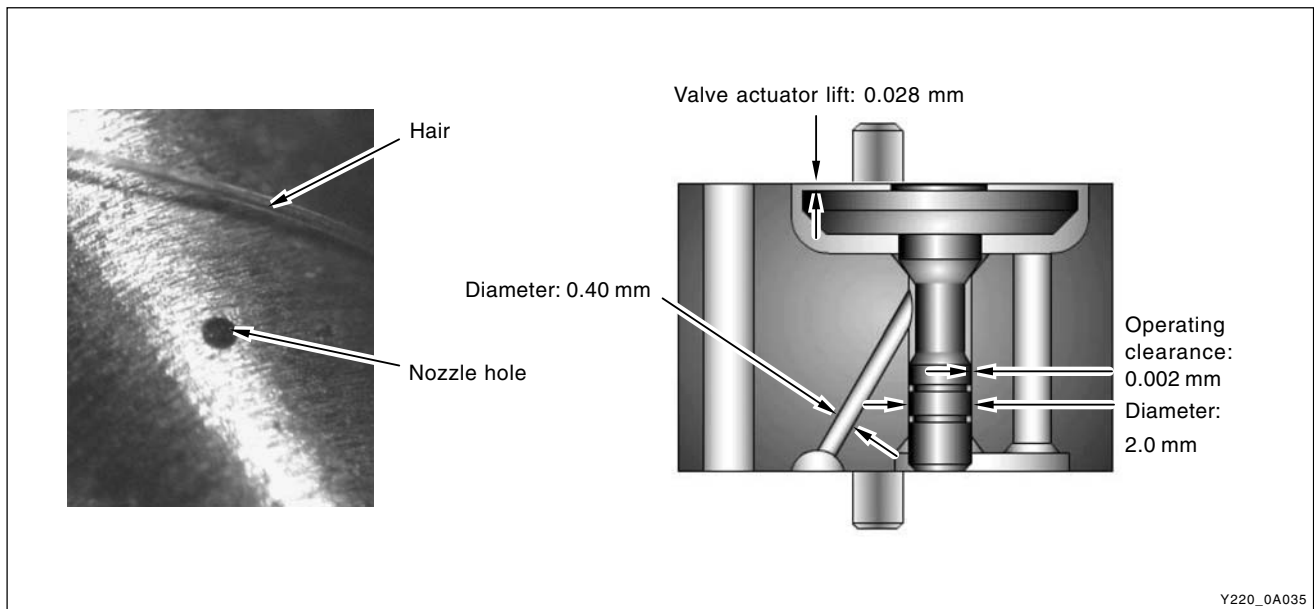


CLEANNES

Cleanness of DI Engine Fuel System and Service Procedures

The fuel system for DI engine consists of transfer (low pressure) line and high pressure line. Its highest pressure reaches over 1600 bar. Some components in injector and HP pump are machined at the micrometer 100 μm of preciseness. The pressure regulation and injector operation are done by electric source from engine ECU. Accordingly, if the internal valve is stucked due to foreign materials, injector remains open. Even in this case, the HP pump still operates to supply high pressurized fuel. This increases the pressure to combustion chamber (over 250 bar) and may cause fatal damage to engine.

You can compare the thickness of injector nozzle hole and hair as shown in below figure (left side). The right side figure shows the clearance between internal operating elements.



The core elements of fuel system has very high preciseness that is easily affected by dust or very small foreign material. Therefore, make sure to keep the preliminary works and job procedures in next pages. If not, lots of system problems and claims may arise.

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ENGINE CONTROLS

ECU RELATED COMPONENTS

ECU/barometric sensor



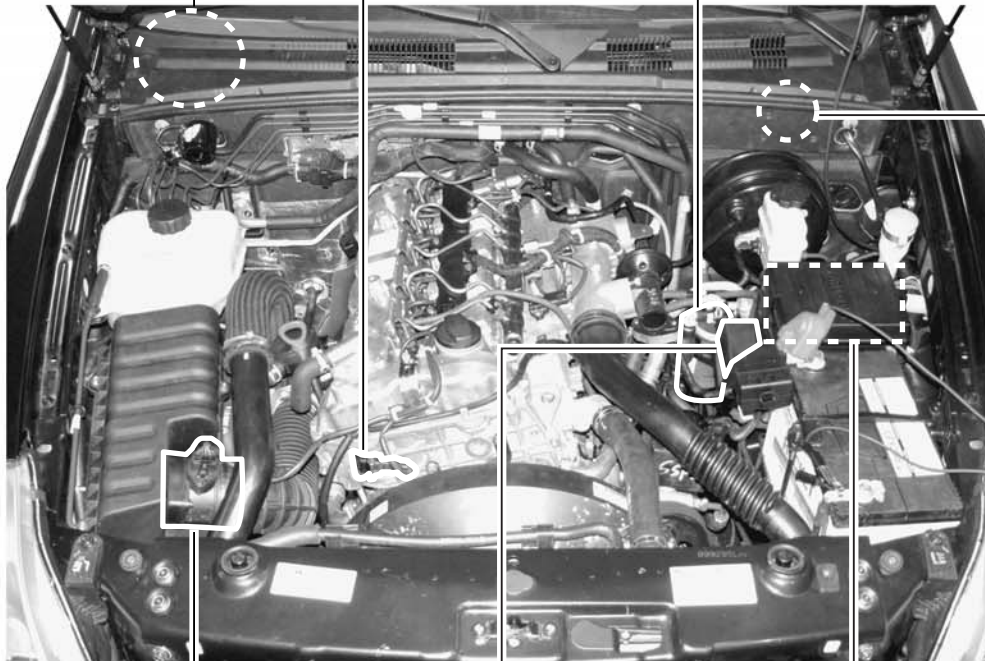
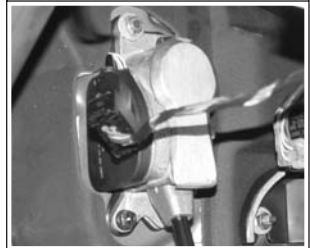
Cam position sensor



Fuel filter (water detection sensor)



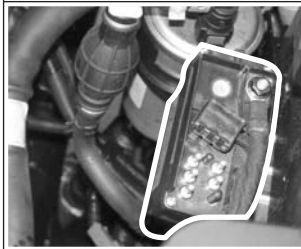
Accelerator pedal sensor



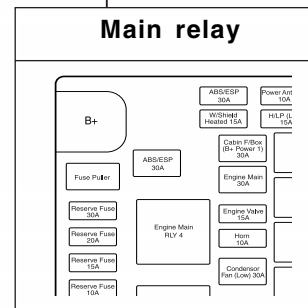
HFM sensor/intake air temperature sensor



Pre heating time relay



Main relay



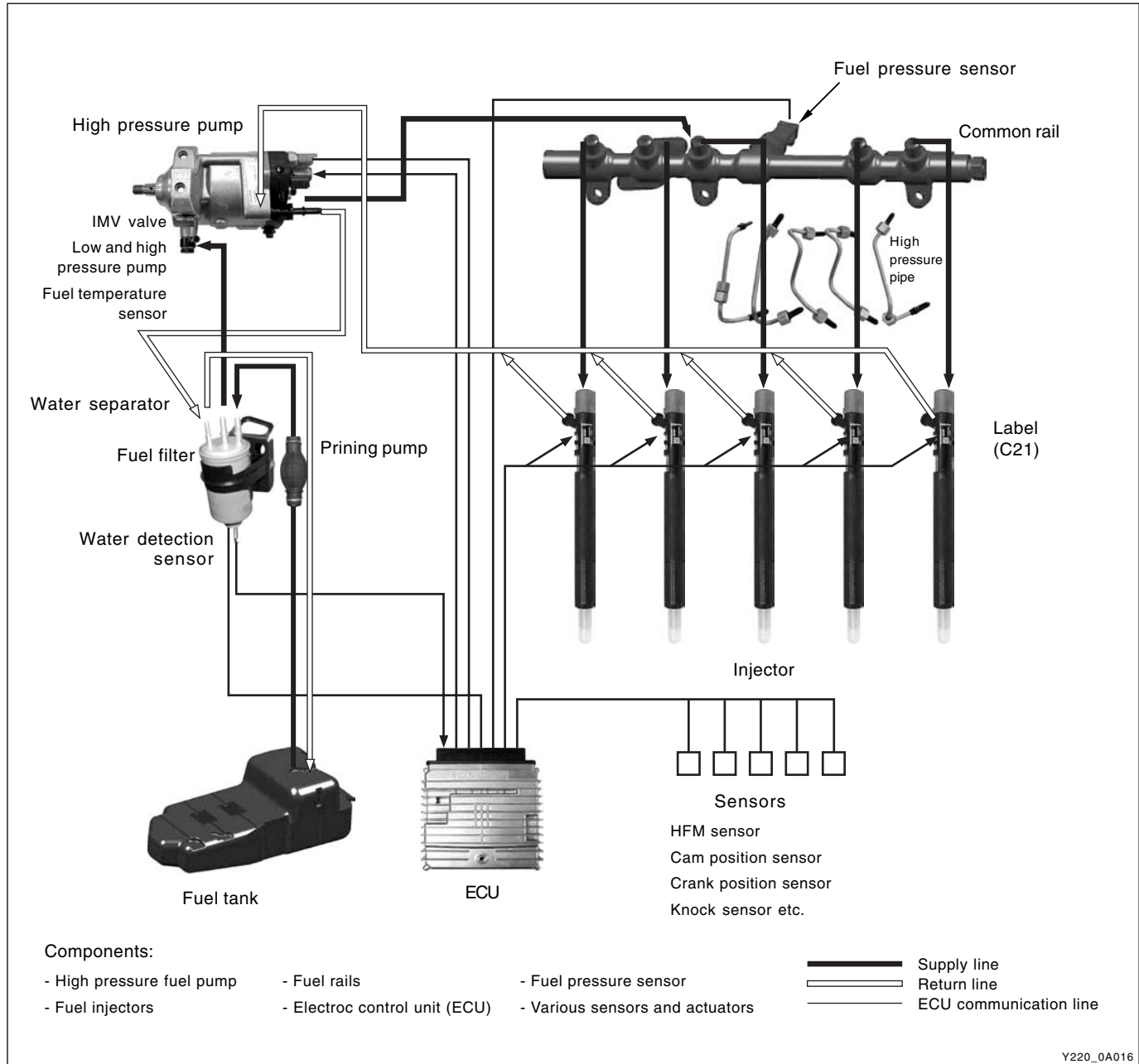
Y220_0A004

GENERAL INFORMATION

DI ENG SM - 2004.4

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FUEL SUPPLY SYSTEM



According to input signals from various sensors, engine ECU calculates driver's demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's demand) through electrical signal that is generated by variable resistance changes in accelerator pedal sensor. Air flow (hot film) sensor detects intake air volume and sends the signals to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes from air flow sensor to decrease the emissions (EGR valve control). Furthermore, ECU uses signals from coolant temperature sensor and air temperature sensor, booster pressure sensor and barometric sensor as compensation signal to respond to injection starting, pilot injection set values, various operations and variables.

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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.
	Others	• Excessive wear of pistons, rings, or cylinders.	• Replace the ring or the piston and boring or replace the cylinder.
• 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.	

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Inspection Before Disassembly and Reassembly

Preparations and Preceding Works

1. Remove the cylinder block drain plug and seal and completely drain the residual coolant from the cylinder block.

Tightening torque	30 Nm
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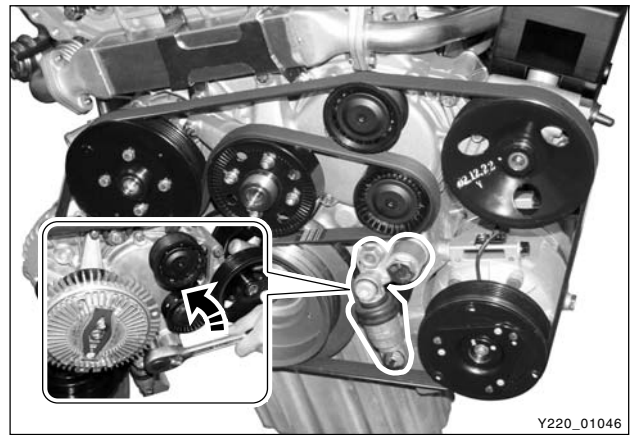
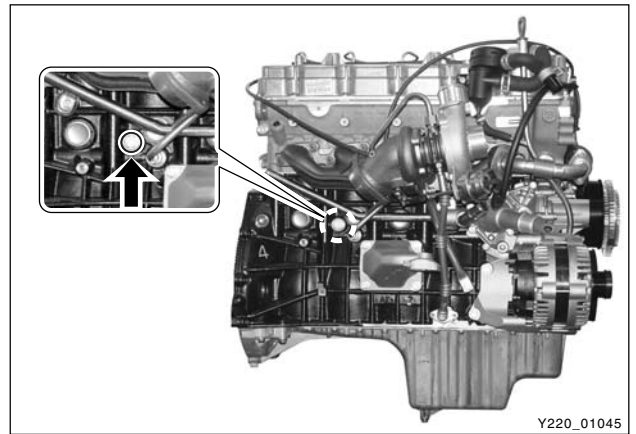
Notice

Replace the seal with new one once removed.

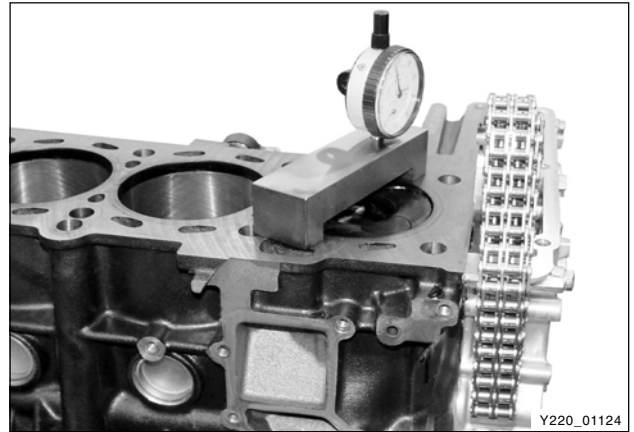
2. When the fan belt is installed, gently pump the belt shock absorber mounting bolt (M19) 3 times.
3. Take off the fan belt while pushing the mounting bolt (M19).

4. Loosen the oil drain plug and completely drain the engine oil.

Drain plug	25 ± 2.5 Nm
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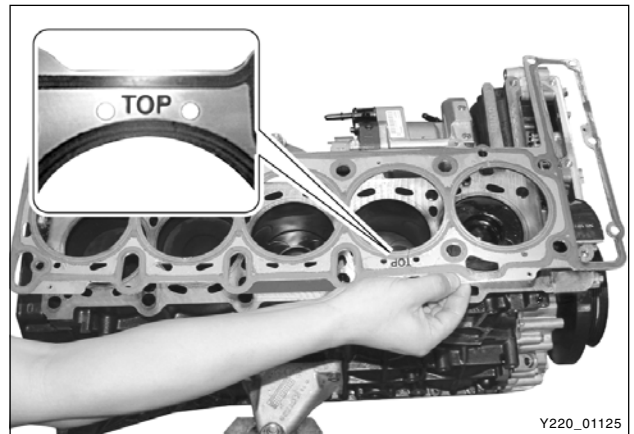
32. Measure the piston protrusion from the parting surface.
- Specified Value: 0.765 ~ 1.055 mm



33. Remove the cylinder head gasket.

Installation Notice

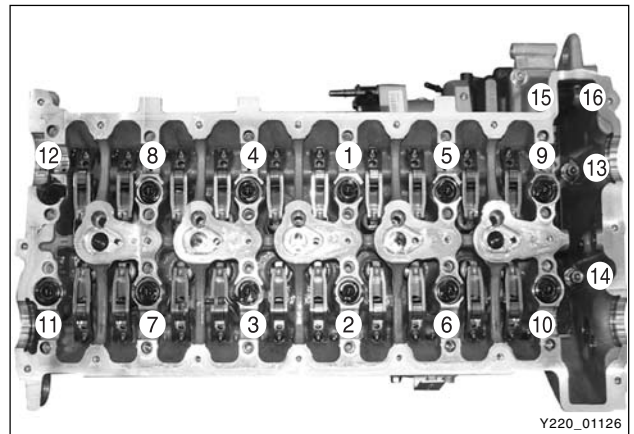
- Replace the cylinder head gasket with new one. Make sure to place the "TOP" mark upward.
- Put the steel gasket on the cylinder block and position the cylinder head.



- Tighten the cylinder head bolts to specified torque and torque angle.

Tightening torque	Step 1	20 ± 2.0 Nm
	Step 2	85 ± 5.0 Nm
	Step 3	90 ± (3 times) + 10°

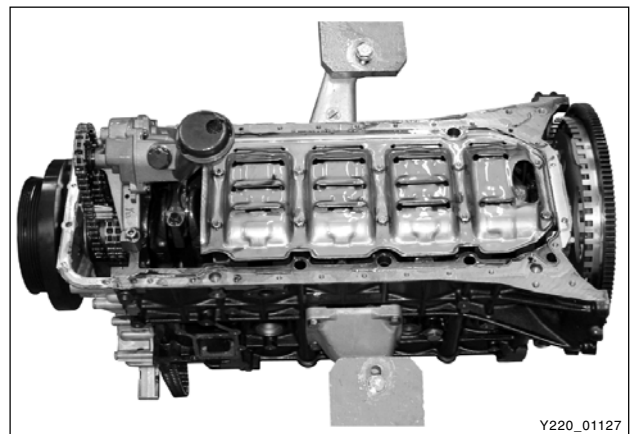
- Apply the oil on the bolt thread when installing.
- Always insert new washer first.
- The bolts (12) at vacuum pump side are shorter than others.



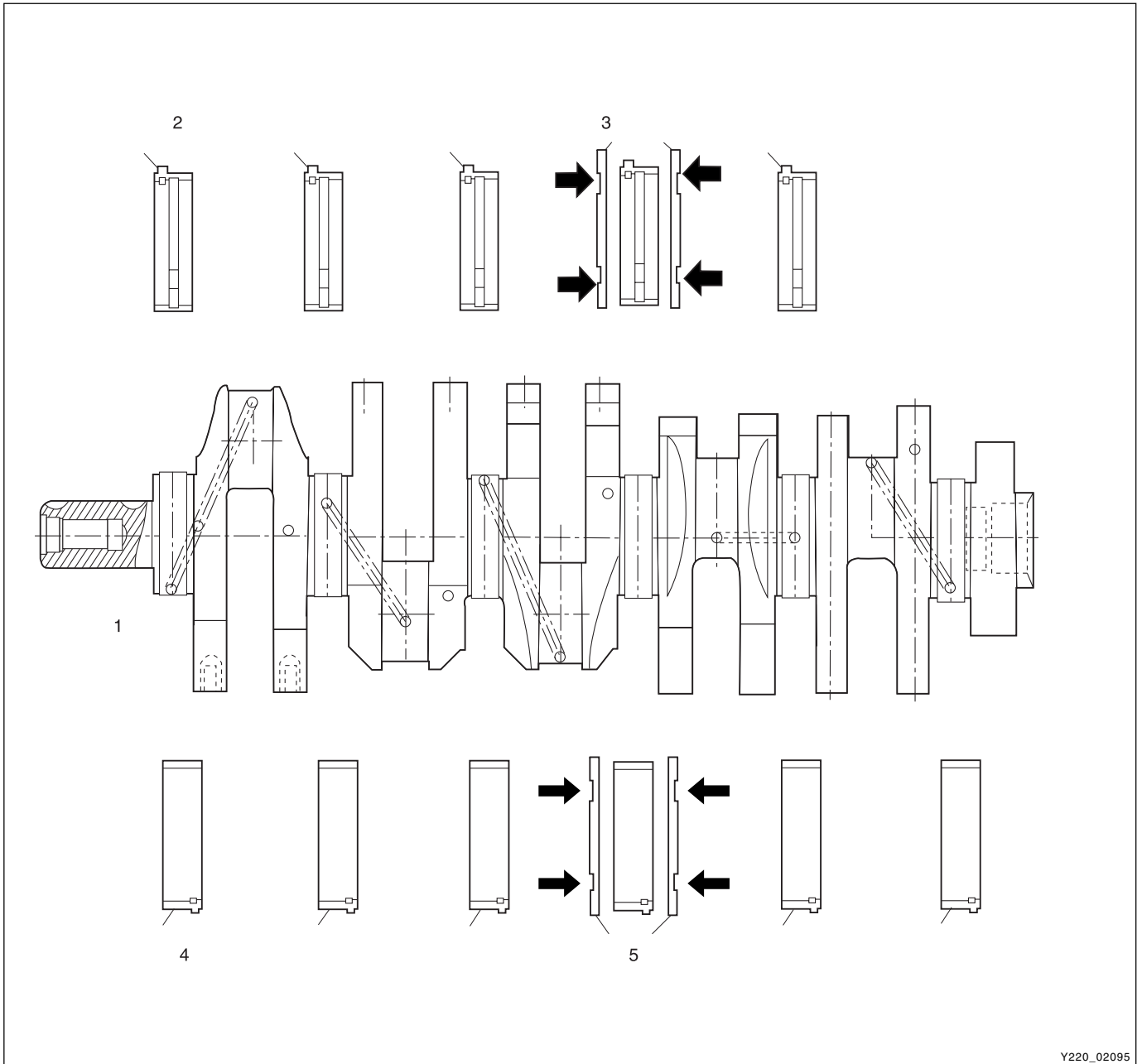
34. Turn over the engine and remove the baffle plate.

Installation Notice

Tightening torque	10 ± 1.0 Nm
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ARRANGEMENT OF THRUST WASHERS AND BEARINGS



Y220_02095

- 1. Crankshaft
- 2. Crankshaft main bearing shells, upper
- 3. Upper thrust bearing
- 4. Crankshaft main bearing shells, lower
- 5. Lower thrust bearing

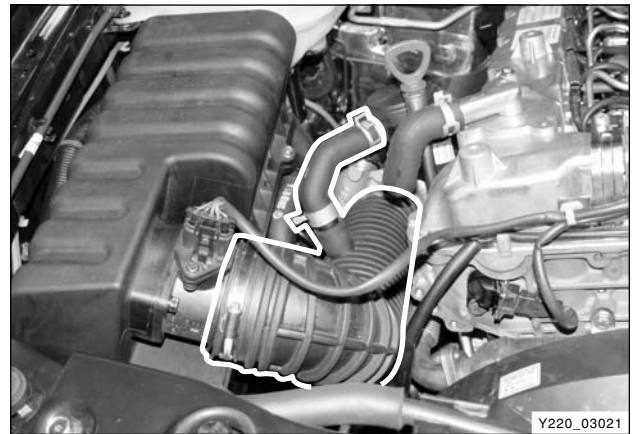
Notice

The clearance between bearing shell and bore and between bearing shell and journal are various. Refer to the table on next page to select bearings when installing.

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Intake Air Inlet Duct (Air Cleaner) - Removal and Installation

1. Loosen the clamp at intercooler side.
2. Loosen the clamp at turbo charger side.
3. Separate the hose from the oil separator and remove the intake duct.
4. Install in the reverse order of removal.



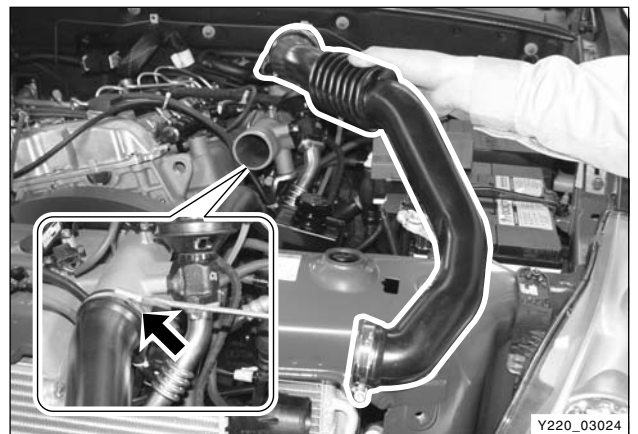
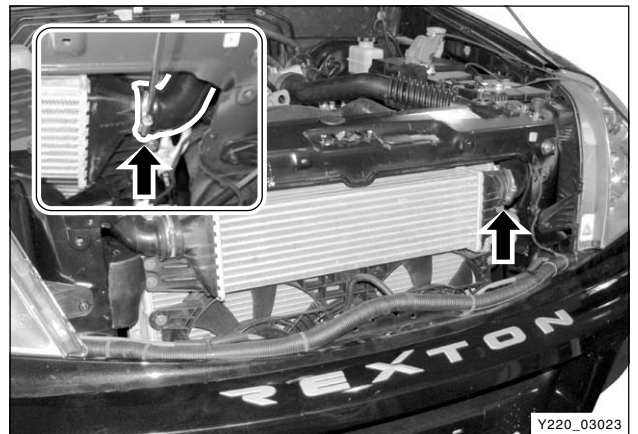
Intake Air Inlet Duct (Intake Manifold) - Removal and Installation

1. Loosen the clamp on the inlet hose in intercooler.
2. Loosen the clamp at the intake manifold and remove the inlet hose.

Installation Notice

Tightening torque	6 ~ 7 Nm
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3. Install in the reverse order of removal.



► Diagnosis and Maintenance for Turbo Charger System

Cautions During Driving

The following lists cautions to take during test drive and on the turbo charger vehicle, which must be considered during the operation;

1. It's important not to drastically increase the engine rpm starting the engine. It could make rotation at excessive speed even before the journal bearing is lubricated and when the turbo charger rotates in poor oil supply condition, it could cause damage of bearing seizure within few seconds.
2. If the engine is running radically after replacing the engine oil or oil filter brings poor oil supply condition. To avoid this, it's necessary to start off after idling the engine for about 1 minute allowing oil to circulate to the turbo charger after the replacement.
3. When the engine is stopped abruptly after driving at high speed, the turbo charger continues to rotate in condition where the oil pressure is at '0'. In such condition, an oil film between the journal bearing and the housing shaft journal section gets broken and this causes abrasion of the journal bearing due to the rapid contact. The repeat of such condition significantly reduces life of the turbo charger. Therefore, the engine should be stopped possibly in the idle condition.

Notice

After string for long period of time during winter season or in the low temperature condition where the fluidity of engine oil declines, the engine, before being started, should be cranked to circulate oil and must drive after checking the oil pressure is in normal condition by idling the engine for few minutes.

Inspection of Turbo Charger

When problem occurs with the turbo charger, it could cause engine power decline, excessive discharge of exhaust gas, outbreak of abnormal noise and excessive consumption of oil.

1. Inspection when installed
 - Check the bolts and nuts for looseness or missing
 - Check the intake and exhaust manifold for looseness or damage
 - Check the oil supply pipe and drain pipe for damages
 - Check the housing for crack and deterioration
2. Inspection of turbine in turbo charger

Remove the exhaust pipe at the opening of the turbine and check, with a lamp, the existence of interference of housing and wheel, oil leakage and contamination (at blade edge) of foreign materials.

- Interference: In case where the oil leak sign exists, even the small traces of interferences on the turbine wheel mean, most of times, that abrasion has occurred on the journal bearing. Must inspect after overhauling the turbo charger.
- Oil Leakage: Followings are the reasons for oil leakage condition;
 - Problems in engine: In case where the oil is smeared on inner wall section of the exhaust gas opening.
 - Problems in turbo charger: In case where the oil is smeared on only at the exhaust gas outlet section.

Notice

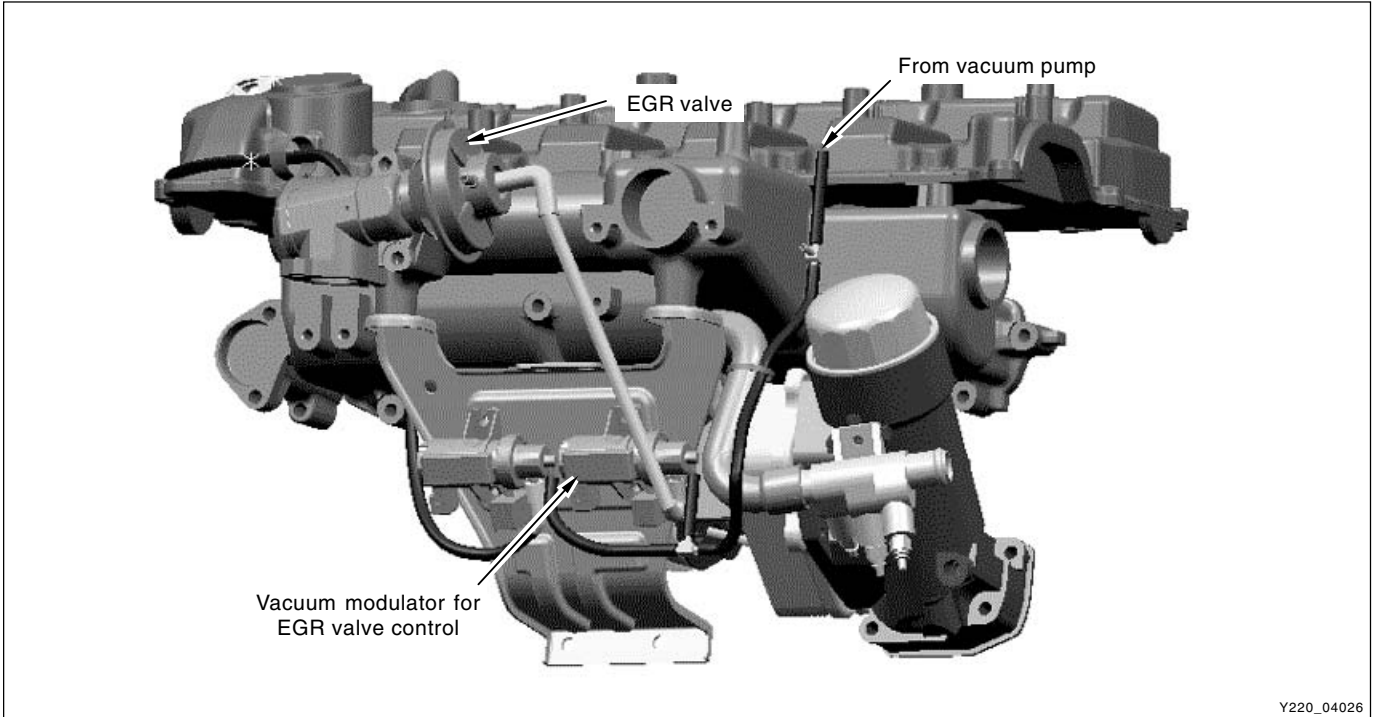
Idling for long period of time can cause oil leakage to the turbine side due to low pressure of exhaust gas and the rotation speed of turbine wheel. Please note this is not a turbo charger problem.

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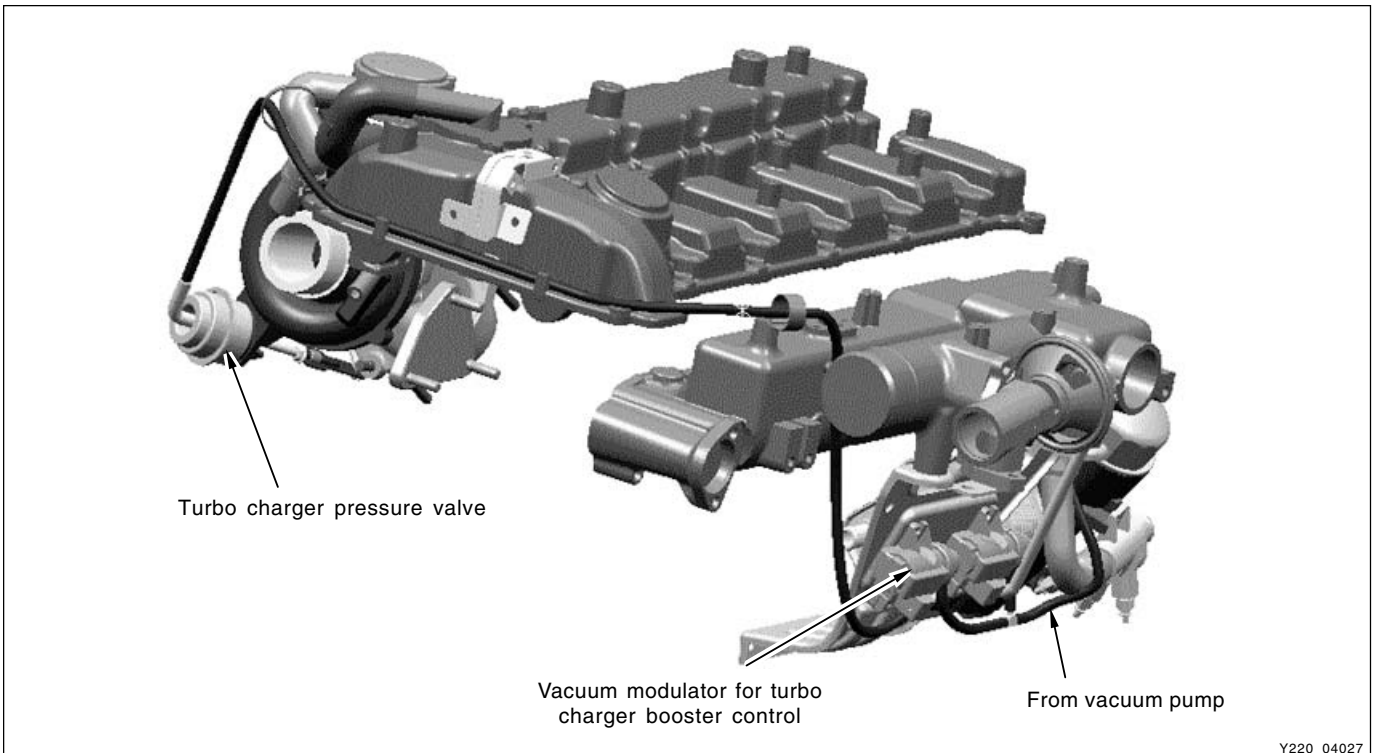
► Vacuum Modulator and Vacuum Hose

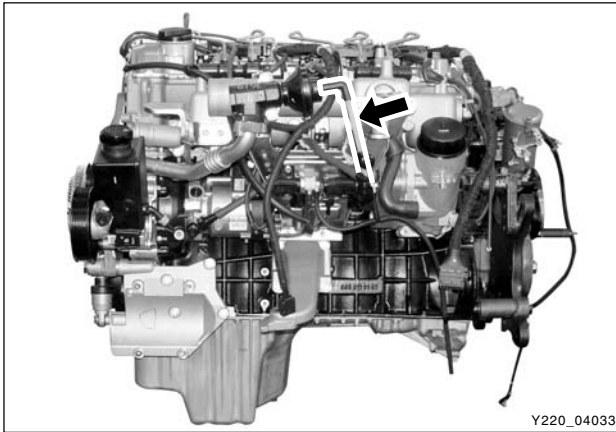
Below figures illustrate vacuum hoses and related parts of EGR or turbo where wrong or poor connection of vacuum hose would display condition of engine irregularity and defect diagnostic codes on the scan tool.

Related with EGR valve



Related with turbo charger actuator

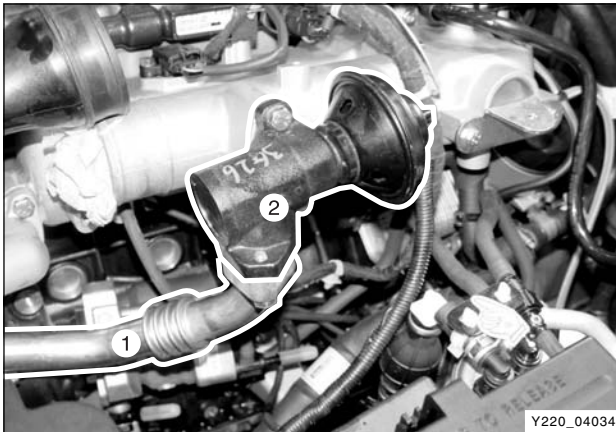




Y220_04033

EGR Valve and Pipe - Removal and Installation

1. Remove the vacuum hose from the EGR valve.



Y220_04034

2. Unscrew the bolts and remove the EGR valve (2), EGR valve #1 pipe (1) and gasket.

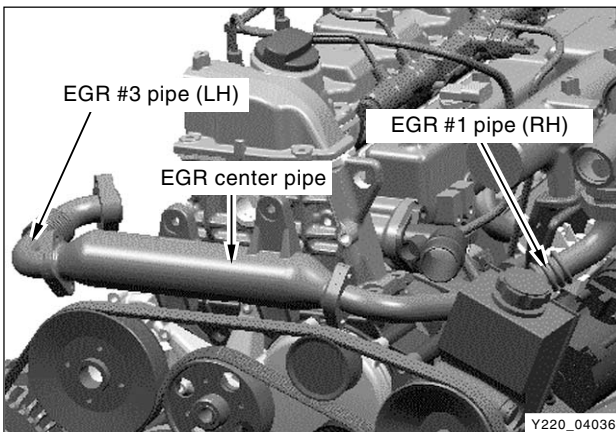
Tightening torque	25 ± 2.5 Nm
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Y220_04035

3. Remove the EGR valve #1 pipe, #2 pipe, #3 pipe and gaskets from the engine.

Tightening torque	25 ± 2.5 Nm
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Y220_04036

4. Install in the reverse order of removal.

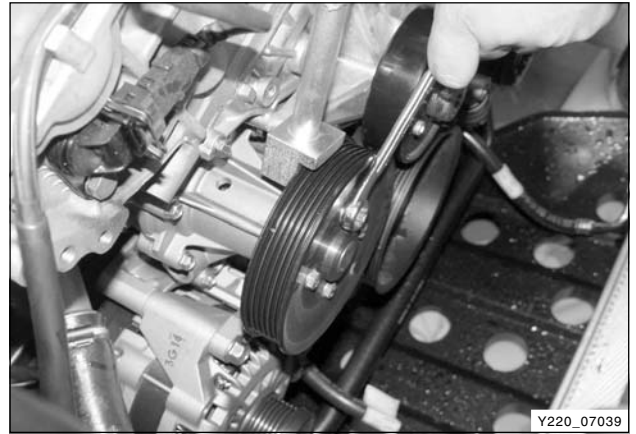
Notice

- **Make sure to observe the specified tightening torques.**
- **Never reuse the EGR #1 pipe (intake) and #3 pipe (exhaust) once removed.**
- **Replace the gaskets with new ones.**

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5. Unscrew the bolts and remove the belt pulley while holding the belt pulley with a special tool.

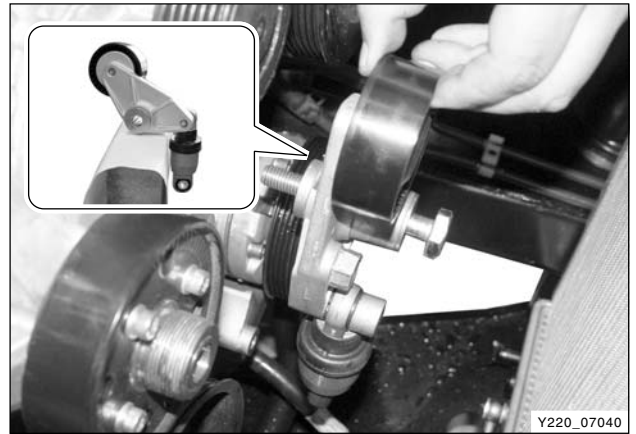
Tightening torque	10 ± 1.0 Nm
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Y220_07039

6. Unscrew the upper and lower bolts and remove the auto tensioner.

Tightening torque	Nm
Upper bolt	82 ± 6.0 Nm
Lower bolt	32 ± 3.0 Nm



Y220_07040

Notice

To prevent oil leaks, store the removed auto tensioner in upright position.

7. Unscrew the bolts and remove the idle pulley.

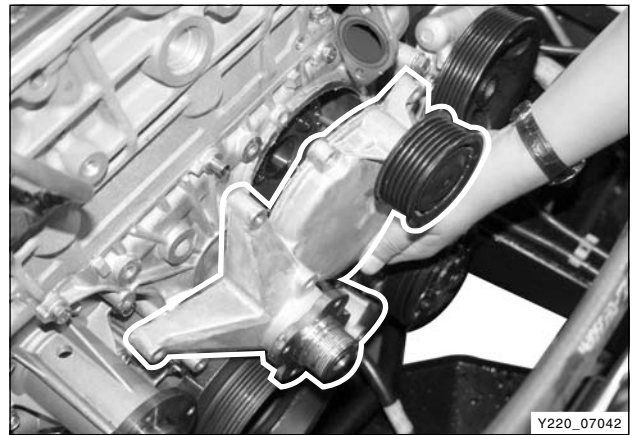
Tightening torque	10 ± 1.0 Nm
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Y220_07041

8. Unscrew the bolts and remove the cooling fan bracket (timing chain cover side).

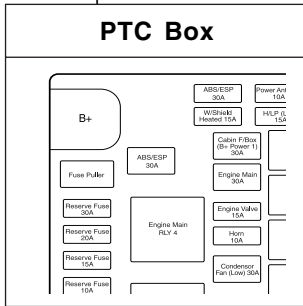
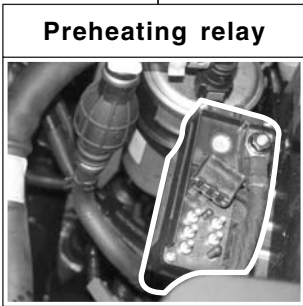
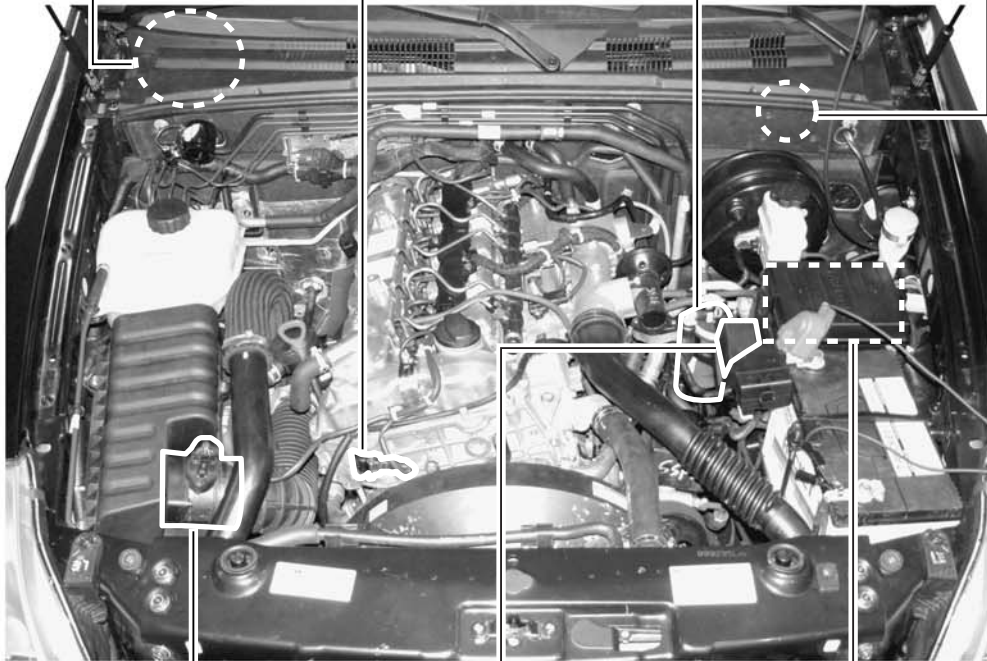
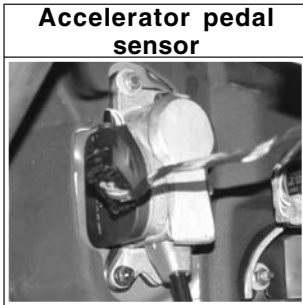
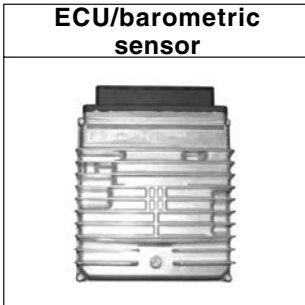
Tightening torque	10 ± 1.0 Nm
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Y220_07042

SENSORS FOR DIAGNOSIS

ENGINE ECU AND OTHER COMPONENTS



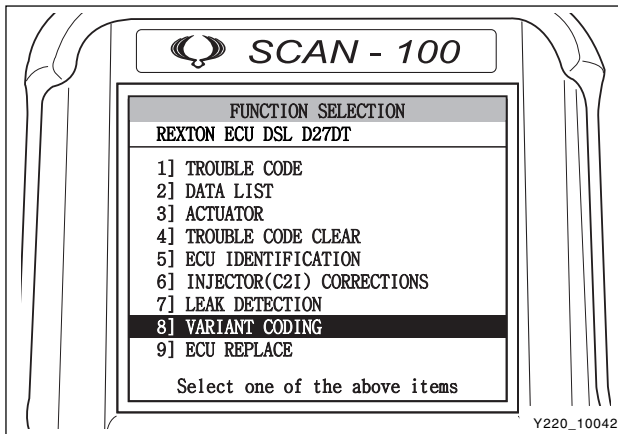
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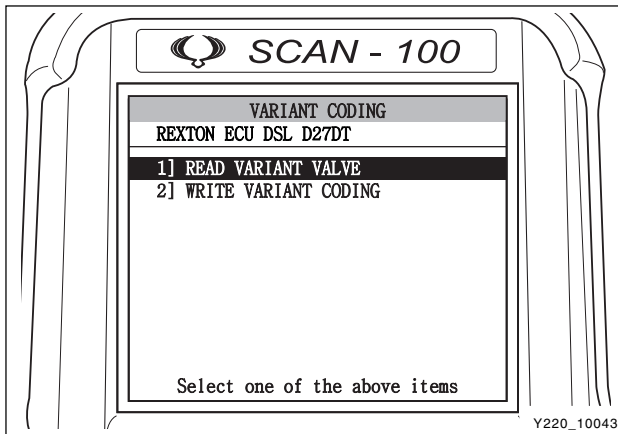


Variant Coding

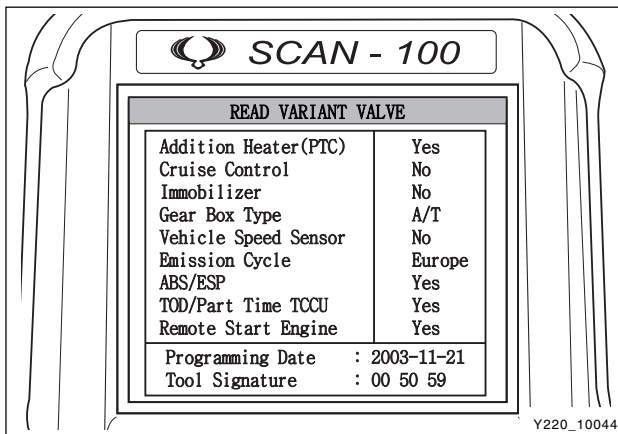
※ Preceding Work: Perform the “Entering Diagnosis Procedures”



1. Select “8] VARIANT CODING” and press “ENTER” in “FUNCTION SELECTION” screen.



2. When the “VARIANT CODING” screen is displayed, select “1] READ VARIANT VALVE” and press “ENTER”.



3. The “VARIANT CODING” screen that shows currently equipped devices is displayed.

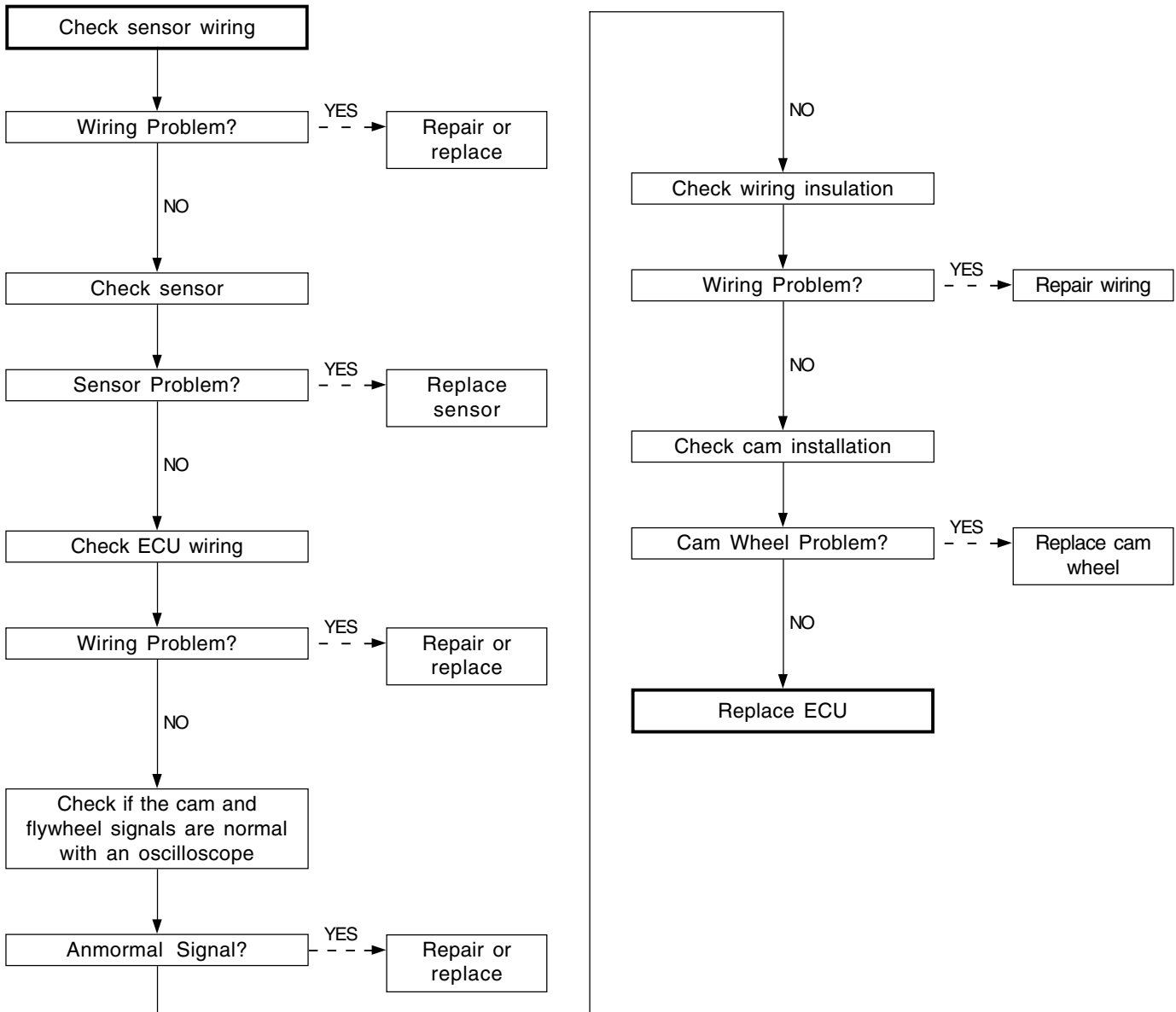
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Cam Position Sensor (missing event)

► Trouble Code and Symptom

Trouble Code		Symptom
P0344	Cam Position Sensor Malfunction	

► Diagnosis Procedures



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