

2008 Kia Optima EX

2008 ENGINE Mechanical (G6EA - GSL 2.7) - Optima & Magentis (Canadian)

2008 ENGINE**Mechanical (G6EA - GSL 2.7) - Optima & Magentis (Canadian)****GENERAL****SPECIFICATIONS****GENERAL SPECIFICATIONS**

Description		Specifications	Limit
General			
Type		V-type, DOHC	
Number of cylinder		6	
Bore		86.7 mm (3.4134 in.)	
Stroke		75 mm (2.9528 in.)	
Total displacement		2,656 cc	
Compression ratio		10:4	
Firing order		1-2-3-4-5-6	
Valve timing			
Intake valve	Opens (ATDC)	4°-56°	
	Closes (ABDC)	60°-0°	
Exhaust valve	Opens (BBDC)	46°	
	Closes (ATDC)	10°	
Cylinder head			
Flatness of gasket surface		0.03 mm (0.0012 in.) or less	0.05 mm (0.0020 in.)
Flatness of manifold mounting	Intake	0.15 mm (0.0059 in.) or less	
	Exhaust	0.15 mm (0.0059 in.) or less	
Camshaft			
Cam height	LH Camshaft	Intake	44.5 mm (1.7520 in.)
		Exhaust	44.5 mm (1.7520 in.)
	RH Camshaft	Intake	44.5 mm (1.7520 in.)
		Exhaust	44.5 mm (1.7520 in.)
Journal outer diameter	LH Camshaft	Intake	27.964-27.980 mm (1.1009-1.1016 in.)
		Exhaust	27.964-27.980 mm (1.1009-1.1016 in.)
	RH Camshaft	Intake	27.964-27.980 mm (1.1009-1.1016 in.)
		Exhaust	27.964-27.980 mm (1.1009-1.1016 in.)

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Bearing oil clearance	Intake	0.020-0.057 mm (0.0008-0.0022 in.)	
	Exhaust	0.020-0.057 mm (0.0008-0.0022 in.)	
End play		0.1-0.2 mm (0.0039-0.0079 in.)	
Valve			
Valve length	Intake	110.1 mm (4.3346 in.)	
	Exhaust	111.1 mm (4.3740 in.)	
Stem outer diameter	Intake	5.965-5.980 mm (0.2348-0.2354 in.)	
	Exhaust	5.950-5.965 mm (0.2343-0.2348 in.)	
Face angle		45°-45.5°	
Thickness of valve head (margin)	Intake	1.0 mm (0.0394 in.)	
	Exhaust	1.3 mm (0.0512 in.)	
Valve stem to valve guide clearance	Intake	0.020-0.050 mm (0.0008-0.0020 in.)	0.10 mm (0.0039 in.) or less
	Exhaust	0.035-0.065 mm (0.0014-0.0026 in.)	0.13 mm (0.0051 in.) or less
Valve guide			
Inner diameter	Intake	6.000-6.015 mm (2.2362-2.2368 in.)	
	Exhaust	6.000-6.015 mm (2.2362-2.2368 in.)	
Length	Intake	45.8-46.2 mm (1.8031-1.8189 in.)	
	Exhaust	46.8-47.2 mm (1.8425-1.8583 in.)	
Valve spring			
Free length		46.8 mm (1.8425 in.)	
Load	Height: 35mm	180.5-199.5 N (18.4-20.3 Kgf, 40.6-44.8 lb)	
	Height: 26.5mm	342-378 N (34.9-38.6 Kgf, 76.9-85.1 lb)	
Out of squareness		1.5° or less	
MLA (Mechanical Lash Adjuster)			
MLA outer diameter	Intake	29.964-29.980 mm (1.1797-1.1803 in.)	
	Exhaust	29.964-29.980 mm	

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		(1.1797-1.1803 in.)	
Cylinder head tappet bore inner diameter	Intake	30.000-30.025 mm (1.1811-1.1821 in.)	
	Exhaust	30.000-30.025 mm (1.1811-1.1821 in.)	
MLA to tappet bore clearance	Intake	0.020-0.061 mm (0.0008-0.0024 in.)	0.07 mm (0.0027 in.) or less
	Exhaust	0.020-0.061 mm (0.0008-0.0024 in.)	0.07mm (0.0027 in.) or less
Valve clearance			
Intake		0.17-0.23 mm (0.0067-0.0090 in.)	0.10-0.30 mm (0.0039-0.0118 in.)
Exhaust		0.27-0.33 mm (0.0106-0.0129 in.)	0.20-0.40 mm (0.0078-0.0157 in.)
Cylinder block			
Cylinder bore		86.70-86.73 mm (3.4134-3.4146 in.)	
Flatness of gasket surface		Less than 0.05 mm (0.0019 in.) [Less than 0.02 mm (0.0008 in.) / 150x150]	
Piston			
Piston outer diameter		86.67-86.70 mm (3.4122-3.4134 in.)	
Piston to cylinder clearance		0.02-0.04 mm (0.0008-0.0016 in.)	
Ring groove width	No. 1 ring groove	1.23-1.25 mm (0.0484-0.0492 in.)	
	No. 2 ring groove	1.22-1.24 mm (0.0480-0.0488 in.)	
	Oil ring groove	2.01-2.03 mm (0.0791-0.0799 in.)	
Piston O.S.		0.25 mm (0.0098 in.), 0.50 mm (0.0197 in.)	
Piston ring			
Side clearance	No. 1 ring	0.04-0.08 mm (0.0016-0.0031 in.)	0.1mm (0.0039 in.)
	No. 2 ring	0.03-0.07 mm (0.0012-0.0027 in.)	0.1 mm (0.0039 in.)
	Oil ring	0.06-0.15 mm (0.0024-0.0059 in.)	0.2 mm (0.0079 in.)
End gap	No. 1 ring	0.15-0.30 mm	0.6 mm (0.0236 in.)

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		(0.0059-0.0118 in.)	
	No. 2 ring	0.30-0.45 mm (0.0118-0.0177 in.)	0.7 mm (0.0275 in.)
	Oil ring	0.20-0.70 mm (0.0078-0.0275 in.)	0.8 mm (0.0315 in.)
Piston ring O.S.		0.25 mm (0.0098 in.), 0.50mm (0.0197 in.)	
Piston pin			
Piston pin outer diameter		21.001-21.007 mm (0.8268-0.8270 in.)	
Piston pin hole inner diameter		21.014-21.023 mm (0.8273-0.8277 in.)	
Piston pin hole clearance		0.011-0.018 mm (0.0004-0.0007 in.)	3 Grade
Connecting rod small end inner diameter		20.974-20.985 mm (0.8257-0.8262 in.)	
Connecting rod small end hole interference		0.016-0.033 mm (0.0006-0.0013 in.)	
Connecting rod			
Connecting rod big end inner diameter		51.000-51.018 mm (2.0079-2.0086 in.)	
Connecting rod bearing oil clearance		0.018-0.036 mm (0.0007-0.0014 in.)	
Side clearance		0.1-0.25 mm (0.0039-0.0098 in.)	0.4mm (0.0157 in.)
Crankshaft			
Main journal outer diameter		61.982-62.000 mm (2.4402-2.4409 in.)	
Pin journal outer diameter		47.982-48.000 mm (1.8891-1.8898 in.)	
Main bearing oil clearance		0.004-0.022 mm (0.0002-0.0009 in.)	
End play		0.07-0.25 mm (0.0028-0.0098 in.)	0.30 mm (0.0118 in.)
Oil pump			
Relief valve opening pressure		490.33-588.40 kPa (5.0-6.0 kgf/cm ² , 71.12-85.34 psi)	
Engine oil			
Oil quantity (Total)		4.5L (4.76 U.S.qts, 3.96 imp.qts)	
Oil quantity (Oil pan)		4.2L (4.44 U.S.qts, 3.70 imp.qts)	

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Oil quantity (Oil filter)		0.3L (0.32 U.S.qts, 0.26 imp.qts)	
Oil quality		Above SJ or SL	
Oil pressure		130 kPa (1.32 kgf/cm ² , 18.77 psi) [at 1000 RPM, 110° C (230°F)]	
Cooling system			
Cooling method		Forced circulation with electrical fan	
Coolant quantity		8.2-8.3L (8.66-8.77 U.S.qts, 7.22-7.30 imp.qts)	
Thermostat	Type	Wax pellet type	
	Opening temperature	82±2°C (179.6±35.6°F)	
	Fully opened temperature	95°C (203°F)	
	Full lift	10 mm (0.3937 in.) or more	
Radiator cap	Main valve opening pressure	93.16-122.58 kPa (0.95-1.25 kg/cm ² , 13.51-17.78 psi)	
	Vacuum valve opening pressure	0.98-4.90 kPa (0.01-0.05 kg/cm ² , 0.14-0.71 psi)	
Engine coolant temperature sensor			
Type		Thermistor type	
Resistance	20°C (68°F)	2.31-2.59 kohms	
	80°C (176°F)	0.3222 kohms	

TIGHTENING TORQUE

TIGHTENING TORQUE

Item	Quantity	N.m	kgf.m	lb-ft
Oil seal case bolt	3	9.8-11.8	1.0-1.2	7.2-8.7
Main bearing cap bolt (M10)	8	29.4 + 90°	3.0 + 90°	21.7 + 90°
Main bearing cap bolt (M8)	8	15.7 + 90°	1.6 + 90°	11.6- + 90°
Rear plate bolt	1	9.8-11.8	1.0-1.2	7.2-8.7
Oil pump case bolt (8x25)	1	18.6-23.5	1.9-2.4	13.7-17.4
Oil pump case bolt	1	18.6-23.5	1.9-2.4	13.7-17.4

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(8x35)				
Timing Oil pump case bolt (8x65)	1	18.6-23.5	1.9-2.4	13.7-17.4
Timing Oil relief plug	1	39.2-49.0	4.0-5.0	28.9-36.2
Oil filter bracket bolt (8x35)	4	18.6-23.5	1.9-2.4	13.7-17.4
Oil filter bracket bolt (8x65)	2	18.6-23.5	1.9-2.4	13.7-17.4
Oil filter insert	1	44.1-53.9	4.5-5.5	32.5-39.8
Timing belt cover bolt	21	9.8-11.8	1.0-1.2	7.2-8.7
Upper oil pan bolt (8x22)	15	18.6-23.5	1.9-2.4	13.7-17.4
Upper oil pan bolt (163.5mm)	1	4.9-6.9	0.5-0.7	3.6-5.1
Upper oil pan bolt (154.5mm)	1	4.9-6.9	0.5-0.7	3.6-5.1
Lower oil pan bolt	11	9.8-11.8	1.0-1.2	7.2-8.7
Oil drain plug	1	34.3-44.1	3.5-4.5	25.3-32.5
Engine support bracket bolt (10x94)	2	58.8-68.6	6.0-7.0	43.4-50.6
Engine support bracket bolt (10x102.5)	1	58.8-68.6	6.0-7.0	43.4-50.6
Camshaft bearing cap bolt (6x38)	24	10.8-12.7	1.1-1.3	8.0-9.4
Camshaft bearing cap bolt (8x38)	12	20.6-25.5	2.1-2.6	15.2-18.8
Cylinder head bolt	16	24.5 + 60° + 45°	2.5 + 60° + 45°	18.1 + 60° + 45°
Cylinder head cover bolt	22	7.8-9.8	0.8-1.0	5.8-7.2
Crankshaft pulley bolt	1	166.7-176.5	17.0-18.0	123.0-130.2
Drive plate bolt	8	71.6-75.5	7.3-7.7	52.8-55.7
Connecting rod bearing cap bolt	12	19.6-90°	2.0-90°	14.5-90°
OCV (Oil Control Valve) bolt	2	7.8-9.8	0.8-1.0	5.8-7.2
CVVT & exhaust cam sprocket bolt	4	66.7-78.5	6.8-8.0	49.2-57.9
Timing chain auto tensioner bolt	4	10.8-12.7	1.1-1.3	8.0-9.4
Camshaft sprocket	2	88.3-107.9	9.0-11.0	65.1-79.6

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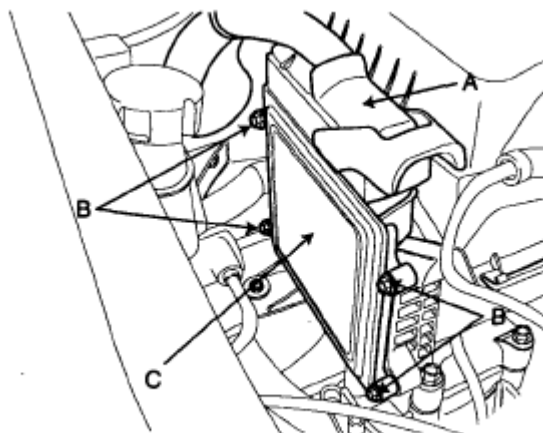
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bolt				
Timing belt idler bolt	1	49.0-58.8	5.0-6.0	36.2-43.4
Timing belt tensioner bolt	2	19.6-26.5	2.0-2.7	14.5-19.5
Timing belt tensioner arm bolt	1	34.3-53.9	3.5-5.5	25.3-39.8
Water pump bolt (8x20)	3	14.7-21.6	1.5-2.2	10.8-15.9
Water pump bolt (8x25)	4	14.7-21.6	1.5-2.2	10.8-15.9
Drive belt idler bolt	1	34.3-53.9	3.5-5.5	25.3-39.8
Drive belt tensioner bolt	1	34.3-53.9	3.5-5.5	25.3-39.8
Water pipe bolt	1	16.7-19.6	1.7-2.0	12.3-14.5
Water temp. control assembly nut	4	29.4-41.2	3.0-4.2	21.7-30.4
Oil level gauge bolt	1	18.6-23.5	1.9-2.4	13.7-17.4
Oil screen bolt	2	14.7-21.6	1.5-2.2	10.8-15.9
Water outlet fitting bolt	3	16.7-19.6	1.7-2.0	12.3-14.5
Water inlet fitting bolt	2	16.7-19.6	1.7-2.0	12.3-14.5
Water inlet fitting nut	1	16.7-19.6	1.7-2.0	12.3-14.5
Surge tank bolt (8x28)	3	18.6-23.5	1.9-2.4	13.7-17.4
Surge tank bolt (8x80)	2	18.6-23.5	1.9-2.4	13.7-17.4
Surge tank nut	2	18.6-23.5	1.9-2.4	13.7-17.4
Intake manifold bolt	4	18.6-23.5	1.9-2.4	13.7-17.4
Intake manifold nut	4	18.6-23.5	1.9-2.4	13.7-17.4
Surge tank bracket bolt	2	18.6-23.5	1.9-2.4	13.7-17.4
Exhaust manifold bolt	14	29.4-34.3	3.0-3.5	21.7-25.3
Heat protect bolt	6	16.7-21.6	1.7-2.2	12.3-15.9
Front muffler bolt	2	39.2-58.8	4.0-6.0	28.9-43.4

COMPRESSION PRESSURE INSPECTION

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

1. Warm up the engine until the normal operating temperature becoming 80-95°C (176-203°F).
2. Remove the surge tank.
3. Remove the ignition coil connectors (A) and ignition coils (B).



LDLG028A

Fig. 1: Identifying Ignition Coil Connectors And Ignition Coils
 Courtesy of KIA MOTORS AMERICA, INC.

4. Using a 16mm plug wrench, remove the 6 spark plugs.
5. Check cylinder compression pressure.
 1. Insert a compression gauge into the spark plug hole.
 2. Open the throttle fully.
 3. With the fully-open throttle in cranking, measure the compression pressure.

NOTE: Always use a fully charged battery to get the engine speed of 250 RPM or more.

Repeat steps 1) through 3) for each cylinder.

NOTE: This measurement must be done in as short a time as possible.

Compression pressure: 1,176.79 kPa (12.0 kgf/cm² , 170.68 psi) - 200-250 RPM

Minimum pressure: 1,029.69 kPa (10.5 kgf/cm² , 149.34 psi)

Difference between cylinders: 98.07 kPa (1.0 kgf/cm² , 14.22 psi)

4. If the compression pressure in 1 or more cylinders is lower than the specification above, pour a small amount of engine oil into the cylinder through the spark plug hole, repeat the steps (1) through (3) for the cylinder and measure the pressure again.
 - If adding oil increases the pressure up, the piston rings or cylinder bores might be worn or

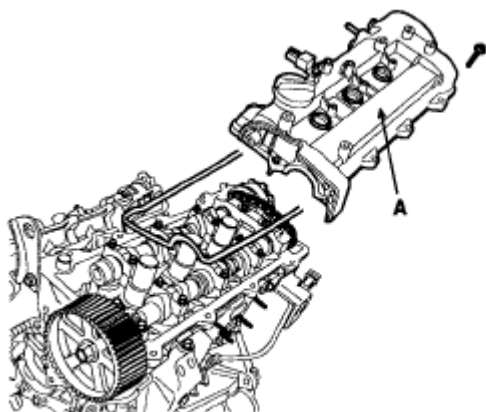
damaged.

- If the pressure doesn't increase, a valve may be sticking or seating may be improper, or there may be leakage from the gasket.
6. Reinstall the spark plugs.
 7. Install the ignition coils and connect ignition coil connectors.
 8. Install the surge tank.

VALVE CLEARANCE INSPECTION AND ADJUSTMENT

NOTE: Inspect and adjust the valve clearance when the engine is cold (Engine coolant temperature: 20°C±C (59-77°F)) and cylinder head is installed on the cylinder block.

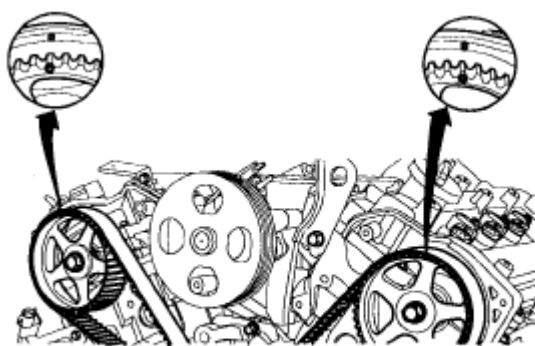
1. Remove the engine cover.
2. Remove air cleaner assembly.
3. Remove the surge tank.
4. Remove the cylinder head cover.
 1. Disconnect the ignition coil connector and remove the ignition coil.
 2. Remove the cylinder head cover.



SMGM16010N

Fig. 2: Identifying Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

5. Set the piston of the No.1 cylinder to TDC (Top Dead Center) position.
 1. Turn the crankshaft pulley clockwise and align its groove with the timing mark "T" of the timing chain cover.
 2. Check that the timing marks of the camshaft sprocket are in straight line on that of the cylinder head cover surface as shown in the illustration. It makes the piston of the No.1 cylinder position at TDC.



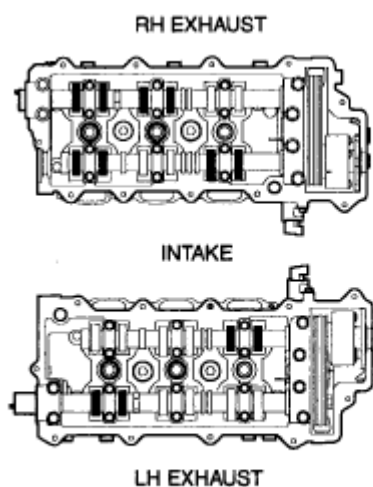
KCBF119B

Fig. 3: Checking Timing Marks

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: If not, turn the crankshaft one revolution clockwise.

6. Inspect the intake and the exhaust valve clearance.
 1. With the piston of the No.1 cylinder positioning at TDC, the valves which can be measured its clearance are as shown below.



LDLG030A

Fig. 4: Identifying Intake And Exhaust Valves

Courtesy of KIA MOTORS AMERICA, INC.

Measurement method.

- Using a thickness gauge, measure the clearance between the tappet and the base circle of camshaft.
- Record the out-of-specification valve clearance measurements. They will be used later to determine the required adjusting tappet for replacement.

Specification

Limit (Engine coolant temperature: 20°C [68°F])

Intake: 0.17-0.23 mm (0.0067-0.0090 in.)

Exhaust: 0.27-0.33 mm (0.0106-0.0129 in.)

2. Turn the crankshaft pulley one revolution (360°) clockwise and align the groove with the timing mark "T" of the timing chain cover.
3. With the piston of the No.4 cylinder positioning at TDC, the valves which can be measured its clearance are as shown below.

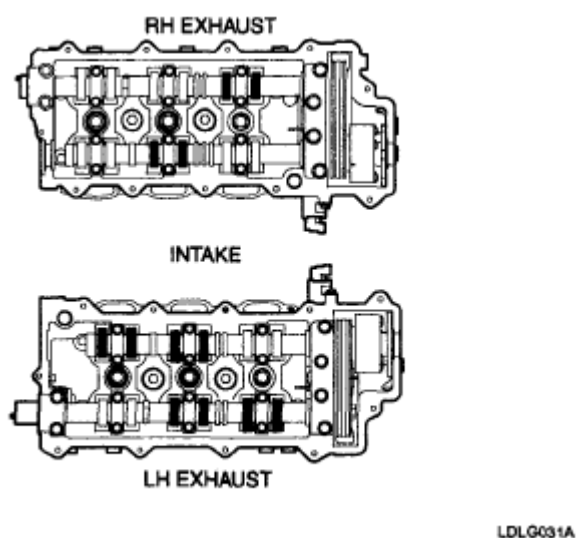
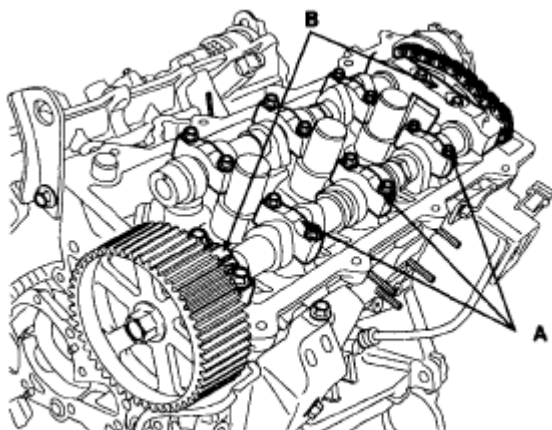


Fig. 5: Identifying Intake And Exhaust Valves
Courtesy of KIA MOTORS AMERICA, INC.

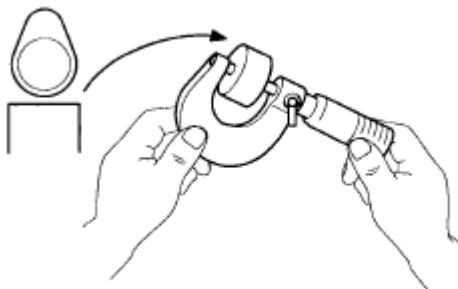
7. Adjust the intake and the exhaust valve clearances.
 1. Set the piston of the No. 1 cylinder to the TDC/position.
 2. Remove the timing belt.
 3. Remove the camshaft bearing caps (A, B).



KCBF169A

Fig. 6: Identifying Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the camshaft assembly.
5. Remove MLA (Mechanical Lash Adjusters).
6. Measure the thickness of the removed tappet using a micrometer.



EDKE008D

Fig. 7: Measuring Thickness Of Tappet With Micrometer
Courtesy of KIA MOTORS AMERICA, INC.

7. Calculate the thickness of a new tappet so that the valve clearance comes within the specified value.

T: Thickness of removed tappet

A: Measured valve clearance

N: Thickness of new tappet

Intake: $N = T + [A - 0.20 \text{ mm (0.0079 in.)}]$

Exhaust: $N = T + [A - 0.30 \text{ mm (0.0118 in.)}]$

8. Select a new tappet with a thickness as close as possible to the calculated value.

NOTE: Tappets are available with 41 different size increments of 0.015 mm (0.0006 in.) from 3.00 mm (0.118 in.) to 3.600 mm (0.1417 in.)

9. Place a new tappet on the cylinder head.

NOTE: Apply engine oil on the periphery surface of the selected tappet.

10. Install the intake and exhaust camshafts.
11. Install the bearing caps.
12. Install the timing belt.
13. Turn the crankshaft two revolutions in the operating direction (clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks (A).
14. Recheck the valve clearance.

Specification (Engine coolant temperature: 20°C [68°F])

Intake: 0.17-0.23 mm (0.0067-0.0090 in.)

Exhaust: 0.27-0.33 mm (0.0106-0.0129 in.)

TROUBLESHOOTING

TROUBLESHOOTING SYMPTOM CHART

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings. Loose or improper engine drive plate.	Replace the crankshaft and bearings as required. Repair or replace the drive plate 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)	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 lifters.
	Faulty cylinder head gasket and/or	Inspect the cylinder head and

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Engine misfire with coolant consumption.	cranking or other damage to the cylinder head and engine block cooling system. Coolant consumption may or may not cause the engine to overheat.	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, 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)	- Inspect 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 timing 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.
	Worn drive belt, idler, tensioner and bearing.	Replace as required.
	Low oil pressure.	Repair as required.
	Loose or damaged drive plate.	Repair or replace the drive plate.
	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, piston pin and cylinder bore.

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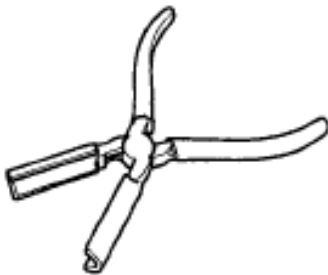
Lower engine noise, regardless of engine speed.		Repair as required.
	Excessive piston pin-to-piston clearance.	- Inspect the piston, piston pin and the connecting rod. - Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required. - The connecting rod bearings. - The connecting rods. - The crankshaft pin journals.
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required. - The crankshaft bearings. - The crankshaft main journals. - The cylinder block.
	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 main journals. - The cylinder block.
	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.

2008 Kia Optima EX

2008 ENGINE Mechanical (G6EA - GSL 2.7) - Optima & Magentis (Canadian)

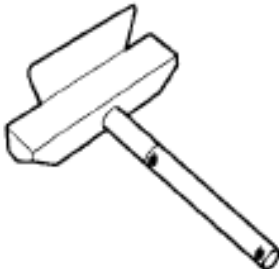
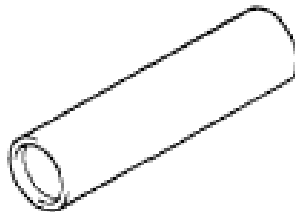
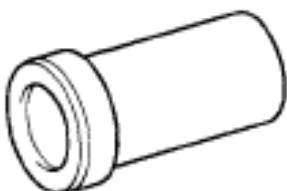
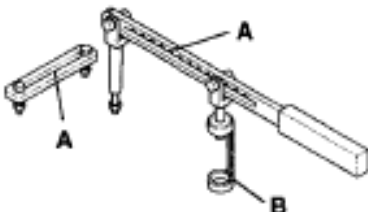
Engine will not crank- crankshaft will not rotate.	Broken timing chain and/or timing chain and/or timing chain gears.	1. Inspect timing chain and gear. 2. Repair as required.
	Material in cylinder. • Broken valve • Piston material • Foreign material	1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	1. Inspect crankshaft and connecting rod bearing. 2. Repair as required.
	Bent or broken connecting rod.	1. Inspect connecting rods. 2. Repair as required.
	Broken crankshaft.	1. Inspect crankshaft. 2. Repair as required.

SPECIAL SERVICE TOOLS**SPECIAL SERVICE TOOLS SPECIFICATIONS**

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-33000)	 KDRF232A	Installation of the front oil seal
Torque angle adapter (09221-4A000)	 LGAC000A	Installation of bolts & nuts needing an angular method

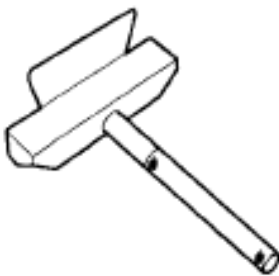
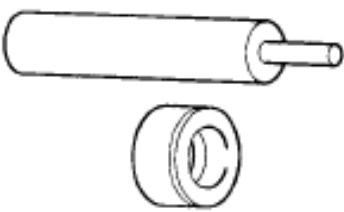
2008 Kia Optima EX

2008 ENGINE Mechanical (G6EA - GSL 2.7) - Optima & Magentis (Canadian)

Valve stem seal remover (09222-29000)	 KDRF219A	Removal of the valve stem seal
Valve stem seal installer (09222-22001)	 LCAC030D	Installation of the valve stem seal
Camshaft oil seal installer (09214-21000)	 EDDA005B	Installation of the camshaft oil seal
Valve spring compressor & holder (09222-3K000) (09222-3C300)	 ECRF003A	Removal and installation of the intake or exhaust valves. A. A: 09222-3K000 B. B: 09222-3C300 (holder)
Crankshaft rear oil seal installer (09231-33000)		Installation of the crankshaft rear oil seal

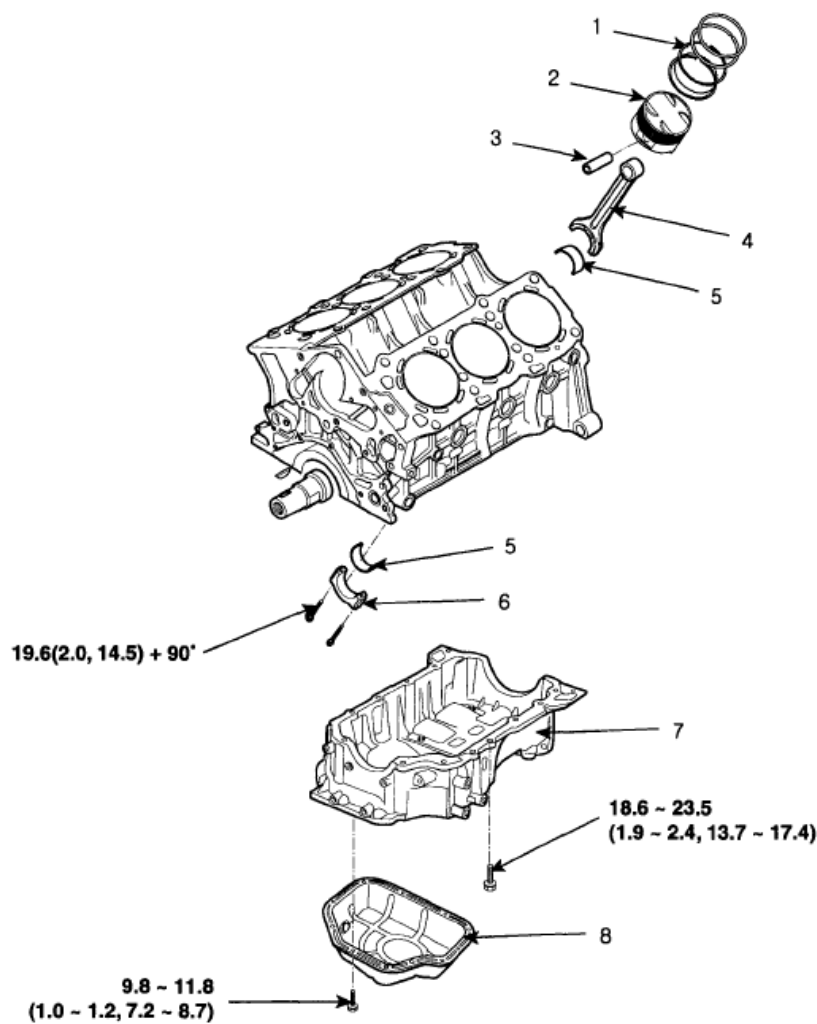
2008 Kia Optima EX

2008 ENGINE Mechanical (G6EA - GSL 2.7) - Optima & Magentis (Canadian)

	 LDLG032A	
Oil pan remover (09215-3C000)	 KDRF219A	Removal of oil pan
Valve guide installer (09221-3F100 A/B)	 ECKA010B	Removal and installation of the valve guide

ENGINE BLOCK

COMPONENTS



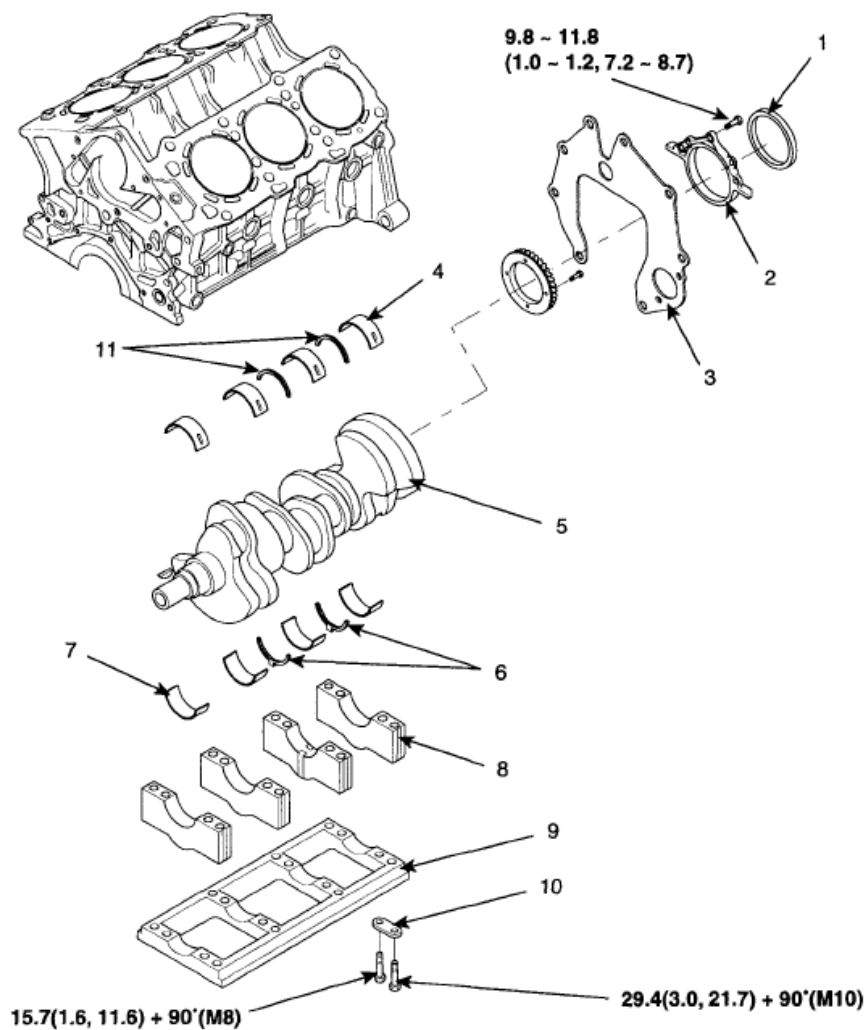
TORQUE : N.m (kgf.m, lb-ft)

1. Piston ring
2. Piston
3. Piston pin
4. Connecting rod

5. Connecting rod bearing
6. Connecting rod cap
7. Upper oil pan
8. Lower oil pan

LDLG042A

Fig. 8: Identifying Engine Block Components (1 Of 2) (With Torque Specifications)
 Courtesy of KIA MOTORS AMERICA, INC.



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

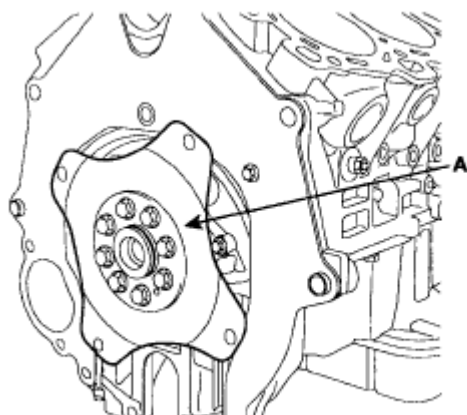
- | | |
|-----------------------------|-----------------------------|
| 1. Rear oil seal | 7. Crankshaft lower bearing |
| 2. Rear oil seal case | 8. Main bearing cap |
| 3. Rear plate | 9. Bearing cap bridge |
| 4. Crankshaft upper bearing | 10. Bearing cap bolt washer |
| 5. Crankshaft | 11. Upper thrust bearing |
| 6. Lower thrust bearing | |

LDLG043A

Fig. 9: Identifying Engine Block Components (2 Of 2) (With Torque Specifications)
 Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Remove the drive plate (A).

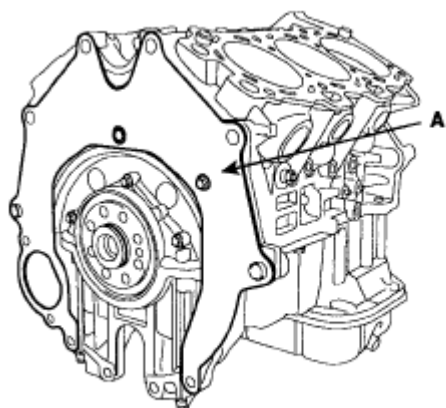


KCBF120A

Fig. 10: Identifying Drive Plate

Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the rear plate (A).



KCBF121A

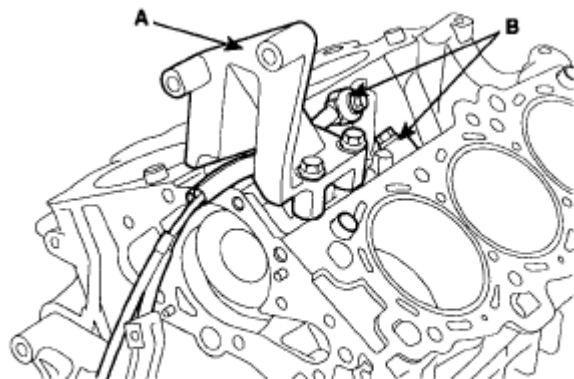
Fig. 11: Identifying Rear Plate

Courtesy of KIA MOTORS AMERICA, INC.

3. Remove timing belt.
4. Remove intake manifold.
5. Remove exhaust manifold.
6. Remove generator from engine. (Refer to **CHARGING SYSTEM - ENGINE ELECTRICAL SYSTEM (G6EA-GSL 2.7L)**).
7. Remove power steering pump from engine. (Refer to **MECHANICAL POWER STEERING SYSTEM**).
8. Remove cylinder head.
9. Remove A/C compressor from engine. (Refer to **AIR CONDITIONING SYSTEM**).
10. Remove water pump assembly.

DISASSEMBLY

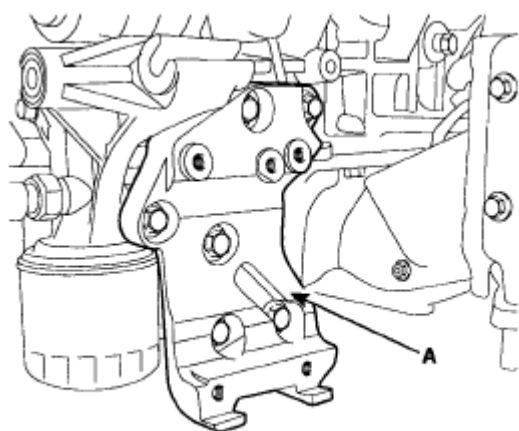
1. Remove the power steering pump bracket (A) and the knock sensor (B).



KCBF122A

Fig. 12: Identifying Power Steering Pump Bracket And Knock Sensor
Courtesy of KIA MOTORS AMERICA, INC.

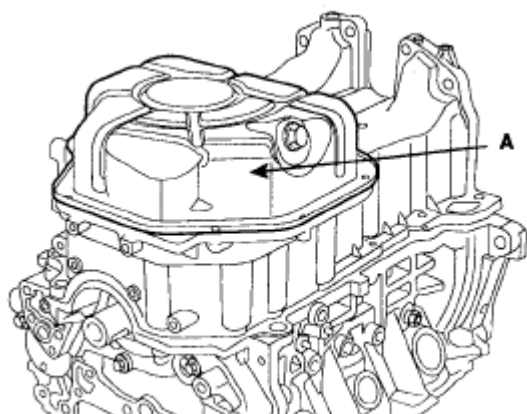
2. Remove the air conditioning compressor bracket (A).



KCBF138A

Fig. 13: Identifying Air Conditioning Compressor Bracket
Courtesy of KIA MOTORS AMERICA, INC.

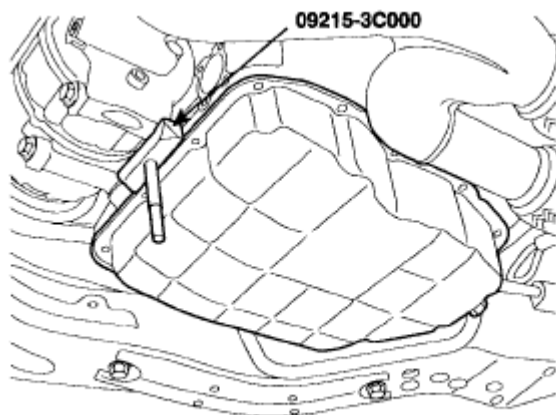
3. Remove the lower oil pan (A).



KCBF123A

Fig. 14: Identifying Lower Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

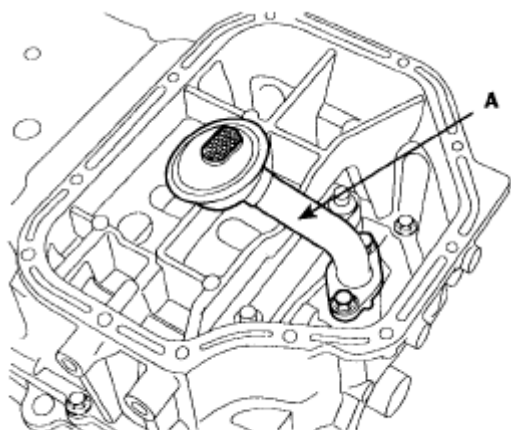
CAUTION: When removing the oil pan, use the SST (09215-3C000) not to damage the contacting surface of the oil pan.



KCBF184A

Fig. 15: Identifying SST (09215-3C000)
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the oil screen (A).

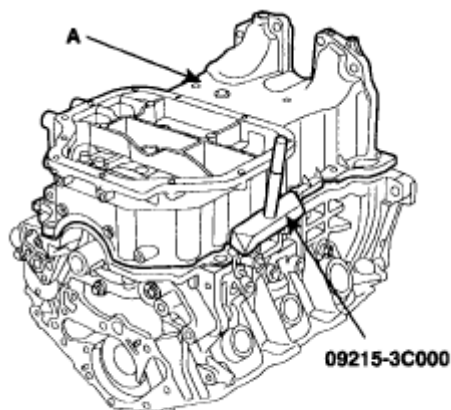


KCBF124A

Fig. 16: Identifying Oil Screen

Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the upper oil pan (A).



09215-3C000

KCBF125B

Fig. 17: Identifying Upper Oil Pan

Courtesy of KIA MOTORS AMERICA, INC.

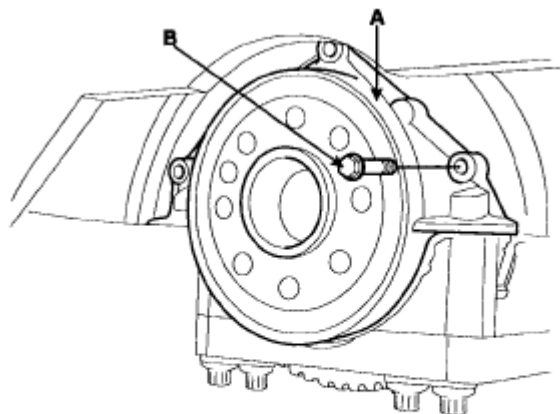
CAUTION: When removing the oil pan, use the SST (09215-3C000) not to damage the contacting surface of the oil pan.

6. Check the connecting rod side clearance.
7. Check the connecting rod bearing oil clearance.
8. Remove the piston and connecting rod assemblies.

NOTE:

- Keep the bearings the connecting rods and the caps together.
- Arrange the piston and connecting rod assemblies in the correct order.

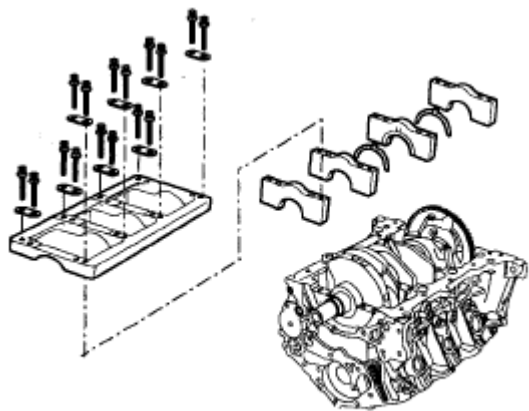
9. Remove the oil pump case.
10. Remove the oil seal case (A).



EDQF174B

Fig. 18: Identifying Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

11. Check the crankshaft end play.
12. Remove the crankshaft bearing cap and check oil clearance.

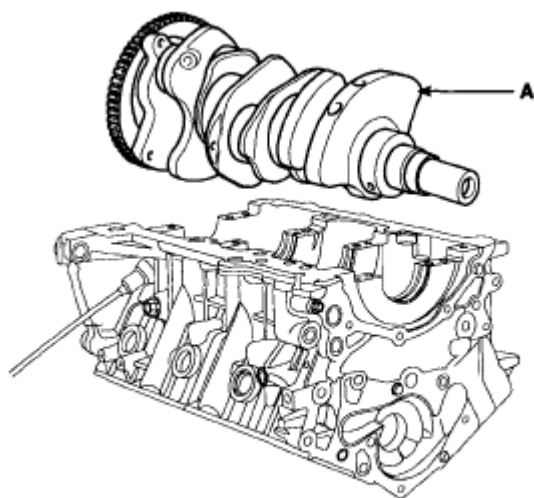


KCBF126A

Fig. 19: Removing Crankshaft Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Arrange the bearings and the bearing caps in order.

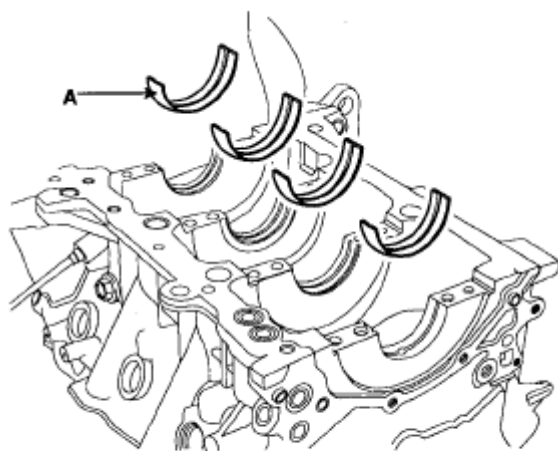
13. Lift the crankshaft (A) out of the block, being careful not to damage journals.



EDQF074A

Fig. 20: Identifying Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

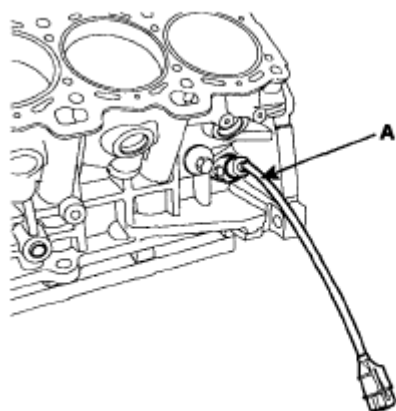
14. Remove and arrange the main bearings (A) and thrust bearings in the correct order.



EDQF076A

Fig. 21: Identifying Main Bearings
Courtesy of KIA MOTORS AMERICA, INC.

15. Remove the CKP sensor (A).



KCBF128A

Fig. 22: Identifying CKP Sensor

Courtesy of KIA MOTORS AMERICA, INC.

16. Check the free play between a piston and a piston pin. Try to move the piston back and forth on the piston pin. If any movement is felt, replace the piston and the piston pin as a set.
17. Remove the piston rings.
 1. Using a piston ring expander, remove the 2 compression rings.
 2. Remove the 2 side rails and the oil ring by hand.

NOTE: **Arrange the piston rings in the correct order only.**

18. Disconnect the connecting rod from the piston. Using a press, remove the piston pin from the piston. (Press-in load: 2451.7-12258.3 N (250-1250 kg, 551.2-2755.8 lb))

INSPECTION

CONNECTING ROD AND CRANKSHAFT

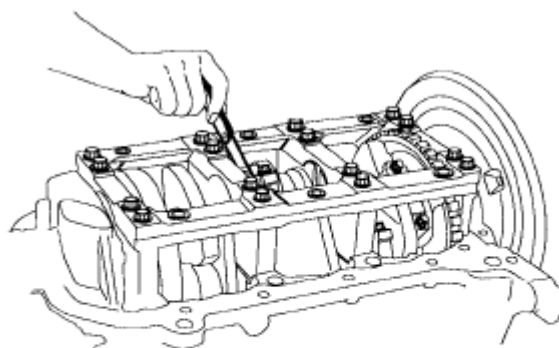
1. Check the connecting rod side clearance.

Using a feeler gauge, measure the side clearance while moving the connecting rod back and forth.

Specification

Standard: 0.1-0.25 mm (0.0039-0.0098 in.)

Limit: 0.4 mm (0.0157 in.)



EDQF159A

Fig. 23: Checking Connecting Rod Side Clearance
Courtesy of KIA MOTORS AMERICA, INC.

- If out-of-tolerance, install a new connecting rod.
 - If still out-of-tolerance, replace the crankshaft.
2. Check the connecting rod bearing oil clearance.
 1. Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.
 2. Remove the 2 connecting rod cap bolts.
 3. Remove the connecting rod cap and the lower bearing.
 4. Clean the crankshaft pin journal and the bearing.
 5. Place a plastigage across the crankshaft pin.
 6. Reinstall the lower bearing and the connecting rod cap and torque the bolts.

Tightening torque

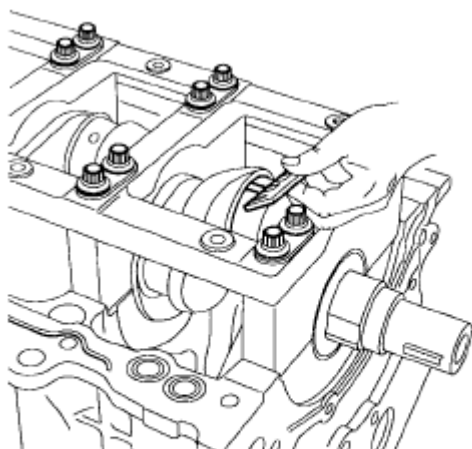
19.6 N.m (2.0 kgf.m, 14.4 6lb-ft) + 90°

NOTE: Do not turn the crankshaft.

7. Remove the connecting rod cap again.
8. Measure the plastigage at its widest point.

Standard oil clearance

0.018-0.036 mm (0.0007-0.0014 in.)



EDQF175A

Fig. 24: Measuring Plastigage
Courtesy of KIA MOTORS AMERICA, INC.

9. If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

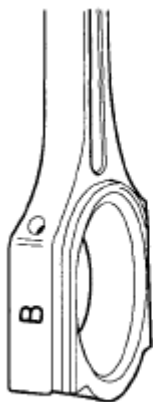
CAUTION: Do not file, shim, or scrape the bearings or the caps to adjust clearance.

10. If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

NOTE: 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



EDQF196A

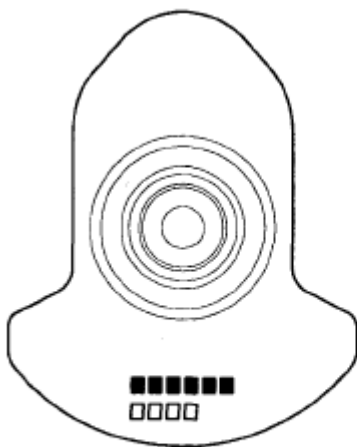
Fig. 25: Identifying Connecting Rod Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CONNECTING ROD

CLASS	MARK	INSIDE DIAMETER
0	a	51.000-51.006 mm (2.0079-2.0081 in.)
1	b	51.006-51.012 mm (2.0081-2.0083 in.)
2	c	51.012-51.018 mm (2.0083-2.0086 in.)

CRANKSHAFT PIN MARK LOCATION

DISCRIMINATION OF CRANKSHAFT



EDQF176B

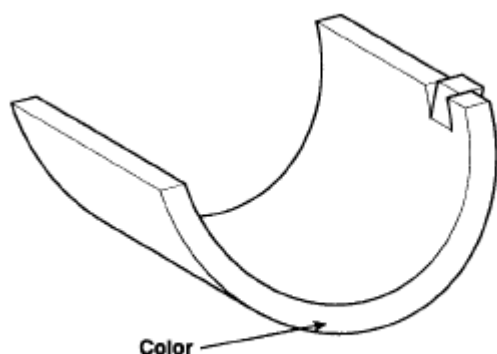
Fig. 26: Identifying Crankshaft Pin Mark Location

Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT

CLASS	MARK	OUTSIDE DIAMETER OF PIN
I	1 or A	47.994-48.000 mm (1.8895-1.8898 in.)
II	2 or B	47.988-47.994 mm (1.8893-1.8895 in.)
III	3 or C	47.982-47.988 mm (1.8891-1.8893 in.)

PLACE OF IDENTIFICATION MARK (CONNECTING ROD BEARING)



ECRF021A

Fig. 27: Identifying Mark (Color) On Connecting Rod Bearing
Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CONNECTING ROD BEARING

CLASS	MARK	THICKNESS OF BEARING
A	BLUE	1.5000-1.503 mm (0.0591-0.0592 in.)
B	BLACK	1.497-1.500 mm (0.0589-0.0591 in.)
C	-	1.494-1.497 mm (0.0588-0.0589 in.)
D	GREEN	1.491-1.494 mm (0.0587-0.0588 in.)
E	YELLOW	1.488-1.491 mm (0.0586-0.0587 in.)

11. Select the proper connecting rod bearing from the table below.

MARK SPECIFICATIONS OF CRANKSHAFT AND CONNECTING ROD

		CONNECTING ROD IDENTIFICATION MARK		
		0 (A)	1 (B)	2 (C)
CRANKSHAFT IDENTIFICATION MARK	I (A)	E (YELLOW)	D (GREEN)	C (-)
	II (B)	D (GREEN)	C (-)	B (BLACK)
	III (C)	C (-)	B (BLACK)	A (BLUE)

3. Check the connecting rod.

1. When reinstalling, check the cylinder numbers on the connecting rods and the caps. When installing a new connecting rod, the notches for bearing fixing on the connecting rods and caps should face the same direction.
2. If one or both edge of the connecting rod thrust surface is damaged, replace the rod. If the inner surface of the rod is damaged or rough, also replace it.
3. Using a connecting rod aligner, measure the bent or torsion of the rod. If the measurement is near the specification, adjust the rod with a press. If the rod is bent or twisted excessively, replace it.

Bending: 0.05 mm/100 mm (0.0020 in./3.9370 in.)

Torsion: 0.1 mm/100 mm (0.0039 in./3.9370 in.)

NOTE: When assembling the rod without a bearing, there should be no difference.

4. Check the crankshaft bearing oil clearance.

1. To check main bearing-to-journal oil clearance, remove the main bearing caps and bearing halves.
2. Clean each main journal and bearing half with a clean shop towel.
3. Place one strip of plastigage across each main journal.
4. Reinstall the bearings and caps, then torque the bolts.

Tightening torque

M8: 15.7 N.m (1.6 kgf.m, 11.6 lb-ft) + 90°

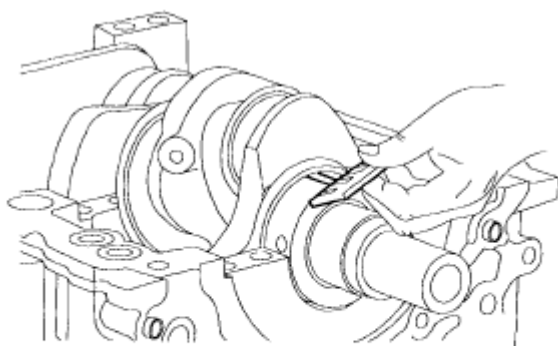
M10: 29.4 N.m (3.0 kgf.m, 21.7 lb-ft) + 90°

NOTE: Tighten the bolts in order.

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

Standard oil clearance

0.004-0.022 mm (0.0002-0.0009 in.)



EDQF075A

Fig. 28: Measuring Plastigage**Courtesy of KIA MOTORS AMERICA, INC.**

6. If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

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

7. If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

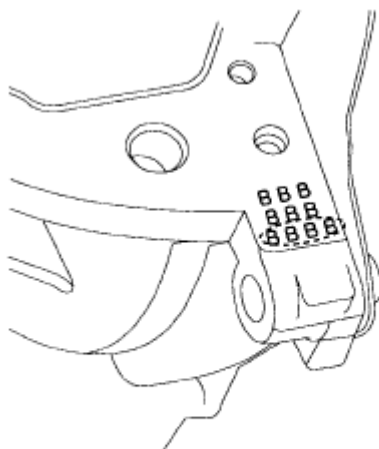
NOTE: If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

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.

Crankshaft bore mark location

Letters have been stamped on the block as a mark for the each size of the 4 main journal bores. No.1 journal stamping mark starts from the front of the engine.

Use the size marks which are stamped on the block and the crankshaft for the journal bore inner diameter and the journal outer diameter to choose the correct bearings.



EDQF078A

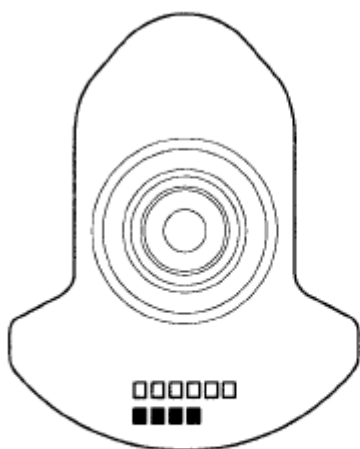
Fig. 29: Identifying Crankshaft Bore Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CYLINDER BLOCK

CLASS	MARK	INSIDE DIAMETER
a	A	66.000-66.006 mm (2.5984-2.5987 in.)
b	B	66.006-66.012 mm (2.5987-2.5989 in.)
c	C	66.012-66.018 mm (2.5989-2.5991 in.)

CRANKSHAFT JOURNAL MARK LOCATION

DISCRIMINATION OF CRANKSHAFT



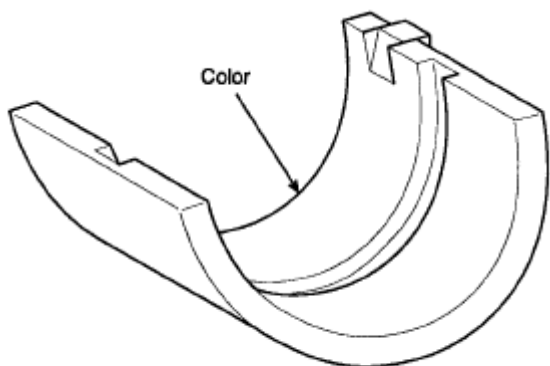
EQGF176A

Fig. 30: Identifying Crankshaft Journal Mark Location
Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT

CLASS	MARK	OUTSIDE DIAMETER OF JOURNAL
I	A	61.994-62.000 mm (2.4407-2.4409 in.)
II	B	61.988-61.994 mm (2.4405-2.4407 in.)
III	C	61.982-61.988 mm (2.4402-2.4405 in.)

PLACE OF IDENTIFICATION MARK (CRANKSHAFT BEARING)



ECRF022A

Fig. 31: Identifying Mark (Color) On Crankshaft Bearing
Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT BEARING

CLASS	MARK	THICKNESS OF BEARING
A	BLUE	2.007-2.010 mm (0.0790-0.0791 in.)
B	BLACK	2.004-2.007 mm (0.0789-0.0790 in.)
C	-	2.001-2.004 mm (0.0788-0.0789 in.)
D	GREEN	1.998-2.001 mm (0.0787-0.0788 in.)
E	YELLOW	1.995-1.998 mm (0.0785-0.0787 in.)

SELECTION TABLE

		CRANKSHAFT BORE IDENTIFICATION MARK		
		a (A)	b (B)	c (C)
CRANKSHAFT IDENTIFICATION MARK	I (A)	E (YELLOW)	D (GREEN)	C (-)
	II (B)	D (GREEN)	C (-)	B (BLACK)
	III (C)	C (-)	B (BLACK)	A (BLUE)

5. Check crankshaft end play.

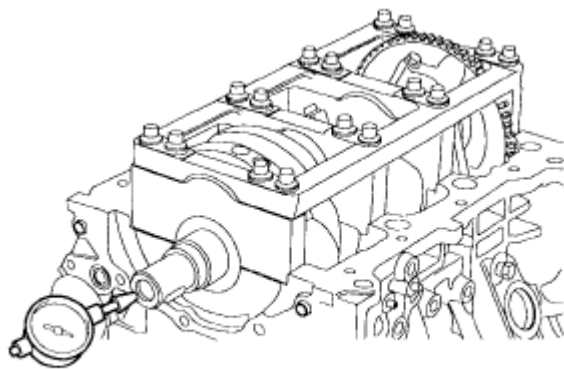
Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard end play

0.07-0.25 mm (0.0028-0.0098 in.)

[Limit]

0.3mm (0.0118 in.)



KCBF127A

Fig. 32: Checking Crankshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

If the end play is greater than the maximum, replace the center bearing.

Thrust bearing thickness

1.925-1.965 mm (0.0758-0.0774 in.)

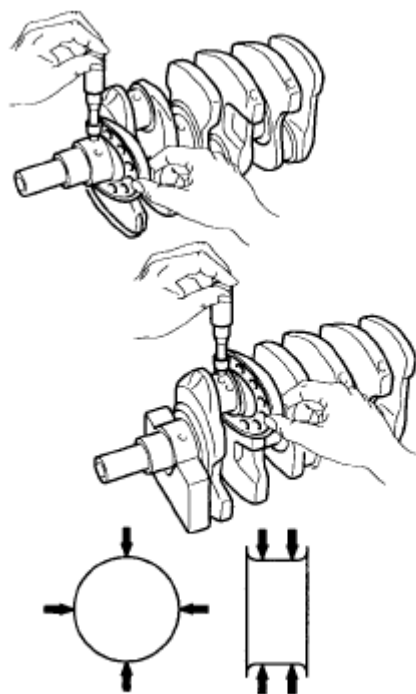
6. Inspect the main journals and the pin journals of the crankshaft.
7. Using a micrometer, measure the outer diameter of each main journal and pin journal.

Main journal diameter: 61.982-62.000 mm

(2.4402-2.4409 in.)

Crank pin diameter: 47.982-48.000 mm

(1.8891-1.8898 in.)



KCRF212A

Fig. 33: Measuring Outer Diameter Of Main Journal And Pin Journal
Courtesy of KIA MOTORS AMERICA, INC.

CYLINDER BLOCK

1. Remove gasket materials.

Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

2. Clean cylinder block

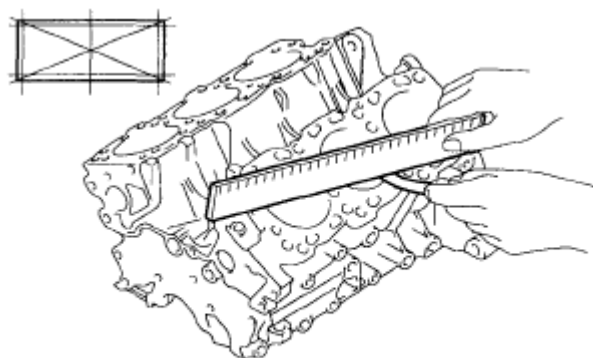
Using a soft brush and solvent, thoroughly clean the cylinder block.

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: 0.03 mm (0.0012 in.) or less



LDLG044A

Fig. 34: Inspecting Top Surface Of Cylinder Block For Flatness
Courtesy of KIA MOTORS AMERICA, INC.

4. Inspect cylinder bore diameter

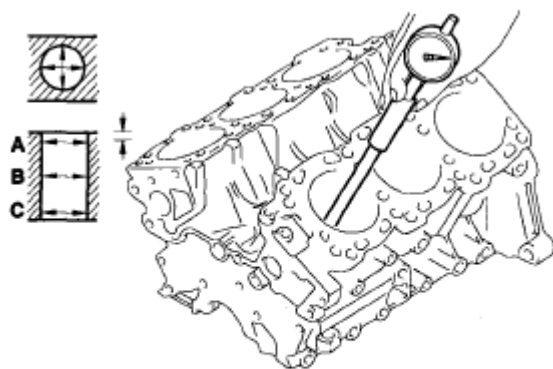
Visually check the cylinder for vertical scratches. If deep scratches are present, replace the cylinder block or process the piston to be oversized.

5. Inspect the cylinder bore diameter

Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial directions.

Standard diameter

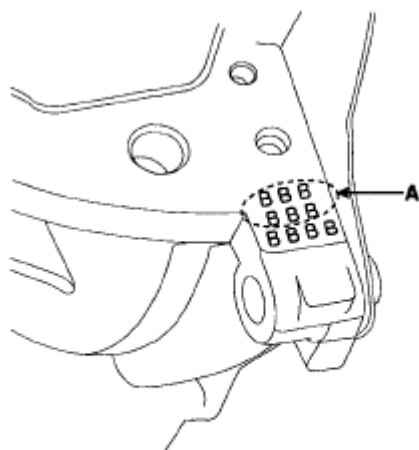
86.70-86.73 mm (3.4134-3.414 6in.)



EDQF153A

Fig. 35: Measuring Cylinder Bore Diameter
 Courtesy of KIA MOTORS AMERICA, INC.

6. Check the cylinder bore size code (A) on the cylinder block.



EDQF078B

Fig. 36: Identifying Cylinder Bore Size Code
 Courtesy of KIA MOTORS AMERICA, INC.

CYLINDER BORE INNER DIAMETER CHART

Class	Size code	Cylinder bore inner diameter
A	A	86.70-86.71 mm (3.4134-3.4138 in.)
B	B	86.71-86.72 mm (3.4138-3.4142 in.)
C	C	86.72-86.73 mm (3.4142-3.4146 in.)

7. Check the piston size code (A) on the piston top face.

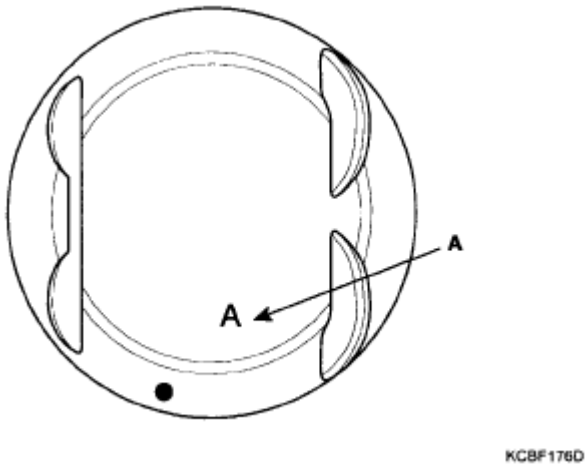


Fig. 37: Identifying Piston Size Code
 Courtesy of KIA MOTORS AMERICA, INC.

PISTON OUTER DIAMETER CHART

Class	Size code	Piston outer diameter
A	A	86.67-86.68 mm (3.4122-3.4126 in.)
B	B	86.68-86.69 mm (3.4126-3.4130 in.)
C	C	86.69-86.70 mm (3.4130-3.4134 in.)

8. Select the proper piston related to the cylinder bore class.

Clearance: 0.02-0.04 mm (0.0008-0.0016 in.)

CYLINDER BORING

1. The over size piston is chosen on the maximum inner diameter of the cylinder.

NOTE: The piston size mark is on the top surface of the piston.

- Measure the outer diameter of the piston which is installed before.
- Calculate the new bore size with the measurement in the step 2.

New bore size = measured outer diameter of piston

+ 0.02-0.04 mm (0.0008-0.0016 in.) [clearance]

- 0.01 mm (0.0004 in.) [for honing]

4. Bore the cylinder to the calculated size.

CAUTION: Bore the cylinders in firing order to prevent the cylinders from be twisted by high temperature.

5. Stop boring and start honing for the proper clearance.
6. Measure the clearance between a piston and a cylinder.

Specification

0.02-0.04 mm (0.0008-0.0016 in.)

NOTE: Bore all the cylinders with the same over size.

PISTON AND RINGS

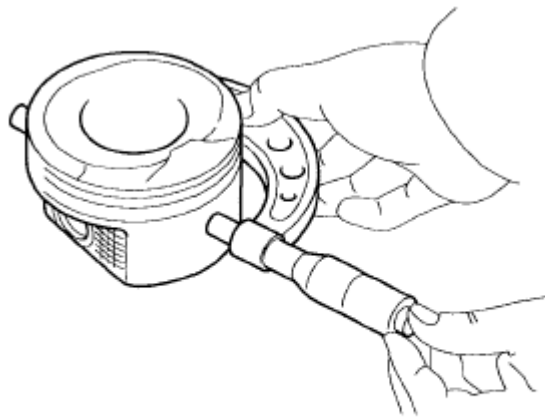
1. Clean pistons.
 1. Using a gasket scraper, remove the carbon from the piston top.
 2. Using a groove cleaning tool or a broken ring, clean the piston ring grooves.
 3. Using solvent and a brush, thoroughly clean the piston.

NOTE: Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 14 mm (0.5512 in.) from the bottom of the piston.

Standard diameter

86.67-87.00 mm (3.4122-3.4252 in.)



ECKD001D

Fig. 38: Measuring Piston Outside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston-to-cylinder clearance

0.02-0.04 mm (0.0008-0.0016 in.)

4. Inspect the piston ring side clearance.

Using a feeler gauge, measure the clearance between a new piston ring and the ring groove.

Piston ring side clearance

Standard

No.1: 0.04-0.08 mm (0.0016-0.0031 in.)

No.2: 0.03-0.07 mm (0.0012-0.0027 in.)

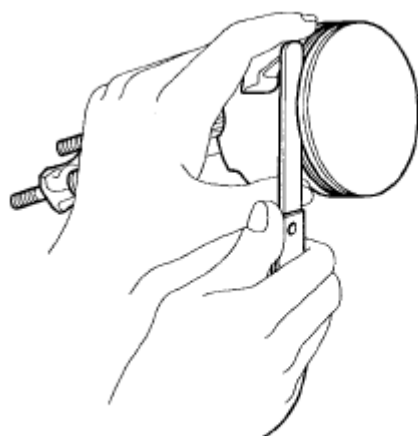
Oil ring: 0.06-0.15 mm (0.0024-0.0059 in.)

Limit

No.1: 0.1 mm (0.004 in.)

No.2: 0.1 mm (0.004 in.)

Oil ring: 0.2 mm (0.008 in.)



LDLG045A

Fig. 39: Measuring Clearance Between Piston Ring And Ring Groove
Courtesy of KIA MOTORS AMERICA, INC.

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

5. Inspect 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 ring. If the gap is too large, recheck the cylinder bore diameter. If the bore is over the service limit, the cylinder block must be replaced or bored

Piston ring end gap

Standard

No.1: 0.15-0.30 mm (0.0059-0.0118 in.)

No.2: 0.30-0.45 mm (0.0118-0.0177 in.)

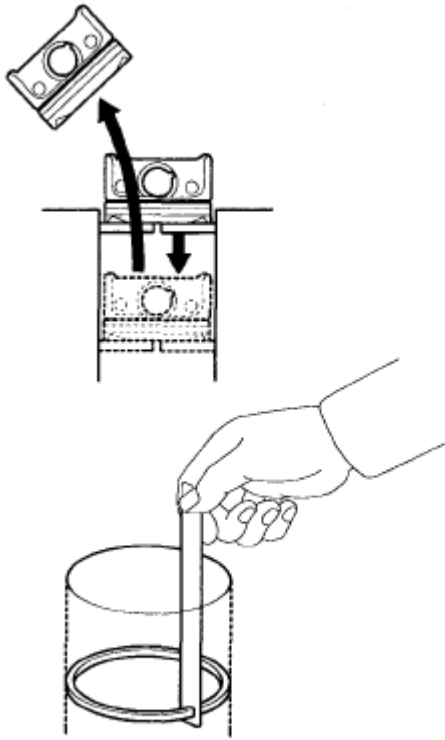
Oil ring: 0.20-0.70 mm (0.0079-0.0275 in.)

Limit

No.1: 0.6 mm (0.0236 in.)

No.2: 0.7 mm (0.0275 in.)

Oil ring: 0.8 mm (0.0315 in.)



ECKD001K

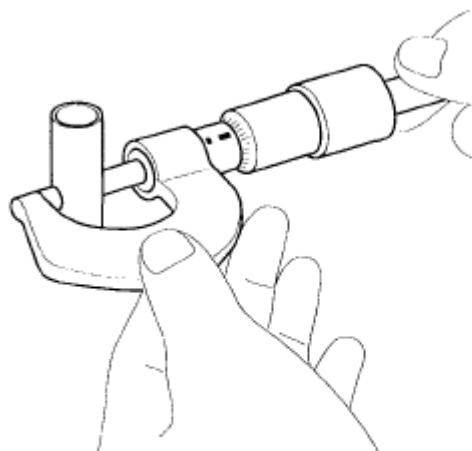
Fig. 40: Checking Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

PISTON PINS

1. Measure the outer diameter of the piston pin.

Piston pin outer diameter

21.001-21.007 mm (0.8268-0.8270 in.)



ECKD001Z

Fig. 41: Measuring Outer Diameter Of Piston Pin
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston pin-to-piston clearance

0.011-0.018 mm (0.0004-0.0007 in.)

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

Piston pin-to-connecting rod interference

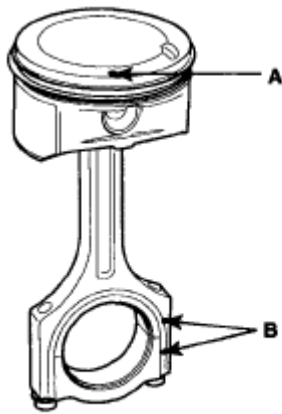
-0.033-0.016 mm (-0.0013-0.0006 in.)

REASSEMBLY

NOTE:

- Thoroughly clean all parts before reassembling.
- 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.

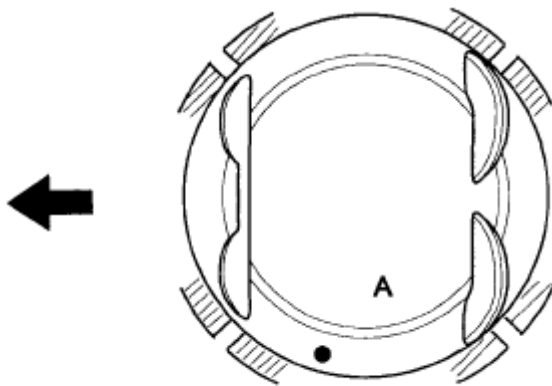
1. Assemble the piston and the connecting rod.
 1. Use a hydraulic press for installation.
 2. The piston front mark (A) and the connecting rod front mark (B) must face the timing belt side of the engine.



KCBF176E

Fig. 42: Identifying Piston Front Mark And Connecting Rod Front Mark
 Courtesy of KIA MOTORS AMERICA, INC.

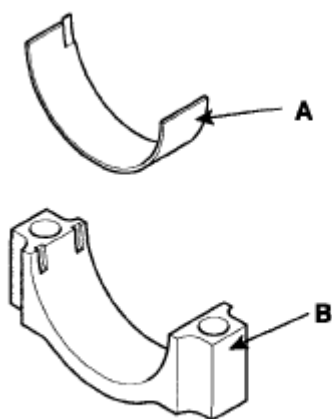
2. Install piston rings.
 1. Install the oil ring spacer and 2 side rails by hand.
 2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
 3. Position the piston rings so that the ring ends are as shown in illustration.



KCBF176F

Fig. 43: Positioning Piston Rings And Ring Ends
 Courtesy of KIA MOTORS AMERICA, INC.

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



KCRF118B

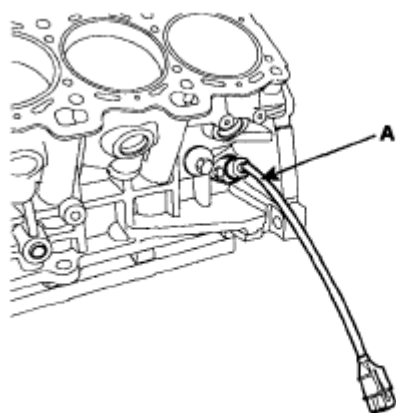
Fig. 44: Identifying Bearing And Connecting Rod Cap
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: When reassembling the connecting rods and the caps, ensure the front marks on them.

4. Install the CKP sensor (A).

Tightening torque

6.9-9.8 N.m (0.7-1.0 kgf.m, 5.1-7.2 lb-ft)



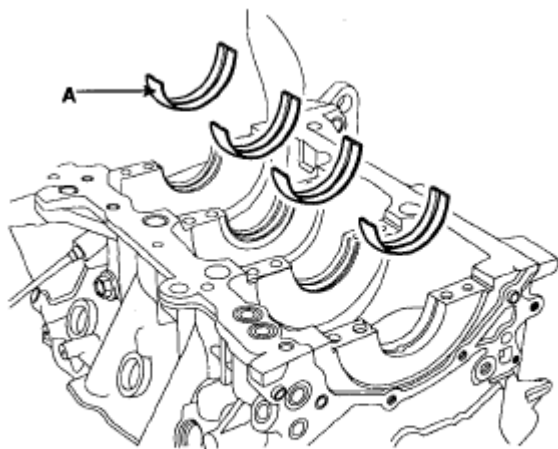
KCBF128A

Fig. 45: Identifying CKP Sensor
Courtesy of KIA MOTORS AMERICA, INC.

5. Install main bearing.

NOTE: Upper bearings have the oil grooves of the oil holes; Lower bearings do not.

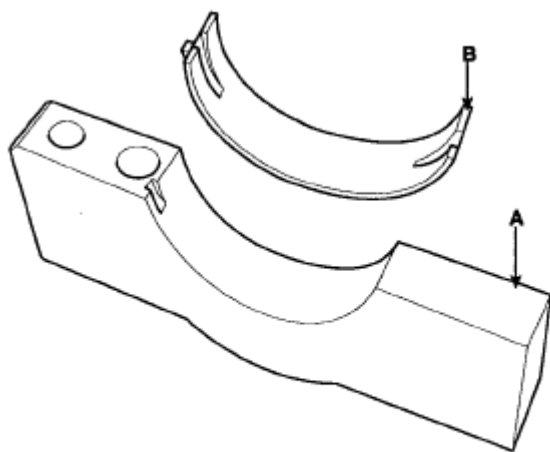
1. Aligning the bearing claw with the claw groove of the cylinder block, push in the 4 upper bearings (A).



EDQF076A

Fig. 46: Identifying Upper Bearings
Courtesy of KIA MOTORS AMERICA, INC.

2. Aligning the bearing claw with the claw groove of the main bearing cap, push in the 4 lower bearings (B) on the bearing caps (A).



EDQF079A

Fig. 47: Identifying Lower Bearing And Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

6. Install thrust bearings.

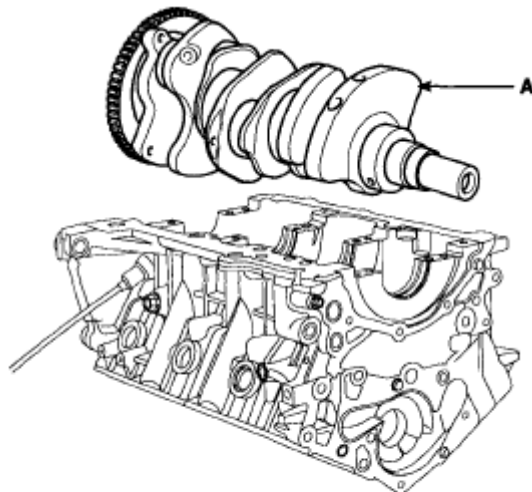
Install the 2 thrust bearings (A) under the No.3 journal position of the cylinder block with the oil grooves facing outward.



ECKD324A

Fig. 48: Identifying Thrust Bearings
Courtesy of KIA MOTORS AMERICA, INC.

7. Place crankshaft (A) on the cylinder block.



EDQF074A

Fig. 49: Identifying Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

8. Place main bearing caps on cylinder block.
9. Install main bearing cap bolts.
 1. Install and uniformly tighten the bearing cap bolts, in two steps, in the sequence shown in

illustration.

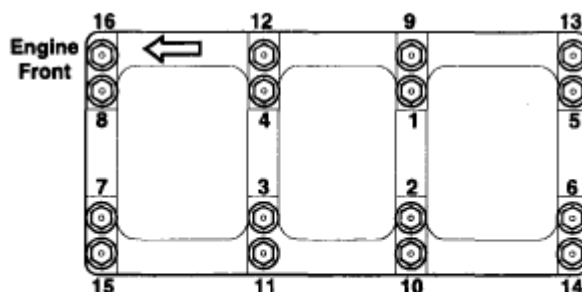
Tightening torque

M8: 15.7 N.m (1.6 kgf.m, 11.6 lb-ft) + 90°

M10: 29.4 N.m (3.0 kgf.m, 21.7 lb-ft) + 90°

NOTE:

- Use new main bearing cap bolt with engine oil applied.
- If any of the bearing cap bolts are broken or deformed, replace it.
- Washers have their direction (Up/Down)
- Assemble the bearing cap bridge on which its arrow mark faces the engine front.
- Before tightening, make the bearing caps be seated on the block firmly.



LDLG048A

Fig. 50: Identifying Bearing Caps Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Use SST (09221-4A000), install main bearing cap bolts.

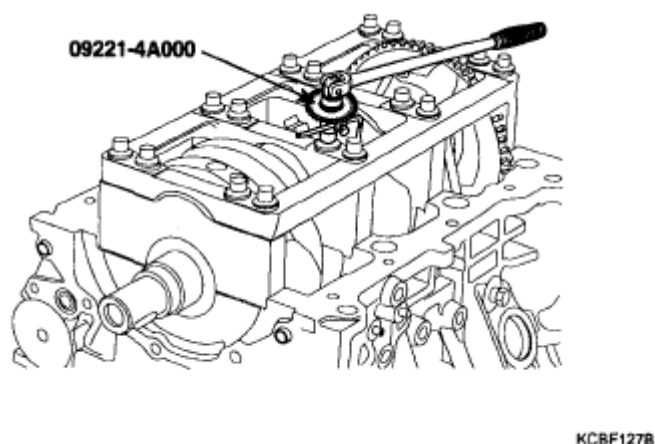


Fig. 51: Identifying SST (09221-4A000)
 Courtesy of KIA MOTORS AMERICA, INC.

2. Check that the crankshaft turns smoothly.
10. Check crankshaft end play.
11. Install the piston and connecting rod assemblies.

NOTE:

- Before installing the pistons, apply a coat of engine oil to the ring grooves and cylinder bores.
- When installing the piston, ensure that the coat on the cylinder wall is not damaged or scratched.

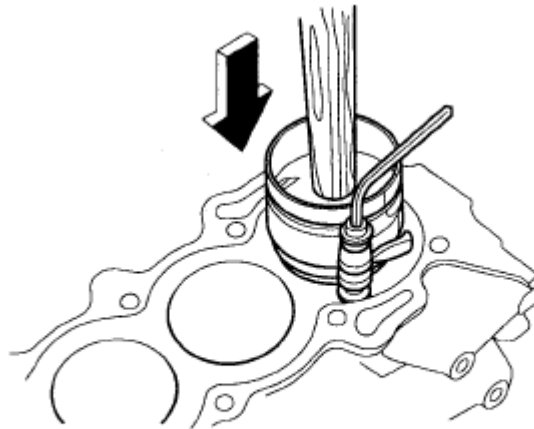
1. Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
2. Stop inserting the piston when the ring inserted in the cylinder and check the alignment of the journal and the connecting rod.
3. Apply engine oil to the bolt threads. Install the rod caps with bearings, and torque the bolts.

Tightening torque

19.6 N.m (2.0 kgf.m, 14.46 lb-ft) + 90°

NOTE:

- Always use new connecting rod bolts.
- Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.

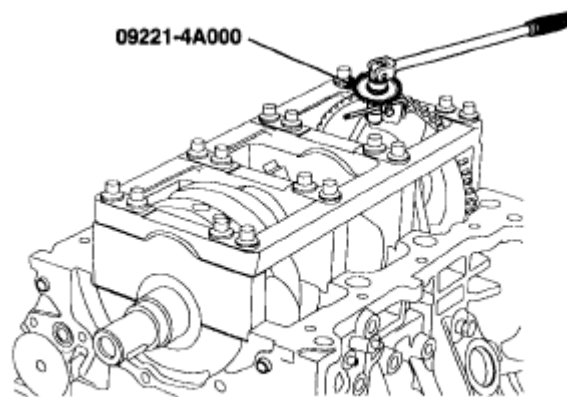


ECKD001F

Fig. 52: Installing Pistons

Courtesy of KIA MOTORS AMERICA, INC.

- Use SST (09221-4A000), install connecting rod bearing cap bolts.



KCBF127C

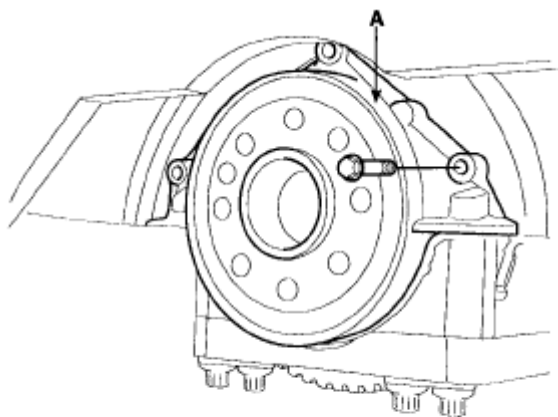
Fig. 53: Identifying SST (09221-4A000)

Courtesy of KIA MOTORS AMERICA, INC.

12. Install the rear oil seal case.

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.67 lb-ft)



EDQF174A

Fig. 54: Identifying Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

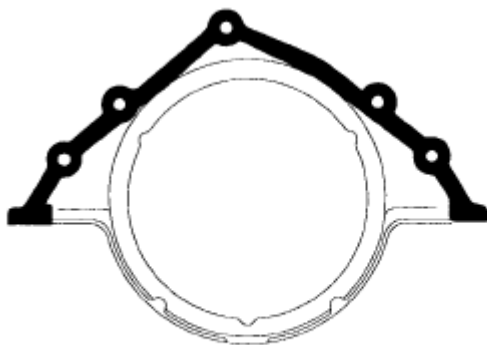
1. Make clean the sealing face before assembling two parts.

NOTE:

- Remove harmful foreign materials on the sealing face before applying sealant
- Apply sealant to the inner threads of the bolt holes.

2. Assembling rear oil seal case, the liquid sealant TB1217H should be applied to the rear oil seal case.

The part must be assembled within 5 minutes after sealant was applied.

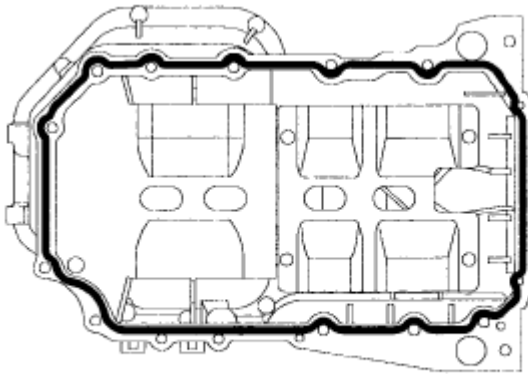


KCBF129A

Fig. 55: Identifying Sealant Area
Courtesy of KIA MOTORS AMERICA, INC.

13. Using SST (09231-33000), install rear oil seal after applying engine oil on the rip of the oil seal.

14. Install the oil pump case.
15. Install upper oil pan.
 1. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
 2. Before assembling the oil pan, the liquid sealant TB1217H should be applied on upper oil pan. The part must be assembled within 5 minutes after the sealant was applied.



KCBF130A

Fig. 56: Identifying Upper Oil Pan Sealant Area
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.

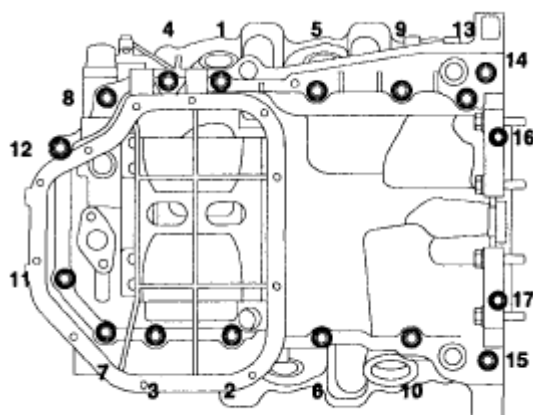
3. Install upper oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

Bolts 1-15: 18.6-23.5 N.m (1.9-2.4 kgf.m, 13.7-17.4 lb-ft)

Bolts 16,17: 4.9-6.9 N.m (0.5-0.7 kgf.m, 3.6-5.1 lb-ft)



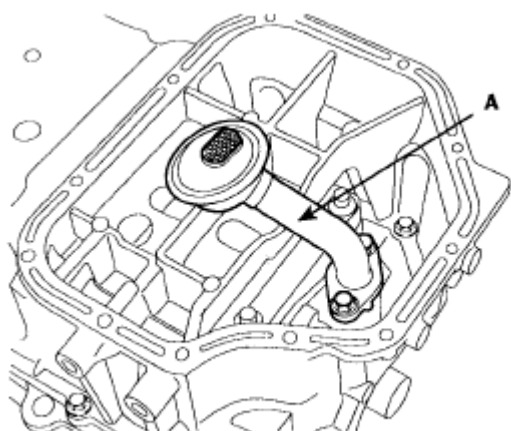
KCBF131A

Fig. 57: Identifying Upper Oil Pan Bolt Tightening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.

16. Install the oil screen (A).

Tightening torque

14.7-21.6 N.m (1.5-2.2 kgf.m, 10.8-15.9 lb-ft)



KCBF124A

Fig. 58: Identifying Oil Screen
 Courtesy of KIA MOTORS AMERICA, INC.

17. Install the lower oil pan.
1. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
 2. Before assembling the oil pan, the liquid sealant TB1217H should be applied on lower oil pan. The part must be assembled within 5 minutes after the sealant was applied.

NOTE:

- **Clean the sealing face before assembling two parts.**

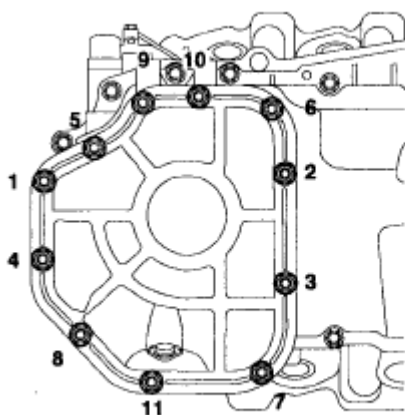
- Remove harmful foreign materials on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.

3. Install lower oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

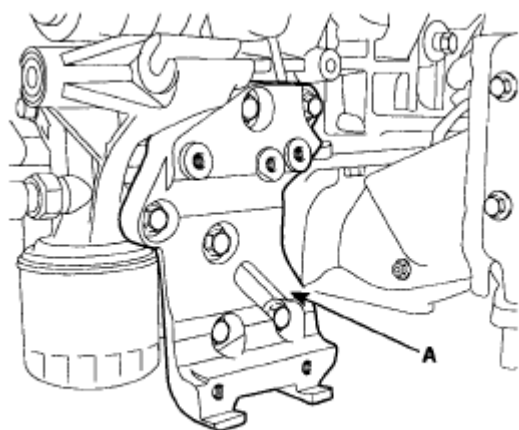
9.8-11.8 N.m (1.0-1.2 kgf.m, 7.2-8.7 lb-ft)



KCBF133A

Fig. 59: Identifying Lower Oil Pan Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

18. Install the air conditioning compressor bracket (A). (Refer to AIR CONDITIONING SYSTEM)



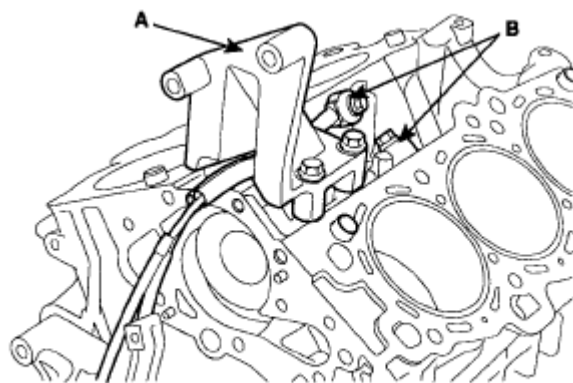
KCBF138A

Fig. 60: Identifying Air Conditioning Compressor Bracket
Courtesy of KIA MOTORS AMERICA, INC.

19. Install the power steering pump bracket (A) and the knock sensor (B).

Tightening torque

18.6-23.5 N.m (1.9-2.4 kgf.m, 13.7-17.4 lb-ft)



KCBF122A

Fig. 61: Identifying Power Steering Pump Bracket And Knock Sensors
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- On Bank 1, the black knock sensor connector should be installed and on Bank 2, the gray one should.

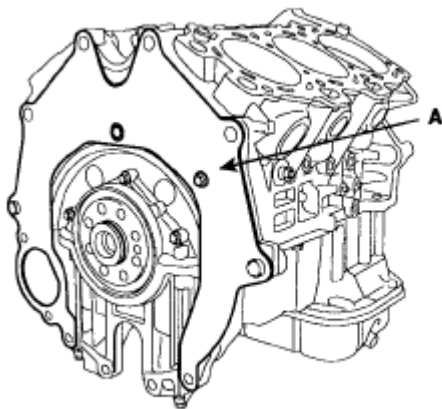
INSTALLATION

1. Install the water pump.
2. Install the air conditioning compressor. (Refer to **AIR CONDITIONING SYSTEM**).

3. Install the cylinder head.
4. Install the power steering pump. (Refer to **MECHANICAL POWER STEERING SYSTEM**).
5. Install the generator.
6. Install the intake manifold.
7. Install the exhaust manifold.
8. Install the timing belt.
9. Install the rear plate (A).

Tightening torque

9.8-11.8 N.m (1.0-1.2 kgf.m, 7.2-8.7 lb-ft)



KCBF121A

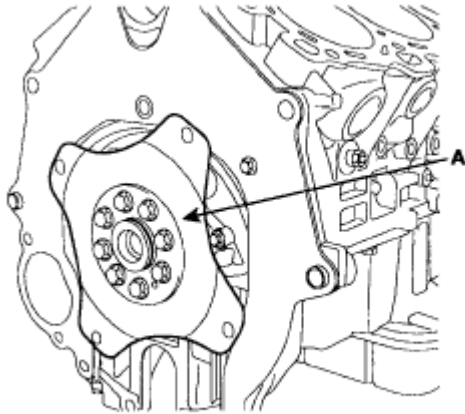
Fig. 62: Identifying Rear Plate

Courtesy of KIA MOTORS AMERICA, INC.

10. Install the drive plate (A).

Tightening torque

71.6-75.5 N.m (7.3-7.7 kgf.m, 52.8-55.7 lb-ft)



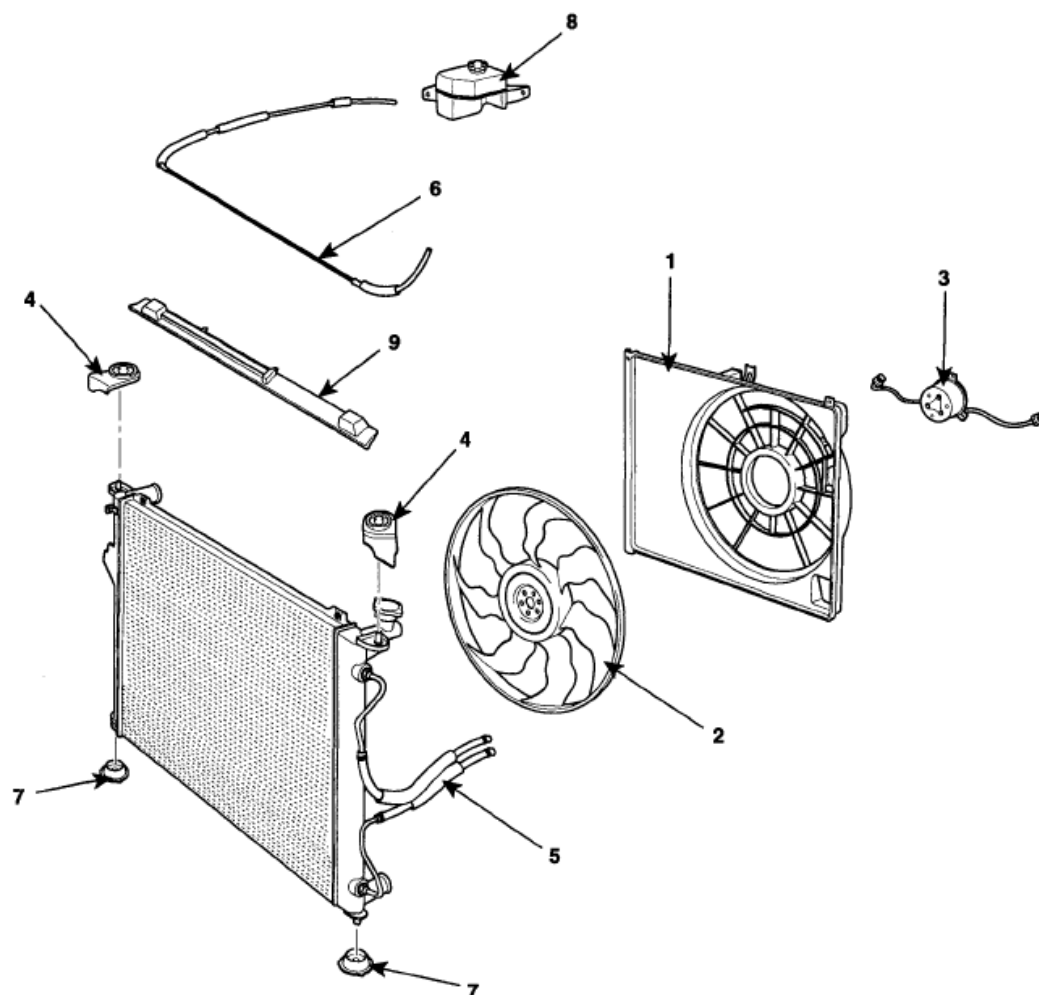
KCBF120A

Fig. 63: Identifying Drive Plate

Courtesy of KIA MOTORS AMERICA, INC.

COOLING SYSTEM

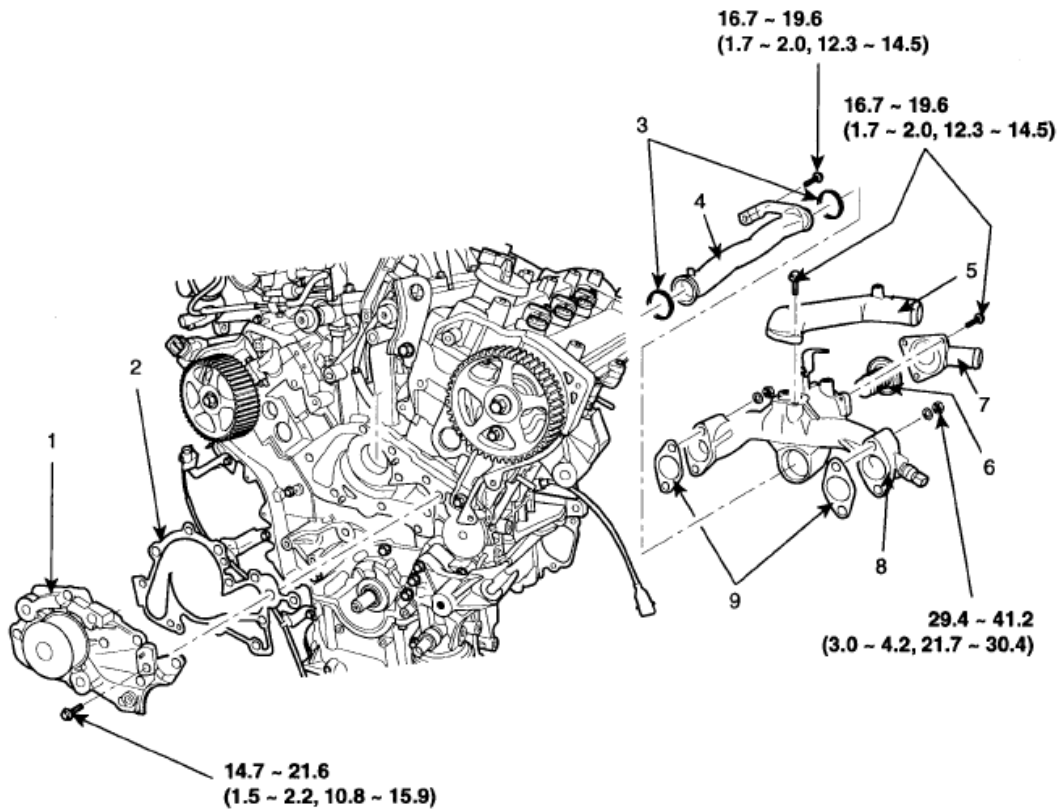
COMPONENTS



- | | |
|------------------------------------|--------------------------------------|
| 1. Fan cover | 6. Water pipe assembly |
| 2. Fan | 7. Radiator lower mounting insulator |
| 3. Motor assembly | 8. Radiator reservoir |
| 4. Radiator upper mounting bracket | 9. Cover |
| 5. Oil cooler assembly | |

LDLG047A

Fig. 64: Identifying Cooling System Components (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

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

- | | |
|-------------------------|--|
| 1. Water pump | 6. Thermostat |
| 2. Water pump gasket | 7. Water inlet fitting |
| 3. Water pipe O-ring | 8. Water temp. control assembly |
| 4. Water inlet pipe | 9. Water temp. control assembly gasket |
| 5. Water outlet fitting | |

SMGM16011N

Fig. 65: Identifying Cooling System Components (2 Of 2) (With Torque Specifications)
 Courtesy of KIA MOTORS AMERICA, INC.

ENGINE COOLANT REFILLING AND BLEEDING

WARNING: Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

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

1. Make sure the engine and radiator are cool to the touch.
2. Open the radiator cap.
3. Loosen the drain plug, and drain the coolant.

4. Tighten the radiator drain plug securely.
5. Remove, drain and clean the reservoir tank.
6. Fill water slowly through the radiator cap. Push the upper/lower hoses of the radiator so as to bleed air easily.
7. Warm the engine until the cooling fan operates 2-3 times.

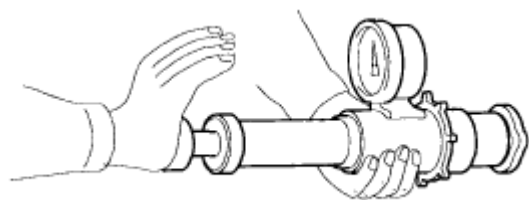
Accelerate the engine 2-3 times without load.

8. Wait until the engine is cold.
9. Repeat the steps 1-8 until the water drained is clean.
10. Fill fluid mixture with coolant and water (4: 6) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as to bleed air easily.
11. Start the engine and run so coolant circulates. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
12. Repeat 11 until the cooling fan cycles 3-5 times and bleed air sufficiently out of the cooling system.
13. Install the radiator cap and fill the reservoir tank to the "MAX" (or "F") line with coolant.
14. Run the vehicle under idle until the cooling fan operates 2-3 times.
15. Stop the engine and wait until coolant gets cool.
16. Repeat 10 to 15 until the coolant level doesn't fall any more, bleeding air out of the cooling system.

NOTE: Check the coolant level again in the reservoir tank for 2-3 days after replacing coolant.

CAP TESTING

1. Remove the radiator cap, wet its seal with engine coolant, and install it to a pressure tester.



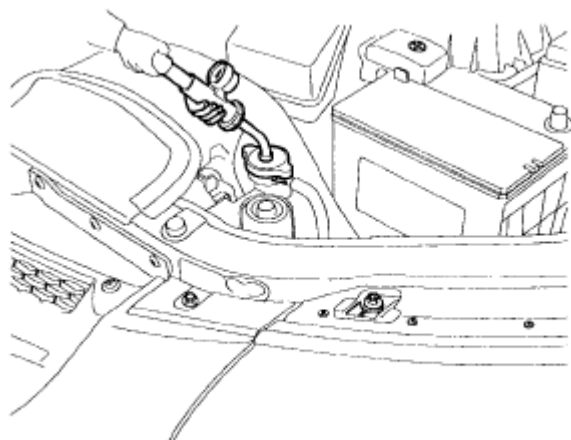
ECKD601X

Fig. 66: Testing Radiator Cap
Courtesy of KIA MOTORS AMERICA, INC.

2. Apply a pressure of 93-123 kPa (0.95-1.25 kgf/cm² , 14-19 psi).
3. Check for a drop in pressure.
4. If the pressure drops, replace the cap.

TESTING

1. Wait until engine is cool, then carefully remove the radiator cap. Fill the radiator with engine coolant and install a pressure tester on it.



KCRF184A

Fig. 67: Testing Radiator**Courtesy of KIA MOTORS AMERICA, INC.**

2. Apply a pressure of 93-123 kPa (0.95-1.25 kgf/cm² 14-18 psi).
3. Inspect for engine coolant leaks and a drop in pressure.
4. Remove the tester and reinstall the radiator cap.

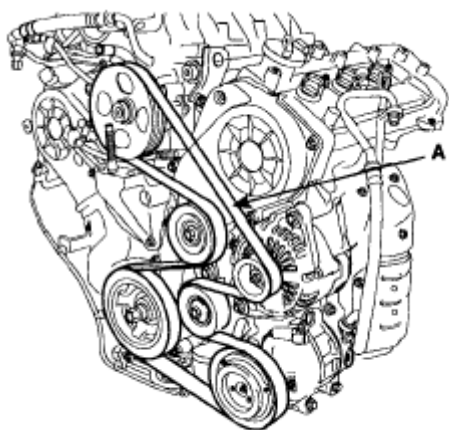
NOTE: Check for engine oil in coolant or coolant in engine oil.

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 drive belt (A).

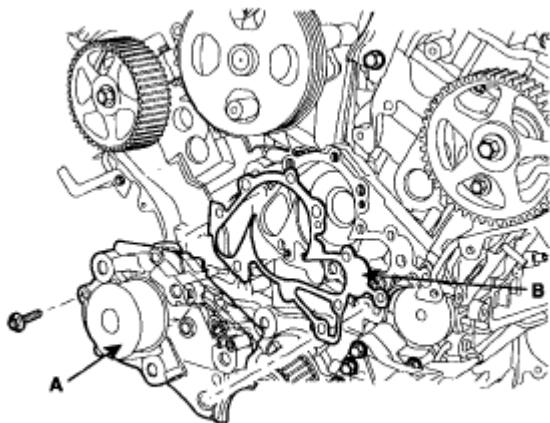


KCBF105A

Fig. 68: Identifying Drive Belt

Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the timing belt.
4. Remove the water pump (A) and gasket (B).



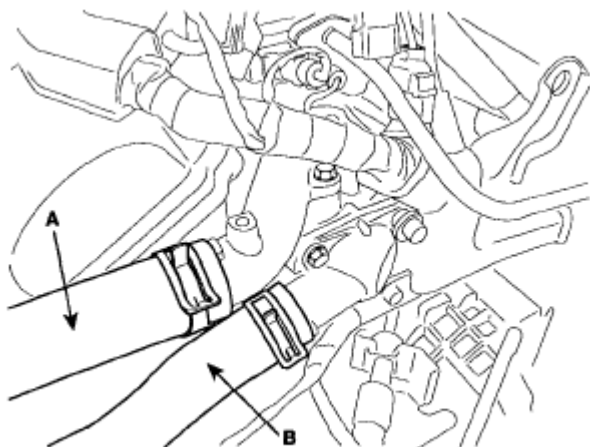
KCBF138A

Fig. 69: Identifying Water Pump And Gasket

Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Do not reuse the water pump gasket disassembled.**WATER TEMPERATURE CONTROL ASSEMBLY**

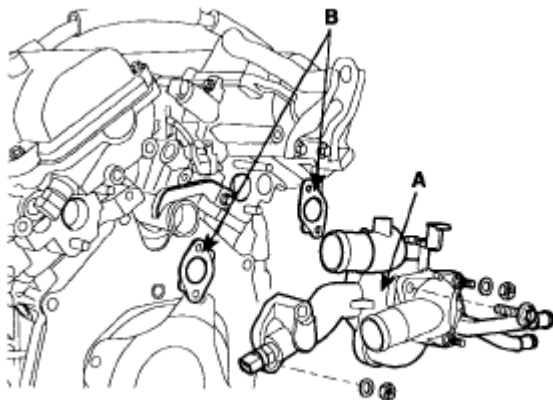
1. Drain the engine coolant.
2. Remove the air cleaner assembly.
3. Disconnect the radiator upper and lower hose (A, B).



LDLG008A

Fig. 70: Identifying Radiator Upper And Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

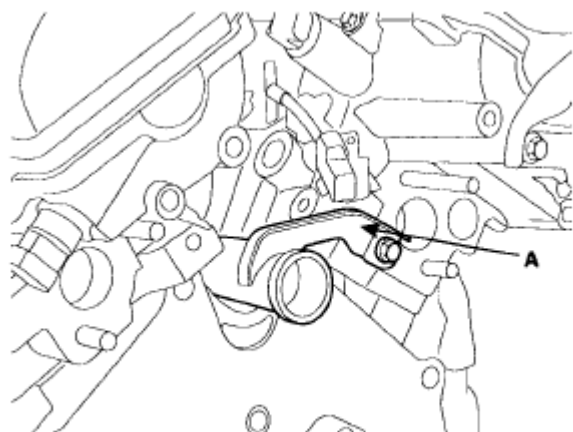
4. Disconnect the ECT (Engine Coolant Temperature) sensor connector.
5. Remove the coolant hose related to the heater hoses and the ECT (Engine Coolant Temperature) system.
6. Remove wiring protector.
7. Remove water temperature control assembly (A) and the gaskets (B).



SMGM16012N

Fig. 71: Identifying Water Temperature Control Assembly And Gaskets
Courtesy of KIA MOTORS AMERICA, INC.

8. Remove the water pipe (A).



KCBF140A

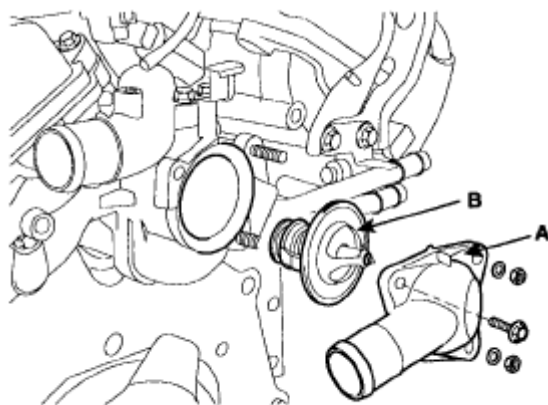
Fig. 72: Identifying Water Pipe

Courtesy of KIA MOTORS AMERICA, INC.

THERMOSTAT

NOTE: Removal of the thermostat would have an adverse effect, causing a lowering of cooling efficiency. Do not remove the thermostat, even if the engine tends to overheat.

1. Drain engine coolant so its level is below thermostat.
2. Remove the coolant inlet pitting (A) and the thermostat (B).



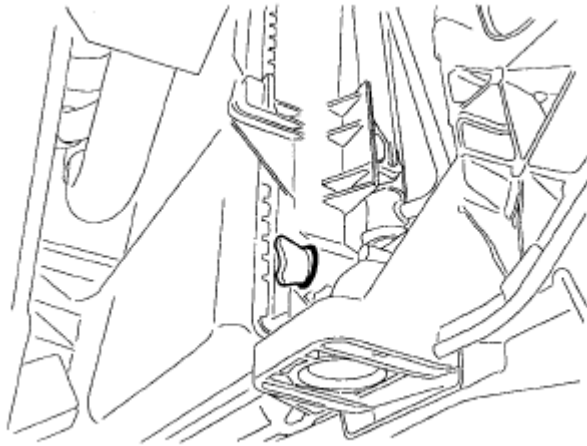
KCBF141A

Fig. 73: Identifying Coolant Inlet Pitting And Thermostat

Courtesy of KIA MOTORS AMERICA, INC.

RADIATOR

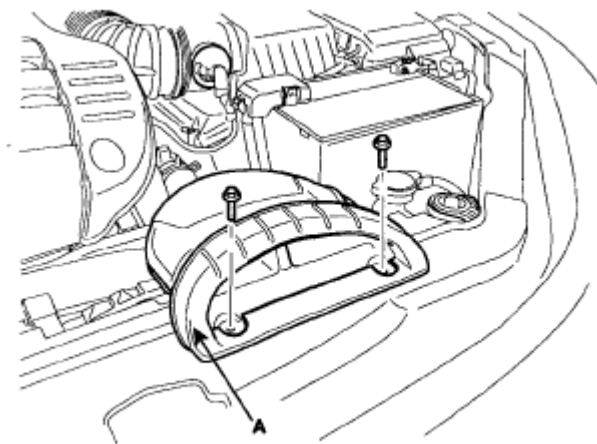
1. Drain the engine coolant. Remove the radiator cap to speed coolant draining.



LDLG007A

Fig. 74: Identifying Radiator Petcock
Courtesy of KIA MOTORS AMERICA, INC.

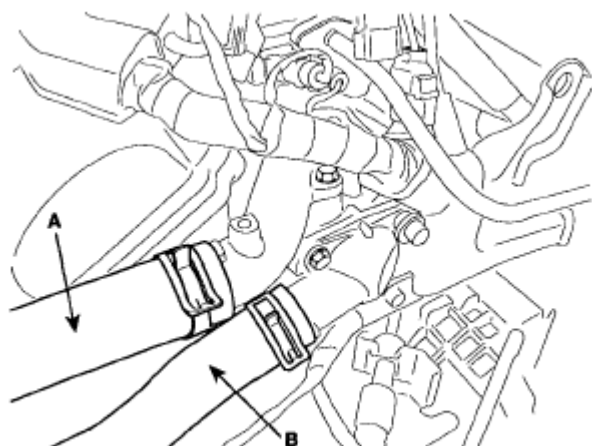
2. Remove the air duct (A).



LDLG049A

Fig. 75: Identifying Air Duct
Courtesy of KIA MOTORS AMERICA, INC.

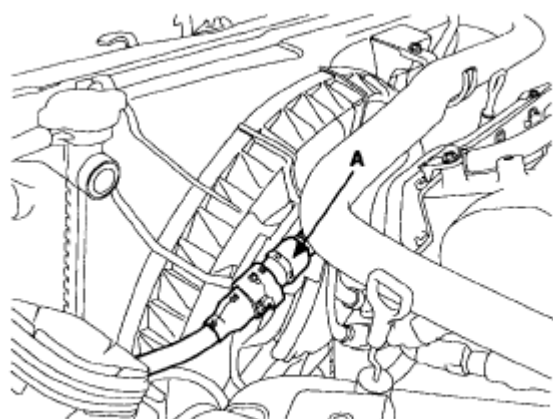
3. Remove the upper radiator hose (A) and lower radiator hose (B).



LDLG008A

Fig. 76: Identifying Radiator Upper And Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

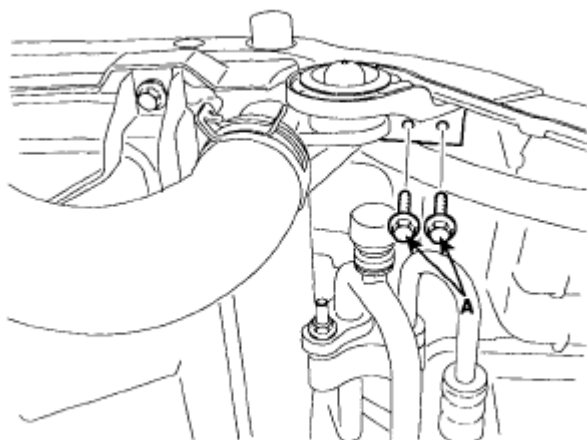
4. Disconnect the transaxle oil cooler hoses (refer to **TRANSAXLE SYSTEM (A/T)**).
5. Disconnect the radiator fan connector (A).



KCBF156A

Fig. 77: Identifying Radiator Fan Connector
Courtesy of KIA MOTORS AMERICA, INC.

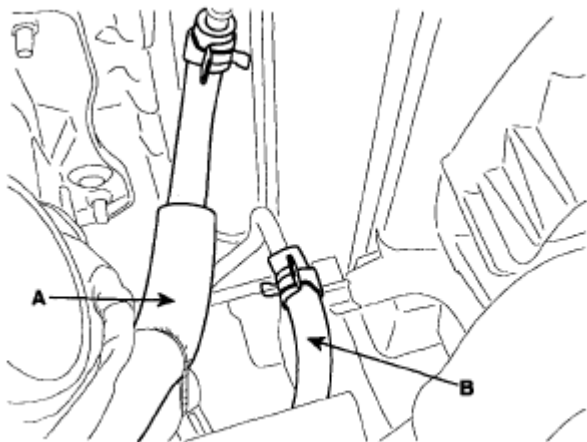
6. Remove the radiator mounting bolts (A).



LDLG015A

Fig. 78: Identifying Radiator Mounting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

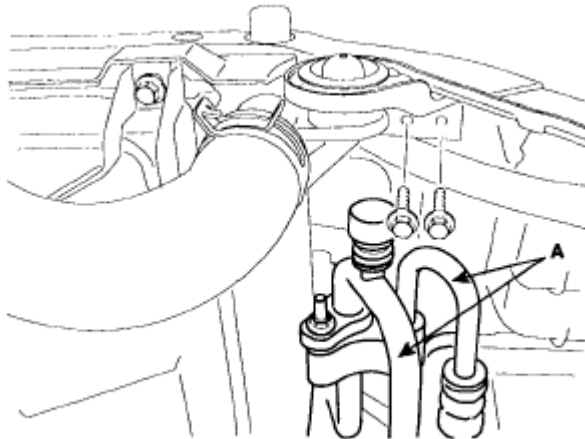
7. Disconnect the ATF (Automatic Transaxle Fluid) cooler hoses (A, B) from the radiator.



LDLG016A

Fig. 79: Identifying ATF Cooler Hoses
Courtesy of KIA MOTORS AMERICA, INC.

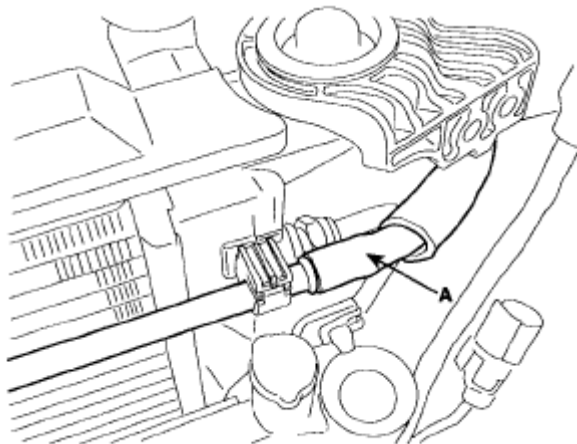
8. Disconnect the air conditioning tube hoses (A).



LDLG050A

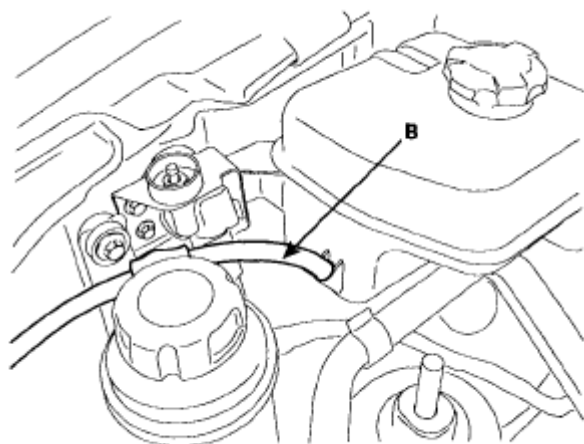
Fig. 80: Identifying Air Conditioning Tube Hoses
Courtesy of KIA MOTORS AMERICA, INC.

9. Disconnect the engine coolant reservoir tank hose (A, B).



LDLG018A

Fig. 81: Identifying Engine Coolant Reservoir Tank Hose (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.



LDLG017A

Fig. 82: Identifying Engine Coolant Reservoir Tank Hose (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove the radiator assembly with a condenser from the vehicle.

INSPECTION

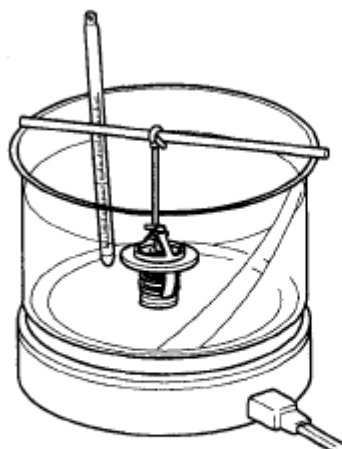
WATER PUMP

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.

NOTE: A small amount of "weeping" from the bleed hole is normal.

THERMOSTAT

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



ECKD503B

Fig. 83: Testing Thermostat**Courtesy of KIA MOTORS AMERICA, INC.**

2. Check the valve opening temperature. Valve opening temperature: 82°C (177°F) Full opening temperature: 95°C (205°F) If the valve opening temperature is not as specified, replace the thermostat.
3. Check the valve lift.

Valve lift: Min. 10 mm (0.4 in.) at 95°C (205°F)

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

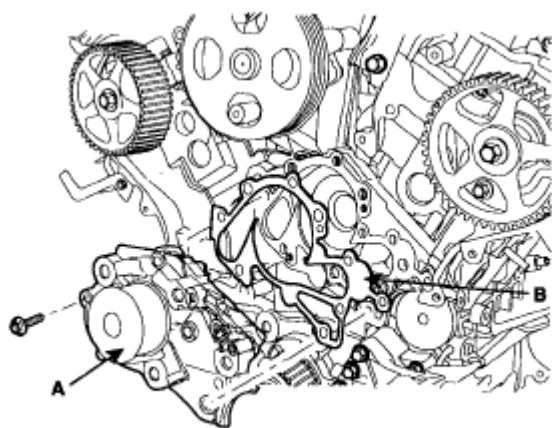
INSTALLATION

WATER PUMP

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

Tightening torque

14.7-21.6 N.m (1.5-2.2 kgf.m, 10.8-15.9 lb-ft)



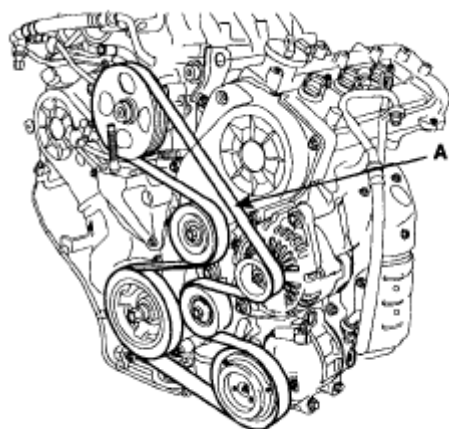
KCBF138A

Fig. 84: Identifying Water Pump And Gasket
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Clean the contacting face before assembling.
- Do not reuse the water pump gasket disassembled.

2. Install the timing belt.
3. Install drive belt (A).



KCBF105A

Fig. 85: Identifying Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

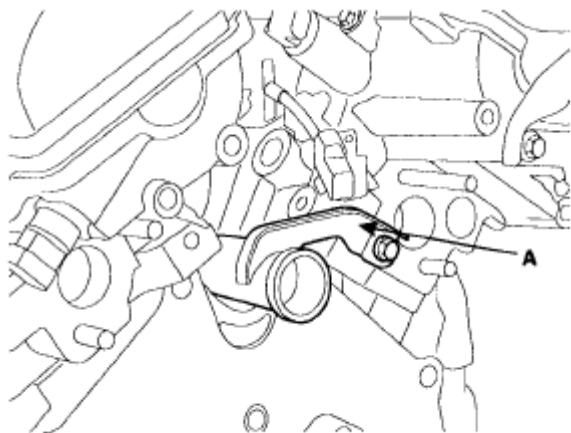
4. Fill with engine coolant.
5. Start engine and check for leaks.
6. Recheck engine coolant level.

WATER TEMPERATURE CONTROL ASSEMBLY

1. Install the water pipe (A).

Tightening torque

16.7-19.6 N.m (1.7-2.0 kgf.m, 12.3-14.5 lb-ft)



KCBF140A

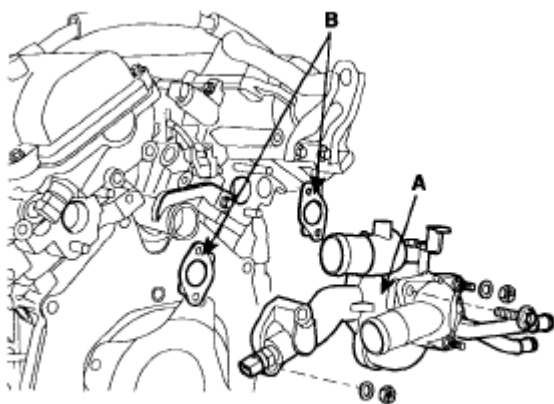
Fig. 86: Identifying Water Pipe

Courtesy of KIA MOTORS AMERICA, INC.

2. Install the water temperature control assembly (A) with a new gasket (B).

Tightening torque

29.4-41.2 N.m (3.0-4.2 kgf.m, 21.7-30.4 lb-ft)



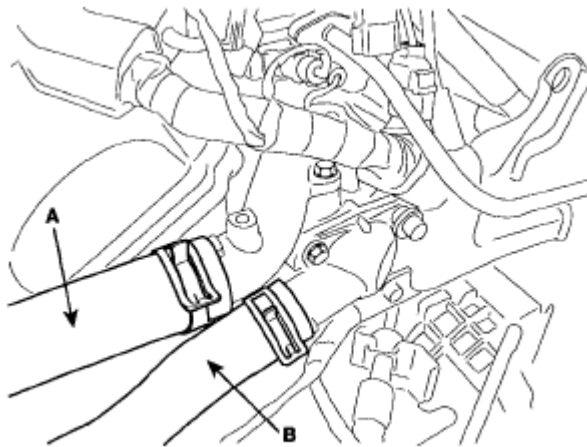
SMGM16012N

Fig. 87: Identifying Water Temperature Control Assembly And Gaskets

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Use new O-rings and wet them with water or coolant when reassembling.

3. Install the wiring protector.
4. Connect the heater hose and ECT hose.
5. Connect the ECT sensor connector.
6. Connect the radiator upper and the lower hose (A).



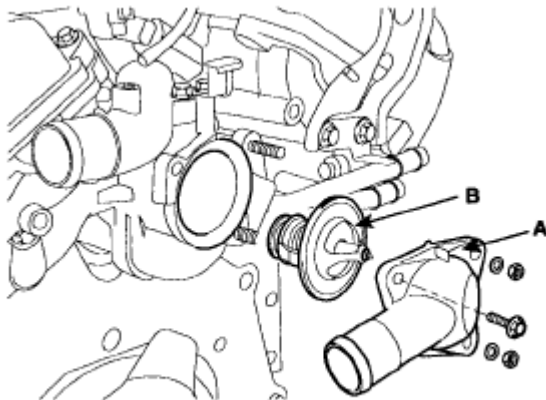
LDLG008A

Fig. 88: Identifying Radiator Upper And Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the air cleaner assembly.
8. Fill with engine coolant.
9. Start engine and check for leaks.
10. Recheck engine coolant level.

THERMOSTAT

1. Place thermostat (B) in coolant inlet pitting (A). Install the thermostat with the jiggle valve upward.



KCBF141A

Fig. 89: Identifying Coolant Inlet Pitting And Thermostat

Courtesy of KIA MOTORS AMERICA, INC.

2. Install the coolant inlet pitting (A).

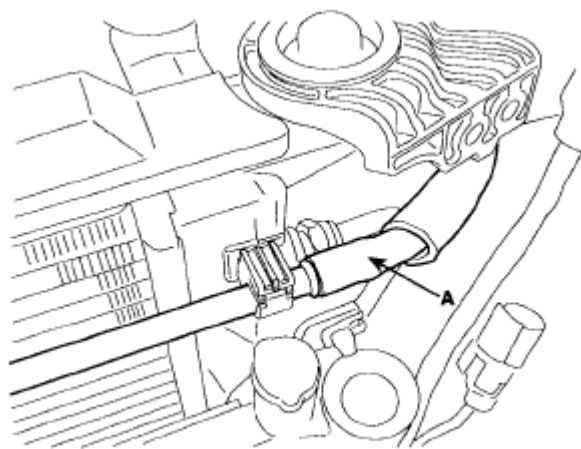
Tightening torque

16.66-19.60 N.m (1.7-2.0 kgf.m, 12.30-14.47 lb-ft)

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

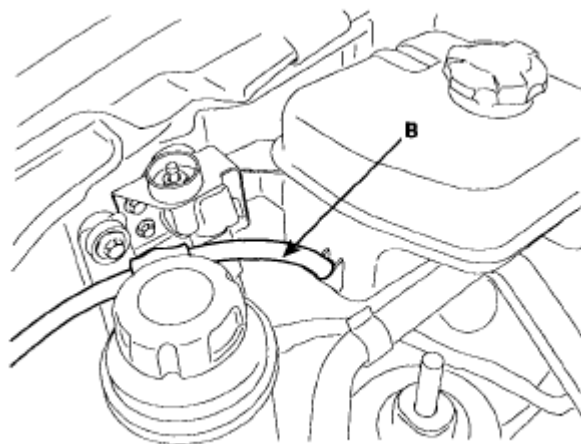
RADIATOR

1. Install the radiator assembly with a condenser to the vehicle.
2. Connect the engine coolant reservoir tank hose (A, B).



LDLG016A

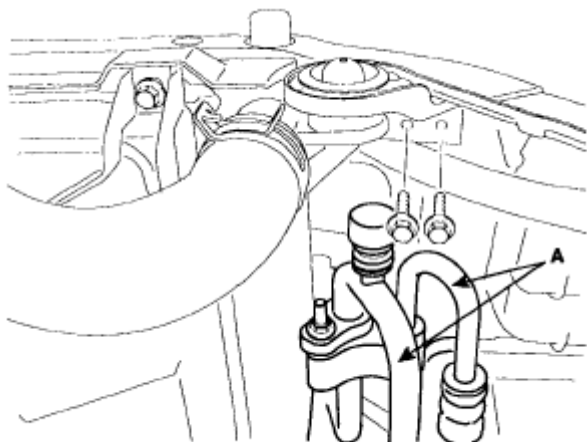
Fig. 90: Identifying Engine Coolant Reservoir Tank Hose (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.



LDLG017A

Fig. 91: Identifying Engine Coolant Reservoir Tank Hose (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

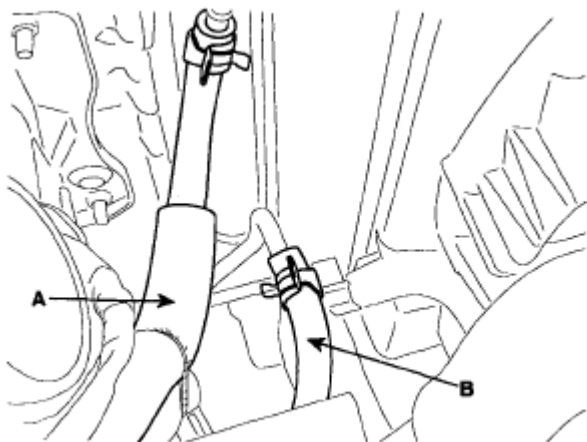
3. Connect the air conditioning tube hoses (A).



LDLG050A

Fig. 92: Identifying Air Conditioning Tube Hoses
Courtesy of KIA MOTORS AMERICA, INC.

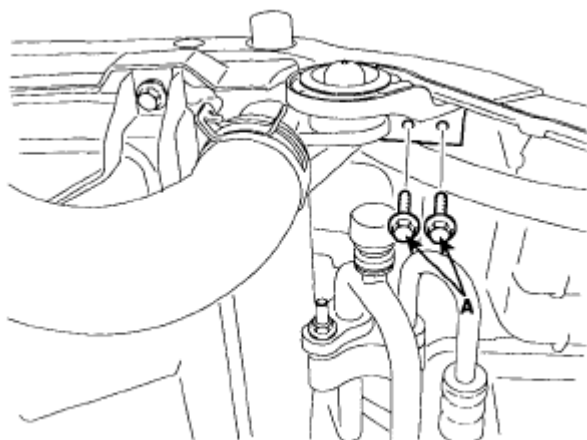
4. Clamp the ATF (Automatic Transaxle Fluid) cooler hoses (A, B) to the radiator.



LDLG016A

Fig. 93: Identifying ATF Cooler Hoses
Courtesy of KIA MOTORS AMERICA, INC.

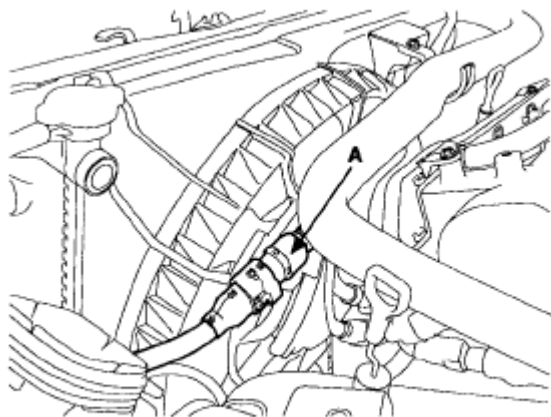
5. Install the radiator mounting bolts (A).



LDLG015A

Fig. 94: Identifying Radiator Mounting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

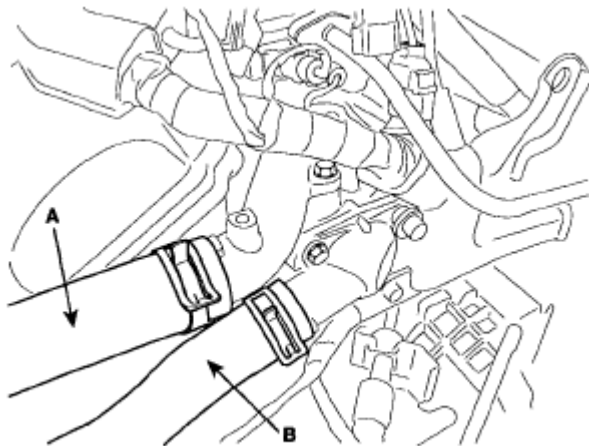
6. Connect the radiator fan connector (A).



KCBF156A

Fig. 95: Identifying Radiator Fan Connector
Courtesy of KIA MOTORS AMERICA, INC.

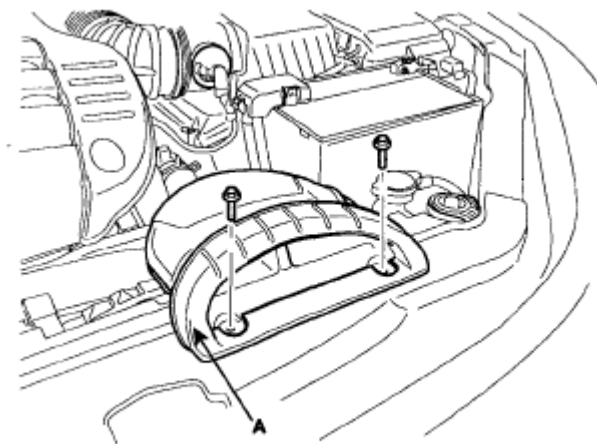
7. Connect the transaxle oil cooler hoses. (Refer to **TRANSAXLE SYSTEM (A/T)**).
8. Install the upper radiator hose (A) and lower radiator hose (B).



LDLG008A

Fig. 96: Identifying Radiator Upper And Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

9. Install the air duct (A).



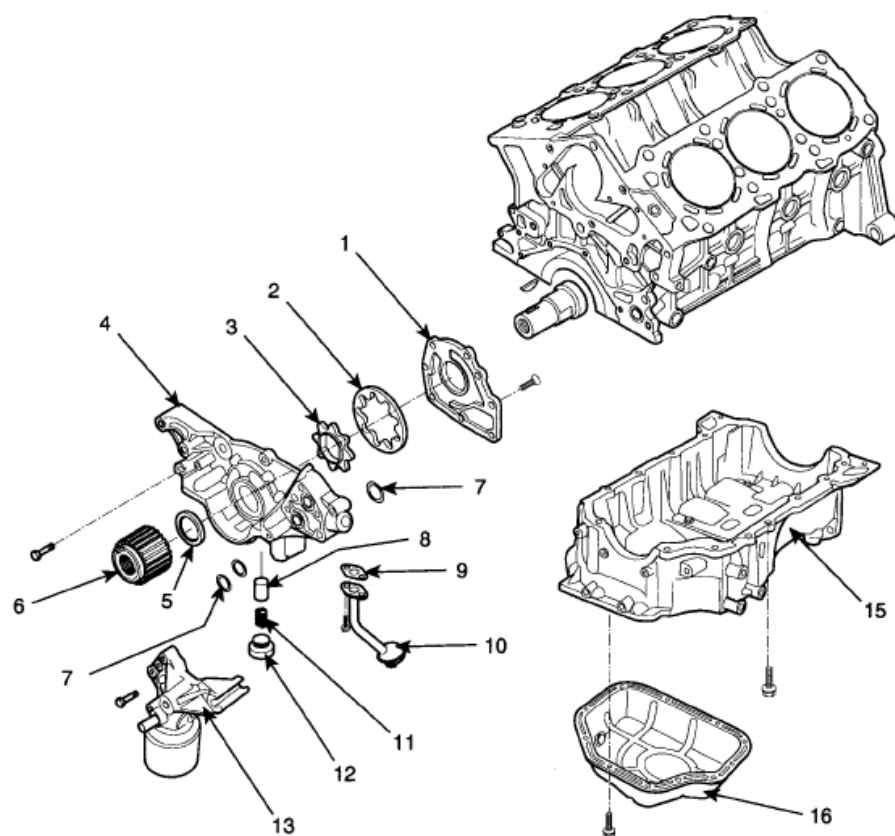
LDLG048A

Fig. 97: Identifying Air Duct
Courtesy of KIA MOTORS AMERICA, INC.

10. Refill with engine coolant.

LUBRICATION SYSTEM

COMPONENTS



- | | |
|-------------------------|------------------------|
| 1. Oil pump cover | 9. Oil screen gasket |
| 2. Oil pump outer rotor | 10. Oil screen |
| 3. Oil pump inner rotor | 11. Relief spring |
| 4. Oil pump case rotor | 12. Plug |
| 5. Oil seal | 13. Oil filter bracket |
| 6. Crankshaft sprocket | 15. Upper oil pan |
| 7. O-ring | 16. Lower oil pan |
| 8. Relief plunger | |

LDLG051A

Fig. 98: Identifying Lubrication System Components
 Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

1. Check engine oil quality.

Check the oil for deterioration, entry of water, discoloring or thinning.

If the quality is visibly poor, replace oil.

2. Check the engine oil level.

After warming up the engine, make the engine stand still for five minutes or more. The oil level should be between the 'L' and 'F' marks on the dipstick, then.

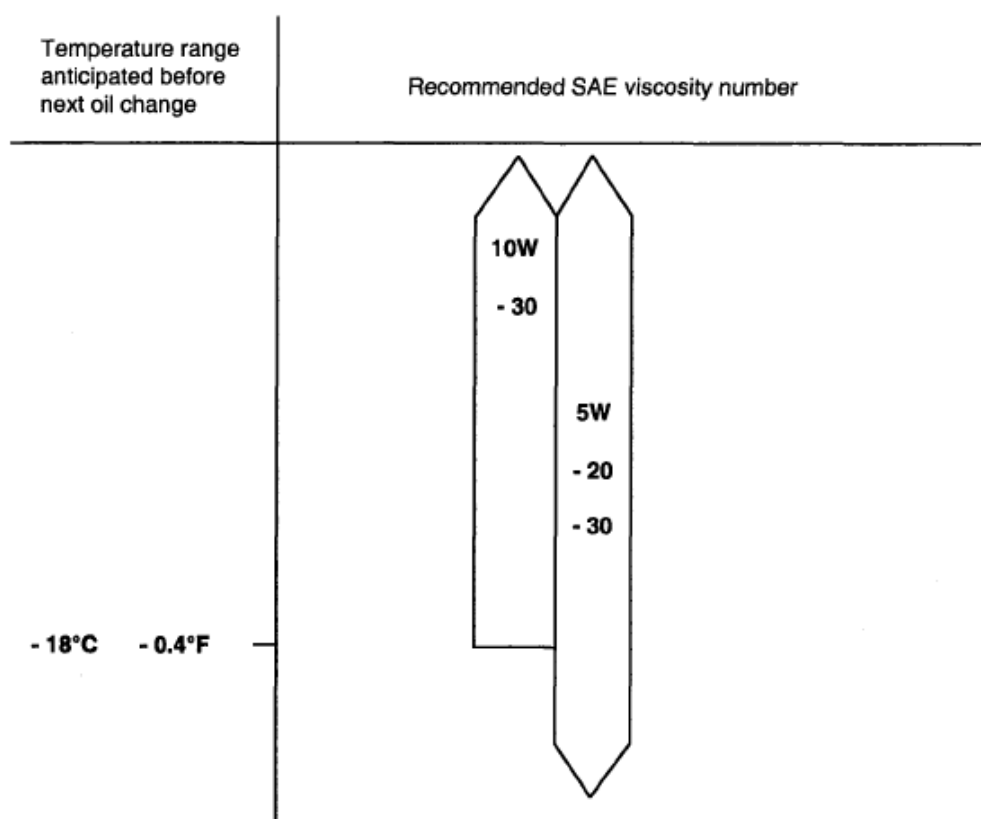
If low, check for leakage and add oil up to the "F" mark.

NOTE: Do not fill with engine oil above the "F" mark.

SELECTION OF ENGINE OIL

Recommended API classification: Above SJ or SL

Recommended SAE viscosity grades: 5W-20



EORF020A

Fig. 99: Recommended SAE Viscosity Grades Chart

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: For best performance and maximum protection of all types of operation, select only those lubricants which:

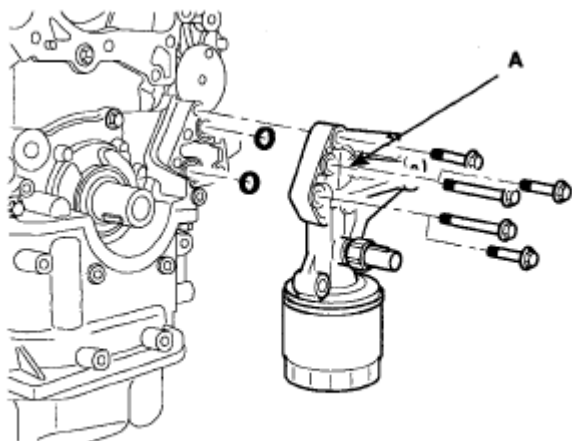
- Satisfy the requirement of the API classification.
- Have proper SAE grade number for expected ambient temperature range.

Lubricants that do not have both an SAE grade number and API service classification on the container should not be used.

REMOVAL

OIL PUMP CASE

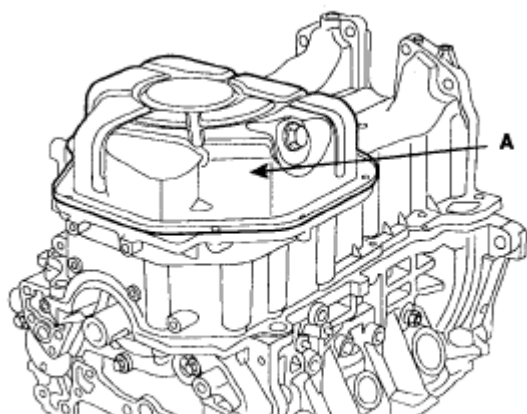
1. Drain engine oil.
2. Remove the front right wheel and tire.
3. Remove the front right side cover.
4. Remove the front muffler.
5. Remove the generator.
6. Remove the timing belt.
7. Remove the oil filter bracket (A).



KCBF147A

Fig. 100: Identifying Oil Filter Bracket
Courtesy of KIA MOTORS AMERICA, INC.

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

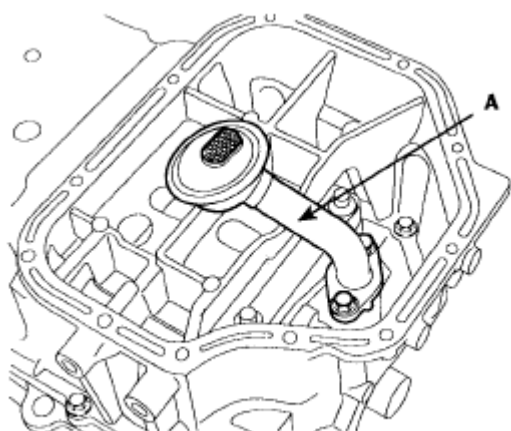


KCBF123A

Fig. 101: Identifying Lower Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Be careful not to damage the contact surfaces of upper oil pan and lower oil pan.

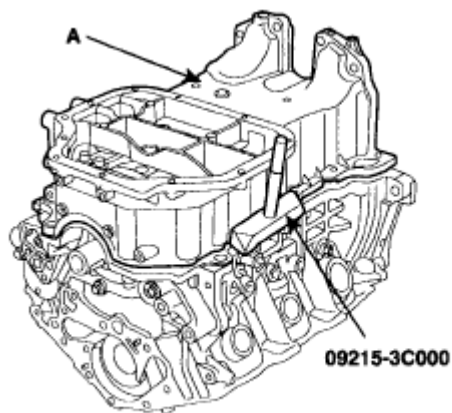
9. Remove the oil screen (A).



KCBF124A

Fig. 102: Identifying Oil Screen
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove the upper oil pan, using the SST (09215-3C000) (A).

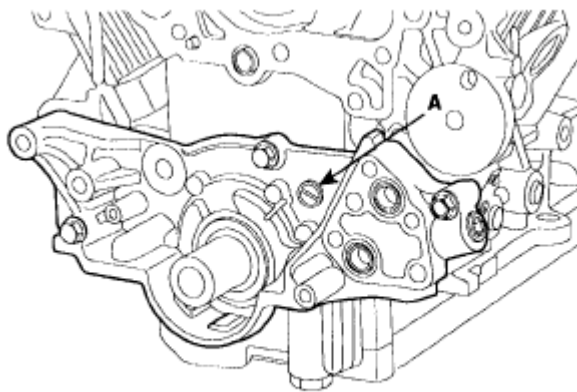


KCBF125B

Fig. 103: Identifying Upper Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Be careful not to damage the contact surfaces of upper oil pan and lower oil pan.

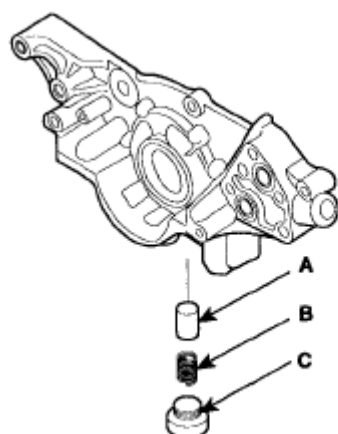
11. Remove the oil pump case (A).



KCBF163A

Fig. 104: Identifying Oil Pump Case
Courtesy of KIA MOTORS AMERICA, INC.

12. After removing the plug (C), remove the relief spring (B) and the relief plunger (A).



KCBF163C

Fig. 105: Identifying Plug, Relief Spring And Relief Plunger
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

RELIEF SPRING

1. Check the relief plunger.

Apply engine oil on the plunger and check that it moves smoothly in the hole. If it does not, replace the plunger or the front case only in necessary cases.

2. Check the relief valve spring.

Check deformation or damage of the relief valve spring.

Specification

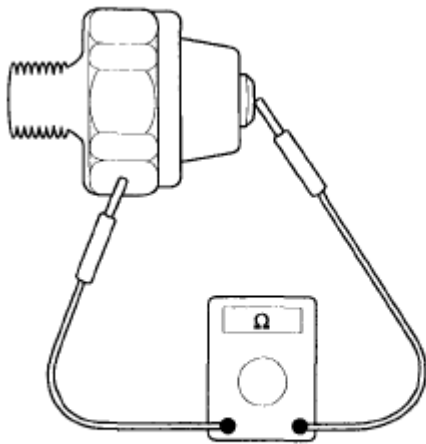
Free length: 43.8 mm (1.7244 in.)

Load: 36.3 N (3.7kg, 8.21lb) $\pm$ 3.9N (0.4 kg, 0.9lb)/40.1 mm (1.5787 in.)

OIL PRESSURE SWITCH

1. Check the continuity between the terminal and the body with an ohmmeter.

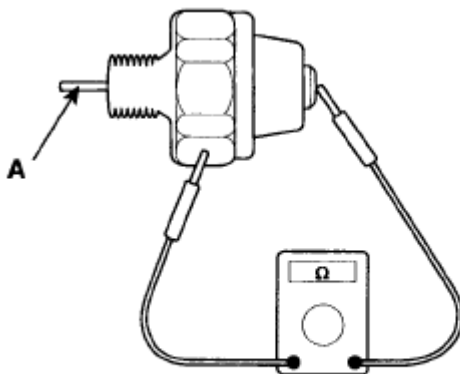
If there is no continuity, replace the oil pressure switch.



ECKD001W

Fig. 106: Checking Continuity Between Terminal And Body
Courtesy of KIA MOTORS AMERICA, INC.

2. Check the continuity between the terminal and the body when its hole is pushed by a fine rod (A). If there is continuity with pressed, replace the switch.



LDLG052A

Fig. 107: Checking Continuity Between Terminal And Body
Courtesy of KIA MOTORS AMERICA, INC.

3. If there is no continuity when the pressure 49.3 kPa (0.5 kg/cm² , 7.11 psi) is applied through the oil hole, the switch is operating properly.

Check for air leakage. If air leaks, the diaphragm is broken. Replace the switch.

REPLACEMENT

OIL AND FILTER

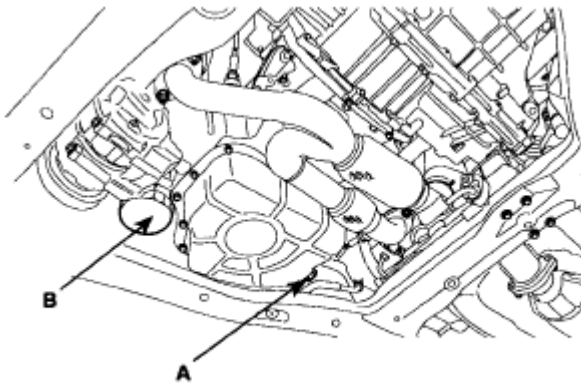
CAUTION:

- 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.
- Wear protective clothing and gloves in order to minimize the length and frequency of contact of your skin to used oil. 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 environment, used oil or used oil filter must be disposed only at designated disposal sites.

1. Park the car on a level ground.

Start the engine and let it warm up.

2. Turn the engine off.
3. Drain engine oil.
 1. Remove the oil filler cap.
 2. After lifting the car, remove the oil drain plug (A) and drain oil into a container.
4. Replace the oil filter.
 1. Remove the oil filter (B).



KCBF162A

Fig. 108: Identifying Oil Filter

Courtesy of KIA MOTORS AMERICA, INC.

2. Check the part number of a new oil filter is as the same as that of the old one.
3. Replace the oil filter.
4. Tighten it slightly until the o-ring of the filter cap contacting on its position.
5. Tighten it with the specified torque.

Tightening torque

16.7-24.5 N.m (1.7-2.5 kgf.m, 12.3-18.1 lb-ft)

5. Refill with engine oil.

1. Install the oil drain plug with a new gasket.

Tightening torque

34.3-44.1 N.m (3.5-4.5 kgf.m, 25.3-32.5 lb-ft)

2. Fill with fresh engine oil, after removing the engine oil level gauge.

Capacity

Total: 4.5L (4.76 U.S.qts, 3.96 imp.qts)

Oil pan: 4.2L (4.44U.S.qts, 3.70 imp.qts)

Oil filter: 0.3L (0.32U.S.qts, 0.26 imp.qts)

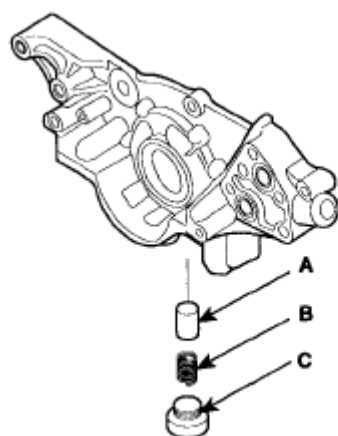
3. Install the oil filler cap and the oil level gauge.
6. Start the engine and ensure that no oil is leaking from the drain plug or the oil filter.
7. Recheck engine oil level.

INSTALLATION**OIL PUMP CASE**

1. Assemble the relief spring (B) and the relief plunger (A) and tighten the plug (C).

Tightening torque

39.2-49.0 N.m (4.0-5.0 kgf.m, 28.9-36.2 lb-ft)



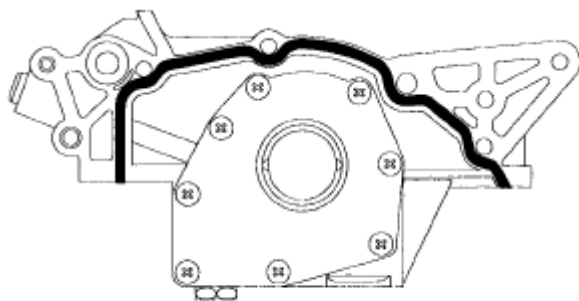
KCBF163C

Fig. 109: Identifying Plug, Relief Spring And Relief Plunger
Courtesy of KIA MOTORS AMERICA, INC.

2. Install oil pump case.
 1. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
 2. Before assembling the oil pan, the liquid sealant TB1217H should be applied on the oil pan.

The part must be assembled within 5 minutes after the sealant was applied.

Bead width: 2.5 mm (0.0984 in.)



KCBF134A

Fig. 110: Identifying Oil Pump Sealant Area
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- Make clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not be protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner

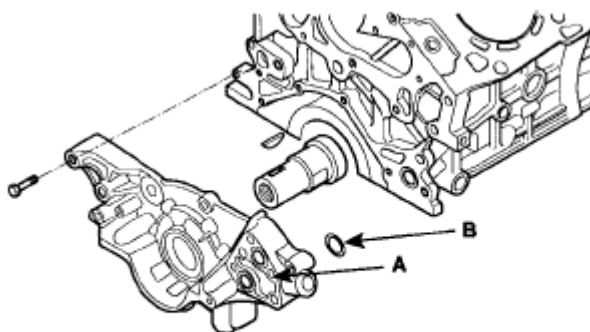
threads of the bolt holes.

- After assembly, wait at least 30 minutes before filling the engine with oil.

3. Install the oil pump case (A).

Tightening torque

18.6-23.5 (1.9-2.4 kgf.m, 13.7-17.4 lb-ft)

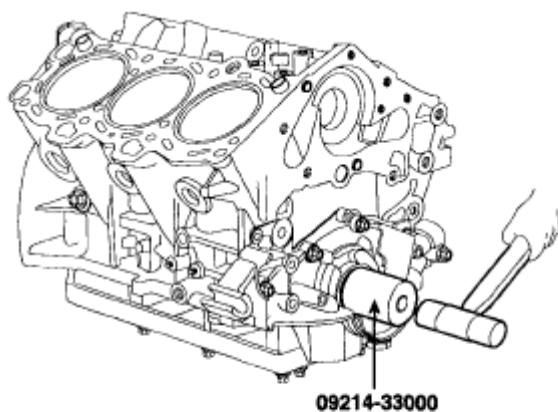


LDLG070A

Fig. 111: Identifying Oil Pump Case
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: In the installation of the oil pump, always use a new o-ring (B).

3. Using the SST (09214-33000), install the oil pump case oil seal.



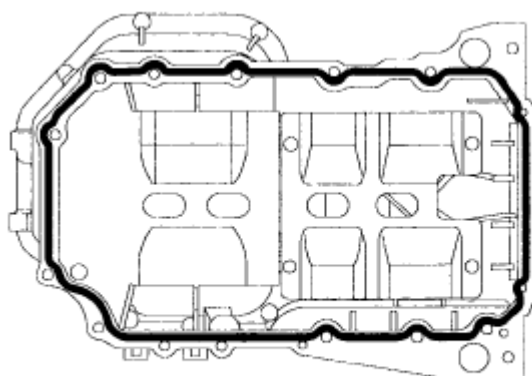
EDQF189A

Fig. 112: Identifying SST (09214-33000)

Courtesy of KIA MOTORS AMERICA, INC.

4. Install the upper oil pan.
 1. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
 2. Before assembling the oil pan, the liquid sealant TB1217H should be applied on the oil pan.

The part must be assembled within 5 minutes after the sealant was applied.



KCBF130A

Fig. 113: Identifying Oil Pan Sealant Area

Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

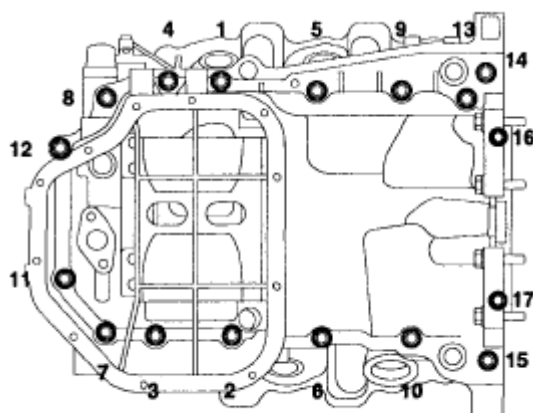
- Make clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not be protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.
- After assembly, wait at least 30 minutes before filling the engine with oil.

3. Fix the oil pan and tighten the bolts in several steps uniformly.

Tightening torque

Bolts 1-15: 18.6-23.5 N.m (1.9-2.4 kgf.m, 13.7-17.4 lb-ft)

Bolts 16,17: 4.9-6.9 N.m (0.5-0.7 kgf.m, 3.6-5.1 lb-ft)



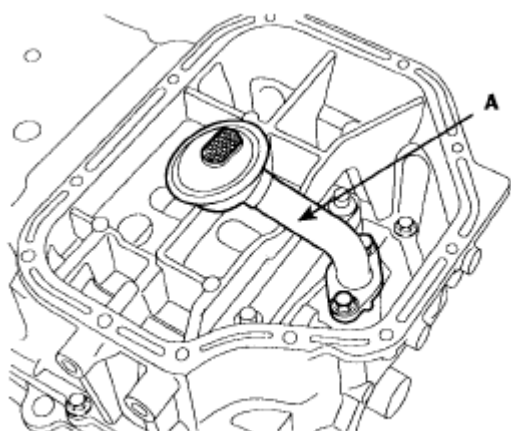
KCBF131A

Fig. 114: Identifying Upper Oil Pan Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

5. Install the oil screen.

Tightening torque

14.7-21.6 N.m (1.5-2.2 kgf.m, 10.8-15.9 lb-ft)



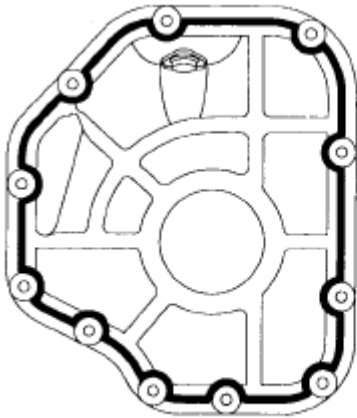
KCBF124A

Fig. 115: Identifying Oil Screen
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Always use a new gasket.

6. Install the lower oil pan.
 1. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
 2. Before assembling the oil pan, the liquid sealant TB1217H should be applied on the oil pan.

The part must be assembled within 5 minutes after the sealant was applied.



KCBF132A

Fig. 116: Identifying Lower Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

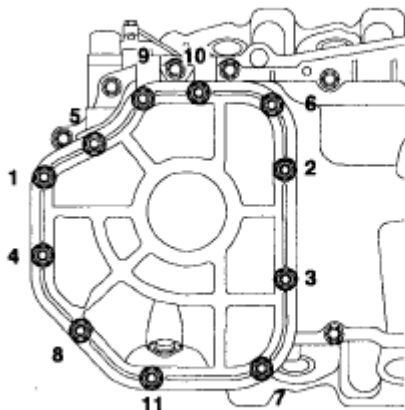
CAUTION:

- Make clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not be protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.
- After assembly, wait at least 30 minutes before filling the engine with oil.

3. Fix the oil pan and tighten the bolts in several steps uniformly.

Tightening torque

9.8-11.8 N.m (1.0-1.2 kgf.m, 7.2-8.7 lb-ft)



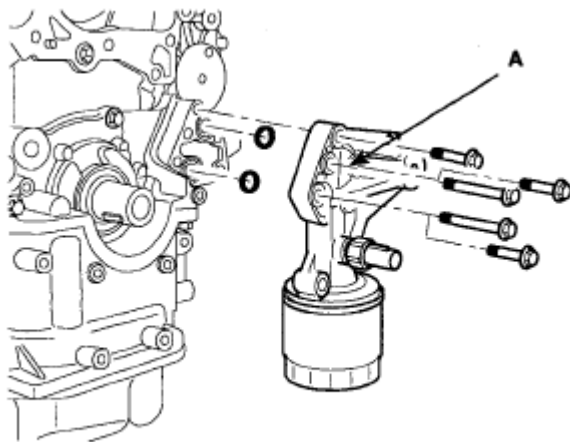
KCBF133A

Fig. 117: Identifying Lower Oil Pan Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the oil filter bracket (A).

Tightening torque

18.6-23.5N.m (1.9-2.4 kgf.m, 13.7-17.4 lb-ft)



KCBF147A

Fig. 118: Identifying Oil Filter Bracket
Courtesy of KIA MOTORS AMERICA, INC.

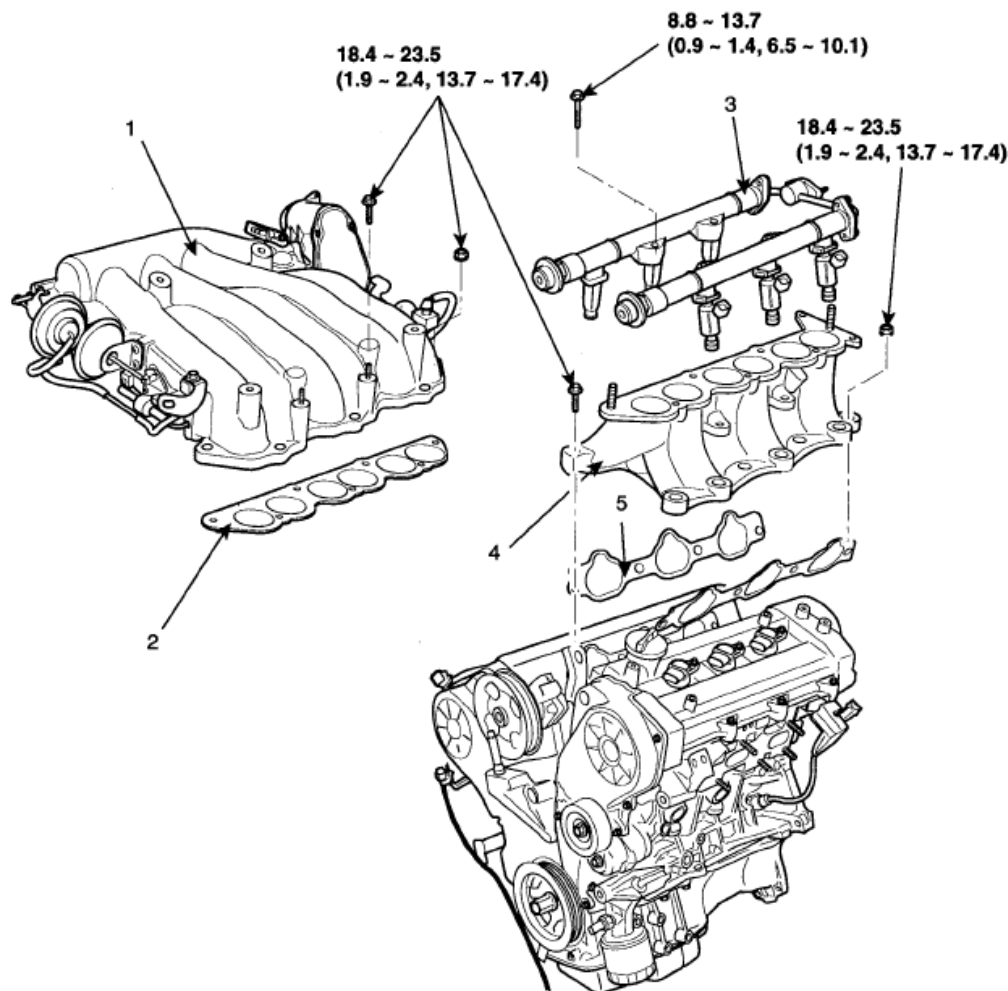
CAUTION: Always use a new O-ring.

8. Install the timing belt, the generator and the front muffler.
9. Install the front right side cover and the wheel and tire.

10. Fill with engine coolant.
11. Start engine and check for leaks.
12. Recheck engine coolant level.

INTAKE AND EXHAUST SYSTEM

COMPONENTS

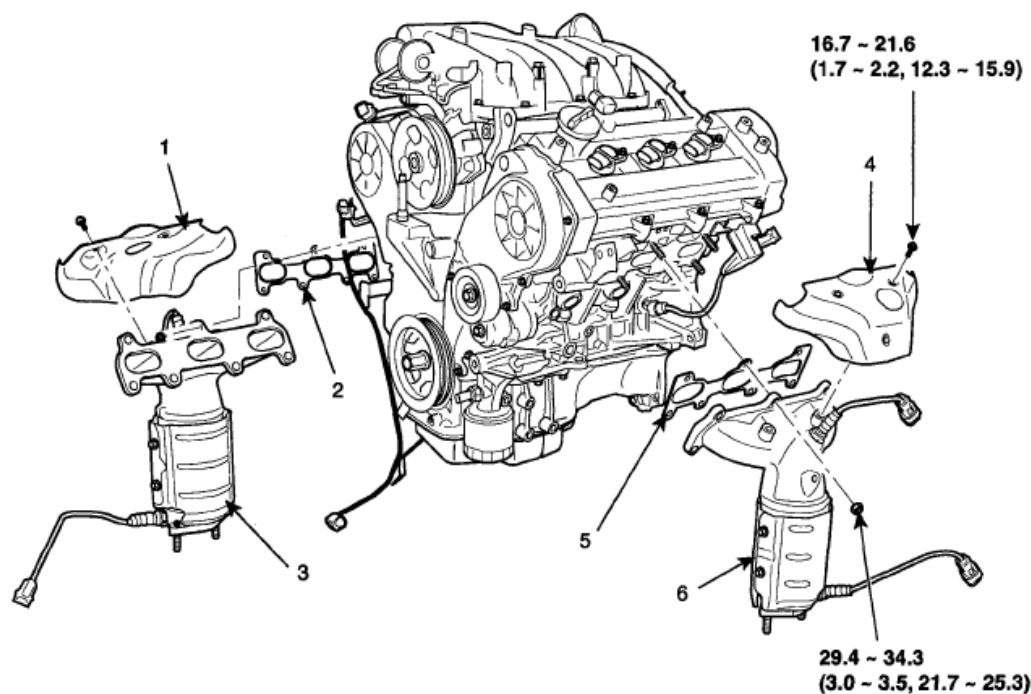


TORQUE : N.m (kgf.m, lb-ft)

1. Surge tank
2. Surge tank gasket
3. Delivery pipe
4. Intake manifold
5. Intake manifold gasket

LDLG053A

Fig. 119: Identifying Intake And Exhaust System Components (1 Of 3) (With Torque Specifications)
 Courtesy of KIA MOTORS AMERICA, INC.



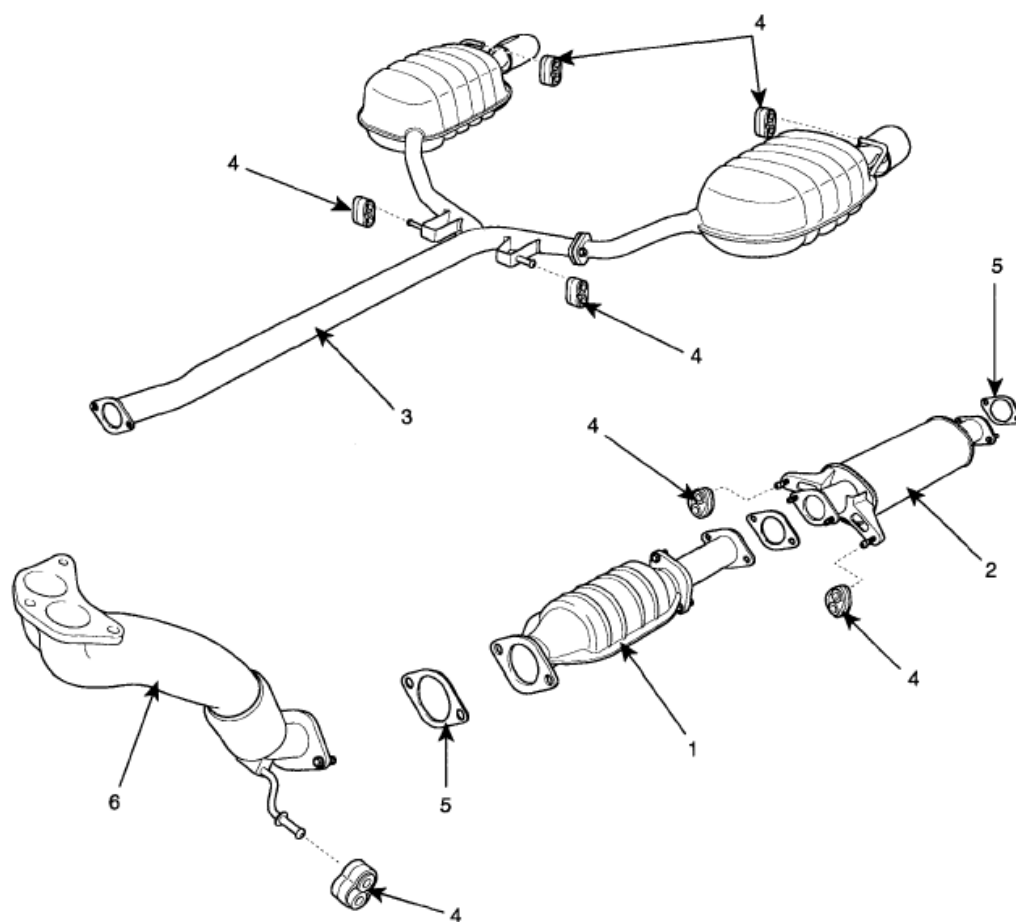
TORQUE : N.m (kgf.m, lb-ft)

- 1. Bank 1 heat protector
- 2. Bank 1 exhaust manifold
- 3. Bank 1 exhaust gasket

- 4. Bank 2 protector
- 5. Bank 2 exhaust manifold gasket
- 6. Bank 2 exhaust manifold

LDLG054A

Fig. 120: Identifying Intake And Exhaust System Components (2 Of 3) (With Torque Specifications)
 Courtesy of KIA MOTORS AMERICA, INC.



- 1. Catalytic convert
- 2. Center muffler
- 3. Main muffler

- 4. Lever hanger
- 5. Gasket
- 6. Front muffler

LDLG065A

Fig. 121: Identifying Intake And Exhaust System Components (3 Of 3)
 Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

INTAKE MANIFOLD ASSEMBLY

1. Remove the engine cover (A).

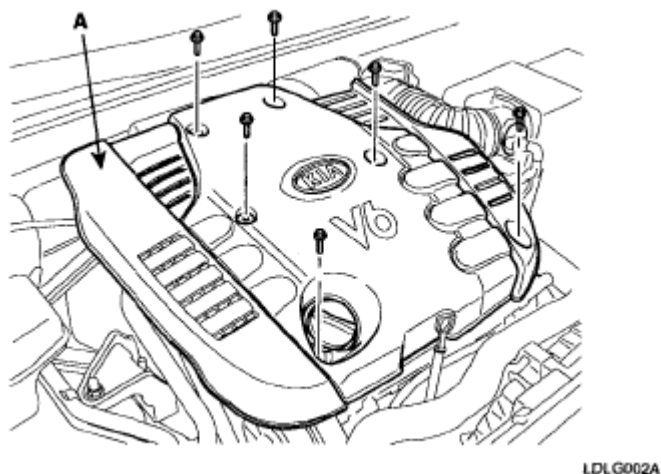


Fig. 122: Identifying Engine Cover

Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the intake air hose and air cleaner assembly.
 1. Disconnect the MAF connector (A).
 2. Disconnect the breather hose (B) from air cleaner hose.
 3. Remove the intake air hose and air cleaner assembly (C).
 4. Disconnect the PCM connectors (D).

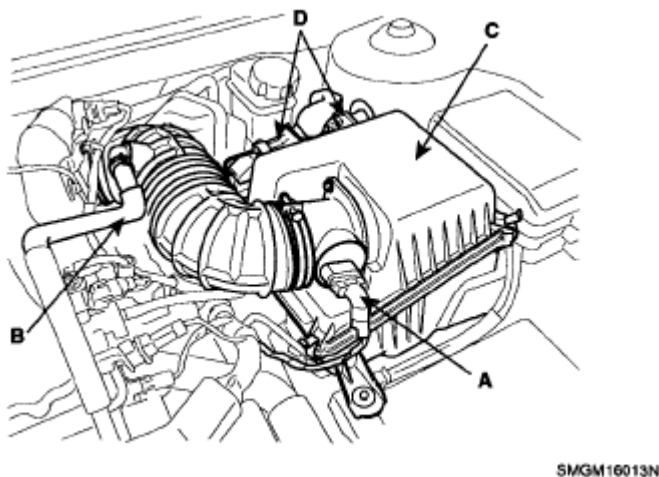


Fig. 123: Identifying Breather Hose, MAF Connector, Air Cleaner Assembly And PCM Connectors

Courtesy of KIA MOTORS AMERICA, INC.

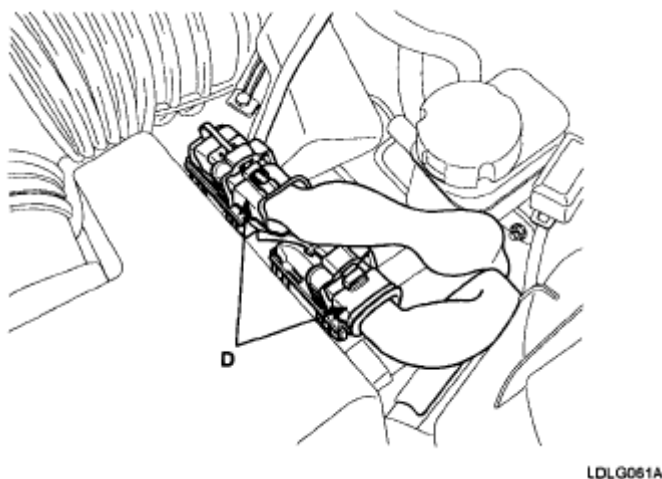


Fig. 124: Identifying PCM Connectors
Courtesy of KIA MOTORS AMERICA, INC.

3. Disconnect the engine wiring harness connectors.
 1. Disconnect the No.1/No.2 knock sensor connectors (A, B), the oil pressure switch connector (C), the ignition coil harness (D) and the No.1 VIS (Variable Induction System) connector (E).

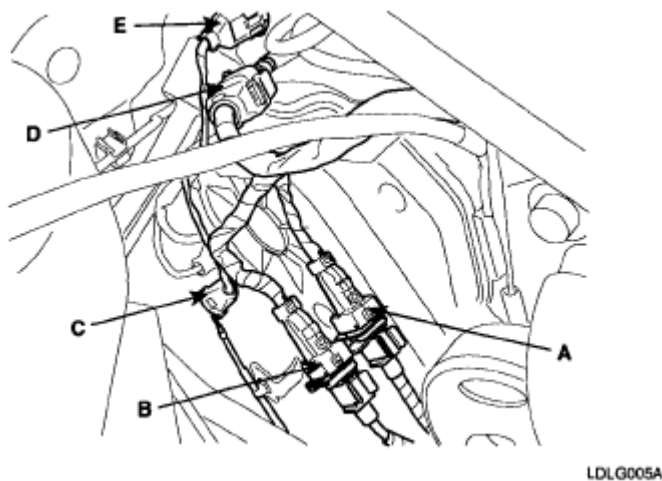
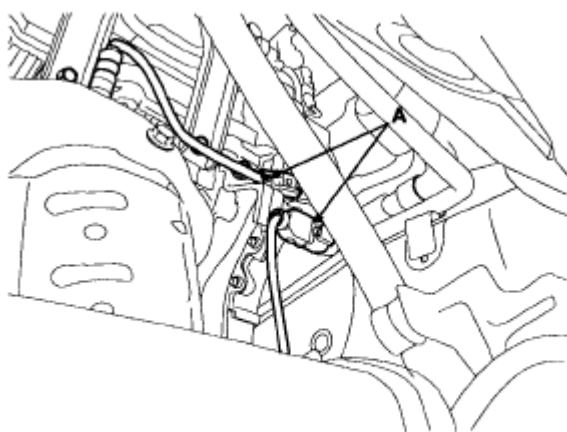


Fig. 125: Identifying Engine Wiring Harness Connectors
Courtesy of KIA MOTORS AMERICA, INC.

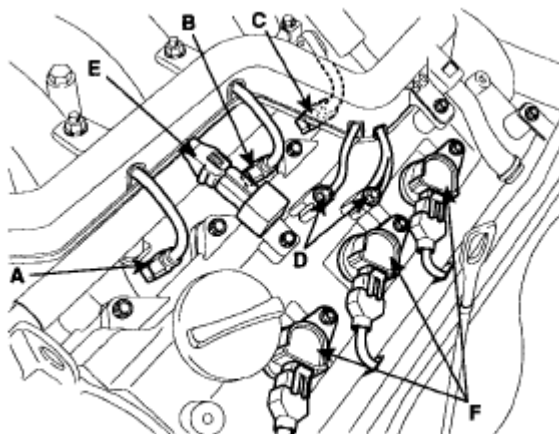
2. Disconnect the bank 1 front/rear O2 sensor connectors (A).



KCBF160A

Fig. 126: Identifying Bank Front/Rear O2 Sensor Connectors
Courtesy of KIA MOTORS AMERICA, INC.

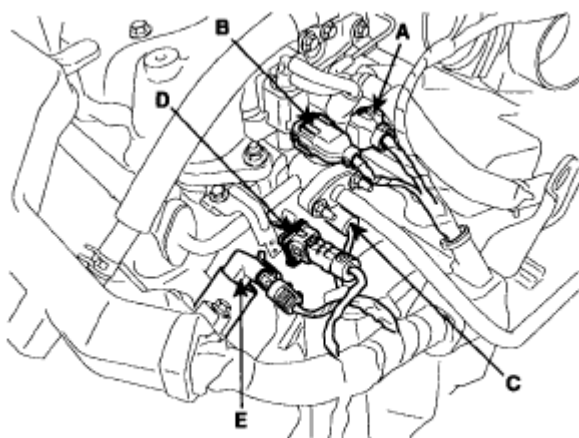
3. Disconnect the injection connectors (A, B, C), the ground lines (D), the condenser connector (E) and the Ignition coil connectors (F).



SMGM16014N

Fig. 127: Identifying Injection Connectors, Ground Lines, Condenser Connector And Ignition Coil Connectors
Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect the injection harness connector (A), the No.2 VIS (Variable Induction System) connector (B), the No.1/No.2 OCV (Oil Control Valve) connectors (C, D) and the OTS (Oil Temperature Sensor) connector (E).

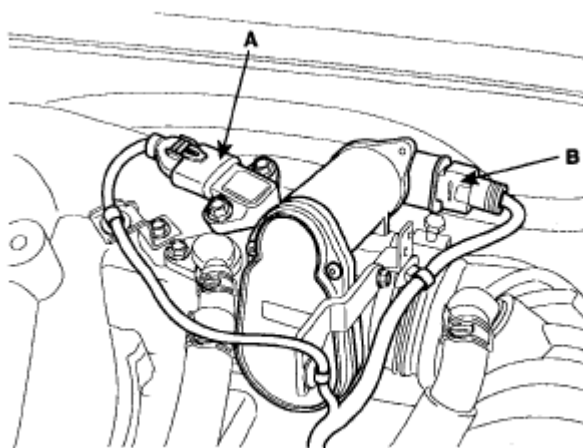


SMGM16015N

Fig. 128: Identifying Injection Harness Connector, VIS Connector, OCV Connectors And OTS Connector

Courtesy of KIA MOTORS AMERICA, INC.

5. Disconnect the MAPS (Manifold Absolute Pressure Sensor) connector (A), the ETC (Electronic Throttle Control) connector (B) and the PCSV (Purge Control Solenoid Valve) connector (C).



SMGM16016N

Fig. 129: Identifying MAPS Connector, ETC Connector And PCSV Connector

Courtesy of KIA MOTORS AMERICA, INC.

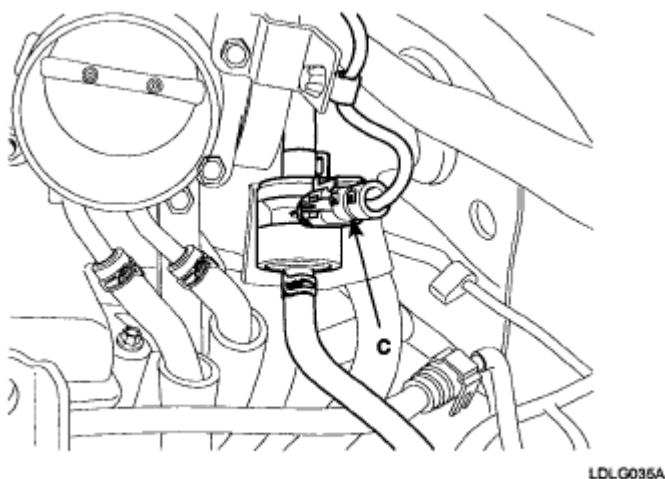


Fig. 130: Identifying PCSV Connector
Courtesy of KIA MOTORS AMERICA, INC.

6. Disconnect the generator connector (A) and the air conditioning compressor connector (B).

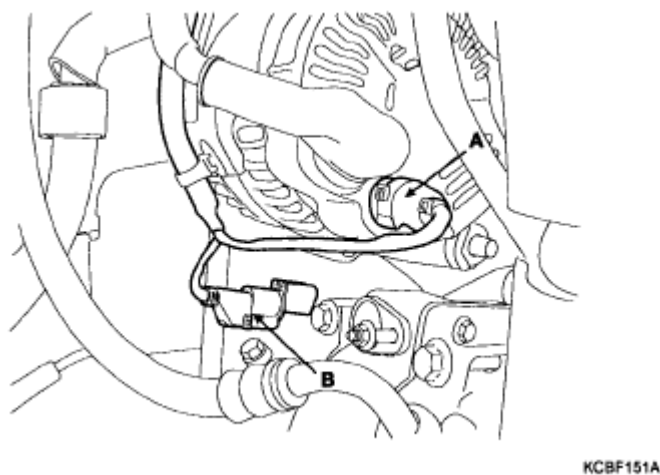
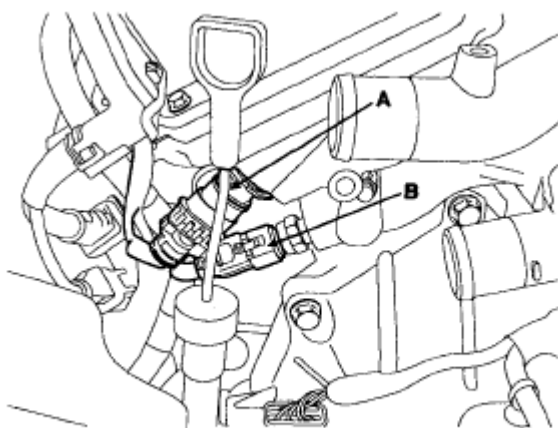


Fig. 131: Identifying Generator Connector And Air Conditioning Compressor Connector
Courtesy of KIA MOTORS AMERICA, INC.

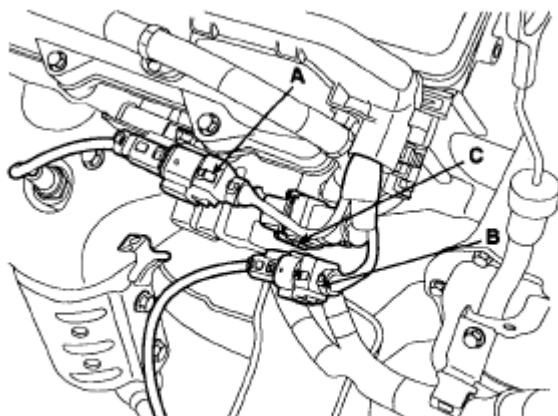
7. Disconnect the bank 2 CMP sensor connector (A) and the ECT (Engine Coolant Temperature) sensor connector (B).



KCBF155A

Fig. 132: Identifying CMP Sensor Connector And ECT Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

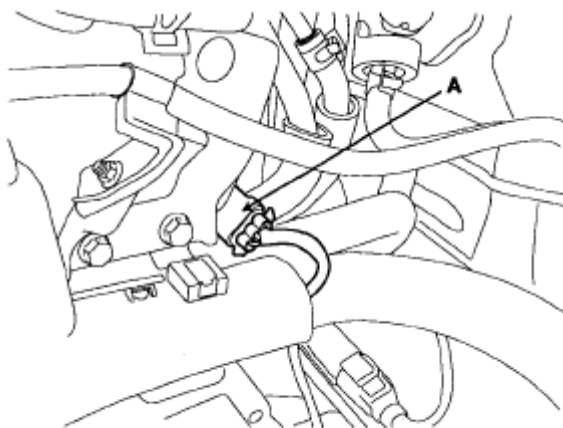
8. Disconnect the bank 2 front/rear O2 sensor connectors (A, B) and the CKP sensor connector (C).



KCBF154A

Fig. 133: Identifying Front/Rear O2 Sensor Connectors And CKP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

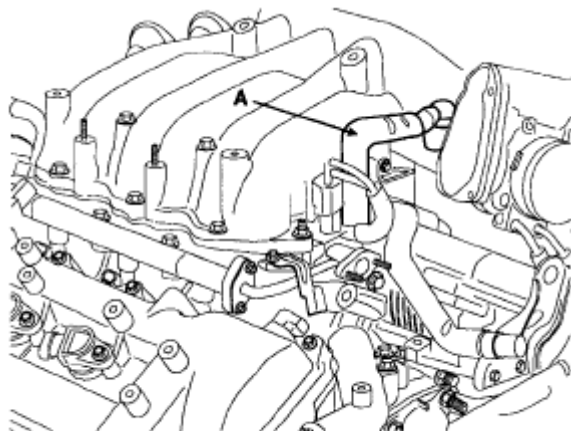
9. Disconnect the bank 1 CMP sensor connector (A).



KCBF152A

Fig. 134: Identifying CMP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

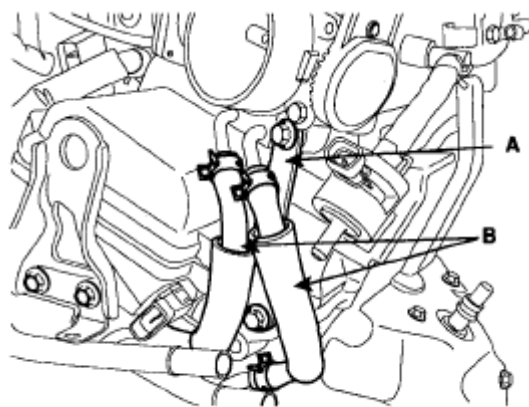
4. Remove the PCV (Purge Control Valve) hose (A).



SMGM16017N

Fig. 135: Identifying PCV Hose
Courtesy of KIA MOTORS AMERICA, INC.

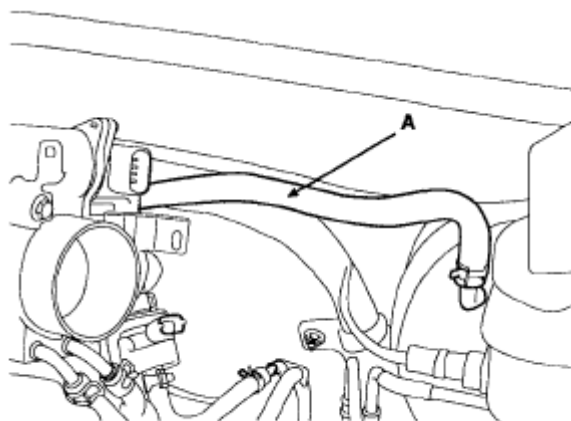
5. Remove the ETC (Electric Throttle Control) bracket (A) and the cooling hoses (B).



KCBF179A

Fig. 136: Identifying ETC Bracket And Cooling Hoses
Courtesy of KIA MOTORS AMERICA, INC.

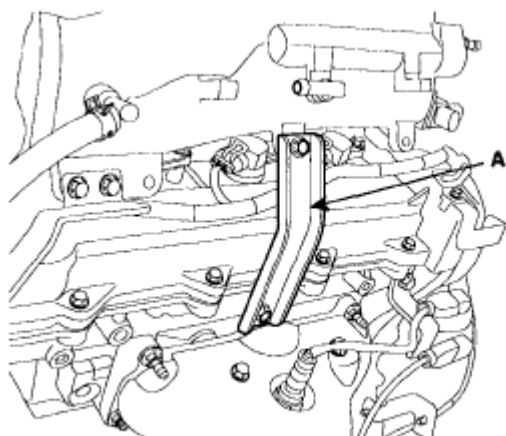
6. Disconnect the brake vacuum hose (A).



LDLG038A

Fig. 137: Identifying Brake Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

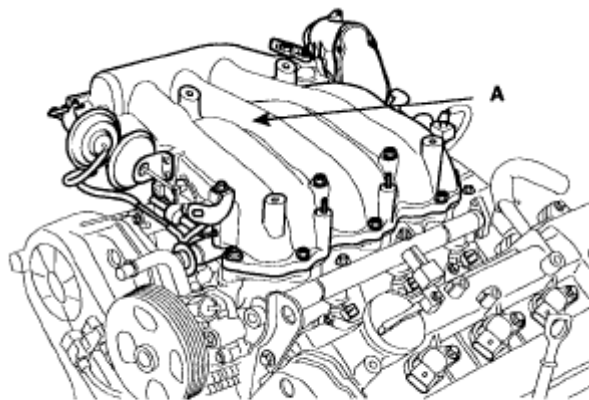
7. Remove the surge tank mounting bracket (A).



KCBF178A

Fig. 138: Identifying Surge Tank Mounting Bracket
Courtesy of KIA MOTORS AMERICA, INC.

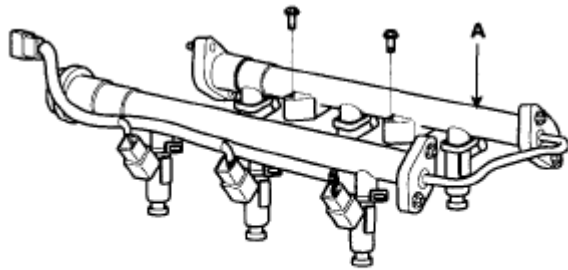
8. Remove the surge tank (A).



SMGM16019N

Fig. 139: Identifying Surge Tank
Courtesy of KIA MOTORS AMERICA, INC.

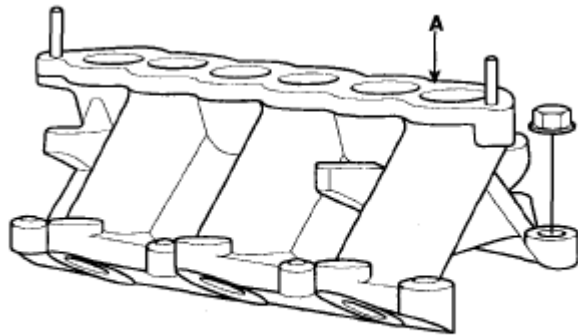
9. Remove the delivery pipe assembly (A).



SMGM16030N

Fig. 140: Identifying Delivery Pipe Assembly
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove the intake manifold assembly (A).

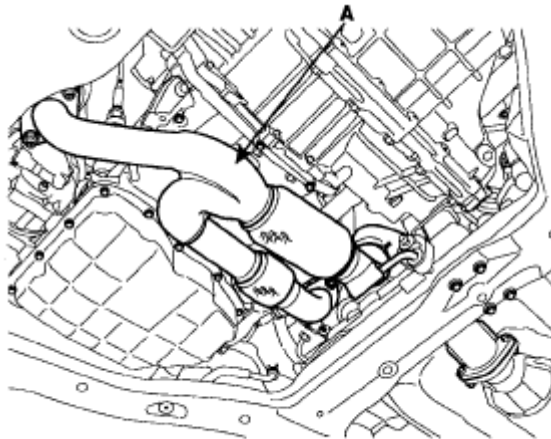


SMGM16020N

Fig. 141: Identifying Intake Manifold Assembly
Courtesy of KIA MOTORS AMERICA, INC.

EXHAUST MANIFOLD ASSEMBLY

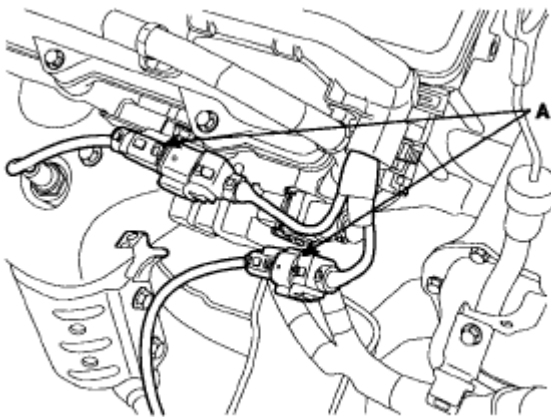
1. Remove the under cover.
2. Remove the front muffler (A).



KCBF102A

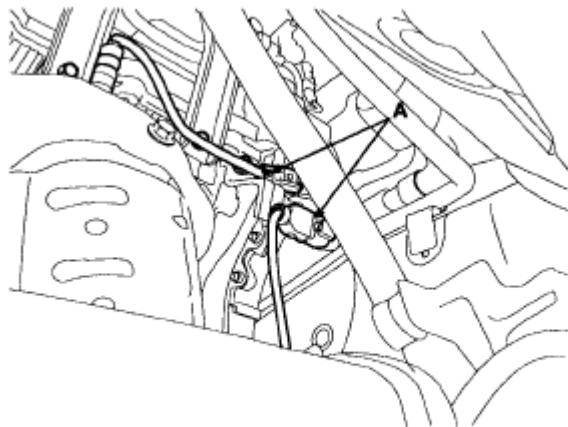
Fig. 142: Identifying Front Muffler
Courtesy of KIA MOTORS AMERICA, INC.

3. Disconnect the oxygen sensor connectors (A).



KCBF154B

Fig. 143: Identifying Oxygen Sensor Connectors
Courtesy of KIA MOTORS AMERICA, INC.



KCBF160A

Fig. 144: Identifying Bank Front/Rear O2 Sensor Connectors
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the oil level gauge.
5. Remove the heat protector.
6. Remove the exhaust manifold assembly.

INSTALLATION

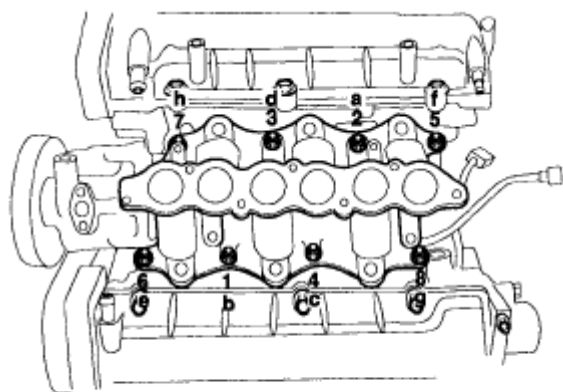
INTAKE MANIFOLD ASSEMBLY

1. Install the intake manifold assembly with a new gasket to a cylinder head assembly. Tighten the bolts in two steps.

Tightening torque

Step 1 (a-h): 3.9-5.9 N.m (0.4-0.6 kgf.m, 2.9-4.3 lb-ft)

Step 2 (1-8): 18.6-23.5 N.m (1.9-2.4kgf.m, 13.7-17.4 lb-ft)



KCBF201A

Fig. 145: Identifying Intake Manifold Assembly Bolts Tighten Sequence
 Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: When installing the gasket on the cylinder head, check the identification marks (LH/RH) not to be installed wrong.

2. Install the delivery pipe.
3. Connect the LH injector connector.
4. Install the surge tank.

Tightening torque

18.6-23.5 N.m (1.9-2.4 kgf.m, 13.7-17.4 lb-ft)

5. Install the surge tank mounting bracket.

Tightening torque

18.6-23.5 N.m (1.9-2.4 kgf.m, 13.7-17.4 lb-ft)

6. Install the ETC (Electronic Throttle Control) system fixing bracket.
7. Connect the hoses and connectors.
8. Install the air cleaner assembly.
9. Install the engine cover.

EXHAUST MANIFOLD ASSEMBLY

1. Install the exhaust manifold assembly with a new gasket.

Tightening torque

29.4-34.3 N.m (3.0-3.5 kgf.m, 21.7-25.3 lb-ft)

2. Install the heat protector.

Tightening torque

16.7-21.6 N.m (1.7-2.2 kgf.m, 12.3-15.9 lb-ft)

3. Install the front muffler assembly.

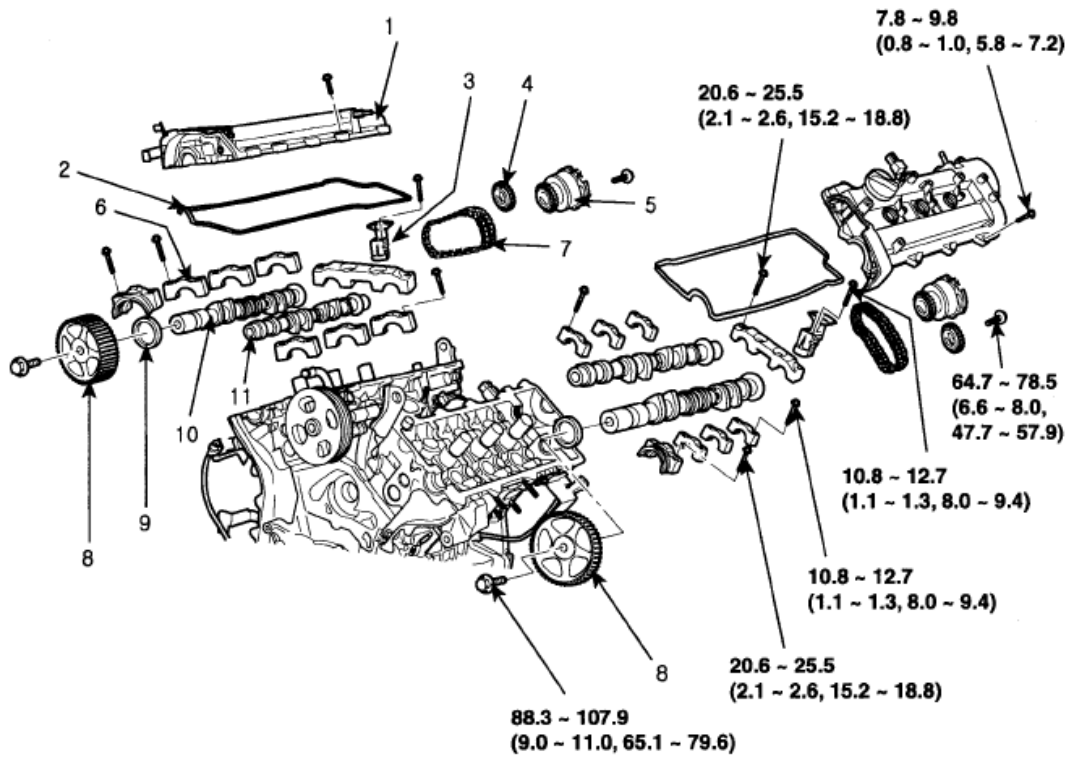
Tightening torque

39.2-58.8 N.m (4.0-6.0 kgf.m, 28.9-43.4 lb-ft)

4. Connect the oxygen sensor connector.
5. Install the under cover.

CYLINDER HEAD ASSEMBLY

COMPONENTS

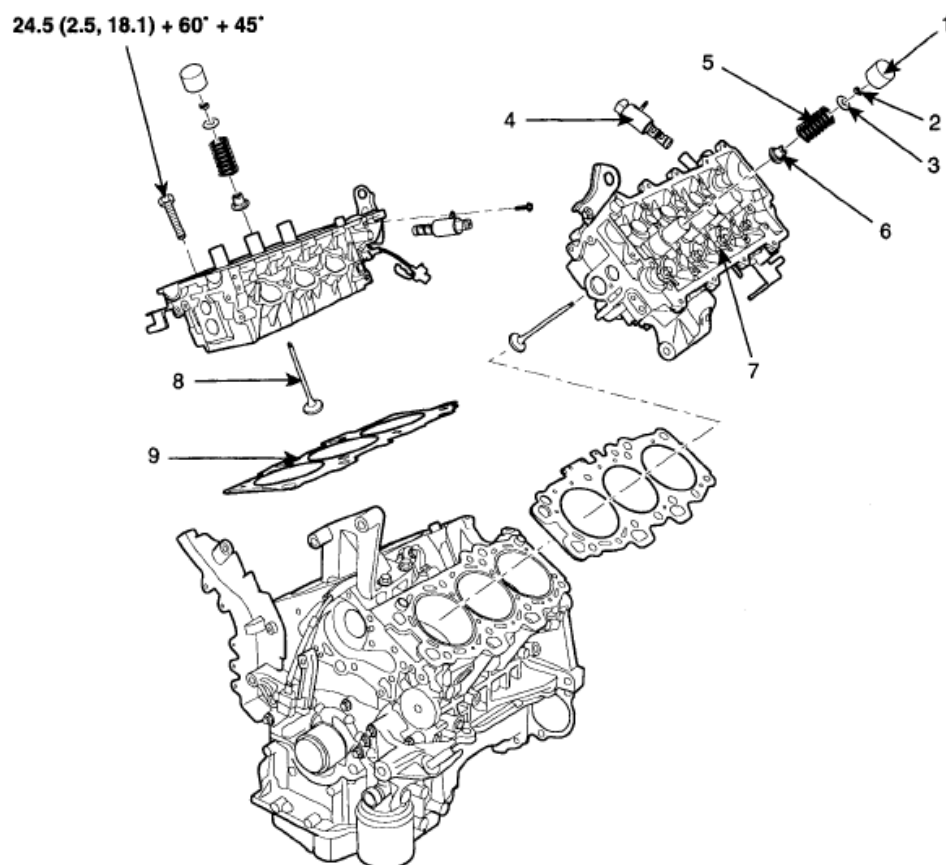


TORQUE : N.m (kgf.m, lb-ft)

- | | |
|------------------------------------|------------------------------|
| 1. Cylinder head cover | 7. Timing chain |
| 2. Cylinder head cover gasket | 8. Exhaust camshaft sprocket |
| 3. Timing chain auto tensioner | 9. Camshaft oil seal |
| 4. Exhaust camshaft chain sprocket | 10. Exhaust camshaft |
| 5. CVVT assembly | 11. Intake camshaft |
| 6. Camshaft bearing cap | |

SMGM16021N

Fig. 146: Identifying Cylinder Head Assembly Components (1 Of 2)) (With Torque Specifications)
 Courtesy of KIA MOTORS AMERICA, INC.


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

- | | |
|----------------------------------|-------------------------|
| 1. MLA(Mechanical Lash Adjuster) | 6. Valve stem seal |
| 2. Retainer lock | 7. Cylinder head |
| 3. Retainer | 8. Valve |
| 4. OCV(Oil Control Valve) | 9. Cylinder head gasket |
| 5. Valve spring | |

SMGM16022N

Fig. 147: Identifying Cylinder Head Assembly Components (2 Of 2)) (With Torque Specifications)
 Courtesy of KIA MOTORS AMERICA, INC.

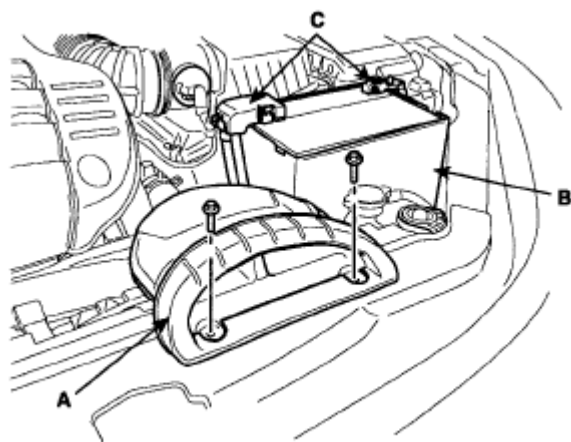
REMOVAL
CAUTION:

- Use fender covers to avoid damaging painted surfaces.
- 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.

NOTE:

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

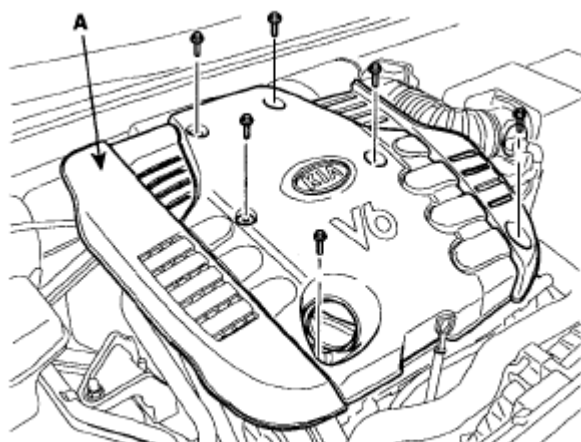
1. Remove the air duct (A) and the battery (B) after disconnecting the terminals (C) from the battery.



LDLG001A

Fig. 148: Identifying Air Duct, Battery And Terminals
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the engine cover (A).

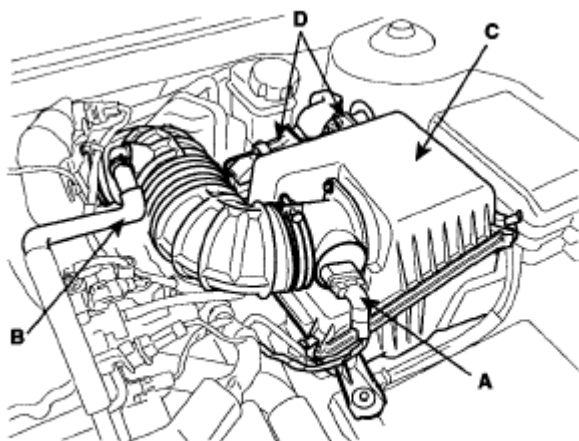


LDLG002A

Fig. 149: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the intake air hose and air cleaner assembly.
 1. Disconnect the MAF connector (A).
 2. Disconnect the breather hose (B) from air cleaner hose.
 3. Remove the intake air hose and air cleaner assembly (C).

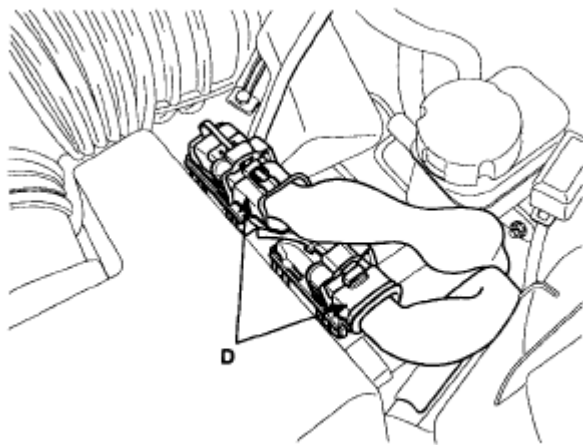
4. Disconnect the PCM connectors (D).



SMGM16013N

Fig. 150: Identifying Breather Hose, MAF Connector, Air Cleaner Assembly And PCM Connectors

Courtesy of KIA MOTORS AMERICA, INC.

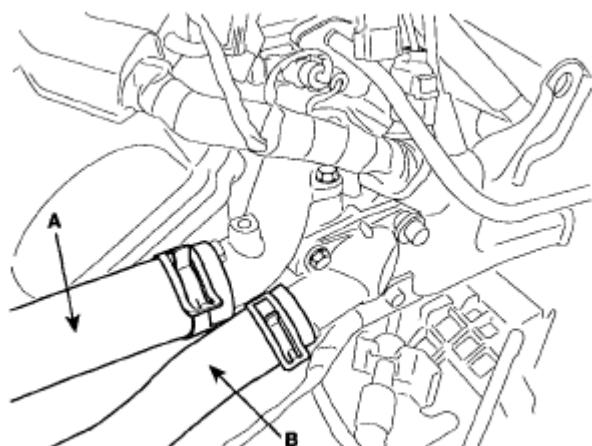


LDLG061A

Fig. 151: Identifying PCM Connectors

Courtesy of KIA MOTORS AMERICA, INC.

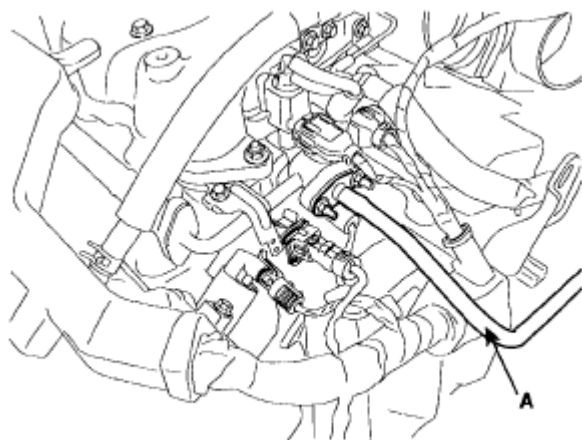
4. Remove the upper radiator hose (A) and lower radiator hose (B).



LDLG008A

Fig. 152: Identifying Radiator Upper And Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the fuel inlet hose (A) from the delivery pipe.



SMGM16031N

Fig. 153: Identifying Fuel Inlet Hose
Courtesy of KIA MOTORS AMERICA, INC.

6. Disconnect the engine wiring harness connectors.
 1. Disconnect the No.1/No.2 knock sensor connectors (A, B), the oil pressure switch connector (C), the ignition coil harness (D) and the No.1 VIS (Variable Induction System) connector (E).

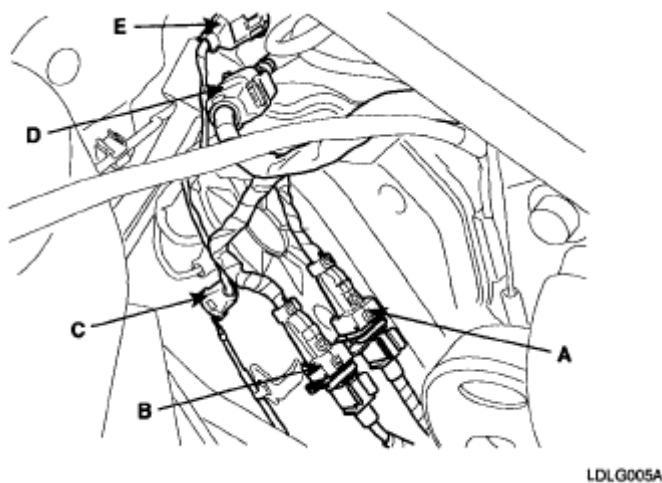


Fig. 154: Identifying Engine Wiring Harness Connectors
 Courtesy of KIA MOTORS AMERICA, INC.

2. Disconnect the bank 1 front/rear O2 sensor connectors (A).

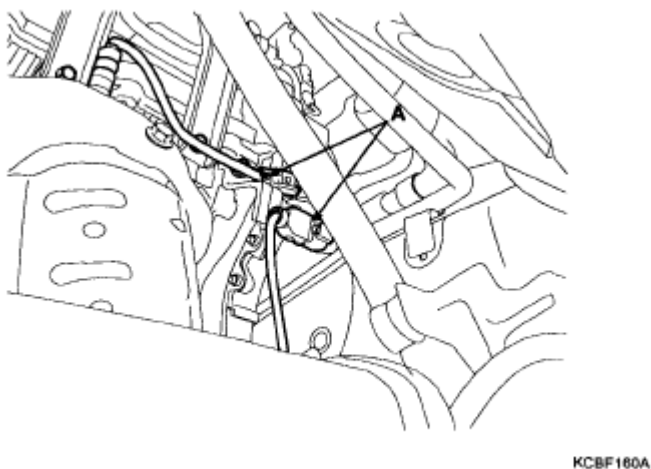


Fig. 155: Identifying Bank Front/Rear O2 Sensor Connectors
 Courtesy of KIA MOTORS AMERICA, INC.

3. Disconnect the injection connectors (A, B, C), the ground lines (D), the condenser connector (E) and the Ignition coil connectors (F).

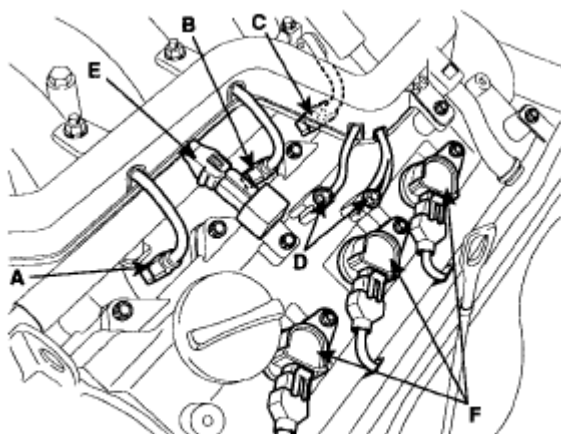


Fig. 156: Identifying Injection Connectors, Ground Lines, Condenser Connector And Ignition Coil Connectors

Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect the injection harness connector (A), the No.2 VIS (Variable Induction System) connector (B), the No.1/No.2 OCV (Oil Control Valve) connectors (C, D) and the OTS (Oil Temperature Sensor) connector (E).

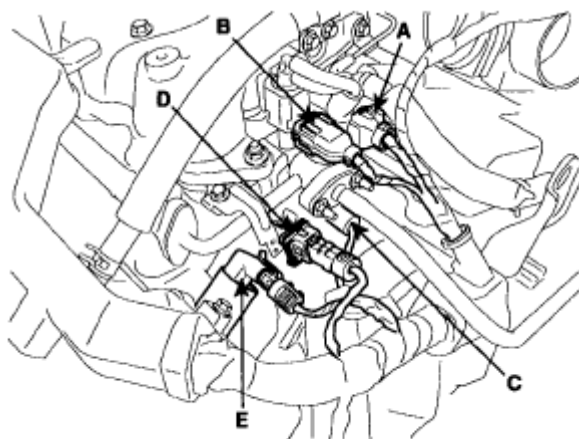


Fig. 157: Identifying Injection Harness Connector, VIS Connector, OCV Connectors And OTS Connector

Courtesy of KIA MOTORS AMERICA, INC.

5. Disconnect the MAPS (Manifold Absolute Pressure Sensor) connector (A), the ETC (Electronic Throttle Control) connector (B) and the PCSV (Purge Control Solenoid Valve) connector (C).

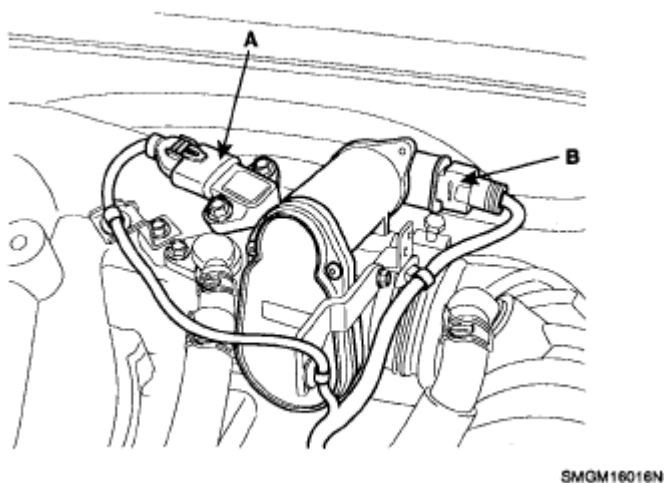


Fig. 158: Identifying MAPS Connector, ETC Connector And PCSV Connector
Courtesy of KIA MOTORS AMERICA, INC.

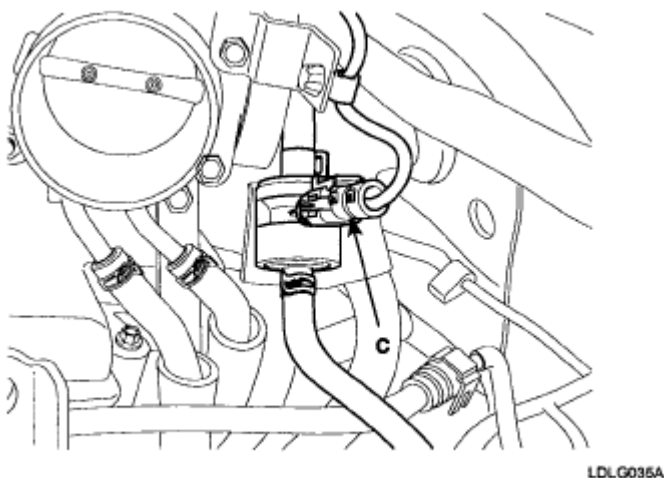
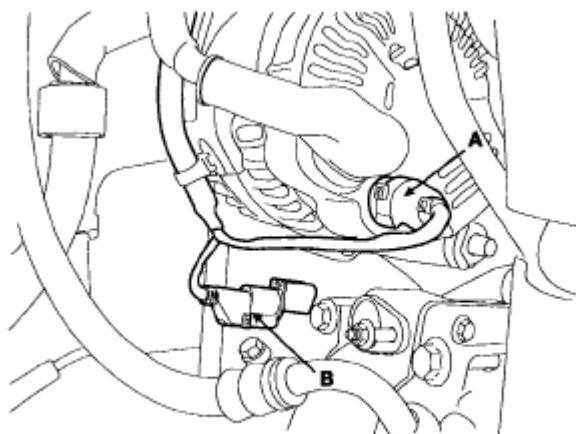


Fig. 159: Identifying PCSV Connector
Courtesy of KIA MOTORS AMERICA, INC.

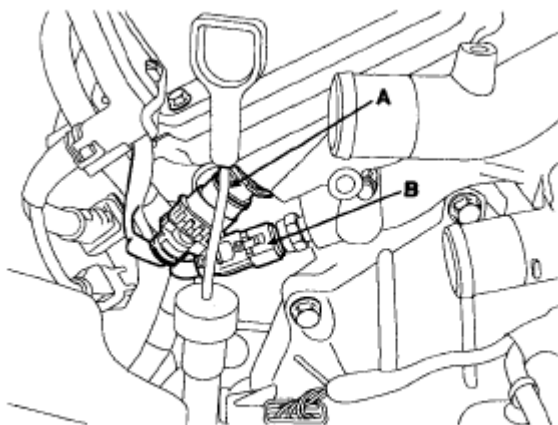
6. Disconnect the generator connector (A) and the air conditioning compressor connector (B).



KCBF151A

Fig. 160: Identifying Generator Connector And Air Conditioning Compressor Connector
Courtesy of KIA MOTORS AMERICA, INC.

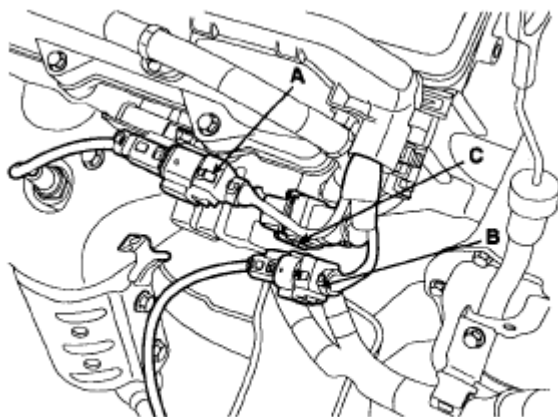
7. Disconnect the bank 2 CMP sensor connector (A) and the ECT (Engine Coolant Temperature) sensor connector (B).



KCBF155A

Fig. 161: Identifying CMP Sensor Connector And ECT Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

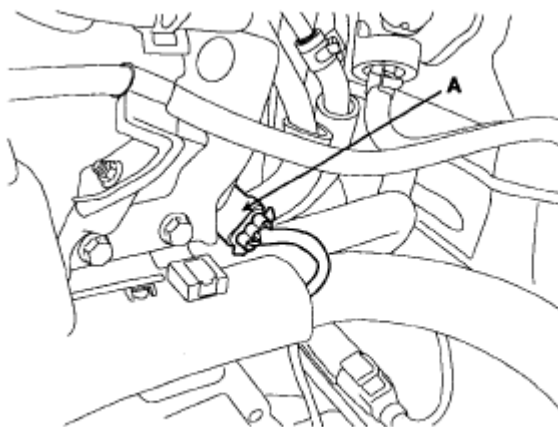
8. Disconnect the bank 2 front/rear O2 sensor connectors (A, B) and the CKP sensor connector (C).



KCBF154A

Fig. 162: Identifying Front/Rear O2 Sensor Connectors And CKP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

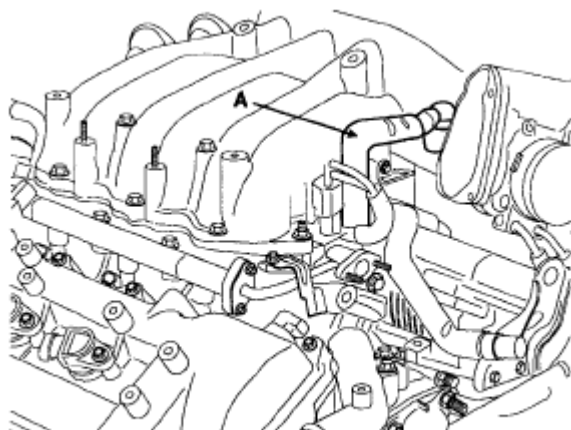
9. Disconnect the bank 1 CMP sensor connector (A).



KCBF152A

Fig. 163: Identifying CMP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove the PCV (Purge Control Valve) hose (A).

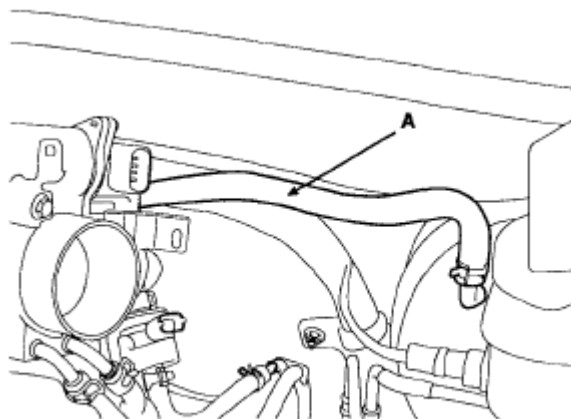


SMGM16017N

Fig. 164: Identifying PCV Hose

Courtesy of KIA MOTORS AMERICA, INC.

8. Disconnect the brake vacuum hose (A).

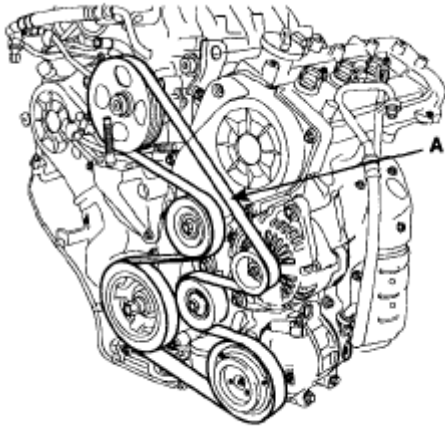


LDLG036A

Fig. 165: Identifying Brake Vacuum Hose

Courtesy of KIA MOTORS AMERICA, INC.

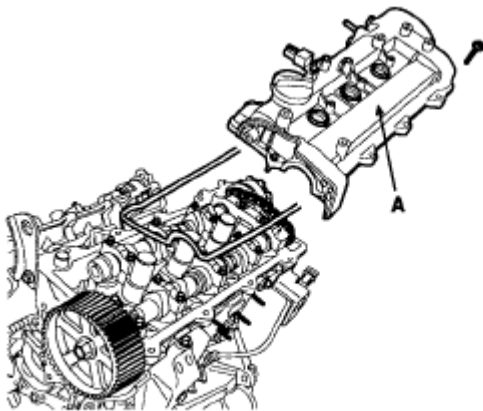
9. Remove the heater hoses.
10. Remove the drive belt (A).



KCBF105A

Fig. 166: Identifying Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

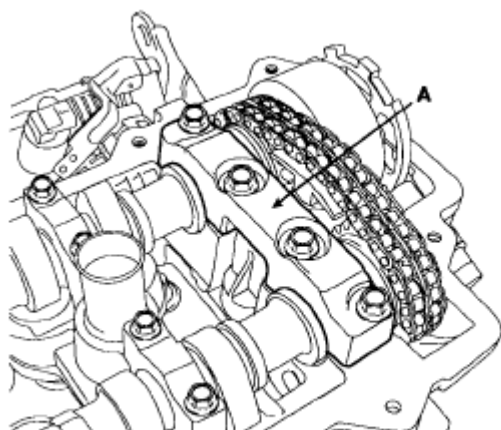
11. Remove the power steering pump. (Refer to **MECHANICAL POWER STEERING SYSTEM**).
12. Remove the exhaust manifold assembly. (Refer to '**INTAKE AND EXHAUST SYSTEM**').
13. Remove the intake manifold assembly. (Refer to '**INTAKE AND EXHAUST SYSTEM**').
14. Remove the timing belt. (Refer to '**TIMING SYSTEM**').
15. Remove the ignition coils.
16. Remove the water temp. control assembly.
17. Remove the cylinder head cover (A).



SMGM16010N

Fig. 167: Identifying Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

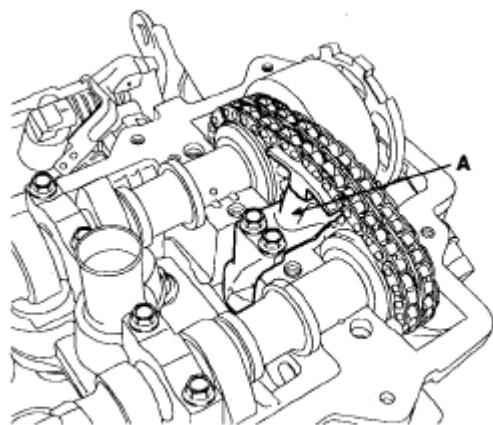
18. Remove the camshaft bearing cap (A).



KCBF167A

Fig. 168: Identifying Camshaft Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

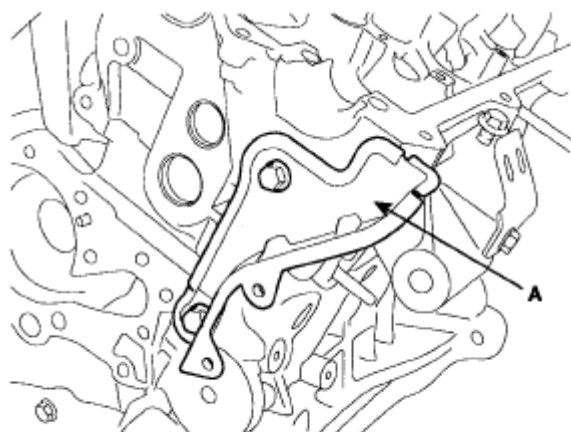
19. Remove the timing chain tensioner (A).



SMGM16023N

Fig. 169: Identifying Timing Chain Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

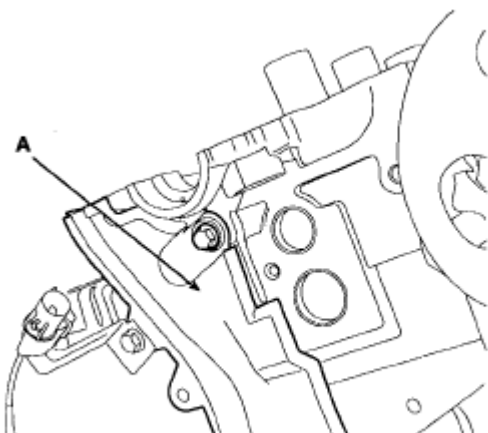
20. Remove the camshaft.
21. Remove the bank 1 timing belt rear cover (A).



KCBF170A

Fig. 170: Identifying Timing Belt Rear Cover
Courtesy of KIA MOTORS AMERICA, INC.

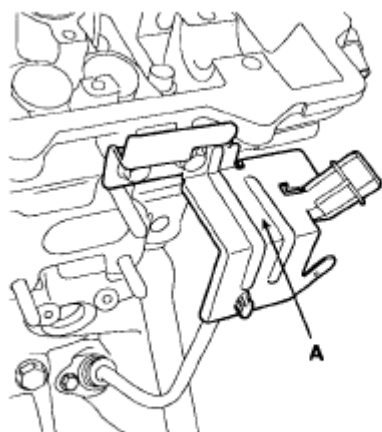
22. Remove the bank 2 timing belt rear cover (A).



KCBF171A

Fig. 171: Identifying Timing Belt Rear Cover
Courtesy of KIA MOTORS AMERICA, INC.

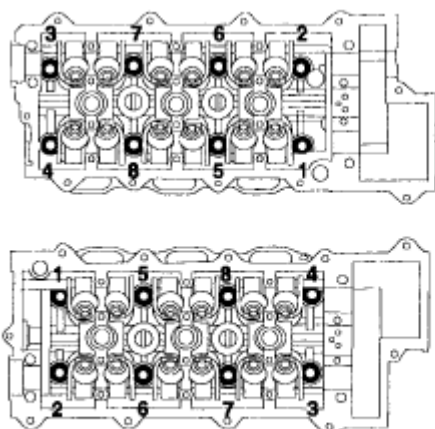
23. Remove the CKP sensor connector bracket (A).



KCBF172A

Fig. 172: Identifying CKP Sensor Connector Bracket
Courtesy of KIA MOTORS AMERICA, INC.

24. Remove the cylinder head assembly.
 1. Remove the bolts in 2-3 steps as following orders.



KCBF176A

Fig. 173: Identifying Cylinder Head Bolt Sequence
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: If the bolts are not removed as the order, the deformation of the head assembly can be occurred.

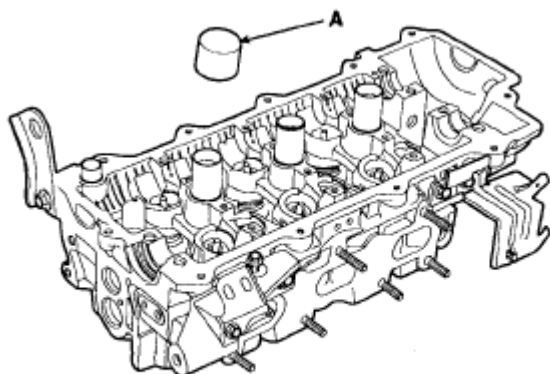
2. Put the cylinder head assembly on a wooden block after removal from the cylinder block.

CAUTION: Ensure that the surface between the cylinder head and the block is not damaged.

DISASSEMBLY

NOTE: Identify MLA (Mechanical Lash Adjuster), valves and valve springs as they are removed so that each item can be reinstalled in its original position.

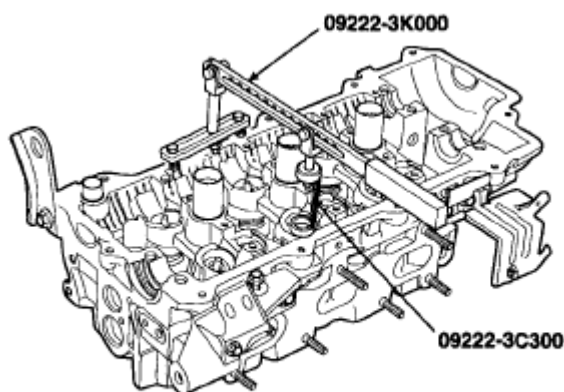
1. Remove MLA (Mechanical Lash Adjusters) (A).



KCBF173D

Fig. 174: Identifying MLA (Mechanical Lash Adjuster)
Courtesy of KIA MOTORS AMERICA, INC.

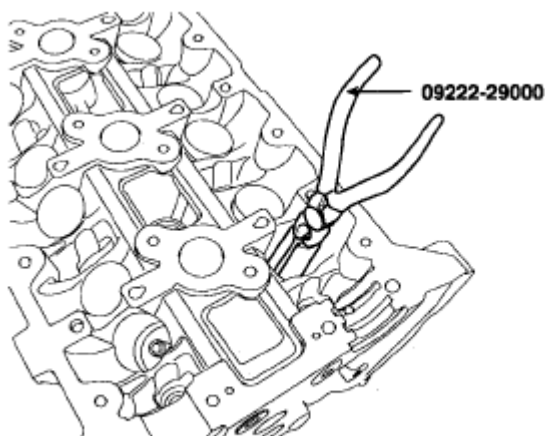
2. Remove valves.
 1. Using SST (09222-3K000, 09222-3C300), compress the valve spring and remove retainer lock.



KCBF173C

Fig. 175: Identifying SST (09222-3K000, 09222-3C300)
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the spring retainer.
3. Remove the valve spring.
4. Remove the valve.
5. Using SST (09222-29000), remove the valve stem seal.

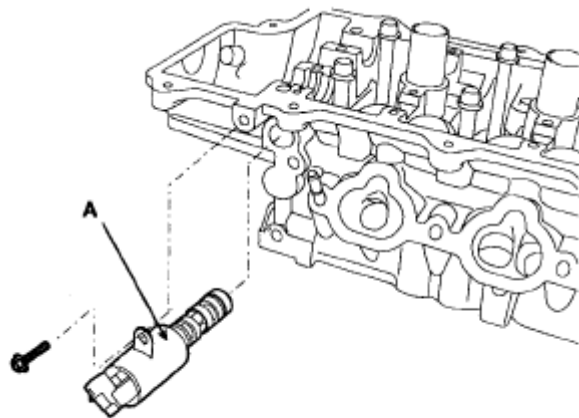


KDRF234A

Fig. 176: Identifying SST (09222-29000)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not reuse the removed valve stem seals.

3. Remove OCV (Oil Control Valve) (A).



KCBF166A

Fig. 177: Identifying OCV (Oil Control Valve)
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

CYLINDER HEAD

1. Inspect for flatness.

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

Flatness of cylinder head gasket surface

Standard: 0.03 mm (0.0012 in.) or less

Flatness of manifold gasket surface

Standard: 0.15 mm (0.0059 in.) or less

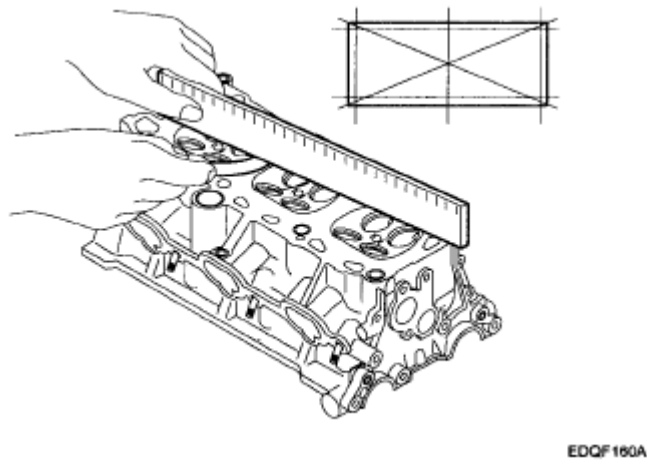


Fig. 178: Measuring Surface Contacting Cylinder Block And Manifolds For Warpage
Courtesy of KIA MOTORS AMERICA, INC.

2. Inspect for cracks.

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

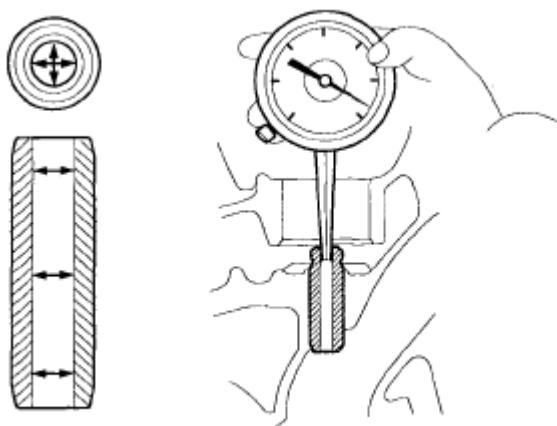
VALVE AND VALVE SPRING

1. Inspect valve stems and valve guides.

1. Using a caliper gauge, measure the inside diameter of the valve guide.

Valve guide inside diameter

Intake / Exhaust: 6.000-6.015 mm (2.2362-2.2368 in.)



ECBF034A

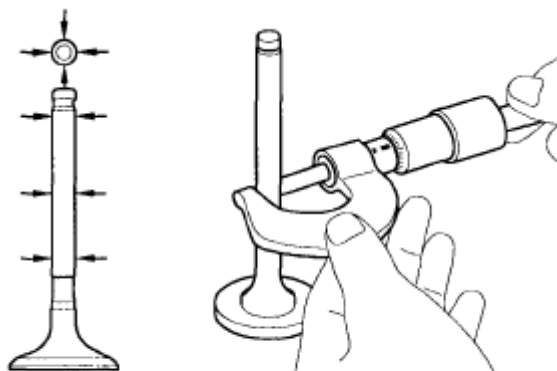
Fig. 179: Measuring Inside Diameter Of Valve Guide
Courtesy of KIA MOTORS AMERICA, INC.

- Using a micrometer, measure the outer diameter of the valve stem.

Valve stem outer diameter

Intake: 5.965-5.980 mm (0.2348-0.2354 in.)

Exhaust: 5.950-5.96 mm (0.2343-0.2348 in.)



KGRF227A

Fig. 180: Measuring Outer Diameter Of Valve Stem
Courtesy of KIA MOTORS AMERICA, INC.

- Calculate the clearance between the valve guides and the stems by difference between the valve stem measured diameter and the valve guide measured inside diameter.

Valve stem-to-guide clearance

[Standard]

Intake: 0.020-0.050 mm (0.0008-0.0020 in.)

Exhaust: 0.035-0.065 mm (0.0014-0.0026 in.)

[Limit]

Intake: 0.10 mm (0.0039 in.) or less

Exhaust: 0.13 mm (0.0051 in.) or less

2. Inspect valves.

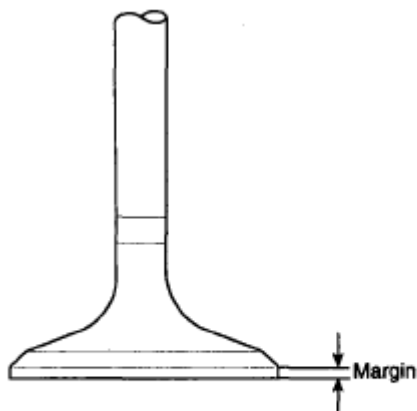
1. Check the valve face angle.
2. Check that the surface of the valve for wear. If the valve face is worn, replace the valve.
3. Check the valve head margin thickness.

If the margin thickness is less than the specification, replace the valve.

Specification

Intake: 1.0 mm (0.0394 in.)

Exhaust: 1.3 mm (0.0512 in.)



ECKD221A

Fig. 181: Identifying Valve Head Margin Thickness
Courtesy of KIA MOTORS AMERICA, INC.

4. Check the valve length.

Length

Intake: 110.1 mm (4.3346 in)

Exhaust: 111.1 mm (4.3740 in)

5. Check the surface of the valve stem tip for wear. If the valve stem tip is worn, replace the valve.
3. Inspect valve seats
 1. Check the valve seat for evidence of overheating or improper contact with the valve face.

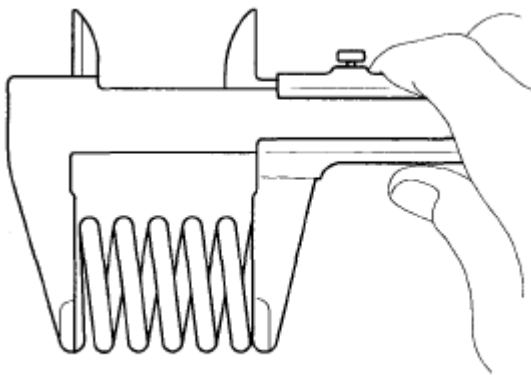
If the valve seat is worn, replace cylinder head.
 2. Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace the valve guide first.
 3. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.
4. Inspect valve springs.
 1. Using a steel square, measure the out-of-square of the valve spring.
 2. Using vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height: 46.8 mm (1.8425 in.)

Out-of-square: 1.5° or less



KCRF205A

Fig. 182: Measuring Free Length Of Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

MLA (MECHANICAL LASH ADJUSTER)

1. Inspect MLA.

Using a micrometer, measure the MLA outside diameter.

MLA O.D.

Intake/Exhaust: 29.964-29.980 mm (1.1797-1.1803 in.)

2. Using a caliper gauge, measure MLA tappet bore inner diameter of cylinder head.

Tappet bore I.D.

Intake/Exhaust: 30.000-30.025 mm (1.1811-1.1821 in.)

3. Calculate the clearance by subtracting MLA outside diameter measurement from tappet bore inside diameter measurement.

MLA to tappet bore clearance

[Standard]

Intake/Exhaust: 0.020-0.061 mm (0.0008-0.0024 in.)

[Limit]

Intake/Exhaust: 0.07 mm (0.0027 in.) or less

CAMSHAFT

1. Inspect cam lobes.

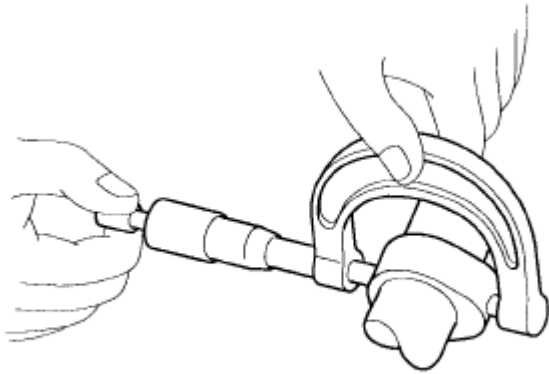
Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

Intake: 44.5 mm (1.7520 in.)

Exhaust: 44.5 mm (1.7520 in.)

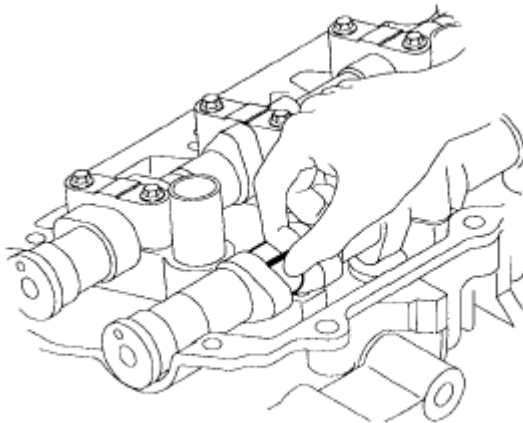


KCRF206A

Fig. 183: Measuring Cam Lobe Height
Courtesy of KIA MOTORS AMERICA, INC.

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

2. Check the cam lobe surface for wear or damage. If necessary, replace it.
3. Inspect 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 journals.



SMGM16024N

Fig. 184: Inspecting Camshaft Journal Clearance
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the bearing caps with the tightening torque.

CAUTION: Do not turn the camshaft.

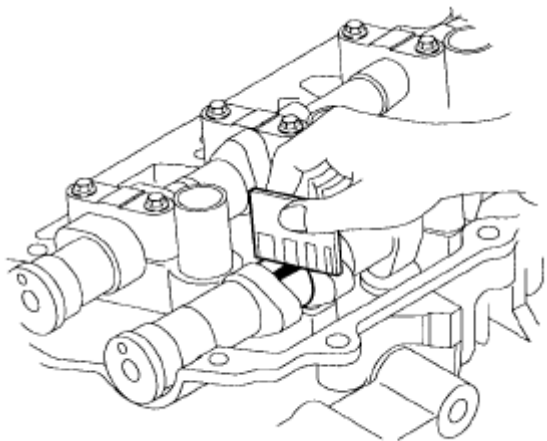
5. Remove the bearing caps.
6. Measure the plastigage at its widest point.

Bearing oil clearance

[Standard value]

Intake: 0.020-0.057 mm (0.0008-0.0022 in.)

Exhaust: 0.020-0.057 mm (0.0008-0.0022 in.)



SMGM16025N

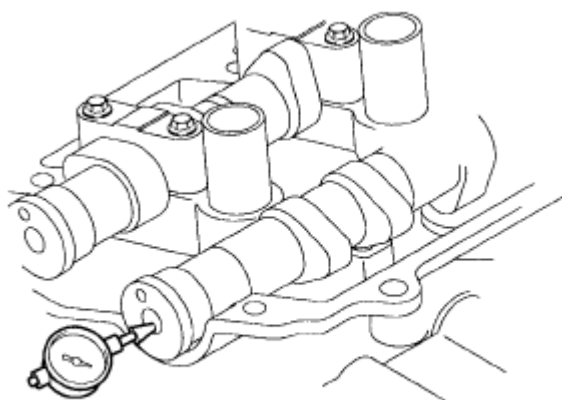
Fig. 185: Measuring Plastigage Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

If the oil clearance is greater than the maximum, replace the camshaft. If necessary, replace the cylinder head.

7. Completely remove the plastigage.
 8. Remove the camshafts.
4. Inspect 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 value]: 0.1-0.2 mm (0.0039-0.0079 in.)



KCBF173E

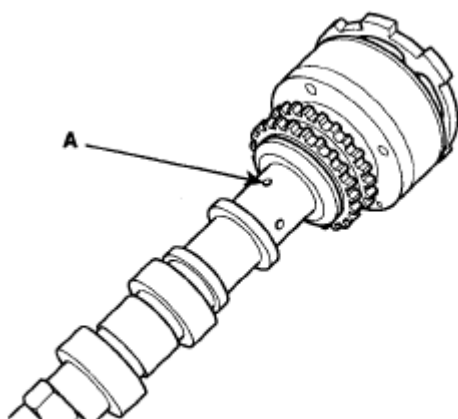
Fig. 186: Identifying Camshaft End Play
 Courtesy of KIA MOTORS AMERICA, INC.

If the end play is greater than the maximum, replace the camshaft. If necessary, replace the cylinder head.

3. Remove the camshafts.

CVVT ASSEMBLY

1. Inspect CVVT assembly.
 1. Fix the CVVT assembly with a vice. Ensure that the cam lobe and journal is not damaged.
 2. Check that the CVVT assembly will not turn. It should not be turned.
 3. Apply vinyl tape to the retard hole except the one (A) indicated by the arrow in the illustration.



KCBF188A

Fig. 187: Identifying CVVT Assembly
 Courtesy of KIA MOTORS AMERICA, INC.

4. Wind tape around the tip of the air gun and apply air of approx. 150 kPa (1.5 kgf/cm², 21 psi) to

the port of the camshaft.

(Perform this in order to release the lock pin for the maximum delay angle locking.)

NOTE: When the oil splashes, wipe it off with a shop rag.

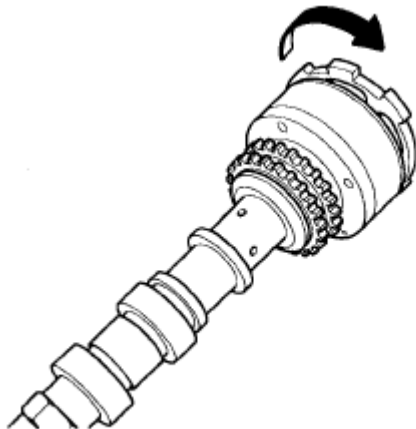
5. After the lock pin released, the CVVT assembly can turned in advanced direction.

If the air applied is leaked much, the lock pin can not be released.

6. Except the position where the lock pin meets at the maximum delay angle, let the CVVT assembly turn back and forth and check the movable range and that there is no resistance to movement.

Standard: Movable smoothly in the range about 30°

7. Turn the CVVT assembly with your hand in retard direction and lock it at the maximum delay angle position.



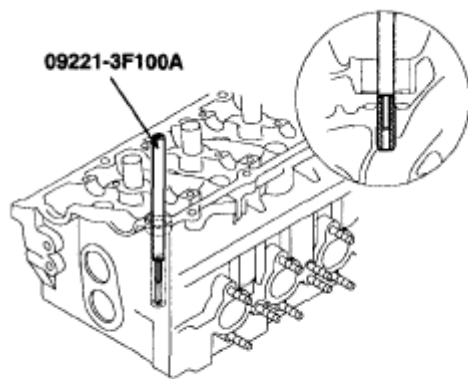
KCBF188B

Fig. 188: Turning CVVT Assembly
Courtesy of KIA MOTORS AMERICA, INC.

REPLACEMENT

VALVE GUIDE

1. Using the SST (09221-3F100A), remove the valve guide from the downside of the cylinder head assembly.



EDKD900A

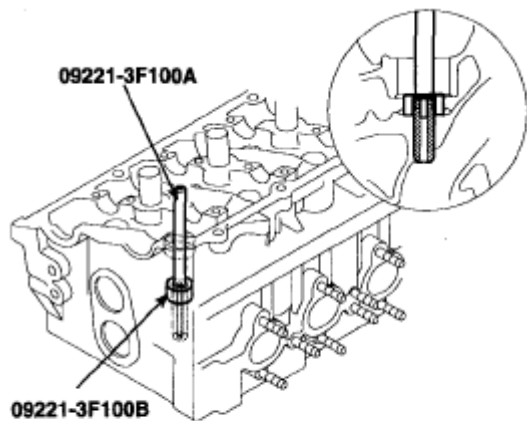
Fig. 189: Identifying SST (09221-3F100A)
Courtesy of KIA MOTORS AMERICA, INC.

2. Reprocess the valve guide hole for the oversized valve guide newly installed.
3. Using the SST (09221-3F100A/B), insert the valve guide in the upside of the cylinder head assembly. Be aware of the difference in length between the intake and the exhaust valve guides.

Specification

Intake valve guide: 45.8-46.2 mm (1.8031-1.8189 in.)

Exhaust valve guide: 46.8-47.2 mm (1.8425-1.8583 in.)



EDKD900B

Fig. 190: Identifying SST (09221-3F100A/B)
Courtesy of KIA MOTORS AMERICA, INC.

4. After installing the valve guides, insert new valves and check the clearance between the valve stems and the valve guides.

5. After replacing the valve guides, check if they are properly installed with the valve seats. Reprocess valve seats if necessary.

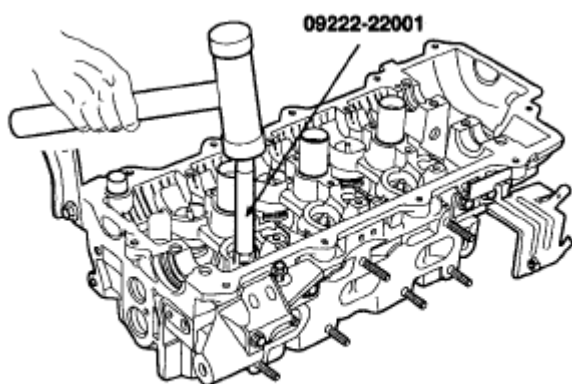
REASSEMBLY

NOTE:

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

1. Install valves.

1. Using SST (09222-22001), push in a new valve stem seal with applying engine oil.



KCBF173B

Fig. 191: Identifying SST (09222-22001)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Do not reuse old valve stem seals.

Incorrect installation of the seal could result in oil leakage past the valve guides.

- Reassemble the valve stem seals

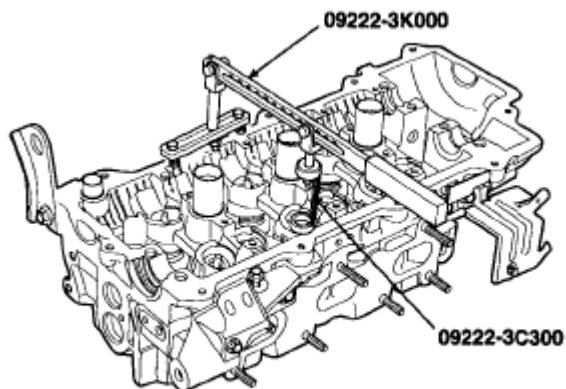
2. After applying engine oil on the outer surface of each valve stem, insert the valve in the valve guide.

Install the valve, valve spring and spring retainer.

NOTE:

When installing valve springs, the side coated with enamel should face toward the valve spring retainer

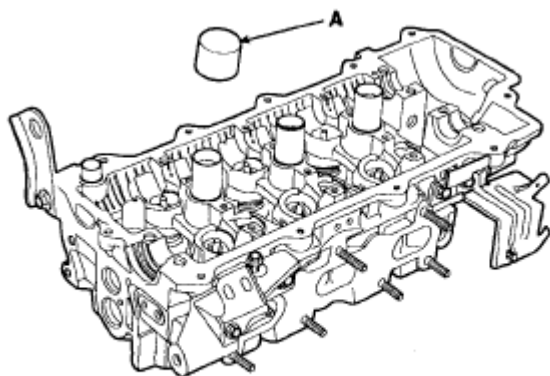
3. Using the SST (09222 - 3K000, 09222-3C300), compress the springs and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



KCBF179C

Fig. 192: Identifying SST (09222-3K000, 09222-3C300)
Courtesy of KIA MOTORS AMERICA, INC.

4. 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.
2. Install MLAs with engine oil applied on its surface. Check that the MLA rotates smoothly by hand.



KCBF173D

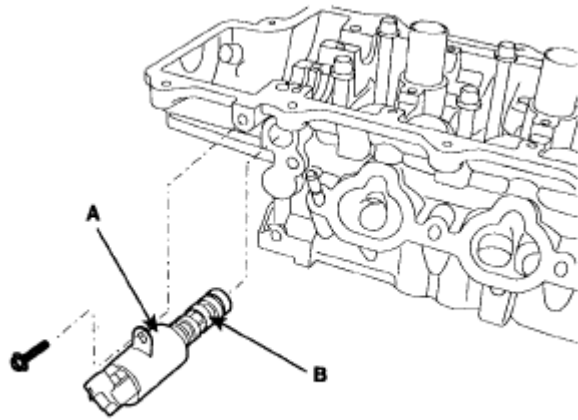
Fig. 193: Identifying MLA (Mechanical Lash Adjuster)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: MLA should be reinstalled in its original position.

3. Install OCV (Oil Control Valve) (A).

Tightening torque

7.8-9.8 N.m (0.8-1.0 kgf.m, 5.8-7.2 lb-ft)



KCBF166B

Fig. 194: Identifying OCV (Oil Control Valve)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- To install OCV with gray colored connector into RH bank.
- To install OCV with black colored connector into LH bank.

CAUTION:

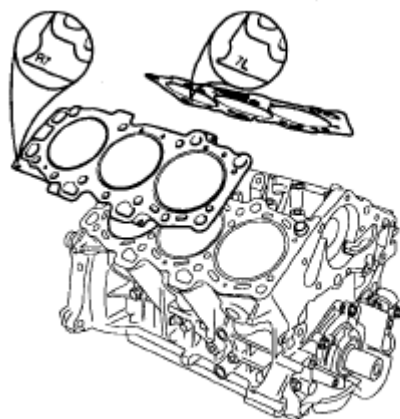
- Do not reuse the OCV when dropped.
- Keep clean the OCV.
- Do not hold the OCV sleeve during servicing.
- When the OCV is installed on the engine, do not move the engine while holding the OCV yoke.
- If there is dust on the filter (B) of the OCV, clean it all.

INSTALLATION

NOTE:

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

1. After putting the cylinder head gasket on the cylinder block, install the cylinder head.



KCBF191A

Fig. 195: Identifying Cylinder Head Gasket
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Ensure the LH/RH classification of the cylinder head gasket when installing.

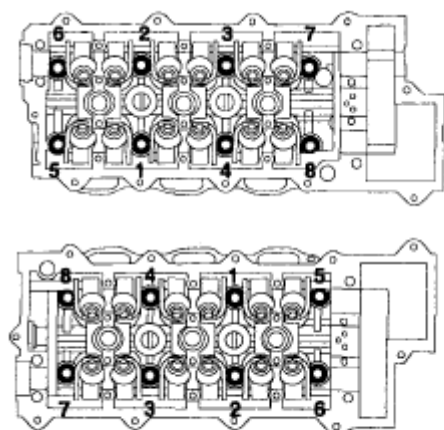
2. Tighten the cylinder head bolts with the plain washers in several steps as following order.

NOTE:

- In assembling washers, the marked surface should face upward.
- In installing the cylinder head bolts, apply engine oil on the thread of the bolts and the surface of the washers.

Tightening torque

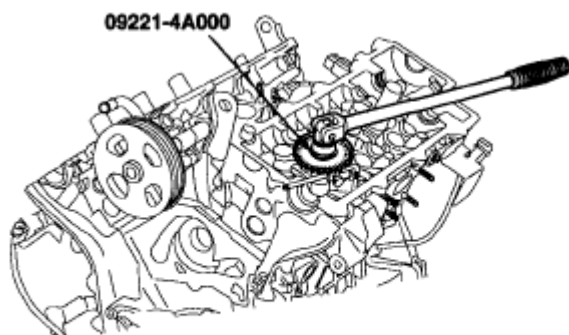
24.5 N.m (2.5 kgf.m, 18.1 lb-ft) + 60° + 45°



KCBF176B

Fig. 196: Identifying Cylinder Head Bolts Tighten Sequence
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Using the SST (09221-4A000), tighten the bolts which need to be tightened with the angular tightening method.



LDLG063A

Fig. 197: Identifying SST (09221-4A000)
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the CVVT assembly and camshaft chain sprocket with the dowel pin in the CVVT installed to the intake camshaft. Ensure that the pin will not be installed in the hole for oil feeding.

Tightening torque

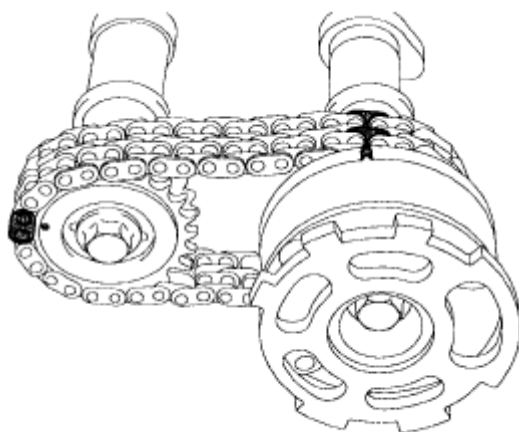
66.7-78.5 N.m (6.8-8.0 kgf.m, 49.2-57.9 lb-ft)

NOTE: After tightening the CVVT bolts, rotate the CVVT assembly housing counterclockwise by hand to seat the lock pin in the CVVT assembly in good position.

CAUTION: Fix the hexagonal part of the camshaft in a vice when tightening the CVVT bolts. Do not fix the CVVT housing or sprocket in a vice.

4. Install the camshaft in the cylinder head assembly.
 1. Align the timing mark of the camshaft timing chain.

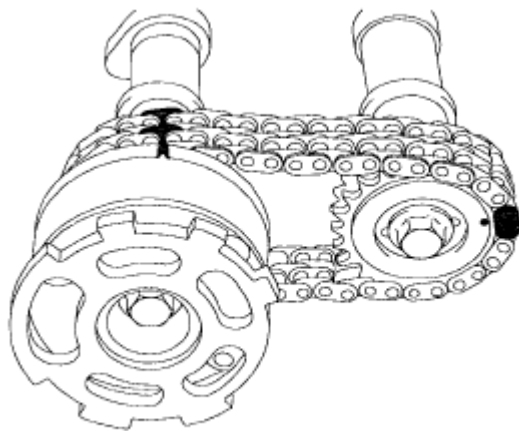
LH CAMSHAFT CHAIN TIMING MARK



KCBF164A

Fig. 198: Identifying LH Camshaft Chain Timing Mark
Courtesy of KIA MOTORS AMERICA, INC.

RH CAMSHAFT CHAIN TIMING MARK

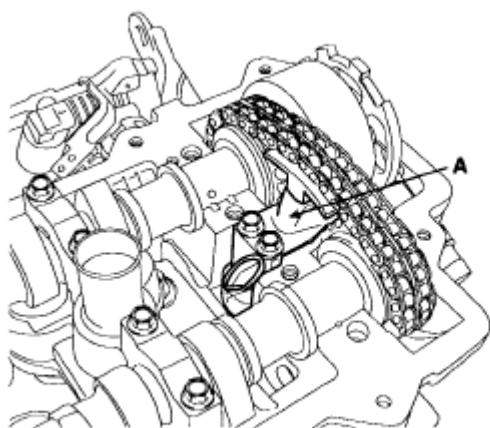


KCBF165A

Fig. 199: Identifying RH Camshaft Chain Timing Mark
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Both timing marks should face upward in reassembly.

5. Install the timing chain tensioner.
 1. Insert the set pin by pressing the timing chain tensioner.
 2. Install the chain tensioner (A) in the cylinder head assembly.
 3. Remove the set pin from the tensioner after installing.



KCBF168A

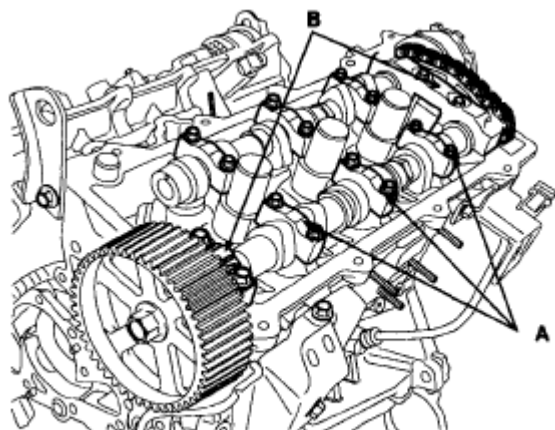
Fig. 200: Identifying Chain Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

6. Install the camshaft bearing caps.

Tightening torque

Bearing cap bolt (A: 6x38) - 10.8-12.7 N.m (1.1-1.3 kgf.m, 8.0-9.4 lb-ft)

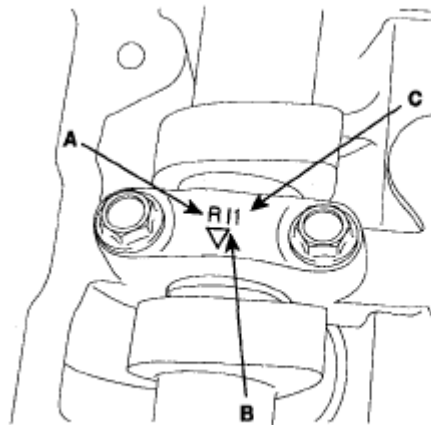
Bearing cap bolt (B: 8x38) - 20.6-22.5 N.m (2.1-2.6 kgf.m, 15.2-18.8 lb-ft)



KCBF169A

Fig. 201: Identifying Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: When installing the bearing caps, check the marks on them as shown below and install them in its proper position.



SMGM16026N

Fig. 202: Identifying Marks On Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

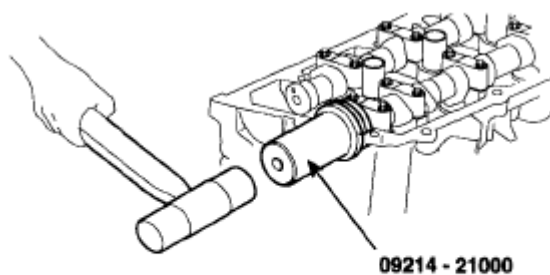
A (LH/RH HEAD): L (LH), R (RH)

B (Intake/Exhaust): I (Intake), E (Exhaust)

C (Cap no.): 1, 2, 3

CAUTION: When installing the bearing caps, turn the crankshaft to place a piston in the middle of the block because interference between valves and pistons can occur.

7. Using the SST (09214-21000), install the camshaft oil seal.



KCBF190A

Fig. 203: Identifying SST (09214-21000)
Courtesy of KIA MOTORS AMERICA, INC.

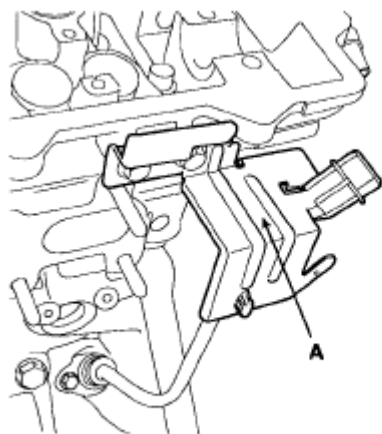
NOTE:

- Before installing, apply engine oil.
- The camshaft cap surface should adhere to the cylinder head

assembly.

- **Do not press an eccentric load.**

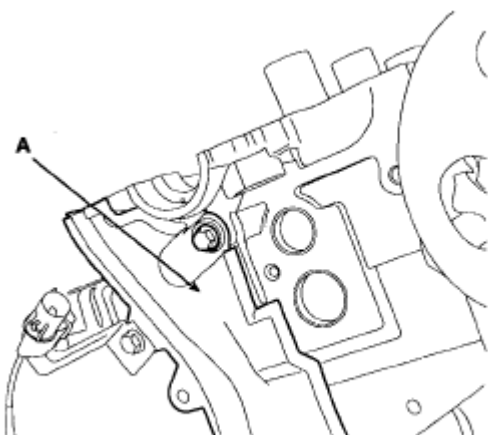
8. Install the CKP sensor connector bracket (A).



KCBF172A

Fig. 204: Identifying CKP Sensor Connector Bracket
Courtesy of KIA MOTORS AMERICA, INC.

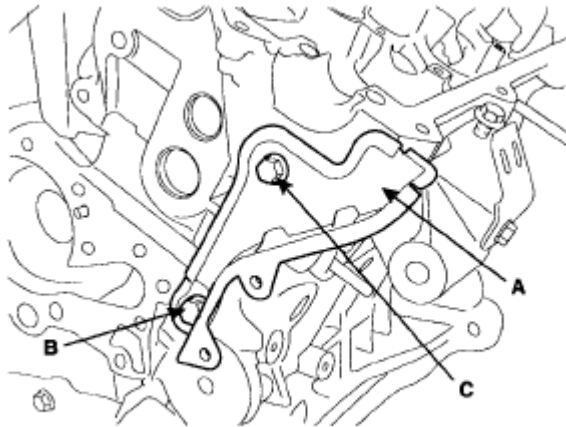
9. Install the bank 2 timing belt rear cover (A).



KCBF171A

Fig. 205: Identifying Timing Belt Rear Cover
Courtesy of KIA MOTORS AMERICA, INC.

10. Install the bank 1 timing belt rear cover (A).

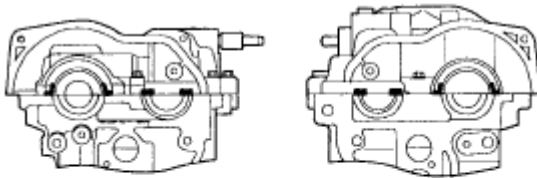


KCBF170B

Fig. 206: Identifying Timing Belt Rear Cover
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: The length of the bolt B is longer than that of the bolt C.

11. Install the timing belt. (Refer to '**TIMING SYSTEM**').
12. Check and adjust the valve clearance.
13. Install the cylinder head cover.
 1. Remove oil, dust or sealant on the upper surface of the cylinder before assembling cylinder head cover.
 2. Assemble the cylinder head cover in five minutes after applying liquid gasket (LOCTITE 5900) on the camshaft cap and packing part.



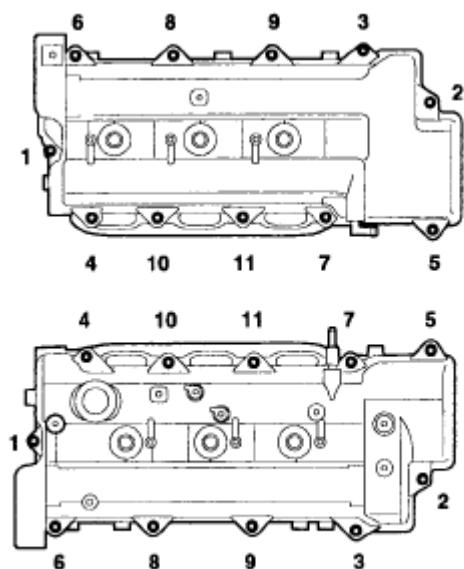
SMGM16027N

Fig. 207: Identifying Cylinder Head Cover
 Courtesy of KIA MOTORS AMERICA, INC.

3. Tighten the cylinder head cover bolts as following order (A).

Tightening torque

7.8-9.8 N.m (0.8-1.0 kgf.m, 5.8-7.2 lb-ft)



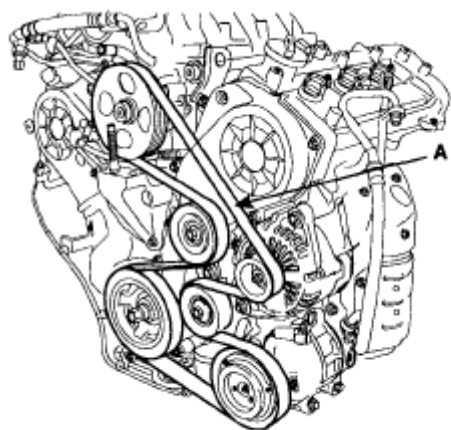
KCBF175A

Fig. 208: Identifying Cylinder Head Cover Bolts Tighten Sequence
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Do not start engine for thirty minutes after assembling the cylinder head cover.
- Do not reuse the cylinder head cover gasket.

14. Install the water temp. control assembly.
15. Install the intake manifold assembly.
16. Install the exhaust manifold assembly.
17. Install the power steering pump. (Refer to **MECHANICAL POWER STEERING SYSTEM**).
18. Install the drive belt (A).

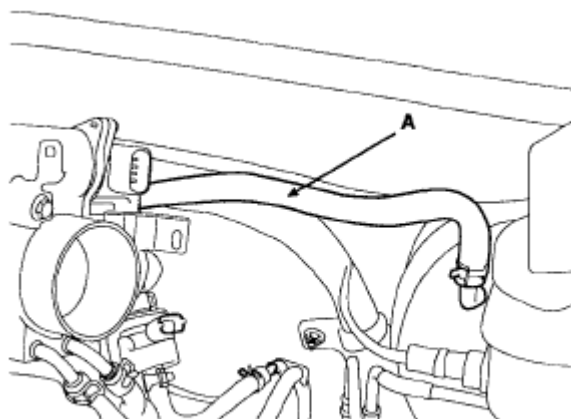


KCBF105A

Fig. 209: Identifying Drive Belt

Courtesy of KIA MOTORS AMERICA, INC.

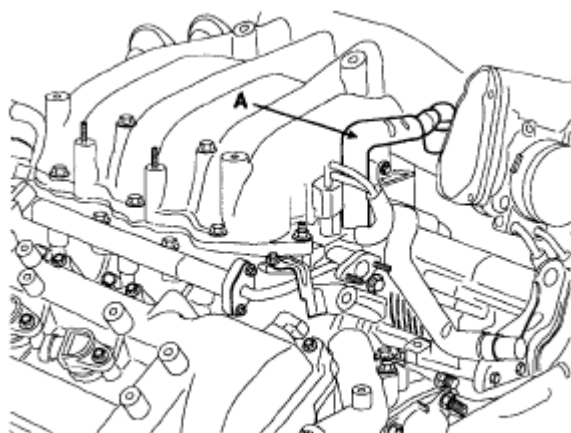
19. Install the heater hose.
20. Connect the brake vacuum hose (A).



LDLG038A

Fig. 210: Identifying Brake Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

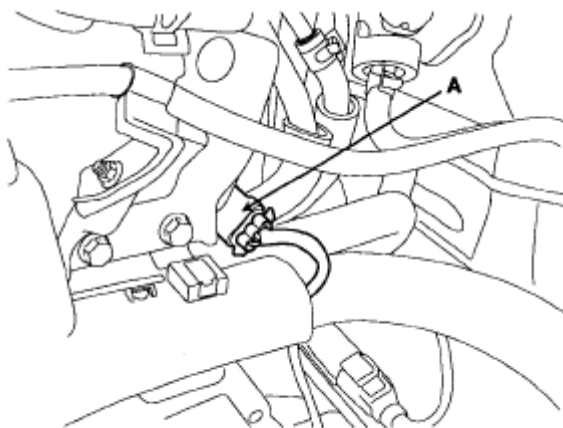
21. Install the PCV (Positive Crankcase Ventilation) hose (A).



SMGM16017N

Fig. 211: Identifying PCV Hose
Courtesy of KIA MOTORS AMERICA, INC.

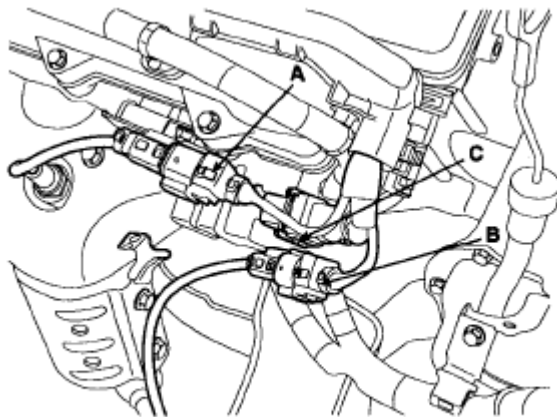
22. Connect the engine wiring harness connectors.
 1. Connect the bank 1 CMP sensor connector (A).



KCBF152A

Fig. 212: Identifying CMP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

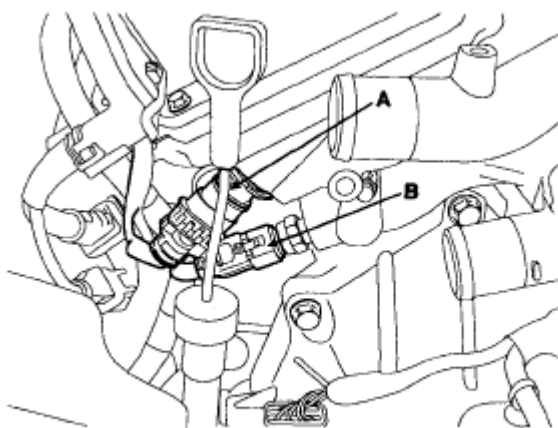
2. Connect the bank 2 front/rear O2 sensor connectors (A, B) and the CKP sensor connector (C).



KCBF154A

Fig. 213: Identifying Front/Rear O2 Sensor Connectors And CKP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

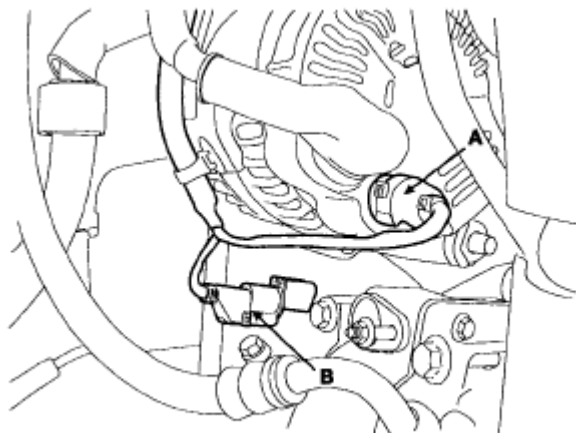
3. Connect the bank 2 CMP sensor connector (A) and the WTS (Water Temperature Sensor) connector (B).



KCBF155A

Fig. 214: Identifying CMP Sensor Connector And ECT Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

4. Connect the generator connector (A) and the air conditioning compressor connector (B).



KCBF151A

Fig. 215: Identifying Generator Connector And Air Conditioning Compressor Connector
Courtesy of KIA MOTORS AMERICA, INC.

5. Connect the MAPS (Manifold Absolute Pressure Sensor) connector (A), the ETC (Electronic Throttle Control) connector (B) and the PCSV (Purge Control Solenoid Valve) connector (C).

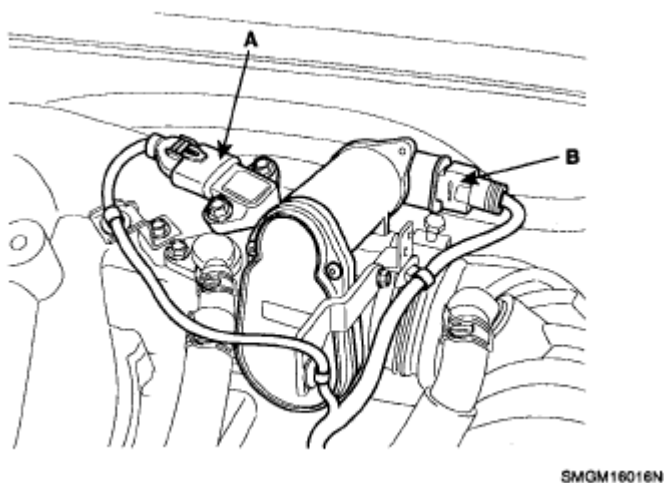


Fig. 216: Identifying MAPS Connector, ETC Connector And PCSV Connector
Courtesy of KIA MOTORS AMERICA, INC.

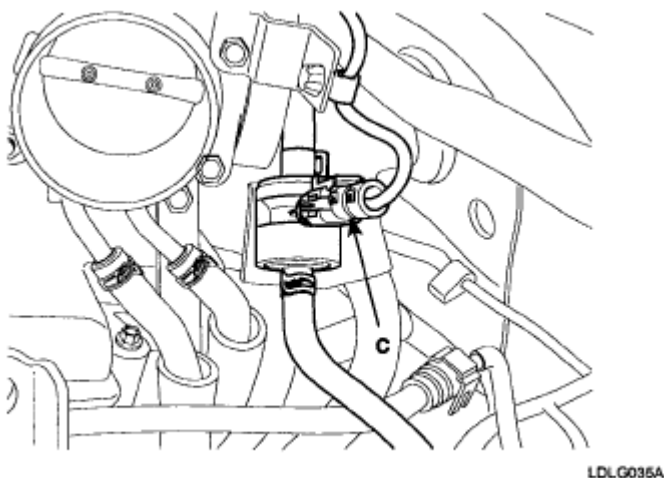
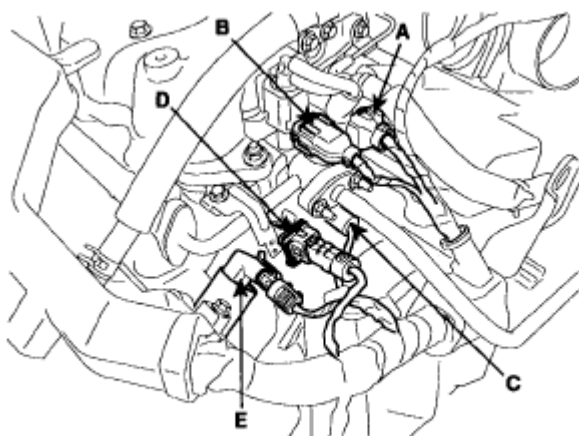


Fig. 217: Identifying PCSV Connector
Courtesy of KIA MOTORS AMERICA, INC.

6. Connect the injection harness connector (A), the No.2 VIS (Variable Induction System) connector (B), the No.1/No.2 OCV (Oil Control Valve) connectors (C, D) and the OTS (Oil Temperature Sensor) connector (E).

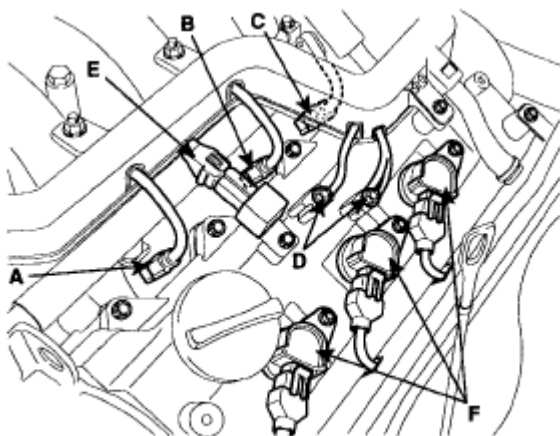


SMGM16015N

Fig. 218: Identifying Injection Harness Connector, VIS Connector, OCV Connectors And OTS Connector

Courtesy of KIA MOTORS AMERICA, INC.

7. Connect the injection connectors (A, B, C), the ground lines (D), the condenser connector (E) and the Ignition coil connectors (F).

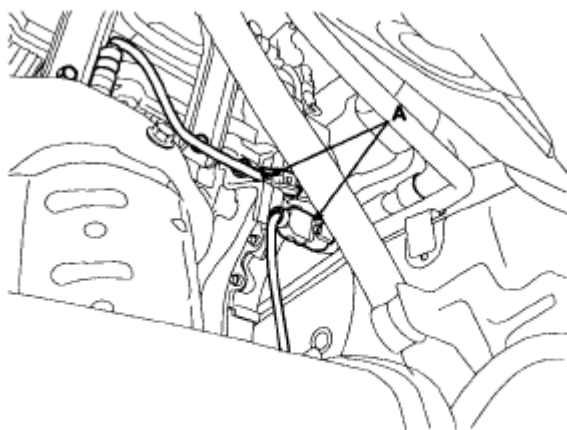


SMGM16014N

Fig. 219: Identifying Injection Connectors, Ground Lines, Condenser Connector And Ignition Coil Connectors

Courtesy of KIA MOTORS AMERICA, INC.

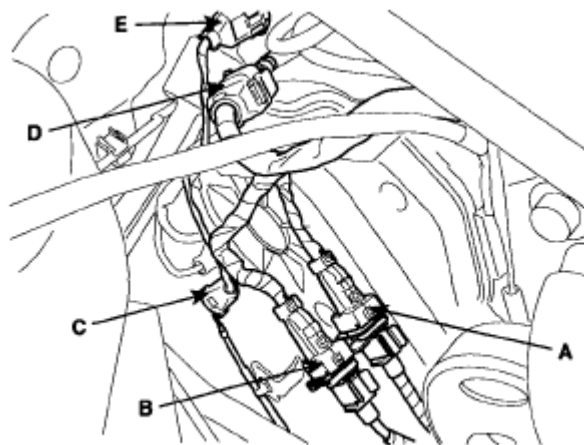
8. Connect the bank 1 front/rear O2 sensor connectors (A).



KCBF160A

Fig. 220: Identifying Bank Front/Rear O2 Sensor Connectors
Courtesy of KIA MOTORS AMERICA, INC.

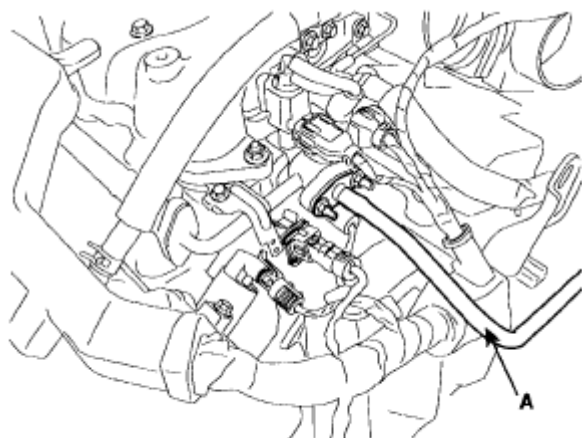
9. Connect the No.1/No.2 knock sensor connectors (A, B), the oil pressure switch connector (C), the ignition coil harness (D) and the No.1 VIS (Variable Induction System) connector (E).



LDLG005A

Fig. 221: Identifying Engine Wiring Harness Connectors
Courtesy of KIA MOTORS AMERICA, INC.

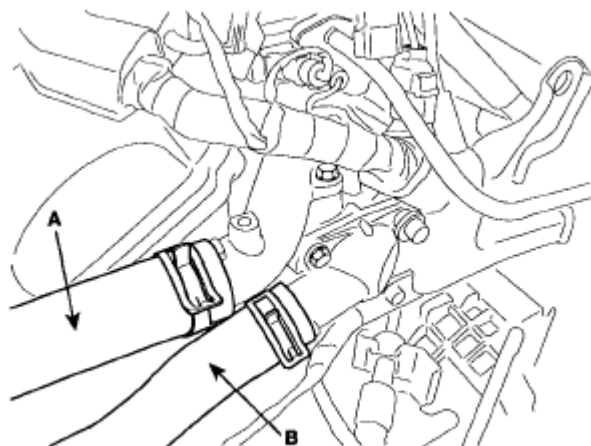
23. Install the fuel inlet hose (A) from the delivery pipe.



SMGM16031N

Fig. 222: Identifying Fuel Inlet Hose
Courtesy of KIA MOTORS AMERICA, INC.

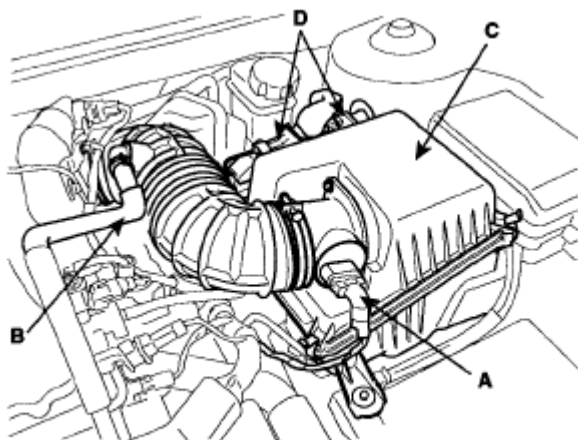
24. Install the upper radiator hose (A) and lower radiator hose (B).



LDLG008A

Fig. 223: Identifying Radiator Upper And Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

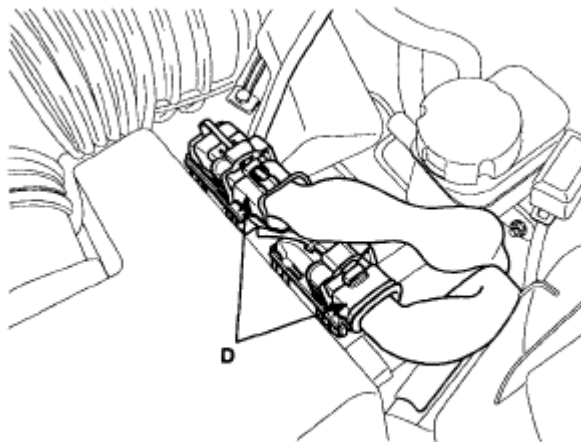
25. Install the intake air hose and air cleaner assembly.
1. Connect the PCM connectors (D).



SMGM16013N

Fig. 224: Identifying Breather Hose, MAF Connector, Air Cleaner Assembly And PCM Connectors

Courtesy of KIA MOTORS AMERICA, INC.



LDLG061A

Fig. 225: Identifying PCM Connectors

Courtesy of KIA MOTORS AMERICA, INC.

2. Install the intake air hose and air cleaner assembly (C).
3. Connect the breather hose (B) from air cleaner hose.
4. Connect the MAF connector (A).
26. Install the engine cover (A).

Tightening torque

7.8-11.8 N.m (0.8-1.2 kgf.m, 5.8-8.7 lb-ft)

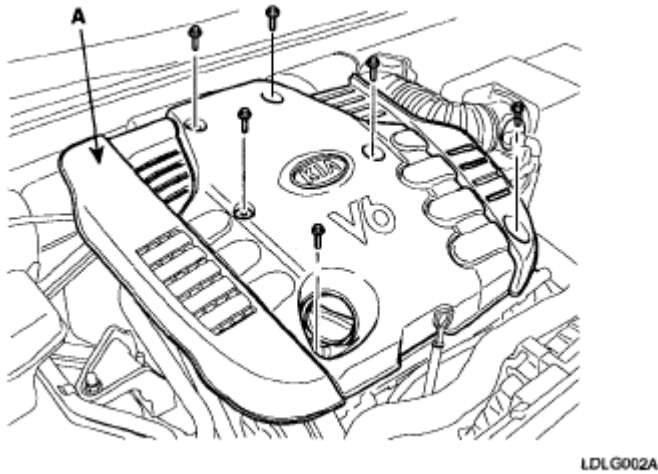


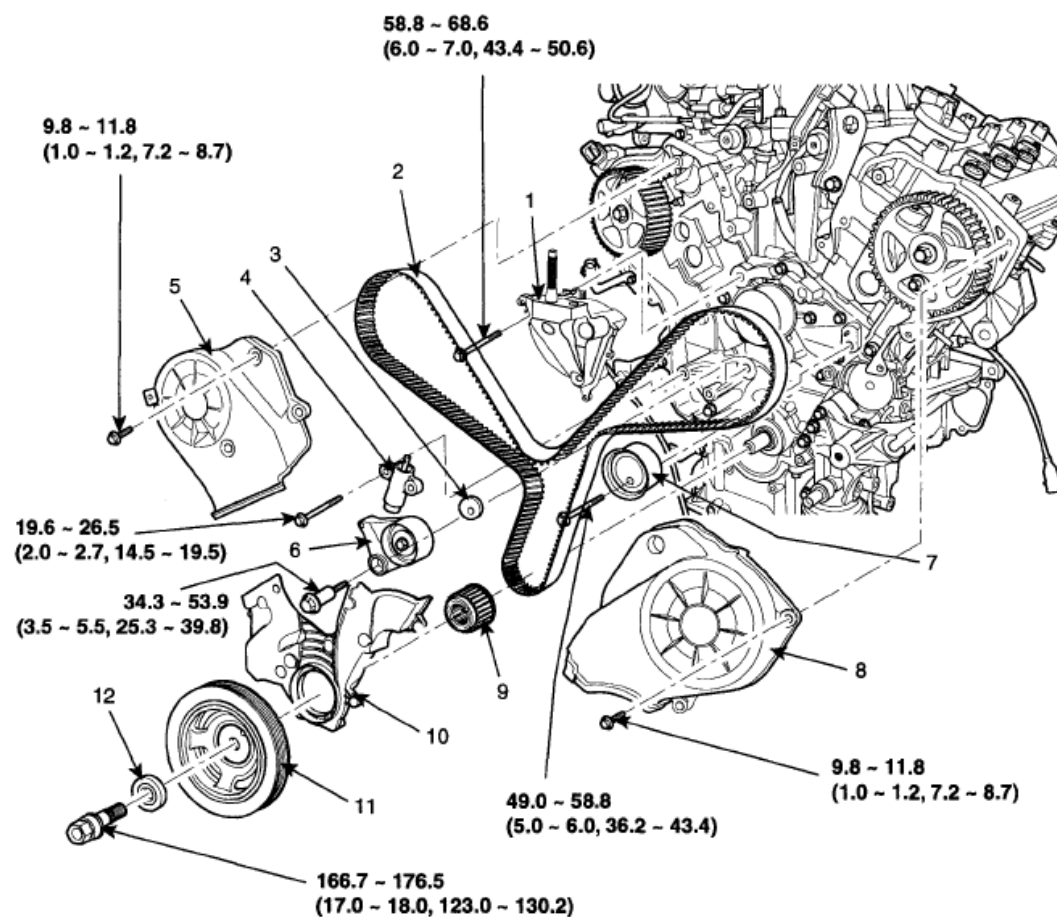
Fig. 226: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

27. Refill engine coolant.

TIMING SYSTEM

TIMING BELT

COMPONENTS


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

- | | |
|---------------------------------------|-----------------------------------|
| 1. Engine support bracket | 7. Idler pulley |
| 2. Timing belt | 8. Bank 2 timing belt upper cover |
| 3. Tensioner arm assembly washer | 9. Crankshaft sprocket |
| 4. Timing belt auto tensioner | 10. Timing belt lower cover |
| 5. Bank 1 timing belt upper cover | 11. Damper pulley |
| 6. Timing belt tensioner arm assembly | 12. Special washer |

LDLG039A

Fig. 227: Identifying Timing System Components (With Torque Specifications)
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Remove the engine cover (A).

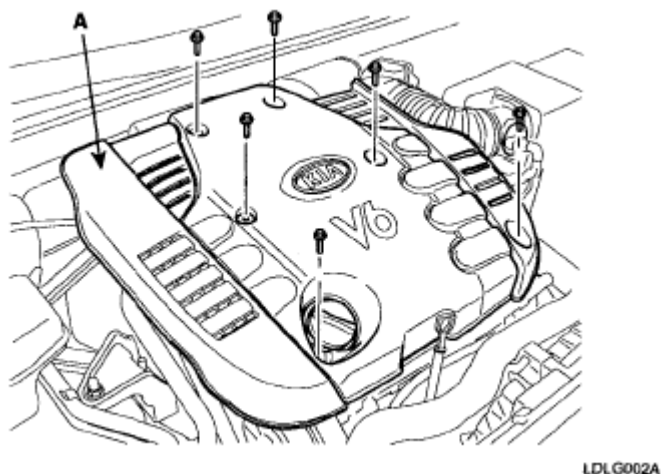


Fig. 228: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the front right wheel and tire.
3. Remove the right side cover.
4. Remove the drive belt (A), the idler (B) and the tensioner (C).

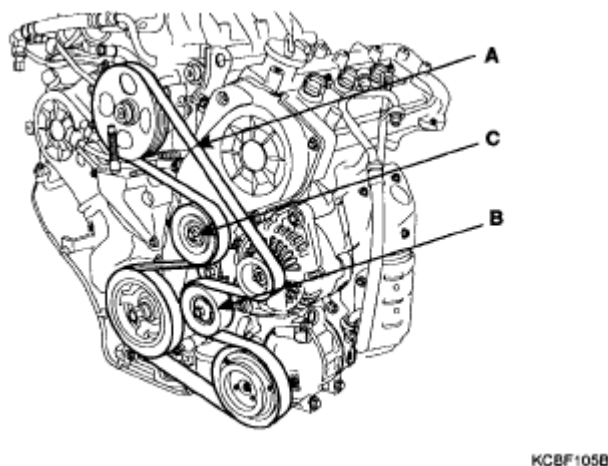
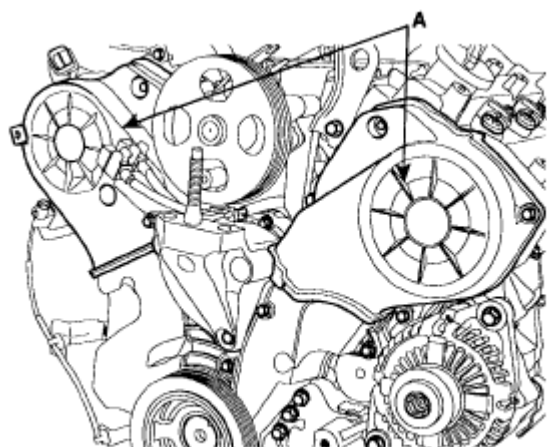


Fig. 229: Identifying Drive Belt, Idler And Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: In removing the drive belt, fix a tool in the auto tensioner pulley bolt and turn the bolt counter clockwise.

5. Remove the timing belt upper cover (A).

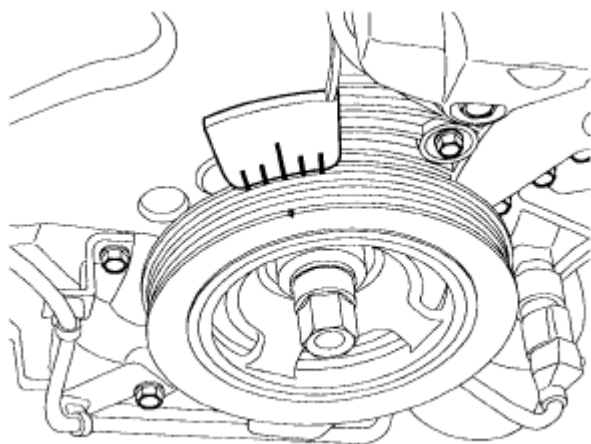


KCBF106A

Fig. 230: Identifying Timing Belt Upper Cover
Courtesy of KIA MOTORS AMERICA, INC.

6. Align the groove of the pulley with the timing mark of the timing belt cover by turning the crankshaft pulley clockwise. Check if the timing mark of the camshaft sprocket is aligned with that of the cylinder head cover.

(No.1 cylinder piston at TDC)



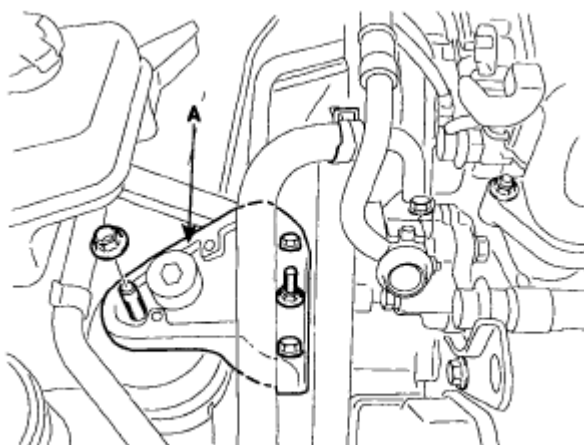
KCBF107A

Fig. 231: Identifying Timing Mark Of Camshaft Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove the engine mounting bracket.
 1. Sustain the engine oil pan with a jack.

CAUTION: Put a wooden or rubber block between the jack and the engine oil pan.

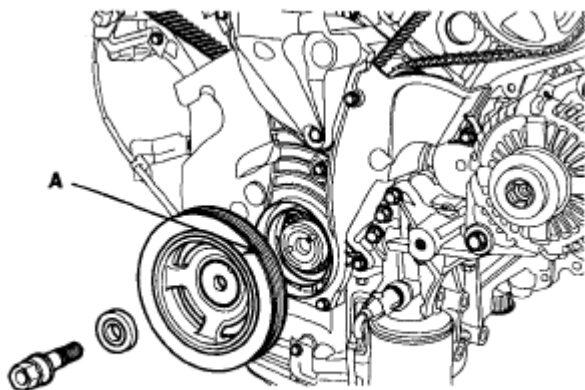
2. Remove the engine mounting bracket (A).



LDLG064A

Fig. 232: Identifying Engine Mounting Bracket
Courtesy of KIA MOTORS AMERICA, INC.

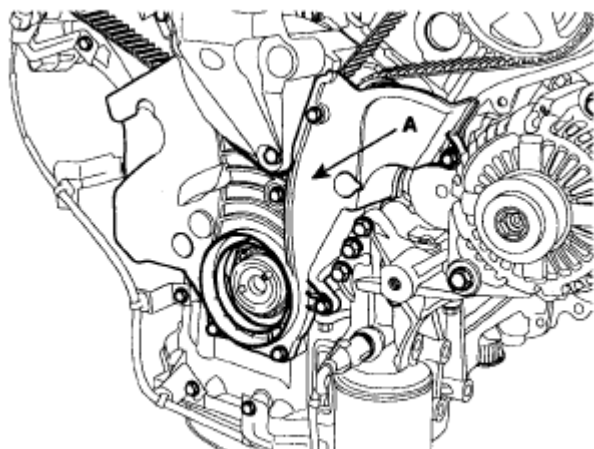
8. Remove the crankshaft damper pulley (A).



KCBF109A

Fig. 233: Identifying Crankshaft Damper Pulley
Courtesy of KIA MOTORS AMERICA, INC.

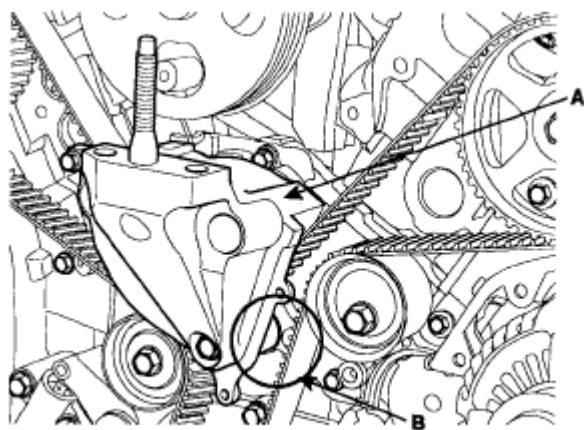
9. Remove the timing belt lower cover (A).



KCBF110A

Fig. 234: Identifying Timing Belt Lower Cover
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove the engine support bracket (A).

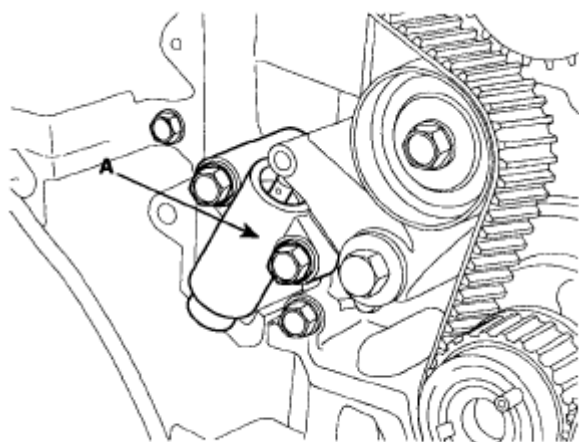


LDLG065A

Fig. 235: Identifying Engine Support Bracket
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: After removal, a small amount of engine coolant may drain from point (B).

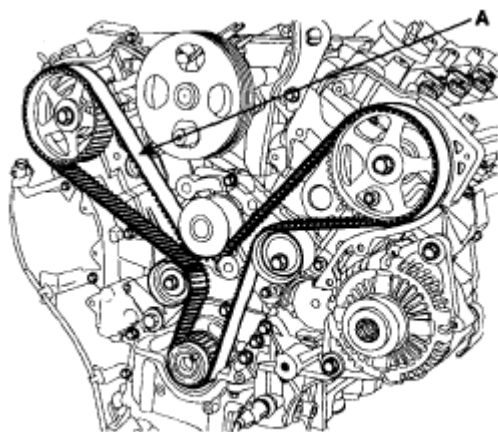
11. Remove the timing belt auto tensioner (A).



KCBF112A

Fig. 236: Identifying Timing Belt Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

12. Remove the timing belt (A).

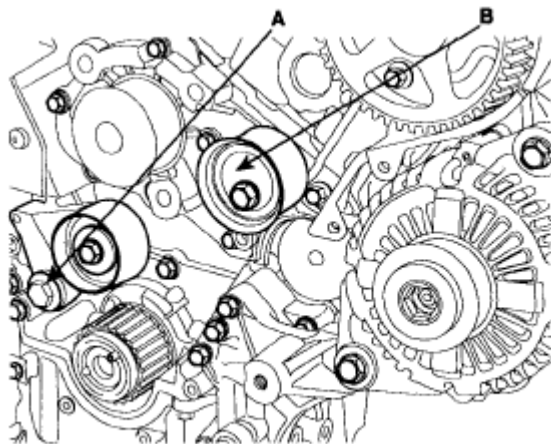


KCBF113A

Fig. 237: Identifying Timing Belt
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Mark the direction of rotation on the timing belt.

13. Remove the tensioner arm assembly (A) and the idler (B).



KCBF114A

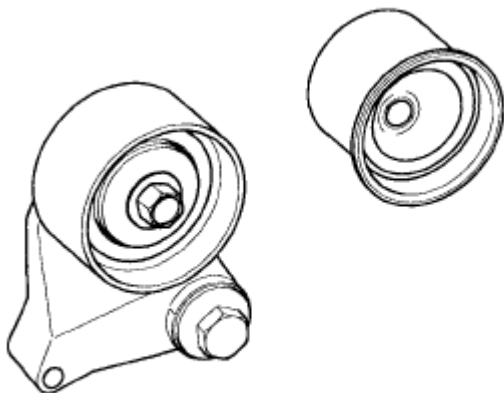
Fig. 238: Identifying Tensioner Arm Assembly
Courtesy of KIA MOTORS AMERICA, INC.

14. Remove the crankshaft sprocket.

INSPECTION

SPROCKETS, TENSIONER, IDLER

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



KCBF115A

Fig. 239: Identifying Crankshaft Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

3. Replace the tensioner and the idler if grease has leaked from the bearings.

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 belt carefully. If any of the following flaws are evident, replace the belt.

NOTE:

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

3. Inspect the idler for easy and smooth rotation and check for play or noise.

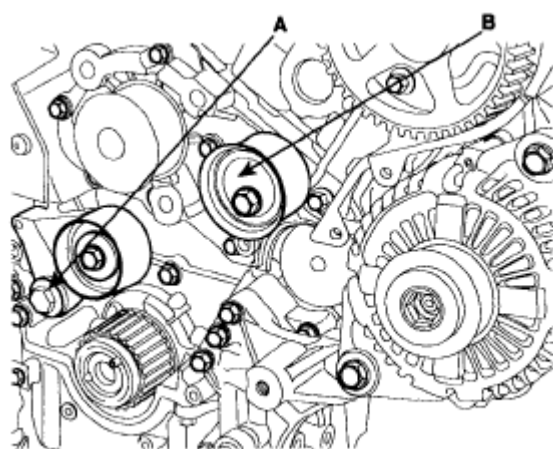
INSTALLATION

1. Install the crankshaft sprocket.
2. Install the tensioner arm assembly (A) and the idler (B).

Tightening torque

Tensioner arm bolt: 34.3-53.9 N.m (3.5-5.5 kgf.m, 25.3-39.8 lb-ft)

Idler pulley bolt: 49.0-58.8 N.m (5.0-6.0 kgf.m, 36.2-43.4 lb-ft)



KCBF114A

Fig. 240: Identifying Tensioner Arm Assembly
Courtesy of KIA MOTORS AMERICA, INC.

3. Ensure the timing marks on the camshaft and the crankshaft sprockets.

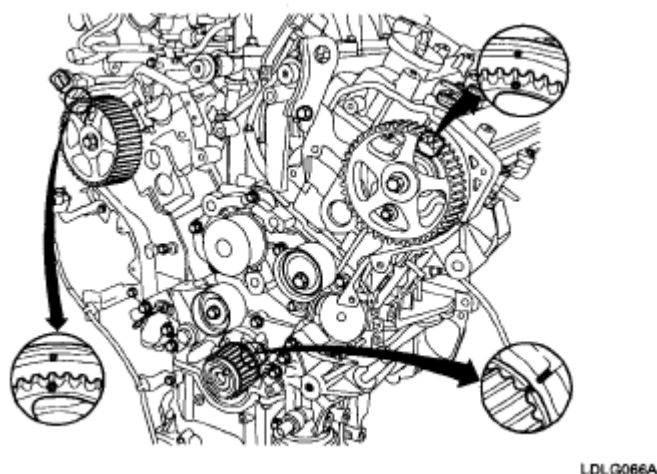


Fig. 241: Identifying Timing Marks On Camshaft And Crankshaft Sprockets
 Courtesy of KIA MOTORS AMERICA, INC.

4. Install the timing belt.

Crankshaft sprocket (A) -> Idler (B) -> Bank 2 exhaust cam sprocket (C) -> Water pump pulley (D) -> Bank 1 exhaust cam sprocket (E) -> Tensioner pulley (F).

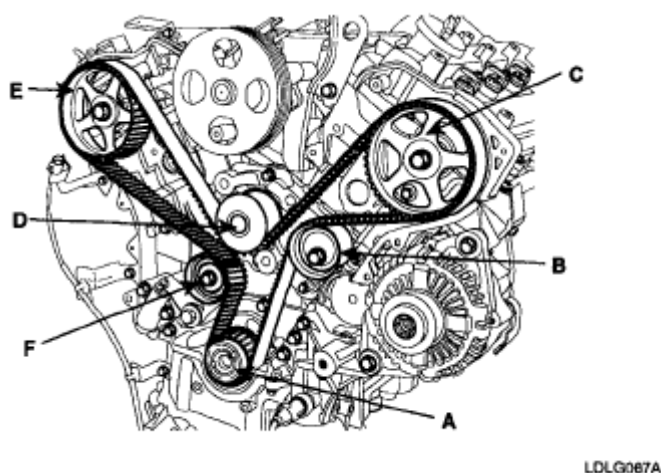
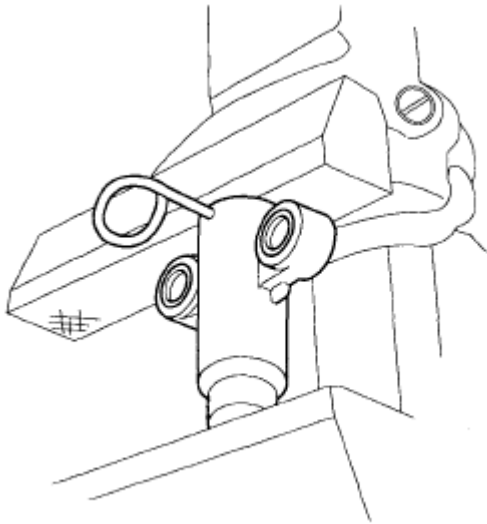


Fig. 242: Identifying Timing Belt Components
 Courtesy of KIA MOTORS AMERICA, INC.

5. Install the timing belt auto tensioner.
 1. Make the tensioner stand for about five minutes before installing.
 2. Press the rod with the weight, 150-200 N.
 3. If the rod is stiff, insert a set-pin with pressing the rod slowly. If not, press the rod 2-3 times from the maximum length to 2.9mm (the position in which the two holes of the rod and the body can be at one).
 4. Check for stiffness. If there is, insert a set-pin and other wise, replace the auto-tensioner.



SMGM16028N

Fig. 243: Identifying Timing Belt Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

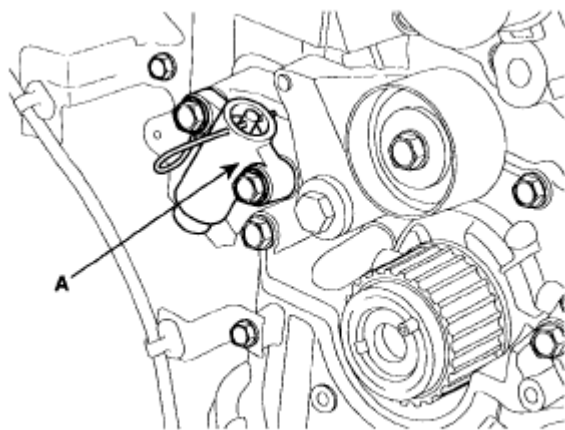
NOTE:

- Do not lay down the auto tensioner.
- Do not compress the rod suddenly. Compress the rod with the weight less than 4000 N.
- When reinstalling the auto tensioner, ensure proper orientation.
- Do not press the rod any more when its projection from the body is 2.5 mm.
- Keep the auto-tensioner stand at room temperature in winter.

6. Install the auto tensioner (A) to the front case with the set-pin inserted.

Tightening torque

19.6-26.5 N.m (2.0-2.7 kgf.m, 14.5-19.5 lb-ft)



KCBF117A

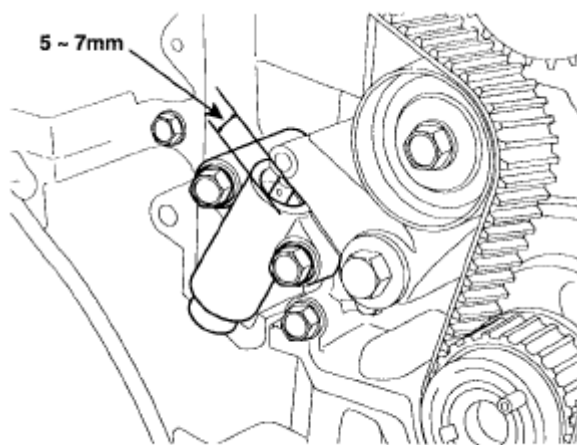
Fig. 244: Identifying Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove the auto tensioner set-pin.
8. Check the tension of the timing belt.
 1. Turn the crankshaft 2 revolutions clockwise, and set the number one cylinder to TDC.

After 5 minutes, measure the length of the projected rod.

Specification

5-7 mm (0.1969-0.2756 in.)



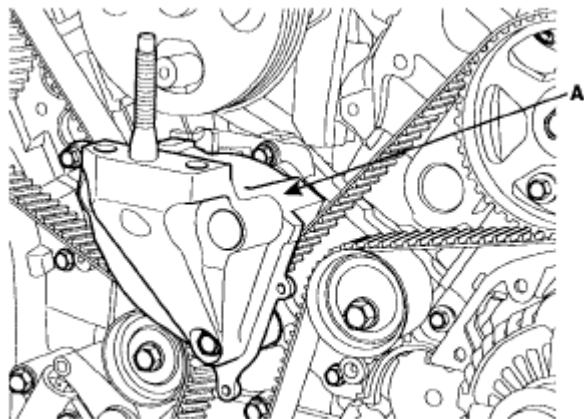
KCBF112B

Fig. 245: Checking Timing Belt Tension
Courtesy of KIA MOTORS AMERICA, INC.

2. Ensure the locations of the timing marks for each sprocket.
9. Install the engine support bracket (A).

Tightening torque

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



LDLG088A

Fig. 246: Identifying Engine Support Bracket
Courtesy of KIA MOTORS AMERICA, INC.

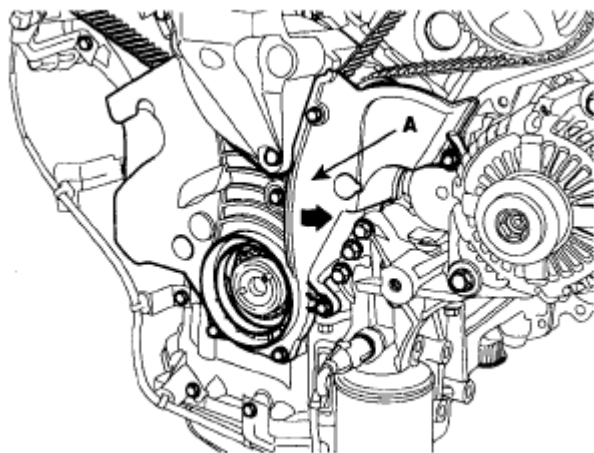
CAUTION:

- Check for the length of the bolts. (Upper-2EA/Lower-1EA).
- Use a torque wrench by all means.

10. Install the timing belt lower cover.

Tightening torque

9.8-11.8 N.m (1.0-1.2 kgf.m, 7.8-8.7 lb-ft)



SMGM16029N

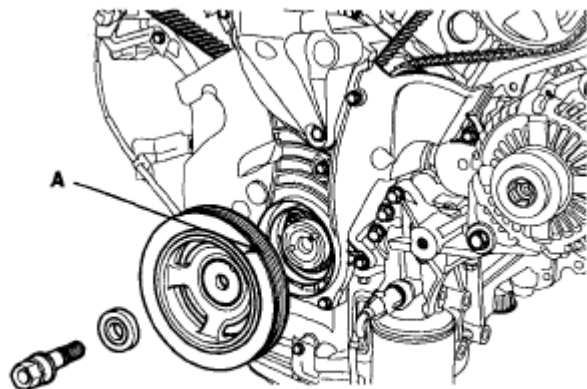
Fig. 247: Locating Timing Belt Lower Cover
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Align the holes of the bolts by pushing the left timing belt lower cover to left a little bit.

11. Install the crankshaft damper pulley (A).

Tightening torque

166.7-176.5 N.m (17.0-18.0 kgf.m, 123.0-130.2 lb-ft)



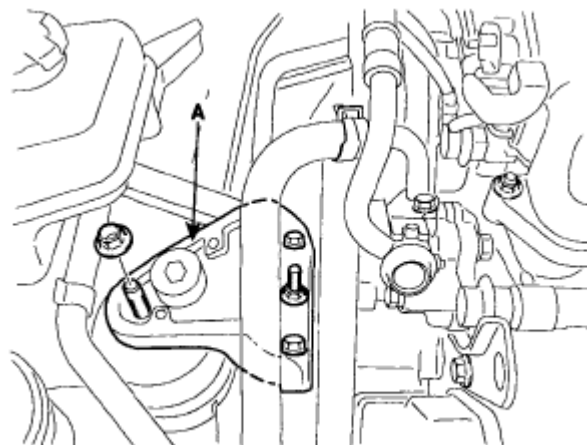
KCBF108A

Fig. 248: Identifying Crankshaft Damper Pulley
Courtesy of KIA MOTORS AMERICA, INC.

12. Install the engine mounting bracket (A).

Tightening torque

63.7-83.4 N.m (6.5-8.5 kgf.m, 47.0-61.5 lb-ft)



LDLG064A

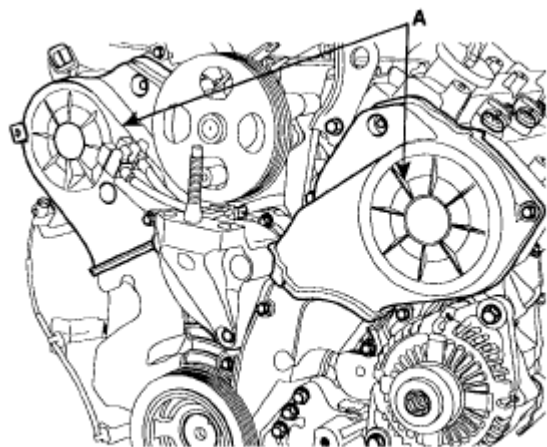
Fig. 249: Identifying Engine Mounting Bracket

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

9.8-11.8 N.m (1.0-1.2 kgf.m, 7.2-8.7 lb-ft)



KCBF106A

Fig. 250: Identifying Timing Belt Upper Cover
Courtesy of KIA MOTORS AMERICA, INC.

14. Install the drive belt tensioner (C).

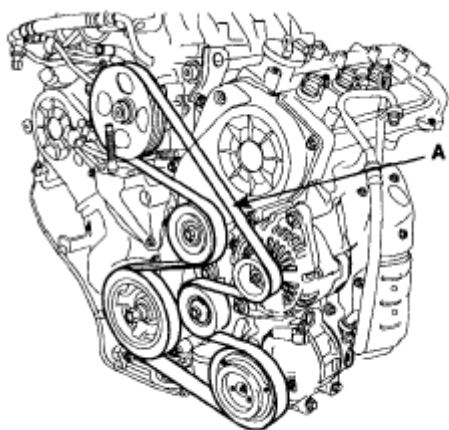
Tightening torque

34.3-53.9 N.m (3.5-5.5 kgf.m, 25.3-39.8 lb-ft)

15. Install the drive belt idler and the drive belt (A).

Tightening torque

34.3-53.9 N.m (3.5-5.5 kgf.m, 25.3-39.8 lb-ft)



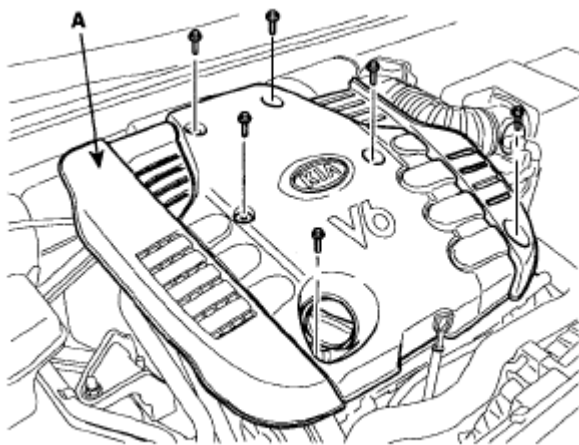
KCBF105A

Fig. 251: Identifying Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

16. Install the right side cover.
17. Install the front right wheel and tire.
18. Install the engine cover (A).

Tightening torque

7.8-11.8 N.m (0.8-1.2 kgf.m, 5.8-8.7 lb-ft)



LDLG002A

Fig. 252: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL

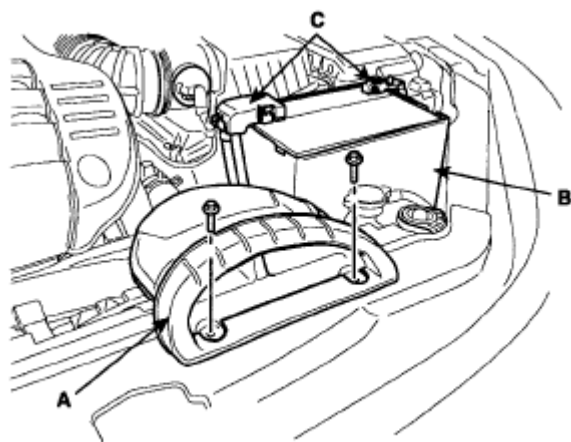
CAUTION:

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

NOTE:

- Mark all wiring and hoses to avoid misconnection.

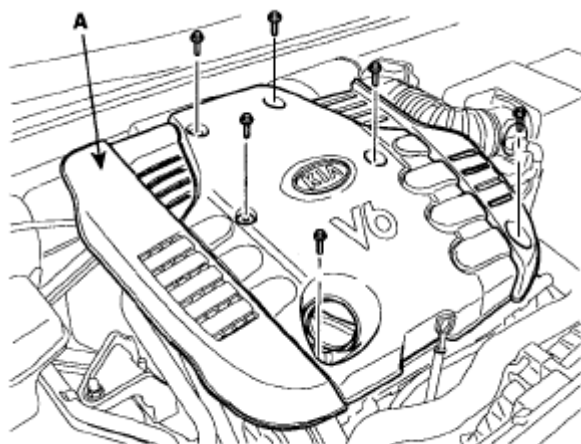
1. Remove the air duct (A) and the battery (B) after disconnecting the terminals (C) from the battery.



LDLG001A

Fig. 253: Identifying Air Duct, Battery And Terminals
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the engine cover (A).

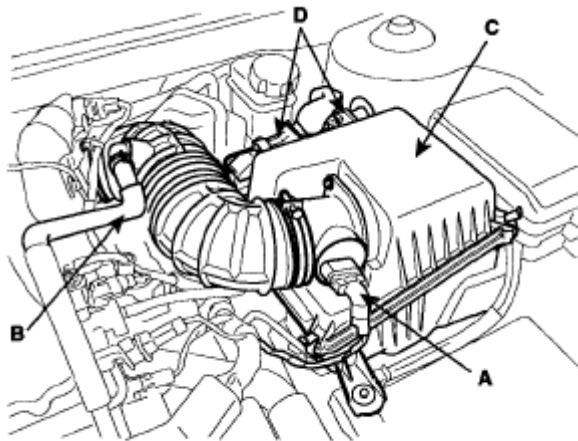


LDLG002A

Fig. 254: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the intake air hose and air cleaner assembly.

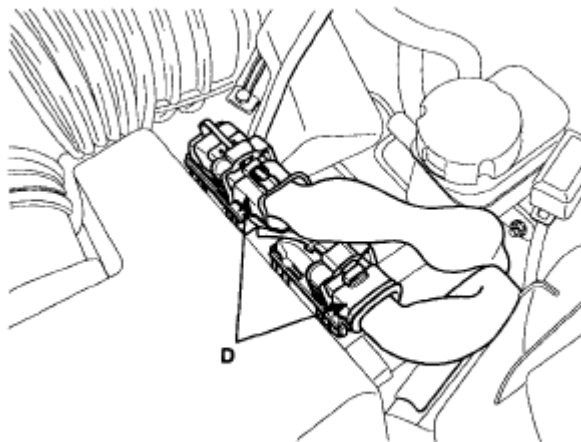
1. Disconnect the MAF connector (A).
2. Disconnect the breather hose (B) from air cleaner hose.
3. Remove the intake air hose and air cleaner assembly (C).
4. Disconnect the PCM connectors (D).



SMGM16013N

Fig. 255: Identifying Breather Hose, MAF Connector, Air Cleaner Assembly And PCM Connectors

Courtesy of KIA MOTORS AMERICA, INC.

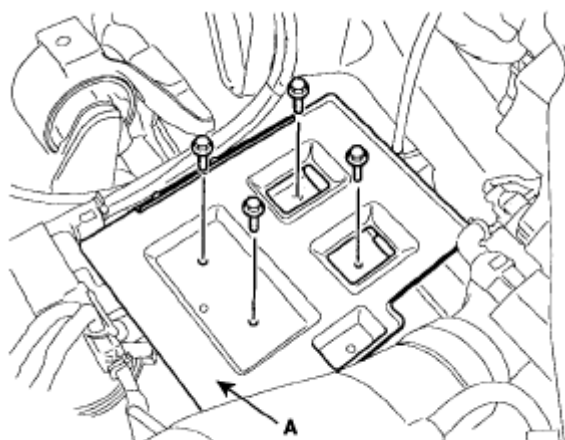


LDLG061A

Fig. 256: Identifying PCM Connectors

Courtesy of KIA MOTORS AMERICA, INC.

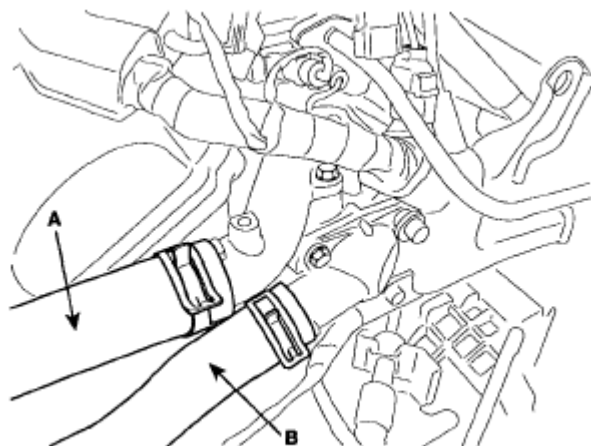
4. Remove the battery tray (A) while recovering refrigerant.



LDLG004A

Fig. 257: Identifying Battery Tray
Courtesy of KIA MOTORS AMERICA, INC.

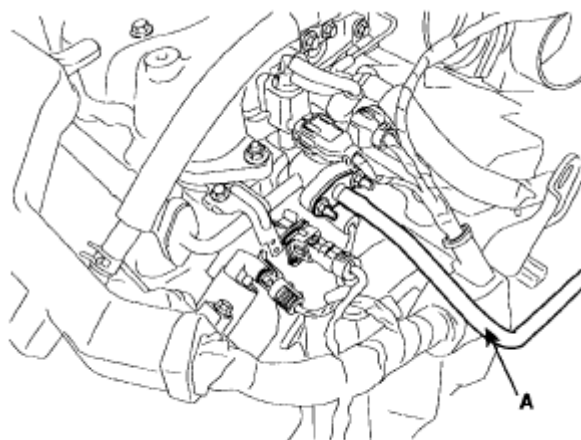
5. Remove the upper radiator hose (A) and lower radiator hose (B).



LDLG008A

Fig. 258: Identifying Radiator Upper And Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

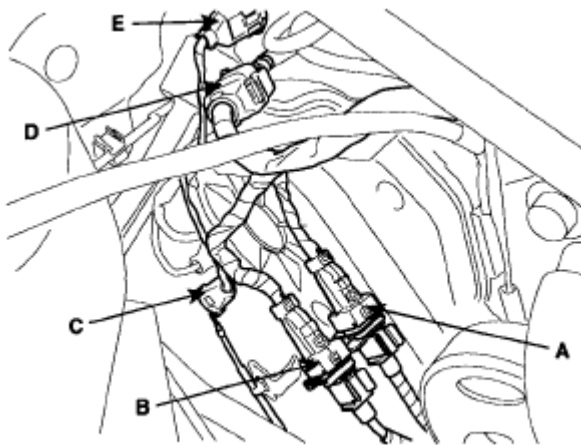
6. Remove the transaxle oil cooler hoses (A/T vehicles only).
7. Remove the fuel inlet hose (A) from the delivery pipe.



SMGM16031N

Fig. 259: Identifying Fuel Inlet Hose
Courtesy of KIA MOTORS AMERICA, INC.

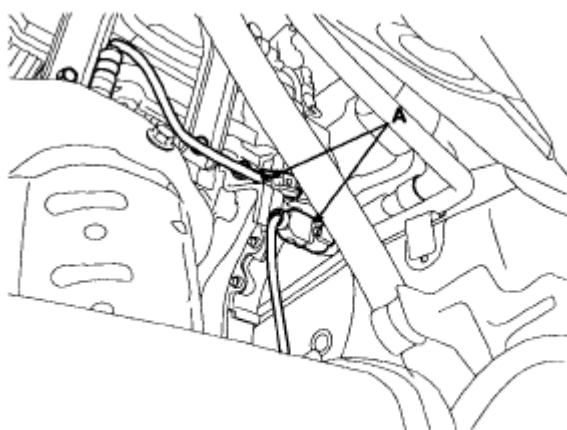
8. Disconnect the engine wiring harness connectors.
 1. Disconnect the No.1/No.2 knock sensor connectors (A, B), the oil pressure switch connector (C), the ignition coil harness (D) and the No.1 VIS (Variable Induction System) connector (E).



LDLG005A

Fig. 260: Identifying Engine Wiring Harness Connectors
Courtesy of KIA MOTORS AMERICA, INC.

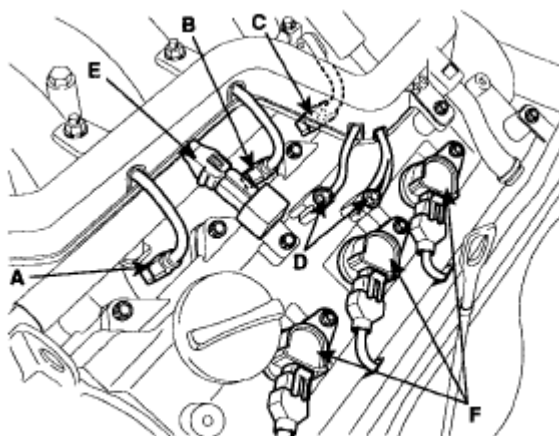
2. Disconnect the bank 1 front/rear O2 sensor connectors (A).



KCBF160A

Fig. 261: Identifying Bank Front/Rear O2 Sensor Connectors
Courtesy of KIA MOTORS AMERICA, INC.

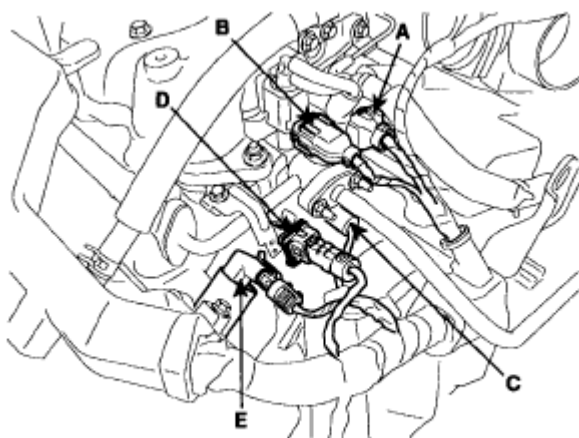
3. Disconnect the injection connectors (A, B, C), the ground lines (D), the condenser connector (E) and the Ignition coil connectors (F).



SMGM16014N

Fig. 262: Identifying Injection Connectors, Ground Lines, Condenser Connector And Ignition Coil Connectors
Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect the injection harness connector (A), the No.2 VIS (Variable Induction System) connector (B), the No.1/No.2 OCV (Oil Control Valve) connectors (C, D) and the OTS (Oil Temperature Sensor) connector (E).

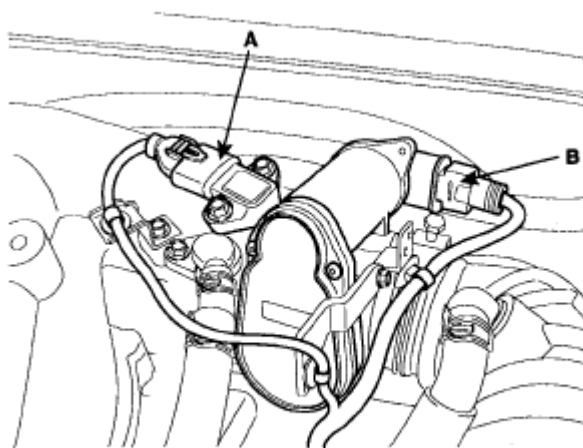


SMGM16015N

Fig. 263: Identifying Injection Harness Connector, VIS Connector, OCV Connectors And OTS Connector

Courtesy of KIA MOTORS AMERICA, INC.

5. Disconnect the MAPS (Manifold Absolute Pressure Sensor) connector (A), the ETC (Electronic Throttle Control) connector (B) and the PCSV (Purge Control Solenoid Valve) connector (C).



SMGM16016N

Fig. 264: Identifying MAPS Connector, ETC Connector And PCSV Connector

Courtesy of KIA MOTORS AMERICA, INC.

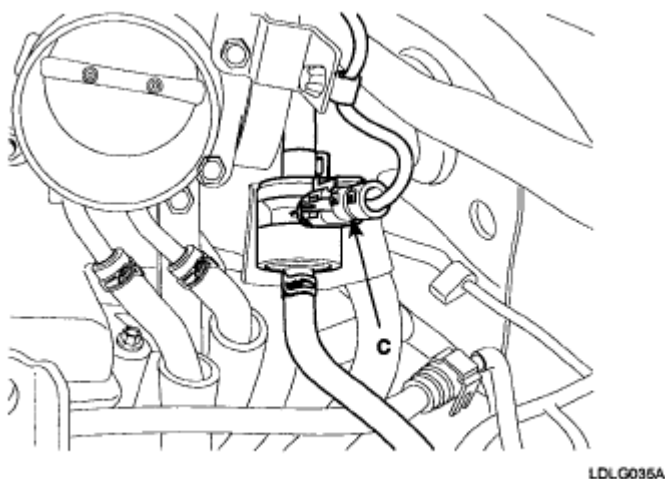


Fig. 265: Identifying PCSV Connector
Courtesy of KIA MOTORS AMERICA, INC.

6. Disconnect the generator connector (A) and the air conditioning compressor connector (B).

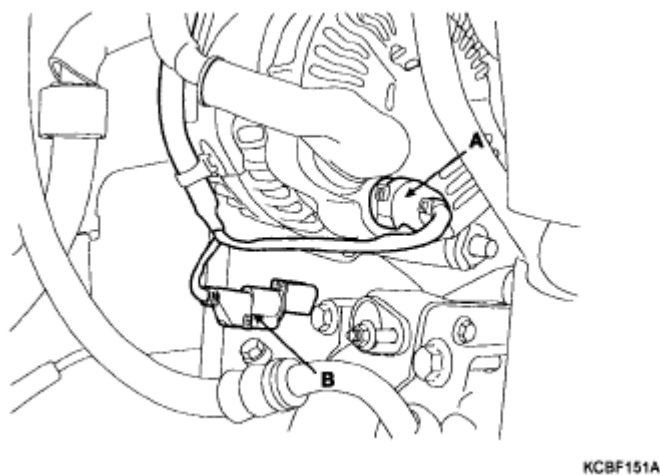
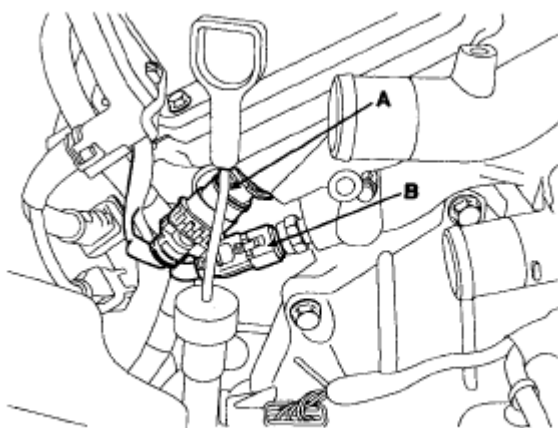


Fig. 266: Identifying Generator Connector And Air Conditioning Compressor Connector
Courtesy of KIA MOTORS AMERICA, INC.

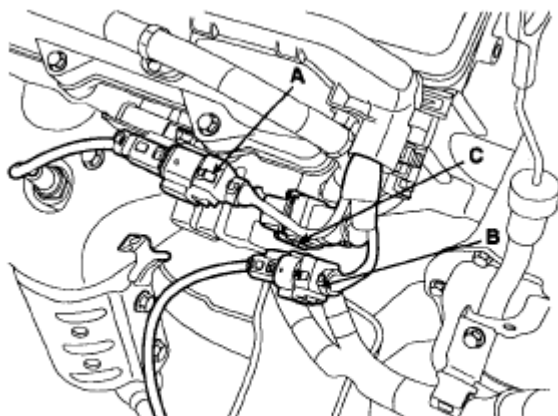
7. Disconnect the bank 2 CMP sensor connector (A) and the WTS (Water Temperature Sensor) connector (B).



KCBF155A

Fig. 267: Identifying CMP Sensor Connector And ECT Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

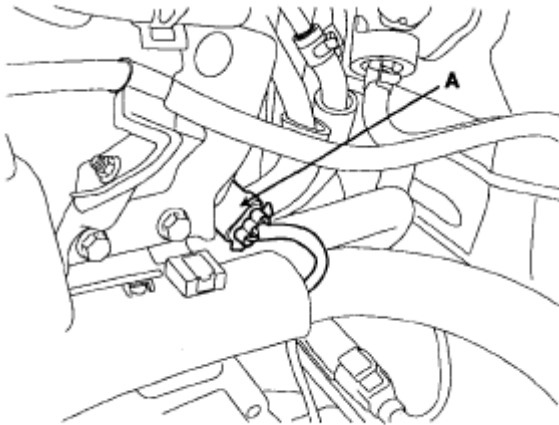
8. Disconnect the bank 2 front/rear O2 sensor connectors (A, B) and the CKP sensor connector (C).



KCBF154A

Fig. 268: Identifying Front/Rear O2 Sensor Connectors And CKP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

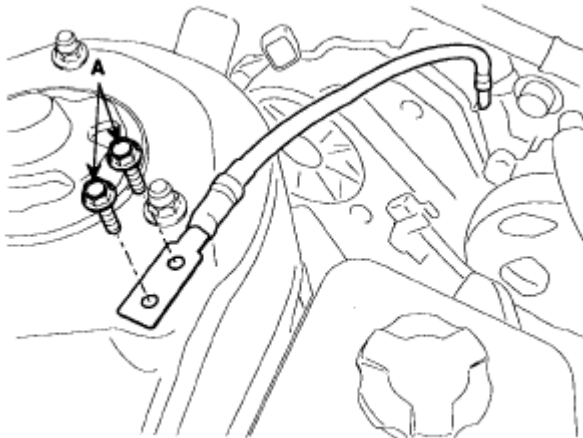
9. Disconnect the bank 1 CMP sensor connector (A).



KCBF152A

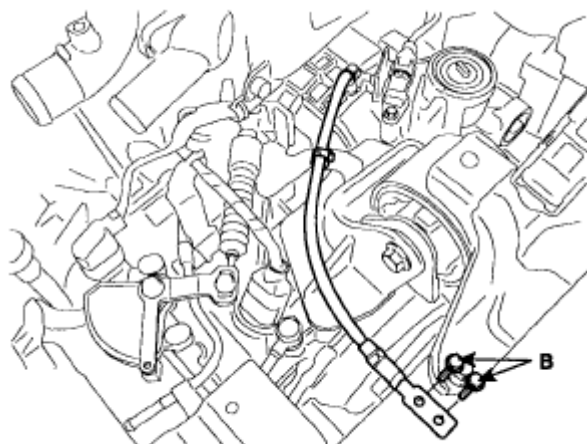
Fig. 269: Identifying CMP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

9. Disconnect ground lines (A, B) from the engine and the transaxle assembly.



LDLG009A

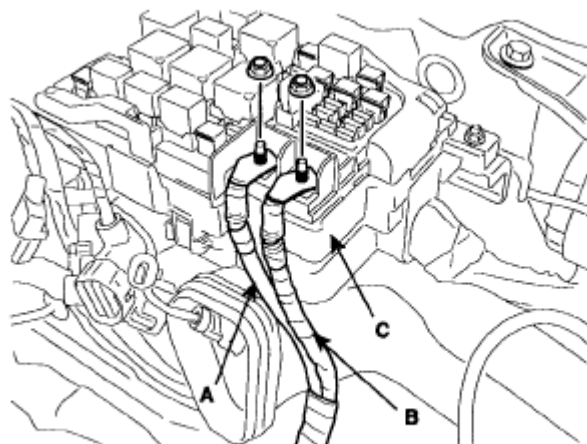
Fig. 270: Identifying Ground Lines (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.



LDLG010A

Fig. 271: Identifying Ground Lines (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

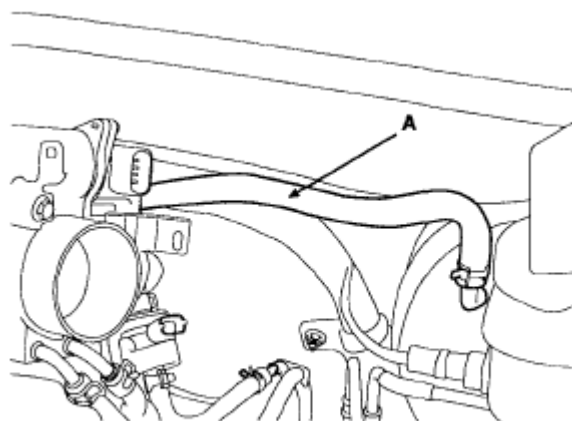
10. Disconnect the battery wirings (A, B) from the engine room fuse & relay box (C).



LDLG011A

Fig. 272: Identifying Battery Wirings
Courtesy of KIA MOTORS AMERICA, INC.

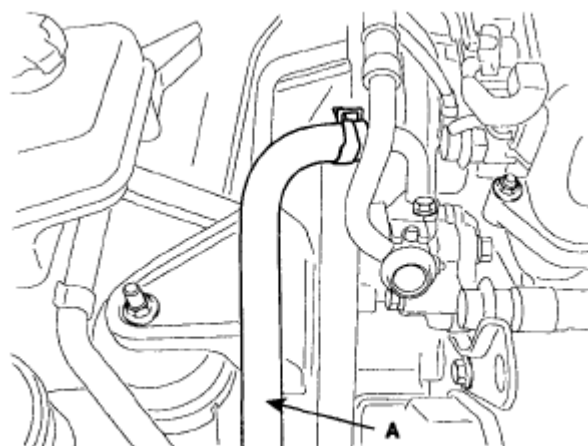
11. Remove the heater hoses.
12. Disconnect the brake vacuum hose (A).



LDLG038A

Fig. 273: Identifying Brake Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

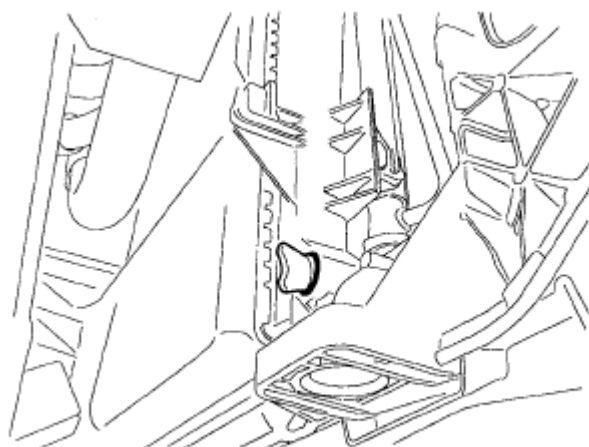
13. Disconnect the transaxle wiring harness connectors. (Refer to **TRANSAXLE SYSTEM (A/T)**).
14. After draining or gathering power steering fluid, disconnect the power steering hose (A).



LDLG012A

Fig. 274: Identifying Power Steering Hose
Courtesy of KIA MOTORS AMERICA, INC.

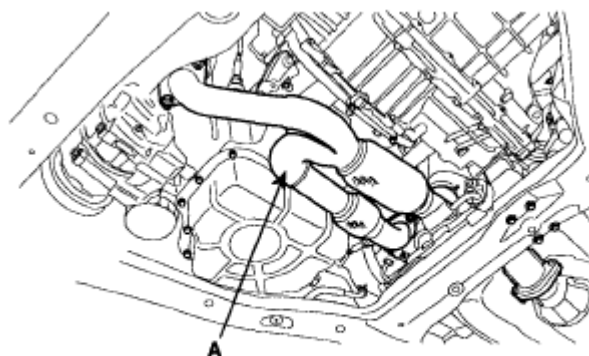
15. Remove the steering column shaft joint bolt. (Refer to **STEERING COLUMN AND SHAFT**).
16. Disconnect the air conditioning compressor hoses. (Refer to **AIR CONDITIONING SYSTEM**).
17. Remove the front wheels and tires. (Refer to **TIRES/WHEELS**).
18. Lifting the vehicle, remove the under cover.
19. Drain the engine coolant, engine oil and transaxle fluid. Remove the radiator cap to speed coolant draining.



LDLG007A

Fig. 275: Identifying Radiator Petcock
Courtesy of KIA MOTORS AMERICA, INC.

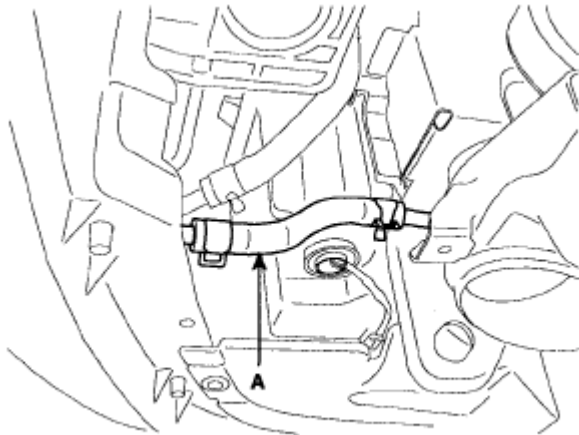
20. Remove the brake caliper. (Refer to **BRAKE SYSTEM**).
21. Disconnect the ABS connectors. (Refer to **ABS (ANTI-LOCK BRAKE SYSTEM)**).
22. Disconnect the stabilizer bar link from the struts. (Refer to **FRONT SUSPENSION SYSTEM**).
23. Remove the knuckles from the struts. (Refer to **FRONT SUSPENSION SYSTEM**).
24. Remove the front muffler (A).



LDLG068A

Fig. 276: Identifying Front Muffler
Courtesy of KIA MOTORS AMERICA, INC.

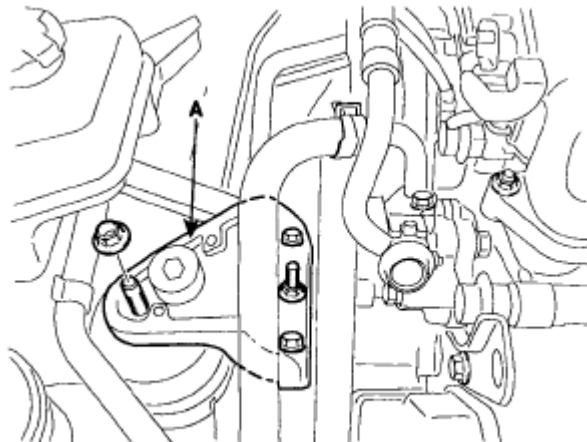
25. Disconnect the power steering return hose (A).



LDLG014A

Fig. 277: Identifying Power Steering Return Hose
Courtesy of KIA MOTORS AMERICA, INC.

26. Remove the engine mounting bracket (A).



LDLG064A

Fig. 278: Identifying Engine Mounting Bracket
Courtesy of KIA MOTORS AMERICA, INC.

27. Remove the transaxle mounting bracket (A).

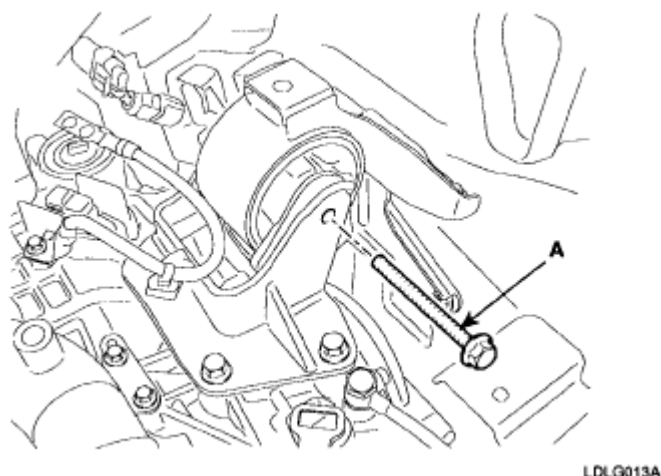


Fig. 279: Identifying Transaxle Mounting Bracket
Courtesy of KIA MOTORS AMERICA, INC.

28. Supporting the engine and transaxle assembly with a jack, remove the assembly from the vehicle by loosening the subframe mounting bolts and lifting up the vehicle slowly.

NOTE: When removing 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.
- Refill the engine with engine oil.
- Refill the transaxle with fluid.
- Refill the radiator with engine coolant.
- Bleed air from the cooling system with the heater valve open.
- Clean the battery posts and cable terminals with "sandpaper" "assemble" them, then apply grease to prevent corrosion.
- Inspect for fuel leakage.

After assembling 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 lines.