



Engine Mechanical System

General Information



COMPRESSION PRESSURE

INSPECTION (J3 TCI DIESEL)

1. Warm up the engine upto the normal operating temperature, then stop the engine and disconnect the connector of fuel cut solenoid.
2. Remove all injection pipes, nozzles and washers.
3. Attach the SST to the nozzle hole.
4. Measure the compression pressure during cranking.

Engine mode		J3 TCI Diesel
Item	Normal	426.6 (2943, 30)-200
	Limit	383.9 (2649, 27)-200
Cylinder-to-cylinder pressure difference psi (kPa, kg/cm ²)		below 42.7 (294, 3.0)

5. Do above step 3~4 again for each cylinder.
6. If the measure value is below the limit, consider it as abrasion or damage of piston and piston ring, misalignment of valve, damage of gasket, and etc..

INSPECTION (COMMON RAIL SYSTEM)

1. Warm up the engine upto the normal operating temperature, then stop the engine and disconnect the fuel inlet and return hoses (between fuel filter and high pressure pump) in fuel filter side.
2. To drain fuel in high pressure pump, crank the engine.

CAUTION

Put return fuel from return hose into container

3. Remove all injection pipes, injectors and washers.
4. to the injector hole.
5. Measure the compression pressure during cranking.

Engine mode		J3 TCI COMMON RAIL SYSTEM
Item	Normal	426.6 (2943, 30)-200
	Limit	383.9 (2649, 27)-200
Cylinder-to-cylinder pressure difference psi (kPa, kg/cm ²)		below 42.7 (294, 3.0)

6. Do above step 4-5 again for each cylinder.
7. If the measure value is below the limit, consider it as abrasion or damage of piston and piston ring, misalignment of valve, damage of gasket, and etc.

IDLE SPEED (EXCEPT FOR COMMON RAIL SYSTEM)

PREPARATION

1. Warm up the engine up to the normal operating temperature.
2. Operate the engine at idle.
 - (1) Put the change lever in neutral position.
 - (2) Put the steering in neutral.

(3) Turn the ignition switch OFF.

3. Check if the deflection of accelerator cable is within the specification.
(Refer to Intake and exhaust system)

Deflection of accelerator cable:
0.04~0.12 in (1~3 mm)

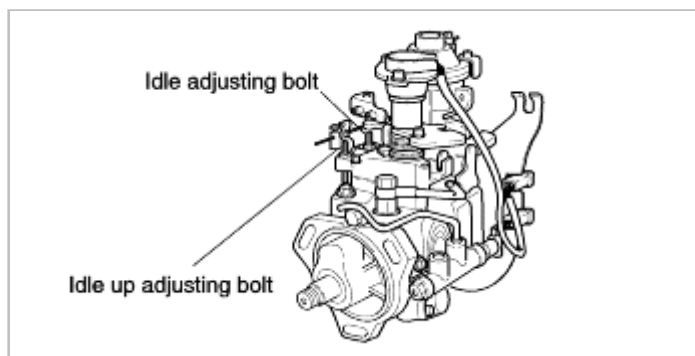
INSPECTION / ADJUSTMENT

1. Measure the engine idle speed by using a tachometer or rpm gauge.

Idle speed: 830 ± 20 rpm (A/con off)

2. If idle speed is not within specified range, loosen lock nut of idle adjusting bolt and adjust idling by turning idle adjusting bolt.

Tightening torque:
4.41~6.64 lb-ft (6~9 N·m, 61.0~91.8 kg-cm)



NOTICE

Idle speed will increase when adjusting bolt is turned clockwise; it will decrease when adjusting bolt is counter clockwise.

IDLE UP SPEED (EXCEPT FOR COMMON RAIL SYSTEM)

1. Check and adjust the idle speed.
2. Start the engine and turn the air conditioner switch ON.
3. Check that the idle speed is within the specified range.

Idle up speed: 880 ± 40 rpm

4. If idle up speed is not within specified range, loosen lock nut of idle up adjusting bolt and adjust idling by turning idle up adjusting bolt.

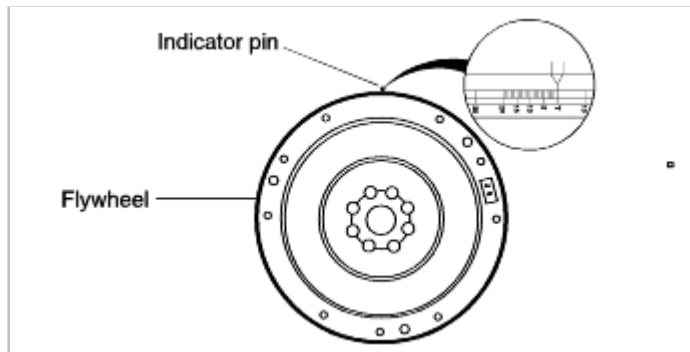
Tightening torque:
4.41~6.64 lb-ft (6~9 N·m, 61.0~91.8 kg-cm)

INJECTION TIMING (EXCEPT FOR COMMON RAIL SYSTEM)

INSPECTION /ADJUSTMENT

1. Rotate the crankshaft slowly, and align white mark on crankshaft pulley to TDC mark on timing cover or

align T mark on flywheel to indicator pin.

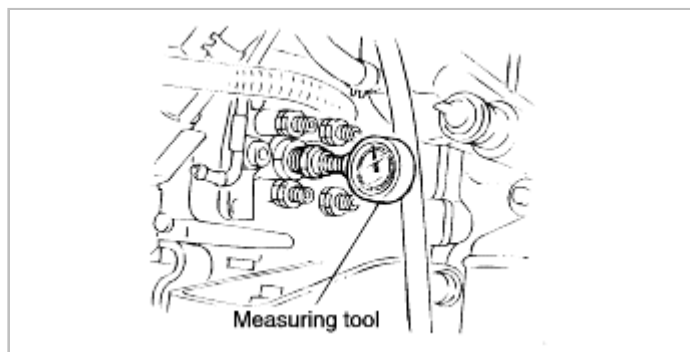


2. Remove the injection pipe between the injection pump and the nozzle.

3. .

CAUTION

- Be careful for fuel leak during removing the injection pump
- Install it so that the SST indicates about 0.0276 in (0.7 mm).



4. Rotate the crankshaft pulley in reverse to align it to BTDC 20°~30°.

5. Align the indicator of dial gauge to 0, rotate the crankshaft pulley in left and right, and then verify the position of indicator.

6. Rotate the crankshaft pulley again to align it to TDC and then check the dial gauge reading.
(Refer to step 1)

Lift amount: 0.0276 $\begin{smallmatrix} +0.0020 \\ -0.0039 \end{smallmatrix}$ in (0.7 $\begin{smallmatrix} +0.05 \\ -0.10 \end{smallmatrix}$ mm)

7. If the dial gauge reading exceeds the specification, loosen the stay bolt of injection pump.

8. Loosen the tightening nut for the injection pump by using a socket wrench.

9. Rotate the injection pump body so that the dial gauge indicates 0.0237~0.0296 in (0.6~0.75 mm) at TDC.

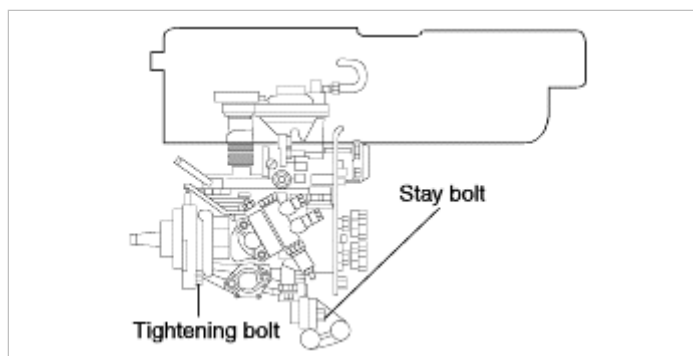
10. Tighten the stay bolt of injection pump and the tightening nut.

Tightening torque:

Tightening nut :11.6~15.9 lb-ft

(16~22 N·m, 1.6~2.2 kg-m)

Stay bolt :23.8~31.1 lb-ft (32~42 N·m, 3.3~4.3 kg-m)



11. .

12. Insert a cap after inserting a new gasket.

Tightening torque:

10.1~14.5 lb-ft (14~20 N·m, 1.4~2.0 kg-m)

13. Tighten the injection pipe temporarily and tighten the nuts(4EA) on the pump side.

Tightening torque:

19.17~24.23 lb-ft (25.9~32.8 N·m, 2.65~3.35 kg-m)

14. After starting the engine, check if there is any fuel leakage.

COMPRESSION PRESSURE

INSPECTION (J3 TCI DIESEL)

1. Warm up the engine upto the normal operating temperature, then stop the engine and disconnect the connector of fuel cut solenoid.
2. Remove all injection pipes, nozzles and washers.
3. Attach the SST to the nozzle hole.
4. Measure the compression pressure during cranking.

Engine mode		J3 TCI Diesel
Item	Normal	426.6 (2943, 30)-200
	Limit	383.9 (2649, 27)-200
Cylinder-to-cylinder pressure difference psi (kPa, kg/cm ²)		below 42.7 (294, 3.0)

5. Do above step 3~4 again for each cylinder.
6. If the measure value is below the limit, consider it as abrasion or damage of piston and piston ring, misalignment of valve, damage of gasket, and etc..

INSPECTION (COMMON RAIL SYSTEM)

1. Warm up the engine upto the normal operating temperature, then stop the engine and disconnect the fuel inlet and return hoses (between fuel filter and high pressure pump) in fuel filter side.
2. To drain fuel in high pressure pump, crank the engine.

CAUTION

Put return fuel from return hose into container

3. Remove all injection pipes, injectors and washers.
4. to the injector hole.
5. Measure the compression pressure during cranking.

Engine mode		J3 TCI COMMON RAIL SYSTEM
Item		
Compression pressure psi (kPs, kg/cm ²)-rpm	Normal	426.6 (2943, 30)-200
	Limit	383.9 (2649, 27)-200
Cylinder-to-cylinder pressure difference psi (kPa, kg/cm ²)		below 42.7 (294, 3.0)

6. Do above step 4-5 again for each cylinder.
7. If the measure value is below the limit, consider it as abrasion or damage of piston and piston ring, misalignment of valve, damage of gasket, and etc.

IDLE SPEED (EXCEPT FOR COMMON RAIL SYSTEM)

PREPARATION

1. Warm up the engine up to the normal operating temperature.
2. Operate the engine at idle.
 - (1) Put the change lever in neutral position.
 - (2) Put the steering in neutral.
 - (3) Turn the ignition switch OFF.
3. Check if the deflection of accelerator cable is within the specification.
(Refer to Intake and exhaust system)

Deflection of accelerator cable:
0.04~0.12 in (1~3 mm)

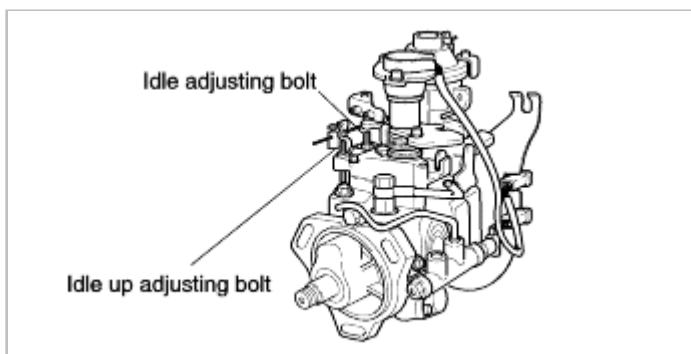
INSPECTION / ADJUSTMENT

1. Measure the engine idle speed by using a tachometer or rpm gauge.

Idle speed: 830 ± 20 rpm (A/con off)

2. If idle speed is not within specified range, loosen lock nut of idle adjusting bolt and adjust idling by turning idle adjusting bolt.

Tightening torque:
4.41~6.64 lb-ft (6~9 N·m, 61.0~91.8 kg-cm)



NOTICE

Idle speed will increase when adjusting bolt is turned clockwise; it will decrease when adjusting bolt is counter clockwise.

IDLE UP SPEED (EXCEPT FOR COMMON RAIL SYSTEM)

1. Check and adjust the idle speed.
2. Start the engine and turn the air conditioner switch ON.
3. Check that the idle speed is within the specified range.

Idle up speed: 880 ± 40 rpm

4. If idle up speed is not within specified range, loosen lock nut of idle up adjusting bolt and adjust idling by turning idle up adjusting bolt.

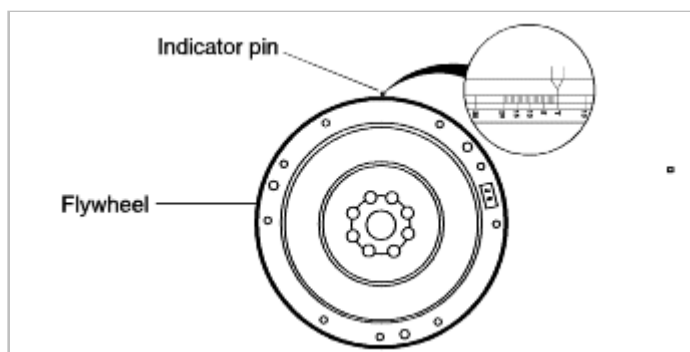
Tightening torque:

4.41~6.64 lb-ft (6~9 N·m, 61.0~91.8 kg-cm)

INJECTION TIMING (EXCEPT FOR COMMON RAIL SYSTEM)

INSPECTION /ADJUSTMENT

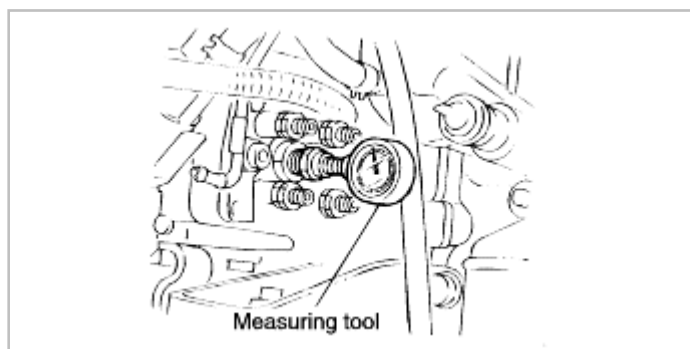
1. Rotate the crankshaft slowly, and align white mark on crankshaft pulley to TDC mark on timing cover or align T mark on flywheel to indicator pin.



2. Remove the injection pipe between the injection pump and the nozzle.
3. .

CAUTION

- Be careful for fuel leak during removing the injection pump
- Install it so that the SST indicates about 0.0276 in (0.7 mm).



4. Rotate the crankshaft pulley in reverse to align it to BTDC 20°~30°.
5. Align the indicator of dial gauge to 0, rotate the crankshaft pulley in left and right, and then verify the position of indicator.
6. Rotate the crankshaft pulley again to align it to TDC and then check the dial gauge reading.
(Refer to step 1)

Lift amount: 0.0276 ^{+0.0020}_{-0.0039} in (0.7 ^{+0.05}_{-0.10} mm)

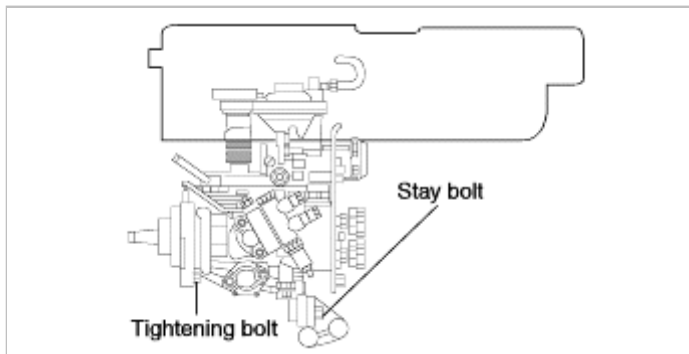
7. If the dial gauge reading exceeds the specification, loosen the stay bolt of injection pump.
8. Loosen the tightening nut for the injection pump by using a socket wrench.
9. Rotate the injection pump body so that the dial gauge indicates 0.0237~0.0296 in (0.6~0.75 mm) at TDC.
10. Tighten the stay bolt of injection pump and the tightening nut.

Tightening torque:

Tightening nut :11.6~15.9 lb-ft

(16~22 N·m, 1.6~2.2 kg-m)

Stay bolt :23.8~31.1 lb-ft (32~42 N·m, 3.3~4.3 kg-m)



11. .
12. Insert a cap after inserting a new gasket.

Tightening torque:

10.1~14.5 lb-ft (14~20 N·m, 1.4~2.0 kg-m)

13. Tighten the injection pipe temporarily and tighten the nuts(4EA) on the pump side.

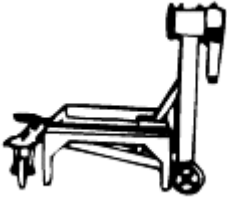
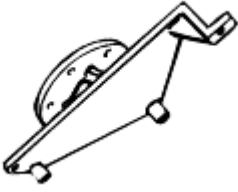
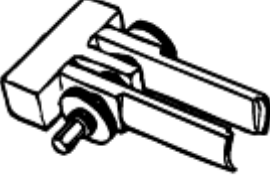
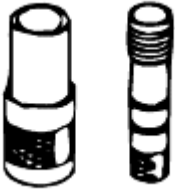
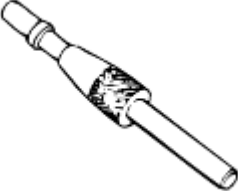
Tightening torque:


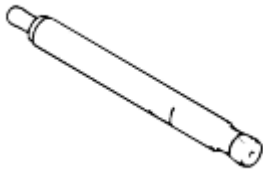



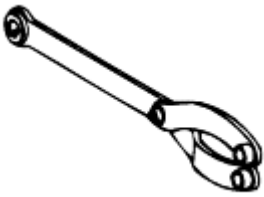
19.17~24.23 lb-ft (25.9~32.8 N·m, 2.65~3.35 kg-m)


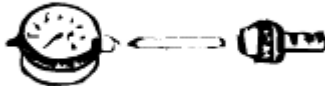
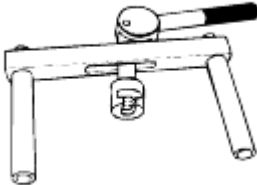

14. After starting the engine, check if there is any fuel leakage.



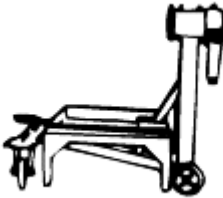
Special service tools

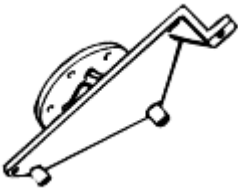
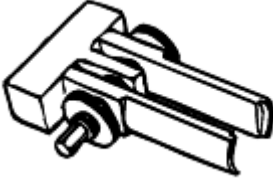
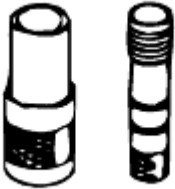
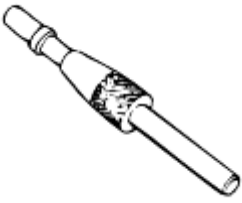

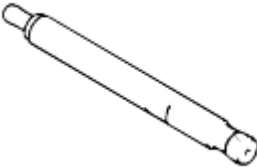
Tool(Number and Name)	Illustration	Use
OK130 990 007 Engine stand		Used to disassemble and assemble engine.
OK410 010 004 Hanger, engine stand		Used to disassemble and assemble engine.
OK993 120 004 Pivot, valve spring lifter		Used to remove and install valve.
OK710 120 004 Installer, valve seal		Used to install valve seal.
OK130 160 010 Centering tool, clutch disc		Used to install clutch disc and clutch cover.

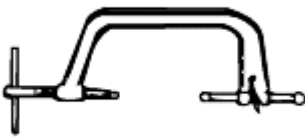


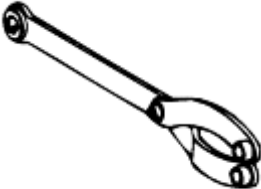

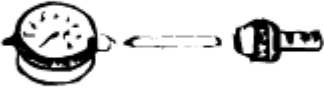
OK552 111 001 Pivot, valve spring lifter		Holder, camshaft pulley.
OK552 131 002 Adapter, compression gauge		Used to measure compression pressure.
OK993 120 001 Arm, valve spring lifter		Used to remove and install vale.
OK993 120 006 Remover, valve seal		Remover, valve seal
OK590 111 001 Ring gear brake set		Used to prevent engine rotation.
09517 - 21700 End yoke holder		Used to remove crankshaft pulley bolt. (With 09231-H1000)

09231 - H1000 Crankshaft pulley adapter		Used to remove crankshaft pulley bolt. (With 09517-21700)
0K670 130 010 (Except for common rail system) Measuring device cam lift		Used to measure cam lift amount.
09351 - H1000 Injector remove		Used to remove injector.
0K670 140 015 Oil pressure gauge		Used to inspect oil pressure.

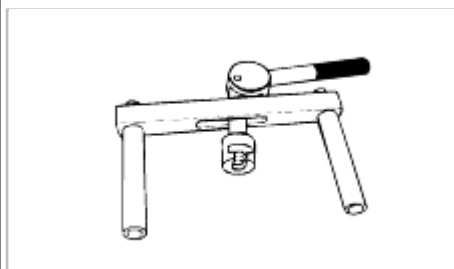
Special service tools

Tool(Number and Name)	Illustration	Use
0K130 990 007 Engine stand		Used to disassemble and assemble engine.

OK410 010 004 Hanger, engine stand		Used to disassemble and assemble engine.
OK993 120 004 Pivot, valve spring lifter		Used to remove and install valve.
OK710 120 004 Installer, valve seal		Used to install valve seal.
OK130 160 010 Centering tool, clutch disc		Used to install clutch disc and clutch cover.
OK552 111 001 Pivot, valve spring lifter		Holder, camshaft pulley.
OK552 131 002 Adapter, compression gauge		Used to measure compression pressure.

OK993 120 001 Arm, valve spring lifter		Used to remove and install vale.
OK993 120 006 Remover, valve seal		Remover, valve seal
OK590 111 001 Ring gear brake set		Used to prevent engine rotation.
09517 - 21700 End yoke holder		Used to remove crankshaft pulley bolt. (With 09231-H1000)
09231 - H1000 Crankshaft pulley adapter		Used to remove crankshaft pulley bolt. (With 09517-21700)
OK670 130 010 (Except for common rail system) Measuring device cam lift		Used to measure cam lift amount.

09351 - H1000
Injector remove



Used to remove injector.

0K670 140 015
Oil pressure gauge



Used to inspect oil pressure.



Troubleshooting guide

Engine

Problem	Possible cause	Action to be taken
Insufficient power smoke generation	Insufficient compression caused by: 1. Contaminated air cleaner element 2. Loose hose connection between compressor and intercooler 3. Leakage from intake manifold 4. Leakage from exhaust manifold 5. Leakage from turbo charger mounting flange 6. Interference between turbo charger compressor turbine and case 7. Blocked duct between air cleaner and turbo charger compressor 8. Blocked duct between compressor and intake manifold 9. Interference between intake and exhaust manifolds 10. Leakage from valve seat 11. Seized valve stem 12. Weak or broken valve spring 13. Failed cylinder head gasket 14. Cracked or distorted cylinder head 15. Sticking, damaged, or worn piston ring 16. Cracked or worn piston	
	Malfunction of fuel system	Refer to section FL, fuel system
	Slipping clutch	Refer to section CH, clutch
	Wrong tire size	Refer to section SS, wheel and tires
	Restricted exhaust system	Refer to exhaust system
Excessive oil consumption	Abnormal engine oil viscosity	Replace
	Leakage from turbo charger compressor (adhesion of oil to housing or wheel)	Repair
	Leakage turbo charger turbine	Repair
	Worn or sticking piston ring or groove	Replace
	Worn piston or cylinder	Repair or replace
	Bad valve seal	Replace
	Worn valve stem or guide	Replace
Engine cranks normally, but does not start	Malfunction of fuel system	Refer to section FL, fuel system
	Malfunction of electrical system	Refer to starting system

	Restricted exhaust system	Refer to exhaust system
	Timing belt and/or related parts	Replace
	Low compression	
	Camshaft worn	Replace
Blue smoke out of exhaust	Usually caused by oil burning in the combustion chamber from: worn rings, worn valve guides, worn valve seals or failed cylinder head gasket	Replace
	Contaminated air cleaner element	Replace
	Loose hose connection between compressor and intercooler	Tighten
	Leakage from intake manifold	Repair
	Blocked oil filter	Replace
	Blocked duct between air cleaner and turbo charger compressor	Repair
	Leakage from turbo charger compressor	Repair
White smoke out of exhaust	Usually caused by water vapor, which is a normal by product of combustion on cold days.	None required
	Excessive white smoke with engine warmed up could be caused by a failed cylinder head or intake gasket, could also be cracked block, cylinder head or intake manifold.	Repair or replace
Black smoke out of exhaust	Malfunction of fuel system	Refer to section FL, fuel system
	Malfunction of emission system	Refer to emission control system
Abnormal combustion	Sticking or burned valve	Replace
	Weak or broken valve spring	Replace
	Carbon accumulation in combustion chamber	Eliminate the carbon
Poor idling	Malfunction of fuel system	Refer to section FL, fuel system
	Malfunction of emission system	Refer to emission control system
	Uneven cylinder compression	Repair
	Poor valve to valve seat contact	Repair or replace
	Broken valve spring	Repair
	Failed cylinder head gasket	Replace
Turbo charger noise	Contaminated air cleaner element	Replace
	Foreign material in intake duct or compressor housing	Clean
	Foreign material between intake manifold and compressor	Clean

	Foreign material in engine exhaust system	Clean
	Carbon deposit on turbine housing	Clean
	Interference between turbo charger rotating parts	Repair or replace
	Loose connecting parts of intake and exhaust system	Tighten
Engine knocks when hot and at idle	Loose or worn accessory drive belt/tensioner	Replace if necessary
	Improper oil viscosity	Install proper oil viscosity for expected temperature
	Excessive piston pin clearance	Install new piston pin and/or connecting rod
	Connecting rod alignment	Check and replace
	Insufficient piston to bore clearance	Hone and fit new pistons
	Faulty timing belt tensioner or guide	Replace
	Loose damper pulley	Tighten or replace
Slight noise at idle, becomes louder as engine speed is increased	Valve spring clicking on cap, off square or broken	Repair or replace
	Excessive stem to guide clearance	Repair
	Excessive valve seat runout	Repair
	Holed exhaust pipe	Replace
Engine knocks when cold	Excessive piston to wall clearance	Replace
	Loose or broken damper pulley	Tighten or replace
Knock increase with torque	Excessive piston to bore clearance	Replace piston
	Bent connecting rod	Replace
Engine has heavy knock when hot and torque is applied	Broken damper pulley	Replace
	Accessory belts too tight or damaged	Adjust or replace belt
	Belt tensioner damaged	Replace
	Flywheel cracked or loose clutch plate	Replace flywheel or clutch plate
	Excessive main bearing clearance	Repair
	Excessive rod bearing clearance	Repair
Engine has light knock when hot and under light load conditions	Improper timing	Check timing
	Piston pin and/or connecting rod	Replace
	Poor quality fuel	Replace
	Exhaust leak at manifold	Tighten or replace
	Excessive rod bearing clearance	Repair
Engine knocks during initial start up and lasts only a few seconds	Improper oil viscosity	Install proper oil viscosity for expected temperature

Interference of turbo charger, poor rotation	Damaged compressor blades due to external cause	Repair or replace
	Interference of turbine and compressor blades with housing	Repair or replace
	Excessive deposit on compressor housing or wheel	Clean or repair
	Excessive carbon deposit on the back of turbine blade	Clean or repair
	Burn out of center housing	Replace
Leakage from turbo charger turbine shaft	Excessive initial oil applying	Burn it normally
	Blocked crankcase breather	Repair
	Obstacle in turbo charger oil drain line	Clean and repair
	Burn out of center housing	Clean and replace
	Wear on turbo charger bearing, bearing bore or shaft journal	Repair or replace
	Excessive crankcase oil	Correct oil amount
Leakage from turbo charger compressor	Contaminated air cleaner element	Replace
	Blocked duct between compressor and air cleaner	Repair
	Loose compressor and intake system connecting duct	Tighten
	Leakage from intake manifold	Repair
	Obstacle in turbo charger oil drain line	Repair or replace
	Blocked blowby passage in crankcase	Repair
	Worn or damaged compressor blades	Clean or replace
	Wear on turbo charger bearing bore, bearing or shaft journal	Replace
Wear on turbo charger bearing, bore or shaft journal	Contaminated oil	Replace
	Insufficient oil supply	Check
	Obstacle in turbo charger oil supply line	Check and repair
	Plugged oil filter	Replace
	Poor oil pump operation	Check and repair

LUBRICATION SYSTEM

Problem	Possible cause	Action
Engine hard starting	Improper engine oil	Replace
	Insufficient engine oil	Add oil
Excessive oil	Internal engine wear	Refer to main moving system

consumption	Oil leak	Repair
Oil pressure drop	Insufficient oil	Add oil
	Oil leakage	Repair
	Worn and/or damaged oil pump gear	Replace
	Worn plunger (inside oil pump) or weak spring	Replace
	Clogged oil strainer	Clean
	Excessive main bearing or connecting rod bearing clearance	Refer to main moving system
Warning lamp illuminates while engine is running	Oil pressure drop	As described above
	Malfunction of oil pressure switch	Inspect oil pressure switch
	Malfunction of electrical system	Inspect electrical system

COOLING SYSTEM

Problem	Possible cause	Action
Overheating	Coolant level insufficient	Add
	Coolant leakage	Repair
	Radiator fins clogged	Clean
	Radiator cap malfunction	Replace
	Fan motor malfunction	Replace
	Thermostat malfunction	Replace
	Water passage clogged	Clean
	Water pump malfunction	Replace
Corrosion	Impurities in coolant	Replace



Specification

Engine

Engine model			J3 TCI Common rail system	J3 TCI
Item				
Type			Diesel, 4-Cycles	
Number of cylinders			4-Cylinder in-line	
Combustion chamber			Re-entrant	
Displacement		cu-in (cc)	177 (2902)	
Bore and stroke		in (mm)	3.82 X 3.85 (97.1 X 98)	
Compression ratio			19.3	18.9
Compression pressure			psi(kpa, kg/cm ²)-rpm	
			426.6 (2943, 30) - 200	
Valve timing	Intake	Open	BTDC 26°	
		Close	ABDC 50°	
	Exhaust	Open	BBDC 50°	
		Close	ATDC 29°	
Valve clearance(cold engine) in(mm)		Intake	0 : Maintenance-free	
		Exhaust	0 : Maintenance-free	
Idle speed		rpm	800±100	880±40(A/con on), 830±20(A/con off)
Injection order			1-3-4-2	
Injection timing			-	TDC/0.0276 in (0.7 mm) Lift

Lubrication system

Engine model			J3 TCI Common rail system	J3 TCI
Item				
Lubrication system			Force-fed type	
Oil pump	Type		Trochoid gear	
	Relief pressure	psi(kpa, kg/cm ²)	78.2-92.4 (539-637, 5.5-6.5)	
Oil filter	Type		Full-flow type, Paper element	
	Relief pressure differential	psi(kpa, kg/cm ²)	11.4-17.1 (78-118, 0.8-1.2)	
Oil pressure switch activation pressure		psi(kpa, kg/cm ²)	2.8-4.9 (20-34, 0.2-0.35)	
Oil capacity	Total (dry engine)	Us qt (liter, Imp qt)	7.50 (7.1, 6.2)	
	Oil pan	Us qt (liter, Imp qt)	5.92 (5.6, 4.39)	
	Oil filter	Us qt (liter, Imp qt)	0.63 (0.6, 0.5)	
Engine oil			API service CF-4, CG-4 SEA 10W-30	API Service CD, SAE 10W-30

Cooling system

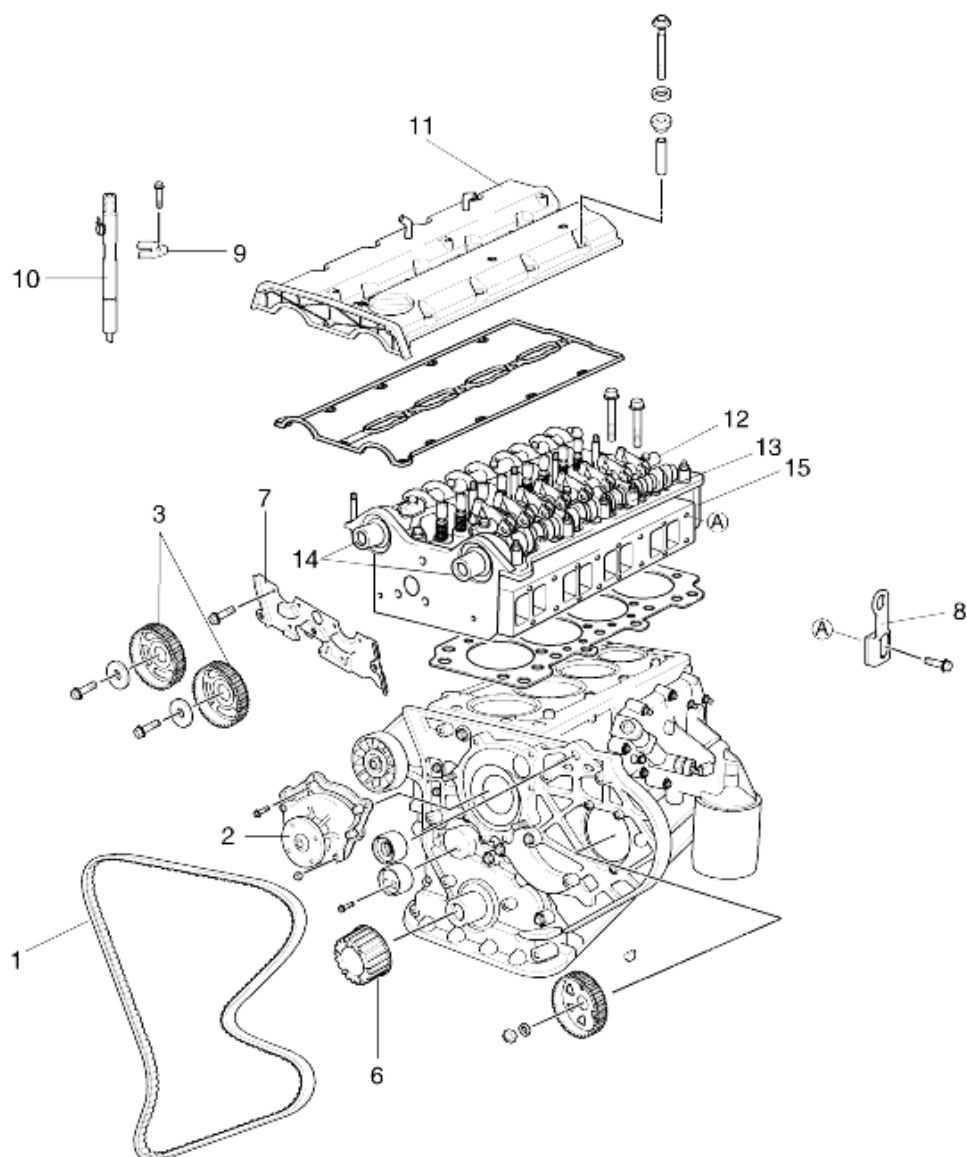
Item		Engine model	J3 TCI Diesel
Cooling system			Water-cooled, forced circulation
Cooling capacity		Us qt (liter, Imp qt)	9.93 (9.4, 8.27)
Water pump	Type		Centrifugal
Thermostat	Type		Wax
	Initial opening temperature	°F (°C)	187.7-193.1 (86.5-89.5)
	Full-open temperature	°F (°C)	212 (100)
Radiator	Full-open lift	in (mm)	0.33 (8.5) minimum
	Type		Corrugated fin
	Cap valve opening pressure	Psi (kPa, kg/cm ²)	10.7-14.9 (73.6-103.0, 0.75-1.05)
Cooling fan	Type		Electric
	Operating temperature	°F (°C)	Above 208.4 (98) - Low speed
			Above 221 (105) - High speed
	Number of blades		5
	Outer diameter	in (mm)	14.4 (366)

Engine Mechanical System

Timing System - Timing Chain



Component



1. Timing belt
2. Water pump
3. Camshaft pulley
4. Tensioner
5. Idler
6. Timing belt pulley
7. Upper plate assembly

8. Engine hanger
9. Injector bracket
10. Injector (Nozzle)
11. Cylinder head cover
12. Rocker arm shaft assembly
13. Camshaft cap
14. Camshaft
15. Cylinder head

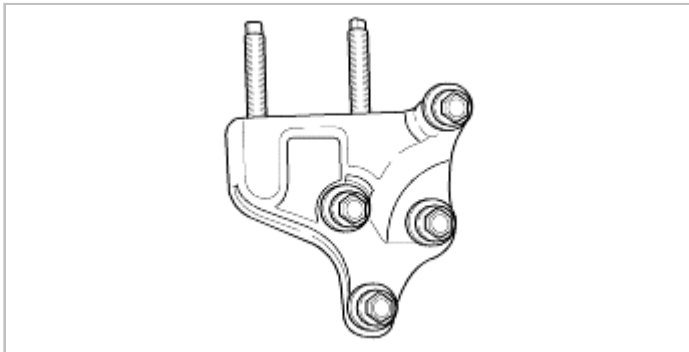


REMOVAL

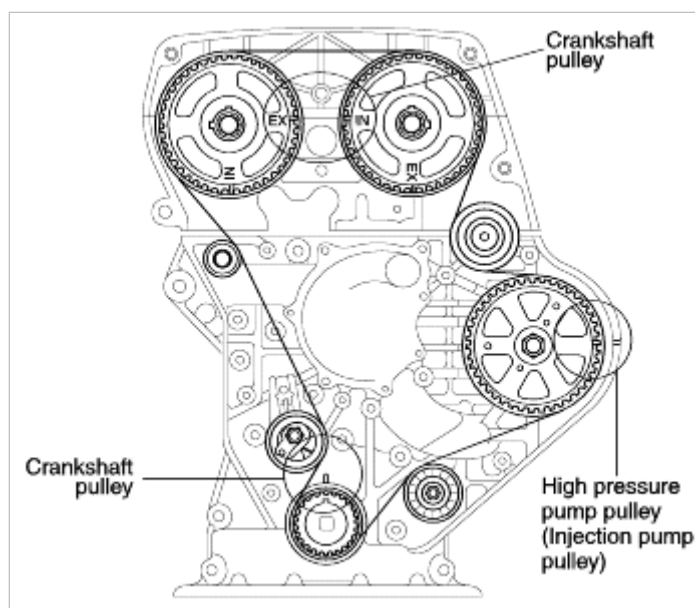
1. Raise vehicle and support it with safety stands.
2. Remove the radiator upper hose.
3. Remove the fuel filter hoses still connected.
4. Remove the No.3 engine mounting rubber.



5. Remove the No.3 engine mounting bracket.



6. Remove the RH side wheel.
7. Remove the A/C drive belt.
8. Remove the drive belt.(Refer to Drive belt replacement)
9. Remove the auto tensioner.
10. Remove the water pump pulley.
11. Remove the crankshaft pulley.
12. Remove the upper timing belt cover.
13. Remove the lower timing belt cover.
14. Rotate crankshaft and align timing mark on timing belt pulley with timing mark on engine block.

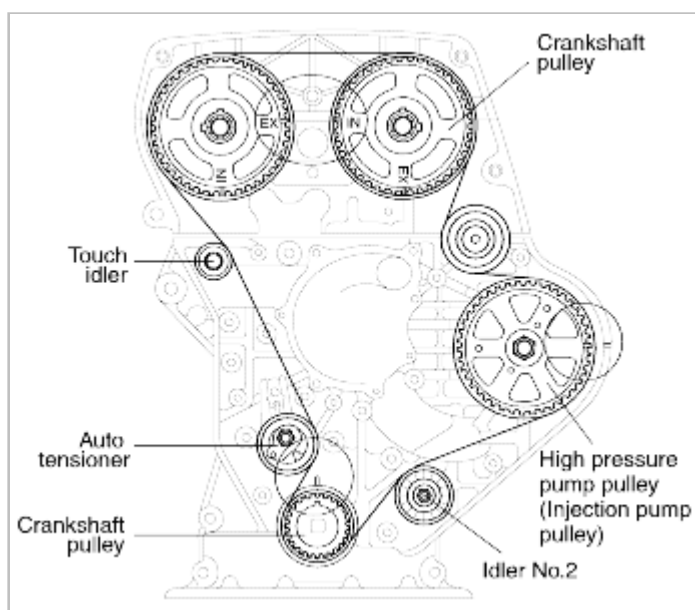


15. Remove the auto tensioner.

16. Remove the timing belt.

REPLACEMENT

1. Check that timing mark on timing belt pulley, camshaft pulley and high pressure pump pulley (injection pump pulley) is aligned with timing mark on engine.



2. Install the timing belt.

(1) The timing belt is installed in sequence crank shaft pulley, idler No.2, high pressure pump pulley (Injection pump pulley), idler No.1 and camshaft pulley.

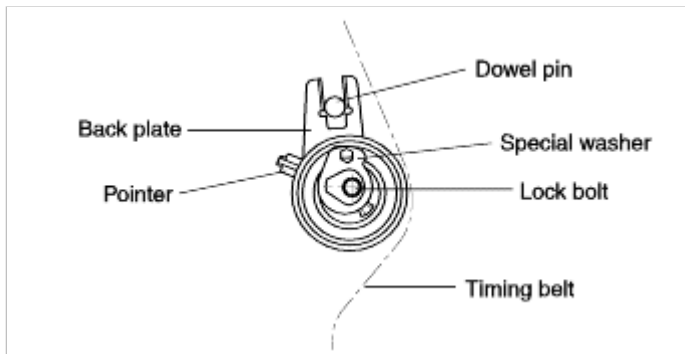
NOTICE

- The auto-tensioner must be mounted onto the engine after the timing belt is installed.
- Keep the tension of timing belt when install timing belt.

3. Install the auto-tensioner.

(1) Install the auto-tensioner as shown illust. The dowel pin has to be located between the tensioner fork

(back plate).



(2) Pretighten the auto-tensioner.

Tightening torque:

2.9lb-ft (3.9N·m , 0.4kg-m)

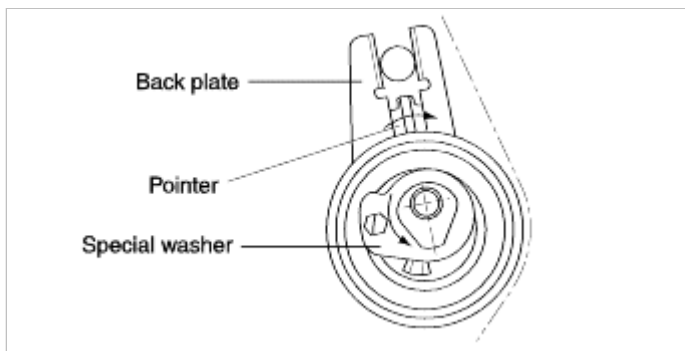
NOTICE

- Oil must not get in contact with the tensioner.
The tensioner has to be replaced by a new one, if it is oily.
- The positions of the pointer, the back plate and the special washer are in accordance to the illust.

4. Check again if the alignment marks of camshafts, crankshaft and high pressure pump(Injection pump)pulley are aligned with the marks on the timing case.

5. Adjust the auto-tensioner, and then tighten it.

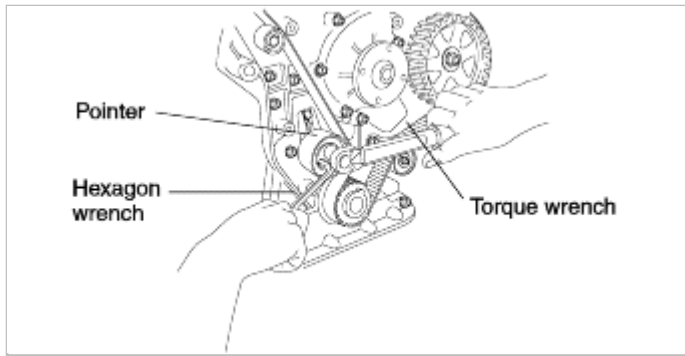
(1) Align the pointer to the back plate by rotating the special washer in counter-clockwise using the hexagon wrench as shown illust.



(2) Tighten the auto-tensioner lock bolt with holding the special washer by the hexagon wrench when the pointer is aligned with the back plate.

Tightening torque:

17.4lb-ft (23.5N·m , 2.4kg-m)



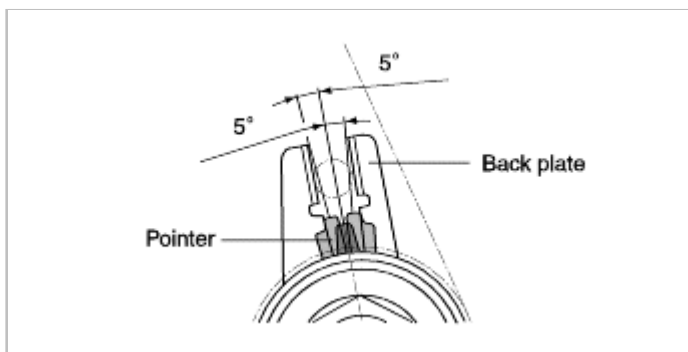
(3) Remove the hexagon wrench.

NOTICE

If the pointer can not be aligned with the back plate, then a new belt has to be used.

6. Rotate the crankshaft two full revolutions in clockwise to align the TDC mark.
7. Check again if the alignment marks of camshafts, crankshaft and high pressure pump(Injection pump)pulley are aligned with the marks on the timing case.
8. Check the alignment of the pointer and back plate.

Allowance misalignment : $\pm 5^\circ$



9. If the misalignment between pointer and back plate is bigger than "5" repeat step 4~8.
10. Install the upper and lower timing belt cover.

Tightening torque:
5.1~7.2 lb-ft (6.9~9.8 N·m, 70~100 kg-cm)

11. Install the crankshaft pulley.

Tightening torque:
253~289 lb-ft (343~392 N·m, 35~40 kg-m)

12. Install the water pump pulley.

Tightening torque:
13.0~20.9 lb-ft (17.6~28.4 N·m, 1.8~2.9 kg-m)

13. Install the auto tensioner.

Tightening torque:

13.0~20.9 lb-ft (17.6~28.4 N·m, 1.8~2.9 kg-m)

14. Install the drive belt and A/C drive belt. (Refer to Drive belt)

15. Install the RH side wheel.

Tightening torque:

65~79 lb-ft (88~108 N·m, 9.0~11.0 kg-m)

16. Install the No.3 engine mounting bracket.

Tightening torque:

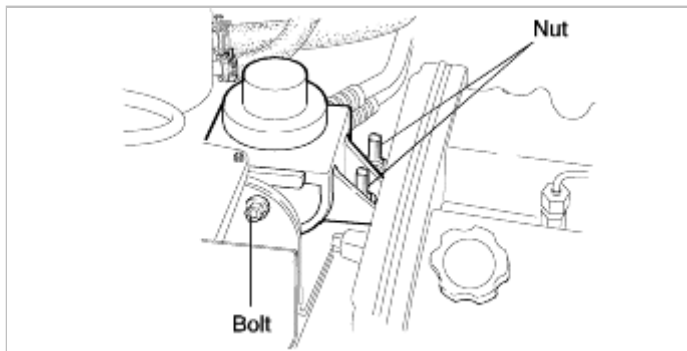
26.7~39.8 lb-ft (36.2~53.9 N·m, 3.7~5.5 kg-m)

17. Install the No.3 engine mounting rubber.

Tightening torque:

Nut: 49.1~68.7 lb-ft (66.7~93.1 N·m, 6.8~9.5 kg-m)

Bolt: 62.9~86.0 lb-ft (85.3~116.7 N·m, 8.7~11.9 kg-m)



18. Install the fuel filter.

19. Install the radiator hose.

20. Fill engine coolant with specified type and amount.(Refer to Cooling system)

21. Start engine and then check for leaks.

DISASSEMBLY

TIMING BELT COVER

1. Remove No.3 engine mounting bracket.
2. Remove water pump pulley.
3. Remove power steering pump.
4. Remove crankshaft pulley.

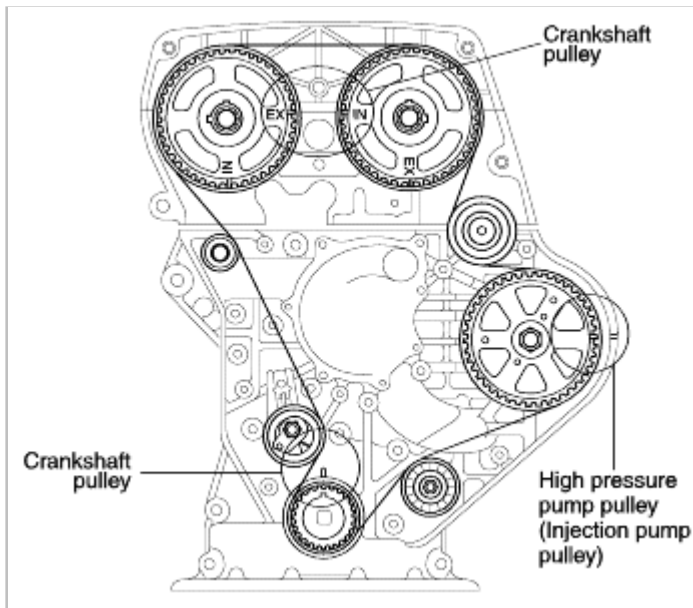
NOTICE

, to prevent the rotation of crankshaft pulley.

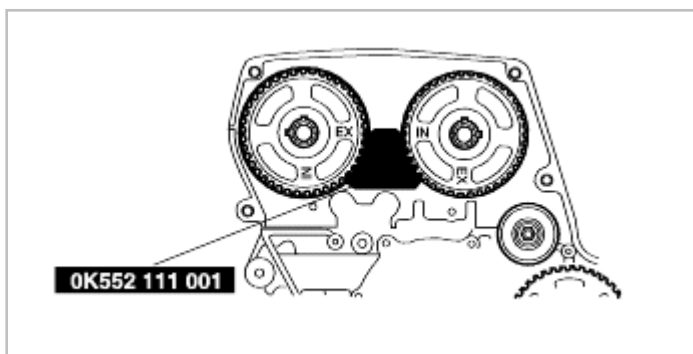
5. Remove idler and bracket.
6. Remove upper timing belt cover.
7. Remove lower timing belt cover.

Timing belt and cylinder head

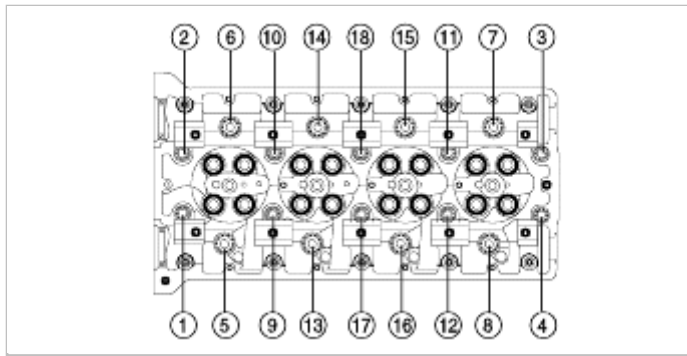
1. Rotate crankshaft and align timing mark on timing belt pulley with timing mark on engine block.



2. Remove the auto tensioner.
3. Remove the timing belt.
4. Remove the high pressure pump (Injection pump pulley).
5. Install the SST (0K552 111 001) as shown in the figure and then remove the camshaft pulley.



6. Remove the idler.
7. Remove the timing belt pulley.
8. Remove the upper plate assembly.
9. Remove the engine hanger.
10. Remove the injector bracket and injector.
11. Remove the cylinder head cover.
12. Remove the rocker arm shaft assembly.
13. Remove the camshaft cap and camshaft.
14. Remove the cylinder head bolts in the order shown in the figure.



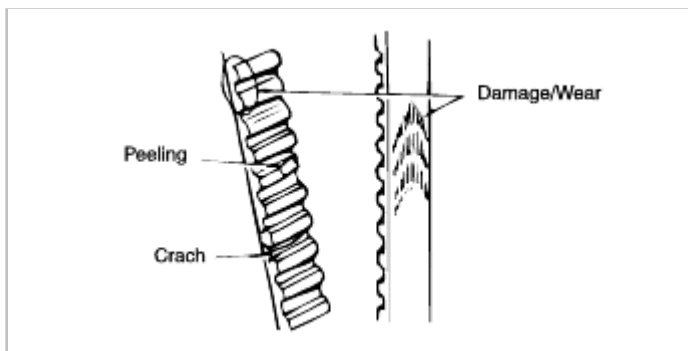
INSPECTION

FRONT TIMING BELT

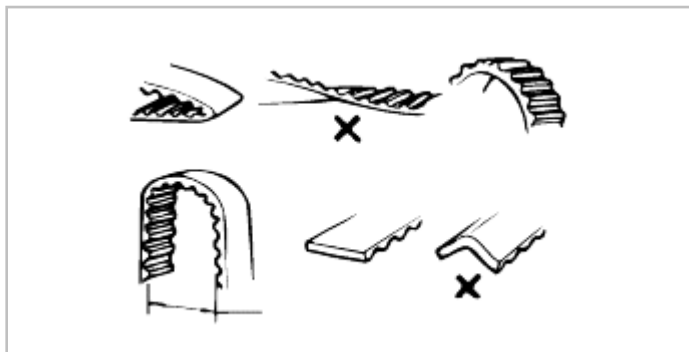
NOTICE

- Never forcefully twist, turn inside out or bend timing belt.
- Do not allow oil or grease to come in contact with timing belt.

1. Replace timing belt if it is contaminated with oil or grease.
2. Check timing belt for uneven wear, fraying, peeling, cracking and hardening. Replace timing belt if necessary.



3. Bend timing belt into a "U" shapes as shown in figure. Distance "A" must be at least 1.0 in (25 mm).



CAMSHAFT PULLEYS AND TIMING BELT PULLEY

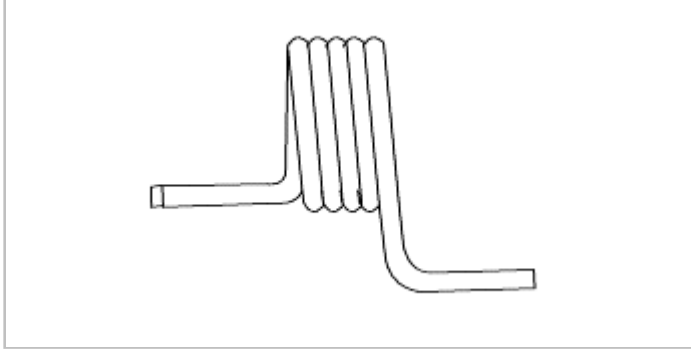
NOTICE

Do not clean pulleys with cleaning fluids. If needed, use a soft cloth to wipe them clean, and avoid scratching the pulleys as it will affect integrity of the timing belt.

1. Check pulley teeth for wear, deformities and other damage. Replace pulleys if necessary.

TENSIONER SPRING

1. Check the tensioner spring. Replace tensioner spring if necessary.

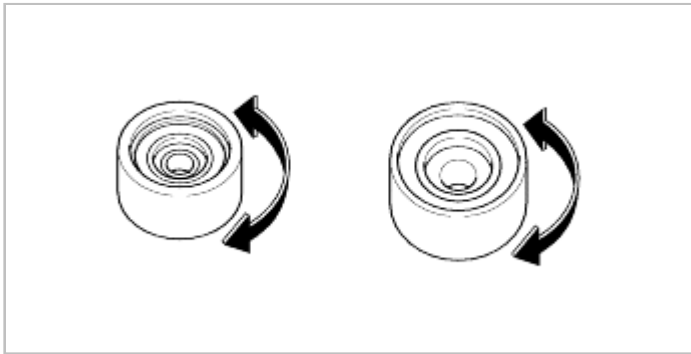


TENSIONER AND IDLER

NOTICE

Do not clean tensioner pulley or idler pulley with cleaning fluids. If needed, use a soft rag to wipe them clean. Avoid scratching tensioner pulley or idler pulley as it can affect integrity of timing belt.

1. Check tensioner pulley and idler pulley for smooth rotation and proper sound. Replace tensioner pulley and idler pulley if necessary.



CYLINDER HEAD AND TIMING BELT (J3 TCI-COMMON RAIL SYSTEM)

1. Remove all foreign material from the top of the cylinder block.
2. Place the new cylinder head gasket in position.

CAUTION

Measure the length of cylinder head bolt, replace if necessary.

Long bolt: 5.2 in (132 mm)

Short bolt: 3.7 in (93 mm)

3. Install the cylinder head.
4. Apply an engine oil into the surface and thread of cylinder head bolt, and install the cylinder head bolts to the cylinder head.
5. Tighten the cylinder head bolts in the order shown in the figure.

Tightening torque:

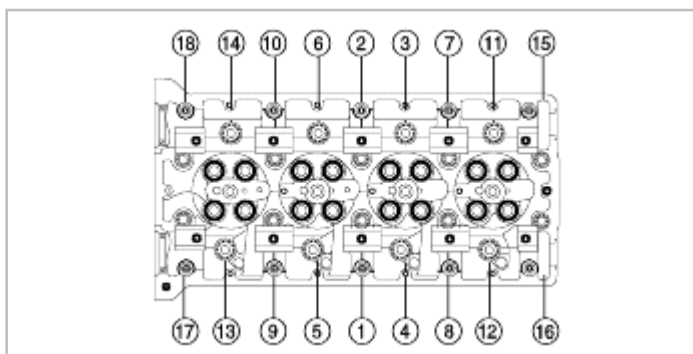
Angle control

Long bolt: 25.32 lb-ft

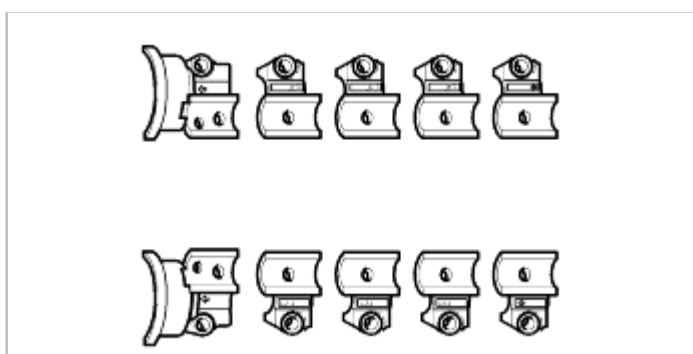
(34.3 N·m, 3.5 kg-m)+45°+70°

Short bolt: 25.32 lb-ft

(34.3 N·m, 3.5 kg-m)+40°+45°



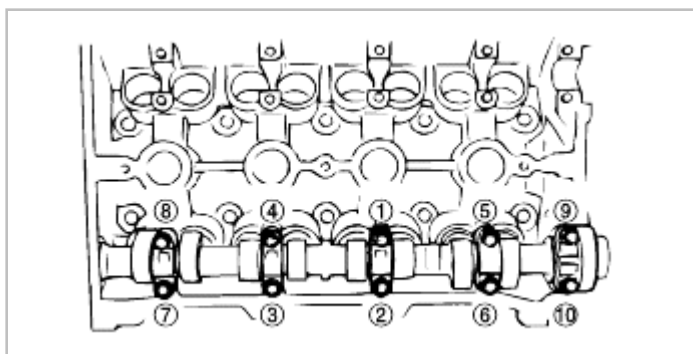
6. Remove all foreign material and oil from the journals and bearing surface.
7. Set the camshaft onto the cylinder head.
8. Install the camshaft caps according to the cap number and arrow mark.



9. Install the camshaft cap nuts and tighten them in two or three steps in the order shown in the figure.

Tightening torque:

13.0~19.5 lb-ft (17.6~26.5 N·m, 1.8~2.7 kg-m)



NOTICE

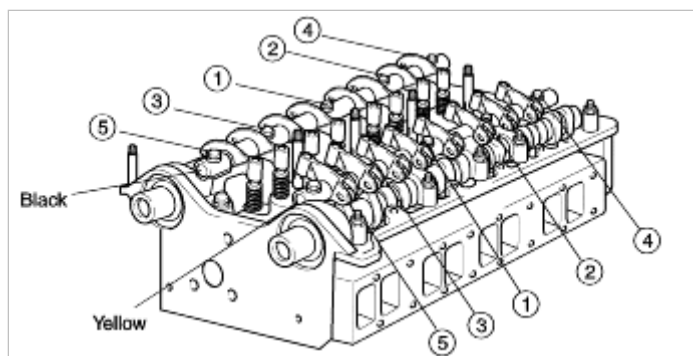
Do not exchange intake rocker arm shaft and exhaust rocker arm shaft each other.

- Intake side: Yellow
- Exhaust side: Black

10. Install the intake rocker arm shaft and exhaust rocker arm shaft and tighten them in two or three steps in the order shown in the figure.

Tightening torque:

13.0~19.5 lb-ft (17.6~26.5 N·m, 1.8~2.7 kg-m)



11. Install the cylinder head cover.

Tightening torque:

5.1~6.5 lb-ft (6.9~8.8 N·m, 0.7~0.9 kg-m)

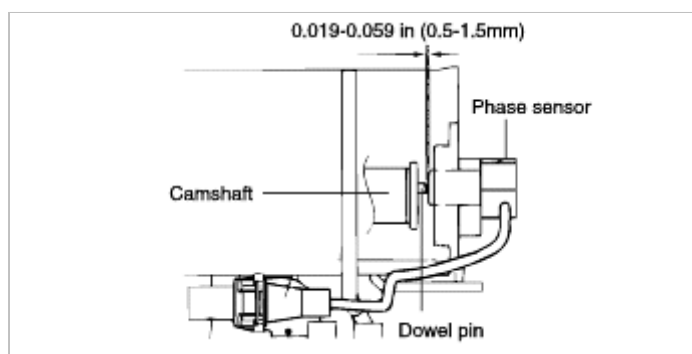
NOTICE

Inspect clearance between dowel pin of camshaft end and phase sensor, before install cylinder head cover.

Clearance: 0.019~0.059 in (0.5~1.5mm)

Tightening torque:

5.1~6.5 lb-ft (6.9~8.8 N·m, 0.7~0.9 kg-m)



12. Install the injector and install the injector bracket.
(Refer to section FL)

Tightening torque:

14.5~15.9 lb-ft (19.6~21.6 N·m, 2.0~2.2 kg-m)

13. Install the front and rear engine hanger.

14. Install the upper plate assembly.

15. Install the idlers.

Tightening torque:

29.7lb-ft (40.2N·m , 4.1kg-m)

NOTICE

Be careful that the idlers does not change. Idler No.1(ø2.36in(ø60mm)), Idler No.2(ø2.16in (ø55mm))

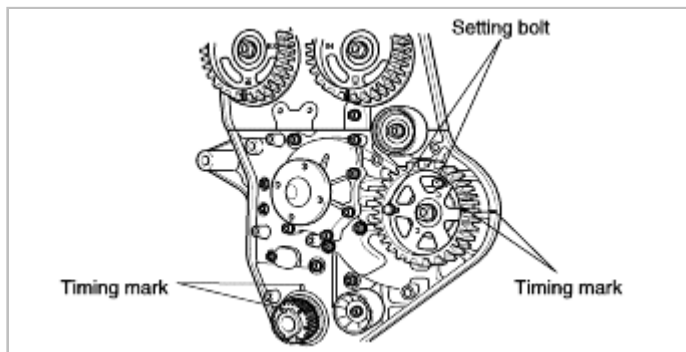
16. Install the high pressure pump.

- (1) Tighten the high pressure pump assembly fixing bolts after installed the high pressure pump to the timing case.

Tightening torque:

15.9~18.8lb-ft (21.6~25.5N·m , 2.2~2.6kg-m)

- (2) Pre-tighten the high pressure pump pulley lock nut after installed the high pressure pump pulley to the high pressure pump shaft with key.
- (3) Fix the high pressure pump pulley by used to two setting bolts, after aligned the high pressure pump pulley timing mark as shown illust.



- (4) Tighten the high pressure pump pulley lock nut.

Tightening torque:

47.0lb-ft (63.7N·m , 6.5kg-m)

- (5) Install the high pressure pump bracket to the high pressure pump and cylinder block.

CAUTION

First tighten the cylinder block side bolts and then second tighten the pump side bolts after checking that there is no clearance between bracket and pump.

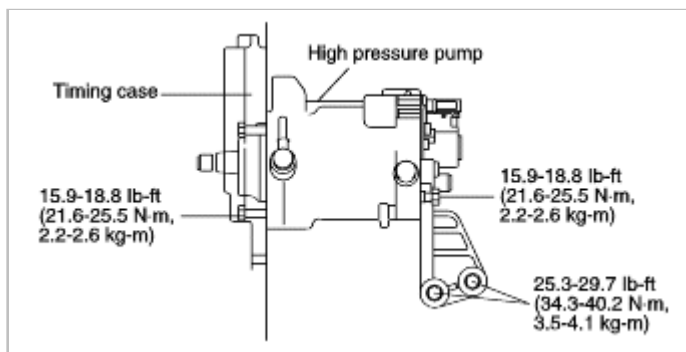
Tightening torque:

Pump side :

15.9~18.8lb-ft (21.6~25.5N·m , 2.2~2.6kg-m)

Cylinder block side :

25.3~29.7lb-ft (34.3~40.2N·m , 3.5~4.1kg-m)



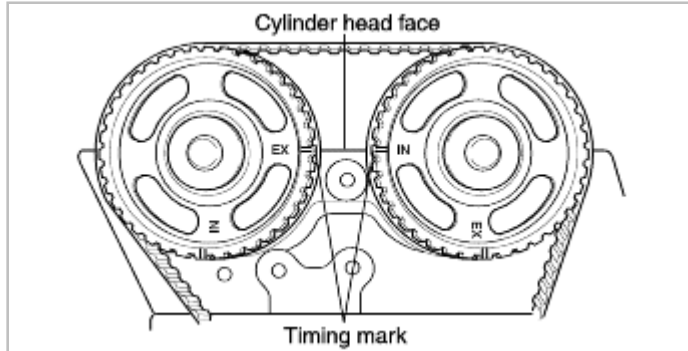
17. Align the crankshaft pulley timing mark.

CAUTION

When the crankshaft is rotated without timing belt, could damage piston and valve.
Before assemble the cylinder head, align TDC for No.1 piston.

18. Align the camshaft pulley timing mark.

- (1) Align "EX" mark of the left camshaft pulley and "IN" mark of the right camshaft pulley to the cylinder head top face as shown illust



CAUTION

When the camshaft is rotated without timing belt, could damage piston and valve. Before assemble the cylinder head, align the camshaft pulley timing mark

- (2) Install the camshaft fixing tool (SST) between two camshaft pulleys.
- (3) Tighten the camshaft pulley lock nut.

Tightening torque:
47.0lb-ft (63.7N·m , 6.5kg-m)

- (4) Remove the camshaft fixing tool (SST).

19. Install the timing belt.

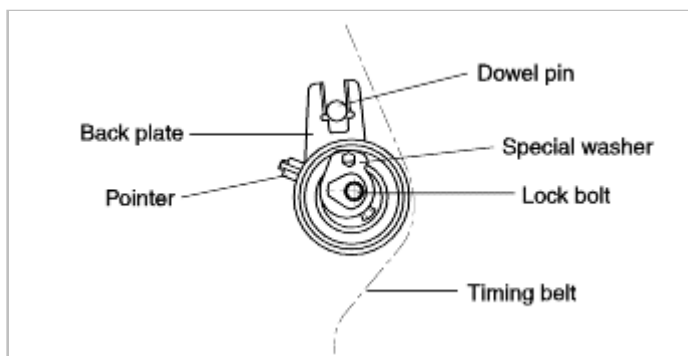
- (1) The timing belt is installed in sequence crank shaft pulley, idler No.2, high pressure pump pulley, idler No.1 and camshaft pulley.

NOTICE

- The auto-tensioner must be mounted onto the engine after the timing belt is installed.
- Keep the tension of timing belt when install timing belt.

20. Install the auto-tensioner.

- (1) Install the auto-tensioner as shown illust.
The dowel pin has to be located between the tensioner fork (back plate).



(2) Pretighten the auto-tensioner.

Tightening torque:

2.9lb-ft (3.9N·m , 0.4kg-m)

NOTICE

- Oil must not get in contact with the tensioner. The tensioner has to be replaced by a new one, if it is oily.
- The positions of the pointer, the back plate and the special washer are in accordance to the illust.

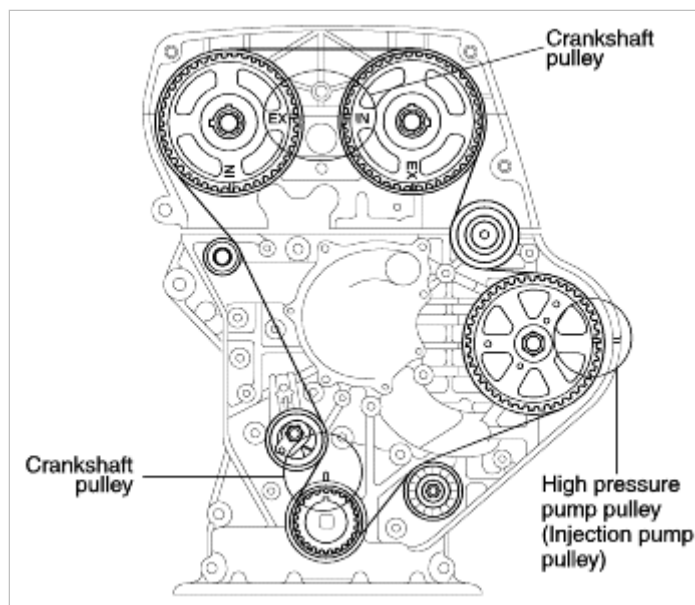
21. Install the touch idler.

Tightening torque:

17.4lb-ft (23.5N·m , 2.4kg-m)

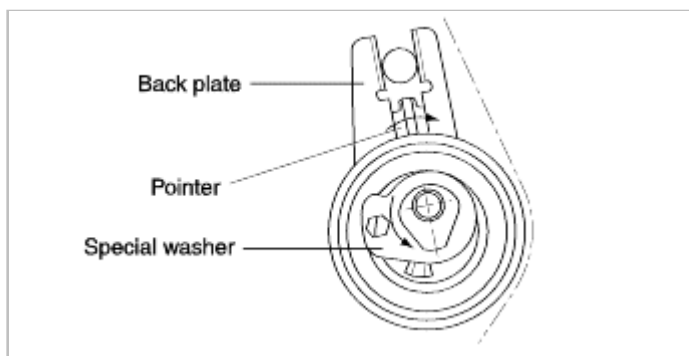
22. Remove two setting bolts from the high pressure pump pulley.

23. Check again if the alignment marks of camshafts, crankshaft and high pressure pump are aligned with the marks on the timing case.



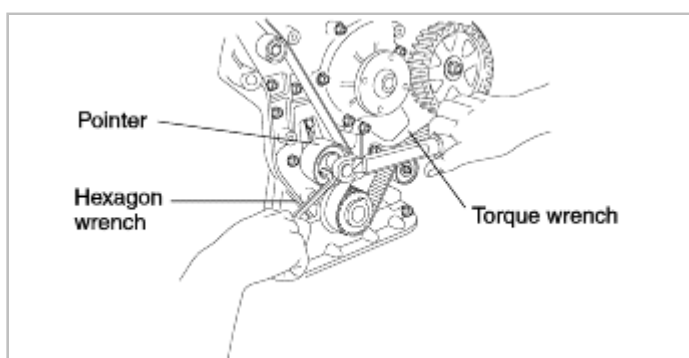
24. Adjust the auto-tensioner, and then tighten it.

- (1) Align the pointer to the back plate by rotating the special washer in counter-clockwise using the hexagon wrench as shown illust.



- (2) Tighten the auto-tensioner lock bolt with holding the special washer by the hexagon wrench when the pointer is aligned with the back plate.

Tightening torque:
17.4lb-ft (23.5N·m , 2.4kg-m)



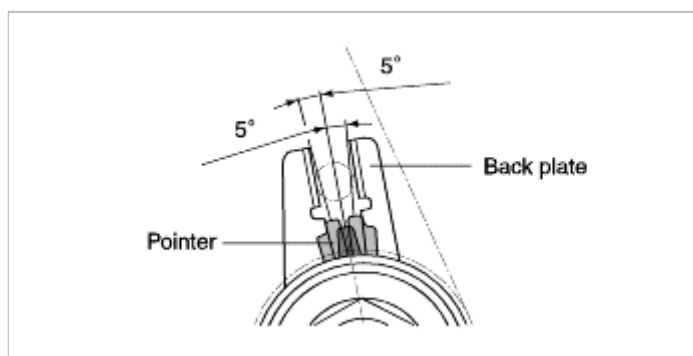
- (3) Remove the hexagon wrench.

NOTICE

If the pointer can not be aligned with the back plate, then a new belt has to be used.

25. Rotate the crankshaft two full revolutions in clockwise to align the TDC mark.
26. Check again if the alignment marks of camshafts, crankshaft and high pressure pump are aligned with the marks on the timing case.
27. Check the alignment of the pointer and back plate.

Allowance misalignment : $\pm 5^\circ$



28. If the misalignment between pointer and back plate is bigger than ($\pm 5^\circ$), repeat step 23~27.

CYLINDER HEAD AND TIMING BELT (J3 TCI)

1. Remove all foreign material from the top of the cylinder block.
2. Place the new cylinder head gasket in position.

CAUTION

Measure the length of cylinder head bolt, replace if necessary.

Long bolt: 5.2 in (132 mm)

Short bolt: 3.7 in (93 mm)

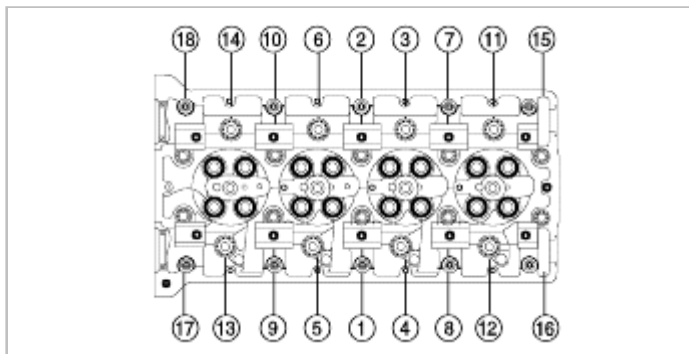
3. Install the cylinder head.
4. Apply an engine oil into the surface and thread of cylinder head bolt, and install the cylinder head bolts to the cylinder head.
5. Tighten the cylinder head bolts in the order shown in the figure.

Tightening torque:

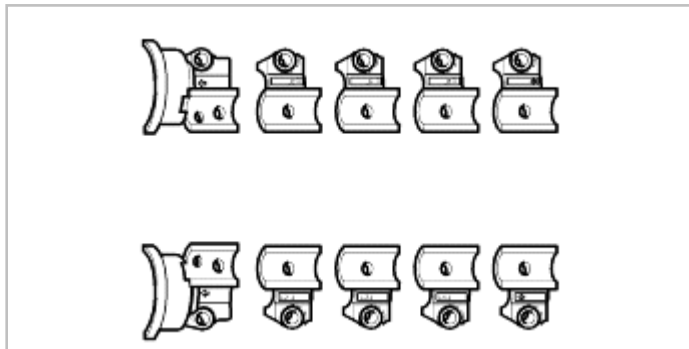
Torque control: 59.31 lb-ft (80 N·m, 8.2 kg-m)

or Angle control: 36.16 lb-ft (49 N·m, 5.0 kg-m)

+retighten 40°~50.



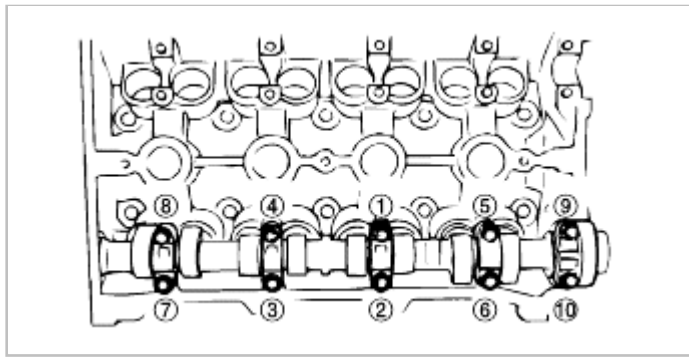
6. Remove all foreign material and oil from the journals and bearing surface.
7. Set the camshaft onto the cylinder head.
8. Install the camshaft caps according to the cap number and arrow mark.



9. Install the camshaft cap nuts and tighten them in two or three steps in the order shown in the figure.

Tightening torque:

13.0~19.5 lb-ft (17.6~26.5 N·m, 1.8~2.7 kg-m)



NOTICE

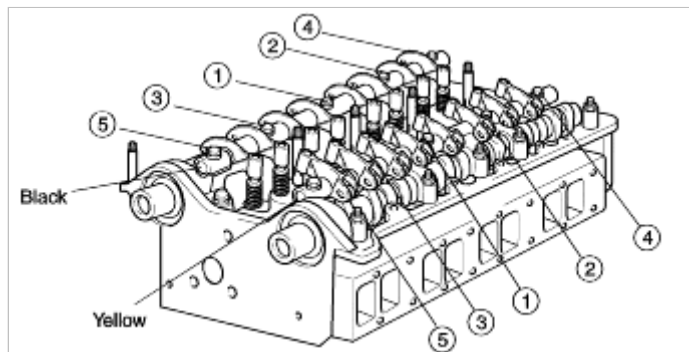
Do not exchange intake rocker arm shaft and exhaust rocker arm shaft each other.

- Intake side: Yellow
- Exhaust side: Black

10. Install the intake rocker arm shaft and exhaust rocker arm shaft and tighten them in two or three steps in the order shown in the figure.

Tightening torque:

13.0~19.5 lb-ft (17.6~26.5 N·m, 1.8~2.7 kg-m)



11. Install the cylinder head cover.

Tightening torque:

5.1~6.5 lb-ft (6.9~8.8 N·m, 0.7~0.9kg-m)

12. Install the nozzle and install the nozzle bracket.

Tightening torque:

11.6~20.6 lb-ft (15.7~20.6 N·m, 1.6~2.1 kg-m)

13. Install the front and rear engine hanger.

14. Install the upper plate assembly.

15. Install the idlers.

Tightening torque:

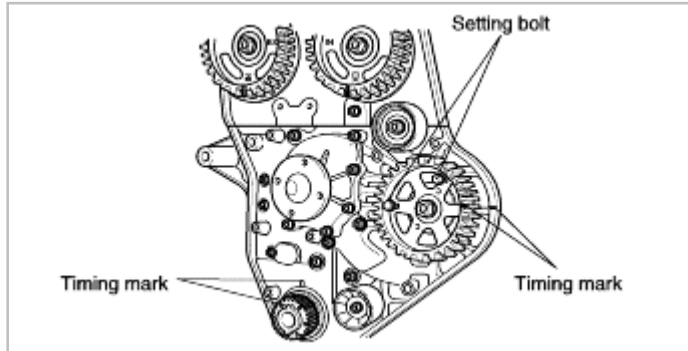
29.7lb-ft (40.2N·m, 4.1kg-m)

NOTICE

Be careful that the idlers does not change. Idler No.1($\phi 2.36\text{in}(\phi 60\text{mm})$), Idler No.2($\phi 2.16\text{in}(\phi 55\text{mm})$)

16. Install the injection pump.

- (1) Pre-tighten the injection pump assembly fixing nut after the injection pump is installed to the cylinder block.
- (2) Pre-tighten the injection pump pulley lock nut after the injection pump pulley is installed to the injection pump shaft with the key.
- (3) Fix the injection pump pulley by used to two setting bolts, after aligned the injection pump pulley timing mark as shown illust.



- (4) Tighten the injection pump pulley lock nut.

Tightening torque:

47.0lb-ft (63.7N·m , 6.5kg-m)

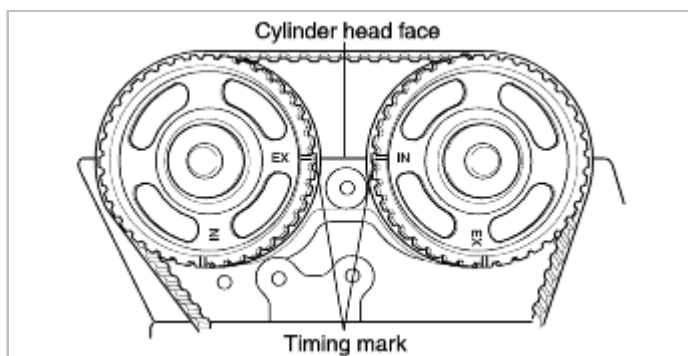
17. Align the crankshaft pulley timing mark.

CAUTION

When the crankshaft is rotated without timing belt, could damage piston and valve.
Before assemble the cylinder head, align TDC for No.1 piston.

18. Align the camshaft pulley timing mark.

- (1) Align "EX"mark of the left camshaft pulley and "IN" mark of the right camshaft pulley to the cylinder head top face as shown illust



CAUTION

When the camshaft is rotated without timing belt, could damage piston and valve. Before assemble the cylinder head, align the camshaft pulley timing mark.

- (2) Install the camshaft fixing tool (SST) between two camshaft pulleys.
- (3) Tighten the camshaft pulley lock nut.

Tightening torque:
47.0lb-ft (63.7N·m , 6.5kg-m)

(4) Remove the camshaft fixing tool (SST).

19. Install the timing belt.

(1) The timing belt is installed in sequence crank shaft pulley, idler No.2, injection pump pulley, idler No.1 and camshaft pulley.

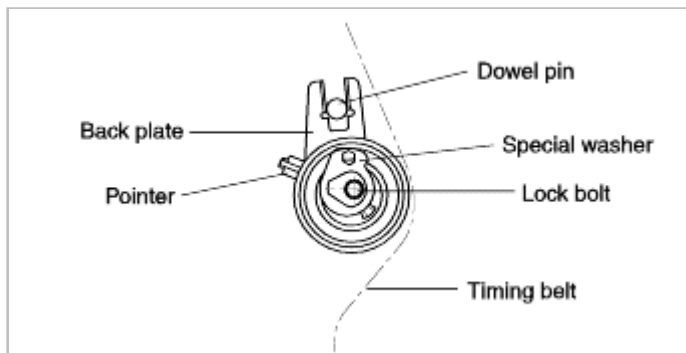
NOTICE

- The auto-tensioner must be mounted onto the engine after the timing belt is installed.
- Keep the tension of timing belt when install timing belt.

20. Install the auto-tensioner.

(1) Install the auto-tensioner as shown illust.

The dowel pin has to be located between the tensioner fork (back plate).



(2) Pretighten the auto-tensioner.

Tightening torque:
2.9lb-ft (3.9N·m , 0.4kg-m)

NOTICE

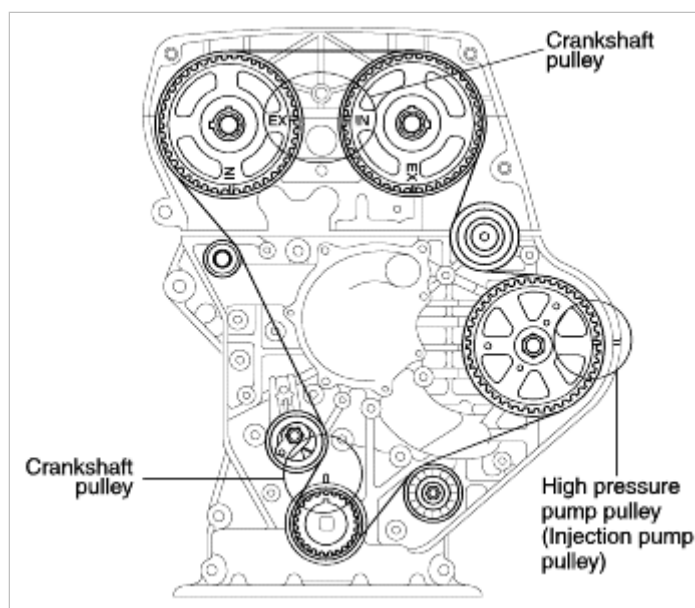
- Oil must not get in contact with the tensioner. The tensioner has to be replaced by a new one, if it is oily.
- The positions of the pointer, the back plate and the special washer are in accordance to the illust.

21. Install the touch idler.

Tightening torque:
17.4lb-ft (23.5N·m , 2.4kg-m)

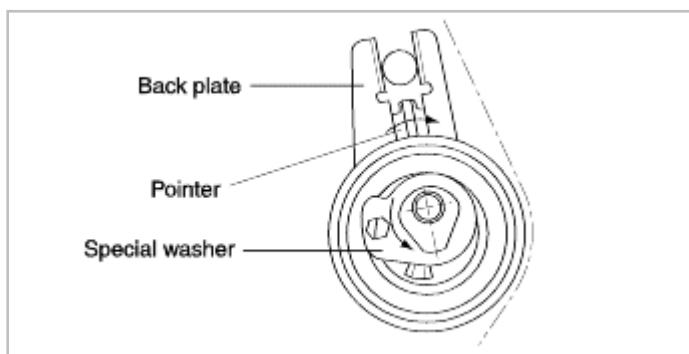
22. Remove two setting bolts from the injection pump pulley.

23. Check again if the alignment marks of camshafts, crankshaft and injection pump are aligned with the marks on the timing case.



24. Adjust the auto-tensioner, and then tighten it.

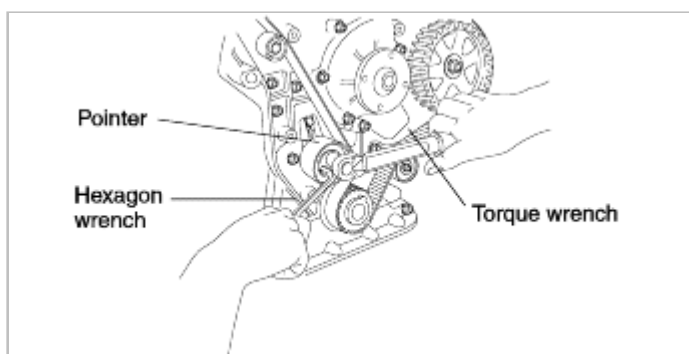
- (1) Align the pointer to the back plate by rotating the special washer in counter-clockwise using the hexagon wrench as shown illust.



- (2) Tighten the auto-tensioner lock bolt with holding the special washer by the hexagon wrench when the pointer is aligned with the back plate.

Tightening torque:

17.4lb-ft (23.5N·m, 2.4kg-m)



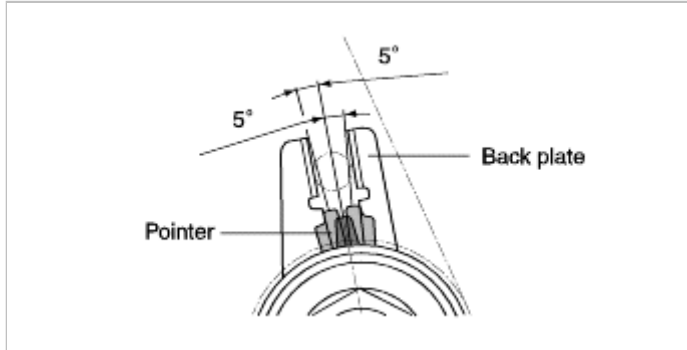
- (3) Remove the hexagon wrench.

NOTICE

If the pointer can not be aligned with the back plate, then a new belt has to be used.

25. Rotate the crankshaft two full revolutions in clockwise to align the TDC mark.
26. Check again if the alignment marks of camshafts, crankshaft and injection pump are aligned with the marks on the timing case.
27. Check the alignment of the pointer and back plate.

Allowance misalignment : $\pm 5^\circ$



28. If the misalignment between pointer and back plate is bigger than ($\pm 5^\circ$), repeat step 23~27.

Timing belt cover

1. Install upper and lower timing belt cover.

Tightening torque:

5.1~7.2 lb-ft (6.9~9.8 N·m, 0.7~1.0 kg-m)

2. Install idler and bracket.

Tightening torque:

27.5~38.3 lb-ft (37.2~51.9 N·m, 3.8~5.3 kg-m)

3. Install crankshaft pulley.

Tightening torque:

253~289 lb-ft (343~392 N·m, 35~40 kg-m)

NOTICE

, to prevent the rotation of crankshaft pulley.

4. Install power steering pump.

Tightening torque:

21.7~28.9 lb-ft (29.4~39.2 N·m, 3.0~4.0 kg-m)

5. Install No.3 engine mounting bracket.

Tightening torque:

49.2~68.7 lb-ft (66.6~93.1 N·m, 6.8~9.5 kg-m)



Engine Mechanical System

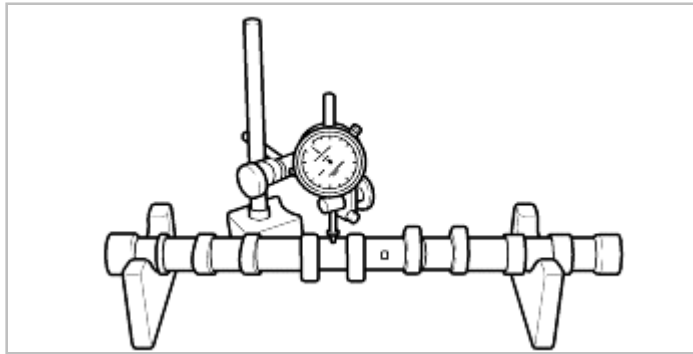
Cylinder Head Assembly - Camshaft



INSPECTION

1. Set front and rear camshaft bearing journals on V-blocks.
2. Position a dial indicator on center bearing journal and zero dial.
3. Rotate camshaft in V-blocks and check runout.

Runout: 0.0031 in (0.08 mm) maximum

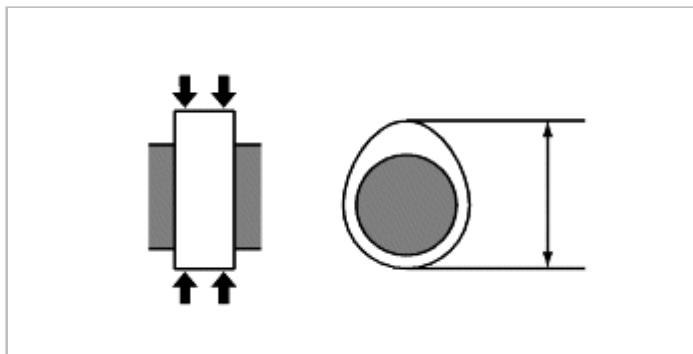


4. Check camshaft for uneven wear patterns, cracks, or damage.
5. Measure cam lobe heights at two points as shown.

Lobe height Intake :

Intake : 0.8857 in (22.497 mm)

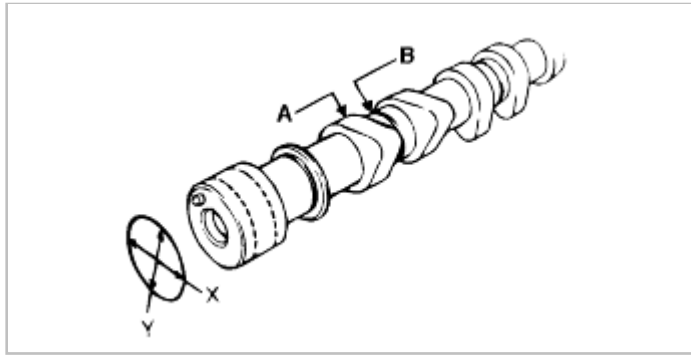
Exhaust : 0.8894 in (22.593 mm)



6. Check camshaft bearing journal diameter (X and Y directions) on both sides (A and B) of journal as shown in figure.

Minimum diameter:

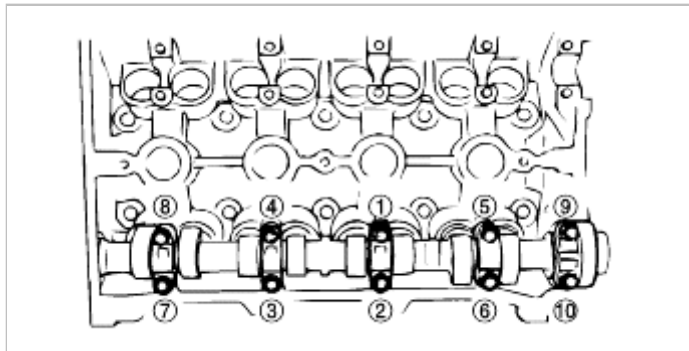
1.1000~1.1032 in (27.941~27.960 mm)



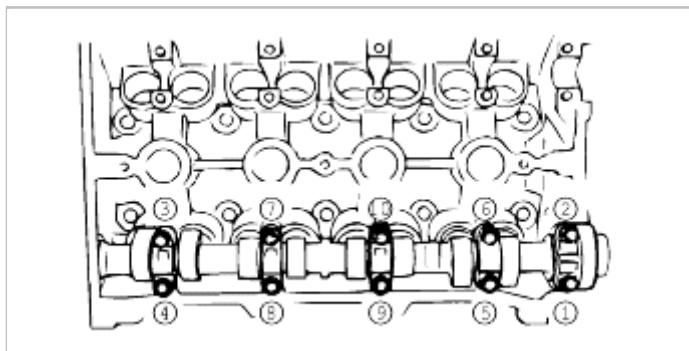
7. Replace camshafts if necessary.
8. Measure camshaft journal oil clearance.
9. Remove all foreign material and oil from journals and bearing surfaces.
10. Set camshafts onto cylinder head.
11. Position plastigauge on journals in axial direction.
12. Do not rotate camshafts.
13. Install camshaft caps according to cap number and arrow mark.
14. Install cap nuts. Tighten them in five or six steps in order shown.

Tightening torque:

13.0~19.5 lb-ft (17.6~26.5 N·m, 1.8~2.7 kg-m)



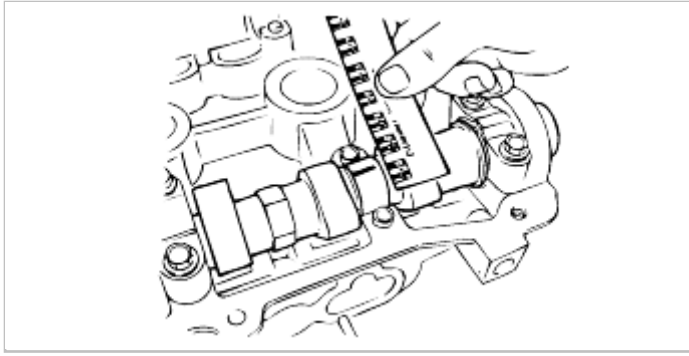
15. Loosen camshaft cap nuts in five or six steps in order shown.
16. Remove camshaft caps.



17. Measure oil clearances.

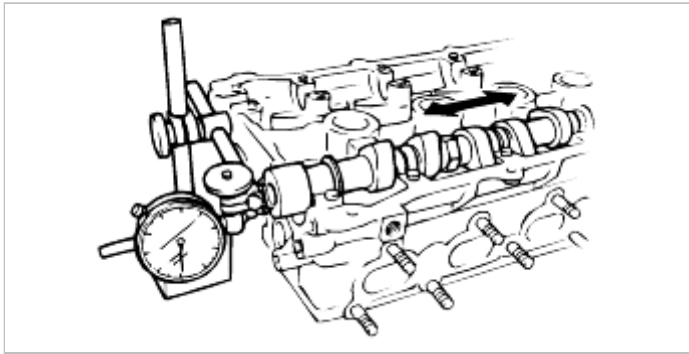
Oil clearance : 0.0016~0.0031 in (0.04~0.08 mm)

18. If oil clearance exceeds specification, replace cylinder head.



19. Install camshafts.
20. Place a dial indicator against end of camshaft.
21. Using a prying tool, move camshaft as far forward as possible.
22. Zero dial.
23. Using prying tool, move camshaft as far rearward as possible.
24. Check gauge to determine how much end play is present.

End play : 0.0031~0.0046 in (0.08~0.11 mm)



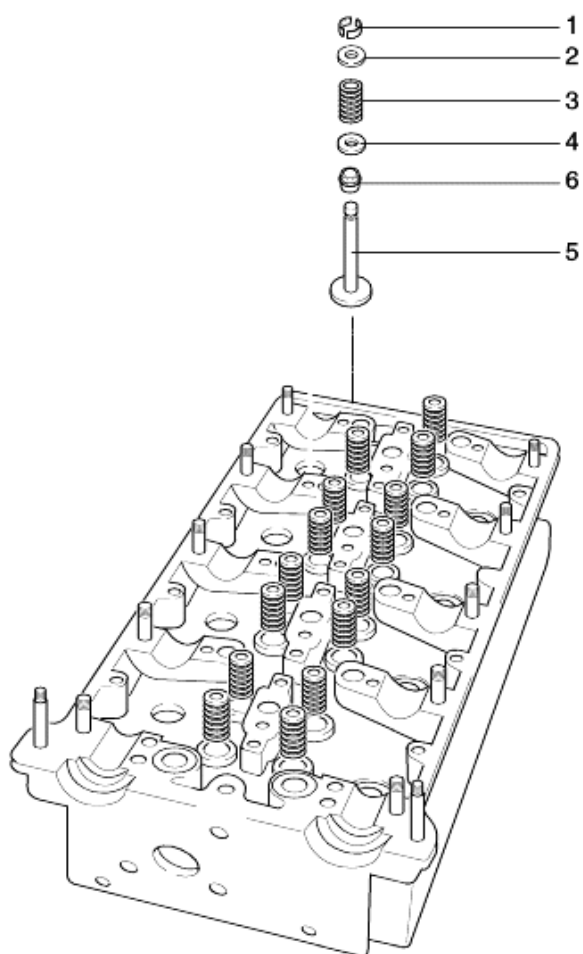


Engine Mechanical System

Cylinder Head Assembly - Valve



Component



- 1. Valve cotter
- 2. Valve spring upper seat
- 3. Valve spring

- 4. Valve spring lower seat
- 5. Valve
- 6. Valve seal

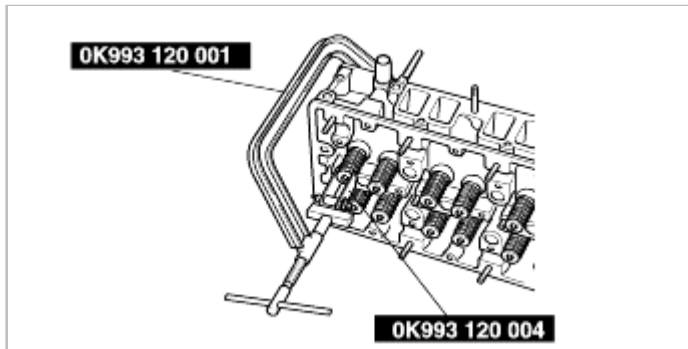
Engine Mechanical System

Cylinder Head Assembly - Cylinder Head



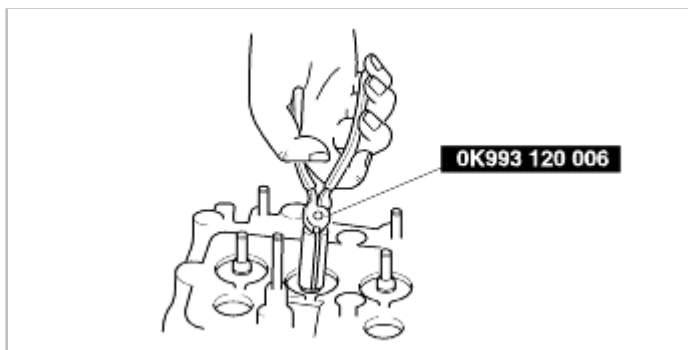
DISASSEMBLY

1. .



2. Remove the valve spring upper seat, valve spring, valve spring lower seat and valve.

3. .



INSPECTION

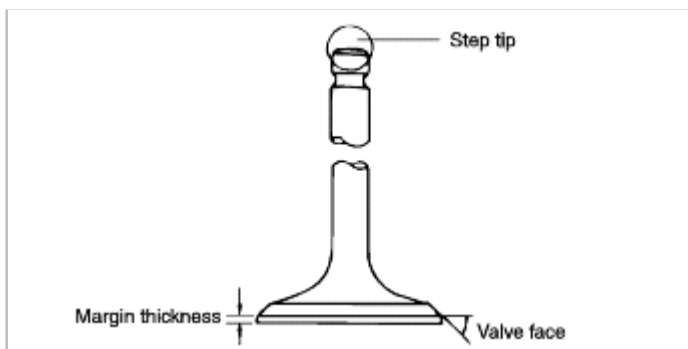
VALVE MECHANISM

1. Inspect each valve for following:
 - (1) Damaged or bent valve stem
 - (2) Rough or damaged face
 - (3) Damaged or unevenly worn stem tip
2. Resurface or replace valve as needed.

Margin thickness

Intake: 0.047 in (1.2 mm)

Exhaust: 0.043 in (1.1 mm)

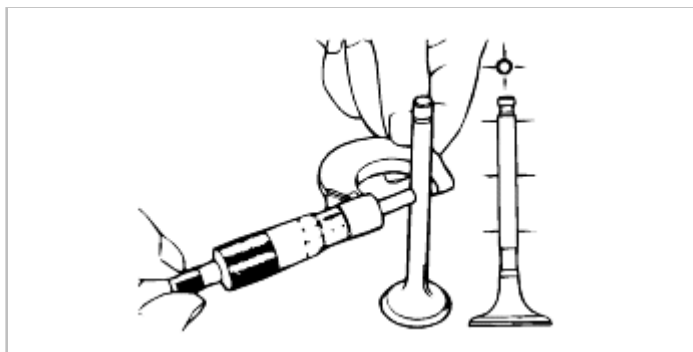


3. Measure diameter of each valve stem.

Diameter

Intake: 0.2742~0.2748 in (6.965~6.980 mm)

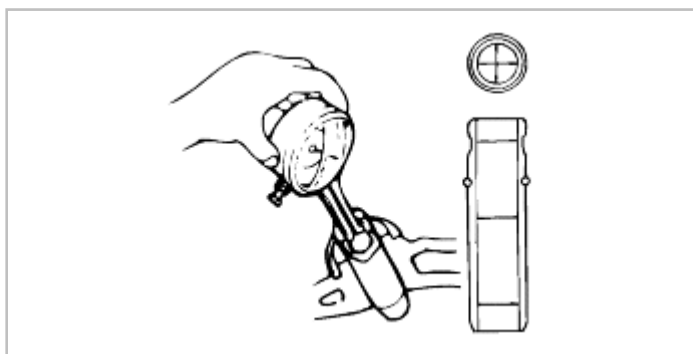
Exhaust: 0.2734~0.2740 in (6.945~6.960 mm)



4. Measure inside diameter of each valve guide at points shown in figure.
-

Diameter intake and exhaust valve guide:

0.2759~0.2767 in (7.010~7.030 mm)

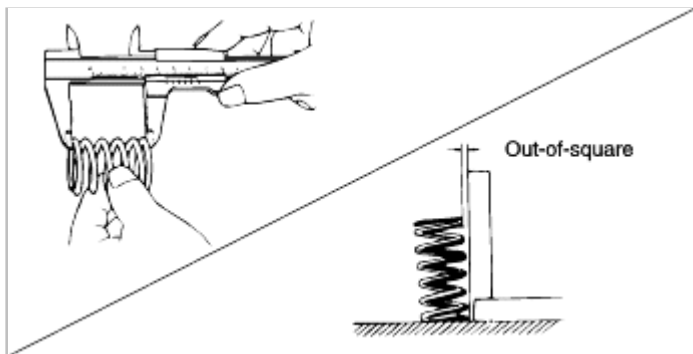


VALVE SPRING

1. Inspect each valve spring for cracks and damage.
 2. Measure free length and out-of-square.
Replace valve springs as needed.
-

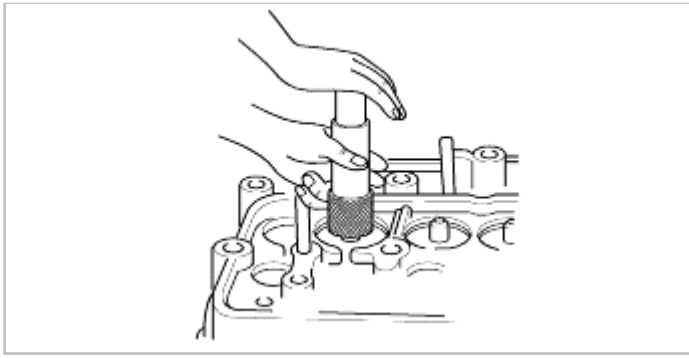
Free length: 2.066 in (52.47 mm)

Out-of-square: 2° maximum

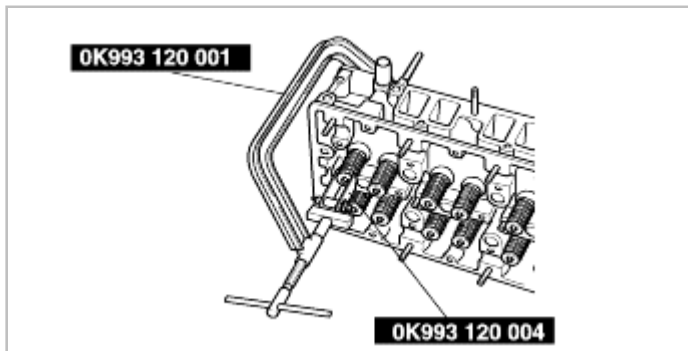


Reassembly

1. By using the proper tool, press the valve seal.



2. Install the valve, valve spring lower seat, valve spring and valve spring upper seat.
3. , compress the valve spring and place the valve cotter securely.
4. By using a plastic hammer, tap the stem lightly to assure proper fit.





Engine Mechanical System

Cylinder Head Assembly - Rocker Arm



Inspection

ROCKER ARM AND ROCKER ARM SHAFT

1. Measure the rocker arm inner diameter.

Inner diameter:

0.7862~0.7874 in (19.97~20.00 mm)

2. Measure the rocker arm shaft outer diameter.

Outer diameter:

0.7875~0.7866 in (19.959~19.980 mm)



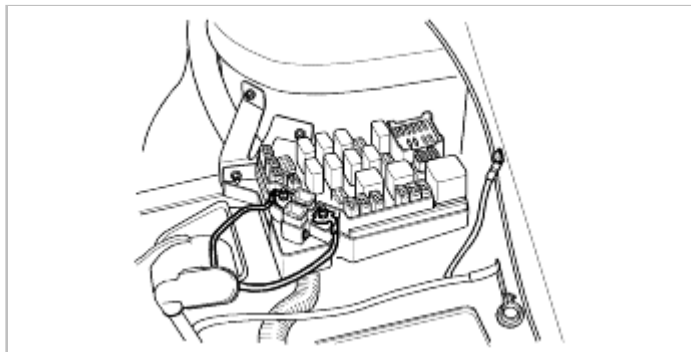
Engine Mechanical System

Engine & Transaxle Assembly

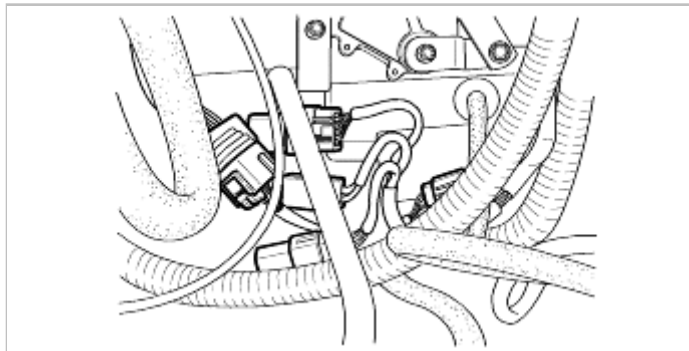


REMOVAL

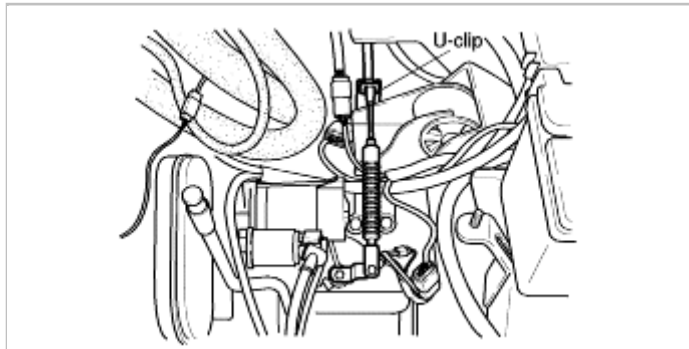
1. Disconnect negative and positive battery cable.
2. Raise and properly support vehicle.
3. Drain engine coolant.(Refer to Cooling system)
4. Remove the battery and battery tray.
5. Remove the fresh air duct, air cleaner assembly and air cleaner bracket.
6. Disconnect the RH side wiper motor connector.
7. Remove the coolant reservoir hose from the thermostat housing.
8. Disconnect the two ground connectors from the fuse box.
9. Remove the ground from the body side.



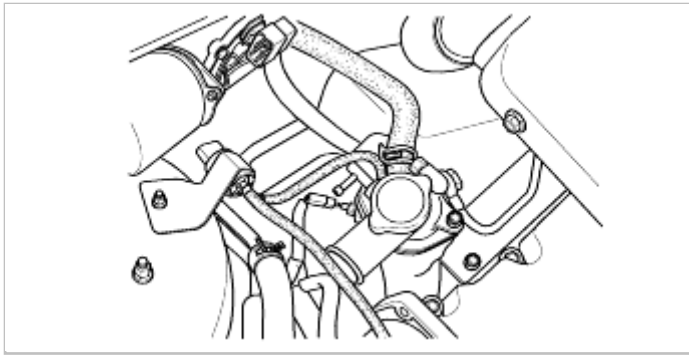
10. Disconnect the five connectors.



11. Remove the U-clip.
12. Remove the nut and washer from the auto transaxle linkage.



13. Disconnect the heater hose from thermostat housing.
14. Disconnect the two vacuum hoses and water temperature sensor connector.

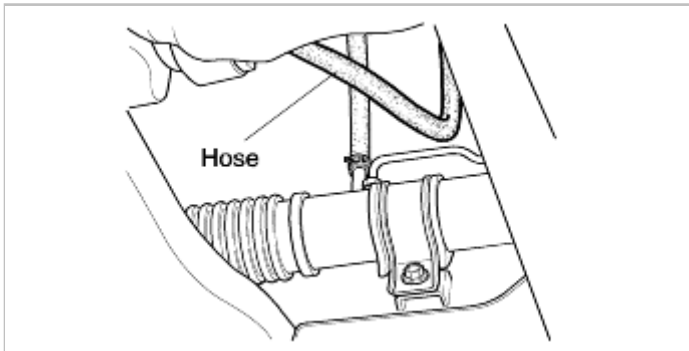


15. Remove the auto transaxle filter tube assembly.
15-1. Remove the accelerator cable from the injection pump. (Except for commonrail system)
16. Disconnect the brake vacuum hose from the alternator.
17. Remove the fuel hose from the sedimenter.
18. Remove the two hoses from power steering reserve tank.

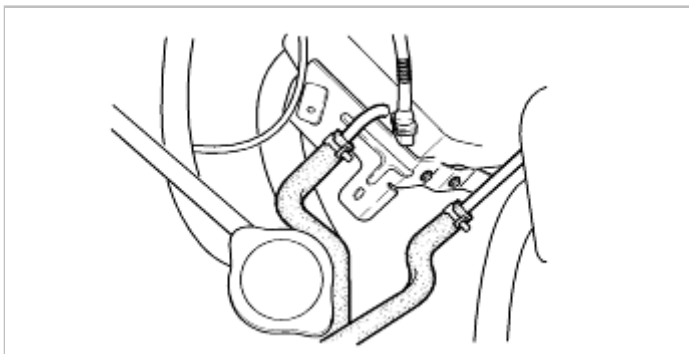
CAUTION

After removing the power steering line, plug the power steering line to avoid fluid leakage.

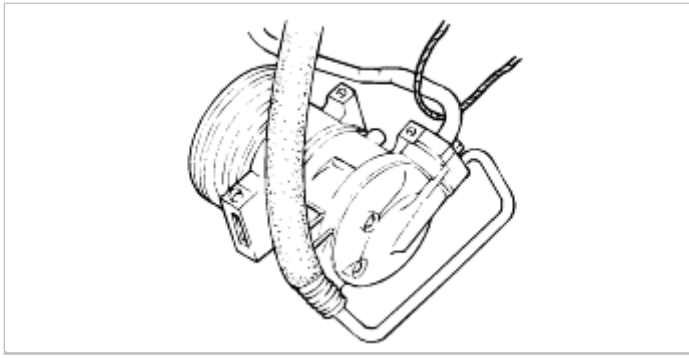
19. Remove power steering fluid pipe from the power steering pump.
20. Remove the heater hose.



21. Disconnect the two ATF cooler hoses.



22. Remove both front wheels.
23. Remove the drive belt. (Refer to Drive belt)
24. Disconnect the magnetic clutch connector.
25. Remove A/C compressor with hoses still connected.
26. Position A/C compressor away from engine and affix it with wire.

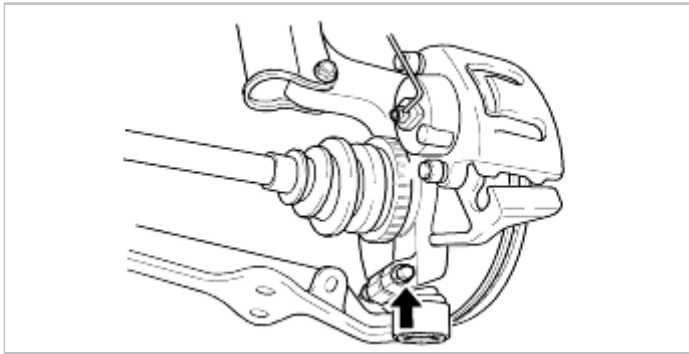


27. Remove exhaust manifold.
28. Remove both right and left tie rod ends from steering knuckles by removing a cotter pin and a nut each.
29. Remove stabilizer bracket and then remove control link from stabilizer.
30. Remove control link from knuckle.

CAUTION

Be careful not to damage the ball joint dust boot.

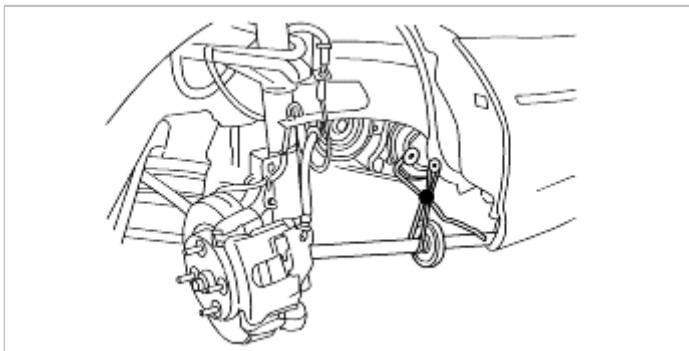
31. Remove pinch bolt and nut from both right and left knuckle. Separate lower arm from knuckle.



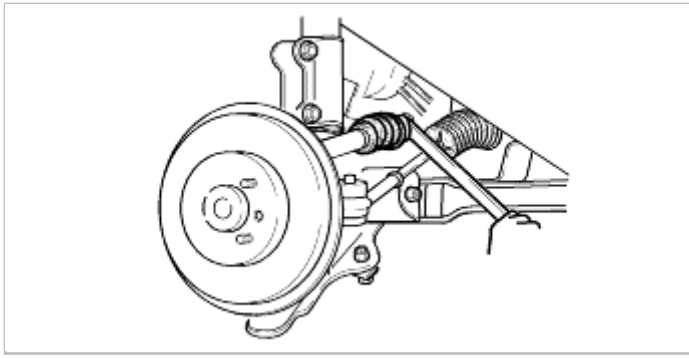
32. Remove joint shaft support bracket from engine block(three bolts).

CAUTION

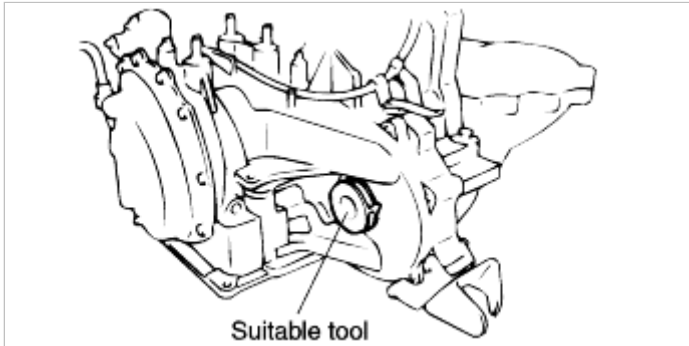
- Separate the front wheel driveshaft and joint from the transaxle gradually. If it is suddenly yanked out of transaxle, the differential oil seal may be damaged.
- After removing the front wheel driveshaft, support the front wheel driveshaft with wire to prevent the driveshaft from damaging the tripod joint bearing and boot.



33. Gently pry both driveshafts from auto transaxle.

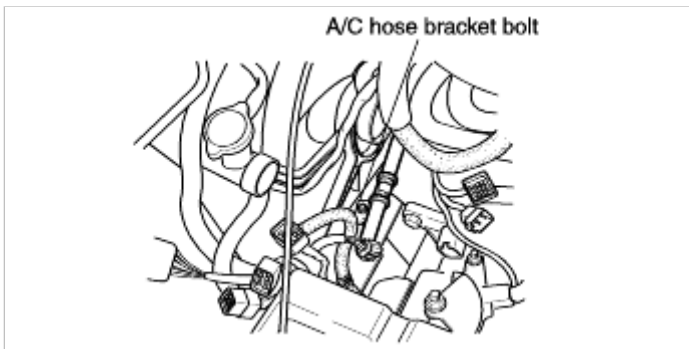


34. Install suitable tool to prevent side gear from becoming misaligned.



35. Remove intermediate shaft bolt.(Refer to section ST. Steering system)

36. Remove A/C hose bracket bolt from subframe.

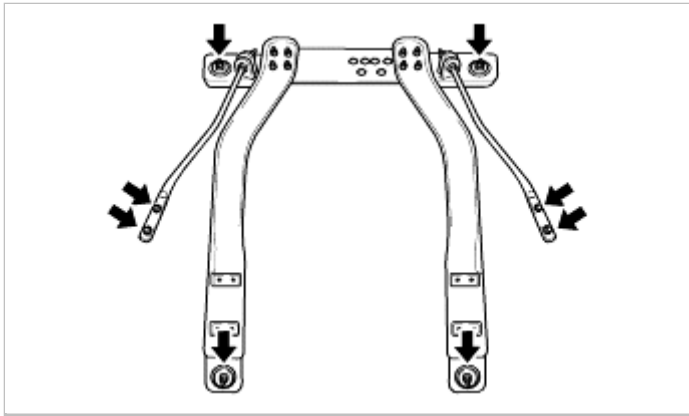


37. Remove No.3 and No.4 engine mounting.

38. Support auto transaxle, engine and subframe with a suitable floor jack.

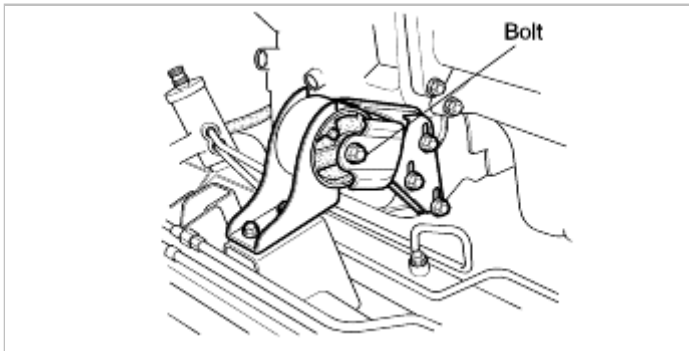


39. Remove four subframe nuts and four tension rod, nut and then remove subframe.

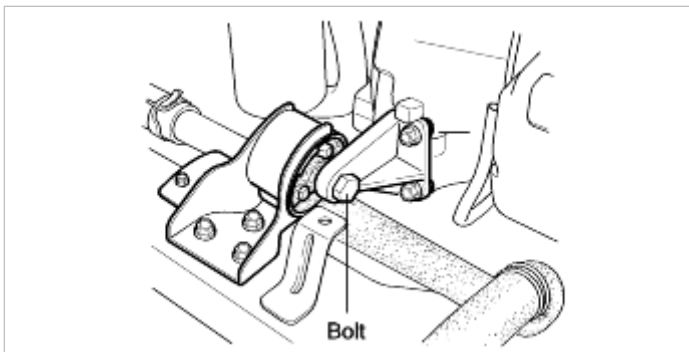


40. Slowly lower engine, auto transaxle and subframe.

41. Remove No.1 engine mounting bolts.

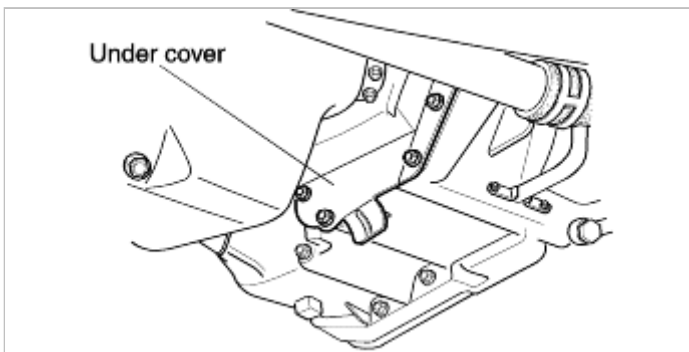


42. Remove No.2 engine mounting bolts.

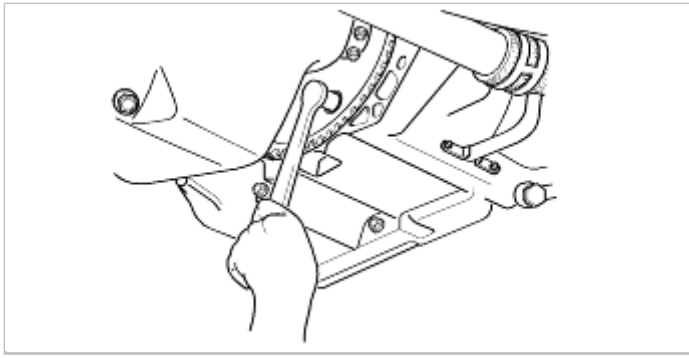


43. Remove starter.(Refer to Starting system)

44. Remove under cover assembly.



45. Remove six drive plate-to-torque converter mounting nuts. Rotate engine at crank pulley to gain access to all six nuts.



46. Remove converter housing bolts.
47. Gently separate transaxle from engine.

REPLACEMENT

1. Install auto transaxle to engine and then install converter housing bolts.

Tightening torque:

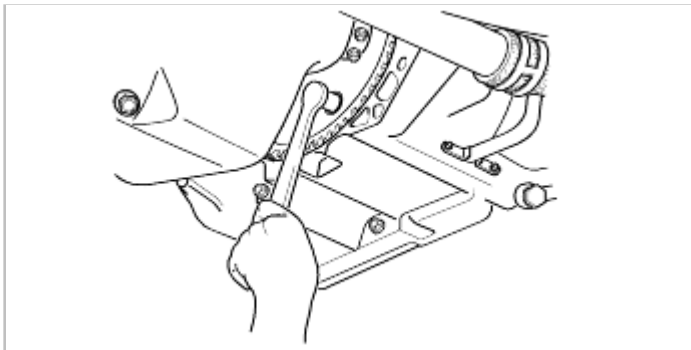
M19: 47.0~65.8 lb-ft (63.7~89.2 N·m, 6.5~9.1 kg-m)

M17: 27.4~38.3 lb-ft (37.2~51.9 N·m, 3.8~5.3 kg-m)

2. Install six drive plate-to-torque converter mounting nuts. Rotate engine at crank pulley to gain access to all nuts.

Tightening torque:

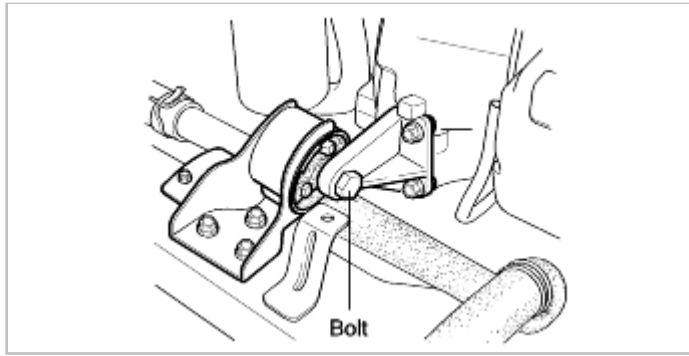
25.3~36.1 lb-ft (34.3~49.0 N·m, 3.5~5.0 kg-m)



3. Install under cover assembly.
4. Install starter. (Refer to Starting system)
5. Install No.2 engine mounting.

Tightening torque:

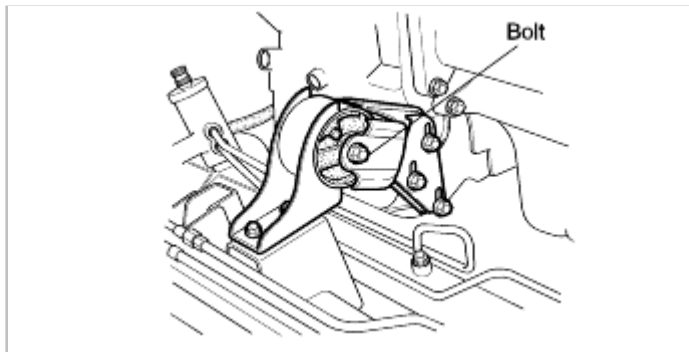
62.9~86.0 lb-ft (85.3~116.7 N·m, 8.7~11.9 kg-m)



6. Install No.1 engine mounting.

Tightening torque:

62.9~86.0 lb-ft (85.3~116.7 N·m, 8.7~11.9 kg-m)



7. Set auto transaxle, engine and subframe on suitable floor jack and then place under vehicle.
8. Raise auto transaxle, engine and subframe and then align with engine compartment.



9. Install four subframe nuts and four tension rod nuts.

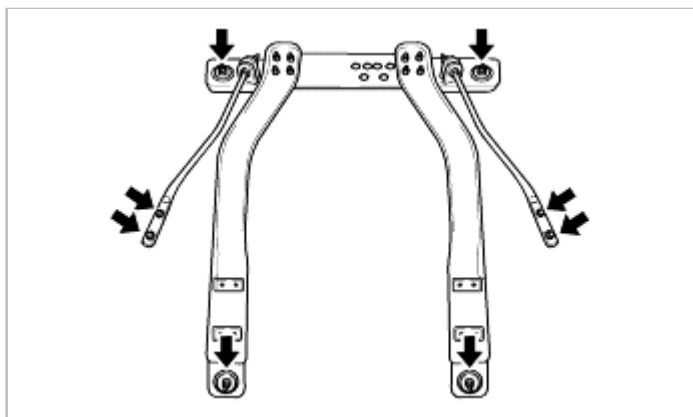
Tightening torque:

Subframe: 88.2~101.2 lb-ft

(119.6~137.3 N·m, 12.2~14.0 kg-m)

Tension rod: 68.7~84.6 lb-ft

(93.1~114.7 N·m, 9.5~11.7 kg-m)

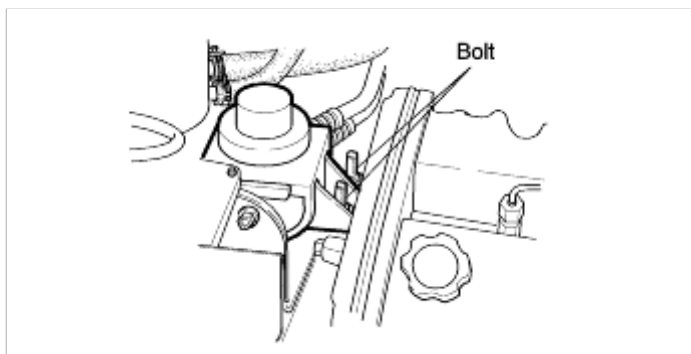


10. Install No.3 engine mounting.

Tightening torque:

A: 62.9~86.0 lb-ft (85.3~116.7 N·m, 8.7~11.9 kg-m)

B: 49.1~68.7 lb-ft (66.7~93.1 N·m, 6.8~9.5 kg-m)

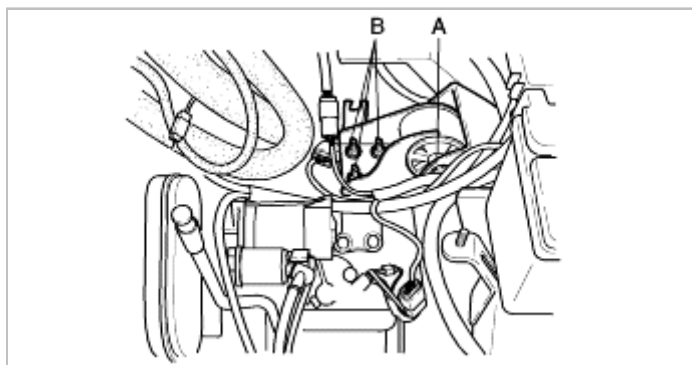


11. Install No.4 engine mounting.

Tightening torque:

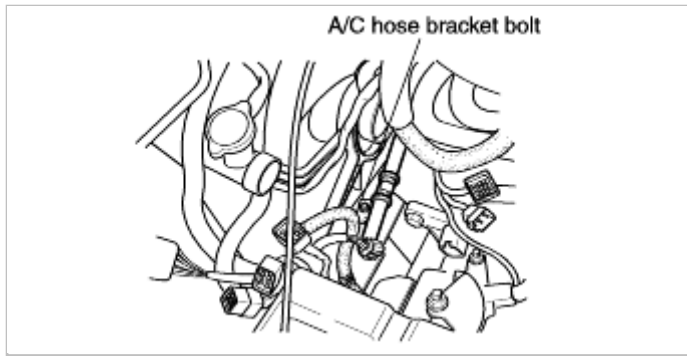
A: 62.9~86.0 lb-ft (85.3~116.7 N·m, 8.7~11.9 kg-m)

B: 49.1~68.7 lb-ft (66.7~93.1 N·m, 6.8~9.5 kg-m)



12. Remove suitable floor jack from auto transaxle and engine.

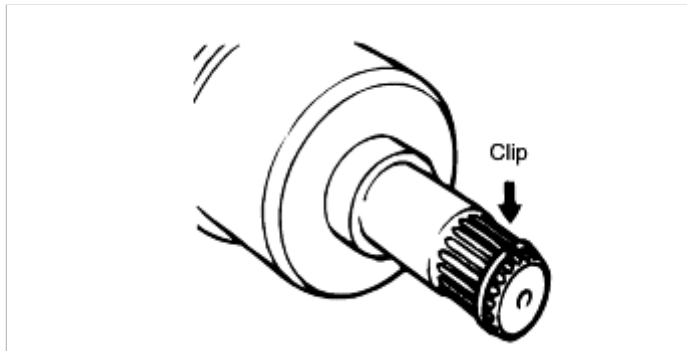
13. Install A/C hose bracket bolt to subframe.



14. Install intermediate shaft bolt.(Refer to section ST, Steering system)
15. Remove suitable tool.
16. Install new clips on driveshaft.
17. Push driveshaft and joint shaft into transaxle with opening of clips pointing upward.
18. Install joint shaft support bracket and then install three bolts.

Tightening torque:

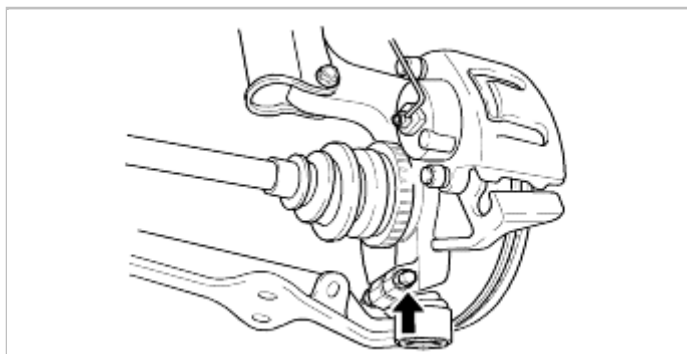
31.1~45.5 lb-ft (42.1~61.8 N·m, 4.3~6.3 kg-m)



19. Install both right and left lower arm ball joint into spindle and then install pinch bolts.

Tightening torque:

68.7~84.6 lb-ft (93.1~114.7 N·m, 9.5~11.7 kg-m)



20. Install both right and left control links.

Tightening torque:

68.7~84.6 lb-ft (93.1~114.7 N·m, 9.5~11.7 kg-m)

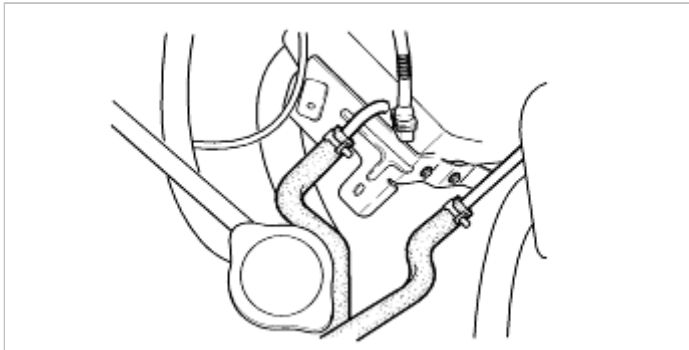
21. Install both right and left tie rod ends to steering knuckle then install tie rod end nuts.
-

Tightening torque:
43.3~58.5 lb-ft (58.8~79.4 N·m, 6.0~8.1 kg-m)

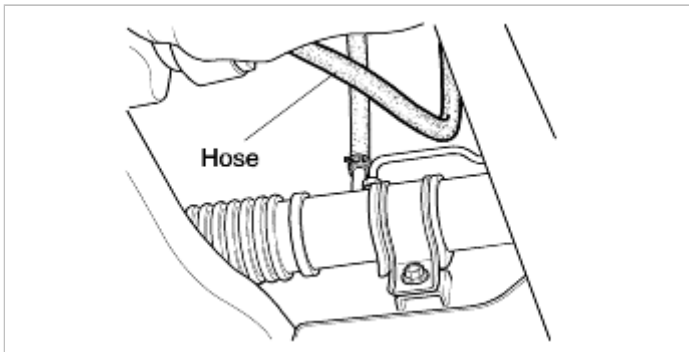
22. Insert cotter pin and then bend over.
 23. Install exhaust manifold.
 24. Install A/C compressor.(Refer to section HA, Air conditioner)
 25. Connect magnetic clutch connector.
 26. Install drive belt.(Refer to drive belt)
 27. Install both right and left wheels then tighten both right and left lug nuts.
-

Tightening torque:
65~87 lb-ft (88~118 N·m, 9~12 kg-m)

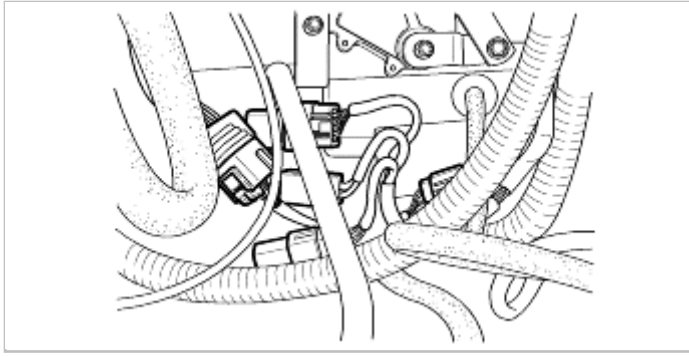
28. Slide ATF inlet and outlet hose onto ATF cooler pipe until it is fully seated against ridge.
29. Install hose clamp onto hose at center of mark and at angle shown.



30. Install heater hose.

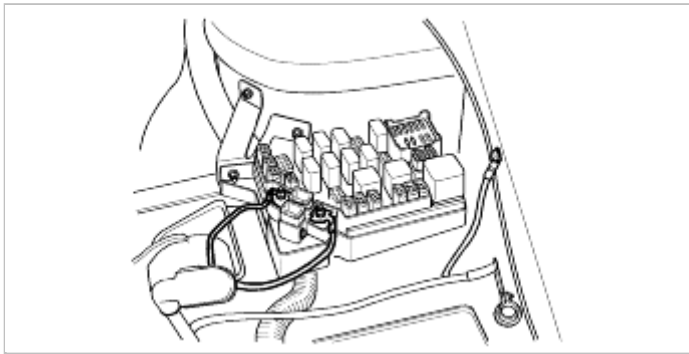


31. Install fuel hose from the fuel filter.
32. Install power steering fluid pipe to power steering pump.
33. Install two hose to power steering reserve tank.
34. Install brake vacuum hose to alternator.
34-1. Install accelerator cable to injection pump (Except for common rail system)
35. Install auto transaxle filter tube assembly.
36. Connect two vacuum hoses and water temperature sensor connector.
37. Connect heater hose to thermostat housing.
38. Install nut and washer to auto transaxle linkage.
39. Install U-clip.
40. Connect five connector.



41. Install ground to body side.

42. Connect two ground connectors to fuse box.



43. Connect coolant reservoir hose to thermostat housing.

44. Connect RH side wiper motor connector.

45. Install fresh air duct, air cleaner assembly and air cleaner bracket.

46. Install battery tray and battery.

47. Connect negative and positive battery cable.

48. Fill transaxle with ATF.(Refer to section AT, Automatic transaxle system)

49. Fill engine coolant with specified type and amount.(Refer to Cooling system)

50. Fill power steering fluid. (Refer to section ST, Power steering system)

51. Adjust auto transaxle control cable. (Refer to section AT, Automatic transaxle system)

52. Perform fuel line bleeding. (Except for common rail system)

53. Adjust accelerator cable. (Except for common rail system)

54. Start engine and then check for leaks.

Engine Mechanical System

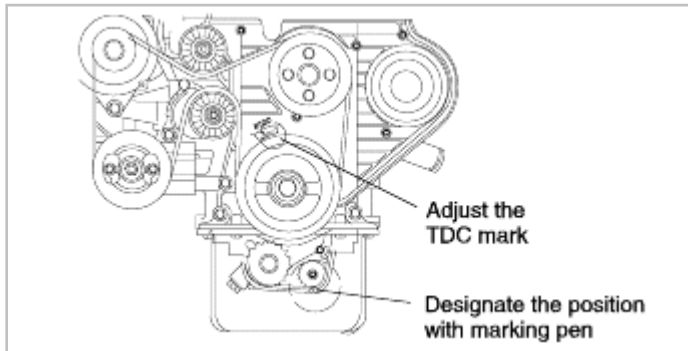
Cylinder Block - Balance Shaft



Removal

LADDER FRAME AND BALANCE SHAFT

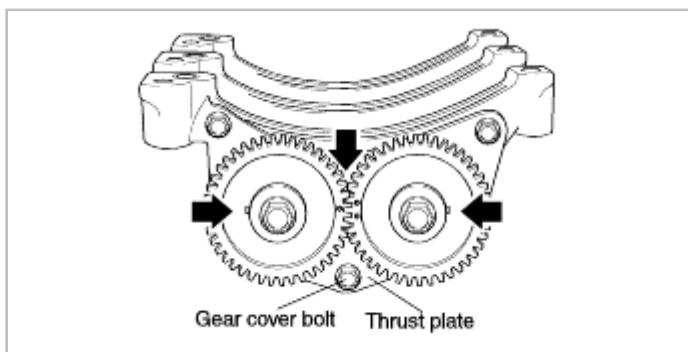
1. Remove oil pan. (Refer to Oil pan)
2. Adjust the V groove TDC mark on the outside of pulley to the TDC mark "T" on the timing cover, by rotating the crank shaft pulley.



3. For timing check, loosen the 3 balance gear cover bolts on the back of ladder frame and check the balance gear assembly mark.

NOTICE

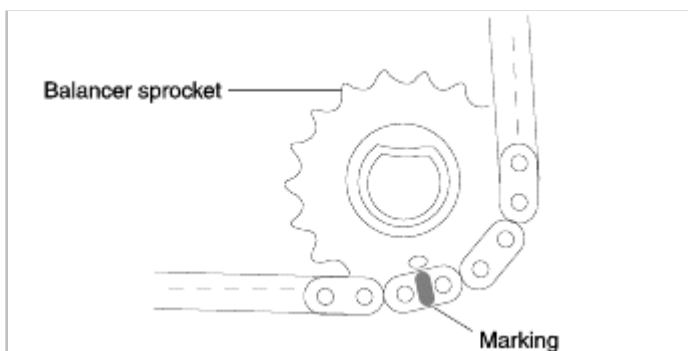
To prevent the balance shaft from being failed out, tighten the 1 of 3 balance gear cover bolts by hand into the thrust plate center.



4. When reassembling after checking the balance gear assembly mark, mark the chain link with marking pen that is matched with $\varnothing 0.12$ in ($\varnothing 3$ mm) round TDC mark to adjust the timing.

NOTICE

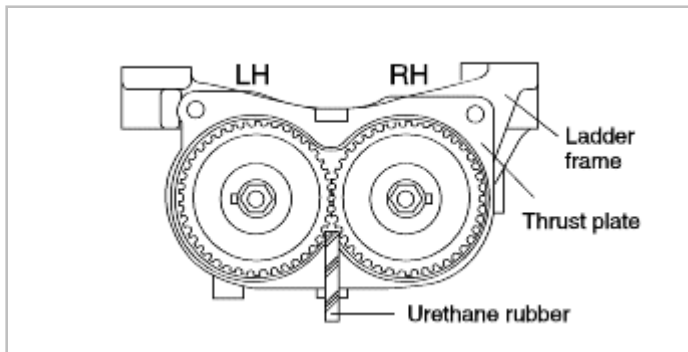
Disregard the 2 yellow points on the chain link because it is only available for engine assembly.



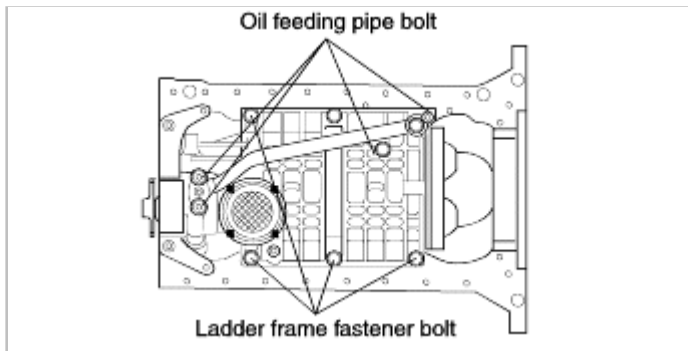
5. Loosen balance sprocket bolt.

NOTICE

Insert the 0.2 in (5 mm) urethane rubber between balance gear to prevent the balance shaft from rotating and the balance gear from damaging.



6. When disassembling the balance sprocket, hold the balance sprocket by one hand with pushing the thrust plate slightly then the balance separates from the neck of balance shaft.
7. When disassembling ladder frame, separate the oil feeding pipe from the oil pump by loosening the oil feeding pipe bolt.



8. Loosen the ladder frame fastener bolt. Remove ladder frame.

REPLACEMENT

Ladder frame and balance shaft

1. Measure end play of balance shaft.

End play: 0.0039~0.0098 in (0.1~0.25 mm)

2. Install the balance shaft and thrust plate assembly into the ladder frame.

NOTICE

To prevent the balance shaft from being failed out, tighten the 1 of 3 balance gear cover bolts by hand into the thrust plate center.

3. Install the ladder frame into block. Check the dowel pin of ladder frame is matched with lower surface of block and insert the oil level gauge into the ladder frame hole.

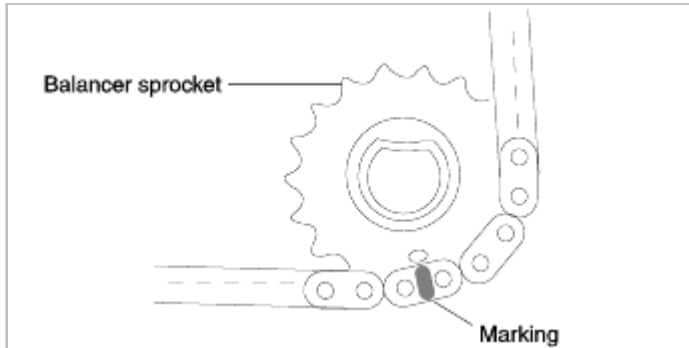
Tightening torque (ladder frame bolt):
32.5 lb-ft (44 N·m, 4.5 kg-m)

4. Install crankshaft sprocket, oil pump sprocket, guide and chain tensioner.

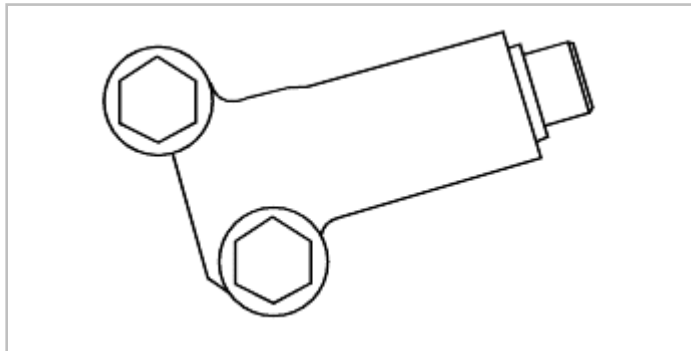
5. Adjust balance shaft sprocket position mark with chain link mark, and then insert the sprocket into the neck of balance shaft.

NOTICE

For smooth operation, pull the thrust plate out and hold, and then push the sprocket into the balance shaft.



6. Push the end of chain tensioner plunger utmost and then install the chain tensioner lever between chain and chain tensioner.



7. Tighten balance sprocket bolt.

NOTICE

Insert the 0.2 in (5 mm) urethane rubber between balance gear to prevent the balance shaft from rotating and the balance gear from damaging.

Tightening torque:

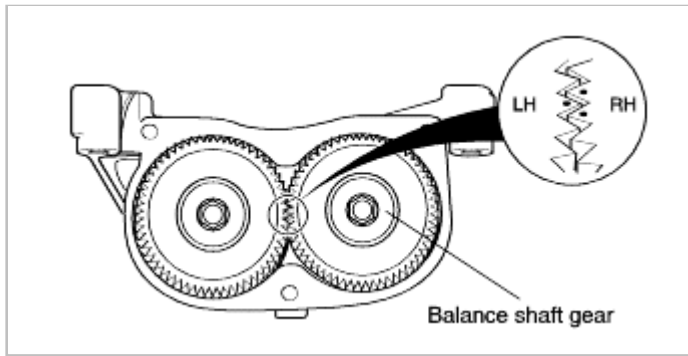
Mark 10T: 50.6 lb-ft (68.6 N·m, 7 kg-m)

Mark 8T: 43.4 lb-ft (58.8 N·m, 6 kg-m)

8. Rotate the crankshaft pulley 2 times and make the chain 1 rotating fully, check the adjustment between crankshaft pulley TDC mark and timing cover TDC mark after checking the balance gear assembly mark. If not, readjustment is needed.

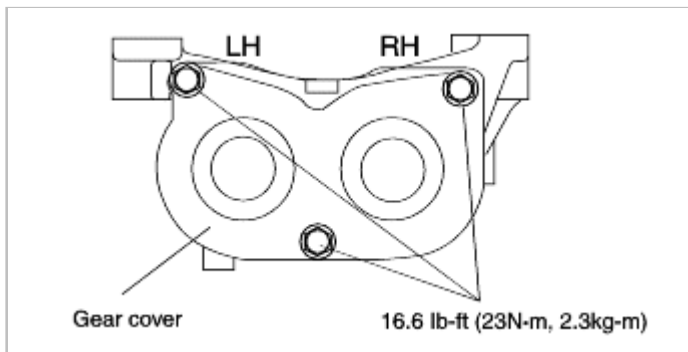
NOTICE

The chain link mark position is only efficient to assembly, but it is not matched after 2 rotation of crankshaft pulley. Timing check is only possible through the balance shaft gear.

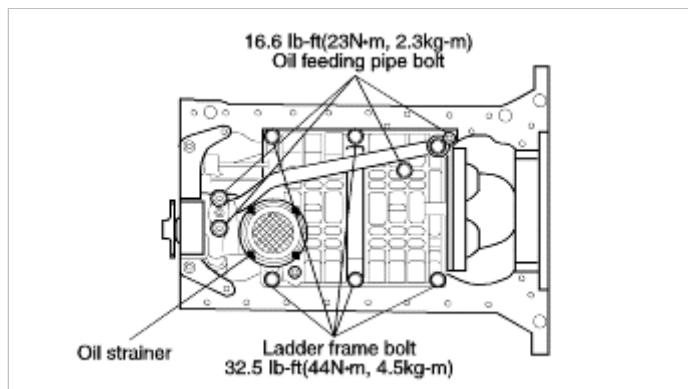


9. Loosen the bolt on the thrust plate, and install the gear cover and tighten 3 bolts.

Tightening torque: 16.6 lb-ft (23 N·m, 2.3 kg-m)



10. Install the oil feeding pipe into the ladder frame, oil pump and block and then tighten bolts.



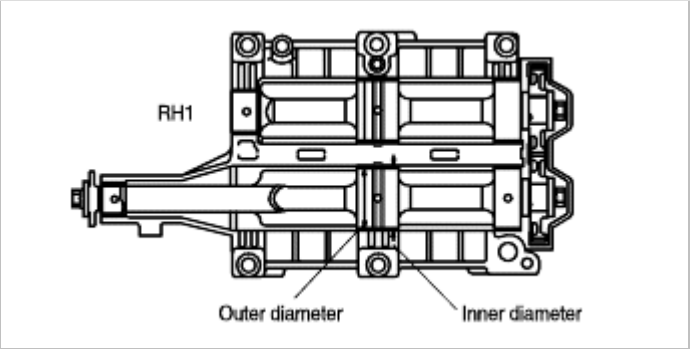
11. Install the oil pan. (Refer to Oil pan)
 12. Fill engine oil with specified type and amount.(Refer to oil pan)
 13. Start engine and then check for leaks.

INSPECTION

LADDER FRAME AND BALANCE SHAFT

Inner diameter of ladder frame (mm)		Outer diameter of balance shaft (mm)	
LH1	0.9843-0.9851 in (25.000-25.021 mm)	LH1	0.9818-0.9827 in (24.939-24.960 mm)
LH2	2.1259-2.1272 in (54.000-54.030 mm)	LH2	2.1224-2.1236 in (53.910-53.940 mm)
LH3	2.2047-2.2059 in (56.000-56.030 mm)	LH3	2.2012-2.2023 in (55.910-55.940 mm)

LH1	1.3779-1.3789 in (35.000-35.025 mm)	LH1	1.3749-1.3759 in (34.925-34.950 mm)
LH2	2.1259-2.1272 in (54.000-54.030 mm)	LH2	2.1224-2.1236 in (53.910-53.940 mm)
LH3	2.2047-2.2059 in (56.000-56.030 mm)	LH3	2.2012-2.20231 in (55.910-55.940 mm)



Engine Mechanical System

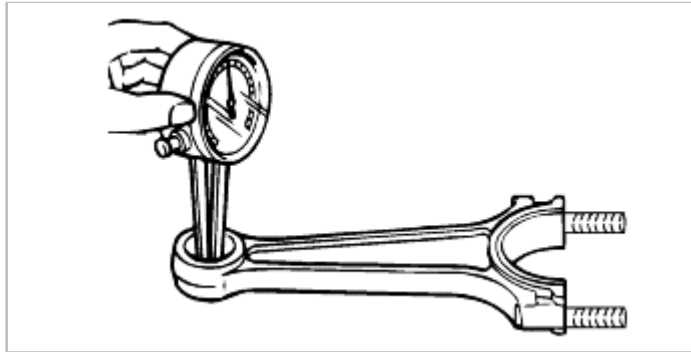
Cylinder Block - Piston and Connecting Rod



INSPECTION

1. Check connecting rod bushing inside diameter.

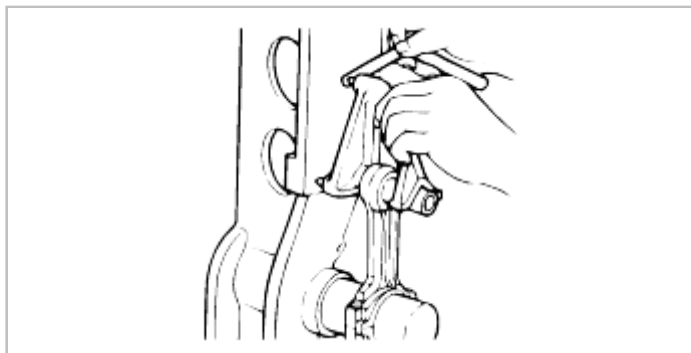
Inside diameter: 1.2603~1.2611 in (32.012~32.033 mm)



2. Subtract piston pin diameter from connecting rod bushing inside diameter to determine piston pin fit.

Clearance: 0.0005~0.0015 in (0.012~0.039 mm)

3. If clearance is not within specification, replace connecting rod bushing.
4. Check each connecting rod for bending.



5. Replace connecting rods if necessary.

NOTICE

Connecting rods must always be replaced as an assembly. Rod cap, rod, bolts and nuts are a matched set.

Replacement

CYLINDER LINER AND PISTON SELECTION

1. Check the cylinder bore inner diameter size code of cylinder block.

NOTICE

The code is carved on the top of each cylinder.

CYLINDER BORE INNER DIAMETER

Code	Cylinder bore inner diameter
X	3.9966-3.9971 in (101.513-101.526 mm)

Y	3.9960-3.9966 in (101.500-101.513 mm)
---	---------------------------------------

2. Choose the proper cylinder liner as below table.

Clearance between cylinder liner and cylinder bore of cylinder block :
0.0003~0.0013 in (0.007~0.033 mm)

CYLINDER LINER SELECTION TABLE

Cylinder bore size code	Cylinder liner mark	Oil clearance
Y	3Y-Yellow	0.0003-0.0013 in (0.007-0.033 mm)
Y	3Y-Blue	0.0003-0.0013 in (0.007-0.033 mm)
X	3X-Yellow	0.0003-0.0013 in (0.007-0.033 mm)
X	3X-Blue	0.0003-0.0013 in (0.007-0.033 mm)

PISTON SELECTION TABLE

Cylinder liner mark	Piston mark	Oil clearance
Yellow	B	0.0028-0.0039 in (0.070-0.098 mm)
Blue	A	0.0028-0.0039 in (0.070-0.098 mm)

NOTICE

The mark for outer diameter is carved on the out surface of liner and for inner diameter is painted on the top of liner.

CYLINDER LINER OUTER DIAMETER AND INNER DIAMETER

Code	Outer diameter	Code	Inner diameter
3Y	3.9958-3.9963 in (101.493-101.506 mm)	Yellow	3.8234-3.8239 in (97.115-97.128 mm)
3Y	3.9958-3.9963 in (101.493-101.506 mm)	Blue	3.8228-3.8233 in (97.100-97.113 mm)
3X	3.9953-3.9958 in (101.480-101.493 mm)	Yellow	3.8234-3.8239 in (97.115-97.128 mm)
3X	3.9953-3.9958 in (101.480-101.493 mm)	Blue	3.8228-3.8233 in (97.100-97.113 mm)

PISTON OUTER DIAMETER

Code	Piston outer diameter
A	3.8195-3.8201 in (97.015-97.030 mm)
B	3.8201-3.8207 in (97.030-97.045 mm)



Engine Mechanical System

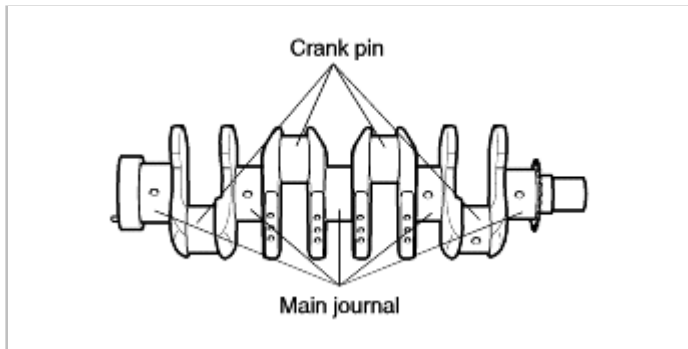
Cylinder Block - Crankshaft



INSPECTION

1. Check crankshaft bearing and crank pin journals for damage and scoring.
2. Check oil holes for clogging.
3. Set crankshaft on V-blocks.
4. Measure crankshaft run-out at center journal. Replace crankshaft if it is not within specification.

Run-out: 0.0055~0.0154 in (0.14~0.39 mm)



Replacement

PIN JOURNAL BEARING SELECTION

1. Check the connecting rod big-end bore size code.

NOTICE

The code is carved on connecting rod cap bolt hole side.

CONNECTING ROD BIG-END BORE DIAMETER

Grade	Connecting rod big-end bore diameter
1	2.39499-2.39523 in (60.833-60.839 mm)
2	2.39523-2.39550 in (60.839-60.846 mm)

Crankshaft pin journal diameter:
2.24827~2.24898 in (57.106~57.124 mm)

2. Choose the proper pin journal bearing as below table.

Pin journal bearing clearance:
0.00138~0.00272 in (0.035~0.069 mm)

PIN JOURNAL BEARING SELECTION TABLE

Connecting rod grade	Pin journal bearing grade	Oil clearance
1	Blue	0.00146-0.00272 in (0.037-0.069 mm)
2	Red	0.00138-0.00268 in (0.035-0.068 mm)

NOTICE

Painting mark is located on the bearing side face.

PIN JOURNAL BEARING THICKNESS

Color	Pin journal bearing thickness
Blue	0.07213-0.07228 in (1.832-1.836 mm)
Red	0.07228-0.07244 in (1.836-1.840 mm)

- Position properly upper bearing and lower bearing to connecting rod and connecting rod cap and then install connecting rod and connecting rod cap to crankshaft pin journal

Tightening torque:

Tighten 50.6 lb-ft (68.6 N·m, 7.0 kg-m) and then loosen nuts.

Retighten 21.7 lb-ft (29.4 N·m, 3.0 kg-m)

and then tighten 90°.

MAIN JOURNAL BEARING SELECTION

- Check the cylinder block main bearing bore size code.

NOTICE

The code is located on the side of ladder frame bolt hole.

CYLINDER BLOCK MAIN BEARING BORE DIAMETER

Code	Cylinder block main bearing bore diameter
A	2.91598-2.91633 in (74.066-74.075 mm)
.	2.91633-2.91669 in (74.075-74.084 mm)
B	2.91669-2.91700 in (74.084-74.092 mm)

- Check the crankshaft main journal size code.

NOTICE

The code is located on the between main journal and pin journal.

CRANKSHAFT MAIN JOURNAL DIAMETER

Code	Crankshaft main journal diameter	
	No. 1, 2, 4, 5	No. 3
A	2.75570-2.75598 in (69.995-70.002 mm)	2.75483-2.75511 in (69.973-69.980 mm)
.	2.75598-2.75625 in (70.002-70.009 mm)	2.75511-2.75539 in (69.980-69.987 mm)
C	2.75625-2.75649 in (70.009-70.015 mm)	2.75539-2.75562 in (69.987-69.993 mm)

- Choose the proper main journal bearing in below table.

Main journal bearing selection table

		Cylinder block main bearing bore size code		
		A	.	C
Crankshaft main journal size code	A	Brown	Black	Black
	.	Green	Brown	Black
	B	Yellow	Green	Brown

Main journal bearing clearance:

No.1,2,4,5: 0.00146~0.00280 in (0.037~0.071 mm)

No.3: 0.00232~0.00366 in (0.059~0.093 mm)

MAIN JOURNAL BEARING THICKNESS

Code	Main journal bearing thickness
Black	0.07925-0.07945 in (2.013-2.018 mm)
Brown	0.07905-0.07925 in (2.008-2.013 mm)
Green	0.07886-0.07905 in (2.003-2.008 mm)
Yellow	0.07866-0.07886 in (1.998-2.003 mm)

- Position properly upper bearing and lower bearing to cylinder block and main bearing cap.
 - Set crankshaft to cylinder block and then install main bearing cap to cylinder block.
-

Tightening torque:

Pretighten 54.97 lb-ft (74.5 N·m, 7.6 kg-m),
and then tighten 60°.

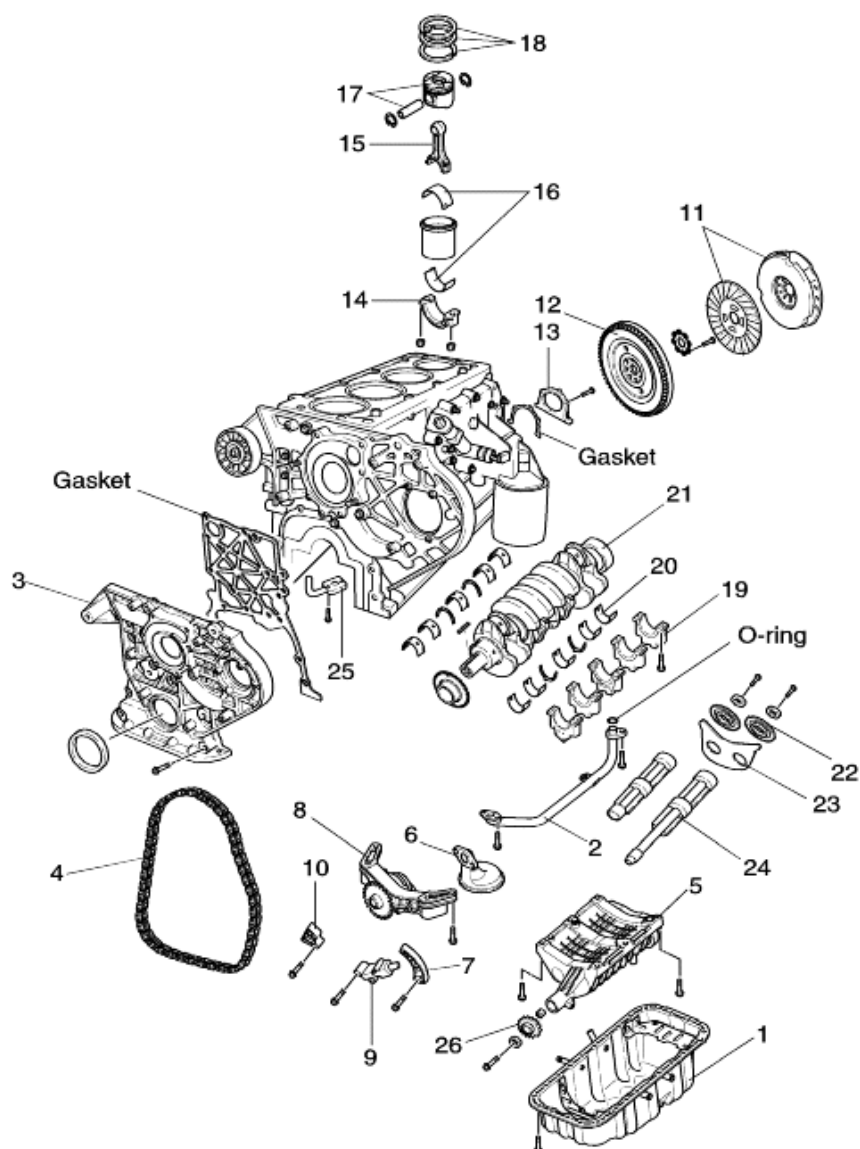


Engine Mechanical System

Cylinder Block - Cylinder Block



COMPONENT



1. Oil pan
2. Oil feed pipe
3. Timing belt case
4. Chain
5. Ladder frame
6. Oil strainer
7. Lever
8. Oil pump
9. Tensioner

10. Guide
11. Clutch cover and clutch disc
(MTX only)
12. Flywheel (MTX only)
13. Rear cover
14. Connecting rod cap
15. Connecting rod
16. Main bearing
17. Piston and piston pin

18. Piston rings
19. Main bearing cap
20. Main bearing
21. Crankshaft
22. Balance gear
23. Thrust plate
24. Balance shaft
25. Oil jet
26. Balance sprocket



DISASSEMBLY

1. Remove the clutch cover, clutch disc and flywheel.
2. Remove the oil pan mounting bolts.
3. Remove oil pan with a screwdriver or suitable tool.

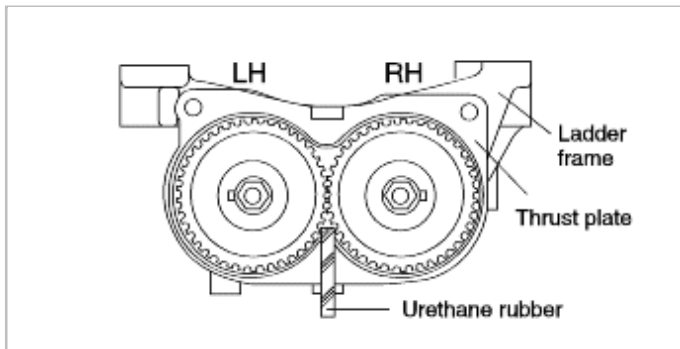
CAUTION

- Do not force tools between cylinder block and oil pan as this may damage sealing surface.
- Do not damage sealing surface when removing old sealant.

4. Remove the oil feed pipe.
5. Remove the timing belt case.
6. Loosen balance sprocket bolt.

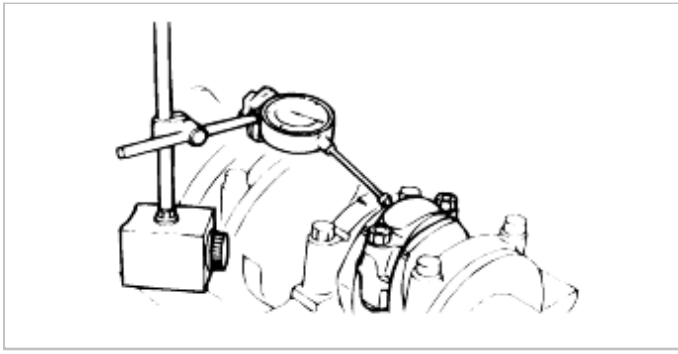
NOTICE

Insert the 0.2 in(5mm) urethane rubber between balance gear to prevent the balance shaft from rotating and the balance gear from damaging.



7. When disassembling the balance sprocket, hold the balance sprocket by one hand with pushing the thrust plate slightly then the balance separates from the neck of balance shaft.
8. Remove the chain.
9. Remove the ladder frame.
10. Remove the oil strainer and oil pump.
11. Remove the lever, tensioner and guide.
12. Remove the rear cover.
13. Before removing the connecting rod, measure the connecting rod side clearance.

Side clearance: 0.0055~0.0153 in (0.14~0.39 mm)

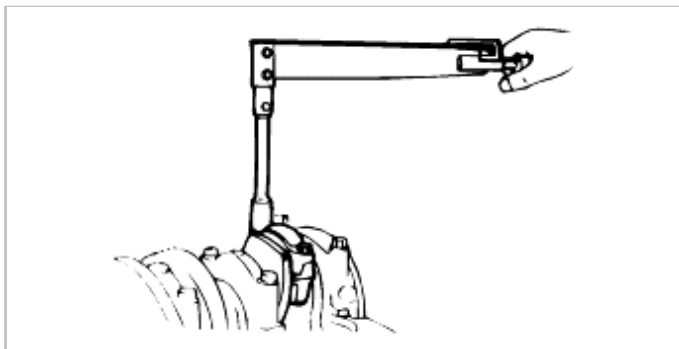


14. Remove connecting rod cap.
15. Measure the connecting rod bearing oil clearance.
 - (1) Remove all foreign material and oil from the crank pin and bearing surface.
 - (2) Position Plastigage atop the crank pin in the axial direction.
 - (3) Install the connecting rod cap and tighten.

Tightening torque:

Tighten 50.6 lb-ft (68.6 N·m, 7.0 kg-m) and then loosen nuts.

Retighten 21.7 lb-ft (29.4 N·m, 3.0 kg-m)
and then tighten 90°.

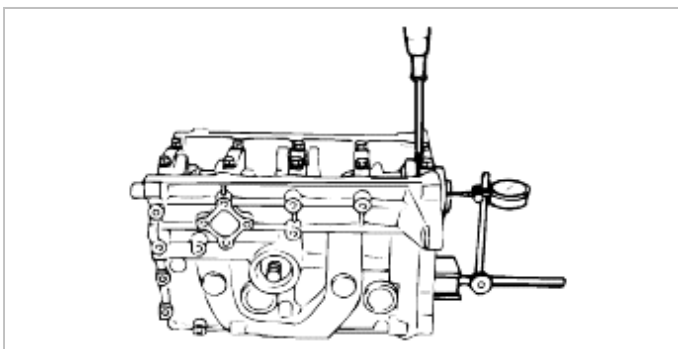


- (4) Loosen the connecting rod cap nuts.
- (5) Measure the oil clearance at each crank pin.

Oil clearance: 0.00169~0.00303 in (0.043~0.077 mm)

16. Remove the connecting rod and piston.
17. Before removing the main bearing cap, measure the crankshaft end play.

End play: 0.0055~0.0153 in (0.14~0.39 mm)

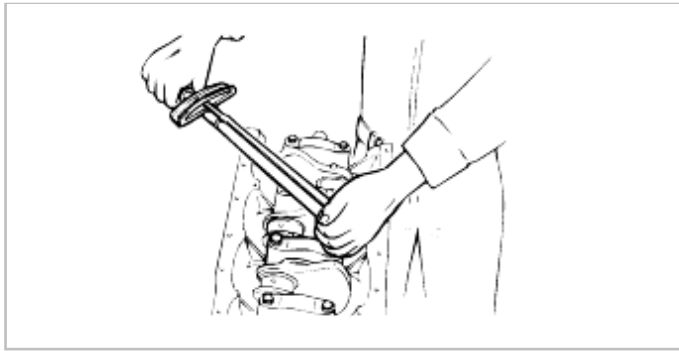


18. Remove main bearing cap.
19. Measure the main bearing oil clearance
 - (1) Remove all foreign material and oil from the journals and bearing surface.
 - (2) Position Plastigauge atop the journals in the axial direction.
 - (3) Install the main bearing cap and tighten as shown in the figure.

Tightening torque:

Pretighten 54.97 lb-ft

(74.5 N·m, 7.6 kg-m), and then tighten 60°.



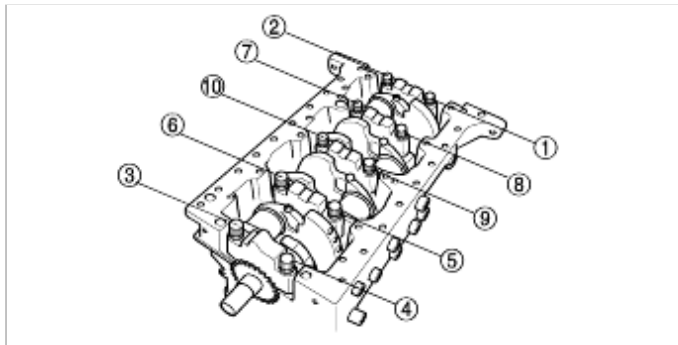
- (4) Loosen the main bearing cap bolts and remove main bearing cap.
- (5) Measure the oil clearance at each journal.

Oil clearance:

No.1,2,4,5: 0.00177~0.00311 in (0.045~0.079 mm)

No.3: 0.00267~0.00397 in (0.068~0.101 mm)

20. Loosen the main bearing cap bolts in two or three steps in the order shown in the figure.
21. Remove the main bearing cap, main bearing and crankshaft.



22. Remove the balance shaft and thrust plate.
23. Remove the balance gear.
24. Remove the oil jet.
25. Remove the snap ring with snap ring pliers and then remove the piston pin.
26. Using a piston ring expander, remove piston rings.

REASSEMBLY

NOTICE

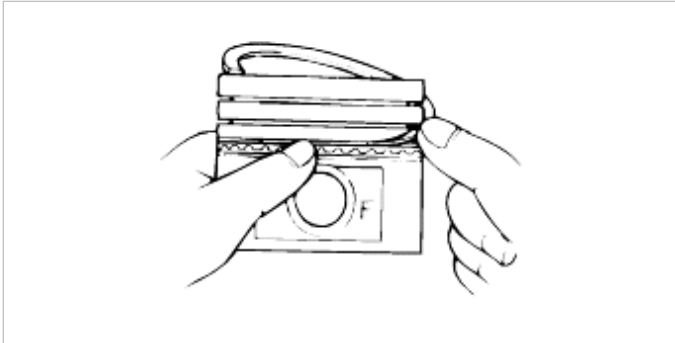
- Clean all parts before reassembly.

- Apply new engine oil to all sliding and rotating parts.

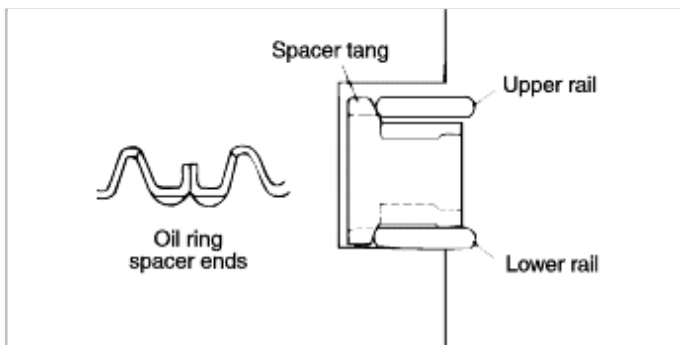
1. Install the three-piece oil rings on the pistons.
 - (1) Apply engine oil to the oil ring spacer and rails.
 - (2) Install the oil ring spacer so that the opening faces upward.
 - (3) Install the upper rail and lower rail.

NOTICE

- The upper rail and lower rail are the same.
- Each rail can be installed with either face upward.



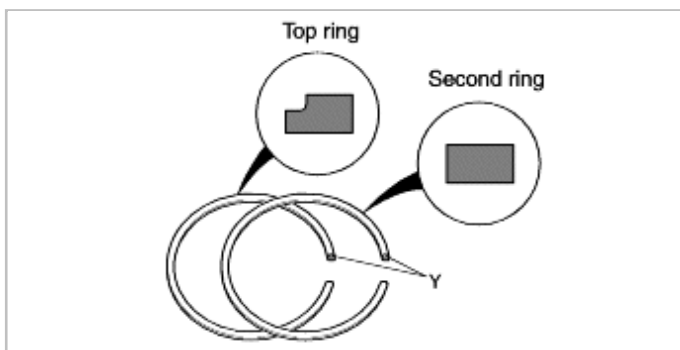
2. Check that both rails are expanded by the spacer tangs as shown in figure by checking that both rails turn smoothly in both directions.



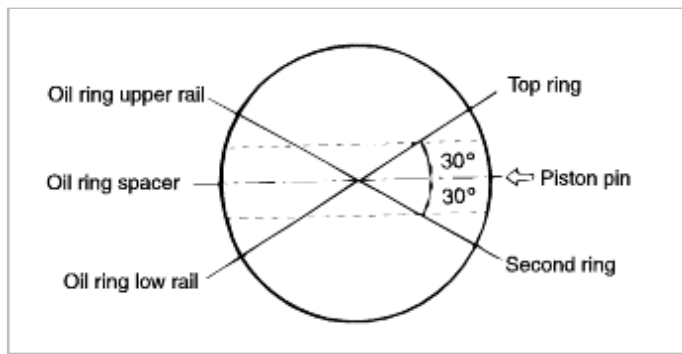
3. Install the second ring to the piston first, then install the top ring. Use piston ring expander.

NOTICE

The rings must be installed with the "Y" marks facing upward.



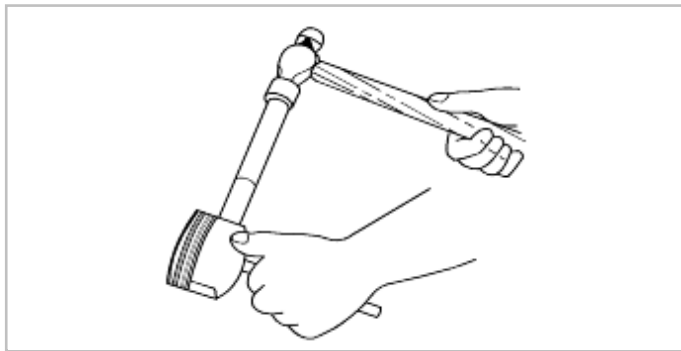
4. Apply a liberal amount of clean engine oil to the second and top piston rings.
5. Position the opening of each ring as shown in the figure.



6. Install one piston pin snap ring into grooves on piston.
7. Insert connecting rod into piston and slide piston pin through piston and connecting rod until it makes contact with the piston pin snap ring already installed.

NOTICE

Verify that piston and rod are assembled in same direction as they were prior to disassembly.



8. Install second piston pin snap ring grooves on opposite side of piston.



9. Hold piston upright and move connecting rod back and forth. Check that rod moves freely.
10. Install the oil jet.
11. Before installing the crankshaft, inspect the main bearing oil clearance as follows.

OIL CLEARANCE INSPECTION

- (1) Remove all foreign material and oil from the journals and bearings.

CAUTION

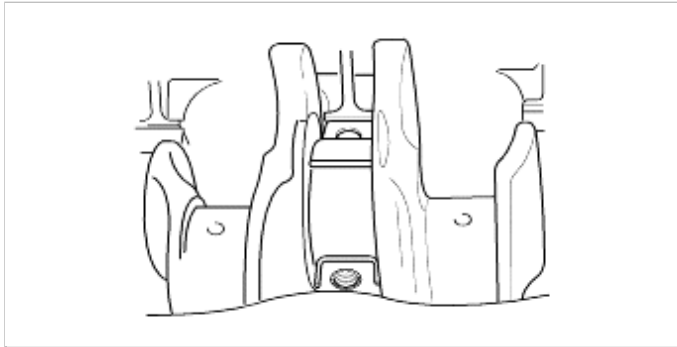
- Install the grooved upper main bearings in the cylinder block.
- Install the thrust bearings with the oil groove facing the crankshaft.

- (2) Install the upper main bearings and thrust bearings.
- (3) Set the crankshaft in the cylinder block.

CAUTION

Do not rotate the crankshaft when measuring the oil clearances.

- (4) Position plastigage atop the journals in the axial direction.

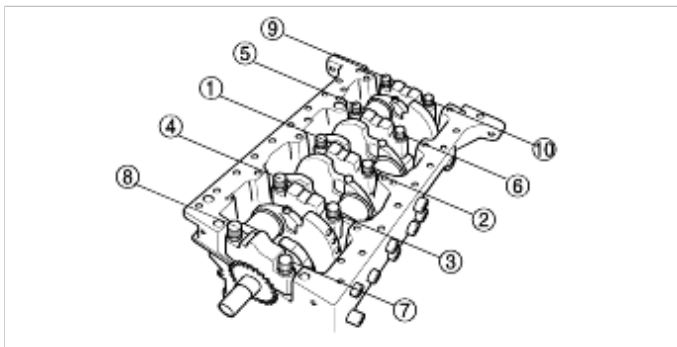


- (5) Install the lower main bearings and the main bearing caps according to the cap number and ← mark.

- (6) Tighten the main bearing cap bolts in two or three steps in the order shown in the figure.

Tightening torque:

Pretighten: 54.97 lb-ft (74.5 N·m, 7.6 kg-m)
and then tighten 60°.



- (7) Remove the main bearing caps, and measure the plastigage at each journal at the widest point for the smallest clearance and at the narrowest point for the largest clearance.

- (8) If the oil clearance exceeds specification, grind the crankshaft and use undersize main bearings.

Oil clearance:

No.1,2,4,5: 0.00146~0.00280 in (0.037~0.071 mm)

No.3: 0.00232~0.00366 in (0.059~0.093 mm)

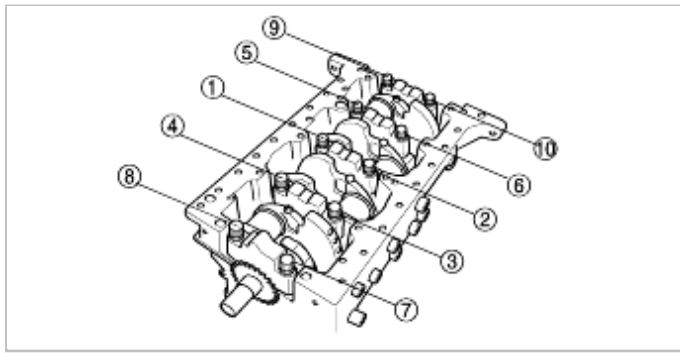
12. Apply a liberal amount of clean engine oil to the main bearings, thrust bearings and main journals.

13. Install the crankshaft and the main bearing caps according to the cap number and ← mark.

14. Tighten the main bearing cap bolts in two or three steps in the order shown in the figure.

Tightening torque:

Pretighten: 54.97 lb-ft (74.5 N·m, 7.6 kg-m)
and then tighten 60°.



15. Before installing the connecting rod, inspect the connecting rod bearing oil clearance as follows.

- (1) Slip piston and connecting rod assembly into a piston ring compressor.
- (2) Rotate crankshaft so that crank pin journal for specific cylinder is at its lowest point(bottom dead center).
- (3) Lower piston and connecting rod assembly until piston ring compressor makes contact with deck surface of engine block.



- (4) Using butt end of a hammer, tap the top of piston into cylinder and continue tapping until connecting rod makes contact with crankshaft.
- (5) Install a connecting rod bearing in each connecting rod cap.
- (6) Place a piece of Plastigauge on crank pin journals.

NOTICE

Align the machining marks on the cap and connecting rod when installing the connecting rod cap.

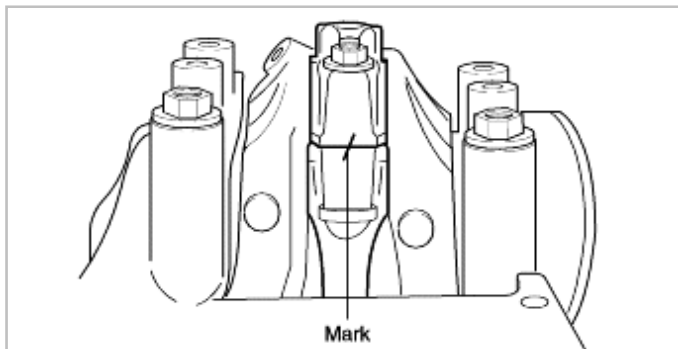
- (7) Install connecting rod caps.

Tightening torque:

Tighten 50.6 lb-ft (68.6 N·m, 7.0 kg-m) and then loosen nuts.

Retighten 21.7 lb-ft (29.4 N·m, 3.0 kg-m)

and then tighten 90°.



- (8) Loosen and remove connecting rod caps.
(9) Check the connecting rod bearing clearance.

Oil clearance: 0.00138~0.00272 in (0.035~0.069 mm)

- (10) If oil clearance exceeds maximum oil clearance specification, grind the crankshaft and use undersized connecting rod bearings.
(11) Apply a coat of clean engine oil to connecting rod bearing in connecting rod cap.
(12) Install connecting rod cap and torque to specification.

Tightening torque:

Tighten 50.6 lb-ft (68.6 N·m, 7.0 kg-m) and then loosen nuts.

Retighten 21.7 lb-ft (29.4 N·m, 3.0 kg-m)

and then tighten 90°.

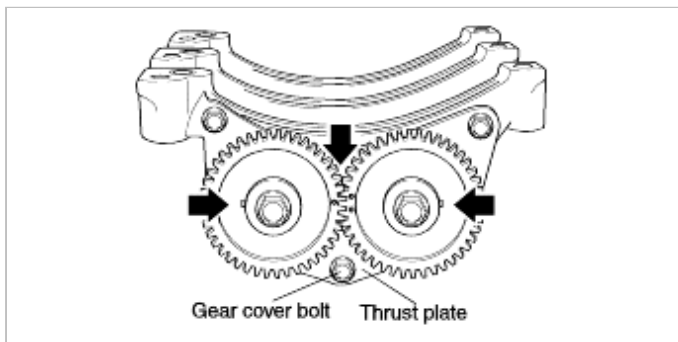
16. Install the balance shaft gear and thrust plate to the balance shaft.

Tightening torque: 32.5 lb-ft (44.1 N·m, 4.5 kg-m)

17. Install the balance shaft and thrust plate assembly into the ladder frame.

NOTICE

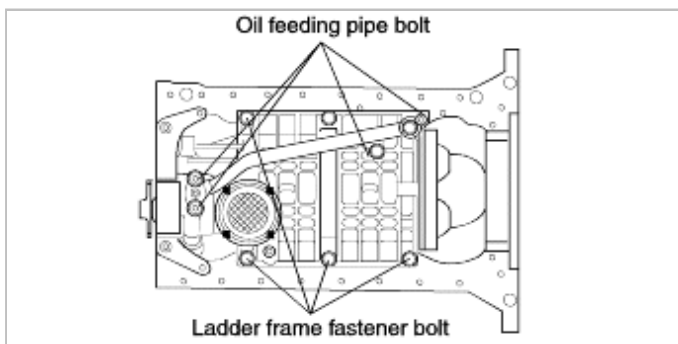
- To prevent the balance shaft from being failed out, tighten the 1 of 3 balance gear cover bolts by hand into the thrust plate center.
- Align the machining marks on the balance gear and balance gear.



18. Install the ladder frame into block. Check the dowel pin of ladder frame is matched with lower surface of block and insert the oil level gauge into the ladder frame hole.

Tightening torque (ladder frame bolt):

32.5 lb-ft (44.1 N·m, 4.5 kg-m)



19. Install the oil pump and oil strainer.
20. Install the oil feeding pipe into the ladder frame, oil pump and block, and then tighten bolts.

Tightening torque (oil feeding pipe bolt):
16.6 lb-ft (23 N·m, 2.3 kg-m)

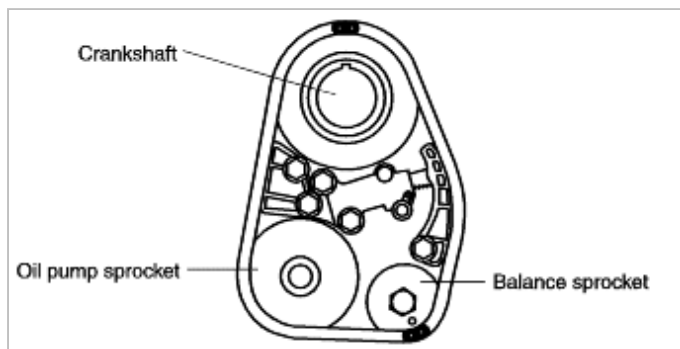
21. Install the crankshaft sprocket, oil pump sprocket, chain guide and chain tensioner.

Tightening torque
Chain guide: 6.5~9.4 lb-ft
(8.8~12.7 N·m, 0.9~1.3 kg-m)
Chain tensioner: 13.7~18.8 lb-ft
(18.6~25.5 N·m, 1.9~2.6 kg-m)

22. Adjust the crank shaft sprocket TDC mark and balance shaft sprocket timing mark with chain link mark (two yellow link), and then insert the balance sprocket into the neck of balance shaft.

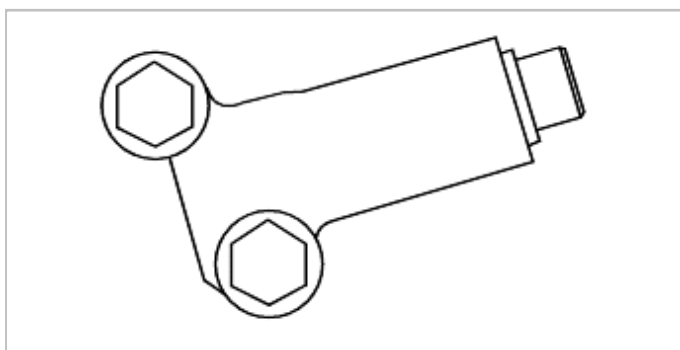
NOTICE

For smooth operation, pull the thrust plate out and hold, and then push the sprocket into the balance shaft.



23. Push the end of chain tensioner plunger utmost and then install the chain tensioner lever between chain and chain tensioner.

Tightening torque (chain tensioner lever):
6.5~9.4 lb-ft (8.8~12.7 N·m, 0.9~1.3 kg-m)



24. Tighten balance sprocket bolt.

NOTICE

Insert the 0.2in (5mm) urethane rubber between balance gear to prevent the balance shaft from rotating and the balance gear from damaging.

Tightening torque:

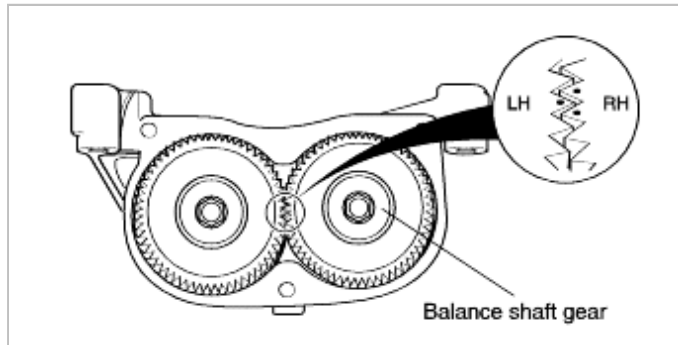
Mark 10T: 50.6 lb-ft (68.6 N·m, 7 kg-m)

Mark 8T: 43.3 lb-ft (58.8 N·m, 6 kg-m)

25. Rotate the crankshaft sprocket 2 times and mark the chain 1 rotating fully, check the crankshaft sprocket TDC mark after checking the balance gear assembly mark. If not, readjustment is needed.

NOTICE

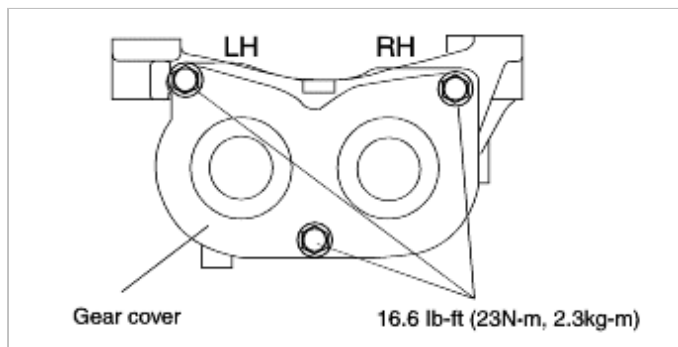
The chain link mark position is only efficient to assembly, but it is not matched after 2 rotation of crank shaft sprocket. Timing check is only possible through the balance shaft gear.



26. Loosen the bolt on the thrust plate, and install the gear cover and tighten 3 bolts.

Tightening torque:

16.6 lb-ft (23 N·m, 2.3 kg-m)



27. Install the timing belt case.

28. Install the rear cover.

Tightening torque:

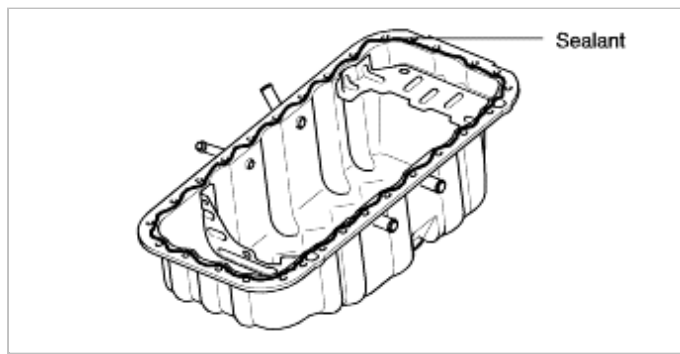
5.8~7.9 lb-ft (7.8~10.8 N·m, 0.8~1.1 kg-m)

29. Remove all foreign material from gasket surface.

NOTICE

Install oil pan within five minutes of applying silicone sealer.

30. Apply a continuous bead of silicone sealant to oil pan contact surfaces.



31. Install the oil pan.
32. Install the flywheel, clutch disc and clutch cover.

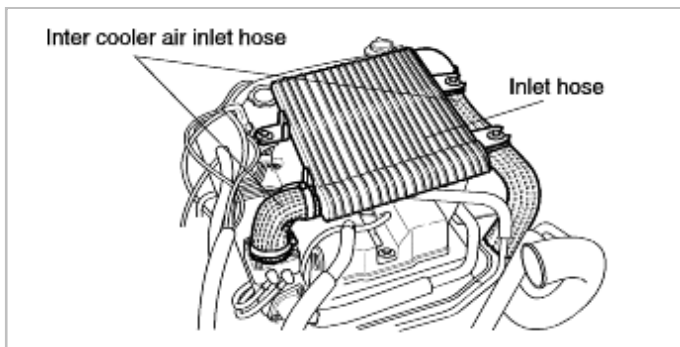
REMOVAL

AUXILIARY PARTS (J3 TCI - COMMON RAIL SYSTEM)

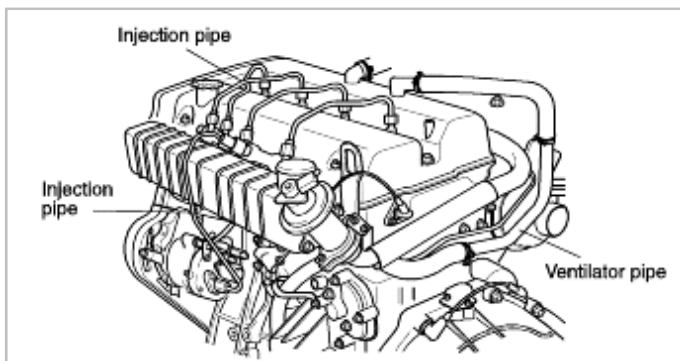
NOTICE

- Code all identical parts(such as pistons, piston rings, connecting rods, and valve springs) so that they can be reinstalled in the cylinder from which they were removed.
- Clean the parts with steam, blow off any remaining water with compressed air.
- Care should be taken during the disassembly of any part or system to study its order of assembly. Any deformation, wear or damage should also be noted.

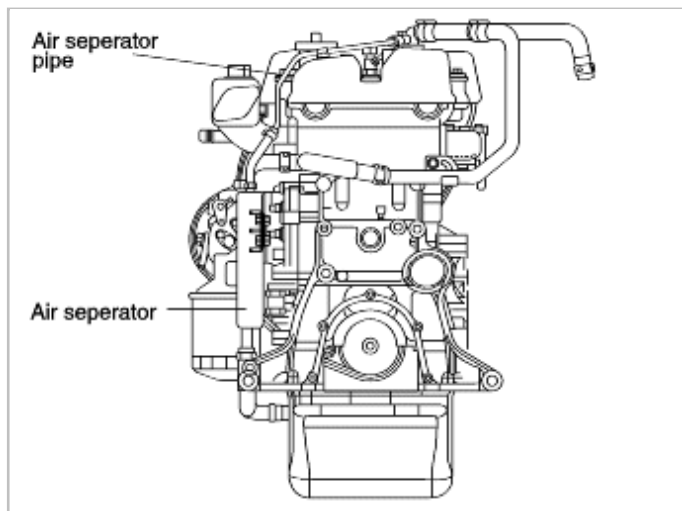
1. Remove inter cooler cover.
2. Remove inter cooler and inter cooler air inlet hose.



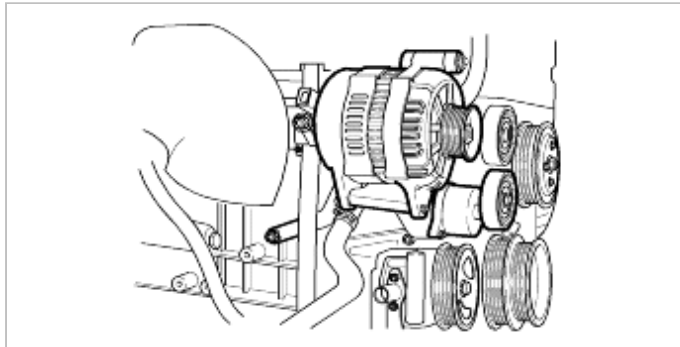
3. Remove engine harness.
4. Remove ventilator hose.
5. Remove fuel injection pipe.



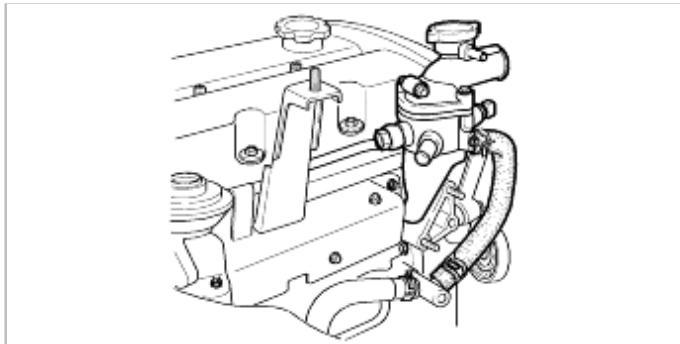
6. Remove air separator and air separator hose/pipe.



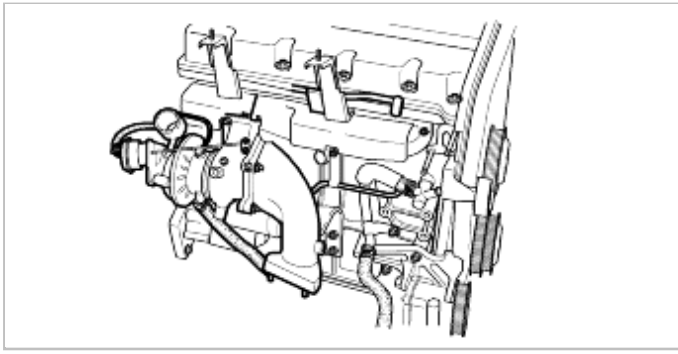
7. Remove ventilation pipe and hose.
8. Remove lower water hose from cylinder block.
9. Remove EGR pipe.
10. Remove alternator, hose, alternator bracket and auto tensioner.



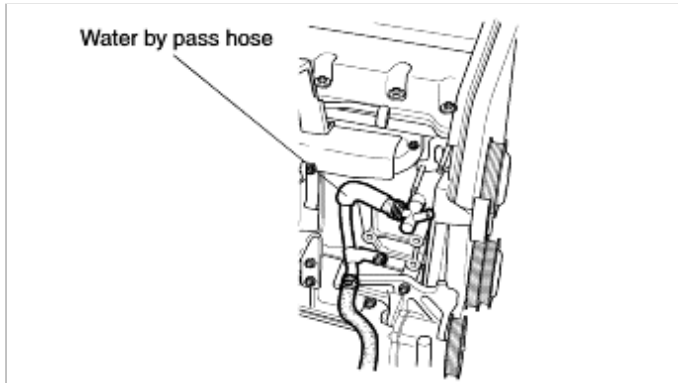
11. Remove thermostat housing assembly.



12. Remove turbo charger insulator.
13. Remove turbo charger assembly.



14. Remove water bypass hose and water bypass pipe.

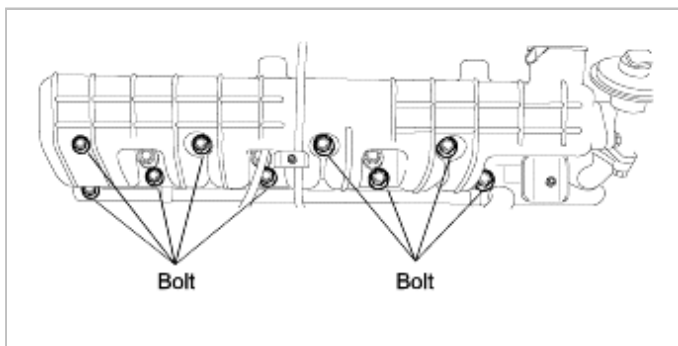


15. Remove power steering pump bracket.

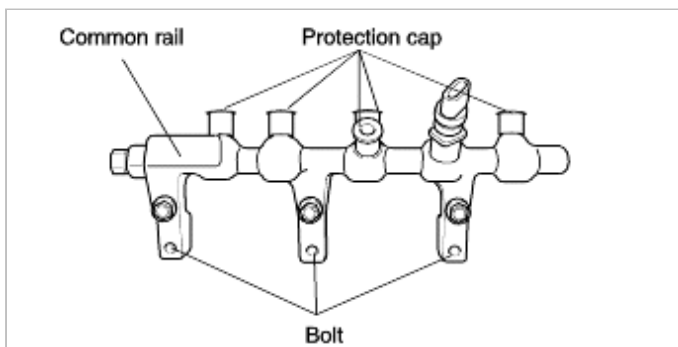
16. Remove exhaust manifold insulator, exhaust manifold and gasket.

17. Remove EGR valve and gasket.

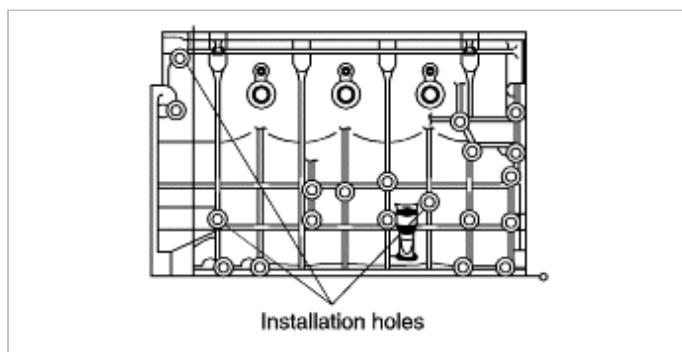
18. Remove intake manifold and gasket.



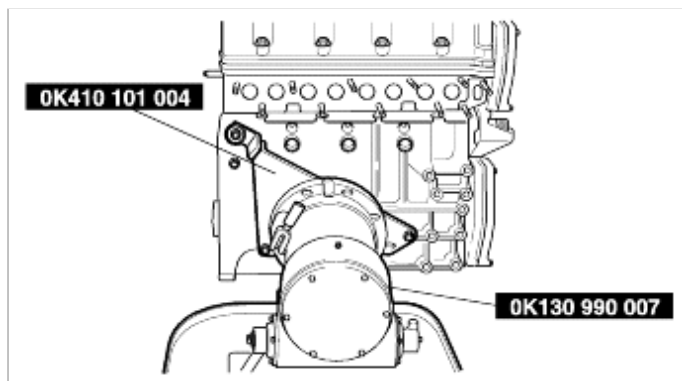
19. Remove common rail.(Refer to section FL)



20. to engine.



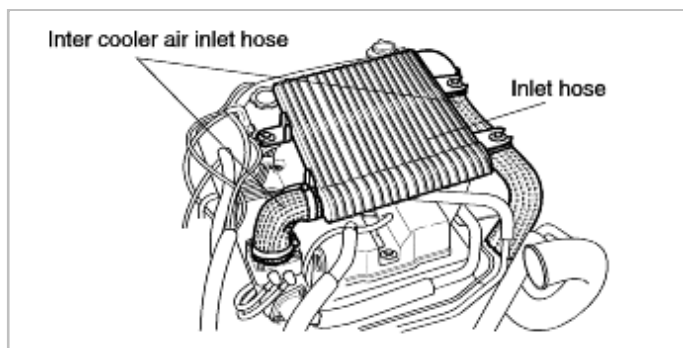
21..



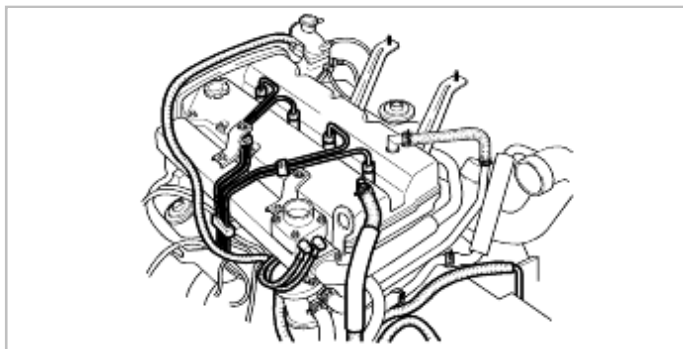
22. Assembly will be performed in the reverse order.

AUXILIARY PARTS (J3 TCI)

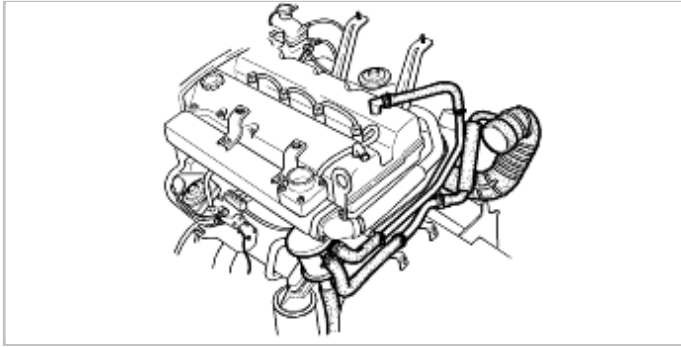
1. Remove inter cooler cover.
2. Remove inter cooler and inter cooler air inlet hose.



3. Remove engine harness.
4. Remove ventilator hose.
5. Remove fuel injection pipe.



6. Remove ventilator and ventilator hose.



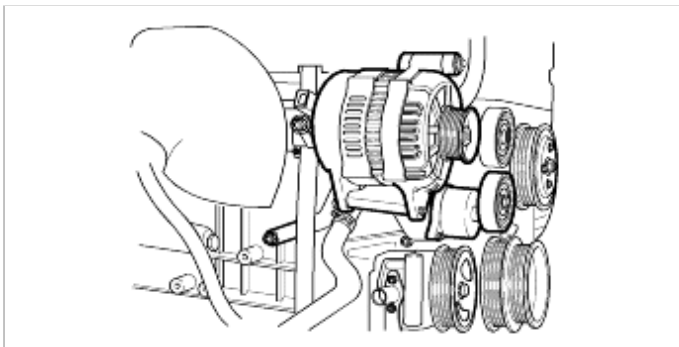
7. Remove return blow-by hose assembly.



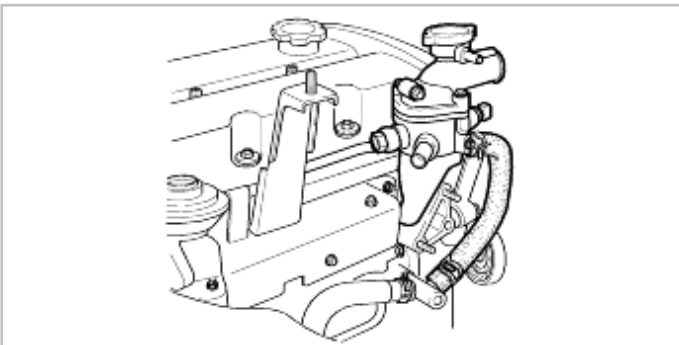
8. Remove lower water hose from cylinder block.

9. Remove EGR pipe.

10. Remove alternator, hose, alternator bracket and auto tensioner.

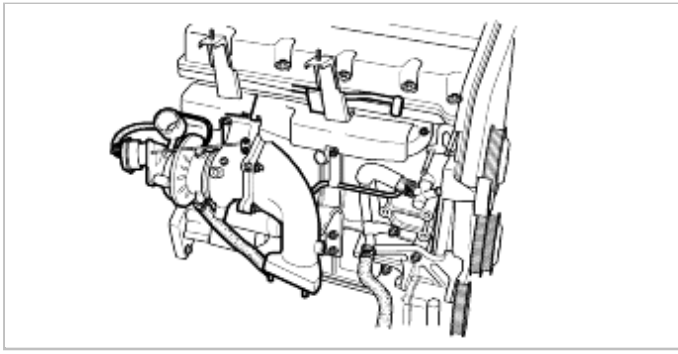


11. Remove thermostat housing assembly.

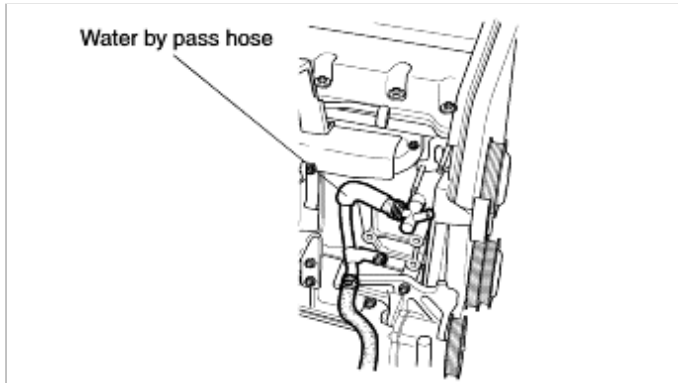


12. Remove turbo charger insulator.

13. Remove turbo charger assembly.



14. Remove water bypass hose and water bypass pipe.



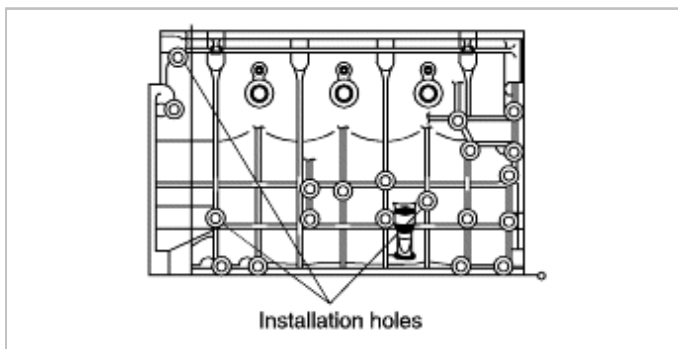
15. Remove power steering pump bracket.

16. Remove EGR valve and gasket.

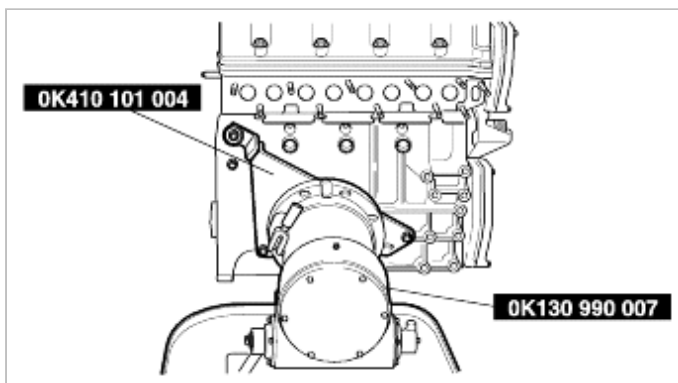
17. Remove exhaust manifold insulator, exhaust manifold and gasket.

18. Remove intake manifold and gasket.

19. to engine.



20. .



21. Assembly will be performed in the reverse order.

Engine Mechanical System

Cooling System - Coolant



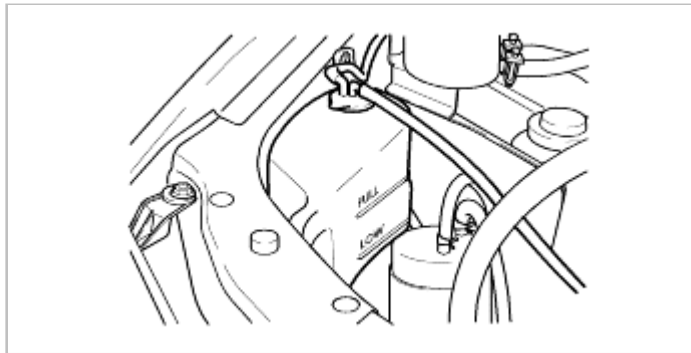
INSPECTION

WARNING

- Never remove radiator cap while engine is hot.
- Wrap a thick cloth around radiator cap before removing.
- When removing radiator cap, loosen slowly to first stop and wait until pressure in radiator is released, then completely remove.

LEVEL

1. Verify that the coolant level is near the radiator filler neck.
2. Check that the level in the coolant reservoir is between the "Full" and "Low" marks.



3. Add coolant if necessary.

COOLANT QUALITY

1. Verify that there is no build up of rust or scale around the radiator cap of radiator filler neck.
2. Verify that the coolant is free of oil.
3. Replace the coolant if necessary.

LEAKAGE

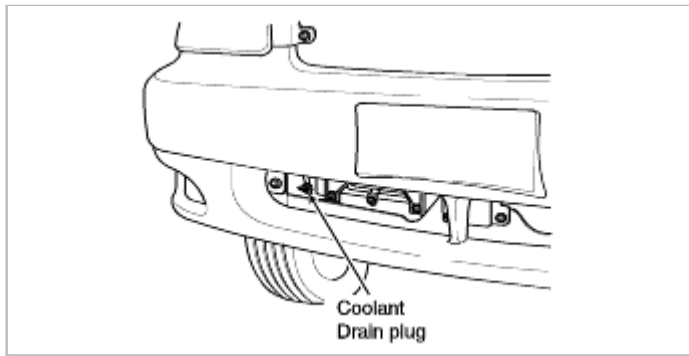
1. Connect a coolant system pressure tester to the radiator filler neck.
2. Apply 15 psi (103kpa, 1.05kg/cm²) pressure to the system.
3. Verify that the pressure remains steady at 15 psi (103kpa, 1.05kg/cm²).
4. If not, check system for coolant leakage.

REPLACEMENT

CAUTION

Never use 100% of water as coolant. The 45% mixture of water and antifreeze is recommended. (To avoid corrosion of cylinder head and cylinder block made of aluminum.)

1. Remove radiator cap and loosen drain plug.



2. Drain coolant into a suitable container.
3. Flush cooling system with water until all traces of color are gone ; then let system drain completely.
4. Install drain plug.
5. Fill with proper mixture of ethylene glycol-based coolant.

Coolant capacity:

9.93 Us qt (9.4 liter, 8.27 Imp qt)

6. Run the engine with the radiator cap removed until the upper radiator hose is hot.
7. With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
8. Install the radiator cap.
9. Allow engine to cool and coolant level.

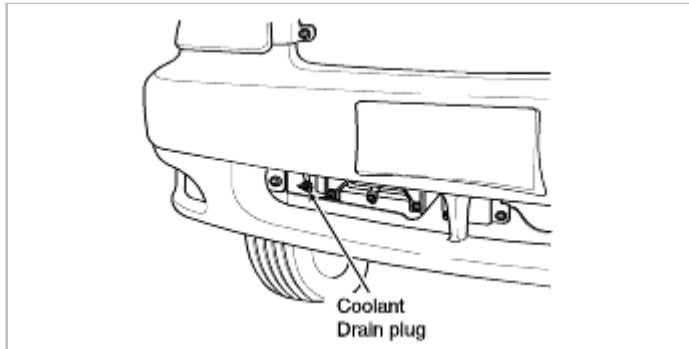
Engine Mechanical System

Cooling System - Water Pump

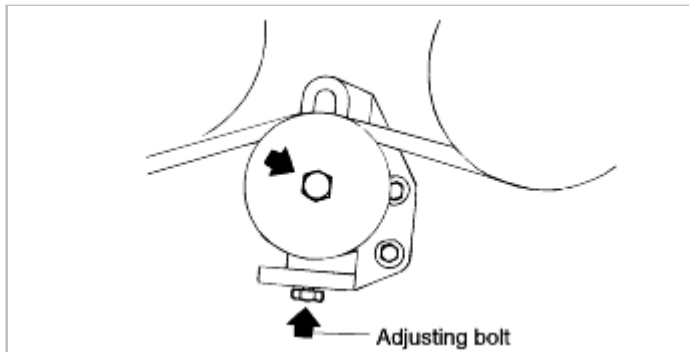


REMOVAL

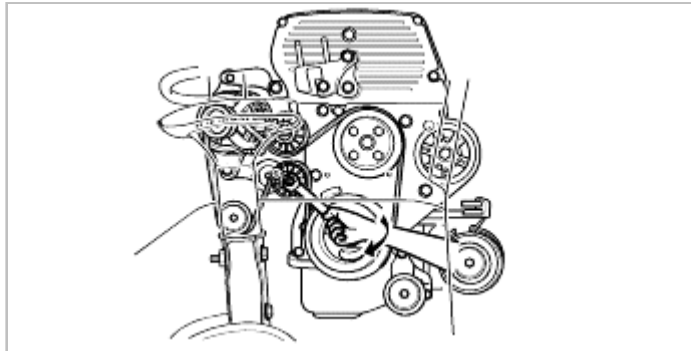
1. Drain engine coolant.



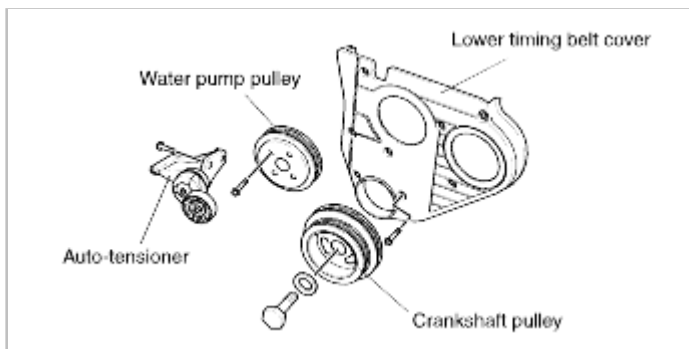
2. Raise vehicle and support it with safety stands.
3. Remove RH side wheel.
4. Loosen A/C drive belt tension by turning idler adjusting bolt.



5. Remove A/C drive belt.
6. Lower auto-tensioner with spanner and then remove drive belt.



7. Remove auto-tensioner.

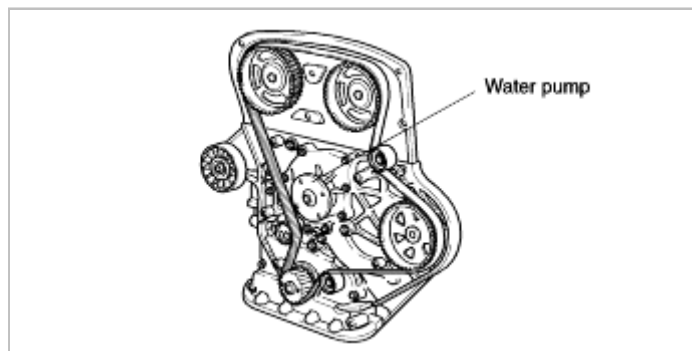


8. Remove water pump pulley.
9. Remove crankshaft pulley.

NOTICE

, to prevent the rotation of crankshaft pulley.

10. Remove lower timing belt cover.
11. Remove water pump.



REPLACEMENT

1. Install new gasket and water pump.
2. Install lower timing belt cover.

Tightening torque:

5.1~7.2 lb-ft (6.9~9.8 N·m, 0.7~1 kg-m)

3. Install crank shaft pulley.

Tightening torque:

253~289 lb-ft (343~392 N·m, 35~40 kg-m)

4. Install water pump pulley.

Tightening torque:

13.0~20.9 lb-ft (17.6~28.4 N·m, 1.8~2.9 kg-m)

5. Install auto-tensioner.

Tightening torque:

13.0~20.9 lb-ft (17.6~28.4 N·m, 1.8~2.9 kg-m)

6. Lower auto-tensioner with spanner and then install drive belt.

7. Install A/C drive belt.

8. Adjust belt deflection by turning adjusting bolt.

Deflection (when applying 22 lb, 98 N, 10 kg)

New one : 0.28~0.35 in (7~9 mm)

Used one : 0.35~0.43 in (9~11 mm)

9. Install RH side wheel.

Tightening torque:
65~79 lb-ft (88~107 N·m, 9~11 kg-m)

10. Refill engine coolant.
(Refer to engine coolant replacement)



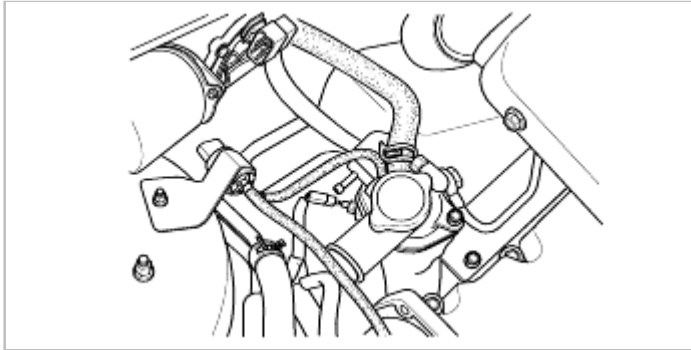
Engine Mechanical System

Cooling System - Thermostat



REMOVAL

1. Remove two bolts securing thermostat housing.



2. Remove thermostat and gasket.
3. Replace thermostat if necessary.

REPLACEMENT

1. Install thermostat.
2. Install new gasket and thermostat housing.



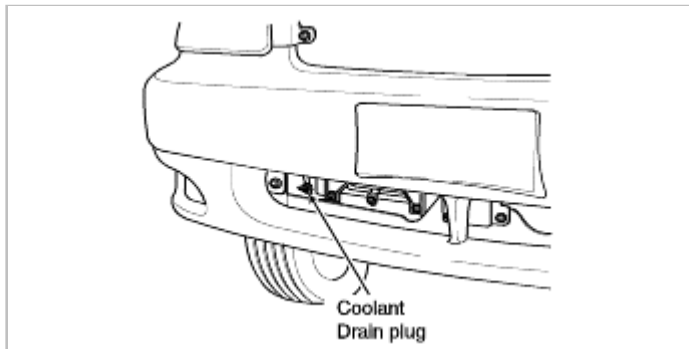
Engine Mechanical System

Cooling System - Radiator

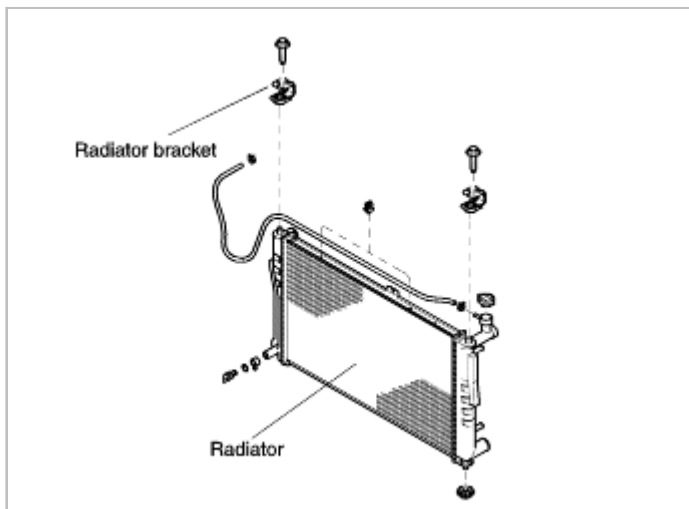


REMOVAL

1. Drain engine coolant.



2. Remove cooling fan assembly.
(Refer to cooling fan motor removal ; from step 1 to step 5.)
3. Disconnect coolant upper hose.
4. Disconnect reserve tank hose.
5. Disconnect coolant lower hose.
6. Remove radiator brackets.



7. Remove radiator.

REPLACEMENT

1. Install radiator.
2. Install radiator bracket.
3. Reconnect coolant lower hose.
4. Reconnect reserve tank hose.
5. Reconnect coolant upper hose.
6. Install cooling fan assembly.
(Refer to cooling fan motor replacement)
7. Refill engine coolant.
(Refer to engine coolant replacement)

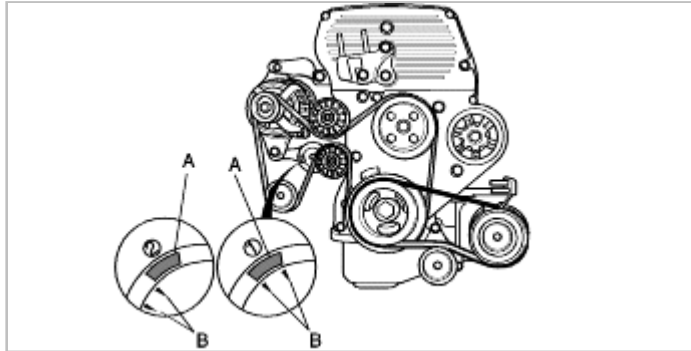
Engine Mechanical System

Cooling System - Drive Belt

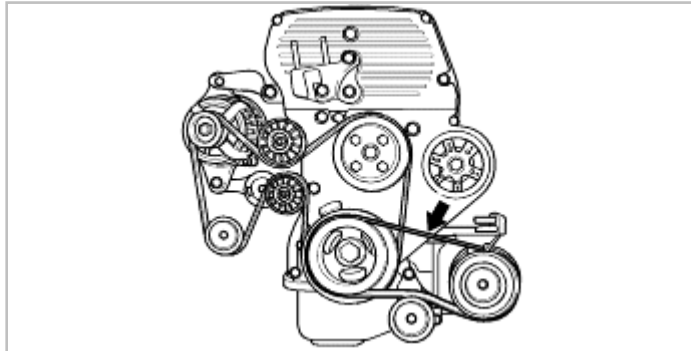


INSPECTION

1. Check the drive belts for wear, cracks, and fraying. Replace if necessary.
2. Verify that the drive belts are correctly mounted on the pulleys.
3. Verify that "A" mark of auto-tensioner align "B" mark. If two marks align as shown (1), the tension of auto-tensioner is good. If not align as shown (2), re-install the auto-tensioner or replace the drive belt.



4. Check the A/C drive belt deflection by applying moderate pressure (22 lb, 98 N, 10 kg) midway between the pulleys.



CAUTION

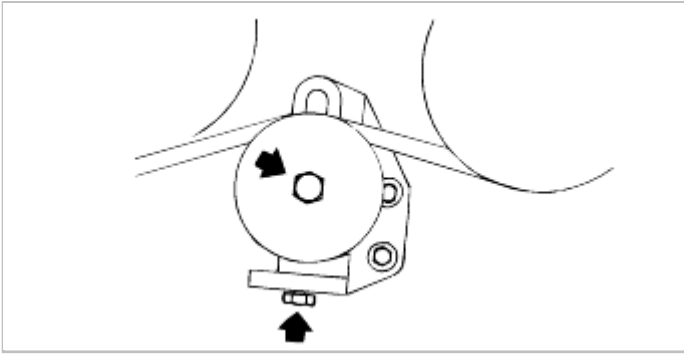
- Measure the belt deflection between the pulleys.
- Consider the belt as a new one if it has been used on a running engine for less than five minutes.
- Check the belt deflection when the engine is cold or at least 30 minutes after the engine is stopped.

A/C belt deflection:

New one: 0.28~0.35 in (7~9 mm)

Used one: 0.35~0.43 in (9~11 mm)

ADJUSTMENT



1. Loosen the idler pulley mounting bolt.
2. Adjust the belt deflection by turning the adjusting bolt.

Deflection (When applying 22 lb, 98 N, 10 kg)

New one: 0.28~0.35 in (7~9 mm)

Used one: 0.35~0.43 in (9~11 mm)

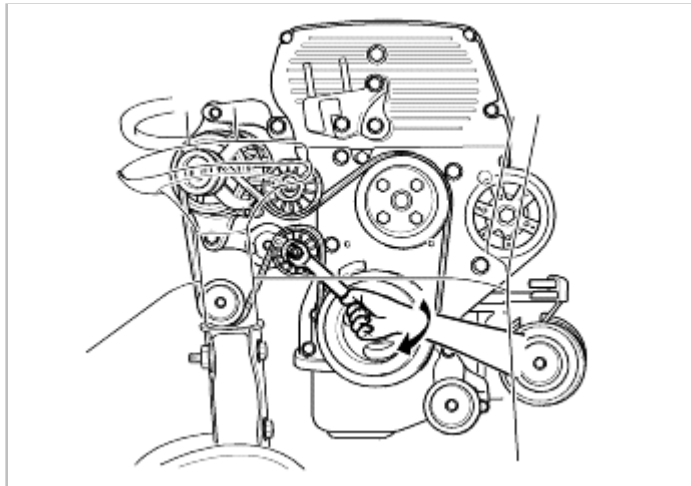
3. After making the adjustment, tighten the idler pulley mounting bolt.

Tightening torque:

28~38 lb-ft (37~52N·m, 3.8~5.3 kg-m)

REPLACEMENT

1. Raise the vehicle and support it with safety stands.
2. Remove the RH side wheel.
3. Loosen the idle pulley mounting bolt.
4. Remove the A/C drive belt.
5. Lower the auto tensioner with spanner and then remove the drive belt.



6. Lower the auto tensioner with spanner and then install the drive belt.
7. Install the A/C drive belt.
8. Check the A/C drive belt deflection. (Refer to Inspection and Adjustment)

Engine Mechanical System

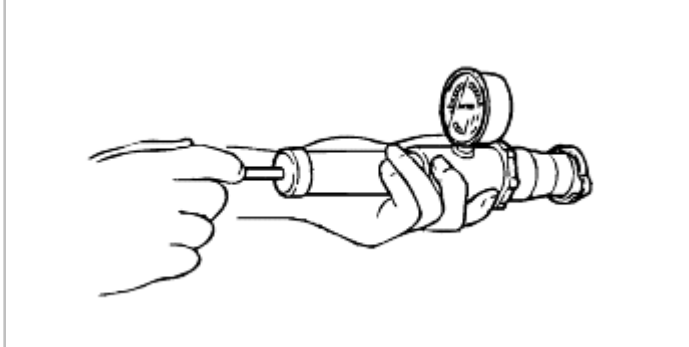
Cooling System - Radiator Cap



INSPECTION

RADIATOR CAP VALVE

1. Remove foreign material from radiator cap valve and the valve seat.
2. Attach radiator cap to a radiator cap tester. Apply pressure gradually to 15 psi (103kpa, 1.05kg/cm²).



3. Wait about 10 seconds. Verify that pressure has not decreased.
4. Replace radiator cap as necessary.

NEGATIVE PRESSURE VALVE

1. Pull negative pressure valve to open it. Verify that it closes completely when released.
2. Check for damage on contact surfaces, and for a cracked or deformed seal.
3. Replace radiator cap as necessary.

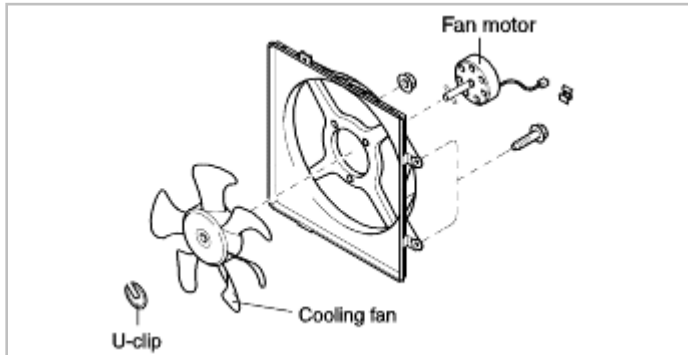
Engine Mechanical System

Cooling System - Cooling Fan Motor
Assembly



REMOVAL

1. Disconnect negative battery cable.
2. Remove fresh air duct.
3. Disconnect cooling fan motor connector.
4. Remove three bolts securing cooling fan assembly.



5. Remove cooling fan assembly.
6. Remove U-clip securing cooling fan and remove cooling fan.
7. Remove nuts securing fan motor and remove fan motor.

REPLACEMENT

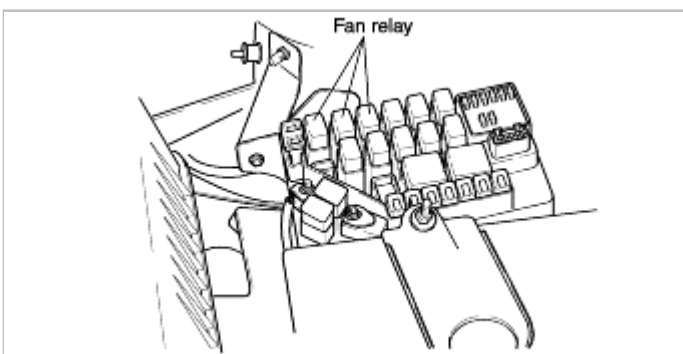
1. Install fan motor.
2. Install cooling fan to fan motor by use of U-clip.
3. Install cooling fan assembly.
4. Reconnect cooling fan motor connector.
5. Install fresh air duct.
6. Reconnect negative battery cable.

INSPECTION

Cooling fan relay

NOTICE

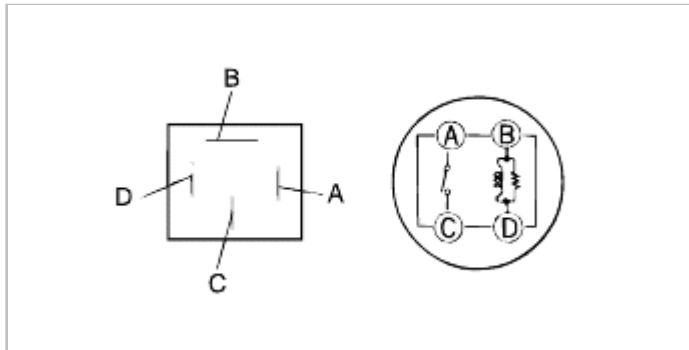
Cooling fan motor relay is located in the engine compartment fuse/relay box.



1. Disconnect negative battery cable.
2. Remove cooling fan motor relay from engine compartment fuse/relay box.

3. Check continuity with an ohmmeter.

Terminal	Continuity
A - C	No
B - D	Yes



4. Apply 12V to terminal B and ground to terminal D. Check for continuity between terminals A and C.

5. If there is no continuity, replace fan motor relay.

Engine coolant temperature sensor

1. Check for resistance.

Water temperature	Resistance (k Ω)
-4°F (-20°C)	1436-17.8
68°F (20°C)	2.2-2.7
176°F (80°C)	0.29-0.35

2. If not as specified, replace the engine coolant temperature sensor.

Engine Mechanical System

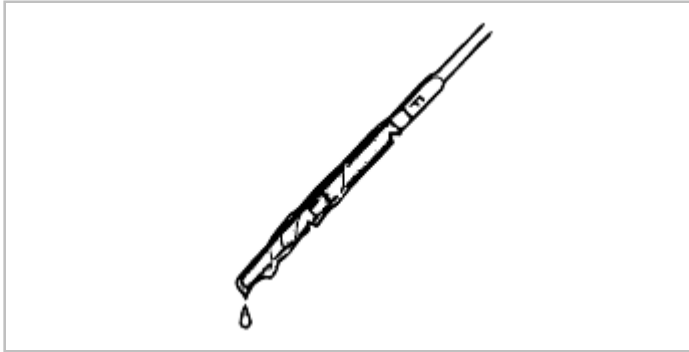
Lubrication System - Engine Oil



Inspection

ENGINE OIL LEVEL

1. Be sure the vehicle is on level ground.
2. Warm up the engine to normal operating temperature and stop it.
3. Wait for 5 minutes.
4. Remove the oil level gauge and check the oil level and condition.



5. Add or replace oil if necessary.

ENGINE OIL REPLACEMENT

WARNING

Be careful when draining because oil is hot and could cause personal injury.

1. Warm engine to normal operating temperature and turn engine off. Position a suitable container under oil pan.
2. Remove oil filler cap and oil pan drain plug.
3. Allow oil to be fully drained.
4. Install drain plug with new gasket.

Tightening torque:

J3 TCI Diesel:

23.1~30.4 lb-ft (31.4~41.2 N·m, 3.2~4.2 kg-m)

5. Refill engine with specified type and amount of engine oil. (Refer to specification table)
6. Install oil filler cap.
7. Run engine and check for leaks.
8. Check oil level by level gauge and add oil if necessary.

OIL PRESSURE CHECK

1. Disconnect and remove oil pressure switch.
2. Install oil pressure gauge into oil pressure switch installation hole.
3. Warm engine to normal operating temperature.
4. Run engine and note gauge readings.

Oil pressure:

J3 TCI Diesel:

45.5~71.1 psi (314~490 kPa,
3.2~5.0 kg/cm²)-3,000 rpm

5. If pressure is not within specification, check for cause, and repair. (Refer to troubleshooting guide)
 6. Remove oil pressure gauge and install oil pressure switch.
-

Tightening torque:
8.7~13.0 lb-ft (11.7~17.6 N·m, 1.2~1.8 kg-m)

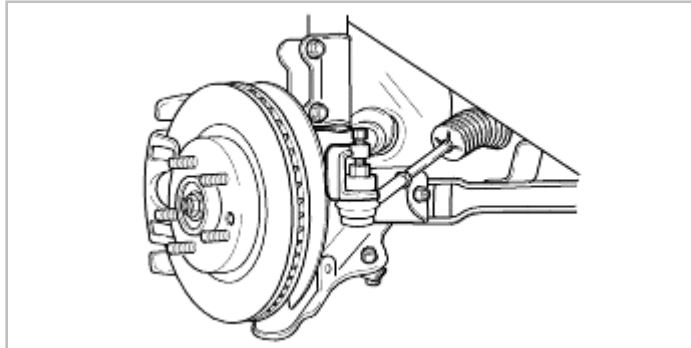
Engine Mechanical System

Lubrication System - Oil Pan

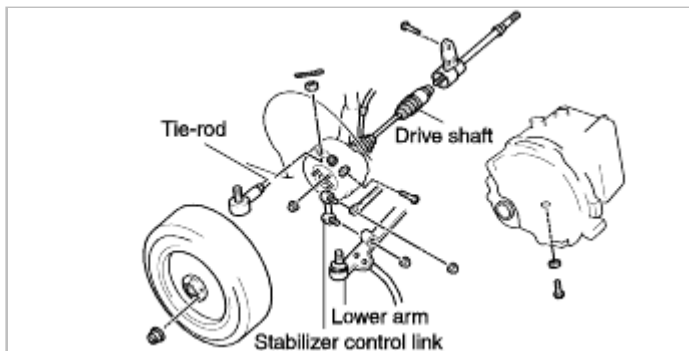


REMOVAL

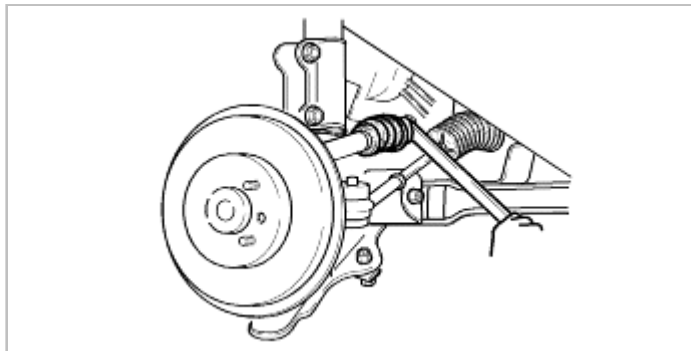
1. Drain engine oil and transaxle oil.
2. Remove wheel and tire (RH side).
3. Remove tie-rod end (RH side).



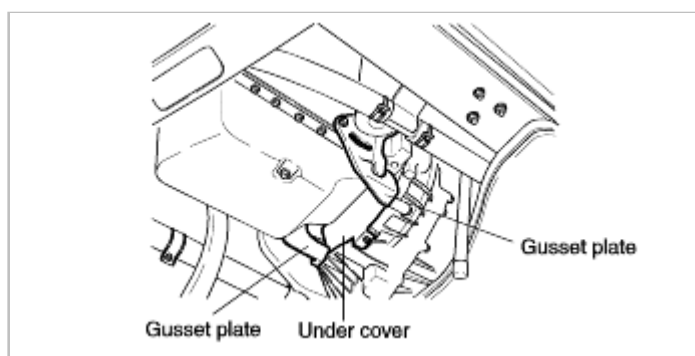
4. Remove stabilizer control link (RH side).



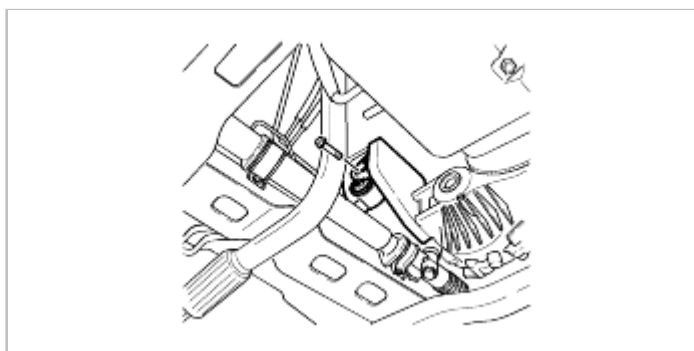
5. Remove lower arm from knuckle (RH side).
6. Remove drive shaft by suitable tool (RH side).



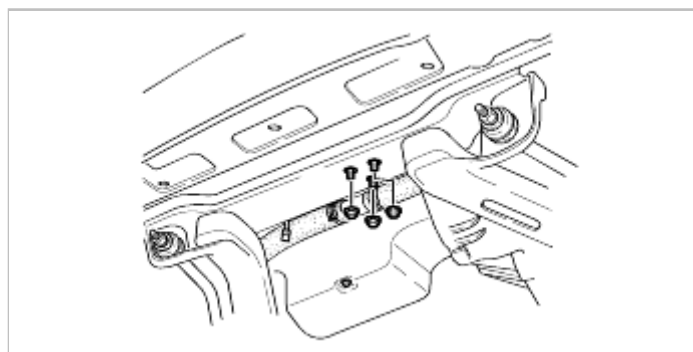
7. Remove joint shaft (RH side).
8. Remove gusset plate and under cover.



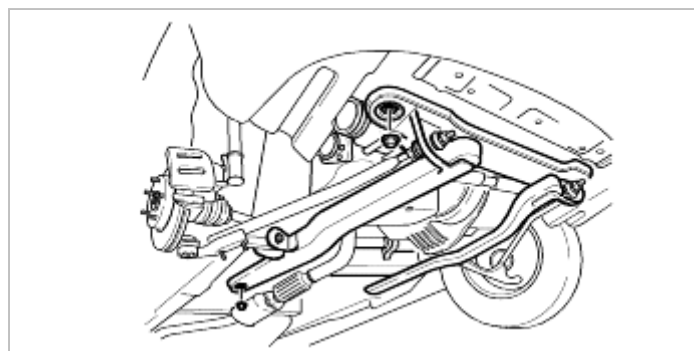
9. Remove No.1 engine mounting bolt.



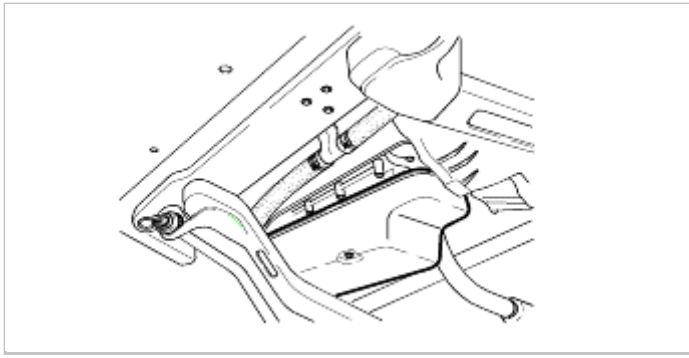
10. Remove No.2 engine mounting nut.



11. Remove two nuts from sub-frame RH. Loosen two nuts of sub-frame LH and tilt sub-frame to RH direction carefully.



12. Remove oil pan.



REPLACEMENT

CAUTION

- If oil pan is reused, remove all foreign material from sealing surfaces of cylinder block and oil pan.
- If bolts are reused, remove old sealant from bolt threads.

1. Apply a continuous bead of silicone sealant to oil pan along inside of bolt holes on contact surfaces.

CAUTION

The oil pan must be installed no longer than 5 minutes after silicone sealant is applied.

2. Install oil pan.

3. Tighten sub-frame nut.

Tightening torque:

88.2~101.3 lb-ft (119~137 N·m, 12.2~14.0 kg-m)

4. Tighten No.2 engine mounting nuts.

Tightening torque:

49.2~68.7 lb-ft (66.6~93.1 N·m, 6.8~9.5 kg-m)

5. Tighten No.1 engine mounting bolt.

Tightening torque:

62.9~86.1 lb-ft (85.3~116.6 N·m, 8.7~11.9 kg-m)

6. Install gusset plate and under cover.

7. Install joint shaft.

8. Install drive shaft.

9. Install lower arm to knuckle.

10. Install stabilizer control link.

Tightening torque:

68.7~84.6 lb-ft (93.1~114.6 N·m, 9.5~11.7 kg-m)

11. Install tie-rod end.

Tightening torque:

43.4~58.6 lb-ft (58.8~79.4 N·m, 6.0~8.1 kg-m)

12. Install wheel and tire.

Tightening torque :

65.1~86.8 lb-ft (88.2~117.6 N·m, 9.0~12.0 kg-m)

13. Fill with specified amount and type of engine oil.

14. Connect negative battery cable.

15. Start engine and check for leaks.

16. Check oil level and add oil if necessary.

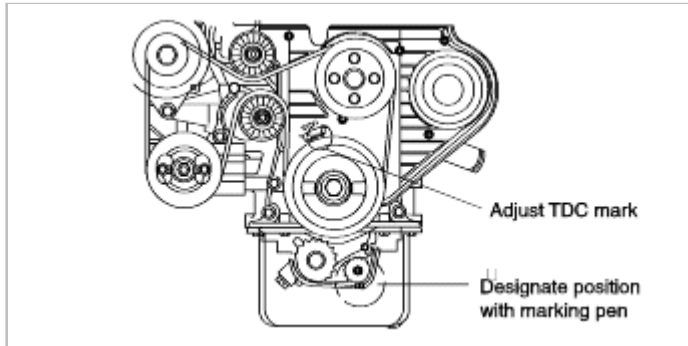
Engine Mechanical System

Lubrication System - Oil Pump

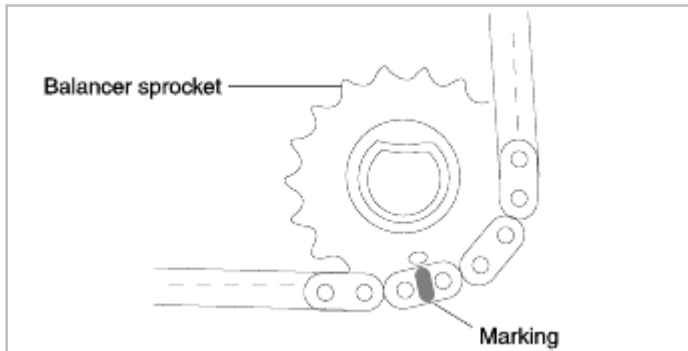


REMOVAL

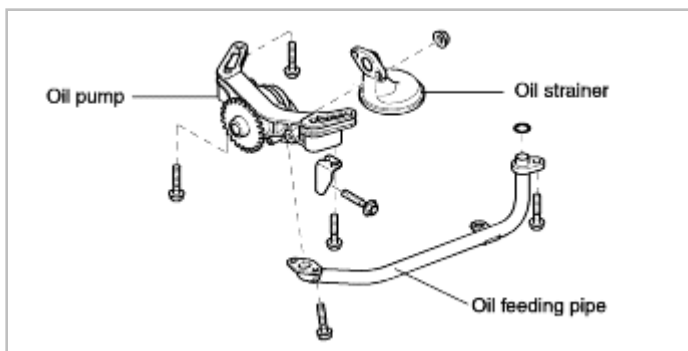
1. Remove oil pan. (Refer to oil pan removal ; from step 1 to step 12.)
2. Adjust V groove TDC mark on outside of pulley to TDC mark "T" on timing cover, by rotating crank-shaft pulley.



3. Mark chain link with marking pen that is matched with $\varnothing 0.12$ in ($\varnothing 3$ mm) round TDC mark to adjust timing.



4. Remove oil feeding pipe from ladder frame.



5. Remove oil pump with four bolts.
6. Remove oil pump after loosen the chain by push the end of chain tensioner with the chain tensioner lever.

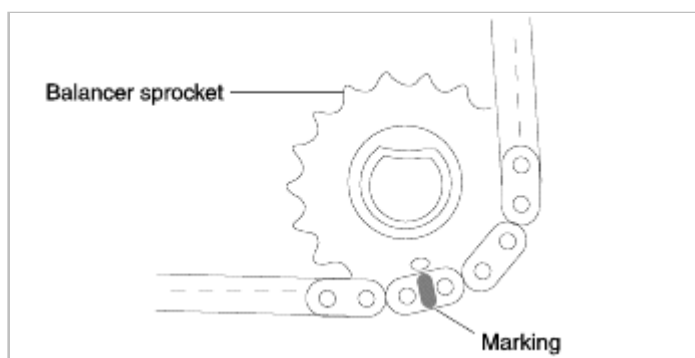
Replacement

1. Remove oil pump after loosen the chain by push the end of chain tensioner with the chain tensioner lever.
2. Install oil feeding pipe.

Tightening torque:

16.6 lb-ft (23 N·m, 2.3 kg-m)

3. Adjust balancer sprocket position mark with chain link mark.



4. Install oil pan.
(Refer to oil pan replacement ; from step 1 to step 16)

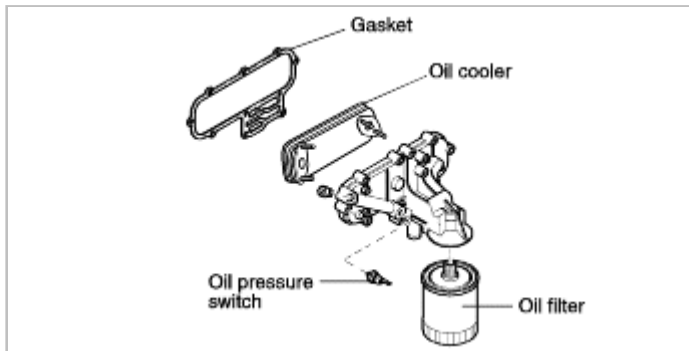
Engine Mechanical System

Lubrication System - Oil Cooler



REMOVAL

1. Remove fresh air duct.
2. Remove ventilator mounting bracket.



3. Remove oil filter assembly with two nuts and eight bolts.
4. Remove four nuts securing oil cooler.
5. Remove oil cooler from oil filter assembly.

REPLACEMENT

1. Install new "O" rings and oil cooler to oil filter assembly.

Tightening torque:

10.8~18.0 lb-ft (14.7~24.5 N·m, 1.5~2.5 kg-m)

2. Install new gasket and oil filter assembly to cylinder block.
3. Install ventilate mounting bracket.
4. Install fresh air duct.

Engine Mechanical System

Lubrication System - Oil Filter



OIL FILTER REPLACEMENT

1. Remove oil filter with oil filter wrench. If rubber seal is stuck to engine, remove it.
2. Apply a small amount of clean engine oil to rubber seal of new filter.
3. Install oil filter and turn it by hand until rubber seal contacts base.
4. Tighten filter 1-1/6 turns with filter wrench.

Tightening torque:

J3 TCI Diesel:

16~18 lb-ft (21.6~24.5 N·m, 2.2~2.5 kg-m)

5. Start engine and check for leaks.
6. Turn engine off, and wait 5 minutes. Check oil level and add oil if necessary.

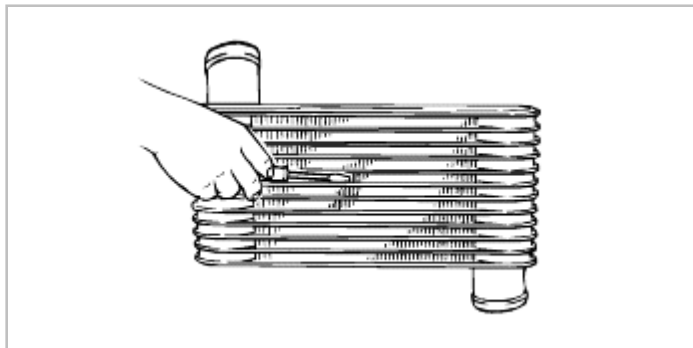
Engine Mechanical System

Intake And Exhaust System - Intercooler



INSPECTION

1. Check if there is crack or damage on the intercooler visually and replace it if it is abnormal.
2. Check if the pin is damaged and adjust it by a driver if damaged.
3. .

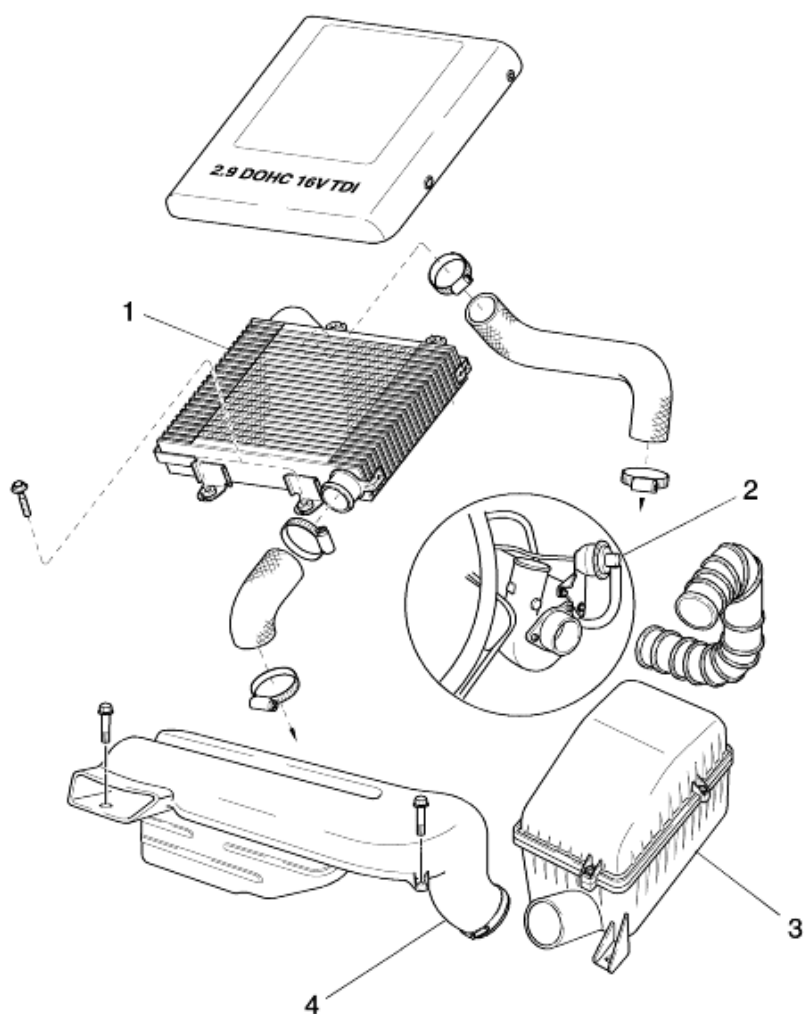


Engine Mechanical System

Intake And Exhaust System - Turbo Charger



COMPONENT



1. Inter cooler
2. Turbo charger

3. Air filter assembly
4. Fresh air duct



TURBO CHARGER

After checking the turbo charger, replace the assembly in case of abnormality.

Check point	Check result	Symptom			
		Oil leak	Smoke	Abnormal noise	Lowpower, poor acceleration
Turbine rotor	Oil leakage	△	●	△	△
	Carbon deposit	△	●	○	○
	Friction with housing	△	○	●	○
	Bent or broken blade			●	●
Compressor oil	Contaminated intake inlet with oil	○	○		
	Friction with housing	△	○	●	○
	Bent or broken blade			●	●
Turbine and compressor check in both directions	Heavy or catching feeling when rotated by finger		△	△	○
	No movement when rotated				
	Excessive looseness in bearing			○	●
	Carbon deposit in drain oil hole	△	△	○	△
Observation on oil hole	Carbon deposit in drain oil hole	△	●	△	△
Operation of waste gate valve (airconditioner used)	No smooth operation when applied after removing positive pressure				●

● : High possibility

○ : Medium possibility

△ : Low possibility



Removal

1. Discharge the coolant.
2. After removing the air duct, keep foreign material from entering the turbo charger inlet.
3. Remove the turbo charger insulator.
4. Remove the turbo charger water outlet pipe.
5. Remove the turbo charger oil supply pipe.
6. Remove the exhaust and front pipe.
7. Remove the turbo charger inlet and outlet pipe.
8. Remove the turbo charger by loosening the turbo charger mounting bolts.

CAUTION

- Don't carry the actuator by holding the actuator rod and the actuator hose.
- Use the stud bolt of specified type when it is damaged. If one of different material is used, it may be elongated at high temperature and that can result in gas leakage.
- The turbo charger is operated at high temperature and high speed that sufficient care should be taken on inclusion of foreign material into the oil pipe, deformation of the oil pump and etc..
- After removing the turbo charger, attach the cap or tape on the air and exhaust gas inlets for foreign material not to be included.
- If the oil in the sensor housing flows out to the turbine and the compressor housing inside, it can be wrongly judged as turbo charger trouble that the turbo charger should be placed horizontally as originally mounted after removal.

INSTALLATION

Install them in the reverse order of removal.

CAUTION

- When installing a new turbo charger, pour small amount of oil into the lubricant inlet of the turbo charger.
- When starting the engine, be sure to connect the lubricant supply pipe and idle it for 1~2 minutes at low speed. Then increase the engine speed after lubricant has been supplied to the turbo charger sufficiently.

ON-VEHICLE INSPECTION

1. Warm up the engine to the normal operating temperature.
2. Disconnect the hose between the air inlet tube and the boost compensator from the air inlet side.
3. Install the pressure gauge by inserting the 3-way connector.
4. Read the maximum value on the pressure gauge after starting the engine and increasing the engine speed.

Pressure gauge reading	Check point
No positive pressure or low pressure	<ul style="list-style-type: none"> • Air exhaust gas leakage • Abnormal turbo charger
Above the specified super charging pressure (Standard value)	<ul style="list-style-type: none"> • Leakage by separation or breakage of actuator hose • Abnormal operation of actuator

ON-VEHICLE INSPECTION

1. Warm up the engine to the normal operating temperature.
2. Disconnect the hose between the air inlet tube and the boost compensator from the air inlet side.
3. Install the pressure gauge by inserting the 3-way connector.
4. Read the maximum value on the pressure gauge after starting the engine and increasing the engine speed.

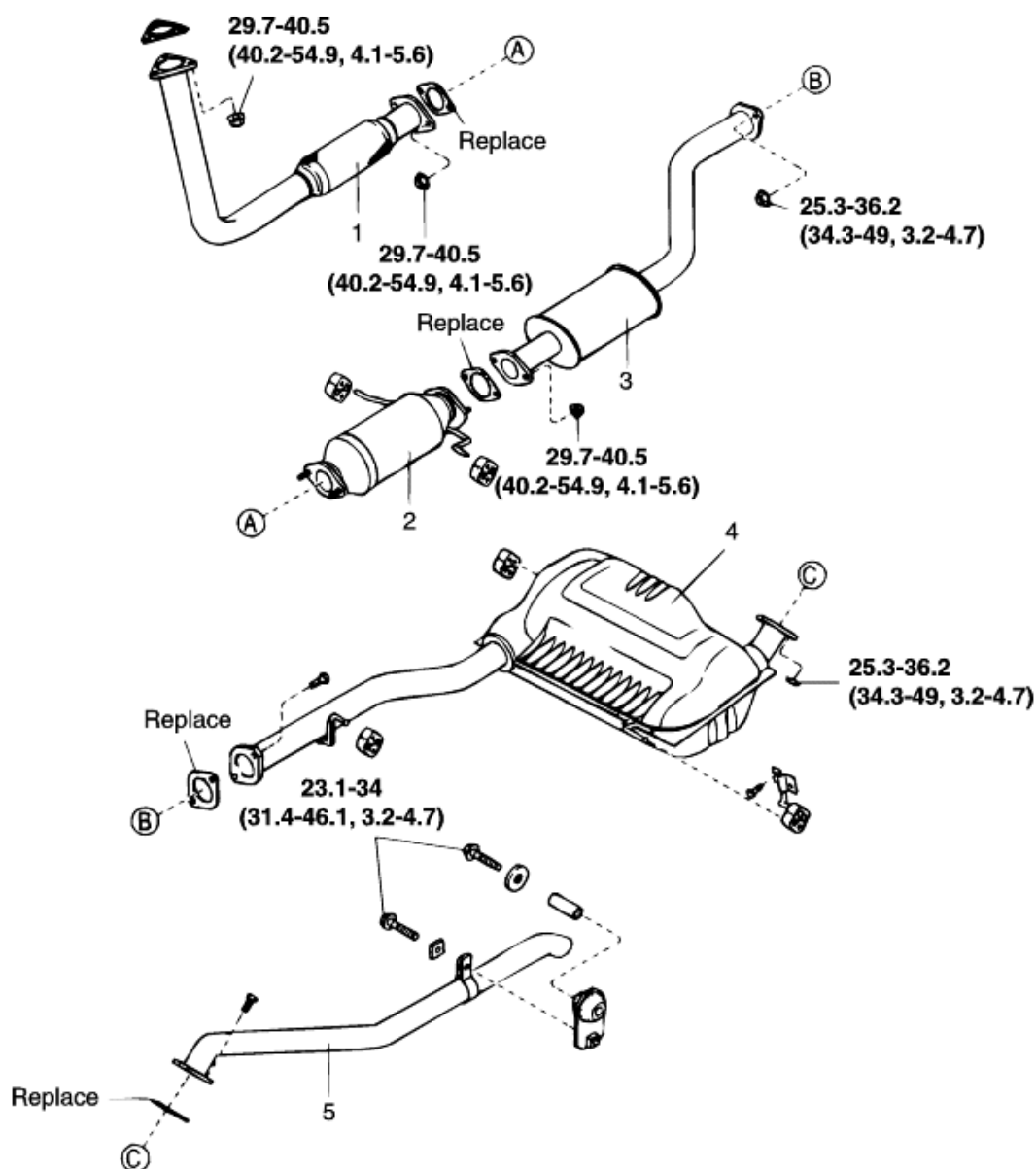
Pressure gauge reading	Check point
No positive pressure or low pressure	<ul style="list-style-type: none">• Air exhaust gas leakage• Abnormal turbo charger
Above the specified super charging pressure (Standard value)	<ul style="list-style-type: none">• Leakage by separation or breakage of actuator hose• Abnormal operation of actuator

Engine Mechanical System

Intake And Exhaust System - Front Exhaust
Pipe



Component (J3 TCI - Common rail system)

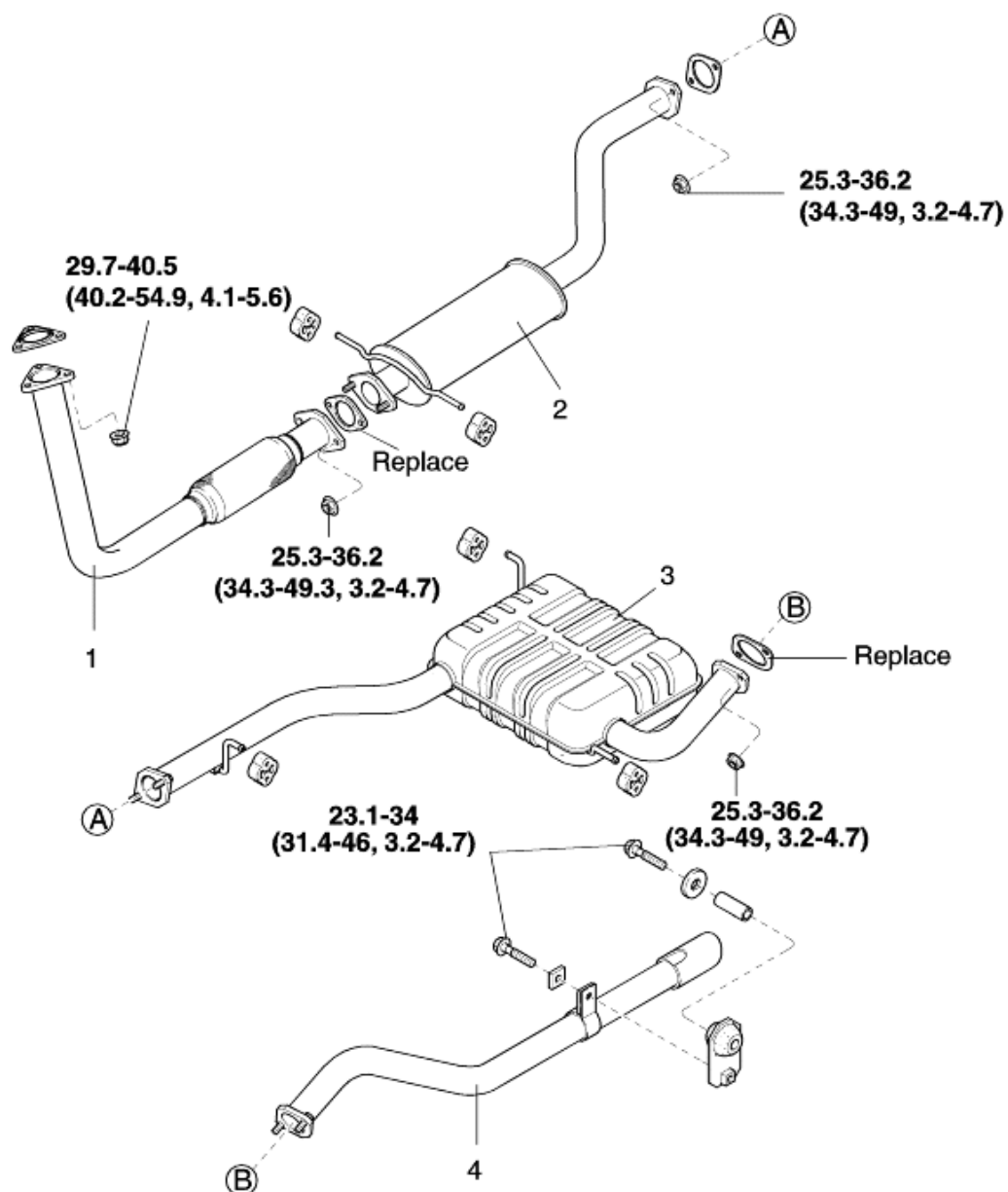


TORQUE : lb·ft(N·m, kg·m)

- 1. Front pipe assembly
- 2. Pre-silencer assembly

- 3. Main-silencer assembly
- 4. Tail pipe assembly

Component (J3 TCI)



TORQUE : lb-ft(N-m, kg-m)

- 1. Front pipe assembly
- 2. Pre-silencer assembly

- 3. Main-silencer assembly
- 4. Tail pipe assembly