KIA MOTORS

Engine Mechanical System

General Information

SPECIFICATIONS

Description		Specifications(J3 - ENG)	Limit
General			
Type		In-line, DOHC	
Number of cylinders		4	
Bore		101.5~101.526mm (3.9961~3.9971in)	
Stroke		98mm (8.8583in)	
Total displacement		2,902 cc (177.08 cu.in)	
Compression ratio		18.4 : 1	
Firing order		1-3-4-2	
Valve timing			
Intake valve	Opens (ATDC)	26°	
	Closes (ABDC)	50°	
Exhaust valve	Opens (BBDC)	72°	
	Closes (ATDC)	32°	
Cylinder head			
Flatness of gasket surface		Less than 0.05mm (0.0020in)	
Flatness of manifold mounting surface	Intake	Less than 0.15mm (0.0059in)	
	Exhaust	Less than 0.15mm (0.0059in)	
Camshaft			
Cam height	Intake	39.397 ~ 39.597mm (1.5511 ~ 1.5589in)	
	Exhaust	39.4932 ~ 39.6932mm (1.5548 ~ 1.5627in)	
Journal outer Diameter (Intake, Exhaust)		27.941 ~ 27.960mm (1.1000 ~ 1.1008in)	
Bearing oil clearance		0.040 ~ 0.080mm (0.0016 ~ 0.0031in)	
End play		0.08 ~ 0.17mm (0.0031 ~ 0.0067in)	
Valve			
Valve length	Intake	126.24mm (4.9701in)	
	Exhaust	126.24mm (4.9701in)	
Stem outer diameter	Intake	6.965 ~ 6.980mm (0.2742 ~ 0.2748in)	
	Exhaust	6.945 ~ 6.960mm (0.2734 ~ 0.2740in)	
Face angle		45°	
Thickness of valve head (margin)	Intake	1.7mm (0.0669in)	
	Exhaust	1.6mm (0.0630in)	
Valve stem to valve guide clearance	Intake	0.030 ~ 0.065mm (0.0012 ~ 0.0026in)	
	Exhaust	0.050 ~ 0.085mm (0.0020~ 0.0033in)	
Valve guide			
Length	Intake	52.5mm (2.0669in)	
	Exhaust	52.5mm (2.0669in)	
Valve seat			

Width of seat contact	Intake	1.4 ~ 2.0mm (0.0551 ~ 0.0787in)	
	Exhaust	0.9 ~ 1.5mm (0.0354 ~0.0591 in)	
Seat angle		45°	
Valve spring			
Free length		52.477mm (2.0660in)	
Load(Intake)	Installed	23.45±1.87kg/40.0mm(51.7±4.1lb/1.5748 in)	
	Valve opened	39.15±3.13kg/31.65mm(86.3±6.9 lb/1.2461 in)	
Load(Exhaust)	Installed	23.45±1.87kg/40.0mm(51.7±4.1lb/1.5748 in)	
	Valve opened	39.43±3.15kg/31.50mm(86.9±6.9 lb/1.2402 in)	
Out of squareness		Less than 2°	3°
Rocker arm and rocker arm shaft			
Rocker arm inner diameter		20.000 ~ 20.027mm (0.7874 ~ 0.7885in)	
Rocker arm shaft outer diameter		19.959 ~ 19.980mm (0.7858 ~ 0.7866in)	
Cylinder block			
Cylinder bore		101.500 ~ 101.526mm (3.9961 ~3.9971 in)	
Liner inner diameter		97.100 ~ 97.126mm (3.8228~ 3.8239in)	
Liner outer diameter		101.480 ~ 101.526mm (3.9953~ 3.9971in)	
Flatness of gasket surface		Less than 0.05mm (0.0020in)	
Piston			
Piston outer diameter		97.015 ~ 97.030mm (3.8195~ 3.8201in)	
Piston to cylinder clearance		0.070 ~ 0.098mm (0.0028 ~ 0.0039in)	
Ring groove width	No. 1 ring groove	2.397 ~ 2.417mm (0.0944~0.0952 in)	
	No. 2 ring groove	2.05 ~ 2.07mm (0.0807~ 0.0815in)	
	Oil ring groove	3.02 ~ 3.04mm (0.1189 ~ 0.1197in)	
Piston ring			
Side clearance			
	No. 2 ring	0.06 ~ 0.10mm (0.0024~0.0039 in)	
	Oil ring	0.03 ~ 0.07mm (0.0012~0.0028 in)	
End gap	No. 1 ring	0.25 ~ 0.40mm (0.0098~ 0.0157in)	
	No. 2 ring	0.40 ~ 0.55mm (0.0157~0.0217in)	
	Oil ring	0.20 ~ 0.40mm (0.0079 ~ 0.0157in)	
Piston pin			
Piston pin outer diameter		31.994 ~ 32.000mm (1.2596 ~ 1.2598 in)	
Piston pin hole inner diameter		32.015 ~ 32.025mm (1.2604 ~ 1.2608 in)	
Piston pin hole clearance		0.015 ~ 0.031mm (0.0006 ~ 0.0012 in)	
Connecting rod small end inner diameter		32.012 ~ 32.033mm (1.2603 ~ 1.2611 in)	
Connecting rod small end hole clearance		0.012 ~ -0.039mm (0.0005 ~ 0.0015 in)	
Connecting rod			
Connecting rod big end inner diameter		60.833 ~ 60.846mm (2.3950 ~ 2.3955 in)	
Connecting rod bearing oil clearance		0.043 ~ 0.077mm (0.0017 ~ 0.0030 in)	
End play		0.239~0.39 (0.0094 ~ 0.0154 in)	

Crankshaft			
Main journal outer diameter	NO 1, 2, 4, 5	69.995 ~ 70.015mm (2.7557 ~2.7565 in)	
	NO 3	69.973~69.993mm (2.7548 ~2.7556 in)	
Pin journal outer diameter		57.106~57.124mm (2.2483~2.2490 in)	
Main bearing oil clearance	NO 1, 2, 4, 5	0.045 ~ 0.079mm (0.0018 ~0.0031 in)	
	NO 3	0.067~0.101 mm (0.0026 ~0.0040 in)	
End play		0.14 ~ 0.39mm (0.0055 ~0.0154 in)	
Flywheel			
Runout		0.10mm (0.0039in)	0.13mm (0.0051in)
Oil pump			
Relief valve opening pressure		588.40±49.0kpa(6.0±0.5kg/cm²,85.34±7.1psi)	
Discharge volume		75L/min(79.25 US qt/min, 65.99 lmp qt/min) (engine3,800rpm)	
Engine oil			
Oil quantity (Total)		8.0 L (8.45 US qt, 7.03 lmp qt)	
Oil quantity (Oil pan)		6.0 L (6.34 US qt, 5.27 lmp qt)	
Oil quantity (Drain and refill including oil filter)		6.6 L (6.97 US qt, 5.08 lmp qt)	
Oil quality		ABOVE API CH-4 or ABOVE ACEA B4	
Oil pressure (Idle)		78.45 kpa (0.8 kg/cm², 11.38 psi)	
Cooling system			
Cooling method		Forced circulation with cooling fan	
Thermostat	Type	Wax pellet type	
	Opening temperature	88±1.5 °C (190.4 ±34.7 °F)	
	Pull opening temperature	100 °C (212.0 °F)	
Radiator cap	Main valve opening pressure	93.16 ~ 122.58kpa(0.95 ~ 1.25kg/cm², 13.51 ~ 17.78psi)	
Water temperature sensor			
Type		Thermister type	
Resistance	20°C (68°F)	2.27~2.64 kΩ	
	80°C (176°F)	0.31~0.33 kΩ	

TIGHTENING TORQUE

Item	Quan-tity	Tightening torque		
		N.m	kgf.m	lb-ft
Cylinder block				
Engine support bracket bolts	8	36.3 ~ 53.9	3.7 ~ 5.5	26.8 ~ 39.8
Engine mounting				
Engine mounting insulator and engine mounting bracket fixing nuts	4	36.3 ~ 53.9	3.7 ~ 5.5	26.8 ~ 39.8
Engine support bracket and engine mounting insulator fixing nuts	2	36.3 ~ 53.9	3.7 ~ 5.5	26.8 ~ 39.8

Transaxle mounting bracket and body fixing bolts	4	36.3 ~ 53.9	3.7 ~ 5.5	26.8 ~ 39.8
Transaxle mounting insulator and transaxle mounting bracket fixing bolt	1	62.8 ~ 93.2	6.4 ~ 9.5	46.3 ~ 68.7
Transaxle and transaxle mounting insulator fixing nuts	4	36.3 ~ 53.9	3.7 ~ 5.5	26.8 ~ 39.8
Main moving system				
Connecting rod cap nuts	8	68.6→Unfasten bolts→29.4+90°	7.0 → Unfasten bolts→3.0+ 90°	50.6→ Unfasten bolts→21.7+ 90°
Crankshaft main bearing cap bolts	10	(63.7 ~ 73.5) + (105 + 115°)	(6.5 ~ 7.5) + (105 + 115°)	(47.0 ~ 54.2) + (105 + 115°)
Flywheel (DMF) bolts (M/T)	8	122.6 ~ 132.4	12.5 ~ 13.5	90.4 ~ 97.6
Drive plate bolts (A/T)	8	159.8 ~ 169.7	16.3 ~ 17.3	117.9 ~ 125.1
Timing belt				
Timing belt upper cover bolts	5	6.9 ~ 9.8	0.7 ~ 1.0	5.1 ~ 7.2
Timing belt upper cover nut	1	6.9 ~ 9.8	0.7 ~ 1.0	5.1 ~ 7.2
Timing belt lower cover bolts	8	6.9 ~ 9.8	0.7 ~ 1.0	5.1 ~ 7.2
Crankshaft pulley bolt	1	372.7 ~ 411.9	38.0 ~ 42.0	274.9 ~ 303.8
Camshaft sprocket bolts	2	58.8 ~ 68.6	6.0 ~ 7.0	43.4 ~ 50.6
Timing belt tensioner bolt	1	20.6 ~ 25.5	2.1 ~ 2.6	15.2 ~ 18.8
Timing belt N0. 1 idler bolt	1	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Timing belt N0. 2 idler bolt	1	37.3 ~ 43.1	3.8 ~ 4.4	27.5 ~ 31.8
Touch idler bolt	1	20.6 ~ 25.5	2.1 ~ 2.6	15.2 ~ 18.8
High pressure pump puli nut	1	58.8 ~ 68.6	6.0 ~ 7.0	43.4 ~ 50.6
High pressure pump and Timing belt case fixing bolts	3	21.6 ~ 25.5	2.2 ~ 2.6	15.9 ~ 18.8
High pressure pump bracket bolts (Pump)	2	21.6 ~ 25.5	2.2 ~ 2.6	15.9 ~ 18.8
High pressure pump bracket bolts (Cylinder block)	2	34.3 ~ 40.2	3.5 ~ 4.1	25.3 ~ 29.7
Timing belt plate bolts	6	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Timing belt case bolts (8 X 25)	8	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Timing belt case bolts (8 X 45)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Timing belt case bolts (8 X 50)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Timing belt case nut	1	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Balancer gear bolt	1	63.7 ~ 73.5	6.5 ~ 7.5	47.0 ~ 54.2
Oil pump gear bolt	1	33.3 ~ 39.2	3.4 ~ 4.0	24.6 ~ 28.9
Idler gear bolt	1	33.3 ~ 39.2	3.4 ~ 4.0	24.6 ~ 28.9
Cylinder head				
Cylinder head cover bolts	15	8.8 ~ -10.8	0.9 ~ -1.1	6.5 ~ -8.0
Rocker arm shaft And camshaft bearing cap bolts	10	17.7 ~ 26.5	1.8 ~ 2.7	13.0 ~ 19.5
Camshaft bearing cap nuts	10	17.7 ~ 26.5	1.8 ~ 2.7	13.0 ~ 19.5
Front camshaft bearing cap nuts(Small nuts)	2	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7

Cylinder head bolt (Long bolts)	10	39.2 + 90° + 120°	4.0 + 90° + 120°	28.9 + 90° + 120°
Cylinder head bolt (Short bolts)	8	39.2 + 90°+ 90°	4.0 + 90° + 90°	28.9 + 90°+ 90°
Cooling system				
Cooling fan water pump pulley bolts	4	5.9 ~ 9.8	0.6 ~ 1.0	4.3 ~ 7.2
Water pump bolt (Long bolts)	3	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Water pump bolt (Short bolts)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Water pump and generator brace fixing bolts (8 X 45)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Thermostat housing and generator strip nuts	2	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Thermostat case cover bolts	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Lubrication system				
Oil filter	1	21.6 ~ 24.5	2.2 ~ 2.5	15.9 ~ 18.1
Oil cooler bolts (8 X 35)	4	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil cooler bolts (8 X 50)	4	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil cooler nuts	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil pan nuts	29	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil pan drain plug	1	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Ladder frame bolts (10 X 45)	5	31.4 ~ 46.1	3.2 ~ 4.7	23.1 ~ 34.0
Ladder frame and oil suppling pipe bolt (8X 50)	1	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Ladder frame bracket (Oil pump and ladder frame fixing) bolts	2	31.4 ~ 46.1	3.2 ~ 4.7	23.1 ~ 34.0
Oil supplying pipe and oil pump fixing bolts (8 X16)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil supplying pipe and Ladder frame fixing bolts (8 X 16)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil pump bolts(10 X 60)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil pump bolt(8 X 30)	1	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil screen nuts	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil pressure switch	1	14.7 ~ 46.1	1.5 ~ 2.2	10.8 ~ 34.0
Intake and exhaust system				
Intake manifold and cylinder head fixing bolts(8 X 45)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Intake manifold and cylinder head fixing bolts(8 X 95)	4	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Intake manifold and cylinder head fixing nuts	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Intake manifold and cylinder head fixing hexagonal wrench bolt	1	17.7 ~ 26.5	1.8 ~ 2.7	13.0 ~ 19.5
Exhaust manifold and cylinder head fixing nut	9	26.5 ~ 34.3	2.7 ~ 3.5	19.5 ~ 25.3
Exhaust manifold heat cover and exhaust manifold fixing bolts(6X12)	3	8.8 ~ 12.7	0.9 ~ 1.3	6.5 ~ 9.4
Engine hanger bracket and exhaust manifold fixing bolts (8 X 18)	2	17.7 ~ 26.5	1.8 ~ 2.7	13.0 ~ 19.5
Exhaust manifold and front muffler fixing nut	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

Front muffler CPF(Catalyzed Particulate Filter) fixing nuts	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
CPF(Catalyzed Particulate Filter) main muffler fixing nuts	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Main muffler and tail pipe fixing nuts	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

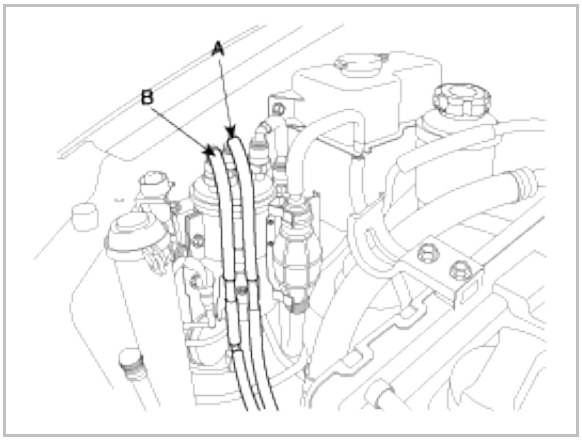
INSPECTION

COMPESSION PRESSURE

NOTICE

If there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.

1. Warm up the engine until the coolant temperature becomes 80~95°C(176~203°F).
2. Remove the fuel inlet(A) and the return hose(B) from the fuel filter.



3. Crank the engine in order to exhaust fuel in the high pressure pump.

NOTICE

Gather residual fuel by putting the return hose into a proper vessel.

4. Remove the injection pipe, injector and washer.(Refer to FL group).
5. Measure the cylinder compression pressure.
   (1) Insert the SST(0K552 131 002) into the injector hole.
   (2) Cranking the engine, measure the pressure.

NOTICE

Use the complete charging battery for the engine to crank at the speed of 350rpm or more.

   (3) Do the above step 1)~2) again for each cylinder.

NOTICE

This work must be done in as short time as possible.

Compression pressure :
3040.05kPa (31kg/cm², 440.92psi) (325 rpm)
Minimum pressure :
2745.85kPa (28kg/cm², 398.25psi)
Difference between each cylinder :
294.20kPa (3.0kg/cm², 42.67psi)

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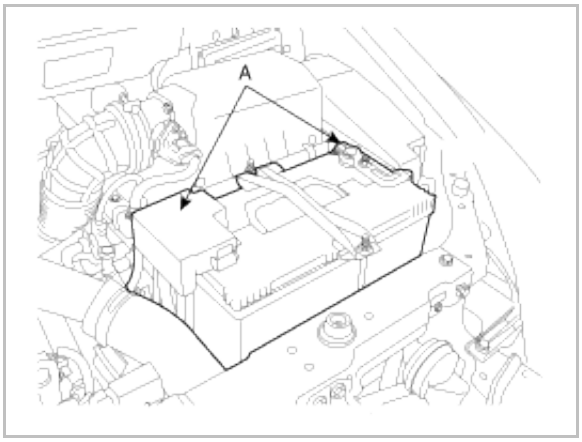
   (4) If, in one or more cylinders, the measured value is below the limit, fill a little engine oil into the injector holes of the cylinders, repeat the step 1)~2) and measure the compression pressure again.
      A. If the re-measured pressure becomes higher, wear or damage of the piston ring or cylinder surface can be the cause.
      B. If the re-measured pressure does not become higher, adherence or poor contact of the valves or inferior

gasket can be the cause.

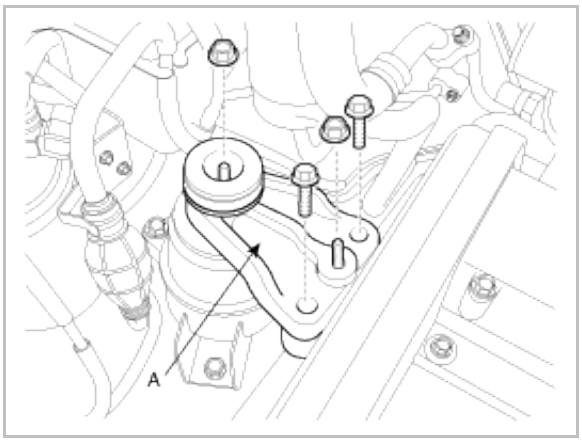
6. Install the injectors, washers and the injector pipes.(Refer to FL group).
7. Install the inlet and the return hoses to the fuel filter.

TIMING BELT TENSION ADJUSTMENT

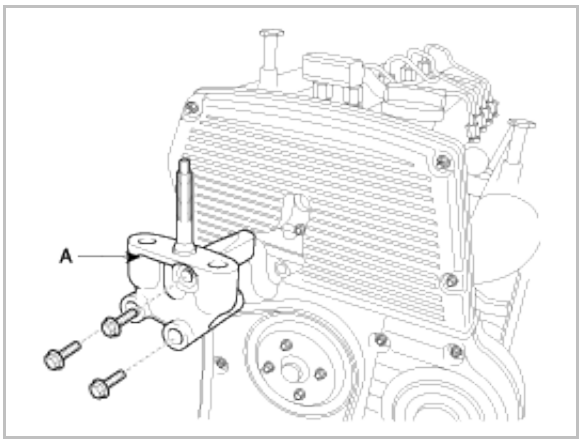
1. Remove the battery terminals (A).



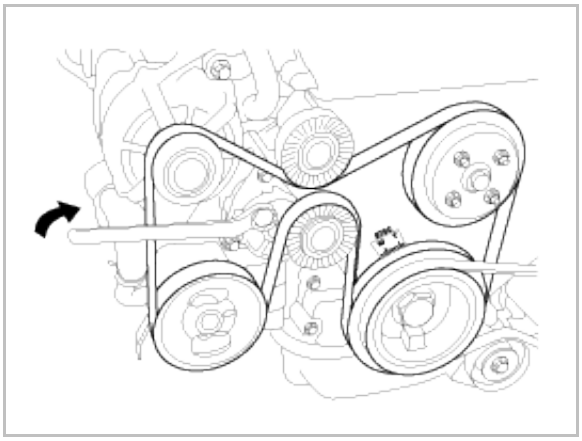
2. Install the jack for oil pan.
3. Remove the engine mounting (A).



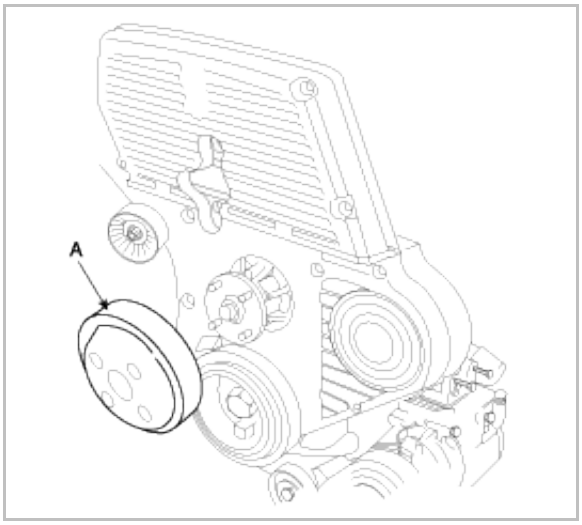
4. Remove the engine support bracket(A).



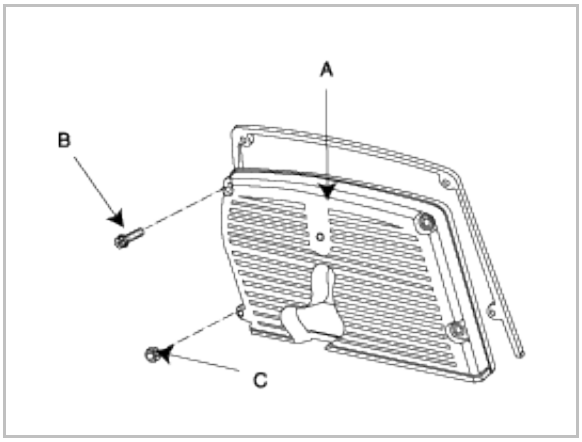
5. Remove the drive belt.



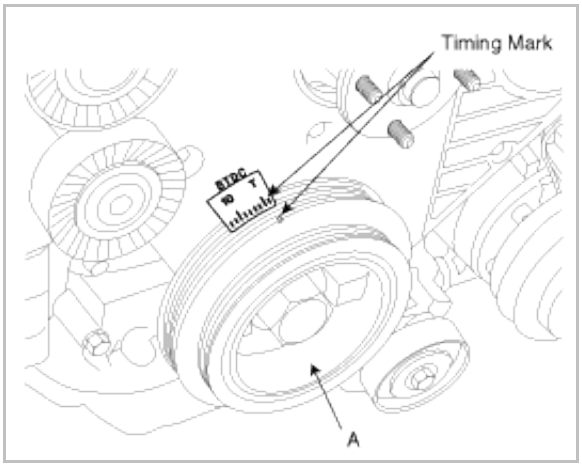
6. Remove the water pump pulley.

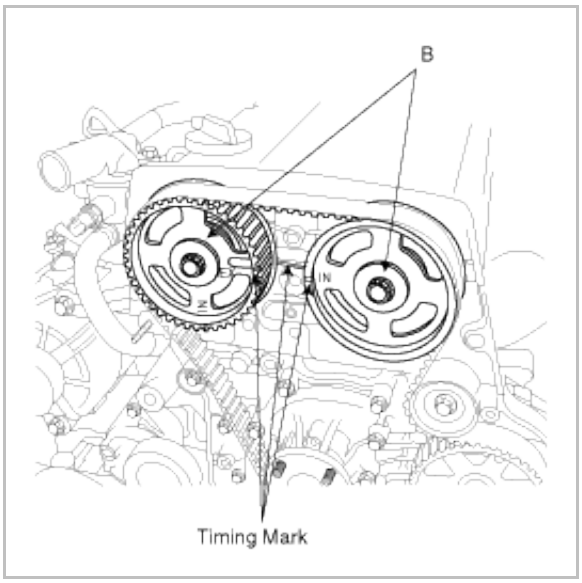


7. Remove the bolts(B), nut(C) and timing belt upper cover (A).

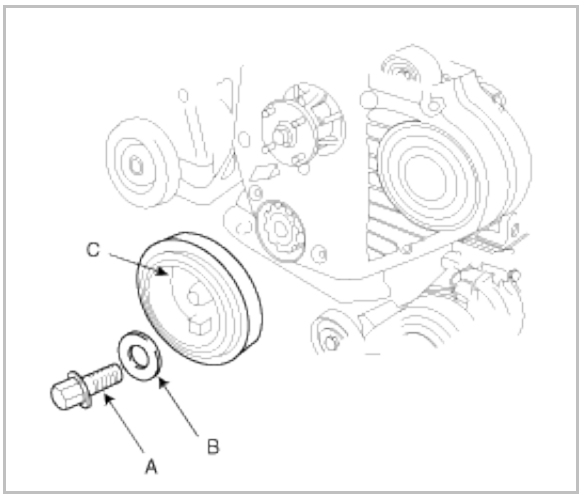


8. Turn the crankshaft pulley(A) and align its groove with the timing mark “T” of the timing belt cover. Check that the timing mark of camshaft sprocket(B) is aligned with that of the cylinder head cover. (No.1 cylinder positioned at the TDC position)





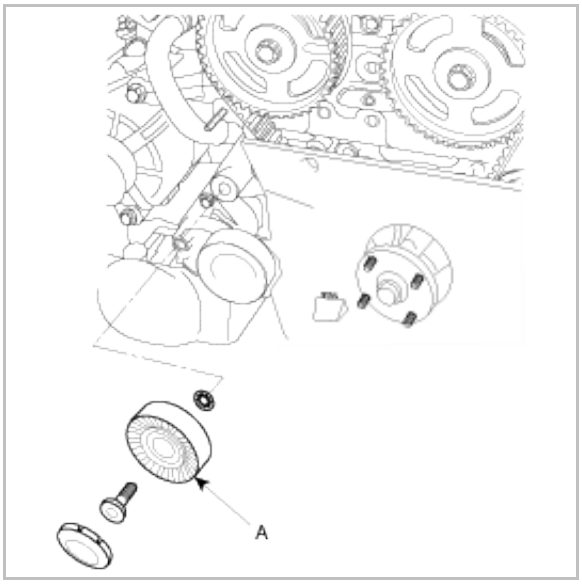
9. Remove the crankshaft pulley bolt(A), washer(B) and crankshaft pulley(C).



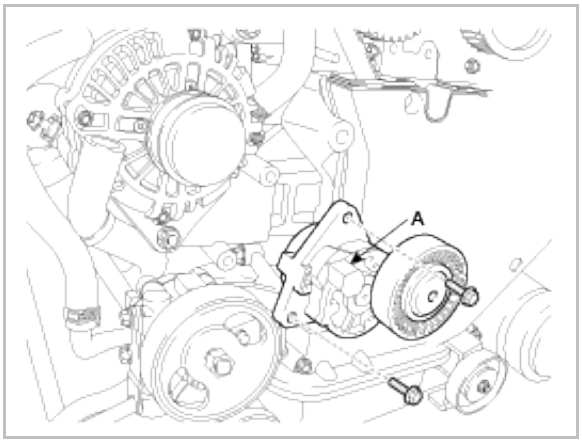
NOTICE

Using the special tool(09517-21700, 09231-H1000), fix the crankshaft pulley and loosen the bolt(A).

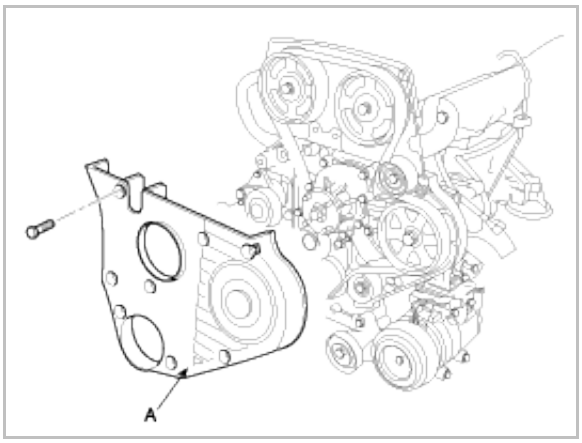
10. Remove the drive belt idler(A).



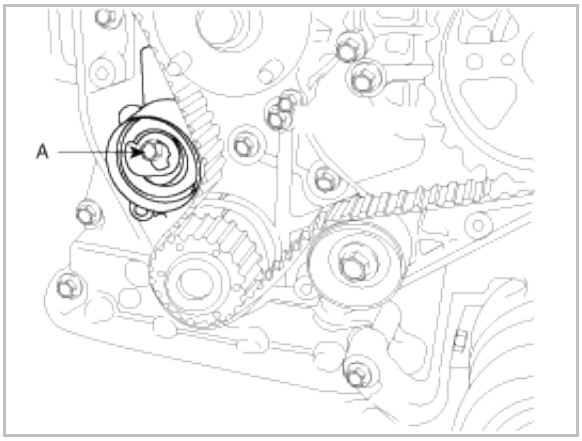
11. Remove the drive belt auto-tensioner (A).



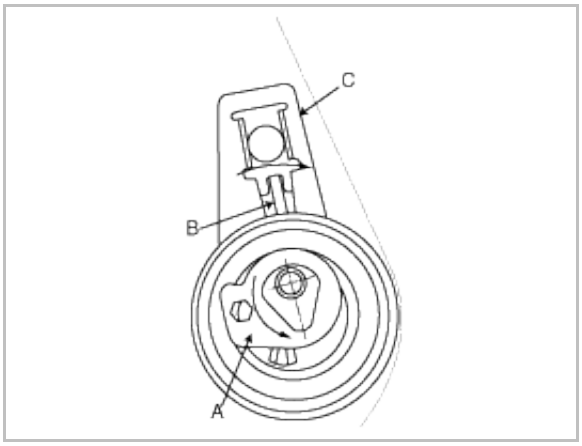
12. Remove the timing belt lower cover(A).



13. Loosen the auto-tensioner fixing bolt(A).

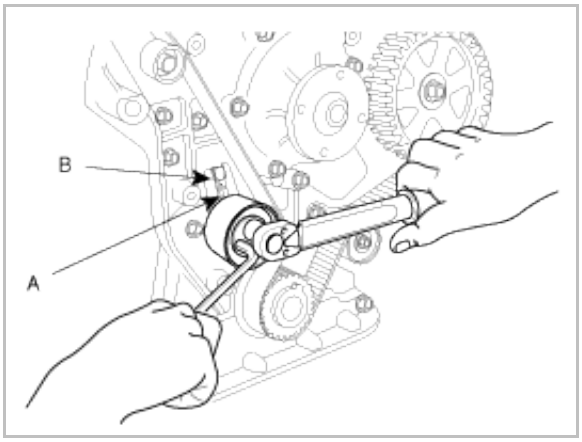


14. Adjust tension of the timing belt.
    (1) Align the pointer(B) with the tensioner fork(back plate)(C) as shown below by turning the special washer(A) counterclockwise with a hexagonal wrench.



    (2) When the pointer(A) is aligned with the tensioner fork(back plate)(B), tighten the tensioner mounting bolts with the special bolt fixed by a hexagonal wrench.

Tightening torque :
19.6~25.5Nm (2.0~2.6kgf.m, 14.5~18.8lb-ft)

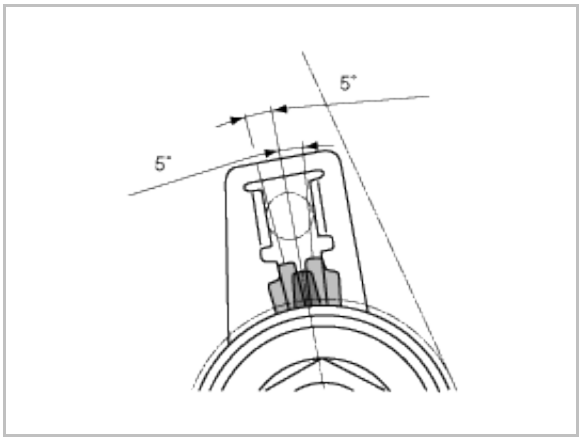


    (3) Remove the hexagonal wrench.

> **NOTICE**
>
> When the pointer (A) can not be aligned with the tensioner fork(back plate)(B), replace a new belt and repeat the steps.

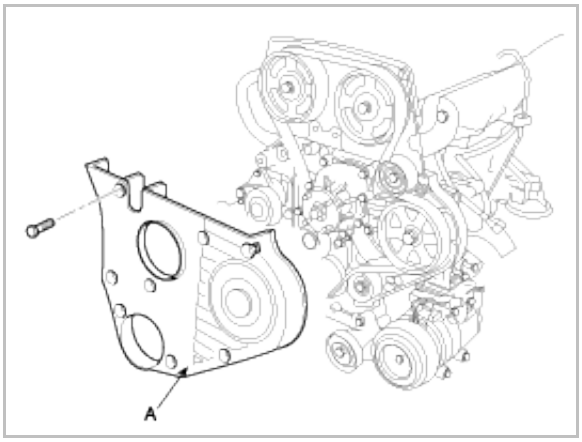
15. Rotate the crankshaft clockwise two revolutions in order to align the timing marks on the crankshaft sprocket, the camshaft sprocket and high pressure pump pulley.
16. Confirm that the location of the pointer is aligned with tensioner fork (back plate).

The margin of error : ± 5°



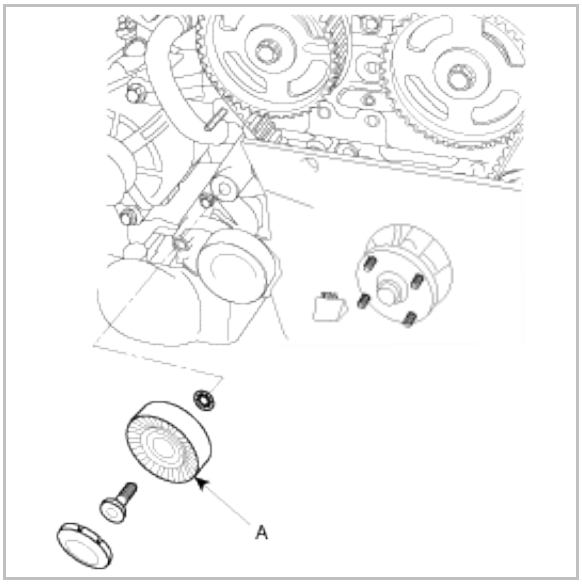
17. Install the timing belt lower cover(A).

Tightening torque :
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)



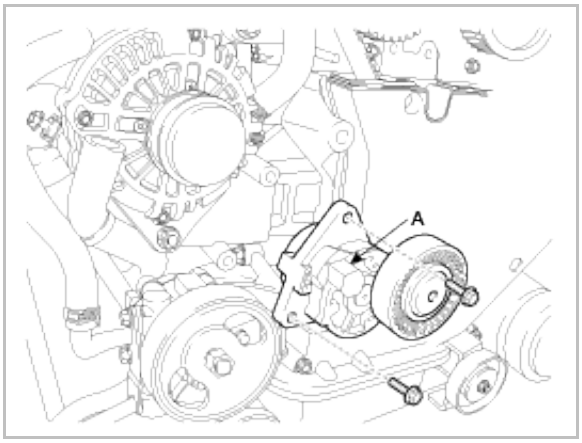
18. Install the drive belt idler(A).

Tightening torque :
37.3Nm (3.8kgf.m, 27.5lb-ft)



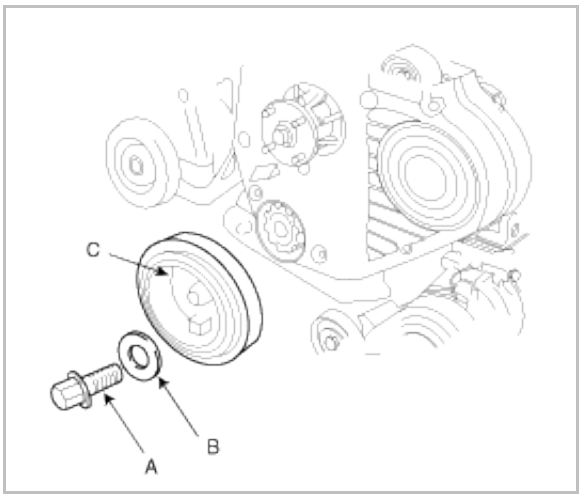
19. Install the drive belt auto-tensioner (A).

Tightening torque :
15.7~22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



20. Install the crankshaft pulley bolt(A), washer(B) and crankshaft pulley (A).

Tightening torque :
376.6~411.9Nm (38.4~42.0kgf.m, 277.7~303.8lb-ft)

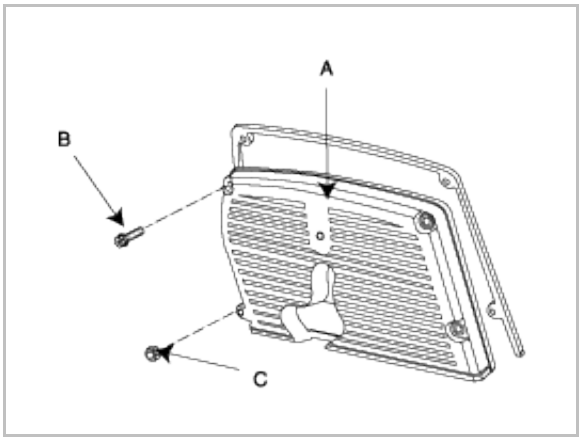


NOTICE

Using the special tool(09517-21700, 09231-H1000), tighten the bolt(A).

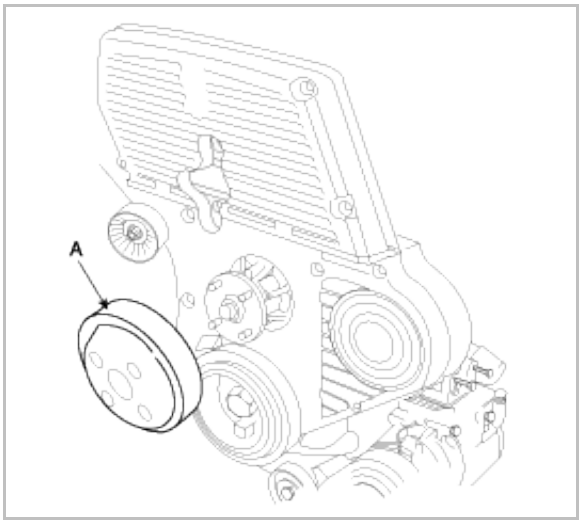
21. Install the bolts(B), nut(C) and timing belt upper cover (A).

Tightening torque :
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)

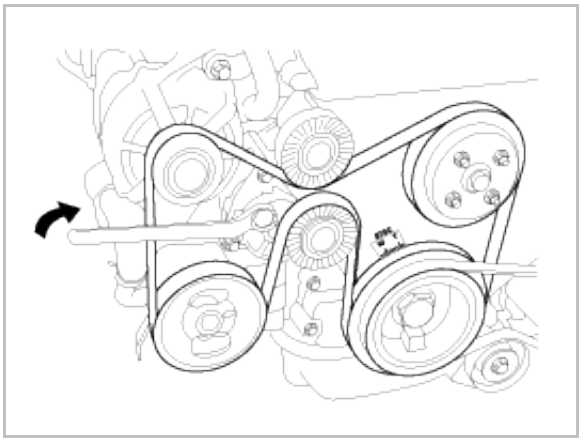


22. Install the water pump pulley.

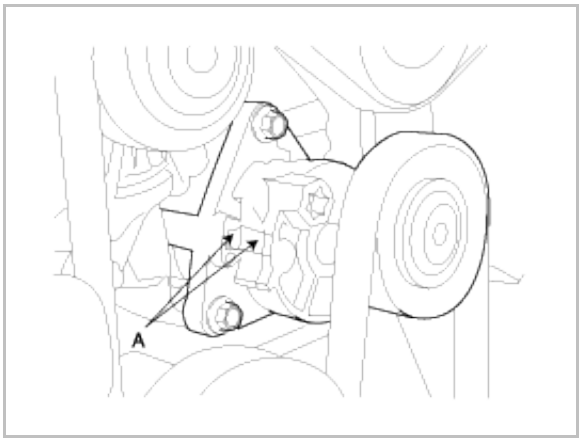
Tightening torque :
5.9~9.8Nm (0.6 ~ 1.0kgf.m, 4.3 ~ 7.2lb-ft)



23. Install the drive belt.

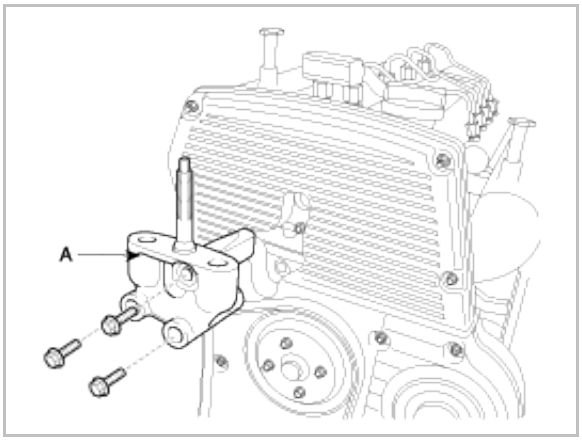


24. Confirm that the 'A' part of the drivebelt auto-tensioner is positioned as shown below. If not, replace the belt.



25. Install the engine support bracket(A).

Tightening torque :
49.0~63.7Nm (5.0 ~ 6.5kgf.m, 36.2 ~ 47.0lb-ft)



26. Install the engine mounting (A).

Tightening torque :
88.3~107.9Nm (9.0 ~ 11.0kgf.m, 65.1 ~ 79.6lb-ft)

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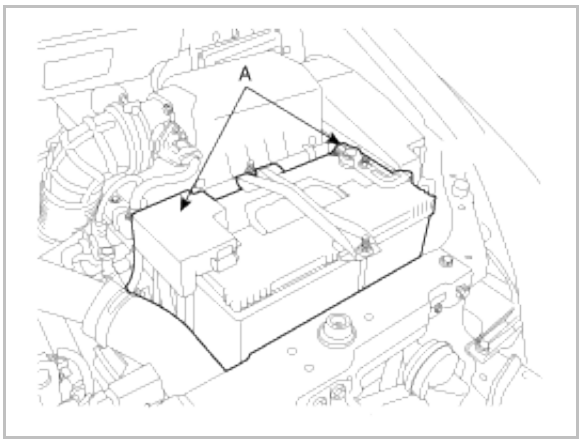
27. Remove the jack for oil pan.
28. Install the battery terminals (A).



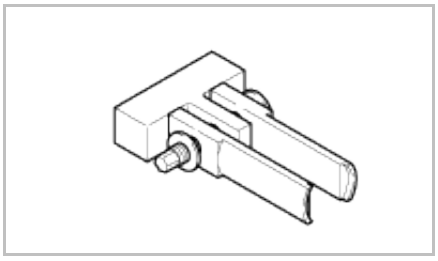
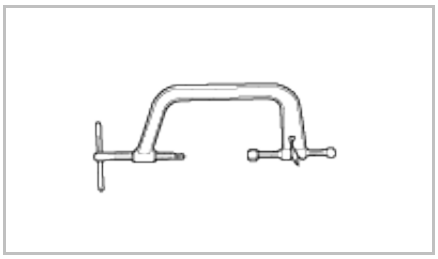
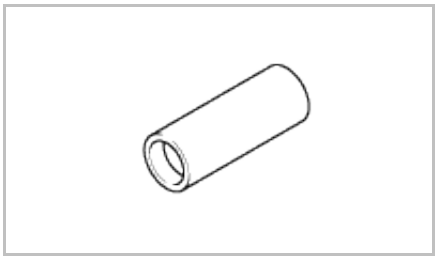
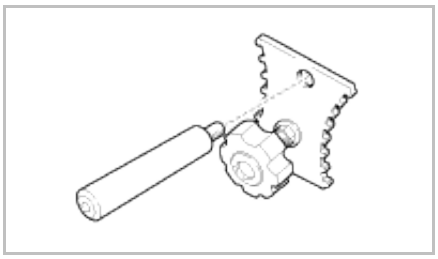
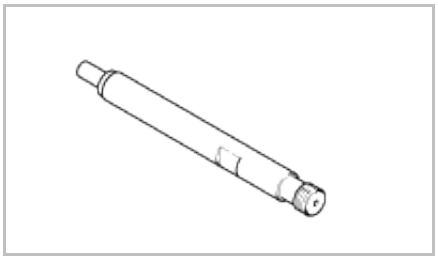
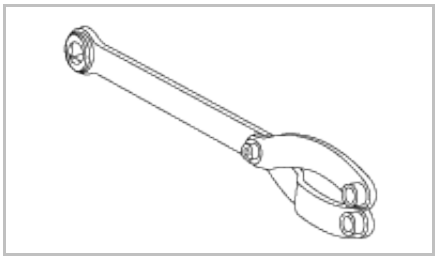
TROUBLESHOOTING

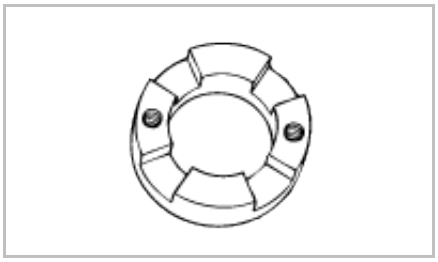
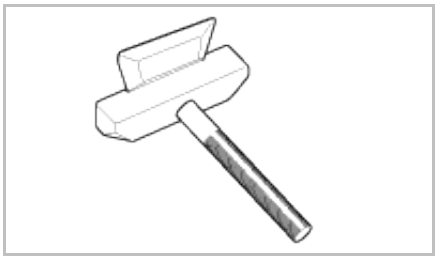
Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Loose or improperly installed engine flywheel.	Repair or replace the flywheel as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression . Repair or replace as required.
	Worn crankshaft thrust bearings.	Replace the crankshaft and bearings as required.
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem can cause the valve not to close properly.)	Repair or replace as required.
	Excessive worn or mis-aligned timing chain.	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifers.
Engine misfire with coolant consumption	• Faulty cylinder head gasket and/or cracking or other damage to the cylinder head and engine block cooling system . • Coolant consumption may or may not cause the engine to overheat.	• Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. • Repair or replace as required.
Engine misfire with excessive oil consumption	Worn valves, valve guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	Inspection the cylinder for a loss of compression Repair or replace as required.
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity.	Drain the oil. Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	Inspect the thrust bearing and crankshaft. Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	Inspect the camshaft lobes. Replace the camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. (Carbon on the valve stem or valve seat may cause the valve to stay open.)	Inspect the valves and valve guides, then repair as required.

Lower engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace damaged components as required.
	Loose or damaged flywheel.	Repair or replace the flywheel.
	Damaged oil pan, contacting the oil pump screen.	Inspect the oil pan. Inspect the oil pump screen. Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	Inspect the oil pump screen . Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	Inspect the piston and cylinder bore. Repair as required.
	Excessive piston pin-to-bore clearance.	Inspect the piston, piston pin and the connecting rod. Repair or replace as required.
	Excessive connecting rod bearing clearance.	Inspect the following components and repair as required. • The connecting rod bearings. • The connecting rods. • The crankshaft. • The crankshaft journal.
	Excessive crankshaft bearing clearance.	Inspect the following components and repair as required. • The crankshaft bearings. • The crankshaft journals.
	Incorrect piston, piston pin and connecting rod installation.	Verify the piston pins and connecting rods are installed correctly. Repair as required.
Engine noise under load.	Low oil pressure.	Repair or replace as required.
	Excessive connecting rod bearing clearance.	Inspect the following components and repair as required. • The connecting rod bearings. • The connecting rods. • The crankshaft.
	Excessive crankshaft bearing clearance.	Inspect the following components and repair as required. • The crankshaft bearings. • The crankshaft journals. • The cylinder block crankshaft bearing bore.
Engine will not crank. (crankshaft will not rotate)	Hydraulically locked cylinder. • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder.	Remove spark plugs and check for fluid. Inspect for broken head gasket. Inspect for cracked engine block or cylinder head. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain gears.	Inspect timing chain and gears. Repair as required.
	Foreign material in cylinder. • Broken valve. • Piston material. • Foreign material.	Inspect cylinder for damaged components and/or foreign materials. Repair or replace as required.

	Seized crankshaft or connecting rod bearings.	Inspect crankshaft and connecting rod bearing. Repair or replace as required.
	Bent or broken connecting rod.	Inspect connecting rods. Repair or replace as required.
	Broken crankshaft.	Inspect crankshaft.Repair or replace as required.

SPECIAL SERVICE TOOLS

Tool (Number and name)	Illustration	Use
Valve spring lifter pivot. (0K993 120 004)		Removal or installation of the valve spring
Valve spring lifter arm. (0K993 120 001)		Removal or installation of the valve spring
Valve seal installer. (09222-22001)		Installation of the valve seal
Camshaft pulley holder. (09231 - 4X100)		Installation of the camshaft
Pressure gauge adapter. (0K552 131 002)		Measurement of compression pressure
End york holder. (09517-21700)		Removal or installation of the crankshaft pulley bolt (used with 09231-H1000)

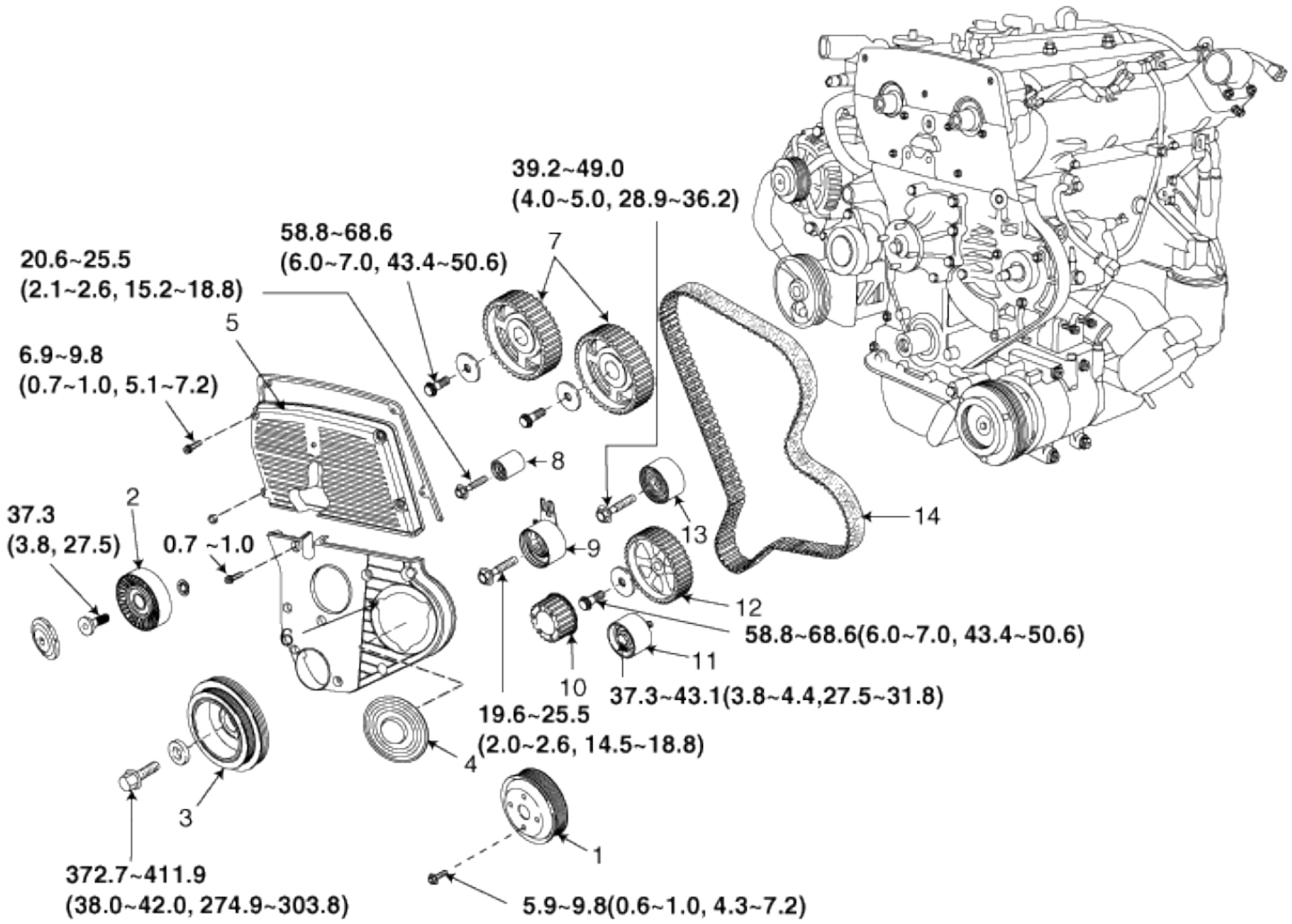
Crankshaft pulley adapter. (09231-H1000)		Removal or installation of the crankshaft pulley bolt (used with 09517-21700)
Oil pan remover. (09215-3C000)		Removal of the oil pan

KIA MOTORS

Engine Mechanical System

Timing System - Timing Belt

COMPONENTS



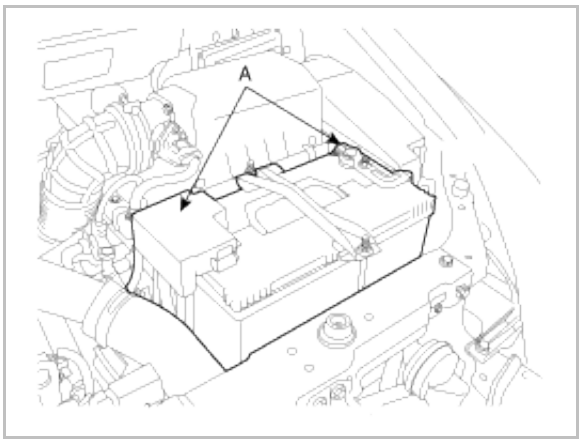
TORQUE : N.m(kgf.m, lb-ft)

1. Water pump pulley
2. Drive belt idler
3. Crank shaft pulley
4. Service cover
5. Timing belt upper cover
6. Timing belt lower cover
7. Camshaft pulley
8. Touch idler
9. Timing belt anto tensioner
10. Cramkshaft sprocket
11. No.2 idler
12. High pressure prmp pulley
13. No.1 idler
14. Timing belt

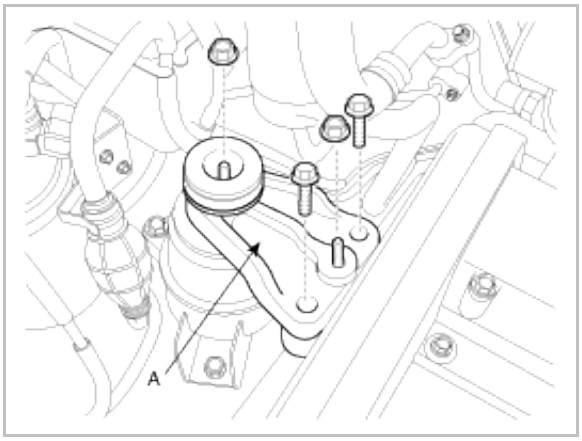
REMOVAL

Engine removal is not required for this procedure.

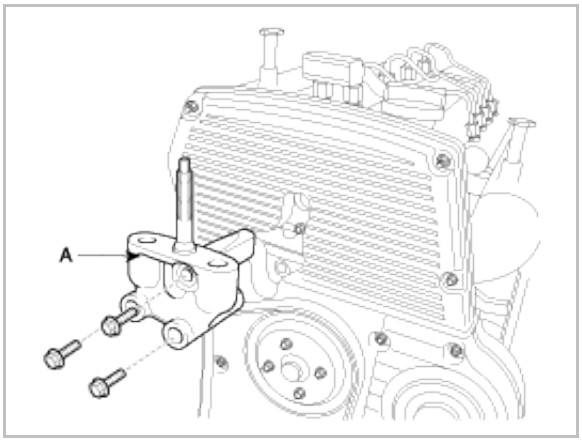
1. Remove the battery terminals (A).



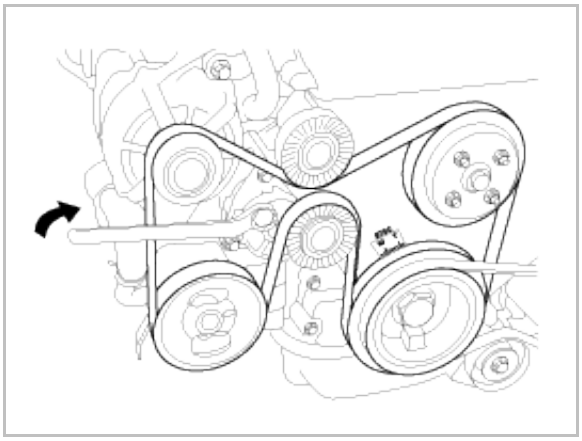
2. Install the jack for oil pan.
3. Remove the engine mounting (A).



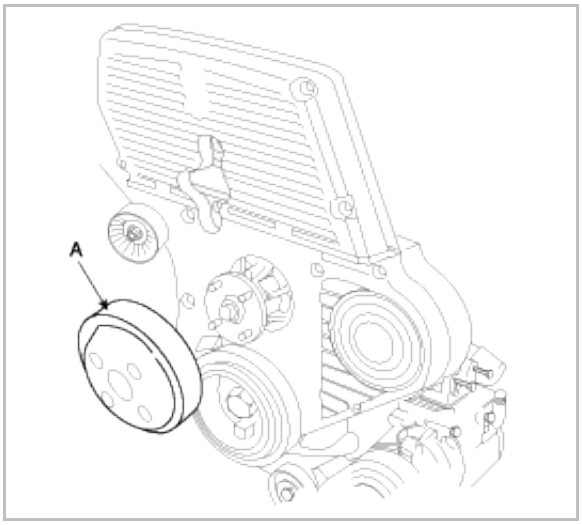
4. Remove the engine support bracket(A).



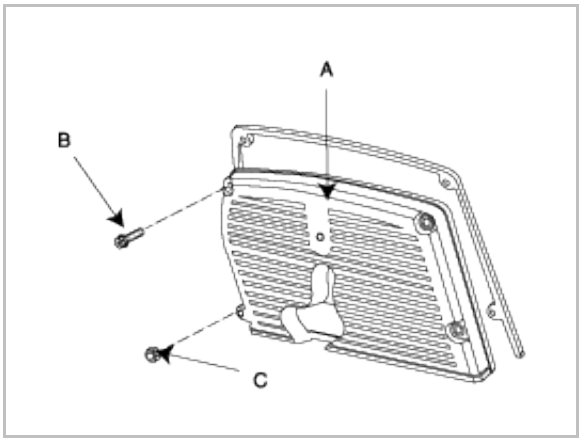
5. Remove the drive belt.



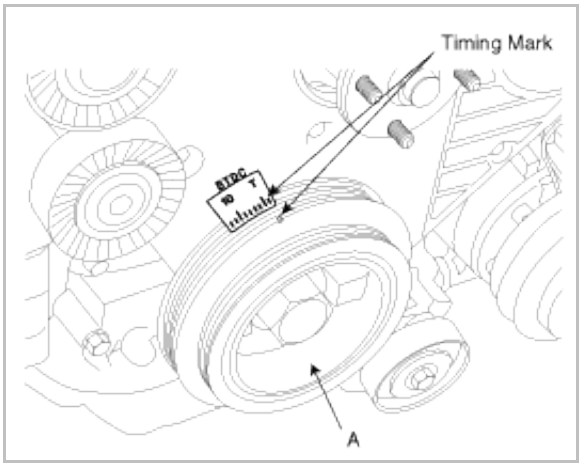
6. Remove the water pump pulley.

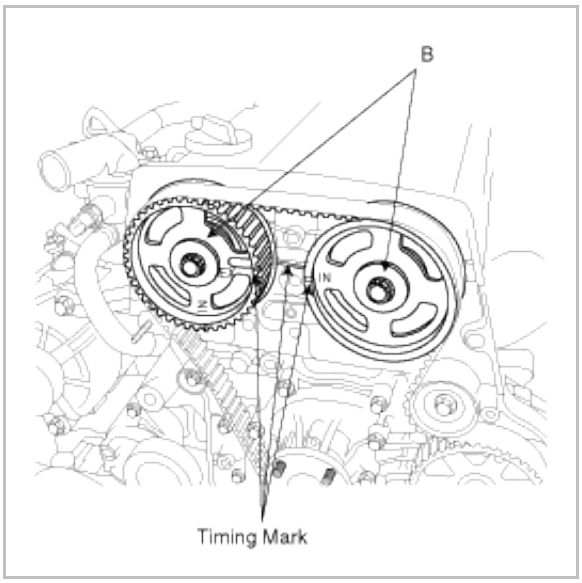


7. Remove the bolts(B), nut(C) and timing belt upper cover (A).

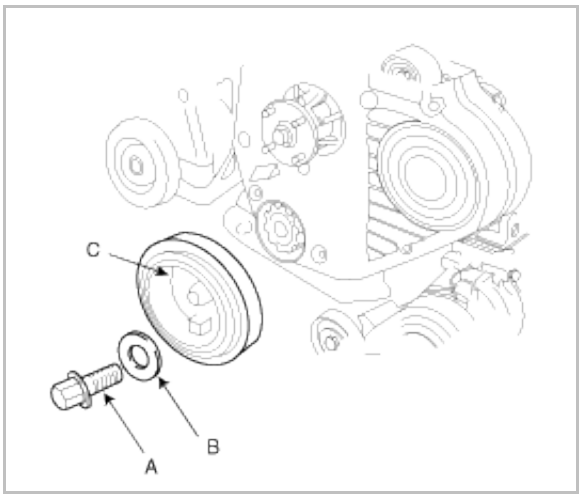


8. Turn the crankshaft pulley(A), and align its groove with timing mark “T” of the timing belt cover. Check that the timing mark of camshaft sprocket(B) is aligned with the timing mark of cylinder head cover. (No.1 cylinder compression TDC position)





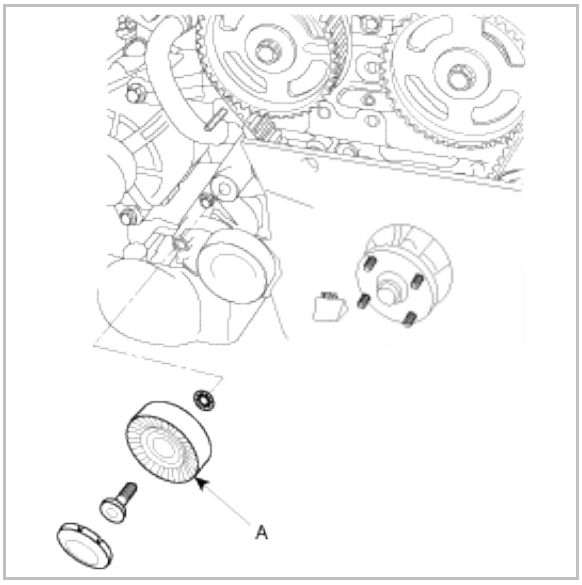
9. Remove the crankshaft pulley bolt(A), washer(B) and crankshaft pulley (C).



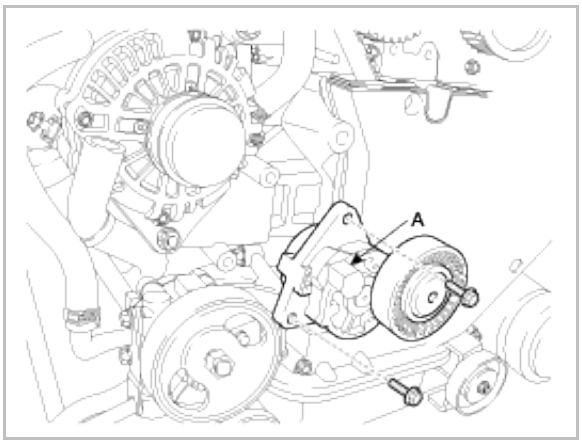
NOTICE

Using the special tool(09517-21700, 09231-H1000), fix the crankshaft pulley and loosen the bolt(A).

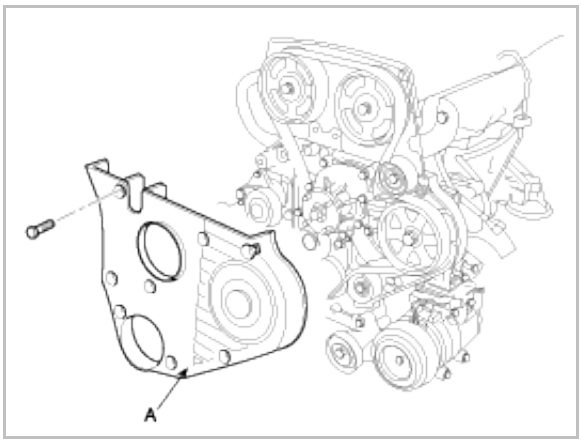
10. Remove the drive belt idler(A).



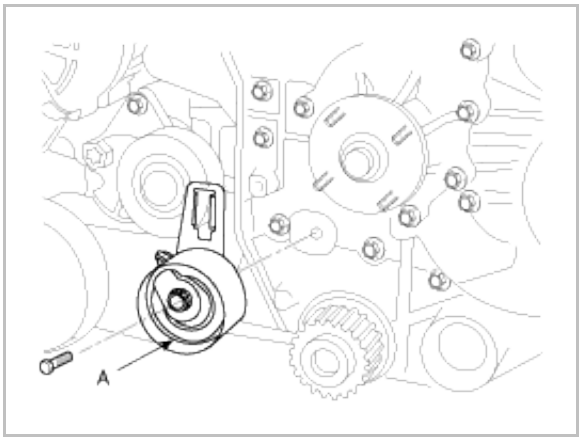
11. Remove the drive belt auto-tensioner (A).



12. Remove the timing belt lower cover(A).



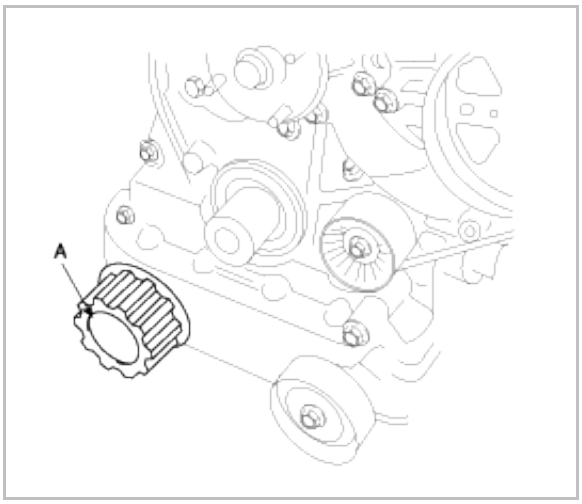
13. Remove the auto-tensioner(A) with the timing belt.



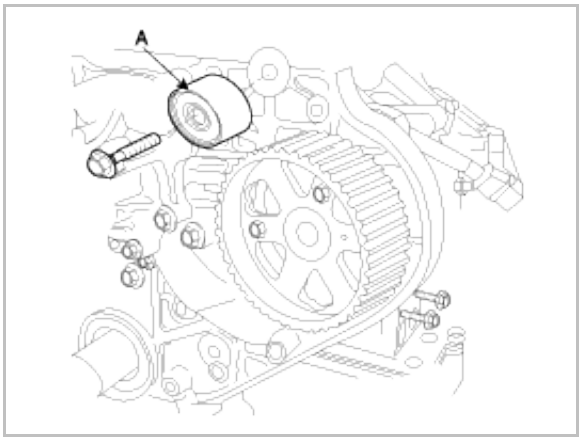
NOTICE

In reusing the timing belt, install the belt with the arrow mark facing to rotating direction.

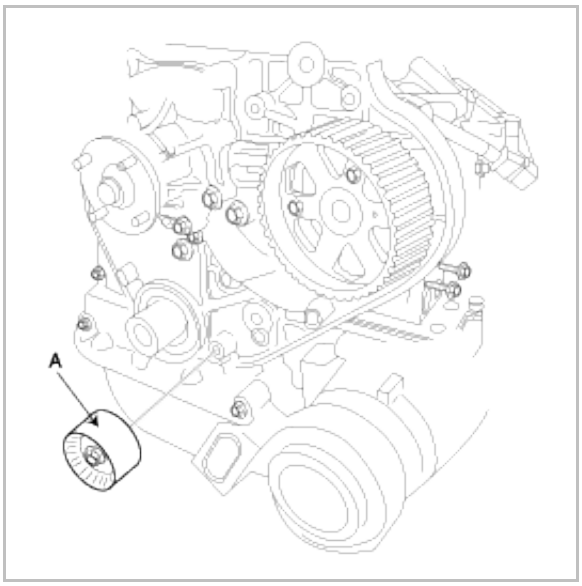
14. Remove the timing belt sprocket(A).



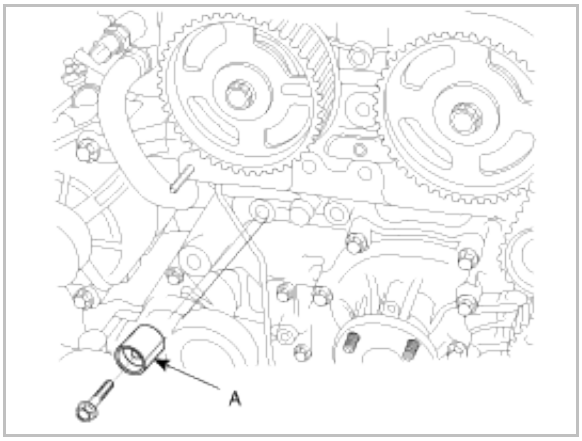
15. Remove the timing belt No.1 idler(A).



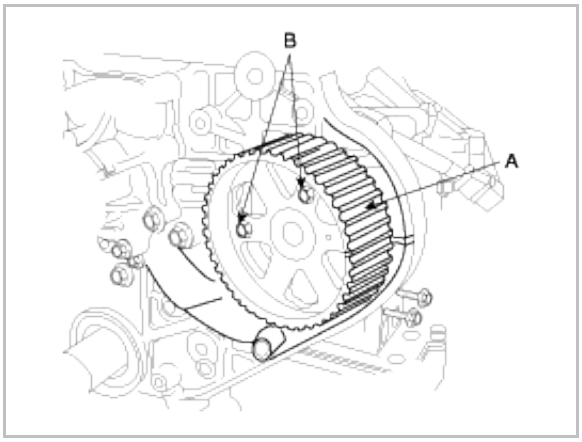
16. Remove the timing belt No.2 idler(A).



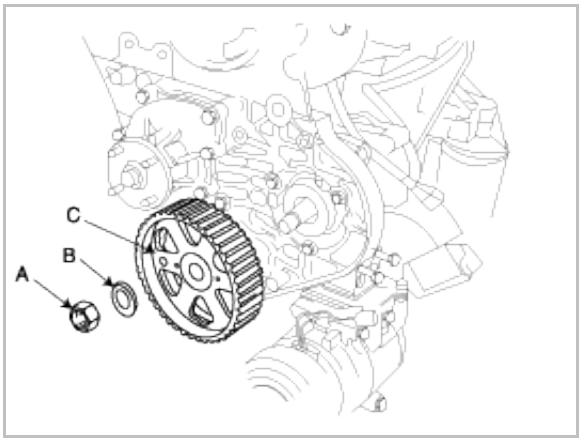
17. Remove the touch idler(A).



18. Fix the high pressure pump pulley, using the setting bolt(B) for the pulley not to be rotated.



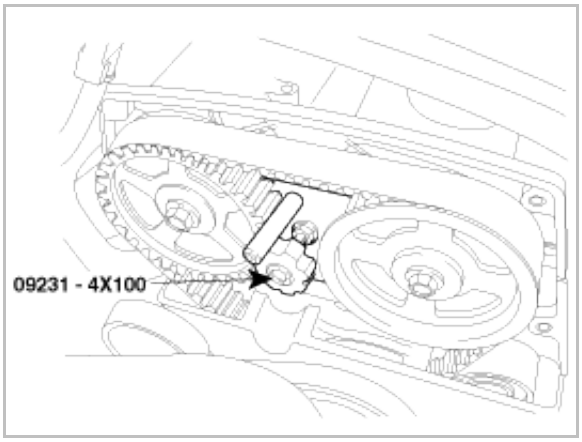
19. Remove the high pressure pulley nut(A), with the washer(B), pulley(C).



NOTICE

Using SST, remove the pulley. (Refer to FL group).

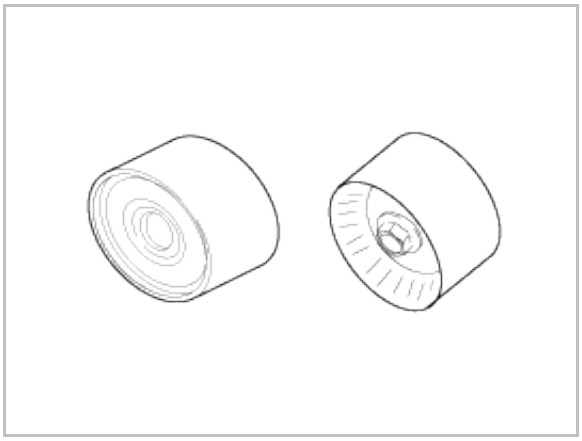
20. Using SST(09231-4X100), remove the camshaft pulley.



INSPECTION

SPROCKETS, TENSIONER, IDLER

1. Check the camshaft sprocket, crankshaft sprocket, tensioner pulley, and idler pulley for abnormal wear, cracks, or damage. Replace as necessary.
2. Inspect the tensioner pulley and the idler pulley for easy and smooth rotation and check for play or noise. Replace as necessary.



3. Replace the pulley if there is a grease leak from its bearing.

TIMING BELT

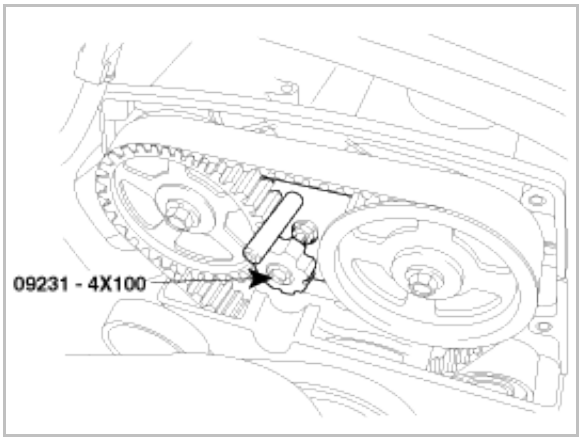
1. Check the belt for oil or dust deposits.
   Replace, if necessary.
   Small deposits should be wiped away with a dry cloth or paper. Do not clean with solvent.
2. When the engine is overhauled or belt tension adjusted, check the carefully. If any of the following flaws are evident, replace the belt.

> NOTICE
>
> • Do not bend, twist or turn the timing belt inside out.
> • Do not allow timing belt to come into contact with oil, water and steam.

INSTALLATION

1. Using SST (09231-4X100), install the camshaft pulley.

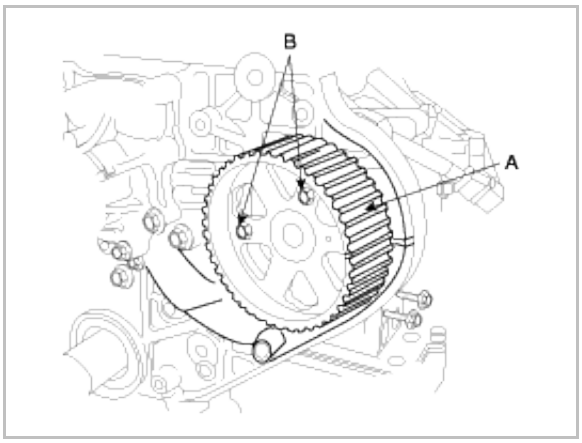
Tightening torque :
58.8~68.6Nm (6.0~7.0kgf.m, 43.4 ~ 50.6lb-ft)



2. After installing the high pressure pump pulley(A), tighten the high pressure pump pulley nut with the setting bolt(B) for the pulley not to be rotated.

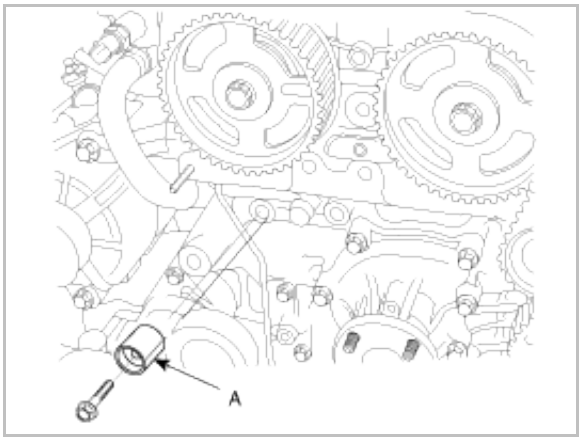
Tightening torque :

58.8~68.6Nm (6.0~7.0kgf.m, 43.4 ~ 50.6lb-ft)



3. Install the touch idler(A).

Tightening torque :
7.8 ~ 9.8Nm (2.1~2.6kgf.m, 5.8 ~ 7.2lb-ft)

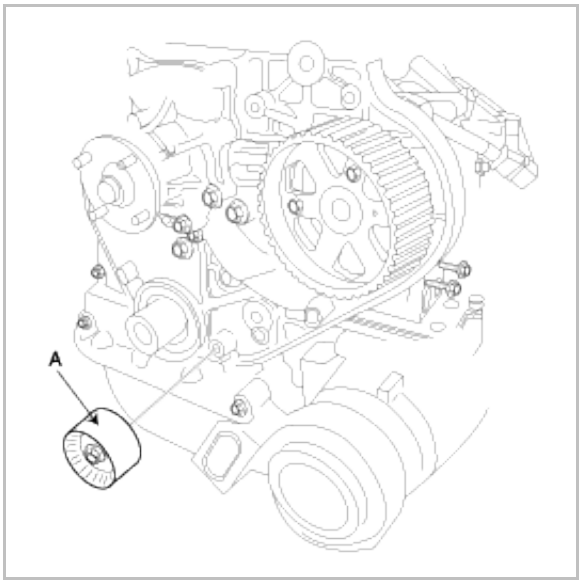


4. Install the timing belt No.2 idler(A).

Tightening torque :
7.8 ~ 9.8Nm (3.8~4.4kgf.m, 5.8 ~ 7.2lb-ft)

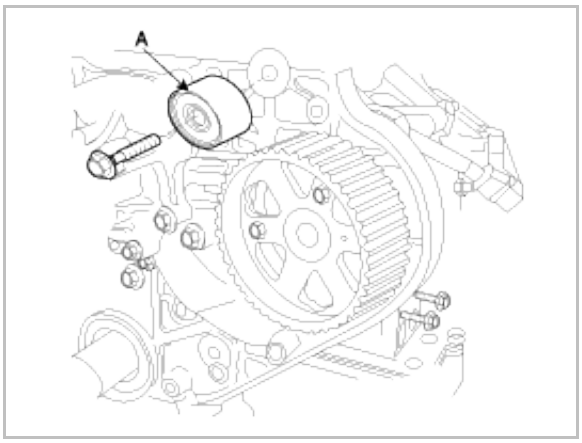
CAUTION

Ensure the location of idlers.
No.1 idler : 60mm(2.3622in)
No.2 idler : 55mm(2.1654in)

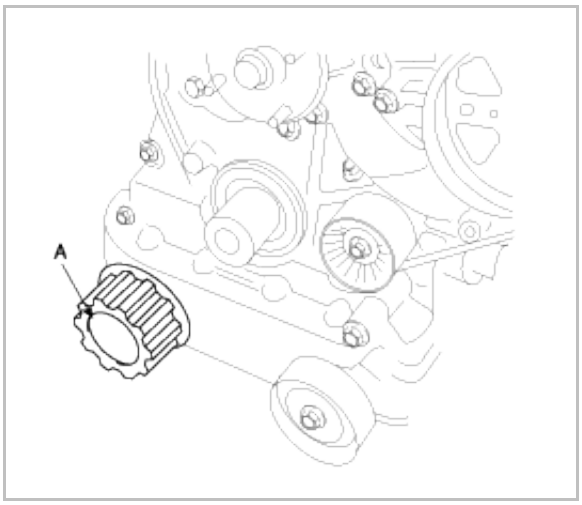


5. Install the timing belt No.1 idler(A).

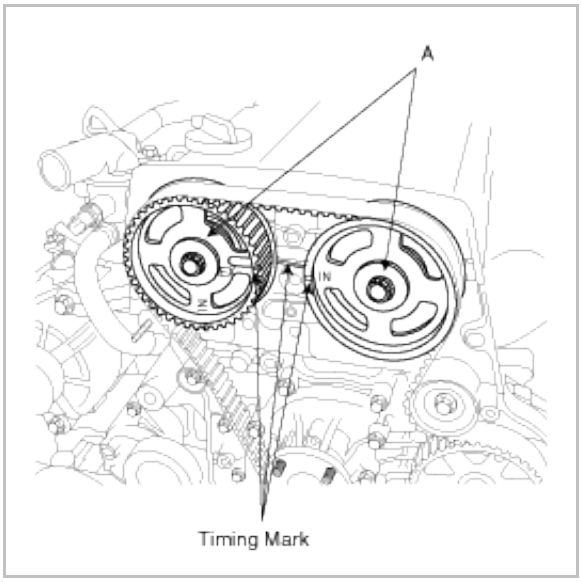
Tightening torque :
7.8 ~ 9.8Nm (4.0~5.0kgf.m, 5.8 ~ 7.2lb-ft)

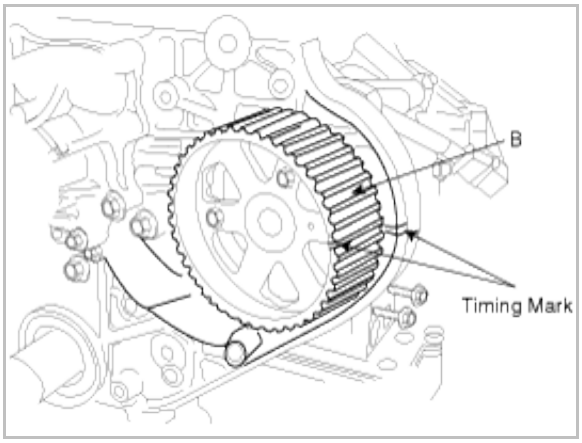


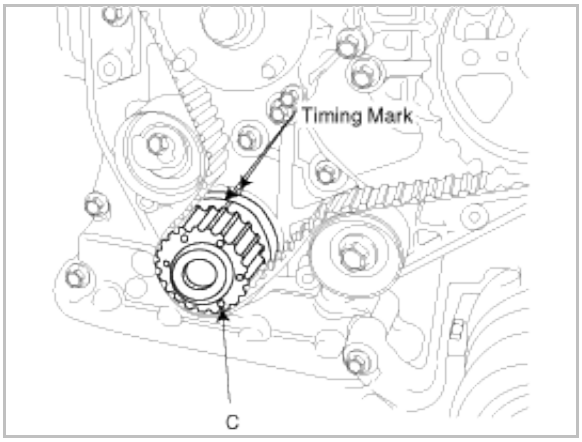
6. Install the timing belt sprocket(A).



7. Check that the timing mark of camshaft pulley(A), high pressure pump pulley(B) and crankshaft pulley(c).

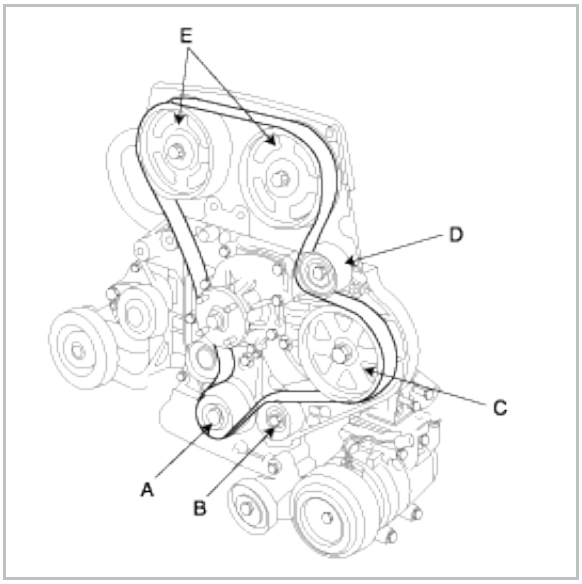




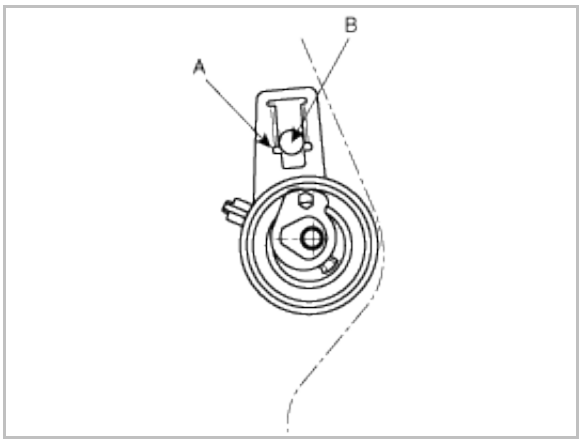


8. Install the timing belt.
   Crankshaft sprocket pulley(A)→No.2 idler(B)→High pressure pump pulley (C) → No.1 idler(D) → camshaft sprocket pulley (E)

> **CAUTION**
>
> Because the auto-tensioner should be installed after the timing belt, be careful about the tension of the belt before the installation of the auto-tensioner.



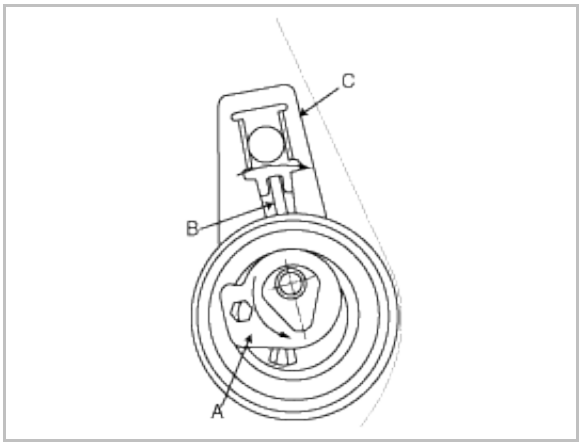
9. Install the auto-tensioner as shown below which the tensioner fork(back plate)(A) positioned around the dowel pin(B).



CAUTION

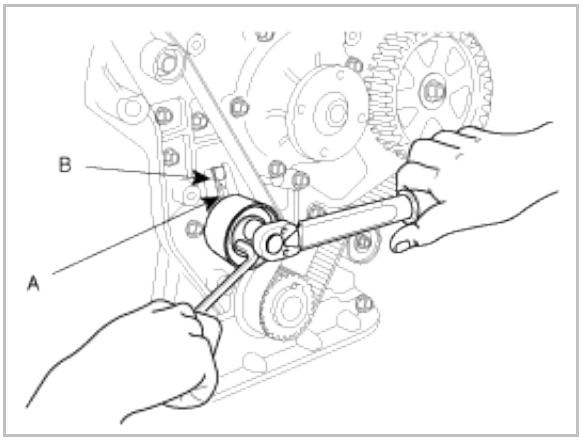
Be careful for the auto-tensioner not to be stained with oil. If so, replace the auto-tensioner with a new one. The location of the pointer, the back plate and the special washer is as shown.

10. Adjust the tension of the timing belt.
    (1) Adjust the location of the pointer (B) aligning the tensioner fork(back plate)(C) as shown below by turning the special washer(A) counterclockwise with a hexagonal wrench.



    (2) When aligning the pointer(A) with the tensioner fork(back plate)(B), tighten the tensioner mounting bolt with fixing the special washer not to move by a hexagonal wrench.

Tightening torque :
19.6~25.5Nm (2.0~2.6kgf.m, 14.5~18.8lb-ft)

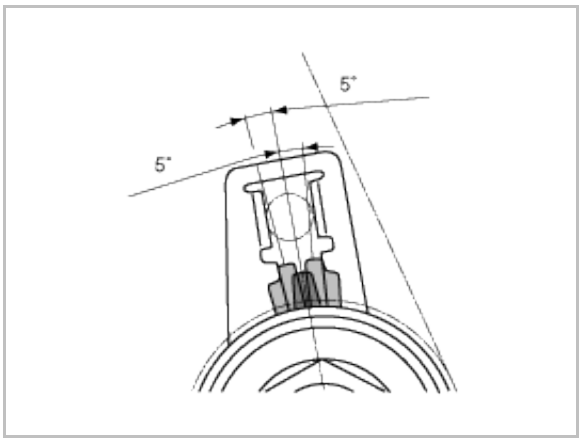


(3) Remove the hexagonal wrench.

> **NOTICE**
>
> If the pointer is not aligned with the tensioner fork(back plate), replace the belt with a new one and adjust them again.

11. Align the timing marks of the crankshaft sprocket, the camshaft sprocket and the high pressure pump pulley by turning the crankshaft clockwise two revolutions.
12. Check that the location of the pointer is aligned with the tensioner fork (back plate).

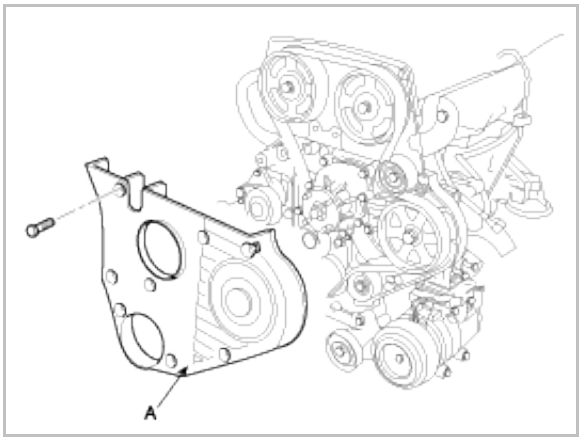
The margin of error : ± 5°



> **NOTICE**
>
> If the location of the pointer is not within the margin of error, repeat the steps 10)~12).

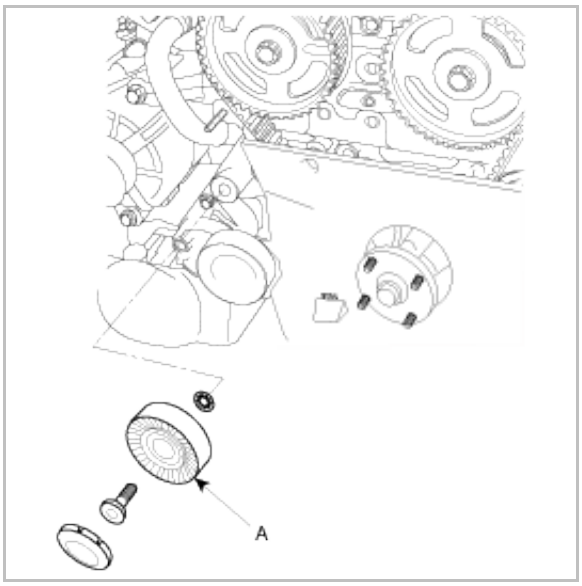
13. Install the timing belt lower cover(A).

Tightening torque :
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)



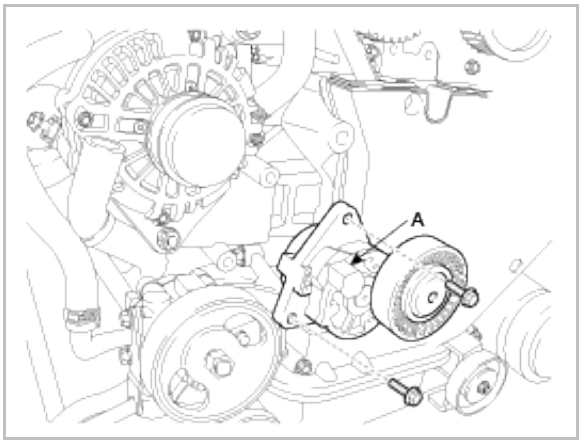
14. Install the drive belt idler(A).

Tightening torque :
37.3Nm (3.8kgf.m, 27.5lb-ft)



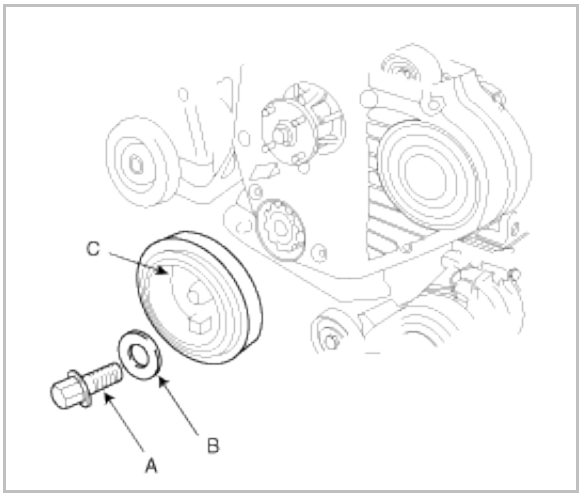
15. Install the drive belt auto-tensioner (A).

Tightening torque :
15.7~22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



16. Install the crankshaft pulley bolt(A), washer(B) and crankshaft pulley (A).

Tightening torque :
376.6~411.9Nm (38.4~42.0kgf.m, 277.7~303.8lb-ft)

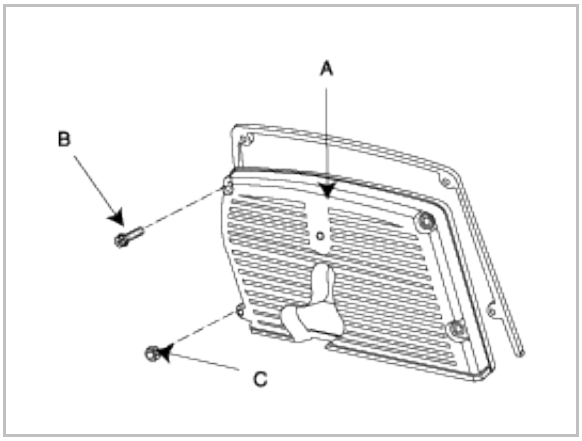


NOTICE

Using the special tool(09517-21700, 09231-H1000).

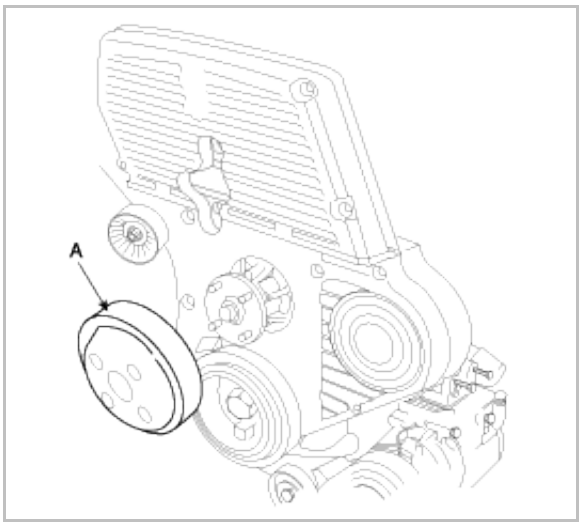
17. Install the bolts(B), nut(C) and timing belt upper cover (A).

Tightening torque :
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)

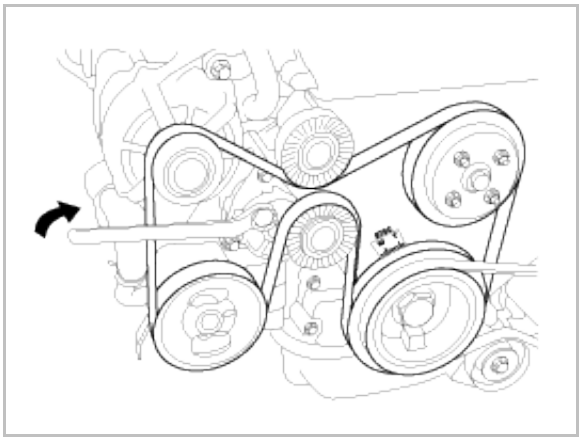


18. Install the water pump pulley.

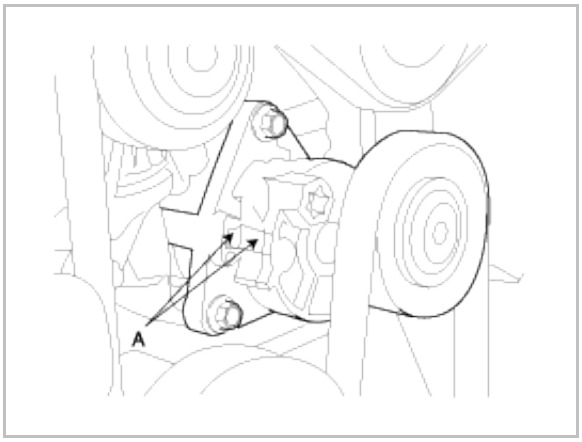
Tightening torque :
5.9~9.8Nm (0.6 ~ 1.0kgf.m, 4.3 ~ 7.2lb-ft)



19. Install the drive belt.

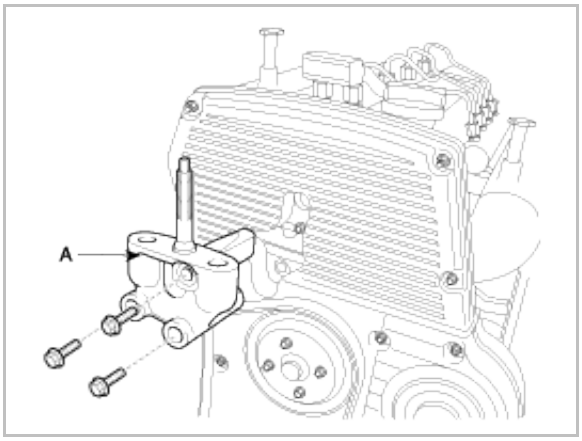


20. Check that the 'A' part of the drivebelt auto-tensioner is aligned as shown below. If not, replace the drivebelt.



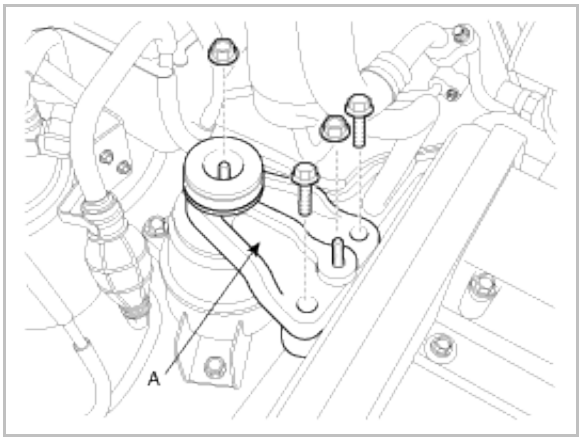
21. Install the engine support bracket(A).

Tightening torque :
49.0~63.7Nm (5.0 ~ 6.5kgf.m, 36.2 ~ 47.0lb-ft)

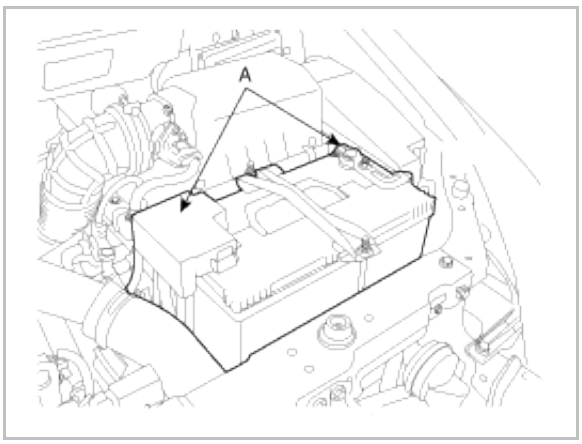


22. Install the engine mounting (A).

Tightening torque :
88.3~107.9Nm (9.0 ~ 11.0kgf.m, 65.1 ~ 79.6lb-ft)



23. Remove the jack for oil pan.
24. Install the battery terminals (A).

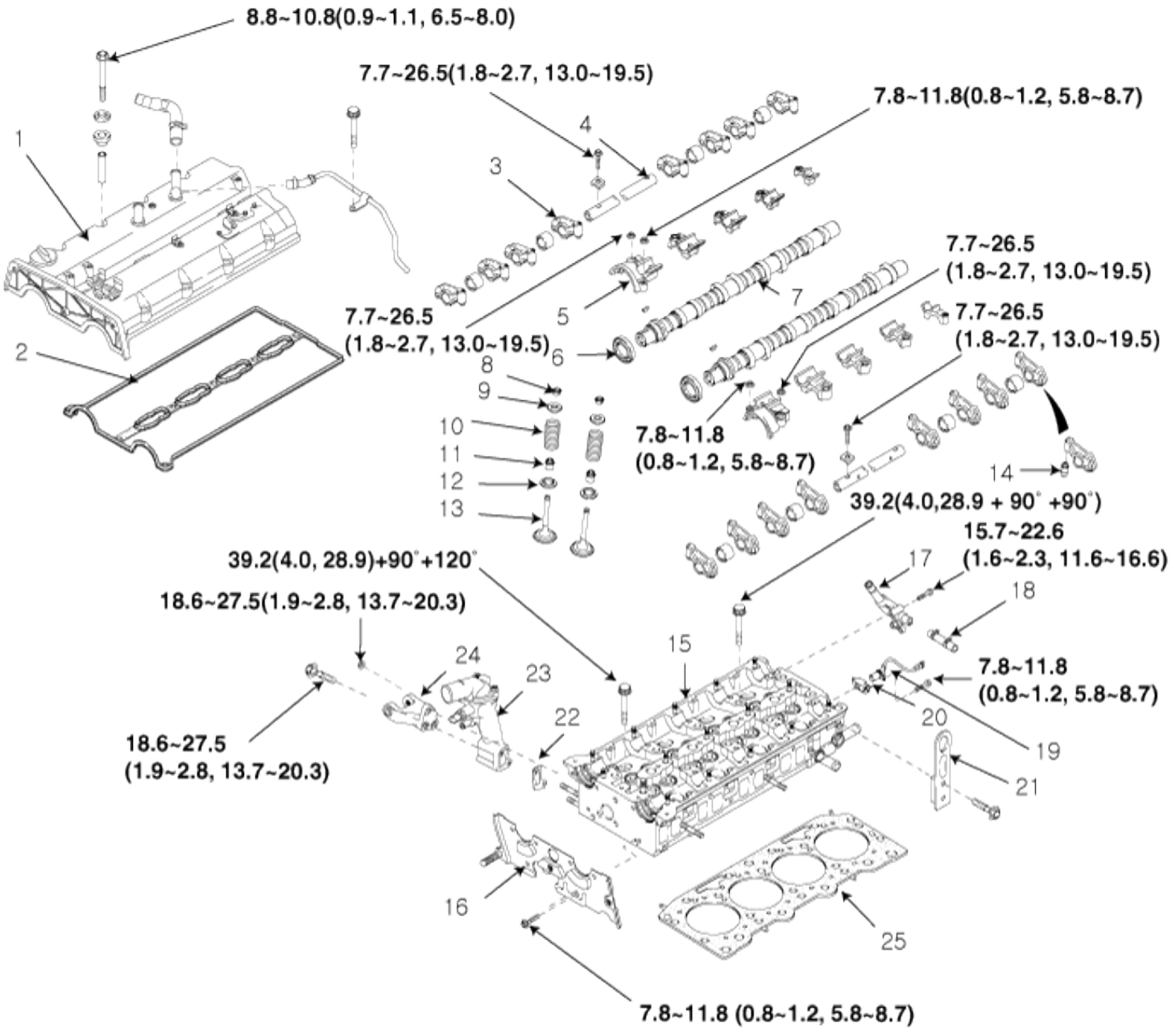


KIA MOTORS

Engine Mechanical System

Cylinder Head Assembly

COMPONENTS



TORQUE : N.m(kgf.m, lb-ft)

1. Cylinder head cover
2. Cylinder head cover gasket
3. Rockerarm
4. Rockerarm shaft
5. Camshaft bearing cap
6. Camshaft oil seal
7. Camshaft
8. Retainer lock
9. Retainer
10. Valve spring
11. Valve stem seal
12. Spring seat
13. Valve
14. Hydramlic lash adjuster
15. Cylinder head
16. Timing belt plate
17. Ventilation housing
18. Ventilation hose
19. Camshaft position sensor
20. Camshaft position sensor housing
21. Engine hanger
22. Thermostat case gasket
23. Thermostat case
24. Generator bracket
25. Cylinder head gasket

REMOVAL

Engine removal is not required for this procedure.

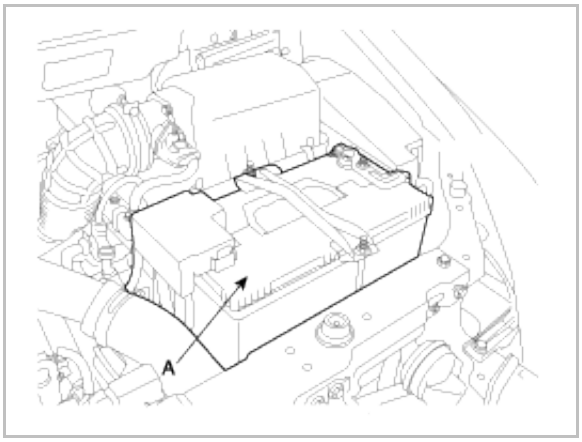
CAUTION

- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

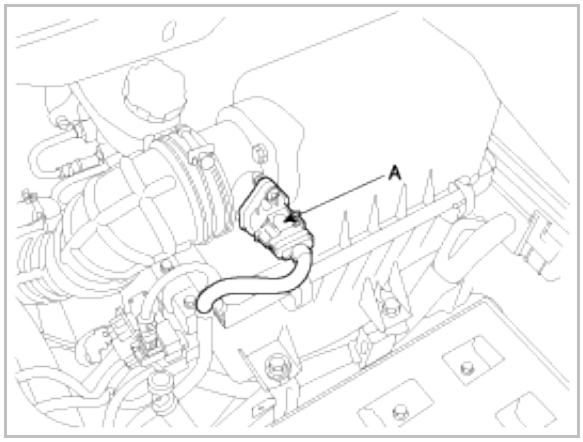
NOTICE

- Mark all wiring and hoses to avoid misconnection.
- Inspect the timing belt before removing the cylinder head.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

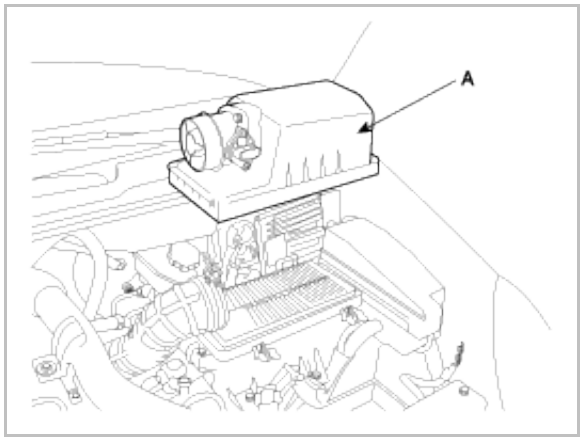
1. Remove the battery(A).



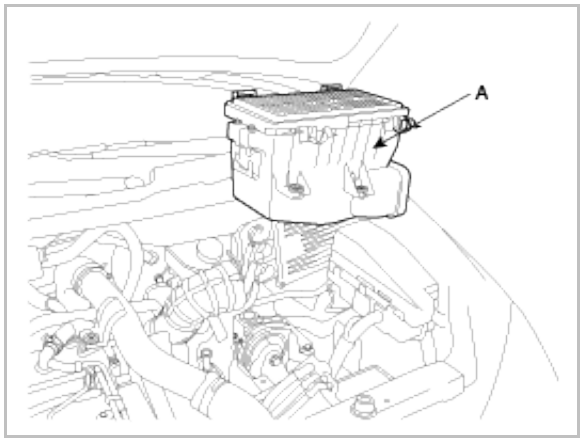
2. Drain the engine coolant.
   Remove the radiator cap to speed draining.
3. Remove the intake air hose and air cleaner assembly.
   (1) Disconnect the AFS(Air Flow Sensor) connector(A).



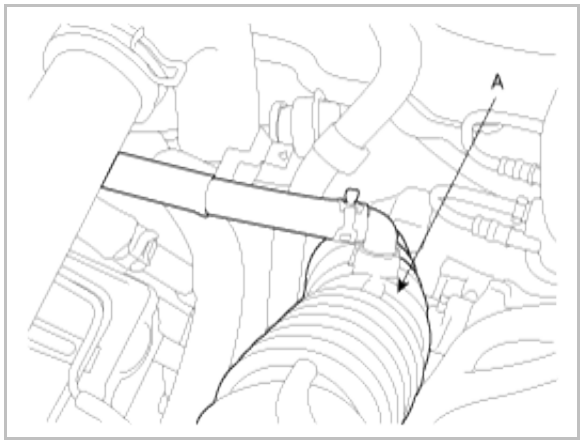
   (2) Disconnect the air cleaner upper cover(A).



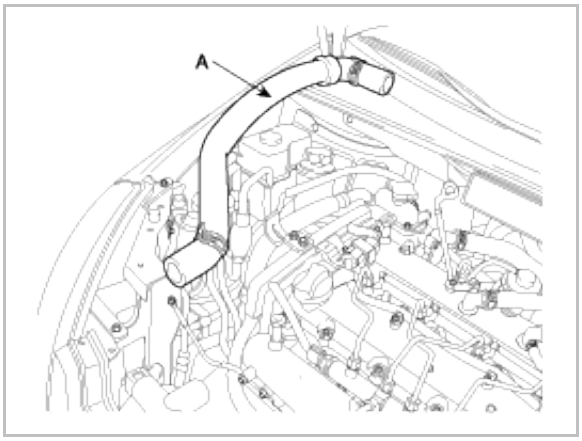
(3) Remove the air cleaner assembly(A).



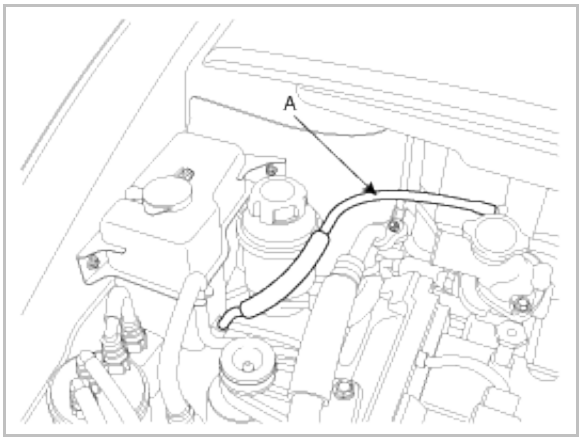
(4) Remove the air intake hose(A).



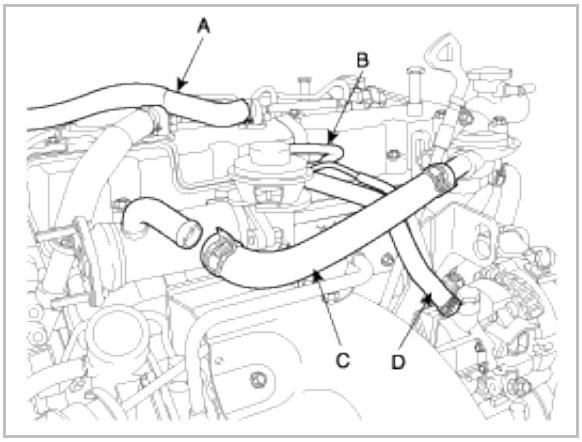
4. Remove the radiator upper hose(A).



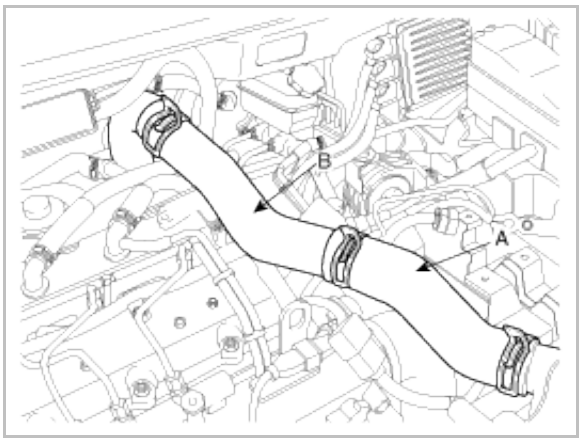
5. Remove the reservoir tank hose(A).

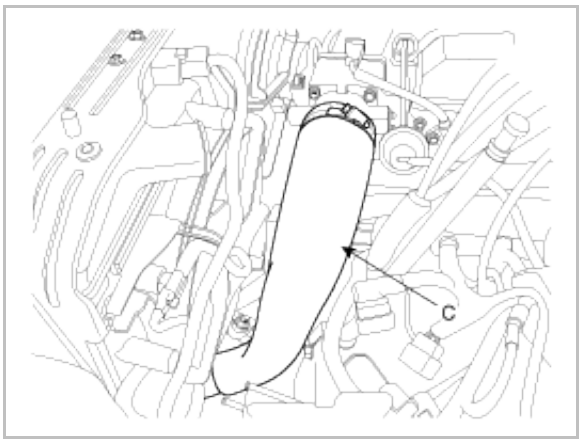


6. Remove the PCV(Positive Crankcase Ventilation) hose(A), EGR valve vacuum hose(B), EGR cooler water hose(C), pump vacuum oil hose(D).

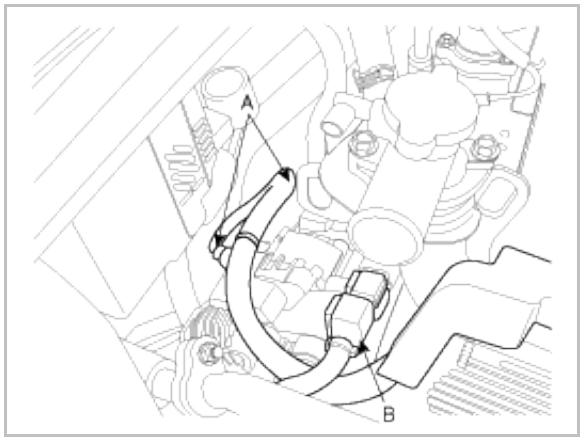


7. Remove the intercooler hose(A,C), pipe(B).

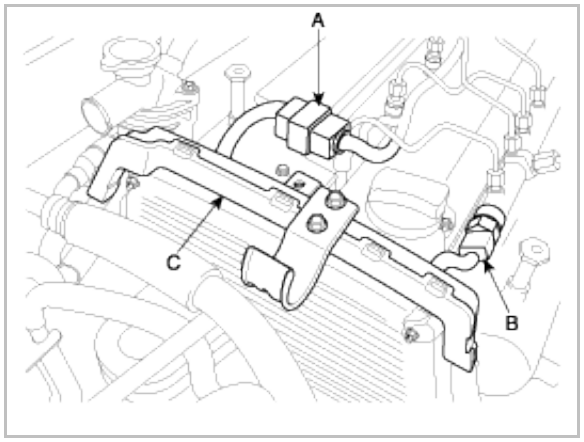




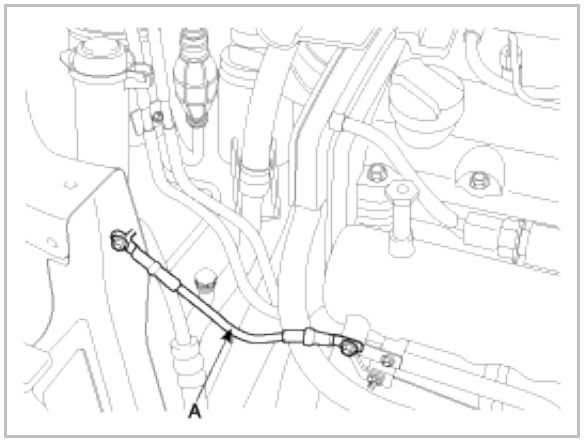
8. Remove the wiring connectors and clamps from cylinder head and intake manifold.
   (1) Remove the generator connector (A) and ETC(Engine Coolant Temperature) sensor connector (B).



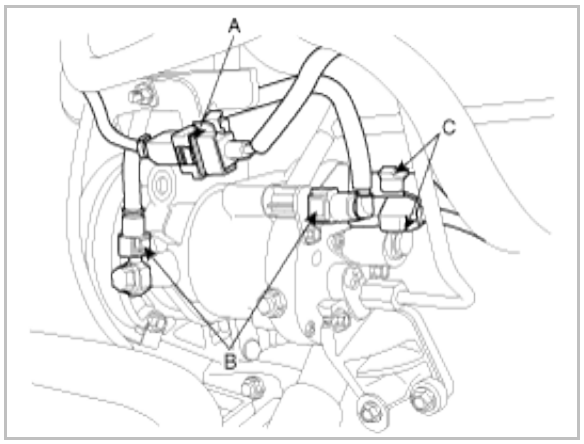
(2) Remove the injector connector(A), common rail pressure sensor connector(B), wire harness protector(C).



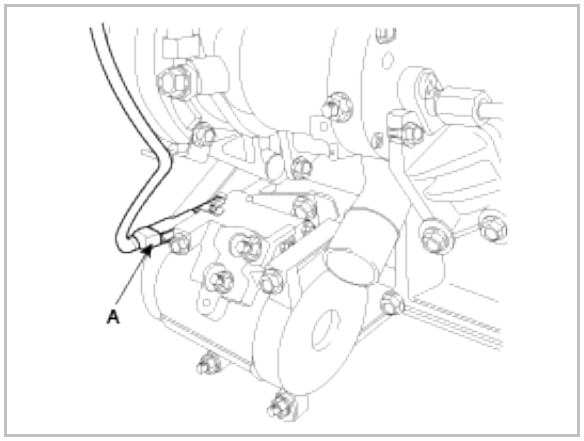
(3) Remove the ground cable(A) from cylinder head.



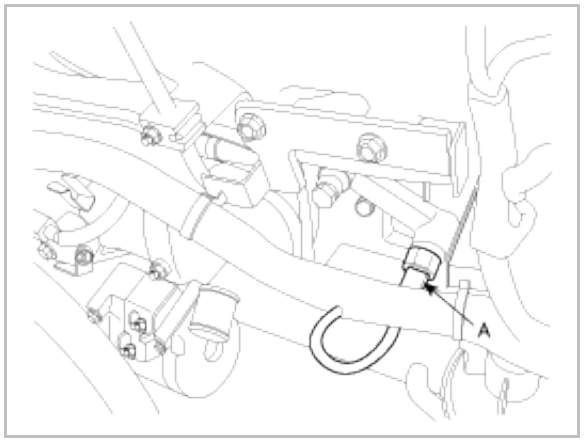
(4) Remove the knock sensor connector (A), high pressure pump fuel hose (B), high pressure pump connector(C).



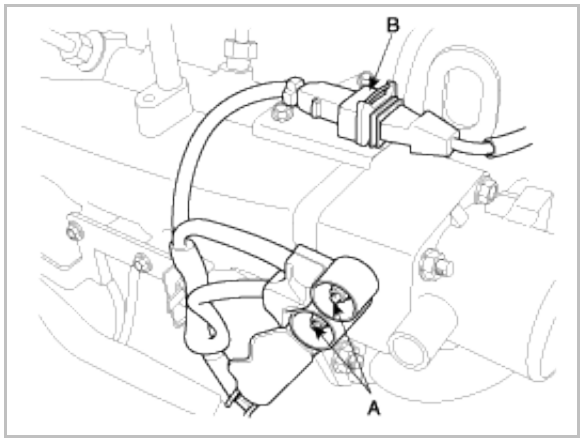
(5) Remove the air conditioner condenser (A).



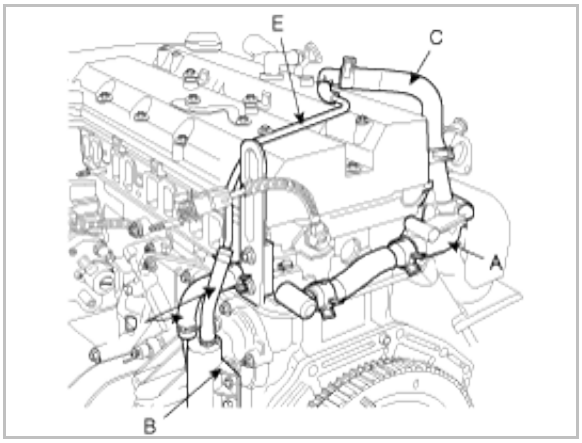
(6) Remove the oil pressure switch connector (A).



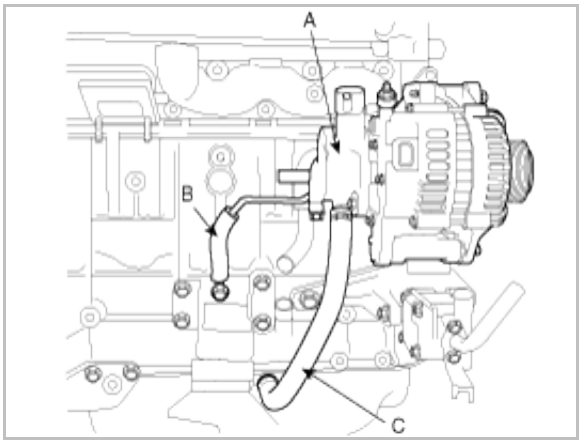
(7) Remove the air heater (A), CMP (Camshaft Position Sensor) connector (B).



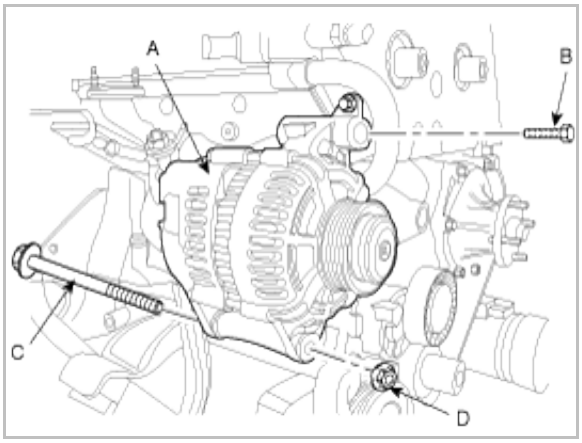
9. Remove the injection pipe, injector. (Refer to FL- injector.)
10. Remove the exhaust manifold.
11. Remove the intake manifold.
12. Remove the timing belt.
13. Remove the hose(C, D) and pipe (E) from. the ventilation housing(A) and the air separator(B).



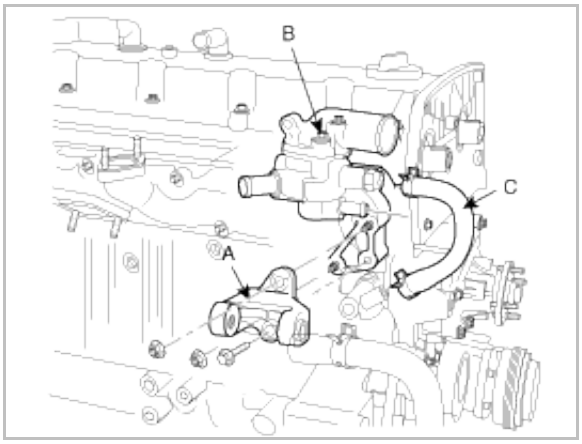
14. Remove the oil pipe (B) and hose(C) from the generator vacuum pump (A).



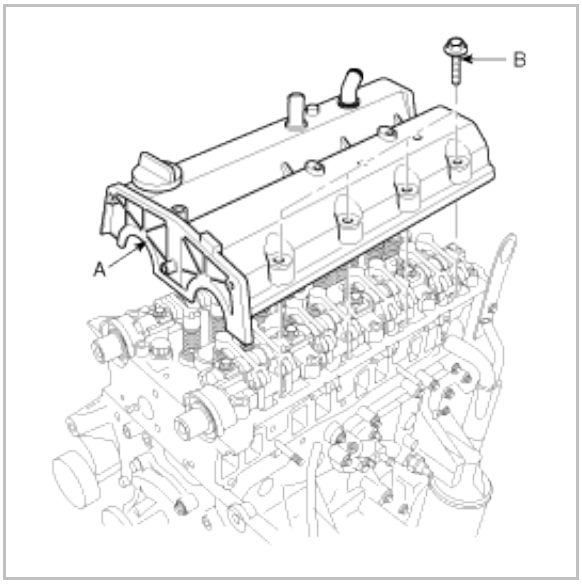
15. Remove the generator fixing bolts(B,C), nuts(D) and then the generator(A).



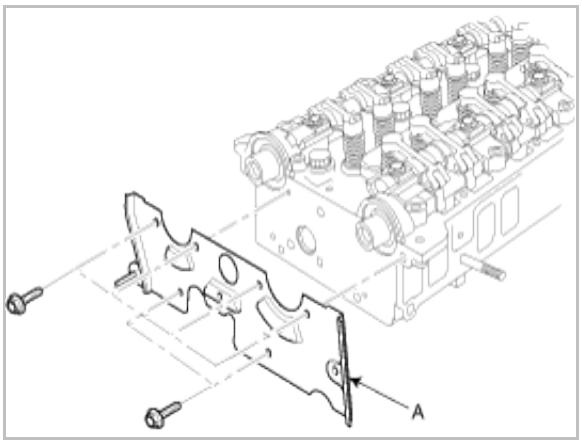
16. After removing the water hose(C) from the thermostat housing (B), remove the generator fixing bracket (A) and the thermostat housing (B).



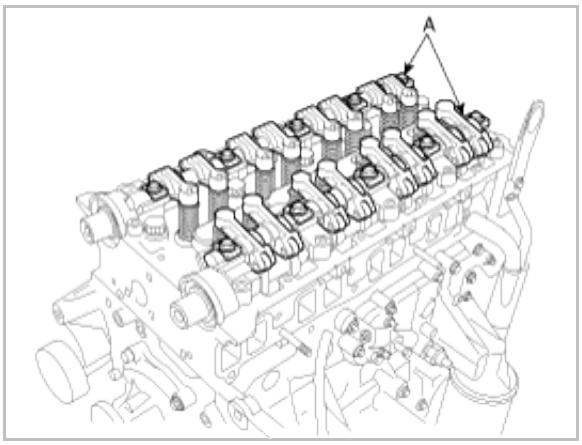
17. Remove the cylinder head cover(A).



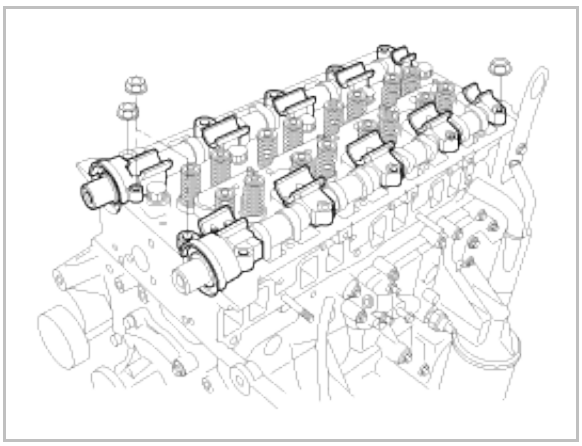
18. Remove the timing belt plate(A).



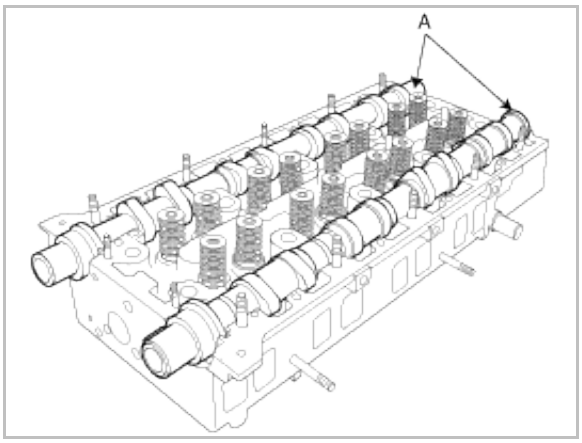
19. Remove the rockerarm shaft(A).



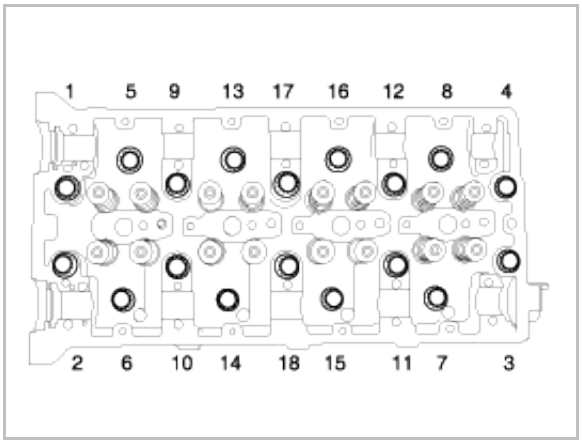
20. Remove the camshaft bearing caps(A).



21. Remove the camshaft(A).



22. Remove the cylinder head bolts, then remove the cylinder head.
(1) Remove the 18 cylinder head bolts, in several steps and the sequence shown below.



CAUTION

Head warpage or cracking could result from removing bolts in an incorrect order.

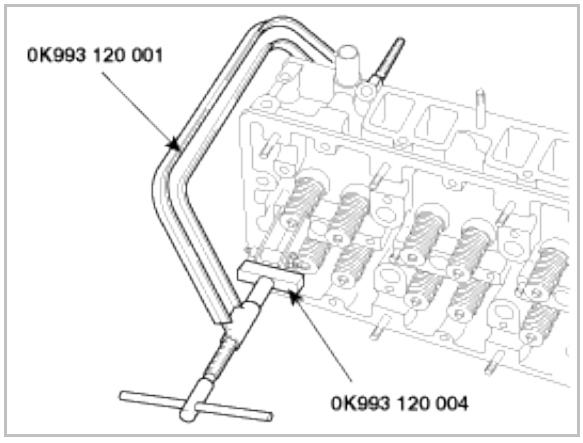
(2) Lift the cylinder head from the dowels on the cylinder block and replace the cylinder head on wooden blocks on a bench.

CAUTION

Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

DISASSEMBLY

1. Remove the valves.
(1) Using the SST (0K9993 120 004, 0K993 120 001), compress the valve spring and remove the retainer lock.



(2) Remove the spring retainer.

(3) Remove the valve spring.

(4) Remove the valve.

(5) Using a needle-nose pliers, remove the oil seal.

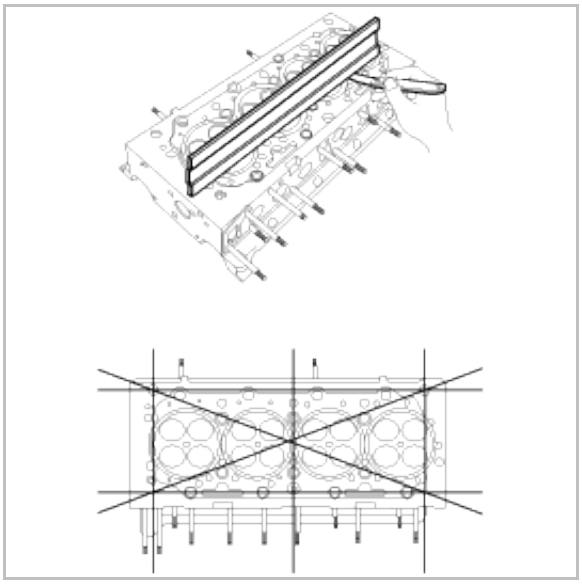
(6) Using a magnetic finger, remove the spring seat.

INSPECTION

CYLINDER HEAD

1. Inspect for flatness.
   Using a precision straight edge and feeler gauge, measure the surface the contacting the cylinder block and the manifolds for warpage.

Flatness of cylinder head gasket surface
Less than 0.05mm (0.0020in)
Flatness of manifold mating surface
Less than 0.15mm (0.0059in)

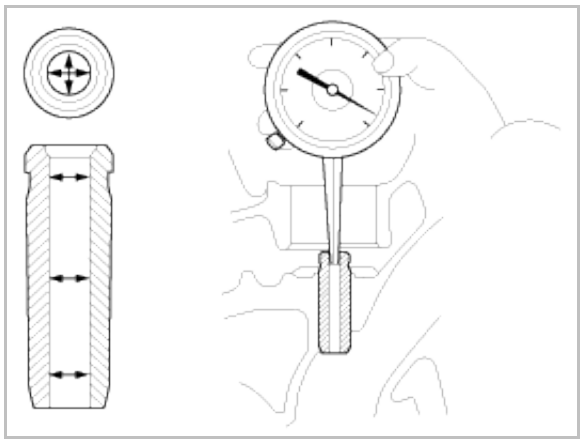


2. Inspect for cracks.
   Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

VALVE AND VALVE SPRING

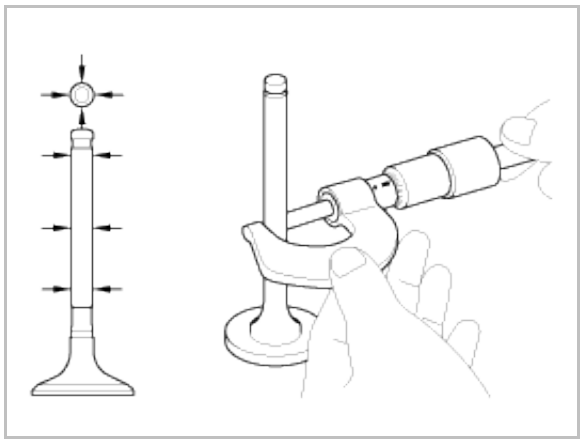
1. Inspect the valve stems and valve guides.
   (1) Using a caliper gauge, measure the innner diameter of valve guide.

Valve guide inner diameter :
7.010~7.030mm (0.2760~0.2768in)



(2) Using a micrometer, measure the outer diameter of valve stem.

Valve stem outer diameter
Intake : 6.965~6.980mm (0.2742~0.2748in)
Exhaust : 6.945~6.960mm (0.2734~0.2740in)



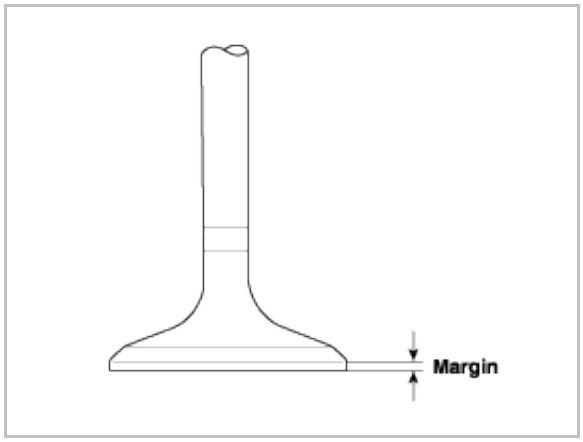
(3) Subtract the valve stem outer diameter measurement from the valve guide innner diameter measurement.

Valve stem- to-guide clearance
Intake : 0.030 ~ 0.065mm (0.0012 ~ 0.0026in)
Exhaust : 0.050 ~ 0.085mm (0.0020 ~ 0.0033in)

If the clearance is greater than maximum, replace the valve and valve guide.

2. Inspect the valves.
(1) Check the valve is ground to the correct valve face angle.
(2) Check that the surface of valve for wear.
If the valve face is worn, replace the valve.
(3) Check the valve head margin thickness.
If the margin thickness is less than minimum, replace the valve.

Margin
Intake : 1.7mm (0.0669in)
Exhaust : 1.6mm (0.0630in)

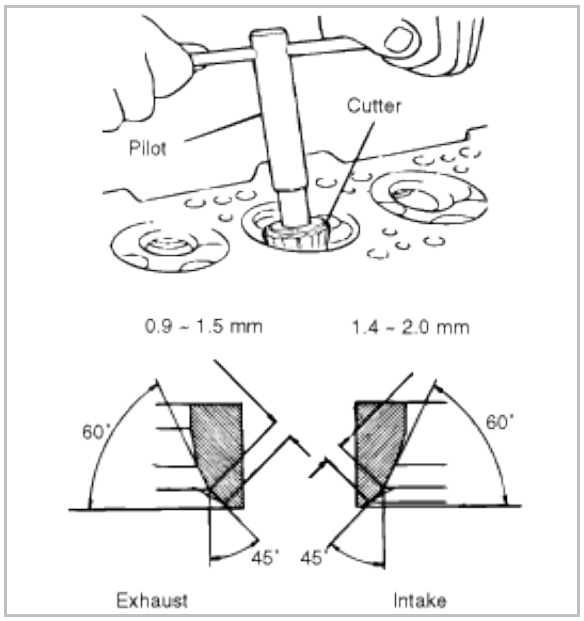


(4) Check the surface of valve stem tip for wear.
If the valve stem tip is worn, replace the valve.

3. Inspect the valve seats.
(1) Check the valve seat for evidence of overheating and improper contact with the valve face.
Replace the seat if necessary.
(2) Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then

recondition the seat.

(3) Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within

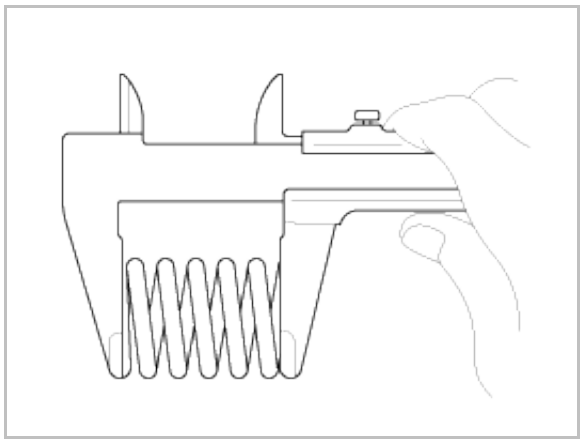


4. Inspect the valve springs.

(1) Using a steel square, measure the out-of-square of valve spring.

(2) Using a vernier calipers, measure the free length of valve spring.

Valve spring
Free height : 52.477mm (2.0660in)
Installed load: 51.7±4.1kg/40.0mm(41.4±2.0lb/1.5748in)
Compressed load:86.3±6.9kg/31.65mm(41.4±2.0lb/1.2461in) (Intake)
86.9±6.9kg/31.50mm(41.4±2.0lb/1.2402in) (Exhaust)
Out of square : Less than 2°

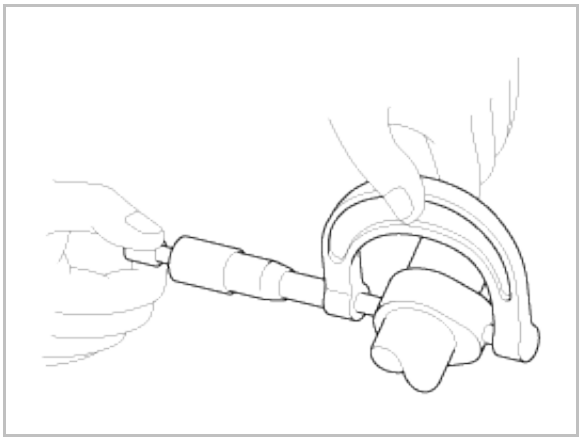


If the loads is not as specified, replace the valve spring.

CAMSHAFT

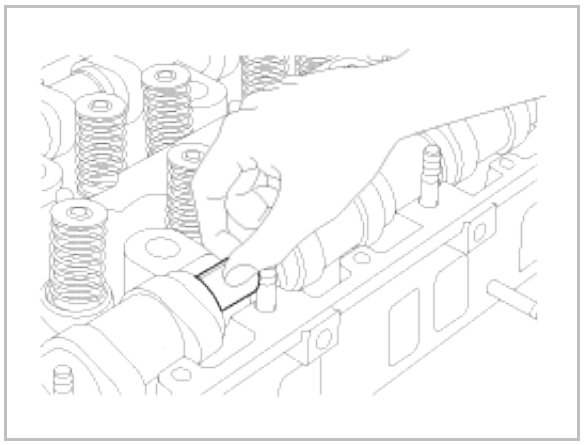
1. Inspect the cam lobes.
Using a micrometer, measure the cam lobe height.

Cam height
Intake : 39.397~39.597mm (1.5511~1.5589in)
Exhaust : 39.4932~39.6932mm (1.5548~1.5627in)



If the cam lobe height is less than minimum, replace the camshaft.

2. Inspect the camshaft journal clearance.
   (1) Clean the bearing caps and camshaft journals.
   (2) Place the camshafts on the cylinder head.
   (3) Lay a strip of plastigage across each of the camshaft journal.

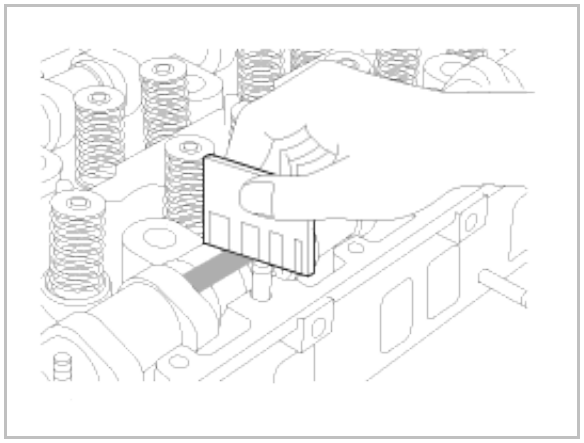


   (4) Install the bearing caps and tighten the bolts with specified torque.

> **CAUTION**
>
> Do not turn the camshaft.

   (5) Remove the bearing caps.
   (6) Measure the plastigage at its widest point.

Bearing oil clearance
Standard : 0.040 ~ 0.080mm (0.0016 ~ 0.0031in)



If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

(7) Completely remove the plastigage.

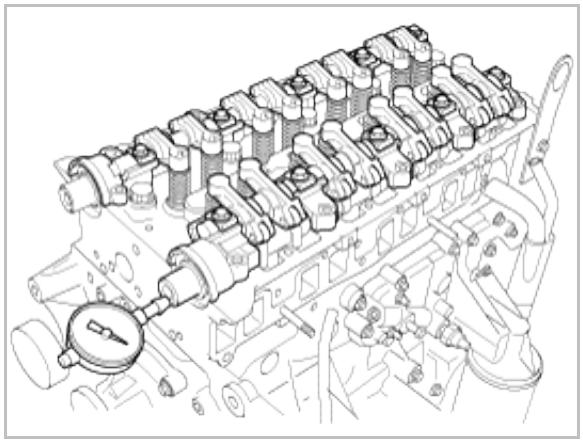
(8) Remove the camshafts.

3. Inspect the camshaft end play.

(1) Install the camshafts.

(2) Using a dial indicator, measure the end play while moving the camshaft back and forth.

Camshaft end play
Standard : 0.08 ~ 0.17mm (0.0031 ~ 0.0067in)



If the end play is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

(3) Remove the camshafts.

Rockerarm and rockerarm shaft

1. Inspect the rockerarm and rockerarm shaft.

(1) Measure the inner diameter of the rocker arm, using a caliper gauge.

Rockerarm inner diameter
20.000~20.027mm (0.7874~0.7885in)

(2) Measure the inner diameter of the rocker arm, using a micro meter.

Rockerarm shaft outer diameter
19.959~19.980mm (0.7858~0.7866in)

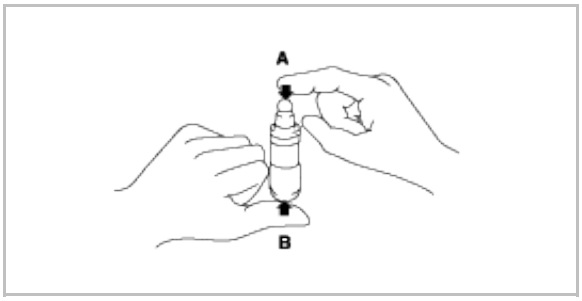
Calculate the clearance between the rocker arm and the rocker arm shaft by the difference between the inner and outer diameter of the rocker arm.

Rockerarm and rockerarm shaft clearance
0.020~0.068mm (0.0008~0.0027in)
Rockerarm shaft outer diameter
19.959~19.980mm (0.7858~0.7866in)

If the clearance is out of the specification above, replace the rocker arm and rocker arm shaft.

HLA (HYDRAULIC LASH ADJUSTER)

Sieze the 'A' part of the HLA filled with engine oil. If it is moved when pushed the 'B' part by hand, replace it.



Problem	Possible cause	Action
Temporary noise when startinga cold engine	Normal	This noise will disappear afterthe oil in the engine reachesthe normal pressure.
Continuous noise when theengine is started after parkingmore than 48 hours.	Oil leakage of the high pressurechamber on the HLA, allowingair to get in.	Noise will disappear within 15minutes when engine runs at2,000~3,000 rpm.If it doesn'tdisappear, refer to step 7 below. **CAUTION** Do not run engine at a speed higher than 3,000 rpm, as this may damage the HLA.
Continuous noise when theengine is first started afterrebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.	
Continuous noise when theengine is started after excessively cranking the engine by the starter motor.	Oil leakage of the high-pressure chamber in the HLA, allowing air to get in. Insufficient oil in the HLA.	
Continuous noise when the engine is running after changing the HLA.		
Continuous noise during idleafter high engine speed.	Engine oil level too high or too low.	Check oil level. Drain or add oil as necessary.
	Excessive amount of air in theoil at high engine speed.	Check oil supply system
Noise continues for morethan 15 minutes.	Deteriorated oil.	Check oil quality. If deteriorated, replace with specified type.
	Low oil pressure	Check oil pressure and oil supplysystem of each part of engine.
	Faulty HLA.	Remove the cylinder head coverand press HLA down by hand.If it moves, replace the HLA. **CAUTION** Be careful with the hot HLAs.

REASSEMBLY

NOTICE

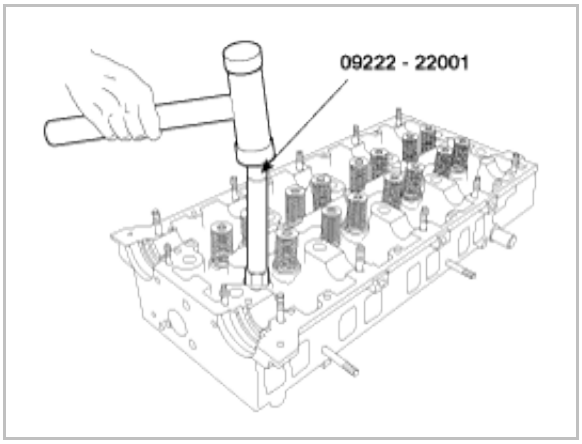
- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surface.
- Replace oil seals with new ones.

1. Install the valves.

(1) Install the spring seats.

(2) Using the SST (09222 - 22001), push in a new oil seal.

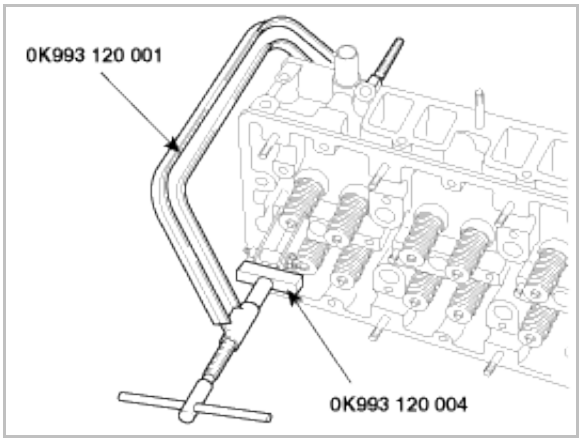
> **NOTICE**
>
> Do not reuse old valve stem oil seals.
> Incorrect installation of the seal could result in oil leakage past the valve guides.



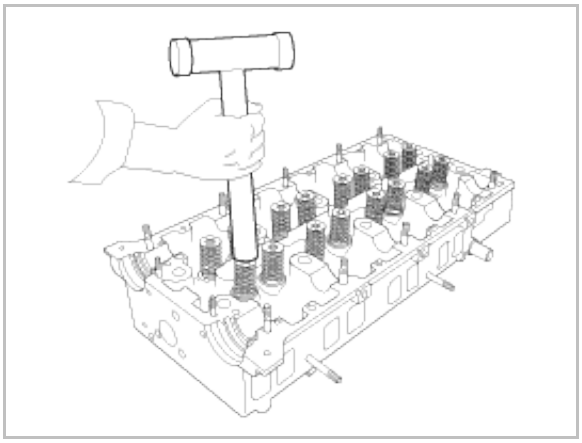
(3) Install the valve, valve spring and spring retainer.

> **NOTICE**
>
> Place the valve springs so that the side coated with enamel faces toward the valve spring retainer and then installs the retainer.

(4) Using the SST(0K993 120 004, 0K993 120 001), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



(5) Lightly tap the end of each valve stem two or three times with the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.



INSTALLATION

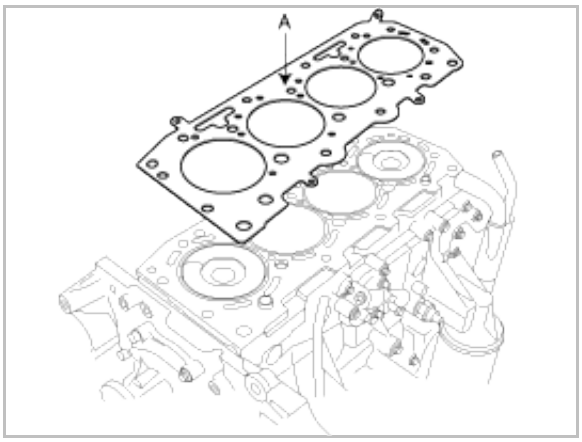
NOTICE

- Thoroughly clean all parts to be assembled.
- Always use a new cylinder head and manifold gasket.
- The cylinder head gasket is a metal gasket. Take care not to bend it.
- Rotating the crankshaft, set the No. 1 piston at TDC.

1. Install the cylinder head gasket(A) on the cylinder block.

NOTICE

Ensure the installation direction.



2. Place the cylinder head quietly in order not to damage the gasket with the bottom part of the end.
3. Install the cylinder head bolts.
   (1) Apply a light coat if engine oil on the threads and under the heads of the cylinder head bolts.

NOTICE

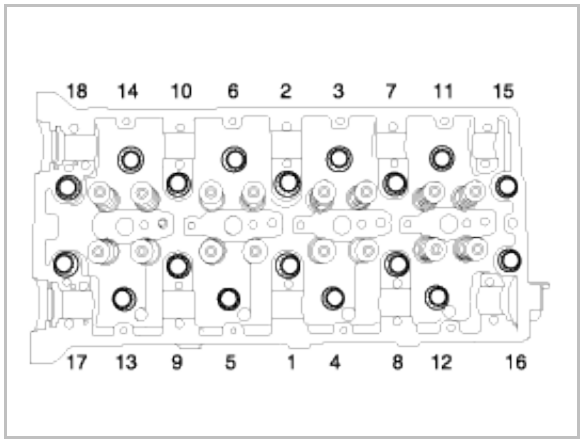
After measuring the length of the cylinder head bolts, replace them, if necessary.
Long bolts : 132mm(5.1968in)
Short bolts :93mm(3.6614in)

   (2) Install and tighten the 18 cylinder head bolts and plate washers, in several passes, in the sequence shown.

Tightening torque :
Long bolts: 39.2Nm (4.0kgf.m, 28.9lb-ft)+ 90° + 120°
Short bolts: 39.2Nm (4.0kgf.m, 28.9lb-ft)+ 90° + 90°

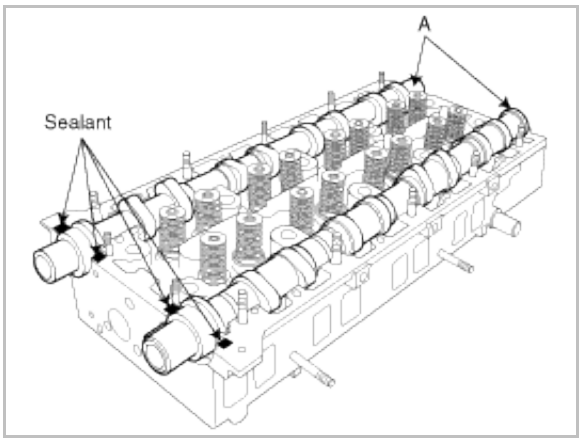
CAUTION

Always use new cylinder head bolts.

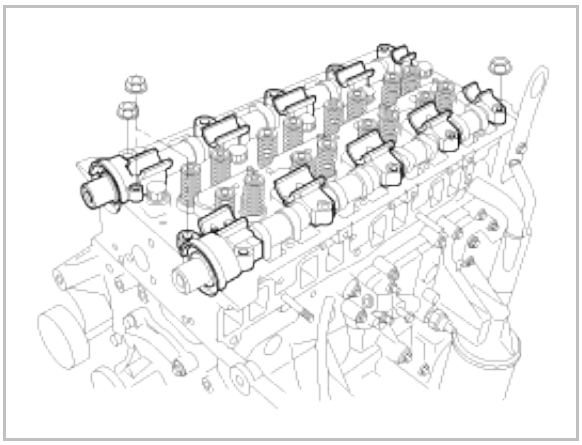


4. Install the camshaft(A) on the cylinder head.

> **CAUTION**
>
> Apply sealant before assembling the front bearing caps
> (LOCTITE NO. 518 or equivalent).



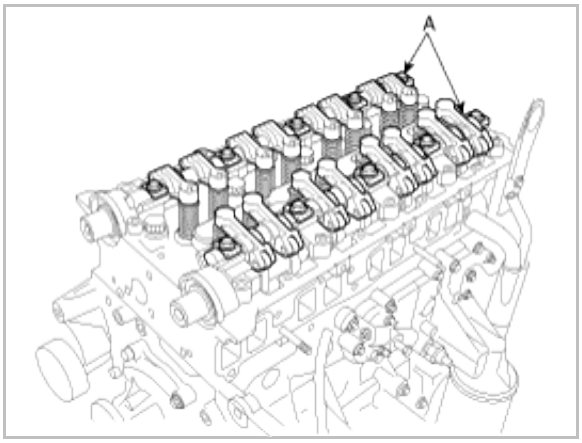
5. Install the bearing caps aligning the cap numbers with the direction of the arrow marks.



6. Install the rockerarm shaft assembly(A) after bearing cap.

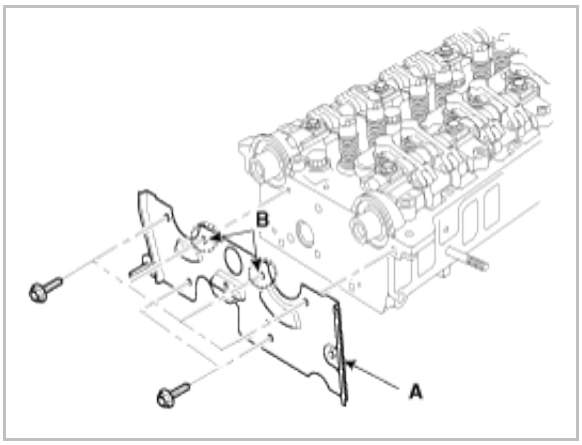
Tightening torque :
Nuts, Bolts: 17.7~26.5Nm (1.8 ~ 2.7kgf.m, 13.0~19.5lb-ft)
Small nuts: 7.8~11.8Nm (0.8 ~ 1.2kgf.m, 5.8~8.7lb-ft)

> **NOTICE**
>
> Distinguish between the intake and the exhaust rocker arm shaft (Intake: yellow, exhaust: black).



7. Install the camshaft oil seal.
8. Install the timing belt plate(A).

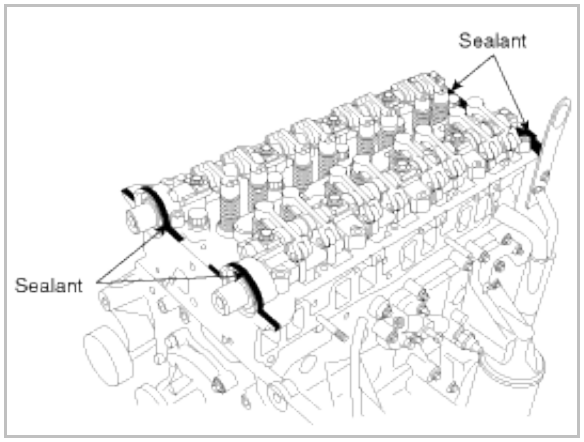
Tightening torque :
7.8 ~ 11.8Nm (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)



CAUTION

When assembling upper plate to the cylinder head assembly, be sure to use including solid sealant bolts at marked 2ea point (B).
An upper plate mounting bolt can not be reused once it is removed and never use normal flange bolt with applying anaerobic or liquid sealant to it. If not, the bolts may be loosened or damaged. In this case, replace them with including solid sealant bolts.

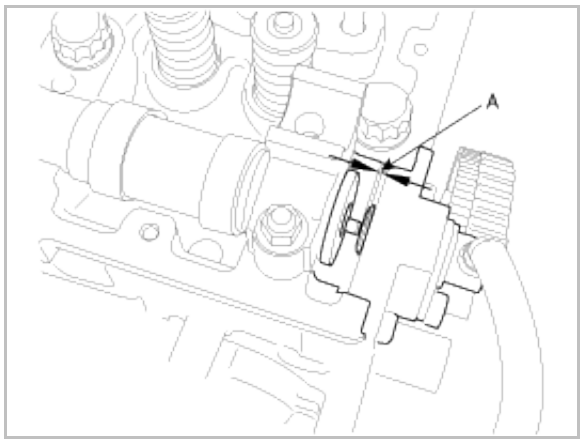
9. Install the cylinder head cover.
   (1) Apply sealant on the cylinder head as shown below.



   (2) Before installing the cylinder head cover, check the clearance (A) between dowel pin on the edge of the camshaft and the phase sensor.

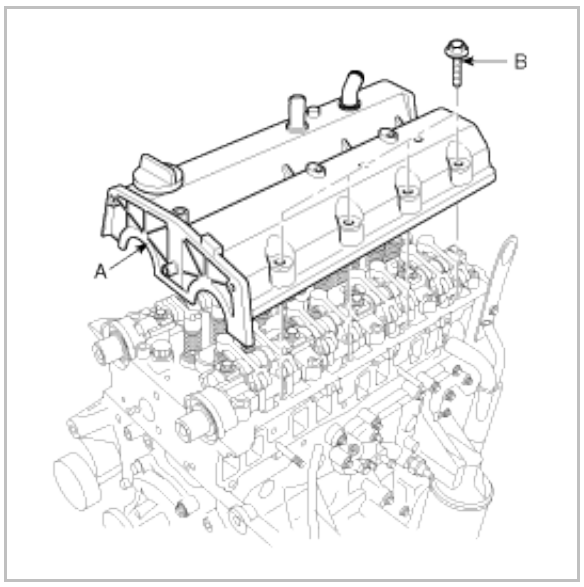
Clearance (A) :

0.5 ~ 1.5mm (0.0197 ~ 0.0591in.)



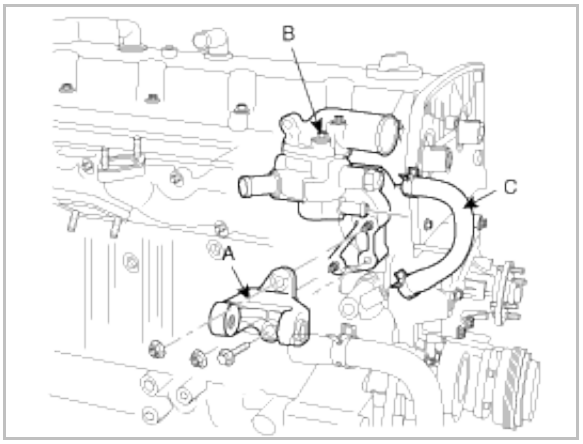
(3) Install the cover (A) to the cylinder head after the gasket.

Tightening torque :
8.8~10.8Nm (0.9~1.1kgf.m, 6.5~8.0lb-ft)



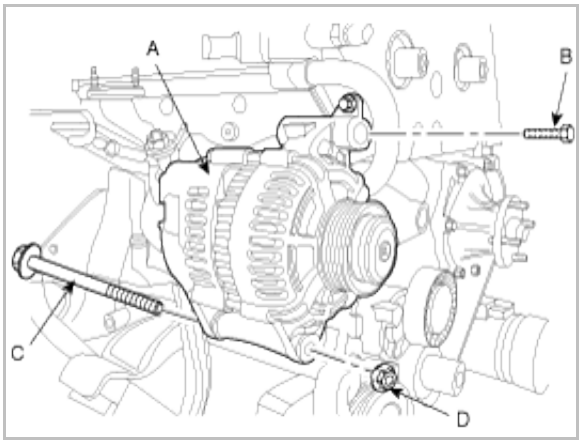
10. Install the thermostat housing (B), the generator fixing bracket (A), and the water hose(C).

Tightening torque :
18.6~27.5Nm (1.9~2.8kgf.m, 13.7~20.3lb-ft)



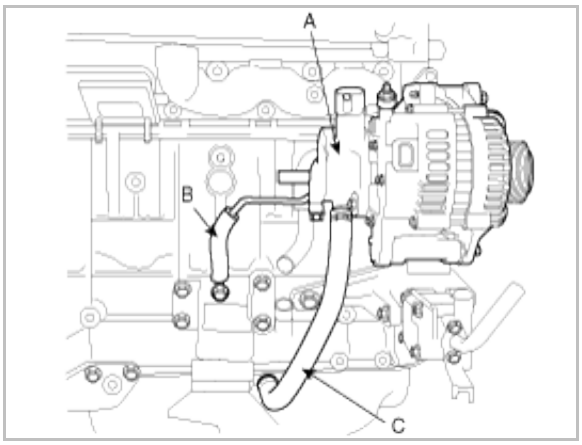
11. Install the generator(A) with the fixing bolts(B,C), nut(D).

Tightening torque :
38.2~58.8Nm (3.9~6.0kgf.m, 28.2~43.4lb-ft)

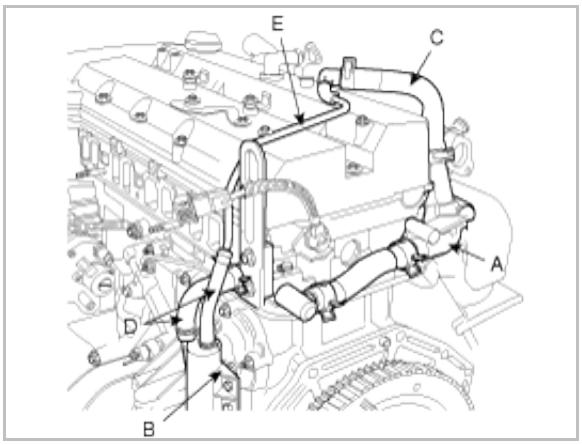


12. Install the oil pipe(B), hose(C) to generator pressure pump(A).

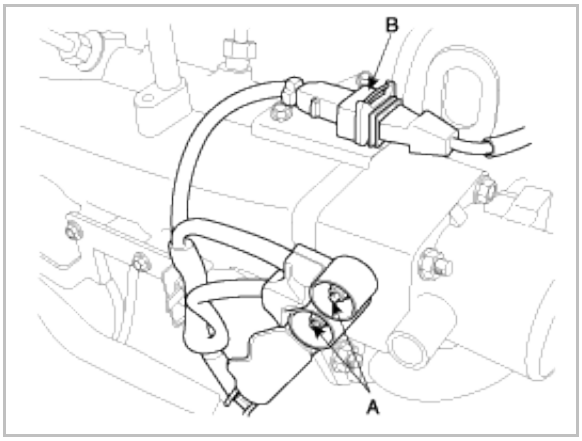
Oil pipe eyd bolt
Tightening torque :
19.6~24.5Nm (2.0~2.5kgf.m, 14.5~18.1lb-ft)



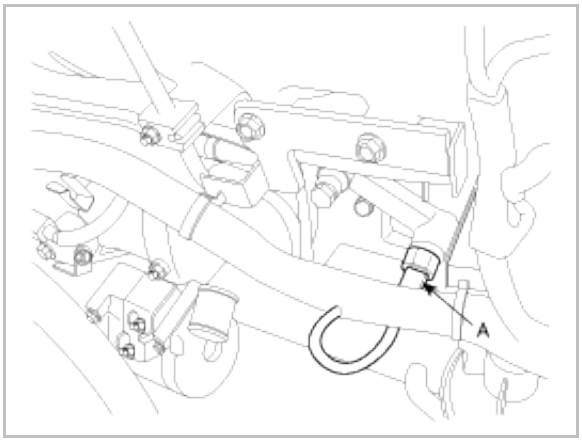
13. Install the hose(C,D) and the pipe(E) to the ventilation housing(A) and the air separator(B).



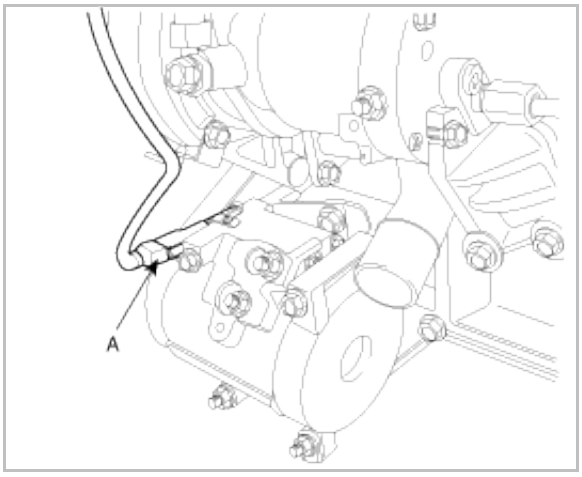
14. Install the timing belt.
15. Install the intake manifold.
16. Install the exhaust manifold.
17. Install the injection pipe, injector. (Refer to FL- injector.)
18. Install the wire harness and the clamp to the cylinder head and the intake manifold.
    (1) Install the air heater(A), CMP (Camshaft Position Sensor) connector(B).



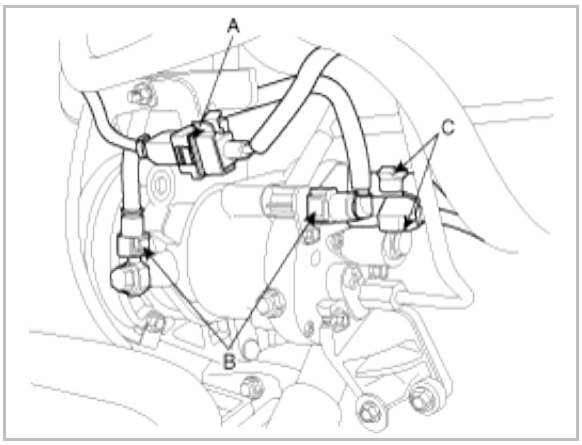
(2) Install the oil pressure switch connector(A).



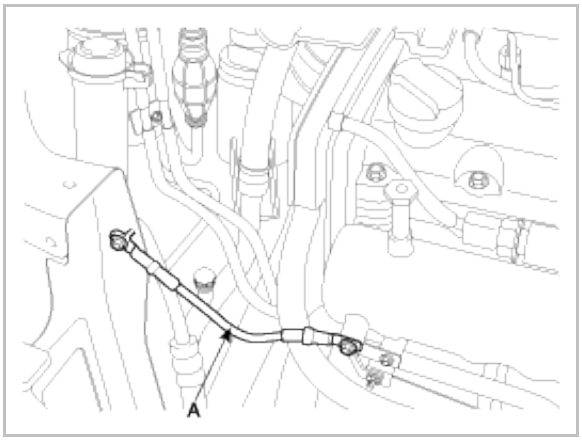
(3) Install the air conditioner condenser(A).



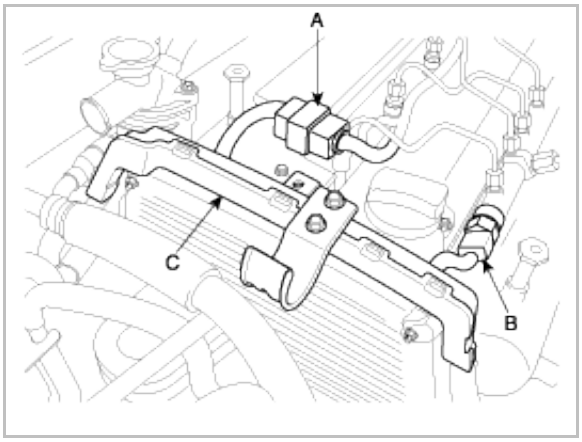
(4) Install the knock sensor connector(A), high pressure pump fuel hose(B), high pressure pump connector(C).



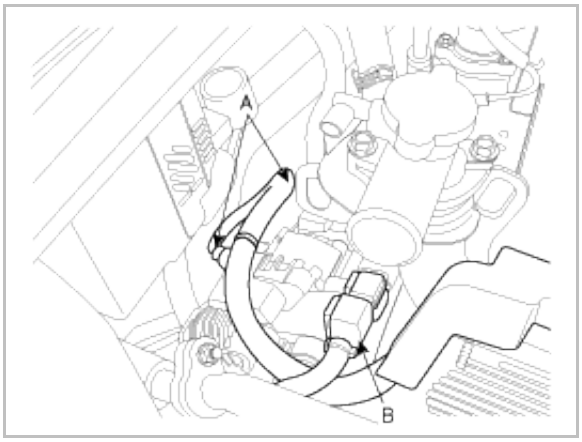
(5) Install the ground cable(A) from cylinder head.



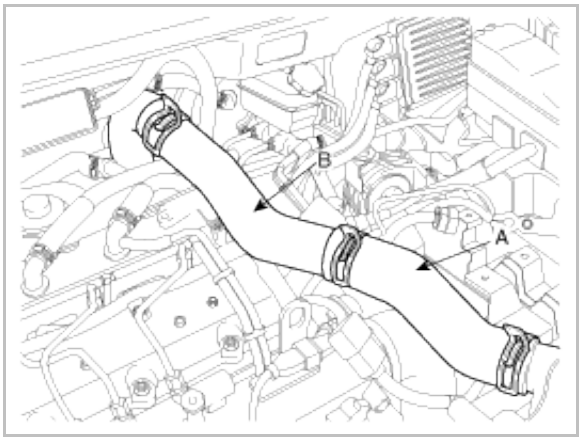
(6) Install the injector connector(A), common rail pressure sensor connector(B), wire harness protector(C).

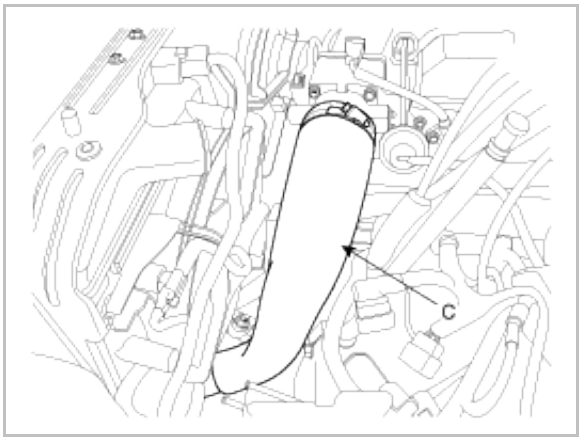


(7) Install the generator connector(A) and the ETC(Engine Coolant Temperature) sensor connector(B).

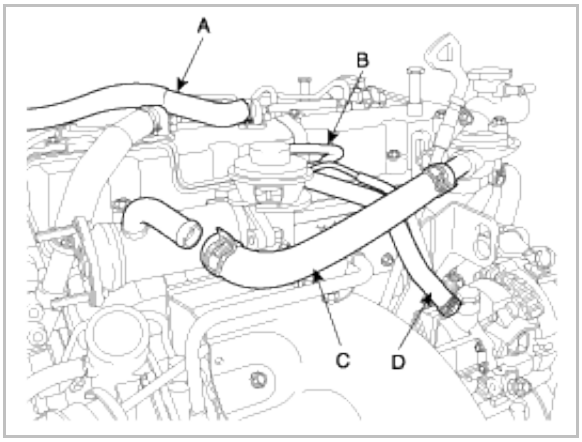


19. Install the intercooler hose(A,C), pipe(B).

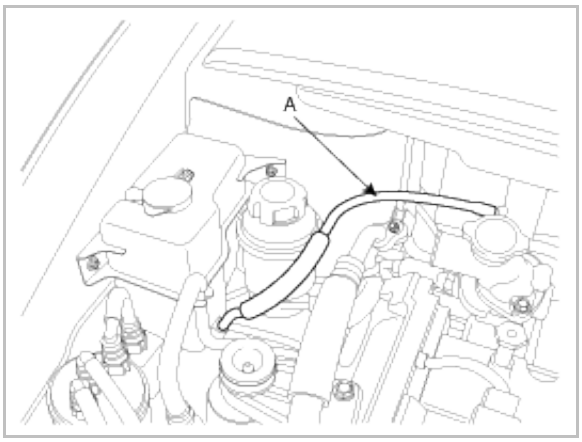




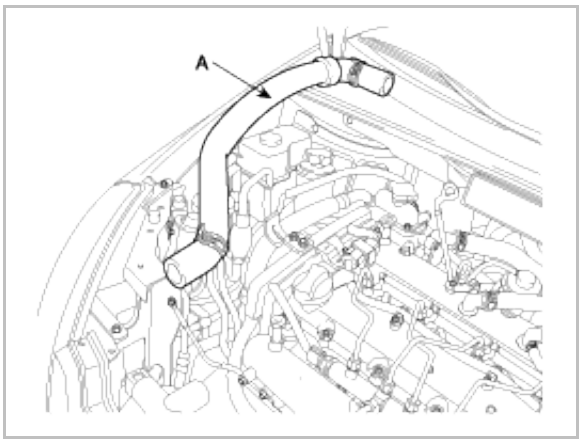
20. Install the PCV(Positive Crankcase Ventilation) hose(A), EGR valve vacuum hose(B), EGR cooler water hose(C), pump vacuum oil hose(D).



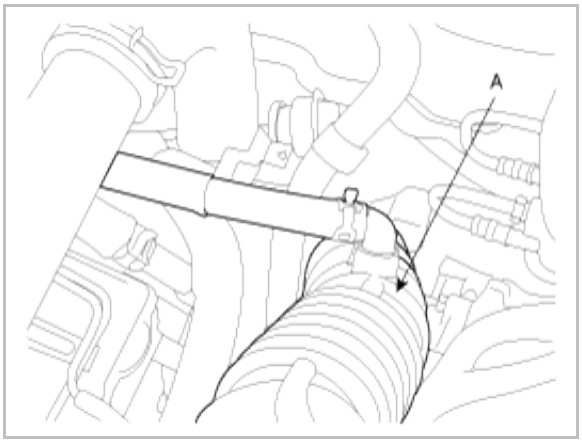
21. Install the reservoir tank hose(A).



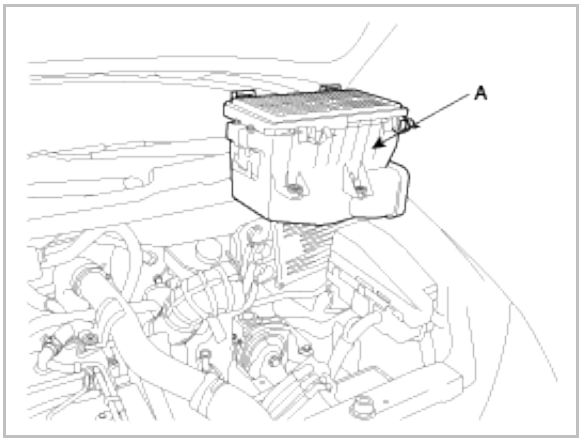
22. Install the radiator upper hose(A).



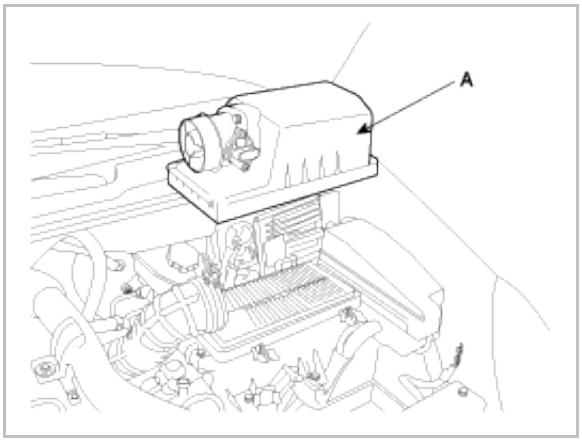
23. Install the intake air hose and air cleaner assembly.
    (1) Install the air intake hose(A).



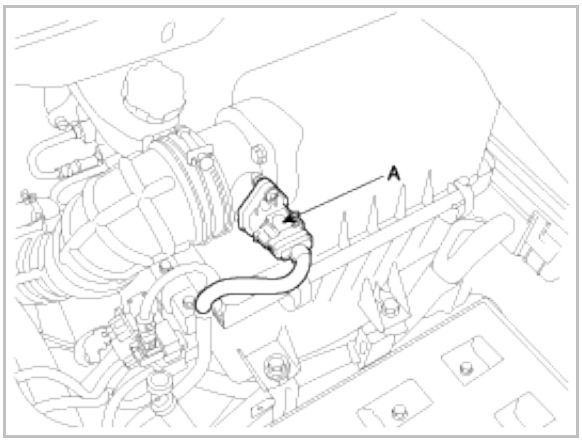
(2) Install the air cleaner assembly(A).



(3) Install the air cleaner upper cover(A).

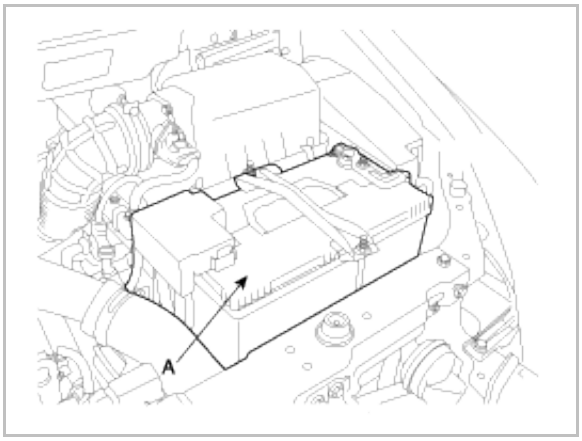


(4) Install the AFS(Air Flow Sensor) connector(A).



24. Fill with engine coolant.

25. Install the battery(A).



26. Start engine and check for leaks.
27. Check the engine coolant and engine oil level.

KIA MOTORS

Engine Mechanical System

Engine And Transaxle Assembly

REMOVAL

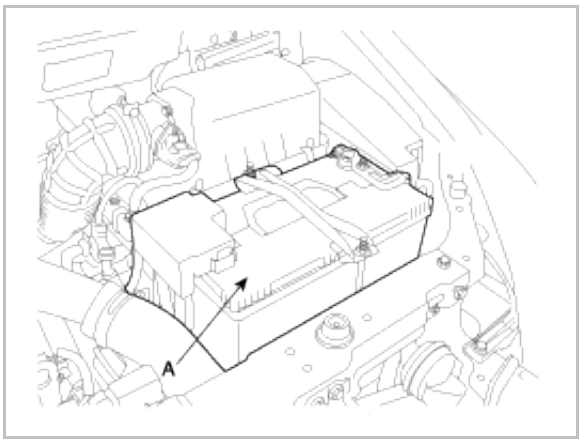
CAUTION

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

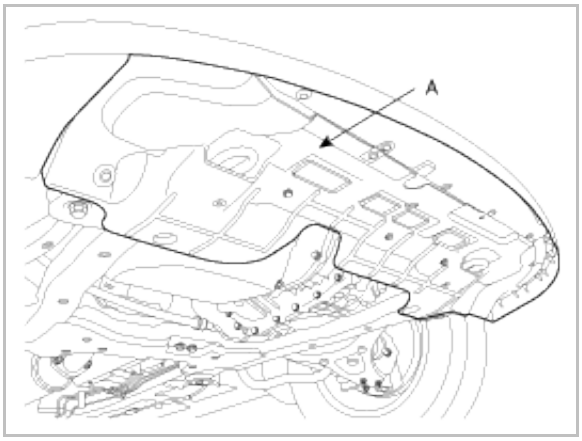
NOTICE

- Mark all wiring and hoses to avoid misconnection.

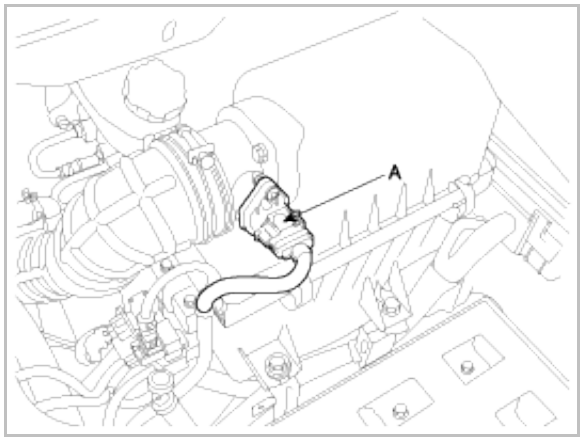
1. Remove the battery(A).



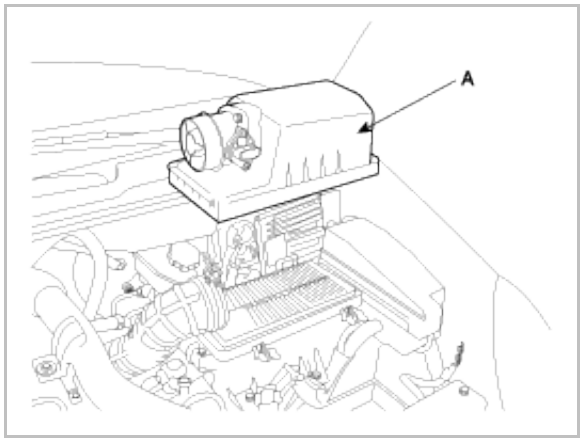
2. Remove the under cover(A).



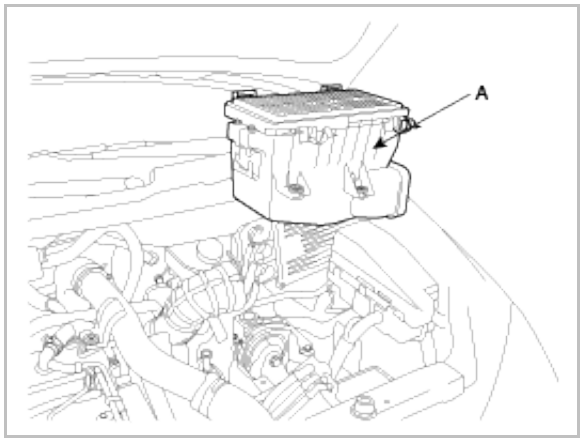
3. Drain the engine coolant.
   Remove the radiator cap to speed draining.
4. Drain the engine oil.
   Remove the oil filler cap to speed draining.
5. Remove the intake air hose and air cleaner assembly.
   (1) Disconnect the AFS(Air Flow Sensor) connector(A).



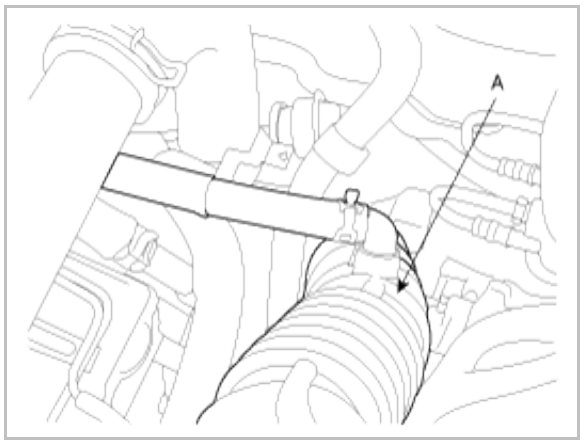
(2) Disconnect the air cleaner upper cover(A).



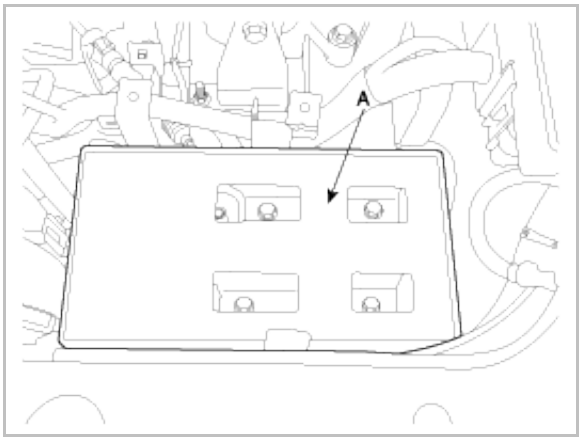
(3) Remove the air cleaner assembly(A).



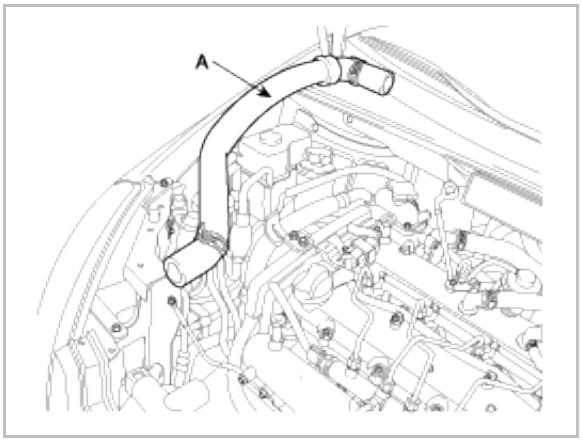
(4) Remove the air intake hose(A).



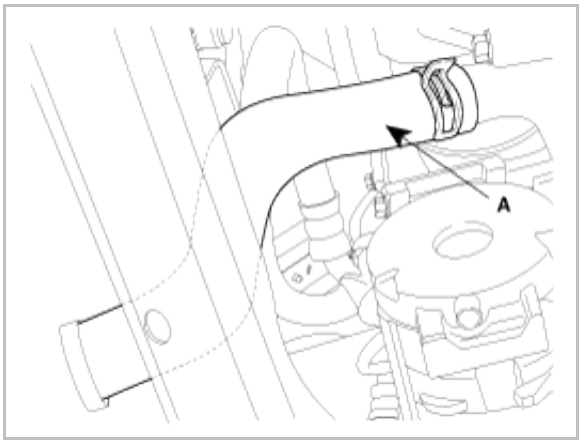
6. Remove the batter tray(A).



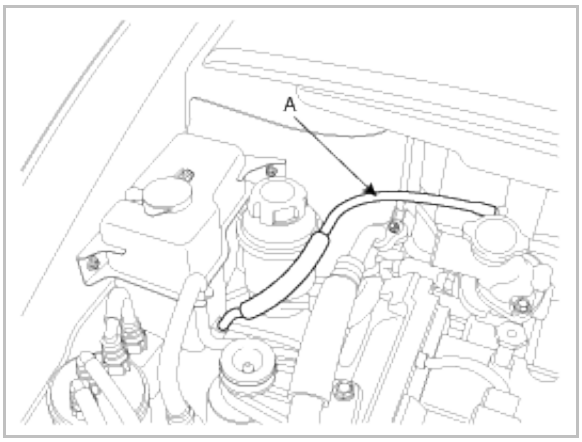
7. Remove the radiator upper hose(A).



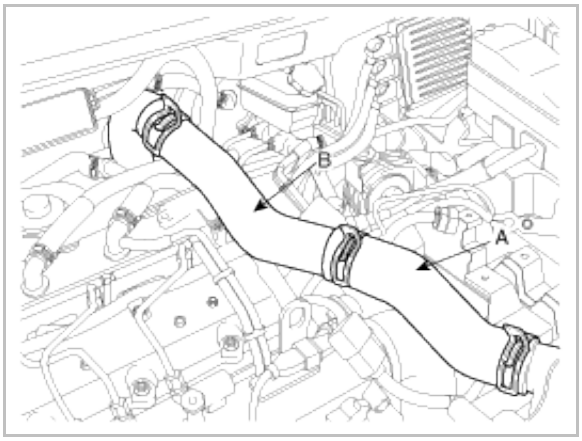
8. Remove the radiator lower hose(A).

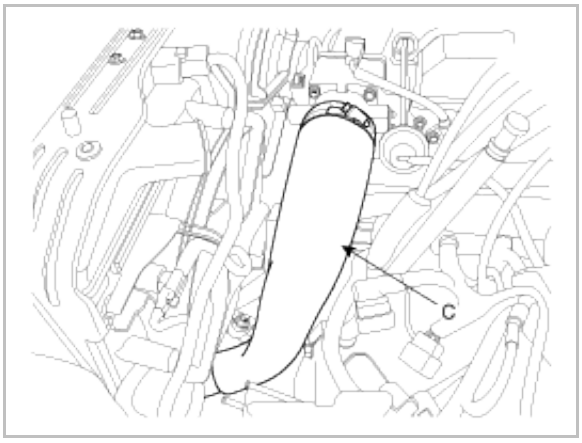


9. Remove the reservoir tank hose(A).

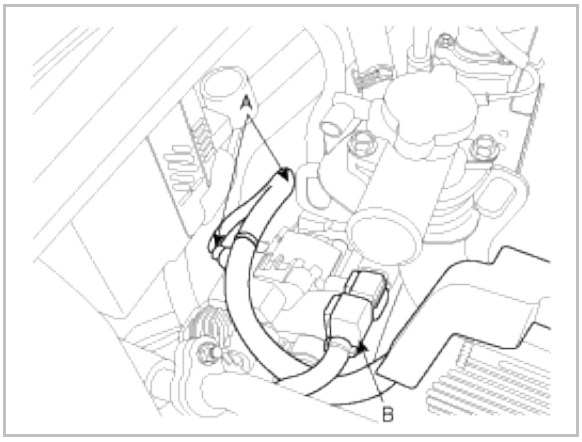


10. Remove the intercooler hose(A,C), pipe(B).

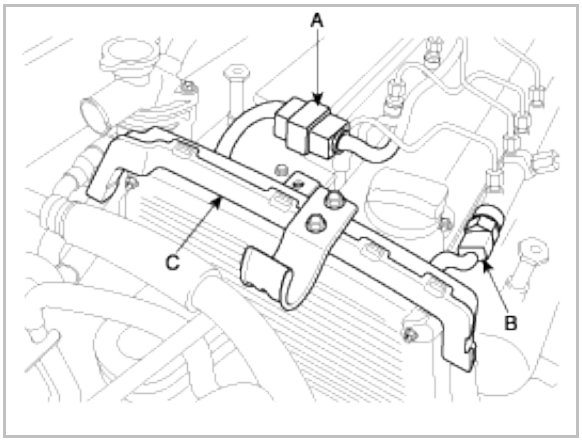




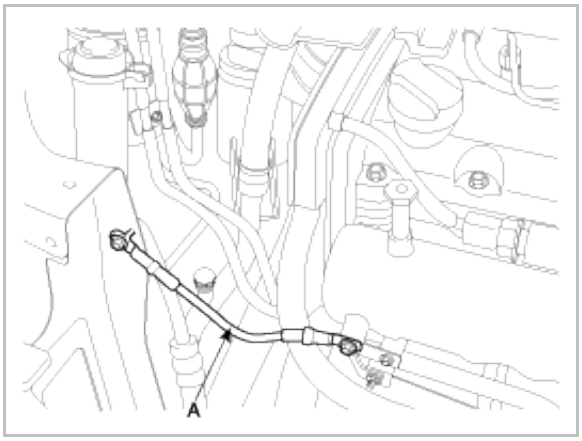
11. Remove the wire harness and the clamp from the cylinder head and the intake manifold.
    (1) Remove the generator connector(A) and the ETC(Engine Coolant Temperature) sensor connector(B).



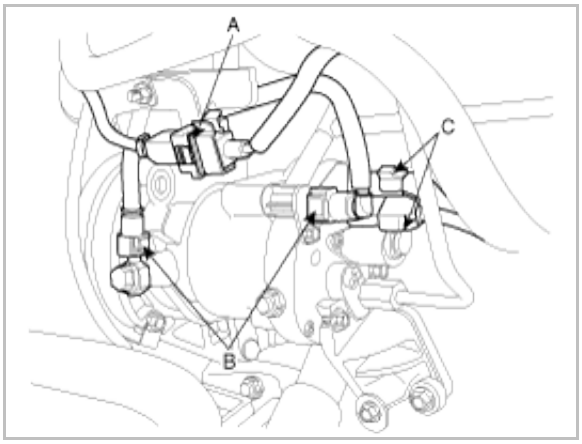
    (2) Remove the injector connector(A), common rail pressure sensor connector(B), wire harness protector(C).



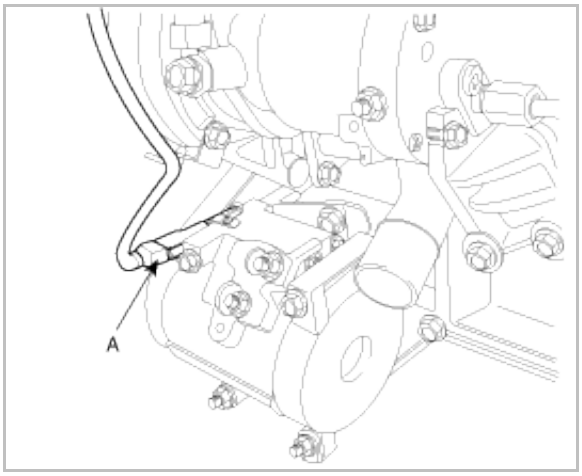
    (3) Remove the ground cable(A) from cylinder head.



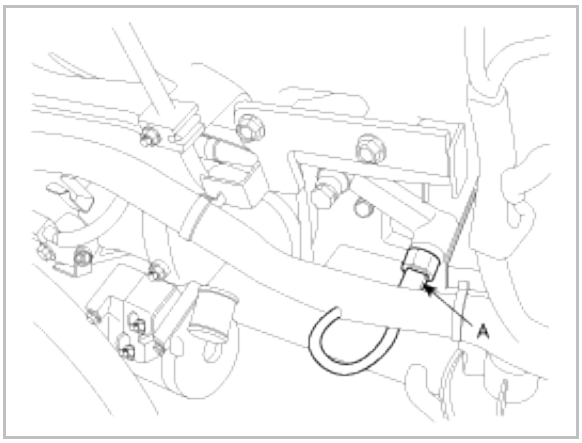
(4) Remove the knock sensor connector(A), high pressure pump fuel hose(B), high pressure pump connector(C).



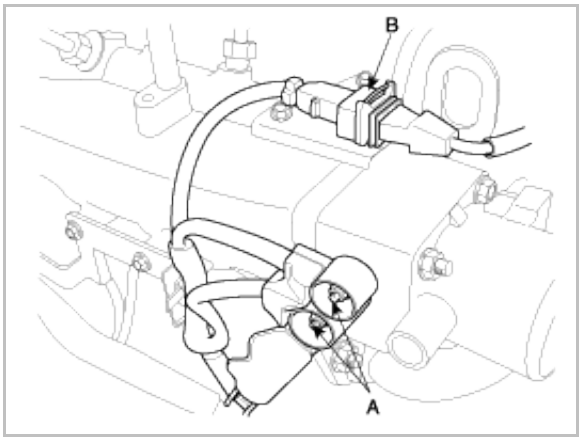
(5) Remove the air conditioner condenser(A).



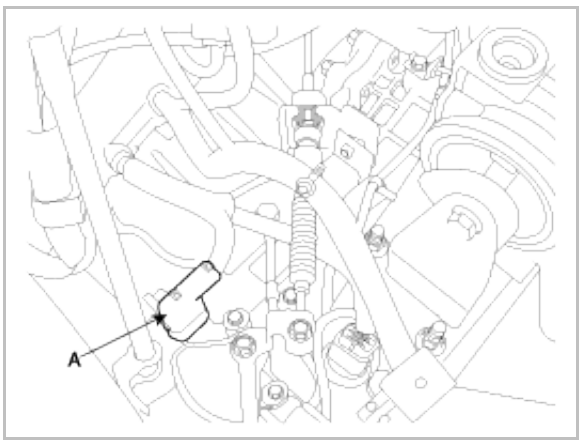
(6) Remove the oil pressure switch connector(A).



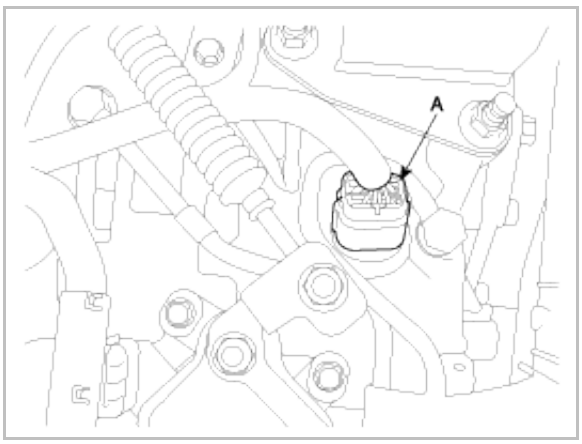
(7) Remove the air heater(A), CMP (Camshaft Position Sensor) connector(B).



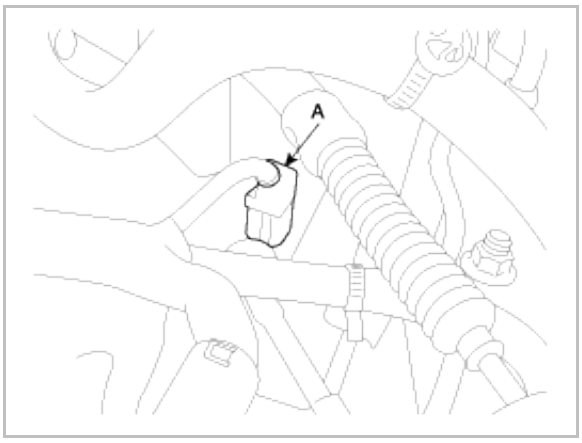
12. Remove the transaxle wire harness connectors and control cable.
    (1) Remove the inhibitor switch connector(A).



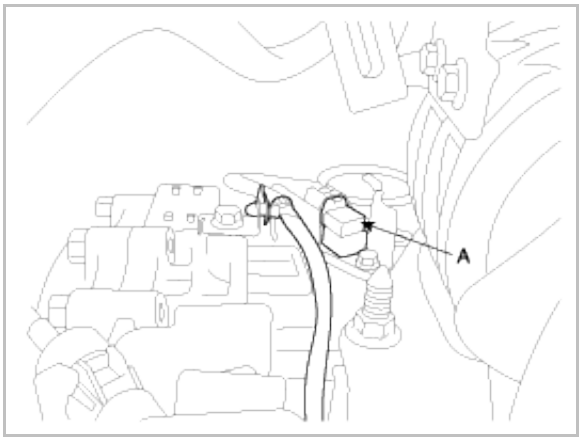
    (2) Remove the solenoid valve connector(A).



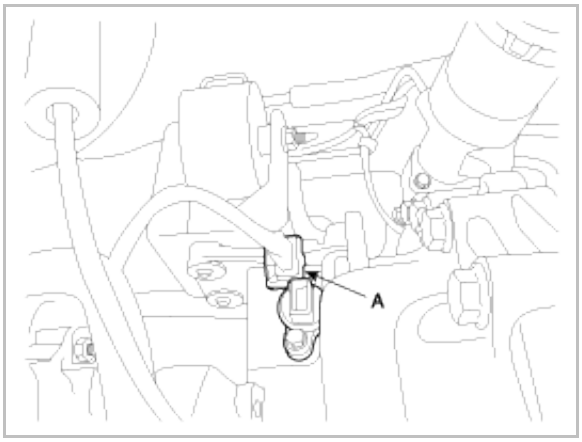
    (3) Remove the input shaft speed sensor connector(A).



    (4) Remove the output shaft speed sensor connector(A).

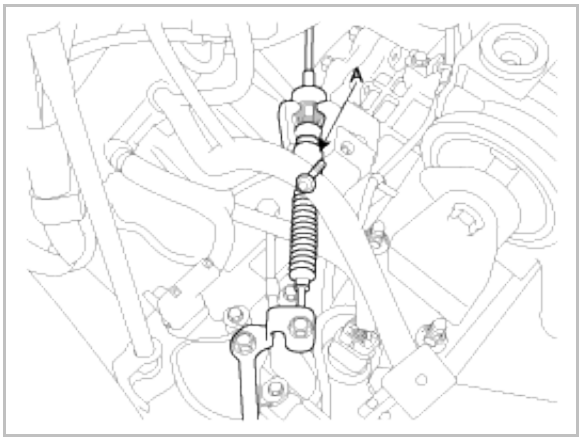


(5) Remove the vehicle speed sensor connector(A).

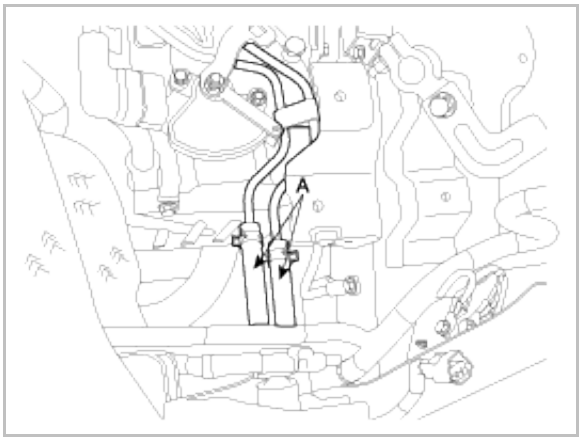


(6) Remove the CKP(Crankshaft position sensor) connector(A).

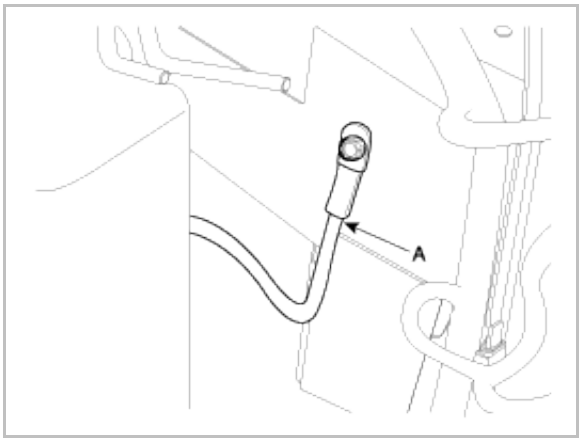
13. Remove the shift cable(A).



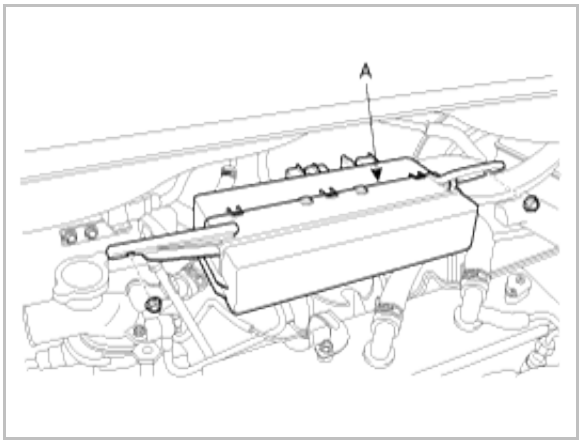
14. Remove the transaxle oil cooler hoses(A).



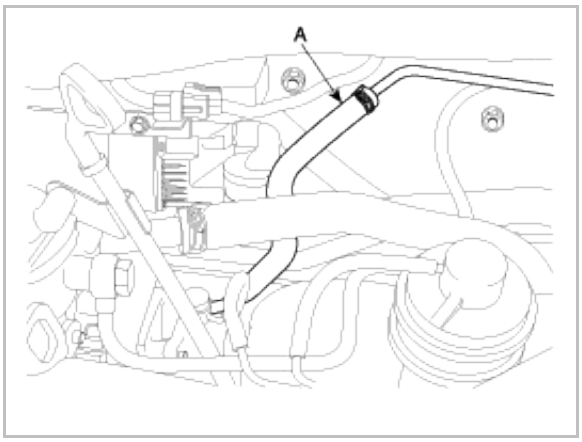
15. Remove the ground cable(A) from transaxle.



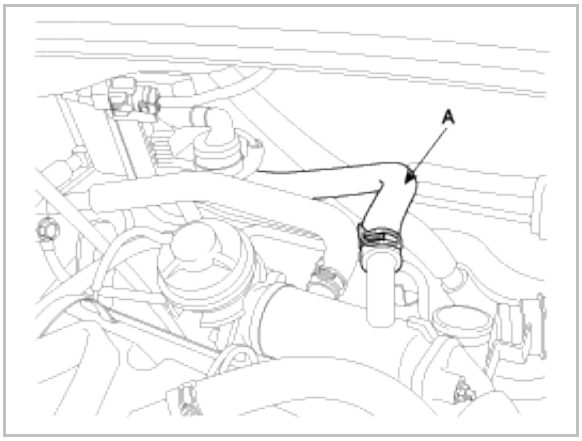
16. Remove the fuse box.(A).

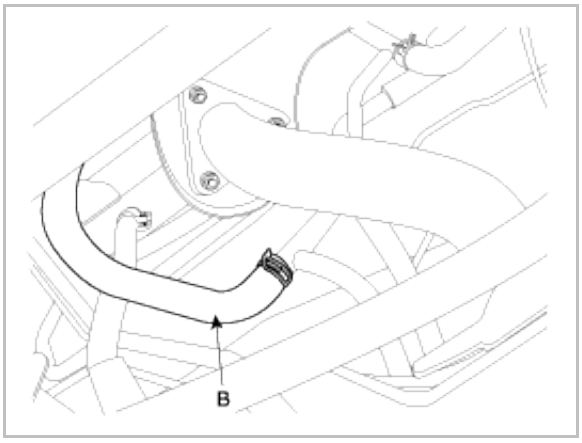


17. Remove the vacuum hose (A) from the generator.

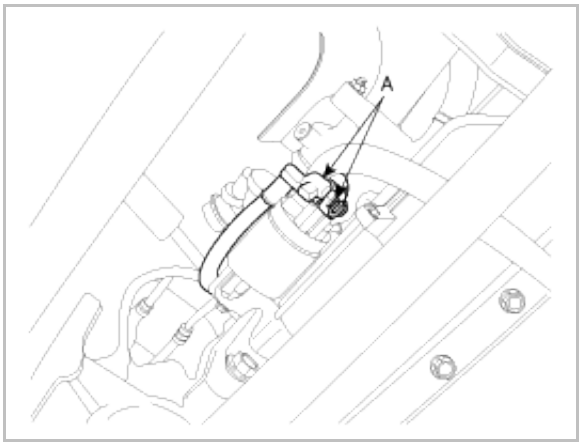


18. Remove the heater hose(A,B).



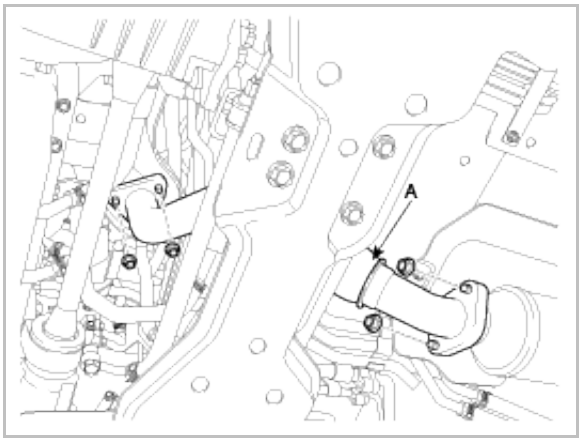


19. Remove the starter motor connector(A).

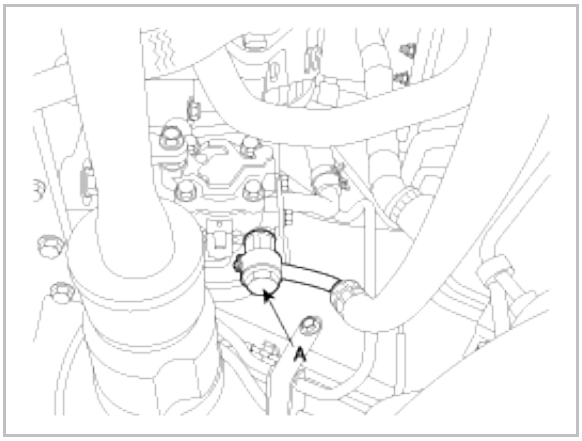


20. Remove the front exhaust manifold(A).

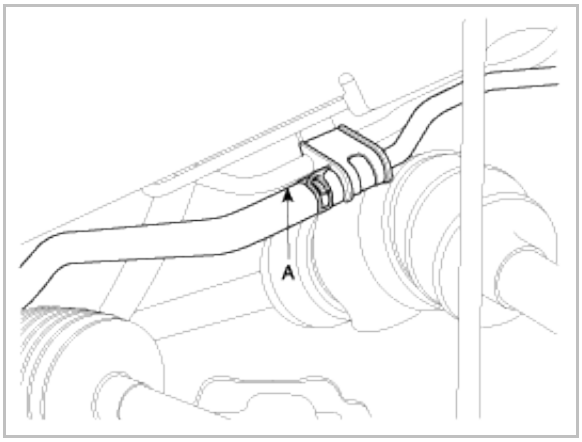
Tightening torque :
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



21. Remove the power steering pump bolt(A).

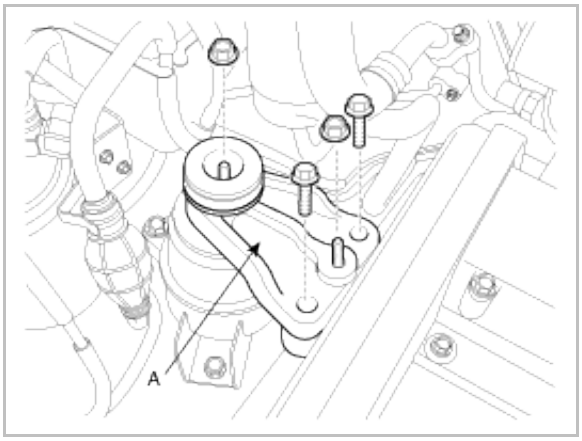


22. Remove the power steering return hose(A).



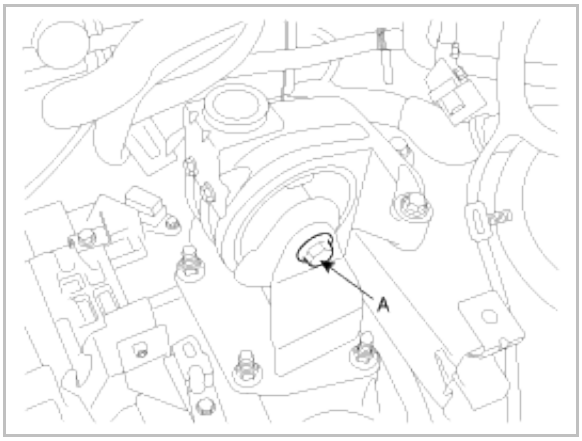
23. Remove the engine mounting support bracket(A).

Tightening torque :
88.3~107.9N.m (9.0~11.0kgf.m, 65.1~79.6lb-ft)

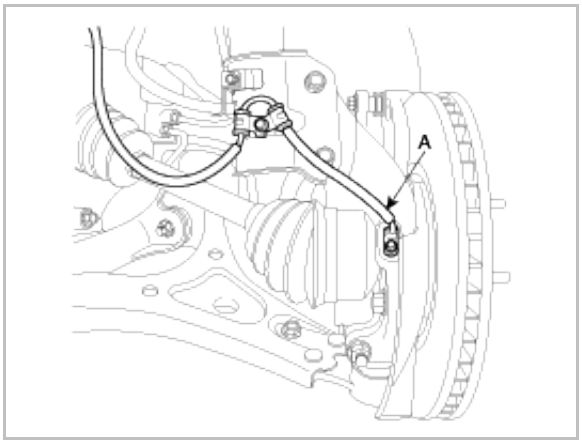


24. Remove the transaxle insulator mounting bolt(A).

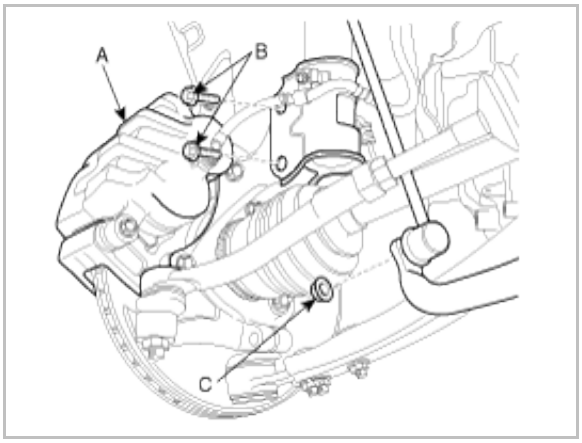
Tightening torque :
88.3~107.9N.m (9.0~11.0kgf.m, 65.1~79.6lb-ft)



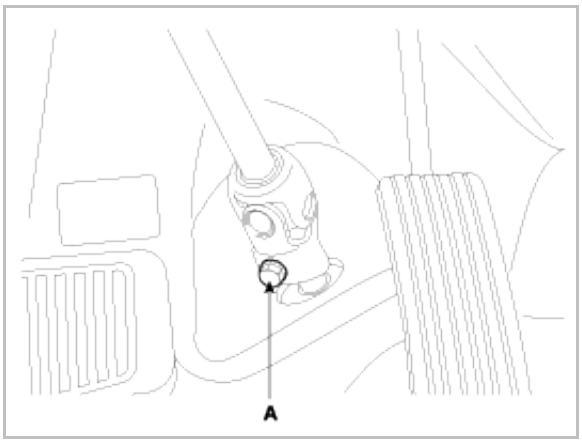
25. Remove the front tires.(Refer to DS group).
26. Remove the ABS wheel speed sensors(A).(Refer to BR group).



27. Remove the caliper and hang the caliper assembly(A).(Refer to BR group).
28. Remove the knuckle mounting bolts(B).(Refer to SS group).
29. Remove the stabilizer link fixing nut(A).(Refer to SS group).



30. Remove the steering u-joint mounting bolt(A).

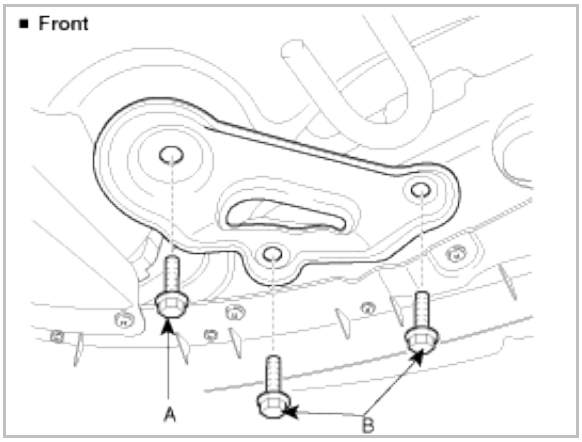


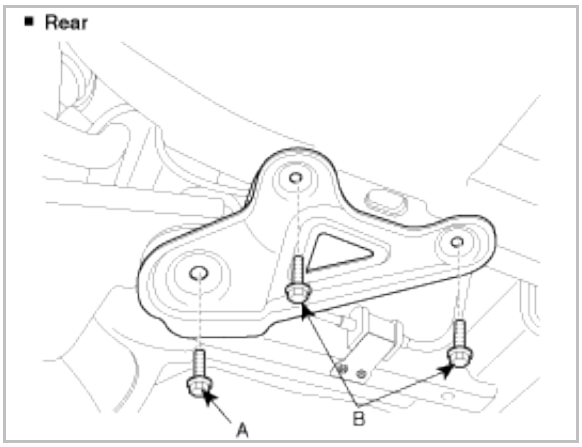
31. Install the jack for supporting engine and transaxle assembly.

> **NOTICE**
>
> Support the assembly safely because the engine and transaxle assembly can be dropped down after removal of the sub frame.

32. Remove the sub frame mounting bolts(A).

Tightening torque :
Bolt(A): 156.9~ 176.5Nm (16.0~18.0kgf.m, 115.7~ 130.2lb-ft)
Bolts(B) :44.1~58.8Nm (4.5~6.0kgf.m, 32.5~43.4lb-ft)





33. Remove the engine and transaxle assembly by lifting vehicle.

> **NOTICE**
>
> When remove the engine and transaxle assembly, be careful not to damage any surrounding parts or body components.

INSTALLATION

Installation is in the reverse order of removal.
Perform the following :

- Adjust the shift cable.
- Adjust the throttle cable.
- Refill the engine with engine oil.
- Refill the transaxle with fluid.
- Refill the radiator and reservoir tank with engine coolant.
- Place the heater control knob on “HOT” positon.
- Bleed air from the cooling system.
  - Start engine and let it run until it warms up. (until the radiator fan operates 3 or 4 times.)
  - Turn Off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be

removed from the cooling system.

- Put the radiator cap on tightly, then run the engine again and check for leaks.

• Clean the battery posts and cable terminals with sandpaper assemble them, then apply grease to prevent corrosion.

• Inspect for fuel leakage.

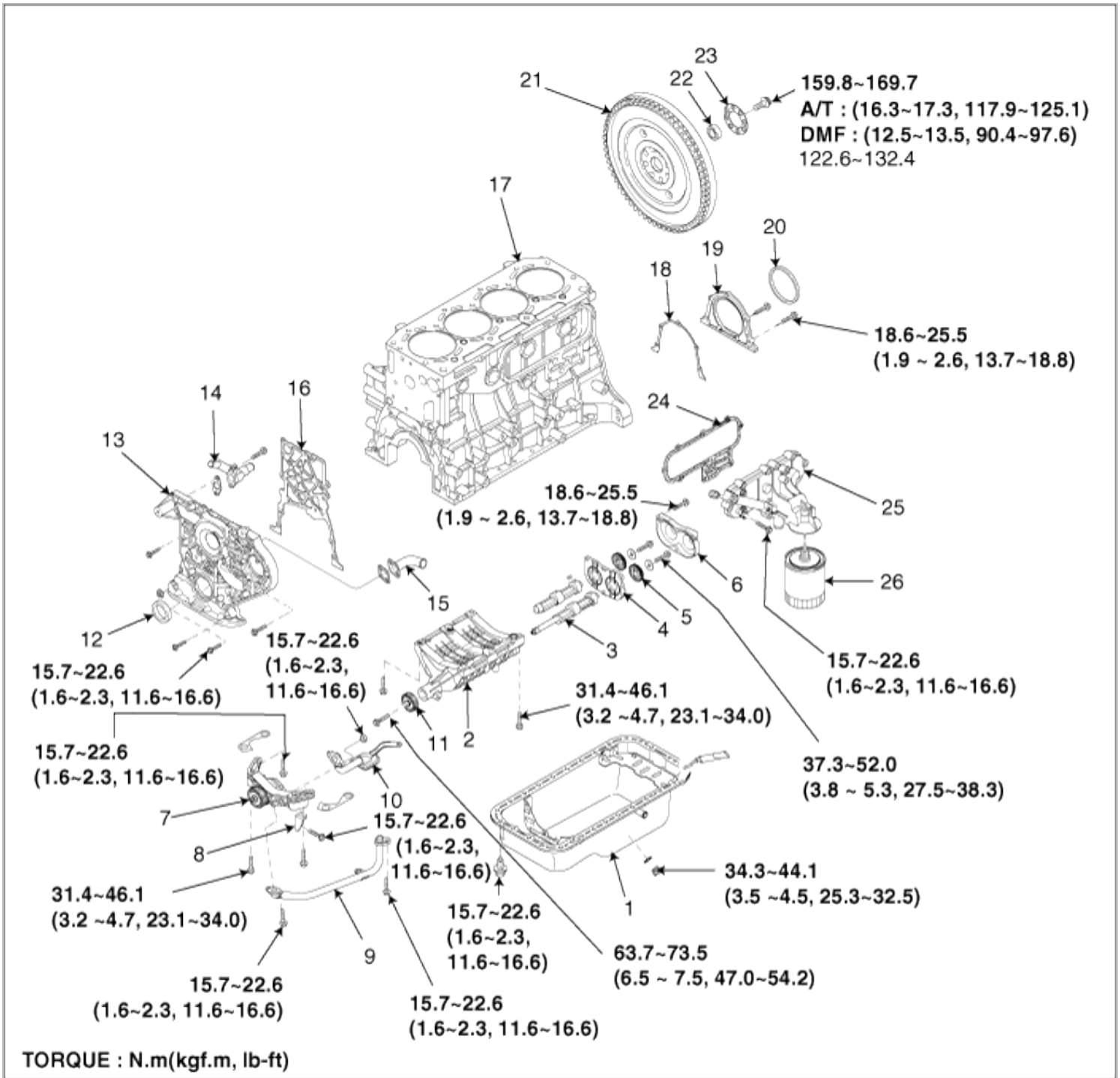
- After assemble the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.
- Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.

KIA MOTORS

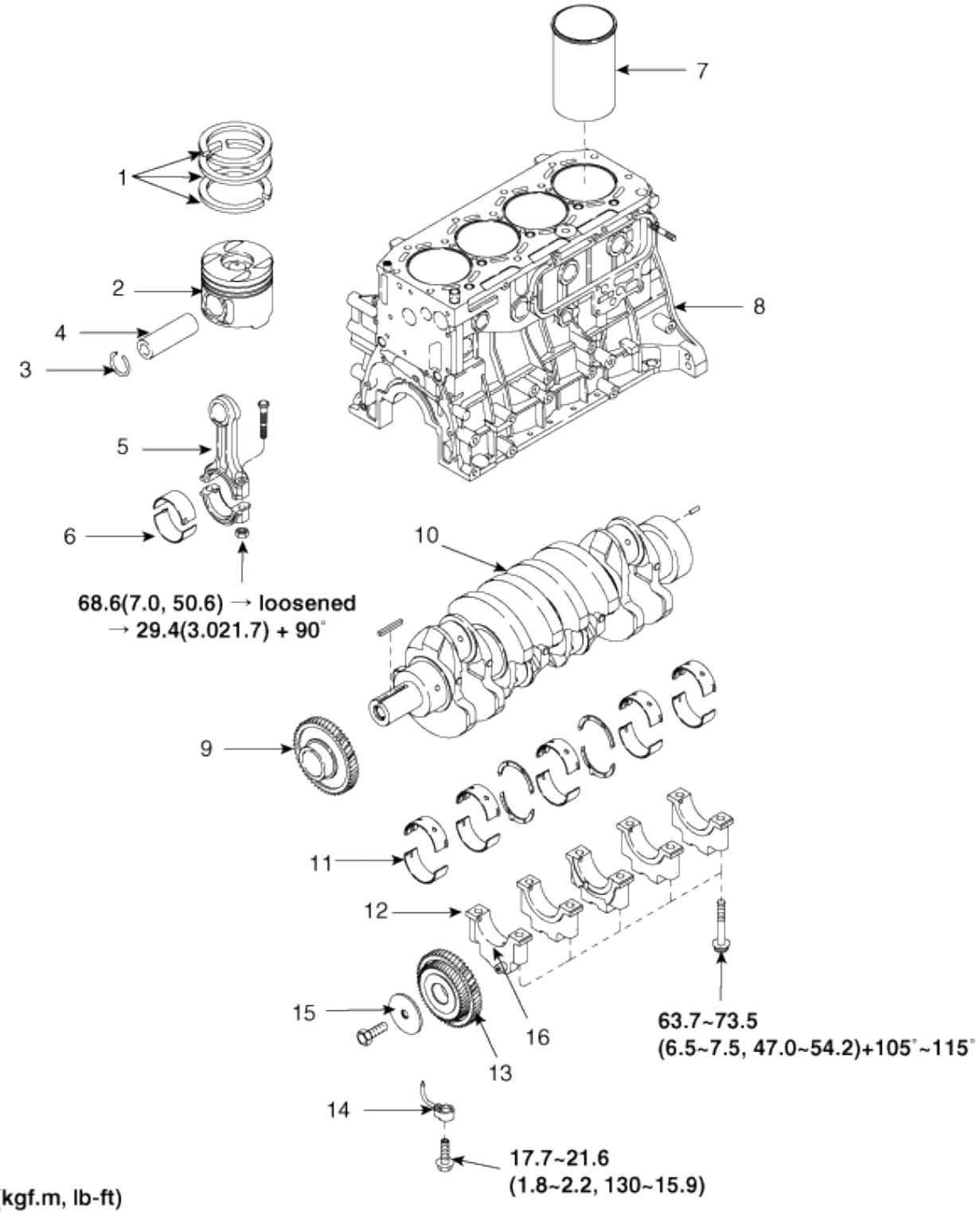
Engine Mechanical System

Cylinder Block

COMPONENTS



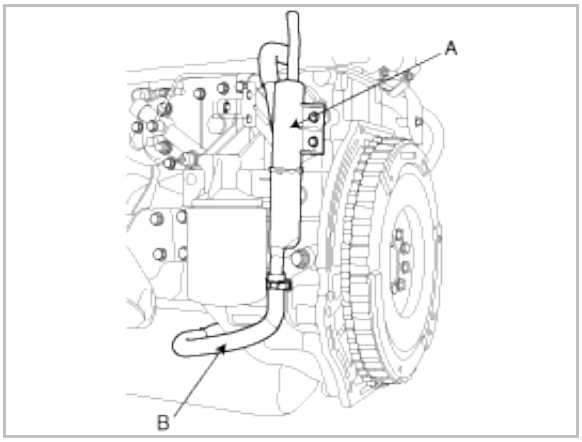
1. Oil pan
2. Ladder frame
3. Balance shaft
4. Thrust plate
5. Balance gear
6. Gear cover
7. Oil pump assembly
8. Ladder frame bracket
9. Oil pump supplying pipe
10. Oil screen
11. Idle gear
12. Crankshaft front oil seal
13. Timing belt case
14. Coolant bypass pipe
15. Coolant inlet pipe
16. Timing belt case gasket
17. Cylinder block
18. Rear oil seal case gasket
19. Rear oil seal case
20. Rear oil seal
21. Flywheel
22. Bearing
23. Washer
24. Oil cooler assembly gasket
25. Oil cooler assembly
26. Oil filter



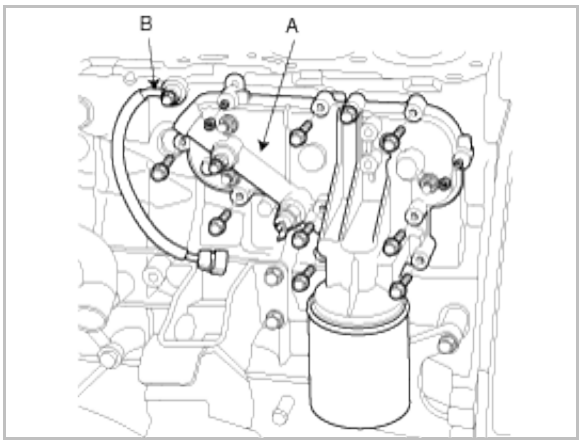
1. Piston ring
2. Piston
3. Snap ring
4. Piston pin
5. Connecting rod
6. Connecting rod bearing
7. Cylinder liner
8. Cylinder block
9. Crankshaft gear
10. Crankshaft
11. Crankshaft main bearing
12. Main bearing cap
13. Idle gear
14. Oil jet
15. Idle gear washer
16. Idle gear spidle

DISASSEMBLY

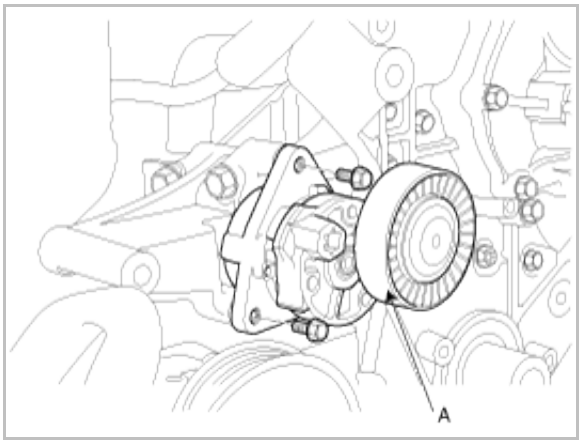
1. Install the engine to engine stand for disassembly.
2. Remove the timing belt.
3. Remove the cylinder head.
4. Remove the water pump.
5. Remove the air separator(A), hose(B).



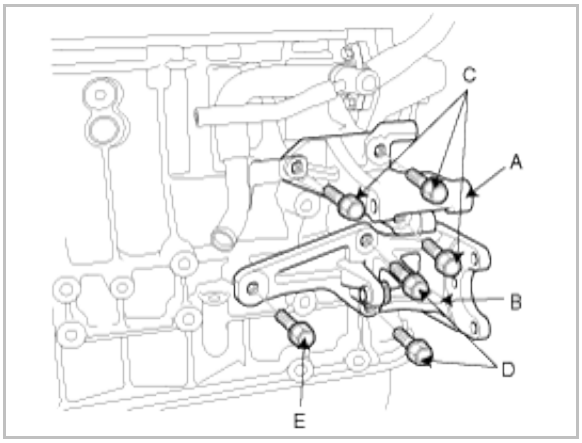
6. Remove the oil cooler assembly(A), knock sensor(B).



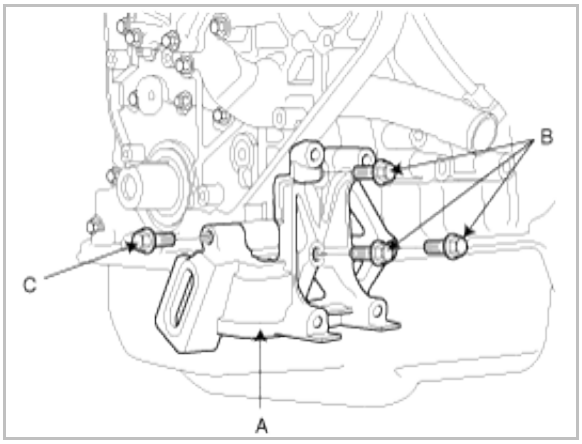
7. Remove the drive belt auto-tensioner (A).



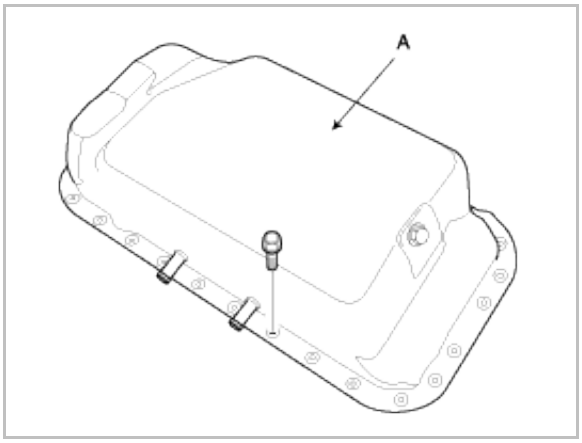
8. Remove the generator mounting bracket(A), power steering pump bracket(B).



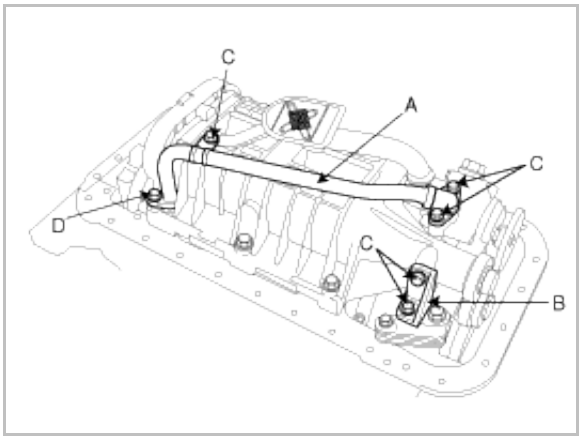
9. Remove the A/C compressor bracket(A).



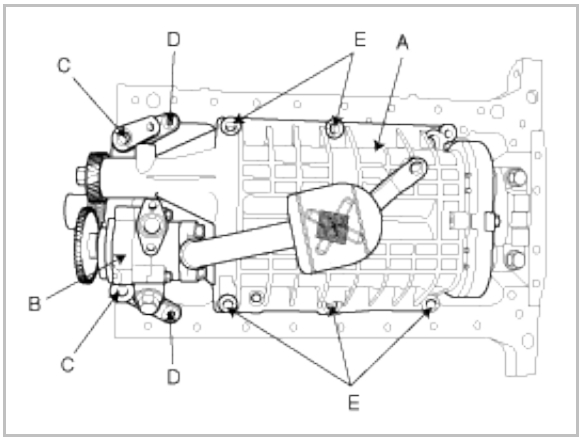
10. M/T : remove flywheel.
11. A/T : remove drive plate and mass wheel.
12. Using the SST(09215 - 3C000) remove the oil pan(A).



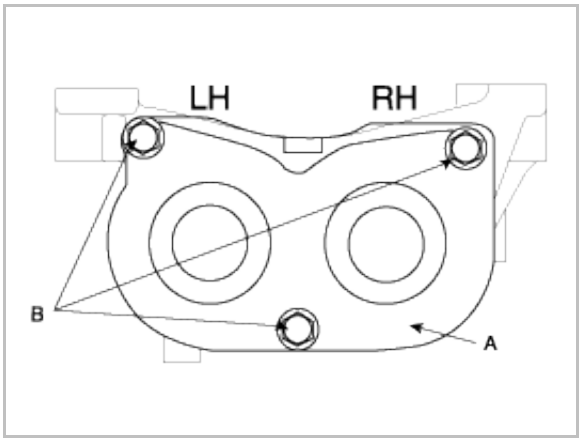
13. Remove the oil pump feed pipe(A) and the ladder frame bracket(B).



14. Remove the ladder frame(A) and the oil pump assembly(B).

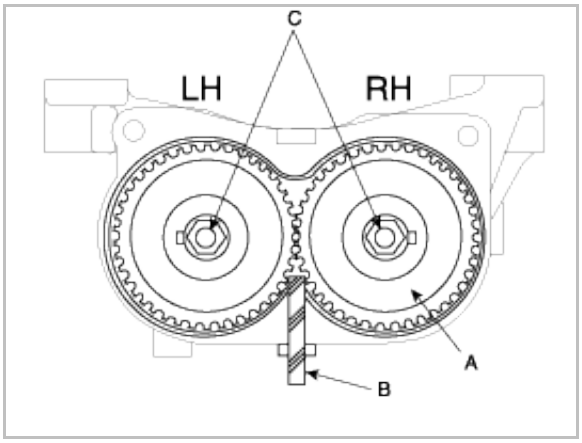


15. Remove the balancer shaft(A) to the ladder frame.
    (1) Remove the gear cover(A) to the ladder frame.



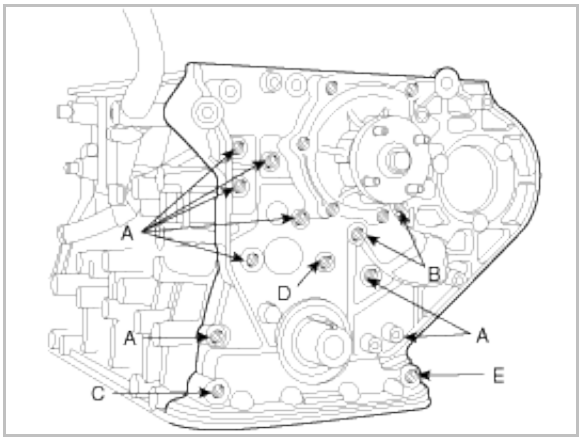
    (2) Remove the balancer sprocket and the balancer gear by loosening the bolts(B).

> **NOTICE**
>
> Not to make the balance shaft be rotated, insert the 5mm-thickeness urethane rubber (B) in the balance gear (A) for protection.



    (3) Remove the thrust plate and the balance shaft.

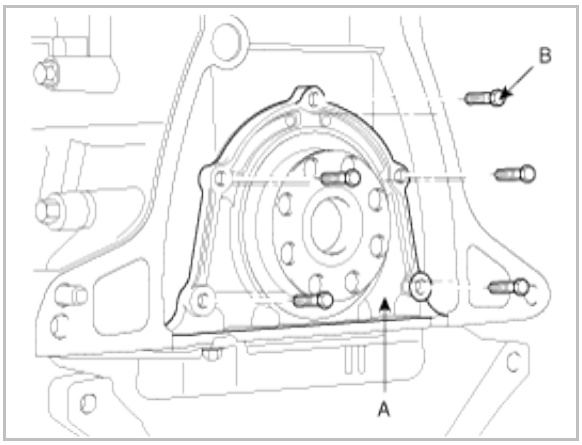
16. Remove the timing belt case(A).



17. Check the connecting rod end play.
18. Remove the connecting rod caps and check oil clearance.
19. Remove the piston and connecting rod assemblies.
    (1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
    (2) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

> **NOTICE**
> - Keep the bearings, connecting rod and cap together.
> - Arrange the piston and connecting rod assemblies in the correct order.

20. Remove the rear oil seal case.
    Remove the 5 bolts(B) and the rear oil seal case(A).



21. Remove the crankshaft bearing cap and check oil clearance.
22. Check the crankshaft end play.
23. Lift the crankshaft(A) out of the engine, being careful not to damage journals.

> **NOTICE**
> Arrange the main bearings and thrust bearings in the correct order.

24. Check fit between piston and piston pin.
25. Remove the piston rings.
    (1) Using a piston ring expender, remove the 2 compression rings.
    (2) Remove the 2 side rails and oil ring by hand.

> **NOTICE**
> Arrange the piston rings in the correct order only.

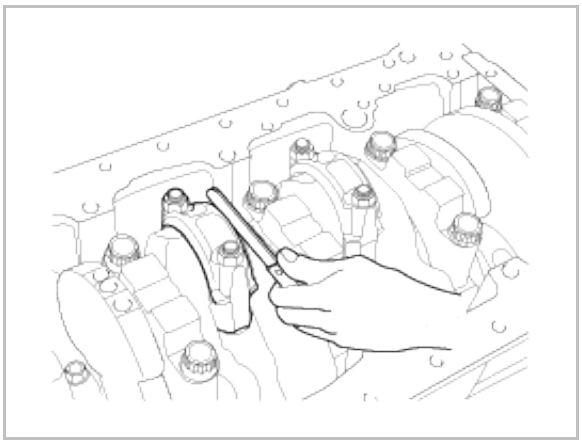
26. Remove the connecting rod from the piston.
Using a press, remove the piston pin from piston.

INSPECTION

CONNECTING ROD AND CRANKSHAFT

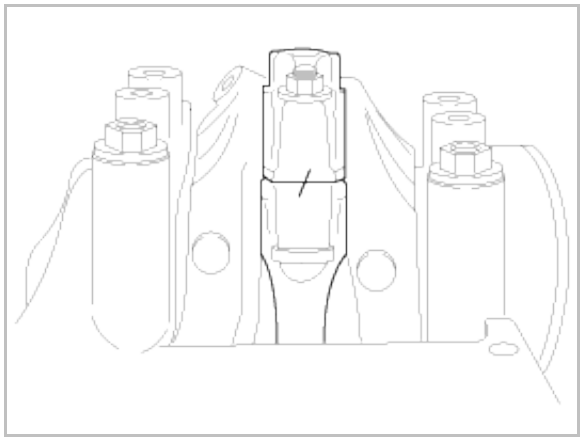
1. Check the connecting rod end play.
Using feeler gauge, measure the end play while moving the connecting rod back and forth.

End play
0.239 ~ 0.39mm (0.0094 ~ 0.0154in)



A. If out-of-tolerance, install a new connecting rod.
B. If still out-of-tolerance, replace the crankshaft.

2. Check the connecting rod bearing oil clearance.
(1) Check the match marks on the connecting rod and cap are aligned to ensure correct reassembly.



(2) Remove the 2 connecting rod cap nuts.
(3) Remove the connecting rod cap and lower bearing.
(4) Clean the crankshaft pin journal and bearing.
(5) Place a plastigage across the crankshaft pin journal.
(6) Reinstall the lower bearing and cap, and tighten the nuts.

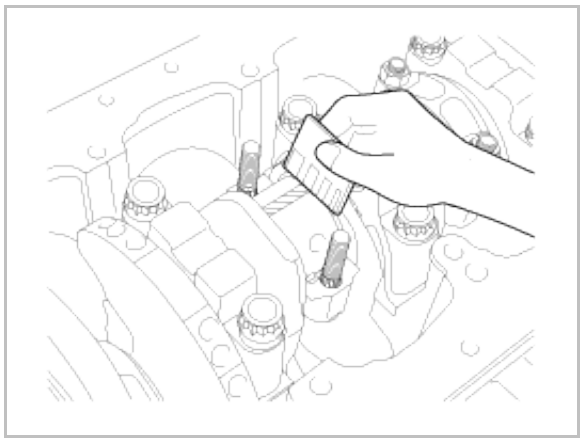
Tightening torque :
68.6Nm (7.0 kgf.m, 50.6lb-ft) → Unfasten bolts→29.4Nm (3.0kgf.m, 21.7lb-ft) + 90°

NOTICE
Do not turn the crankshaft.

(7) Remove the 2nuts, connecting rod cap and lower bearing .

(8) Measure the plastigage at its widest point.

Standard oil clearance
0.043 ~ 0.077mm (0.0017 ~ 0.0030in)



(9) If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark. (Refer to connecting rod bearing selection table)
Recheck the oil clearance.

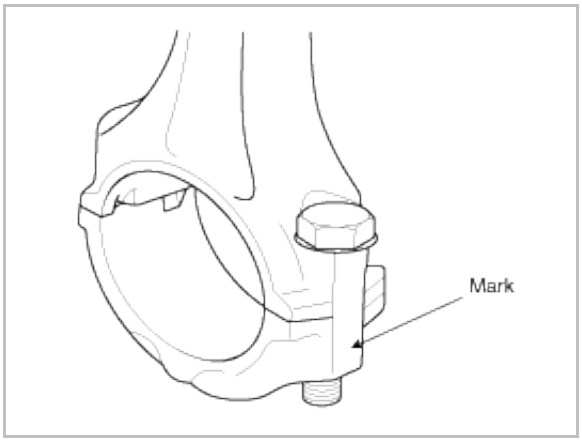
> CAUTION
>
> Do not file, shim, of scrape the bearings or the caps to adjust clearance.

(10) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing. (Refer to connecting rod bearing selection table))
Recheck the oil clearance.

> NOTICE
>
> If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

> CAUTION
>
> If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.

Connecting rod mark location



Discrimination of connecting rod

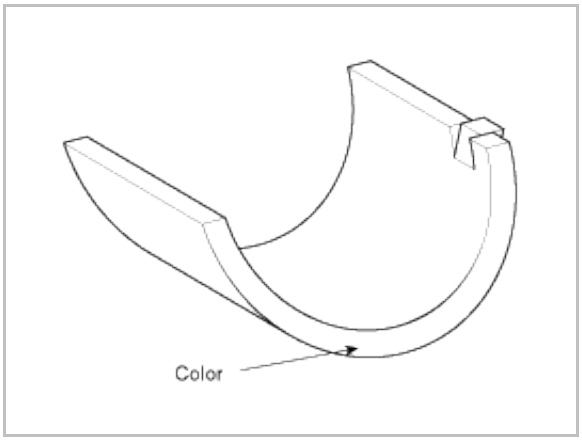
Mark	Connecting rod big-endinner diameter
1	60.833 ~ 60.839mm (2.3950 ~ 2.3952 in)

2	60.839 ~ 60.846mm (2.3952 ~ 2.3955 in)

CRANKSHAFT PIN JOURNAL

Journal outer diameter
57.106~57.124mm (2.2483~2.2490in)

CONNECTING ROD BEARING MARK LOCATION



Discrimination of crankshaft pin journal

Color	Connecting rod bearing thickness
Blue	1.0828~1.832mm (0.0720~0.0721in)
Red	1.832~1.836mm (0.0721~0.0723in)

(11) Select the bearing by using the selection table.
Connecting rod bearing selection table

Connecting rod mark	Connecting rod bearing thickness	Oil clearance
1	Blue	0.045~0.077mm(0.0018~0.0030in)
2	Red	0.043~0.076mm(0.0017~0.0030in)

3. Check the connecting rods.
   (1) When reinstalling, make sure that cylinder numbers put on the connecting rod and cap at disassembly match. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
   (2) Replace the connecting rod if it is damaged on the thrust faces at either end. Also if step wear or a severely rough surface of the inside diameter of the small end is apparent, the rod must be replaced as well.
   (3) Using a connecting rod aligning tool, check the rod for bend and twist. If the measured value is close to the repair limit, correct the rod by a press. Any connecting rod that has been severely bent or distorted should be replaced.

Allowable bend of connecting rod :
0.04mm / 50mm (0.0016in / 1.9685in) or less
Allowable twist of connecting rod :
0.1mm / 50mm (0.0039in / 1.9685in) or less

4. Check the crankshaft bearing oil clearance.
   (1) To check main bearing-to-journal oil clearance, remove the main bearing caps and lower bearings.

(2) Clean each main journal and lower bearing with a clean shop towel.

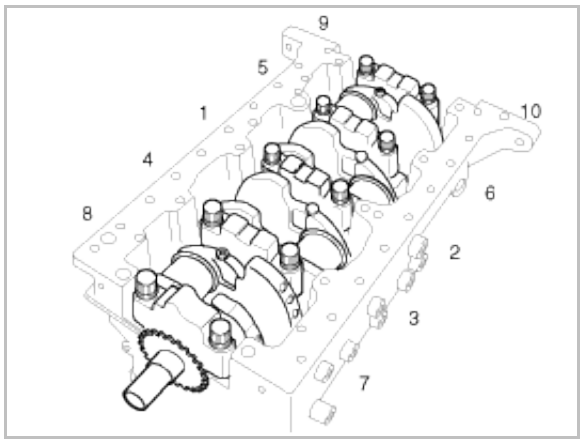
(3) Place one strip of plastigage across each main journal.

(4) Reinstall the lower bearings and caps, then tighten the bolts.

Tightening torque :
63.7~73.5Nm(6.5~7.5kgf.m, 47.0~54.2lb-ft)+105°~115°

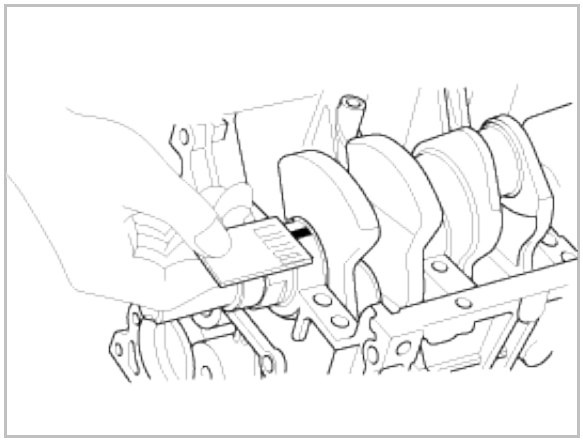
NOTICE

Do not turn the crankshaft.



(5) Remove the cap and lower bearing again, and measure the widest part of the plastigage.

Standard oil clearance :
No.1, 2, 3, 5: 0.045~0.079mm (0.0018 ~0.0031 in)
No.3: 0.067~0.101 mm (0.0026 ~0.0040 in)



(6) If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark. (Refer to crankshaft main bearing selection table).
Recheck the oil clearance.

CAUTION

Do not file, shim, or scrape the bearings or the cap to adjust clearance.

(7) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing. (Refer to crankshaft main bearing selection table).
Recheck the oil clearance.

NOTICE

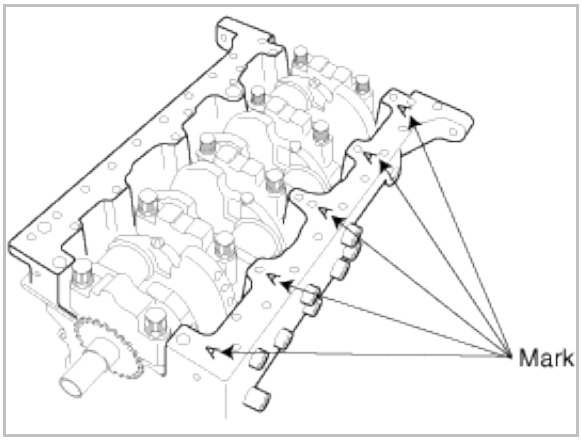
If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

CAUTION

If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.

CYLINDER BLOCK CRANKSHAFT JOURNAL BORE MARK LOCATION

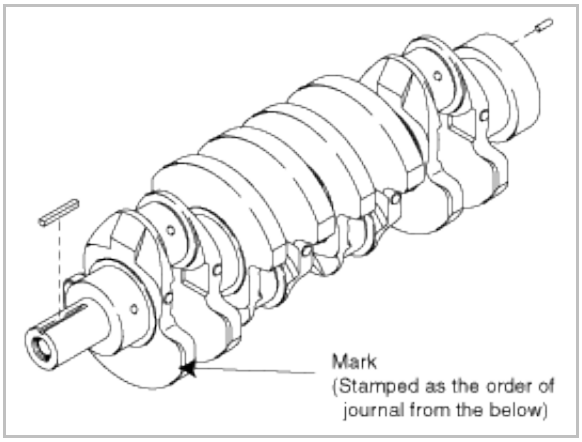
Letters have been stamped on the end of the block as a mark for the size of each of the 5 main journal bores. Use them, and the numbers or letters stamped on the crank (marks for main journal size), to choose the correct bearings.



Discrimination of cylinder block crankshaft journal bore

Mark	Cylinder block crankshaft journal bore inner diameter
A	74.066~74.075mm (2.9160~2.9163in)
None	74.075~74.084mm (2.9163~2.9167in)
C	74.084~74.092mm (2.9167~2.9170in)

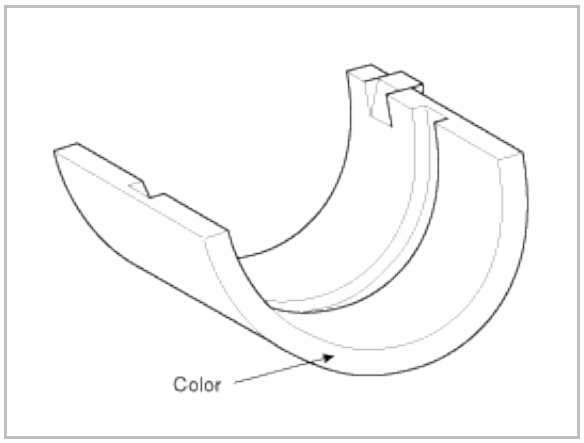
Crankshaft main journal mark location



Discrimination of crankshaft main journal

Mark	Crankshaft main journalouter diameter	
	No.1, 2, 3, 5 journal	No.3 journal
1	69.995~70.002mm(2.7557~2.7560in)	69.973~69.980mm(2.7548~2.7551in)
*	70.002~70.009mm(2.7560~2.7563in)	69.980~69.987mm(2.7551~2.7554in)
3	70.009~70.015mm(2.7563~2.7565in)	69.987~69.993mm(2.7554~2.7556in)

Crankshaft main bearing mark location



Discrimination of crankshaft bearing

Color	Crankshaft bearing thickness
Black	2.013 ~ 2.018mm(0.0793~0.0794in)
Brown	2.008 ~ 2.013mm(0.0791~0.0793in)
Green	2.003 ~ 2.008mm(0.0789~0.0791in)
Yellow	1.998 ~ 2.003mm(0.0787~0.0789in)

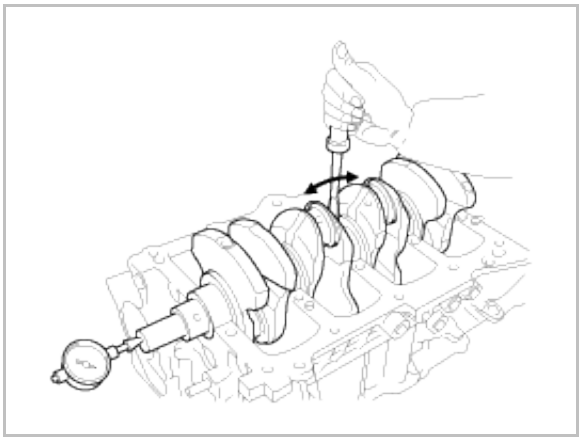
(8) Select the bearing by using selection table.

Crankshaft main bearing selection table

		Cylinder block crankshaft journal bore mark		
		A	None	C
Crank shaft main journal mark	A	(Green)	(Brown)	(Black)
	*	(Yellow)	(Green)	(Brown)
	C	(Yellow)	(Yellow)	(Green)

5. Check the crankshaft end play.
   Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

End play
Standard: 0.14~ 0.39mm (0.0055 ~ 0.0154in)

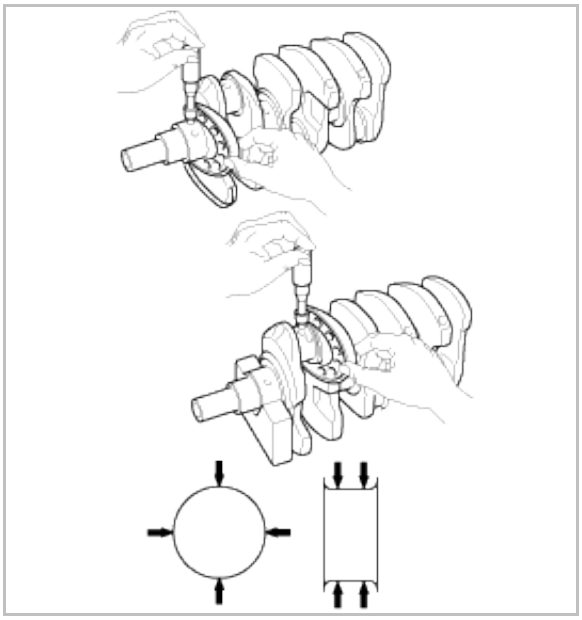


If the end play is greater than maximum, replace the thrust bearings as a set.

6. Inspect the crankshaft main journals and pin journals.
   Using a micrometer, measure the diameter of each main journal and pin journal.

Main journal outer diameter :
NO.1, 2, 3, 5: 69.995 ~ 70.015mm (2.7557 ~2.7565 in)

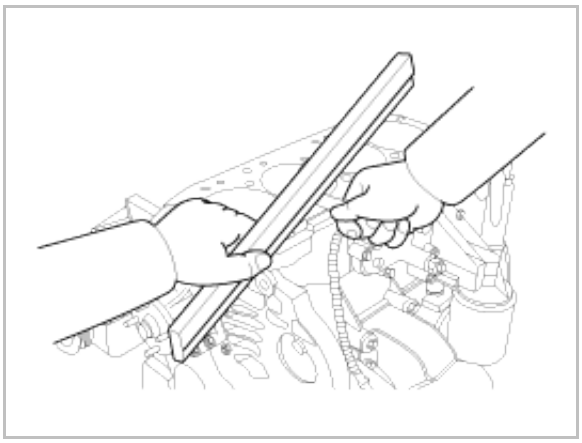
NO.3: 69.973~69.993 mm (2.7548 ~2.7556 in)
Pin journal outer diameter :
57.106 ~ 57.124mm (2.2483 ~2.2490 in)



CYLINDER BLOCK

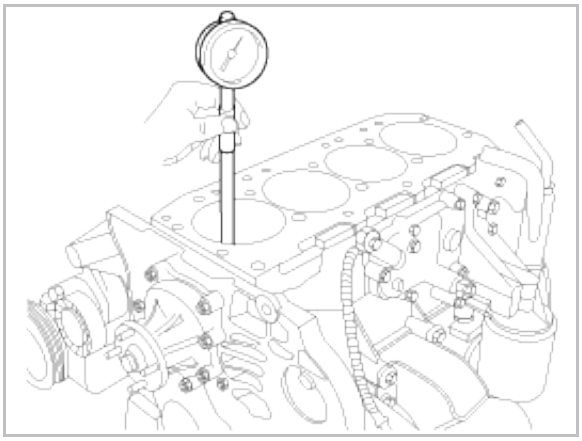
1. Remove the gasket material.
   Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.
2. Clean the cylinder block
   Using a soft brush and solvent, thoroughly clean the cylinder block.
3. Inspect the top surface of cylinder block for flatness.
   Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

Flatness of cylinder block gasket surface Standard:
Less than 0.05mm (0.0020in)



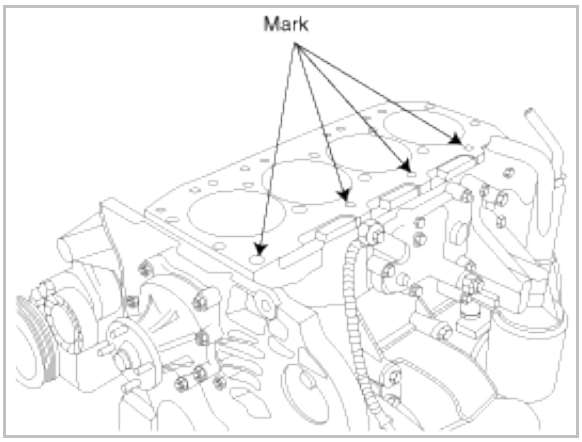
4. Inspect the cylinder bore.
   Visually check the cylinder for vertical scratchs.
   If deep scratchs are present, replace the cylinder block.
5. Inspect the cylinder bore diameter.
   Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial direction.

Standard diameter :
97.100~97.126mm (3.8228~3.8239in)



6. Check the cylinder bore size code on the cylinder block bottom face.

Cylinder bore inner diameter mark location



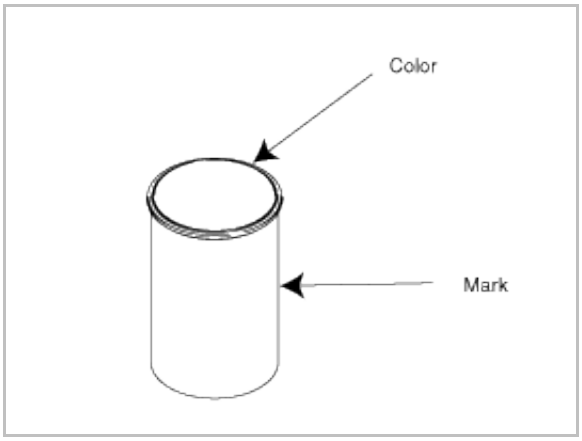
Discrimination of cylinder bore inner diameter

Mark	Cylinder bore inner diameter
Y	101.513~101.526mm (3.9966~3.9971in)
X	101.500~101.513mm (3.9961~3.9966in)

Cylinder liner classifying mark location

NOTICE

The outer discrimination mark of the cylinder liner is on the outer surface of the liner and the inner mark is on the top surface of it.

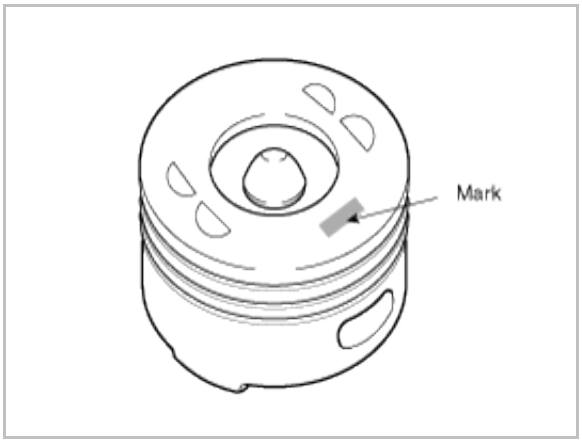


Discrimination of cylinder liner

Mark	Outer diameter (mm)	Mark	Inner diameter (mm)

3Y	101.493~101.506mm(3.9958~3.9963in)	Yellow	97.113~97.126mm(3.8233 ~ 3.8239in)
3Y	101.493~101.506mm(3.9958~3.9963in)	Blue	97.100~97.113mm(3.8228~ 3.8233in)
3X	101.480~101.493mm(3.9953 ~ 3.9958in)	Yellow	97.113~97.126mm(3.8233~3.8239in)
3X	101.480~101.493mm(3.9953 ~ 3.9958in)	Blue	97.100~97.113mm(3.8228~ 3.8233in)

Piston Outer diameter mark location



Discrimination of piston outer diameter

Mark	Piston outer diameter
A	97.015~97.030mm(3.8195~3.8201in)
B	97.030~97.045mm(3.8201~3.8207in)

7. Check the piston size mark on the piston top face.

Cylinder liner selection table

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

Piston

Cylinder liner mark	Piston outer diameter mark	Oil clearance
Yellow	B	0.068~0.096mm(0.0027~0.0038in)
Blue	A	0.070~0.098mm(0.0028~0.0039in)

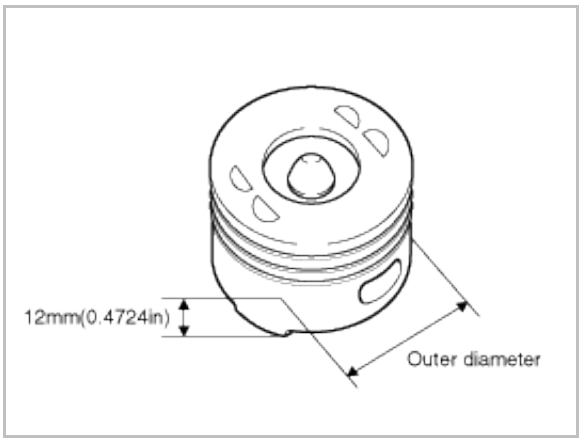
PISTON AND PISTON RINGS

1. Clean the piston.
   (1) Using a gasket scraper, remove the carbon from the piston top.
   (2) Using a groove cleaning tool or broken ring, clean the piston ring grooves.
   (3) Using solvent and a brush, thoroughly clean the piston.

> NOTICE
>
> Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 47mm (1.85in) from top land of the piston.

Standard diameter :
97.015~97.045mm (3.8195 ~ 3.8207in)

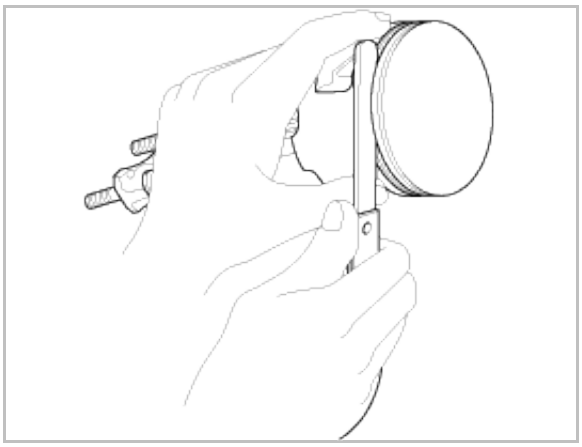


3. Calculate the difference between the cylinder bore inner diameter and the piston outer diameter.

Piston-to-cylinder clearance :
0.070 ~ 0.098mm (0.0028 ~ 0.0039in)

4. Inspect the piston ring side clearance.
Using a feeler gauge, measure the clearance between new piston ring and the wall of ring groove.

Piston ring side clearance
No. 2 : 0.06 ~ 0.10mm (0.0024 ~ 0.0039in)
Oil ring : 0.03 ~ 0.07mm (0.0012 ~ 0.0028in)



If the clearance is greater than maximum, replace the piston.

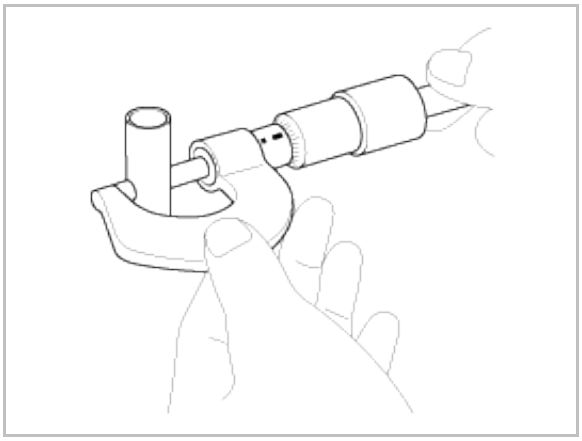
5. Inspect the piston ring end gap.
To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston rings. If the gap is too large, recheck the cylinder bore inner diameter. If the bore is over the service limit, the cylinder block must be rebored.

Piston ring end gap
Standard
No.1 : 0.25~ 0.40mm (0.0098 ~ 0.0157in)
No.2 : 0.40 ~ 0.55mm (0.0157 ~ 0.0217in)
Oil ring : 0.20 ~ 0.40mm(0.0079 ~ 0.0157in)

PISTON PINS

1. Measure the outer diameter of piston pin.

Piston pin diameter :
31.994~32.000mm (1.2596 ~ 1.2598in)



2. Measure the piston pin-to-piston clearance.

Piston pin hole inner diameter:
32.015~32.025 mm (1.2604~1.2608 in)
0.015~0.031 mm(0.0003~0.0012 in)

3. Check the difference between the piston pin outer diameter and the connecting rod small end inner diameter.

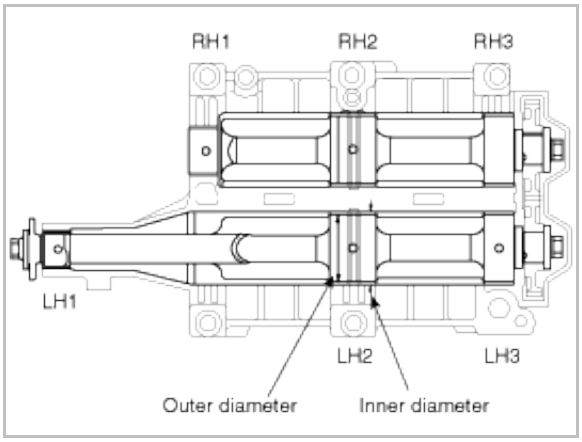
Inside diameter of connecting rod small end bore:
32.012~32.033mm (1.2603~1.2611 in)
0.012~0.039 mm(0.0005~0.0015 in)

4. Apply oil on the piston pin when assembling.

LADDER FRAME AND BALANCE SHAFT

1. Measure the ladder frame inner diameter.

Ladder frame inner diameter	
LH1	25.000 ~ 25.021 mm(0.9843~0.9851in)
LH2	54.000 ~ 54.030 mm(2.1260~2.1272in)
LH3	56.000 ~ 56.030 mm(2.2047~2.2059in)
RH1	35.000 ~ 35.025 mm(1.3780~1.3789in)
RH2	54.000 ~ 54.030 mm(2.1260~2.1272in)
RH3	56.000 ~ 56.030 mm(2.2047~2.2059in)



2. Measure the balance shaft outer diameter.

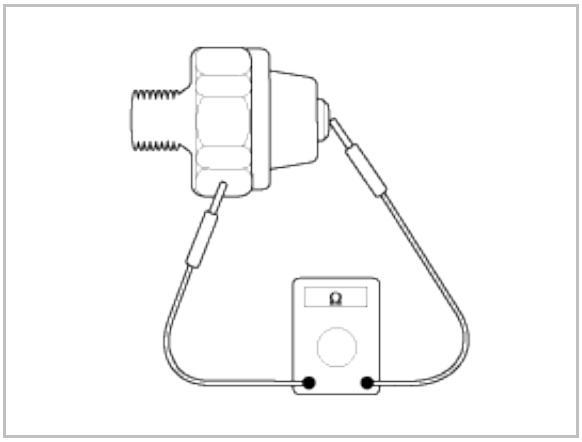
Balance shaft outer diameter	
LH1	24.939 ~ 24.960 mm(0.9818~0.9827in)
LH2	53.910 ~ 53.940 mm(2.1224~2.1236in)
LH3	55.910 ~ 55.940 mm(2.2012~2.2024in)
RH1	34.925 ~ 34.950 mm(1.3750~1.3760in)
RH2	53.910 ~ 53.940 mm(2.1224~2.1236in)
RH3	55.910 ~ 55.940 mm(2.2012~2.2024in)

3. Measure the end play of the balance shaft.

0.10~0.25mm (0.0036~0.0098in)

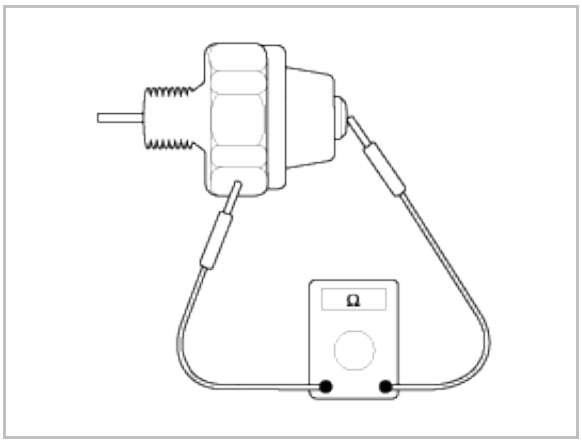
OIL PRESSURE SWITCH

1. Check the continuity between the terminal and the body with an ohmmeter. If there is no continuity, replace the oil pressure switch.



2. Check the continuity between the terminal and the body when the oil hole is blocked with a fine stick. If there is

continuity with a fine stick is pushed, replace the switch.



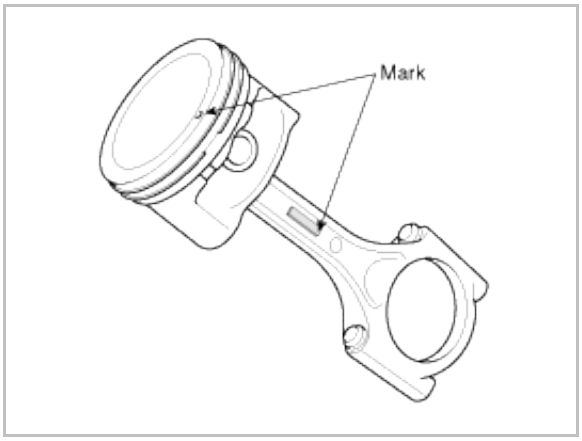
3. If there is no continuity when a 49.0kpa (0.5kg/cm², 7.1psi) is applied through the oil hole, the switch is operating properly.
   Check for air leakage. If air leaks, the diaphragm is broken. Replace it.

REASSEMBLY

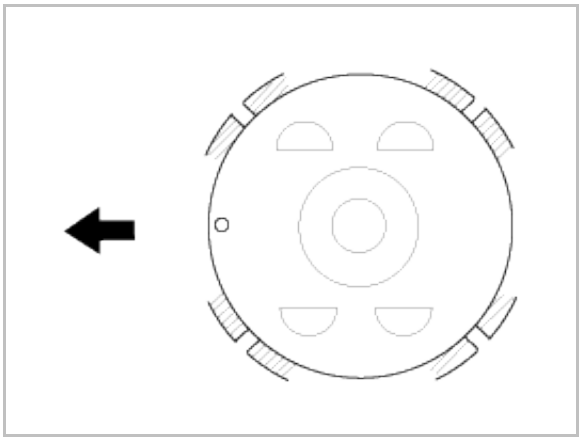
NOTICE

- Thoroughly clean all parts to assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.

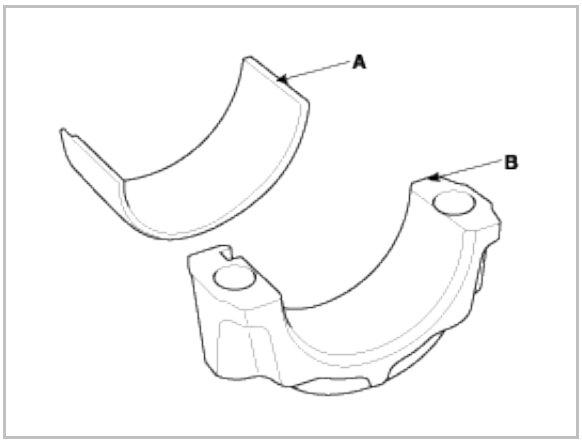
1. Assemble the piston and connecting rod.
   (1) Insert the piston pin and fix the piston pin clip.
   (2) The piston front mark and the connecting rod front mark must face the timing belt side of the engine.



2. Install the piston rings.
   (1) Install the oil ring expander and two side rails by hand.
   (2) Using a piston ring expander, install the two compression rings with the code mark facing upward.
   (3) Position the piston rings so that the ring ends are as shown.



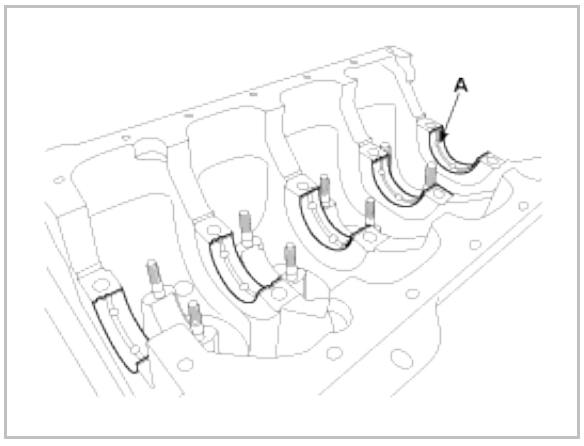
3. Install the connecting rod bearings.
   (1) Align the bearing (A) claw with the groove of the connecting rod and bearing cap (B).
   (2) Install the bearings (A) in the connecting rod and bearing cap (B).



4. Install the crankshaft main bearings.

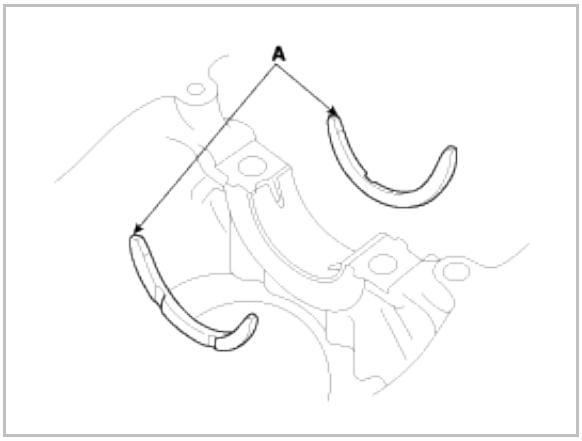
> **NOTICE**
>
> Upper bearings have oil grooves of the oil holes; Lower bearings do not.

   (1) Aligning the bearing protrusions with the grooves of the cylinder block, push in the 5 upper bearings (A).



   (2) Aligning the bearing protrusions with the grooves of the main bearing cap, and push in the 5 lower bearings.

5. Install the thrust bearings.
   Install the 2 thrust bearings(A) under the No.3 journal position of the cylinder block with the oil grooves facing outward.



6. Place the crankshaft on the cylinder block.
7. Place the main bearing caps on the cylinder block.
8. Install the main bearing cap bolts.

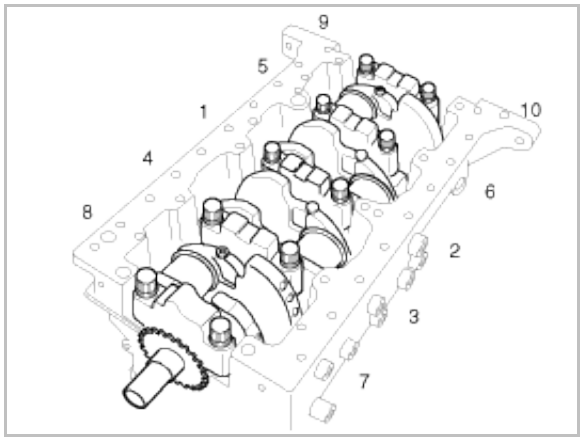
NOTICE

- The main bearing cap bolts are tightened in 2 progressive steps.
- Always use new main bearing cap bolts.

(1) Apply a light coat of engine oil on the threads of the main bearing cap bolts.

(2) Install and uniformly tighten the 10 bearing cap bolts (A), in several passes, in the sequence shown.

Tightening torque :
63.7~73.5Nm(6.5~7.5kgf.m, 47.0~54.2lb-ft)+105°~115°



(3) Check that the crankshaft turns smoothly.

9. Check the crankshaft end play.
10. Install the piston and connecting rod assemblies.

NOTICE

- Before installing the piston, apply a coat of engine oil to the piston ring grooves and the cylinder bores.
- When installing the piston pin to the piston, apply engine oil sufficiently

(1) Remove the connecting rod bearing caps and insert short sections of rubber hose over the threaded ends of the connecting rod bolts.

(2) Install the ring compressor, checking that the rings are securely in place and positioning the piston in the cylinder, tap it in using the wooden handle of a hammer.

(3) Stop inserting after the ring inserted in the cylinder, and check the connecting rod to crank journal alignment before complete inserting.

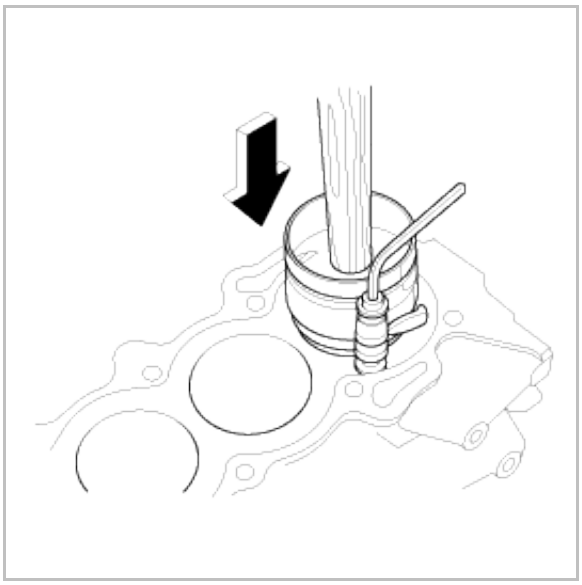
(4) Apply engine oil to the bolt threads after removing rubber hose. Install the connecting rod caps with bearings,

and tighten the nuts.

Tightening torque :
68.9Nm (7.0kgf.m, 50.6lb-ft) → Loosened →29.4Nm (3.0kgf.m, 21.7lb-ft) + 90°

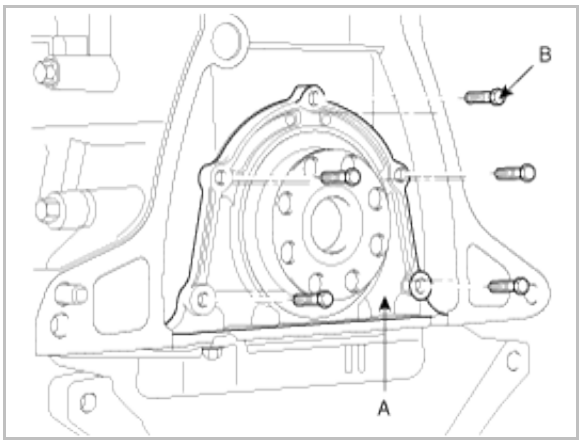
NOTICE

Maintain downward force on the ring compressor to prevent the rings from expending before entering the cylinder bore.



11. Install a new gasket and rear oil seal case(A) with 5 bolts(B).

Tightening torque :
7.8 ~ 10.8Nm (0.8 ~ 1.1kgf.m, 5.8 ~ 8.0lb-ft)

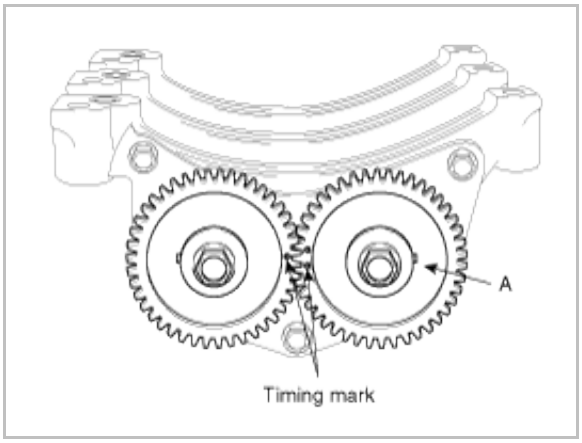


NOTICE

Check that the mating surfaces are clean and dry.

12. Install the rear oil seal.
    (1) Apply engine oil to a new oil seal lip.
    (2) Tap in the rear oil seal until its surface is flush with the rear oil seal retainer edge.

13. Install the balance shaft to the ladder frame.
    (1) Install the thrust plate and balance shaft to the ladder frame.
    (2) Aligning the timing marks on the balance gear(A), install the balance sprocket.

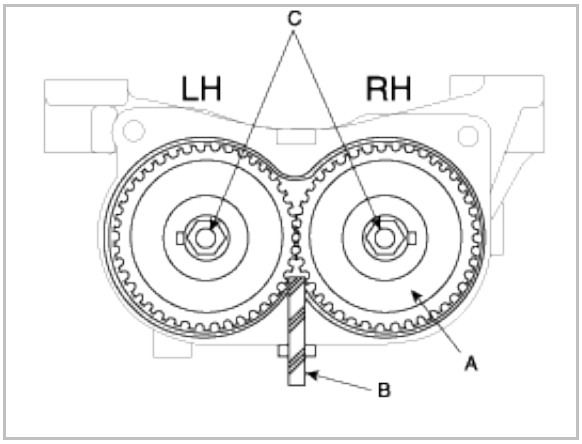


(3) Tighten the balance sprocket bolt and balance gear bolt(C).

Tightening torque :
Rear balance gear bolt(C)-
37.3 ~ 52.0Nm (3.8 ~ 5.3kgf.m, 27.5 ~ 38.3lb-ft)
Front balance gear bolt-
63.7 ~ 73.5Nm (6.5 ~ 7.5kgf.m, 47.0 ~ 54.2lb-ft)

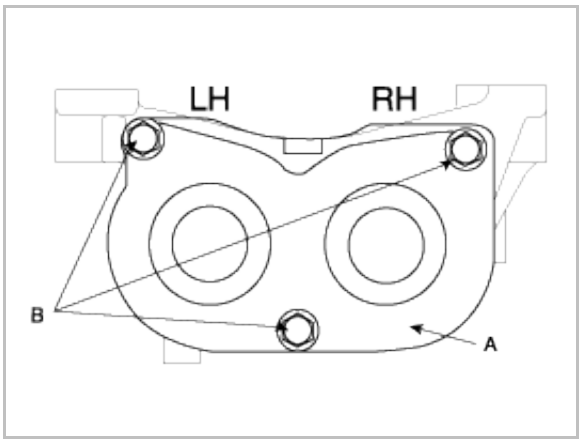
NOTICE

Not to make the balance shaft be rotated, insert the 5mm-thickeness urethane rubber (B) in the balance gear (A) for protection.



(4) Install the gear cover (A) to the ladder frame and tighten the bolts (B).

Tightening torque :
18.6 ~ 25.5Nm (1.9 ~ 2.6kgf.m, 13.7 ~ 18.8lb-ft)

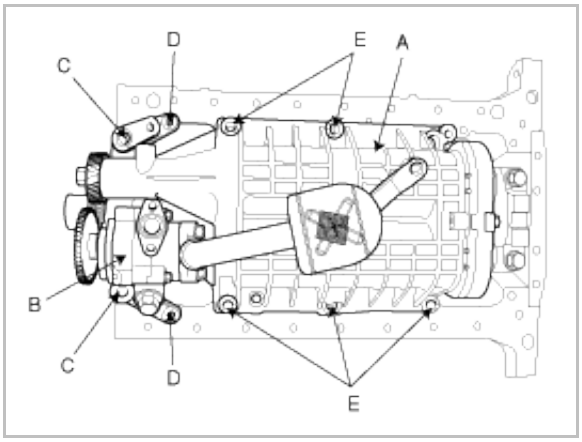


14. Install the oil screen with a new gasket to the oil pump.

Tightening torque :
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

15. Install the ladder frame(A) and pump assembly(B) and tighten the bolts(C,D,E).

Tightening torque :
Bolts (C): 31.4 ~ 46.1Nm (3.2 ~ 4.7kgf.m, 23.1 ~ 34.0lb-ft)
Bolts (D): 15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)
Bolts (E): 31.4 ~ 46.1Nm (3.2 ~ 4.7kgf.m, 23.1 ~ 34.0lb-ft)

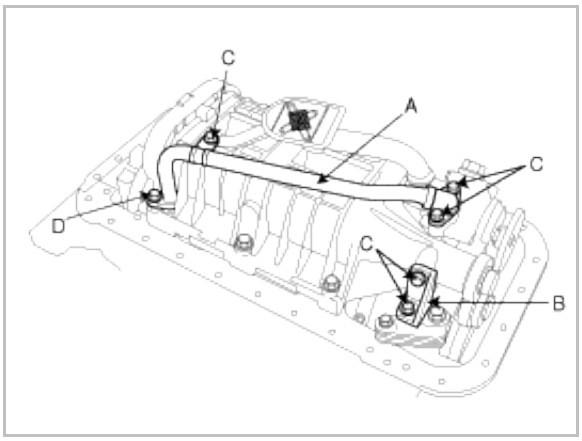


NOTICE

Check that the timing marks on the crankshaft sprocket(A), idler(B) and balance sprocket(C) are aligned.

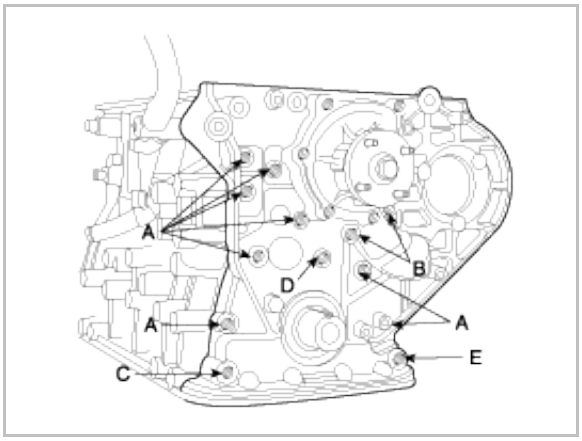
16. Install the oil pump supplying pipe(A) and ladder frame bracket(B) and tighten the bolts(C,D) as shown below.

Tightening torque :
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



17. Install the timing belt case.

Length of the bolts :
(A): 25mm, (B): 45mm, (C):50mm, (D): nut
Tightening torque :
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



18. Install the oil pan.
    (1) Remove the gasket from the surface of the oil pan by using a knife or a scraper.

> **NOTICE**
>
> After checking that the contact surface is clean and dry, apply liquid gasket.

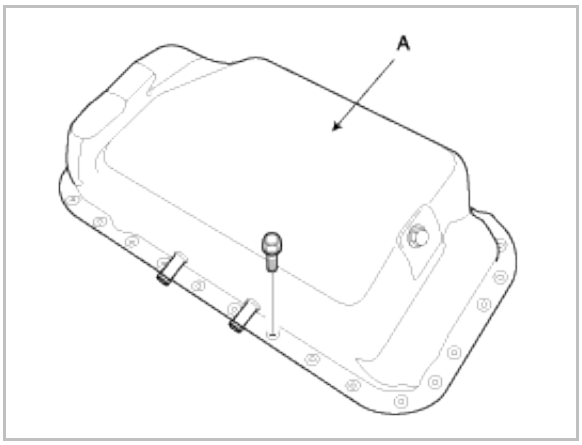
    (2) Apply liquid gasket on the surface of the oil pan.

Liquid gasket: LOCTITE 5900 or equivalent.

> **NOTICE**
>
> - Apply liquid gasket on the thread of the bolts in order to prevent oil from being leaked.
> - If the time, five minutes, passes after applying, remove the applied gasket before. Apply it again and install it.
> - After the minimum 30 minutes passing from assembly, refill engine oil.

    (3) Install the oil pan (A) and tighten the oil pan bolts uniformly in several steps.

Tightening torque :
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



19. Install the fly wheel (manual transaxle vehicles only).

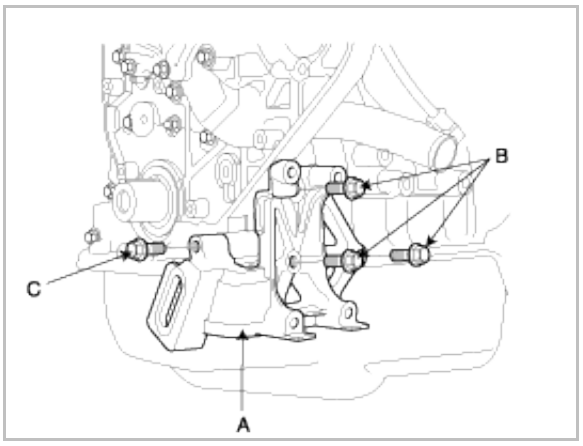
Tightening torque :
122.6 ~ 132.4Nm (12.5 ~ 13.5kgf.m, 90.4 ~ 97.6lb-ft)

20. Install the mass wheel and drive plate (automatic transaxle vehicles only).

Tightening torque :
159.8 ~ 169.7Nm (16.3 ~ 17.3kgf.m, 117.9 ~ 125.1lb-ft)

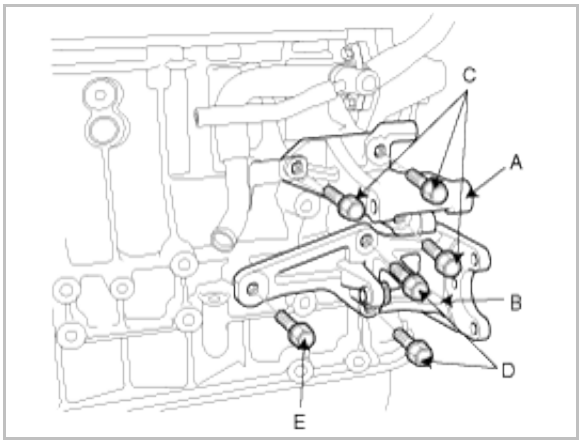
21. Install the air conditioning compressor bracket (A).

Tightening torque :
BOLT (B):
38.2 ~ 58.8Nm (3.9 ~ 6.0kgf.m, 28.2 ~ 43.4lb-ft)
BOLT (C):
18.6 ~ 27.5Nm (1.9 ~ 2.8kgf.m, 13.7 ~ 20.3lb-ft)



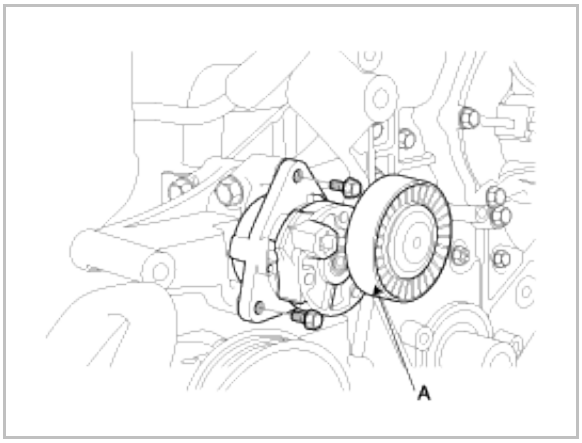
22. Install the generator mounting bracket (A) and the power steering pump bracket (B).

Tightening torque :
BOLT (C):
38.2 ~ 58.8Nm (3.9 ~ 6.0kgf.m, 28.2 ~ 43.4lb-ft)
BOLT (D):
34.3 ~ 53.9Nm (3.5 ~ 5.5kgf.m, 25.3 ~ 39.8lb-ft)
BOLT (E):
68.6 ~ 93.2Nm (7.0 ~ 9.5kgf.m, 50.6 ~ 68.7lb-ft)



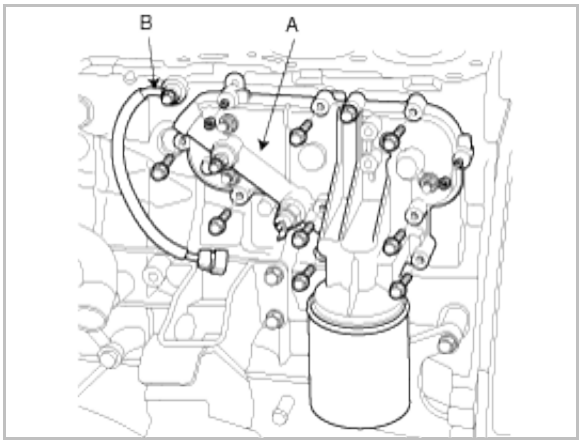
23. Install the drive belt auto-tensioner (A).

Tightening torque :
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



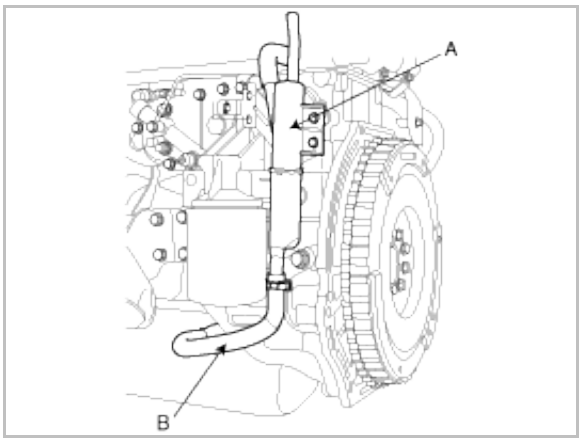
24. Install the oil cooler assembly (A) and the knock sensor (B).

Tightening torque :
Oil cooler bolts:
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)
Knock sensor bolts:
14.7 ~ 24.5Nm (1.5 ~ 2.5kgf.m, 10.8 ~ 18.1lb-ft



25. Install the air separator (A) and hose (B).

Tightening torque :
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



26. Install the water pump, cylinder head and timing belt in order.
27. Remove the engine stand.

KIA MOTORS

Engine Mechanical System

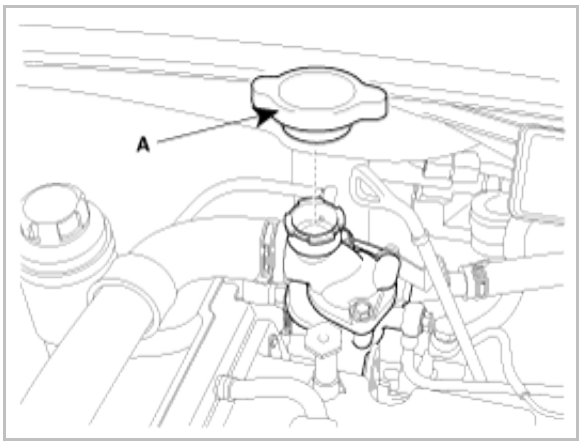
Cooling System

ENGINE COOLANT REFILLING AND BLEEDING

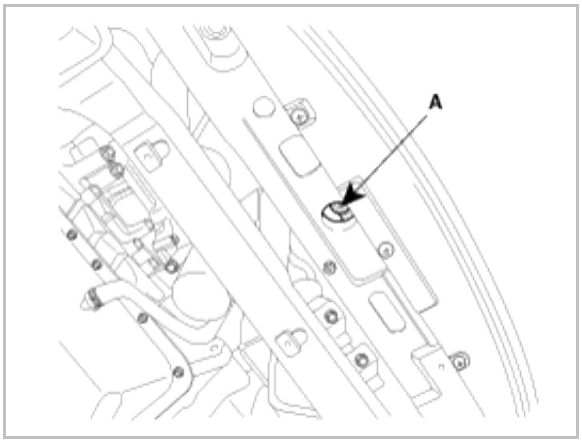
CAUTION

When pouring engine coolant, be sure to shut the relay box lid and not to let coolant spill on the electrical parts of the paint. If any coolant spills, rinse it off immediately.

1. Slide the heater temperature control lever to maximum heat. Make sure the engine and radiator are cool to the touch.
2. Remove the radiator cap(A).



3. Loosen the drain plug(A), and drain the coolant.



4. Tighten the radiator drain plug securely.
5. Remove the coolant reservoir tank. Drain the coolant and reinstall the coolant reservoir tank. Fill the coolant reservoir tank to the MAX mark with the coolant.
6. Mix the recommended antifreeze with an equal amount of water in a clean container.

NOTICE

- Use only genuine antifreeze/coolant.
- For best corrosion protection, the coolant concentration must be maintained year-round at 50% minimum. Coolant concentrations less than 50% may not provide sufficient protection against corrosion of freezing.
- Coolant concentrations greater then 60% will impair cooling efficiency and are not recommended.

CAUTION

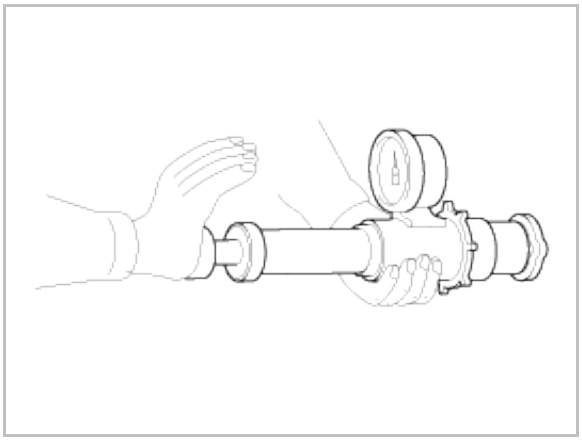
- Do not mix different brands of antifreeze/coolants.
- Do not use additional rust inhibitors or antirust products; they may not be compatible with the coolant.

7. Pour the coolant into the radiator to the base of the filler neck, and install the radiator cap loosely.

8. Start the engine and let it run until it warms up. (until the radiator fan operates 3 or 4 times.)
9. Turn off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be removed from the cooling system.
10. Put the radiator cap on tightly, then run the engine again and check for leaks.

RADIATOR CAP TESTING

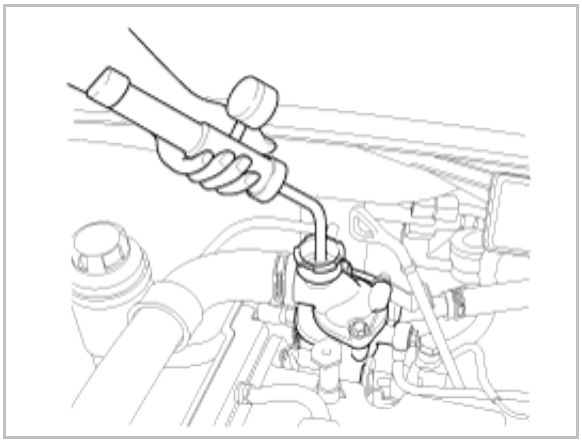
1. Remove the radiator cap, wet its seal with engine coolant, then install it no pressure tester.



2. Apply a pressure of 93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm², 13.51 ~ 17.78psi).
3. Check for a drop in pressure.
4. If the pressure drops, replace the cap.

RADIATOR LEAKGE TEST

1. Wait until engine is cool, then carefully remove the radiator cap and fill the radiator with engine coolant, then install it on the pressure tester.
2. Apply a pressure tester to the radiator and apply a pressure of 93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm², 13.51 ~ 17.78psi).

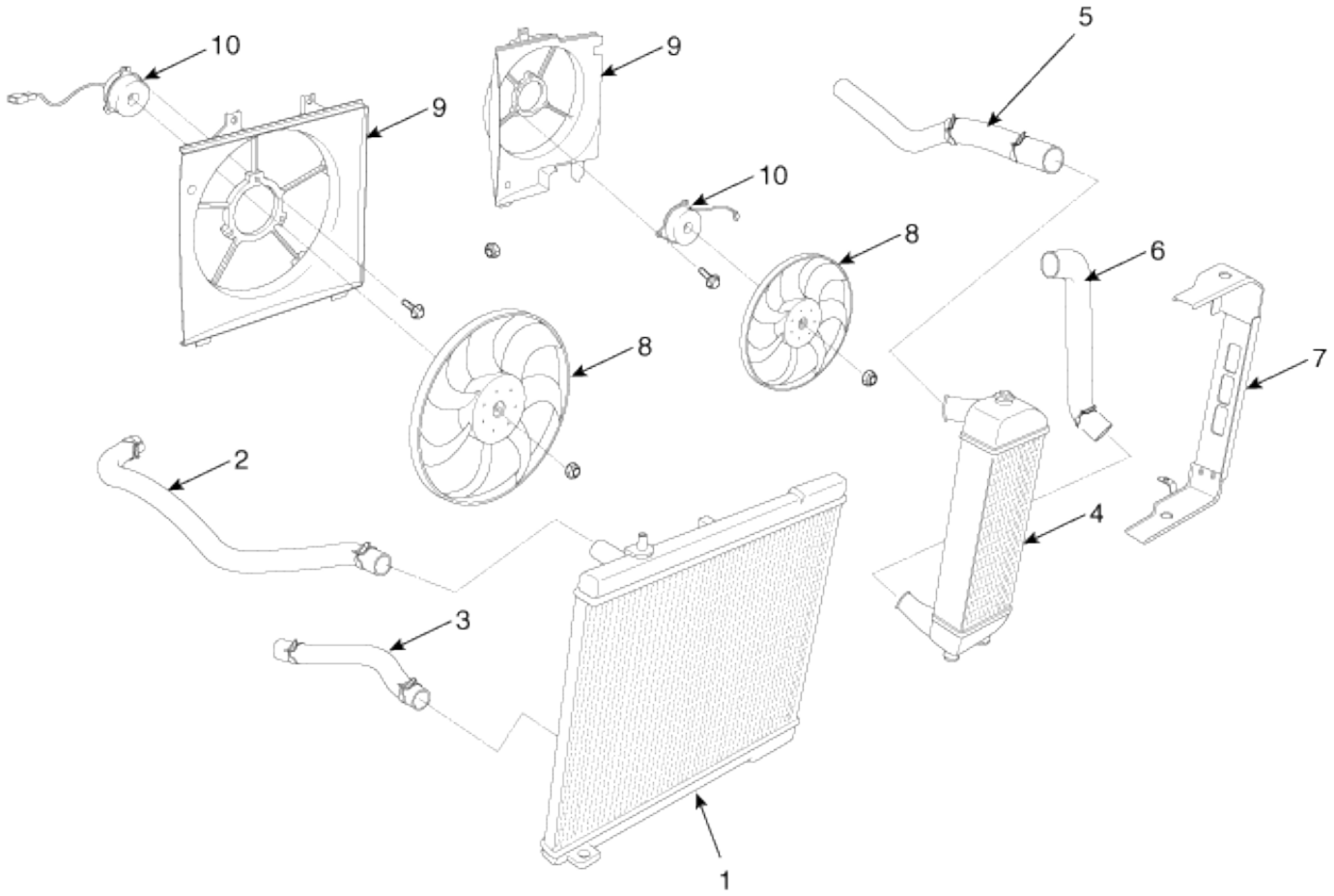


3. Inspect for engine coolant leaks and a drop in pressure.
4. Remove the tester and reinstall the radiator cap.

NOTICE

Check for engine oil in the coolant and/or coolant in the engine oil.

COMPONENTS



1. Radiator
2. Radiator upper hose
3. Radiator lower hose
4. Intercooler
5. Intercooler upper hose
6. Intercooler lower hose
7. Intercooler bracket
8. Cooling fan
9. Cooling fan shroud
10. Cooling fan motor

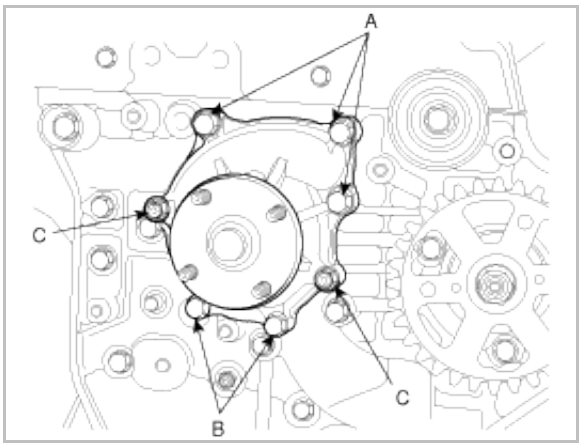
REMOVAL

WATER PUMP

1. Drain the engine coolant.

> **WARNING**
>
> System is under high pressure when the engine is hot. To avoid danger of releasing scalding engine coolant, remove the cap only when the engine is cool.

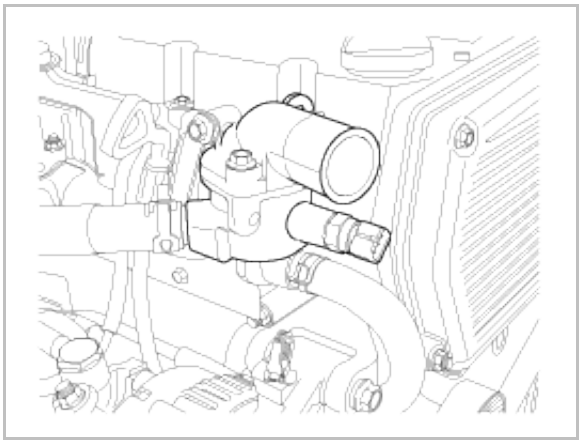
2. Remove the drive belts.
3. Remove the timing belt.
4. Remove the water pump.



THRMOSTAT

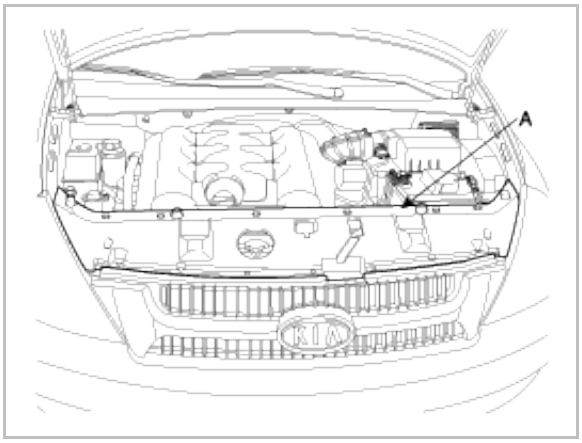
> **NOTICE**
>
> Disassembly of the thermostat would have an adverse effect, causing a lowering of cooling efficiency.

1. Drain the engine coolant so its level is below thermostat.
2. Remove the thermostat housing, gasket and thermostat.

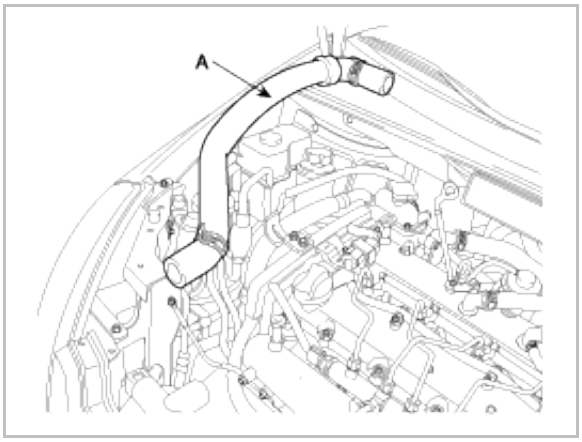


RADIATOR

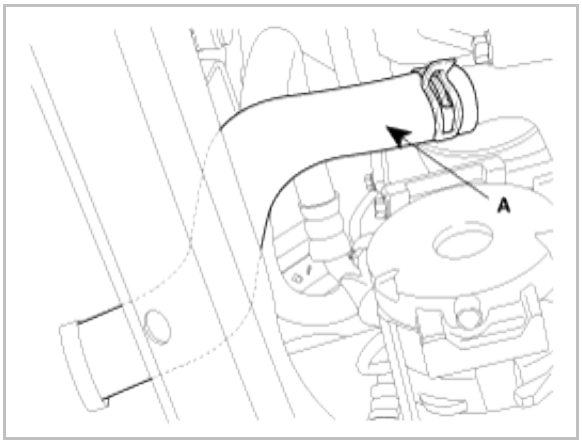
1. Drain the engine coolant.
2. Remove the radiator upper cover(A).



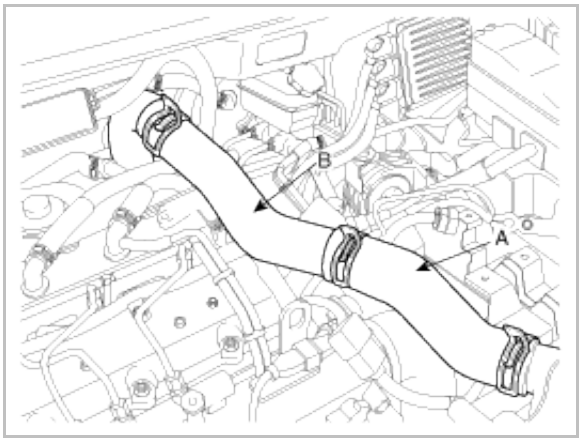
3. Remove the radiator upper hose(A).

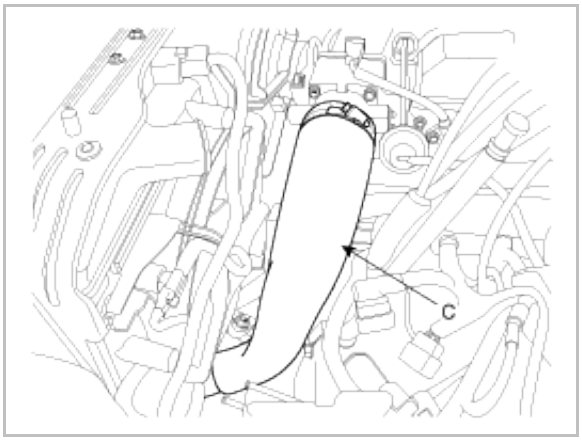


4. Remove the radiator lower hose(A).

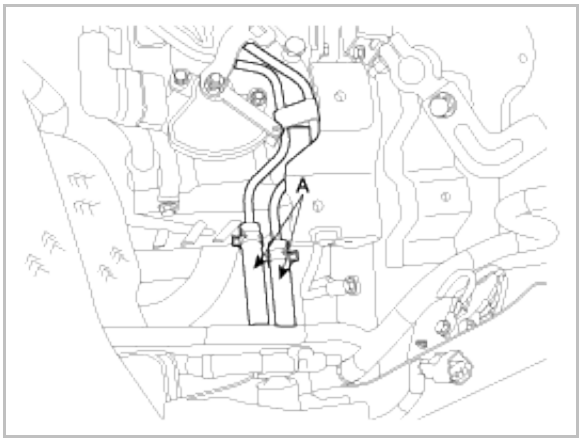


5. Remove the intercooler hose(A,C), pipe(B).

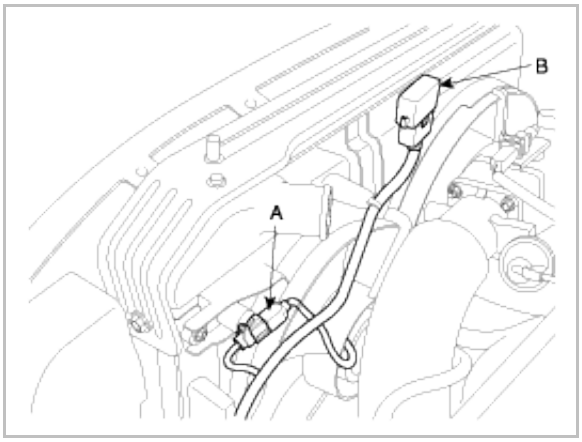


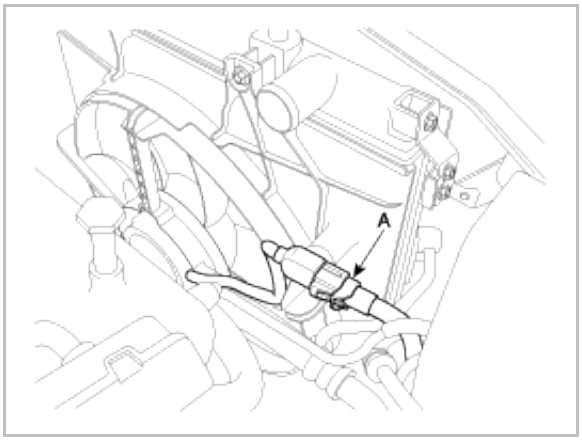


6. Remove the transaxle oil cooler hose(A).

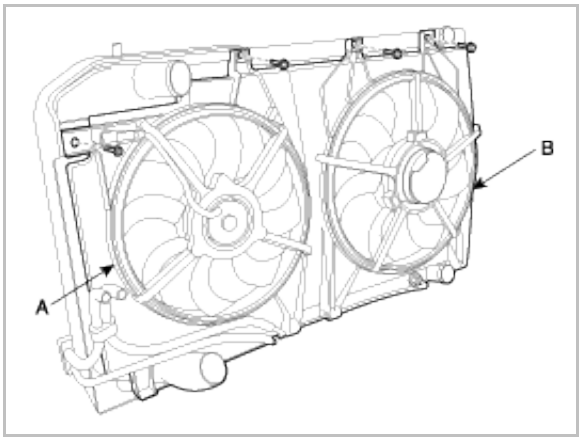


7. Remove the cooling fan motor connector(A) diagnosis connector(B).

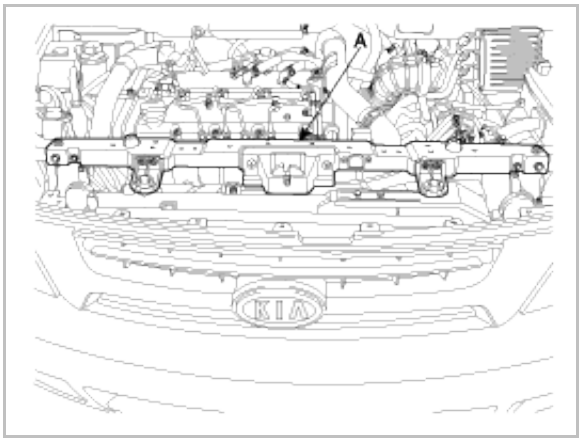




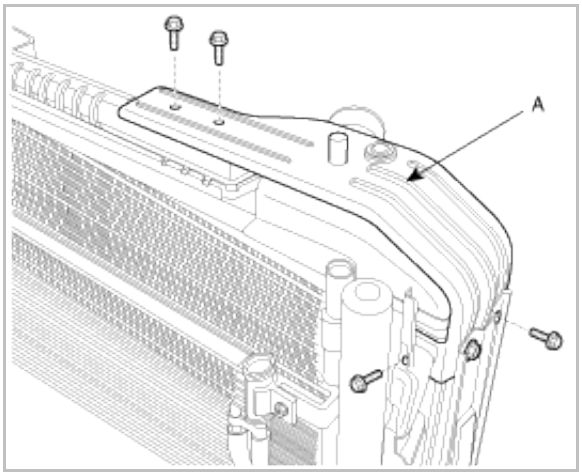
8. Remove the cooling fan motor assembly(A).

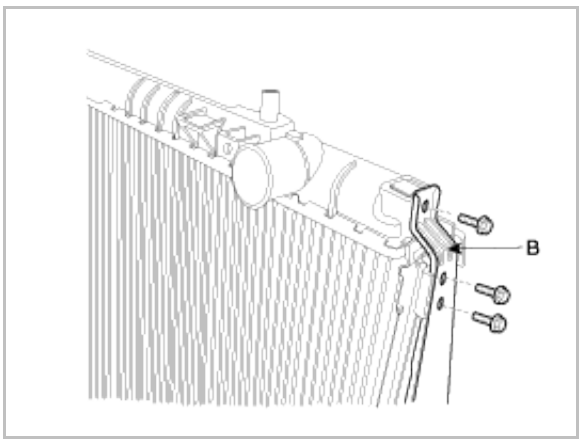


9. Remove the radiator upper bracket(A).



10. Remove the radiator bracket(A,B).





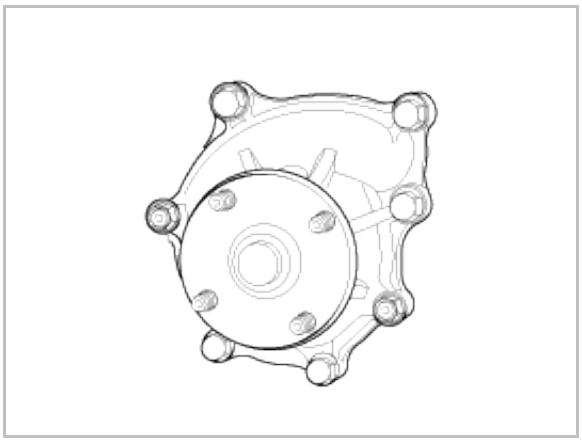
11. Remove the intercooler.

12. Remove the radiator.

INSPECTION

WATER PUMP

1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.

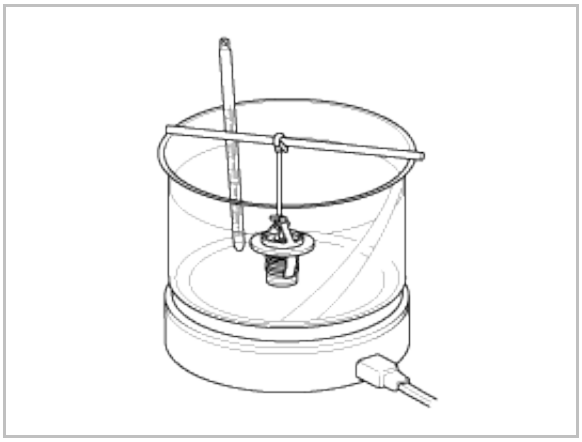


3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. Replace the coolant pump assembly.

> **NOTICE**
>
> A small amount of "engine coolant" from the bleed hole can be weeped.

THERMOSTAT

1. Immerse the thermostat in water and gradually heat the water.



2. Check the valve opening temperature.

Valve opening temperature : 86.5~89.5°C (187.7~193.1°F)
Full opening temperature : 100°C (212°F)

If the valve opening temperature is not as specified, replace the thermostat.

3. Check the valve lift.

Valve lift : 8.5mm(0.3346in) or more at 100°C (212°F)

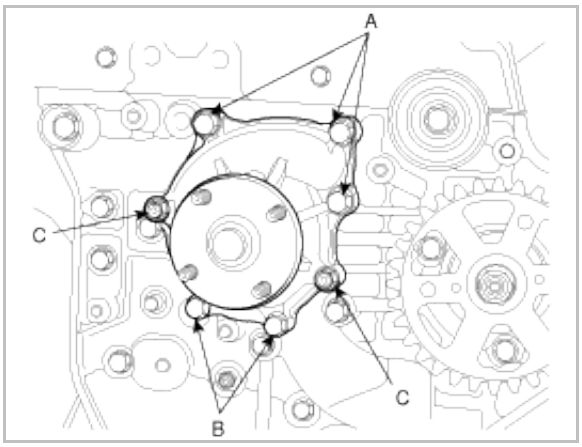
If the valve lift is not as specified, replace the thermostat.

INSTALLATION

WATER PUMP

1. Install the water pump.
   (1) Install the water pump and a new gasket with the bolts, nuts(A,B,C).

Tightening torque :
15.7~22.6Nm (1.6 ~ 2.3kg-m, 11.6~16.6lb-ft)



2. Install the timing belt.
3. Install the water pump pulley, cooling fan.
4. Install the drive belt.
5. Fill with engine coolant.
6. Start engine and check for leaks.
7. Recheck engine coolant level.

THERMOSTAT

1. Install the thermostat housing, thermostat.
2. Install the thermostat bolts.

Tightening torque :
15.7~22.6Nm (1.6 ~ 2.3kgf.m, 11.6~16.6lb-ft)

3. Fill with engine coolant.
4. Start engine and check for leaks.

RADIATOR

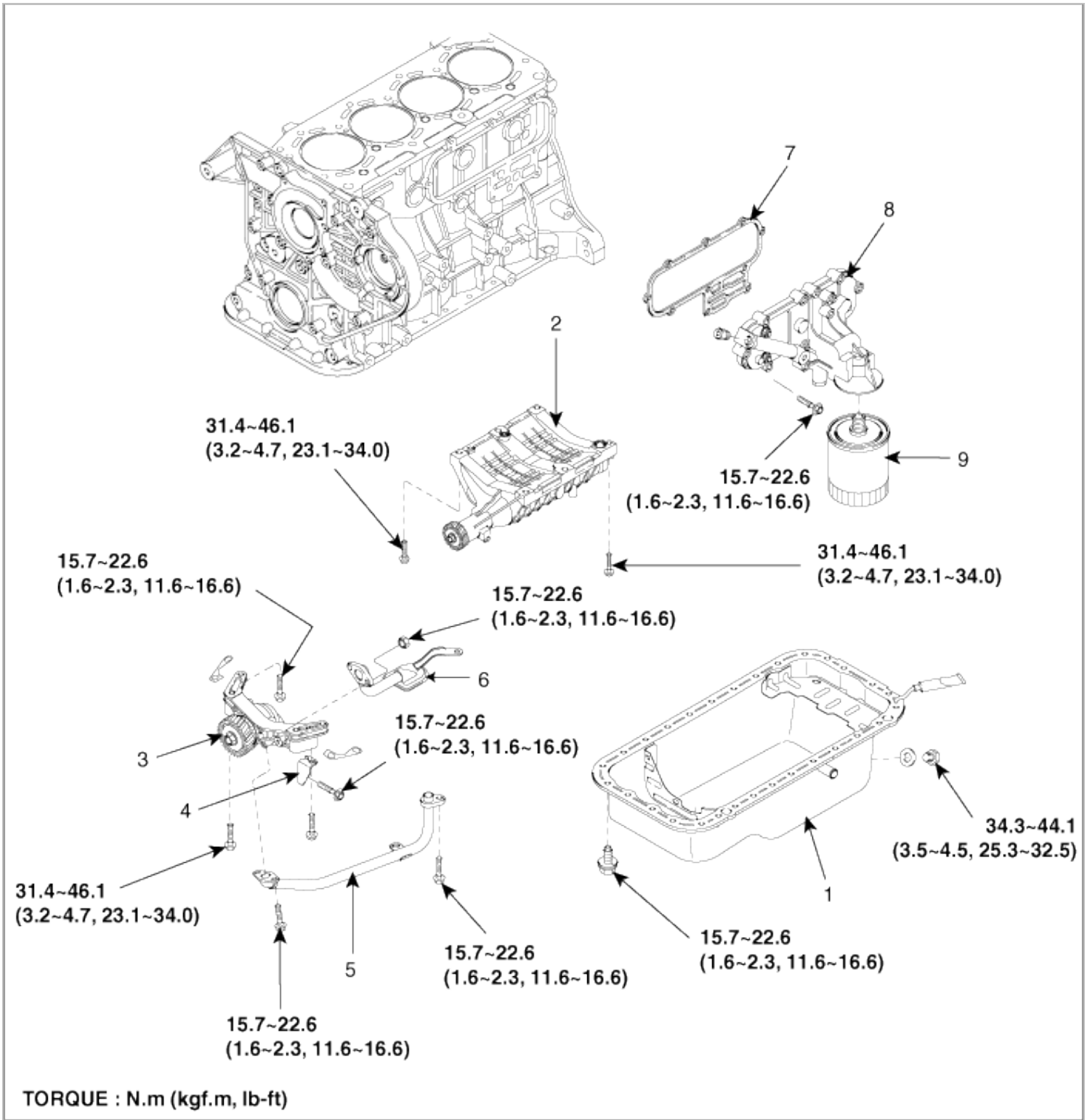
1. Install the radiator. Installation is in the reverse order of removal.
2. Install the air conditioner condenser. (Refer to HA- air conditioner condenser).
3. Install the upper and lower radiator hoses.
4. Refill with engine coolant.
5. Start engine and check for leaks.

KIA MOTORS

Engine Mechanical System

Lubrication System

COMPONENTS



TORQUE : N.m (kgf.m, lb-ft)

1. Oil pan
2. Ladde frame assembly
3. Oil pump assembly
4. Ladde frame bracket
5. Oil pump supply pipe
6. Oil screen
7. Oil cooler gasket
8. Oil cooler assembly
9. Oil filter

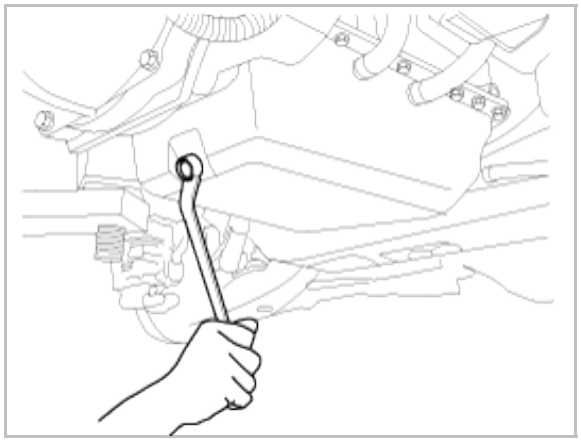
REPLACEMENT

OIL AND FILTER

CAUTION

- Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
- Exercise caution in order to minimize the length and frequency of contact of your skin to used oil. Wear protective clothing and gloves. Wash your skin thoroughly with soap and water, or use water-less hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.
- In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.

1. Drain the engine oil.
   (1) Remove the oil filler cap.
   (2) Remove the oil drain plug, and drain the oil into a container.



2. Replace the oil filter.
   (1) Remove the oil filter.
   (2) Check and clean the oil filter installation surface.
   (3) Check the part number of the new oil filter is as same as old one.
   (4) Apply clean engine oil to the gasket of a new oil filter.
   (5) Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.
   (6) Tighten it an additional 3/4 turn.

Tightening torque :
21.6~24.5Nm (2.2~2.5kgf.m, 15.9~18.1lb-ft)

3. Refill with engine oil.
   (1) Clean and install the oil drain plug with a new gasket.

Tightening torque :
34.3~44.1Nm (3.5~4.5kgf.m, 25.3~32.5lb-ft)

   (2) Fill with fresh engine oil.

Oil Capacity
Total : 8.0 L (8.45 US qt, 7.03 Imp qt)
Oil pan : 6.0 L (6.34 US qt, 5.27 Imp qt)
Drain and refill including oil filter : 6.6 L (6.97 US qt, 5.08 Imp qt)

Oil quality : ABOVE API CH-4 or ABOVE ACEA B4

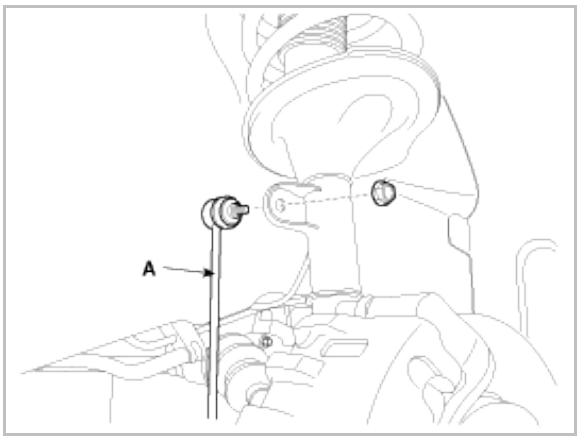
(3) Install the oil filler cap.

4. Start engine and check for oil leaks.
5. Recheck the engine oil level.

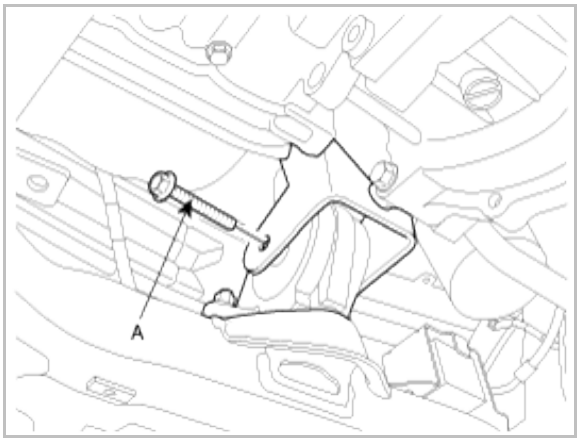
REMOVAL

OIL PAN

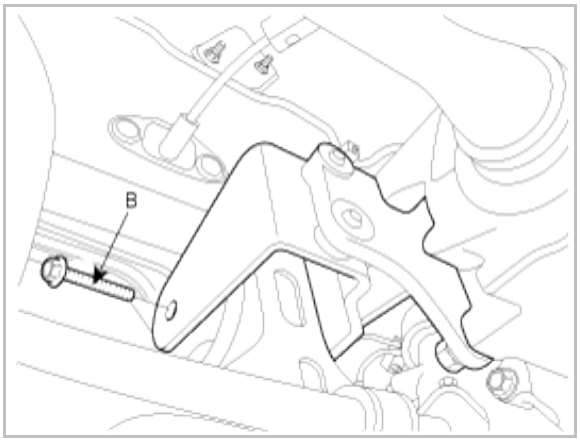
1. Drain the engine oil.
2. Remove the RH tires.
3. Remove the RH stabilizer bar link(A).



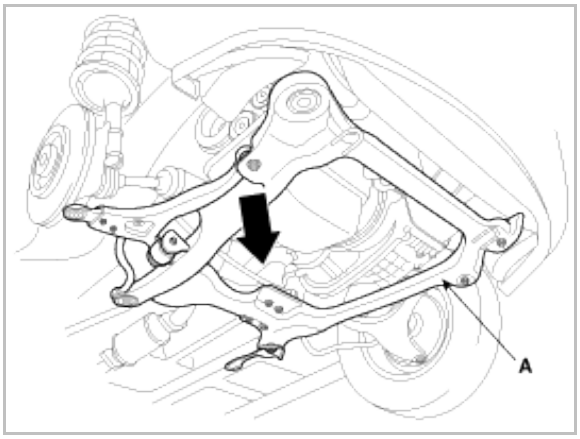
4. Remove the front roll stopper insulator mounting bolt(A).



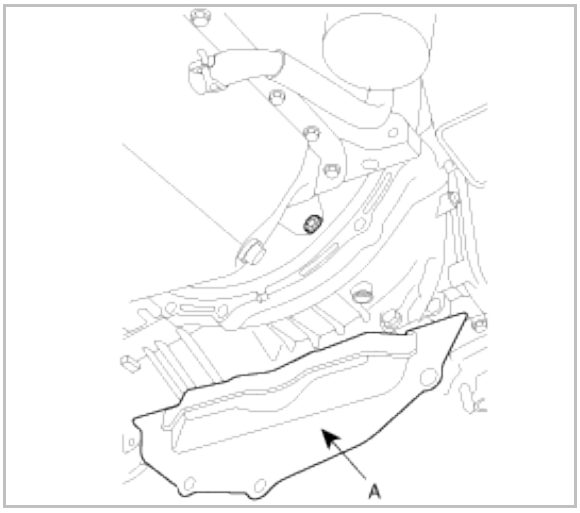
5. Remove the rear roll stopper insulator mounting bolt(B).



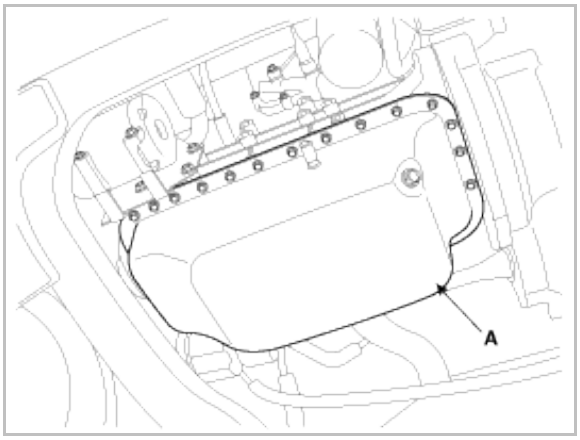
6. Remove the RH sub frame mounting bolts.
7. Tilt the sub frame(A) sideways by loosening the RH sub frame mounting bolts only.



8. Remove the plate(A) between the engine and the transaxle.

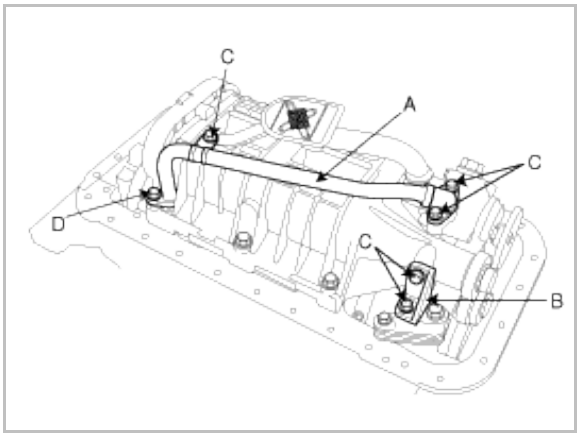


9. Using the SST(09215-3C000), remove the oil pan(A).

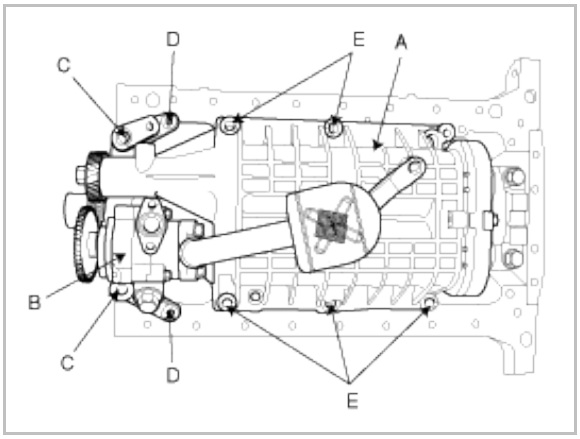


OIL PUMP

1. Drain the engine oil.
2. Turn the crankshaft pulley, and align its groove with timing mark “T” of the timing belt cover.
3. Remove the oil pan.
4. Remove the oil supply pipe(A), ladde frame bracket(B).



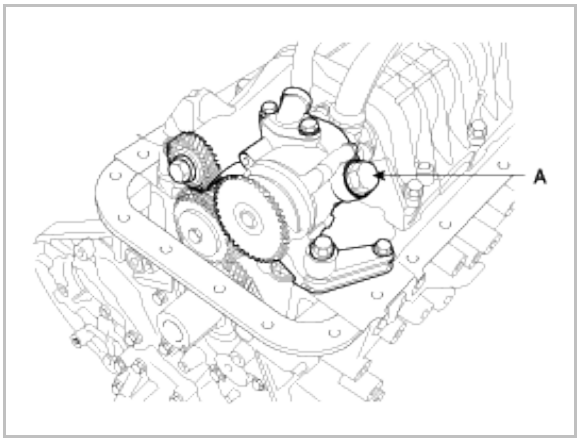
5. Remove the ladde frame(A), oil pump assembly(B).



DISASSEMBLY

RELIEF PLUNGER

1. Remove the relief plunger.
   Remove the plug(A), spring and relief plunger.



INSPECTION

RELIEF PLUNGER

1. Inspect the relief plunger.
   Coat the plunger with engine oil and check that it falls smoothly into the plunger hole by its own weight.
   If it does not, replace the relief plunger. If necessary, replace the front case.
2. Inspect the relief valve spring.
   Inspect for distorted or broken relief valve spring.

Standard value
Free height : 46.3mm (1.8228in)
Load : 6.13±5% kgf/38.05mm (13.5±1.1% lb/1.4980in)

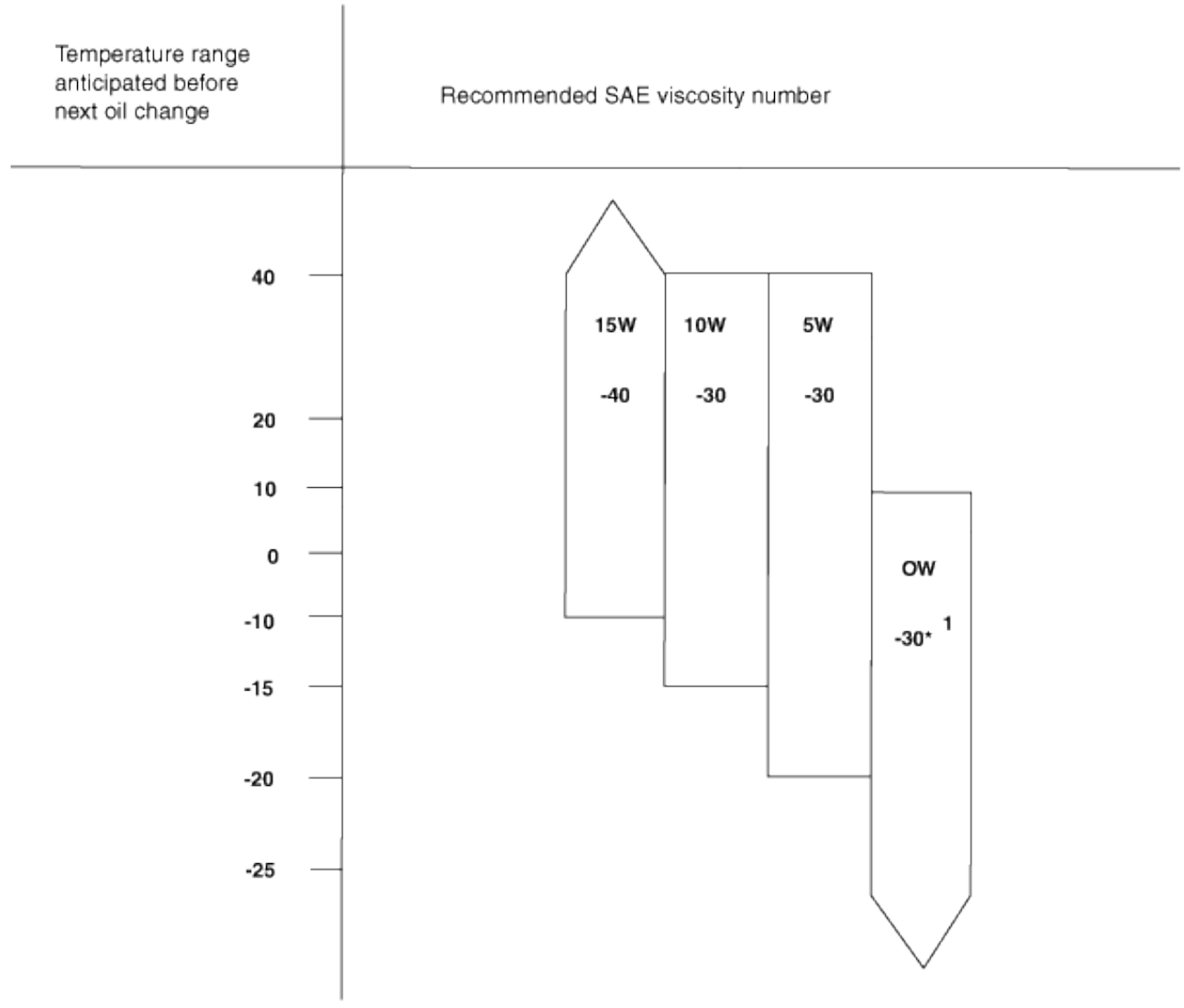
ENGINE OIL

1. Check the engine oil quality.
   Check the oil deterioration, entry of water, discoloring of thinning.
   If the quality is visibly poor, replace the oil.
2. Check the engine oil level.
   After warning up the engine and then 5 minutes after the engine stop, oil level should be between the “L” and “F” marks in the dipstick.
   If low, check for leakage and add oil up to the “F” mark.

> **NOTICE**
>
> Do not fill with engine oil above the “F” mark.

SELECTION OF ENGINE OIL

Recommended API classification : CH- 4 OR ABOVE(5W-30)
Recommended SAE viscosity grades :



*1 Restricted by driving condition and environment.
Not recommended for sustained high speed vehicle operation

> **NOTICE**
>
> For best performance and maximum protection of all types of operation, select only those lubricants which :
> • Satisfy the requirement of the API classification.
> • Have proper SAE grade number for expected ambient temperature range.
> Lubricants that do not have both an SAE grade number and API service classification on the container should not

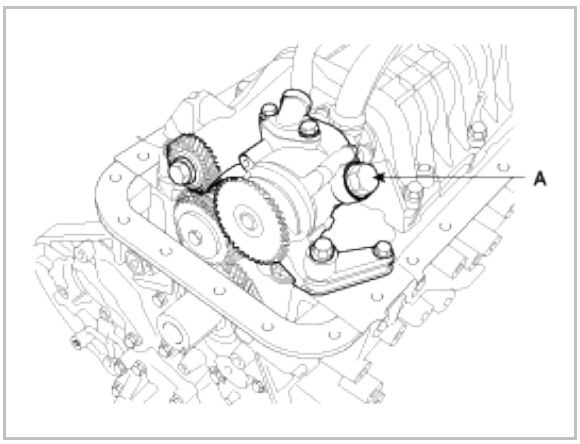
be used.

REASSEMBLY

RELIEF PLUNGER

1. Install the relief plunger.
   Install relief plunger and spring into the front case hole, and install the plug(A).

Tightening torque :
32.4~42.2Nm (3.3~4.3kgf.m, 23.9~31.1lb-ft)



INSTALLATION

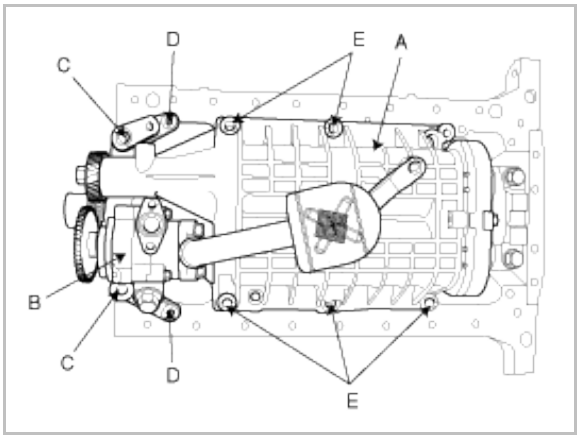
OIL PUMP

1. Install the oil screen and new gasket.

Tightening torque :
15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)

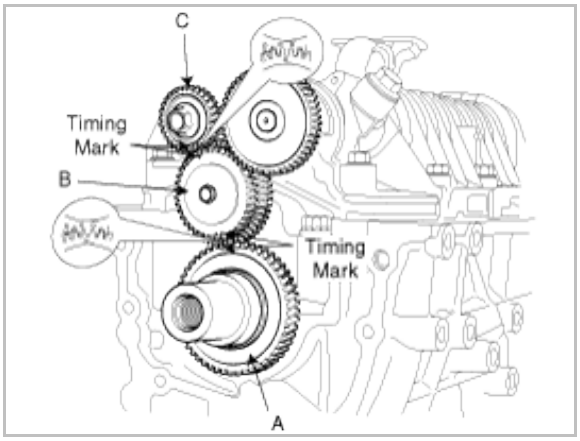
2. Install the ladde frame(A), oil pump assembly(B) with the bolts(C,D,E).

Tightening torque :
Bolts(C): 31.4~46.1Nm (3.2~4.7kgf.m, 23.1~34.0lb-ft)
Bolts(D): 15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)
Bolts(E): 31.4~46.1Nm (3.2~4.7kgf.m, 23.1~34.0lb-ft)



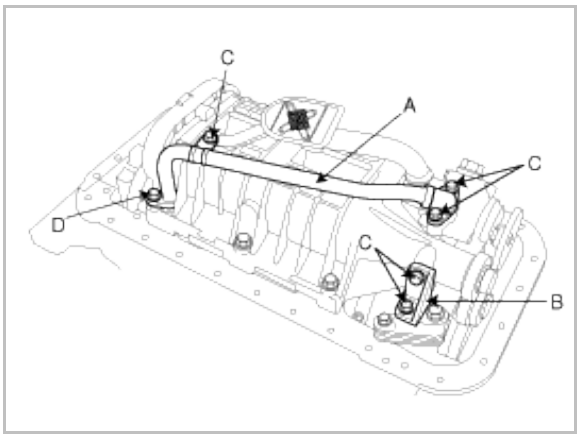
NOTICE

Align the timing marks on the crankshaft sprocket(A), idler(B) and balancer sprocket(C).



3. Install the oil supply pipe(A), ladde frame bracket(B) with the bolts(C,D).

Tightening torque:
15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)



4. Install the oil pan.
5. Fill with engine oil.

OIL PAN

1. Install the oil pan.
   (1) Using a razor blade and gasket scraper, remove all the old packing material from the gasket surfaces.

> **NOTICE**
> Check that the mating surfaces are clean and dry before applying liquid gasket.

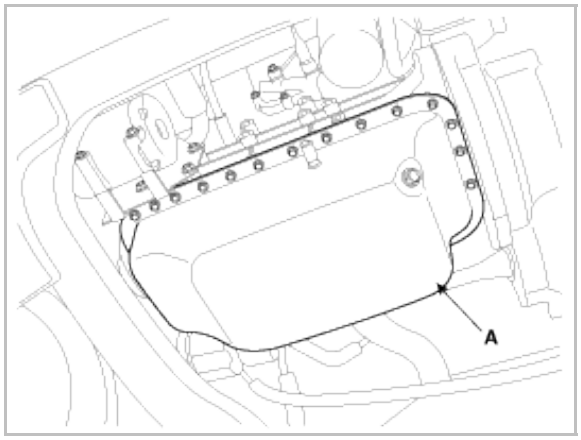
   (2) Apply liquid gasket as an even bead, centered between the edges of the mating surface.

Liquid gasket: LOCTITE 5900 or equivalent

> **NOTICE**
> - To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.
> - Do not install the parts if five minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the residue.
> - After assembly, wait at least 30 minutes before filling the engine with oil.

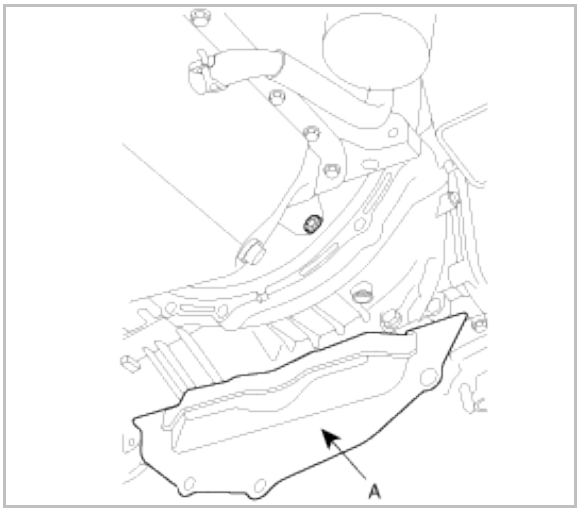
   (3) Install the oil pan(A) with the bolts.
   Uniformly tighten the bolts in several passes.

Tightening torque :
15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)



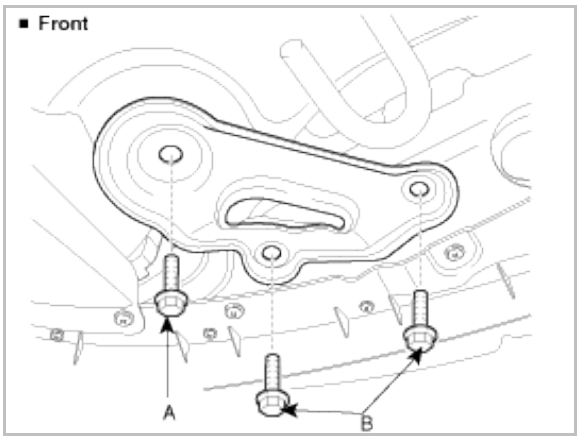
2. Install the plate(A) between the engine and the transaxle assembly.

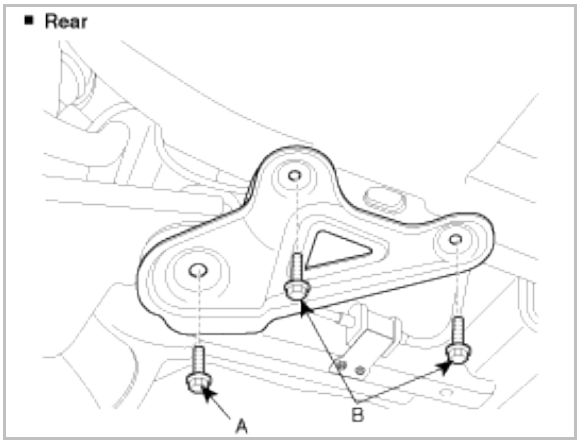
Tightening torque :
15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)



3. Install the RH, LH sub frame mounting bolts(A,B).

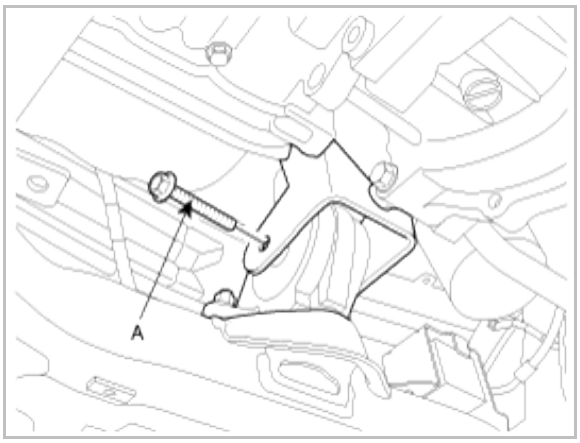
Tightening torque :
156.9~176.5Nm (16.0~18.0kgf.m, 115.7~130.2lb-ft)
44.1~58.8Nm (4.5~6.0kgf.m, 32.5~43.4lb-ft)





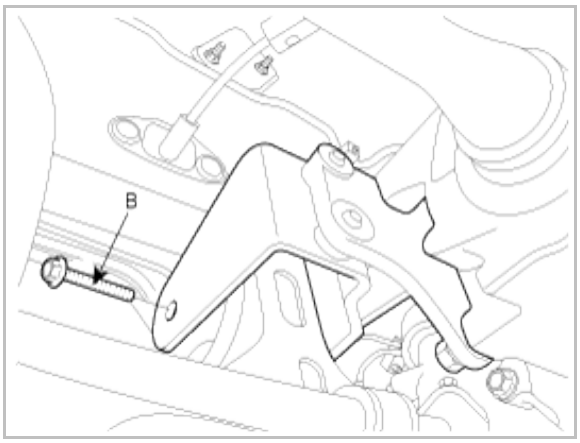
4. Install the front roll stopper insulator mounting bolt(A).

Tightening torque :
88.3~107.9Nm (9.0~11.0kgf.m, 65.1~79.6lb-ft)



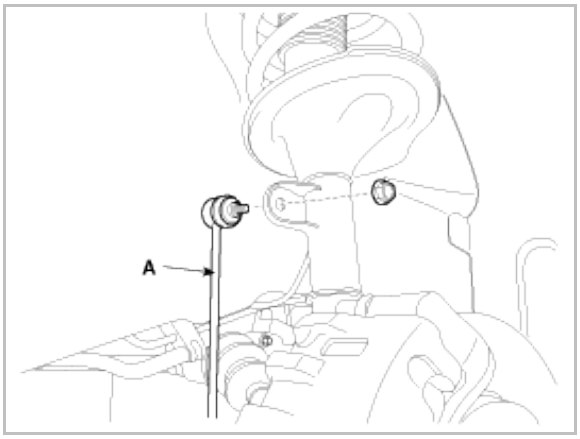
5. Install the rear roll stopper insulator mounting bolt(A).

Tightening torque :
88.3~107.9Nm (9.0~11.0kgf.m, 65.1~79.6lb-ft)



6. Install the RH stabilizer bar link(A).

Tightening torque:
98.1~117.7Nm (10.0~12.0kgf.m, 72.3~86.8lb-ft)



7. Remove the RH tires.

Tightening torque :
88.3~107.9Nm (9.0~11.0kgf.m, 65.1~79.6lb-ft)

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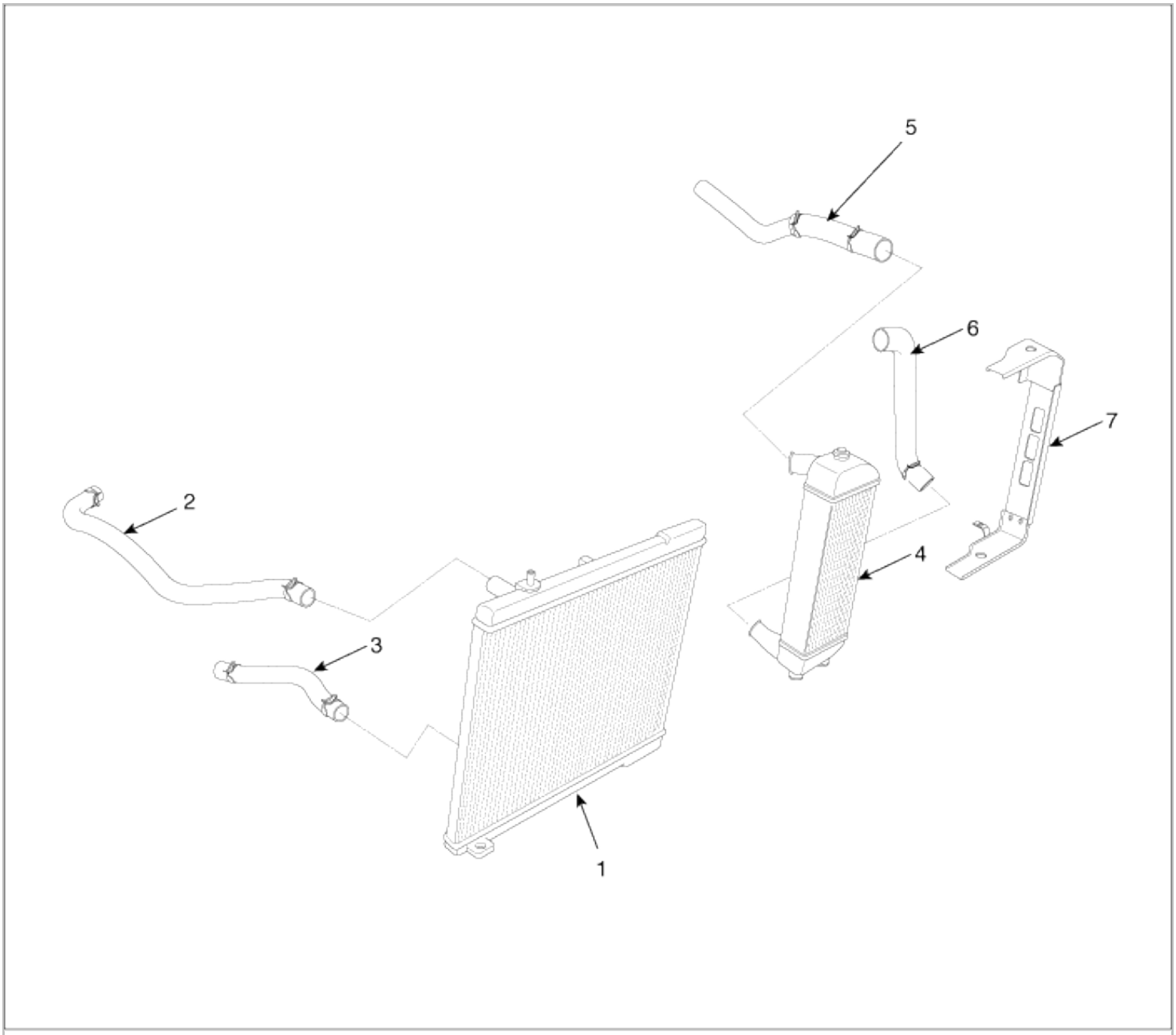
8. Fill with engine oil

KIA MOTORS

Engine Mechanical System

Intake and Exhaust System - Intercooler

COMPONENTS



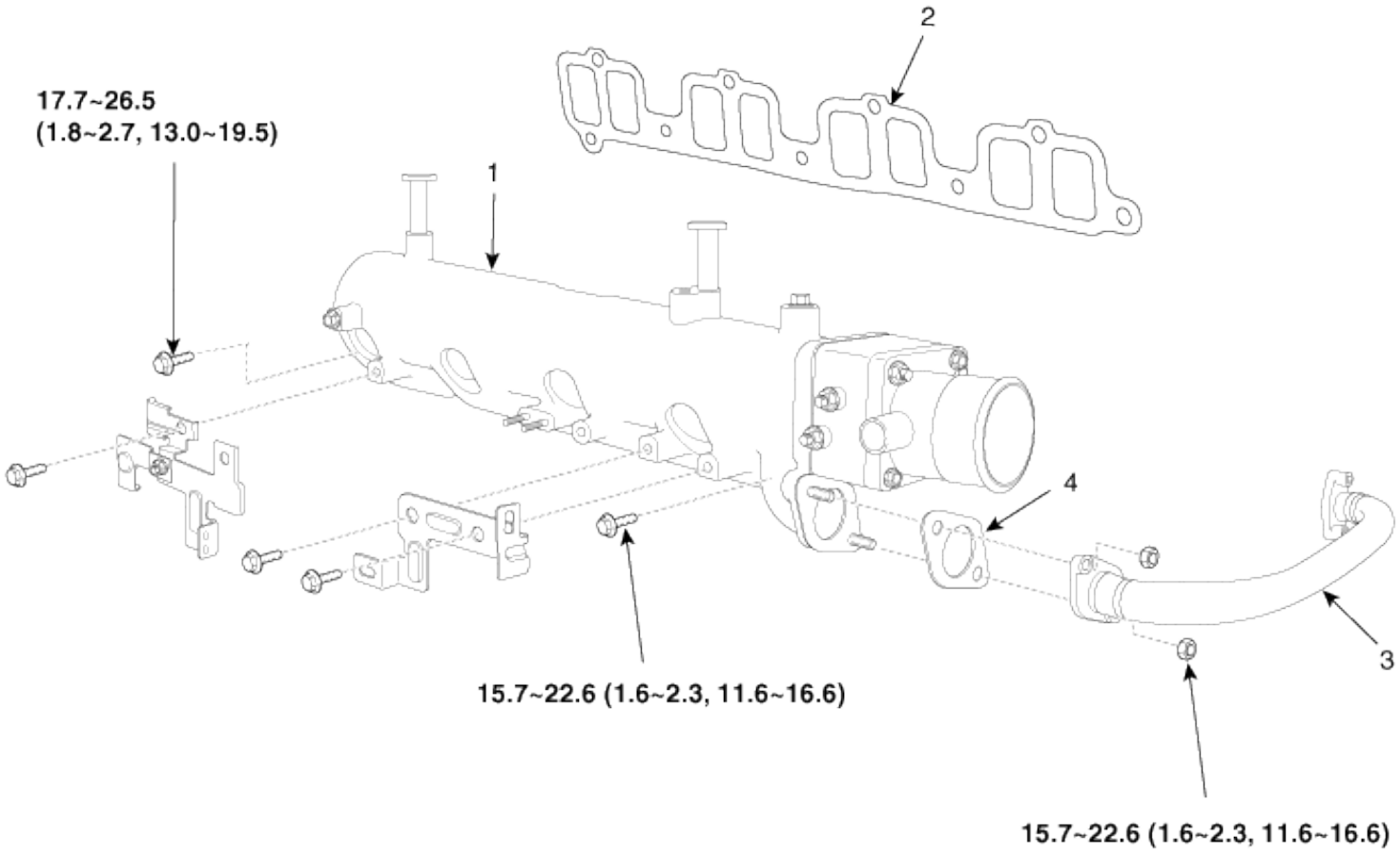
1. Radiator
2. Radiator upper hose
3. Radiator lower hose
4. Intercooler
5. Intercooler upper hose
6. Intercooler lower hose
7. Intercooler bracket

KIA MOTORS

Engine Mechanical System

Intake and Exhaust System - Intake Manifold

COMPONENTS



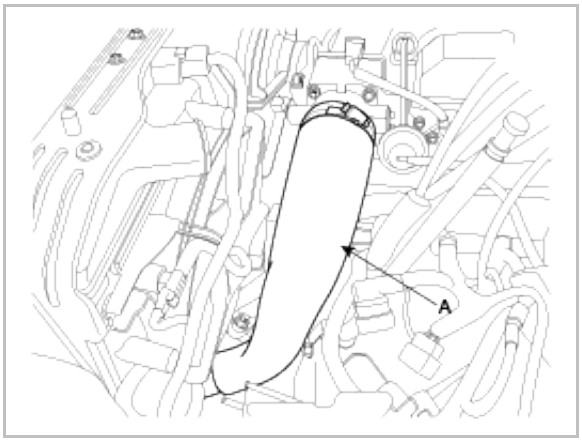
TORQUE : N.m (kgf.m, lb-ft)

1. Intake manifold
2. Intake manifold gasket
3. EGR pipe
4. EGR pipe gasket

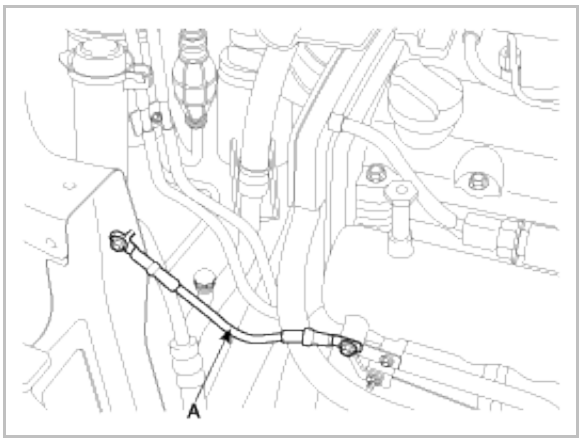
REMOVAL

INTAKE MANIFOLD

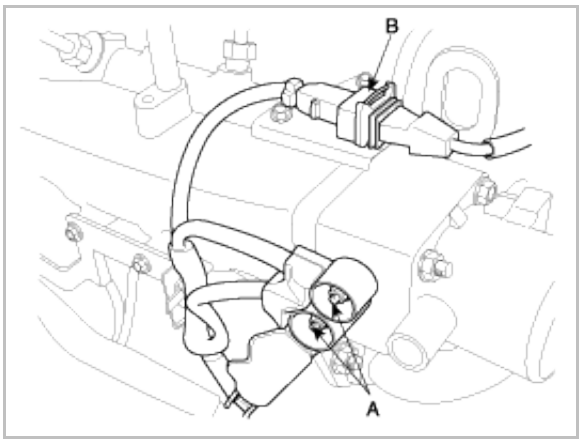
1. Remove the air intake hose, air cleaner assembly.
2. Remove the intercooler hoses(A).



3. Remove the ground cable(A) from cylinder head.

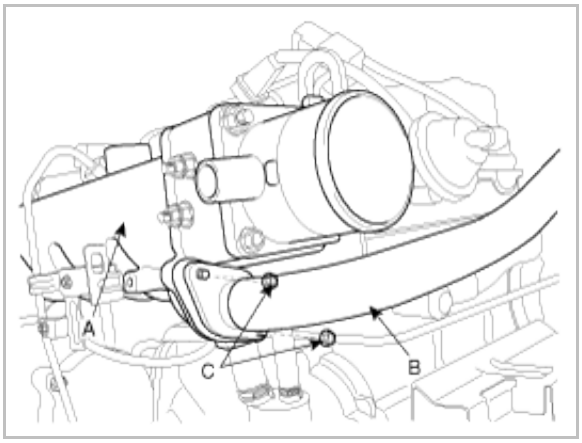


4. Remove the air hester terminals(A) CMP(Crankshaft position sensor) connector(B).



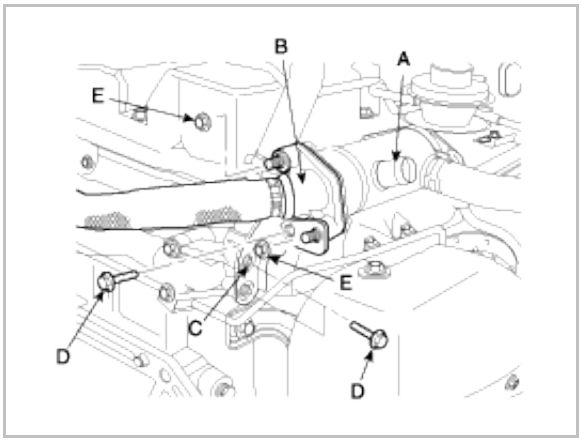
5. Remove the injection high pressure. (Refer to FL group).
6. Remove the EGR pipe(B).

Tightening torque :
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

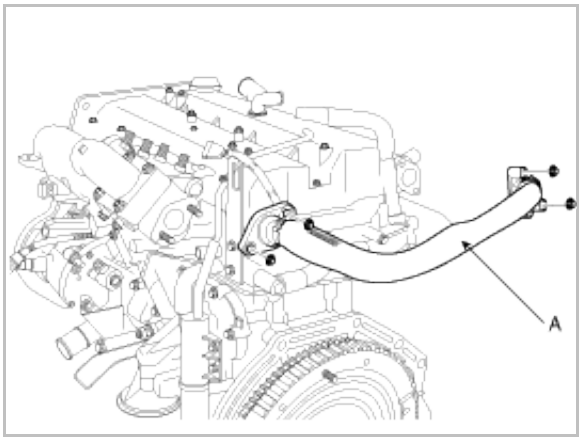


7. Remove the EGR pipe

Tightening torque :
Bolts(D), Nut(E): 15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

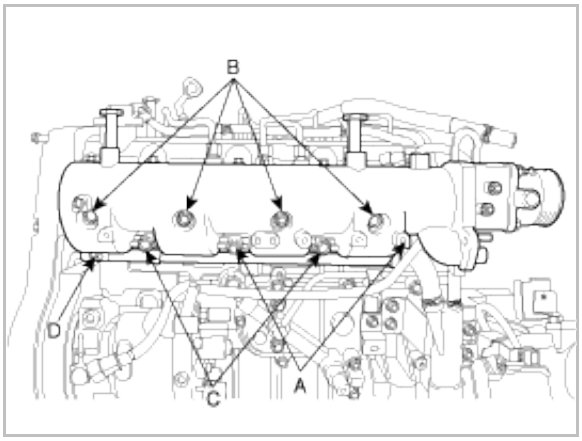


8. Remove the EGR pipe(A).



9. Remove the intake manifold.

Tightening torque :
Bolts(A,B), Nut(C): 15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)
Hexagonal wrench bolt (D): 17.7 ~ 26.5Nm (1.8 ~ 2.7kgf.m, 13.0 ~ 19.5lb-ft)



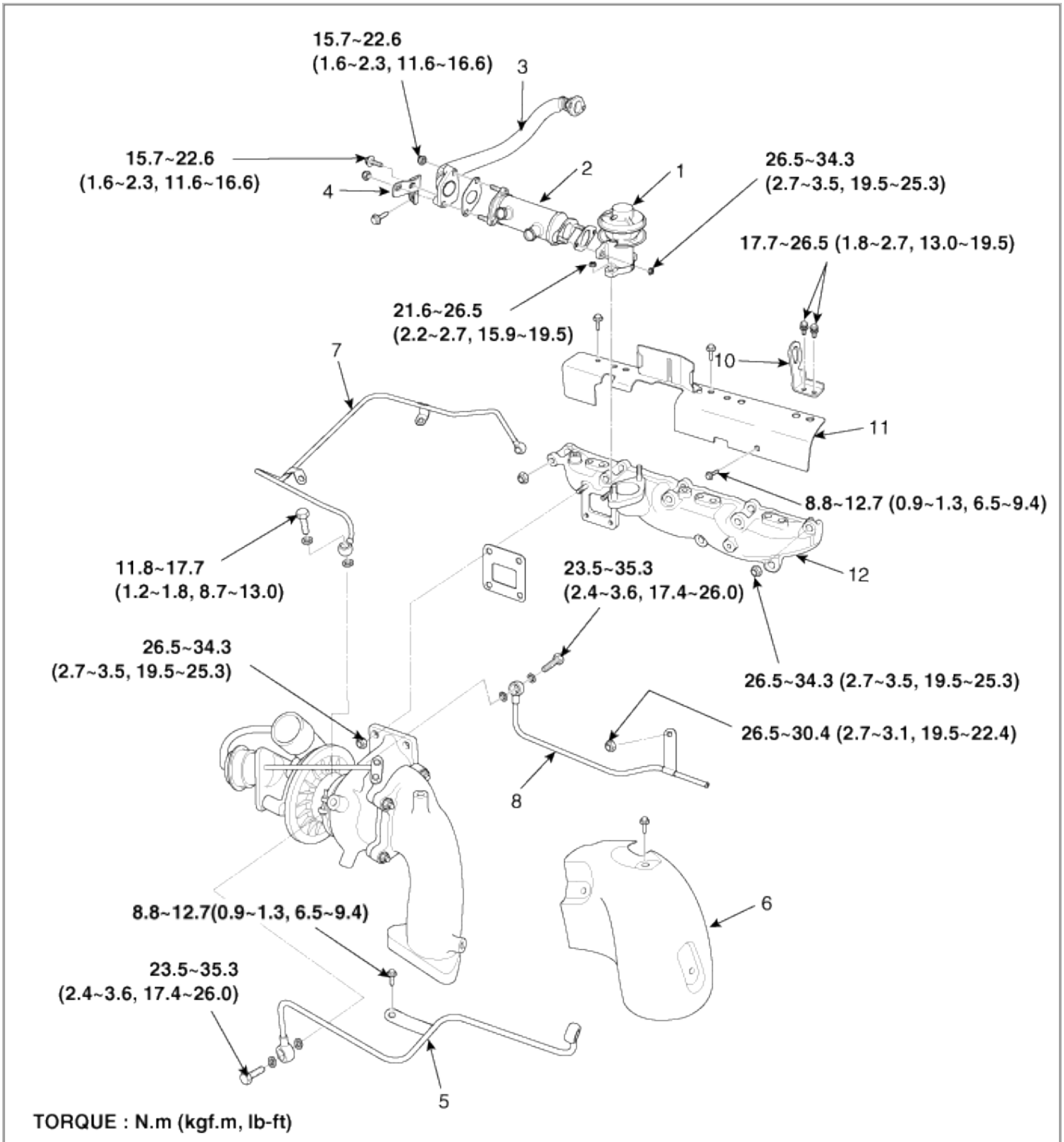
10. Installation is in the reverse order of removal with new gasket.

KIA MOTORS

Engine Mechanical System

Intake and Exhaust System - Exhaust Manifold

COMPONENTS

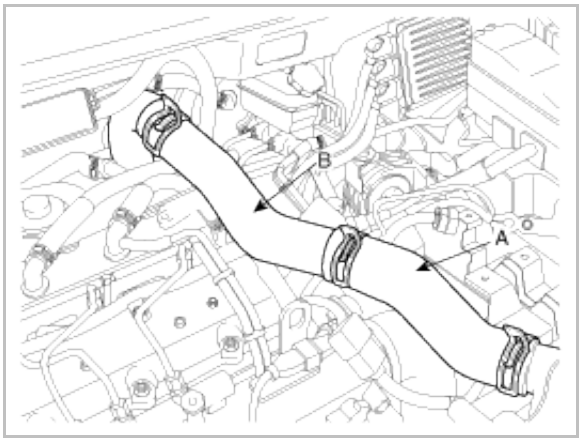


1. EGR valve
2. EGR cooler
3. EGR pipe
4. EGR pipe mounting
5. Turbo chargers water inlet pipe
6. Heat protector
7. Turbo chargers oil inlet pipe
8. Turbo chargers water outlet pipe
9. Turbo charger assembly
10. Engine hanger
11. Exhaust manifold insulator
12. Exhaust manifold

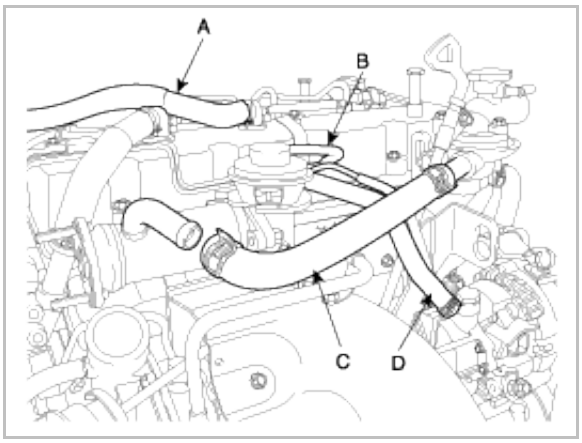
REMOVAL

EXHAUST MANIFOLD

1. Remove the air intake hose, air cleaner assembly.
2. Remove the intercooler hoses, pipe(A, B).

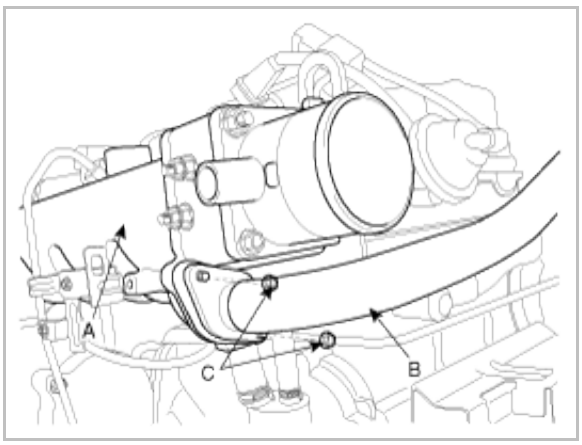


3. Remove the PCV(Positive Crankcase Ventilation) hose(A), EGR valve vacuum hose(B), EGR cooier water hose(C), vacuum pump oil hose(D).



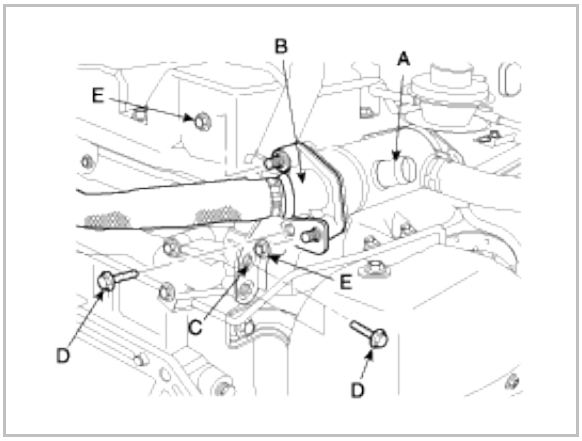
4. Remove the EGR pipe(B).

Tightening torque :
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

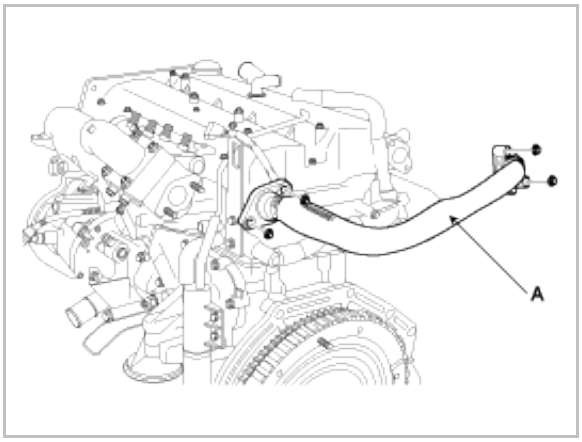


5. Remove the EGR pipe

Tightening torque :
Bolts(D), Nut(E): 15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

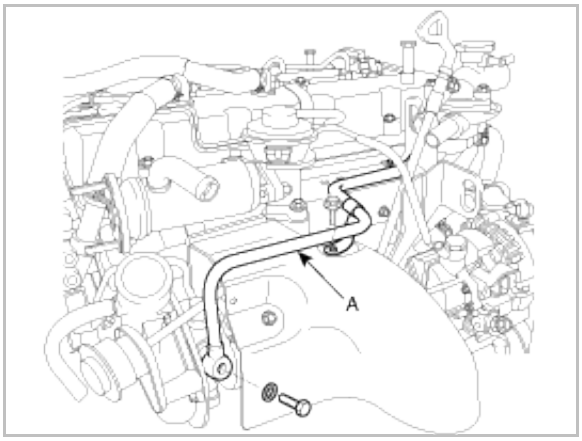


6. Remove the EGR pipe(A).



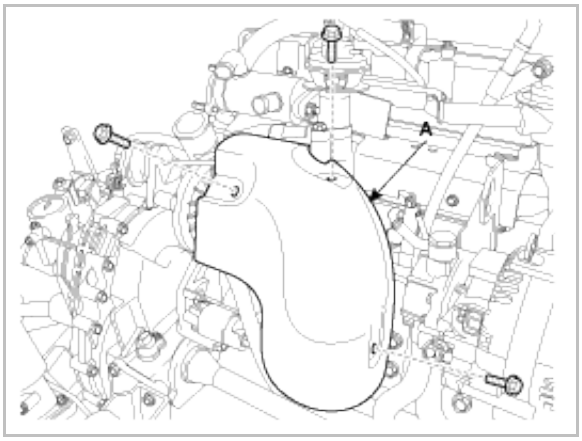
7. Remove the turbo chargers water inlet pipe(A).

Tightening torque :
Eye bolt(B): 23.5~35.3Nm (2.4~3.6kgf.m, 17.4~26.0lb-ft)
Bolt(C): 8.8~12.7Nm (0.9~1.3kgf.m, 6.5~9.4lb-ft)



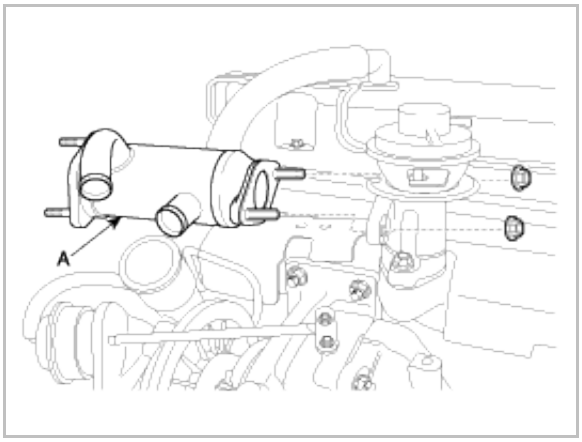
8. Remove the heat protector(A).

Tightening torque :
8.8~12.7Nm (0.9~1.3kgf.m, 6.5~9.4lb-ft)



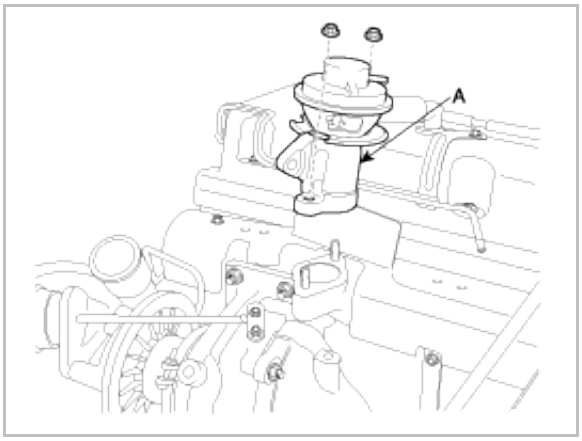
9. Remove the EGR cooler(A).

Tightening torque :
26.5~34.3Nm (2.7~3.5kgf.m, 19.5~25.3lb-ft)



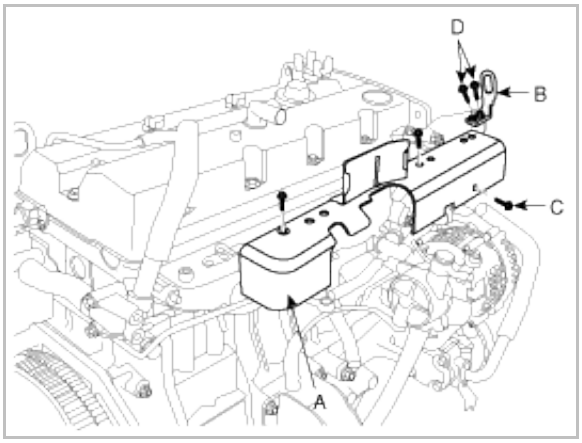
10. Remove the EGR valve(A).

Tightening torque :
21.6~26.5Nm (2.2~2.7kgf.m, 15.9~19.5lb-ft)



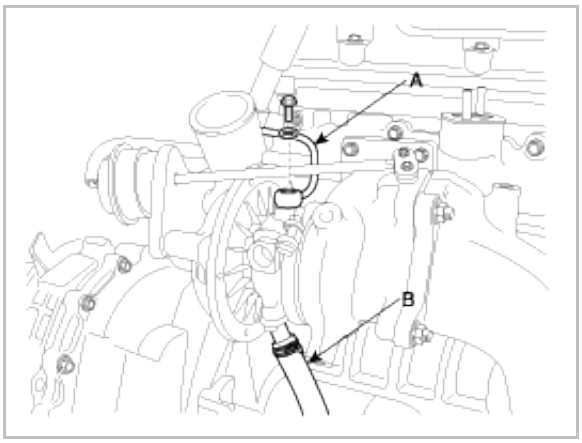
11. Remove the exhaust manifold insulator(A), engine hanger(B).

Tightening torque :
Bolts(C): 8.8~12.7Nm (0.9~1.3kgf.m, 6.5~9.4lb-ft)
Bolts(D): 17.7 ~ 26.5Nm (1.8 ~ 2.7kgf.m, 13.0 ~ 19.5lb-ft)



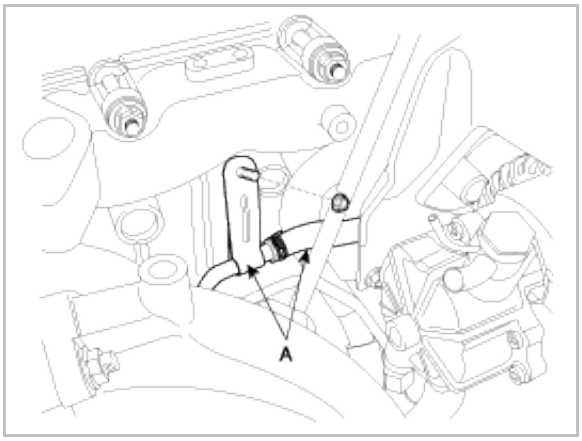
12. Remove the turbo charger oil inlet pipe(A), oil outlet hose(B).

Tightening torque :
11.8~17.7Nm (1.2~1.8kgf.m, 8.7~13.0lb-ft)



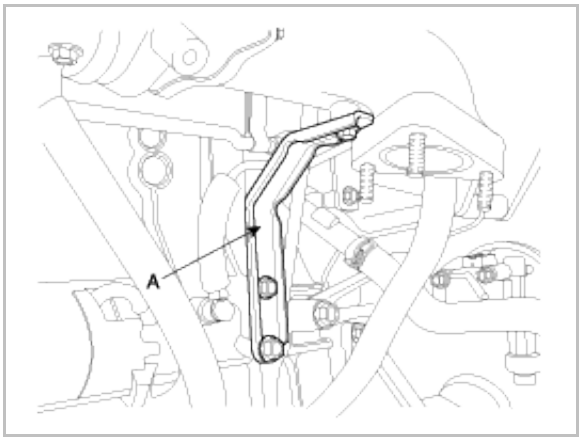
13. Remove the turbo charger water outlet pipe, hose(A).

Tightening torque :
23.5~35.3Nm (2.4~3.6kgf.m, 17.4~26.0lb-ft)



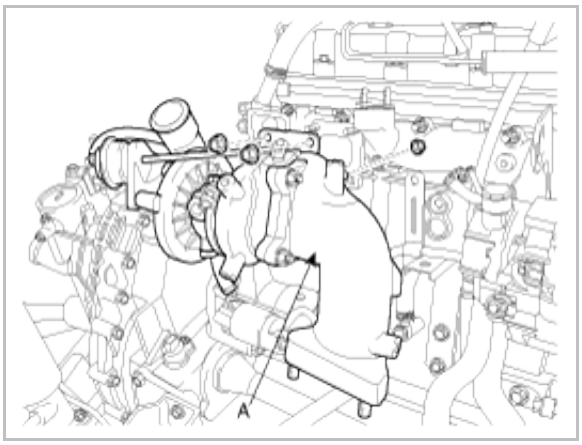
14. Remove the turbo charger stay(A).

Tightening torque :
30.4~36.3Nm (3.1~3.7kgf.m, 22.4~26.8lb-ft)

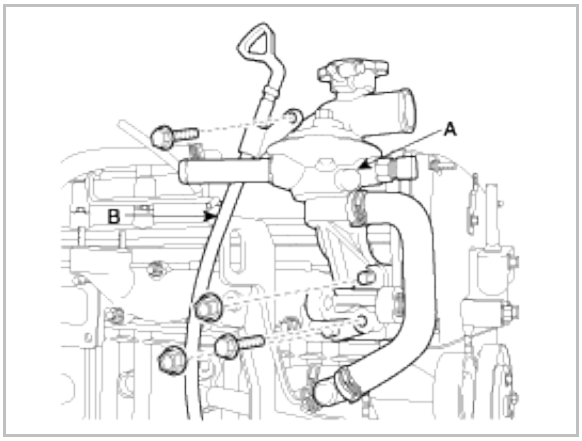


15. Remove the turbo charger assembly(A).

Tightening torque :
26.5~34.3Nm (2.7~3.5kgf.m,19.5~25.3lb-ft)

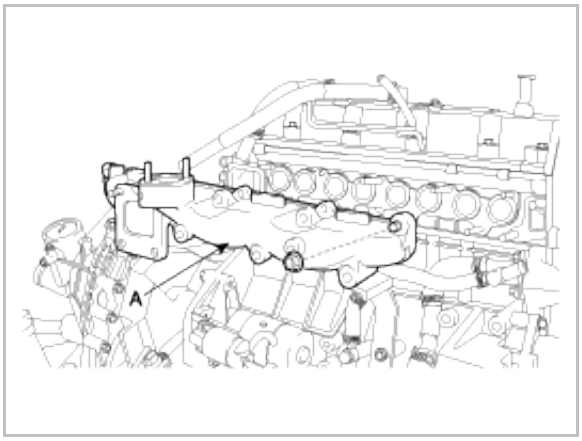


16. Remove the generator. (Refer to EE group).
17. Remove the thermostat case(A), oil level gauge tube(B).



18. Remove the exhaust manifold(A).

Tightening torque :
26.5~34.3Nm (2.7~3.5kgf.m,19.5~25.3lb-ft)



INSPECTION

TURBO CHARGER

1. Warm up the engine to the normal temperature.
2. After removing the hose between the intake manifold and the intercooler, install the pressure gauge with 3-way connector.
3. Measure the maximum pressure data by starting the engine and raising up the rpm.

PRESSURE GAUGE	INSPECTION
Not fixed pressure or low pressure	- Leakage from the intake or exhaust system - Inferior turbocharger
Pressure is above the standard. (630~670mmHg/3,800rpm)	- Leakage from the inferior actuator hose - Actuator defect

ACTUATOR

1. After removing the air hose from the actuator, install the pressure tester.
2. Install the dial gauge in a straight line with the actuator rod.
3. Using the pressure tester, when the pressure, 1,320~1,360Hg is applied, check whether the actuator rod is shifted 2.0mm.

> CAUTION
>
> If the pressure more than 1.7 kg/cm²(1,250mmHg) is applied, there is a danger which the actuator will be damaged.

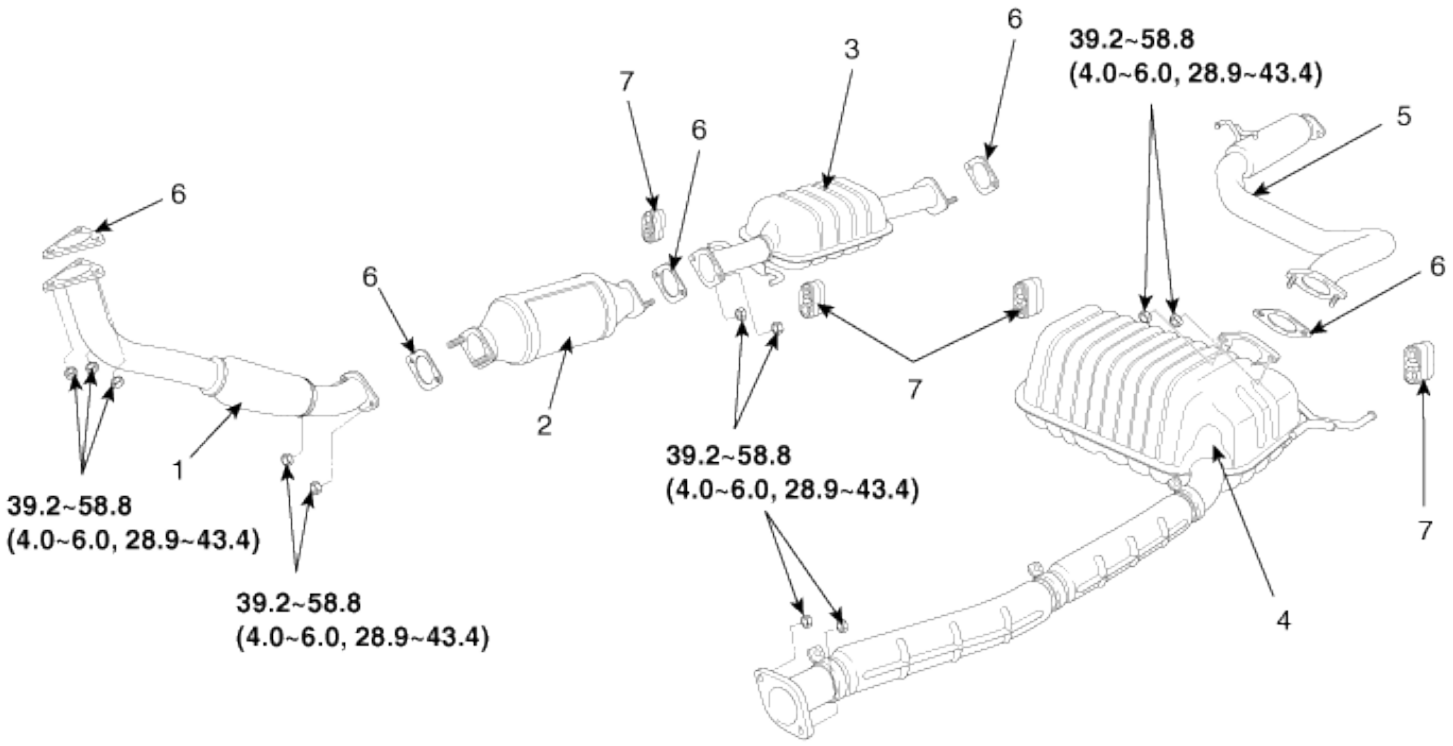
4. Replace an actuator when it is not working or pressure can not be applied.

KIA MOTORS

Engine Mechanical System

Intake and Exhaust System - Front Exhaust Pipe

COMPONENTS



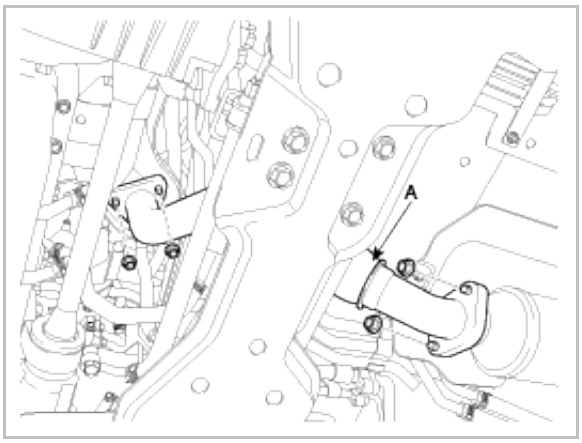
TORQUE : N.m (kgf.m, lb-ft)

1. Front muffler
2. Catalytic converter
3. Center muffler
4. Main muffler
5. Tail pipe
6. Gasket
7. Rubber hanger

REMOVAL

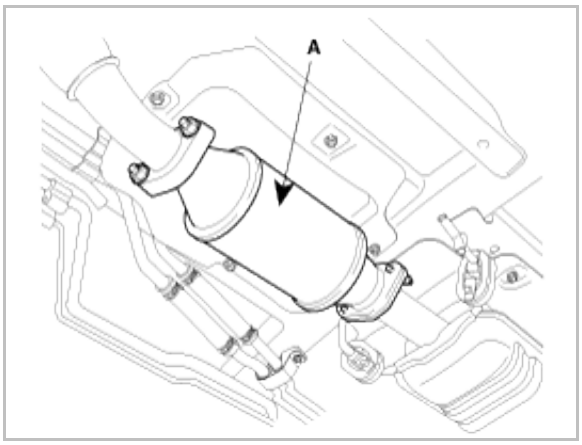
1. Remove the front muffler(A).

Tightening torque:
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



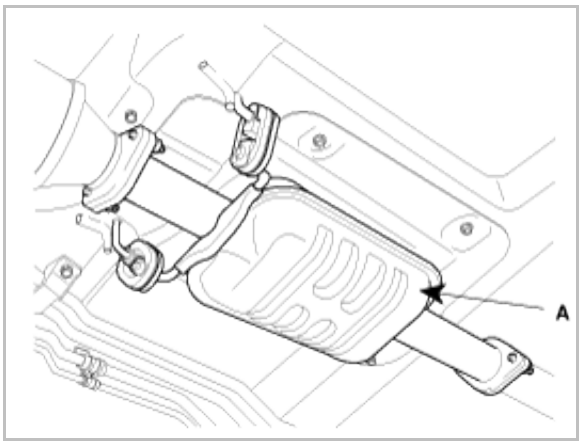
2. Remove the catalytic converter(A).

Tightening torque :
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



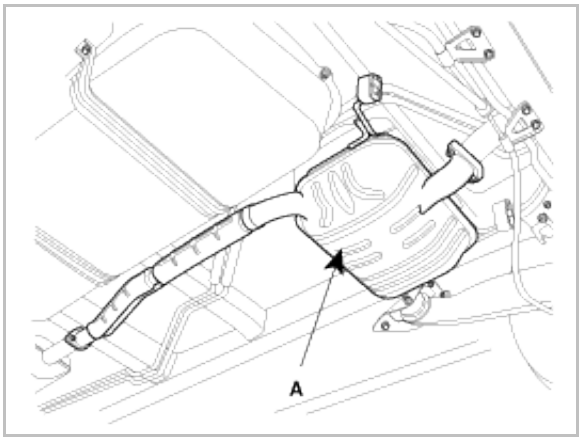
3. Remove the center muffler(A).

Tightening torque :
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



4. Remove the main muffler(A).

Tightening torque :
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



5. Remove the tail pipe(A).

Tightening torque :
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)