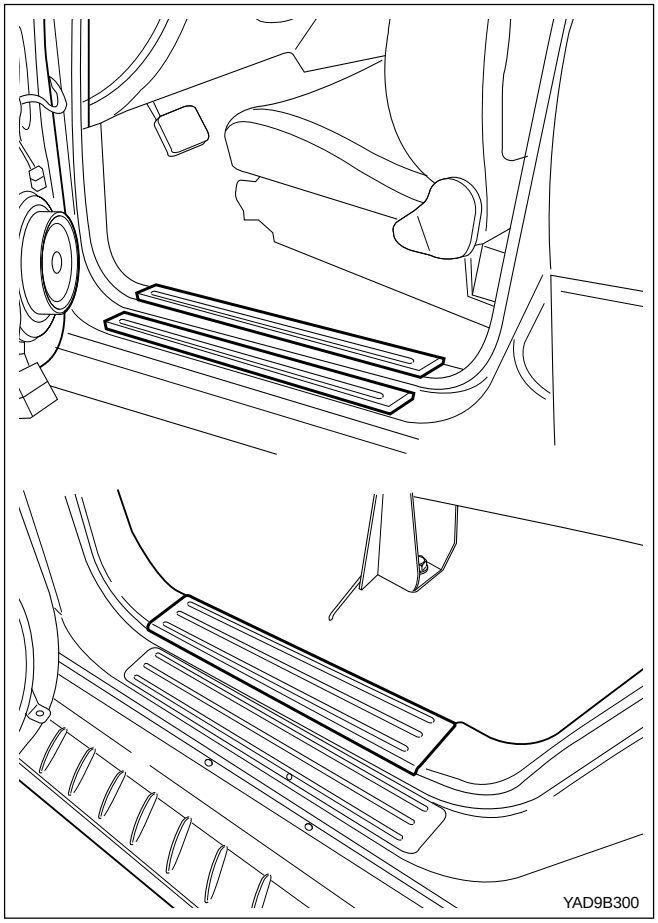
2. Release fixing bolt of rear seat belt lower.



3. After releasing fixing screw, separate upper quarter trim.



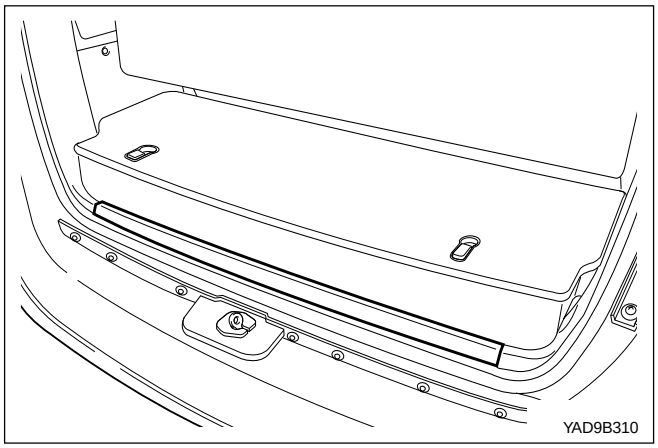
4. Separate lower quarter trim, in order to make easy repair, cover of lower quarter trim (right/left) is separated in advance.



Door scuff trim

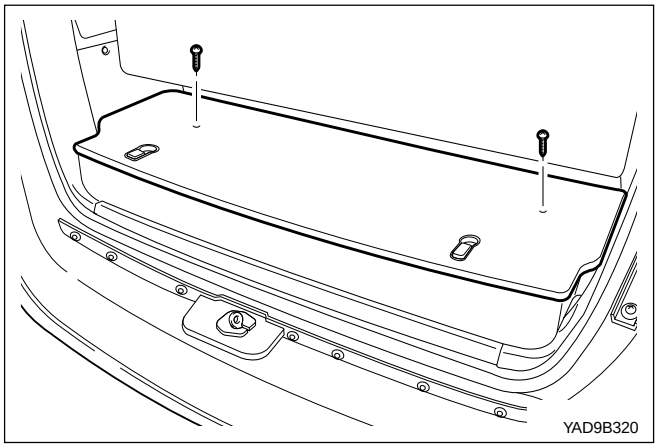
1. Using special tool, separate door scuff trim of front and rear.

   Notice: First of all, remove door scuff trim of front and rear in advance while door scuff trim of front and rear is installed finally.



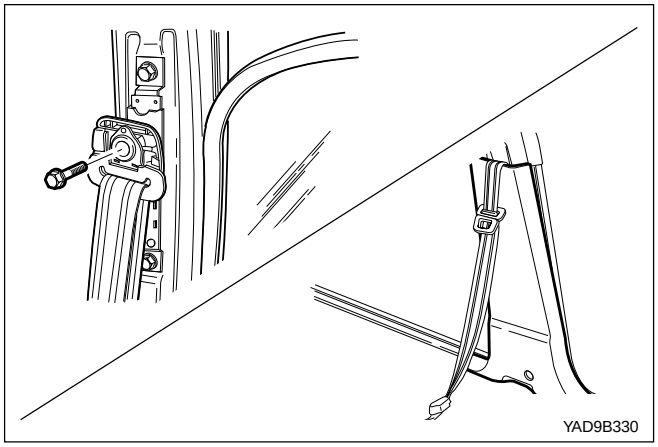
Rear transverse trim of tail gate

1. After opening the tail gate, release fixing screw of rear transverse trim.
2. Separate rear transverse.



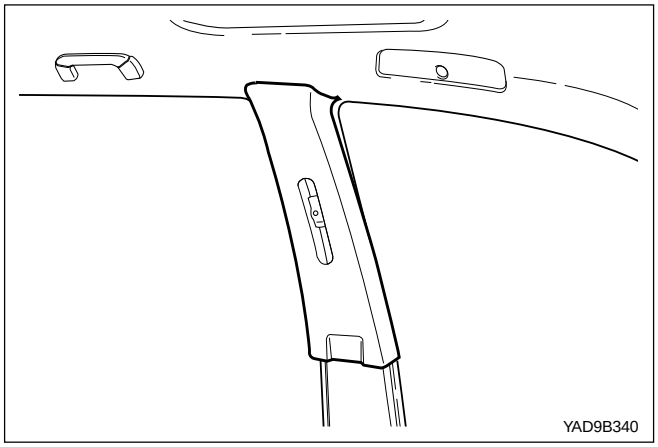
Multi-purpose luggage box

1. Opening the cover of tool box, separate bolt and screw in the multi-purpose,box.
2. Separate multi-purpose box from luggage compartment.

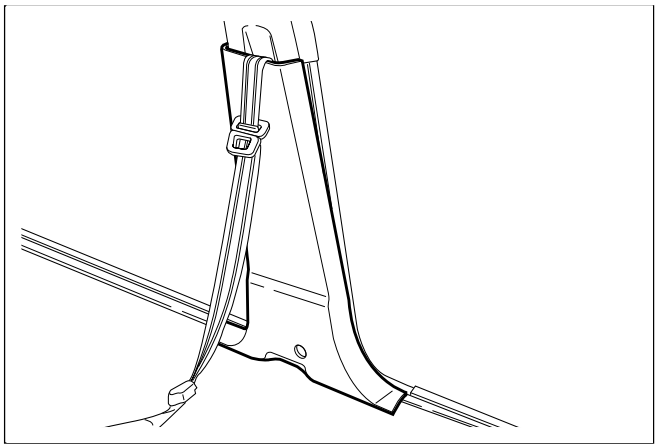


B - pillar trim

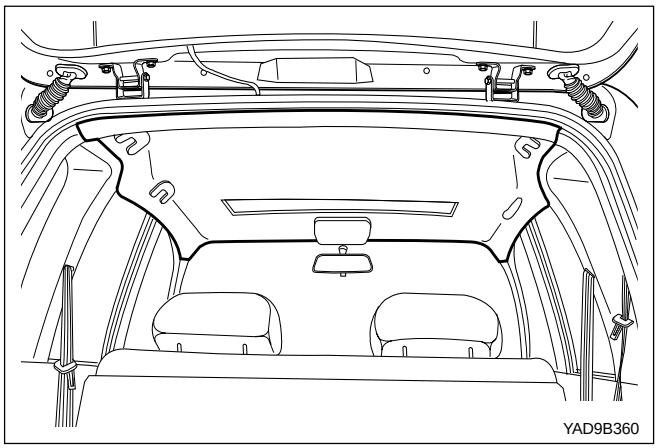
1. Release fixing bolt upper and lower of seat belt.



2. After pulling trim of upper B-pillar trim by the hand, pick up key of trim from panel, and then separate trim.

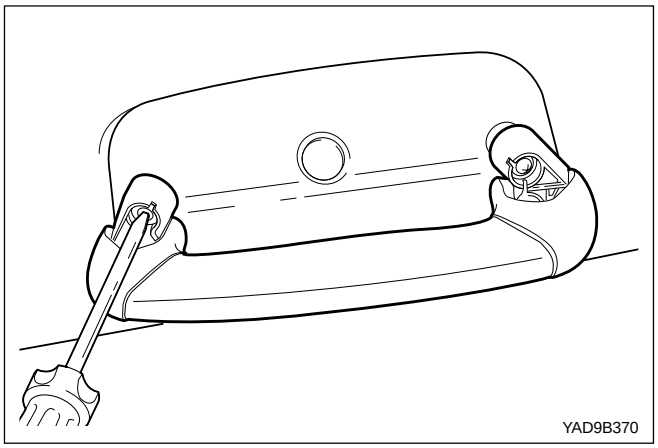


3. Separate trim of lower B-pillar trim with the same method to separate, upper trim.



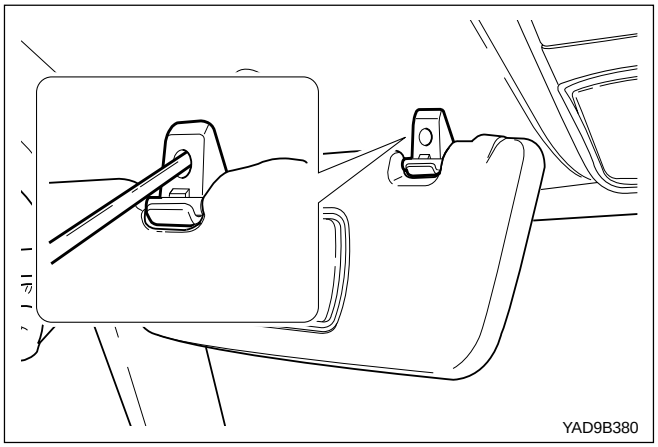
Roof (Head lining)

1. Separate sun-visor right and left.
2. Separate upper trim right and left.
3. Separate four handle.
4. Separate room lamp, sun roof, door opening weather strip.
5. After pulling clip bolt out of headlining, separate headlining.



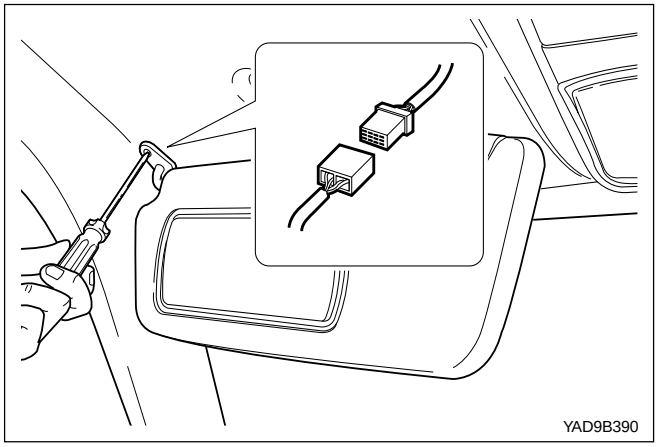
HANDLE

1. After downing handle, release screw.
2. Separate handle.

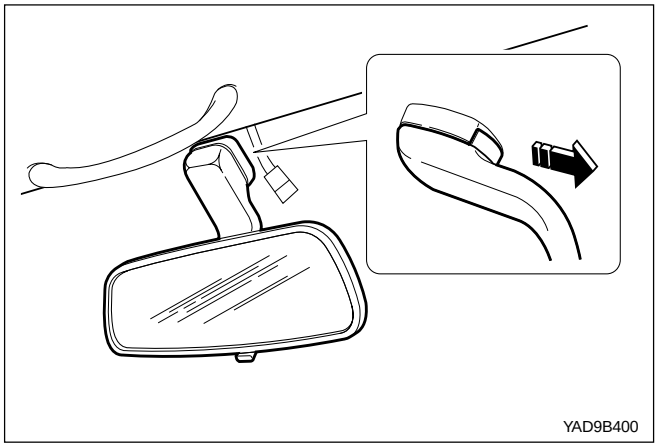


SUNVISOR

1. Separate fixing hook of sun-visor.

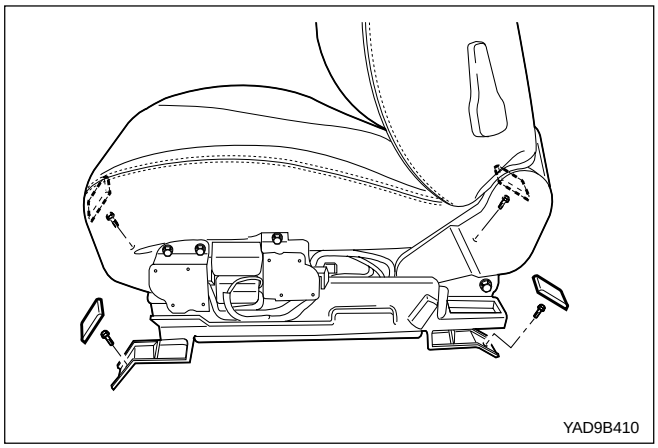


2. After separating fixing bracket, separate connector of mirror lamp.
3. Separate sun-visor.



ROOM - MIRROR

1. Pulling room mirror, separate it.

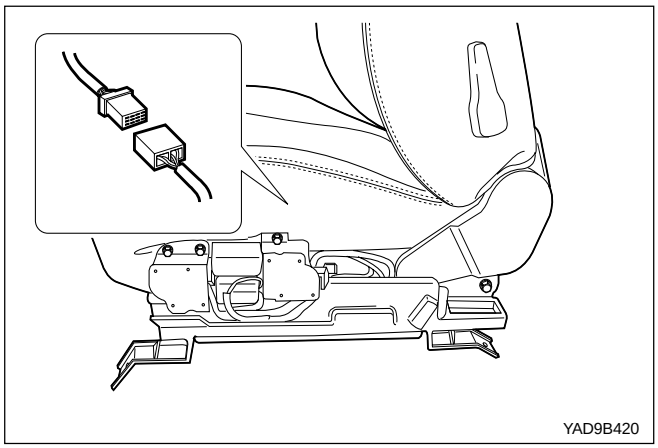

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SEAT

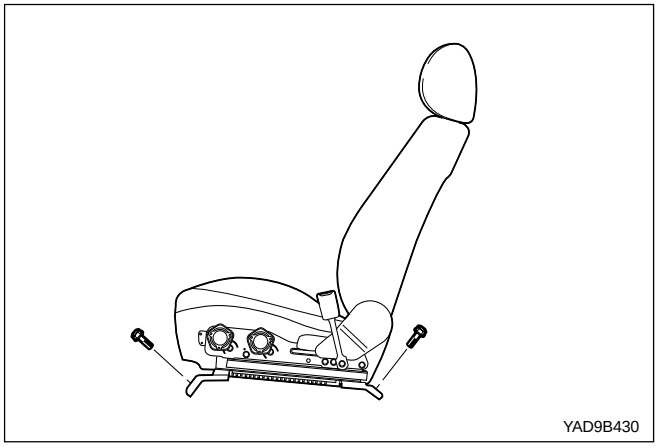
Removal / Installation

Front seat

1. Remove plastic cap (3ea) of seat rail.
2. Separate fixing bolt (4ea: M10) of seat rail right and left.

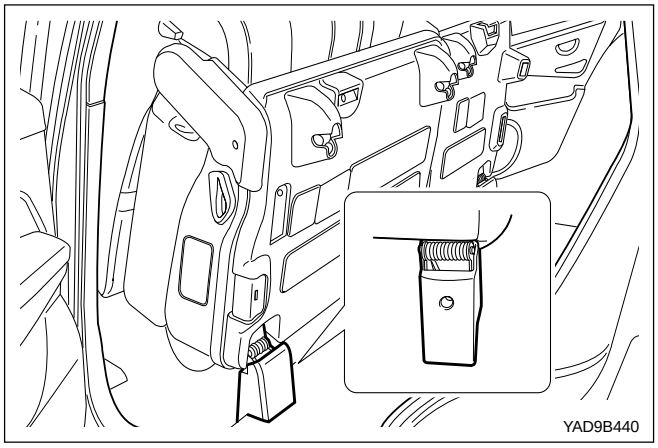

YAD9B420

3. After separating connector of floor wiring, remove front seat.
   - Position of connectors
     1) Driver seat : 2 each , SAB : 3 each
     2) Passenger seat : 1each, SAB : 2 each


YAD9B430

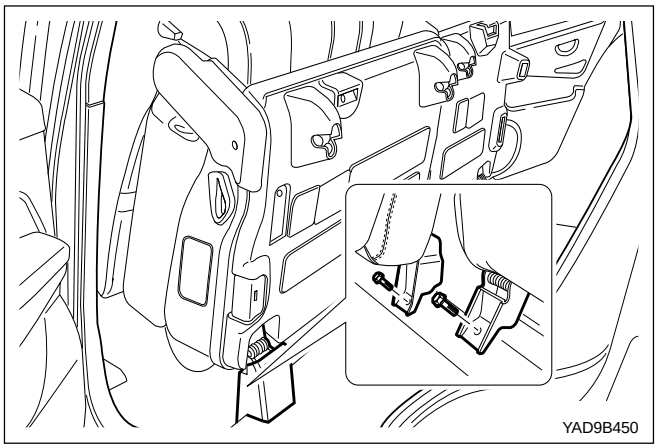
While the seat is installed, technician should tight the torque, as following.

Tightening Torque	35 - 55 N•m (44 - 52 lb-ft)


YAD9B440

Two row seat

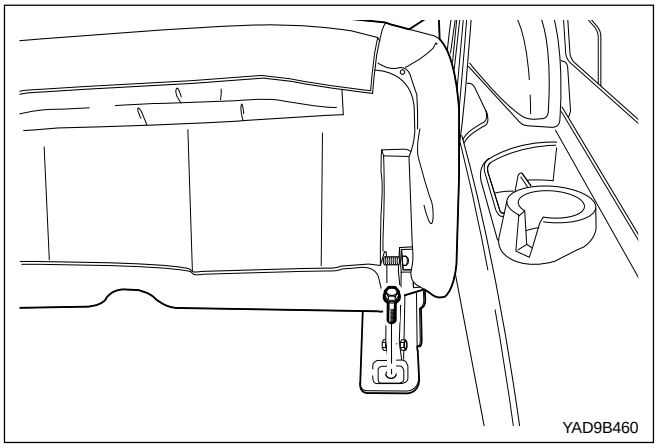
1. After separating cover fixing screw (2 each) of seat mounting in the seat right and left, remove cover of seat rail.



2. After separating fixing bolt of mounting in the seat right and, left, remove seat.

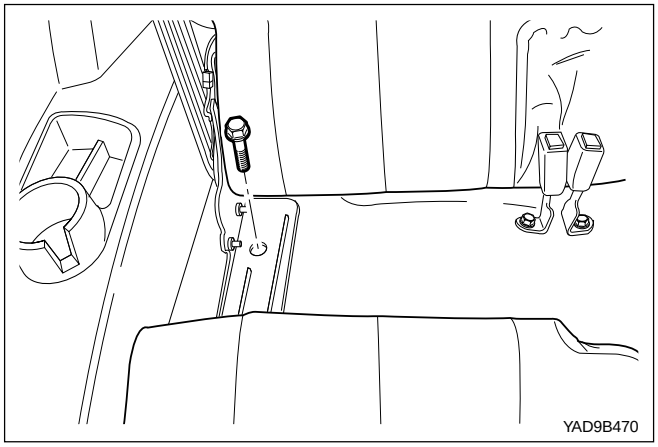
While the seat is installed, technician should tight fixing bolt, as following.

Tightening Torque	60 - 70 N•m (44 - 52 lb-ft)

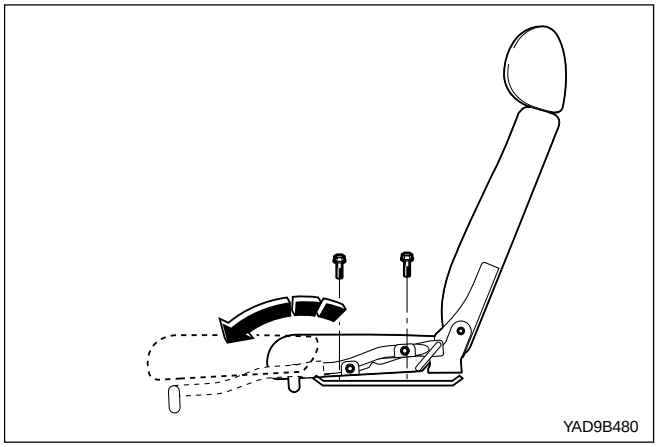


Three row seat

1. Pull seat cushion of three row seat forward
2. Separate fixing bolt of three row in the seat right and left.



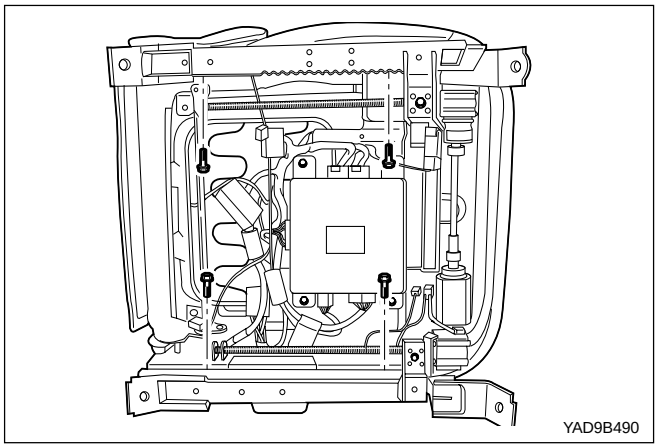
3. After separating fixing bolt of mounting in the rear seat right and, left, remove seat.



While the seat is installed, technician should tight fixing bolt, as following.

Torque fo front fixing bolt	35 - 55 N•m
Torque fo front fixing bolt	35 - 55 N•m

REMOVAL AND INSTALLATION

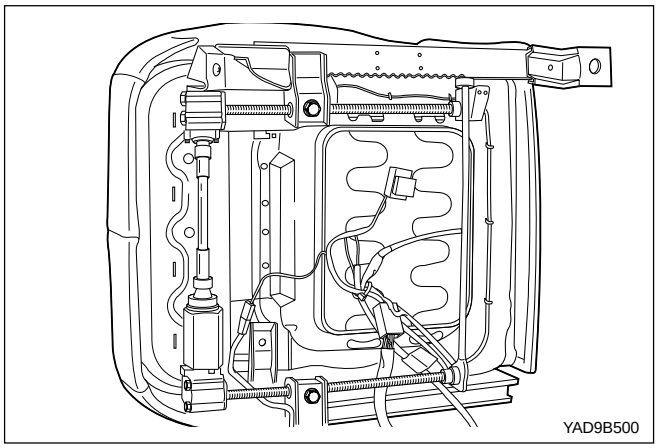


FRONT SEAT

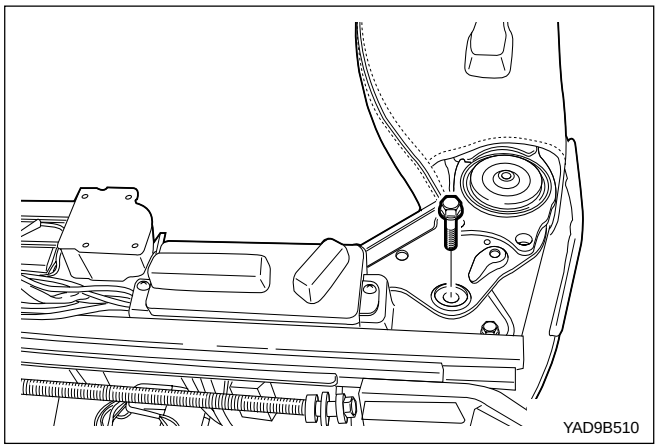
1. Release fixing bolt (4 each) of seat cushion from the separated seat.

   While the seat is installed, technician should tight the fixing bolt, as following

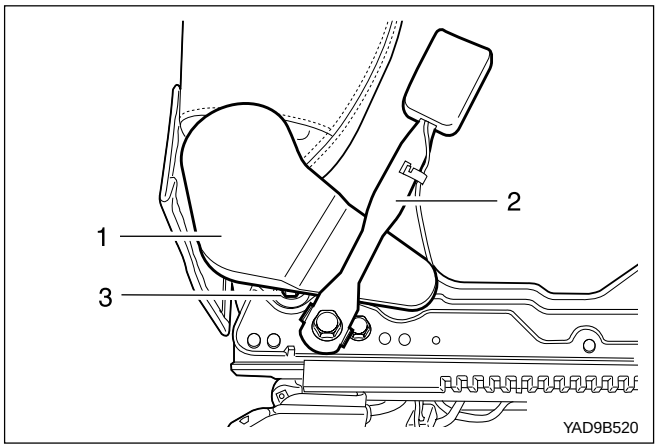
Torque fo front fixing bolt	41.2 - 49 N•m
Torque fo front fixing bolt	41.2 - 49 N•m



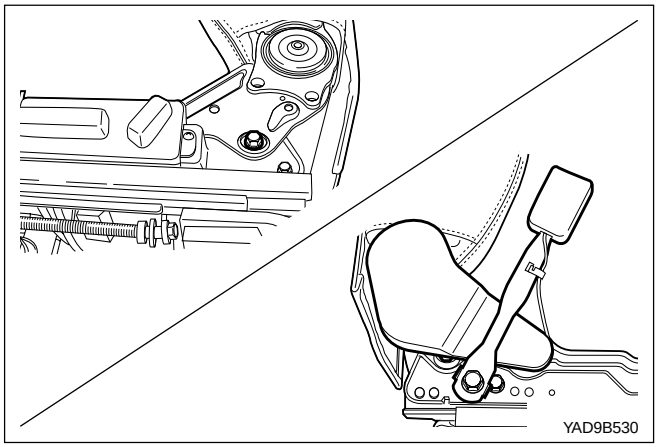
2. Separate seat cushion from the seat rail, at this time, if seat warmer is equipped , separate connector.



3. After separating connector of adjusting switch, remove external cover of seat.
4. Remove fixing bolt of seat rail (M10 x P1.25. 2each).

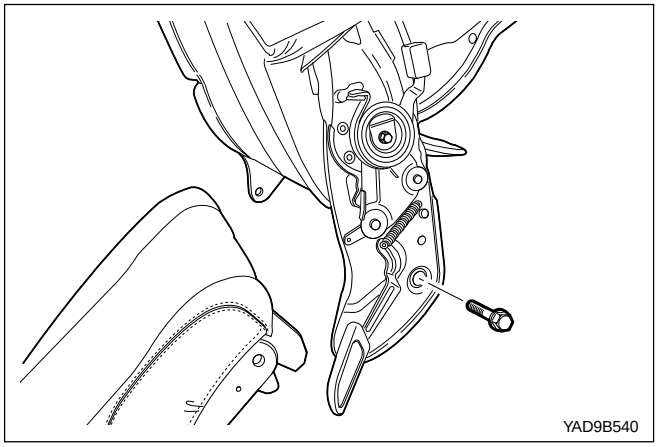


5. After separating external cover(1) of seat and buckle assembly(2) the other side, separate fixing bolt of seat rail.
   1) Remove the cover : screw, 2 each
   2) Remove buckle assembly (7-16[11]-20)
      : After separate the connector.
   3) Separate fixing bolt of seat rail
      : 2 each (M10 x P1.25)

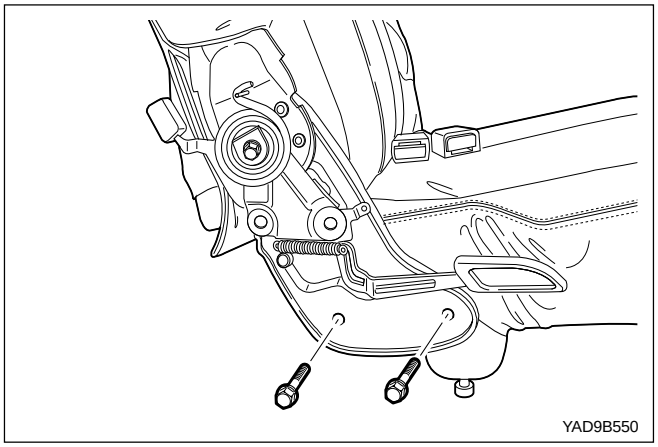


6. Install reverse order of removal.

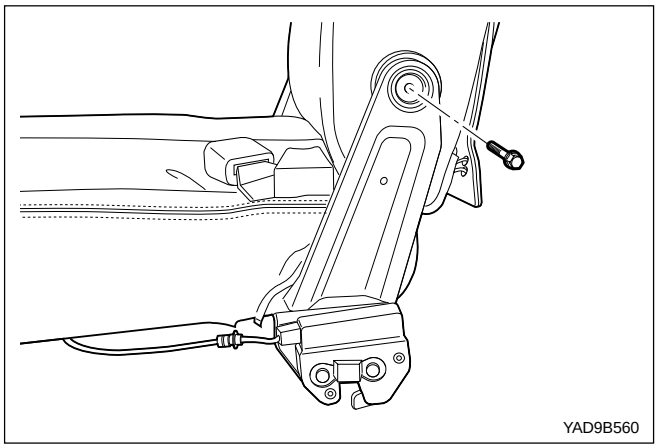
TWO ROW SEAT

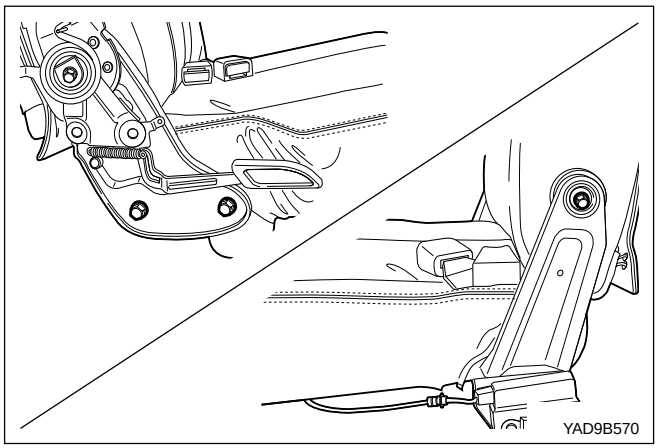


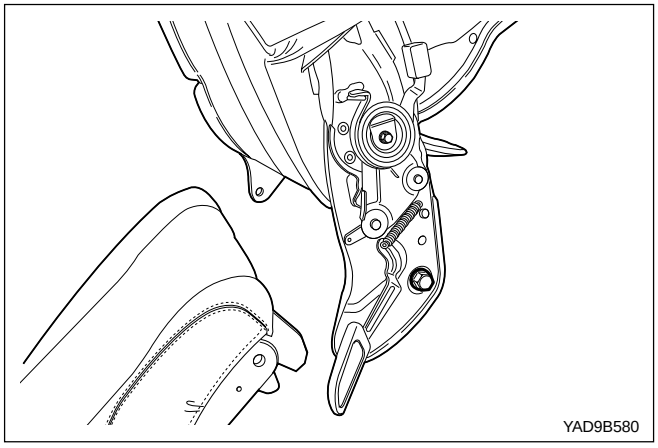
1. After releasing fixing bolt of bracket in the two row seat of two person, separate seat cushion.
   1) Remove nob of recliner
   2) Remove cover of recliner
      (External cover of seat) : screw : one)
   3) Separate fixing bolt of seat and remove cable
      (M10 x P 1.25 : 2 each)



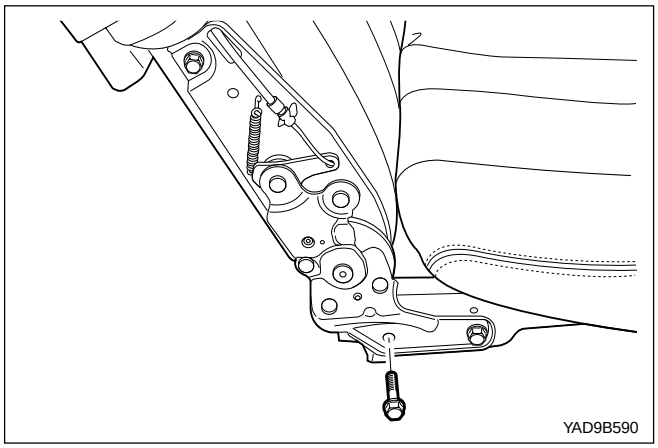
2. Position of fixing bolt differs in the left and right each other in the seat of one person (see picture), after checking the position, remove seat cushion.
   1) seat of two person : after removing external cover (screw : one), separate fixing bolt and remove cable(M10Xp1.25)
   2) seat of one person : after removing external cover (screw : one), remove bolt of hinge.


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YAD9B570

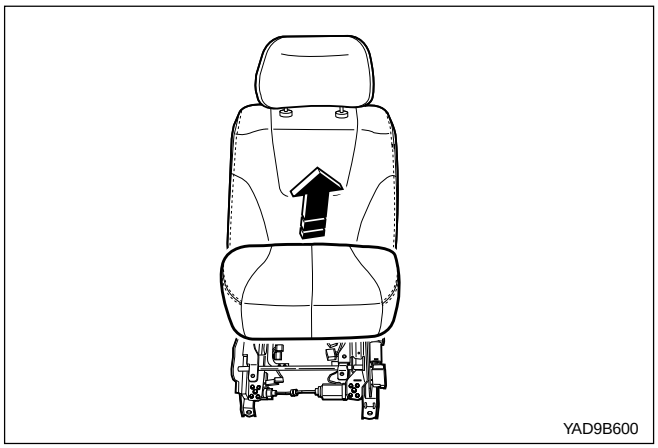

YAD9B580

3. Install reverse order of removal.



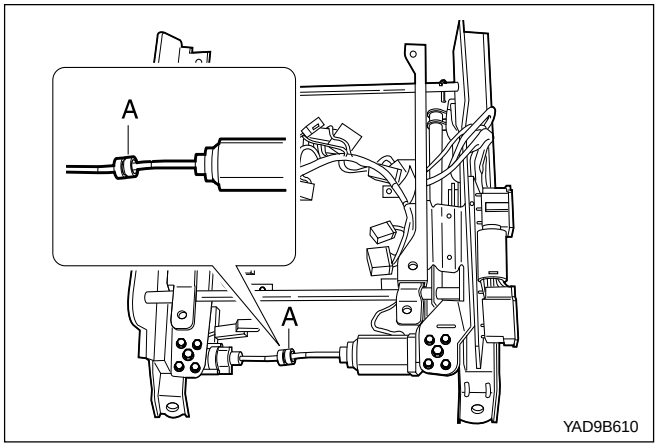
SEAT OF THREE ROW

1. After releasing bolt of seat socket at the bracket of the seat right and left, remove seat.



Replacing Seat Motor In The Guide Rail Of Seat

1. Separate seat cushion.



2. After releasing A of part of seat motor, separate wire.
3. After releasing fixing nut of seat motor, separate motor assembly.

SECTION 9C

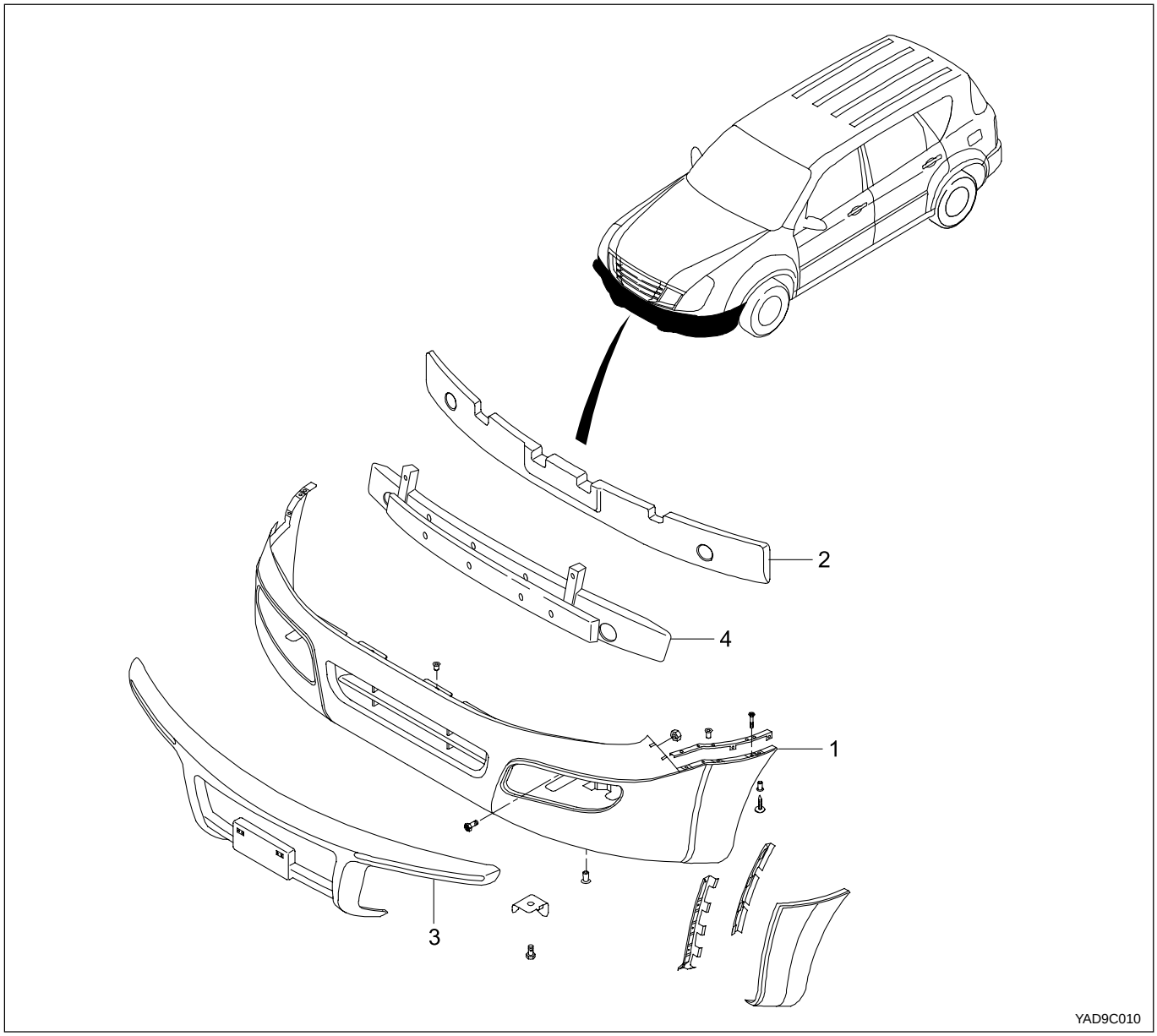
BODY EXTERIOR

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PARTS COMPONENTS

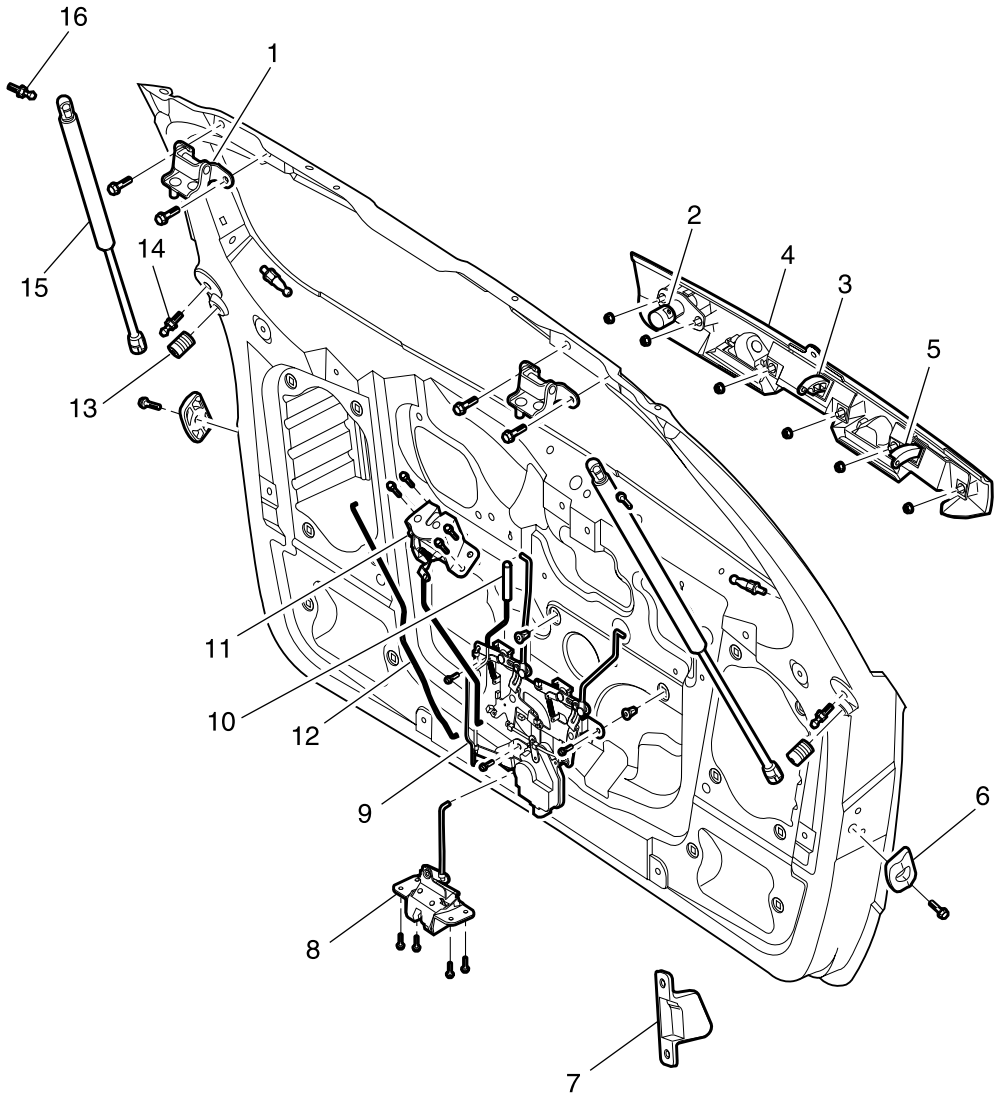
FRONT BUMPER



1 Front Bumper Facia Assembly
2 Energy Absorber
3 Front Nudge Bar Assembly
4 Bumper

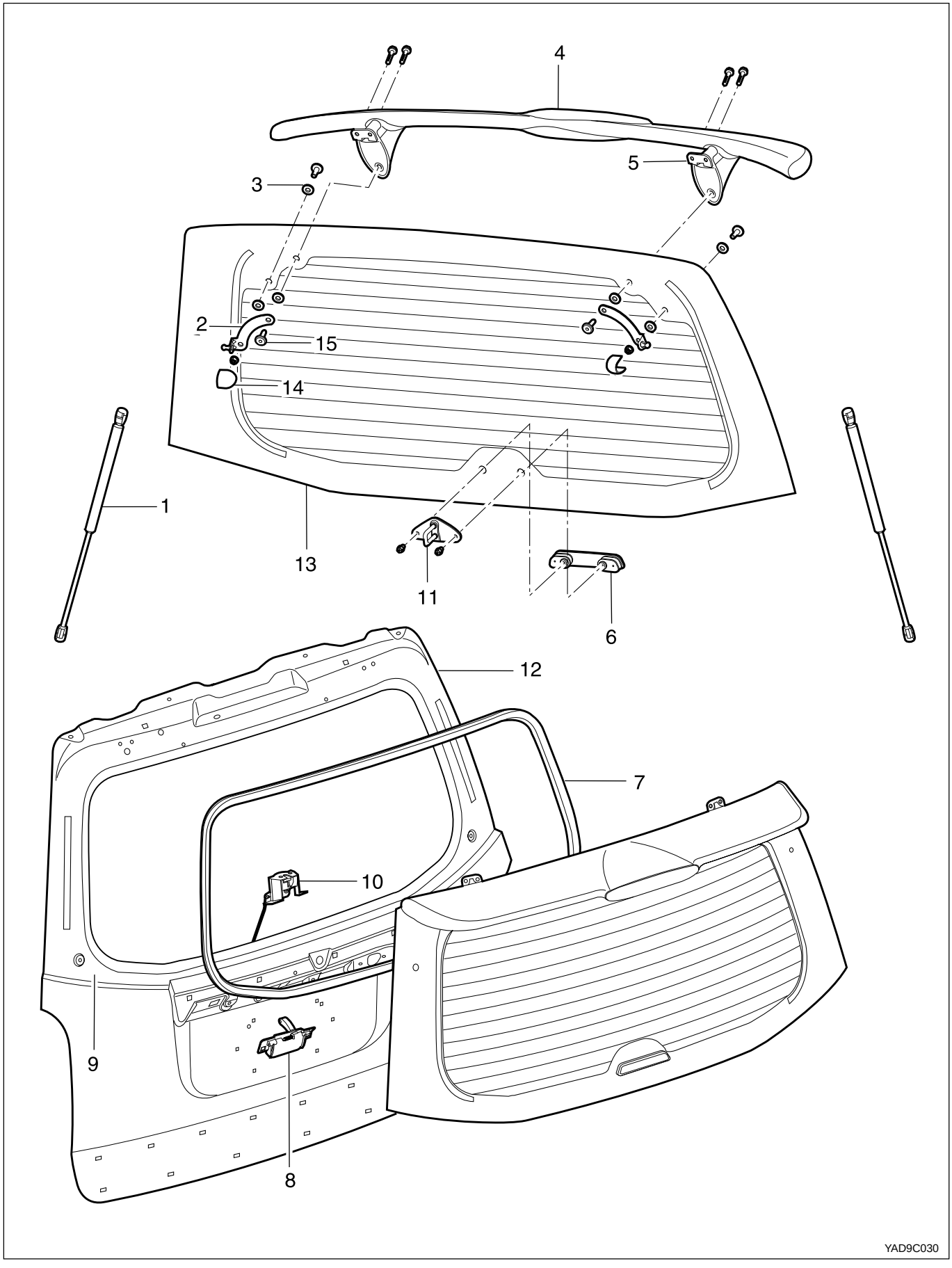
TAIL GATE

Mechanism



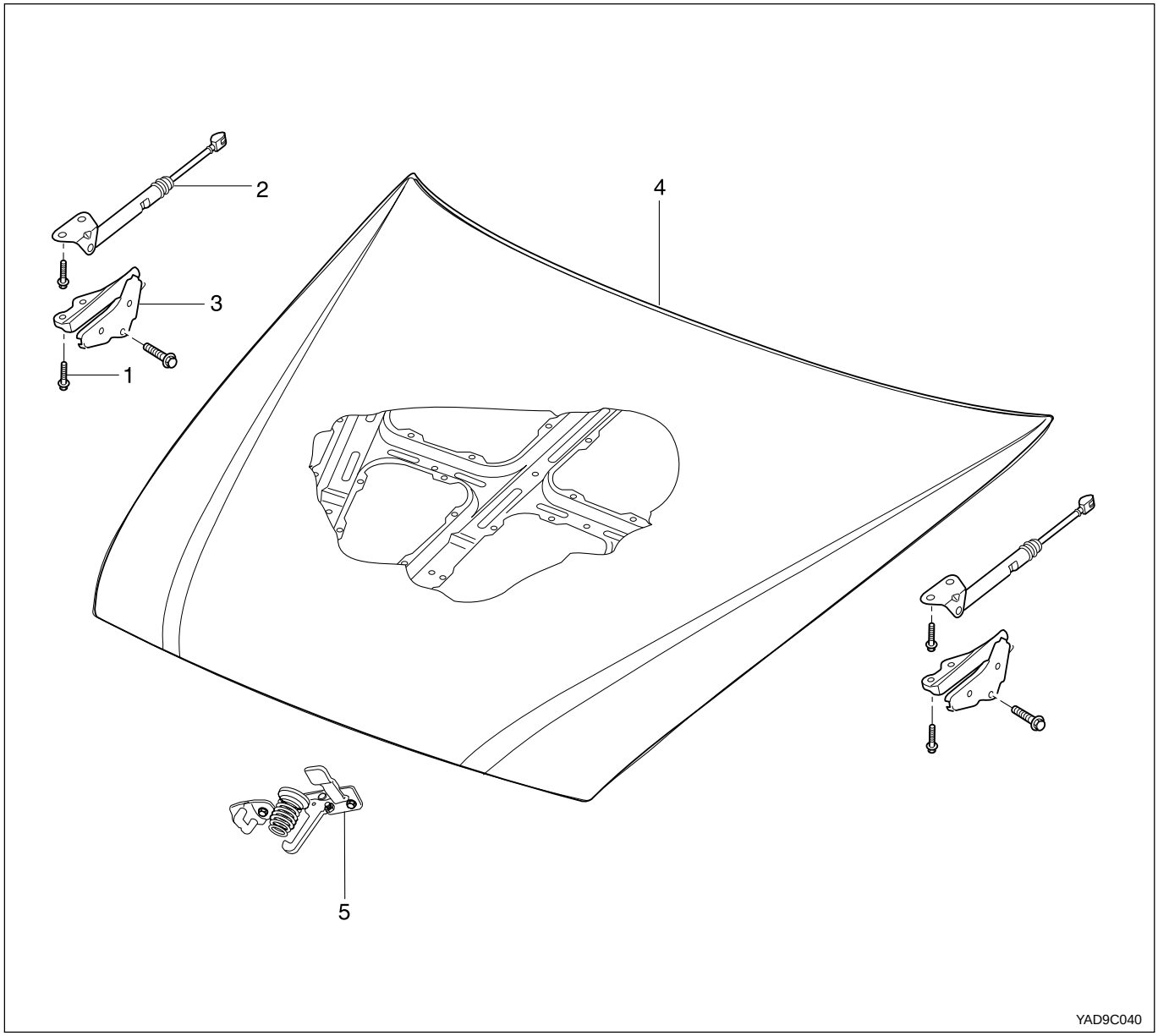
1 Hinge
2 Key
3 Tail Gate Release Handle
4 Garnish
5 Glass Handle
6 Guide Bumper
7 Body Side Guide Bumper
8 Tail Gate Latch
9 Door Safety Rod Box Crank
10 Safety Nob
11 Glass Open Latch
12 Key Rod
13 Over Slam Bumper
14 Ball Stud
15 Lifter
16 Ball Stud

FLIP- UP SYSTEM



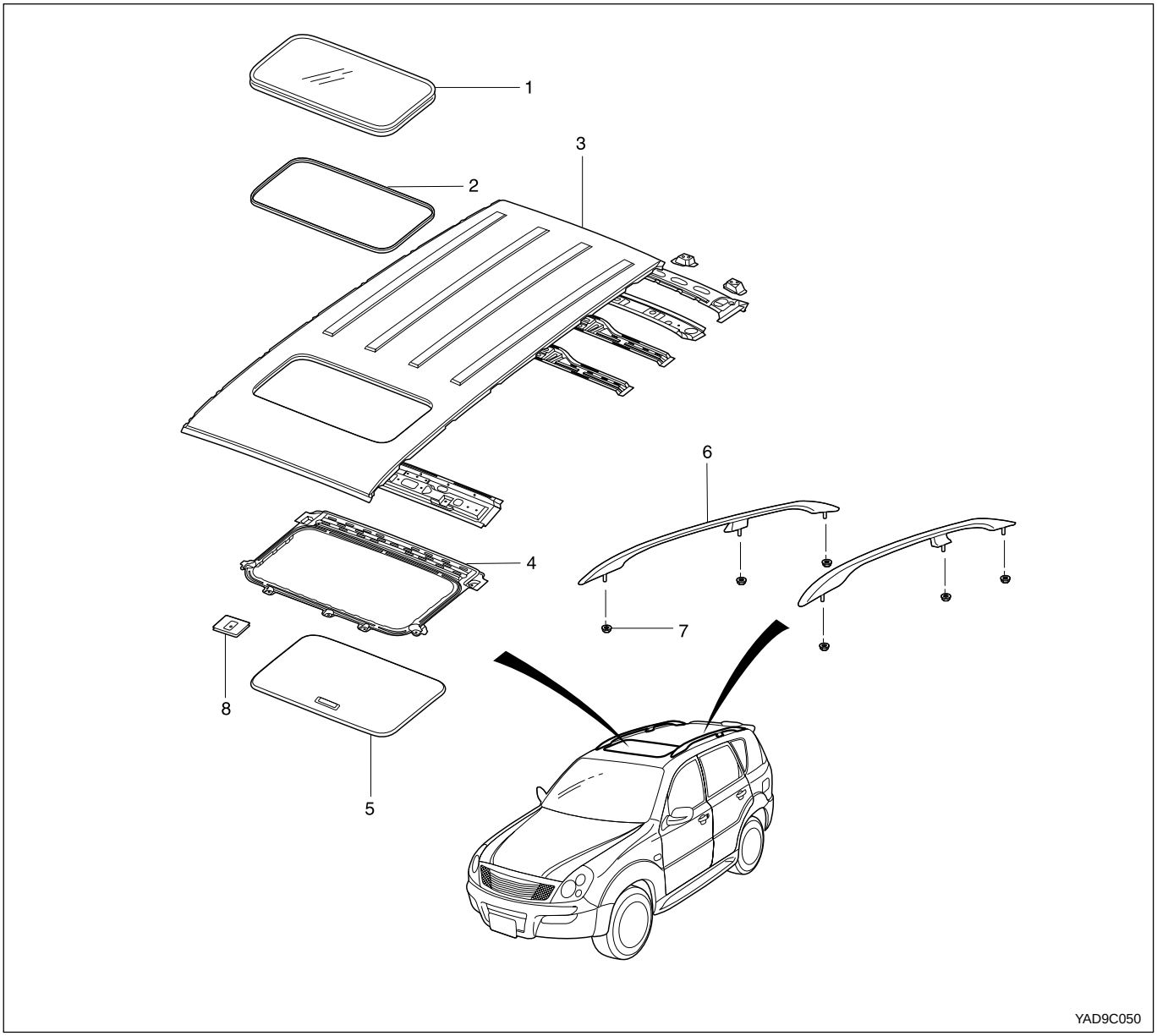
1 Glass Lifter
2 Ball Stud Bracket
3 Bolt Pad
4 Spoiler
5 Glass Open Hinge
6 Glass Handle
7 Glass Weather Strip
8 Glass Release Handle
9 Over Slam Bumper
10 Latch
11 Striker
12 Panel
13 Glass (Standard : 4.0 T Flip-Up : 5.0 T)
14 Bracket Cover Of Ball Stud
15 Bolt

HOOD



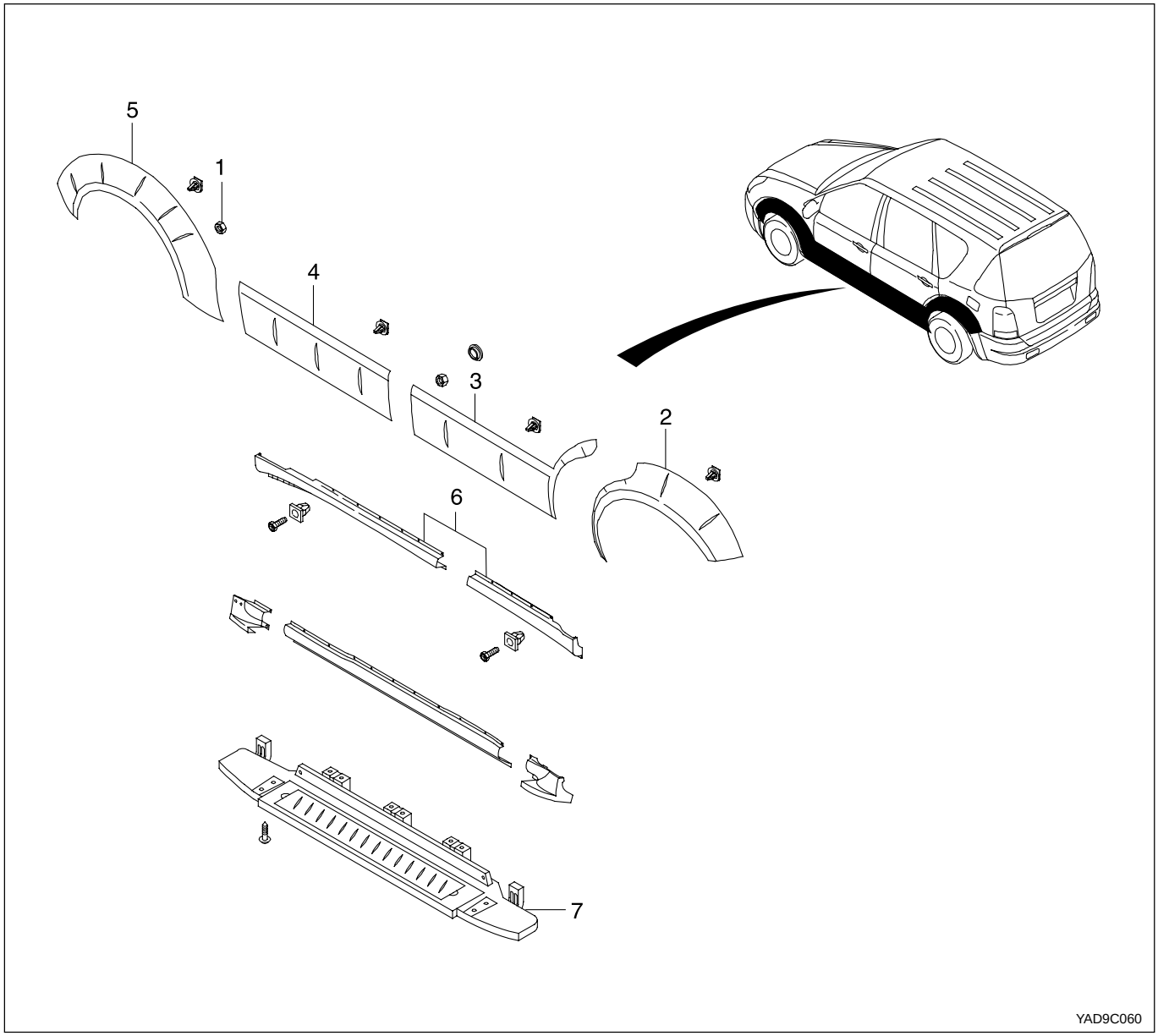
1 Bolt
2 Shock Absorber
3 Hood Hinge
4 Hood
5 Hood Striker

SUN-ROOF AND ROOF RACK

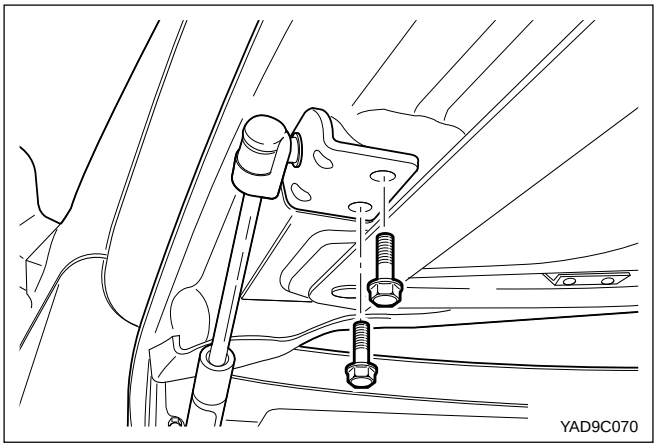


1 Sun-Roof Glass
2 Glass Moulding
3 Head-Lining Assembly
4 Roof Channel
5 Sun-Roof Glass Panel
6 Roof Carrier
7 Nut
8 Motor And Relay Box

MOULDING



1 Nut (M5)
2 Wheel Arch Front Moulding
3 Front Door Garnish
4 Rear Door Garnish
5 Wheel Arch Rear Moulding
6 Moulding
7 Side Step



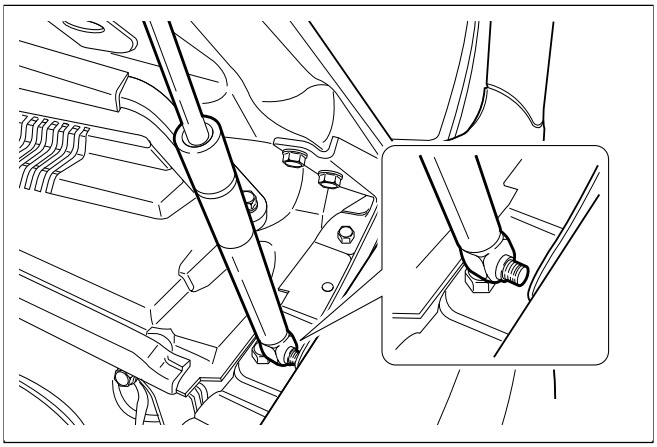
REPAIR PROCEDURE

HOOD ASSEMBLY

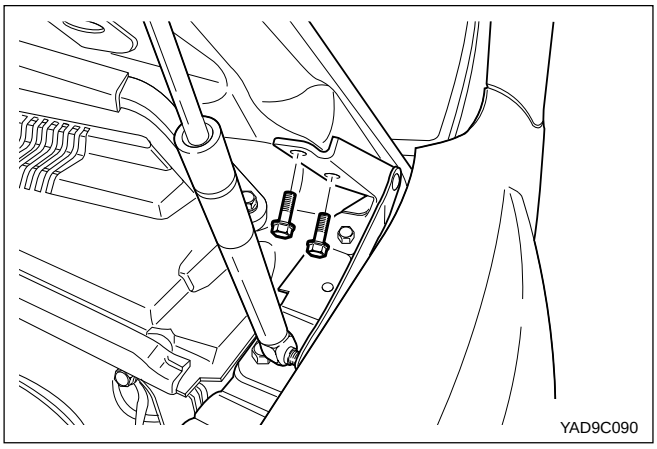
Removal and Installation

1. Release bolt of fixing bracket of shock absorber in the hood.

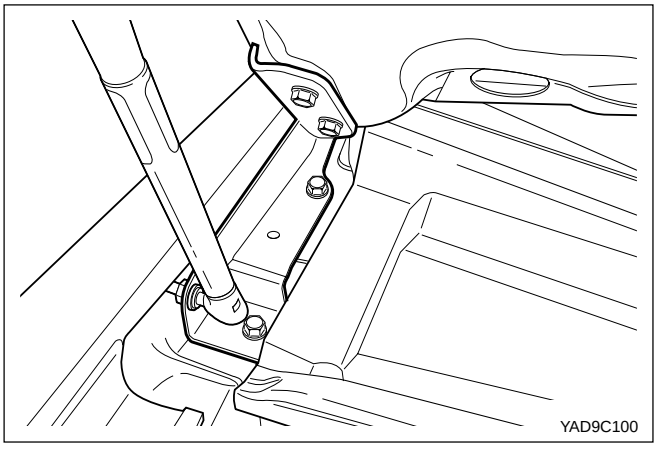
   Notice: While fixing bracket of shock absorber is removed, back up hood, to prevent closing of hood or use another supporting bar to prevent closing of hood.



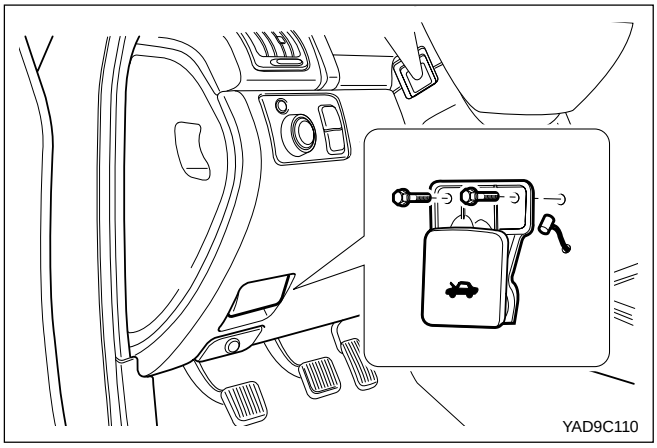
2. Remove shock absorber. (Method to remove shock absorber ; refer to replacement shock absorber of hood)



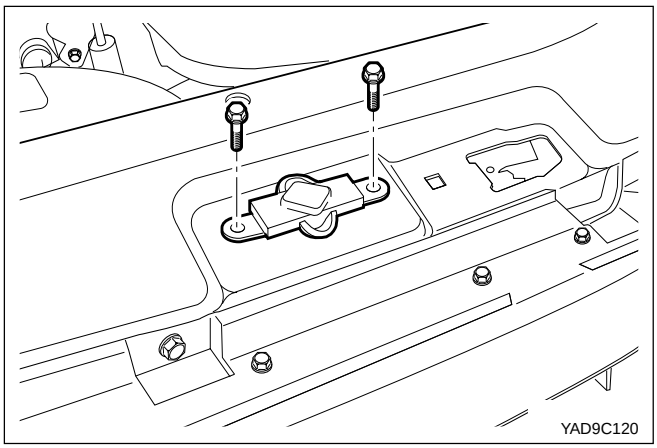
3. Remove hose of wiper washer.
4. After releasing fixing bolt of hood hinge, remove hood assembly.



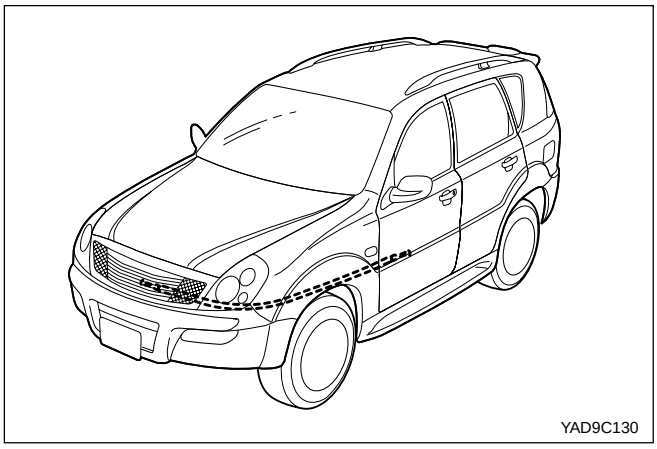
5. After releasing fixing bolt of hood hinge, remove hood hinge.



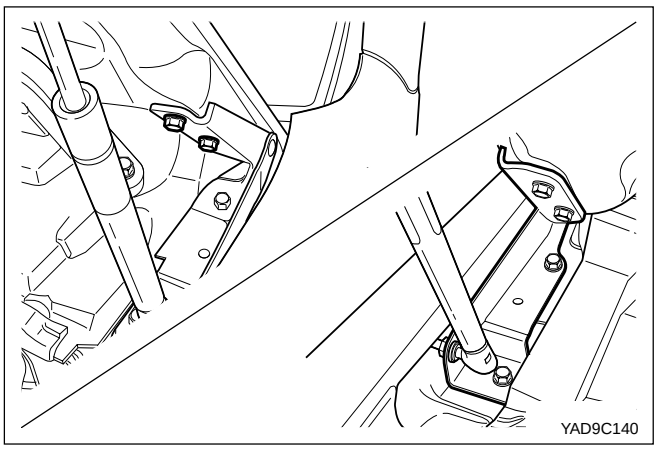
6. Remove hood latch and cable.
   1) Remove cable and hood latch lever in the lower main panel.



   2) Push cable removed through groove of body into direction of engine room.
   3) After releasing fixing bolt of hood latch, remove latch and cable.

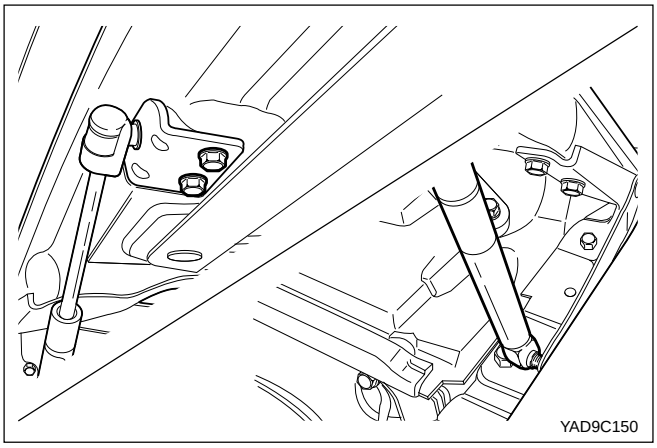


   4) Remove cable of hood latch.

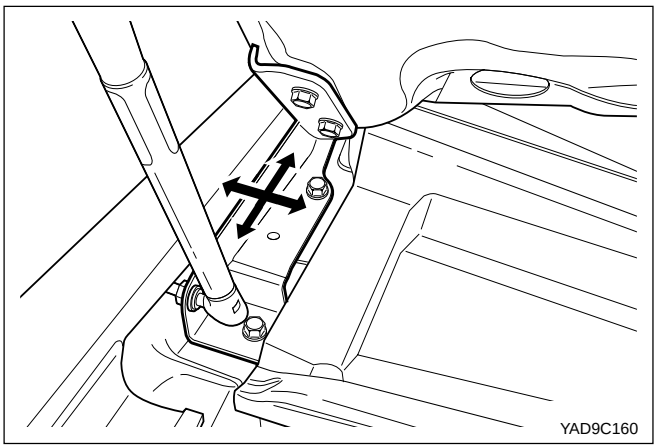


7. Install the reverse order of removal .
   1) After installing hood hinge into body and hood, tighten fixing bolt with the torque of specification.

Tightening Torque	29 - 39 N•m (21 - 29 lb-ft)

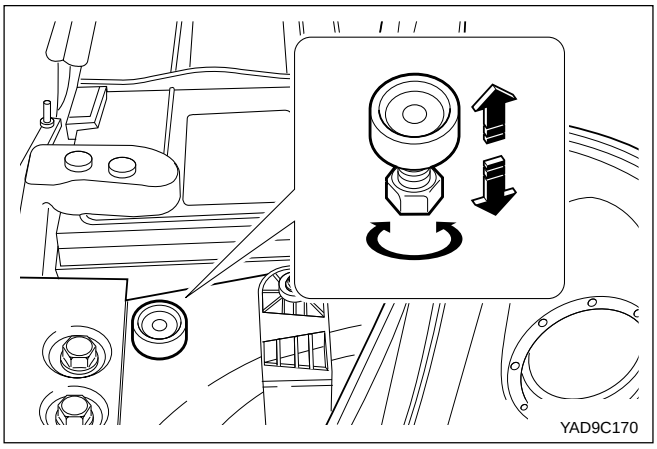


2) Install the shock absorber.

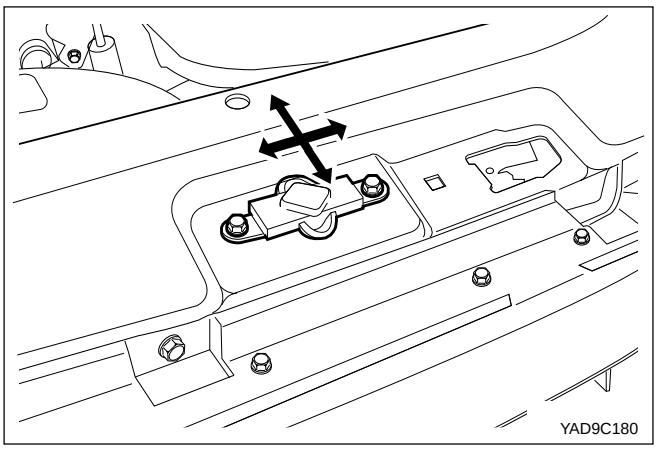


Adjusting Hood Hinge

1. Release little bit fixing bolt of hood hinge.
2. After adjusting hood hinge to forward and backward, left and right, check whether right position of hood is installed or not.



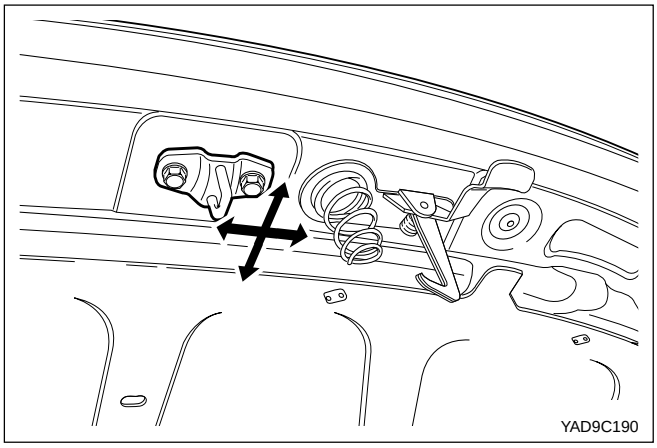
3. After adjusting over slam bumper, adjust height of front end of hood.



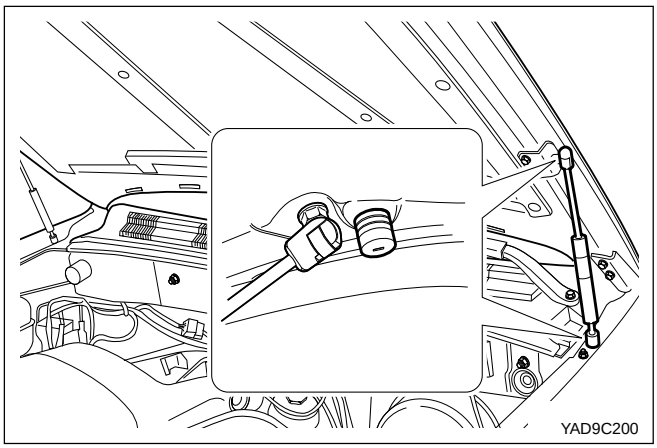
Adjusting Hood Latch

1. Install hood latch on the right position, if hood latch is not installed on the right position, while hood is installed, hood may distort and be unbalanced.

Bolt of Hood Latch	8 - 11 N•m (44 - 52 lb-ft)

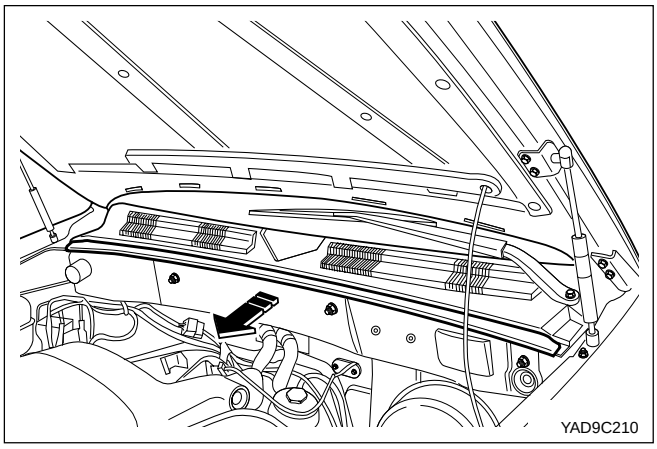


2. Release a little bit fixing bolt of striker.
3. After adjusting position of striker to forward and backward, left and right, put center of latch.



Replacement Shock Absorber of Hood

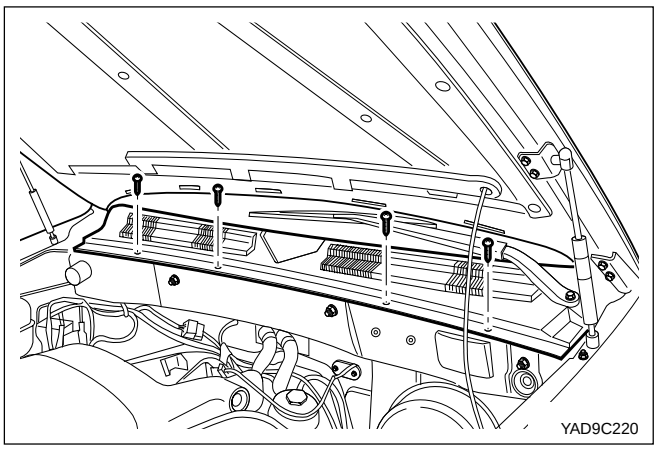
1 . After inserting driver on the upper of bending equipped both end of shock absorber, get the bending out of shock absorber, and then, remove shock absorber.
2. Insert shock absorber, until is sounded like a kind of equipped sound.



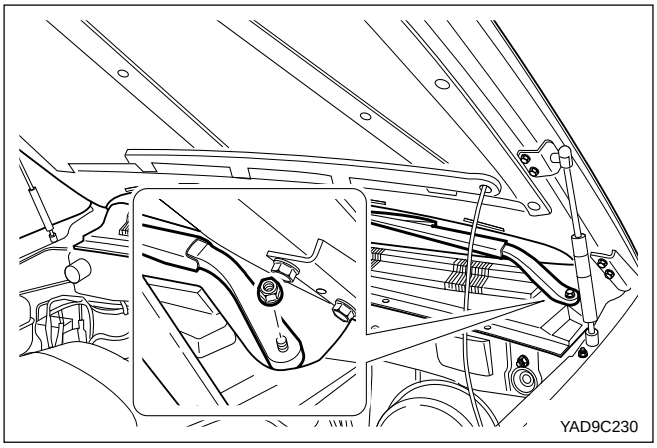
COWL GRILL

Removal and Installation

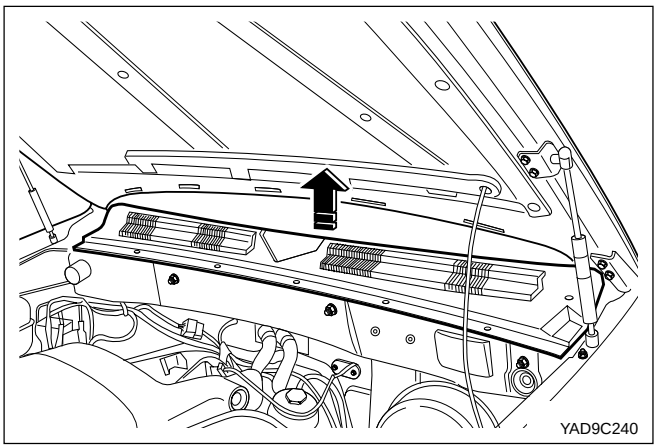
1. Remove wiper arm and fixing nut of wiper in the right and left. (M8)



2. Remove weather strip.

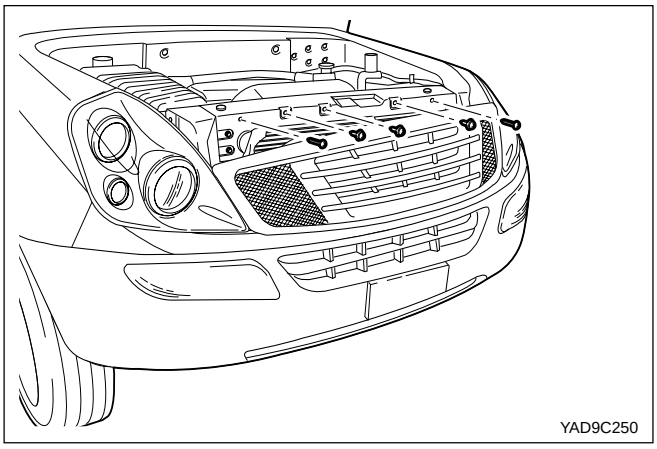


3. Separate fixing clip of cowl. (4 EA)



4. Remove cowl of left / right. (first, cowl of right is removed, and then cowl of left is removed)
5. Install reverse order of removal.

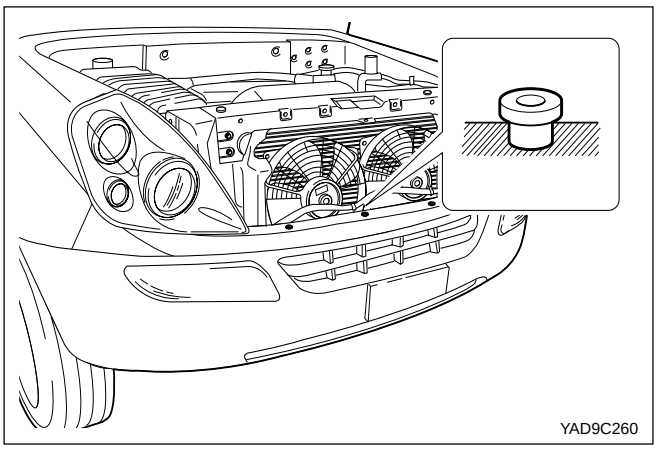
Wiper Fixing Nut	14 - 17 N•m (44 - 52 lb-ft)



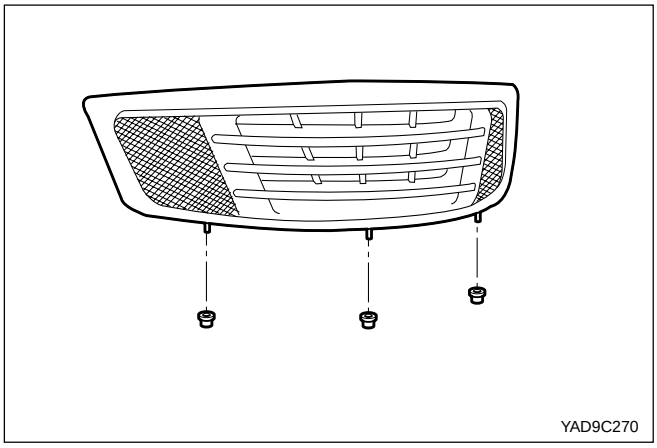
RADIATOR GRILL

Removal and Installation

1. Remove fixing screw (2 ea) of radiator grill and rivet (3 ea).

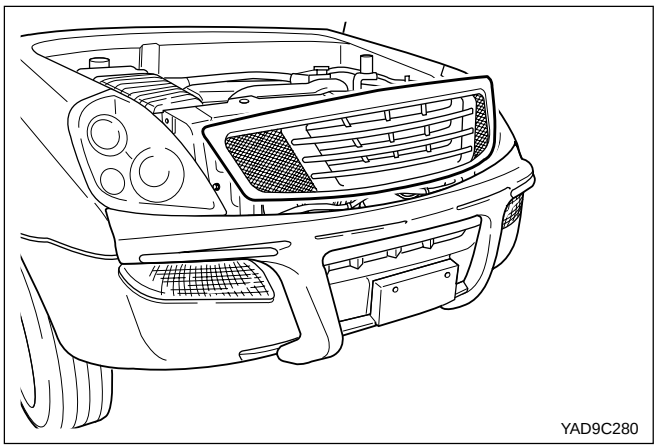


2. Remove radiator grill and fixing rubber of grill.


YAD9C270

3. Install reverse order of removal.

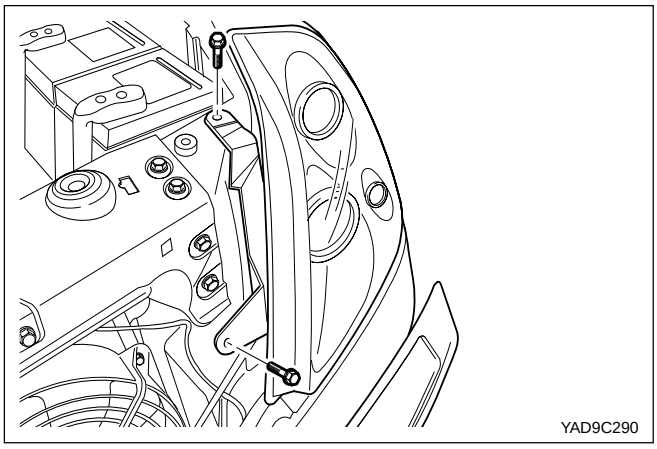
   Notice: Check damage of fixing rubber and damage of grill.


YAD9C280

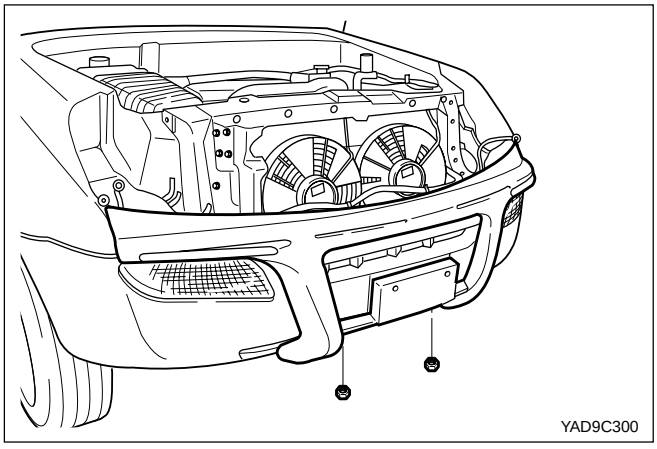
FRONT BUMPER ASSEMBLY

Removal and Installation

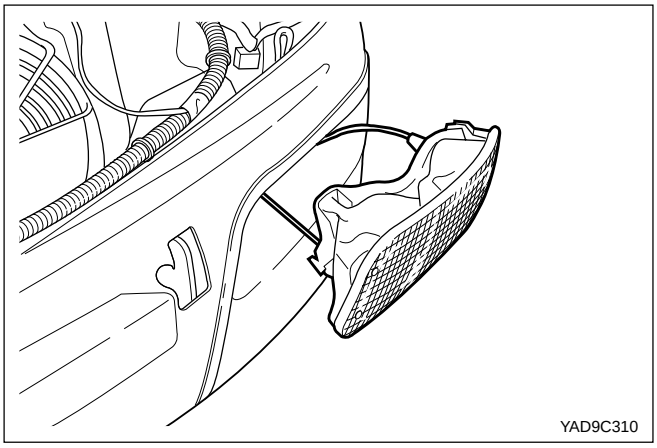
1. After releasing screw of radiator grill and screw rivet, remove grill assembly.


YAD9C290

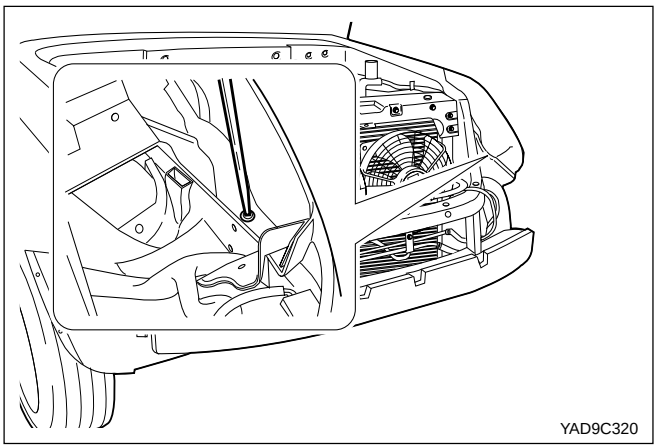
2. After releasing fixing bolt, remove connector of headlamp and remove headlamp. (first, after removing cap of wheel house cover, remove fixing nut of headlamp)


YAD9C300

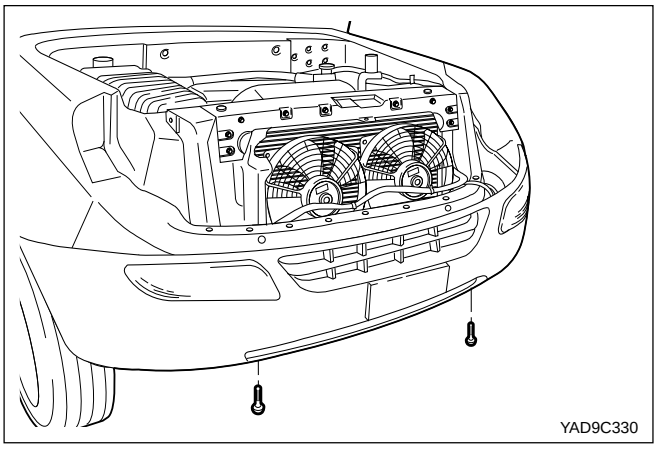
3. After releasing fixing bolt (4 ea) of bumper guide, remove bumper guide from bumper.
   - After releasing fixing bolt of bumper guide support, remove bumper guide support.


YAD9C310

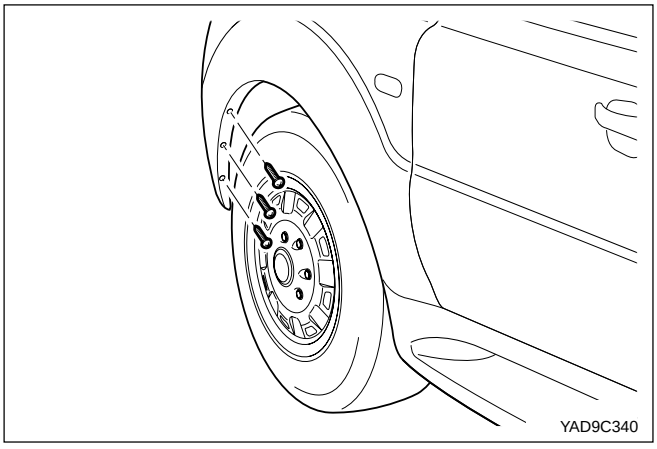
4. Remove fog lamp. (After releasing nut (2 ea) of internal section of bumper facia)


YAD9C320

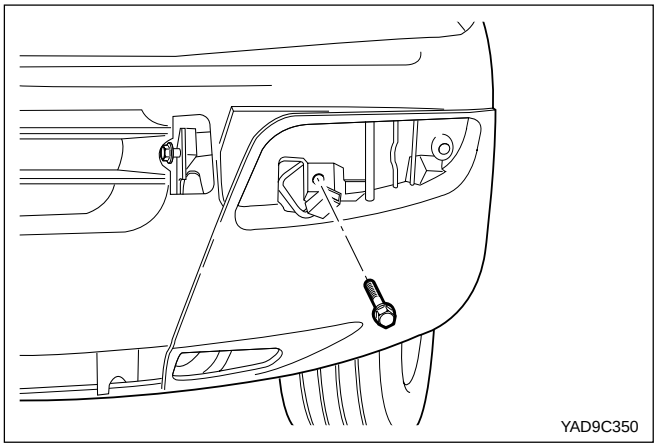
5. Remove bumper cover
   1) Separate rivet (6 ea) of the upper of bumper facia.
      - Remove screw (2 ea) and nut (2 ea) of fender.


YAD9C330

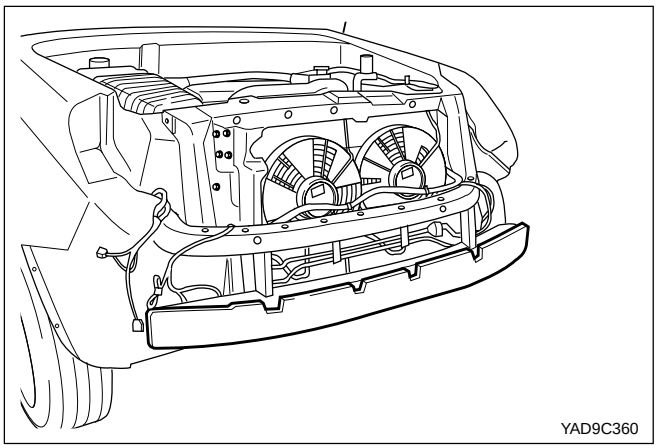
   2) Separate screw of the lower of bumper facia. (2 ea)


YAD9C340

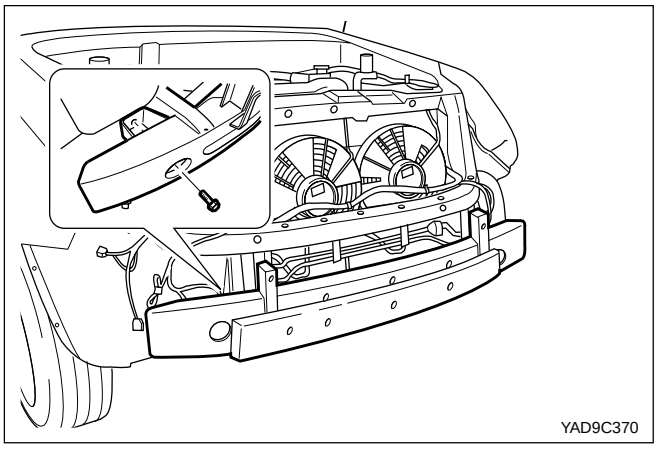
   3) Separate screw of bumper facia in the wheel house.
      - Side section : 4 ea
      - Rivet of lower section : 1 ea



4) After releasing fixing bolt of center of bumper facia, remove bumper facia.
   - Left : 1 ea
   - Right: 1 ea



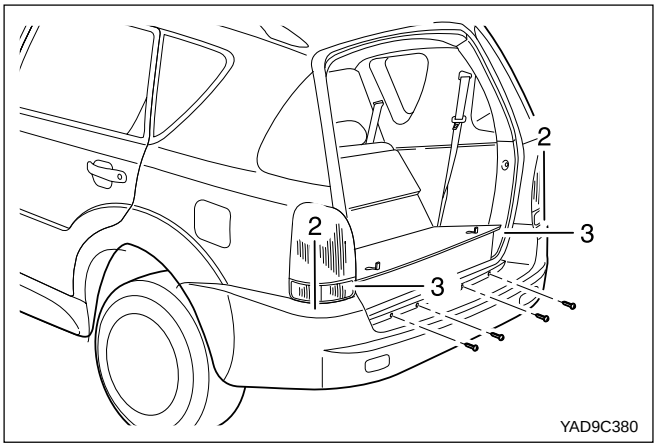
6. Remove energy absorber.



7. After releasing fixing bolt of bumper in the frame, remove bumper.

8. Install reverse order of removal.

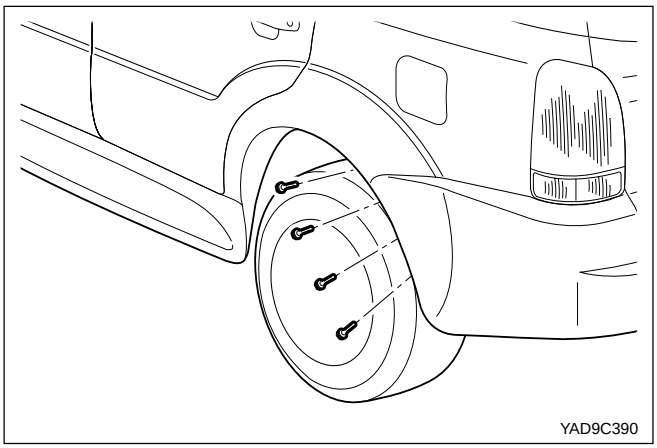
Fixing Bolt of Bumper	76 - 114 N•m
Bolt of Bumper cover	2.8 - 5.2 N•m
Bolt of Bumper Guide	16.8 - 31.2 N•m



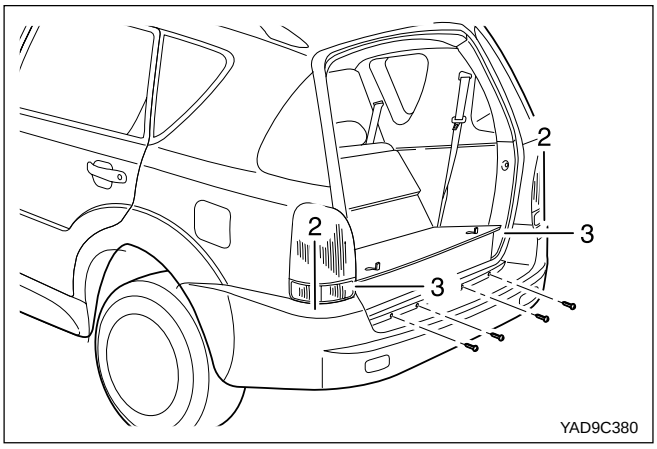
REAR BUMPER ASSEMBLY

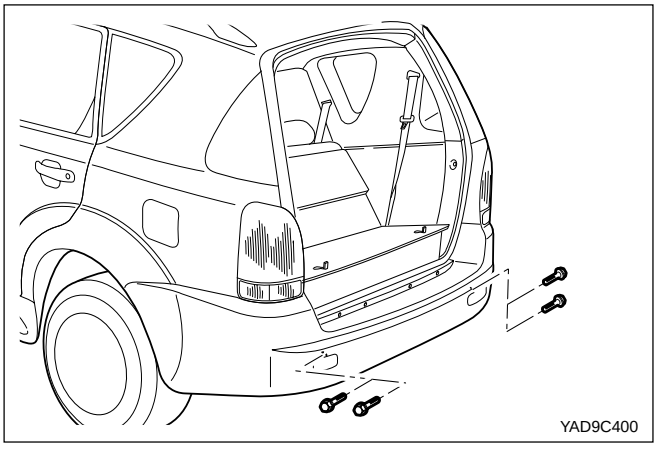
Facia

1. Remove rear combi - lamp.
2. Separate screw of section of combi - lamp. (left: 1 ea, right: 2 ea)
3. Separate screw of the upper of the bumper. (left: 1 ea, right: 1 ea)



4. Separate rivet of the upper of bumper facia. (5 ea)
5. Separate fixing screw of bumper facia in the rear wheel house. (left: 4 ea, right: 4 ea)
6. Install reverse order of removal.

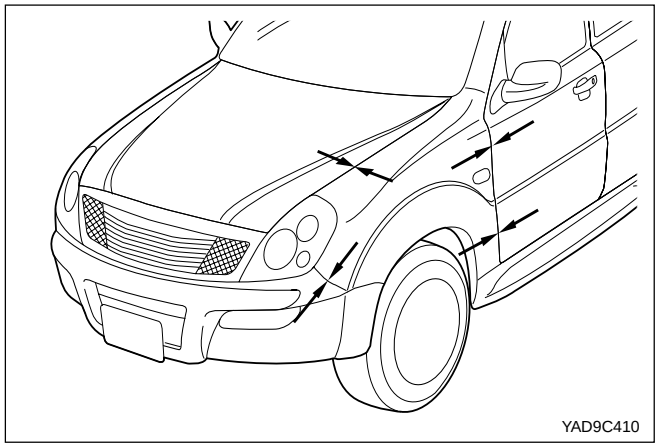




BACK BEAM

1. After releasing fixing bolt of rear bumper, remove back beam assembly.
2. Install reverse order of removal.

Tightening Torque	41.6 - 62.4 N•m (44 - 52 lb-ft)

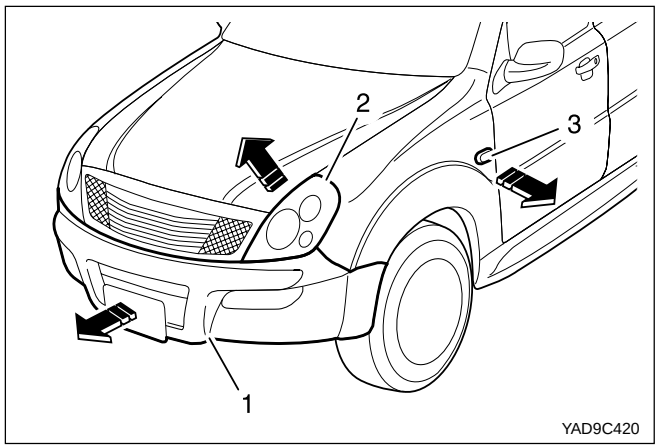

YAD9C410

FENDER

Removal and Installation

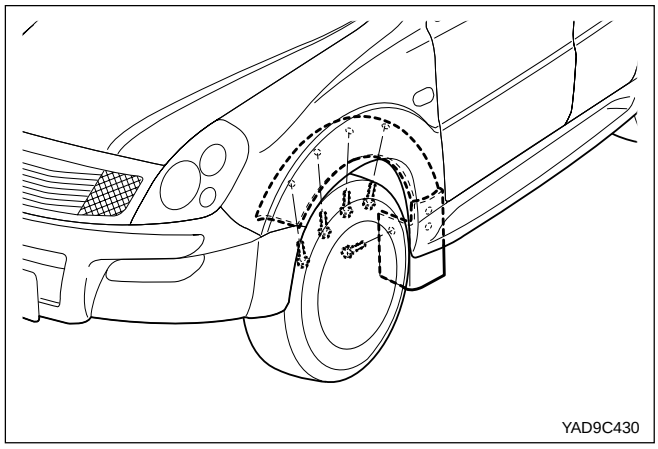
1. Vehicle is fixing safely, and then lift up the vehicle.

   Notice: Before the fender is removed, adjust and check the gap and clearance between front door, side sill, and front bumper.

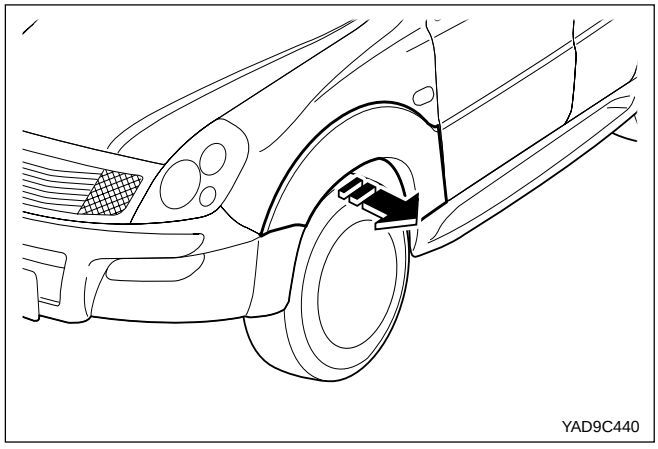


YAD9C420

2. Remove front bumper facia (1 ea), head lamp (2 ea), head lamp guide bracket, side repeater.

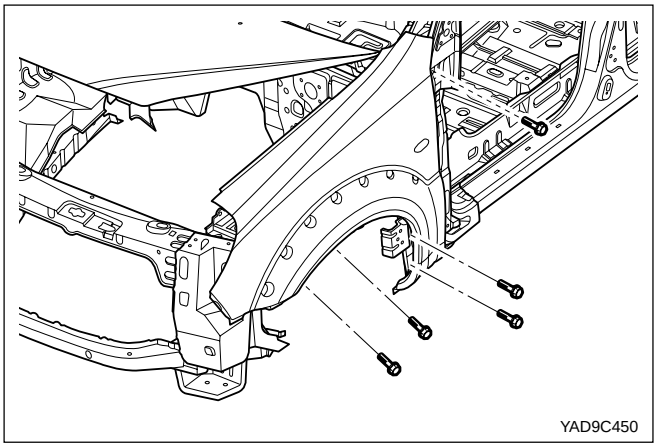

YAD9C430

3. Separate wheel guard, mud guard, and spring nut.

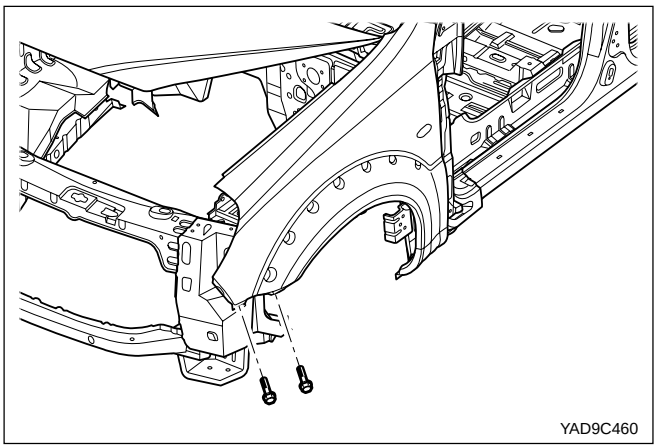

YAD9C440

4. Using driver, special service tool, remove fender garnish.

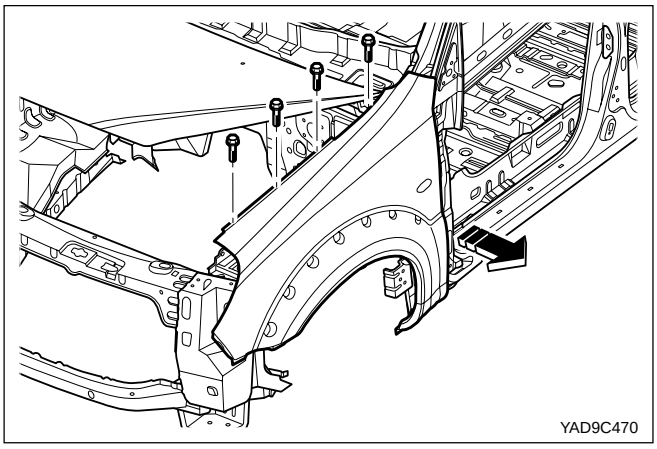
   Notice: Be careful about damage paint of body, not to make blemishes.


YAD9C450

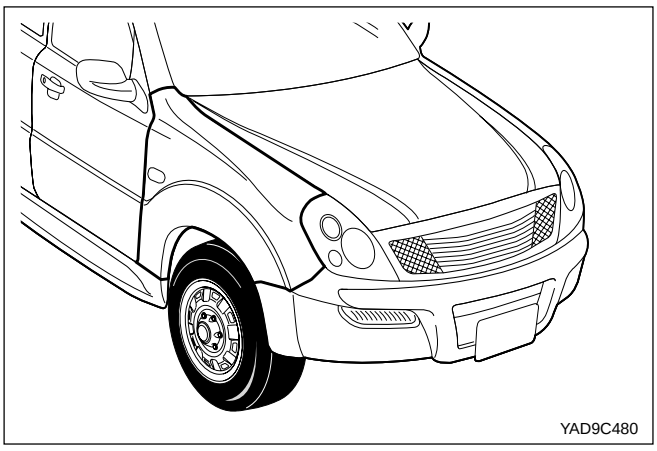
5. Release fixing bolt (2 ea) of mud guard in the lower vehicle. (the section of wheel rear)
6. After opening the door, release fixing bolt of fender. (1ea)


YAD9C460

7. Release bolt (2ea) of the section of bumper facia.


YAD9C470

8. Separate fixing bolt (1ea) of rear section of hood hinge and separate fixing bolt (3ea)of the upper section of fender and then remove fender.


YAD9C480

9. Install reverse order of removal.

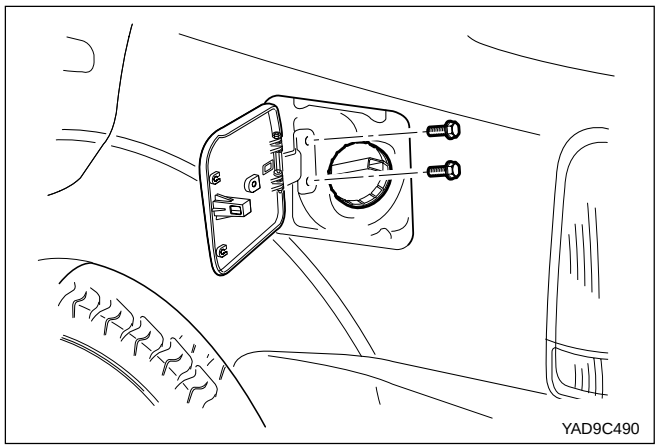
   Notice:

   1) Paint internal section of fender and installed section of fender.
   2) After installing fender, tighten temporarily bolt (2 ea) the upper section of hood, in the back and front, adjust the gap and clearance of door, hood, and lamp.

3) After spread water-proof materials on the section of tightening, tighten the bolt with the torque of specification.

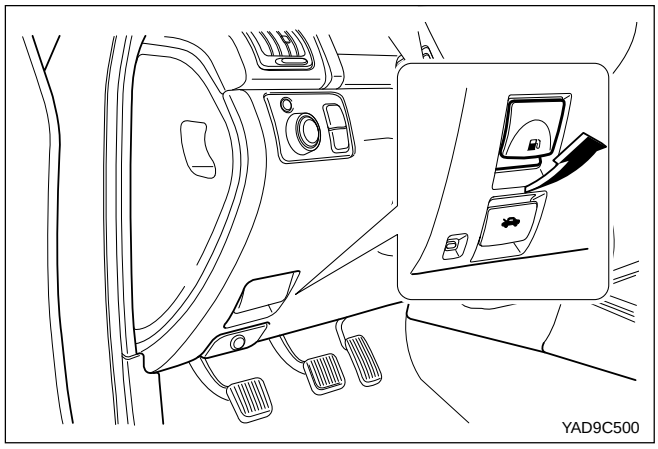
Fender Bolt	6.9 - 8.8 N•m (44 - 52 lb-ft)

4) After painting, check connection of electrical parts and operation.

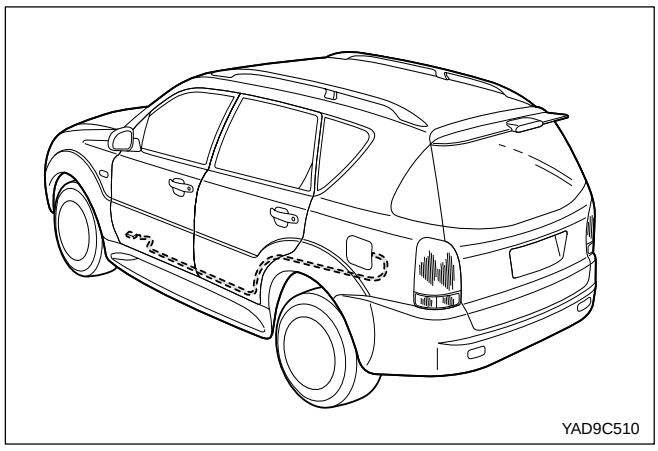

YAD9C490

FUEL FILLER OPENING SYSTEM

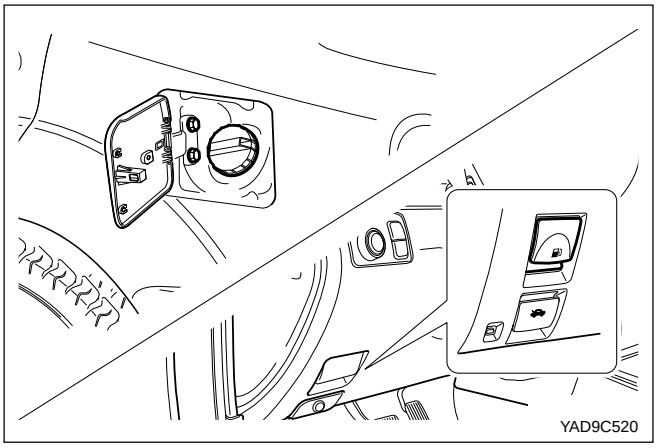
1. After opening the door of fuel filler, separate fixing bolt of door.


YAD9C500

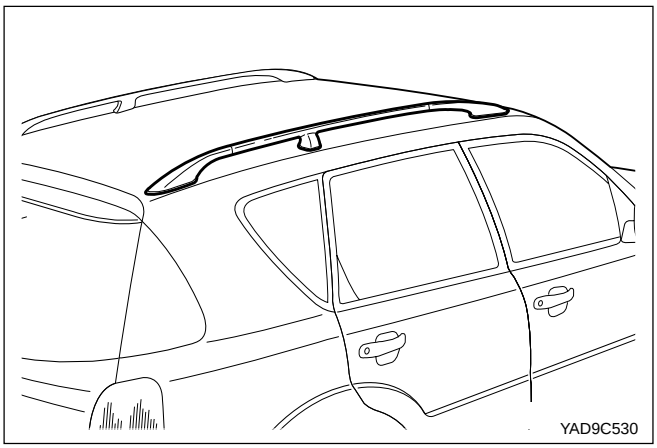
2. Separate release handle of fuel filler in the lower main panel of driver seat.


YAD9C510

3. Remove the cable of fuel filler in the vehicle.



4. Install the reverse order of removal

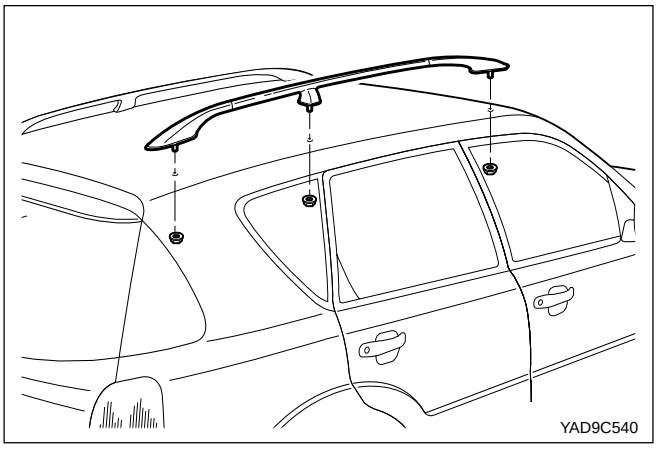


ROOF CARRIER

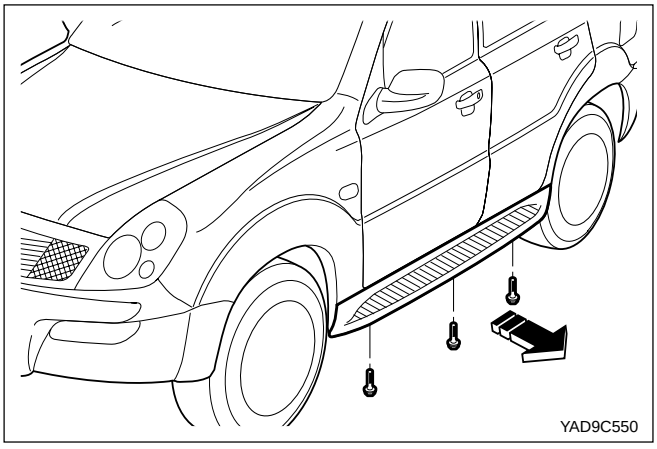
Removal and Installation

1. In order to remove roof carrier , first remove headlining
2. After releasing fixing nut of roof carrier, remove roof carrier, assembly.
3. Install reverse order of removal.

Roof Carrier Nut	7 - 10 N•m (44 - 52 lb-ft)



Notice: Maximum load of roof carrier is approximately 45 kg, all the load should equivalently distribute on the roof carrier.

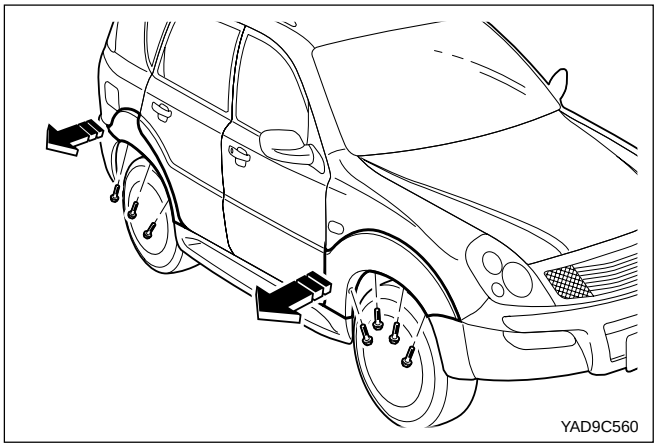


SIDE STEP

Removal and Installation

1. After releasing bolt and nut of side step , remove side step assembly.
2. Install reverse order of removal.

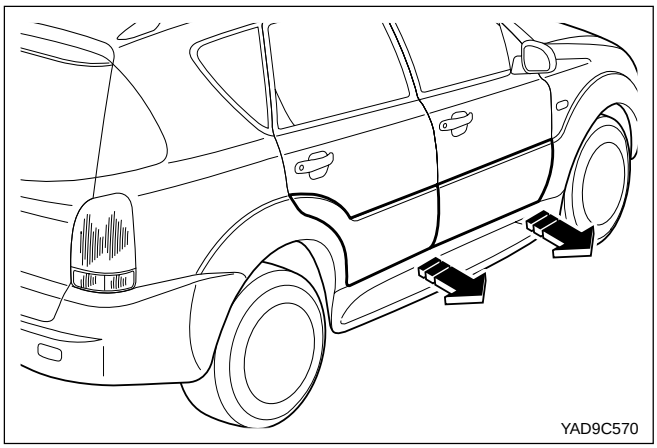
Bolt and Nut of Side Step	16.8 - 31.2 N•m (44 - 52 lb-ft)


YAD9C560

SIDE MOULDING

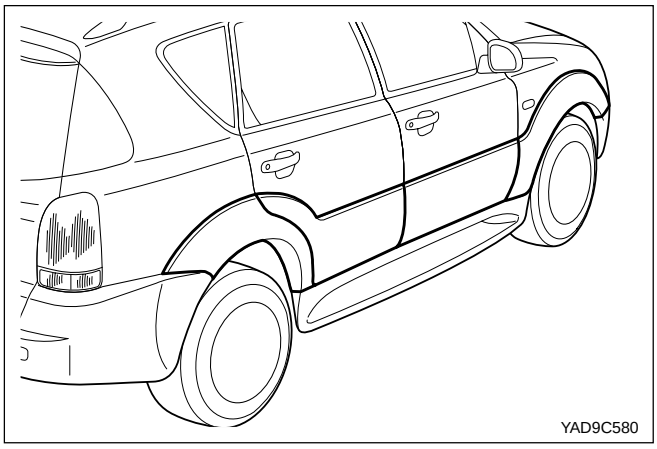
Removal and Installation

1. After releasing fixing screw of wheel housing moulding in the front and rear, remove moulding.


YAD9C570

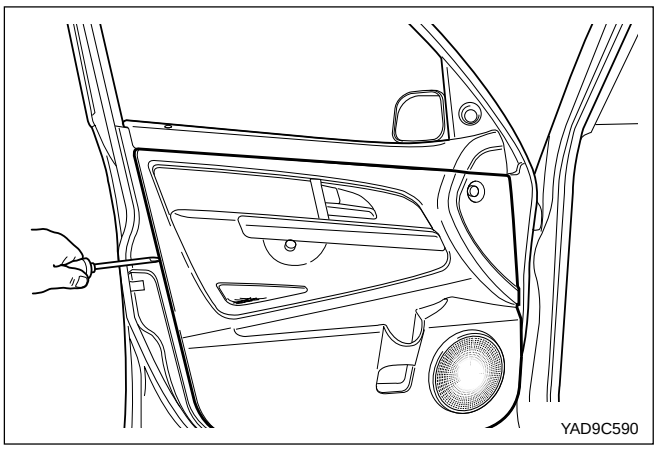
2. Using special service tool, remove door moulding of front and rear.

   Notice: While door moulding and moulding of wheel housing is removed, pay attention on the damage of painting section, in order not to make scratch of moulding.


YAD9C580

3. Install reverse order of removal .

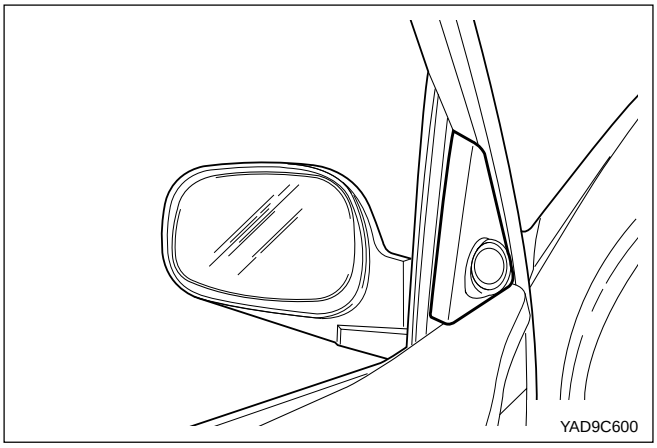
   Notice: While moulding is installed, install moulding tightly, not to make the gap.


YAD9C590

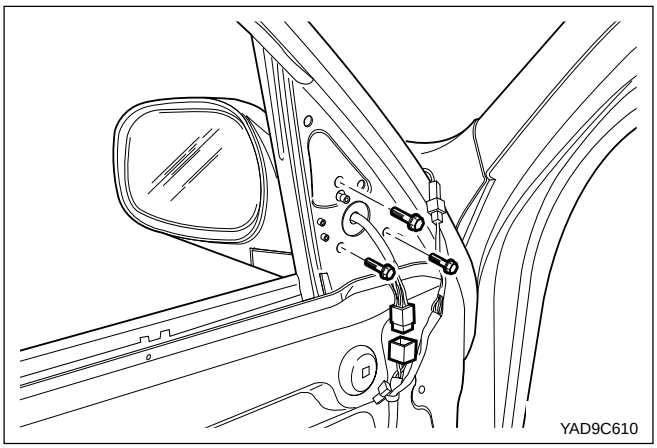
OUTSIDE MIRROR

Removal and Installation

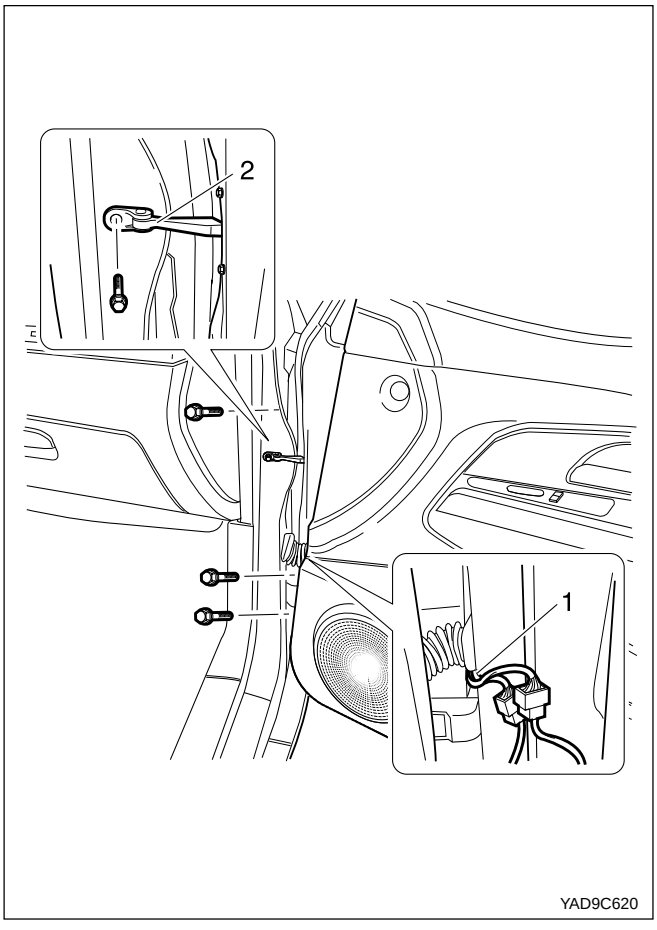
1. Remove trim cover of front door.



2. Remove inner cover of outside mirror or cover of speaker assembly.



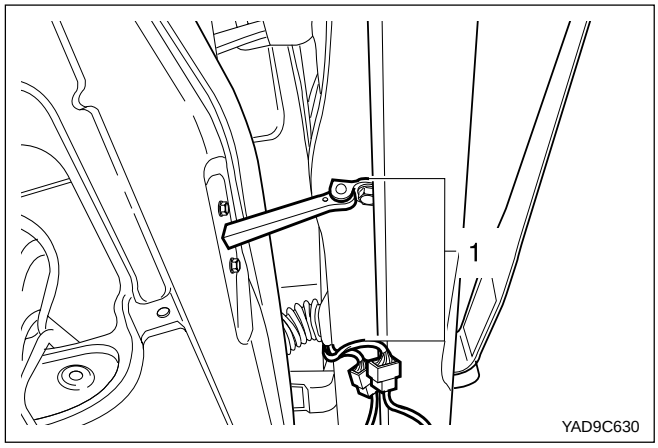
3. Separate fixing bolt (3 ea) of outside mirror.
4. Separate connector of outside mirror, remove outside mirror.
5. Install reverse order of removal.

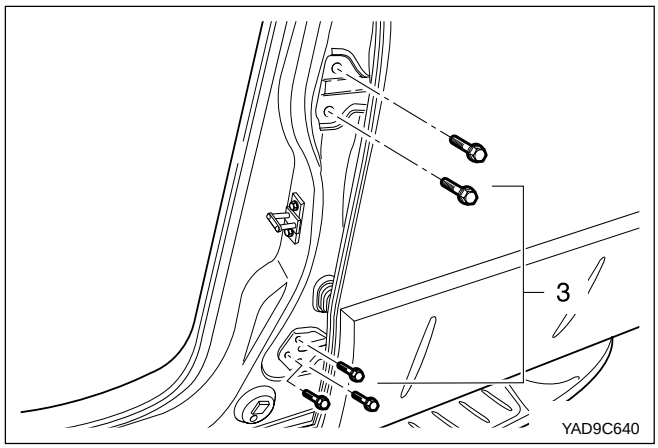


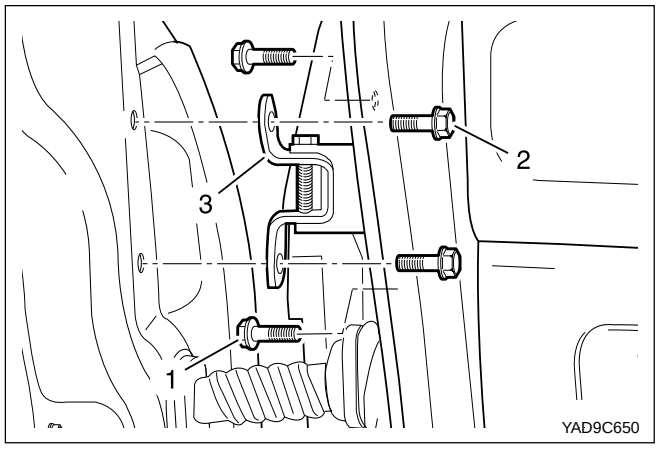
DOOR ASSEMBLY

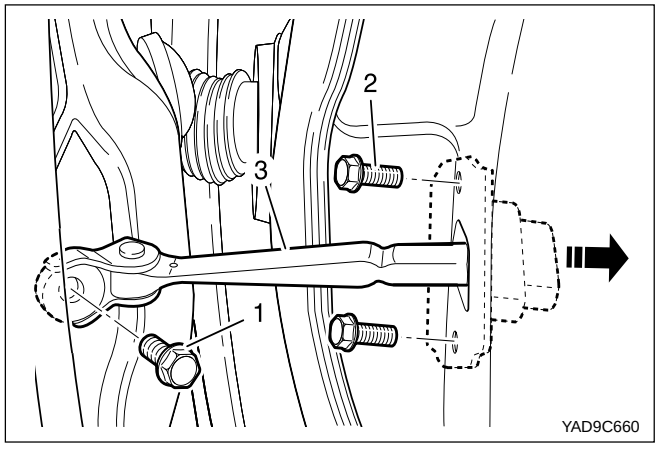
Removal and Installation

1. remove the negative (-) terminal of battery.
2. After removing the trim of cowl side, separate connector of door(1).
3. Disassemble the bolt of check link(2ea) in the body.
4. Disassemble the fixing bolt(3ea) of hinge in the body.
5. Remove the door assembly.









6. Install reverse order of removal.

Bolt of Door Hinge	44 - 54 N•m
Bolt of Door Check Link	20 - 30 N•m

DOOR HINGE

Removal and Installation

1. After opening the door, remove hinge of door.
   1) Release the bolt(2ea) of in the body side.
   2) Release the bolt(2ea) of door.
   3) Remove the hinge.
2. Install the reverse order of removal.

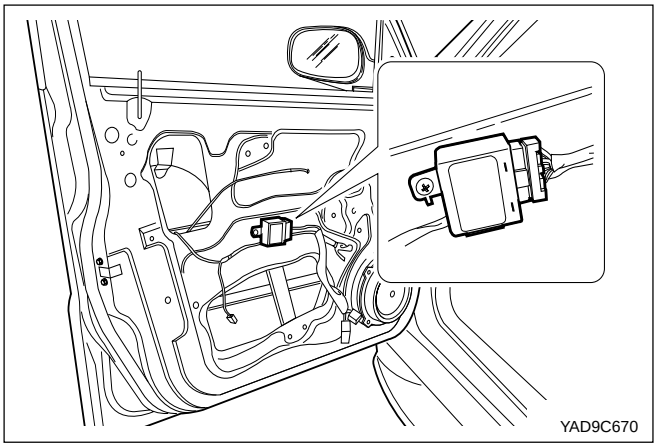
Bolt of Door Hinge	16 - 29 N•m (44 - 52 lb-ft)

DOOR CHECK LINK

Removal and Installation

1. Remove vinyl seal of door trim.
2. Remove door check link.
   1) Release bolt (3 ea).
   2) Remove door check link.
3. Install reverse order of installation.

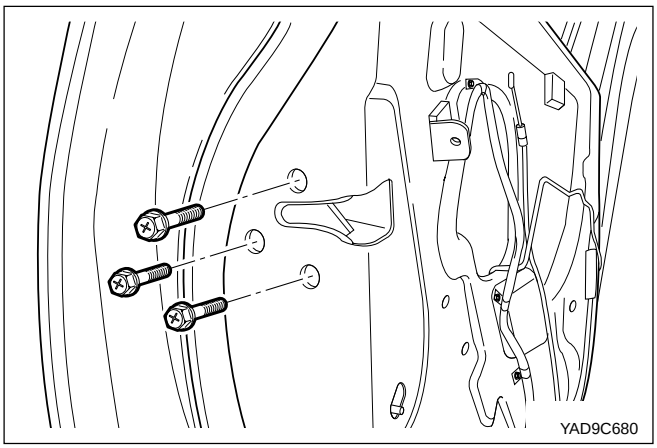
Door Check Link Bolt	7 - 11 N•m (44 - 52 lb-ft)


YAD9C670

DOOR LOCK ASSEMBLY

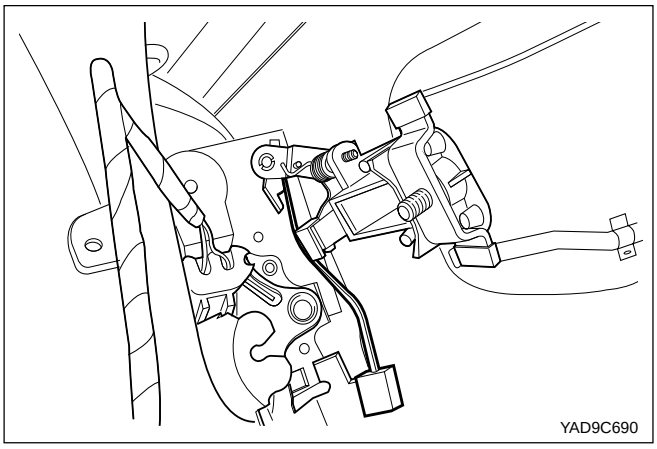
Removal and Installation

1. Remove the negative (-) terminal of battery
2. Remove vinyl seal and internal trim of door
3. In case door lock of central locking system, separate connector of door actuator and then remove actuator.

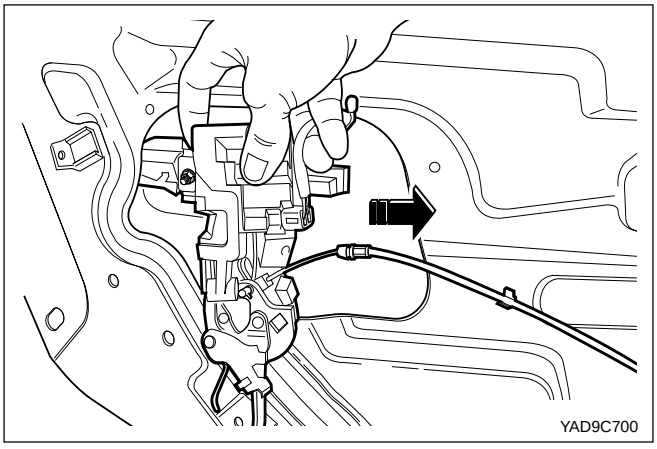

YAD9C680

4. After releasing fixing bolt of door lock, separate glass panel.

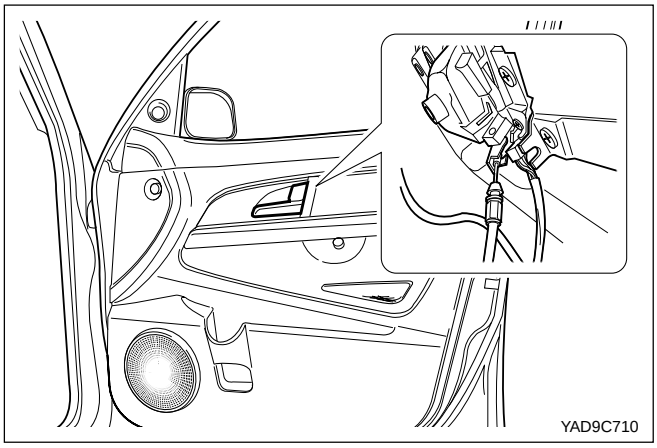
Door Lock Bolt	7 - 9 N•m (44 - 52 lb-ft)


YAD9C690

5. After removing rod and cable from the door lock assembly, remove door lock assembly.
   1) Separate rod of the external door handle.


YAD9C700

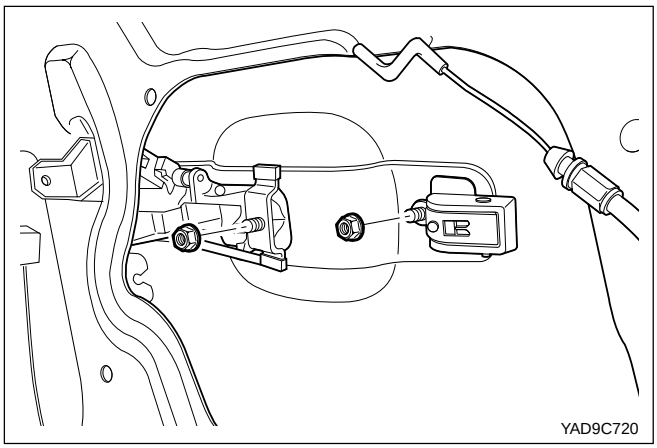
   2) Remove the connector.
   3) After removing internal cable of handle, remove door lock assembly.



DOOR HANDLE

Removal and Installation

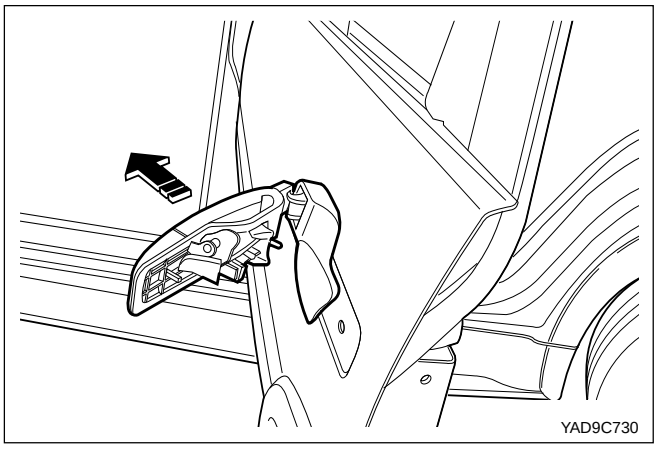
1. After removing door trim, separate internal handle cable of door trim.



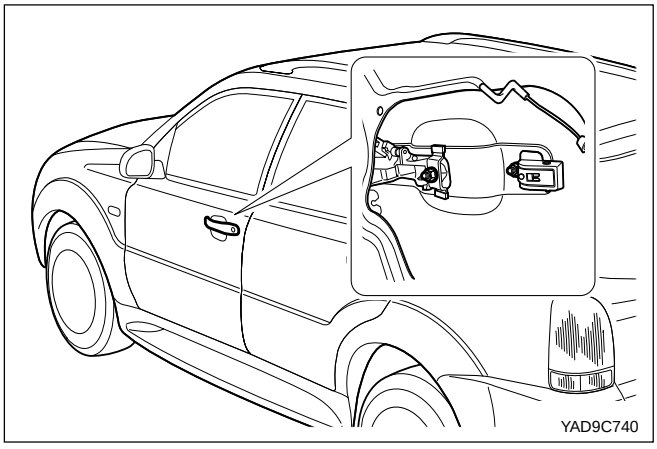
2. Remove door lock assembly

   Notice: After removing rod of key lock, separate fixing nut of front external door handle

3. Release external fixing nut of door.

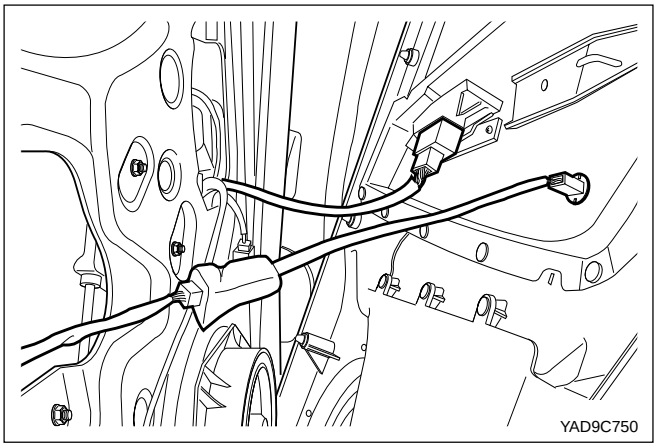


4. Remove external handle of door.



5. Install reverse order of installation.

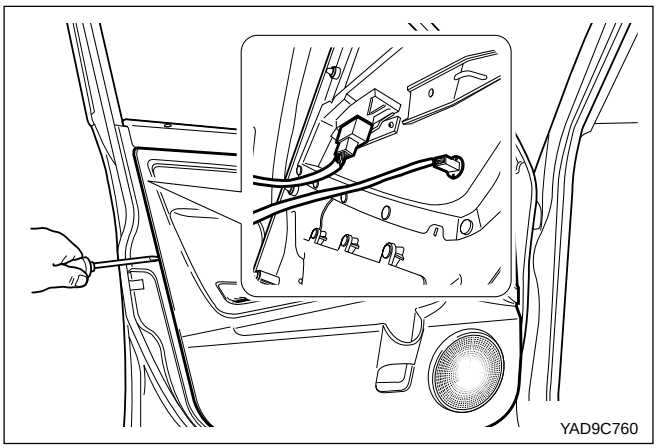
Fixing Nut of Handle	4 - 5 N•m (44 - 52 lb-ft)


YAD9C750

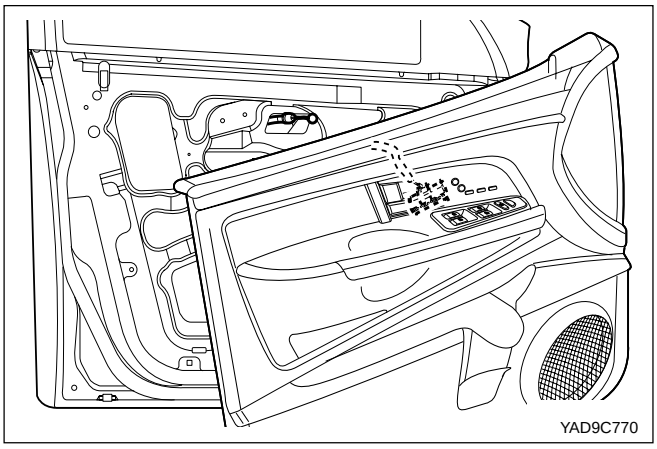
DOOR TRIM

Removal and Installation

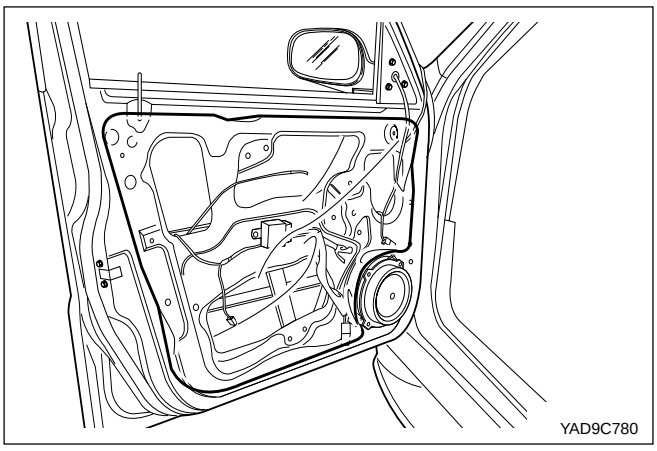
1. Remove the negative (-) terminal of battery.
2. Separate power window switch assembly.


YAD9C760

3. After inserting special tool or driver, remove door trim.

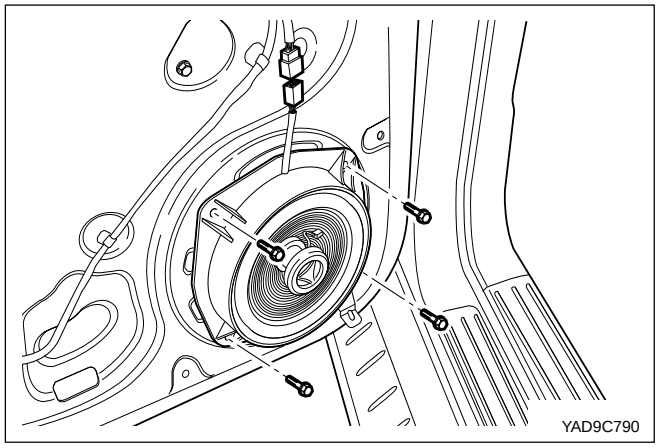

YAD9C770

4. After removing door trim , remove connector of door lamp and, cable of internal door handle.

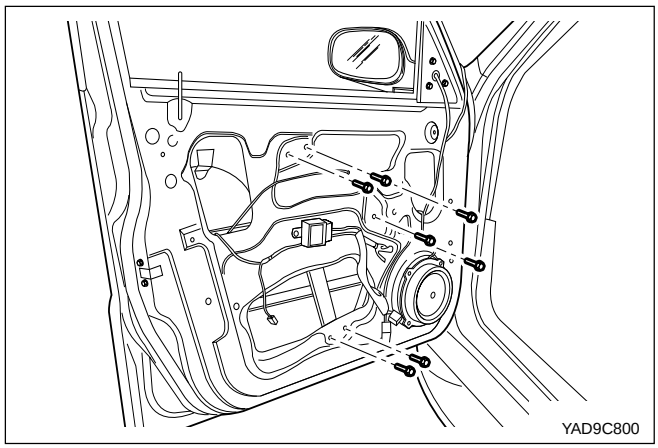

YAD9C780

5. Remove seal of door trim.

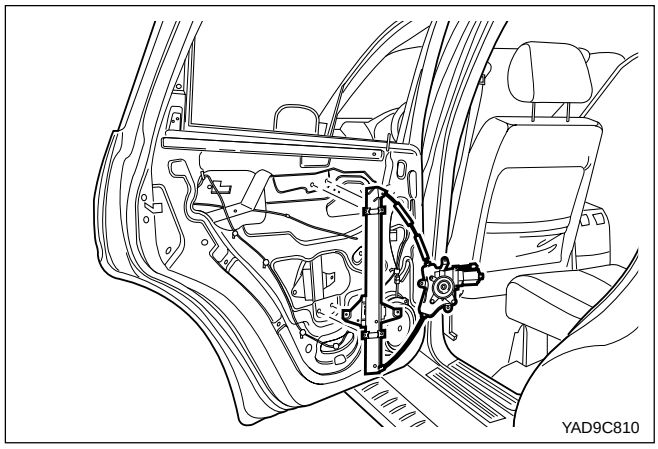
   Notice: Pay attention about damage of seal.



6. After fixing screw of door speaker, separate connector and then, remove speaker.

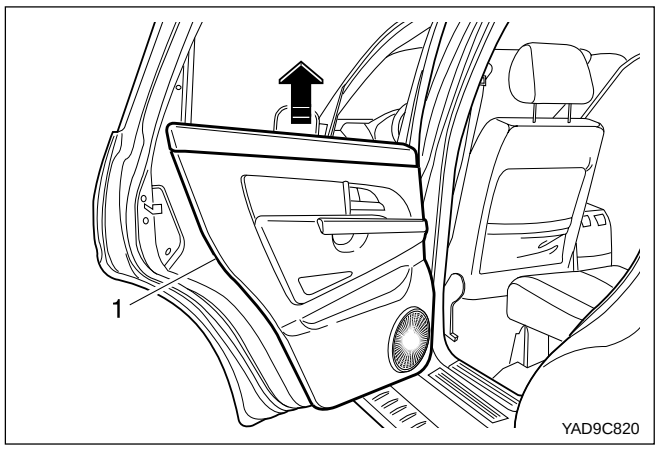


7. After releasing nut of regulator and window motor, remove regulator and window assembly.



8. Install reverse order of removal.

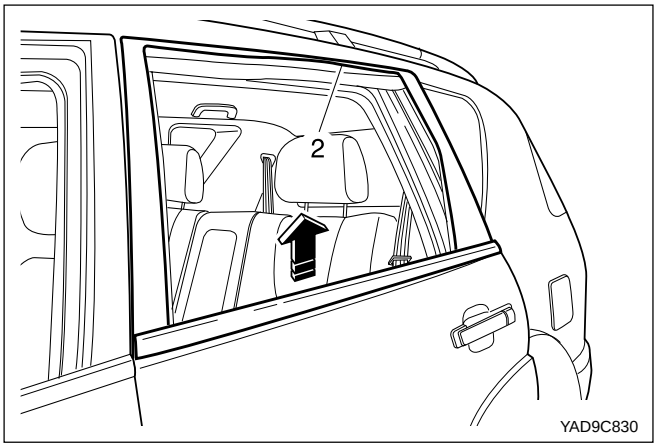
   Notice: Spread sealant on the seal of door trim, and then install the right position.



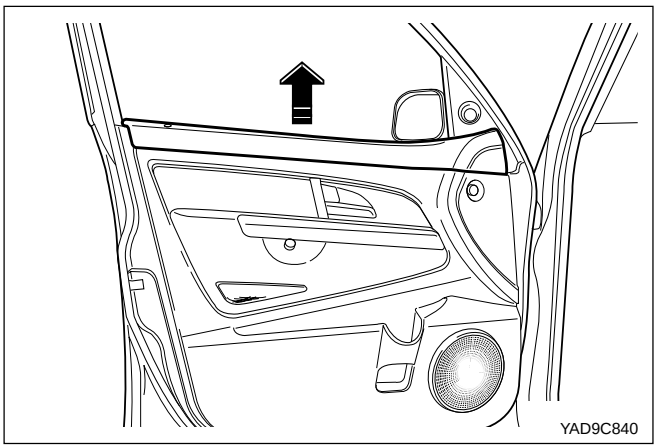
DOOR OPENING WEATHER STRIP

Removal and Installation

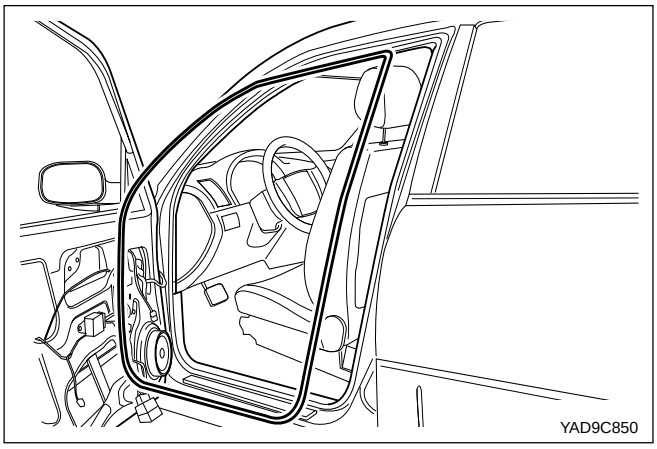
1. Remove door checker in the body.

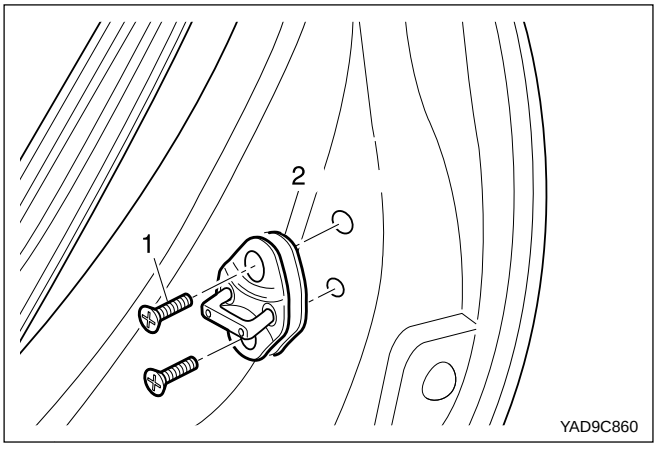


2. Remove the upper section from the rail.
3. After removing the clip, remove the lower section.



Notice: As clip and door opening weather strip is removed, due to damage of those part, install the new one.



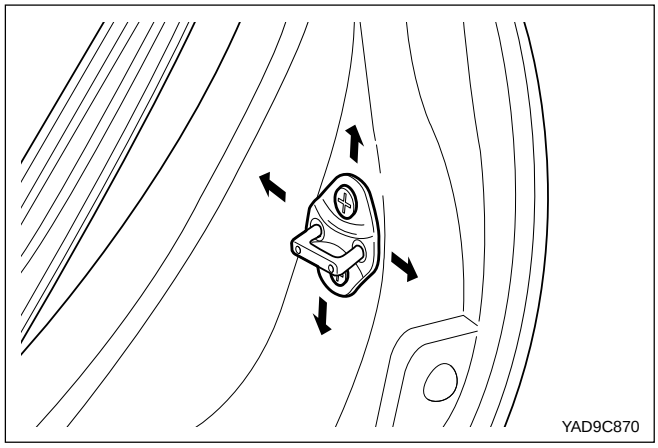


FORK STRIKER

Removal and Inatallation

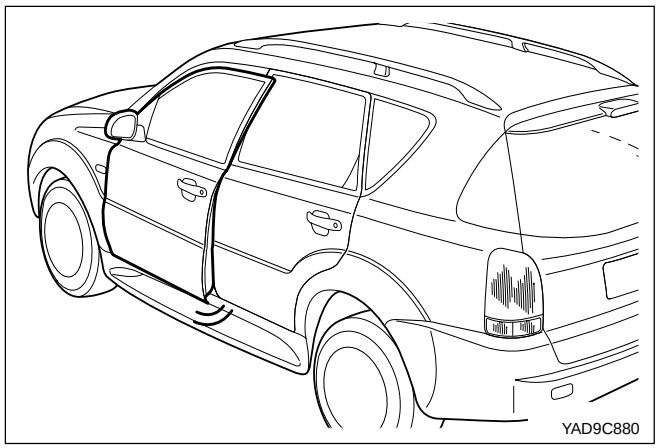
1. Remove the striker of door lock.
   1) Release screw (2 ea).
   2) Remove the striker.
2. Install the striker of door lock.
   1) Install temporarily striker of door lock .
   2) After opening and closing the door, tighten screw in the proper position.

Screw of Door Lock	20 - 28 N•m (44 - 52 lb-ft)



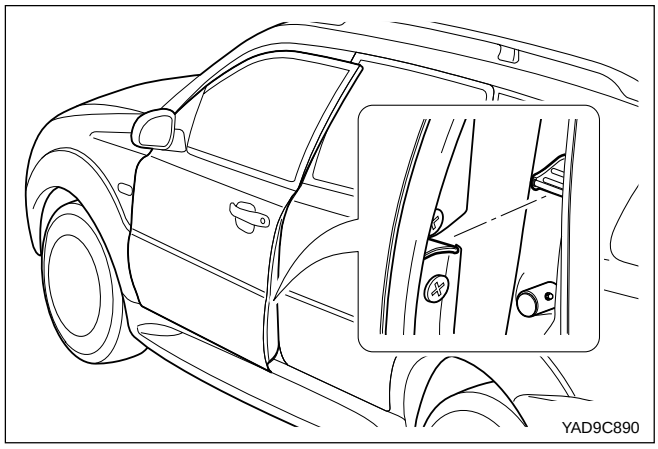
Adjusting Striker of Door Lock

Notice: Striker of door lock consists of striker and plate of floating cage in the pillar body, plate of floating cage can easily adjust by controlling striker up and down, left and right. As fork snap of door lock is linking the striker, the door comes to position of closing.

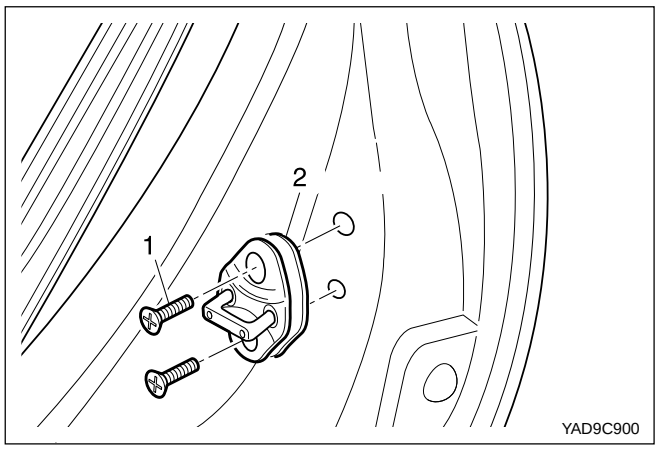


Adjusting Forward and Backward

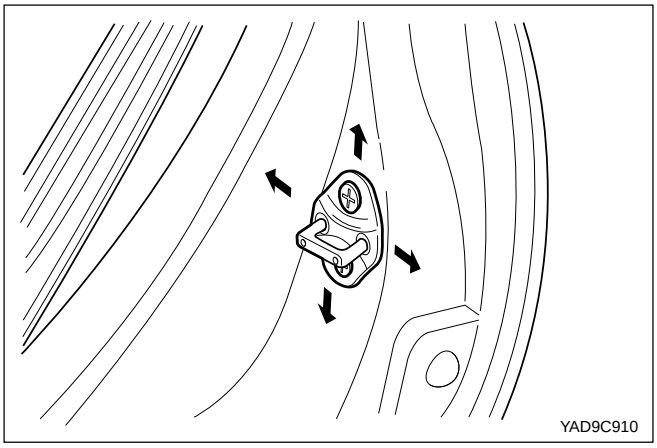
1. Door keep on the one line between door lock fork and striker.
2. Handle of door is pushing fork of door lock into contact on striker.
3. After door is set on position of opening, to keep contact fork of door lock with striker, open and close the door slow repeatedly.



4. Technician can see keeping fork of door lock alignment with striker. Fork of door lock is linking perpendicular to center of striker, is linking center of body pillar.



5. As striker is required for adjusting to forward and backward, proceed following the descriptions.
   1) Release fixing bolt of striker.
   2) If striker move to backward of vehicle , spacer is removed.
   3) If striker move to forward of vehicle, put addition spacer (2 mm).
   4) Tighten fixing bolt of striker.
6. Proceed to repair adjusting up and down, forward and backward.



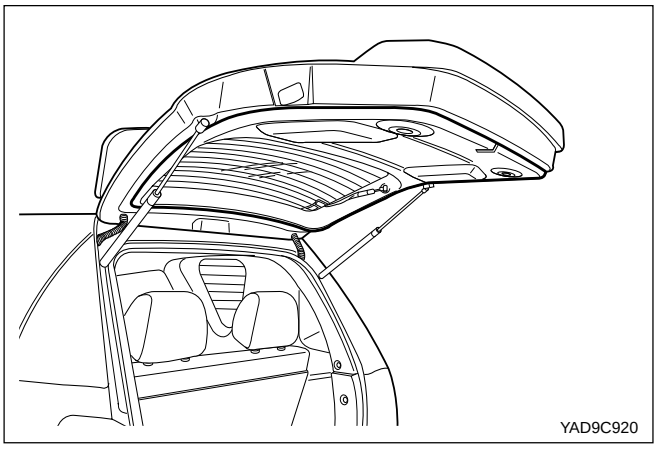
Adgusting Up and Down, Left and Right

Adjusting striker up and down, left and right is required in following case, such as damage of vehicle collision, installation of new weather strip , wind-noise, difficulty of opening and closing door, in case adjusting up and down, left and right, proceed to repair the following.

1. Door keep on the one line between door lock fork and striker.
2. Release fixing bolt of door striker.
3. Plate of plotting gauge moves little bit to end of striker screw, plate of plotting gauge is put to adjust the position which is wanted.

   Notice: To protect section of screw from damage, while plate of plotting gauge is adjusted, flat rotary pile is used for adjusting.

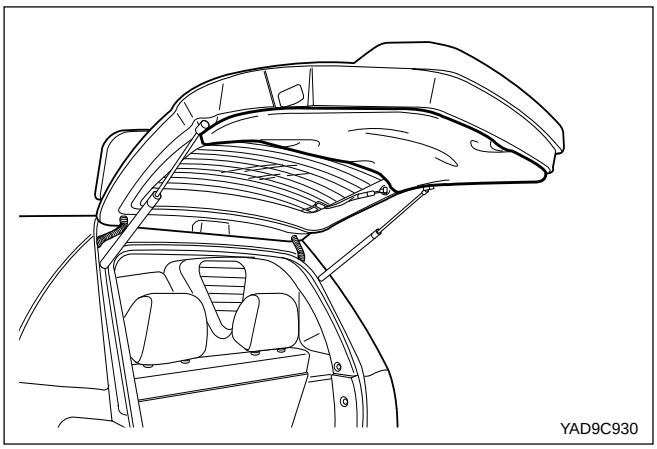
4. As adjusting is required beyond of limit of distance movable, in order to make big hall , electrical hand drill or flat rotary pile (3/8¢) is used.
5. According to direction adjusted, tighten fixing bolt of striker.



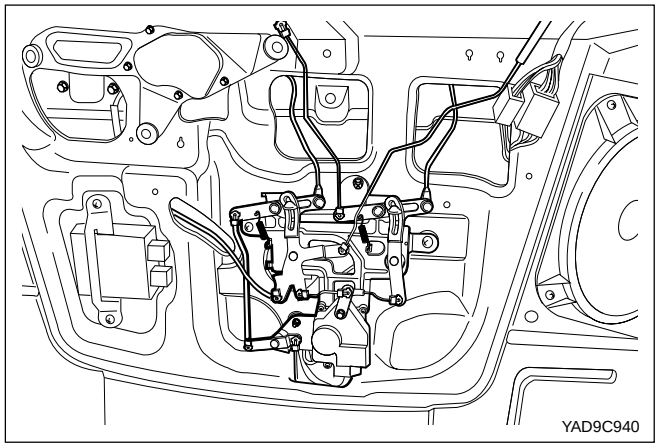
TAIL GATE CRANK

Removal and Installation

1. Separate the negative (-) terminal of battery.
2. Remove inner panel trim cover of tail gate.



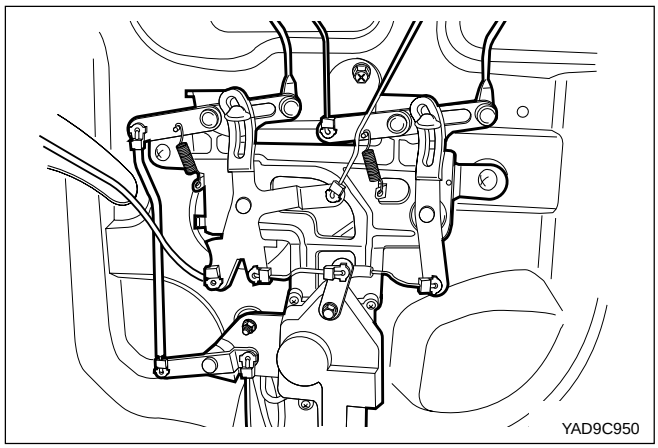
3. Remove inner panel trim vinyl seal of tail gate.
4. Separate wiring connector of actuator.
5. Separate outside handle, glass handle.
6. Separate safety rod.
7. Remove tail gate, glass latch rod.

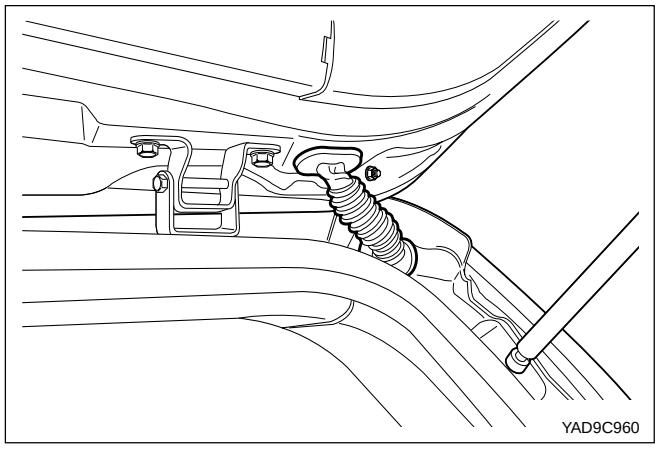


8. After separating fixing bolt (3 ea) of crank of tail gate, remove crank.

   Notice: If rekes is installed, key road is removed.

9. Install reverse order of removal.

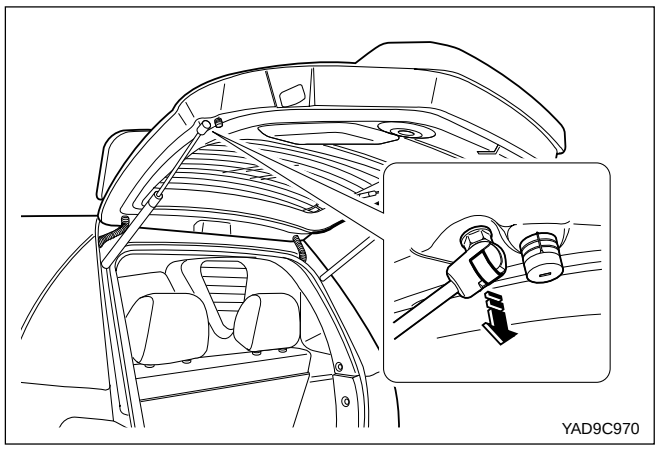




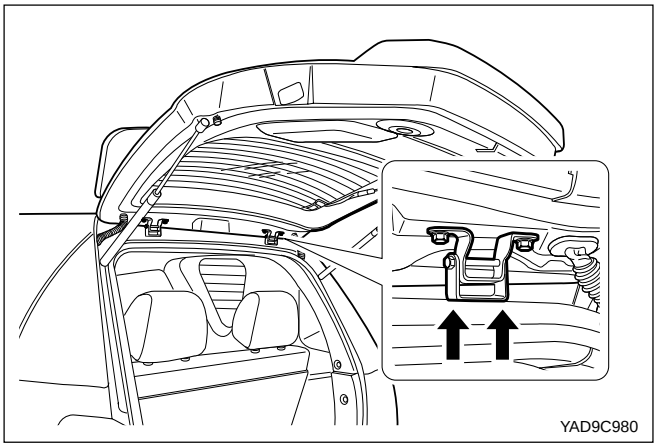
TAIL GATE

Removal and Installation

1. After separating grommet of tail gate and wiring connector (2 section), remove hose of nozzle washer.

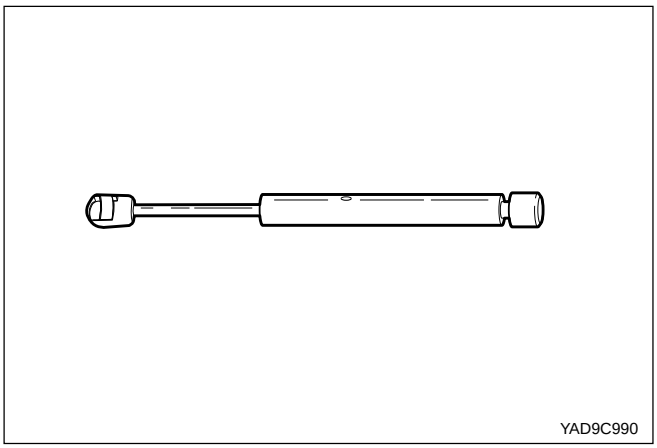


2. Using service tool, after opening up clip (4 ea) at end of both gas lifter, remove gas lifter (right/left).


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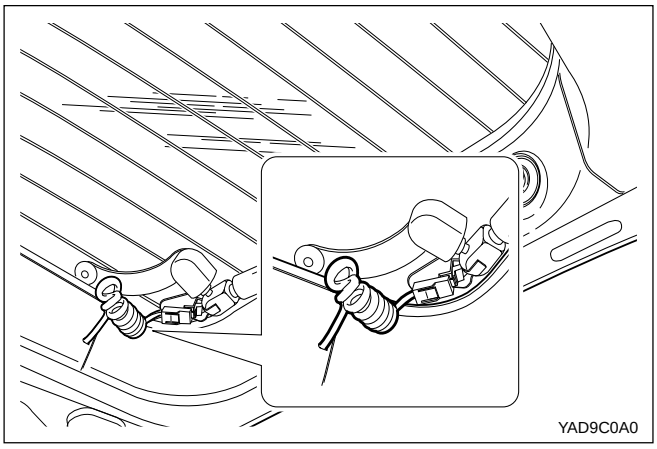
3. After releasing nut (4 ea) of body of tail gate hinge, remove tail gate from the body (proceed to remove after removing head-lining).

   Notice: In order for tail gate not to deflect, staff technician should support tail gate.


YAD9C990

4. Install reverse order of removal.

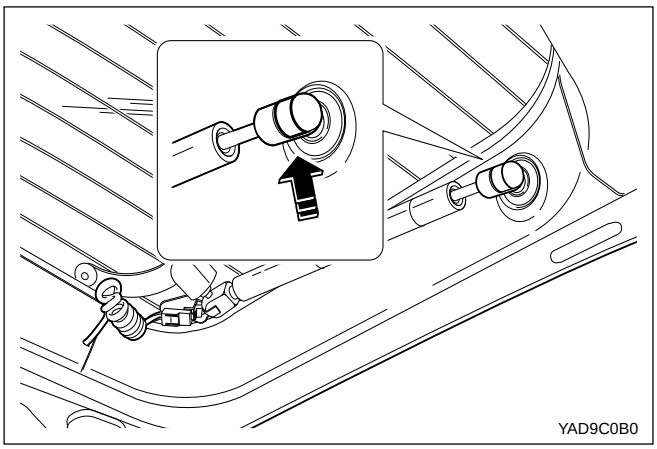
   Notice: High pressing nitrogen gas and oil is filled in the gas lifter, as gas lifter is removed, to prevent damage of (body of technician) and explosion, make hole (diameter 3 mm) into gas lifter for removal gas.


YAD9C0A0

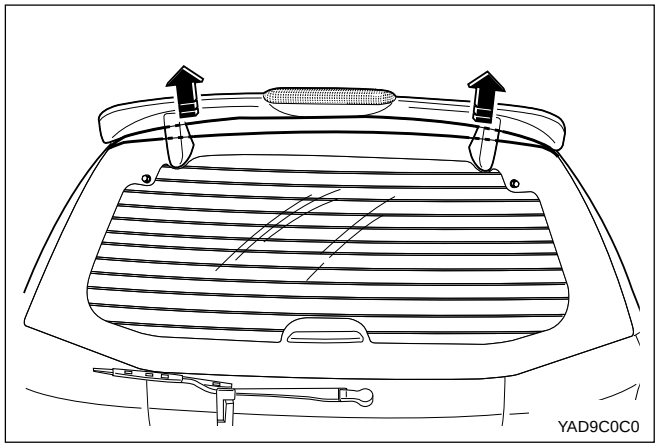
TAIL GATE FLIP UP SYSTEM

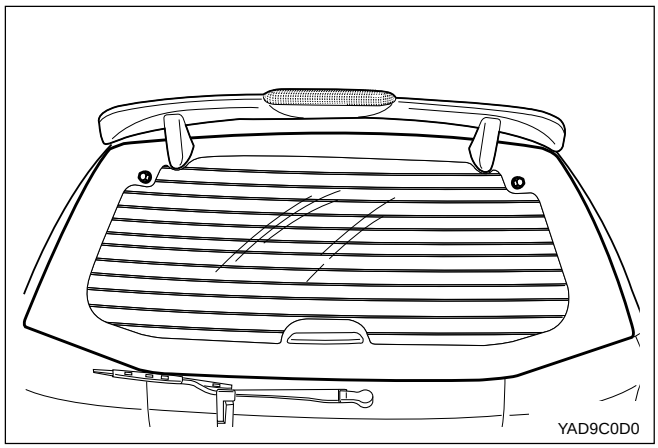
Removal and Installation

1. Remove the upper garnish.
2. Separate wiring (2 ea) in the connector of heating line of rear glass and wiring (1 ea) of stop lamp (section of left spoiler).

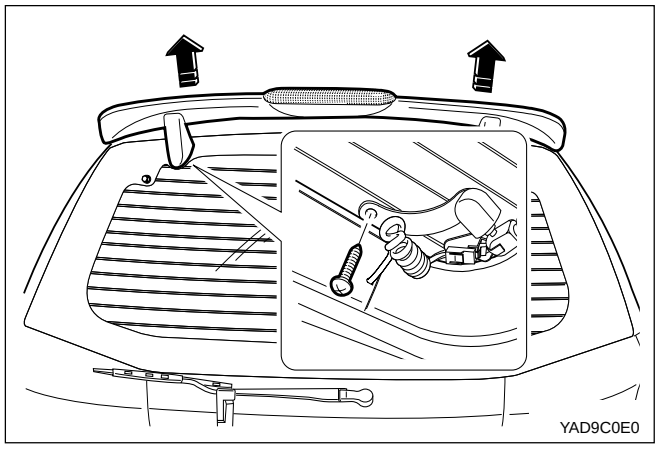

YAD9C0B0

3. Using service tool, after opening up clip (4 ea) at end of both gas lifter, remove gas lifter (right/left).





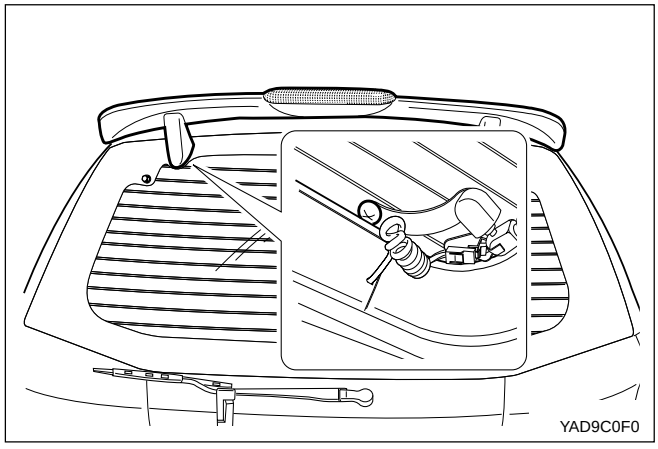
4. After separating fixing bolt (2 ea) of hinge (right/ left) of glass, remove glass from tail gate.
5. Install reverse order of removal.



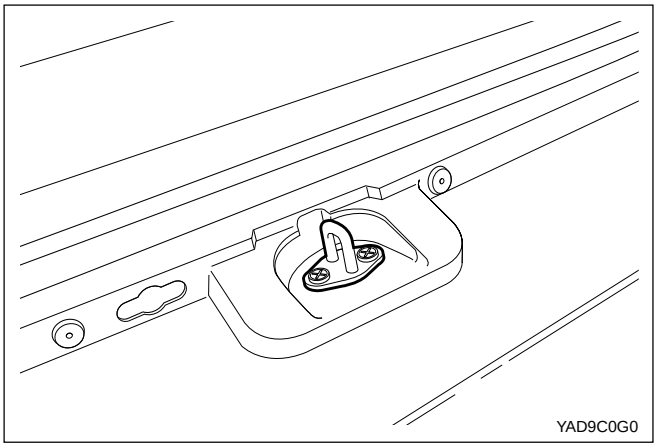
TAIL GATE AIR SPOILER

Removal and Installation

1. Separate fixing bolt (2 ea)of hinge in the left / right.



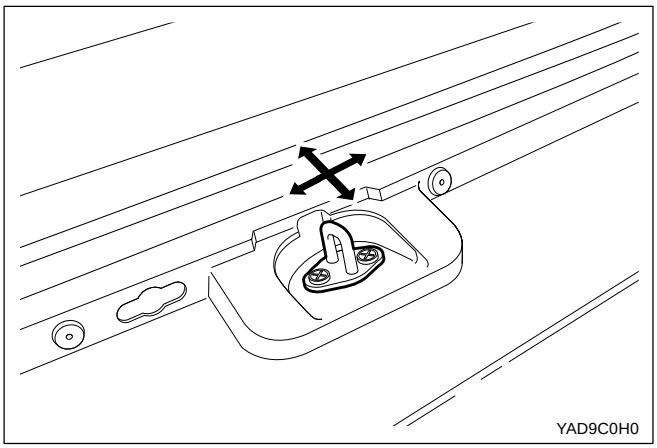
2. Remove air spoiler of tail gate.
3. Install reverse order of removal.


YAD9C0G0

CHECK AND ADJUST TAIL GATE

Lock striker of back door consists of striker and tail gate striker plate. Tail gate striker plate can be adjusted easily by fixing bolt of striker, up and down, forward and backwards. Lock of back door is linking striker and then turn to position of closing.

Notice: As latch of tail gate and glass latch is installed, bolt of ground should be used.

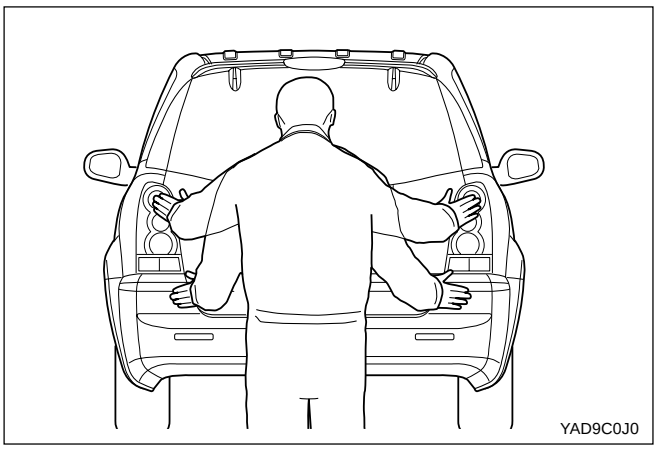

YAD9C0H0

Adjust Striker Forward and Backward, Left and Right

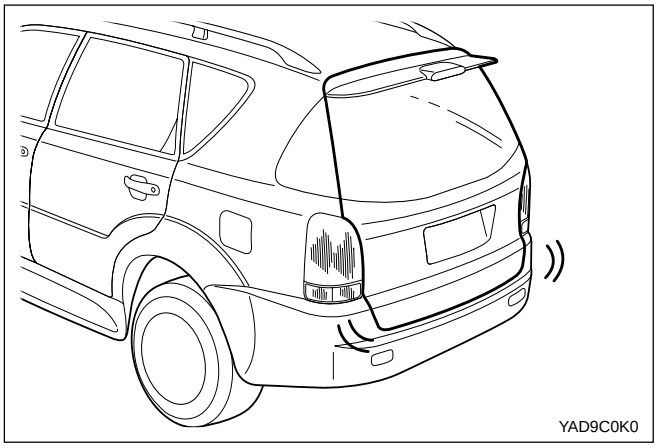
Adjusting of striker of tail gate to forward and backward, left and right is required in, case of damage of frame due to collision, wind-noise, difficulty of opening and closing. If striker is adjusted to forward and backward, left and right, proceed to repair as following.

1. Tail gate keep on the one line.
2. Release fixing bolt of striker of tail gate.
3. Plate of plotting gauge moves little bit to end of striker screw, tail gate striker plate is put to adjust the position which is wanted.

   Notice: To protect section of screw from damage, while tail gate striker plate is adjusted, flat rotary pile is used for adjusting.

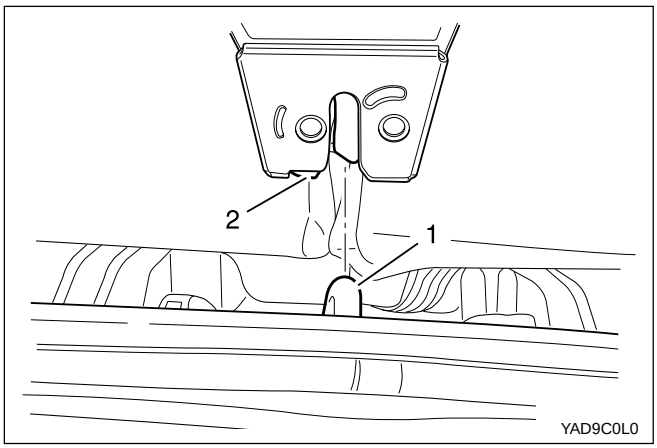

YAD9C0J0

4. As adjusting is required beyond of limit of distance movable, in order to make big hall, electrical hand drill or flat rotary pile (3/8″) is used.
5. According to direction adjusted, tighten fixing bolt of striker.
6. Proceed to adjust up and down.


YAD9C0K0

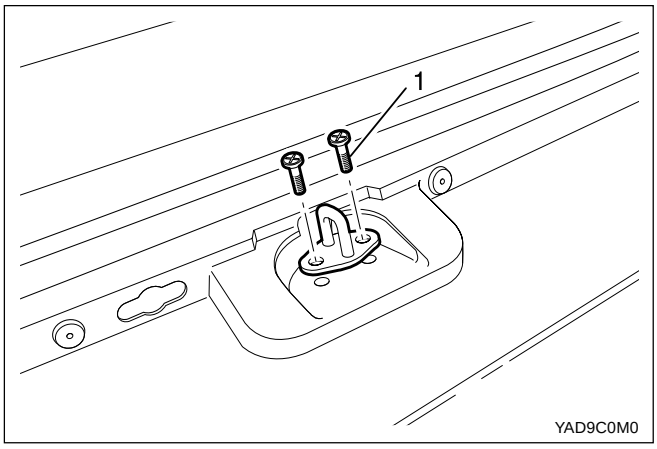
Adjust Up and Down

1. Door of tail gate keep on the one line around parts.
2. Back door keep closing until door lock fork of tail gate into contacting to striker.
3. After door is set on position of opening, to keep contact fork of door lock with striker, open and close the door repeatedly.



YAD9C0L0

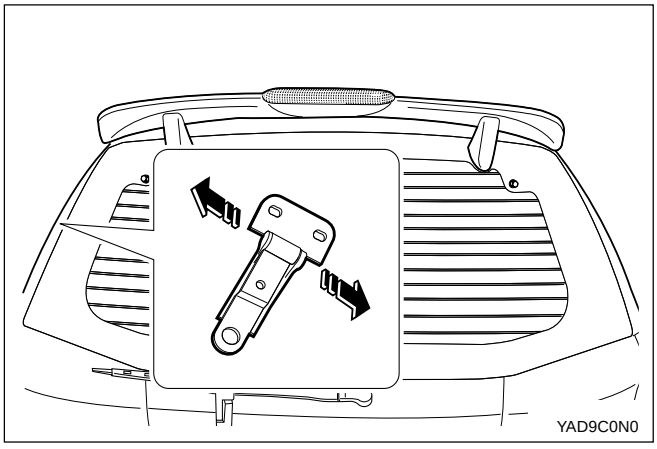
4. Technician can see and keep fork of door lock alignment with striker, fork of door lock is linking perpendicular to center of striker, is linking center of body pillar.



YAD9C0M0

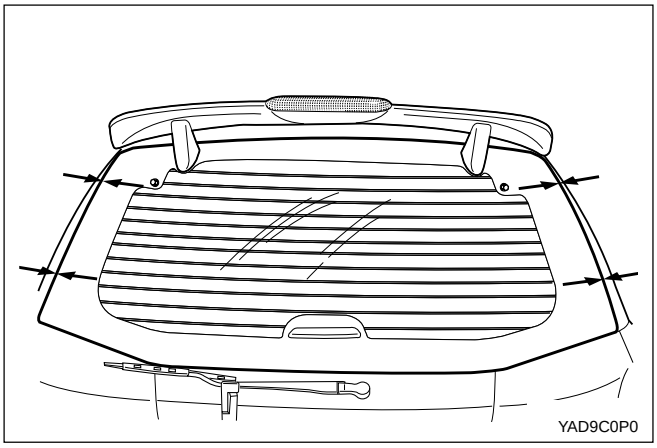
5. As striker is required for adjusting to up and down, proceed to repair, following the descriptions.
   1) Release fixing bolt of striker.
   2) If striker move to upward, put addition spacer (2 mm).
   3) Tighten fixing bolt of striker.

Torque of Tightening	10 - 14 N•m (44 - 52 lb-ft)


YAD9C0N0

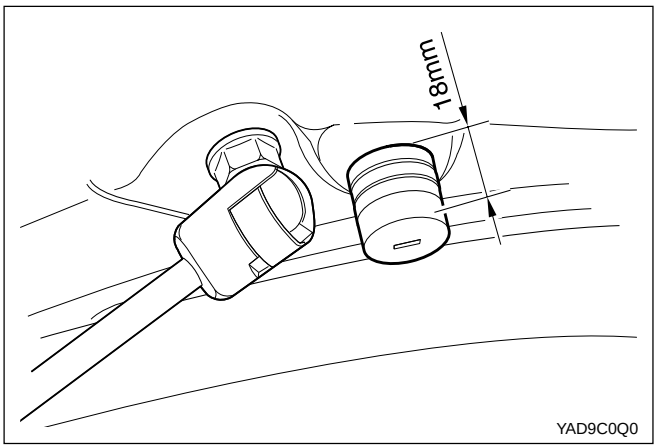
Adjust Flip Up

1. After removing the upper garnish, release little bit mounting bolt of flip up glass.



2. After adjusting glass left and right, fit gap with quarter glass.

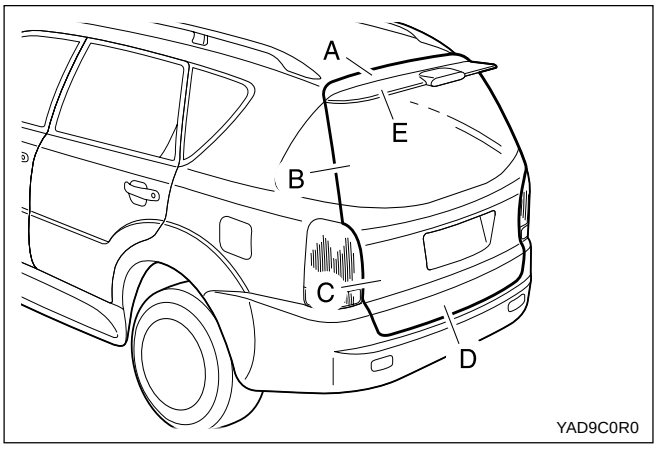
Torque of Tightening	9 - 10 N•m (44 - 52 lb-ft)



Check the Deflection

As tail gate is pushed from the external, not to occur the deflection, adjust overlap.

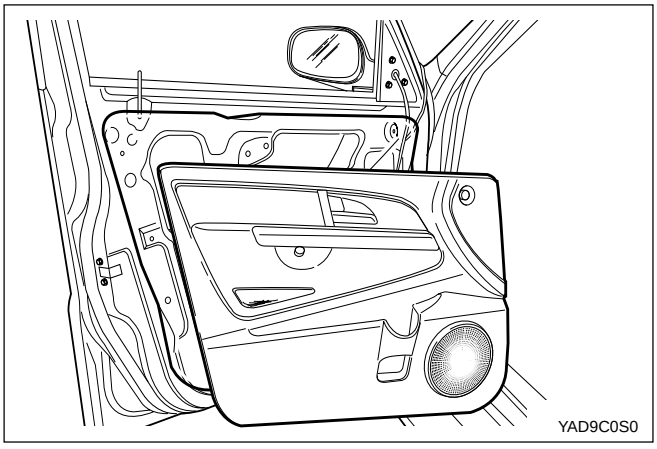
Standard	18 mm



Adjust Gap of Fitting

(mm)

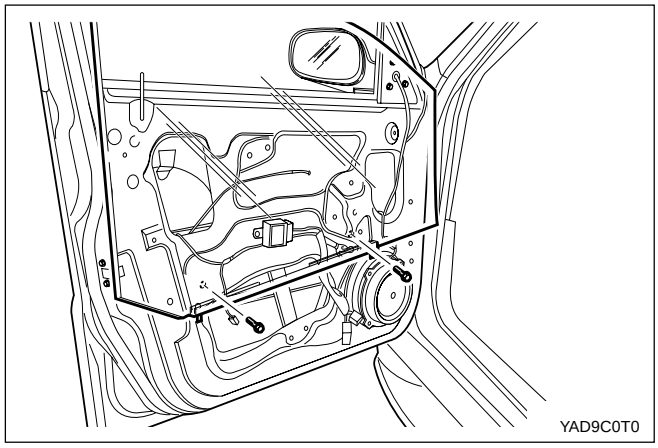
Section	A	B	C	D	E
Gap	11	5	5	5.7	4.2



FRONT DOOR WINDOW

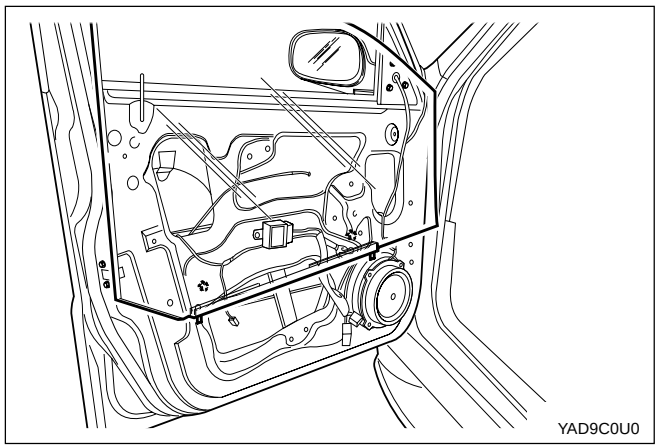
Removal and Installation

1. Remove seal and door trim.



2. Remove glass of front door.
   1) Release fixing screw (2 ea) of glass, at this time, position of plate of regulator carrier should be position of installation.
   2) Remove glass.

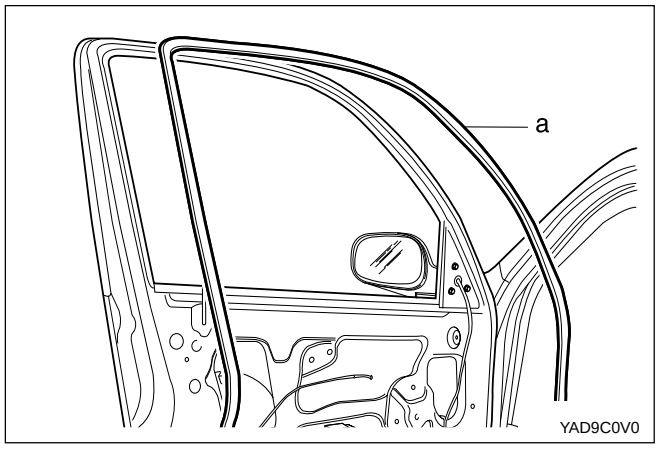
   Notice: If glass interfere to the body, damage of section of body painting may happen, so glass should not interfere body.



3. Install reverse order of removal.

Fixing Bolt of Glass	3 N•m (26 lb-ft)

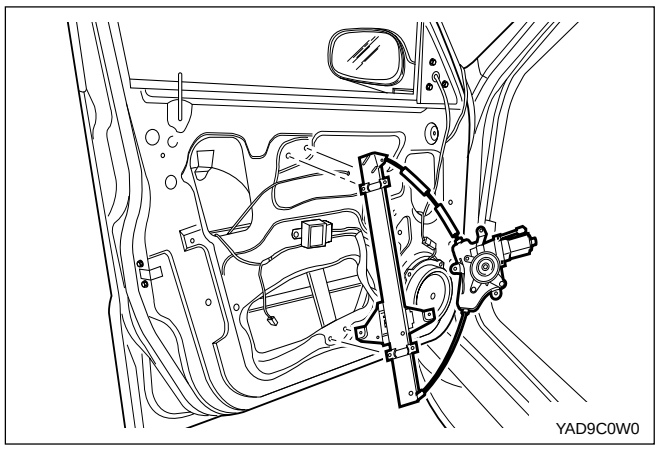
Notice: If water of soap spread on contacting section between glass run and glass, so that, can be installed easily.



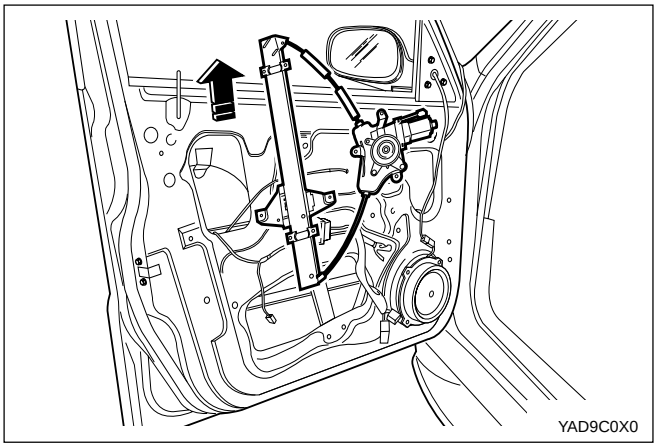
FRONT DOOR GLASS RUN AND REGULATOR

Removal and Installation

1. Remove door trim, seal, and window glass.
2. Remove door glass run from door .

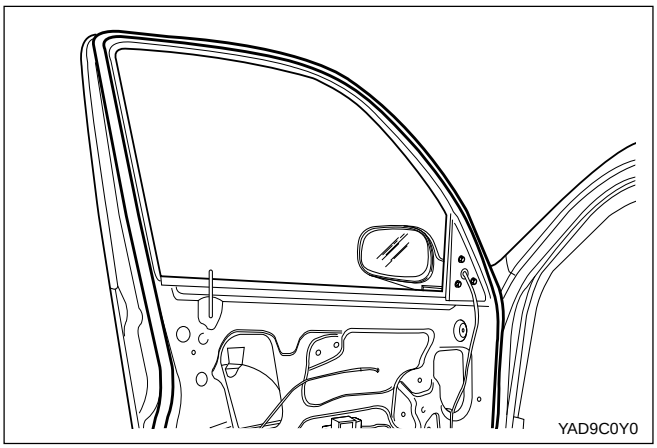


3. After releasing fixing nut of door regulator, and then remove motor connector of power window.

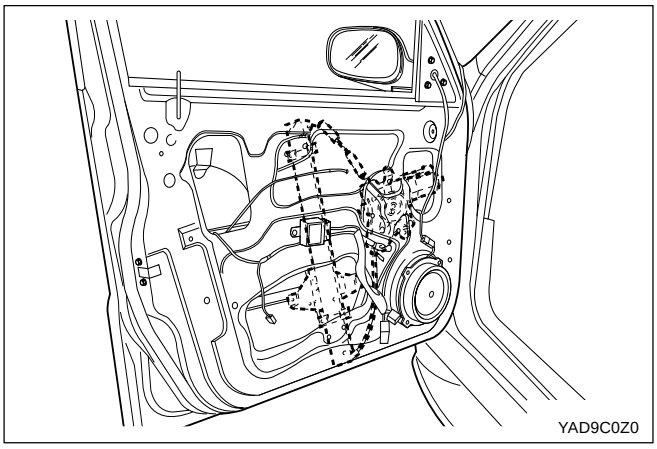


4. Remove door regulator assembly.

   Notice: After separating door glass run and regulator, remove and install them .

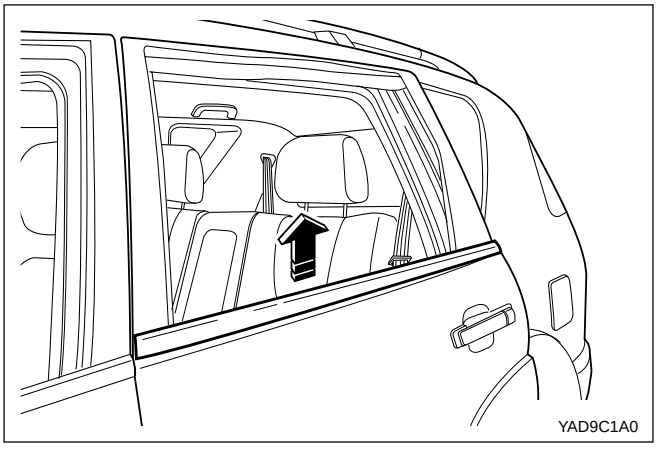


5. As door glass run is installed, water of soap spead on section of glass run so door glass run can be installed easily.



6. Install reverse order of removal.

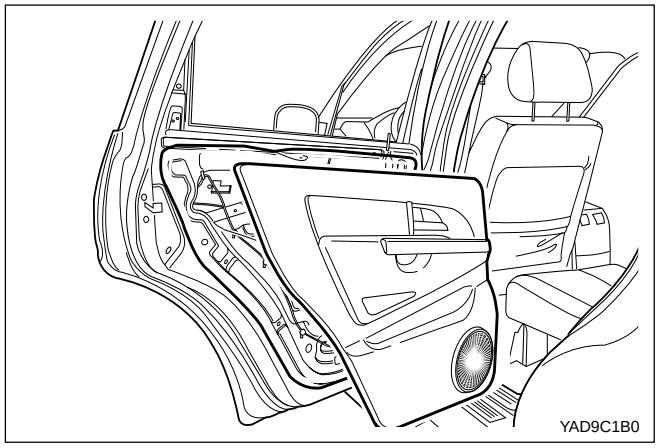
Fixing Nut of Regulator	8 N•m (26 lb-ft)



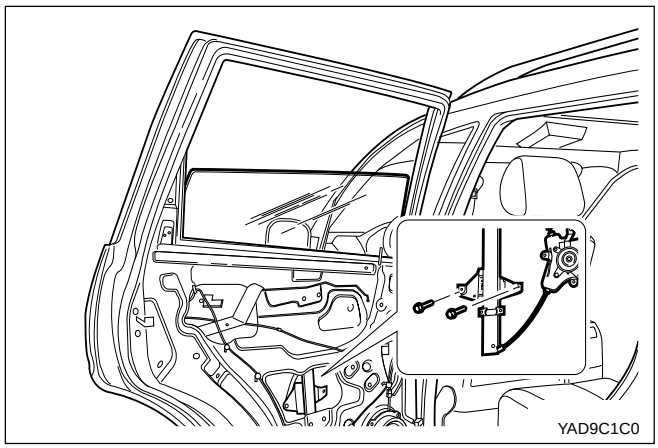
REAR WINDOW

Removal and Installation

1. Remove external weather strip of door window
2. Remove front garnish of rear door.

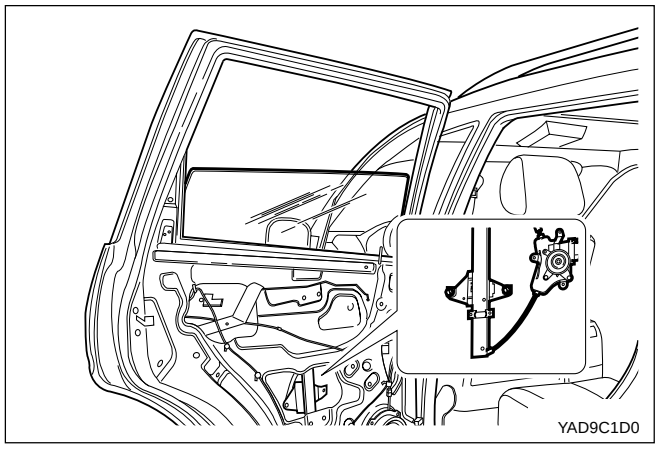


3. Remove seal and door trim.



4. Remove rear door glass.
   1) Release screw (move up carrier plate of regulator).
   2) Extract glass upwards.

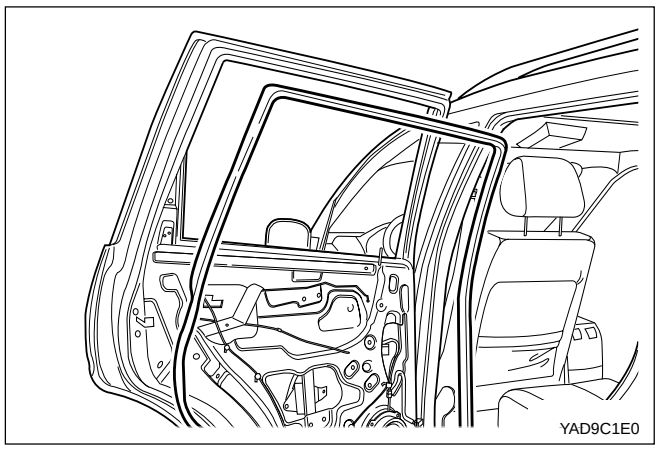
   Notice: If glass interfere to the body, damage of section of body painting may happen, so glass should not interfere body.



5. Install reverse order of removal.

Fixing Nut of Glass	3 N•m (26 lb-ft)

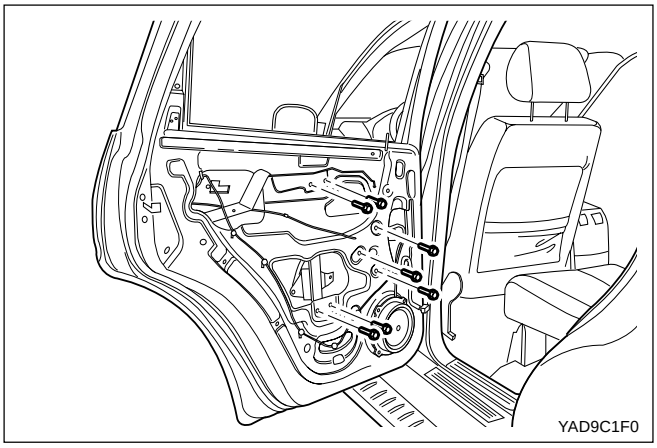
Notice: As door glass run is installed, water of soap spead on section of glass run so door glass run can be installed easily.



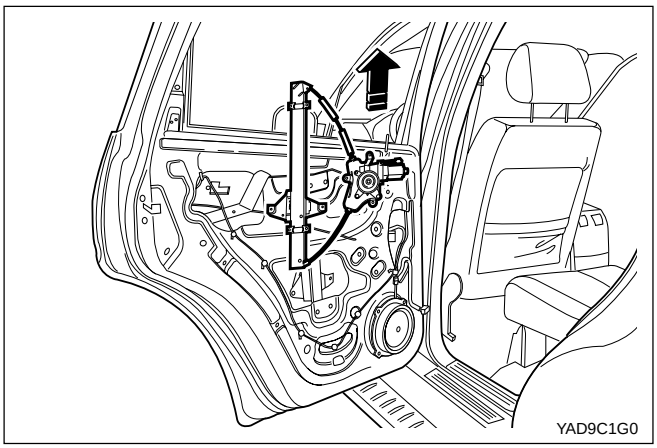
REAR GLASS RUN/ REGULATOR/ CHANNEL

1. Remove door trim, seal, and glass
2. Remove glass run.
   - Pull door glass run internally, and then extract glass run.

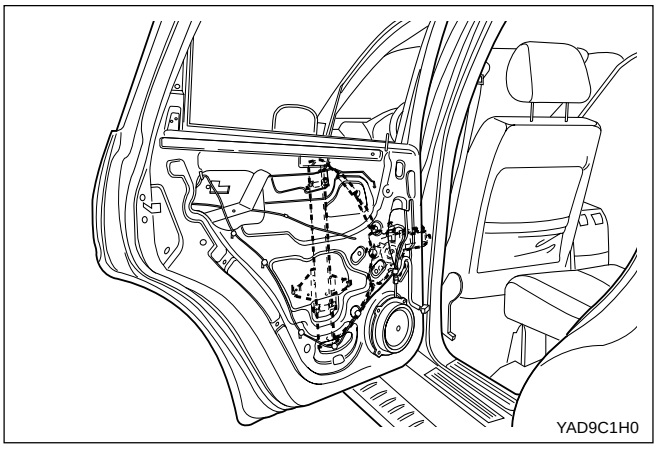
   Notice: As door glass run is installed, water of soap spead on section of glass run so door glass run can be installed easily.



3. Remove door regulator assembly.
   1) Separate connector of window motor.
   2) After separating fixing nut (7 ea) of window regulator, remove regulator assembly.

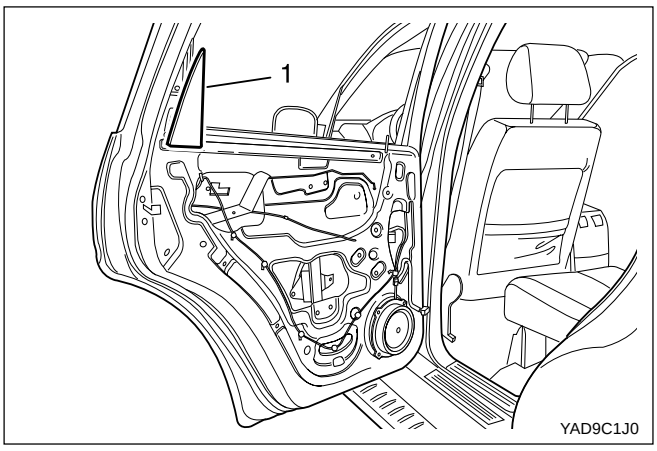


   3) Remove regulator assembly.

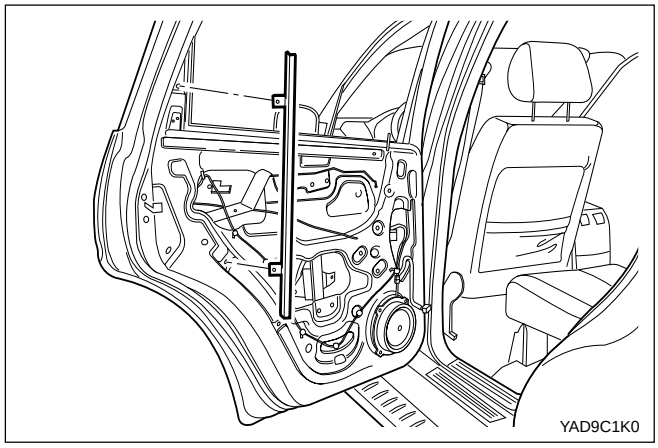


Installation

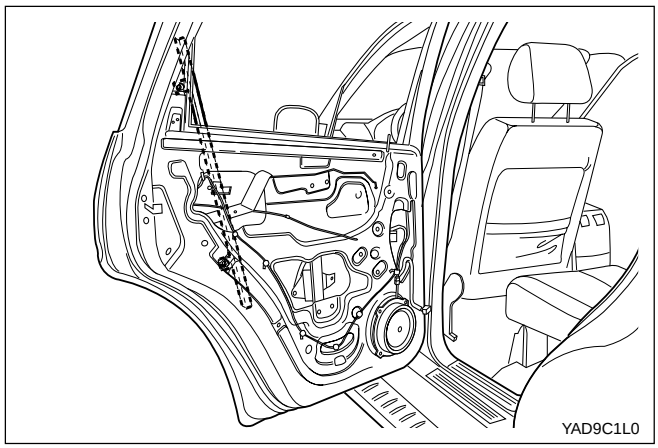
Fixing Nut of Regulator	8 N•m (26 lb-ft)



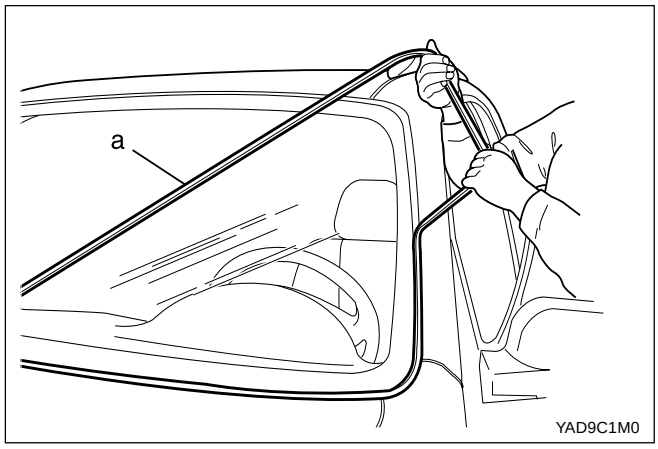
4. Remove glass channel.
   1) Remove internal (1) panel of rear door.



2) After releasing fixing nut of glass channel, remove glass channel.



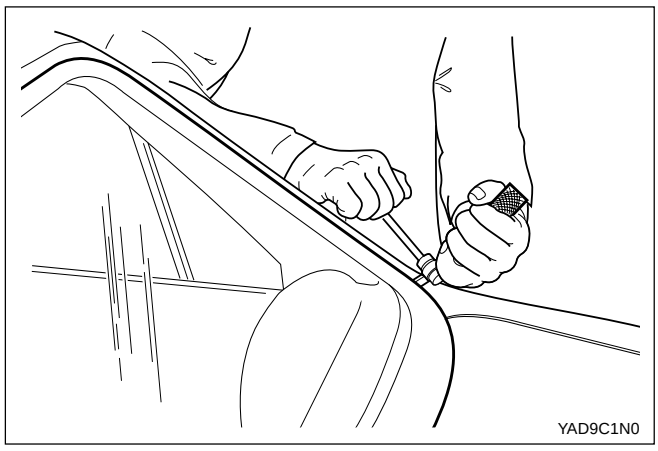
3) As glass channel is installed, in order for glass channel not to change up and down, should be installed right position, tighten fixing bolt.



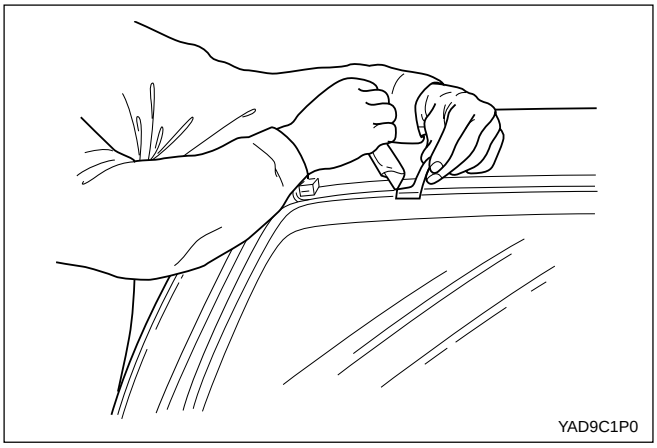
WIND SHIELD GLASS

Removal

1. Remove cowl grill.
2. Remove room back mirror.
3. Remove moulding (a) of wind shield glass.

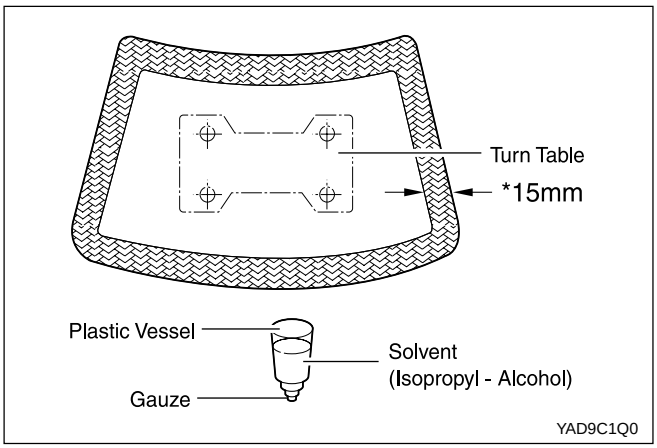


4. Using special tool, cut sealant of wind shield glass.


YAD9C1P0

5. Remove wind shield glass
6. Using knife, remove sealant of wind shield glass and frame.

   Notice: In order to prevent damage of painting, approximately 1mm of sealant should not be removed from body.

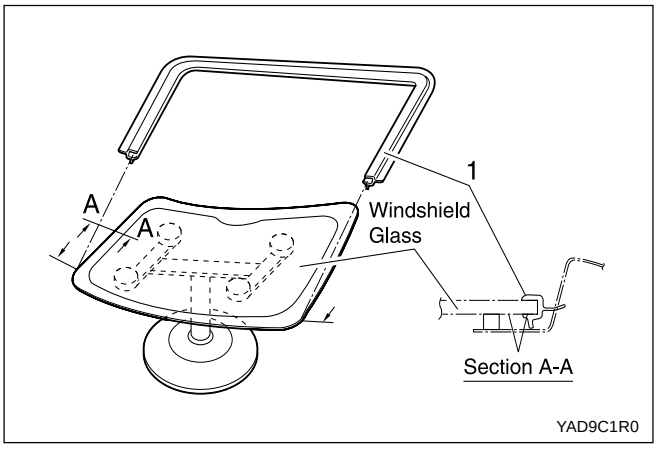


YAD9C1Q0

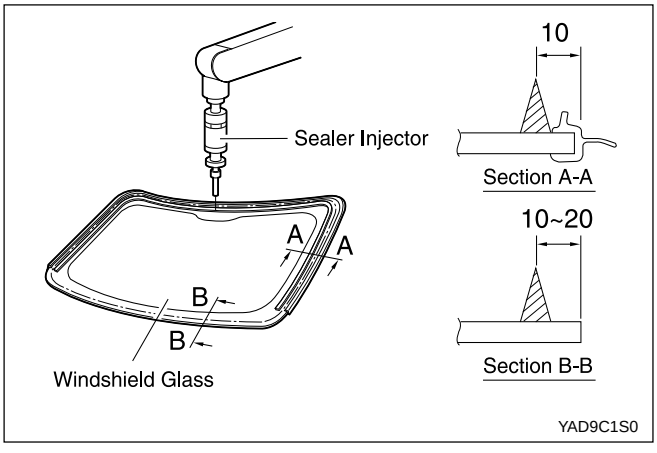
Installation

1. Clean up section to spread primer of wind shield glass by washing.
   1) Section of washing keep distance 15 mm from the end of glass.
   2) After using gauze 20 times, gauze is thrown away.
   3) Gauze is a solvent (isopropyl alcohol), gauze keep wet completely.
   4) Keep an eye on the washed section of glass not to be touched by any thing polluted.
   5) After washed glass, spread primer on the glass section of wet state.
2. Install new wind shield moulding on wind shield glass.

   Notice: After spreading sealant on the glass, glass should be installed within 5 minutes.



YAD9C1R0

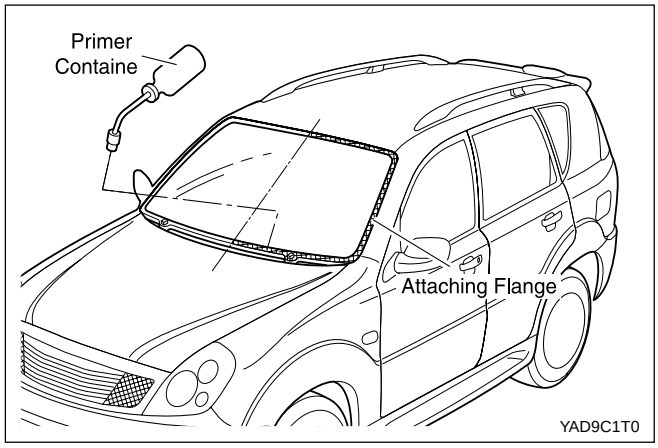


YAD9C1S0

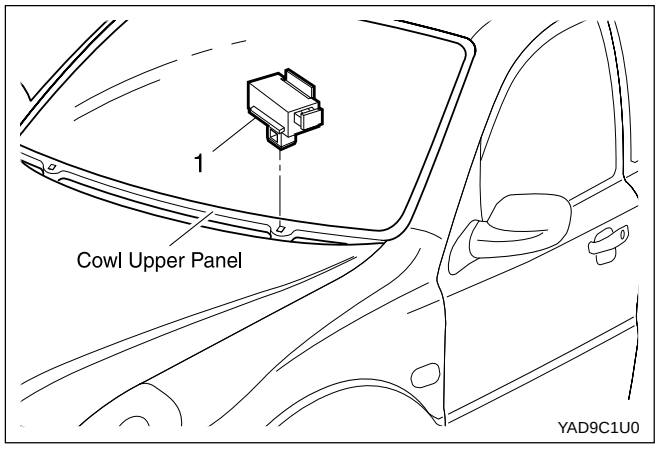
3. Spread sealant on the wind shield.

   Notice:

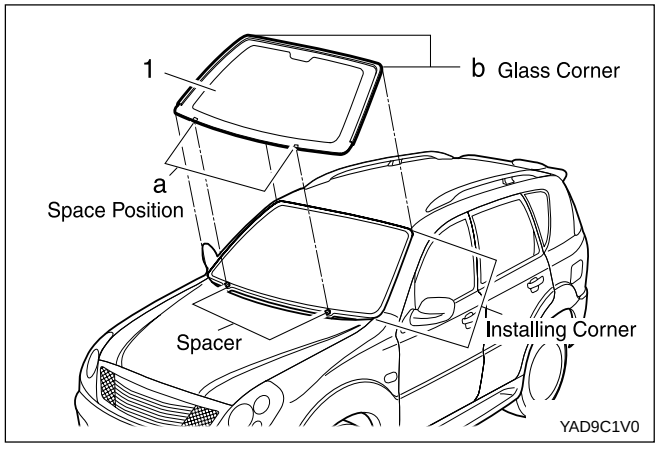
   1) If shape of spreading is not uniform, thickness of spreading is not uniform after installing wind shield, leaking of water may occur.
   2) As sealant is spreading, due to interfering of nozzle, keep eye on for glass moulding, glass dam not to drop.



4. Wash up flange of wind shield glass.
   - After using gauze 20 times, gauze is thrown away
   - Gauze is a solvent (isopropyl alcohol), gauze keep wet completely
   - Keep an eye on the washed section of glass not to be touched by any thing polluted.
   - After washed body flange, spread primer on the glass section of wet state.
   - If oil is stuck on the body flange, primer does not spread on the body flange.
   - After spreading, is available time for use : from 3 hours to 8 hours
   - As the body is polluted by primer, as soon as possible mixing with ethil alcohol and ethil asetate (as a volume 50 : 50) and with this wet cloth is wiping solvent.
   - Term of validity of primer (90 days) which is passed is thrown away.
   - As spreading primer, flowing into other sections, pay attention not to pollute other sections.

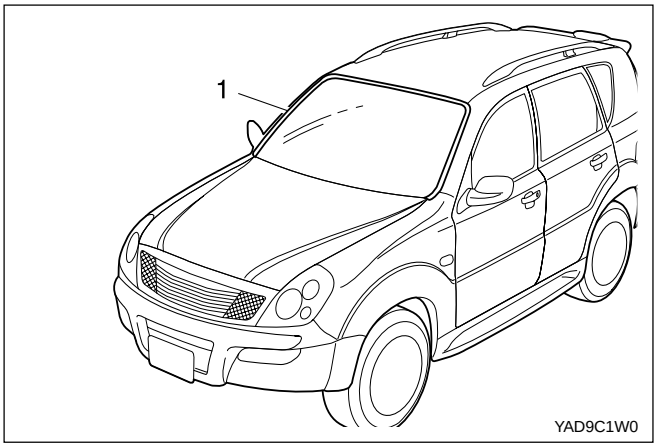


5. Insert spacer of wind shield.
   - Insert spacer until kind of sound occur.
   - After spacer insert body, no clearance.

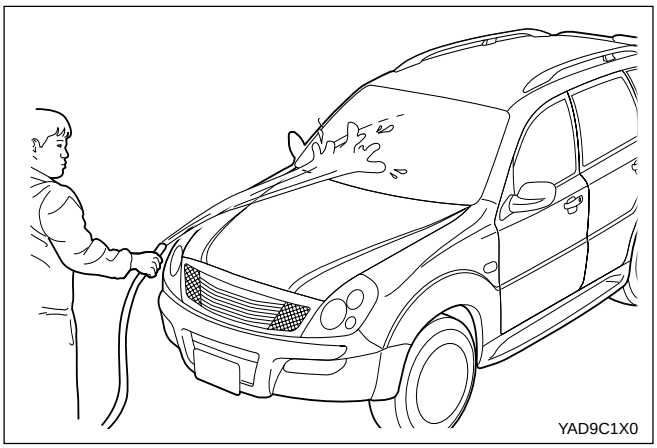


6. After install glass of wind shield, check the following description.

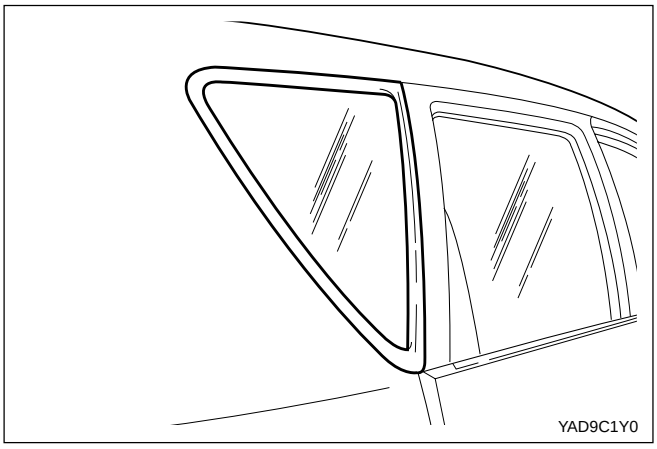
   Notice: If the section (b) of glass corner happen clearance between moulding and body, spacer can adjust this clearance.



7. For the right position installed of glass which wind shield is fixed, stick tape on moulding, and frame of wind shield.
8. To keep sealant dry, park the vehicle for 24 hours.
9. Remove tape1.



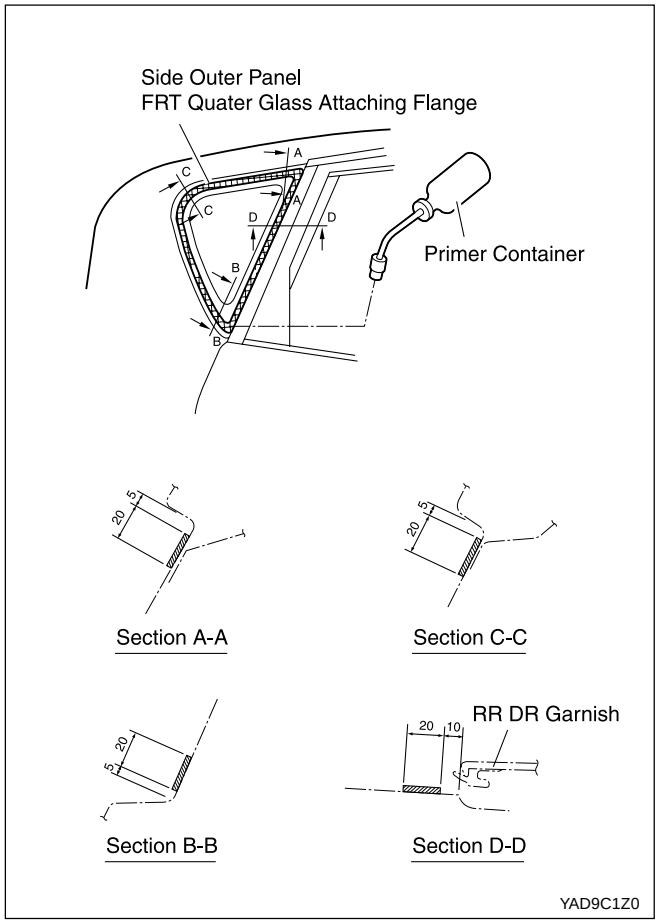
10. Spread water on the wind shield glass, and then check leaking of water. If leaking of water happen, after keep wind shield glass dry, fill sealant on the section of leaking, if leaking of water goes on, wind shield glass is removed, the above descriptive work proceed to repair once again.



FRONT QUARTER GLASS

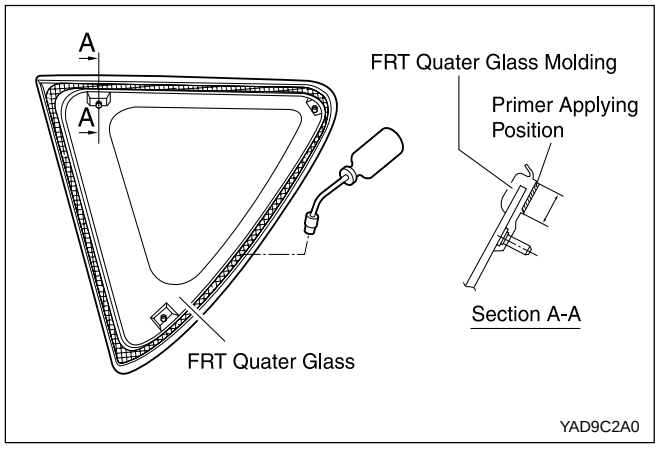
Removal

1. After releasing fixing nut of quarter glass, remove cover of glass moulding.
2. After removing quarter glass, using knife, remove sealant of quarter and frame.

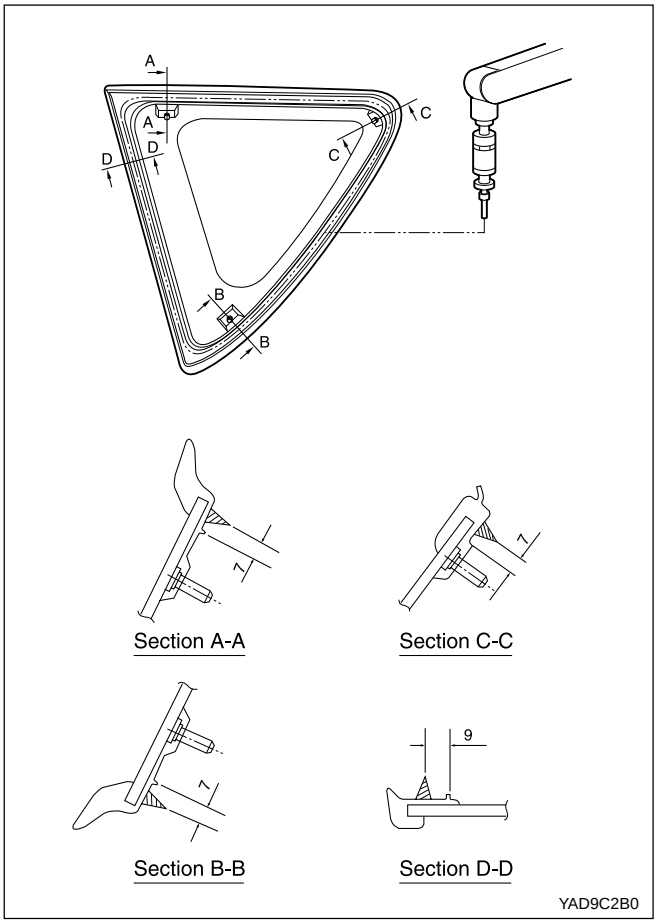


Installation

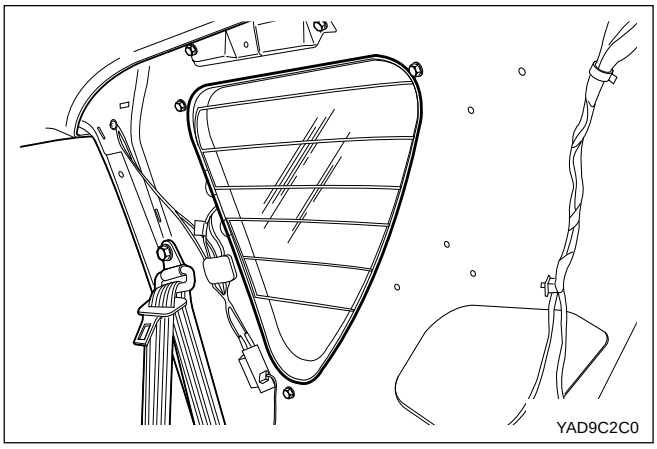
1. Wash up body frame (section of glass installed).
2. As keeping distance like the left picture, spread primer on the section of frame of installed glass.



3. Spread primer on the moulding of quarter glass of new quarter glass.

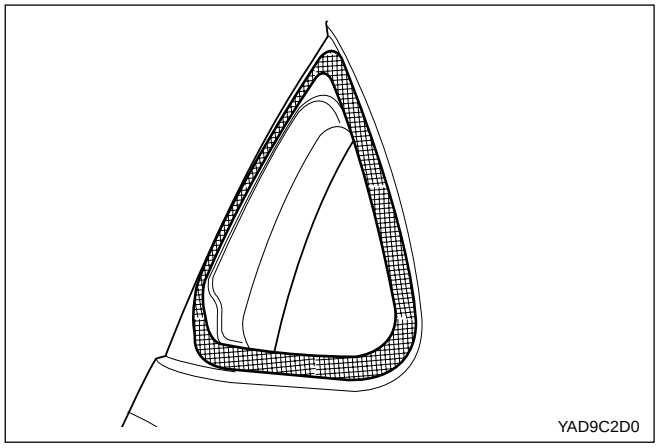


4. As keep distance like left picture, spread sealant on the glass.



5. After Install glass of front quarter on the body frame, tighten nut on the bolt of mounting.

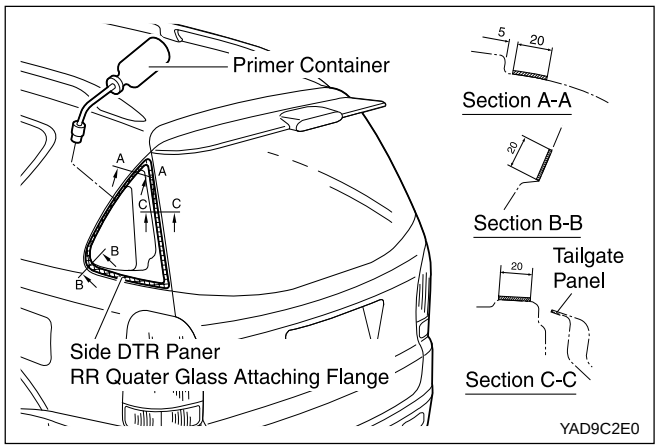
6. After installing front quarter glass, proceed to check leaking of water.



REAR QUARTER GLASS

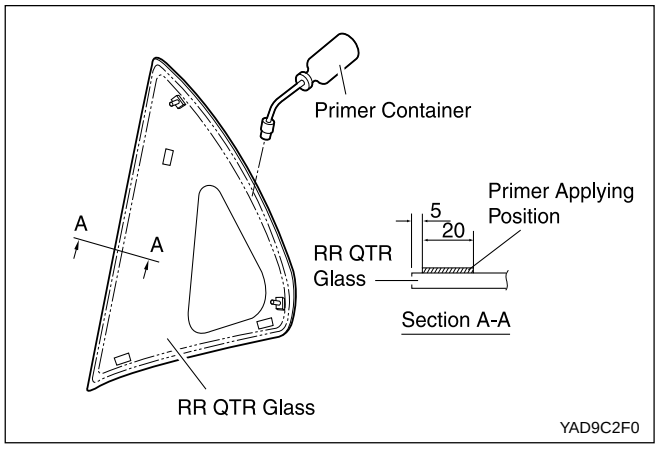
Removal

1. After using special tool, remove sealant around glass.
2. Remove rear quarter glass.

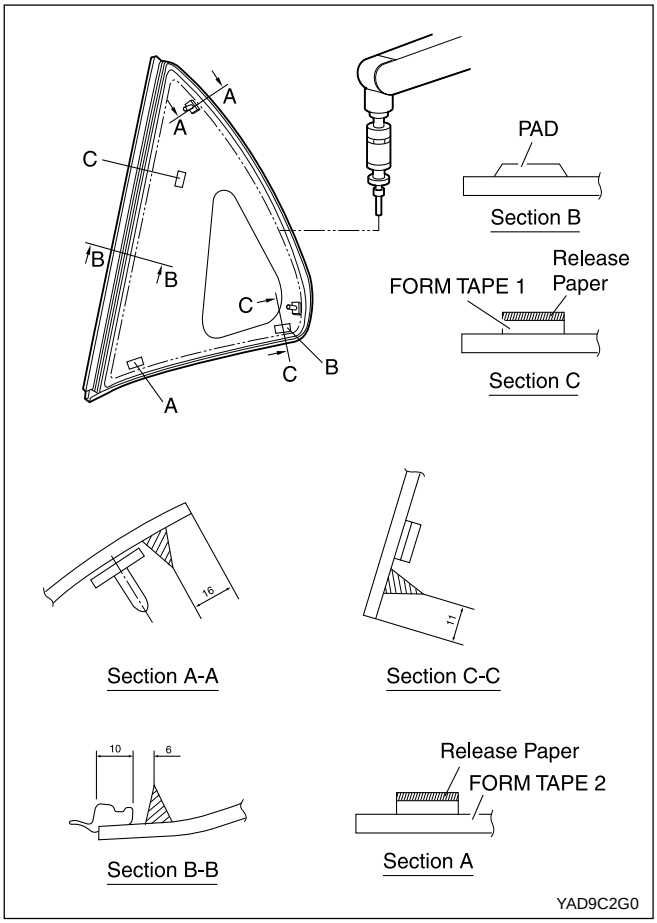


Installation

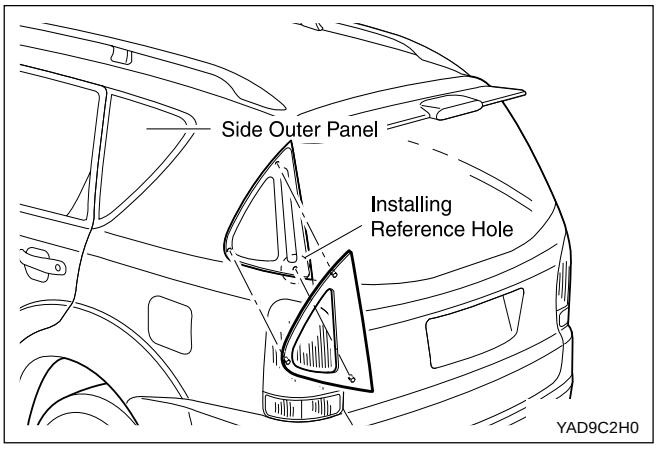
1. Wash up the section of body frame.
2. As keep distance like the left picture, spread primer.



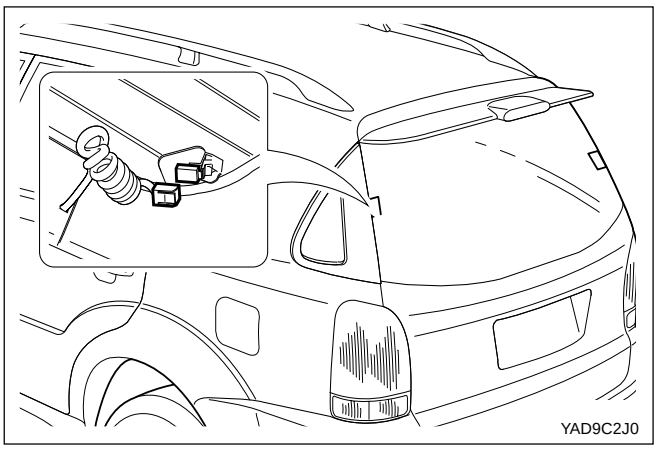
3. After spread on the new rear quarter glass, install glass moulding.



4. Spread sealant on the rear quarter glass.



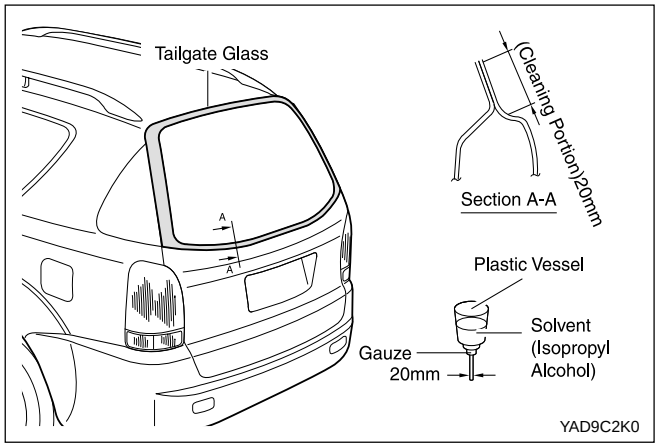
5. After installing rear quarter glass on the body frame, tighten nut on the bolt of mounting.
6. After installing rear quarter glass, proceed to check leaking of water.



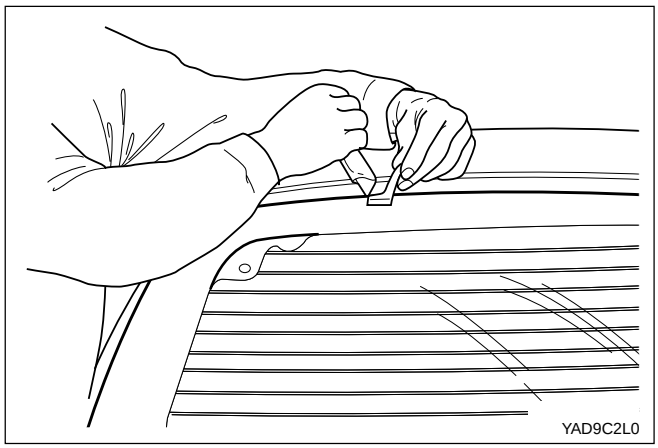
TAIL GATE GLASS

Removal

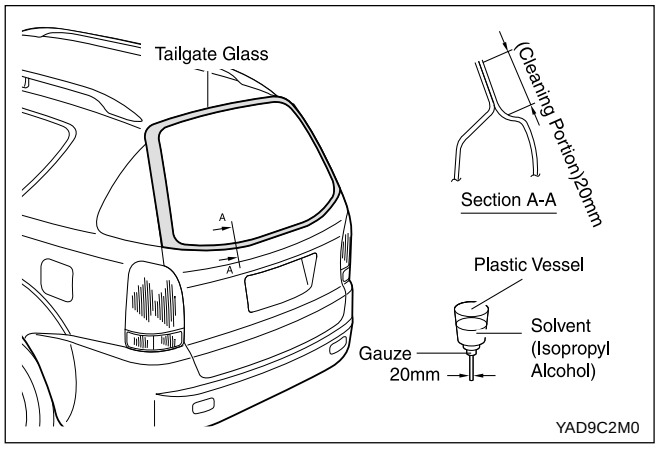
1. Separate negative cable of battery.
2. Separate connector of heat line of back door glass.



3. Using special tool, remove sealant of door glass of tail gate.

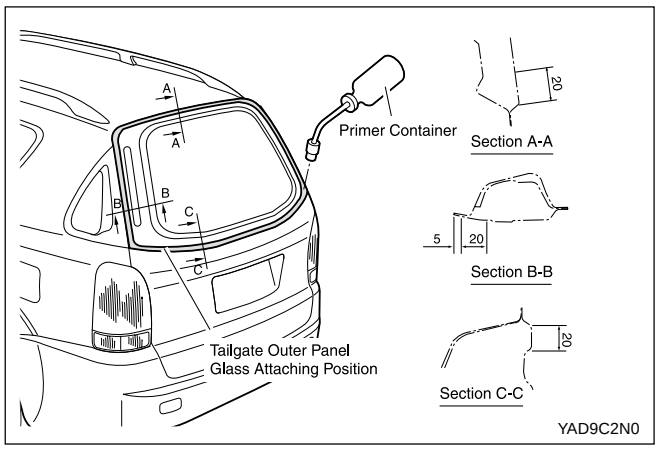


4. Remove door glass of tail gate from the vehicle.
5. Using the knife, remove sealant around door glass of tail gate and frame.



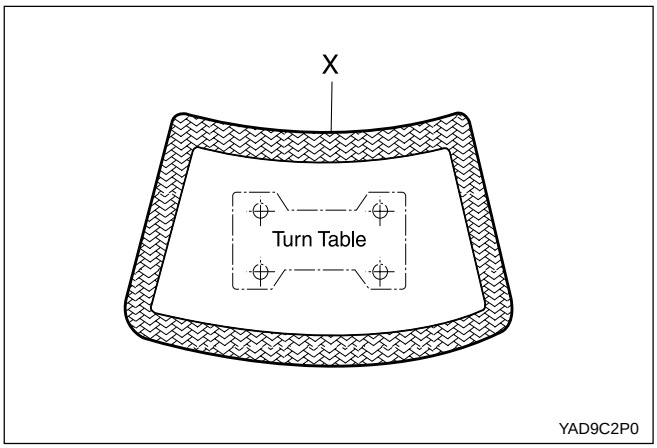
Installation

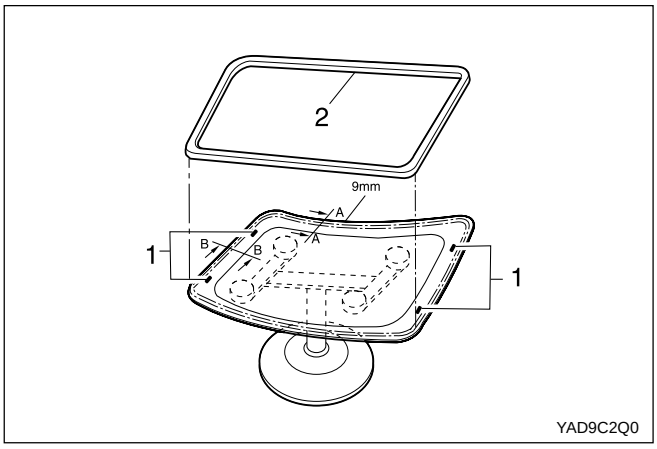
1. Wash up outer panel of tail gate.
   - After using gauze 20 times, gauze is thrown away.
   - Gauze is a solvent (isopropyl alcohol), gauze keep wet completely.
   - Keep an eye on the washing section of glass not to be touched by any thing polluted.
   - After washing glass, spread primer on the glass section of wet state.
   - Wash up on the section of spreading primer without being touched by any thing polluted.



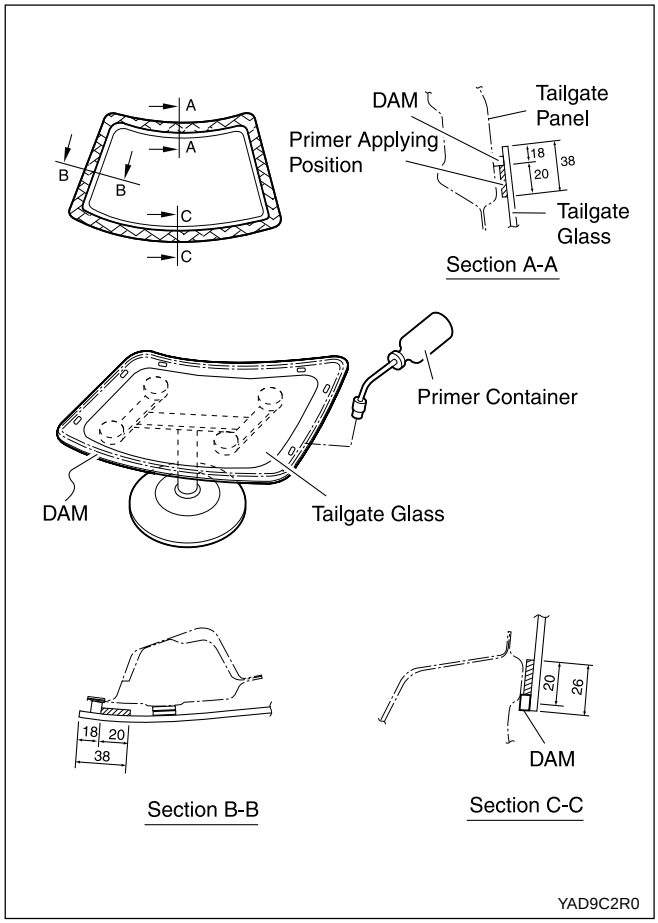
2. After washing up outer panel of tail gate, and then spread primer.
   - Keep primer in the refrigerator.
   - Mix up primer.
   - Opening vessel, use them within 2 hours.
   - Opening vessel, immediately use them, if you reopen them, use them within 24 hours, as soon as possible.
   - Spread uniformly primer on the surface of vehicle.
   - Available hour for spreading primer to the vehicle : after 3 hour.

- If body of vehicle is polluted by primer : solvent is washed up to body of vehicle.
- Keep eye on section of spreading ,not to overflow other section to vehicle

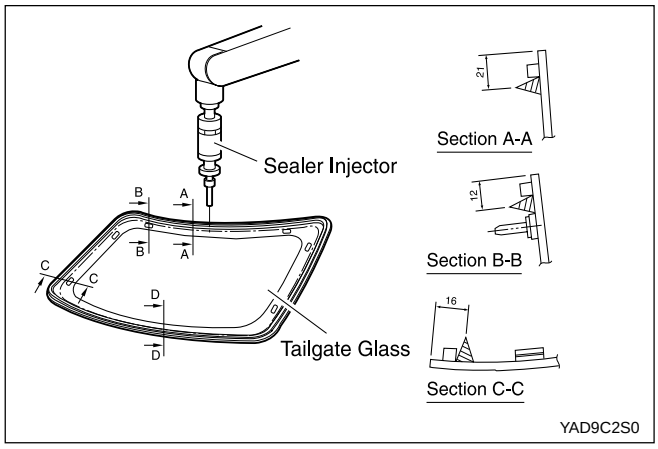




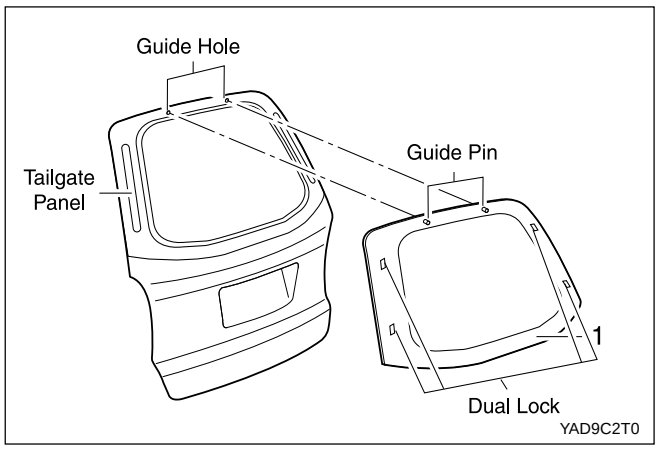
3. Wash up glass tail gate.
   - The section washed of glass keep distance 15 mm from the end of glass.
   - After using gauze 20 times, gauze is thrown away.
   - Gauze is a solvent (isopropyl alcohol), gauze keep wet completely.
   - Keep an eye on the washing section of glass not to be touched by any thing polluted.
   - After washing glass, spread primer on the glass section of wet state.
   - Wash up on the section of spreading primer without being touched by any thing polluted.
4. Installing dual lock (1) on the glass (2), install the glass dam.



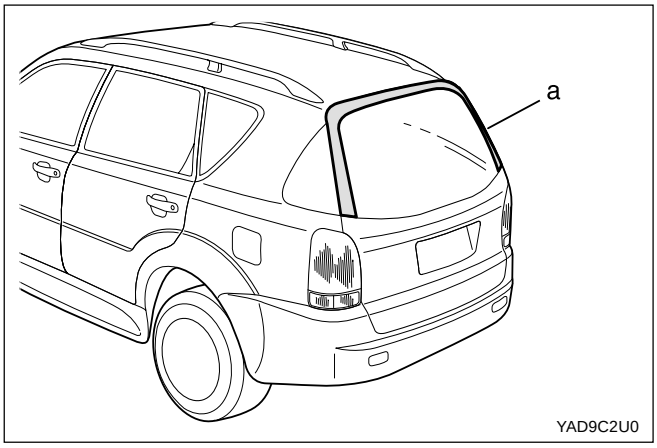
5. Spread primer on the glass of tail gate.
   - Mix up primer.
   - Due to excessive spreading, keep eye on overflowing spreading other section.
   - Available hour for spreading primer to the vehicle: after 3hour.
   - Sealant is not available, if sealant has sludgematerial.
   - If available date of sealant is passed, this sealant is throwing away. available date of sealant is 90 day for use.
   - After using gauze 20 times, gauze is thrown away.
   - Spread uniformly primer on the surface of glass.



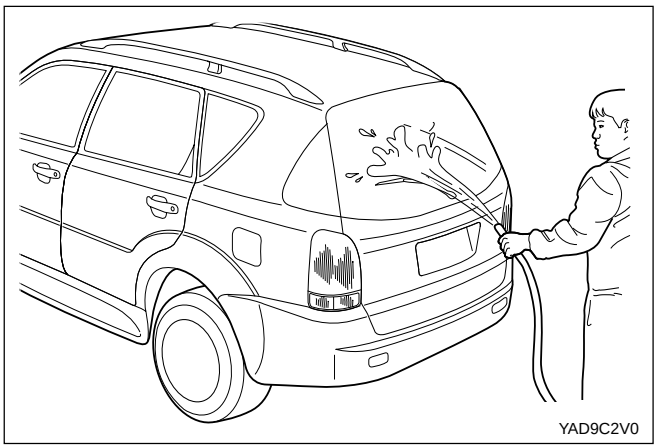
6. Spread sealant on the glass.
   - Spread sealant point (200 mm) of lower section of right, like right picture.
   - If shape of spreading, thickness is not uniform, leaking of water may occur.



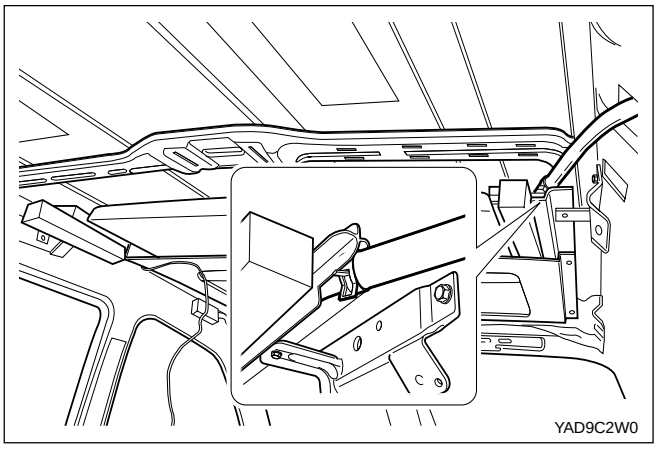
7. After spreading sealant, using compressor, install glass of tail gate within 5 minutes.
   - After install glass, tape tail gate, two the point of glass and one point of the section of arm side.



8. After installing, check leaking of water as following procedure.
   - In order to fix glass of back door, in the right position of installing, tape glass and frame of door glass.
   - To keep sealant dry, wait for 24 hours.
   - Remove taping(a).



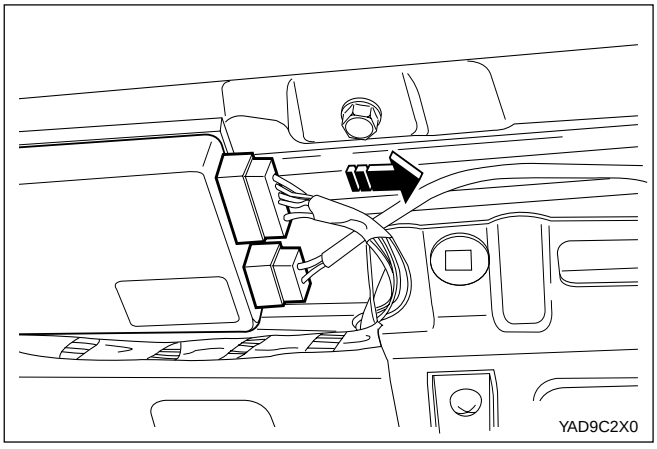
   - After spread water on the door of tail gate, check leaking of water. If leaking of water occur, keeping door glass of tail gate dry, fill sealant in the section of leaking. Leaking of water goes on, remove door glass of tail gate, and then proceed to repair above procedure.
   - Connect connector of heating line to the door glass of tail gate.
   - Connect negative cable of battery.



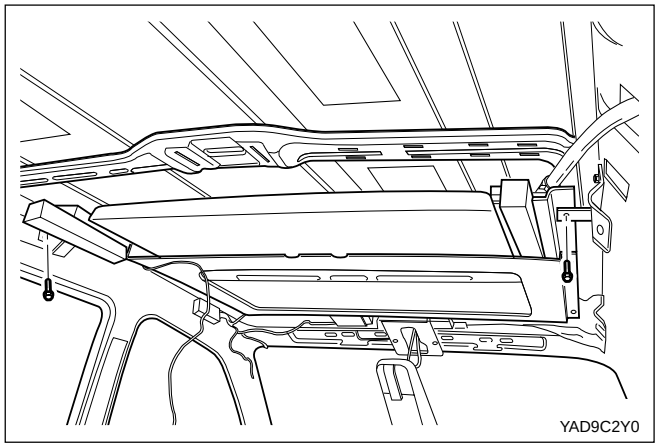
SUN ROOF

Removal and Installation

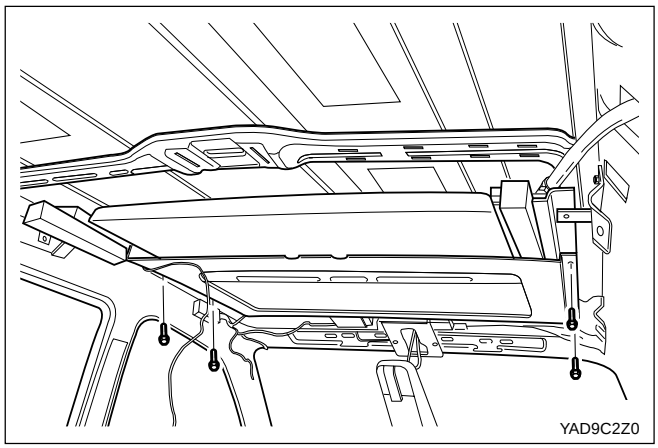
1. Remove headlining, room lamp, and sun visor.
2. Separate hose clip of drain hose of sun roof (4 ea), pull hose slow, turning hoses to the left direction and to the right direction slow.



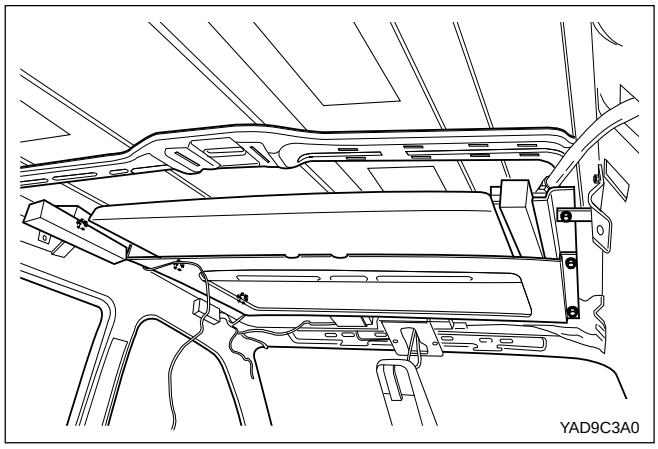
3. Remove the power connector in the relay box.



4. Remove fixing bracket of sun roof.

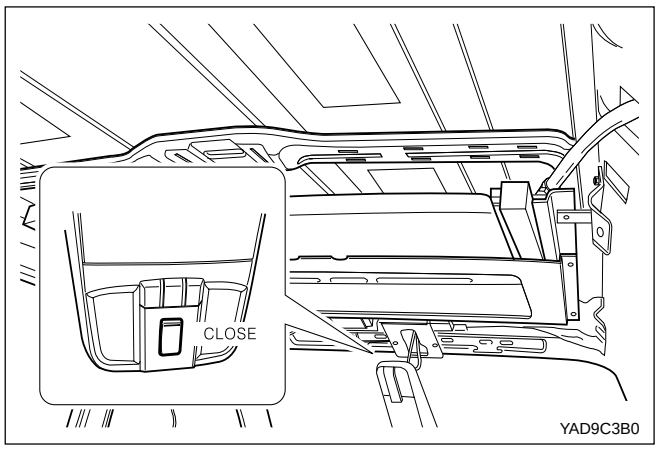


5. After releasing mounting bolt of sun, remove sun roof assembly.



6. Install reverse order of removal.

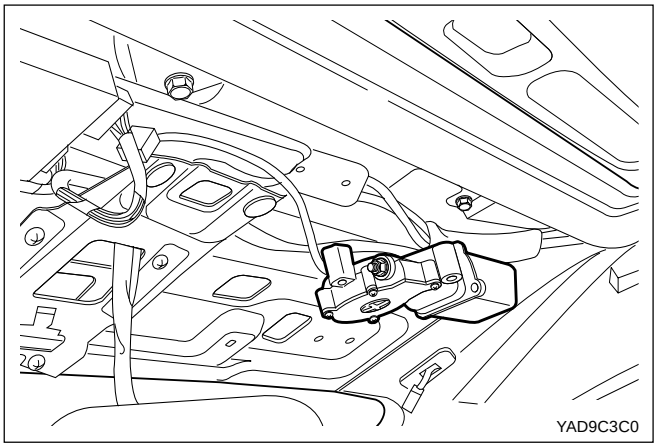
Bracket Bolt of Sun Roof	25 - 35 N•m
Fixing Bolt of Sun Roof	25 - 35 N•m



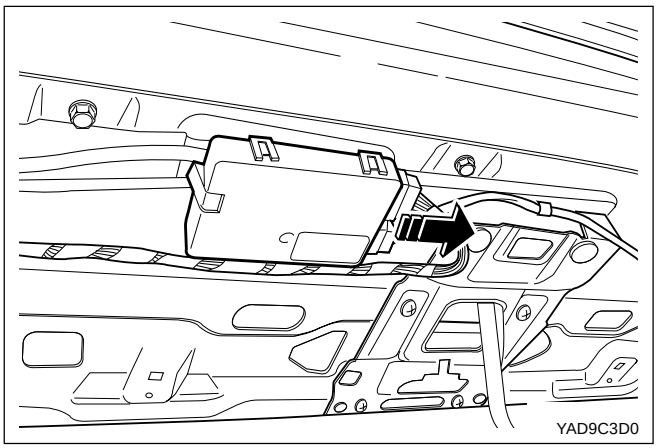
MOTOR AND RELAY BOX

Removal and Installation

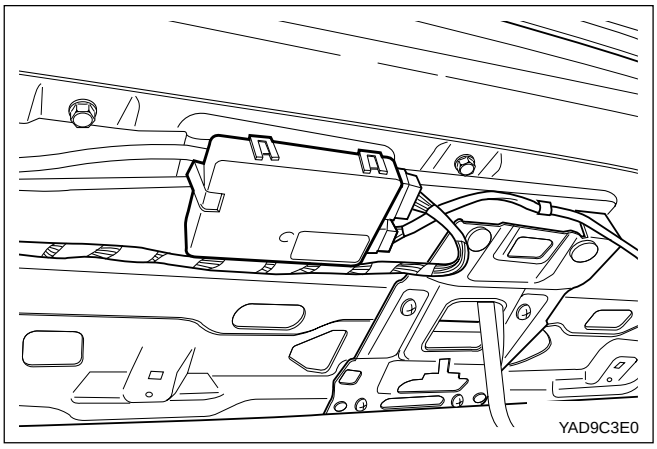
1. Close sun roof.
2. Remove head lining, room lamp, and sun visor.
3. Cut tie –wrap of relay box.



4. After releasing fixing bolt of motor, remove motor connector in the relay box, and then separate motor assembly.

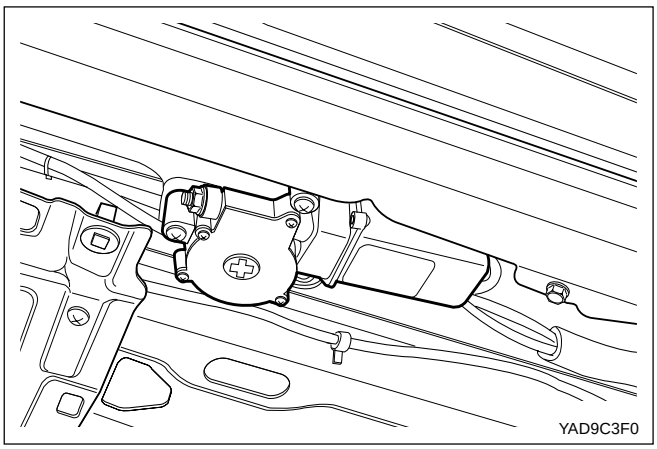


5. Separate power connector in the relay box.
6. After releasing fixing bolt of relay box, separate relay box from front beam (pushing hook of relay box of front beam by hand, remove it).

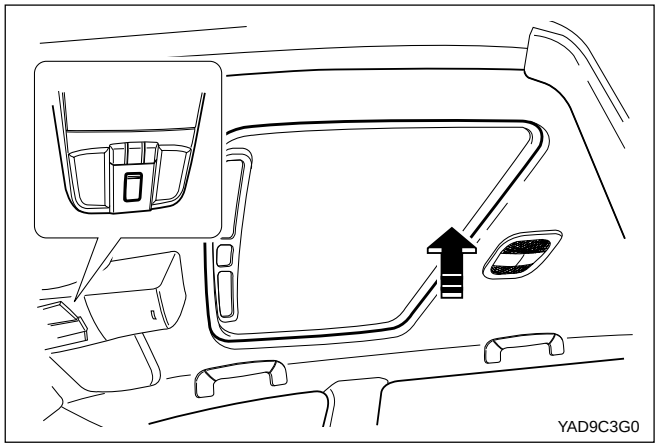


7. Install reverse order of removal.
   1) Assemble the closing state in the position of glass panel
   2) Check the position of normal close:
      - NORMAL CLOSE POSITION : After connecting between relay box and motor, connect the power and then touch on switch and then the motor stop.
   3) Install the motor.
   4) Tighten the fixing bolt of motor.

Tightening Torque	3 N•m (26 lb-ft)



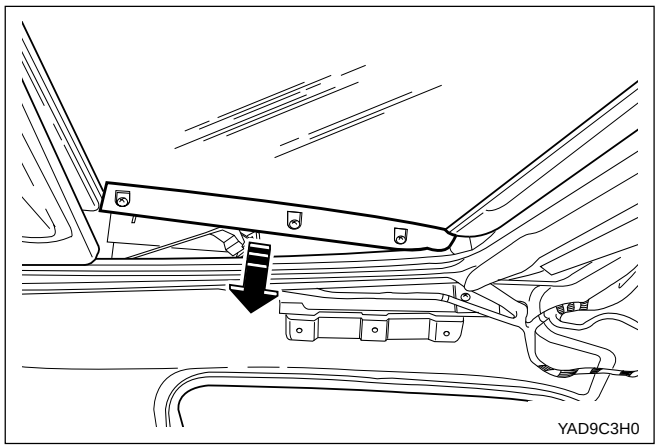
   5) Insert hook of relay box into beam of front.
   6) Fix relay box with tie wrap.
   7) Check operation of sunroof.



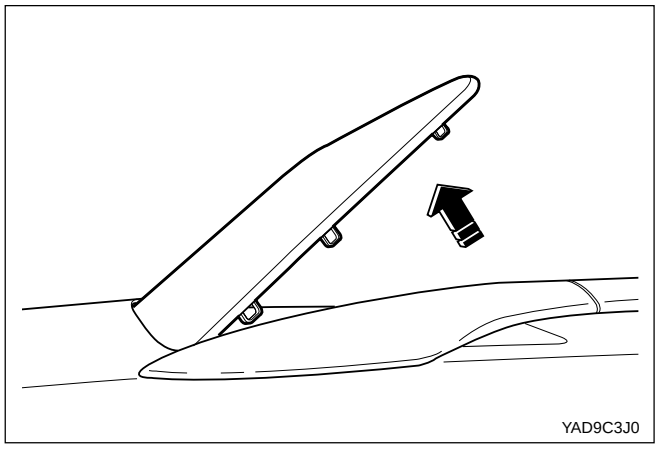
GLASS PANEL

Removal

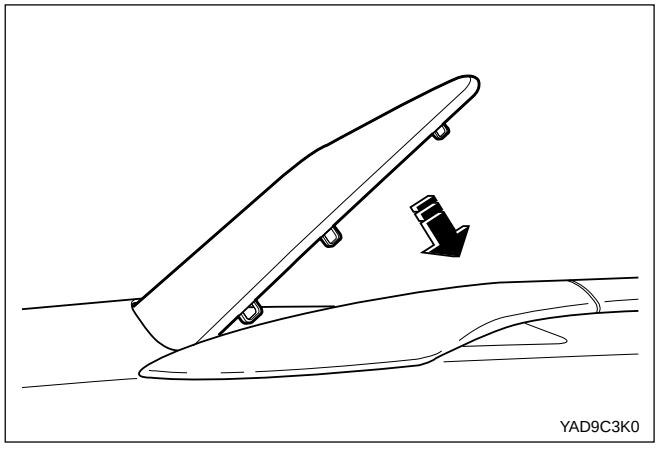
1. Turn on the switch, tilt glass.



2. Remove side inner cover.
3. Separate fixing bolt (6 ea) glass.



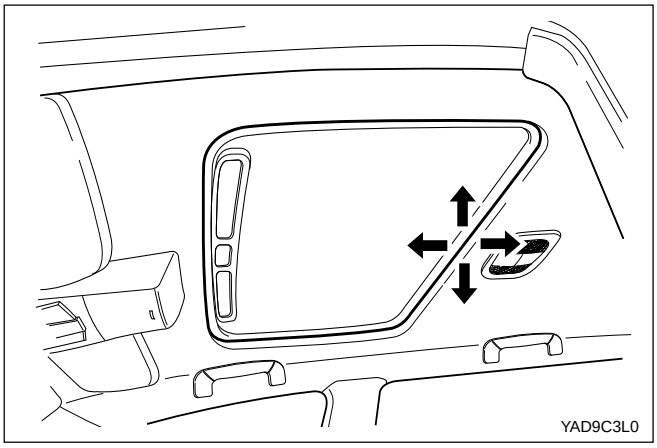
4. Extract panel of glass.



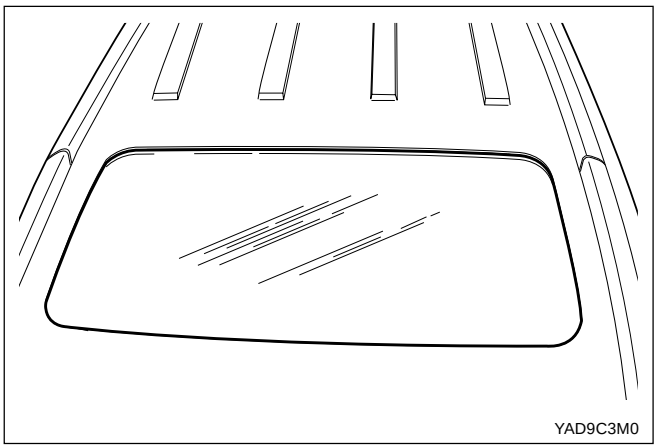
Installstion

1. Install glass panel on internal panel of cover (check the tightening position in the vehicle).

   Notice: Install for marking glass indicator to put rear direction.



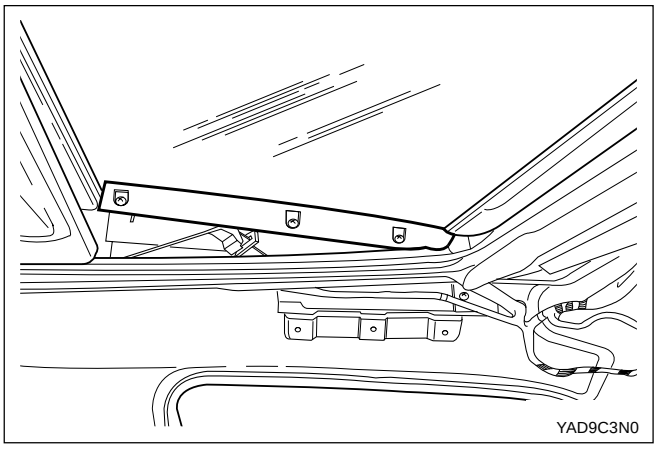
2. Tighten temporarily fixing bolt.
3. Using operation switch of sunroof, close glass panel slow. (Check motion of glass, up and down, forwards and backwards freely).



4. Pulling the glass panel, adjust the height of glass and body.
5. After hight of front glass put the same of height of body and glass seal and 1 mm height to the rear is higher than height of body, and then tighten the bolt.

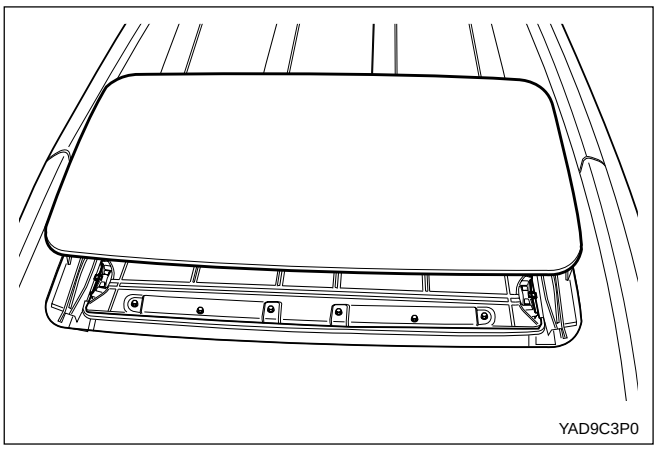
Tightening Torque	5 N•m (26 lb-ft)

6. Using switch of sunroof, check operation.



7. Turn on the switch, up the glass.
8. Insert side cover (left/right).

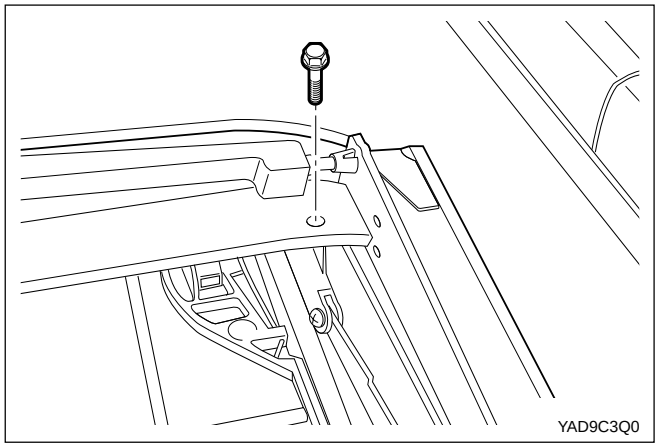
   Notice: Check the state of installation between side inner cover and side outer cover.



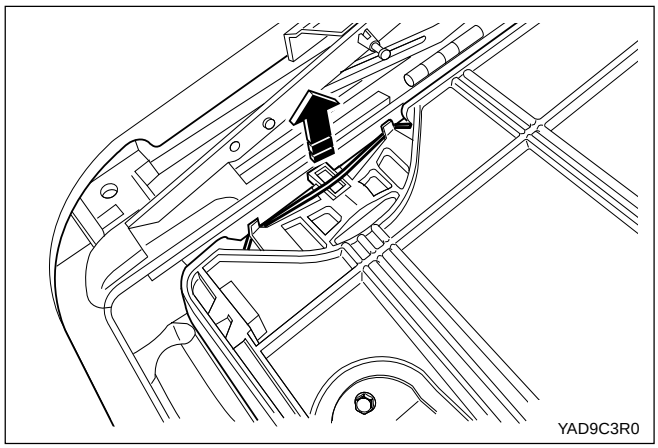
SUN SHADE

Removal

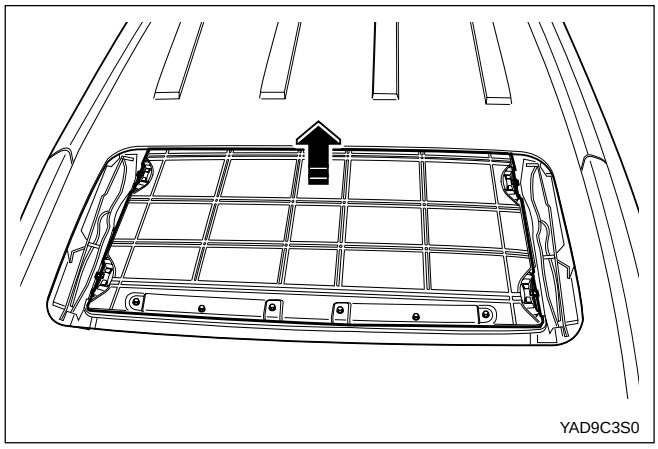
1. Remove glass panel.



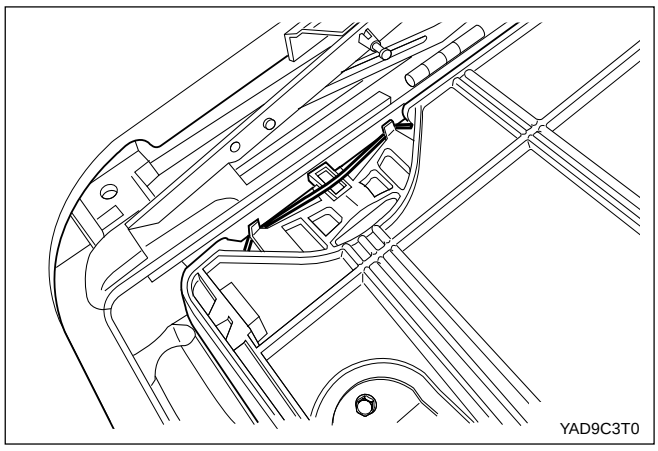
2. After removing fixing bolt of drain channel, push hook of support drain channel by hand, remove drain channel.



3. Close panel of sun shade, using driver, extract slide block of sun shade panel from the guide rail (4 ea).

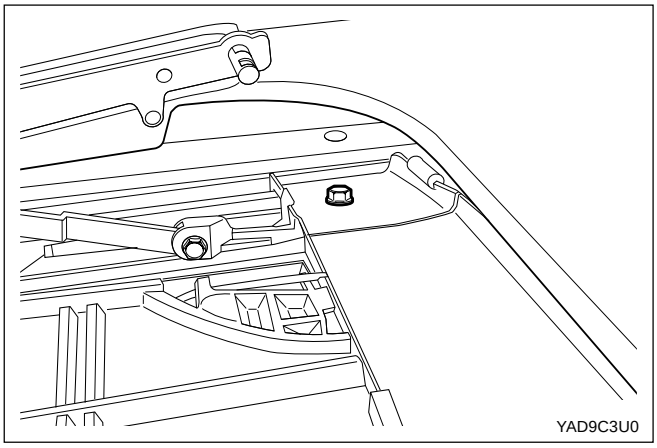


4. Remove panel of sun shade.



Installation

1. Put sun shade on the guide rail.
2. Using driver, pushing slide block of sun shade panel, and then insert guide rail.



3. After inserting drain channel into roof, and then insert drain channel into support drain channel and push front hook.

Tightening Torque	12 N•m (26 lb-ft)

4. Check operation of sun shade panel.
5. Install the glass panel.

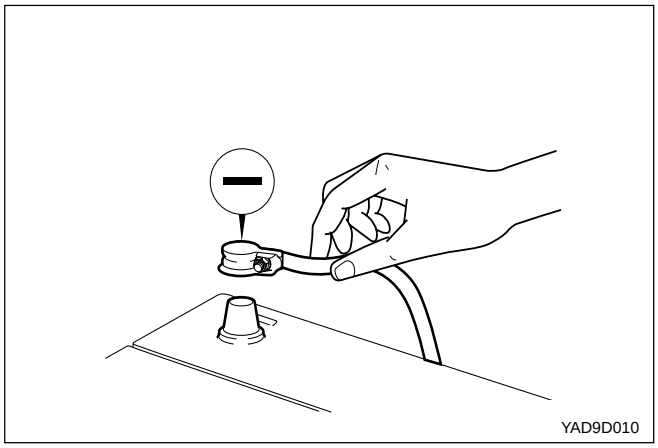
GROUP 9D

BODY ELECTRICAL

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GENERAL DESCRIPTION

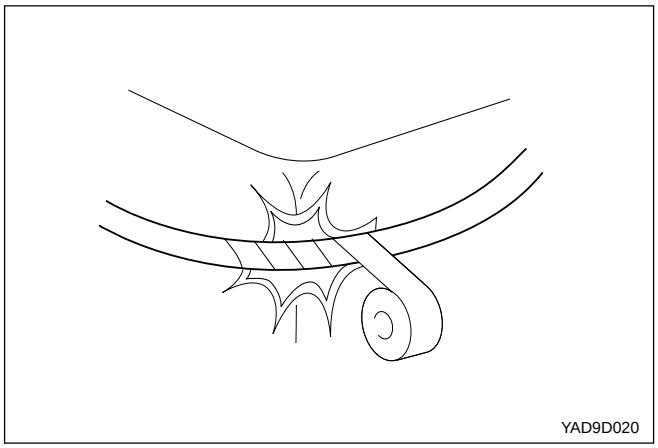

YAD9D010

NOTICE: REPAIRING ELECTRICAL SYSTEM

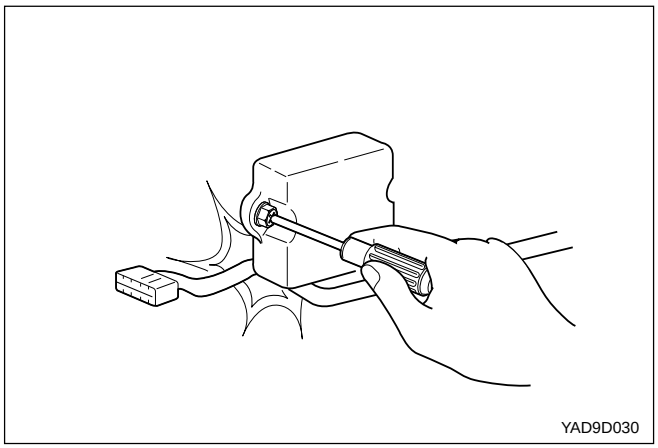
1. While electrical parts is repaired, first of all separate negative terminal of battery.

   Notice: Before separate and link negative terminal, turn starting switch or all the switch of lamp off (if switches are not turned off, parts of semi-conductor may be impaired).

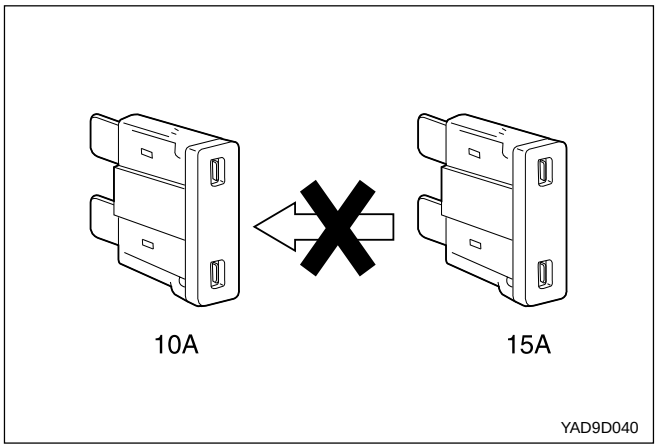
   Notice: Memory values of electrical parts may be erased, so those value should be kept another place.


YAD9D020

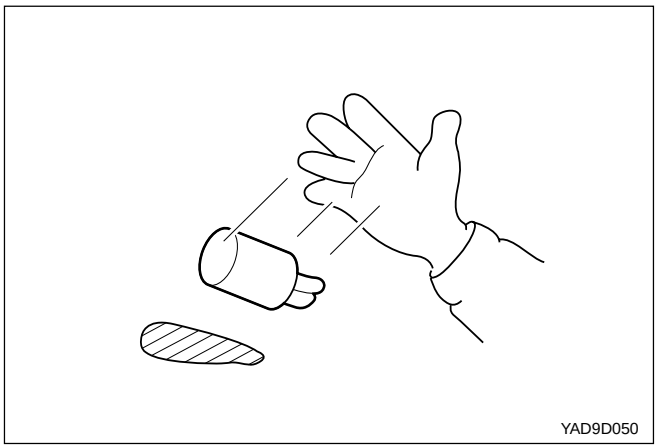
2. If harness is interfered by other sharp section, wrap them, and then, for protecting of harness.


YAD9D030

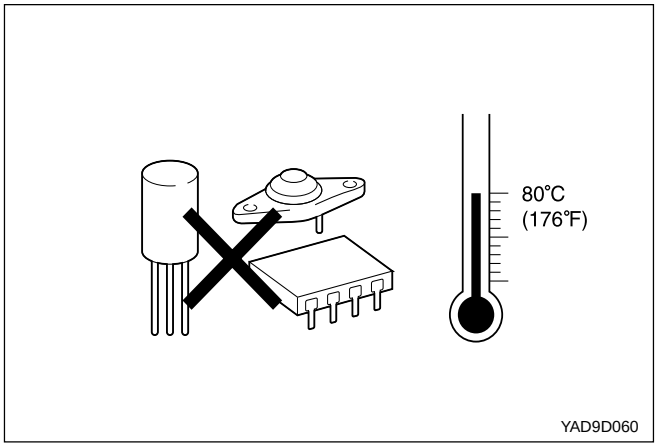
3. While parts is instslled on the vehicle, keep in mind, in order not to tear or impair to the wiring harness.



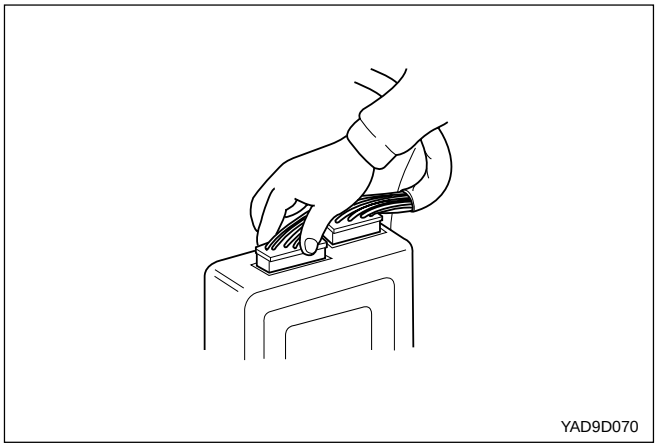
4. If fuse is damaged, fuse is replaced by rated capacity, if fuse is replaced by excessive rated capacity, parts may be impaired or fired.



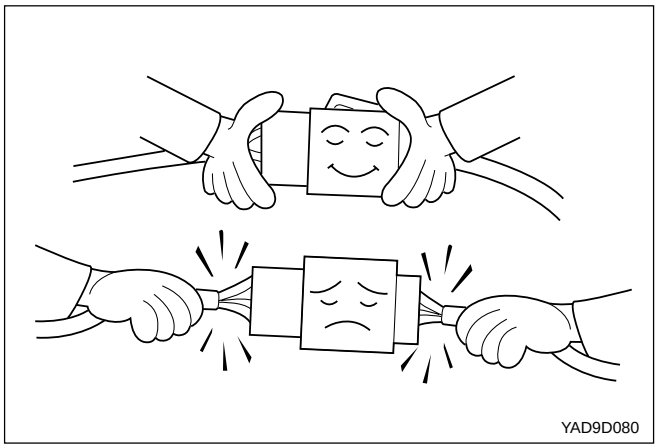
5. Sensors and relays should not be influenced by impact and should not be dropped on the floor.



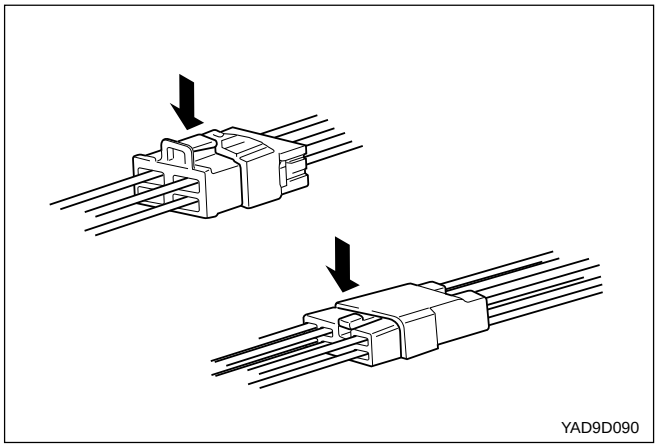
6. Electrical parts are impaired by heat, so if work of repair should be done excessive temperature of 8°C, remove electrical parts before done this.



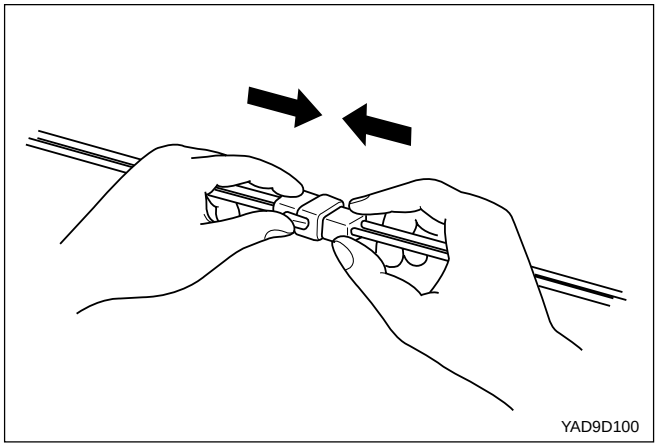
7. If connector is connecting loose, this cause to repair, make sure connecting of connector.


YAD9D080

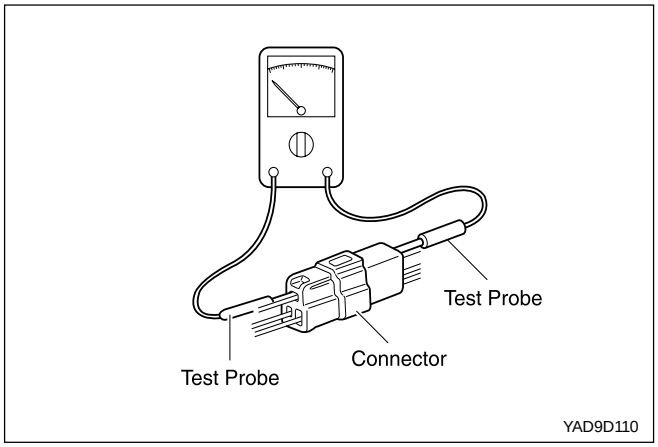
8. While harness is separated, connector should be pulled, harness should not be pulled, like the picture.


YAD9D090

9. While connector is separated with the lock, pushing arrow indicated, remove the connector.


YAD9D100

10. While connector is linked, insert this until sounds like tack!, tack!

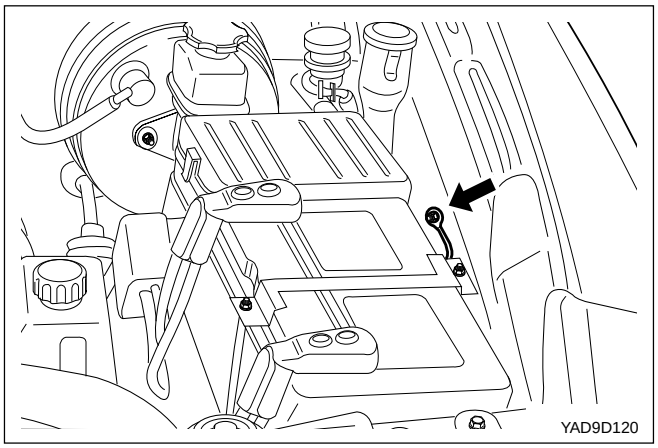


YAD9D110

11. If electric current is sent or check voltage through tester of circuit, probe is set from the harness, if connector is kind of sealing type, probe is set through hole of cap in the wiring rubber.

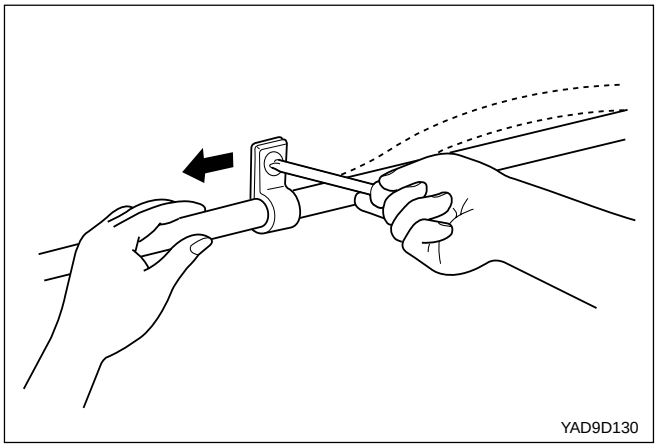
    At this time, keep in mind, not to damage isolation of wiring, insert probe until contact connector of terminal completely.

    Notice: Tester of circuit is not used on the air bag system, while this system is checked, scanner should be used.


YAD9D120

Check Cable and Wire

1. Check looseness of the connecting and corrosion.
2. Check the corrosion of terminal and wire by the eletrolyte.
3. Check open circuit for terminal and wire.
4. Check isolation of wire, damage, deformation.
5. Check interference between parts of terminal and other metal parts.


YAD9D130

6. Check applying an electrical current complete between fixing bolt and body on the section of ground.
7. Check lay-out of wiring proper.
8. After fixing wiring completely, wiring should not be contacting by section of sharpness, section of high temp. (For example: exhaust manifold, exhaust pipe).
9. Keep the clearance between wiring and fan- pully, fan-belt, other parts.
10. After loosening wiring and fix, for vibration between section of body and the section of engine.

SPECIFICATION

Description			Spec	
Multi - function switch	Rated voltage		DC 12 V	
	Range for operating temp		-30 °C ~ +80 °C	
	Rated load	Light switch	Illumination: 1 A (Load of relay)	
		Dimmer and passing switch	High beam: 9.2 A	
			Lower beam: 1 A	
			Passing: 10 A	
		Switch of turn signal	6.6±0.5	
		Wiper switch	Lower: 5 A, High: 7 A	
			Intermittemt: 0.22 ± 0.05 A	
			Fixing: MA X 28 A	
		Washer switch	: 4 A	
		Intermittent wiper switch	MAX: 25 mmA	
		Horn connector	1 A	
Instrument panel	Turn signal lamp		14 V,1.4 W	Green
	Seat belt		2.2 V, 20 mA	Red
	Charging lamp		2.2 V, 20 mA	Red
	Fuel indicator lamp		2.2 V, 20 mA	Orange
	High beam		14 V, 3 W	Blue
	Oil pressure lamp		2.2 V, 20mA	Red
	Brake lamp		2.2 V, 20 mA	Red
	Door open warning lamp		2.2 V, 20 mA	Red
	ABS warning lamp		14 V, 1.4 W	Orange
	Pre heating lamp		2.2 V, 20 mA	Orange
	Air bag warning lamp		14 V, 1.4 W	Red
	Hazard lamp		2.2 V, 20 mA	Red
	4WD check lamp		2.2 V, 20 mA	Red
	4WD high lamp		14 V, 1.4 W	Green
	4WD low lamp		2.2 V, 20 mA	Orange
	Winter lamp		14 V, 1.4 W	Green
	Power lamp		2.2 V, 20 mA	Orange
	EBD lamp		14 V, 1.4 W	Red
	Engine check warning lamp		2.2 V, 20 mA	Orange
	TCS lamp		14 V, 1.4 W	Orange
	Rear defogger lamp		2.2 V, 20 mA	Orange
Lamp	Head lamp	High beam	55 W X 2	
		Low beam	55 W X 2	
		Position lamp	5 W X 2	
	Front combi lamp	Turn signal lamp	28 W X 2	
		Fog lamp	27 W X 2	
	Side mounted lamp		5 W X 2	
	High mounted lamp		5 W X 1	

Description			Spec
Lamp	Rear combi lamp	Tail/ Stop	27 W X 2
		Tail lamp	8 W X 2
		Stop lamp	27 W X 2
		Turn signal lamp	27 W X 2
		Brake lamp	27 W X 2
	Licensee lamp		5 W X 2
	Room lamp	Front	8 W X 2
		Center	10 W X 1
		Rear	10 W X 1
	Door lamp		5 W X 4
	Glove box lamp		10 W

DIAGNOSIS AND ACTION TAKEN

Gauge Panel amd Warning System

Nature of Defect	Cause of Defect	Action Taken
Tacometer is not operated	Cut of fuse Defective tacometer Defective wiring	Check short of fuse, replace fuse Check tacometer If necessary, repair wiring
Gauge of fuel is not operated	Cut of fuse Defective fuel gauge Defective fuel sender defective wiring	Check short of fuse, replace fuse Check gauge Check fuel sender If necessary,repair wiring
Warning lamp of fuel is not operated	Cut of fuse Failure of bulb Defective sensor of fuel Defective wiring or defective grounding	Check short of fuse replace fuse Replace bulb Check sensor If necessary, repair wiring or grounding
Gauge of temperature is not operated	Cut of fuse Defective gauge of coolant temp Defective coolant temp sender Defective wiring or defective grounding	Check short of fuse, replace fuse Check gauge Check sender If necessary, repair wiring or grounding
Warning lamp of oil pressure is not turned on	Cut of fuse Failure of bulb Defective sensor of oil pressure Defective wiring,and grounding	Check short of fuse, replace fuse Replace bulb Check sensor If necessary, repair wiring or grounding
Warning lamp of brake is not turned on	Cut of fuse Failure of bulb Defective warning switch of brake fluid Defective parking brake switch Defective wiring or defective grounding	Check short of fuse, replace fuse Replace bulb Check switch Check switch If necessary, repair wiring or grounding
Warning lamp of opening door or tail gate is not turned on	Cut of fuse Failure of bulb Defective door switch Defective wiring or defective grounding	Check short of fuse, replace fuse Replace bulb Check switch If necessary, repair wiring or grounding
Warning lamp of seat belt is not turned on.	Cut of fuse Failure of bulb Defective buckle switch Defective wiring or defective grounding	Check short of fuse Replace bulb Check switch If necessary, repair wiring or grounding

Lighting System

Nature of Defect	Cause of Defect	Action Taken
On side of lamp only is turned on (All the lamp of outdoors)	Failure of bulb Defective socket, wiring defective grounding	Replace bulb If necessary replace socket, wiring
Head lamp is not turned on	Failure of bulb Defective fusible link Defective head lamp relay Defective lighting switch Defective wiring or grounding	Replace bulb Replace fusible link Check relay Check switch If necessary, replair wiring or grounding
Lamp of tail or lamp of license plate is not turned on	Cut of tail lamp fuse Defective fusible link Defective relay of tail lamp Defective lighting switch Defective wiring or grounding	Replace fuse, check short of fuse Replace fusible link Check relay Check switch If necessary, replair wiring or grounding
Stop lamp is not turned on	Cut of fuse Defective switch of stop lamp Defective wiring or grounding	Replace fuse check short of fuse Adjust switch, or replace switch If necessary, replair wiring or grounding
Stop lamp continue to turn on	Malfunction of relay of stop lamp Malfunction of switch of stop lamp.	Replace relay Adjust switch or replace switch.
Gauge lamp is not turned on	Malfunction of connector Malfunction of wiring or grounding	Check the state of connecting
One side of signal lamp is not turned on	The burned of bulb Malfunction of switch of turn signal lamp Malfunction of wiring or grounding	Replace bulb Check switch If necessary, replair wiring or grounding
Turn signal lamp is not operated	The burned of bulb Malfunction of flasher unit Malfunction of switch of turn signal Malfunction of wiring or grounding	Replace fuse, check short of fuse Check flasher unit Check switch of turn signal If necessary, replair wiring or grounding
Hazard lamp is not turned on	Cut of fuse Malfunction of flasher unit Malfunction of hazard lamp switch Malfunction of wiring or grounding	Check short of circuit replace fuse Check flasher unit Check switch If necessary, replair wiring or grounding
Frequency of flash is too quick or delaying	Standard of bulb is out of specification Cut of bulb, malfunction of connecting Malfunction of flasher unit	Replace bulb Check cut of bulb or connecting Replace flasher unit
Lamp of back up is not turned on	Cut of fuse Malfunction of switch of back up lamp Malfunction of wiring or grounding	Check short of circuit Check switch If necessary, replair wiring or grounding
Console lamp of over head is not turned on	Cut of fusible link Malfunction of wiring or grounding	Replace fusible link If necessary, replair wiring or grounding

CHECK AND ADJUST

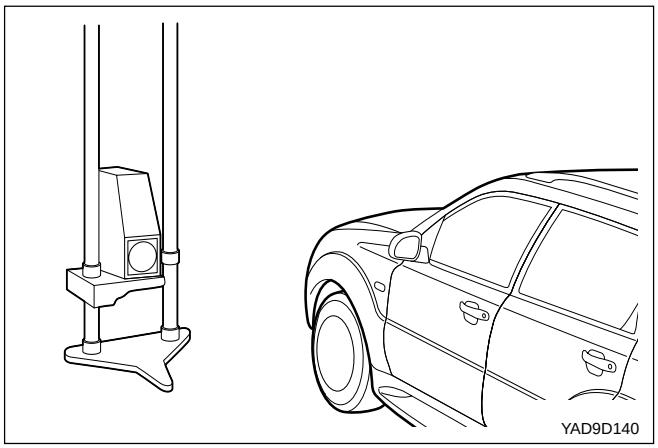
Adjust Focus of Head Lamp (Aiming)

Beam adjusting equipment approved can adjust accurately focus of head lamp.

This equipment should be operated by manufacturer's operation manual.

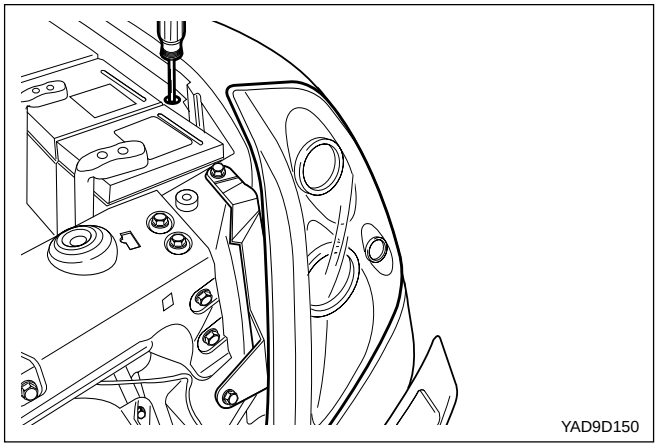
While focus of head lamp is arranged, condition of vehicle keep air pressure of tire specified, except spare tire and tool of OVM, every thing is unloaded, and vehicle is parked on the even place.

If beam adjusting is not installed, focus of head lamp can be arranged by using screen.

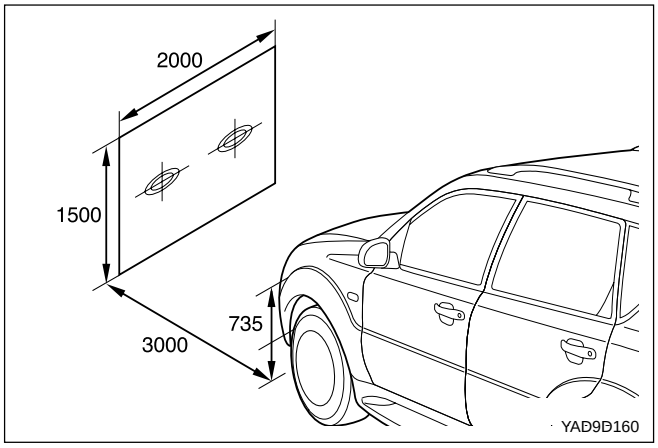


Using Beam Adjusting Equipment

1. Beam adjusting equipment should be arranged with vehicle.

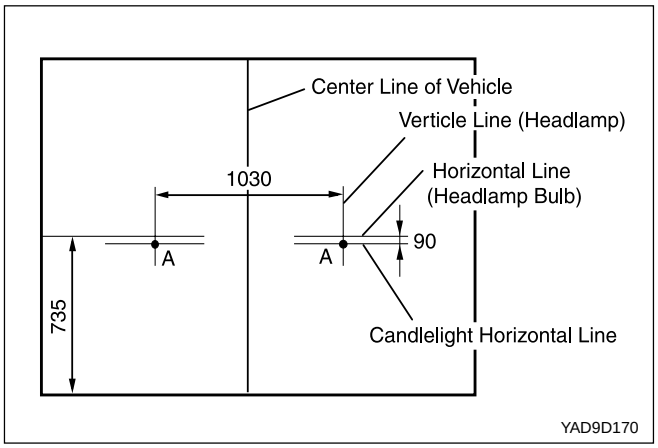


2. Switch on control lever of up and down, left and right by the screw, arrange focus of head lamp.

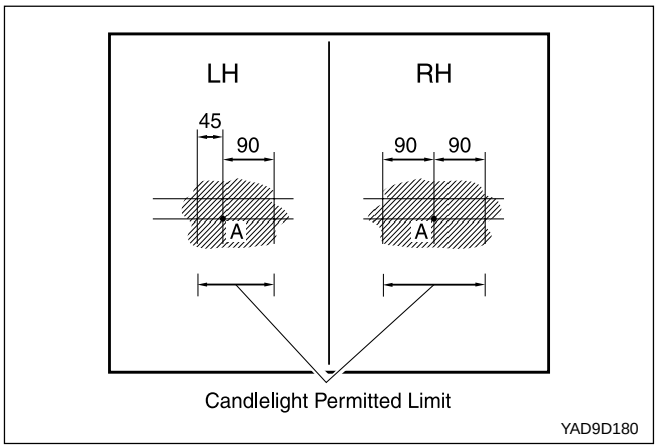


Arrange Focus of Head Lamp by Screen (Unit: mm)

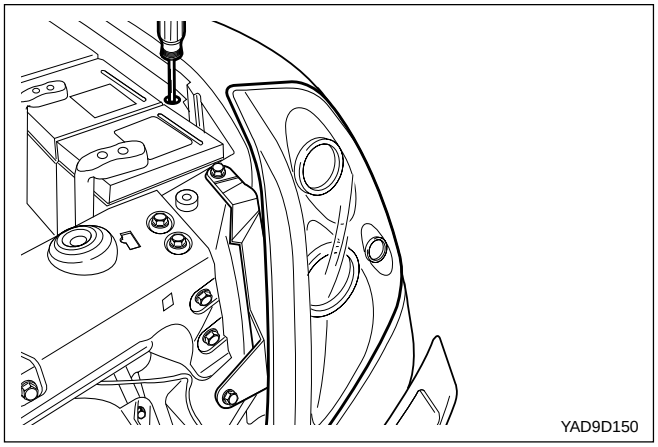
1. After screen (2 m x 1.5 m) installs the verticalness position of 3m of distance from the front head lamp of vehicle, keep line of center between vehicle and screen such as the right below picture.



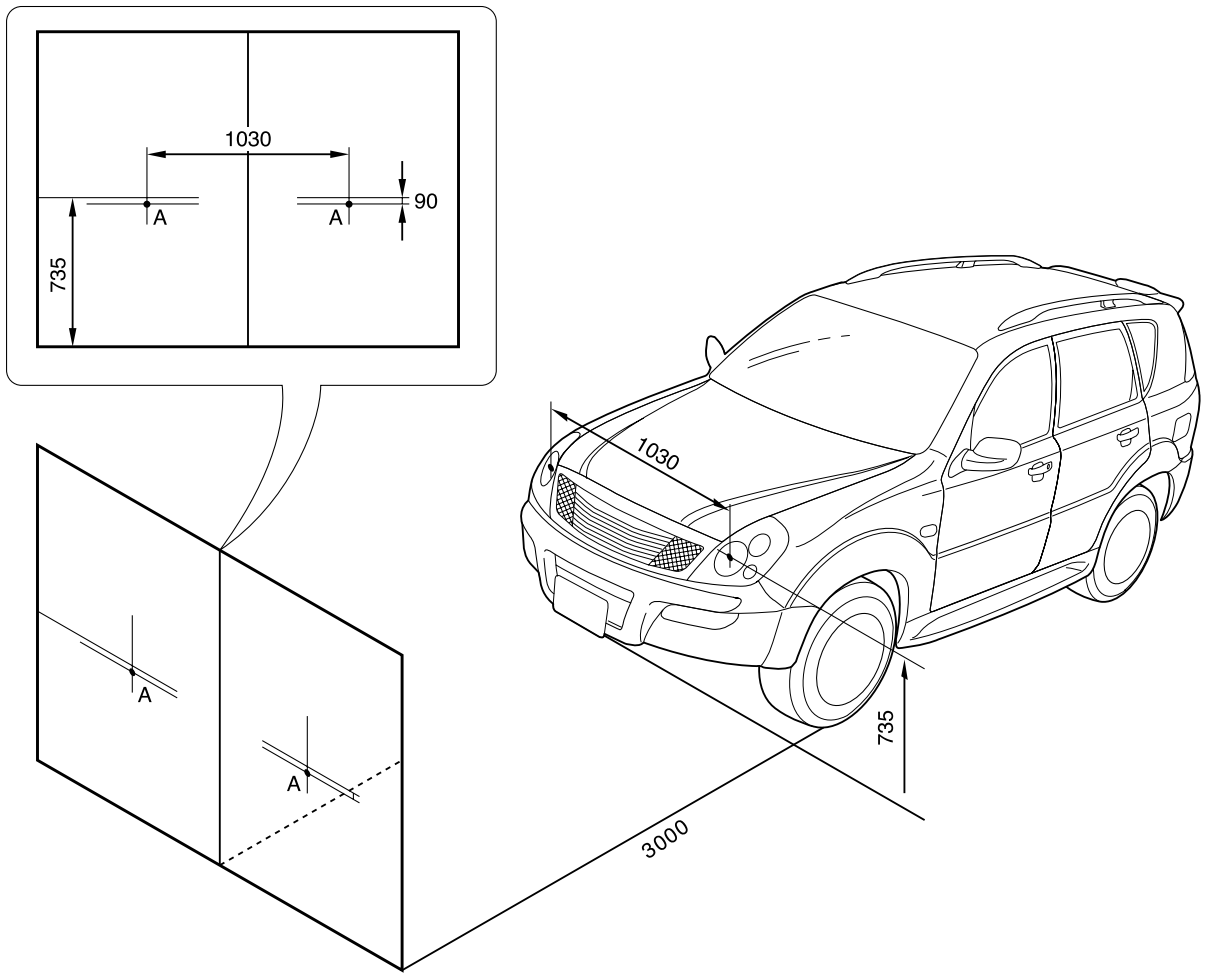
2. Keep line of center between through horizontal line of center of head lamp and center of screen.



3. Keep engine R.P.M of 2000, and then switch head lamp on, at this time focus of head lamp should indicate position of “A” .



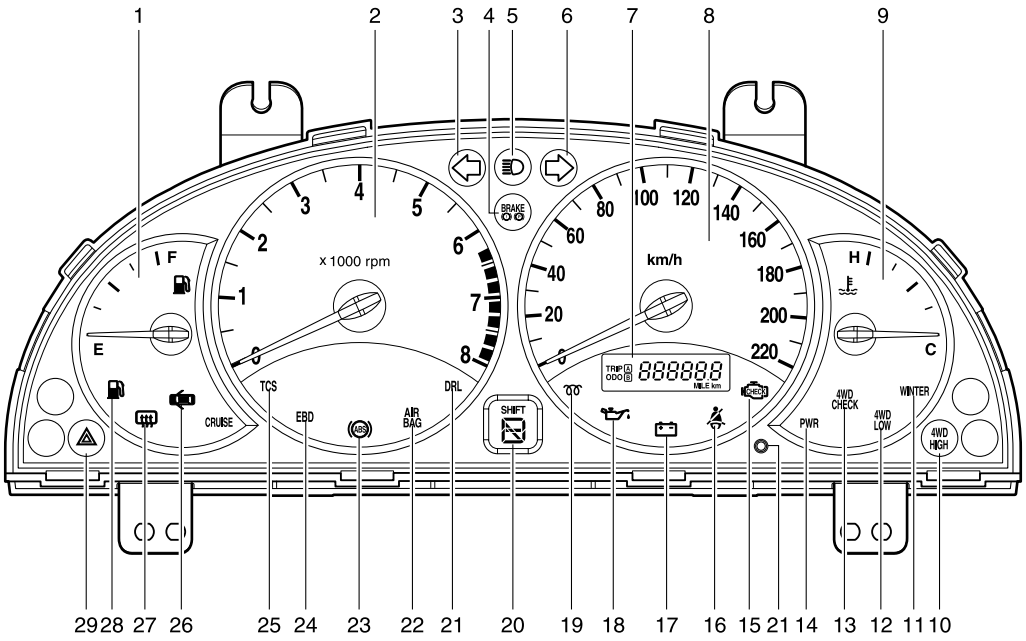
4. If focus of head lamp get out of specification, after switching control lever of up and down, left and right, arrange focus of head lamp.

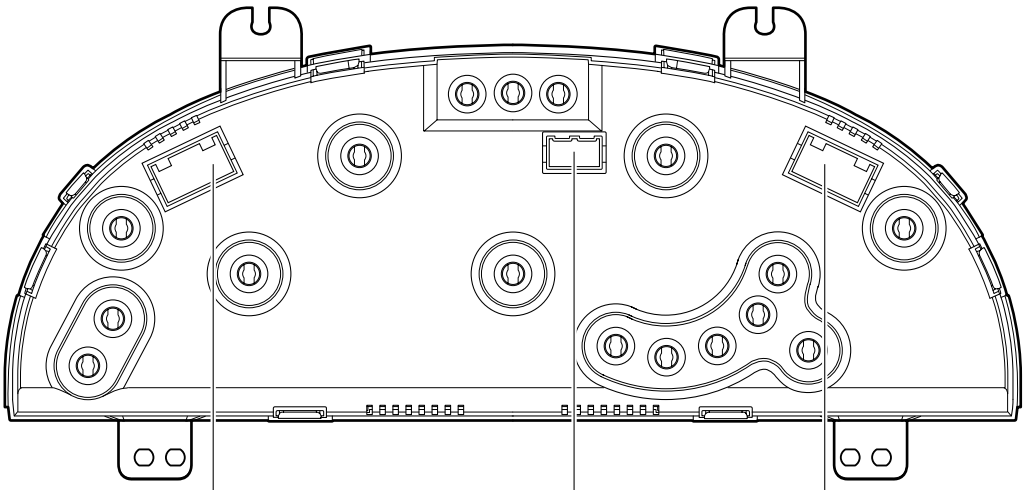


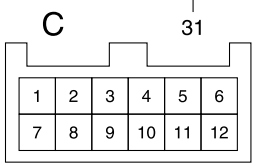
YAD9D190

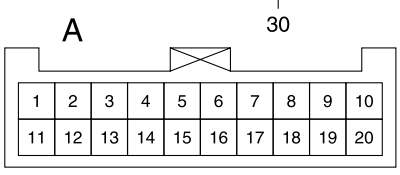
REPAIR OF EACH SYSTEM

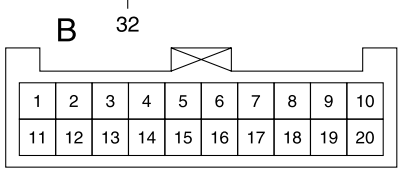
INSTRUMENT PANEL ASSEMBLY







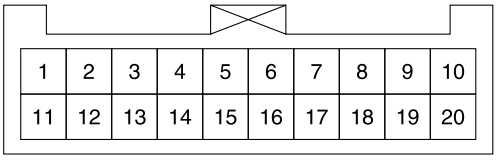
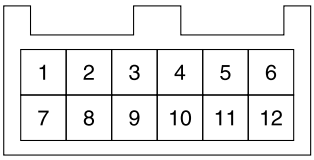


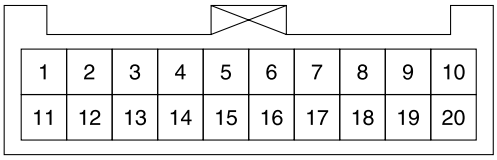


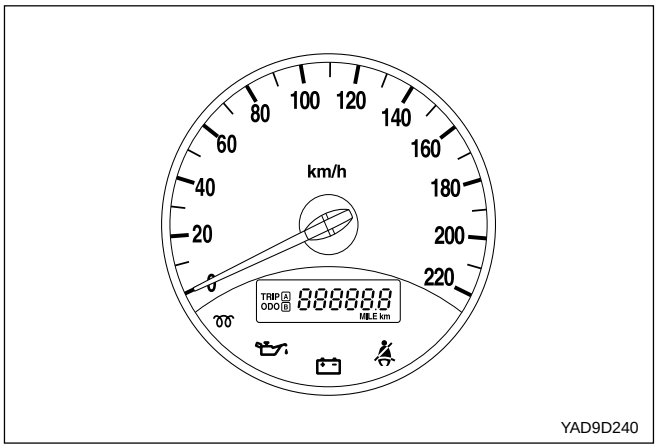
YAD9D200

1 Fuel Gauge
2 Speed Gauge
3 Turn Signal Lamp (Left)
4 Lamp of Operating of Brake or Flude
5 Lamp of Position And High Beam
6 Turn Signal Lamp (Right)
7 Speedometer Gauge
8 Speed Gauge
9 Temperature Gauge
10 Lamp of High Speed of 4WD
11 Lamp of Winter (Automatic Transmission)
12 Lamp of Low Speed of 4WD
13 Check Lamp of 4WD (Gasoline)
14 Power Lamp (Automatic Transmission)
15 Lamp of Engine Check (for Gasoline)
16 Warning Lamp of Seat Belt
17 Warning Lamp of Charge
18 Warning Lamp of Oil Pressure
19 Lamp of Pre Heating
20 Lamp of Selector Lever (Automatic Transmisson)
21 Button of Reset
22 Warning Lamp of Air Bag
23 Warning Lamp of ABS
24 Warning Lamp of EBD
25 Lamp of TCS
26 Warning Lamp of Door Opening
27 Lamp of Outside And Lamp of Heat Line of Rear Glass
28 Warning Lamp of fuel refilling
29 Warning Lamp of Hazard
30 Connector of White Color
31 Colorless Connector (Auto)
32 Gray Connector

Component of Connector Pin

Layout of Connect	Number of Pin	Description
Color of connect : gray color  YAD9D210	A1	Opening of door
	A2	Oil pressure
	A3	Seat belt
	A4	Charging
	A5	ILL (-)
	A6	EBD
	A7	1GN (+), B
	A8	Ground2
	A9	ACC
	A10	B (+)
	A11	Checking of 4 WD (+)
	A12	Checking of 4 WD (-)
	A13	Low speed of 4 WD
	A14	ILL (+)
	A15	High speed of 4 WD
	A16	Turn signal lamp (Left)
	A17	High beam (Lamp of position)
	A18	Lamp of position
	A19	Turn signal lamp (Right)
	A20	Brake
Color of connect  YAD9D220	C1	Automatic transmission - D range
	C2	Automatic transmission - 3 range
	C3	Automatic transmission - 2 range
	C4	Automatic transmission - 1 range
	C5	-
	C6	-
	C7	Automatic transmission - R range
	C8	Automatic transmission - N range
	C9	Automatic transmission - NC
	C10	Automatic transmission - P range
	C11	Winter
	C12	Power

Layout of Connect	Number of Pin	Description
Color of connect  YAD9D230	B1	Unit of tacometer
	B2	Speed sensor
	B3	Chime bell
	B4	Signal out of speed
	B5	-
	B6	-
	B7	ABS
	B8	Air bag
	B9	Engine check
	B10	TCS
	B11	Fuel sender
	B12	Temp sender
	B13	-
	B14	Gnd (ground1)
	B15	IGN (+), A
	B16	Emegency
	B17	-
	B18	Rear defogger
	B19	Pre - heat
	B20	-



CHECK AND REPAIR

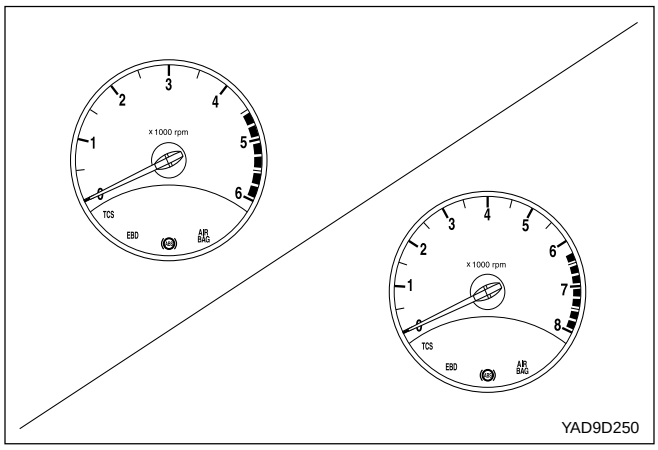
Speed Meter

1. Using tester of speed meter, check error of allowance of speed meter and operation of tacometer.

Standard of speed	20	40	60	80	100	120
Error of allowance	3	+4 0	+4 0	+5 0	+5 0	+5.5 +0.5
Standard of speed	140	160	180	200	220	-
Error of allowance	+5.5 +0.5	+5.5 +0.5	+6 +1	+6 +1	-	-

2. Check trembling of indicator of speed meter or noise of unusual
3. Tap speed meter, and then remove hysteresis.

   Notice: If tire is weared or out of specification of air pressure, error allowed increase.



Tacometer

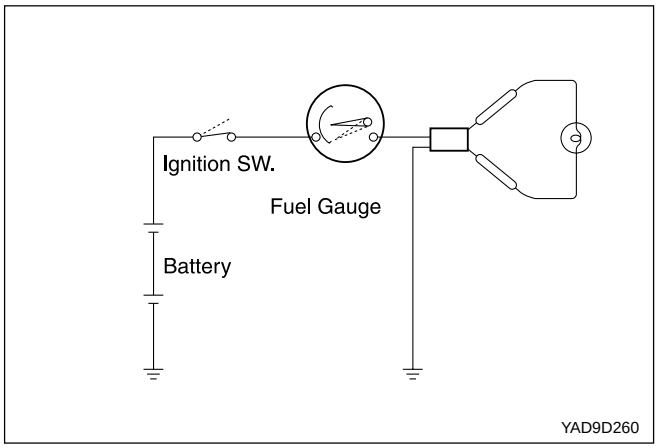
1. Connect tacometer of testing, start engine.
2. Comparing value indicated between tester and tacometer, error is big enough, replace tacometer.
3. While tacometer is inspected, tap tacometer, and then remove magnetic power.

Diesel vehicle (rpm)

Standard of speed	1000	2000	3000	4000	5000	6000
Error of allowance	+137 - 67	+199 - 51	+261 - 39	+298 - 2	+335 +35	-

Gasoline vehicle (rpm)

Standard of speed	1000	2000	3000	4000	5000	6000	7000	8000
Error of allowance	± 100	± 125	± 150	± 150	± 150	± 180	± 180	-



Fuel System

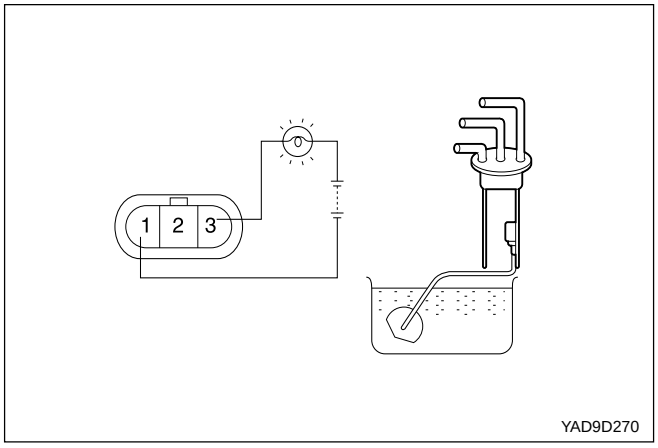
Gauge of fuel

1. Separate connector of fuel sender.
2. Ground connector (B11, B14) of direction of harness through bulb (12 V, 3.4 W).
3. Turn the start switch on.
4. See if bulb of testing turn on, and see if indicator of fuel gauge gradually move to position of 'F'.

Check resistence of fuel sender

1. Put float on the position of 'F' and 'E', and check resistence between B11 and B14.
2. While float is moving from position of 'E' to position of 'F', check if resistence change gradually.

Position of float	Specified resistence
E	approximately 285 Ω
1/2	approximately 101.5 Ω
F	approximately 40 Ω

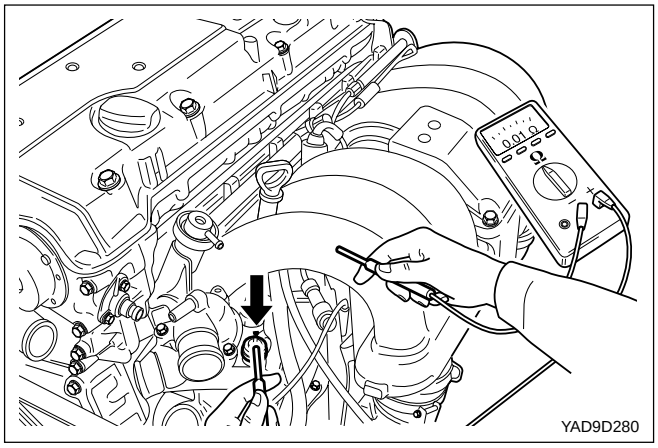


Fuel sender

1. Connect testing bulb (12 V. 3.4 W) of fuel gauge terminal deepen thermister in the water.
2. See if thermister is deepened in the water, light is off, and see if thermister get out of water, light is on.

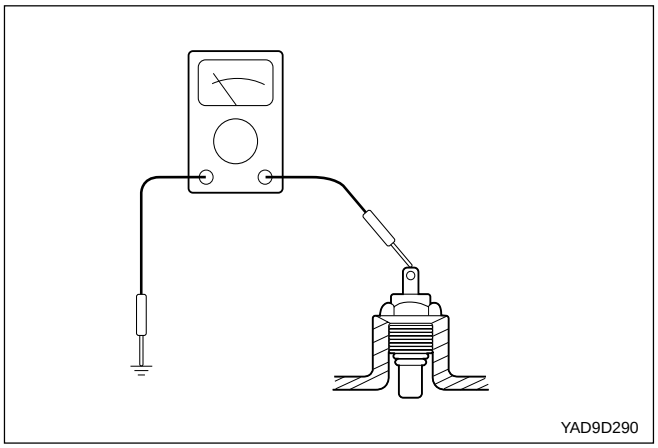
Notice:

- If malfunction may happen, replace fuel sender assembly.
- After this testing have done, before fuel sender is installed, fuel sender should dry up completely.



Gauge of Temp

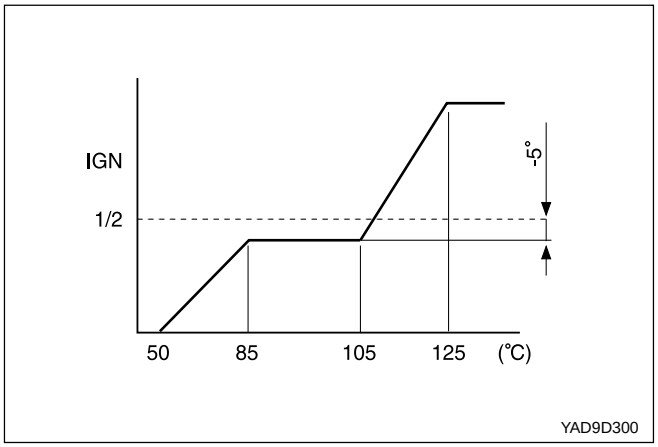
1. Separate wiring connector of water coolant in the engine room.
2. Ground between testing bulb (12 V,3.4 W) and connector to harness in a series.
3. Turn ignition switch on.
4. See if testing light turns on or not, check if gauge of water temp operate or not.


YAD9D290

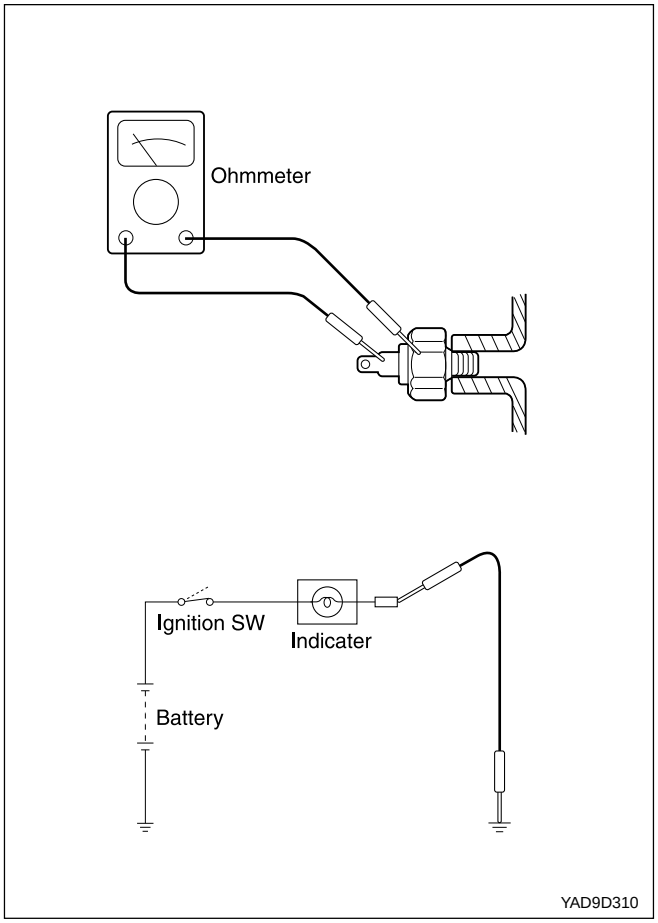
Check resistence of sensor of water temp

After checking resistence between terminal and ground with gage of resistence, if resistence get out of specification, replace it by new one.

temp (°C)	C (50)	C (50)	C (50)	C (50)
resistence(Ω)	254	77	42.2	27.8



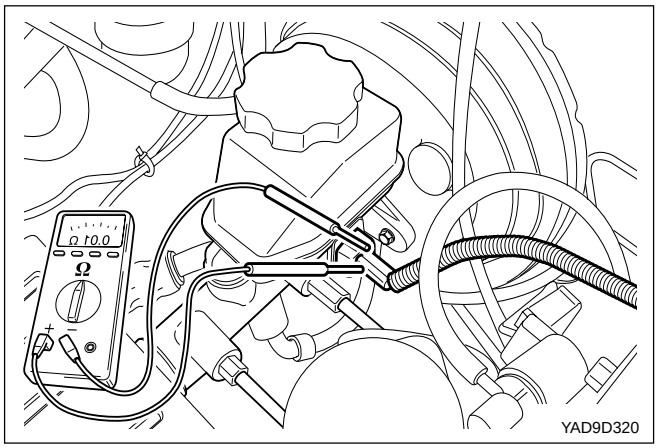
YAD9D300



YAD9D310

Switch of Oil Pressure

1. After stopping engine, check applying of electric current between terminal and ground.
2. After driving engine, check applying of electric current between terminal and ground.
3. Separate connector from terminal of ground and warning switch to wiring harness.
4. After ignition switch turn to “on” and then check if the light is on, if the light is not “on” test the bulb and check harness.



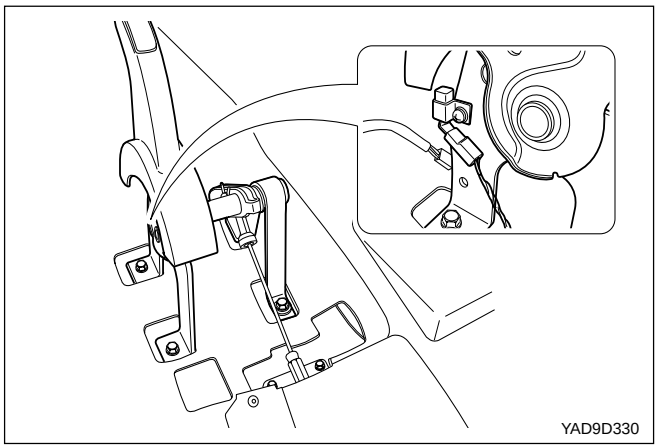
YAD9D320

Brake

If the switch of starting turns on, the fluid of brake is under specified level, or while lever of parking brake is pulling, sensor of brake or switch of parking brake is “on” and then warning of brake turns on.

Notice: Sensor of brake fluid is installed on the reservoir tank of master cylinder.

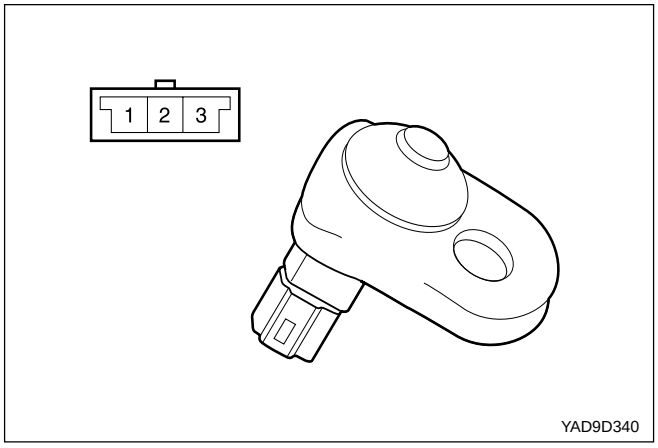
1. Separate gauge connector of brake fluid level.
2. While switch is turned off, check applying of electric current between terminal.
3. While switch is turned on, check applying of electric current between terminal.


YAD9D330

Switch of parking brake

Switch of parking brake is located under lever of parking brake, if switch of parking brake is adjusted, after releasing parking brake, switch of parking brake is installed .

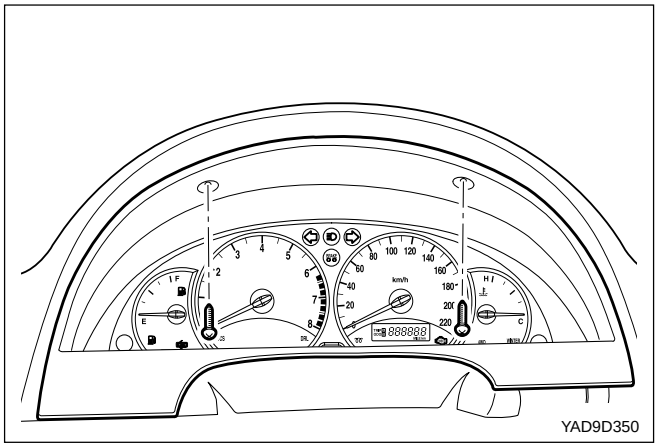
1. While switch is turned on (lever is pulling), check applying of electric current between terminal and switch.
2. While switch is turned off (lever is released), check applying of electric current between terminal and switch, applying of electric current get out of specification, replace switch, or check grounding.



YAD9D340

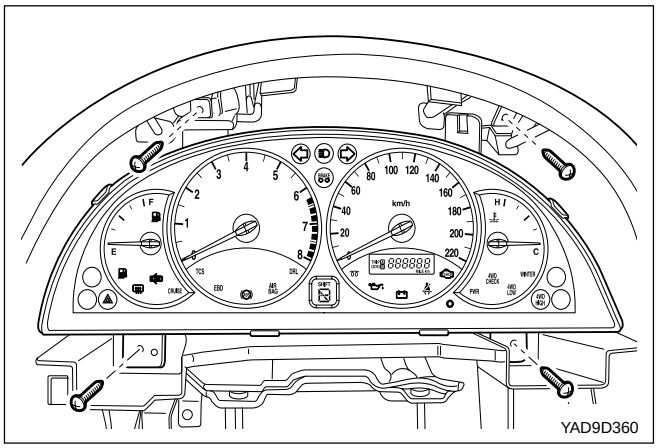
Door Switch

1. Switch of door is removed, check applying of electric current between terminals.
2. If applying of electric current between terminals get out of specification, replace switch of door.


YAD9D350

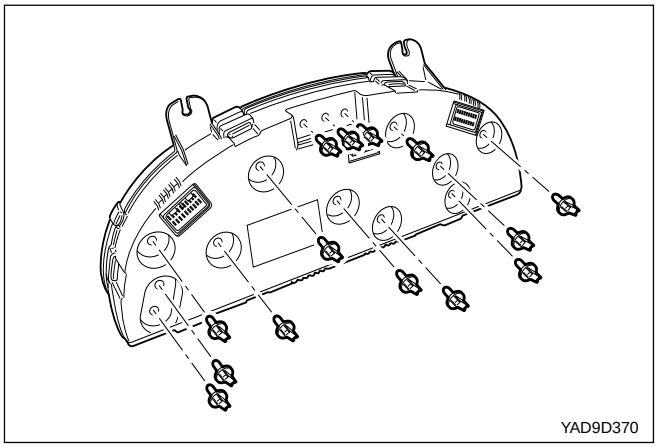
REMOVAL AND INSTALLATION OF INSTRUMENT PANEL

1. Remove negative terminal of battery.
2. After releasing screw (2ea), remove housing of instrument panel .

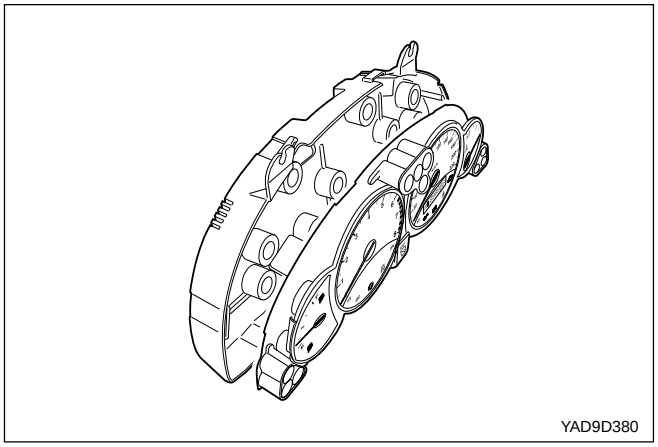


YAD9D360

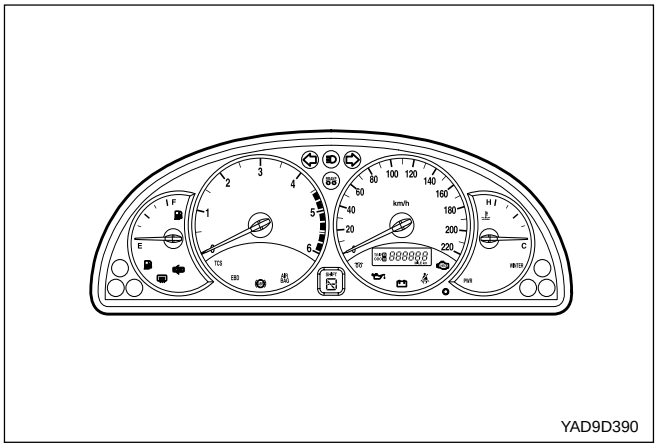
3. After releasing fixing screw (4ea) of instrument panel, separate connector (3ea), and then remove instrument panel.


YAD9D370

4. Separate all the bulb from the instrument removed like the left picture.


YAD9D380

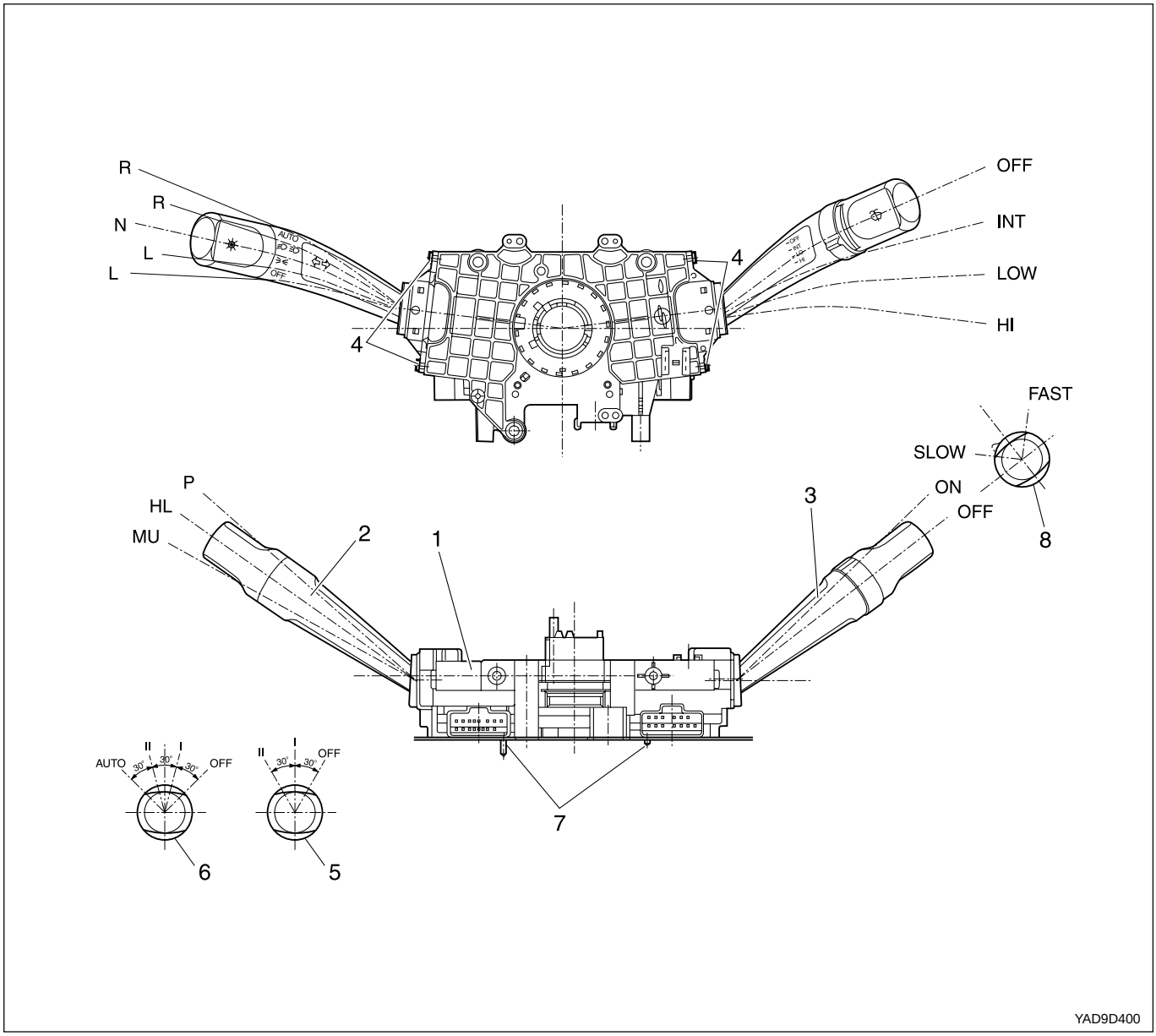
5. After separating the glass of instrument, and then release fixing screw (5ea), and separate instrument panel and housing.



YAD9D390

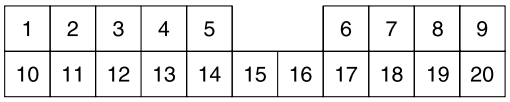
6. Install reverse order of removal, after installing, check operation of instrument panel.

SWITCH OF MULTI – FUNCTION



1 Multi - Function Switch Assembly
2 Turn Signal Switch Assembly
3 Turn Signal Switch Assembly
4 Screw
5 Switch of Light
6 Switch of Auto - Light
7 Connector
8 Switch of Wiper

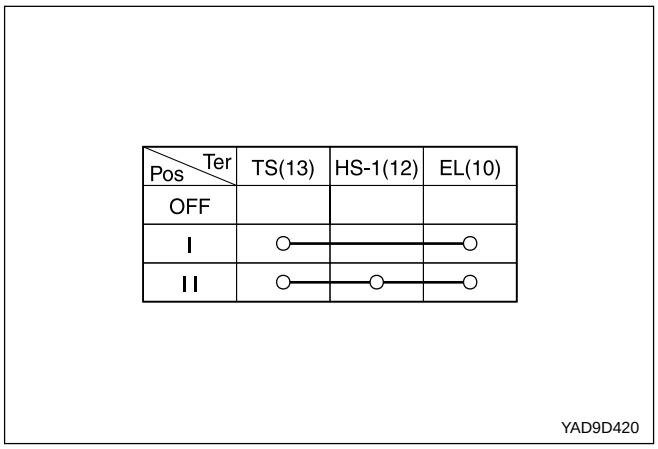
Components of Connector Pin

Layout of connect	Number of pin	Name of connector	
 YAD9D410	1	TL	Switch of turn signal (LH)
	2	TB	Power of flasher unit
	3	TR	Switch of turn signal (RH)
	4	HU	Power of head lamp upper beam
	5	HS (2)	Switch passing of head lamp
	6	W	Front washer switch
	7	EW	Wiper and washer ground
	8	AUTO	Auto wiper
	9	P	Wiper parking
	10	ES	Ground of light switch
	11	A	Auto light switch
	12	HS (1)	Switch of head lamp
	13	TS	Switch of tail lamp
	14	EB	Ground of dimmer and passing switch
	15	-	-
	16	LO	Low speed of wiper
	17	HI	High speed of wiper
	18	ET	Ground of intermittent wiper
	19	INT	Intermittent wiper
	20	HORN	Horn relay

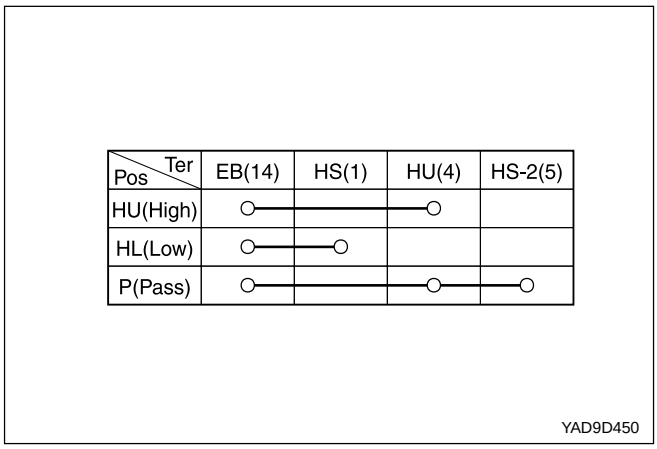
Check and Repair

Check applying of electric current below terminal at each position of multi-function switch, if each terminals are not applied of electric current, replace multi-function switch.

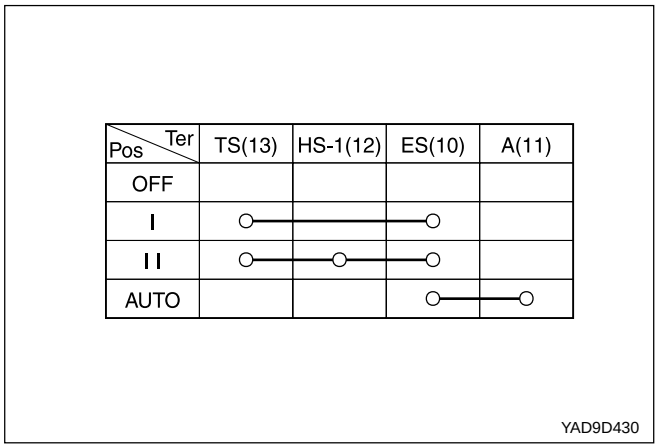
Light switch



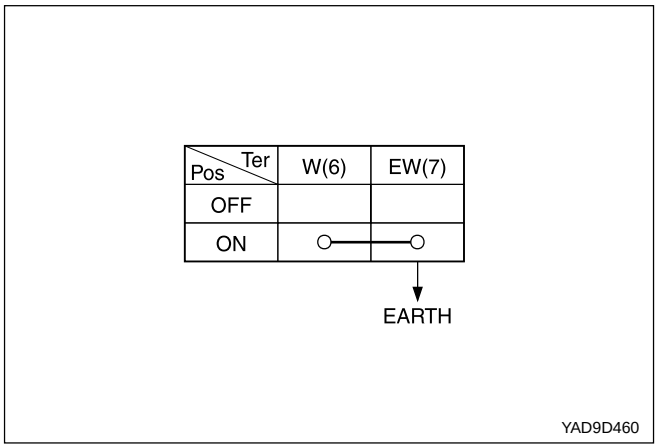
Dimmer and passing



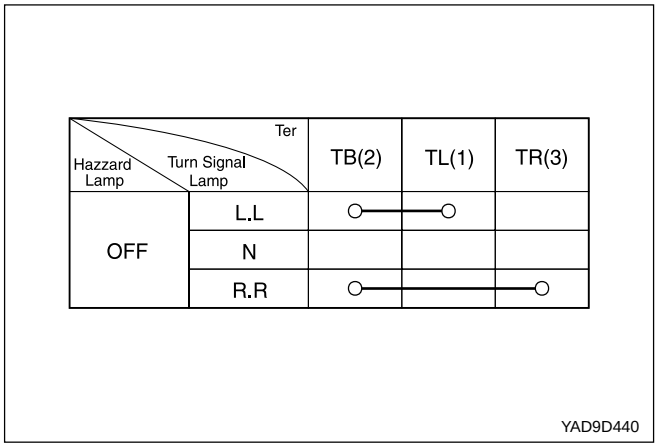
Auto - light switch



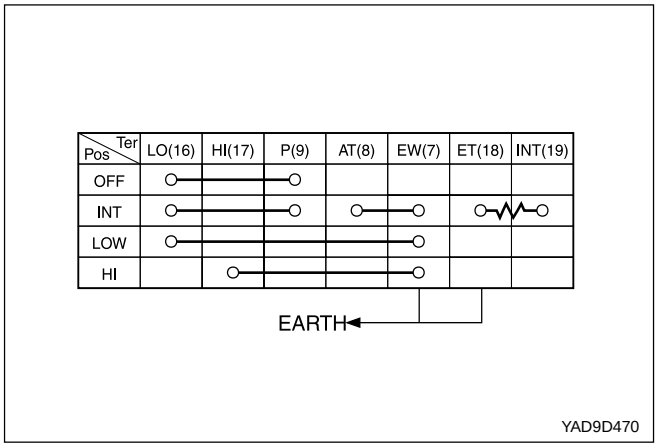
Washer



Turn signal lamp



Wiper switch

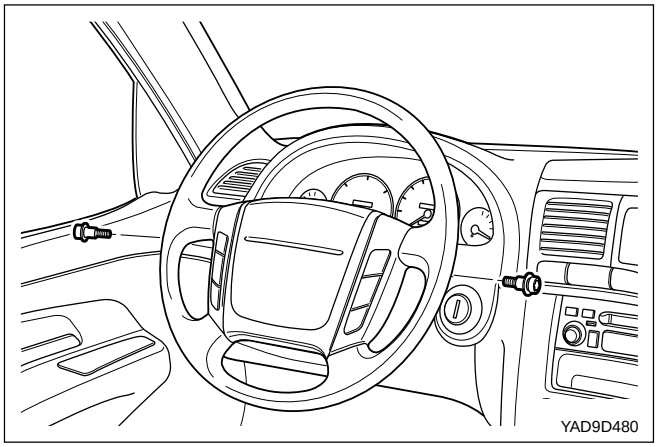


Removal and Installation

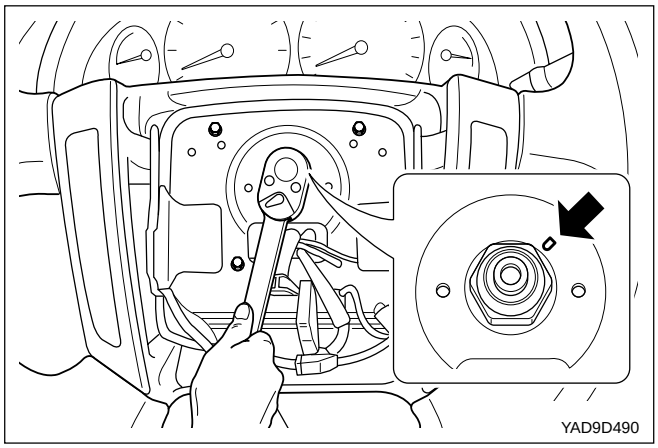
Before multi-function switch is removed in the vehicle with air bag, keep in mind the following.

Notice:

- Do not separate module of air bag or coil of contact, if malfunction of air bag or coil of contact happen, replace them.
- Do not drop down module of air bag or coil of contact, do not contact module of air bag or coil of contact over water, grease, and oil, if crack deformation and corrosion are detected, replace them, if module of air bag keep in the place, put this on the even place, set the surface of pad on the above, do not put anything on them, module of air bag is not kept in the room temp 93 °C.
- After air-bag is exploded, coil of contact and module of air bag should be replaced. While exploded air bag is treated, wear glove and glasses of protection.
- In case for module of air bag not to explode, treat as the procedure described.
- While module of air bag and coil of contact are separated, do not force them to push excessively.
- Before coil of contact is not installed, after keep front tire forward in align, keep in line between mark of contact coil and mark of neutral and then install contact coil. If mark of contact coil does not keep in line properly, steering wheel does not revolve, flat cable can be damaged, air bag does not operate normally, so can cause driver to damage, if contact coil is inspected any situation, refer to the section of air bag.
- If module of air bag is not blown, module of air bag should be treated by procedure.
- If module of air bag and connector of contact coil are separated, excessive force does not be put in those one.
- Before contact coil is installed front wheel should be aligned to the forward, mark on the contact coil should keep on the one line with mark of NEUTRAL, and then contact coil should be installed.

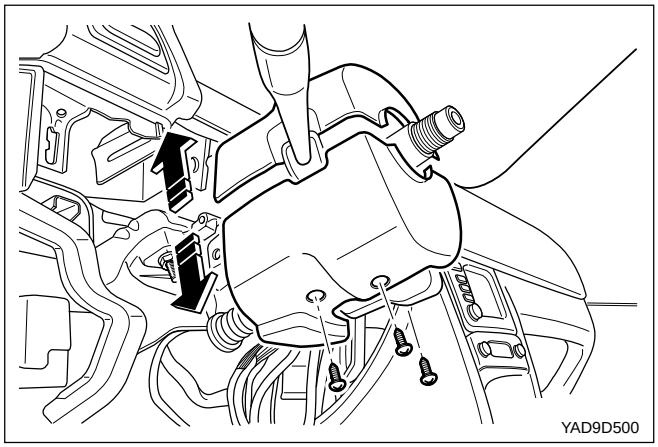


1. Separate negative terminal of battery.
2. Put direction of wheel on the forward and moving direction of vehicle, after releasing screw (left and right), remove module of air bag.

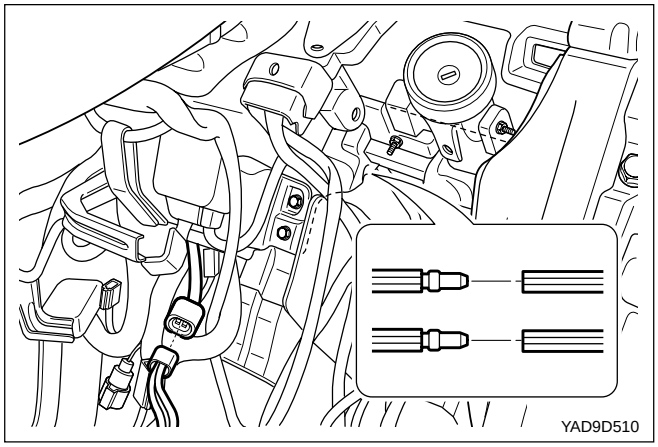


3. Mark installing mark on the wheel nut, release wheel nut.
4. Using the special tool, remove steering wheel.

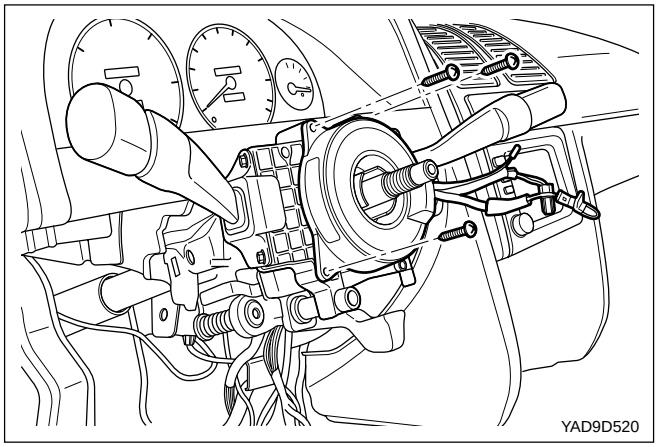
   Notice: Separate all the connector.



5. Separate cover equipped in the steering column shaft.



6. Separate vacuum hose of fuel cut and connector which is linked to switch of multi- function.
7. After separating coil connector of air bag contact, remove contact coil.



8. Remove switch of multi- function.
9. Install reverse order of removal.

COMPONENTS OF LIGHTING

General Description

Head lamp

Head lamp is controlled by light switch which is located in the left of steering column. If light switch is set on first stage, position lamp, lamp of license plate and lamp of instrument panel illumination is turned on, if light switch is set on two stage, head lamp is turned on.

If light switch is off, all the lamp are turned off.

High beam and low beam is controlled by operation of light switch.

As light switch is pushed and pulled, is switched to high beam and low beam, if head lamp is turned on by high beam, high beam is displayed on the instrument panel.

Aiming of head lamp is adjusted properly.

If new head lamp is replaced, aiming of head lamp should be inspected.

Front turn signal lamp / position lamp

If light switch is set on the first stage, lamp of position is turned on, if light switch is off, lamp of position is turned off.

Turn signal lamp is controlled by light switch which is located in the left of steering column, as light switch is operated by moving up and down, and then turn signal lamp is turned on and off.

Change of vehicle direction is finished completely, light switch back to original position, turn signal lamp is turned off, operating of steering wheel is small in the narrow road or in the narrow turn signal lamp so, light switch does not turn back to original position automatically, at this time, as light switch is operated by hand, and then light switch back to normal position, and turn signal lamp is turned off.

Fog lamp

Switch of fog lamp is located on the instrument panel of left gauge panel of audio system, after position lamp and head lamp are turned on, in the result of this, turn switch of fog lamp on, so fog lamp is “on”, if switch of fog lamp is turned on, fog lamp is “on”, indicated lamp also is turned on,in the instrument panel, instead of head lamp, fog lamp should not be used, in case new fog lamp is replaced, adjustment of aiming to the fog lamp should be inspected.

Tail lamp

Tail lamp consists of rear back lamp, tail lamp, back up lamp and turn signal lamp in the assembling part. If position lamp or head lamp are turned, rear back lamp is turned on. As rear back lamp and brake lamp consist of double lamp, if technician is put foot on the brake pedal, brake lamp is turned brighter. If lever of transmission is operated to backwards, back up lamp is turned on.

Assistant brake lamp

Assistant brake lamp is located on the upper section of back glass, if pedal of brake is operated, assistant brake lamp is turned on.

Lamp of license plate

If position lamp or head lamp is turned on, lamp of license is turned on, this lamp is attached rear deck lid of license plate.

Lamp for reading and room lamp

Lamp for reading and room lamp is attached on the head lining, if switch of lamp for reading is turned on, lamp for reading is “on” in the driver seat and passenger seat, if switch is touched one, lamp is “on”, if switch is touched twice, lamp is “off”. Switch of room lamp is the type of three point, if open door, in the state of pushing switch of door, room lamp is turned on, if door is closed, room lamp is gradually turned off.

In the state of switch “ off “, though door is opened, yet room lamp is not turned.

Auto Light System

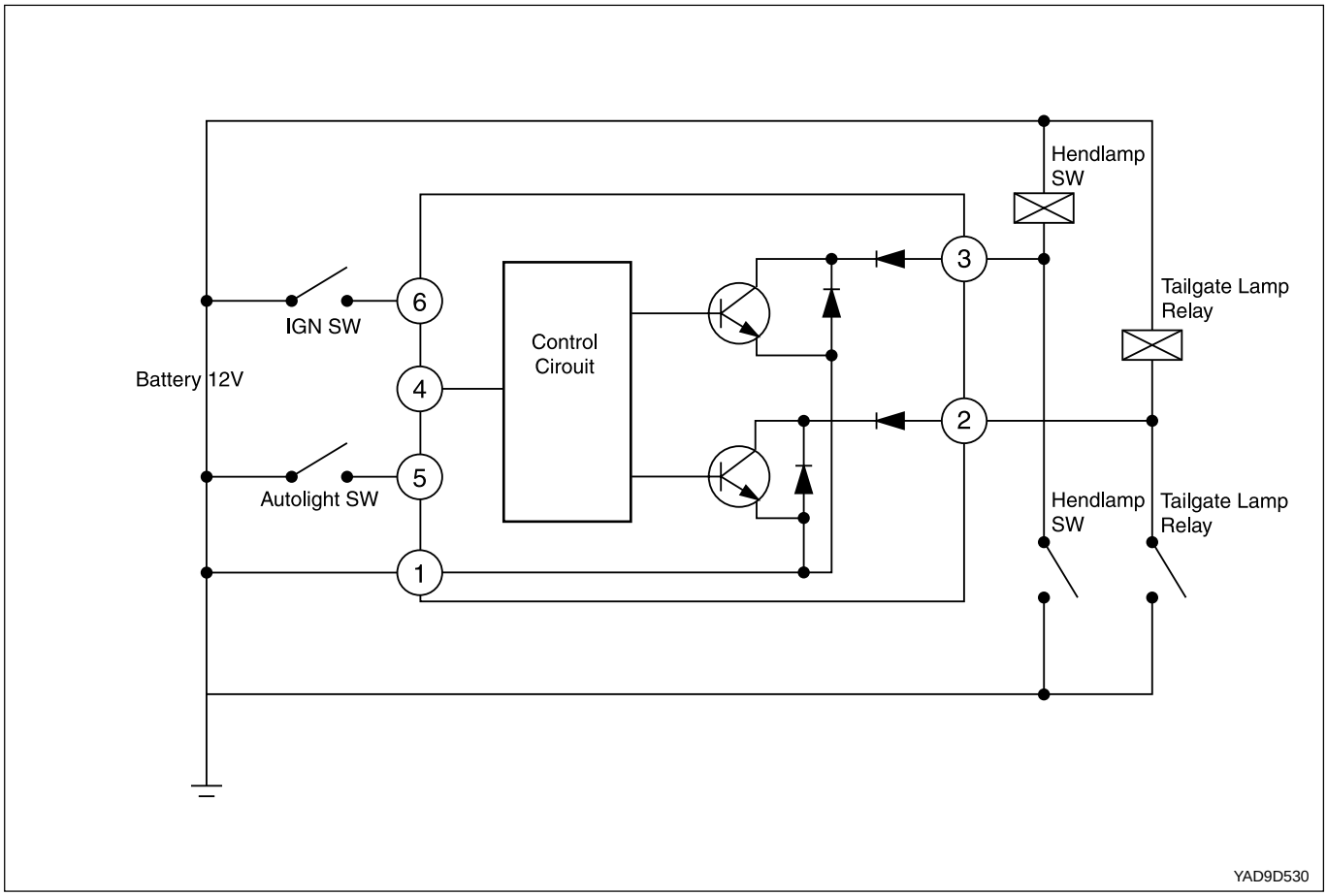
Summary

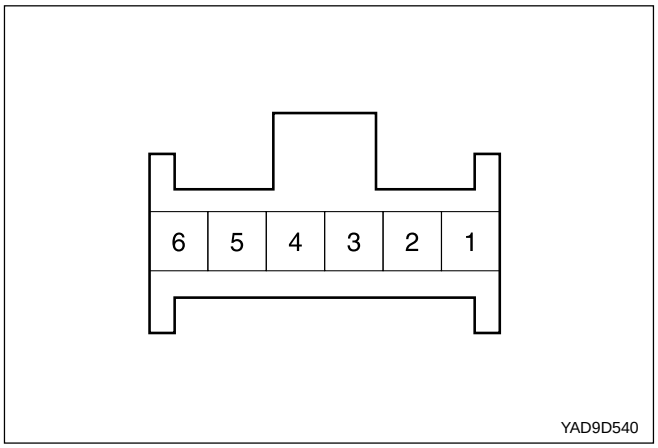
Controlling of auto light cause tail lamp or position lamp to turn on or off, sensor unit of auto light is attached on the upper panel of instrument, this unit is sensing change of illumination to atmosphere, though driver does not operate light switch, yet if mode is set on AUTO, head lamp and tail lamp is automatically turned on and off, during the vehicle is driven on the time of day through tunnel area, foggy area, rainy day, or snowy day, due to the low of illumination around atmosphere, this system is operating.

Specification

Name of part	Description	
Sensor unit of auto light	Voltage of load	9 -16 V
	Load	MAX 200 mA
	Temp available	- 30 ~ +85 °C
	Room temp for keeping	- 40 ~ +120 °C
	Position of attaching	Upper right section of instrument panel

Input and Output of Diagram





Sensor Unit Terminal of Auto Light

1 Power Supply For System
2 Auto Light Switch
3 Non-Use
4 Relay of Head Lamp
5 Relay of Tail Lamp
6 System Grounding

Operation of Auto Light and Operating Condition

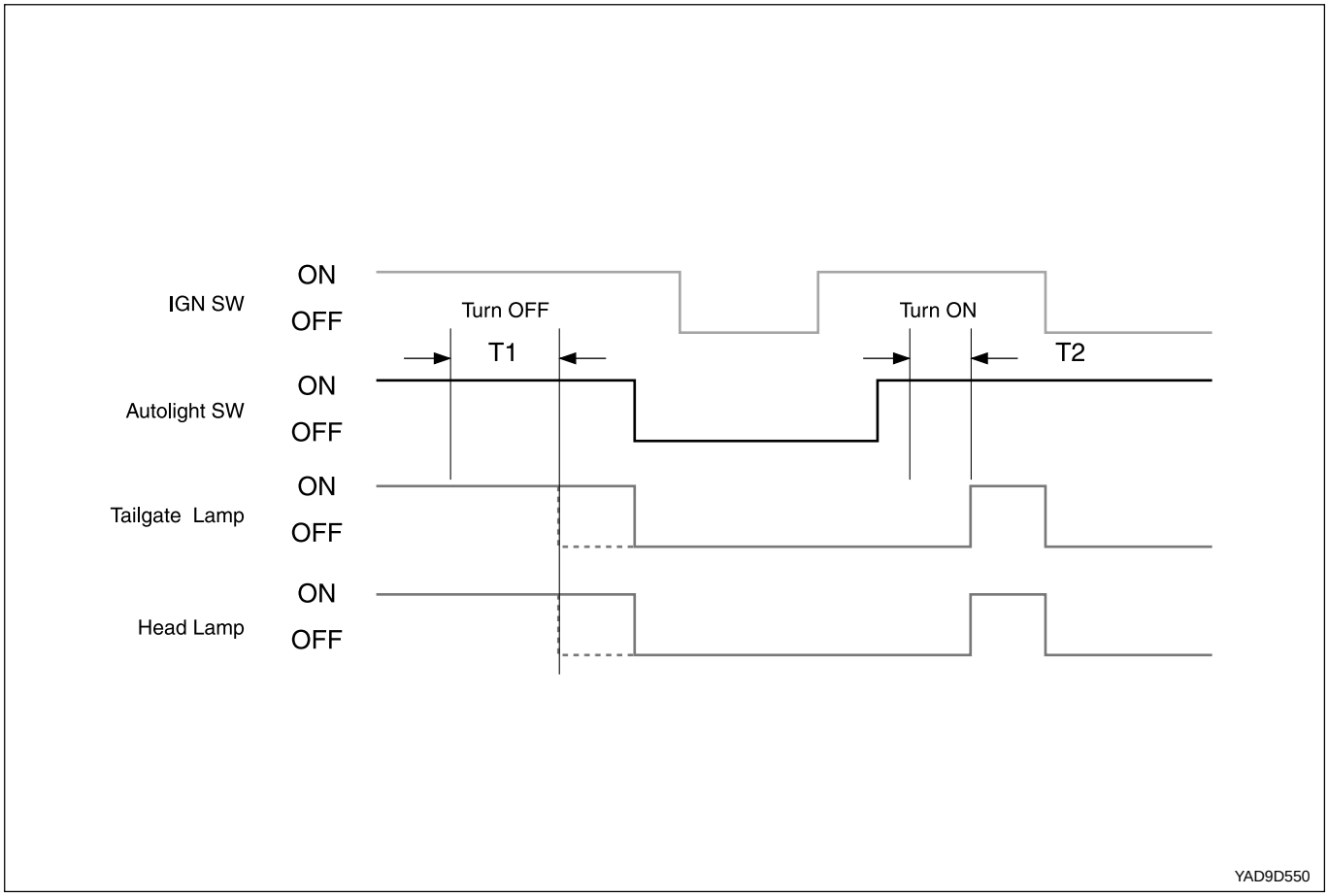
Operation of switch function

1. After turning ignition on, operate multi-function switch, OFF → TAIL LAMP → HEAD LAMP → AUTO switch.
2. Turn tail lamp, head lamp “on and off”
3. Turn switch of AUTO ON, While sensor is sensing illumination of light, which is set on the diode of photo. As quantity of illumination of light is equivalent to voltage which is set on the internal CPU, tail lamp and head lamp is turned on and off automatically.
4. Switch of tail lamp and head lamp is operated by hand, tail lamp and head lamp are not turned, on and off by sensor.
5. If switch of ignition is turned off, tail lamp and head lamp is turned off.

Operation Condition

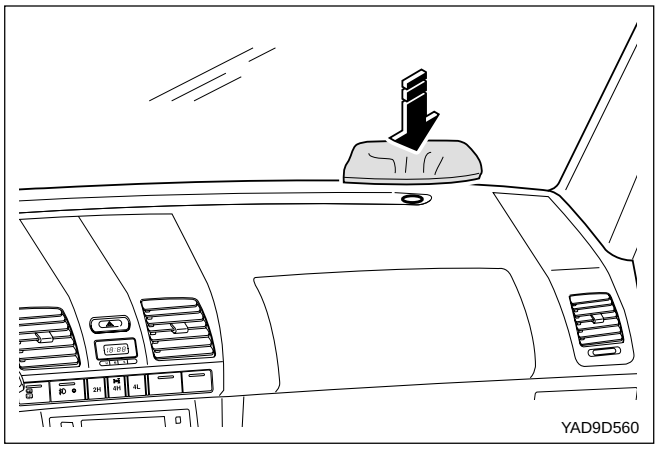
Lamp / Illumination intensity	Condition of tail lamp	Condition of head lamp	Time of delaying
Illumination intensity of light on	30.5 ±¾5 (LUX)	8.9 ± 3 (LUX)	0.5 ± 0.1
Illumination intensity of light off	60.5 ±¾5 (LUX)	17.2 ± 3 (LUX)	3 ± 1

The Characteristic of Operation



Operation condition should be under on and off range with tail lamp, head lamp

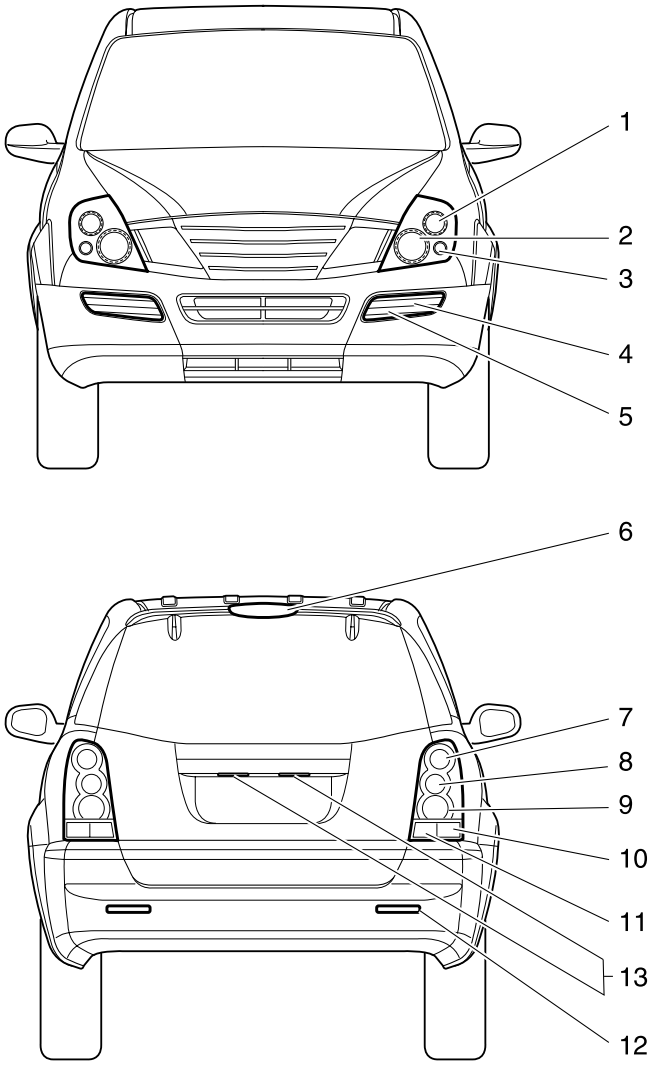
T1 : 3 ± 1.0 sec T2 : 500 ± 100 msec



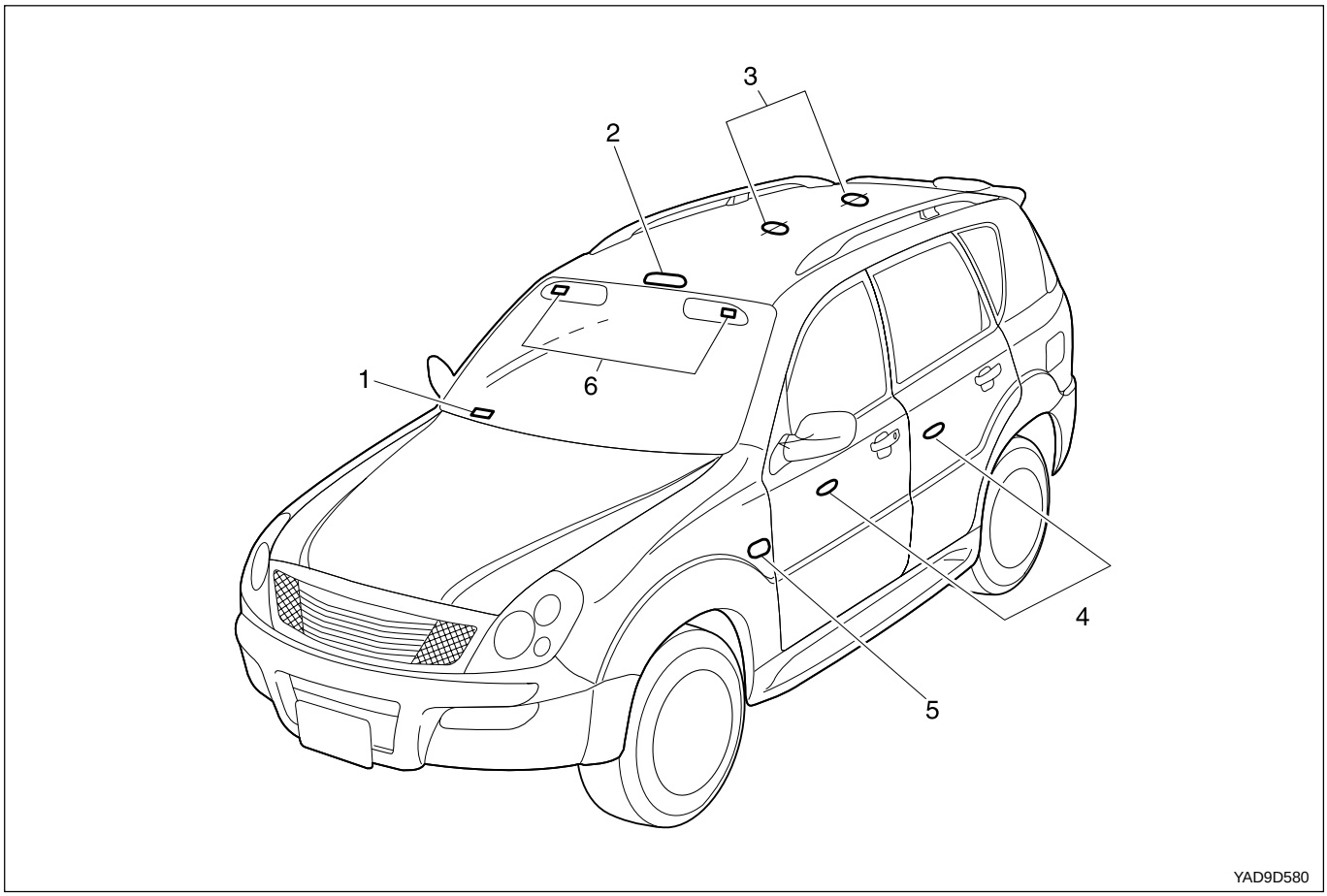
Check

After turn to position of AUTO, put black cloth on the section of sensor, check if head lamp, tail lamp are turned on or not.

LOCATION OF LAMP



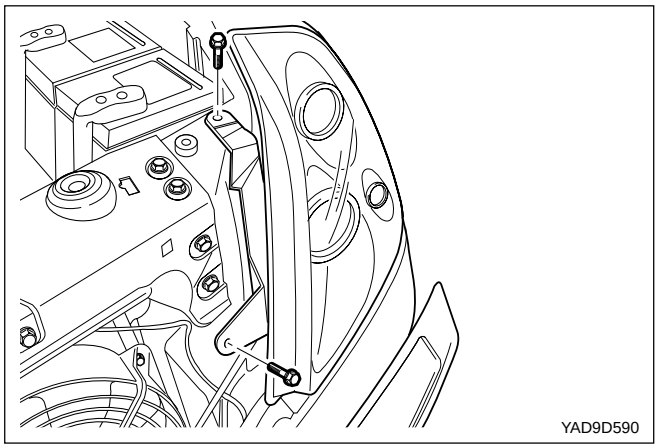
1 Head Lamp - Low
2 Head Lamp - High Beam, Position Lamp
3 Position Lamp
4 Turn Signal Lamp
5 Fog Lamp
6 High Mounted Stop Lamp Plate
7 Tail and Stop Lamp
8 Tail Lamp
9 Stop Lamp
10 Turn Signal Lamp
11 Back up Lamp
12 Rear Back Mirror
13 Lamp of License



1 Lamp of Glove
2 Room Ramp
3 Lamp of Center Room
4 Door Lamp
5 Turn Signal Lamp of Side
6 Lamp of Cosmetic Mirror

Specification of Lamp

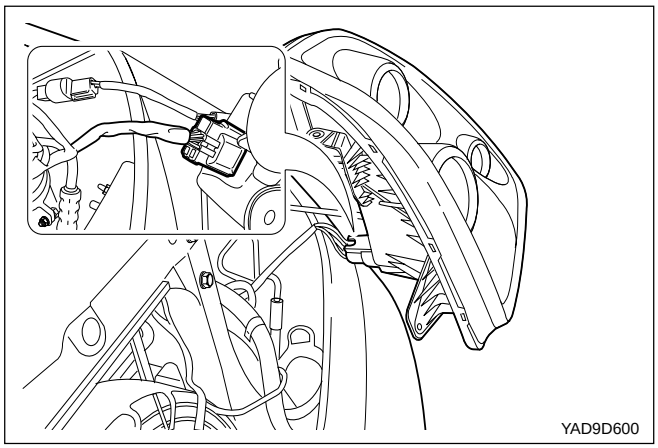
Item		Quantity	Spe	Item		Quantity	Spe
Head lamp	Low beam	(L, R) (1, 1)	55 W	Rear combi lamp	Back up lamp	(L, R) (1, 1)	27 W
	High beam	(L, R) (1, 1)	55 W	Back mirror	Rear	(L, R) (1, 1)	-
	Position lamp	(L, R) (2, 2)	5 W	Lamp of license plate	Lamp of license plate	(2)	5 W
Front combi lamp	Fog lamp	(L, R) (1, 1)	27/ 8 W	Room	Glove box	(1)	10 W
	Turn signal lamp	(L, R) (1, 1)	28 W		Front room lamp	(2)	8 W
Rear	High mounted stop lamp	4 EA	5 W		Lamp of center room	(2)	10 W
Rear combi lamp	Tail/ stop	(L, R) (1, 1)	27/ 8 W		Door lamp	(4)	5 W
	Tail lamp	(L, R) (1, 1)	8 W		Cosmetic mirror lamp	(L, R) (1, 1)	
	Stop lamp	(L, R) (1, 1)	27 W	Side combi	Turn signal lamp	(L, R) (1, 1)	5 W
	Turn signal lamp	(L, R) (1, 1)	27 W				


YAD9D590

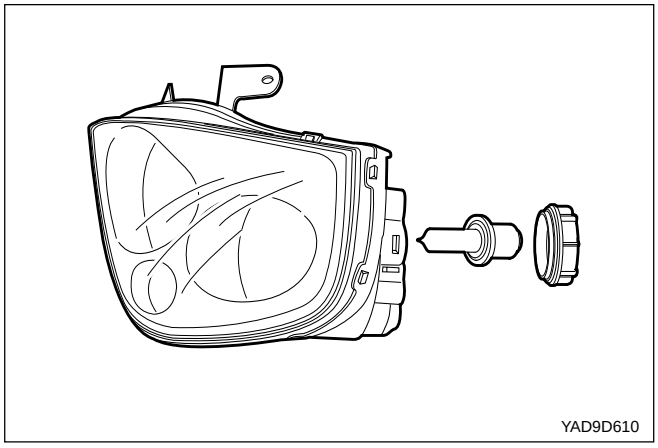
Removal and Installation

Head Lamp

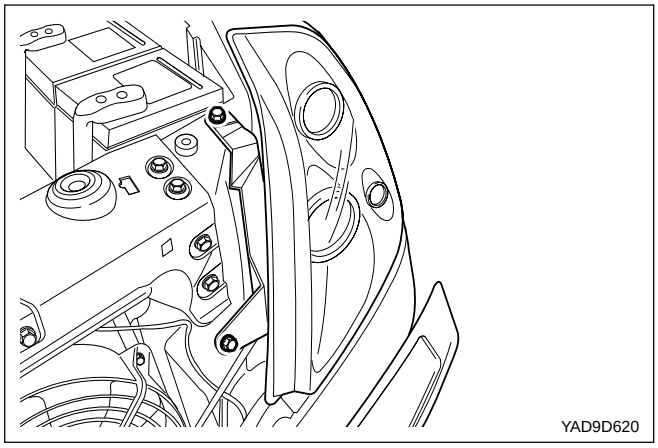
1. Remove negative terminal of battery.
2. Remove the grill of radiator.
3. Remove mounting bolt (3ea) of head lamp.


YAD9D600

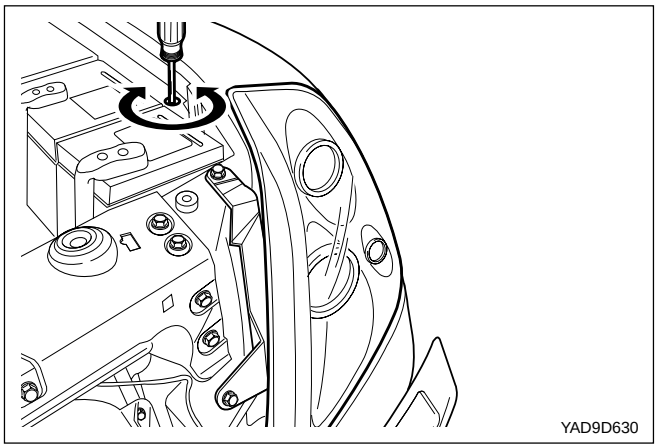
4. After separating connector of head lamp, remove the head lamp.


YAD9D610

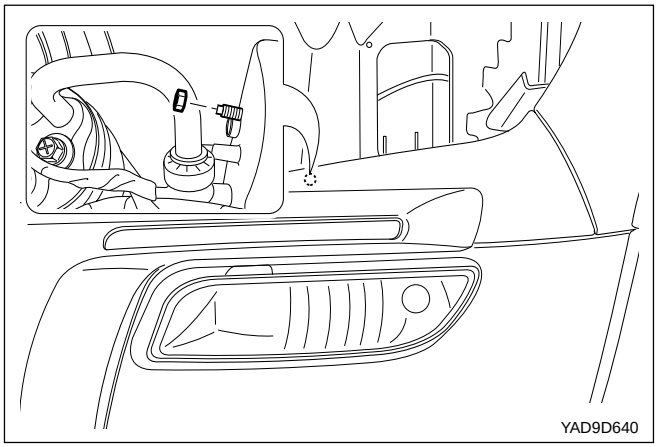
5. Separate cover of bulb, connector, and bulb orderly, from head lamp separated.


YAD9D620

6. Install the reverse order of removal.

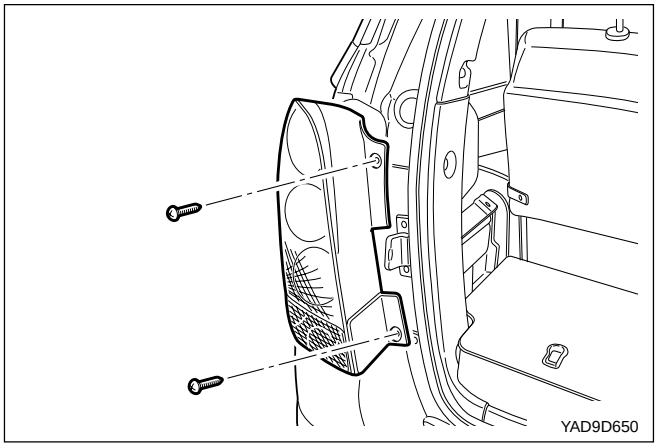


- After installing head lamp, proceed to arrange of focus.



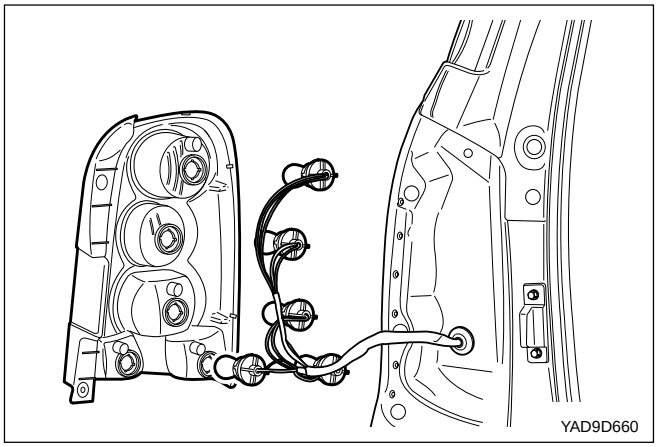
Turn signal lamp / fog lamp

1. Remove the negative terminal of battery and head lamp.
2. After releasing fixing bolt of lamp of front turn signal lamp and fog lamp, remove connector.
3. Remove lamp assembly from the bumper.
4. Install the reverse order of removal.
   - Fix the left of lamp on the hook of bumper, and then tighten the right with fixing nut (2 ea).

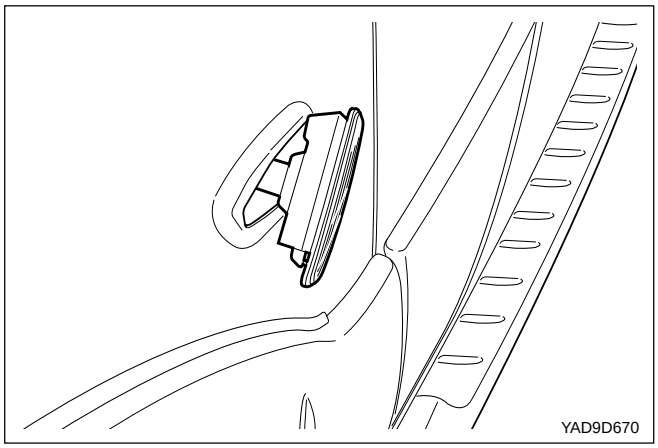


Rear combi - lamp

1. Remove the negative terminal from battery.
2. Separate fixing screw (2ea) of rear combi - lamp.

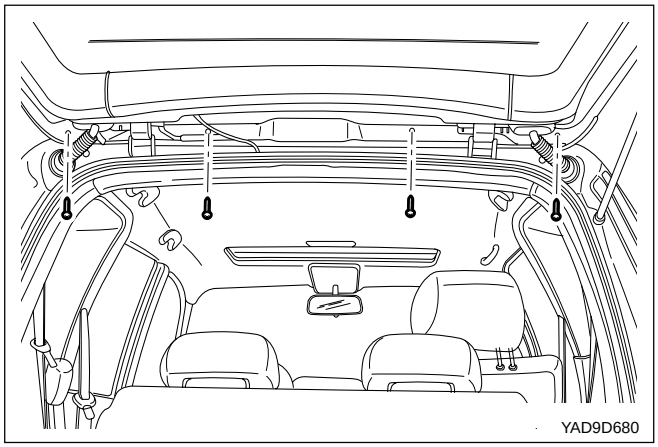


3. After separating bulb from rear combi-lamp and then remove rear combi - lamp.



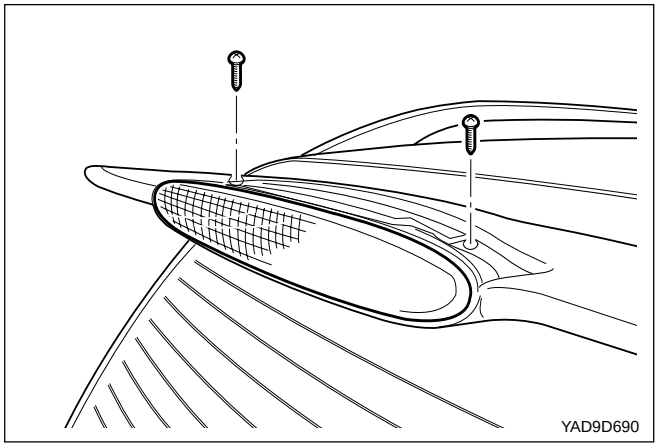
Side lamp

1. After pushing side lamp to front side, pulling rear of lamp, and then remove side lamp.
2. After removing the connector, remove side lamp.

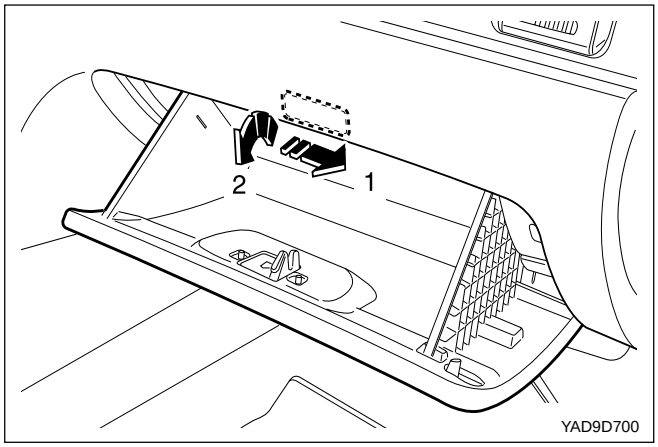


High mounted lamp

1. Remove spoiler from the tail gate.

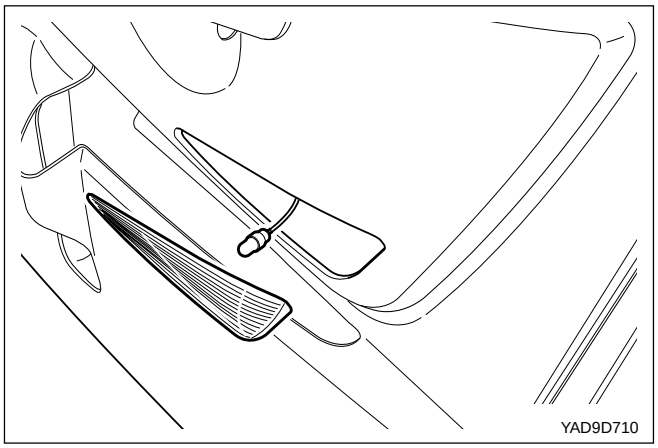


2. After separating fixing screw (2 ea) of lamp spoiler of tail gate, and then remove connector.
3. Remove lamp assembly.
4. Install the reverse order of removal.



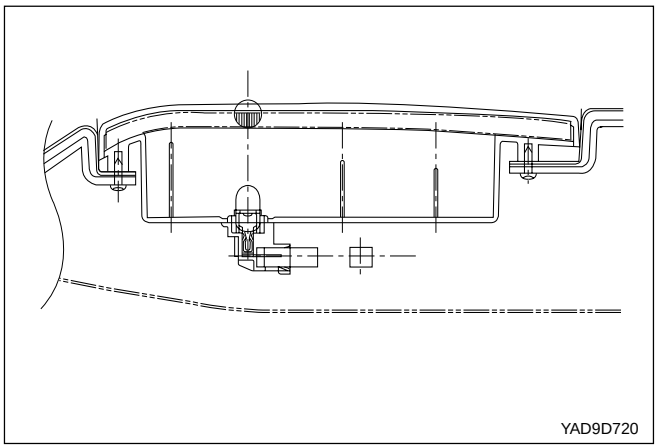
Lamp of glove box

1. Open up cover of glove box.
2. After pushing lamp as indicated mark, remove lamp of glove box.
3. After separating connector of lamp, remove lamp.
4. Install the reverse order of removal.

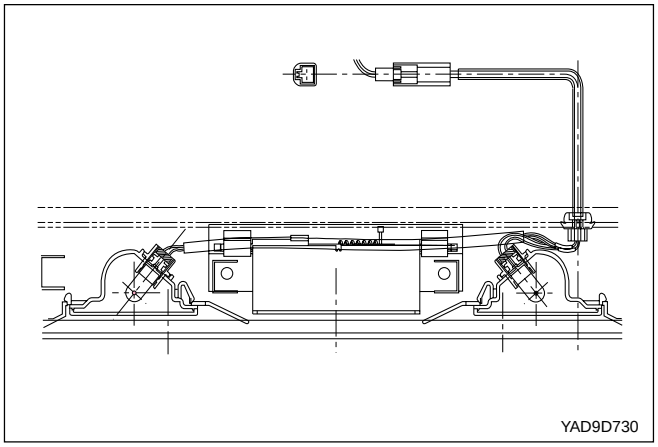

YAD9D710

Door lamp

1. Remove the negative terminal of battery.
2. After removing door trim, and then separate connector of lamp.

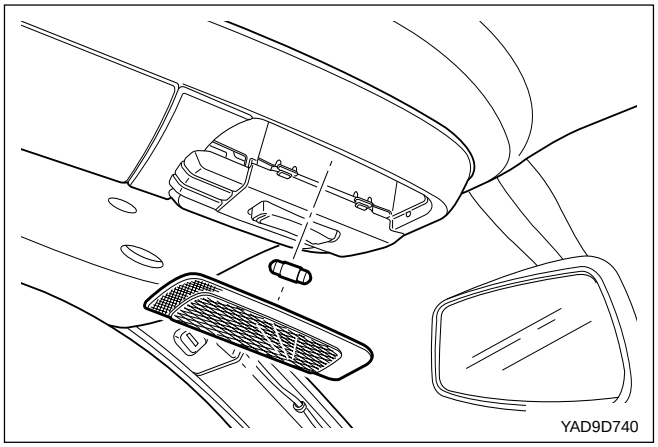

YAD9D720

3. After releasing fixing screw of lamp, remove lamp.
4. Install the reverse order of removal.


YAD9D730

Lamp of license plate

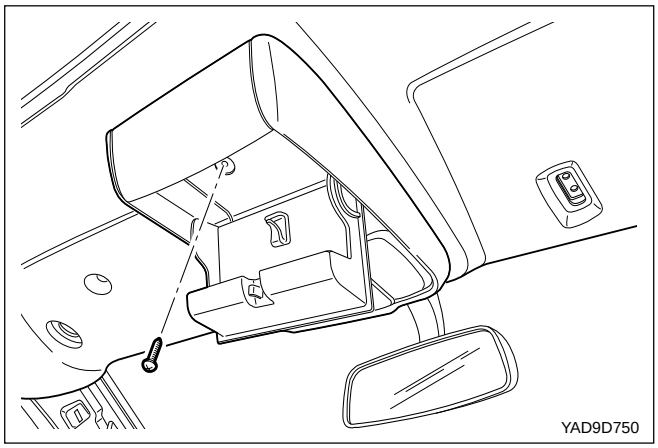
1. Remove lamp of license plate.
2. Separate bulb from lamp.
3. After insert bulb into lamp, and then insert in the hole of mounting of tail gate.


YAD9D740

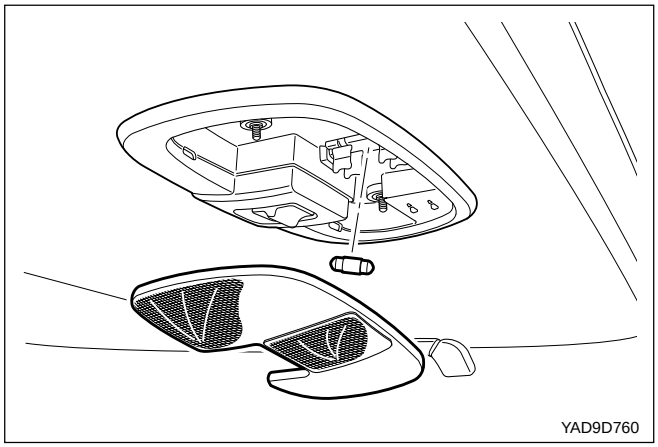
Room lamp

Front lamp

1. After removing lense of lamp, remove bulb.

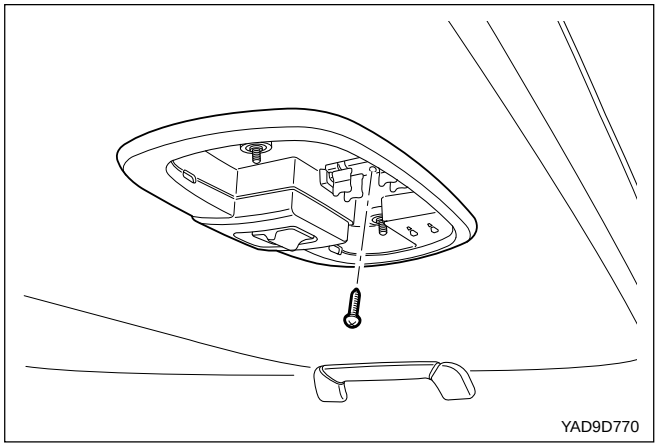


2. After releasing the housing fixing screw of lamp, and then separate housing.
3. After separating connector of lamp housing, remove lamp housing.
4. Install the reverse order of removal.



Center / rear lamp

1. After removing lense of lamp, remove bulb.



2. After releasing housing fixing screw of lamp, separate the housing.
3. After removing connector from the lamp housing, remove lamp housing.
4. Install the reverse order of removal.

HORN AND AUDIO SYSTEM

General Description

Horn

Horn is located under the hood, is also installed near radiator in the front. Horn is operated by pushing pad of steering wheel which is linking to the electric circuit.

Audio system

Audio

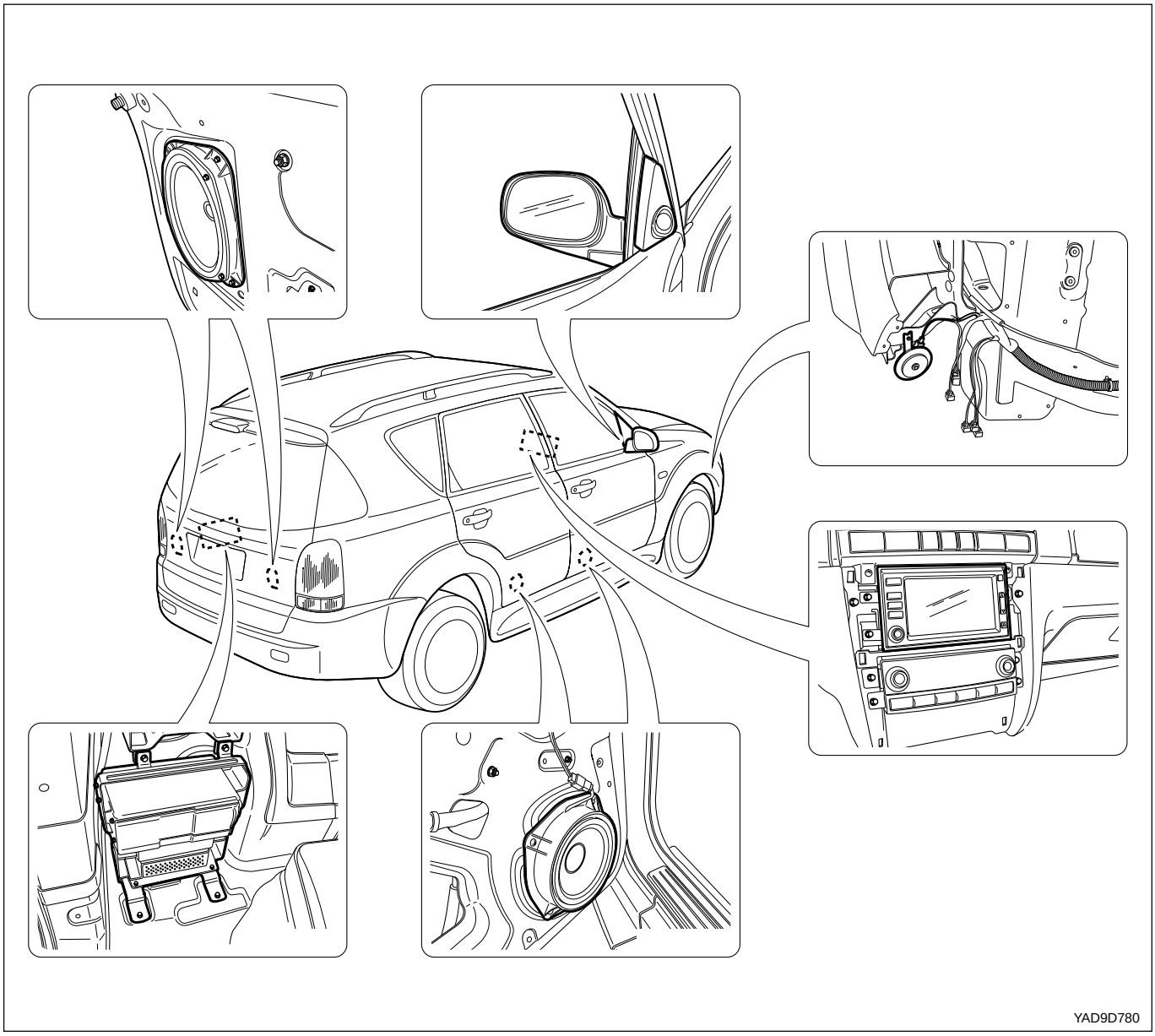
Radio and cassette are installed in the audio system by standard specification, changer of cd is applied option specification, which is installed on the room of trunk.

Front and rear speaker

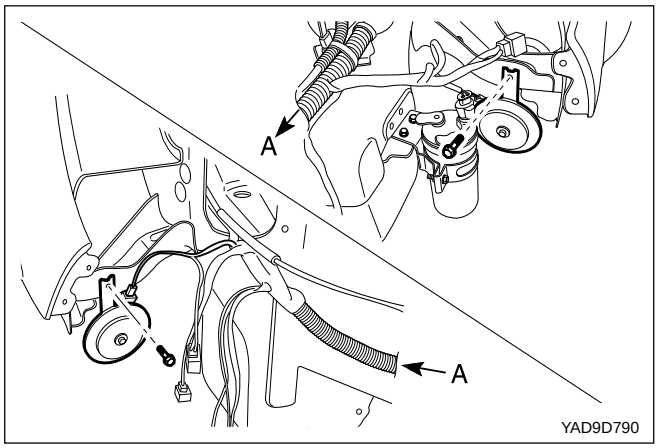
Eight of speaker is installed in the vehicle, two of speaker is installed on the front door, rear door, and tail gate and an speaker is installed each side mirror (left, right).

Glass antenna

Glass antenna is different from existing antenna, is not appeared external shape of antenna,this one is installed on the quarter glass, consists of module of glass antenna, harness, and connector. The sensitivity of reception are better than the existing antenna.



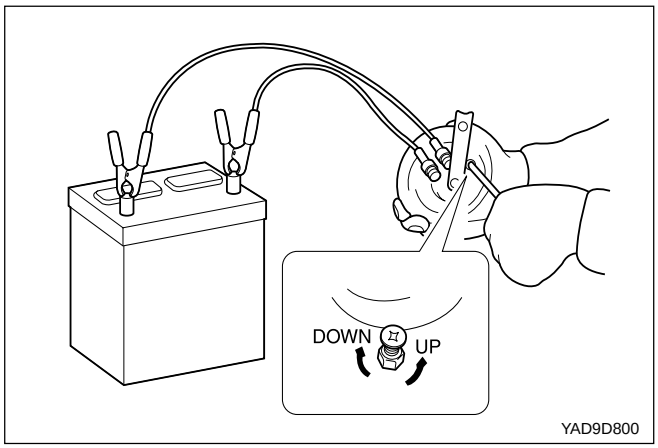
YAD9D780



Removal and Installation

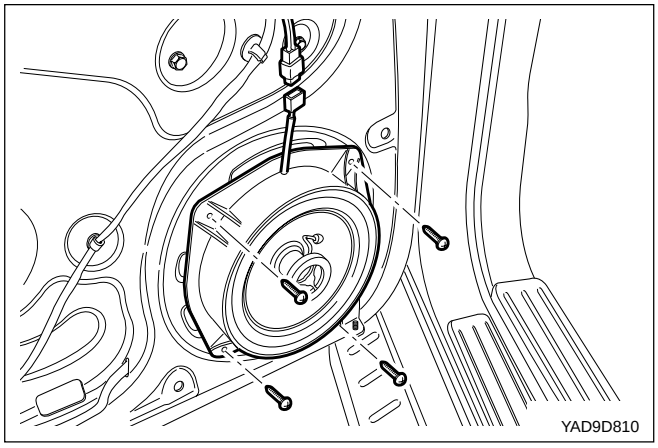
Horn

1. After releasing fixing bolt, remove horn.
2. Install the reverse order of removal.



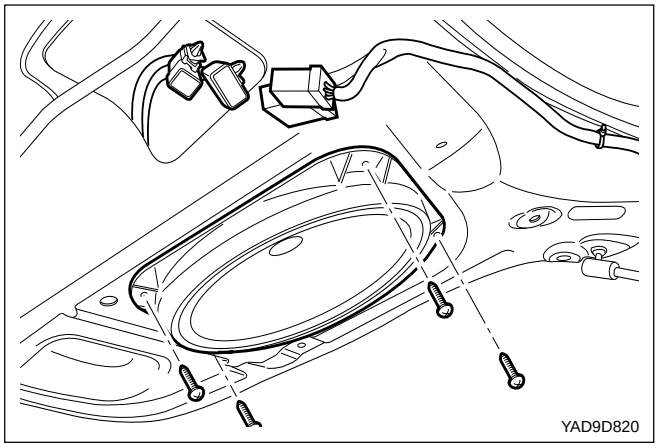
3. Adjust
   - After operating the horn, and then adjust tone of horn proper (adjust screw of controlling).

   Notice: After adjusting screw, spread paint on the screw of adjusting, do not release screw of adjusting.

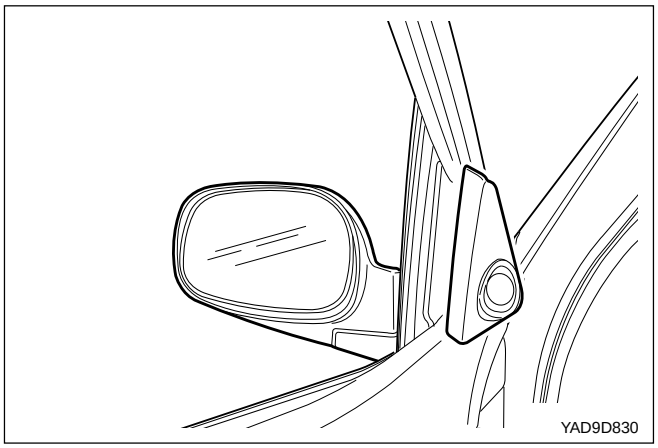


Speaker

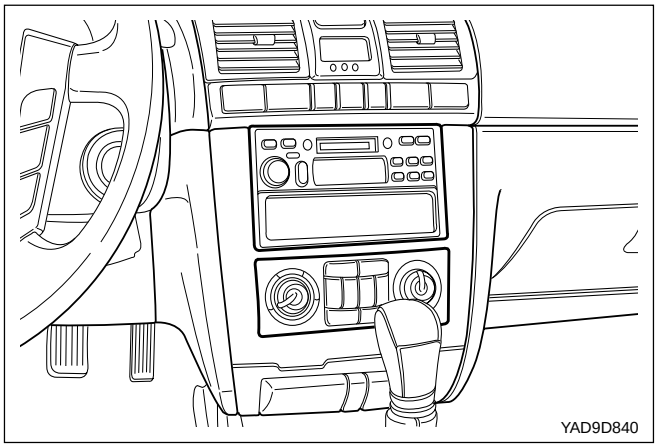
1. Remove front door speaker and rear.
   1) Remove door trim and seal.
   2) After separating connector of speaker, and then release fixing screw of speaker.
   3) Remove speaker.
   4) Install the reverse order of removal.



2. Remove speaker of tail gate.
   1) Remove trim of tail gate and seal.
   2) After releasing fixing screw and connector of speaker, remove speaker.
   3) Install the reverse order of removal.



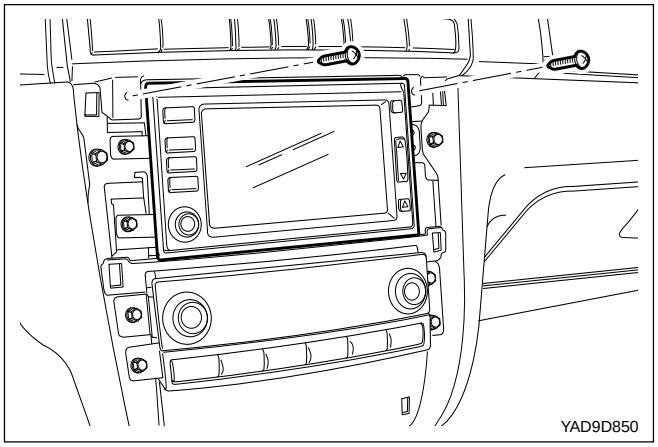
3. Remove speaker of side.
   1) Remove door trim.
   2) After removing speaker assembly, remove connector of speaker.
   3) Install the reverse order of removal.



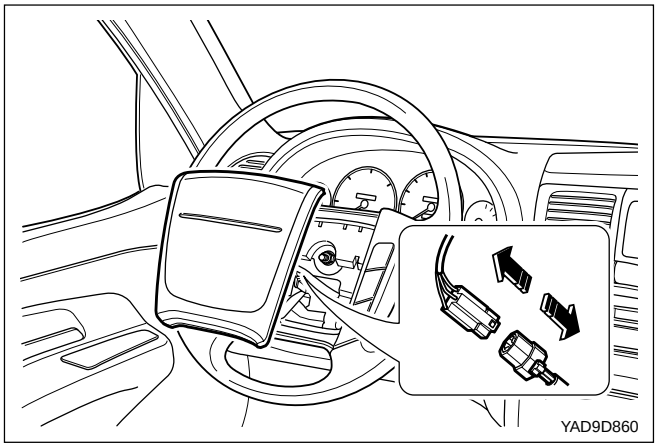
Accessory of audio system

Audio

1. Separate the negative terminal of battery.
2. Remove center of instrument panel.

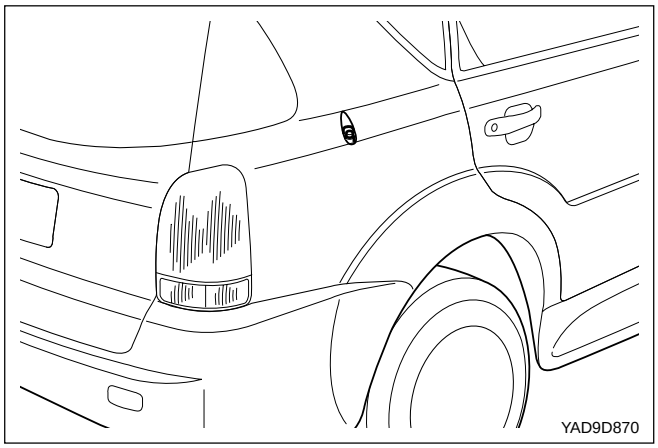


3. Remove audio
   - Release fixing screw of audio.
   - Separate cable of antenna and connector.
   - Remove audio.
4. Install the reverse order of removal.



Controller of audio remote

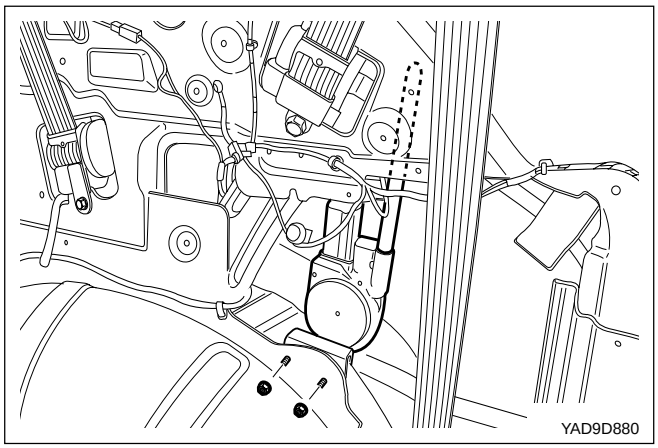
1. Remove air bag module of steering wheel or horn pad on the driver seat.
2. After releasing connector and fixing screw, and then remove remote control.
3. Install the reverse order of removal.



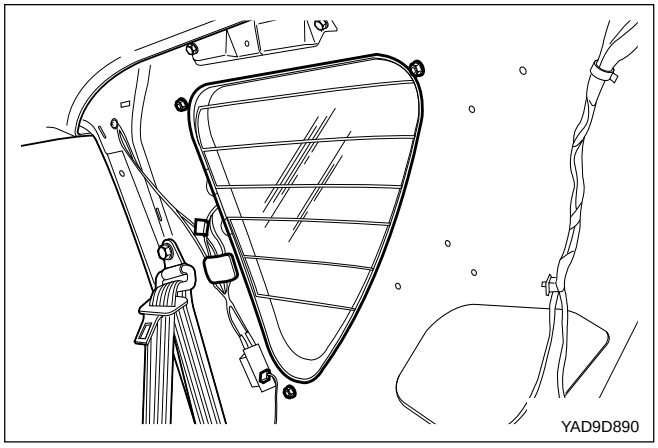
Power antenna and module

Power antenna

1. After separating the negative terminal, remove lower quarter panel of seat in the passenger seat.
2. Remove fixing cover of power antenna.

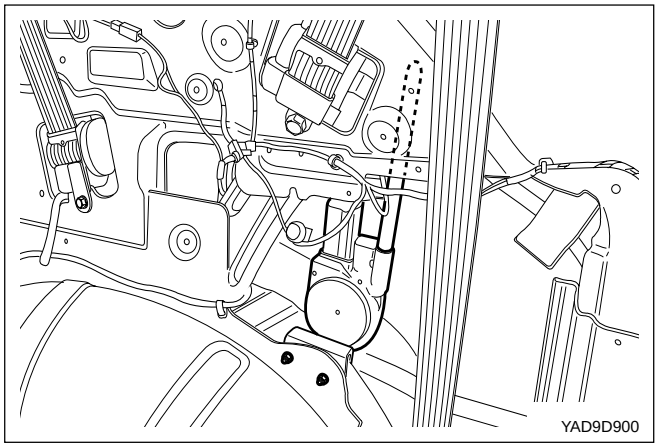


3. After separating motor connector of power antenna, and then release fixing nut of motor.
4. Remove power antenna assembly.

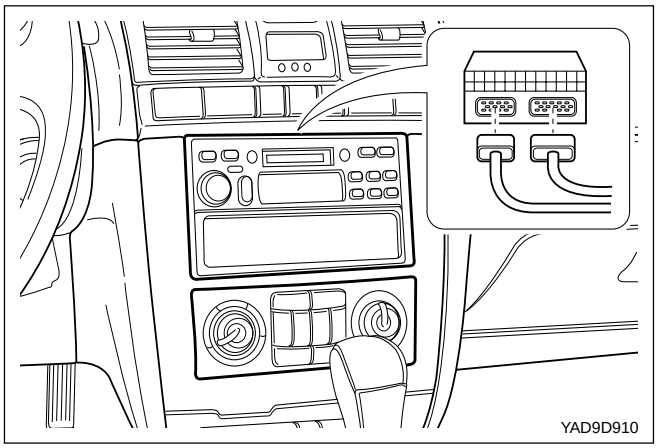


Module of glass antenna

1. Remove the upper quarter panel.
2. Remove module of glass antenna.
   - Separate connector of glass antenna.
   - Separate jack of antenna.
   - Release bolt (2ea).
   - Separate connector of rear heating line.
   - Remove module of glass antenna.

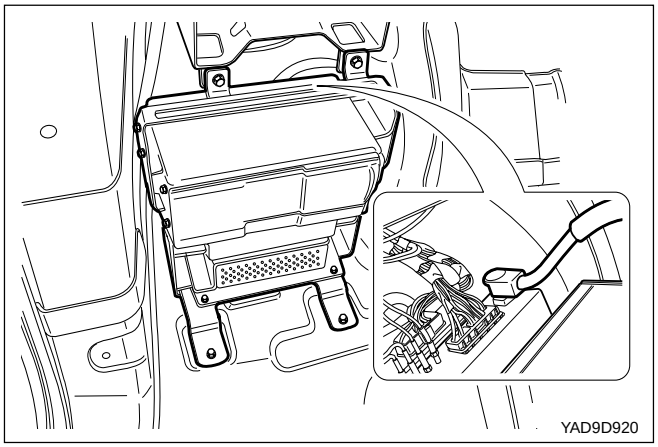


3. Install the reverse order of removal.

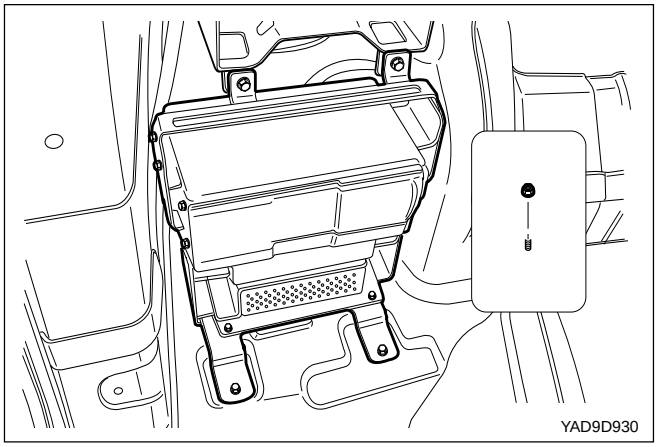


CD Changer

1. Remove the negative terminal of battery and AUDIO.
2. Separate cable of CD changer from the AUDIO.



3. Remove rear lower quarter panel in the driver seat.
4. Remove cable from the changer of CD.



5. After releasing bracket fixing bolt of changer of CD, remove changer of CD.
6. After Installing the reverse order of removal, check unusual noise or state of operation.

WIPER AND WASHER

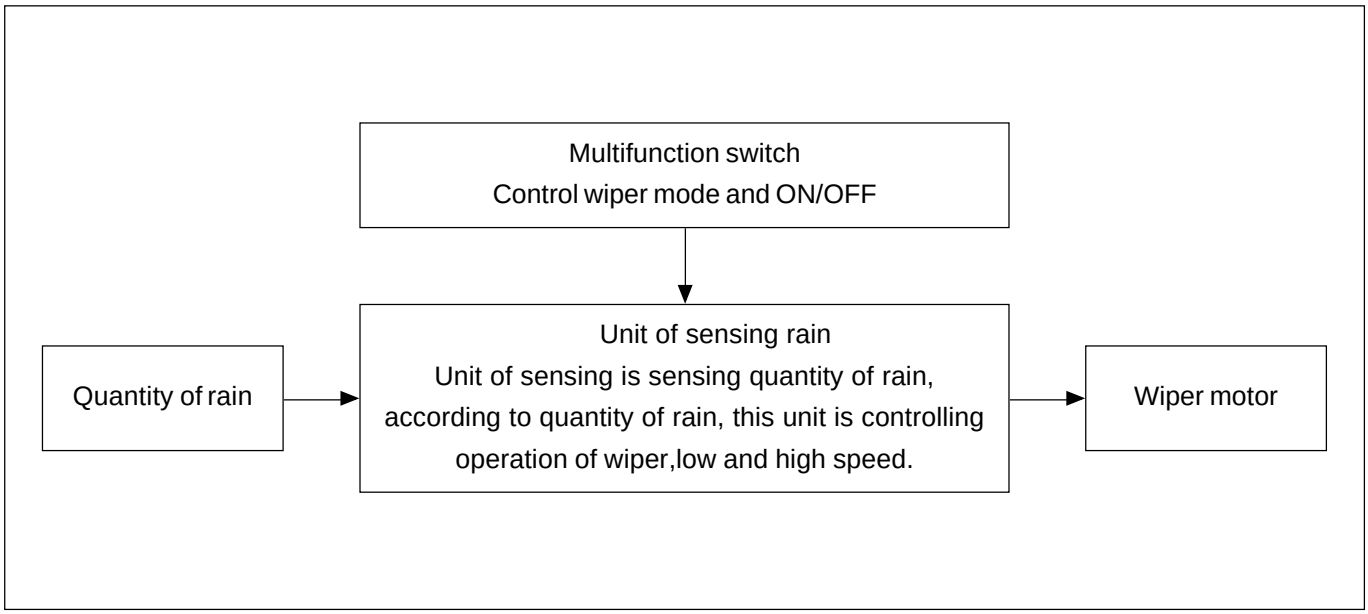
General Description

Wiper system of sensing rain

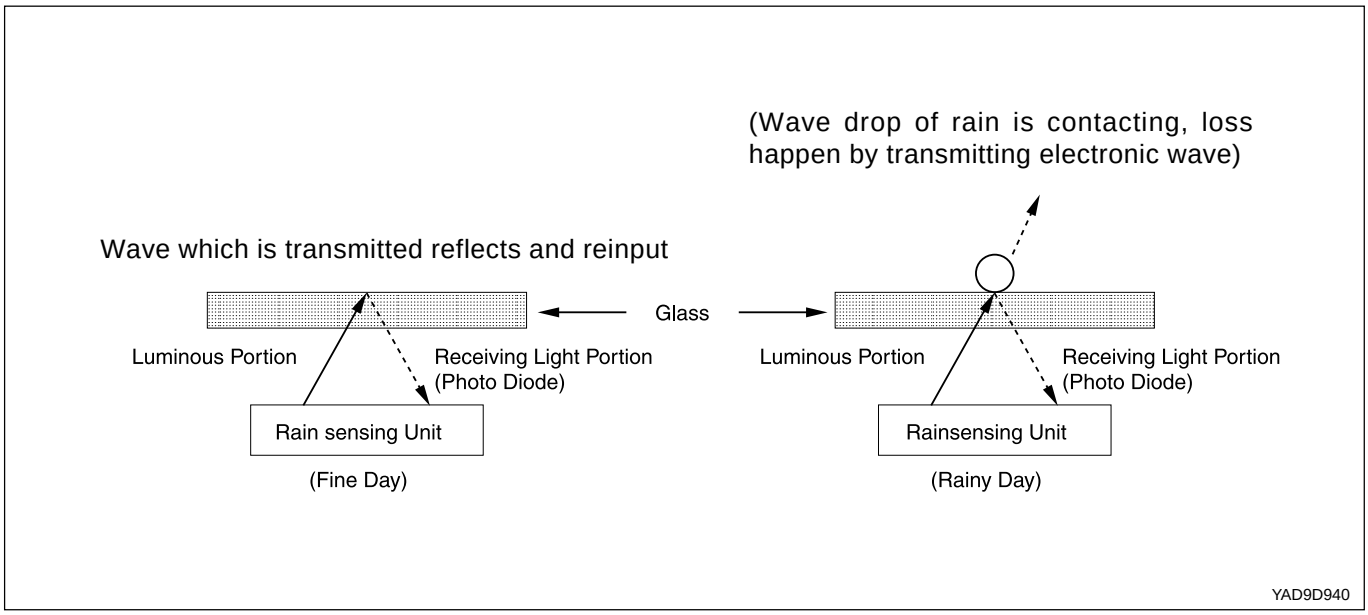
Summary

Wiper motor of musso and korando is controlled by stics. In the case of this, time of operation of wiper is controlled by stics, driver should control time which is drived of stics. But wiper system of rexton is sensing quantity of rain by the unit of sensing rain which is installed on the upper center of windshield, this unit is controlling operation of wiper, low and high speed according to quantity of rain.

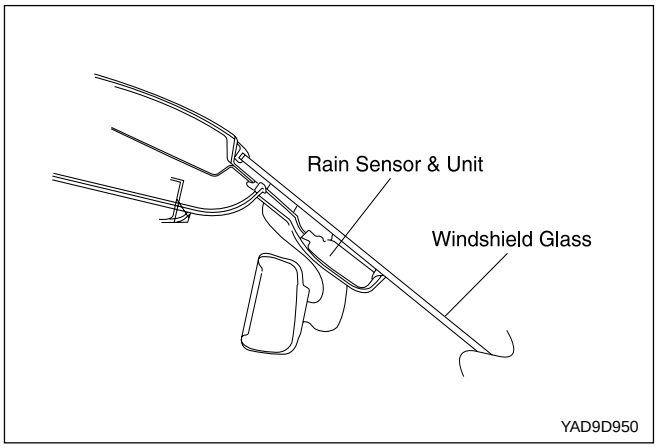
Diagram Of System



Principle of Rain Sensor



1. Unit of sensing rain is sensing by the LED and the diode of photo.
2. As infrared ray is emitting from LED, diode of photo which is reflected by drop of rain is sensing the quantity of rain.
3. Unit of sensing rain is correcting itself, so regardless of transmitting of windshield, this unit is constantly sensing rain.
4. This unit is sensing the area between the LED and diode of photo.



Mode of operation

Wiper control system consist of OFF, MIST, LOW, WASHER, plus AUTO mode, if turn to the position of AUTO, rain sensor is sensing drop of rain, and then, is controliing time of operation, speed of operation with LOW, HIGH.

1. OFF Mode

If switch of wiper is turned off and switch of ignition is turned on, at this time, rain sensor is operating with OFF MODE, under this mode, wiper mode is stopped, during rain sensor is OFF MODE, rain sensor is sensing the state of windshield, so that turn switch to proper position.

2. Auto Mode

If wiper switch is transferred OFF MODE into AUTO MODE, immediately wiper is operating once, that means wiper system is operating, after wiper is operating once, is calcurated the time of gap between drop of rain and speed of wiper operation. After stoppng time, rain sensor transfer signal into wiper motor, wipe out rain.

3. Automatic Intermittent Mode

At the automatic intermittent mode, wiper is operating once with low speed, and then this mode has variable stopping time.

4. Automatic Low Speed

This mode is operating beyond value of limit of automatic intermittent and automatic low speed.

5. Automatic High Speed

As quantity of rain beyond value of automatic low speed and automatic high speed is operating.

6. Washer Mode (48Page)

Rain sensor is sensing whether switch of wiper select function of washer or not. If switch of wiper is turned on more than 0.6 sec, wiper is operating for 2.5 - 3.8sec, under this value is operating only once. At washer mode, motor of wiper is operating with low speed.

7. Manual Mode

Switch operation of driver turn motor of wiper to low speed, high speed, at this time, wiper is operated by not rain sensor by but wiper switch.

Notice: As rain sensor is out of order, wiper is operating with low speed and high speed.

Characteristic of rain sensor

1.Supply power

Power is supplying to rain sensor and within 250 msec, rain sensor is emitting the signal " OFF" , until effective power is supplying, effective power is available for supplying power, after 2 second.

2. Speed of wiper and control frequency of revolution

Main function of rain sensor is controlling wiper speed and delaying of time to between the driving time, due to sensing and the accumulation of rain, algorithm of rain sensor is deciding mode of motion, automatic intermittent, automatic low speed, and automatic high speed.

If the stage is set, without the operation of driver, wiper is continuously operating.

3. Transfer between the modes

Algorithm of rain sensor is transferred automatic intermittent,automatic low speed, and automatic high speed under low stage so doesn't make noise.

4. Performance of sensing

Sensing of rain sensor is set 5 stage, due to accumulated drop of rain, driver can satisfy, range of adjusting can control from the short delaying time to thelong delaying time, but, due to heavy rain, regardless of sensing which is set, is continuously operating with high speed.

5. Responding characteristic of automatic low speed

As wiper is operated from the zero state of dropping of rain to the automatic low mode.

Time is needed within only 9 second for high required signal.

6. Responding characteristic of automatic high speed

As wiper is operated from the zero state of dropping of rain to the automatic high mode.

Time is needed within only 9 second for high required signal

7. Responding characteristic from the automatic low speed to the automatic high speed

As wiper is operated from the automatic low speed to the automatic high speed mode, time is needed within only 6 second for high required signal.

8. Responding characteristic from the automatic high speed to the state of off (48 Page)

As wiper is operated from the automatic high speed mode to the the zero state of dropping of rain mode, times of wiper motion is under 19 times.

9. The instant operating of wiper

While system of wiper is operating by switch of wiper, before wiper back to the position of operating, wiper is operating once, such as once operating, is occurred at time from the lower stage to the high stage by operating of wiper switch, but if the high stage is moving to the low stage, once operating of wiper does not happen.

If the ignition switch is off and if wiper switch is set on any position, turn ignition switch on, the instant operation of wiper is occurred, signal to driver beginning of wiper operating, due to lack of rain drop, if wiper is not operated, rain sensor stay on the automatic intermittent mode.

Check unit of rain sensor

Check selection of sensing (check position of nob of variable resistent)

Check if variable resistent nob of multifunction switch is positioned in the middle of between S of position and F of position, if nob is positioned F (fast) or S (slow),sensing is much higher or much lower, so customer can complain this.

Self - diagnosis

1. Rain sensor has two kind of self diagnosis test mode.
   1) Self diagnosis of FAULT A

      In case operating point of rain sensor servo is beyond range of soft ware, that means sensor has a fault, if part of wind shield glass has a damage, or if sensor is removed from the coupler.
   2) Self diagnosis of FAULT B

      While rain sensor does not reaction with signal of rain, that means FAULT B, if wind shield glass which is equipped coupler has a damage or sensor is out of order.
2. Value of cohesion

   While FAULT A is sensed, the cohesion is decided, the value of cohesion is 140,in this case, except heavily damage of wind shield glass, rain sensor is operating in the all conditions.
3. Failure which is occurred with adjustment of intermittent volume

   Due to adjustment of sensing and motion of wiper, self diagnosis is described as below.
   1) Wiper switch is transferred the intermittent into 5 step stage, under the state of " ignition on "
   2) Under this state, sensing is changed 5 step stage into 4 step stage.
   3) At this time, wiper is moving once, that means self diagnosis of FAULT A, check if wind shield glass has a damage or not, also check if sensor is installed completely on the coupler.
   4) After check 3) article, sensing is changed 4 step stage into 3 step stage.
   5) If wiper is operating once, this means self diagnosis of FAULT OF B.

      Replace new rain sensor.

Wiper blade

Check the state of wear of wiper blade, due to excessive wear of wiper blade, if is not cleaned up over section of sensor, quantity of rain is not sensed accurately.

Coupler

Check if blister is shaped on the external section of coupler which is stuck on the wind shield.

If there is a blister in the internal section of sensor, is not sensed accurately, check if coupler is installed the right position or not, specially check if section of coupler sensor is positioned on the section of ceramic coating or not, if the space of sensing is shielded, infrared of sensor is not passed so sensing is not available accurately.

Wind shield glass

Check if wind shield glass surface of the external sensor has excessive wear,damage, and scratch or not. Wear of sensor is compensated little bit, if there come to beyond constant value, sensor is not sensing, such a kind of diagnosis is used self diagnosis.

Exterior cover

Check the state of exterior cover of rain sensor, check that sensor is impacted by shaking, owing to releasing fixing section of cover, also check interference with wind shield glass or head lining.

Spring clip

Check if rain sensor release from coupler or not, after removing exterior cover, check the state of spring clip.

Connector

After check the state of tighting between terminal of connector and wiring, check that the terminal is inserted into connector as the state of locking. Check the state of combination between the connector of wiring and the connector of rain sensor, check interference between them.

Relay

Check if low relay of wiper and high relay of wiper is operating normally, as relay is damaged by fire so motor of wiper is not operated, at the auto mode, blade of wiper is not operated.

Circuit

Check circuit, specially check if the value of variable resistence of multifunction switch is feeding properly or not, this can see by moving nob of variable resistence step by step from the state of slow to the state of fast (This is called Instant Wipe).

If parking position of wipe motor is not feeding properly or not, if parking position of wipe motor is not feeding, wiper motor can be operated quickly rather than the state of normal, intermittent speed shifting time of wiper motor is not sensing, wiper motor is not operated normally.

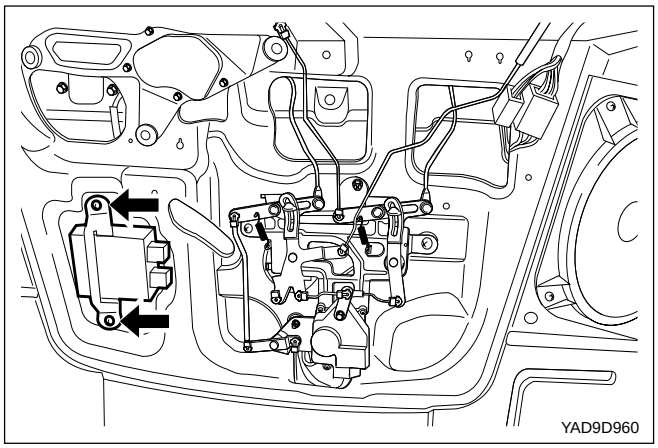
Notice: While unit of rain sensor is removed.

1. Remove exterior cover, at this time, if exterior cover is removed by compulsion, keep in mind not to break fixing hook of coupler, as exterior cover is removed, using hole of cover by driver, after section of fixing hook is pushing, and remove them.
2. As rain sensor is removed from coupler, using driver after open up spring clip, remove them.
3. Remove connector to the wiring from the sensor.

Rear Wiper System

Summary

Controlling of existing rear wiper is controlled by relay which is operated with switch, but rear wiper of Rexton is controlled by ECU, in the existing vehicle, brush of rear wipe is installed on the rear glass, but rear glass can is opened up, brush of rear wiper can not be installed, so,this one is installed on the back panel, wiper motor is operating by second stage.



Description of System Operation

Operation for wipping mode

1. Turn switch of wiper on, and then relay 1 of CONT is on, turn motor with clockwise
2. On the turning, Applying the current between contact point of W and contact point of C, after relay 2 of CONT is “OFF” relay 1 is “ON”, turn motor counter clock-wise.
3. On the turning, Applying the current between contact point of W of CAM switch and contact point of C, relay 2 of CONT is “OFF” and relay 1 is “ON” and then, turn motor clock wise, wiper is operating between position of B and position of C by transfering pole of motor.

Operation of parking mode

1. Parking on the operation with the clockwise : Under the wiper is operating,switch of wiper is “off” On the turning,applying the current between contact point of W of CAM switch and contact point C, after relay 1 is off, stopping the motor, within approximately 1 second, relay 2 of CONT is on, turning motor counter-clockwise, apply the current between “P” ground of CAM switch and C ground, and then relay 2 of CONT is OFF, motor can stop.

Operation for washer mode

Turn washer switch on above 0.5 second, after operation of wiper mode is operating twice, after operation of parking mode is operating and then motor is stopped, but if washer switch is on below 0.5 second, wiper motor is not operating.

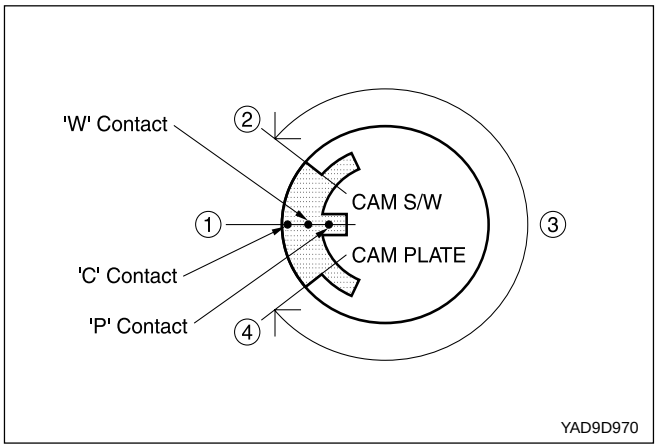
Mode operation of limit switch ON

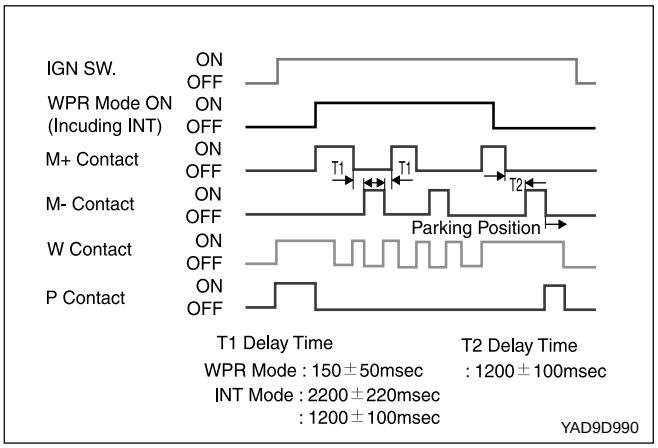
1. Limit switch on: Under wiper is operating while wiper is operating, limit switch is “ON”, immediately back to the position of parking, and then stop the motor.
2. Limit switch on at the position of parking.

   Though turn wiper switch or intermittent switch on, motor is not operated.

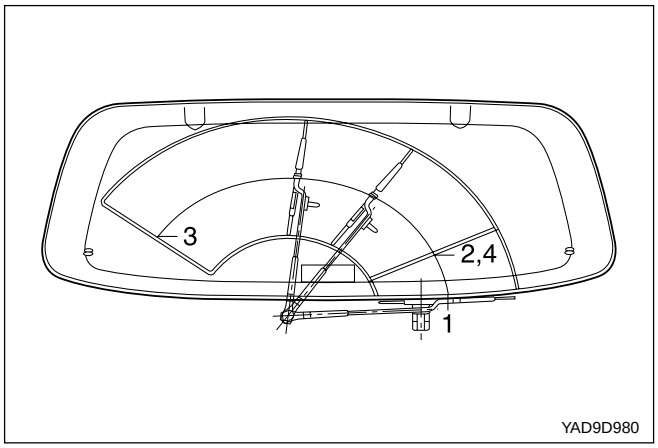
Description of system operation

1. Turn motor switch on, after relay 1 of controller is on, turn motor clockwise (operation order: (1) → (2) → (3) → (4))
2. On the turning, Applying the current between contact point of W of CAM switch and contact point of C, relay 2 of controller is “OFF” and relay 1 is “ON” and then, turn motor clock wise. CAM switch is operating between position of (2) and position of (4) by transfering pole of motor. (operation order :(2) → (3) → (4) → (3) → (2): motion of cycle)
3. Angle of DSP denote the angle between (1) and (2) or the angle between (1) and (4).
4. Turning motor from position of (3) to position of (4), stopping in the position of (1), turning from position of (3) to position of (2), stop in the position of (1), namely, as motor is parking, such as below the picture, contact point of W, C, and P are on the one line.





Position of (1) : Position of soft contact
Position of (2) and (4) : Reverse position

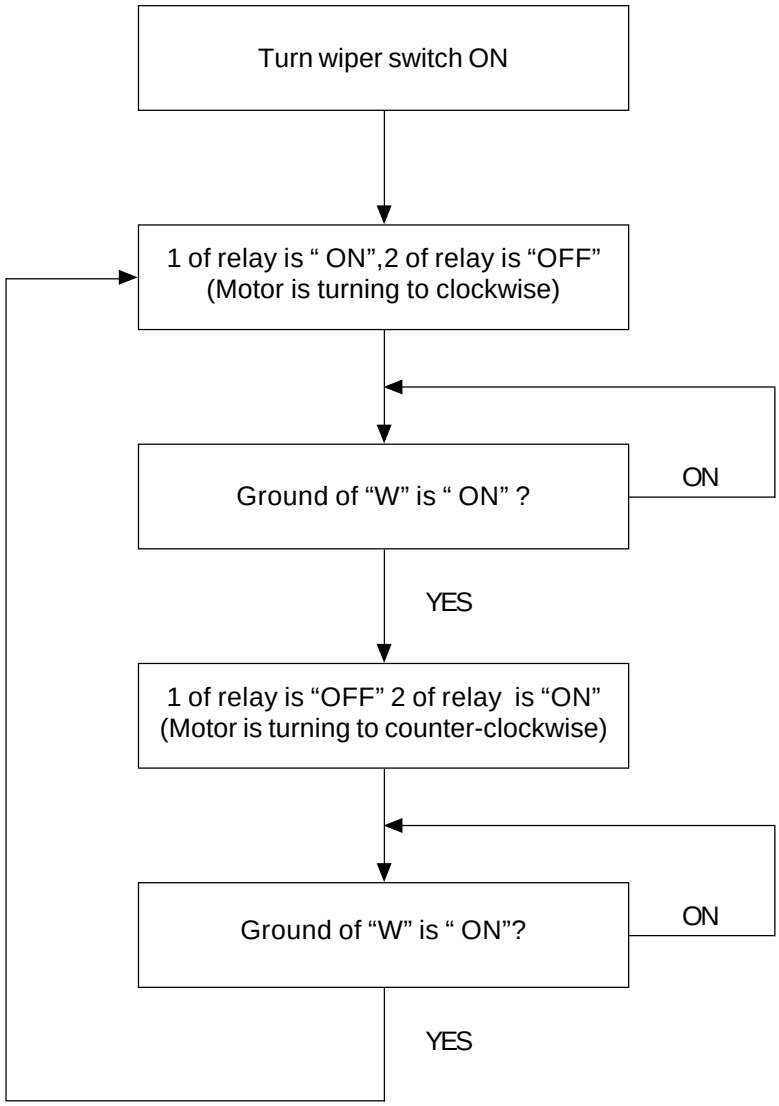


Function of rear wipe

1. While switch of ignition turns on, turning switch of wiper on, and then 1of relay is operated, so wiper motor is controlled.
2. While wiper motor is operating, after contact signal of “W” is feeding, so 2 of relay is operated, cause wiper motor to reverse direction (angle of revolution of wiper motor : 260 °)
3. As above the description, under the control of wiper motor, if wiper switch is “ off” , turn power of wiper motor until position of ‘P’ is feeding, and then back to the position of parking.

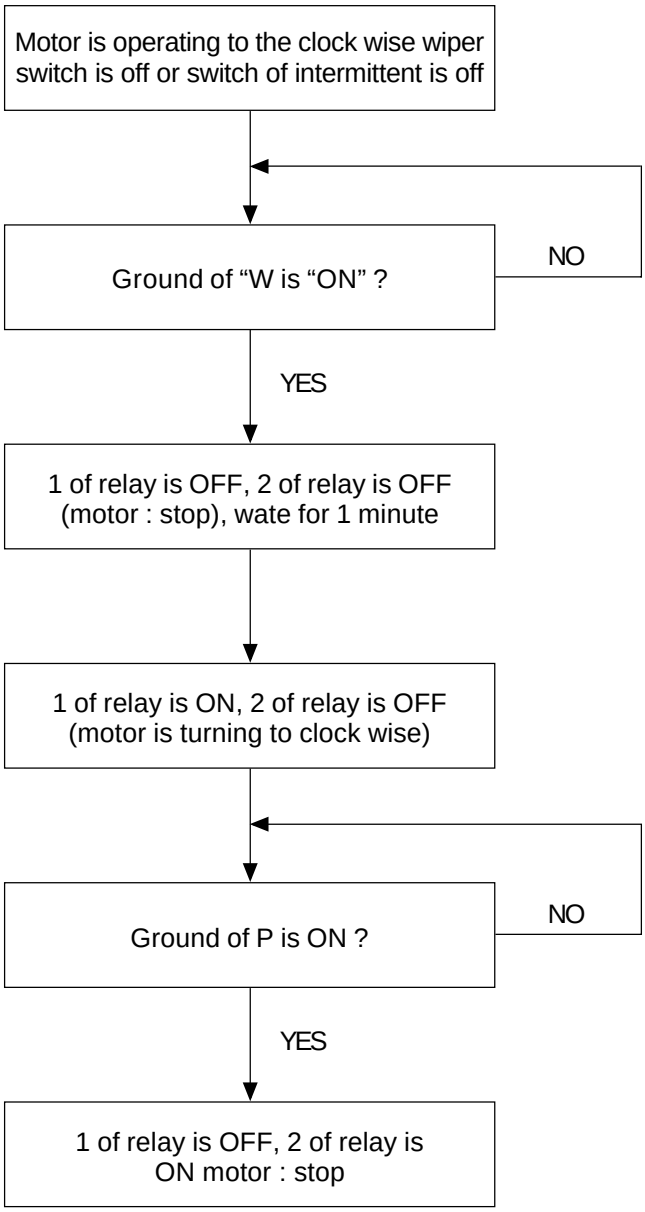
Trouble Shooting

Flow Chart – Mode Of Wiper Operation

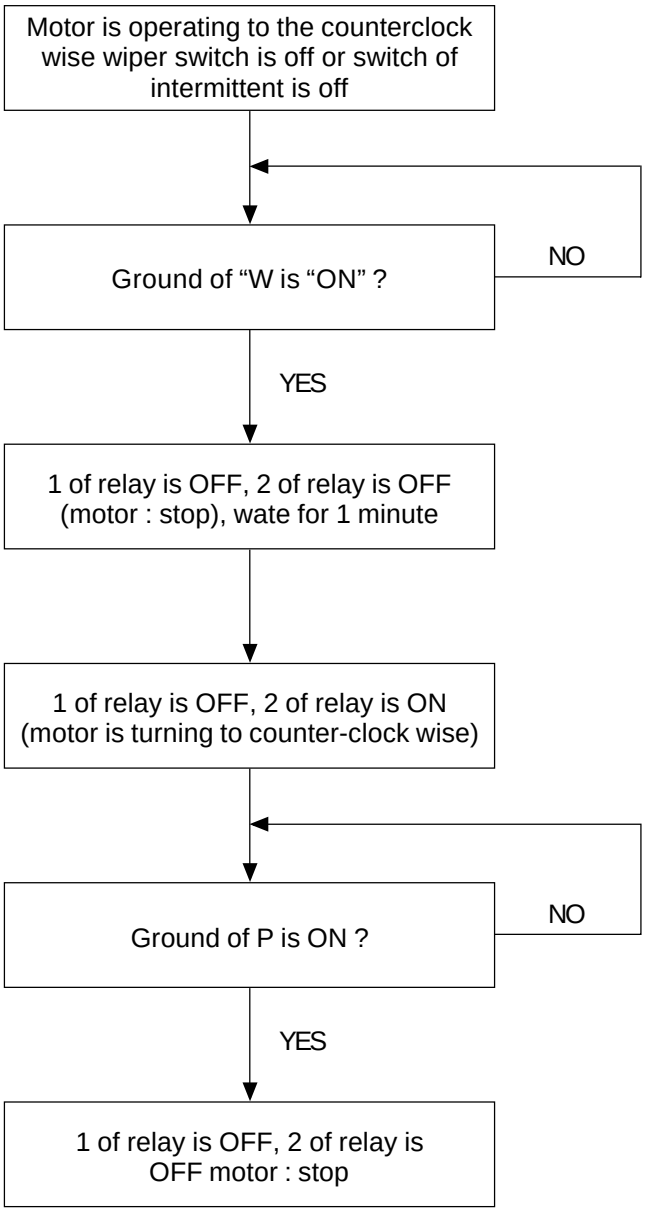


Parking Mode

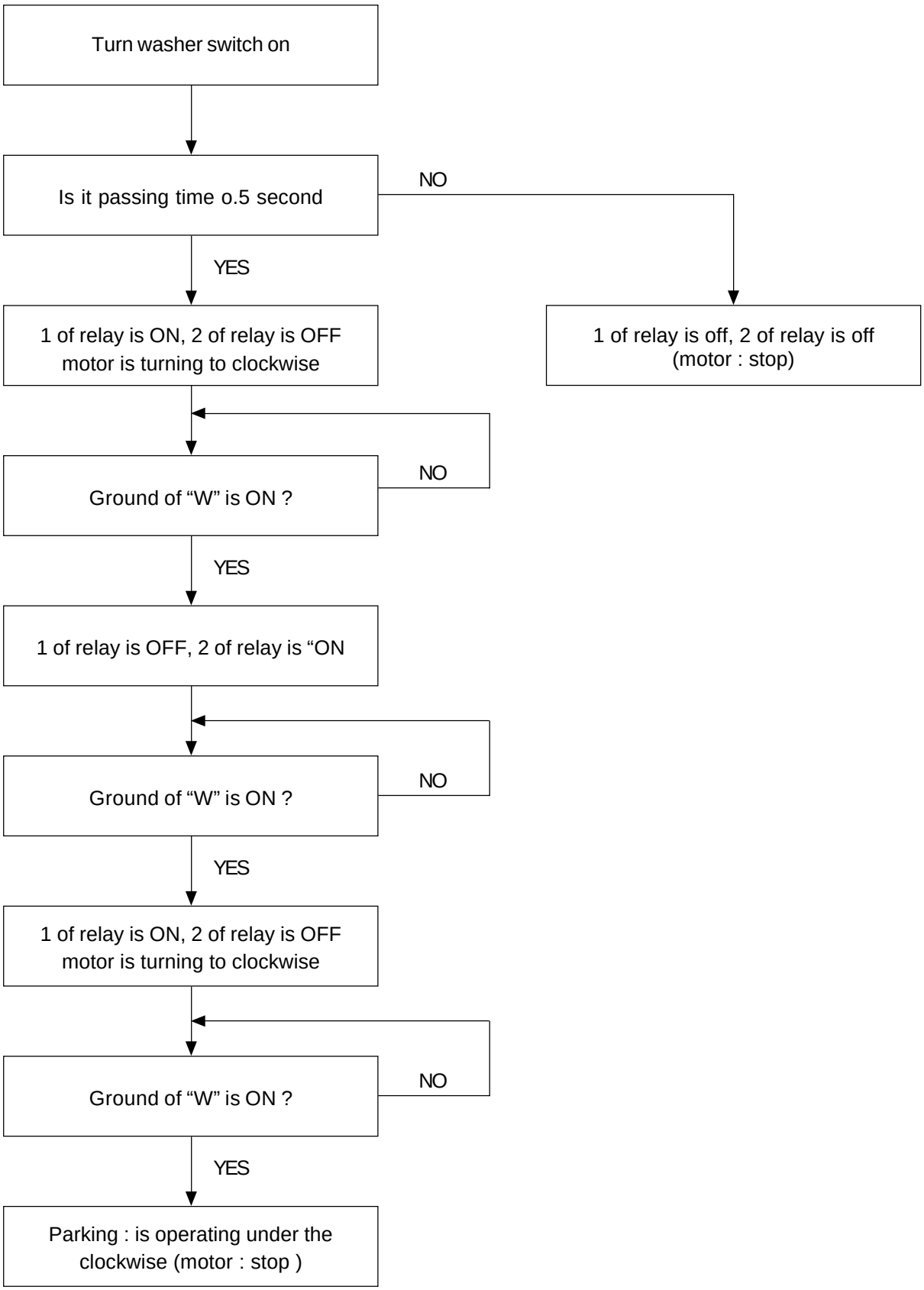
Parking is under operation of the clock wise.



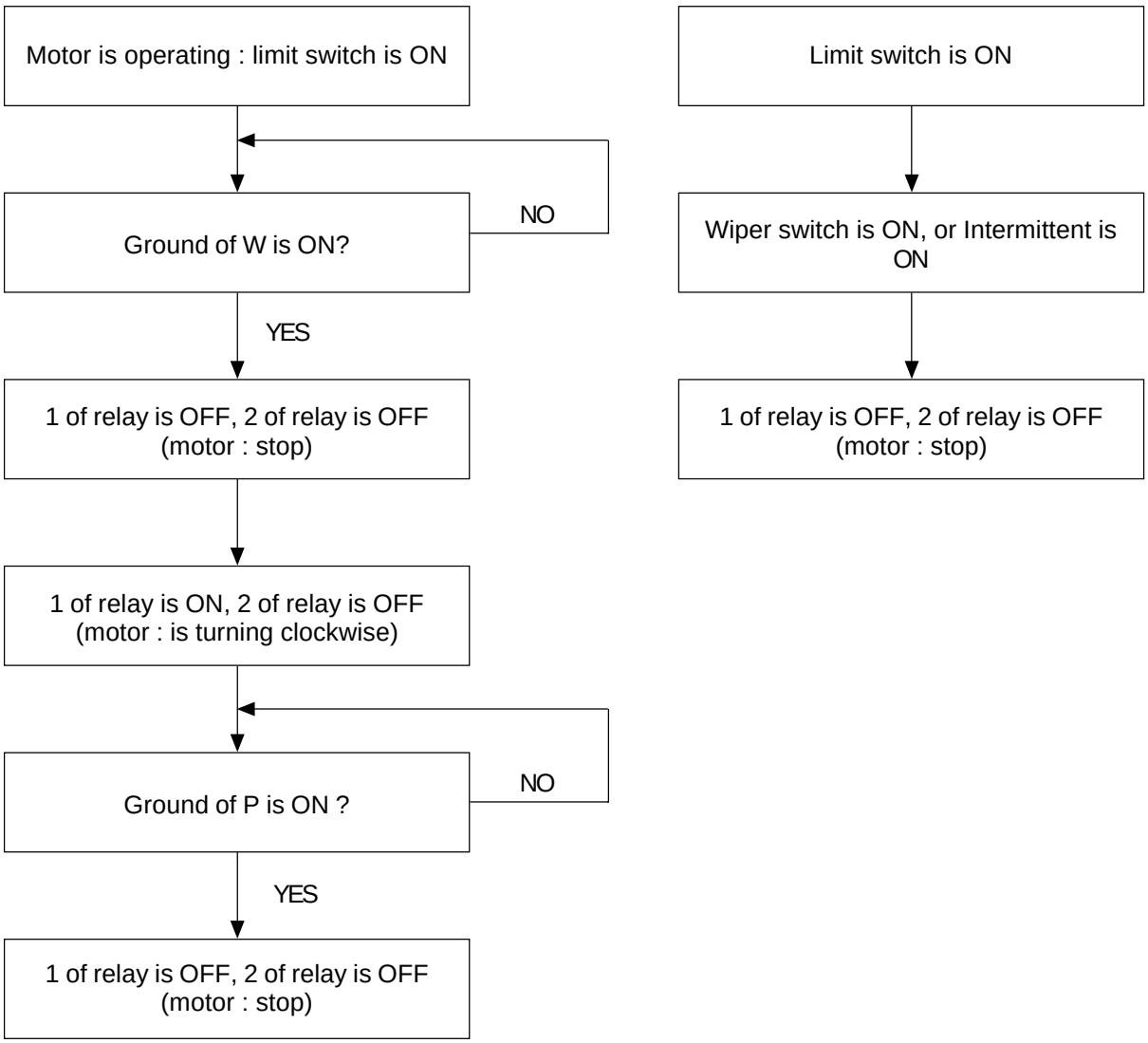
Parking is under operation of the counter clock wise.

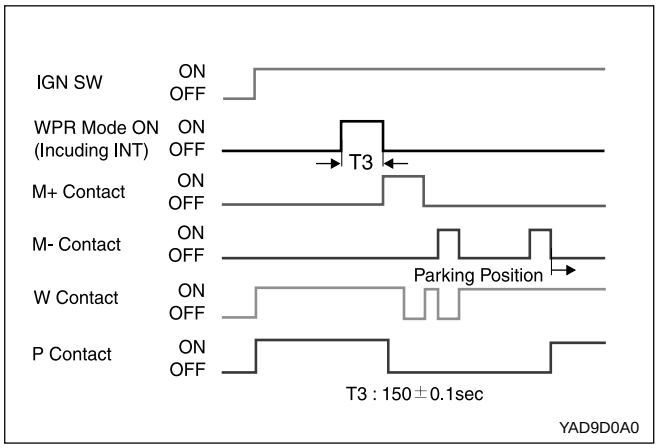


Operation Of Washer Mode



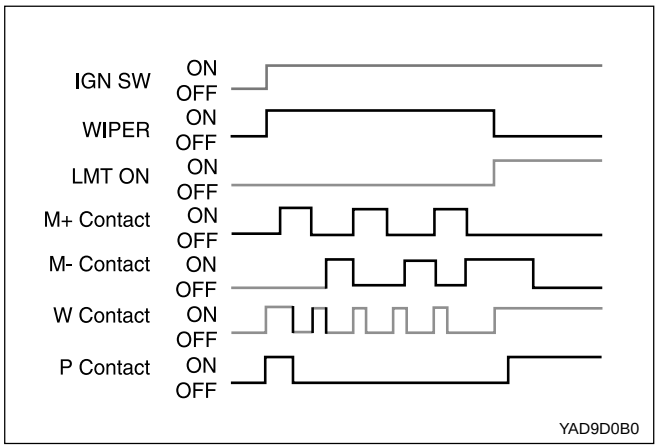
Operation of Limit Switch





Washer linked mode

1. As turn ignition switch on, wiper switch is ON more than 0.6 seconds, and then, power of washer linked mode is “ON”
2. After turning washer switch off, operation of wiper mode is operating twice, and then back to parking position.
3. Power of wiper motor is operating with the same mode of wiper operation.

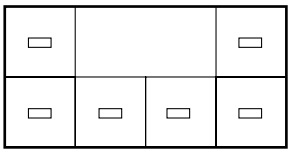
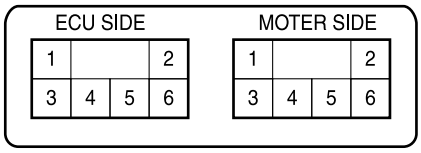


Operation of limit switch: ON/ OFF mode

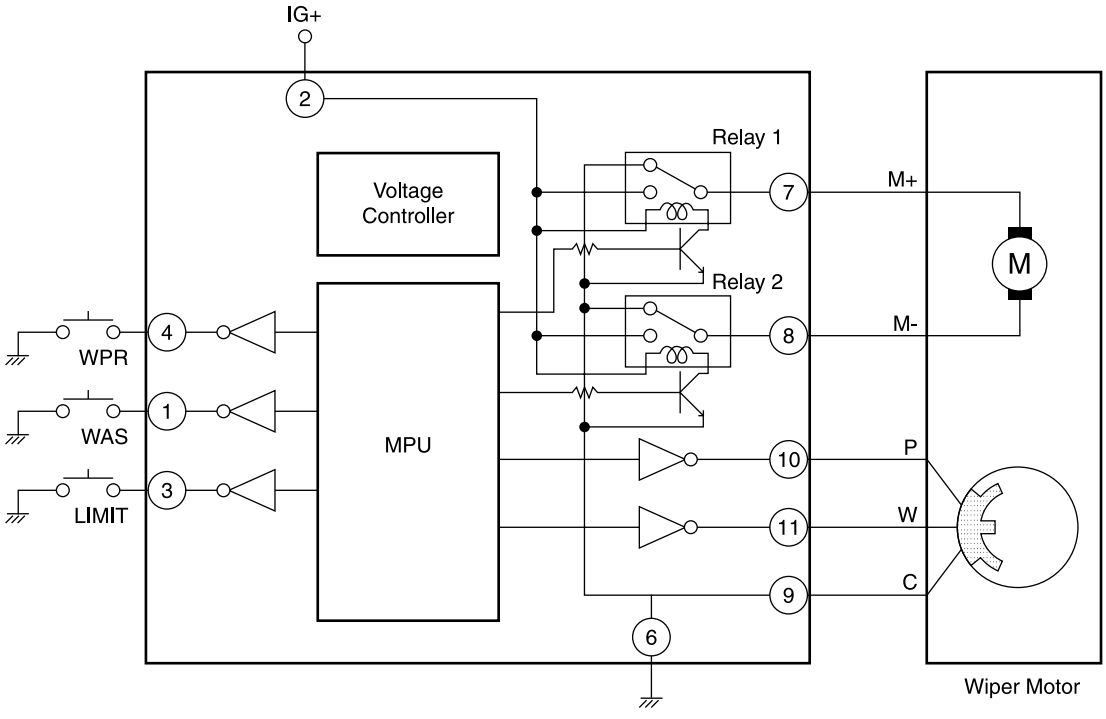
1. As turn ignition switch on, if wiper motor turn limit on, without delay, back to parking position and then stop motor.
2. Being state of turning on, stop control power of wiper motor.

   (Namely, opening up rear glass, for wiper not to be interfered)

Specification

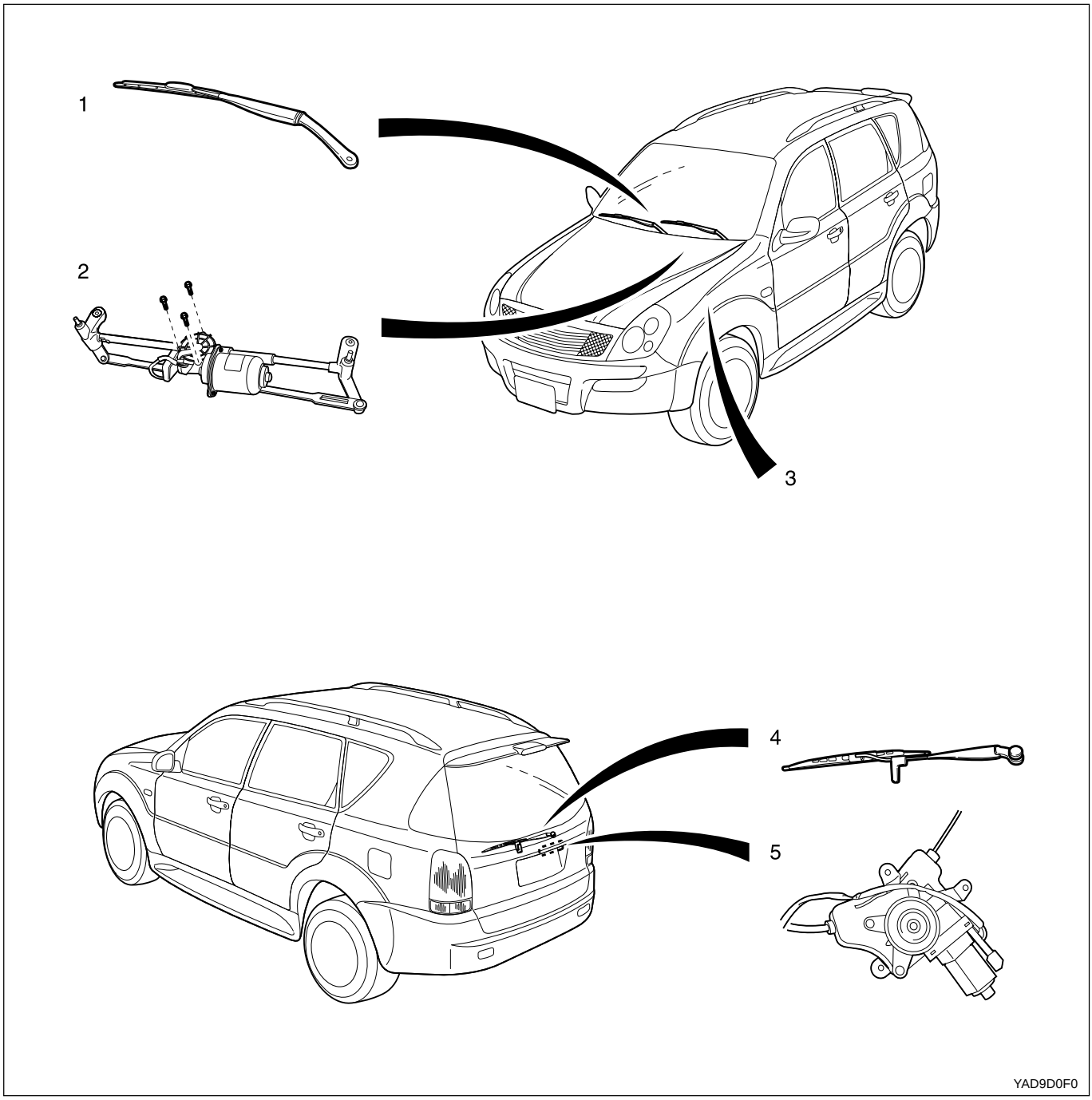
Description			Specification
Motor  YAD9D0C0	Rated voltage		DC 12 V ± 0.3 V
	Test voltage		DC 13.5 ± 0.3 V
	Range of allowed voltage		DC 10 - 15 V
	Minimum operating voltage		DC 8 V
	Insulated resistence		500 V 1 MΩ
	Restraint test	Torque	1.1 Km
		Current	14 A
	Range of atmosphere temp allowed		- 40 °c ~ + 80°C
Control  YAD9D0D0	Rated voltage		DC 12 V
	Range of allowed voltage		DC 9 ~ 16 V
	Range of allowed temperature		- 30 °C ~ + 80°C
	Range of conserved temperature		- 40 °C~ + 90°C
	Insulated resistence		1 MΩ (500 V)
	Voltage dropping		0.5 V
	Test voltage		14.0 ± 0.5 A
	Load allowed current		10 A

Circuit diagram

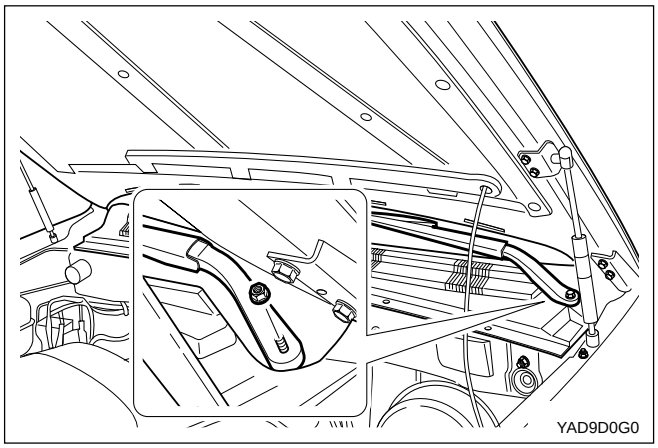


YAD9D0E0

Components



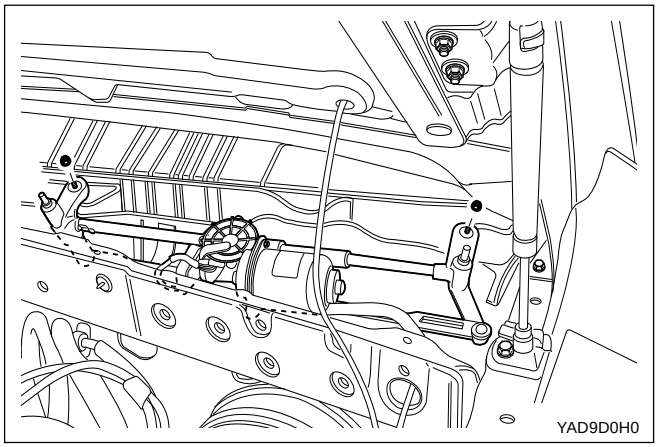
1 Wiper Blade
2 Wiper Motor And Link
3 Washer Tank Assembly
4 Wiper Blade
5 Wiper Motor



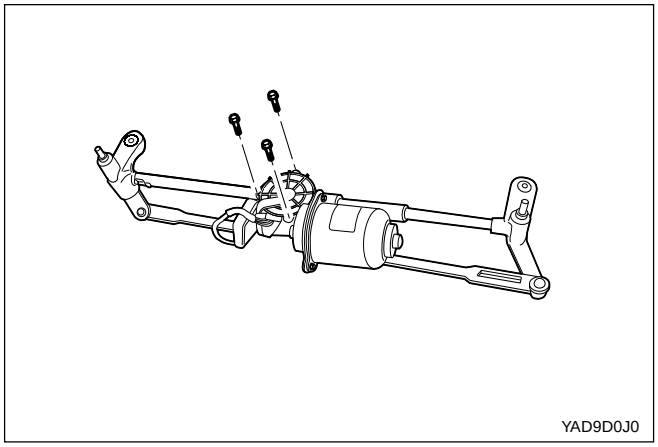
Removal and Installation

Front wiper Assembly

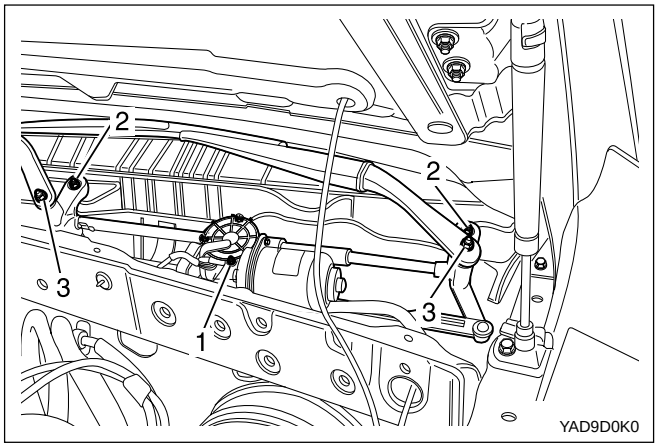
1. After opening up front hood, remove wiper arm.



2. After cowl left is removed, remove wiper linkage assembly. (At this time, separate connector of wiper motor)

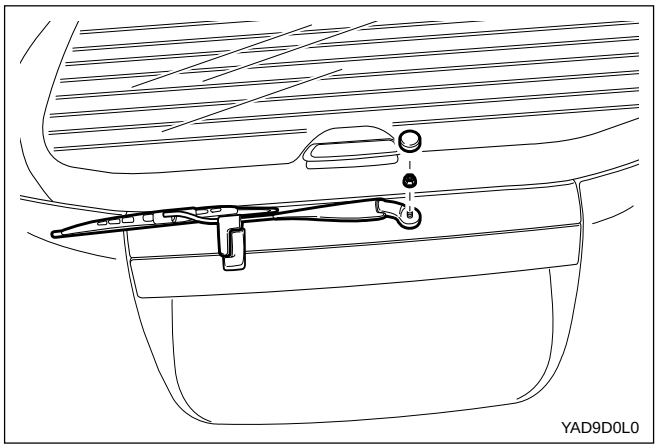


3. From linkage separated, releasing fixing bolt of wiper motor, separate linkage and motor.



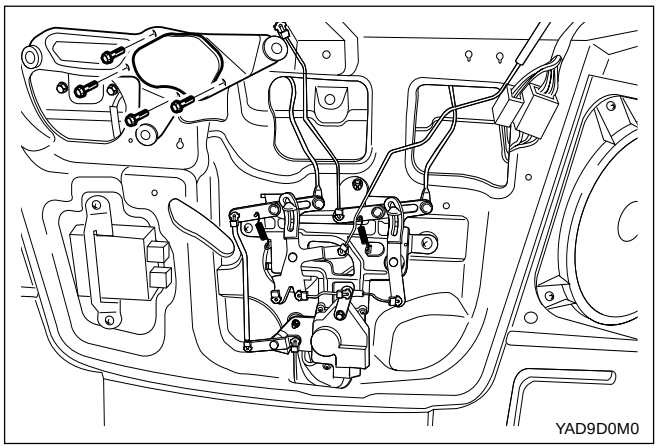
4. Install the reverse order of removal.

Fixing bolt of motor	7 -11 N•m
Nut of linkage	4 - 6 N•m
Nut of blade	19 - 28 N•m

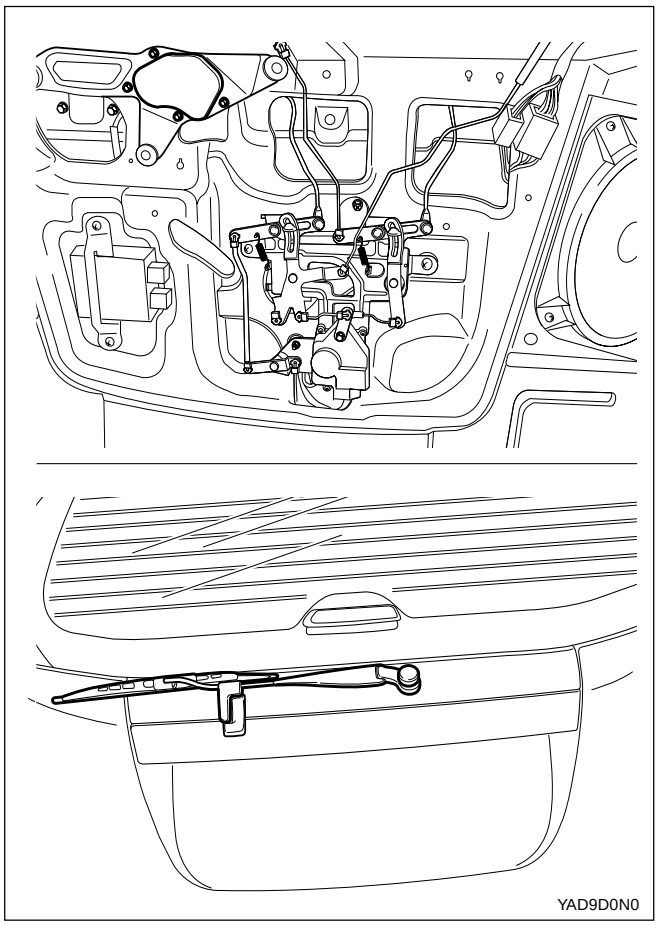


Rear wiper assembly

1. After cap of wiper arm, remove nut of wiper and blade of wiper.



2. Remove trim of tail gate.
3. After connector of wiper motor is separated, release fixing nut.
4. Remove wiper motor assembly from the tail gate.



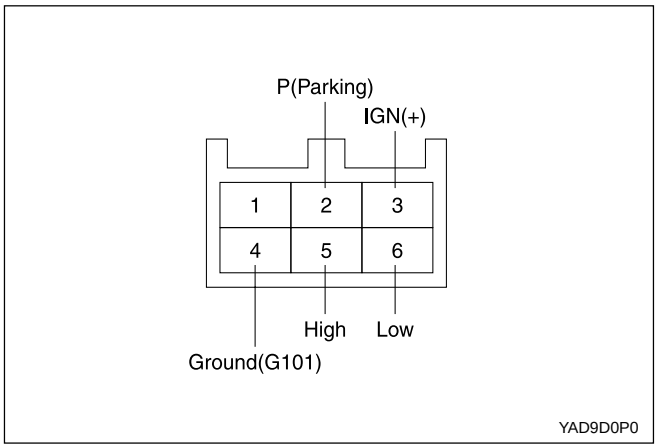
5. Install the reverse order of removal.

Wiper motor assembly

Bolt of motor	7 - 11 N•m
Bolt of motor bracket	7 - 9 N•m

Rear wiper blade

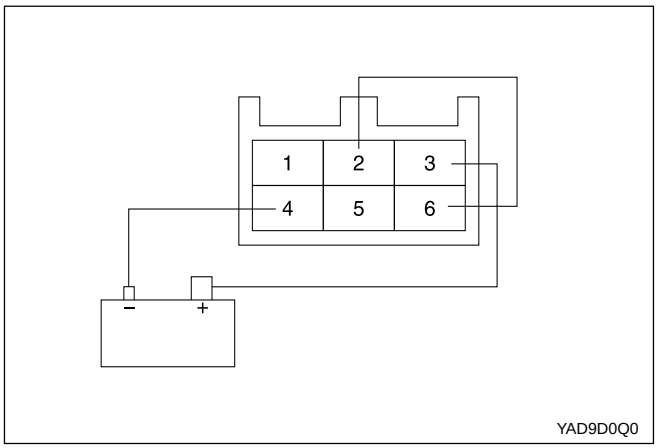
Torque of Tightening	19 - 28 N•m (44 - 52 lb-ft)



Check

Check speed of front wiper motor

1. Remove connector from the motor of wiper.
2. Connect positive terminal into 3 terminal and negative terminal into 6 terminal.
3. Check motor with low speed.
4. Connect positive terminal into 3 terminal and negative terminal into 5 terminal.
5. Check motor with high speed.

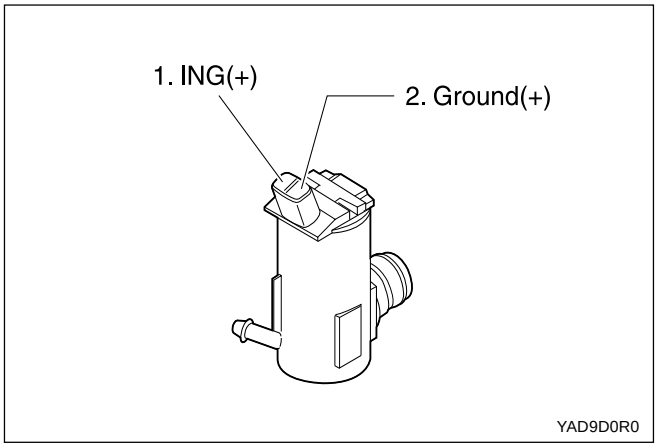


Check operation of automatic stop of front

1. Operate motor with low speed
2. After separating 6 terminal, stop operation of motor except position of “OFF”
3. Connect 2 terminal and 6 terminal.
4. After connecting positive terminal into 3 terminal, and then 4 terminal turn to the ground.
5. Check motor at the “OFF” position.

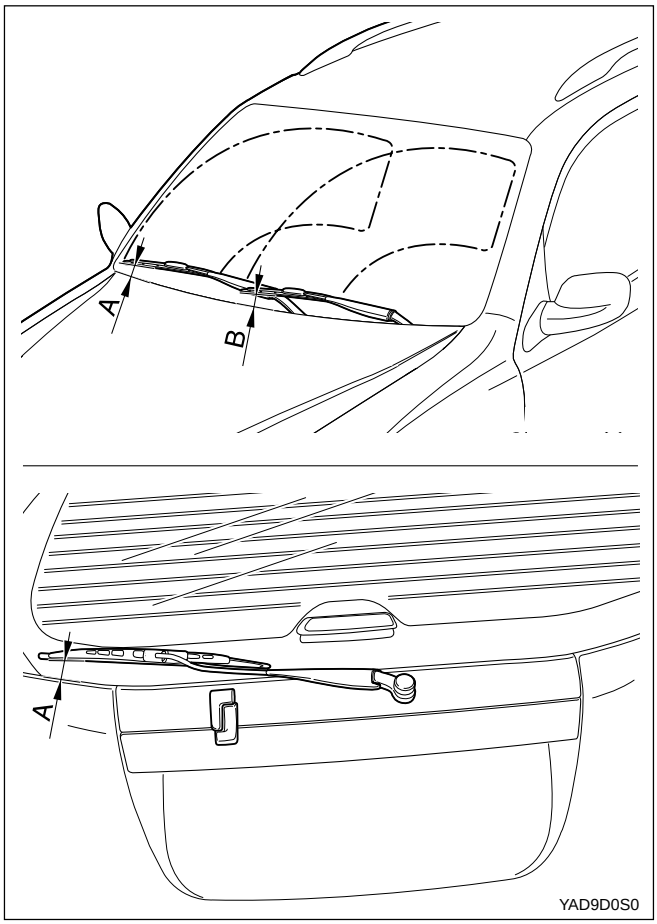
Check motor of rear wiper

1. Remove connector from the motor of rear wiper
2. Connect positive terminal into 4 terminal and negative terminal into 3 terminal.
3. Check motor is operating normally, if motor has a problem, replace motor.



Check washer motor

1. After installing washer motor into washer tank, and then fill fluid of washer
2. Connect 1 terminal into positive terminal of battery and 2 terminal into 3 negative terminal
3. Aftter motor of washer is operated, check the fluid of washer is operated.



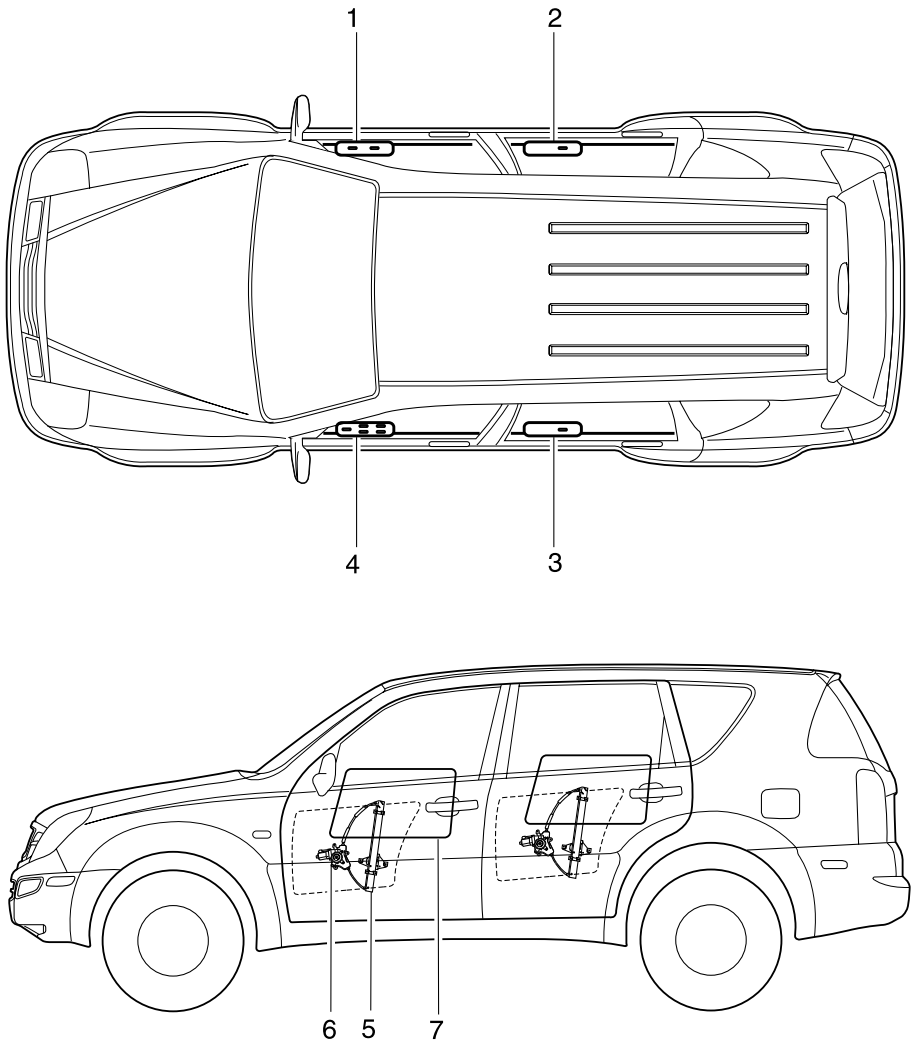
Check position of wiper arm

While installing wiper arm, check position of front wiper arm and rear wipe arm, and reinstall, to positioned original position.

- Front wiper arm: Distance from the end of cowl grill to the blade: 45 mm
- Rear wiper arm: Distance from the lower section of rear glass to the blade: 30 mm

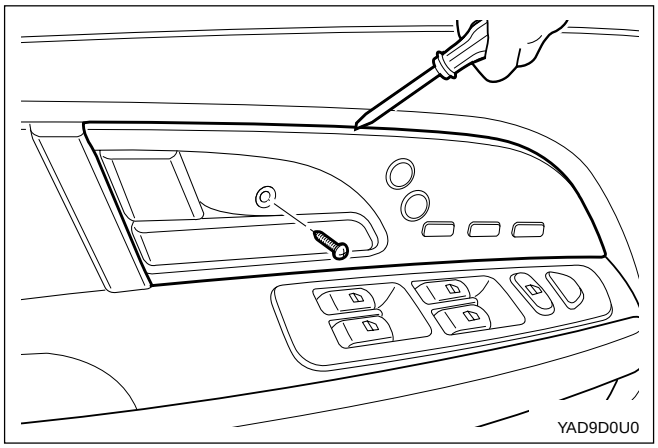
POWER WINDOW

Components



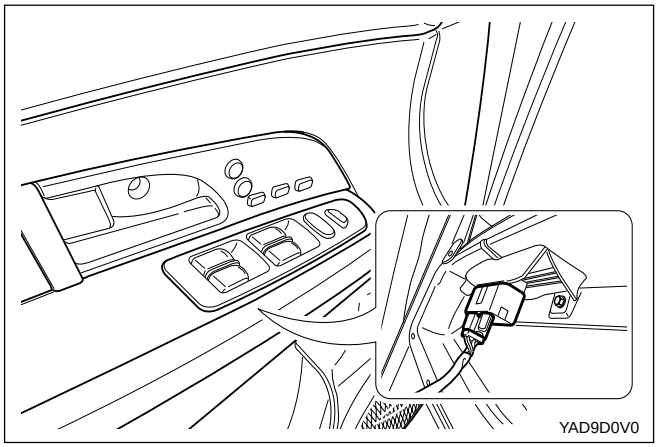
YAD9D0T0

1 Power Window Switch Of Passenger Seat
2 Power Window Switch Of Rr Seat (LH)
3 Power Window Switch Of Rr Seat (RH)
4 Power Window Switch Of Driver Seat
5 Window Regulator
6 Window Motor
7 Window

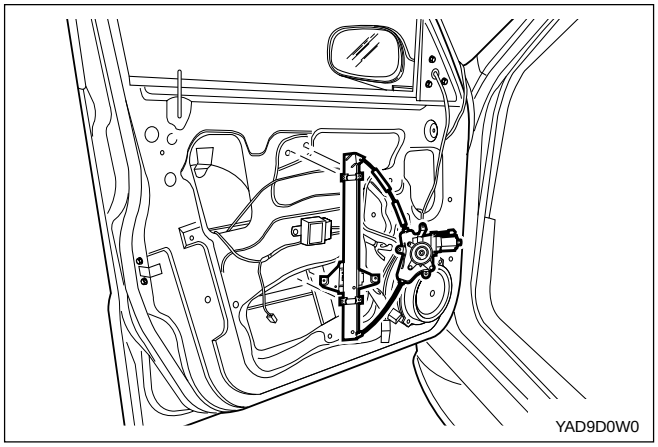


Removal and Installation

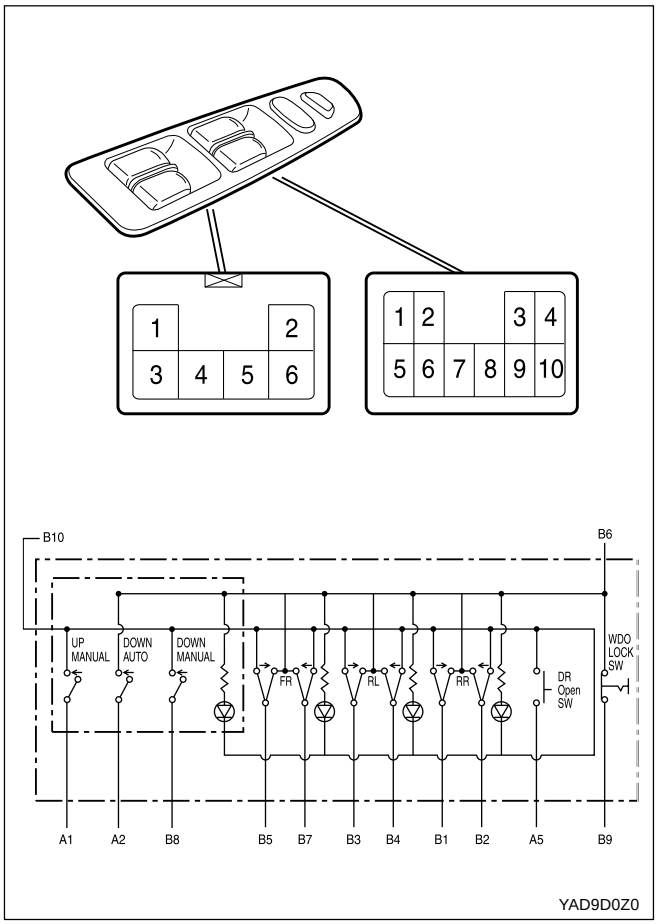
1. After inserting switch of window in the door handle, separate grip of fixing hook.



2. After connector of window switch is separated, remove window switch assembly.

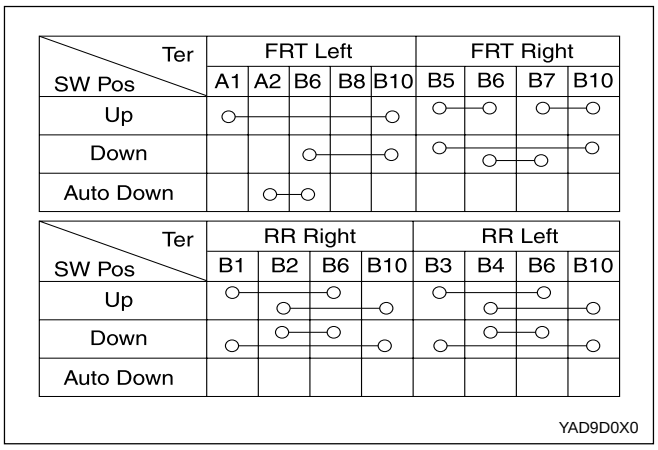


3. Remove trim of door and seal.
4. After window glass is removed, remove regulator assembly.
5. Remove motor of window from the regulator which is separated.
6. Install the reverse order of removal.

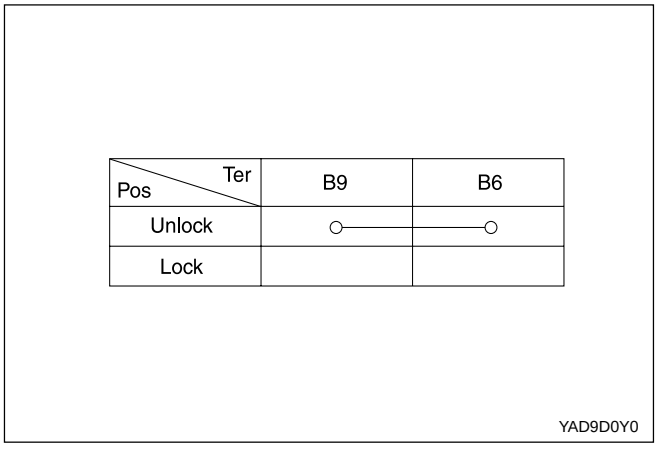


Check and Repair

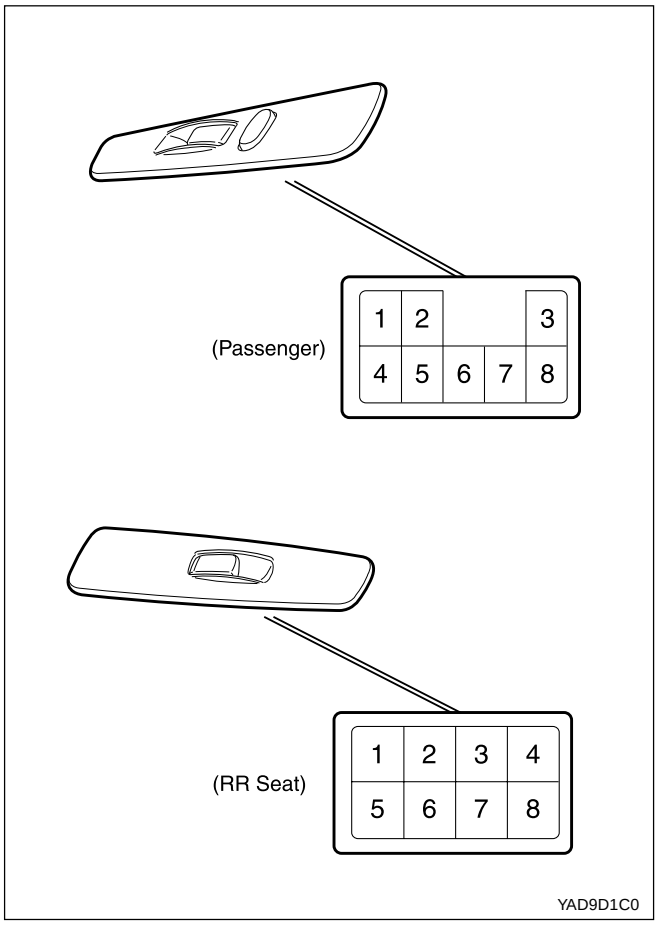
Main switch of power window



1. After main switch of power window is removed in the driver seat, check that applying an electric current of each terminal.

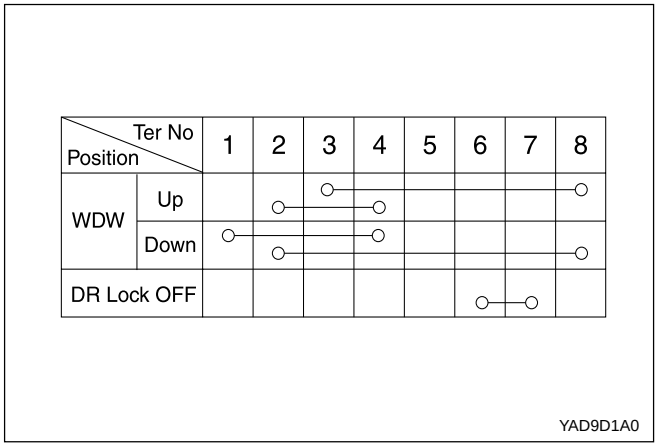


2. Lockong system of window.

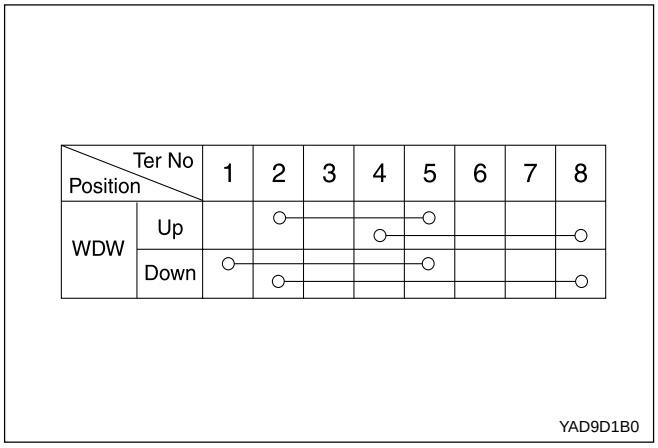


Serve switch of passenger set and rear seat

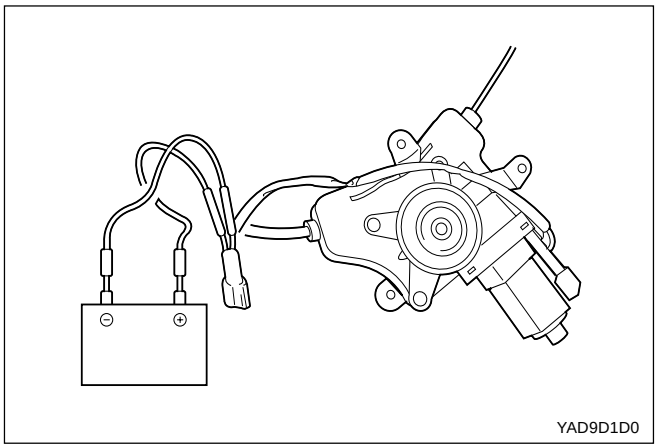
1. After switch is removed, check that applying an electric current of each terminal.



Passenger seat

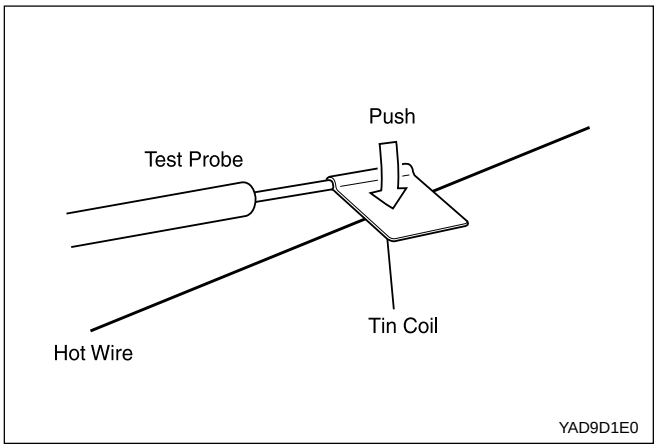


Rear seat


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Check motor of power window

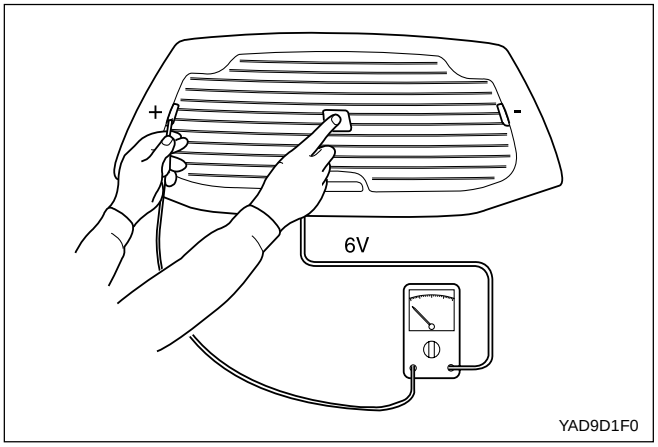
After terminal of motor is connected, check that motor is operating softly, and then change pole of current, motor is operating to the reverse direction softly, if motor is operating unnormal, and then replace motor.



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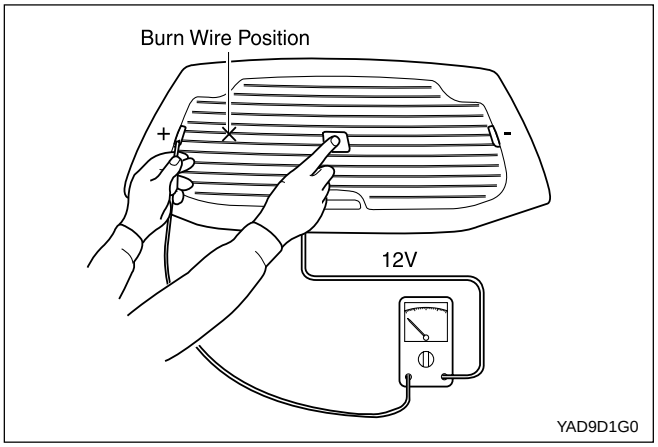
Check rear window and defogger of quarter glass

Notice: It is prevention for the defogger not to have a impact, so after taping foil of tin at the end of tester, foil of tin is moving along with line of grid for checking the circuit open or not.



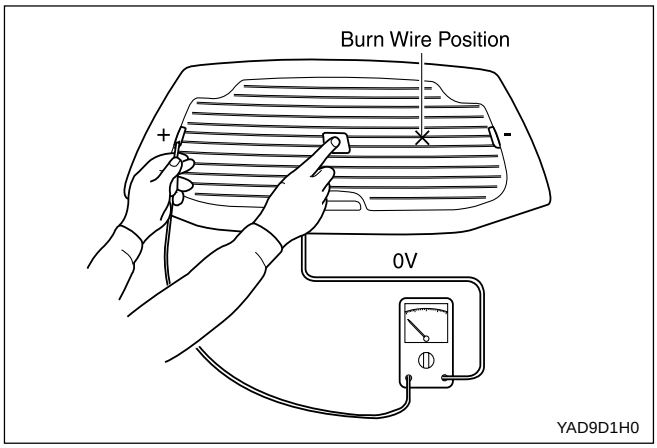
YAD9D1F0

1. At the state of idling, after switch of defogger is turned on, check the below description.
   1) After turn switch of defogger on, measure voltage of defogger with voltmeter in the center of glass, if value of voltage is 6V, heater line of rear window is normal.

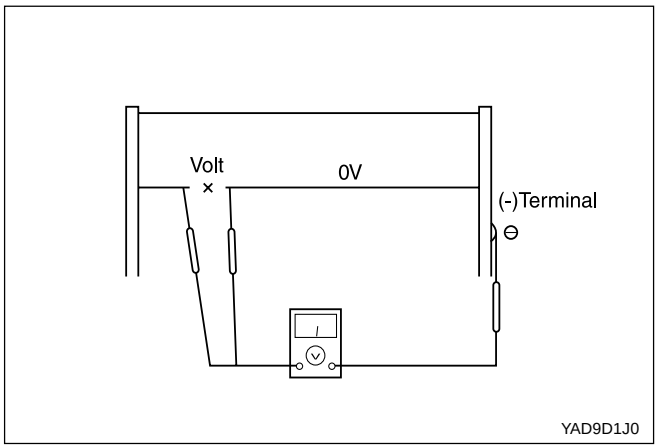


YAD9D1G0

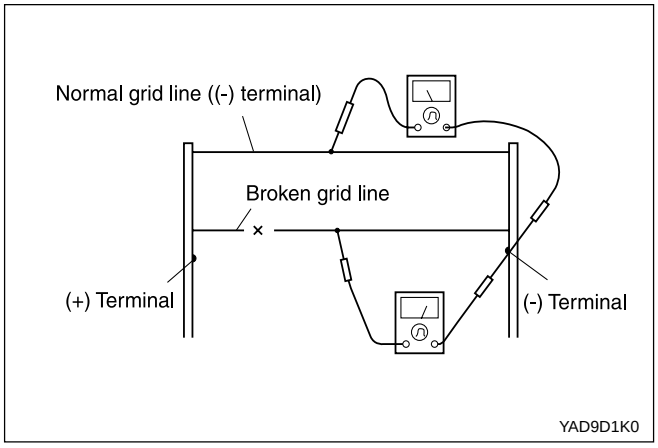
   2) If defogger is damaged by a fire between center and positive terminal, value of voltage is indicated 12 V.



3) If defogger is damaged by a fire between center and negative terminal, value of voltage is indicated 0 V.

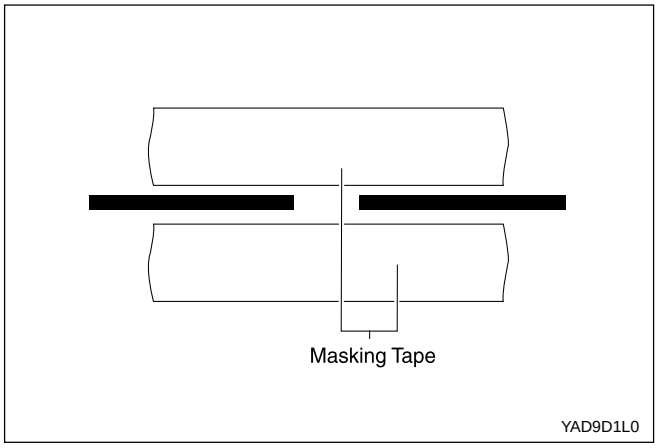


4) Lid of tester is moving into the section which is assumed circuit open, after measuring circuit open look for the section of 0 V, voltage which is changed in the section, which is open of circuit.



2. After turn switch of defogger off, check the below description.

   Using voltmeter, measure resistence of each defogger in the center of grid line, resistence between the same terminal and defogger orderly. Broken section of defogger is 2 times rather than other the section of defogger, section which is impacted with the rapid change of resistence.



Method to repair grid line of defogger

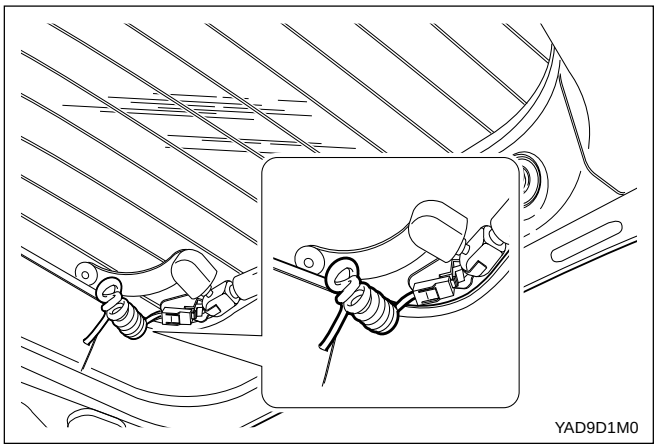
After being prepared, repair section of defogger which is broken.

1) Paint of applying electric current
2) Thinner of paint
3) Masking tape
4) Alcohol

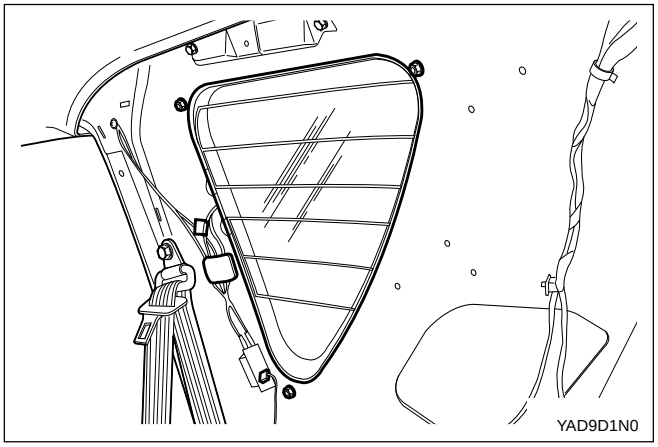
5) Slim brush

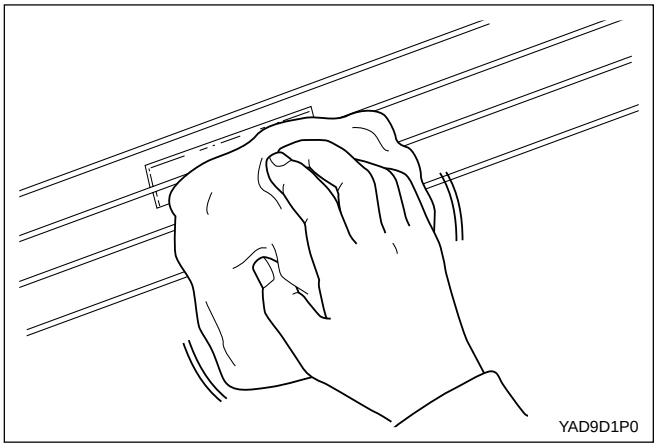
Clean up the section of defogger which is broken, indicating like left picture, with the state which is sticking masking tape, clean up with alcohol. After mixing between paint of applying electric current and thinner per interval of 15 minutes, paint 3 times. Before power is supplying, pull tape out of the section broken, to finish up better, after drying up completely (approximately after one day), remove the edge painting unnecessary with knife.

Notice: After repairing, clean up glass with the soft towel, grid line with the towel wet.

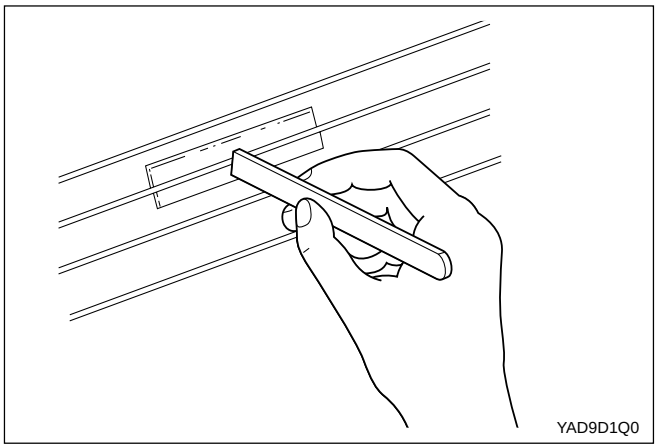

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1. Disconnect cable of negative terminal of battery.
2. Disconnect defogger connector of tail gate.

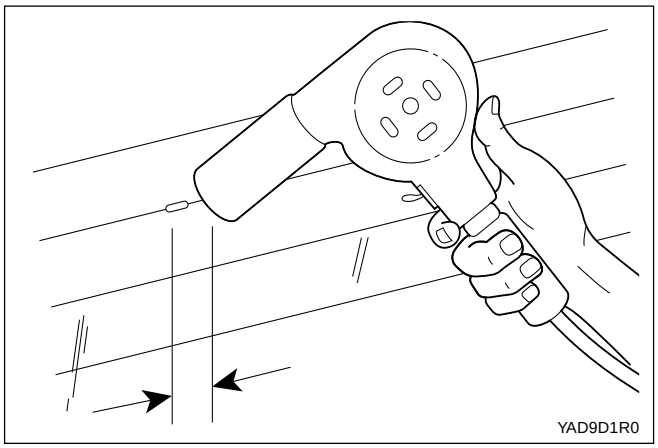

YAD9D1N0


YAD9D1P0

3. After checking grid line, scraping approximately 6 mm to both section from disconnection of a line with wooden spoon, clean up these section, a kind of cloth wet with alcohol.



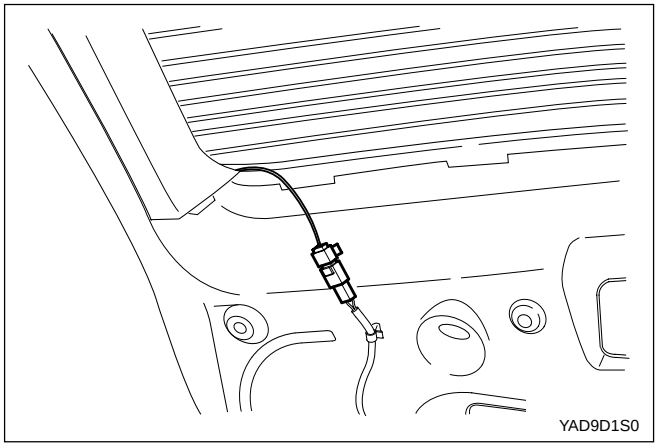
4. Attach tape of repair of grid line properly.
   - Attach tape to have a same width with grid line.
5. Spread material of repair with wooden spoon.
6. Remove tape carefully.



7. Heat up the section which is repaired, keep distance 25 mm from this section, with drier below 149¡É for 1-2 minutes

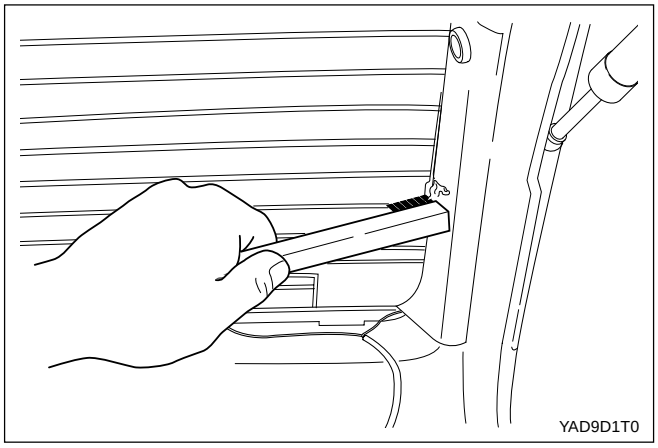
   Notice: Repair material of grid line dry up with heating, while is heating repairing section trim which is linked should be protected from heating, pay attention to deformation of interior trim

8. If grid line of repairing is discolored, after spreading coating of paint of iodine on section discolored, if get spreading out of grid line, after half hour is passed, clean up grid line with soft wiper.



9. Check if grid line is repaired or not, operate glass defogger of back door.

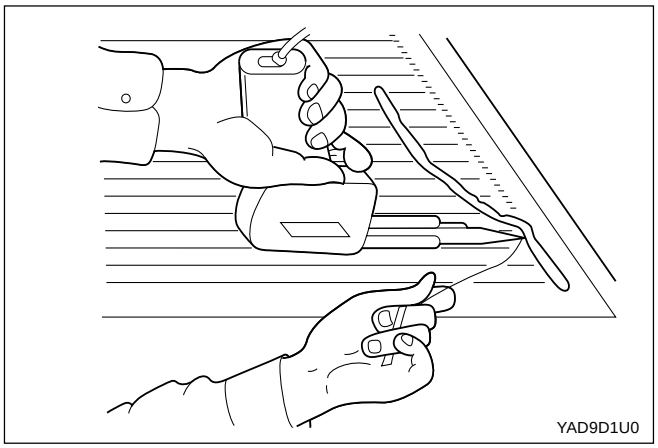
   Notice: Until repair material is dried up completely, this is needed 24 hours at least, section repaired should be protected from unnormal material.



Repair of defogger of tail gate

Copper line of glass defogger have reinstallation available with soldering, soldering consists of 30 % silver solder and rosin solvent

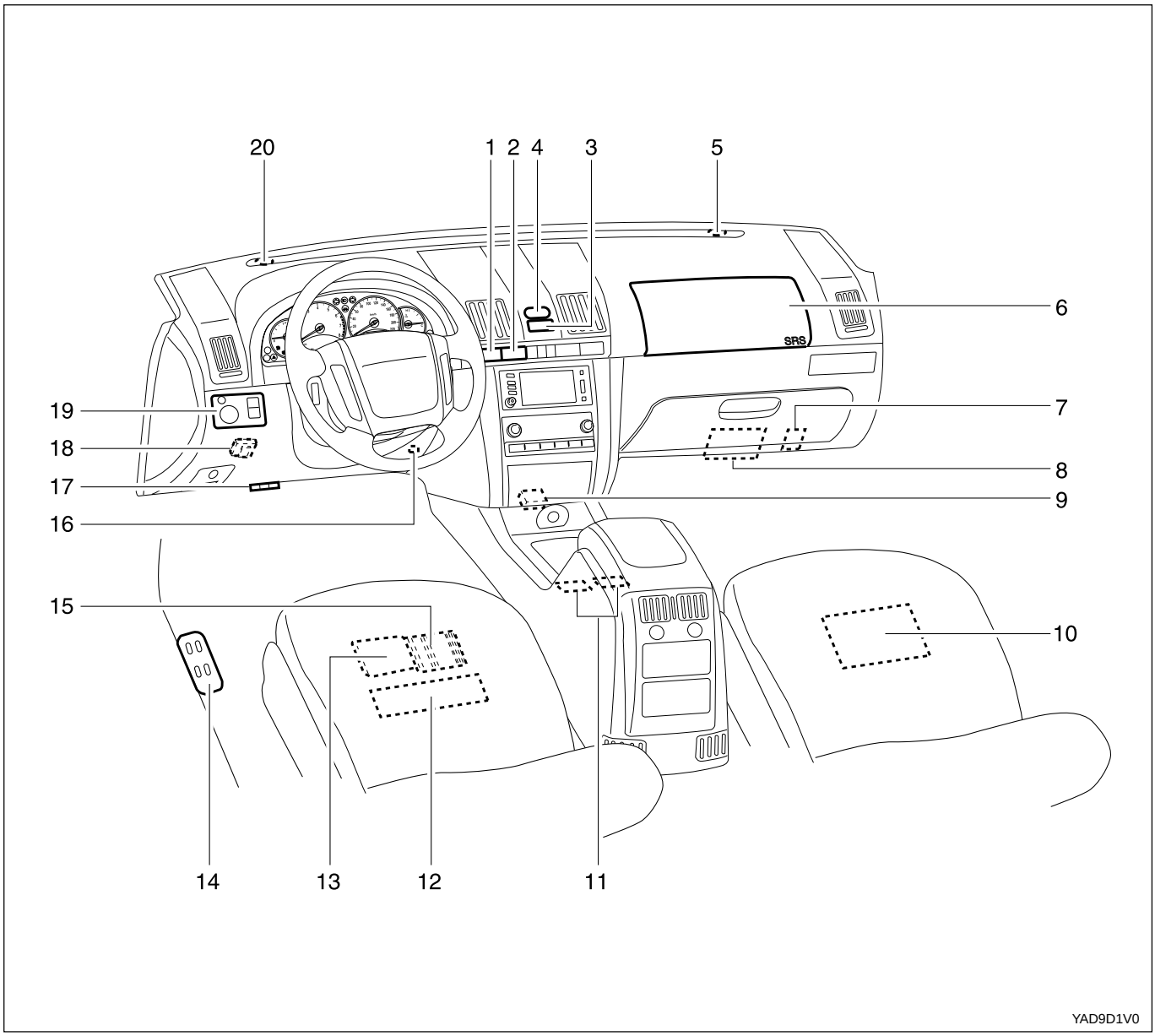
1. Disconnect negative cable of battery.
2. Scrape the around section of repair with wooden spoon
3. After spreading on the copper line, clean up on the section which is repaired with brush.



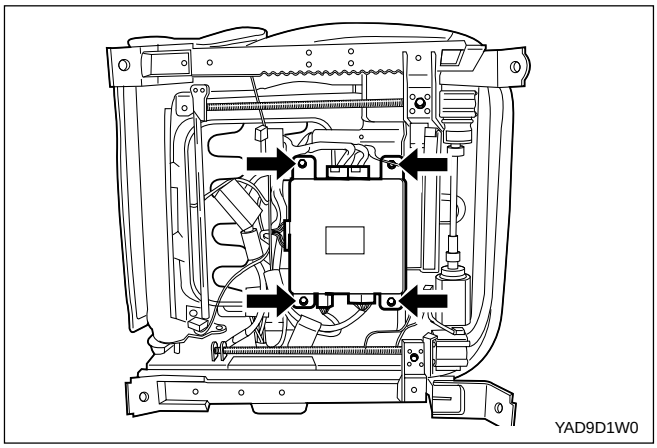
4. Put soldering on the the end of soldering gun.
5. If copper line is repaired with soldering, for copper line not to overheat, this work should be repaired under limit of temperature which can melt solder.

SWITCH AND ELECTRICAL SYSTEM

Components



1 Defogger Switch
2 Front Switch of Fog Lamp
3 Digital Watch
4 Switch of Hazard Warning Lamp
5 Sensing Unit of Auto Lighting
6 Air Bag of Passenger
7 Unit of EGR
Unit of OVPR
8 ECM
9 SDM
10 Nevigation System
11 Switch of Seat Warmer
12 Unit of Seat Position and Seat Warmer
13 TCM
14 Switch of Position Memory
15 TOD, TCCU
16 Internal Sensor of Temp
17 Connector of Self Dignosis
18 Stics / Rekes
19 Fold Switch of Side Mirror
20 Sensor of Sun



Description of System

Unit of seat position and seat warmer

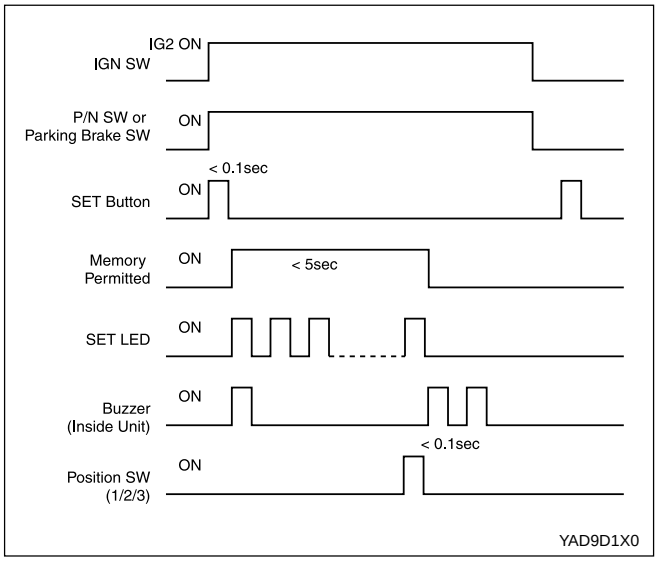
This unit is located on the lower section of passenger which controls driver seat and out side mirror manual operation, put in memory, function of returning and also has a function which warm up seat and fold up outside mirror.

Function of Operation

Type	Description		Specification
SEAT Regardless of ignition switch	Operating voltage		DC 11 - 15 V
	Rang of operating temp		-30 °C - 80°C
	Operating speed of seat	Slide	20 ± 7 mm/sec
		Tilt	10.6 ± 5 mm/sec
		Height	7 ± 2 mm/sec
	Operating distance of seat	Slide	228 ± 3 mm
		Recline	23 ° ↔ 0 ↔ 48 °
		Lift	30 ± 3 mm
	Operating current (at 13.5 V)	Slide	7 A
		Tilt and lift	8 A
	Heater switch of seat	Rated load	DC 12 V / 1A
		Range of operating temp	35 °c - 45 °c
		Foce of switch operation	0.3 - 0.7 kgf
Outside mirror	Angle of up and down		-8 ° - 8 °
	Angle of left and right		-8 ° - 8 °
	Angle of folding		± 67 °

Seat and Out Side Mirror, With Memory

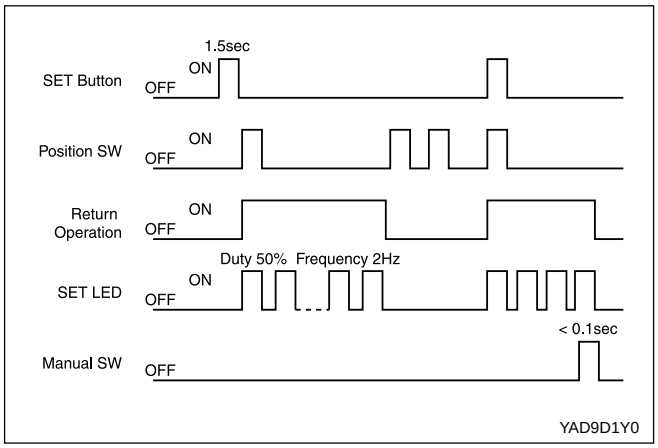
Part of function		Set memory	Release mory
Seat	Slide	1. Condition: If ignition is “ON” position of selector lever is “P and N 2. Parking brake is “ON” 3. Switch of set is “ON 4. Switch of 1/2/3 is operating within 5 seconds	1. After switch of set is“ON” time is passed more than 5 seconds. 2. While switch of seat or switch of outside mirror (manual operati on is set) 3. Ignition switch is “OFF”
	Recline		
	Lift (front/rear)		
	Warmer (driver/passenger)		
Outside mirror	Up and down		
	Left and right		



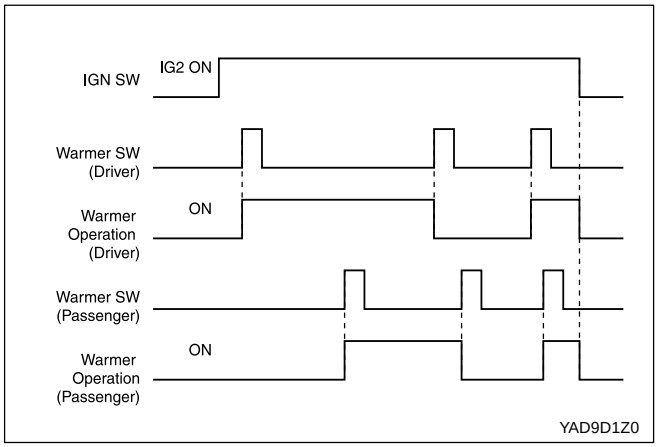
The characteristic of operation.

Function of Memory Return

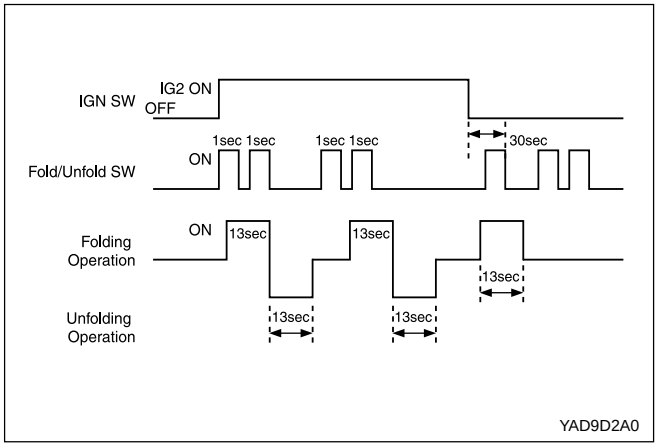
Item	Description
Operation condition	1. Position of selector lever is “ P and N on condition that, ignition switch is “ON” 2. Automatic vehicle: P/N or parking brake is “ON” 3. Manual transmission : parking brake is “ON” 4. Memory return is operating at the state of stop (vehicle speed : 0 km/h).
The state of operation: Another condition is set under function of memory is returning	1. If position button is operating while memory is returning, memory is returnng as memory is set on before. 2. While memory is returning, button of stop is set, return operation is stoping immediately.



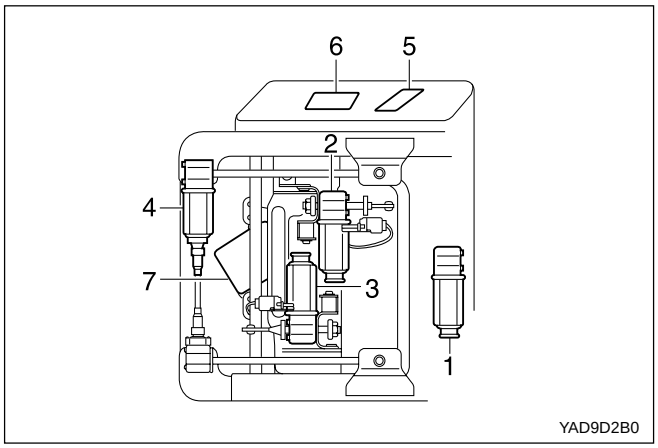
The characteristic of operation



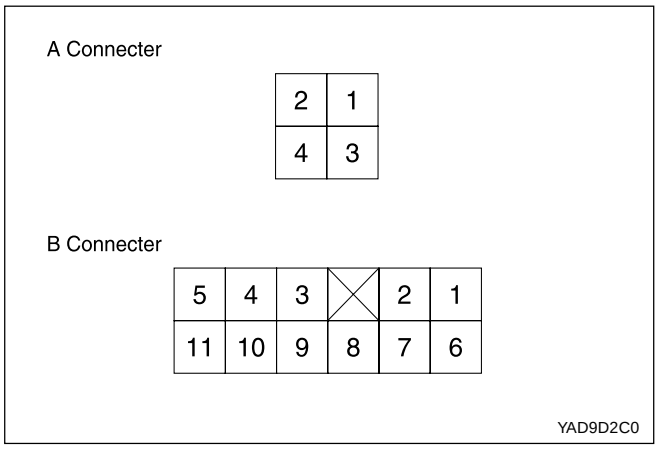
Function of outside mirror(folding /unfolding)



Function of seat warmer



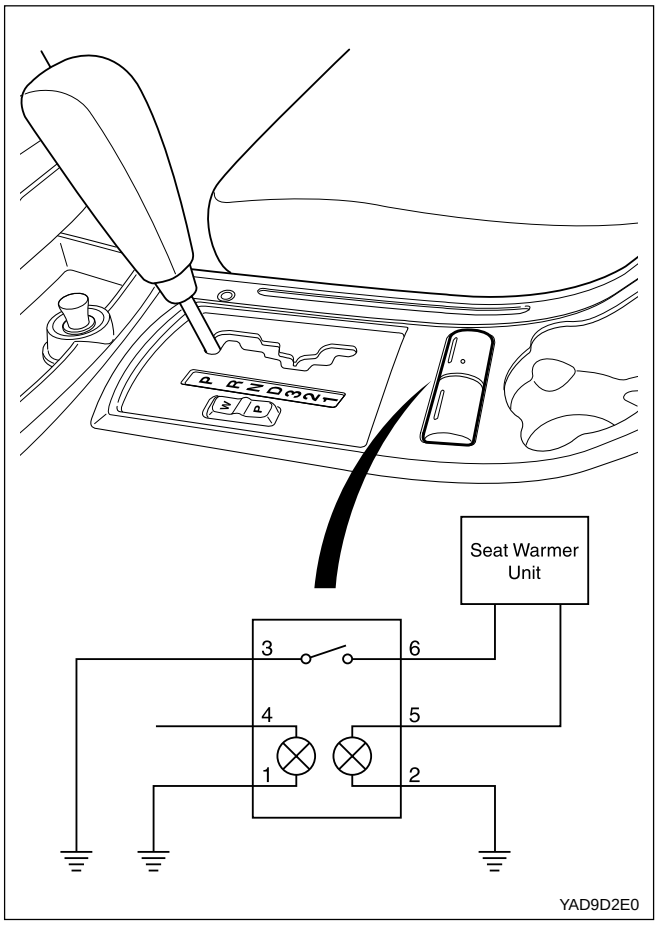
1 Slide Adjusting Motor
2 Height Adjusting Motor
3 Tilt Adjusting Motor
4 Recline Adjusting Motor
5 Driver Power Seat Recline Switch
6 Driver Power Seat Switch (Slide, Height, Tilt)
7 Seat Heater Control Unit



Power seat

Connector and connected circuit

NO.	Size / color	Connected circuit
A1, A2	BW	Battery
A3, A4	BLACK	Ground
B1	WB	Slide
B2	Y	Slide
B3	GB	Tilt
B4	RG	Tilt
B5	BY	Recline
B6	GY	Height
B7	BR	Height
B11	GB	Recline

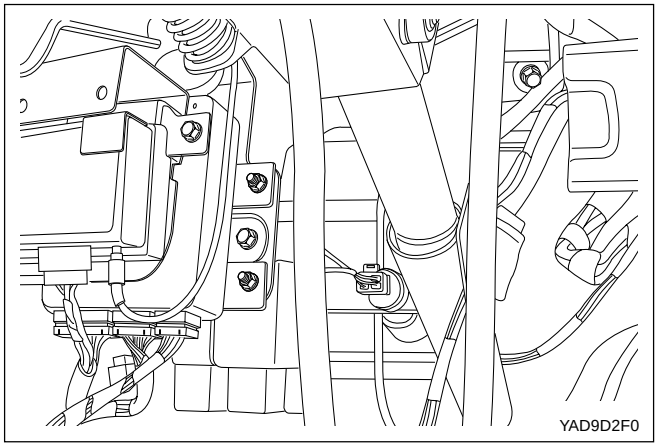


Seat warmer switch

Connected circuit

P / T	ON	OFF
(SIG) - 6	○	
(-) - 3	○	
(+) - 5	○ ⊗	
(IND) - 2	○	
(ILL+) - 4	○	⊗
(ILL-) - 1	○	

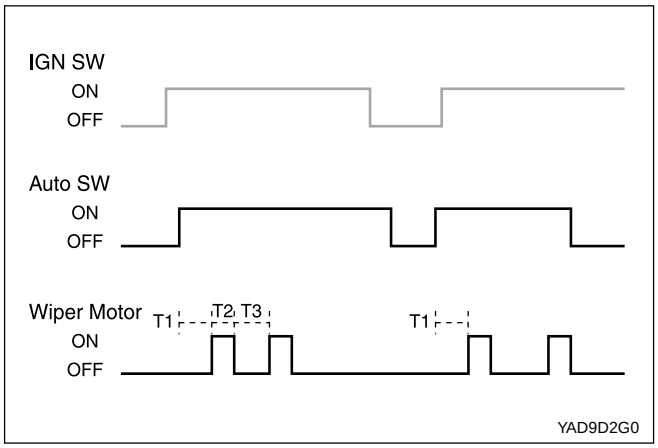
YAD9D2D0



Stics

Summary

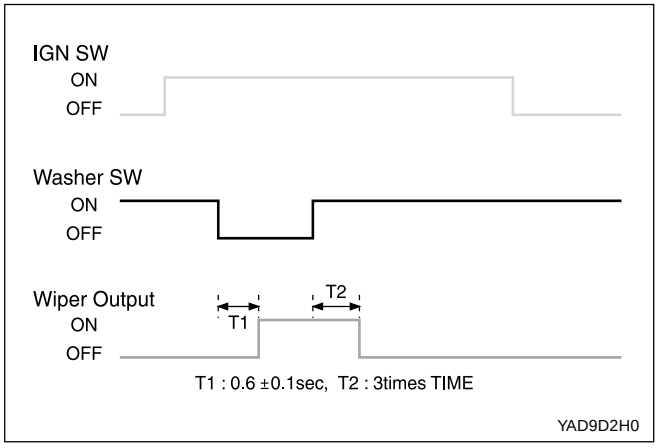
Stics which is electron control unit, has the function of sixteen, if stics is unnormal at the sensor or load, unit of stics has self –diagnosis.



FUNCTION OF OPERATION AND THE CHARACTERISTIC

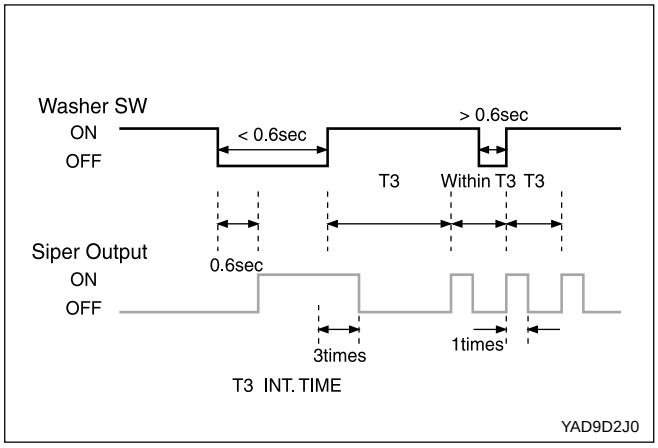
Intermittent Wiper of Velocity Induction Type

1. Intermittent wiper of velocity induction type which is linked according to velocity of vehicle, intermittent time is changed automatically a kind of wiper system, this one is controlled by below switch of control.
   - Auto switch : which is selected to the intermittent mode.
   - Time control switch of the intermittent : this one control the intermittent time
   - Intermittent time is set (at 0 km/h) : 2.6 ± 0.5 sec ~ 18 sec ± 2 sec
2. After IGN 2 switch is “ ON”, turn auto switch on, or after turn auto switch is “ ON”, turn IGN2 on, immediately, velocity linking mode is operating.

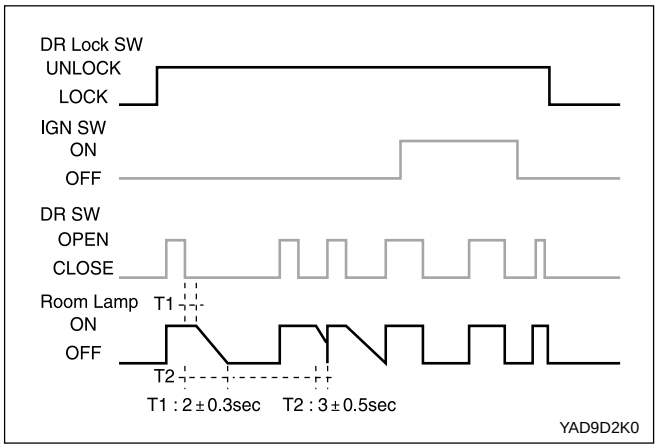


Washer linking wiper

1. As ignition switch is turning on, if washer switch is “ON”, after 0.6 second, wiper is operating, after washer switch is “OFF”, wiper is operating 3 times and then wiper is turned “OFF”

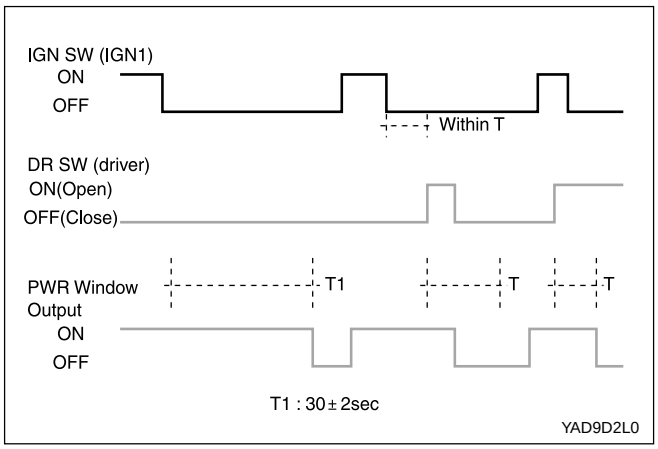


2. While the intermittent wiper is operating, washer switch is turned on more than 0.6 seconds and then washer linked wiper is operating, if washer switch is turned between 0.2 and 0.6, such as MIST wiper, wiper is operating only once



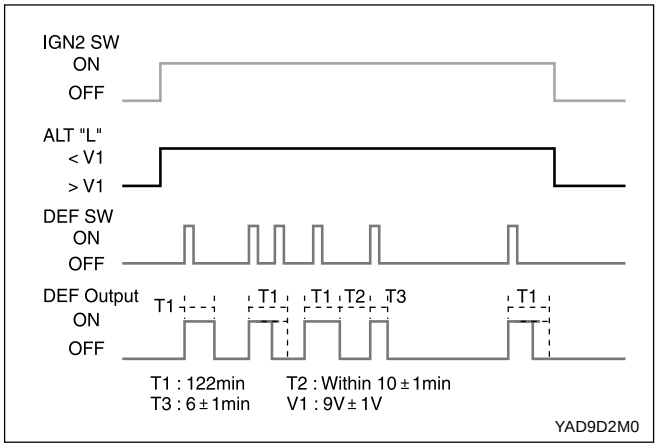
Room lamp of light sensitive type

1. As switch of room lamp is set on the position of door is linked operation, release lock switch of driver or lock switch of passenger, turn the switch of ignition (IGN2) “OFF”, and then open up door, lamp of room is turned on, after door is closed, after 2 seconds, light is “ON” and then gradually is sensing light, after 3 seconds approximately, should be turned off completely.
2. If switch of ignition (IGN2) is turned “ON” or lock switch of driver seat or passenger is set free, open up door and then the light is turned on and if door driver seat and passenger are closed, and then,immediately should be turned off (Disregard time of turning on which is less than 0.2 seconds).
3. Capacity of time resolving is more than 32 stem per 1 seconds.



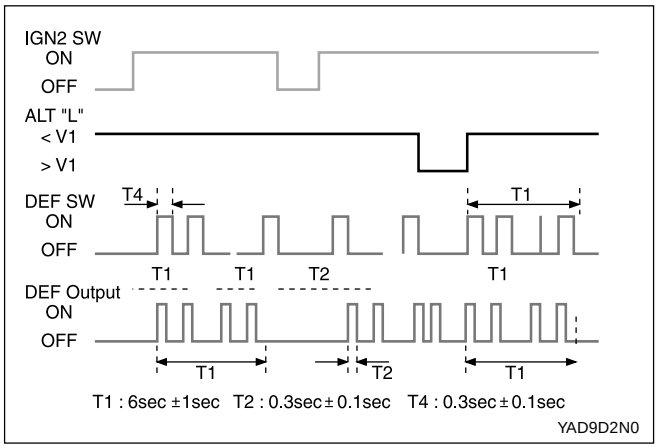
Power window of time delaying

After turn ignition switch (IGN1) OFF, during 30 seconds, switch of power window is operating available and within this time (30 seconds) if door is opened up, from at that time, time is extending for 30 minutes,if door is closed within a time extended, power is “ OFF”.



Function of defogger timer

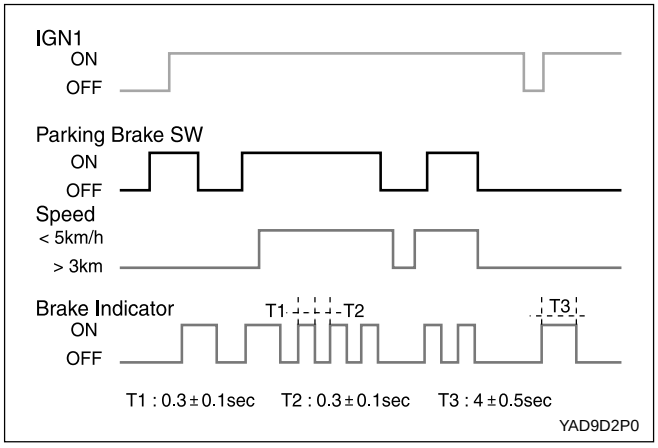
1. At state of engine which is operated, if switch of defogger is operated, defogger is operated (12 minutes).
2. Under defogger is operating, if switch of defogger is reoperated, operating is stopped.
3. After operation of defogger is finished, within 10 minutes, again switch of defogger is turned on only once this one is operated for 6 minutes. (except that switch of defogger is turned off)
4. If ignition switch (IGN2) is “OFF” or if the VOLT of L terminal of alternator is less than 10 V, operating of defogger is stopped.



Warning lamp of no wearing seat belt

1. If switch of ignition is turned on, warning lamp of seat belt is lighting on for 6 seconds with 0.6 seconds of frequency duty 50 %, chime bell is sounding for 6 seconds with 0.6 seconds of frequency duty 50 %.
2. Within 6 seconds, if switch of ignition is “OFF”, chime bell is not operated immediately.

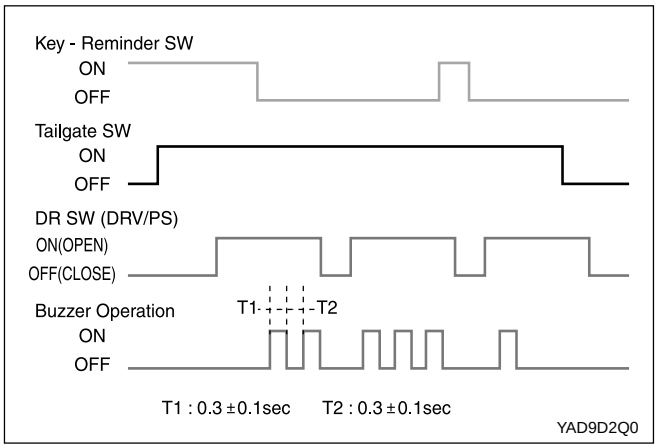
   Within 6 seconds, if switch of seat belt is “OFF”, chime bell is not operated immediately, and warning lamp of seat belt is sounding for 6 seconds.
3. After seat belt is worn under ignition is “ON”, on the every time that seat belt is taken off, chime bell is always operating.

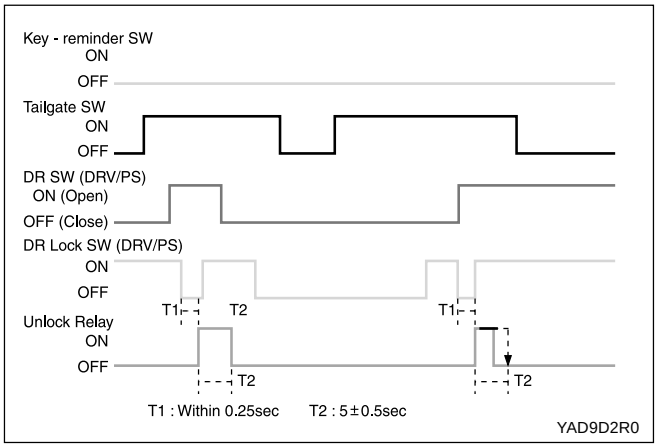


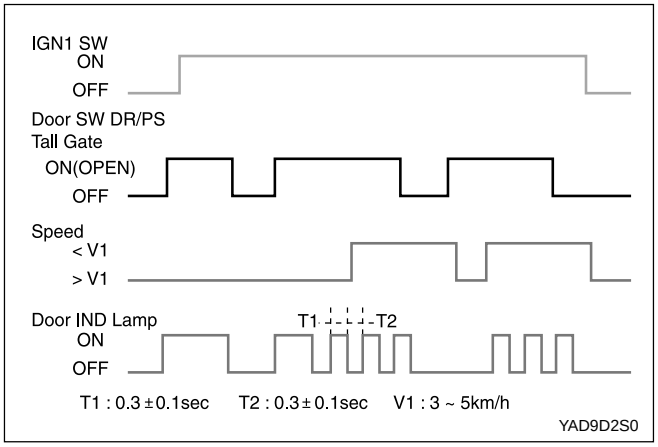
Warning lamp of parking breake

1. Parking brake is pulling under vehicle’s stopping, warning lamp is turned “ON”, under this situation vehicle is running and then speed of vehicle goes up to 3 - 5 km/h or after speed of vehicle goes up more than 5 km/h if parking brake is pulled, lamp of warning should be turned off (After switch of ignition is turned on, after time is passed more than 1.5 seconds, speed of vehicle should be sensed.
2. While switch of IGN 1 is off in the above number 1, warning lamp of brake is “OFF”
3. While switch of parking brake under the state of “OFF”, after key of ING 1 is OFF, as switch of ignition is “ON”, after lighting is four times, and then “OFF”

   (During lighting of 4 seconds, if key of ignition is “OFF”, immediately is turned “OFF”)







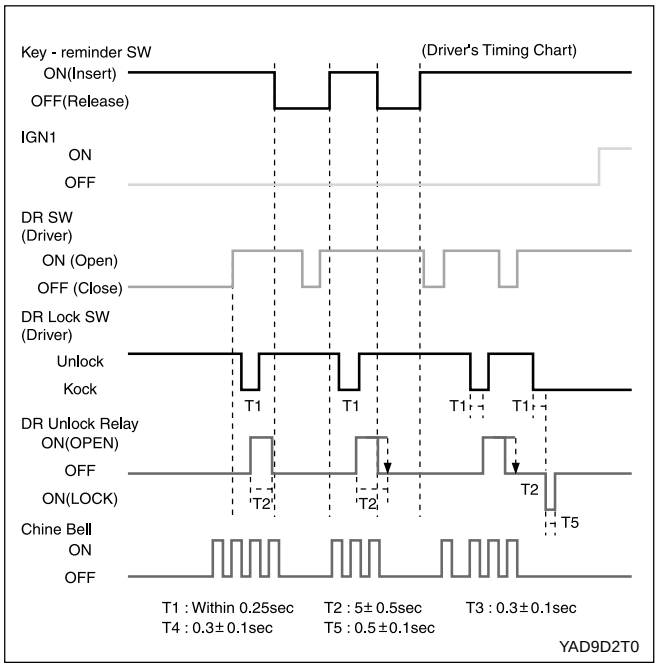
The waring of operating tail lamp

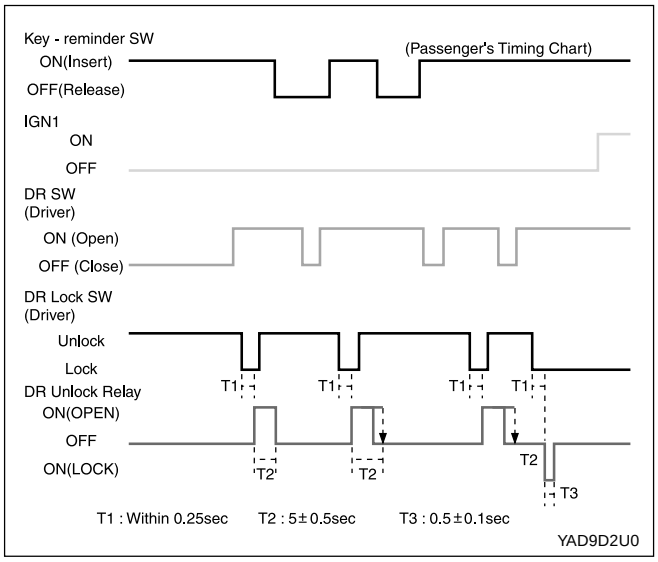
1. If switch of key reminder is “OFF” under the state of operating switch of tail lamp, rekes is also not operating. If there is no the vigilance of robbery or the condition of alarm, under this situation, open up door of passenger seat or driver seat, buzzer is “ON/OFF repeatedly by the frequency of 0.3 seconds.
2. If one of them is getting out of above 1 description, buzzer should be “OFF” immediately.

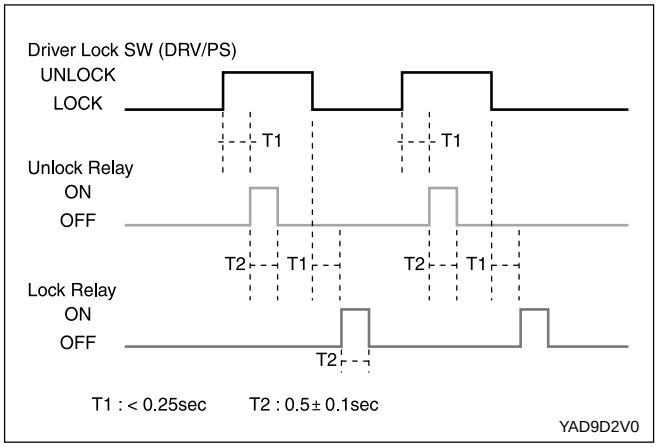
   At this time, if lock switch of driver seat or passenger seat is locked, unlock relay is operating for 5 seconds at this time,if all the door of driver seat and passenger seat are closed or switch of tail lamp is “OFF”, relay of unlock is “OFF” immediately.

The waring of opening door

1. At state of warning lamp to the door which is opened, if door is opened up, the state of half closing, if velocity of vehicle is more than V1 (3 km/h – 5km/h),after speed of velocity is more than V1, the state of half closing or if door is opened up, the lamp of warning should be “ON AND OFF” repeatedly. (After switch of IGN 1 is “ON”.,after the time is passing more than 1.5 second, velocity of vehicle should be sensed.)







The warning of not being pulling key out of key hole

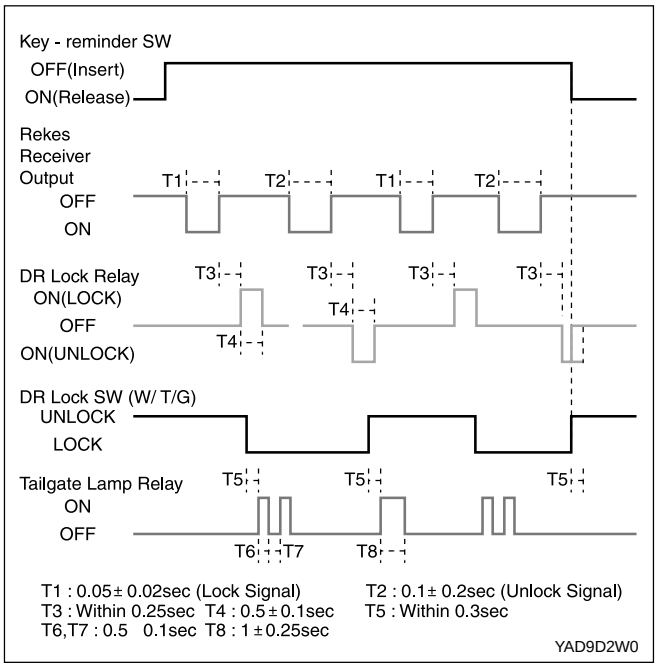
1. If the switch of ignition is turned on and then open up the door, chime bell is operating, if nob of door lock is locking, nob is up from the original position, door should get back to the state of unlock.
2. This function should not be operated under the state of IGN 1 switch of BEING TURNED ON.

   If the key is pulled or door is closed, the signal of operating should be “OFF”, should be operated prior to warning lamp of “NOT BEING TURNED OFF”.

Central locking function

1. If door lock nob of driver seat or passenger seat is downed, all the door are locked, and if door lock nob of driver seat or passenger seat is lifted, all the door are unlocked.

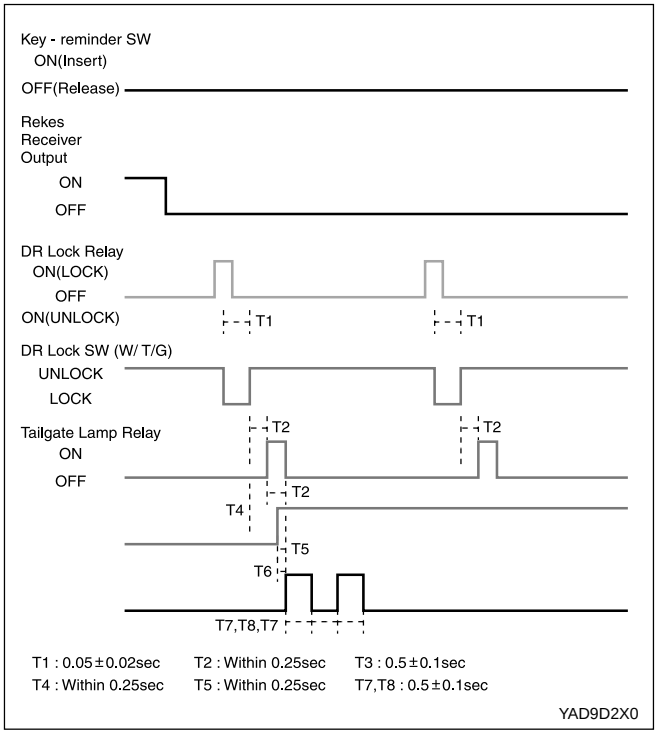
   If door of driver seat or passenger seat is locked or unlocked by key at the external area, the same situation will be happen.



Function which is linked with rekes

1. If switch of key reminder is “OFF”, all the door are locked or unlocked according to the signal of rekes
2. If the rekes is unlocked, lock switch of driver seat door is locked, unlock relay of driver seat is “ON” for 0.5 seconds(multi-function), and then unlock of rekes is operating, relay of unlock is “ON” for 0.5 seconds.
3. Under the operation of above 2 number, after 0.5 second of operating the unlock relay to the driver seat, lock switch of driver seat door is locked, release function of the multifunction, before battery is “ON/OFF”, while unlock of rekes is operating, only relay of unlock is operating.

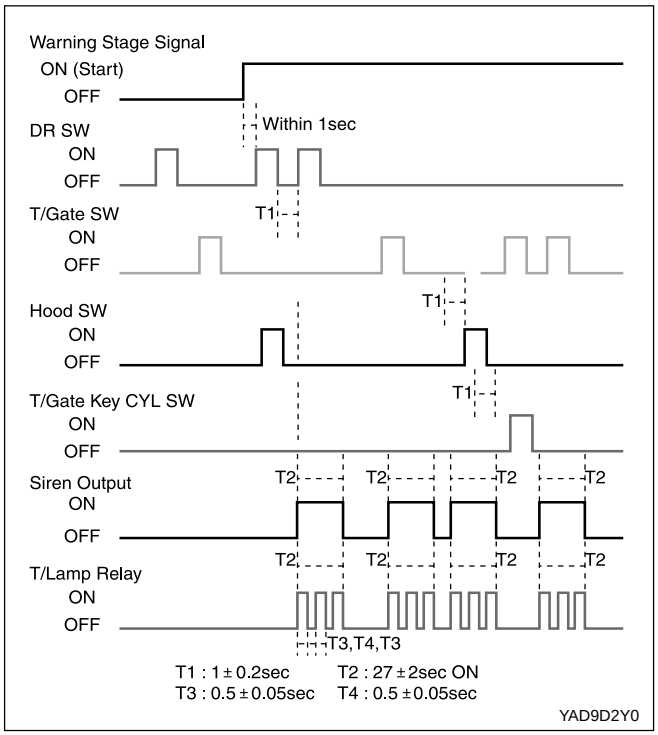
   After unlock is operating, within 30seconds, if opening of door is not operated, after 30 seconds, door should be locked automatically.



The alarming of robbery

Function of alarming robbery is made a alarming unrecognized method by intruder, which cause buzzer to make a alarming sound and notice to surrounding people, has operating mode as below .

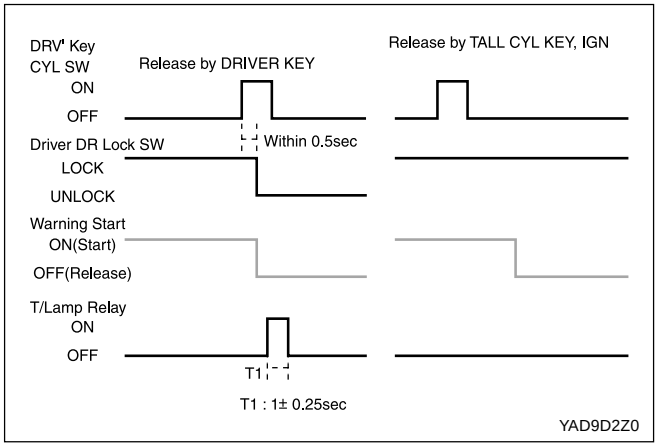
1. set on the situation of vigilance.
   - Setting on the situation of vigilance is available on condition that door is locked by the transmitter of rekes, but if door is locked by key, state of vigilance should not be set.
   - If switch of ignition is removed, under all the door and hood are closed, signal of lock of operation from the receiver of rekes is transferred low speed into high speed, after that, within 0.5 seconds, lock switch of all the door are transferred ON into OFF, after happening of signal, 0.5 seconds later, should be set to the state of vigilance.
   - As the state of robbery vigilance is set on, siren is operating for 0.05 seconds, tail lamp is operating two times for 0.5 seconds.



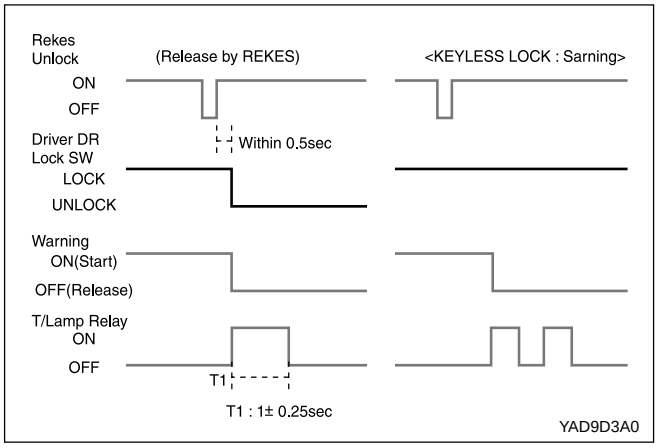
2. operation of alarm
   - After the situation of robbery vigilance is set on, not released the situation of robbery vigilance, with all the door, tail gate and hood are closing, after this situation are going on more than one second, if door, tail gate and hood is opened, alarm should be operating immediately.
   - If only one thing among alarm conditions is satisfied, immediately the operation should begin to start, siren is operating continuously for 27 seconds, after siren,condition of alarming is again satisfied, once again siren is operating continuously for 27 seconds.
   - Under the state of vigilance, if only tail gate is opened by key, the state of vigilance should be set on the regular state of vigilance into secondary state of vigilance.(At this time, proceed alarming as open up tail gate, hood, assist and rear door)

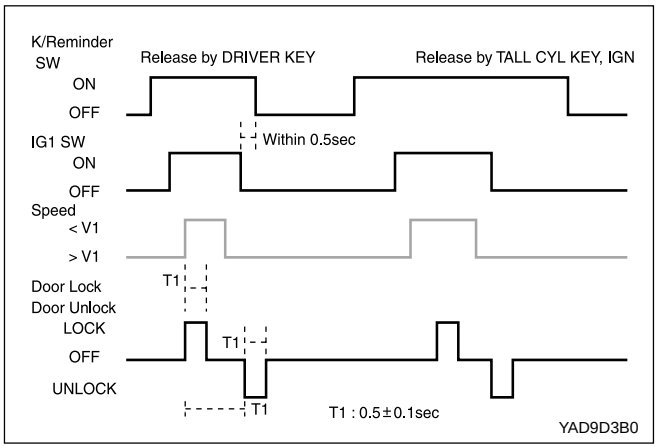
     In other words, while not being releasing condition of vigilance, although switch of tail gate is turned on, alarming is not operating, state of closing tail gate is going on more than one seconds, again back to regular state of vigilance, with siren once, tail lamp is “ON/OFF” two times for 0.5 seconds.

     Under the operation of alarming, if battery is removed, and then if the battery is installed, state of memory which is previously removed gets back, this state will be operating.



3. set vigilance of robbery free
   - In case switch of driver key cylinder is unlocked or rekes is unlocked, IGN1 OR IGN2 is turned, under the those condition only, should be set vigilance of robbery free.(while alarming of robbery is turned on, turn IGN1, IGN2 ON, relay of start inhibitor is “OFF”, alarming of robbery is continuously operating for remaining times)
   - Setting vigilance of robbery free is released by key of driver seat, key of tail gate, unlock of rekes and lock.

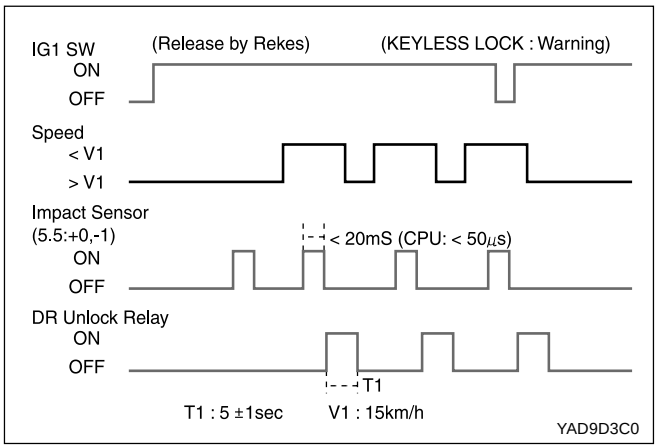




Function of auto door lock

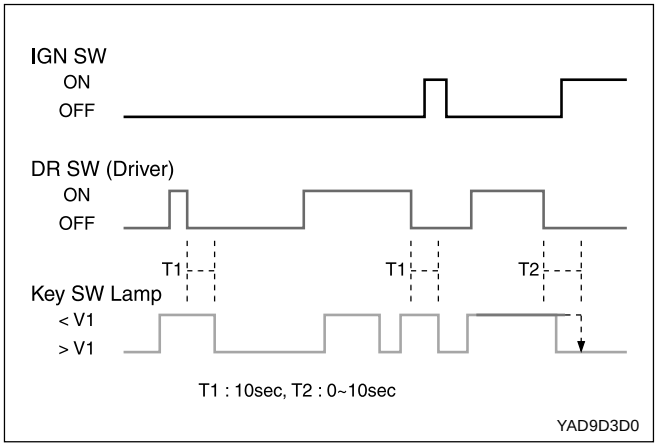
1. If switch of IGN is turned “ON”, and if velocity of vehicle is more than V1(50km/h)all the door is locked automatically,and under this velocity of vehicle, if door is unlocked,but door is automatically locked (after switch of IGN1 is turned, from passing time of 1.5 seconds, velocity should be sensing)

2. After auto unlock of door is operating, should not operate auto lock of door by velocity of vehicle



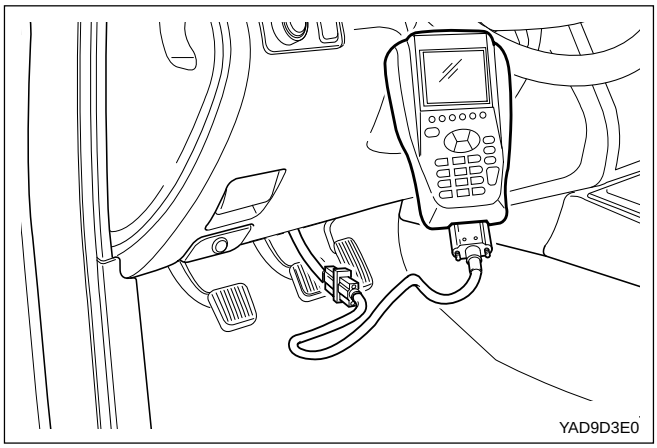
Function of auto unlock of door

1. Under turning ignition switch on, while vehicle is running more than 15km/h, if vehicle has a collision with other vehicle, automatically all the door should be unlocked.(After switch of IGN1 is turned on, and then passing time 1.5 seconds, velocity of vehicle should be sensed.)
2. Auto unlock of door with is operating with average of vehicle velocity which is setting for 8 seconds(While velocity of vehicle is reduced)



Function of key hole which is illuminated

1. If door is opened under vehicle’s stop, as illuminating lamp round key hole, at time of stopping door, is lighting on for 10 seconds, but within 10 seconds, if signal of rekes is operating or if switch is turned “ON”, should be turned “OFF”


YAD9D3E0

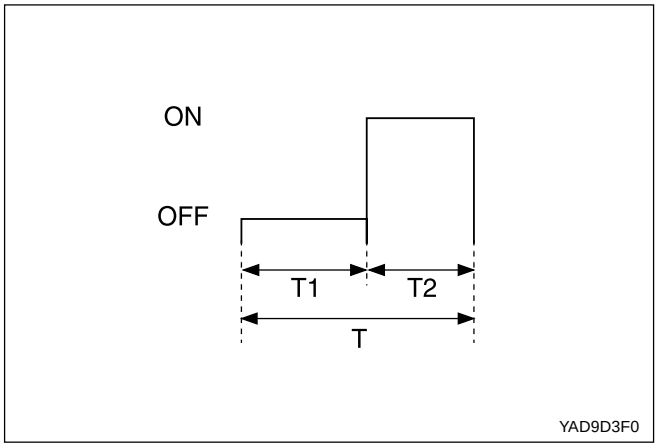
SELF DIAGNOSIS

Summary

After using the service connector which is installed on the instrument panel of lower driver seat, each failure is diagnosed internal unit of stics, can be checked the state of normal or mode of failure.

Method to Diagnose

1. While failure is checking, use buzzer
2. While the switch of diagnosis is turned “ON”, (stics of diagnosis socket box : number 7 and ground 1 is connected), the following operation should not proceed.
   - warning : the first step of light is “ ON”(buzzer is not operating, lock or unlock of door is not operating)
   - warning of seat belt(chime bell is not operating)
   - warning of key reminder (chime bell is not operating, lock or unlock of door is not operating)
   - central door lock(lock or unlock of door is not operating)
3. While switch of diagnosis is “OFF”, function of number 2 should get back to original position
4. While switch of diagnosis is “ON,” data which is diagnosed should output only once
5. If switch is operated by operation of other switch, among them, first input data will be output(buzzer is “ON”), and output is “OFF” for one seconds, and remaining input data is proceeding output.



YAD9D3F0

6. Output of buzzer is as following

   T1 : 0.3 ± ¾0.1 seconds

   T2: 0.3 ± ¾0.1 seconds

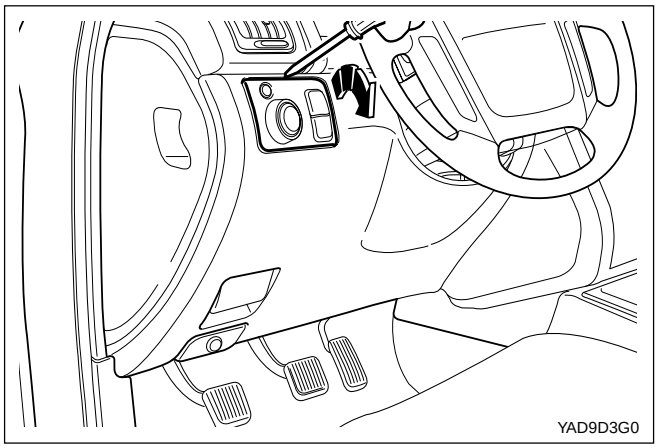
   T: 0.6 ± ¾0.2 seconds

   Notice:

   - If system is diagnosed, switch of diagnosis should be always “ON”
   - While the diagnosis of system is operated, if system is normal, buzzer is coming out, if system is out of order, buzzer is not coming out.

CHART OF DIAGNOSIS

NO	Conditions	Check	Normal	Remark
1	Switch of diagnosis is "ON"	Confirm 0f beginning to dignose	Buzzer,frequency: once	Switch of diagnosis is "ON"
2	Power of battery is supplied	Check battery	Buzzer,frequency: twice	
3	Battery plus: related	Tail gate, rear door lock switch	Buzzer,frequency: once	
4		Driver seat door lock switch	Buzzer,frequency: once	
5		Passenger seat door lock switch	Buzzer,frequency: once	
6		Driver seat door switch	Buzzer,frequency: once	
7		Passenger and rear door switch	Buzzer,frequency: once	
8		Rekes is operating	Buzzer,frequency: once	
9	Ignition switch is operating	Switch of key reminder	Buzzer,frequency: once	
10	Ignition plus related parts is operated	IGN and relay of power window	IGN2 : Buzzer,frequency: twice IGN1: Buzzer,frequency: once Power window: buzzer: Three times	
11		Switch parking brake	Buzzer,frequency: once	
12		Switch of seat belt	Buzzer,frequency: once	
13		Washer switch	Parking of wiper motor: 3 times Switch of washer :once Relay of wiper : twice	
14		Wiper auto switch	Wiper motor parking: 3times Wiper auto switch; once Relay of wiper : twice	
15		Switchof variable volume	Buzzer, frequency: once	
16	IGN, starting plus	ALT 'L'	Buzzer,frequency: once	
17	related parts is	Switch of defogger	Buzzer,frequency: once	
18	operating.	Signal of speed sensor	Buzzer,frequency: once	

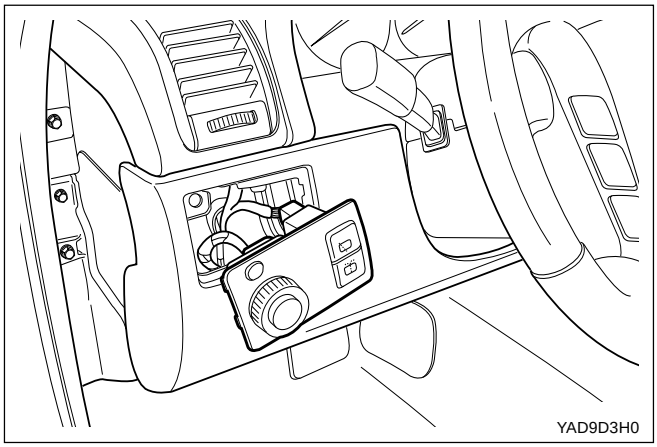

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REPAIR OF THE SYSTEM

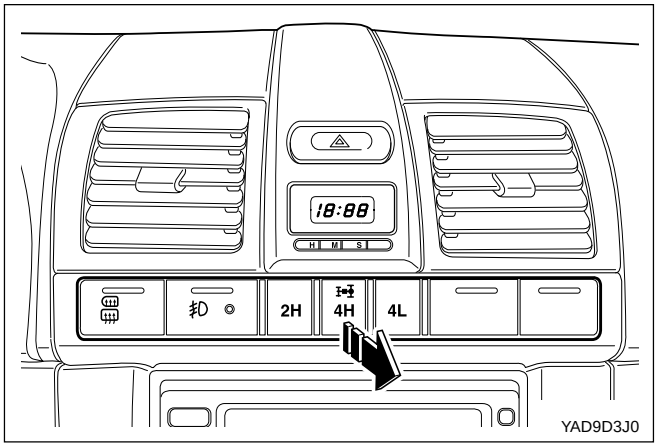
Switch of Outside Mirror

1. Remove upper section of switch (between IP and section of ground) with driver.

   Notice: switch is attaching on the upper section


YAD9D3H0

2. After disconnecting the connector, remove switch assembly.
3. Install the reverse order of removal



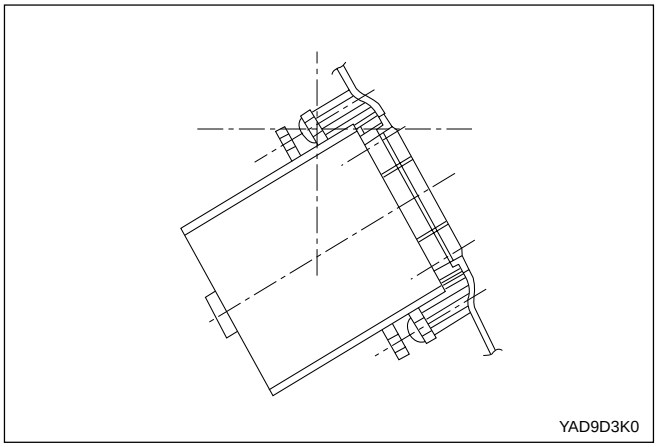
YAD9D3J0

Switch of Center IP

1. After panel of center IP is removed, each switch can be separated.
2. After center panel is removed, disconnect connector
3. Separate each switch from removed panel.
4. Install the reverse order of removal.

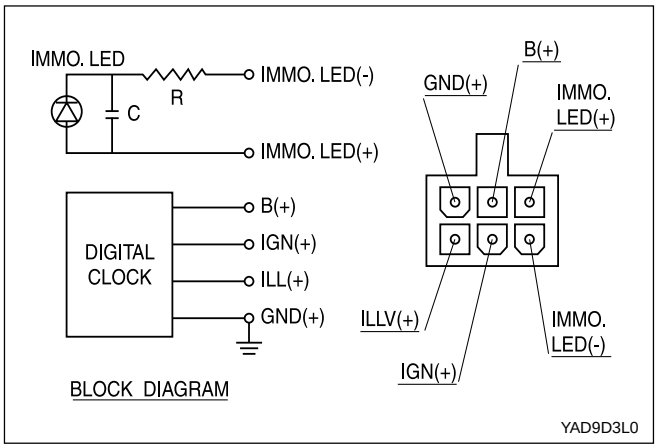
   Notice: While each switch is checked, refer to the following circuit, and then check whether apply an electric current or not,

   - Switch of front fog lamp

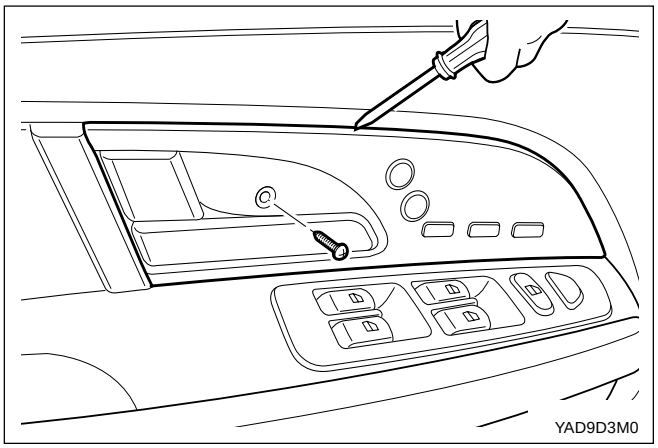

YAD9D3K0

Digital Watch

1. Remove the center panel
2. After releasing fixing screw from the panel, remove the digital watch.
3. After digital watch is fixing on the panel, link the connector, and then install panel on the panel of IP.



Circuit of Digital Watch and Connector



Switch of Seat Memory

1. Release the fixing screw.
2. Using the (-) driver, like the left picture, separate switch cover of seat memory.
3. After disconnecting the connector, remove the switch.
4. Install the reverse order of removal.

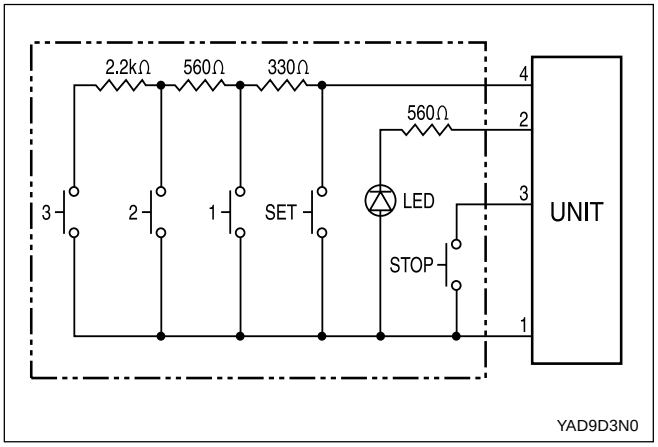
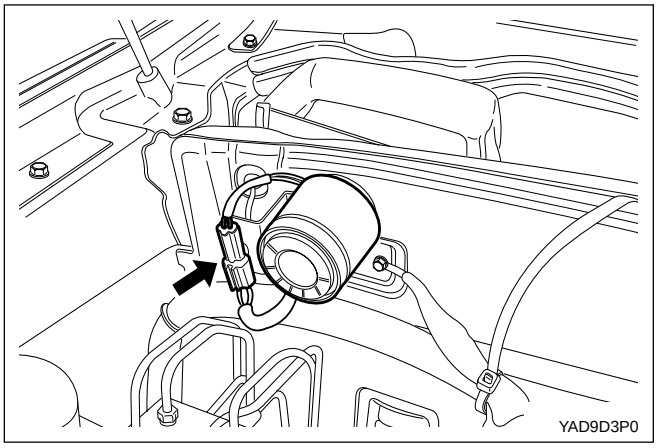


Diagram of Switch Circuit



Siren

1. After opening up the hood, disconnect the negative terminal of battery.
2. Disconnect the connector (indicating arrow) of siren.
3. After fixing bolt is released, remove the siren
4. Install the reverse order of removal.

SECTION 9E

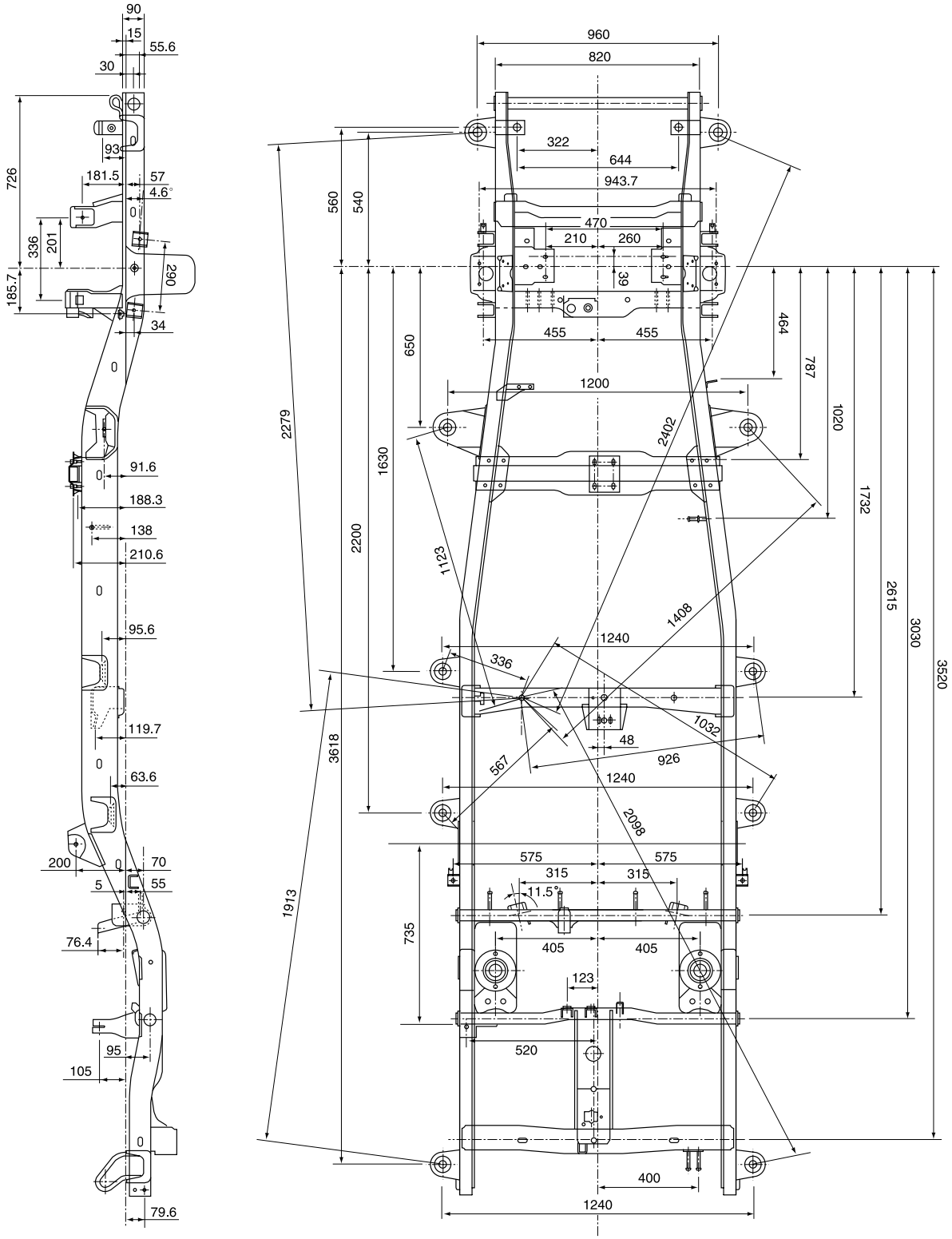
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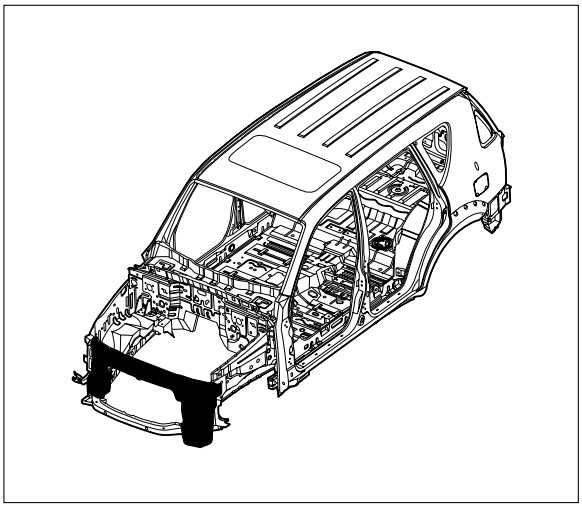
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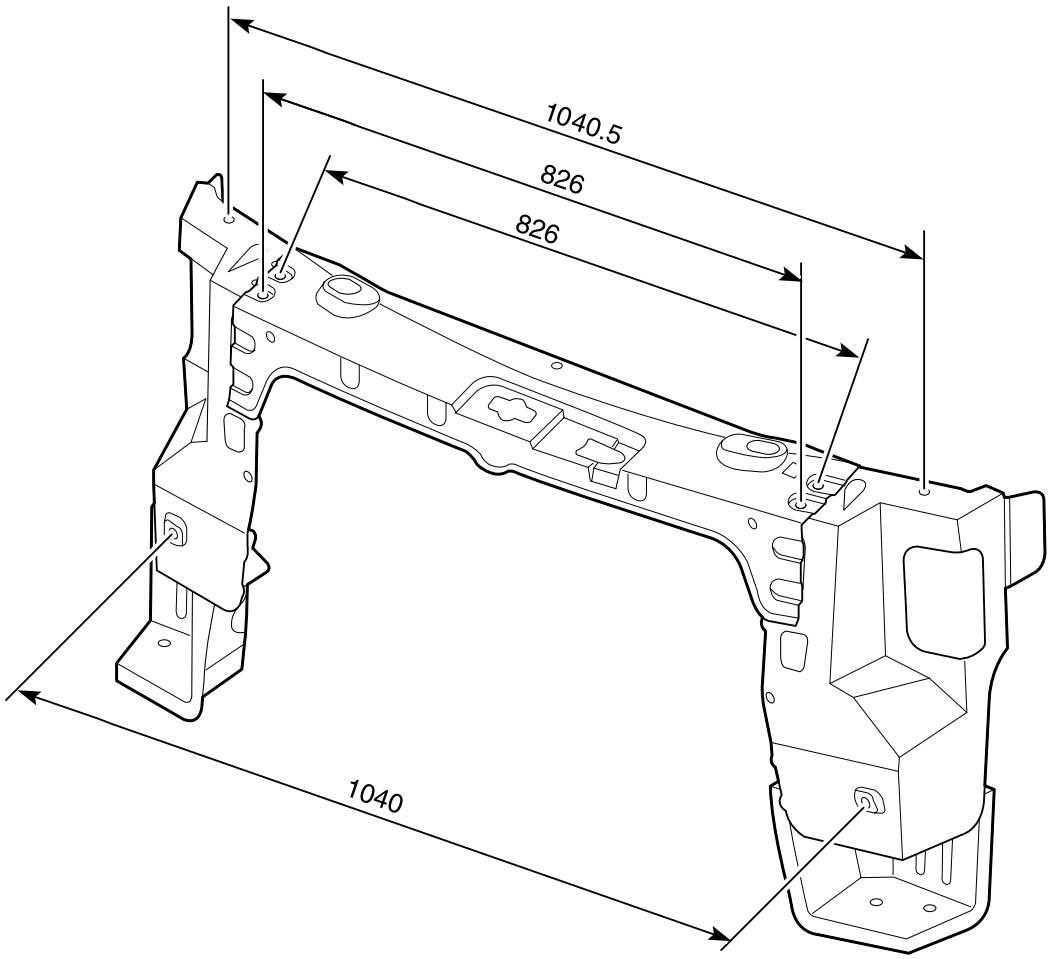
BODY'S MEASURING DEMENSION

UNDER BODY(FRAME)



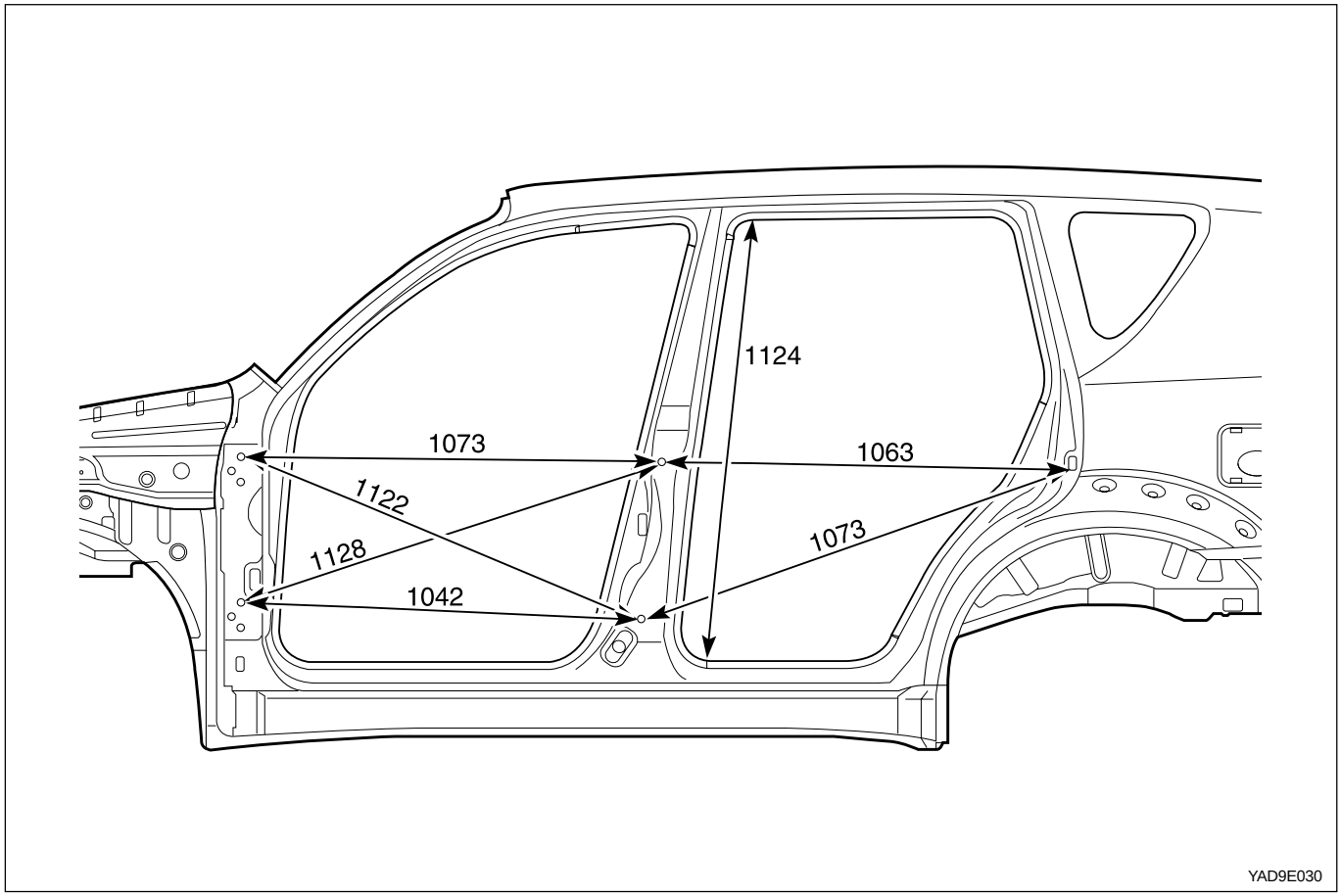
FRAME

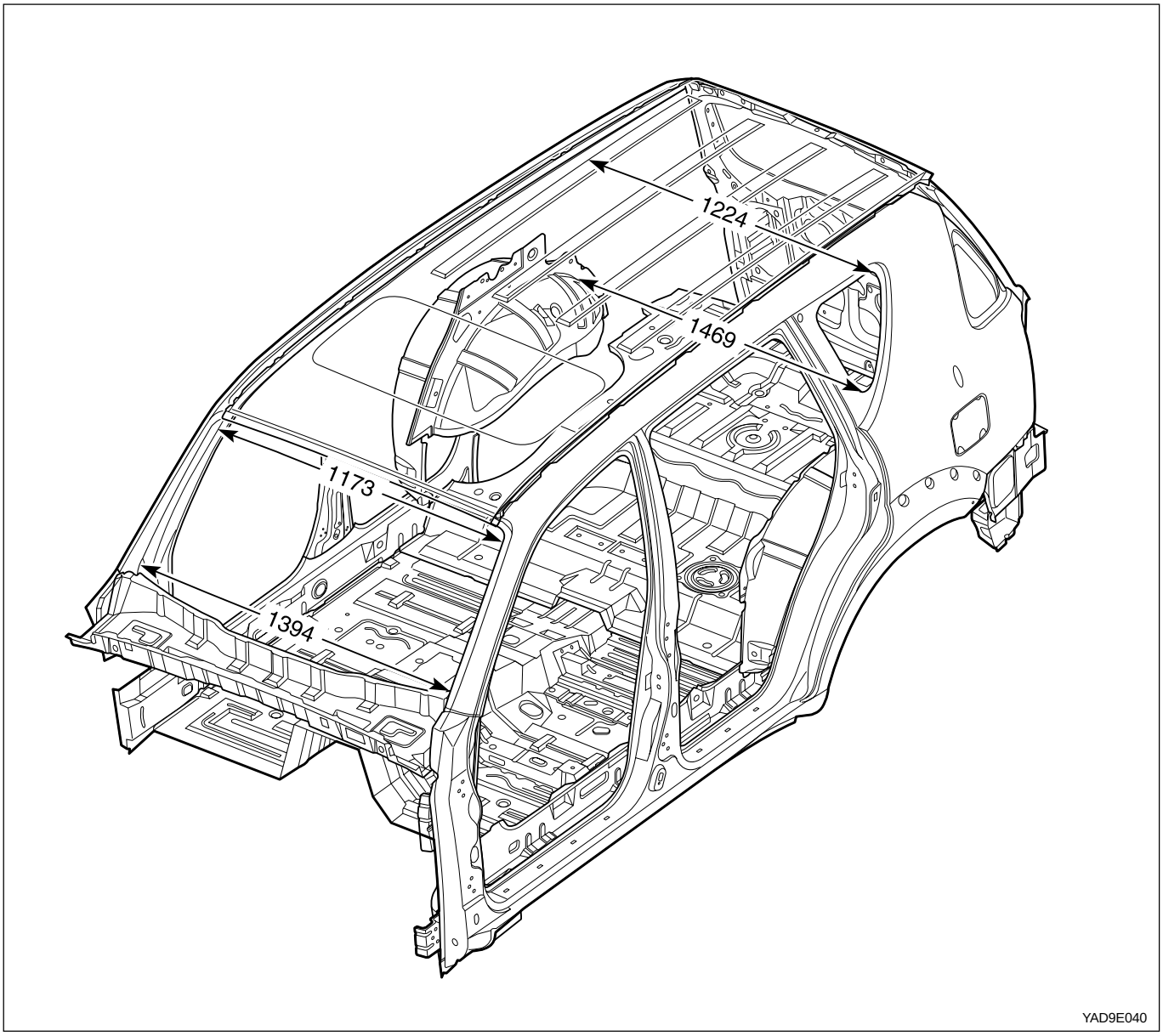




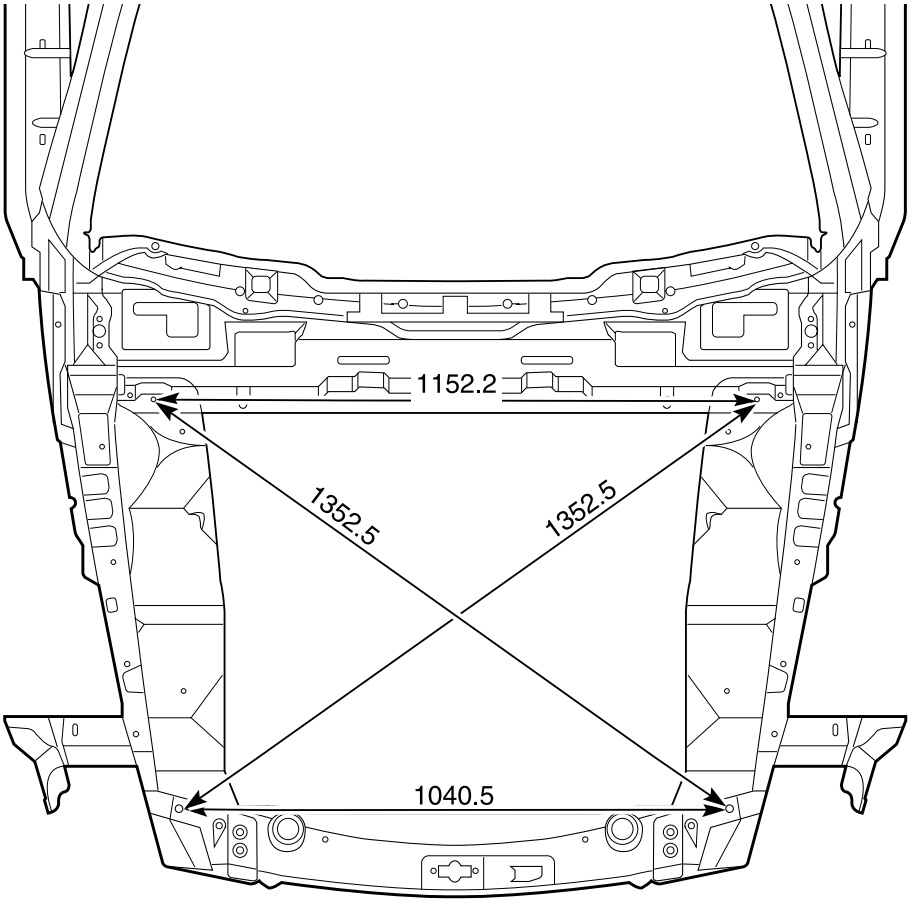
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SIDE STRUCTURE COMPLETE



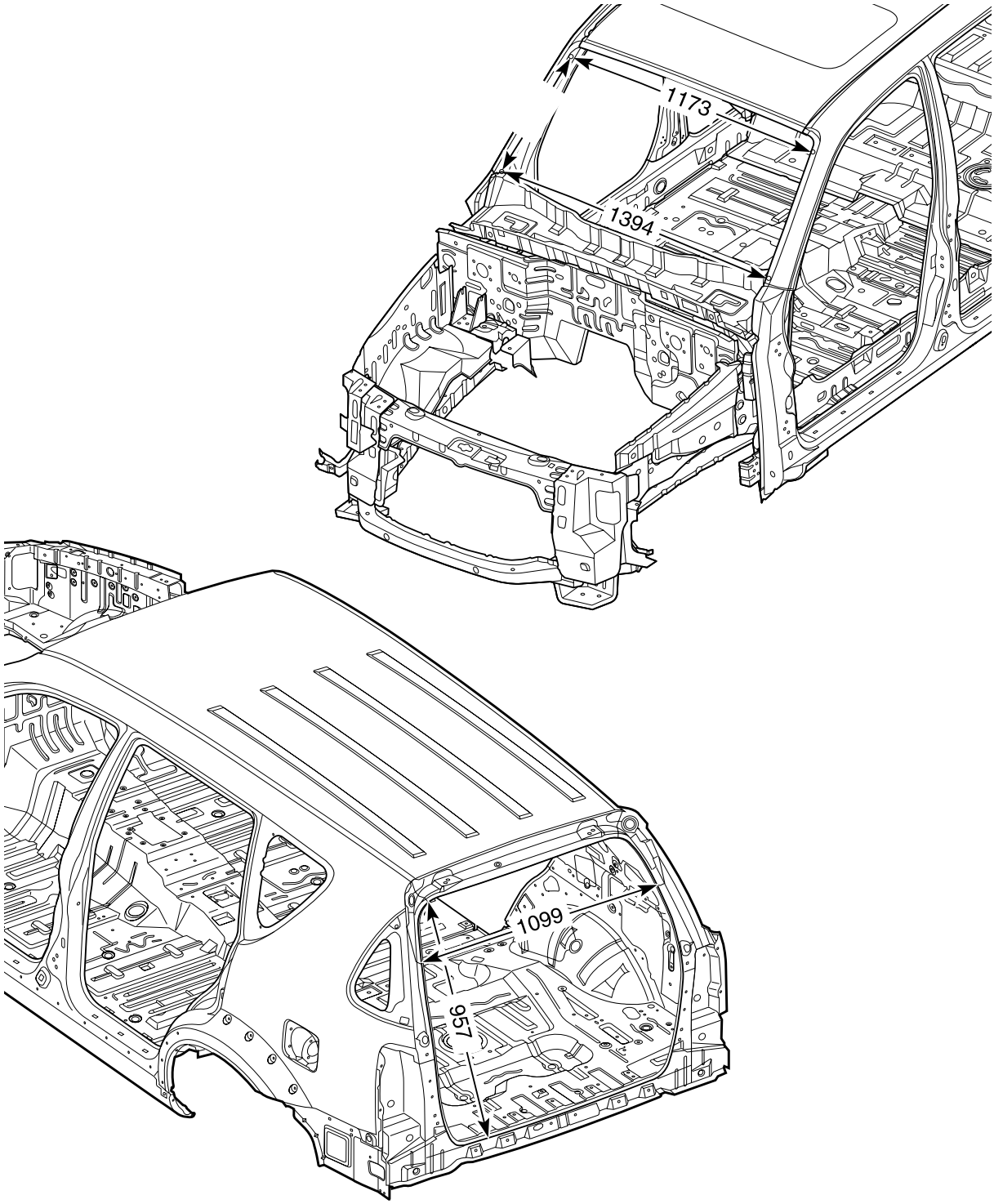

1224
1469
1173
1394
YAD9E040

ENGINE ROOM



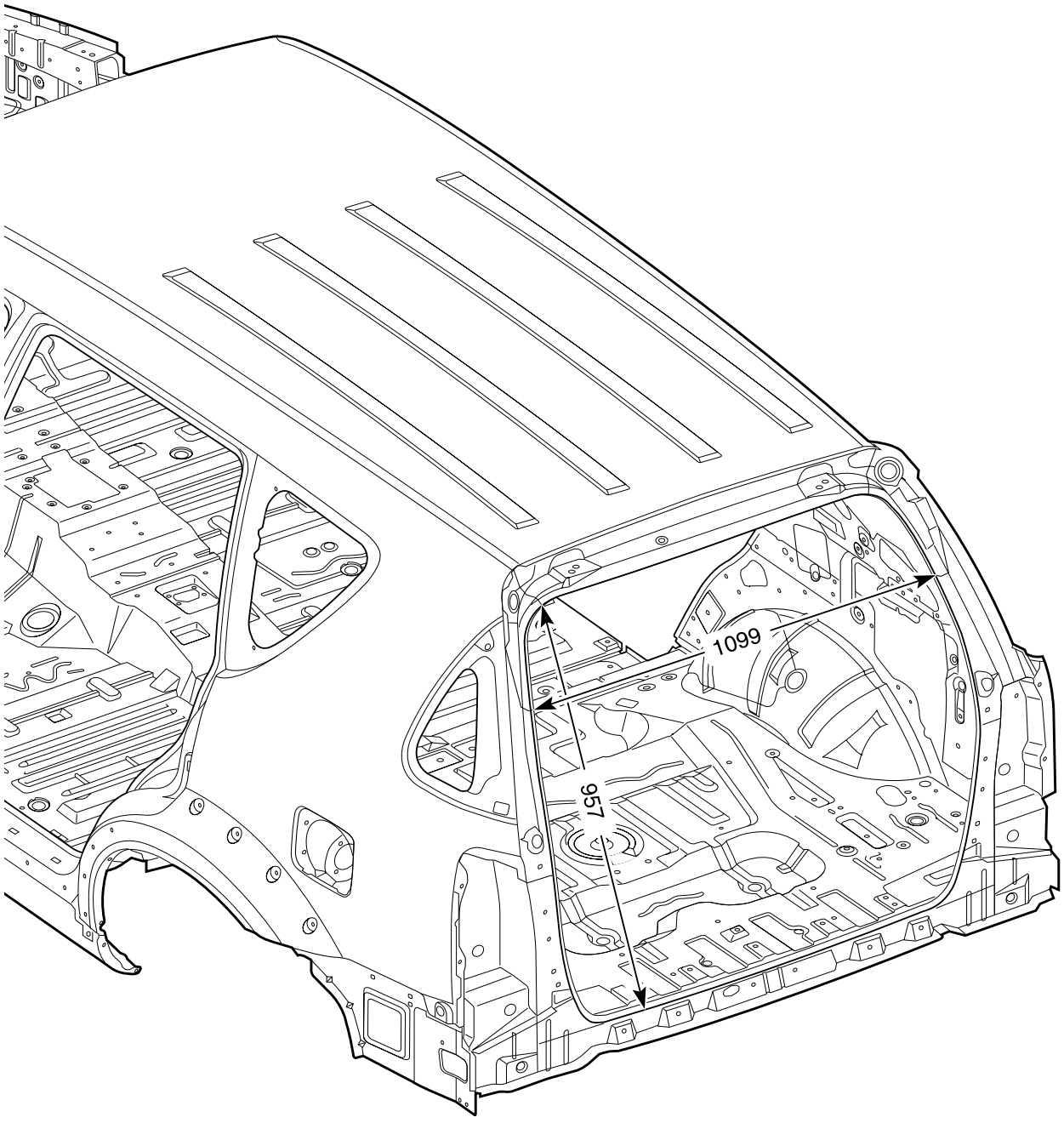
YAD9E050

WIND SHIELD AND REAR GLASS



YAD9E060

TAIL GATE



YAD9E070

CHART OF GAP

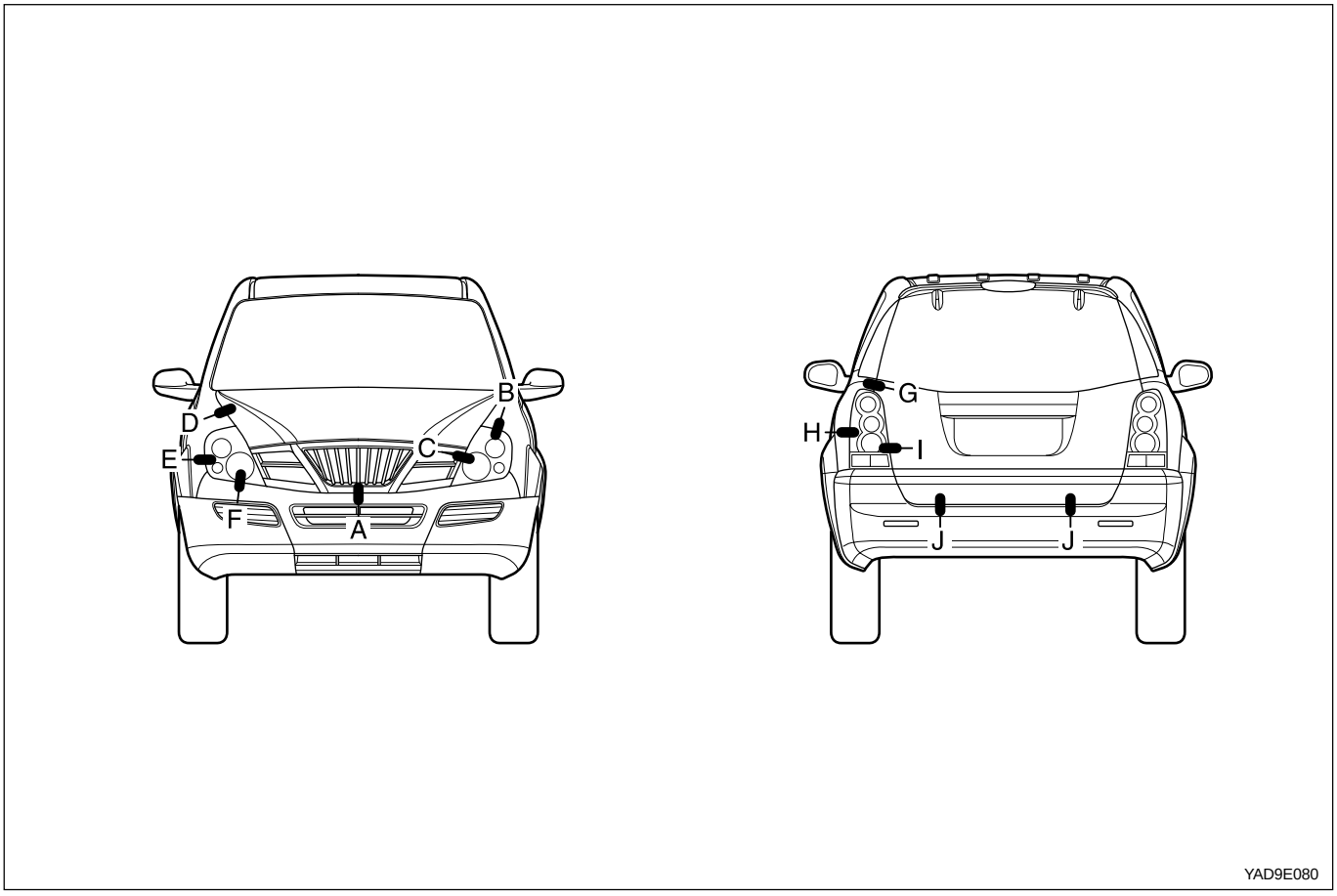
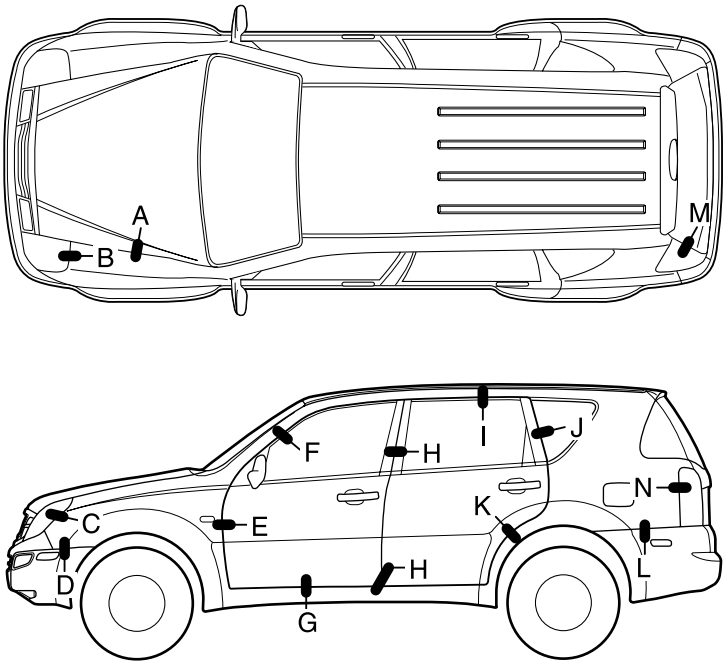


Chart of measuring demension

Position	Control of Measuring Demension	Position	Control of Measuring Demension
A:	$2.2^{+1}_{-0.5}$	F:	2.5
B:	40	G:	5.0 ± 0.5
C:	3.0 ± 0.5	H:	3.5
D:	$4^{+1}_{-0.5}$	I:	4.9 ± 0.5
E:	$4.5 \rightarrow 4.2$ Variable	J:	5.7^{+2}_{-0}

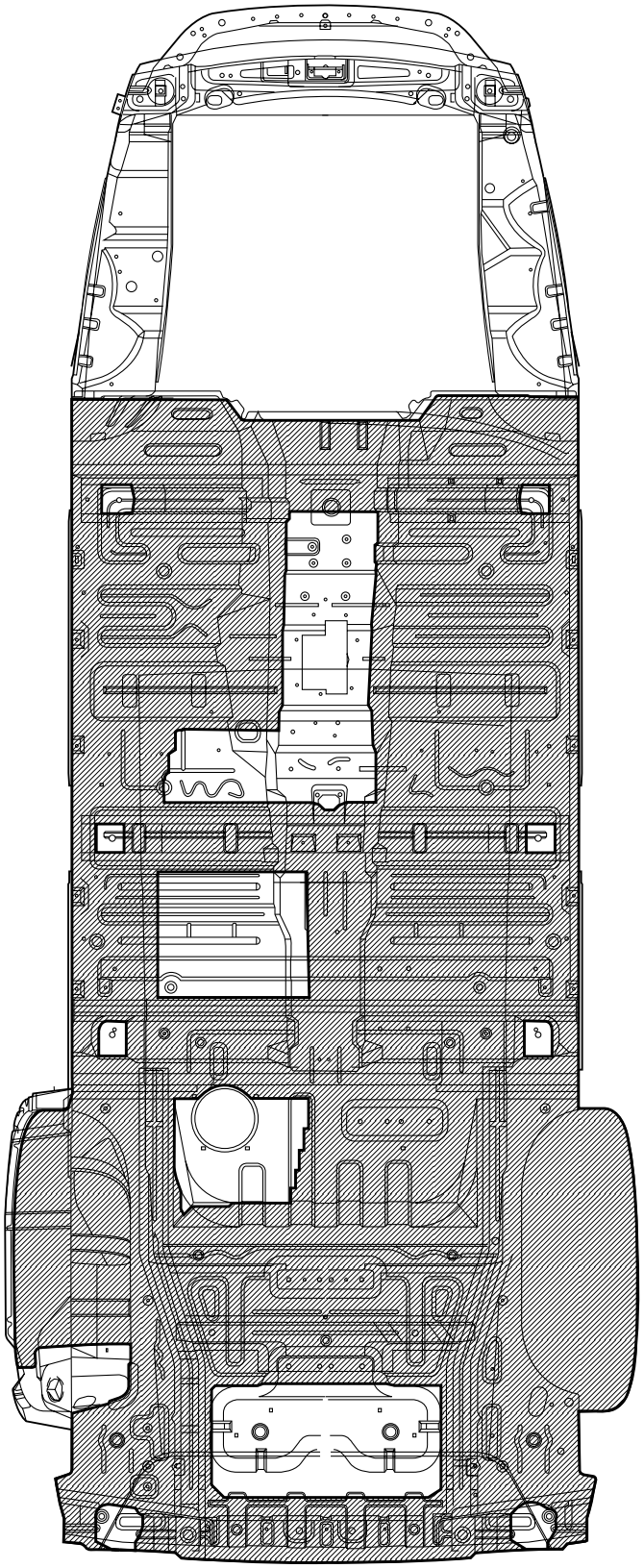


YAD9E090

Chart of measuring demension

Position	Control of Measuring Demension	Position	Control of Measuring Demension
A:	$4\ ^{+1}_{-0.5}$	H:	$4.5\ ^{+1}_{-0}$
B:	4.0	I:	↑
C:	4.5 → 4.2 Variable	J:	↑
D:	$2.2\ ^{+1}_{-0.5}$	K:	↑
E:	$4.5\ ^{+1}_{-0}$	L:	$2.2\ ^{+1}_{-0}$
F:	$4.5\ ^{+1}_{-0}$	M:	5 ± 0.5
G:	6.5 ± 1	N:	3.5

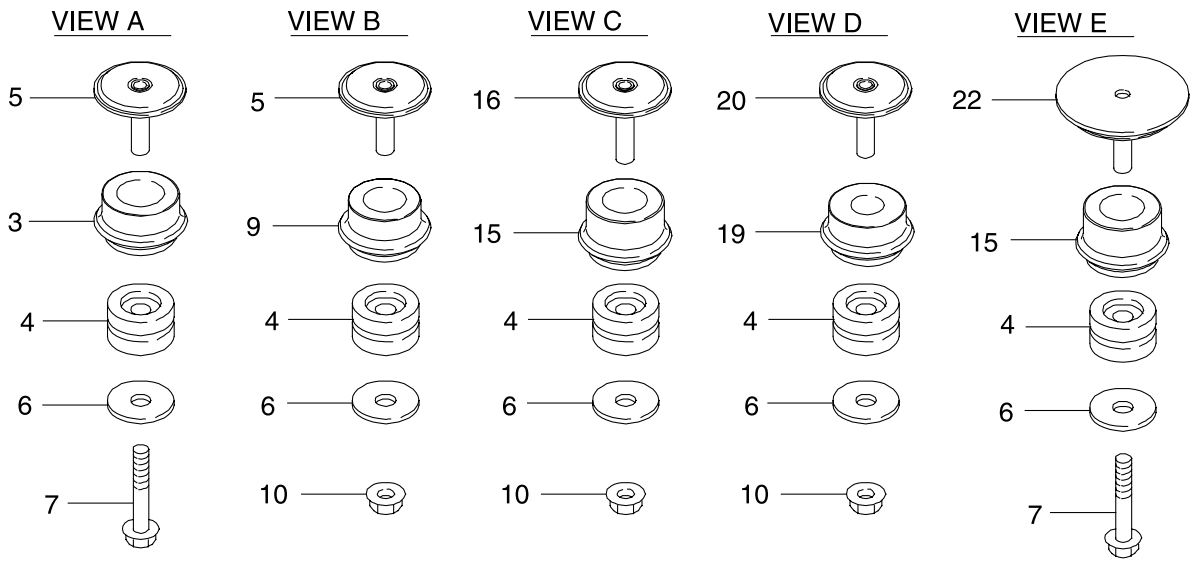
UNDER COATING

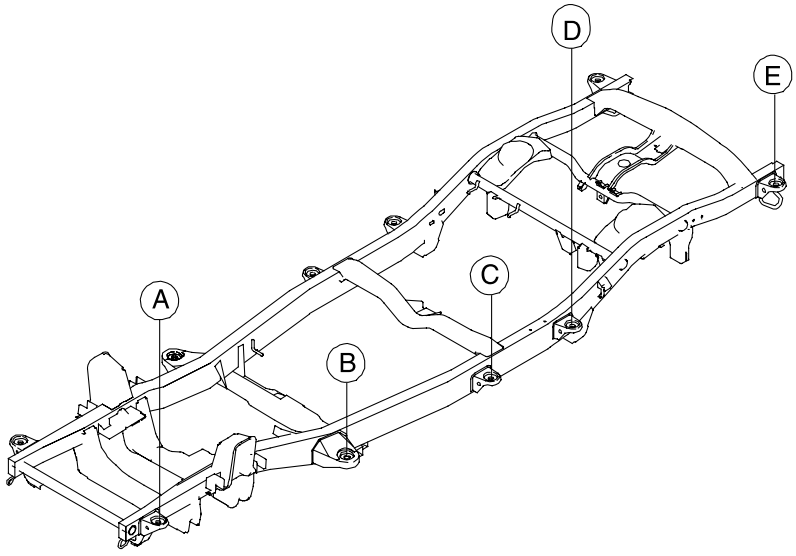


YAD9E100

BODY MOUNTING

Mounting Point





YAD9E110