

2009 Kia Sedona

2009 ENGINE Mechanical - Sedona

2009 ENGINE**Mechanical - Sedona****GENERAL****SPECIFICATION**

Description			Specifications	Limit
General				
Type			V-type, DOHC	
Number of cylinders			6	
Bore			96 mm (3.7795 in.)	
Stroke			87.0 mm (3.4252 in.)	
Total displacement			3.778 cc (230.55 cu. in.)	
Compression ratio			10.4	
Firing order			1-2-3-4-5-6	
Valve timing				
Intake	Opens (ATDC)		10°	
	Closes (ABDC)		62°	
Exhaust	Opens (BBDC)		42°	
	Closes (ATDC)		6°	
Cylinder head				
Flatness of gasket surface			Less than 0.05 mm (0.0019 in.) [Less than 0.02 mm (0.0008 in.) / 150x150]	
Flatness of manifold mounting	Intake		Less than 0.1 mm (0.0039 in.) [Less than 0.03 mm (0.001 in.)/110x110]	
	Exhaust		Less than 0.1 mm (0.0039 in.) [Less than 0.03 mm (0.001 in.)/110x110]	
Camshaft				
Cam height	LH Camshaft	Intake	46.8 mm (1.8425 in.)	
		Exhaust	45.8 mm (1.8031 in.)	
	RH Camshaft	Intake	46.8 mm (1.8425 in.)	
		Exhaust	45.8 mm (1.8031 in.)	
Journal outer diameter	LH, RH camshaft	Intake	No. 1: 27.964-27.980 mm (1.1009-1.1016 in.) No .2,3,4: 23.954-23.970 mm (0.9430-0.9437 in.)	
		Exhaust	No. 1: 27.964-27.980 mm (1.1009-1.1016 in.)	

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			No. 2,3,4: 23.954-23.970 mm (0.9430-0.9437 in.)	
Bearing oil clearance	LH, RH camshaft	Intake	No. 1: 0.020-0.057 mm (0.0008-0.0022 in.) No. 2,3,4: 0.030-0.067 mm (0.0012-0.0026 in.)	
		Exhaust	No. 1: 0.020-0.057 mm (0.0008-0.0022 in.) No. 2,3,4: 0.030-0.067 mm (0.0012-0.0026 in.)	
End play			0.02-0.18 mm (0.0008-0.0071 in.)	
Valve				
Valve length	Intake		105.27 mm (4.1445 in.)	
	Exhaust		105.50 mm (4.1535 in.)	
Stem outer diameter	Intake		5.465-5.480 mm (0.2151-0.2157 in.)	
	Exhaust		5.458-5.470 mm (0.2149-0.2153 in.)	
Face angle			45.25°-45.75°	
Thickness of valve head (margin.)	Intake		1.56-1.86 mm (0.06142-0.07323 in.)	
	Exhaust		1.73-2.03 mm (0.06811-0.07992 in.)	
Valve stem to valve guide clearance	Intake		0.020-0.047 mm (0.00078-0.00185 in.)	0.07 mm (0.00275 in.)
	Exhaust		0.030-0.054 mm (0.00118-0.00212 in.)	0.09 mm (0.00354 in.)
Valve guide				
Inner diameter	Intake		5.500-5.512 mm (0.2165-0.2170 in.)	
	Exhaust		5.500-5.512 mm (0.2165-0.2170 in.)	
Length	Intake		41.8-42.2 mm (1.6457-1.6614 in.)	
	Exhaust		41.8-42.2 mm (1.6457-1.6614 in.)	
Valve seat				
Width of seat contact	Intake		1.15-1.45 mm (0.05118-0.05709 in.)	
	Exhaust		1.35-1.65 mm (0.05315-0.06496 in.)	
Seat angle	Intake		44.75°-45.20°	
	Exhaust		44.75°-45.20°	
Valve spring				
Free length			43.86 mm (1.7267 in.)	
Load			19.3±0.8 kg/34.0 mm (42.7±1.8	

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		lb/1.3386 in.)	
		42.3±1.3 kg/24.2 mm (93.3±2.9 lb/0.9527 in.)	
Out of squareness		Less than 1.5°	
MLA			
MLA outer diameter	Intake	34.964-34.980 mm (1.3765-1.3772 in.)	
	Exhaust	34.964-34.980 mm (1.3765-1.3772 in.)	
Cylinder head tappet bore inner diameter	Intake	35.000-35.025 mm (1.3779-1.3789 in.)	
	Exhaust	35.000-35.025 mm (1.3779-1.3789 in.)	
MLA to tappet bore clearance	Intake	0.020-0.061 mm (0.0008-0.0024 in.)	0.07 mm (0.0027 in.)
	Exhaust	0.020-0.061 mm (0.0008-0.0024 in.)	0.07 mm (0.0027 in.)
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		96.00-96.03 mm (3.7795-3.7807 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		95.96-95.99 mm (3.7779-3.7791 in.)	
Piston to cylinder clearance		0.03-0.05 mm (0.0012-0.0020 in.)	
Ring groove width	No. 1 ring groove	1.22-1.24 mm (0.0480-0.0488 in.)	1.26 mm (0.0496 in.)
	No. 2 ring groove	1.22-1.24 mm (0.0480-0.0488 in.)	1.26 mm (0.0496 in.)
	Oil ring groove	2.01-2.03 mm (0.0791-0.0799 in.)	2.05 mm (0.0807 in.)
Piston ring			
Side clearance	No. 1 ring	0.03-0.07 mm (0.0012-0.0027 in.)	0.1 mm (0.004 in.)
	No. 2 ring	0.03-0.07 mm (0.0012-0.0027 in.)	0.1 mm (0.004 in.)
	Oil ring	0.06-0.15 mm (0.0024-0.0059 in.)	0.2 mm (0.008 in.)
End gap	No. 1 ring	0.17-0.32 mm (0.0067-0.0126 in.)	0.6 mm (0.0236 in.)

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	No. 2 ring	0.32-0.47 mm (0.0126-0.0185 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 pin			
Piston pin outer diameter		23.001-23.006 mm (0.9055-0.9057 in.)	
Piston pin hole inner diameter		23.016-23.021 mm (0.9061-0.9063 in.)	
Piston pin hole clearance		0.01-0.02 mm (0.0039-0.0078 in.)	
Connecting rod small end inner diameter		22.974-22.985 mm (0.9045-0.9049 in.)	
Connecting rod small end hole clearance		-0.032--0.016 mm (-0.0012-0.0006 in.)	
Connecting rod			
Connecting rod big end inner diameter		58.000-58.018 mm (2.2834-2.2842 in.)	
Connecting rod bearing oil clearance		0.038-0.056 mm (0.0015-0.0022 in.)	
Side clearance		0.1-0.25 mm (0.0039-0.0098 in.)	
Crankshaft			
Main journal outer diameter		68.942-68.960 mm (2.7142-2.7149 in.)	
Pin journal outer diameter		54.954-54.972 mm (2.1635-2.1642 in.)	
Main bearing oil clearance		0.022-0.040 mm (0.0008-0.0016 in.)	
End play		0.10-0.28 mm (0.0039-0.0110 in.)	
Oil pump			
Relief valve opening pressure		450-550 kPa (4.59-5.61 kgf/cm ² , 65.28-79.79 psi)	
Engine oil			
Oil quantity (Total)		6.0L (6.34 U.S.qts, 5.27 Imp.qts)	
Oil quantity (Oil pan)		5.5L (5.81 U.S.qts, 4.83 Imp.qts)	
Oil quantity (Drain and refill including oil filter)		5.2L (5.49 U.S.qts, 4.57 Imp.qts)	
Oil quality		Above API, SJ / SL or SAE 5W-20	
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		8.6L (9.09 U.S.qts, 7.57 Imp.qts)	
Thermostat	Type	Wax pellet type	
	Opening temperature	82±2°C (179.6±35.6°F)	

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Radiator cap	Fully opened temperature	95°C (203°F)	
	Full lift	10 mm (0.3937 in.)	
	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)	
Water 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
Crankshaft pulley bolt	1	284.2-303.8	29.0-31.0	209.76-224.22
Timing chain cover bolt B	17	18.62-21.56	1.9-2.2	13.74-15.91
Timing chain cover bolt C	4	9.80-11.76	1.0-1.2	7.23-8.68
Timing chain cover bolt D	1	58.80-68.80	6.0-7.0	43.40-50.63
Timing chain cover bolt E	1	58.80-68.80	6.0-7.0	43.40-50.63
Timing chain cover bolt F	2	24.50-26.46	2.5-2.7	18.08-19.53
Timing chain cover bolt G	4	21.56-23.52	2.2-2.4	15.91-17.36
Timing chain cover bolt H	1	9.80-11.76	1.0-1.2	7.23-8.68
Timing chain cover bolt I	1	9.80-11.76	1.0-1.2	7.23-8.68
Timing chain cover bolt J	1	9.80-11.76	1.0-1.2	7.23-8.68
Cam to cam guide bolt	4	9.80-11.76	1.0-1.2	7.23-8.68
Timing chain auto tensioner bolt	2	9.80-11.76	1.0-1.2	7.23-8.68
Timing chain auto tensioner nut	2	9.80-11.76	1.0-1.2	7.23-8.68
Timing chain guide bolt	4	19.60-24.50	2.0-2.5	14.17-18.08
Oil pump chain cover bolt	3	9.80-11.76	1.0-1.2	7.23-8.68
Oil pump chain tensioner bolt	1	9.80-11.76	1.0-1.2	7.23-8.68
Oil pump chain guide bolt	2	9.80-11.76	1.0-1.2	7.23-8.68
Oil pump chain sprocket bolt	1	18.62-21.56	1.9-2.2	13.74-15.91
Lower oil pan bolt	13	9.80-11.76	1.0-1.2	7.23-8.68
Drive belt auto tensioner bolt (M12)	1	96.04-99.96	9.8-10.2	70.88-73.78
Drive belt auto tensioner bolt (M8)	1	17.64-21.56	1.8-2.2	13.02-15.91
Drive belt idler bolt	1	53.90-57.82	5.5-5.9	39.78-42.67
OCV (oil control valve) bolt	2	9.80-11.76	1.0-1.2	7.23-8.68
Cylinder head bolt	16	37.3-41.2 + 118-122° + 88-92°	3.8-41.2 + 118-122° + 88-92°	27.5-30.4 + 118-122° + 88-92°

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Cylinder head bolt	1	18.62-23.52	1.9-2.4	13.74-17.36
CVVT & exhaust cam sprocket bolt	4	64.68-76.44	6.6-7.8	47.74-56.42
Camshaft bearing cap bolt	32	9.80-11.76	1.0-1.2	7.23-8.68
Cylinder head cover bolt	38	9.80-11.76	1.0-1.2	7.23-8.68
Connecting rod bearing bolt	12	17.7-21.6 + 88-92°	1.8-2.2 + 88-92°	13.0-15.9 + 88-02°
Main bearing cap inner bolt (M11)	8	49.00 + 90°	5.0 + 90°	36.16 + 90°
Main bearing cap outer bolt (M8)	8	19.60 + 120°	2.0 + 120°	14.46 + 120°
Main bearing cap side bolt (M8)	6	29.40-31.36	3.0-3.2	21.70-23.14
Oil drain cover bolt	6	9.80-11.76	1.0-1.2	7.23-8.68
Rear oil seal case bolt	6	9.80-11.76	1.0-1.2	7.23-8.68
Baffle plate bolt	12	9.80-11.76	1.0-1.2	7.23-8.68
Upper oil pan bolt	16	9.80-11.76	1.0-1.2	7.23-8.68
Knock sensor bolt	2	15.68-23.52	1.6-2.4	11.57-17.36
Drive plate bolt	8	71.54-75.46	7.3-7.7	52.80-55.69
Oil filter cap		24.50	2.5	18.08
Oil drain bolt cap	1	34.30-44.10	3.5-4.5	25.31-32.55
Oil pump bolt	3	19.6-23.5	2.0-2.4	14.5-17.4
Oil filter body bolt	10	9.80-11.76	1.0-1.2	7.23-8.68
Oil filter body cover bolt	11	9.80-11.76	1.0-1.2	7.23-8.68
Water vent hose bolt (Timing chain cover bolt L)	2	9.80-11.76	1.0-1.2	7.23-8.68
Water pump bolt (Timing chain cover bolt K)	1	21.56-26.46	2.2-2.7	15.91-19.53
Water pump bolt	4	9.80-11.76	1.0-1.2	7.23-8.68
Water pump pulley bolt	4	7.84-9.80	0.8-1.0	5.78-7.23
Water temp, control nut	4	18.62-23.52	1.9-2.4	13.74-17.36
Water temp, control bolt	2	18.62-23.52	1.9-2.4	13.74-17.36
Water inlet pipe bolt	3	16.66-19.60	1.7-2.0	12.30-14.47
Air vent pipe bolt	2	9.80-11.76	1.0-1.2	7.23-8.68
Intake manifold bolt	6	18.62-23.52	1.9-2.4	13.74-17.36
Intake manifold nut	2	18.62-23.52	1.9-2.4	13.74-17.36
Surge tank bolt (M8 x 25)	3	18.62-23.52	1.9-2.4	13.74-17.36
Surge tank bolt (M6 x 106)	2	9.80-11.76	1.0-1.2	7.23-8.68
Surge tank nut	1	18.62-23.52	1.9-2.4	13.74-17.36
Breather pipe bolt	2	9.80-11.76	1.0-1.2	7.23-8.68
Surge tank bracket bolt rear (M10 x 18)	2	27.44-31.36	2.8-3.2	20.25-23.14
Surge tank bracket bolt front (M8 x 16)	2	18.62-23.52	1.9-2.4	13.74-17.36
ETC bracket bolt	2	15.68-25.48	1.6-2.6	11.57-18.80
Exhaust manifold nut	16	39.20-44.10	4.0-4.5	28.93-32.55

Heat protector bolt	8	3.9-5.9	0.4-0.6	2.89-4.34
Front muffler	2	39.20-58.80	4.0-6.0	28.93-43.40

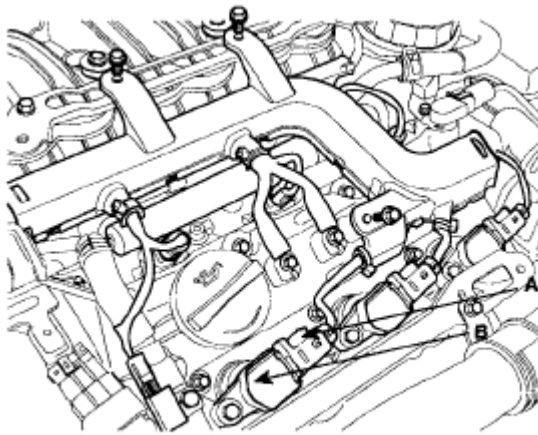
COMPRESSION

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

1. Warm up and stop engine.

Allow the engine to warm up to normal operating temperature.

2. Remove the surge tank. Refer to **INTAKE MANIFOLD**.
3. Remove the ignition coil connectors (A) and ignition coils (B).



KDRF158B

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

4. Remove the spark plugs.

Using a 16 mm plug wrench, remove the 6 spark plugs.

5. Check cylinder compression pressure.
 1. Insert a compression gauge into the spark plug hole.
 2. Fully open the throttle.
 3. After 7 times of cranking the engine, measure the compression pressure.

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

4. Repeat steps (1) through (3) for each cylinder.

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

Compression pressure:

1,225 kPa (12.5 kgf/cm² , 177 psi) - 200-250 RPM

Minimum pressure:

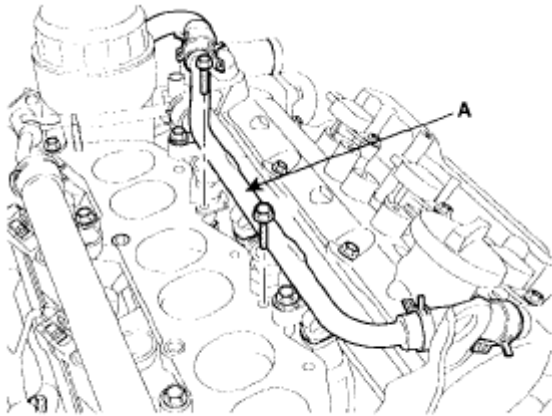
1,078 kPa (11.0 kgf/cm² , 156 psi)

5. If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (1) through (3) for cylinders with low compression.
 - If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
 - If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.
6. Reinstall the spark plugs.
7. Install the ignition coil and ignition coil connectors.
8. Install the surge tank. Refer to **INTAKE MANIFOLD**.

VALVE CLEARANCE INSPECTION AND ADJUSTMENT

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

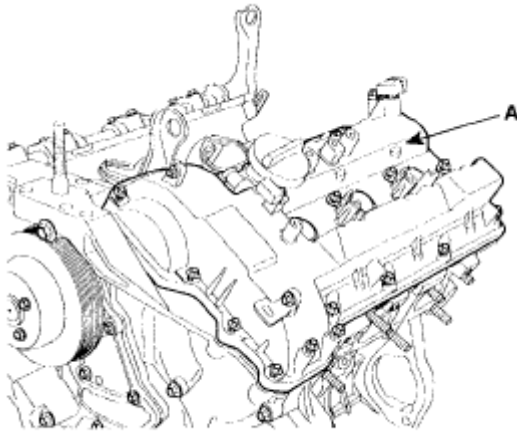
1. Remove the engine cover.
2. Remove air cleaner assembly. Refer to **REMOVAL**.
3. Remove the surge tank. Refer to **INTAKE MANIFOLD**.
4. Remove the cylinder head cover.
 1. Disconnect the ignition coil connector and remove the ignition coil.
 2. Disconnect the breather pipe assembly (A) from the cylinder head cover.



ECBF031A

Fig. 2: Locating Breather Pipe Assembly
Courtesy of KIA MOTORS AMERICA, INC.

3. Loosen the cylinder head cover bolts and then remove the cover (A) and gasket.



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Fig. 3: Locating Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

5. Set No. 1 cylinder to TDC/compression.
 1. Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing chain cover.

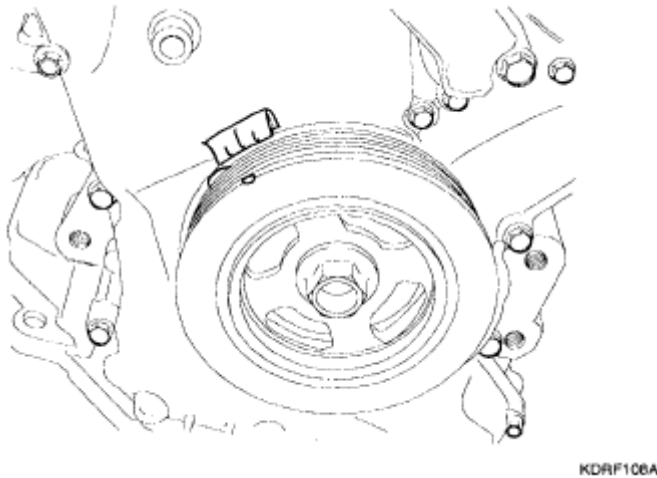


Fig. 4: Aligning Crankshaft Pulley With Timing Mark Of Lower Timing Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

2. Check that the mark (A) of the camshaft timing sprockets are in straight line on the cylinder head surface as shown in **Fig. 5**.

If not, turn the crankshaft one revolution (360°)

NOTE: Do not rotate engine counterclockwise

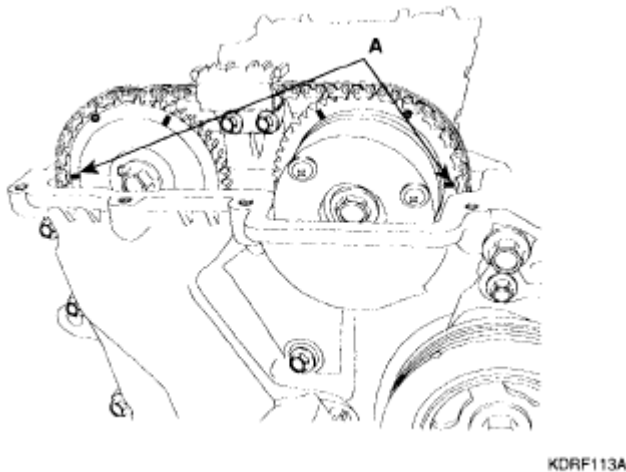


Fig. 5: Locating Marks Of Camshaft Timing Sprockets
Courtesy of KIA MOTORS AMERICA, INC.

6. Inspect the valve clearance.
 1. Check only the valve indicated as shown in **Fig. 6**. [No. 1 cylinder: TDC/Compression] measure the valve clearance.

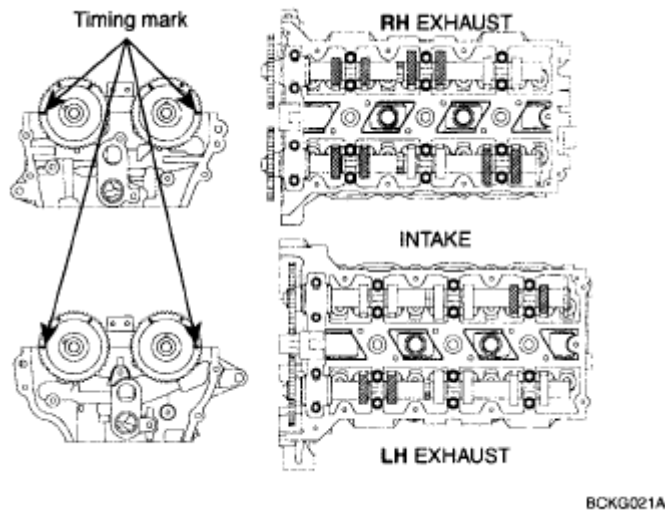


Fig. 6: Identifying Valves To Check
Courtesy of KIA MOTORS AMERICA, INC.

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 replacement adjusting tappet.

Valve clearance

Specification

Engine coolant temperature: 20°C [68°F]

Limit

Intake: 0.10-0.30 mm (0.0039-0.0118 in.)

Exhaust: 0.20-0.40 mm (0.0079-0.0157 in.)

2. Turn the crankshaft pulley one revolution (360°) and align the groove with timing mark "T" of the lower timing chain cover.

NOTE: Do not rotate engine counterclockwise

3. Check only valves indicated as shown in **Fig. 7**. [No. 4 cylinder: TDC/compression]. Measure the valve clearance. See Measurement method.

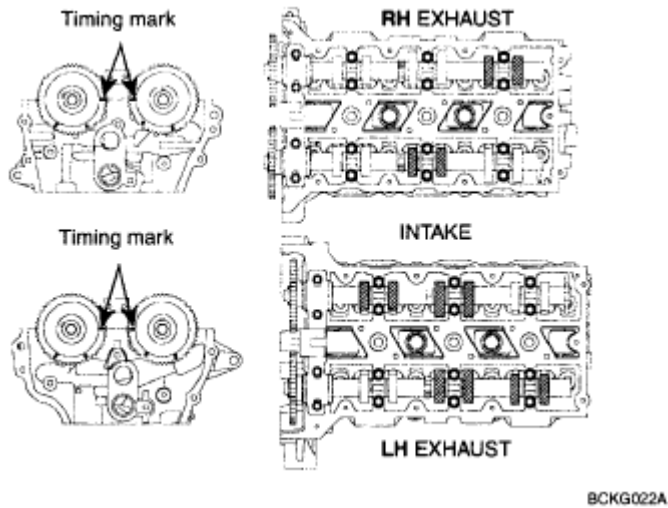


Fig. 7: Identifying Valves To Check
Courtesy of KIA MOTORS AMERICA, INC.

7. Adjust the intake and exhaust valve clearance.
 1. Set the No. 1 cylinder to the TDC/compression. Refer to step 5.
 2. Remove the timing chain. Refer to **REMOVAL**.

NOTE: Before removing the timing chain, mark the RH/LH timing chain with an identification based on the location of the sprocket because the identification mark on the chain for TDC (Top Dead Center) can be erased.

3. Remove the camshaft bearing caps (A).

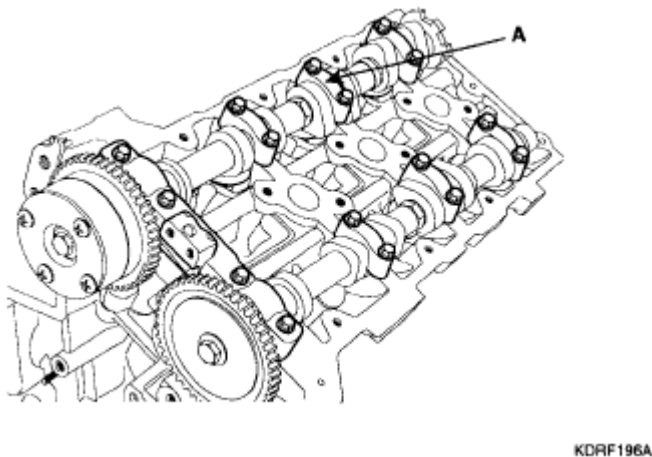
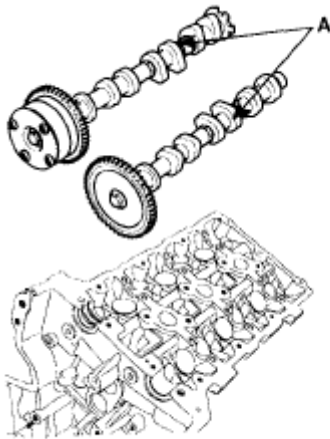


Fig. 8: Locating Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

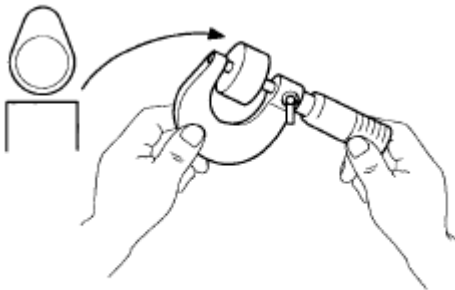
4. Remove the camshaft assembly (A).



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Fig. 9: Identifying Camshaft Assemblies
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove MLAs.
6. Measure the thickness of the removed tappet using a micrometer.



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Fig. 10: 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.

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

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: Shims are available in 41 size increments of 0.015 mm (0.0006 in.) from 3.00 mm (0.1 in.) to 3.600 mm (0.1417 in.)

9. Place a new tappet on the cylinder head.

NOTE: Applying engine oil at the selected tappet on the periphery and top surface.

10. Install the intake and exhaust camshaft. Refer to INSTALLATION.
11. Install the bearing caps. Refer to INSTALLATION.
12. Install the timing chain. Refer to REASSEMBLY.
13. Turn the crankshaft two turns in the operating direction (clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks (A).

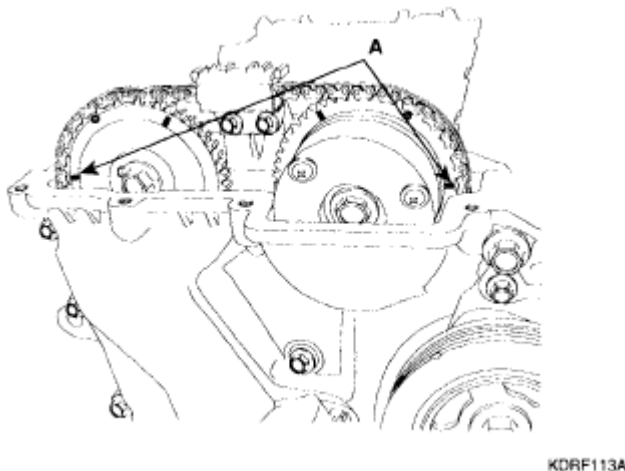


Fig. 11: Locating Marks Of Camshaft Timing Sprockets
Courtesy of KIA MOTORS AMERICA, INC.

14. Recheck the valve clearance.

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

[Specification]

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

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

TROUBLESHOOTING

2009 Kia Sedona

2009 ENGINE Mechanical - Sedona

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings. Loose or improperly installed 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.
Engine misfire with coolant consumption.	- Malfunctioning cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system. - Coolant consumption may or may not cause the engine to overheat.	- Inspect the cylinder head and engine block for damage to the coolant passages and/or a malfunctioning 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,

2009 Kia Sedona

2009 ENGINE Mechanical - Sedona

		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.
Lower engine noise, regard-less of engine speed.	Low oil pressure.	Repair or 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. • 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

2009 Kia Sedona

2009 ENGINE Mechanical - Sedona

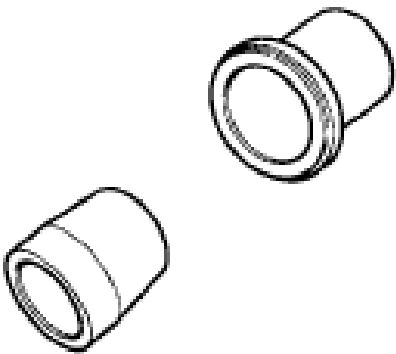
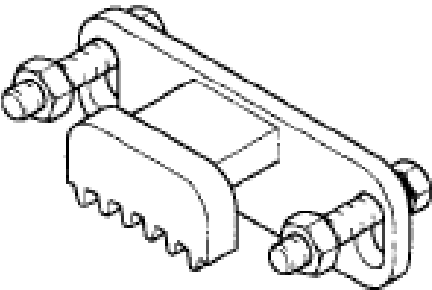
		repair as required. • The crankshaft bearings. • The crankshaft main journals. • The cylinder block.
Engine will not crank-crankshaft will not rotate.	Hydraulically locked cylinder. • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder.	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain and/or timing chain gears.	1. Inspect timing chain and gears. 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 TOOLS

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09231-3C100)		Installation of the front oil seal

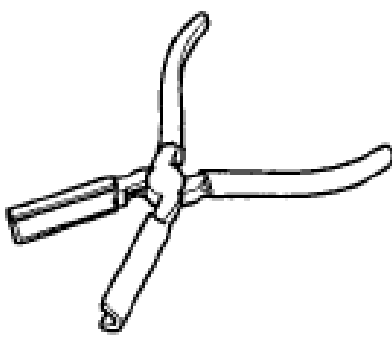
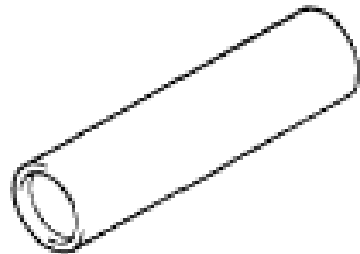
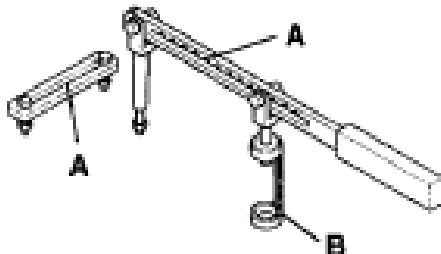
2009 Kia Sedona

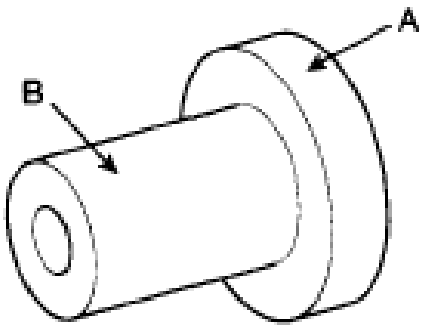
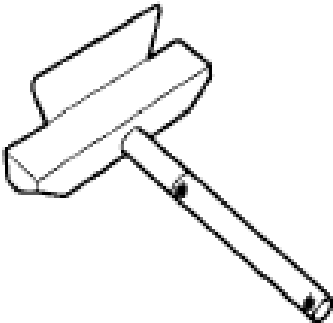
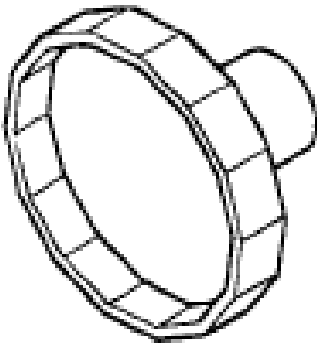
2009 ENGINE Mechanical - Sedona

	 KDRF233A	
Flywheel stopper (09231-3C300)	 KCRF030D	Removal and installation of the flywheel and crankshaft pulley.
Torque angle adapter (09221-4A000)	 LGAC030A	Installation of bolts & nuts needing an angular method
Valve stem seal remover (09222-29000)		Remover of the valve stem seal

2009 Kia Sedona

2009 ENGINE Mechanical - Sedona

	 KDRF232A	
Valve stem seal remover (09222-3C100)	 LCAC0300	Installation of the valve stem seal
Valve spring compressor & holder (09222-3K000) (09222-3C300)	 ECRF003A	Removal and installation of the intake or exhaust valve A: 09222-3K000 B: 09222-3C300 (holder)
Crankshaft rear oil seal installer (09231-3C200) (09231-H1100)		Installation of the crankshaft rear oil seal A: 09231-3C200 B: 09231-H1100

	 ACRF003A	
Oil pan remover (09215-3C000)	 KDRF219A	Removal of oil pan
Oil filter wrench (09263-3C100)	 B6327000	Removal and installation of the oil filter housing cover

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 engine cover (A).

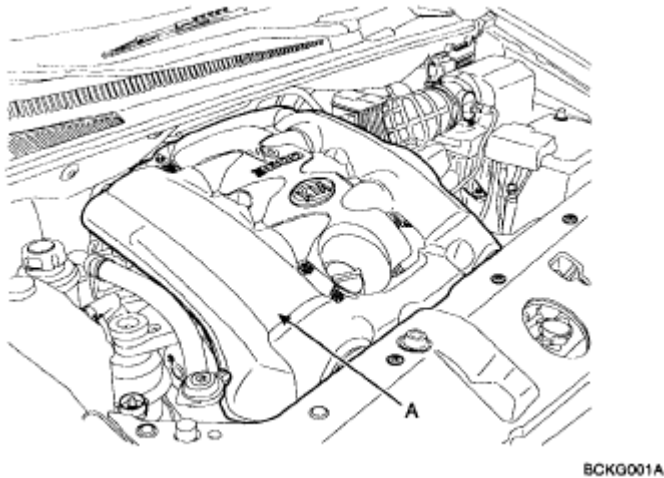


Fig. 12: Locating Engine Cover

Courtesy of KIA MOTORS AMERICA, INC.

2. Recover refrigerant, opening the high & low pressure pipe caps and connecting the refrigerant station. Refer to **AIR CONDITIONING SYSTEM**.
3. Disconnect the negative terminal from the battery and remove the battery (A).

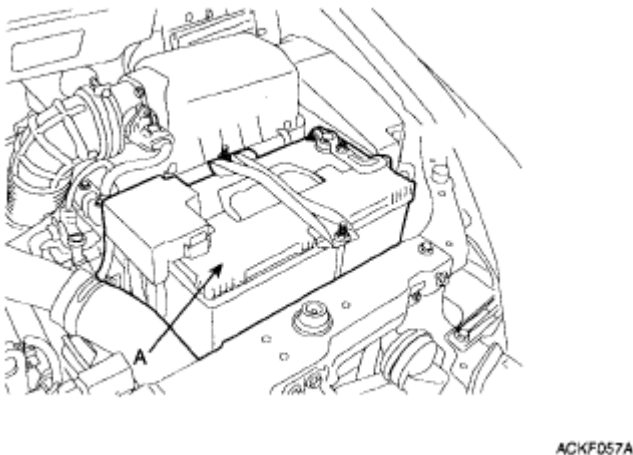
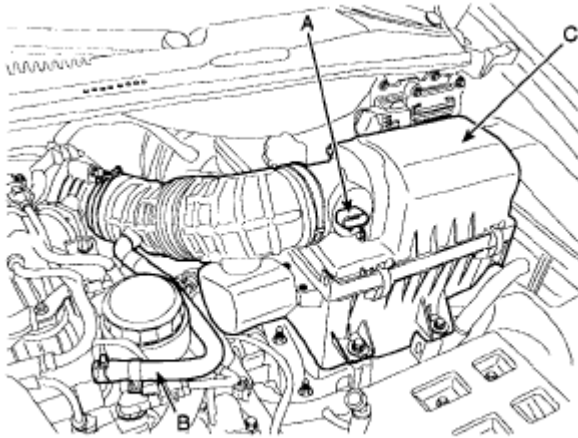


Fig. 13: Locating Battery

Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the intake air hose and air cleaner assembly.
 1. Disconnect the MAF connector (A).

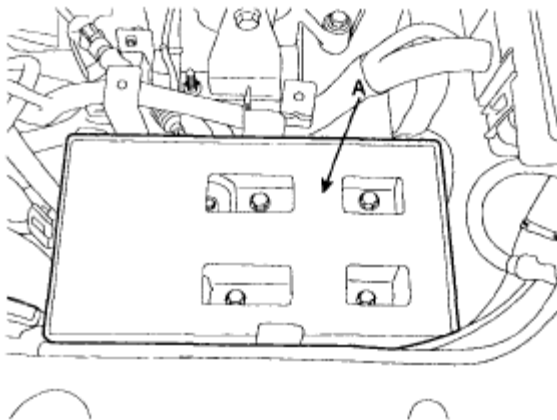
2. Disconnect the breather hose (B) from air cleaner hose.
3. Remove the intake air hose and air cleaner assembly (C).



BCKG002A

Fig. 14: Locating MAF Connector, Breather Hose And Air Cleaner Assembly
Courtesy of KIA MOTORS AMERICA, INC.

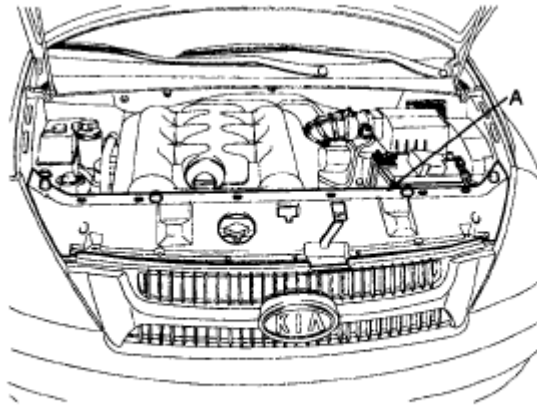
5. Remove the battery tray (A).



ACKF065A

Fig. 15: Locating Battery Tray
Courtesy of KIA MOTORS AMERICA, INC.

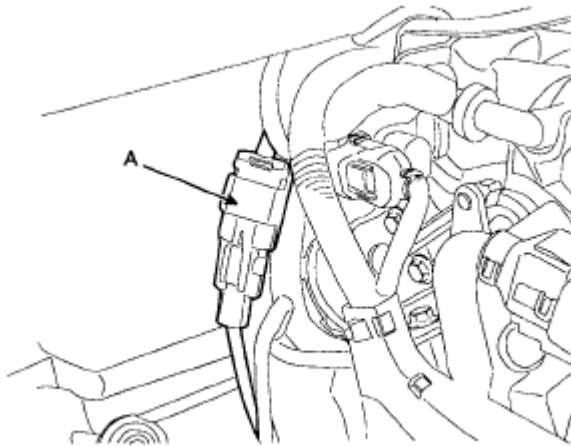
6. Remove the radiator grille upper cover (A).



ACKF043A

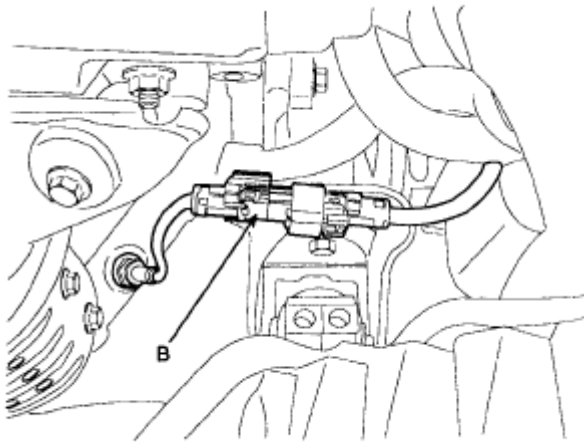
Fig. 16: Locating Radiator Grille Upper Cover
Courtesy of KIA MOTORS AMERICA, INC.

7. Disconnect the RH and LH oxygen sensor connectors (A, B).



BCKG008A

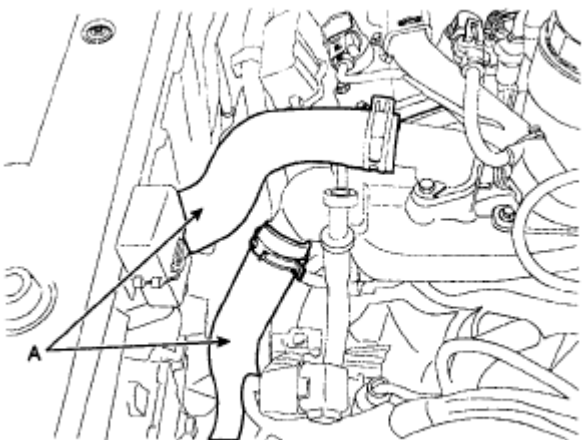
Fig. 17: Locating RH Oxygen Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.



BCKG007A

Fig. 18: Locating LH Oxygen Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

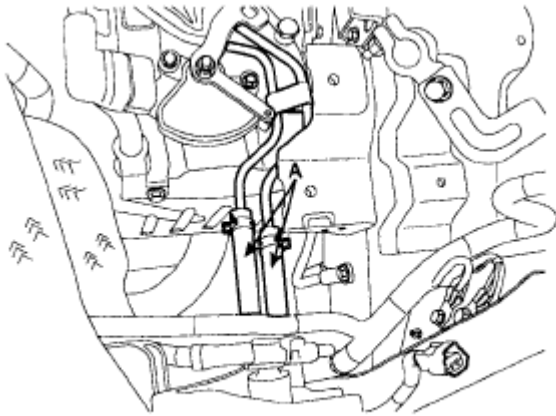
8. Remove the radiator upper and lower hoses (A).



BCKG005A

Fig. 19: Locating Radiator Upper And Lower Hoses
Courtesy of KIA MOTORS AMERICA, INC.

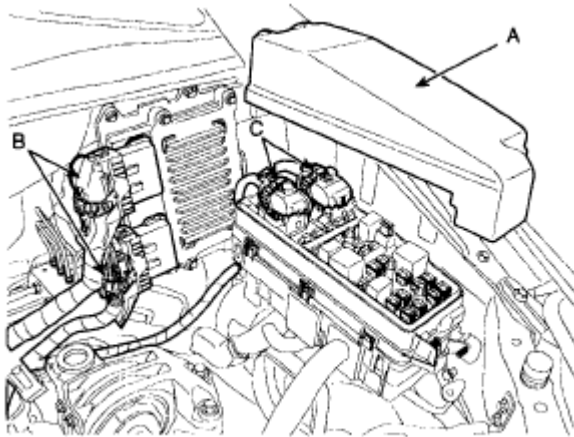
9. Disconnect the automatic transaxle fluid cooler hoses (A).



ACKF072A

Fig. 20: Locating Automatic Transaxle Fluid Cooler Hoses
Courtesy of KIA MOTORS AMERICA, INC.

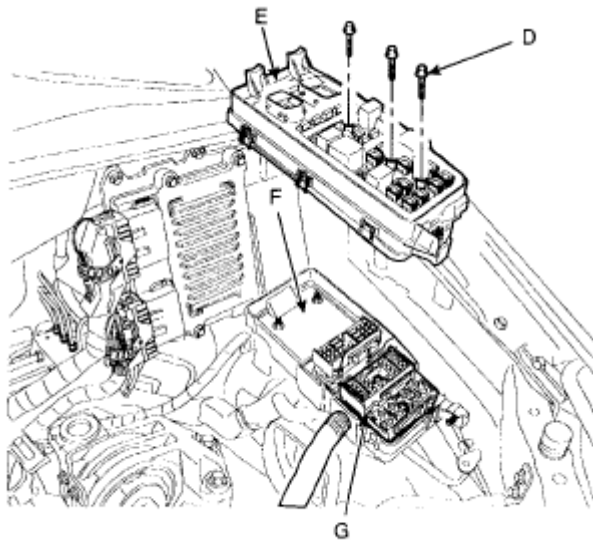
10. Disconnect the high and low pressure pipes from the radiator or the compressor.
11. Disconnect engine wiring.
 1. Remove the engine room fuse and relay box cover (A).
 2. Disconnect the PCM connectors (B).
 3. Disconnect the FAM connectors (C). Refer to **AIR CONDITIONING SYSTEM** .



BCKG003A

Fig. 21: Locating Relay Box Cover, PCM Connectors And FAM Connectors
Courtesy of KIA MOTORS AMERICA, INC.

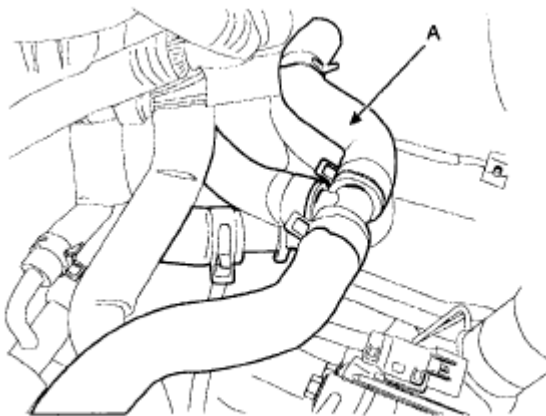
4. Unscrew the FAM mounting bolts (D-3 EA) and take the FAM (E) out of the splash shield (F).
5. Disconnect the connector (G) from the splash shield (B).



BCKG004A

Fig. 22: Locating FAM mounting Bolts, FAM, Splash Shield And FAM Connector
 Courtesy of KIA MOTORS AMERICA, INC.

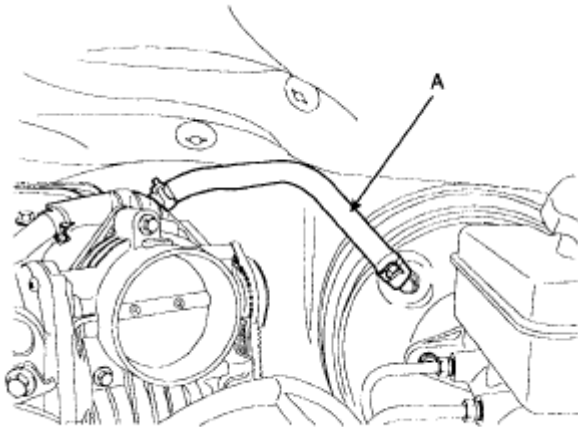
12. Disconnect the transaxle wire harness connector and remove the transaxle control cable. Refer to **AUTOMATIC TRANSAXLE SYSTEM** .
13. Remove heater hose (A).



BCKG008A

Fig. 23: Locating Heater Hose
 Courtesy of KIA MOTORS AMERICA, INC.

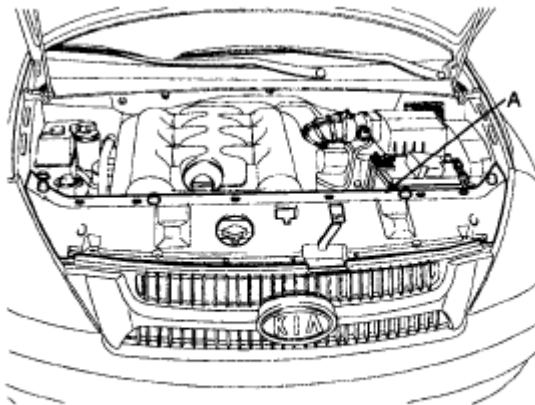
14. Remove the brake vacuum hose (A).



BCKG014A

Fig. 24: Locating Brake Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

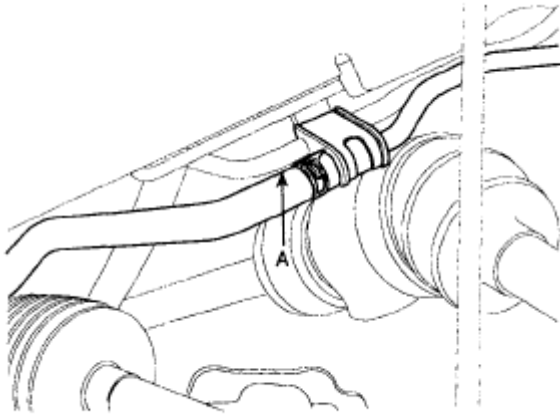
15. Remove power steering pump hose. Refer to **MECHANICAL POWER STEERING SYSTEM** .
16. Remove front wheels. Refer to **TIRES/WHEELS** .
17. Remove the radiator grille upper cover (A) for convenience sake.



ACKF043A

Fig. 25: Locating Radiator Grille Upper Cover
Courtesy of KIA MOTORS AMERICA, INC.

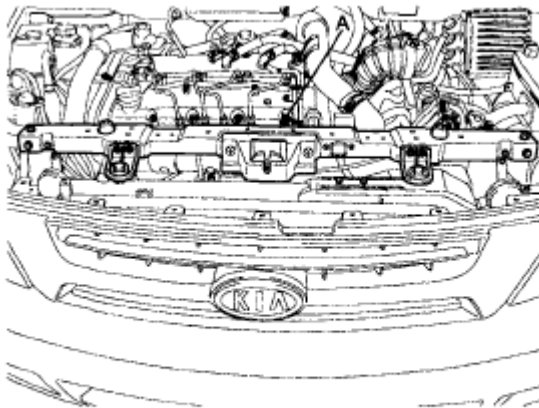
18. Disconnect the power steering return hose (A).



ACKF020A

Fig. 26: Locating Power Steering Return Hose
Courtesy of KIA MOTORS AMERICA, INC.

19. Remove the radiator support upper member assembly for convenience sake.



ACKF047A

Fig. 27: Locating Radiator Support Upper Member Assembly
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: The bottom side bolt (A) which can be seen after removing the under cover should be loosened for removal of the radiator support upper member assembly.

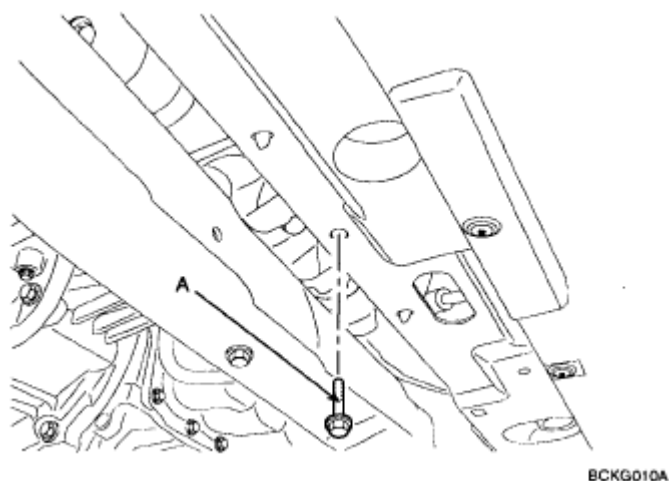


Fig. 28: Identifying Bottom Side Bolt
 Courtesy of KIA MOTORS AMERICA, INC.

20. Remove the under cover (A).

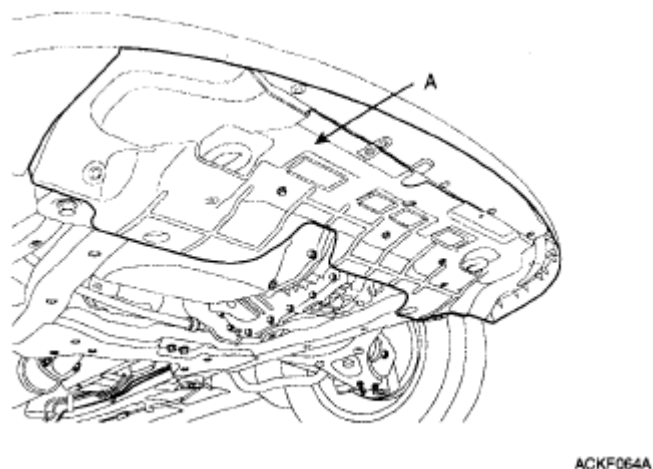
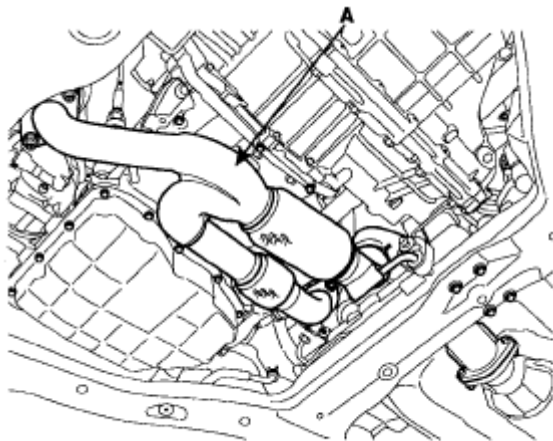


Fig. 29: Locating Under Cover(A)
 Courtesy of KIA MOTORS AMERICA, INC.

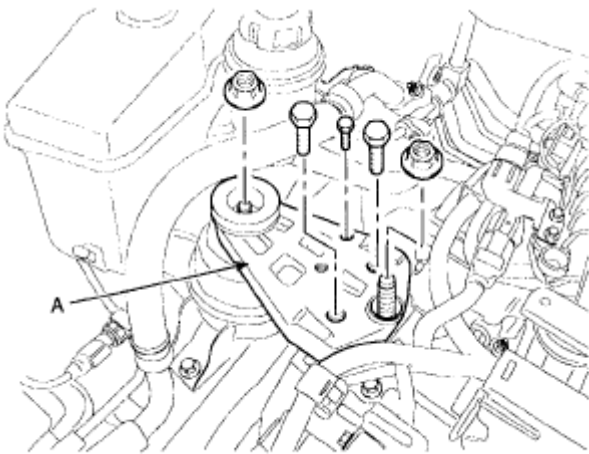
21. Drain engine oil.
22. Coolant should be drained before heater hose removal.
23. Remove front exhaust pipe (A).



KCBF102A

Fig. 30: Locating Front Exhaust Pipe
Courtesy of KIA MOTORS AMERICA, INC.

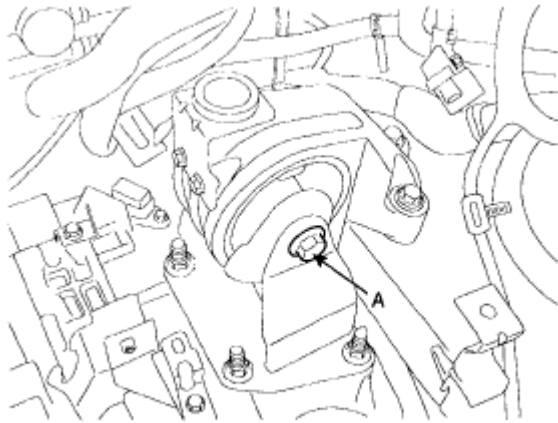
24. Disconnect the wheel speed sensor and the stabilizer bar link. Refer to **FRONT SUSPENSION SYSTEM** .
25. Remove the caliper assembly and suspend it with a wire. Refer to **BRAKE SYSTEM** .
26. Supporting the engine and transaxle assembly with sub frame, remove the engine mounting bracket (A).



BCKG009A

Fig. 31: Locating Engine Mounting Bracket
Courtesy of KIA MOTORS AMERICA, INC.

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



ACKF075A

Fig. 32: Locating Transaxle Insulator Mounting Bolt
Courtesy of KIA MOTORS AMERICA, INC.

28. Supporting the engine and transaxle assembly with a jack, remove the sub frame with the engine and transaxle assembly.

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

INSTALLATION

Installation is in the reverse order of removal.

Perform the following :

- Adjust the shift cable.
- 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.

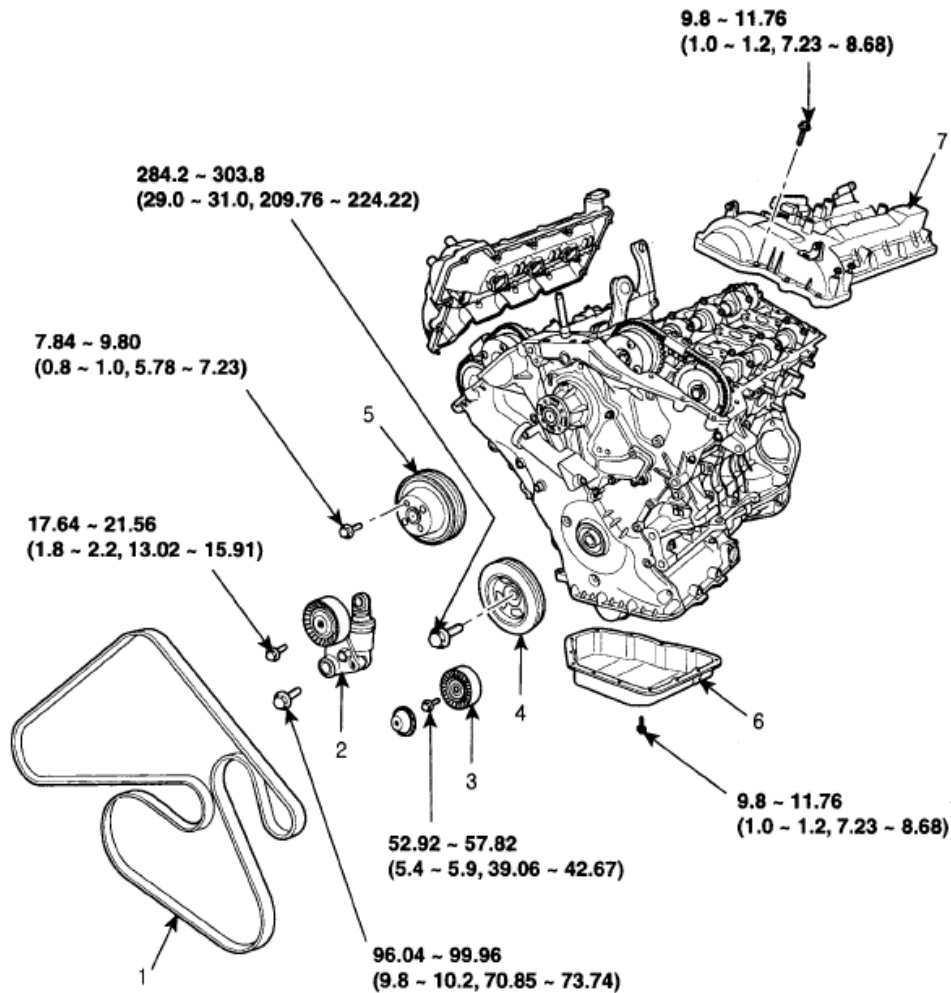
After assembling the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.

Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.

TIMING SYSTEM

TIMING CHAIN

COMPONENT

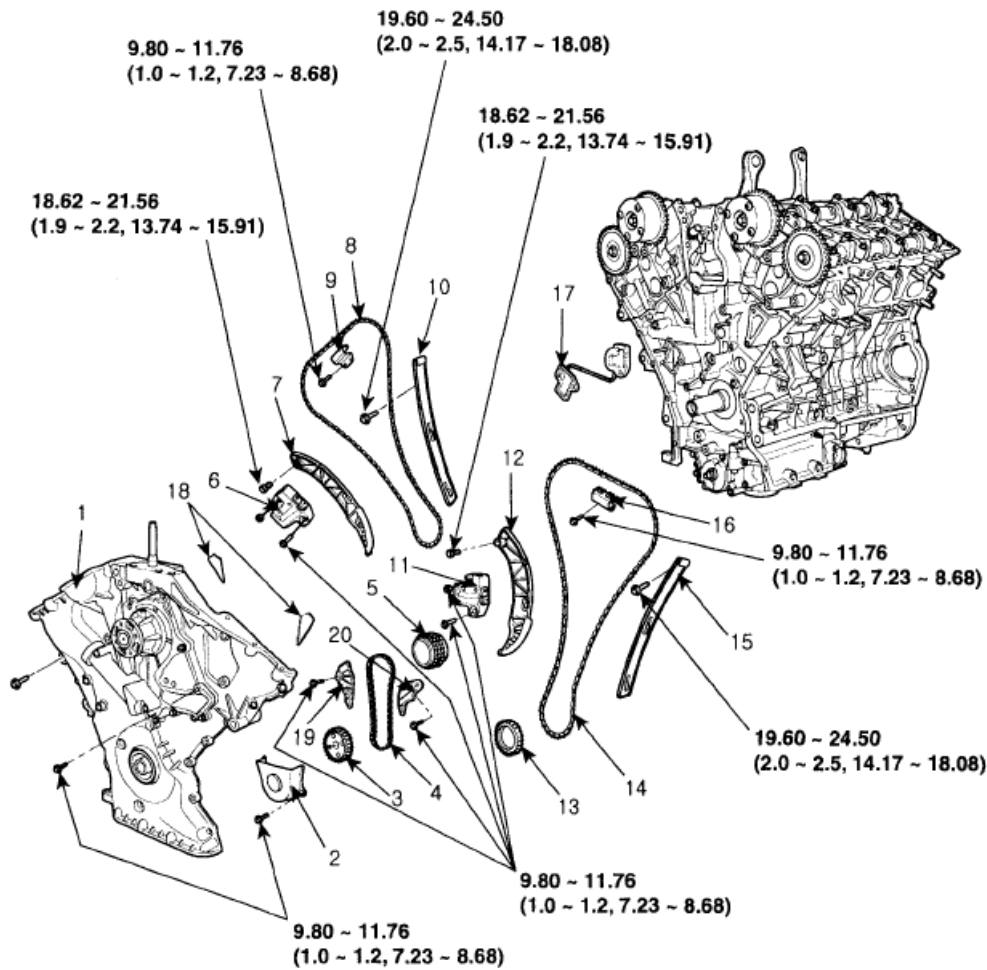


TORQUE : N.m (kgf.m, lb-ft)

- | | |
|-------------------------|------------------------|
| 1. Drive belt | 5. Water pump pulley |
| 2. Drive belt tensioner | 6. Oil pan |
| 3. Idler | 7. Cylinder head cover |
| 4. Damper pulley | |

ECBF008A

Fig. 33: Identifying Timing System Components With Torque Specifications (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.



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

- | | | |
|--------------------------------|---------------------------------|---------------------------------|
| 1. Timing chain cover | 8. Timing chain | 15. Timing chain guide |
| 2. Oil pump chain cover | 9. Cam to cam guide | 16. Cam to cam guide |
| 3. Oil pump sprocket | 10. Timing chain guide | 17. Tensioner adapter |
| 4. Oil pump chain | 11. Timing chain auto tensioner | 18. Gasket |
| 5. Crankshaft sprocket | 12. Timing chain tensioner arm | 19. Oil pump chain guide |
| 6. Timing chain auto tensioner | 13. Crankshaft sprocket | 20. Oil pump tensioner assembly |
| 7. Timing chain tensioner arm | 14. Timing chain | |

ECBF009A

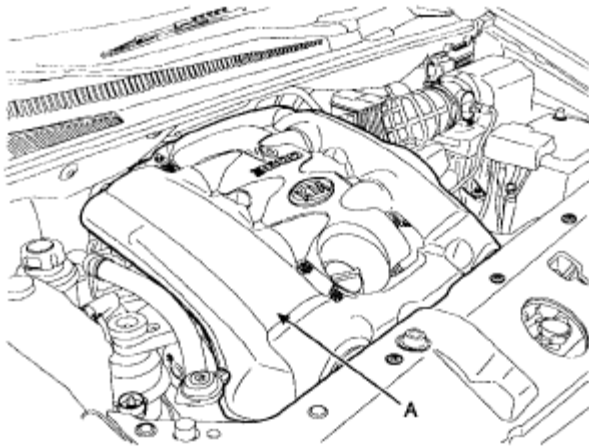
Fig. 34: Identifying Timing System Components With Torque Specifications (2 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

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. Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

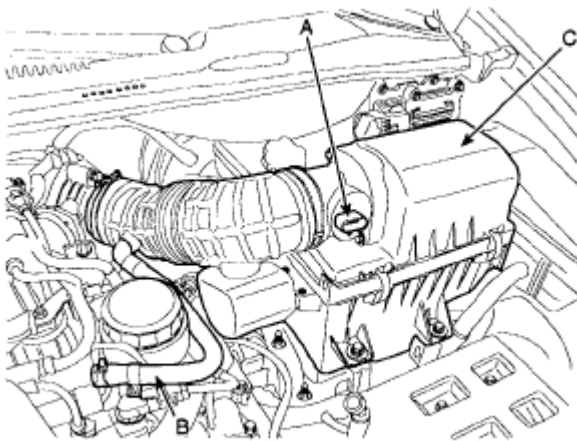
1. Disconnect the battery negative cable (A).
2. Remove the engine cover (A).



BCKG001A

Fig. 35: Locating Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

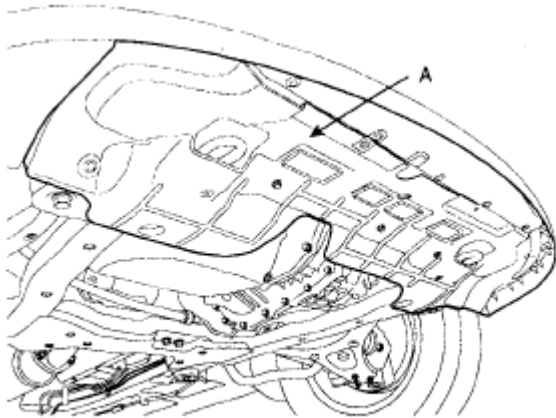
3. Remove the intake air hose and air cleaner assembly.
 1. Disconnect the MAF sensor connector (A).
 2. Disconnect the breather hose (B) from air intake hose.
 3. Remove the intake air hose and air cleaner assembly(C).



BCKG002A

Fig. 36: Locating MAF Connector And Air Cleaner Assembly
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the RH front wheel.
5. Remove the under cover (A).



ACKF064A

Fig. 37: Locating Under Cover(A)
 Courtesy of KIA MOTORS AMERICA, INC.

6. Remove the side cover.
7. Loosen the drain plug and drain the engine coolant.
8. Drain the engine oil.
9. Remove the surge tank.
 1. Disconnect the RH oxygen sensor connector (A) and loosen the power steering hose mounting bolts (B).

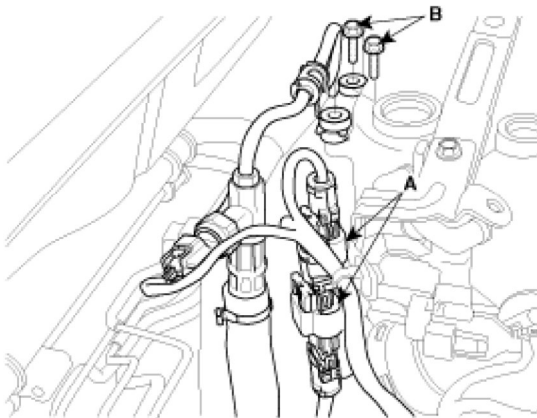
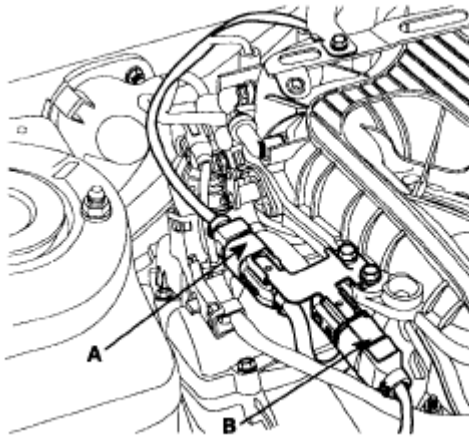


Fig. 38: Identifying RH Oxygen Sensor Connector & Power Steering Hose Mounting Bolts
 Courtesy of KIA MOTORS AMERICA, INC.

2. Disconnect the RH injector connector (A) and ignition coil connector (B).



KDRF153A

Fig. 39: Locating RH Injector Connector And Ignition Coil Connector
Courtesy of KIA MOTORS AMERICA, INC.

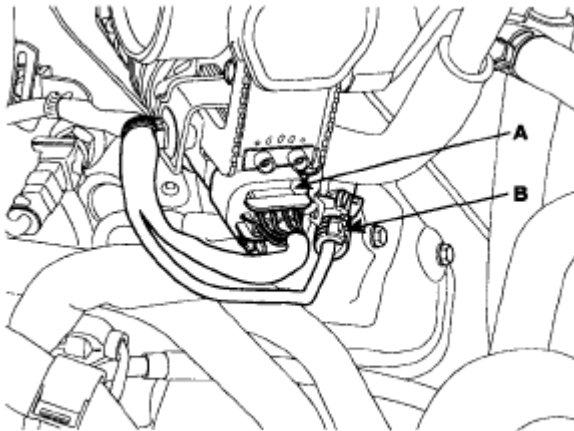


KDRF160A

3.

Fig. 40: Locating PCSV Connector, MAP Sensor Connector And PCSV Hose
Courtesy of KIA MOTORS AMERICA, INC.

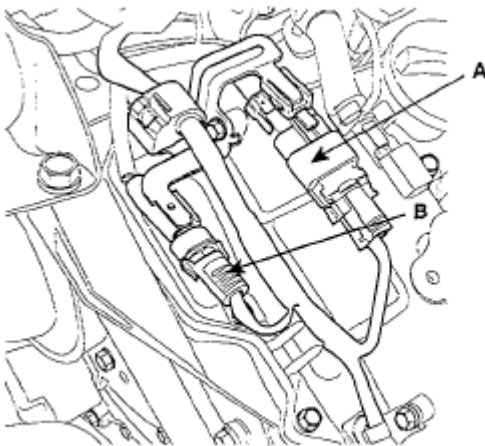
4. Disconnect the ETC connector (A) and knock sensor connector (B).



KDRF152A

Fig. 41: Locating ETC Connector & Knock Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

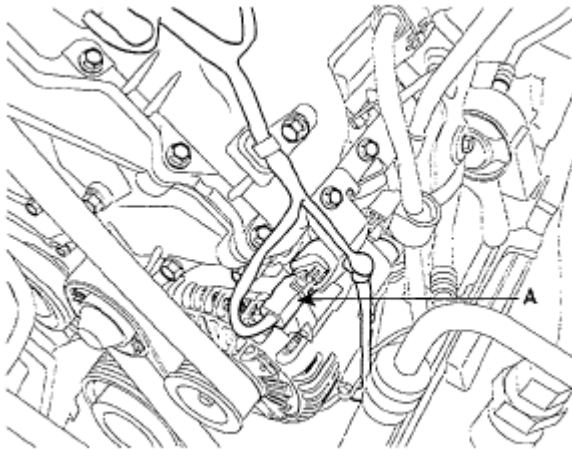
5. Disconnect the OCV connector (A) and knock sensor connector (B).



KDRF155A

Fig. 42: Identifying OCV Connector And Knock Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

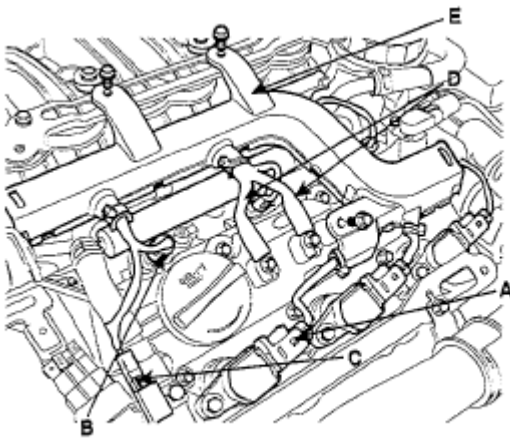
6. Disconnect the LH front oxygen sensor connector (A).



KDRF158A

Fig. 43: Identifying LH Front Oxygen Sensor Connector
 Courtesy of KIA MOTORS AMERICA, INC.

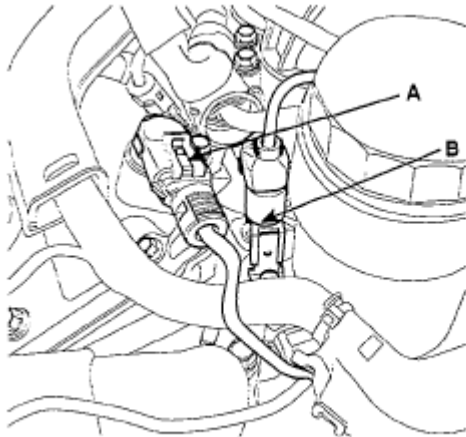
7. Disconnect the LH ignition coil connector (A), injector connector (B), condenser connector (C) and ground (D), and remove the wiring harness protector (E).



KDRF158A

Fig. 44: Identifying LH Ignition Coil Connector And Condenser Connector
 Courtesy of KIA MOTORS AMERICA, INC.

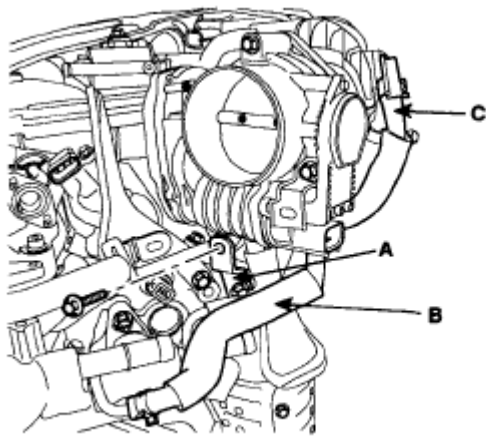
8. Disconnect the LH CMPS (A) and oil pressure switch connector (B).



KDRF159A

Fig. 45: Identifying LH CMPS And Oil Pressure Switch Connector
 Courtesy of KIA MOTORS AMERICA, INC.

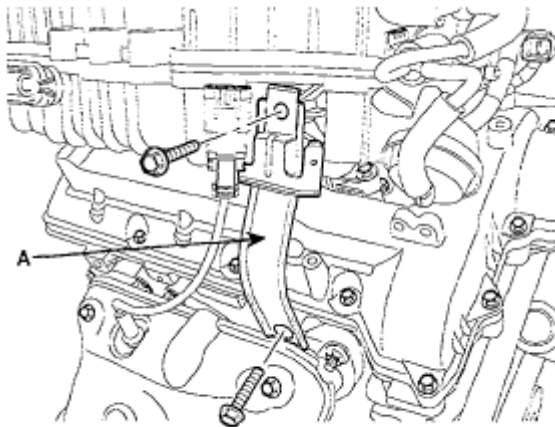
9. Remove the ETC bracket (A).
10. Disconnect the water hoses (B) from ETC.
11. Disconnect the PCV hose (C).



KDRF176A

Fig. 46: Locating PCV Hose
 Courtesy of KIA MOTORS AMERICA, INC.

12. Disconnect the brake vacuum hose.
13. Remove the surge tank stay (A).



UCBF020A

Fig. 47: Identifying Surge Tank Stay
Courtesy of KIA MOTORS AMERICA, INC.

14. Remove the connector bracket (A) from surge tank.

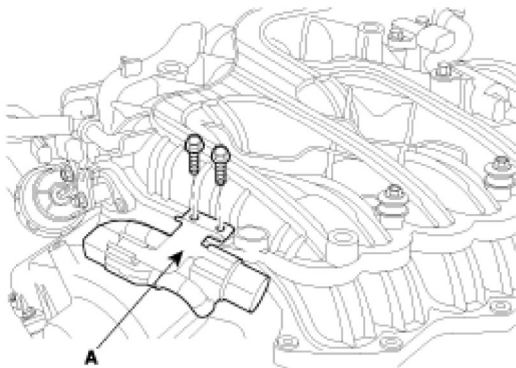
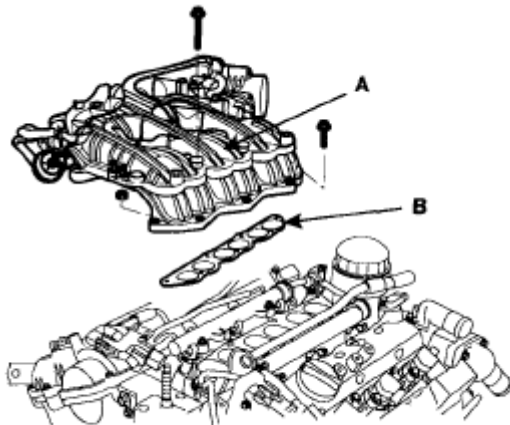


Fig. 48: Identifying Surge Tank Connector Bracket
Courtesy of KIA MOTORS AMERICA, INC.

15. Remove the surge tank (A).

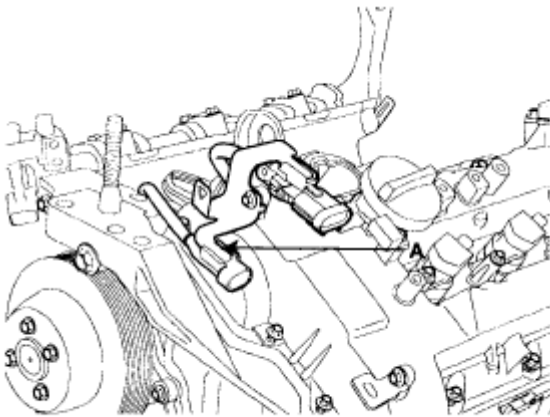


BCKG031A

Fig. 49: Locating Surge Tank(A)
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Cover the inlet of intake manifold with a clean woven stuff or vinyl cover to prevent foreign materials from entering.

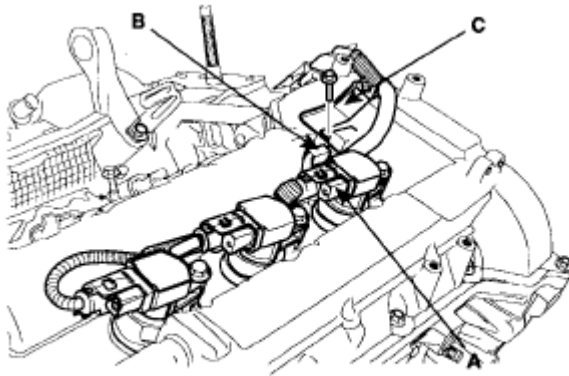
10. Remove the cylinder head cover.
 1. Remove the connector bracket (A) from LH cylinder head cover.



KDRF110A

Fig. 50: Locating Connector Bracket(A)
 Courtesy of KIA MOTORS AMERICA, INC.

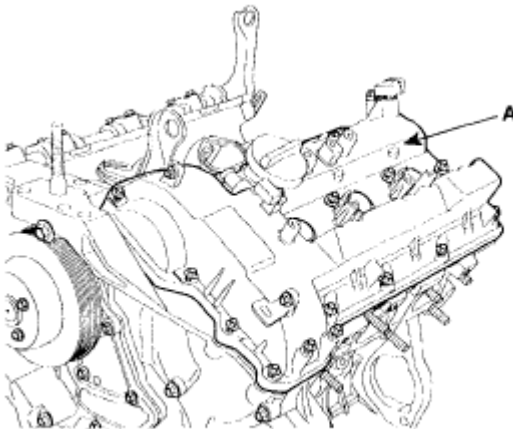
2. Disconnect the RH ignition coil connector (A), condenser connector (B) and remove the wiring bracket (C).



KDRF111A

Fig. 51: Locating RH Ignition Coil Connector, Condenser Connector & Wiring Bracket
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the LH, RH ignition coil.
4. Remove the LH, RH cylinder head cover (A).



KDRF112A

Fig. 52: Locating Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

11. Using SST (09215-3C000) remove lower oil pan (A).

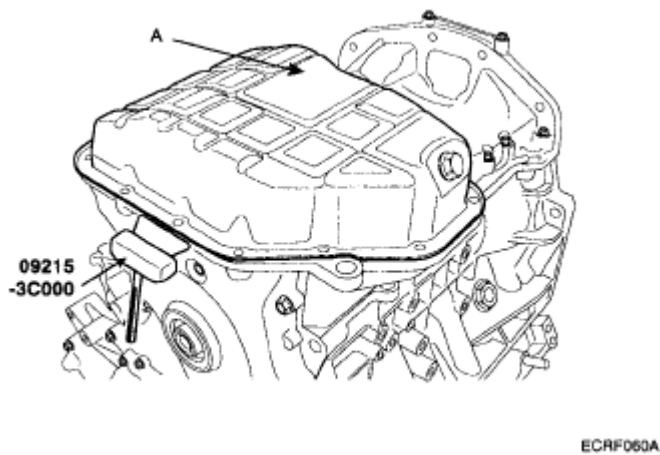


Fig. 53: Locating Lower Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

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

12. Set a jack to the upper oil pan.

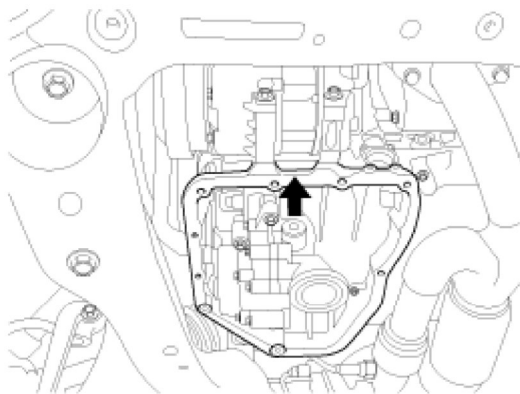


Fig. 54: Setting Jack To Upper Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

13. Remove the coolant reservoir tank.
14. Remove the engine mounting bracket (A).

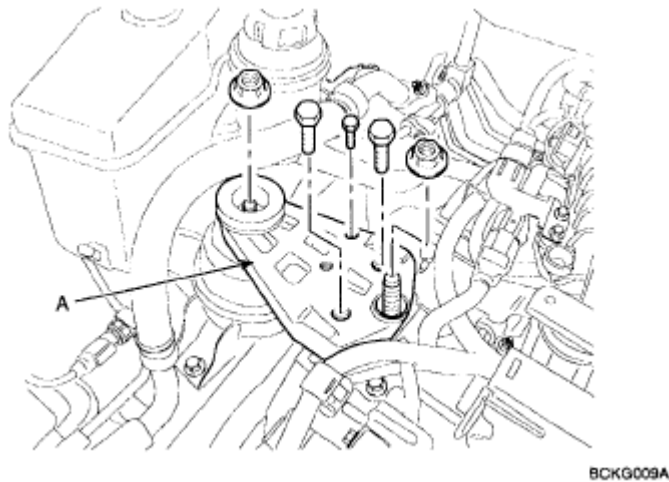


Fig. 55: Locating Engine Mounting Bracket(A)
 Courtesy of KIA MOTORS AMERICA, INC.

15. Set No. 1 cylinder to TDC/compression.
 1. Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing chain cover.

NOTE: Do not rotate engine counterclockwise.

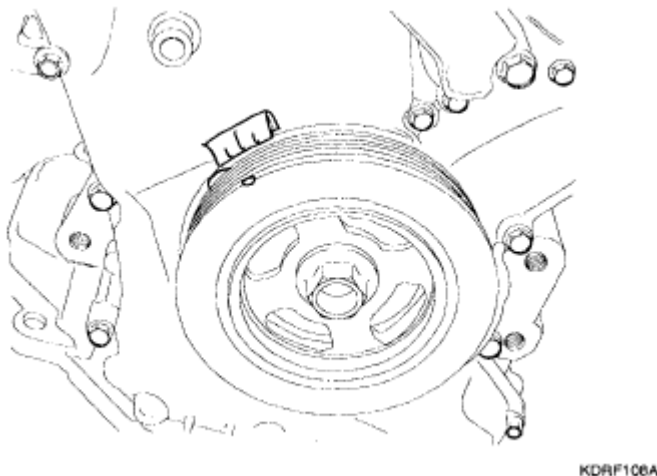
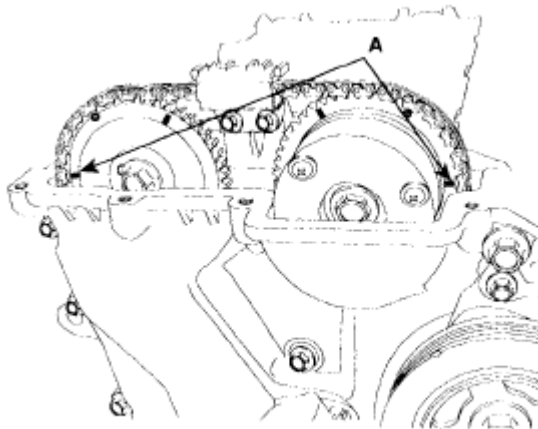


Fig. 56: Aligning Crankshaft Pulley With Timing Mark T Of Lower Timing Chain Cover
 Courtesy of KIA MOTORS AMERICA, INC.

2. Check that the mark (A) of the camshaft timing sprockets are in straight line on the cylinder head surface as shown in the illustration. If not, turn the crankshaft one revolution (360°).

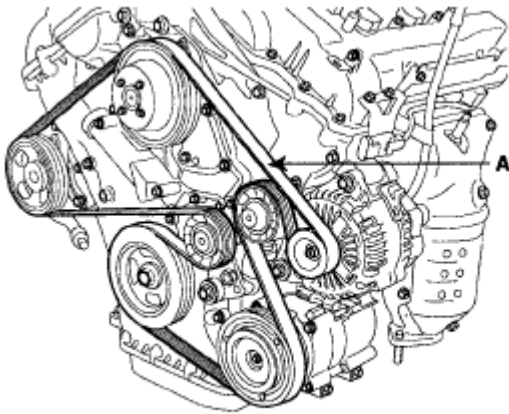


KDRF113A

Fig. 57: Locating Mark Of Camshaft Timing Sprockets
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not rotate engine counterclockwise.

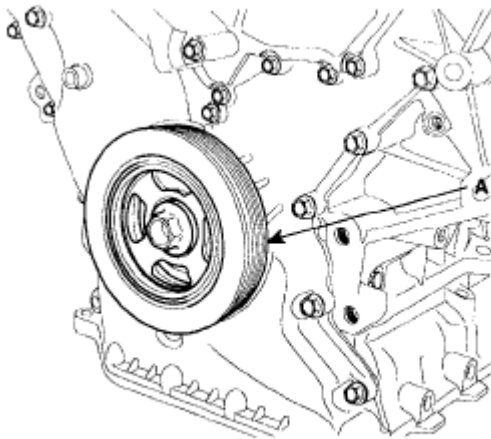
16. Remove the drive belt (A).



KDRF101A

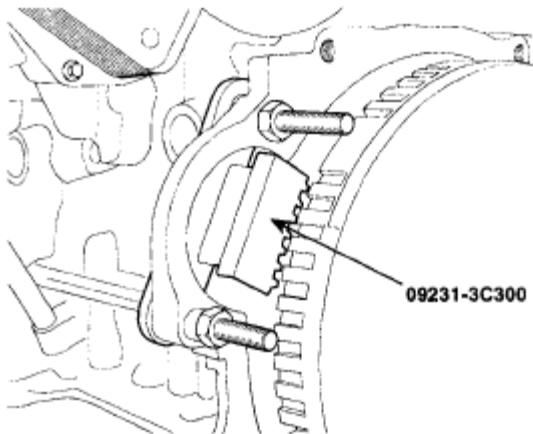
Fig. 58: Identifying Drive Belt Routing
Courtesy of KIA MOTORS AMERICA, INC.

17. Using SST (09231-3C300) remove the crankshaft damper pulley (A).



KDRF109A

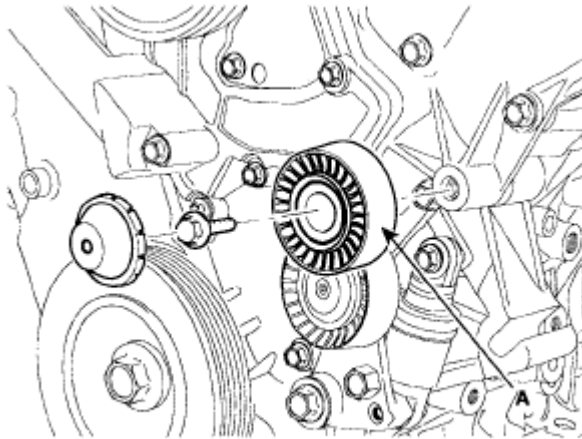
Fig. 59: Locating Crankshaft Damper Pulley(A)
Courtesy of KIA MOTORS AMERICA, INC.



ECRF061A

Fig. 60: Identifying SST(09231-3C300)
Courtesy of KIA MOTORS AMERICA, INC.

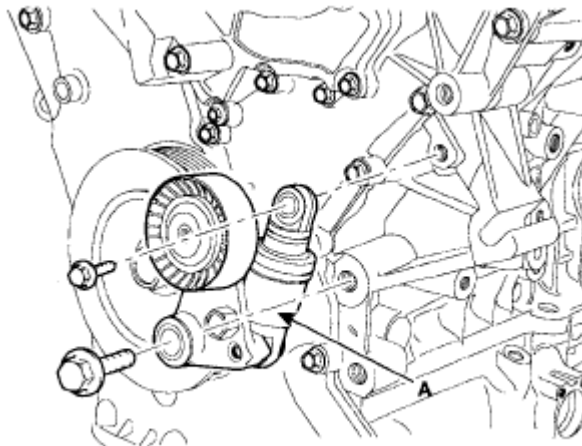
18. Lift up the engine assembly to using the jack.
19. Remove drive belt idler (A).



KDRF105A

Fig. 61: Locating Drive Belt Idler
Courtesy of KIA MOTORS AMERICA, INC.

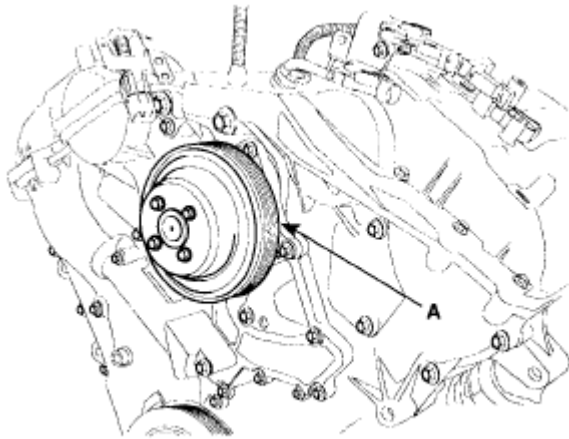
20. Remove drive belt auto tensioner (A).



KDRF106A

Fig. 62: Locating Drive Belt Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

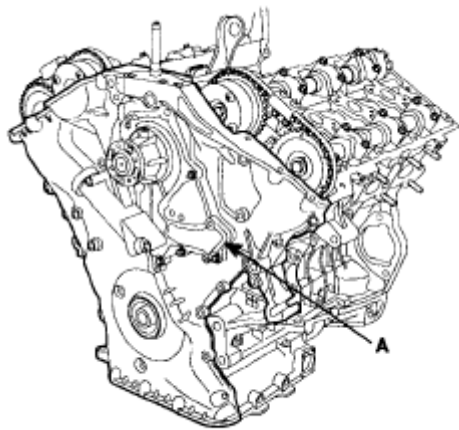
21. Remove water pump pulley (A).



KDRF107A

Fig. 63: Locating Water Pump Pulley
Courtesy of KIA MOTORS AMERICA, INC.

22. Remove the timing chain cover (A).

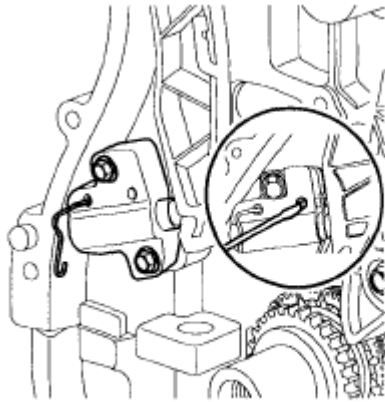


KDRF115A

Fig. 64: Locating Timing Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover. Before removing the timing chain, mark the RH/LH timing chain with an identification based on the location of the sprocket because the identification mark on the chain for TDC (Top Dead Center) can be erased.

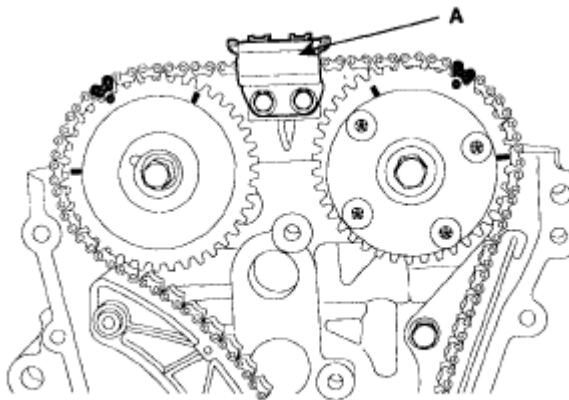
23. Install a set pin after compressing the timing chain tensioner.



KCRF105A

Fig. 65: Identifying Pin Compressing Timing Chain Tensioner
 Courtesy of KIA MOTORS AMERICA, INC.

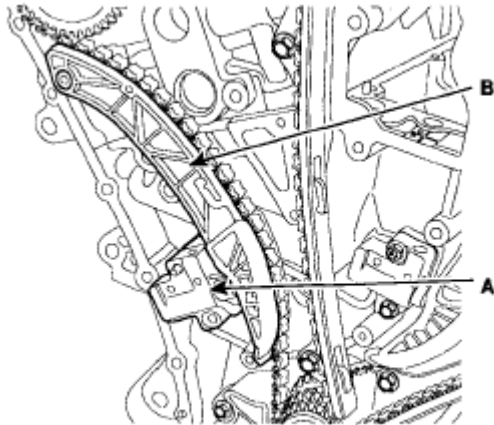
24. Remove the RH cam-to-cam guide (A).



KDRF116A

Fig. 66: Locating RH Cam-To-Cam Guide(A)
 Courtesy of KIA MOTORS AMERICA, INC.

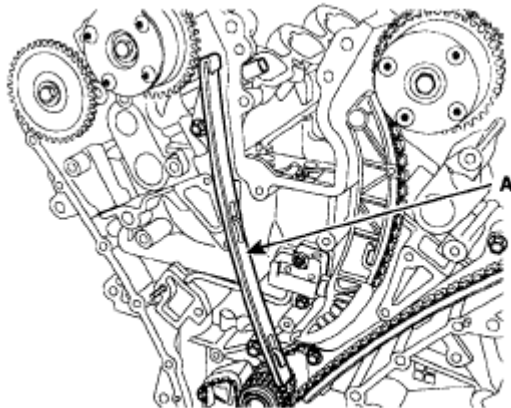
25. Remove the RH timing chain auto tensioner (A) and RH timing chain tensioner arm (B).



KDRF117A

Fig. 67: Locating RH Timing Chain Auto Tensioner & RH Timing Chain Tensioner Arm
Courtesy of KIA MOTORS AMERICA, INC.

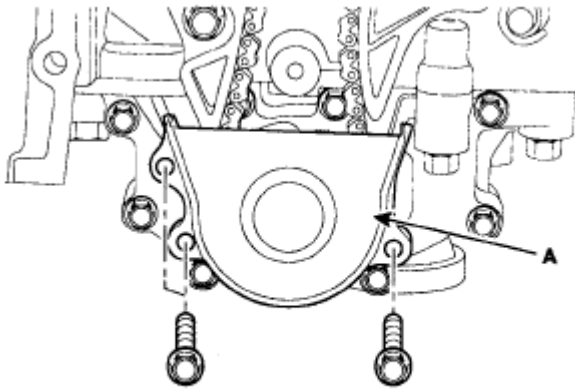
26. Remove the RH timing chain.
27. Remove the RH timing chain guide (A).



KDRF118A

Fig. 68: Locating RH Timing Chain Guide(A)
Courtesy of KIA MOTORS AMERICA, INC.

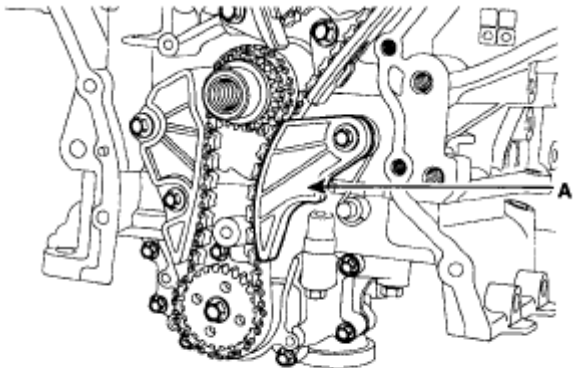
28. Remove the oil pump chain cover (A).



KDRF185A

Fig. 69: Locating Oil Pump Chain Cover(A)
Courtesy of KIA MOTORS AMERICA, INC.

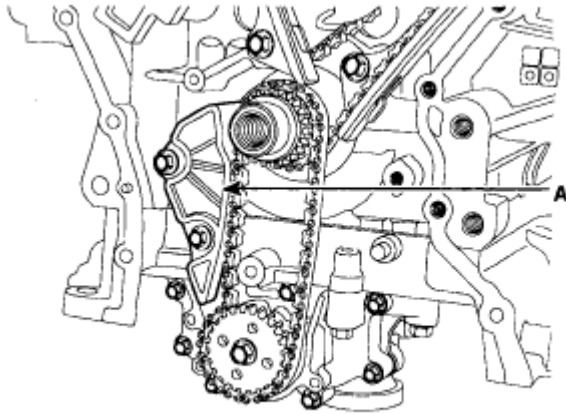
29. Remove the oil pump chain tensioner assembly (A).



KDRF119A

Fig. 70: Locating Oil Pump Chain Tensioner Assembly
Courtesy of KIA MOTORS AMERICA, INC.

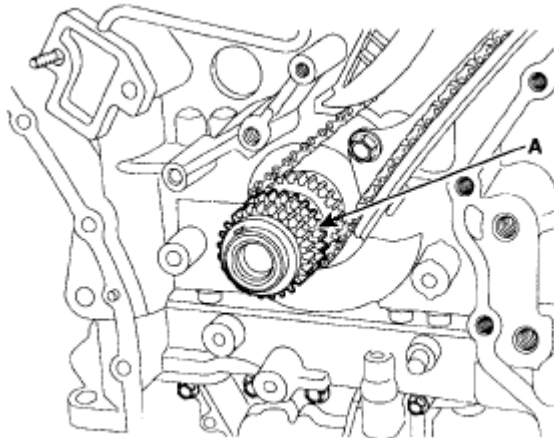
30. Remove the oil pump chain guide (A).



KDRF120A

Fig. 71: Locating Oil Pump Chain Guide
 Courtesy of KIA MOTORS AMERICA, INC.

31. Remove the oil pump chain sprocket (A) and oil pump chain (B).
32. Remove the crankshaft sprocket (A) (Oil pump & RH camshaft drive).



KDRF122A

Fig. 72: Locating Crankshaft Sprocket (Oil Pump & RH Camshaft Drive)
 Courtesy of KIA MOTORS AMERICA, INC.

33. Install a set pin after compressing the LH timing chain tensioner.

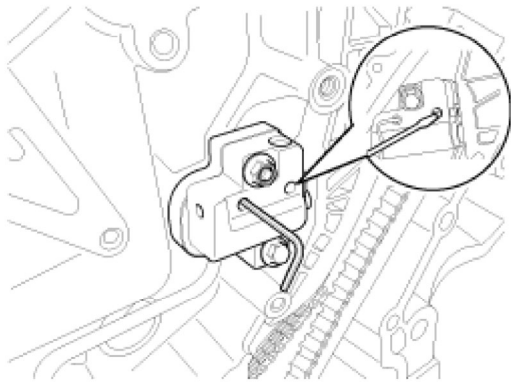
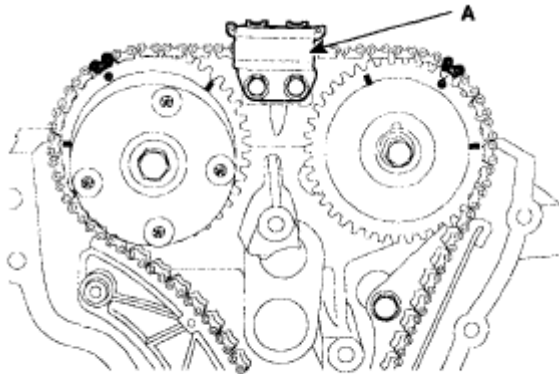


Fig. 73: Identifying Set Pin (LH)

Courtesy of KIA MOTORS AMERICA, INC.

34. Remove the LH cam-to-cam guide (A).

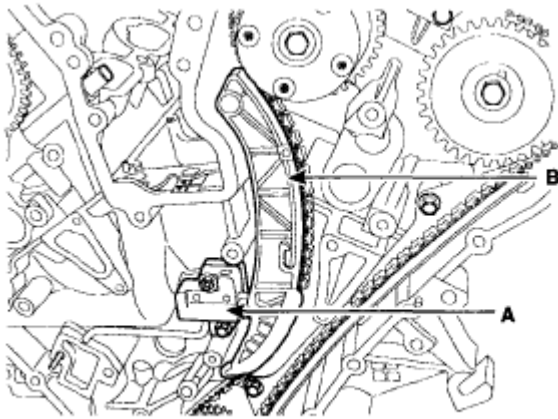


KDRF123A

Fig. 74: Locating LH Cam-To-Cam Guide(A)

Courtesy of KIA MOTORS AMERICA, INC.

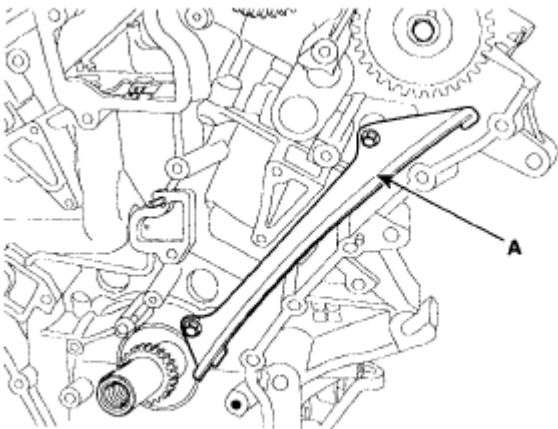
35. Remove the LH timing chain auto tensioner (A) and LH timing chain tensioner arm (B).



KDRF124A

Fig. 75: Locating LH Timing Chain Auto Tensioner & LH Timing Chain Tensioner Arm
 Courtesy of KIA MOTORS AMERICA, INC.

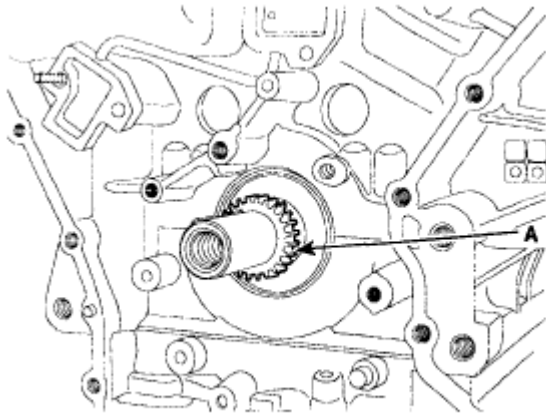
36. Remove the LH timing chain.
37. Remove the LH timing chain guide (A).



KDRF125A

Fig. 76: Locating LH Timing Chain Guide
 Courtesy of KIA MOTORS AMERICA, INC.

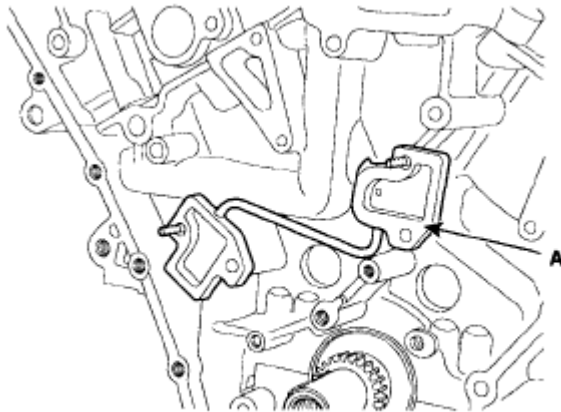
38. Remove the crankshaft sprocket (A) (LH camshaft drive).



KDRF126A

Fig. 77: Locating Crankshaft Sprocket (LH Camshaft Drive)
 Courtesy of KIA MOTORS AMERICA, INC.

39. Remove the tensioner adapter assembly (A).



KDRF127A

Fig. 78: Locating Tensioner Adapter Assembly
 Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

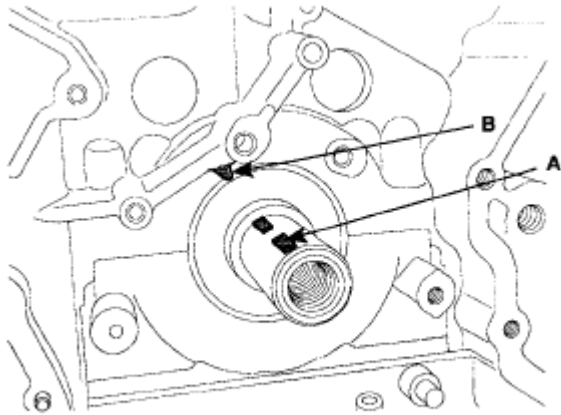
SPROCKETS, CHAIN TENSIONER, CHAIN GUIDE, CHAIN TENSIONER ARM

1. Check the camshaft sprocket and crankshaft sprocket for abnormal wear, cracks, or damage. Replace as necessary.
2. Inspect the tensioner arm and chain guide for abnormal wear, cracks, or damage. Replace as necessary.
3. Check that the tensioner piston moves smoothly when the ratchet pawl is released with thin rod.

INSTALLATION

1. Install the jack to the upper oil pan.

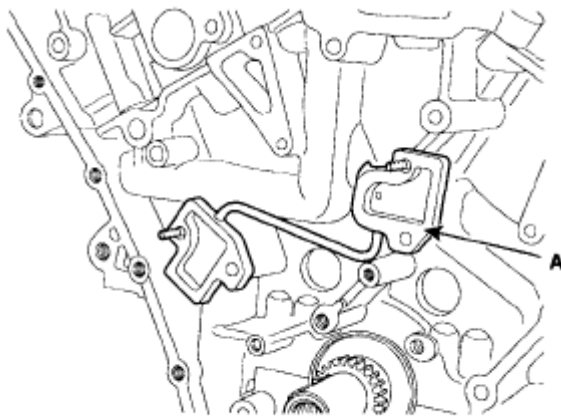
2. The key (A) of crankshaft should be aligned with the timing mark (B) of timing chain cover. As a result of this, the piston of No. 1 cylinder is placed at the top dead center on compression stroke.



KDRF128A

Fig. 79: Identifying Crankshaft Key And Timing Chain Cover Timing Mark
 Courtesy of KIA MOTORS AMERICA, INC.

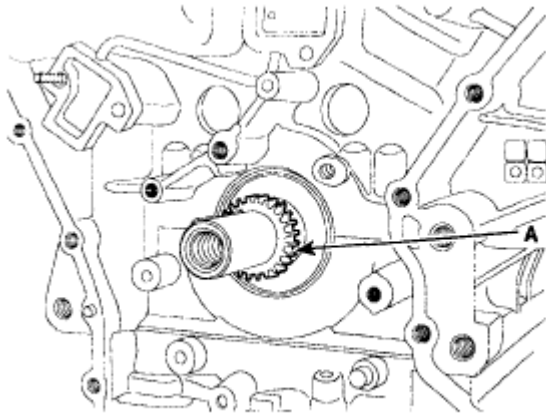
3. Install tensioner adapter assembly (A).



KDRF127A

Fig. 80: Locating Tensioner Adapter Assembly
 Courtesy of KIA MOTORS AMERICA, INC.

4. Install crankshaft sprocket (A) (LH camshaft drive).



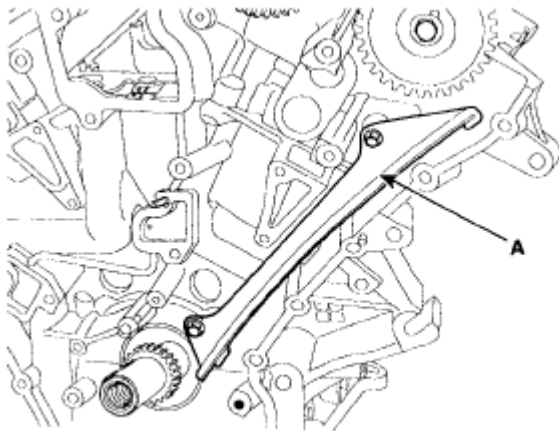
KDRF126A

Fig. 81: Locating Crankshaft Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

5. Install LH timing chain guide (A).

Tightening torque

19.60-24.50 N.m (2.0-2.5 kgf.m, 14.17-18.08 lb-ft)



KDRF126A

Fig. 82: Locating LH Timing Chain Guide
Courtesy of KIA MOTORS AMERICA, INC.

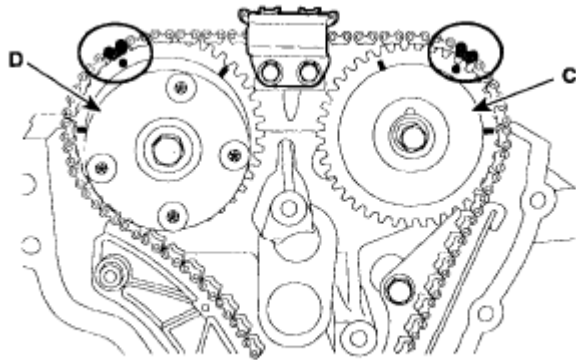
6. Install LH timing chain.

To install the timing chain with no slack between each shaft (cam, crank), follow the procedure below.

Crankshaft sprocket --> Timing chain guide --> Exhaust camshaft sprocket (C) --> Intake camshaft sprocket (D).

The timing mark of each sprockets should be matched with timing mark (color link) of timing chain at

installing timing chain.



BCKG023A

Fig. 83: Identifying Exhaust Camshaft Sprocket And Intake Camshaft Sprocket Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

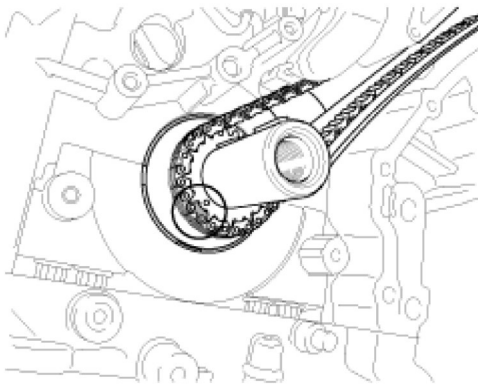


Fig. 84: Identifying Timing Mark Of Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

7. Install LH timing chain tensioner arm (B).

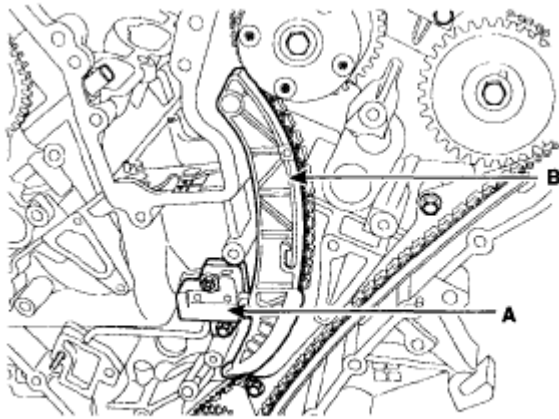
Tightening torque

18.62-21.56 N.m (1.9-2.2 kgf.m, 13.74-15.91 lb-ft)

8. Install LH chain tensioner (A).

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



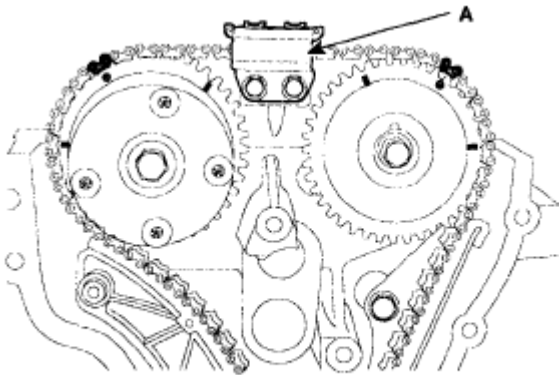
KDRF124A

Fig. 85: Locating LH Timing Chain Auto Tensioner And LH Timing Chain Tensioner Arm
 Courtesy of KIA MOTORS AMERICA, INC.

9. Install LH cam-to-cam guide (A).

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



KDRF123A

Fig. 86: Locating LH Cam-To-Cam Guide
 Courtesy of KIA MOTORS AMERICA, INC.

10. Install crankshaft sprocket (A) (Oil pump & RH camshaft drive).

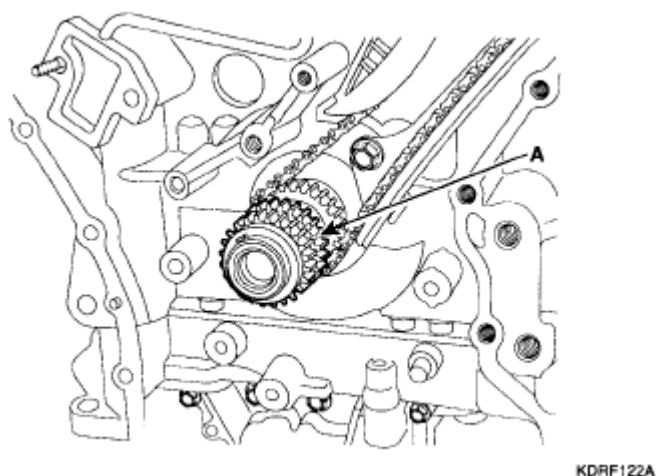


Fig. 87: Locating Crankshaft Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

11. Install oil pump chain (B) and oil pump sprocket (A).

Tightening torque

18.62-21.56 N.m (1.9-2.2 kgf.m, 13.74-15.91 lb-ft)

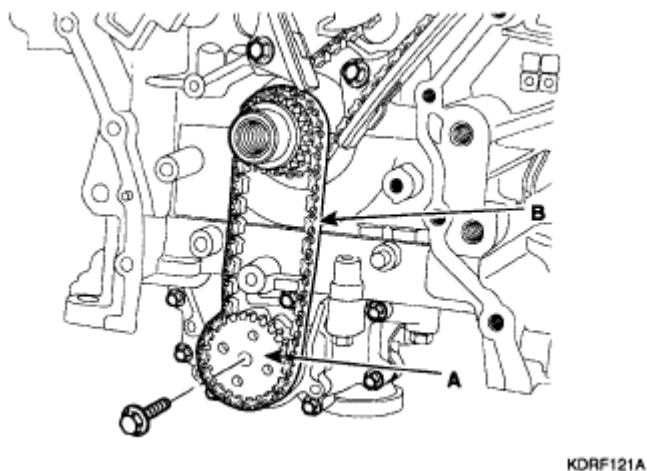
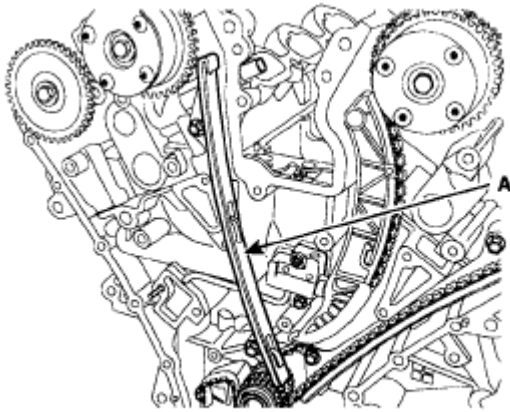


Fig. 88: Locating Oil Pump Chain Sprocket And Oil Pump Chain
Courtesy of KIA MOTORS AMERICA, INC.

12. Install RH timing chain guide (A).

Tightening torque

19.60-24.50 N.m (2.0-2.5 kgf.m, 14.17-18.08 lb-ft)



KDRF118A

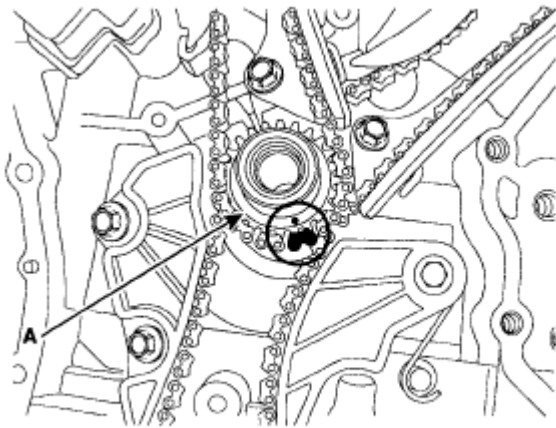
Fig. 89: Locating RH Timing Chain Guide
Courtesy of KIA MOTORS AMERICA, INC.

13. Install RH timing chain.

To install the timing chain with no slack between each shaft (cam, crank), follow the procedure below.

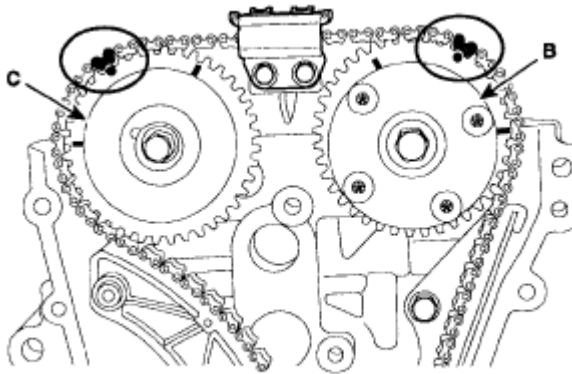
Crankshaft sprocket (A) --> Intake camshaft sprocket (B) --> Exhaust camshaft sprocket (C).

The timing mark of each sprockets should be matched with timing mark (color link) of timing chain at installing timing chain.



BCKG024A

Fig. 90: Locating Crankshaft Sprocket Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.



BCKG025A

Fig. 91: Locating Intake Camshaft Sprocket And Exhaust Camshaft Sprocket Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

14. Install RH timing chain tensioner arm (B).

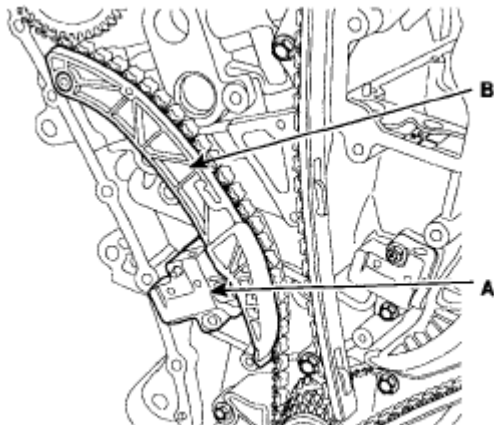
Tightening torque

18.62-21.56 N.m (1.9-2.2 kgf.m, 13.74-15.91 lb-ft)

15. Install RH timing chain auto tensioner (A).

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



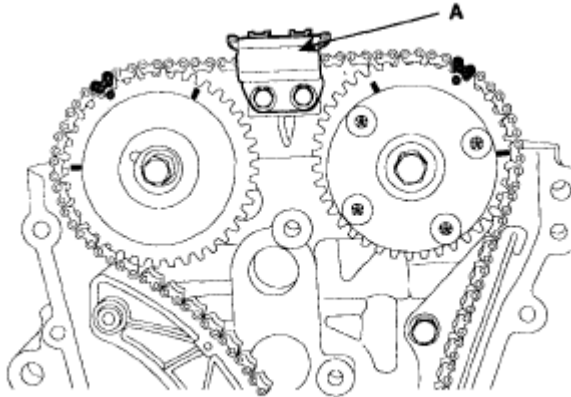
KDRF117A

Fig. 92: Locating RH Timing Chain Auto Tensioner And RH Timing Chain Tensioner Arm
Courtesy of KIA MOTORS AMERICA, INC.

16. Install RH cam-to-cam guide (A).

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



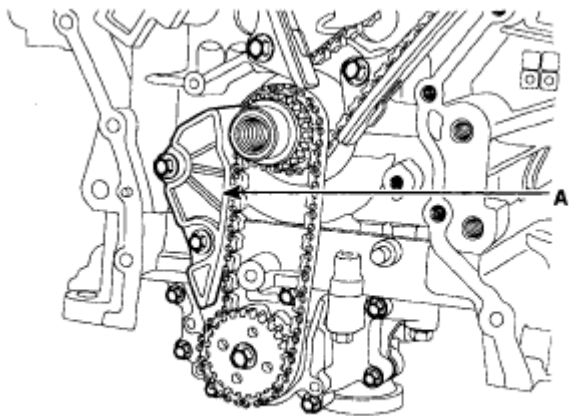
KDRF116A

Fig. 93: Locating RH Cam-To-Cam Guide
Courtesy of KIA MOTORS AMERICA, INC.

17. Install oil pump chain guide (A).

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



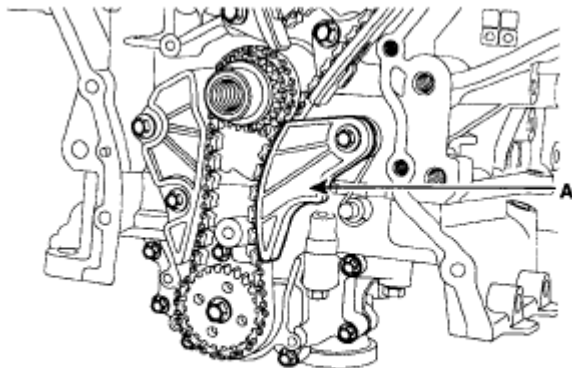
KDRF120A

Fig. 94: Locating Oil Pump Chain Guide
Courtesy of KIA MOTORS AMERICA, INC.

18. Install oil pump chain tensioner assembly (A).

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



KORF119A

Fig. 95: Locating Oil Pump Chain Tensioner Assembly
 Courtesy of KIA MOTORS AMERICA, INC.

19. Pull out the pins of hydraulic tensioners (LH & RH).

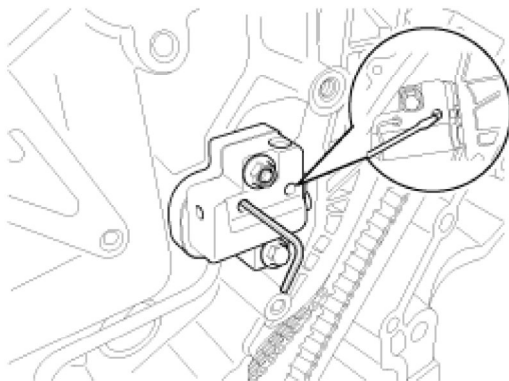
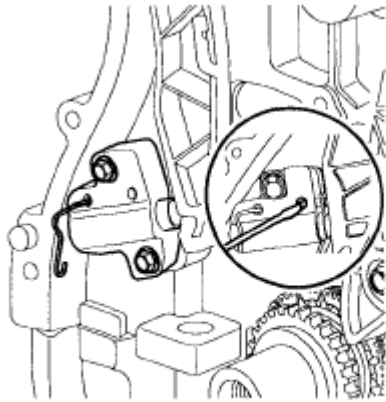


Fig. 96: Identifying Set Pin (LH)
 Courtesy of KIA MOTORS AMERICA, INC.



KCRF105A

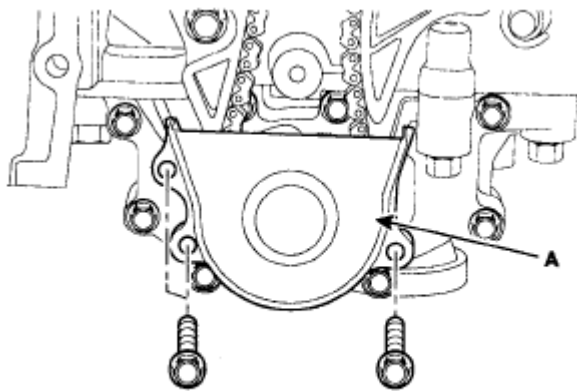
Fig. 97: Identifying Set Pin (RH)

Courtesy of KIA MOTORS AMERICA, INC.

20. Install oil pump chain cover (A).

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



KDRF186A

Fig. 98: Locating Oil Pump Chain Cover

Courtesy of KIA MOTORS AMERICA, INC.

21. After rotating crankshaft 2 revolutions in regular direction (clockwise viewed from front), confirm the timing mark.

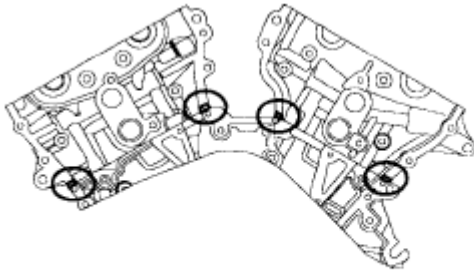
NOTE: Always turn the crankshaft clockwise.

22. Install timing chain cover.
 - a. The sealant locations on chain cover and on counter parts (cylinder head, cylinder block, and lower

oil pan) must be free of engine oil and ETC.

- b. Before assembling the timing chain cover, the liquid sealant TB1217H should be applied on the gap between cylinder head and cylinder block. The part must be assembled within 5 minutes after sealant was applied.

Bead width: 2.5 mm (0.1 in.)



KDRF134A

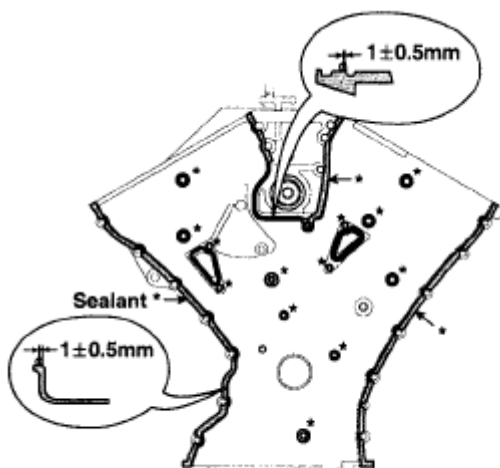
Fig. 99: Identifying Sealant Locations On Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

- c. After applying liquid sealant TB1217H on timing chain cover.

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

Sealant should be applied without discontinuity.

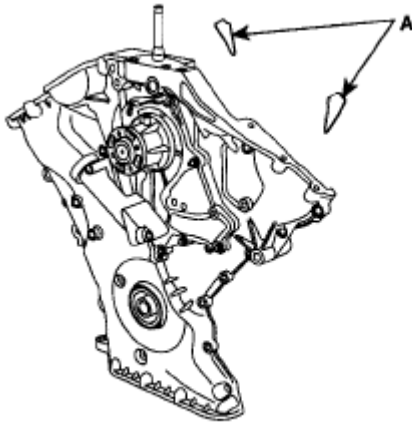
Bead width: 2.5 mm (0.1 in.)



ECBF032A

Fig. 100: Identifying Timing Chain Cover Sealant Bead
Courtesy of KIA MOTORS AMERICA, INC.

- d. Install the new gasket (A) to the timing chain cover.



KDRF220A

Fig. 101: Identifying Gasket Of Timing Chain Cover
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: During timing cover installation, care not to take off applied sealant on the timing cover by contact with other parts.

- e. The dowel pins on the cylinder block and holes on the timing chain cover should be used as a reference in order to assemble the timing chain cover to be in exact position.

Tightening torque

NOTE: Letters refer to positions in **Fig. 102**.

B (17): 18.62-21.56 N.m (1.9-2.2 kgf.m, 13.74-15.91 lb-ft)

C (4): 9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)

D (1): 58.80-68.80 N.m (6.0-7.0 kgf.m, 43.40-50.63 lb-ft)

E (1): 58.80-68.80 N.m (6.0-7.0 kgf.m, 43.40-50.63 lb-ft)

F (2): 24.50-26.46 N.m (2.5-2.7 kgf.m, 18.08-19.53 lb-ft)

G (4): 21.56-23.52 N.m (2.2-2.4 kgf.m, 15.91-17.36 lb-ft)

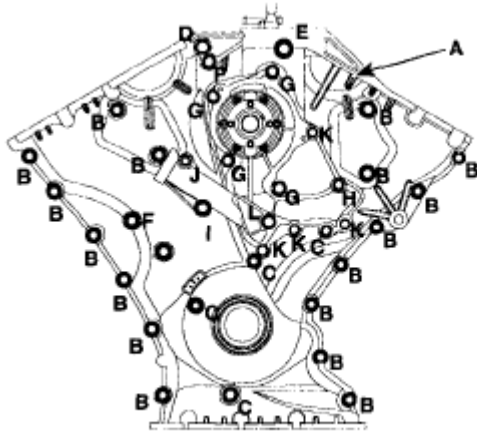
H (1): 9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)

I (1): 9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)

J (1): 9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)

K (4): 9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)

L (1): 21.56-26.46 N.m (2.2-2.7 kgf.m, 15.91-19.53 lb-ft) - New bolt



ECBF033A

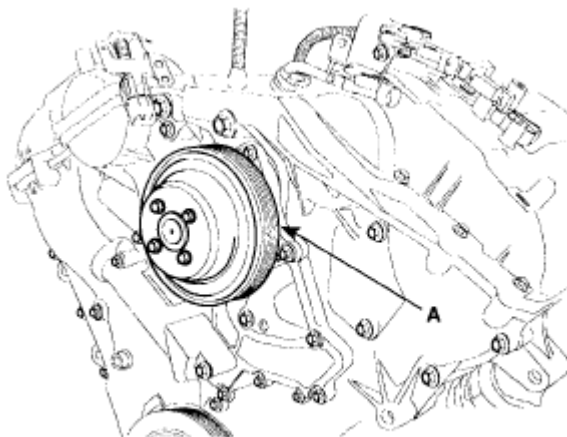
Fig. 102: Identifying Timing Chain Cover Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

- f. The firing and/or blow out test should not be performed within 30 minutes after the timing chain cover was assembled.

- 23. Install water pump pulley (A).

Tightening torque

7.84-9.80 N.m (0.8-1.0 kgf.m, 5.78-7.23 lb-ft)



KDRF107A

Fig. 103: Locating Water Pump Pulley
Courtesy of KIA MOTORS AMERICA, INC.

- 24. Install drive belt auto tensioner (A).

Tightening torque

Bolt (B) 81.39-85.32 N.m (8.3-8.7 kgf.m, 60.03-62.93 lb-ft)

17.64-21.56 N.m (1.8-2.2 kgf.m, 13.02-15.91 lb-ft)

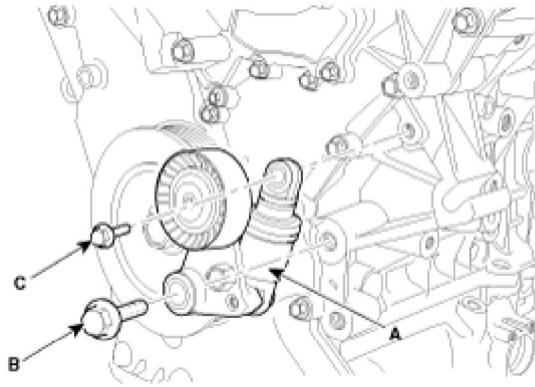


Fig. 104: Identifying Drive Belt Auto Tensioner Bolts
Courtesy of KIA MOTORS AMERICA, INC.

25. Install drive belt idler (A).

Tightening torque

52.92-57.82 N.m (5.4-5.9 kgf.m, 39.06-42.67 lb-ft)

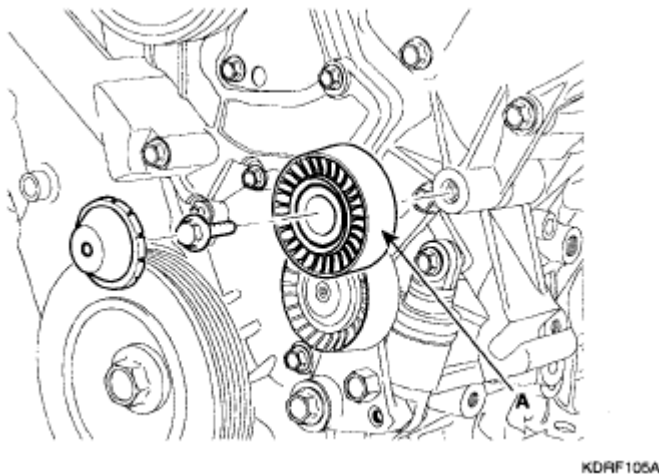
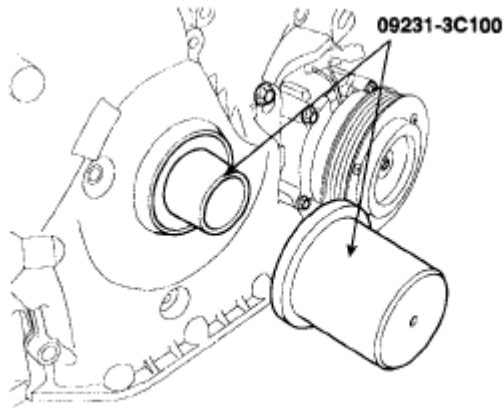


Fig. 105: Locating Drive Belt Idler
Courtesy of KIA MOTORS AMERICA, INC.

26. Lower the engine assembly by using the jack.
27. Using SST (09231-3C100), install timing chain cover oil seal.



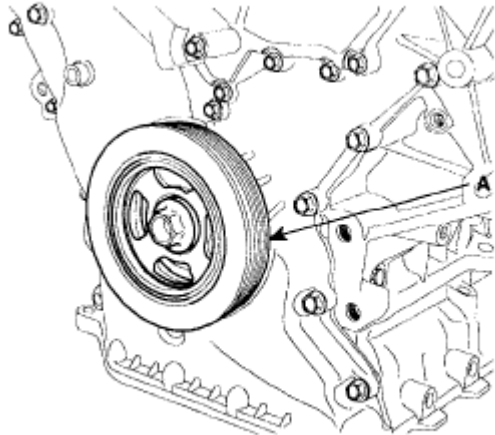
ECRF050A

Fig. 106: Identifying SST (09231-3C100)
Courtesy of KIA MOTORS AMERICA, INC.

28. Using SST (09231-3C300) install crankshaft damper pulley (A).

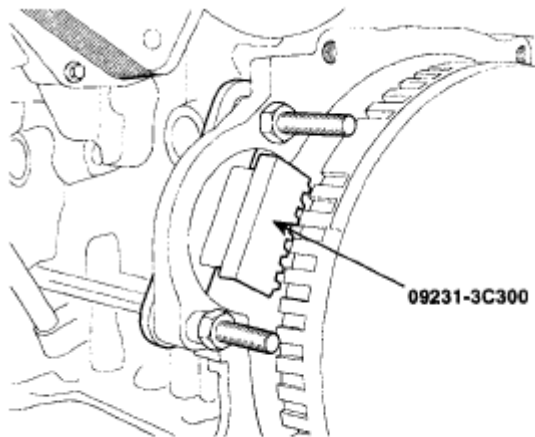
Tightening torque

284.2-303.8 N.m (29.0-31.0 kgf.m, 209.76-224.22 lb-ft)



KDRF109A

Fig. 107: Locating Crankshaft Damper Pulley
Courtesy of KIA MOTORS AMERICA, INC.



ECRF061A

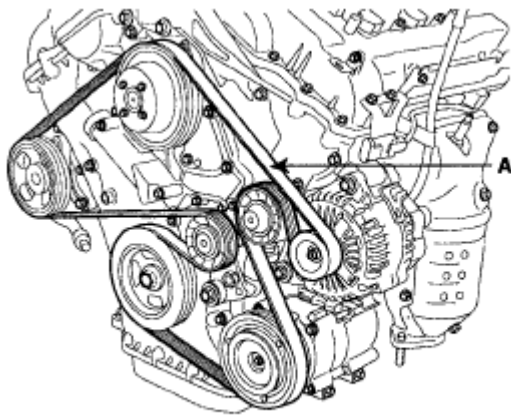
Fig. 108: Identifying SST (09231-3C300)
Courtesy of KIA MOTORS AMERICA, INC.

29. Install drive belt (A).

Crankshaft pulley --> A/C pulley --> idler pulley --> generator pulley --> water pump pulley --> P/S pump pulley --> tensioner pulley.

Rotate auto tensioner arm in the counter - clockwise moving auto tensioner pulley bolt with wrench.

After putting belt on auto tensioner pulley, release the auto tensioner pulley slowly.



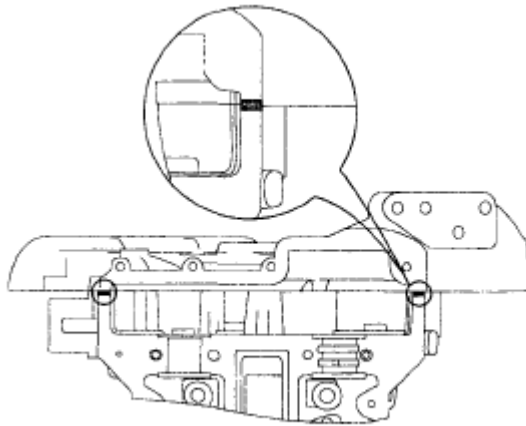
KDRF101A

Fig. 109: Identifying Drive Belt Routing
Courtesy of KIA MOTORS AMERICA, INC.

30. Install cylinder head cover.

1. The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
2. After applying sealant (TB1217H), it should be assembled within 5 minutes. Bead width: 2.5 mm

(0.1 in.)



KDRF231A

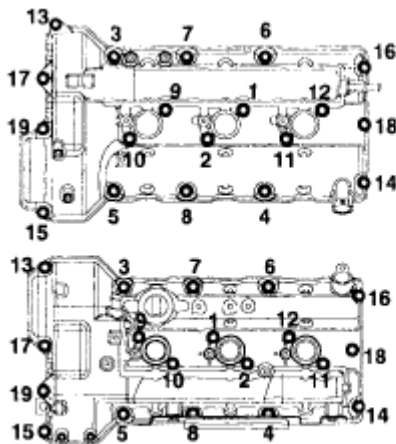
Fig. 110: Identifying Hardening Sealant On Upper Area Between Timing Chain Cover And Cylinder Head

Courtesy of KIA MOTORS AMERICA, INC.

3. The firing and/or blow out test should not be performed within 30 minutes after the cylinder head cover was assembled.
4. Install the cylinder head cover bolts as following method.

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



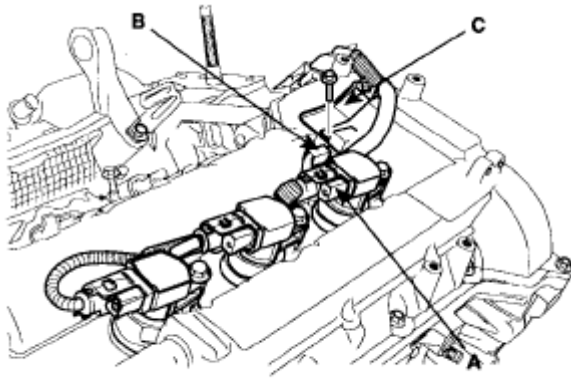
KDRF139A

Fig. 111: Identifying Cylinder Head Cover Bolts Tightening Sequence

Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Do not reuse cylinder head cover gasket.

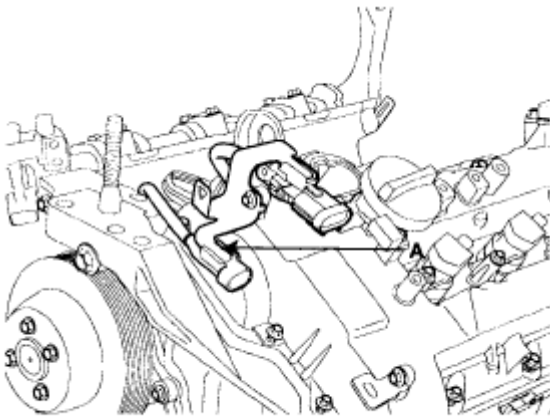
5. Install ignition coil
6. Connect RH ignition coil connector (A), condenser connector (B) and install wiring bracket (C).



KDRF111A

Fig. 112: Locating RH Ignition Coil Connector, Condenser Connector And Wiring Bracket
 Courtesy of KIA MOTORS AMERICA, INC.

7. Install connector bracket (A) from LH cylinder head cover.



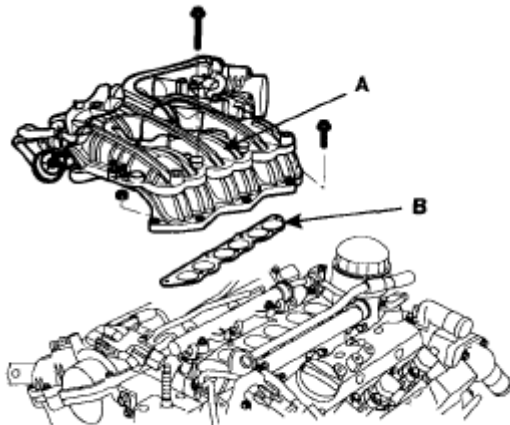
KDRF110A

Fig. 113: Locating Connector Bracket
 Courtesy of KIA MOTORS AMERICA, INC.

31. Install the surge tank and wiring connectors.
 1. Install the surge tank (A).

Tightening torque :

9.80 ~ 11.76 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.68 lb-ft)



BCKG031A

Fig. 114: Locating Surge Tank
 Courtesy of KIA MOTORS AMERICA, INC.

2. Install the connector bracket (A) to the surge tank.

Tightening torque :

6.86 ~ 10.78 N.m (0.7 ~ 1.1 kgf.m, 5.06 ~ 7.96 lb-ft)

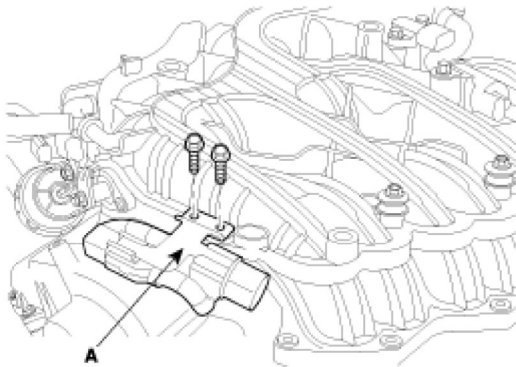
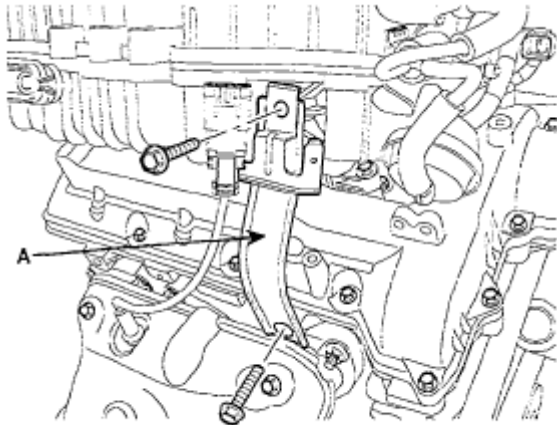


Fig. 115: Identifying Surge Tank Connector Bracket
 Courtesy of KIA MOTORS AMERICA, INC.

3. Install the surge tank stay.

Tightening torque :

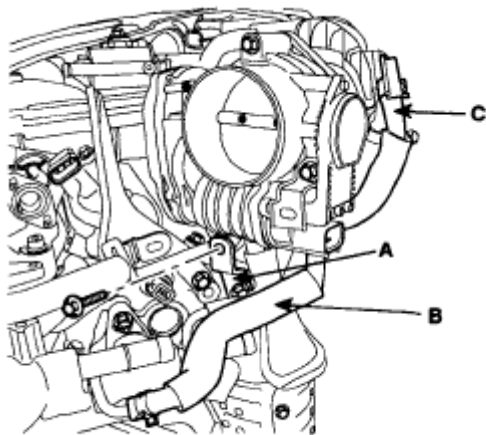
27.44 ~ 31.36 N.m (2.8 ~ 3.2 kgf.m, 20.25 ~ 23.14 lb-ft)



UCBF020A

Fig. 116: Identifying Surge Tank Stay
 Courtesy of KIA MOTORS AMERICA, INC.

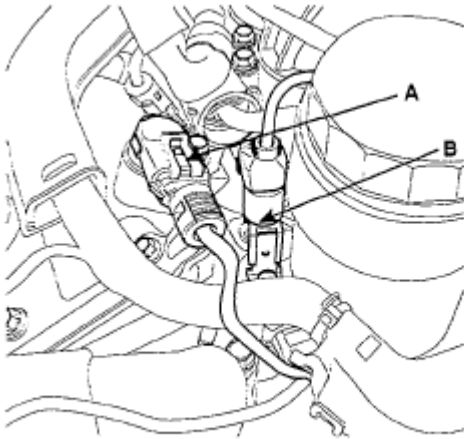
4. Connect the brake vacuum hose.
5. Connect the PCV hose (C).
6. Connect the water hoses (B) to the ETC.
7. Install the ETC bracket (A).



KDRF176A

Fig. 117: Locating PCV(C) Hose
 Courtesy of KIA MOTORS AMERICA, INC.

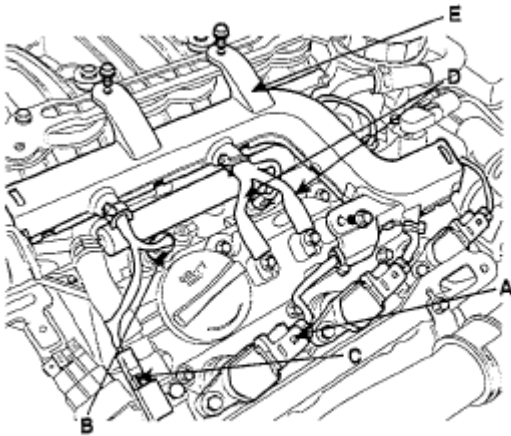
8. Connect the LH CMPS connector (A) and oil pressure switch connector(B).



KDRF159A

Fig. 118: Identifying LH CMPS And Oil Pressure Switch Connector
Courtesy of KIA MOTORS AMERICA, INC.

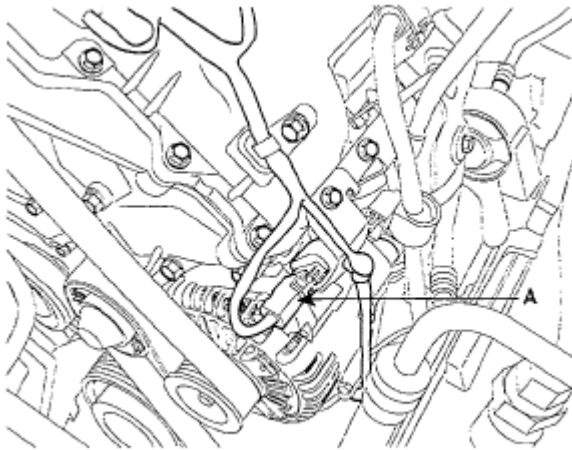
9. Install the wiring harness protector (E) and connect the LH ignition coil connector (A), injector connector (B), condenser connector (C) and ground (D).



KDRF158A

Fig. 119: Identifying LH Ignition Coil Connector And Condenser Connector
Courtesy of KIA MOTORS AMERICA, INC.

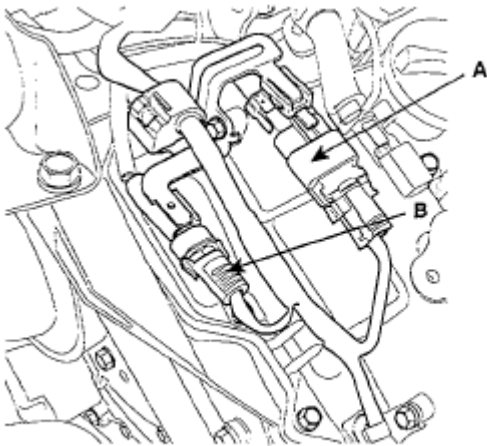
10. Connect the LH front oxygen sensor connector (A).



KDRF155A

Fig. 120: Identifying LH Front Oxygen Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

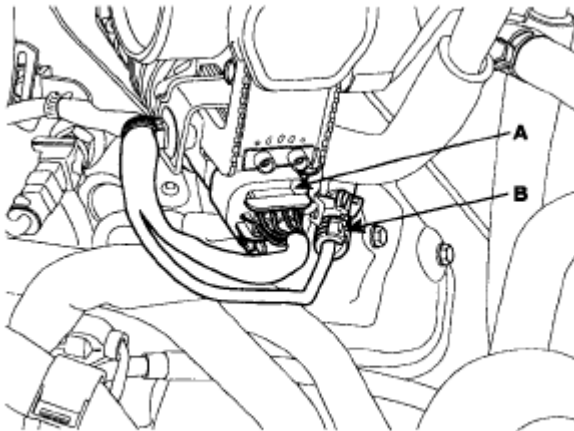
11. Connect the OCV connector (A) and knock sensor connector (B).



KDRF155A

Fig. 121: Identifying OCV Connector And Knock Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

12. Connect the ETC connector (A) and knock sensor connector (B).



KDRF162A

Fig. 122: Locating ETC Connector & Knock Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

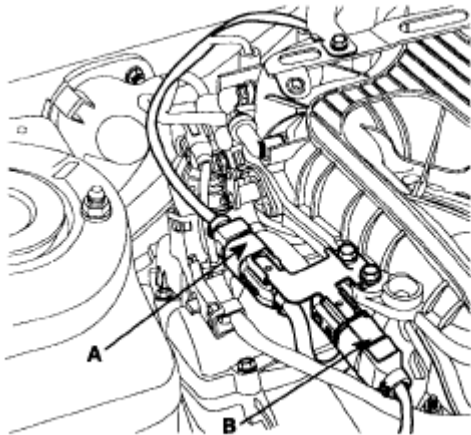
13. Connect the PCSV connector (A), MAP sensor connector (B) and PCSV hose.



KDRF160A

Fig. 123: Locating PCSV Connector, MAP Sensor Connector And PCSV Hose
Courtesy of KIA MOTORS AMERICA, INC.

14. Connect the RH injector connector (A) and ignition coil connector (B).



KDRF153A

Fig. 124: Locating RH Injector Connector And Ignition Coil Connector
 Courtesy of KIA MOTORS AMERICA, INC.

15. Connect the RH oxygen sensor connector (A) and tighten the power steering hose mounting bolts (B).

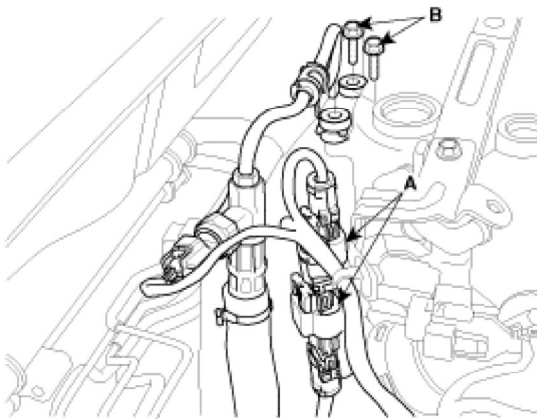


Fig. 125: Identifying RH Oxygen Sensor Connector & Power Steering Hose Mounting Bolts
 Courtesy of KIA MOTORS AMERICA, INC.

32. Install the engine mounting bracket (A).

Tightening torque :

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

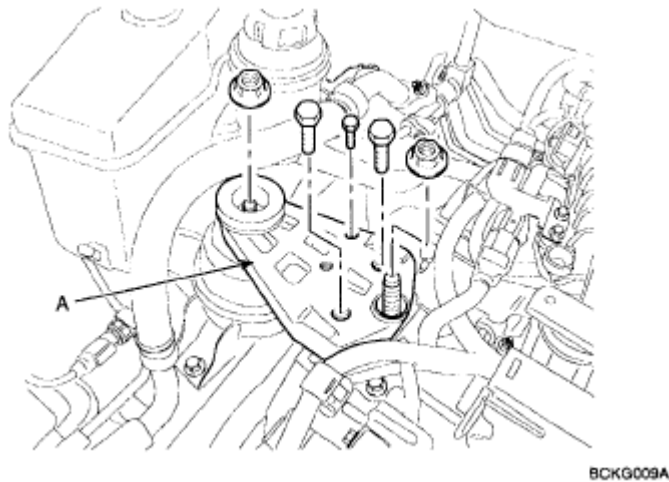


Fig. 126: Locating Engine Mounting Bracket(A)
Courtesy of KIA MOTORS AMERICA, INC.

33. Install the coolant reservoir tank.
34. Remove the jack from the upper oil pan.
35. Install 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 oil pan.

Bead width : 2.5mm (0.1in.).

But marked area (*) to be 5.0mm (0.2in.)

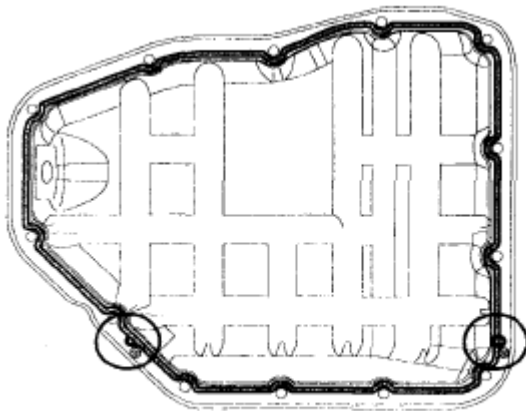


Fig. 127: Identifying Lower Oil Pan Bead Width
Courtesy of KIA MOTORS AMERICA, INC.

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

2. Remove harmful foreign matters on the sealing face before applying sealant.
3. When applying sealant gasket, sealant must not be protruded into the inside of oil pan.
4. To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.

3. Install the lower oil pan (A).

Tightening torque :

9.80 ~ 11.76 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.68 lb-ft)

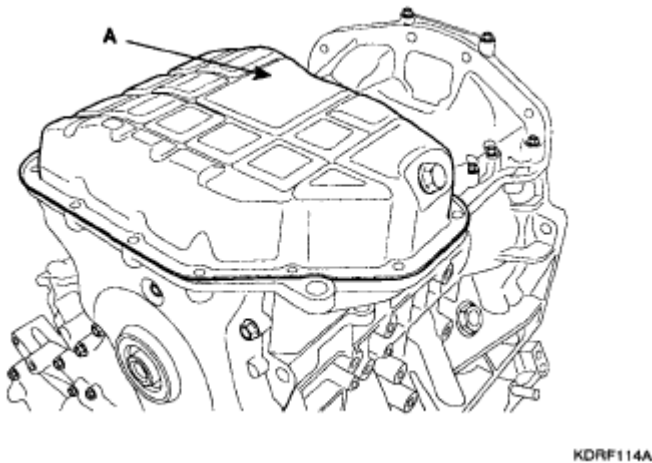


Fig. 128: Identifying Lower Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

36. Install the side cover.

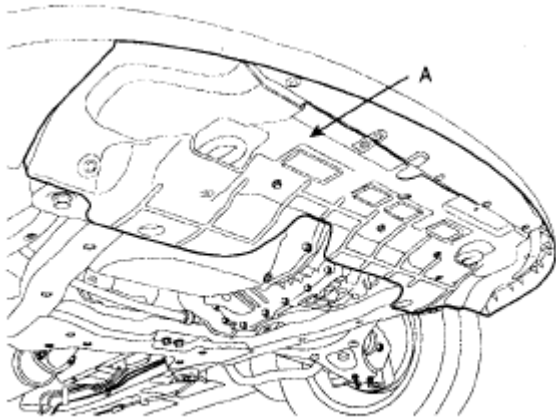
Tightening torque :

8.8 ~ 10.8 N.m (0.9 ~ 1.1 kgf.m, 6.5 ~7.9 lb-ft)

37. Install the under cover (A).

Tightening torque :

8.8 ~ 10.8 N.m (0.9 ~ 1.1 kgf.m, 6.5 ~7.9 lb-ft)



ACKF064A

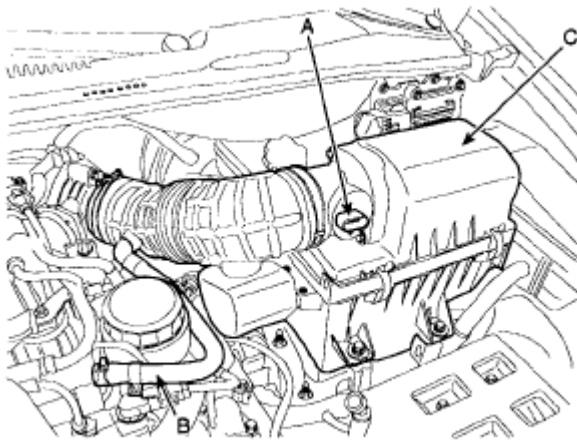
Fig. 129: Locating Under Cover(A)
Courtesy of KIA MOTORS AMERICA, INC.

38. Install the RH front wheel.

Tightening torque :

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

39. Install the intake air hose and air cleaner assembly.
1. Install the intake air hose and air cleaner assembly(C).
 2. Connect the breather hose (B) to the air intake hose.
 3. Connect the MAF sensor connector (A).



BCKG002A

Fig. 130: Locating MAF Connector And Air Cleaner Assembly
Courtesy of KIA MOTORS AMERICA, INC.

40. Install the engine cover (A).

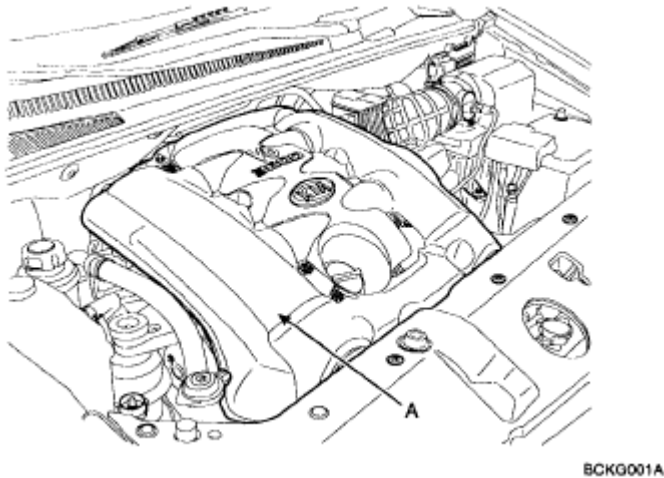


Fig. 131: Locating Engine Cover

Courtesy of KIA MOTORS AMERICA, INC.

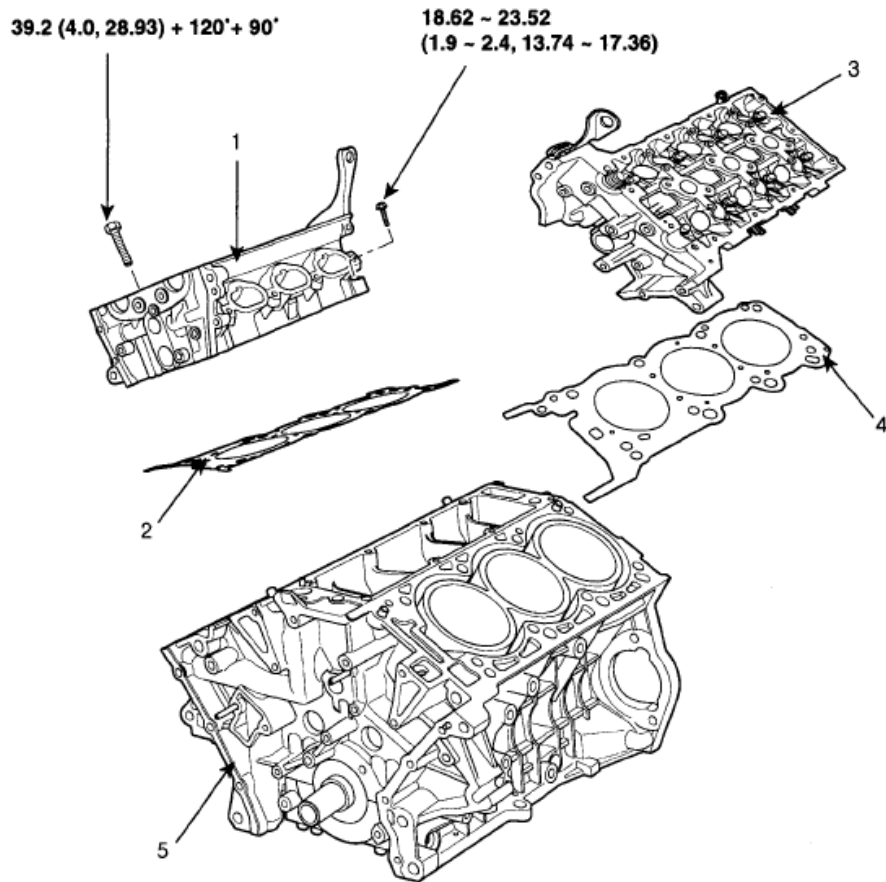
41. Connect the battery negative cable (A).

NOTE:

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

CYLINDER HEAD ASSEMBLY

COMPONENTS

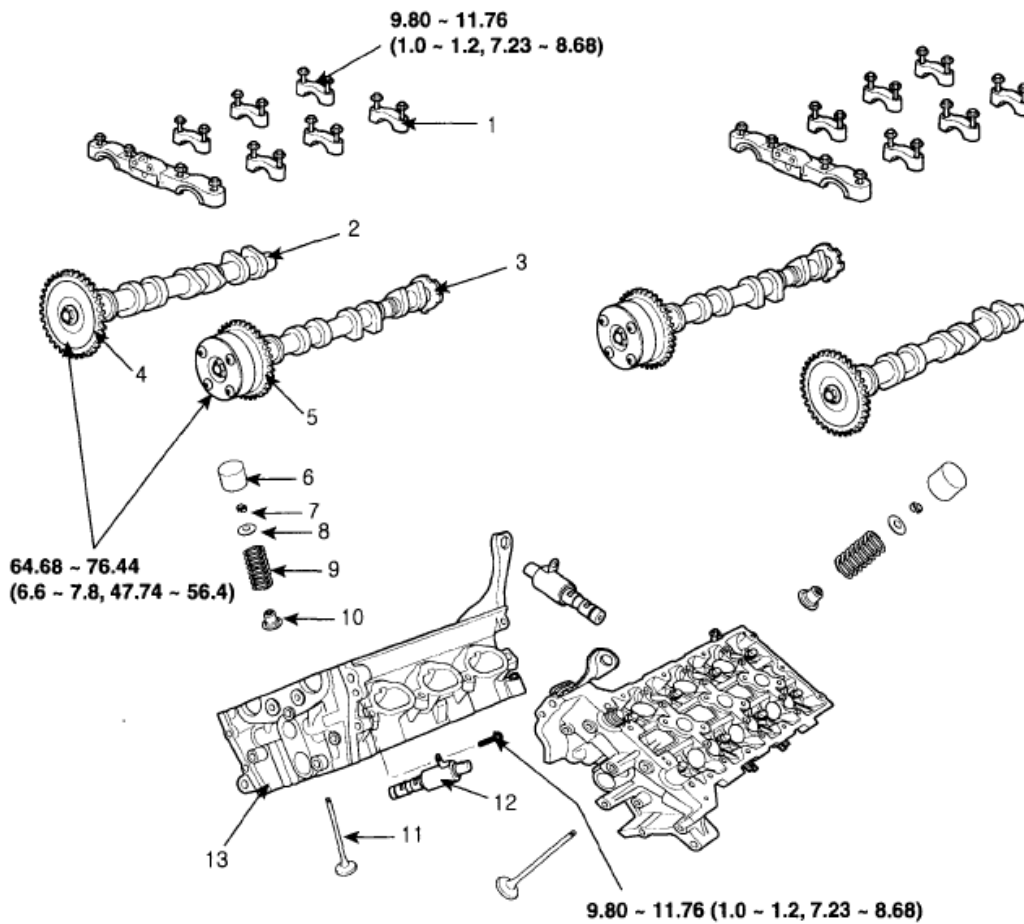


TORQUE : N.m (kgf.m, lb-ft)

- | | |
|----------------------------|----------------------------|
| 1. RH cylinder head | 4. LH cylinder head gasket |
| 2. RH cylinder head gasket | 5. Cylinder block |
| 3. LH cylinder head | |

ECBF010A

Fig. 132: Identifying Cylinder Head Assembly Components And Torque Specifications (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.



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

- | | | |
|------------------------------|---------------------|-------------------|
| 1. Camshaft bearing cap | 6. MLA | 11. Valve |
| 2. Exhaust camshaft | 7. Retainer lock | 12. OCV |
| 3. Intake camshaft | 8. Retainer | 13. Cylinder head |
| 4. Exhaust camshaft sprocket | 9. Valve spring | |
| 5. CVVT assembly | 10. Valve stem seal | |

LDK9001A

Fig. 133: Identifying Cylinder Head Assembly Components And Torque Specifications (2 Of 2)
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 operating 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

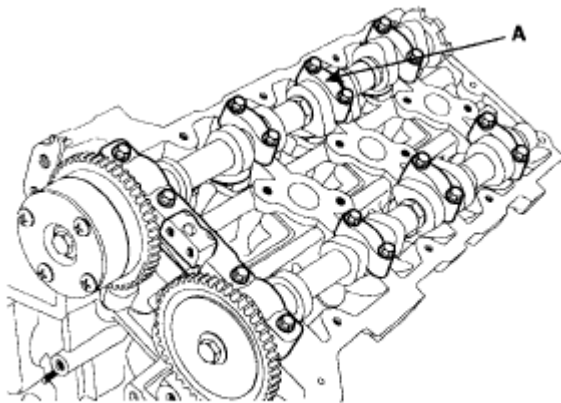
holding the connector portion.

NOTE:

- Mark all wiring and hoses to avoid disconnection.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center. Refer to VALVE CLEARANCE INSPECTION AND ADJUSTMENT.

Engine removal is required for this procedure.

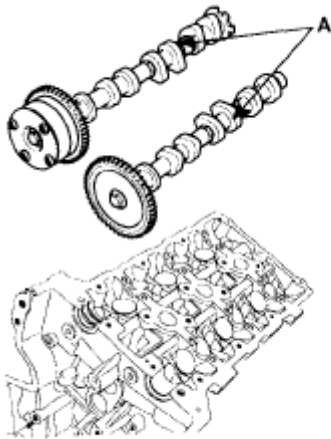
1. Remove exhaust manifold. Refer to EXHAUST MANIFOLD.
2. Remove intake manifold. Refer to INTAKE MANIFOLD.
3. Remove timing chain. Refer to REMOVAL.
4. Remove water temperature control assembly. Refer to WATER TEMPERATURE CONTROL ASSEMBLY.
5. Remove camshaft bearing cap (A).



KDRF196A

Fig. 134: Locating Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

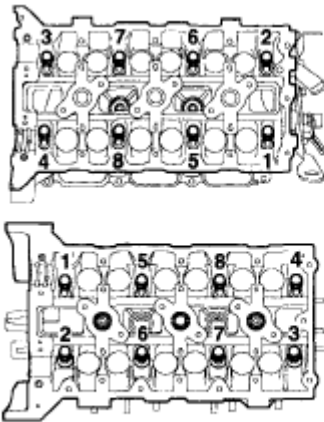
6. Remove camshaft assembly (A).



KDRF197A

Fig. 135: Identifying Camshaft Assemblies
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove cylinder head bolts, then remove cylinder head.
 1. Uniformly loosen and remove the 16 cylinder head bolts, in several passes, in the sequence shown in illustration. Remove the 16 cylinder head bolts and plate washers.



KDRF199A

Fig. 136: Identifying Cylinder Head Bolts Loosening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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

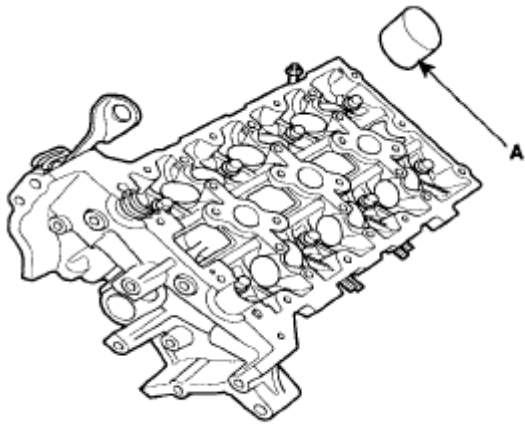
2. Lift the cylinder head from the dowels on the cylinder block and place the cylinder head on wooden blocks on a bench.

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

DISASSEMBLY

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

1. Remove MLAs (A).

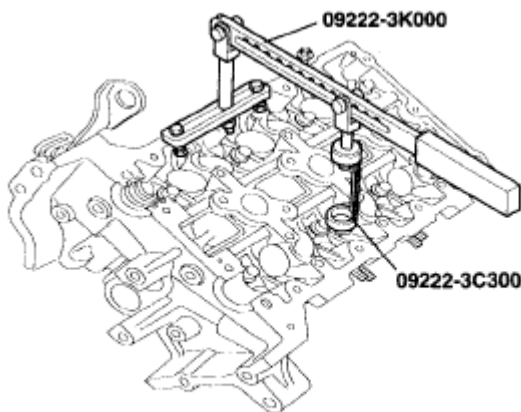


KDRF200A

Fig. 137: Identifying MLA)

Courtesy of KIA MOTORS AMERICA, INC.

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



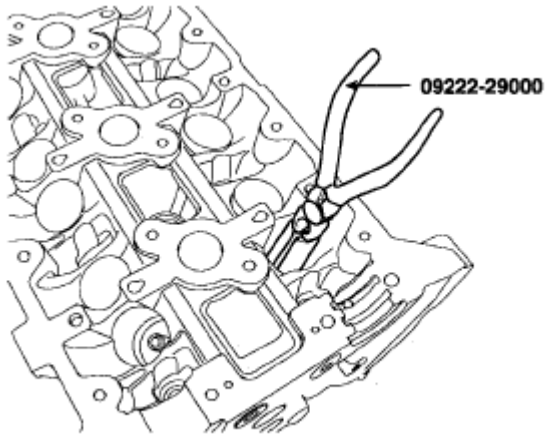
LDKG002A

Fig. 138: 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.

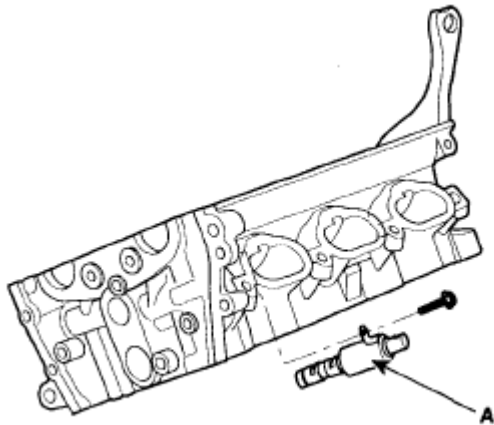


KDRF234A

Fig. 139: Identifying SST (09222-29000)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not reuse old valve stem seals.

3. Remove OCV (A).



KDRF202A

Fig. 140: Identifying OCV
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

CYLINDER HEAD

1. Inspect for flatness.

Using a precision straight edge and feeler gauge, measure the surface the contacting the cylinder block

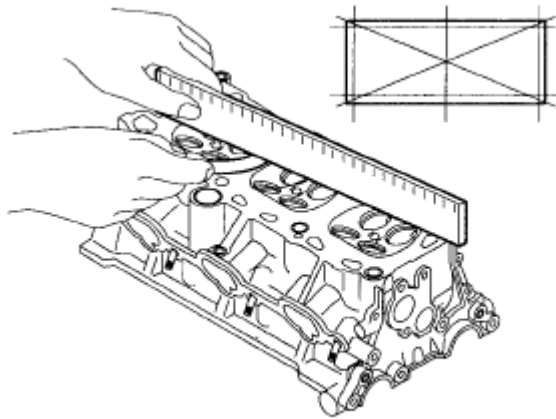
and the manifolds for warpage.

Flatness of cylinder head gasket surface

Standard: Less than 0.05 mm (0.002 in.) [Less than 0.02 mm (0.0008 in.)/150x150]

Flatness of manifold gasket surface

Standard: Less than 0.03 mm (0.001 in.)/110x110



EQQF160A

Fig. 141: Measuring Surface Contact Cylinder Block And Manifolds For Warpage
Courtesy of KIA MOTORS AMERICA, INC.

2. Inspect for cracks.

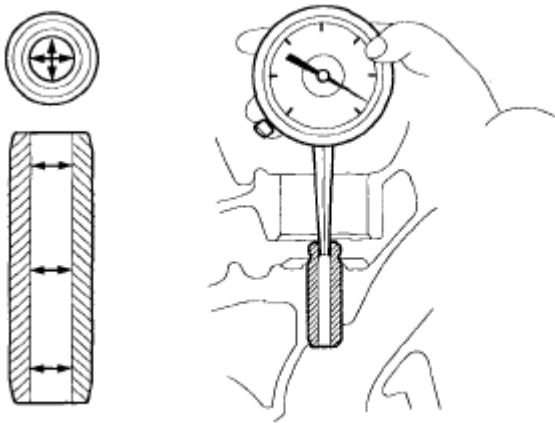
Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

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 I.D.

Intake/Exhaust: 5.500-5.512 mm (0.216-0.217 in.)



ECBF034A

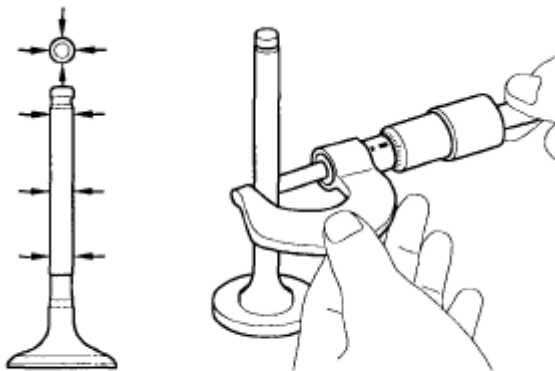
Fig. 142: Measuring Inside Diameter Of Valve Guide
Courtesy of KIA MOTORS AMERICA, INC.

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

Valve stem O.D.

Intake: 5.465-5.480 mm (0.2151-0.2157 in.)

Exhaust: 5.458-5.470 mm (0.2149-0.2153 in.)



KGRF227A

Fig. 143: Measuring Outer Diameter Of Valve Stem
Courtesy of KIA MOTORS AMERICA, INC.

3. Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.

Valve stem-to-guide clearance

[Standard]

Intake: 0.020-0.047 mm (0.0008-0.0018 in.)

Exhaust: 0.030-0.054 mm (0.0012-0.0021 in.)

[Limit]

Intake: 0.07 mm (0.0027 in.)

Exhaust: 0.09 mm (0.0035 in.)

2. Inspect valves.

1. Check the valve is ground to the correct 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.

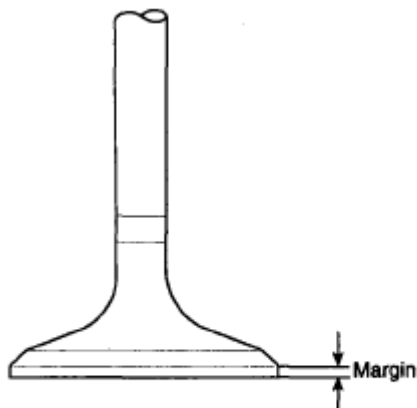
If the margin thickness is less than minimum, replace the valve.

Margin

[Standard]

Intake: 1.56-1.86 mm (0.06142-0.07323 in.)

Exhaust: 1.73-2.03 mm (0.06811-0.07992 in.)



ECKD221A

Fig. 144: Identifying Valve Head Margin Thickness
Courtesy of KIA MOTORS AMERICA, INC.

4. Check the valve length.

Length

Intake: 105.27 mm (4.1445 in.)

Exhaust: 105.50 mm (4.1535 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

Check the valve seat for evidence of overheating and improper contact with the valve face.

If the valve seat is worn, replace cylinder head.

Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace cylinder head. 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.

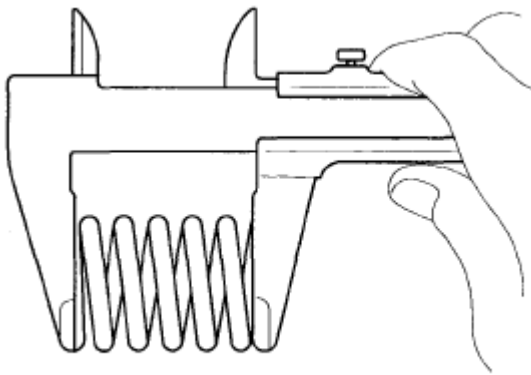
4. Inspect valve springs.
 1. Using a steel square, measure the out-of-square of the valve spring.
 2. Using a vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height: 43.86 mm (1.7267 in.)

Out-of-square: 1.5°



KCRF205A

Fig. 145: Measuring Free Length Of Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

MLA

1. Inspect MLA.

Using a micrometer, measure the MLA outside diameter.

MLA O.D.

Intake/Exhaust: 34.964-34.980 mm (1.3765-1.3771 in.)

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

Tappet bore I.D.

Intake/Exhaust: 35.000-35.025 mm (1.3779-1.3789 in.)

3. Subtract 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.)

CAMSHAFT

1. Inspect cam lobes.

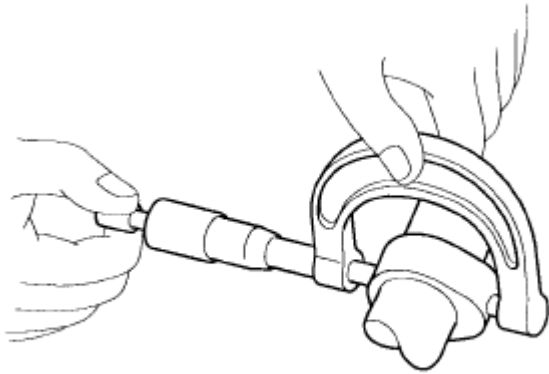
Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

Intake: 46.8 mm (1.8425 in.)

Exhaust: 45.8 mm (1.8031 in.)

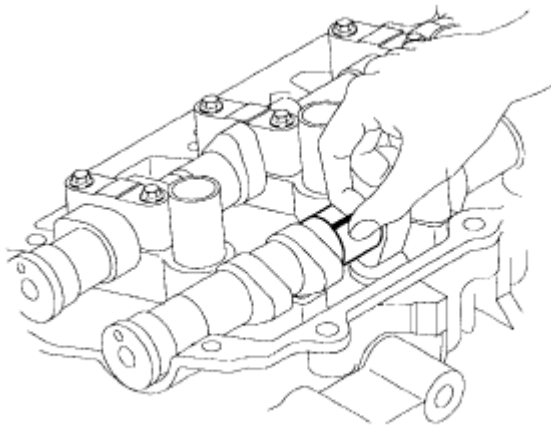


KCRF206A

Fig. 146: Measuring Cam Lobe Height
Courtesy of KIA MOTORS AMERICA, INC.

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

2. 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 journal.



KCRF207A

Fig. 147: Inspecting Camshaft Journal Clearance
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the bearing caps. Refer to **INSTALLATION**.

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

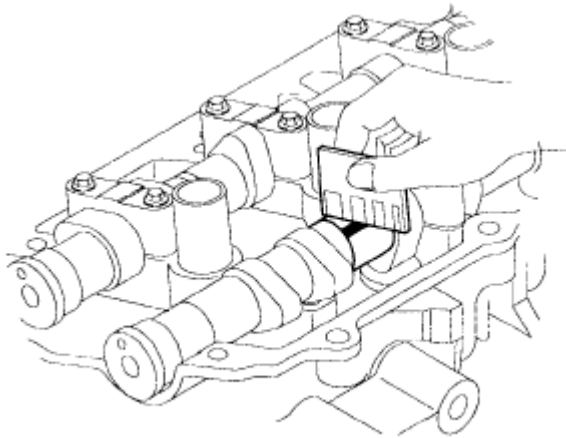
No. 1 journal: 0.020-0.057 mm (0.0008-0.0022 in.)

No. 2, 3, 4 journal: 0.030-0.067 mm (0.0012-0.0026 in.)

Exhaust

No. 1 journal: 0.020-0.057 mm (0.0008-0.0022 in.)

No. 2, 3, 4 journal: 0.030-0.067 mm (0.0012-0.0026 in.)



KCRF208A

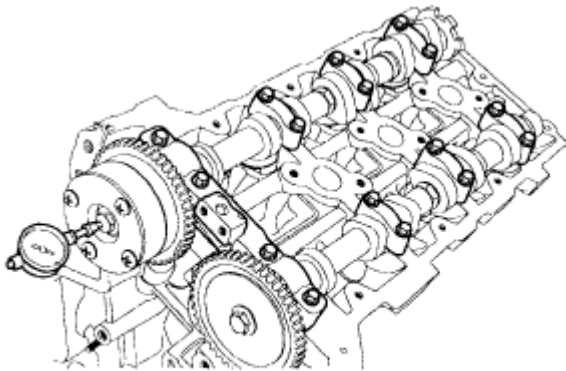
Fig. 148: Measuring Plastigage At Its Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

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

7. Completely remove the plastigage.
8. Remove the camshafts.
3. Inspect camshaft end play.
 1. Install the camshafts. Refer to **INSTALLATION**.
 2. Using a dial indicator, measure the end play while moving the camshaft back and forth.

Camshaft end play

[Standard value]: 0.02-0.18 mm (0.0008-0.0071 in.)



KDRF196B

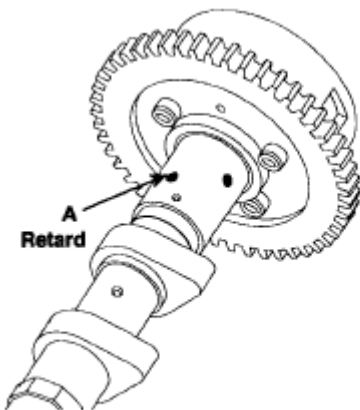
Fig. 149: Measuring Camshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

3. Remove the camshafts.

CVVT ASSEMBLY

1. Inspect CVVT assembly.
 1. Check that the CVVT assembly will not turn.
 2. Apply vinyl tape to the retard hole except the one indicated by the arrow. See **Fig. 150**.



ECRF015A

Fig. 150: Locating Retard Hole
Courtesy of KIA MOTORS AMERICA, INC.

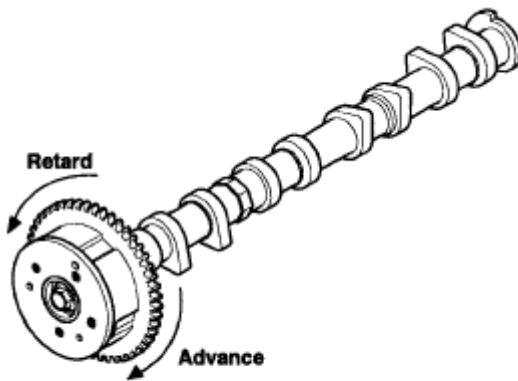
3. Wind tape around the tip of the air gun and apply air of approx. 150 kPa (1.5 kgf/cm², 21 psi) to the port of the camshaft.

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

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

4. Under the condition of (3), turn the CVVT assembly to the advance angle side (the arrow marked direction in the illustration) with your hand.

Depending on the air pressure, the CVVT assembly will turn to the advance side without applying force by hand. Also, If excessive air leaks from the port, the lock pin may not be fully released.



ECRF016A

Fig. 151: Identifying Retard And Advance Angle
Courtesy of KIA MOTORS AMERICA, INC.

5. 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 22.5°

6. Turn the CVVT assembly with your hand and lock it at the maximum delay angle position (counter clockwise).

REASSEMBLY

Thoroughly clean all parts to be assembled.

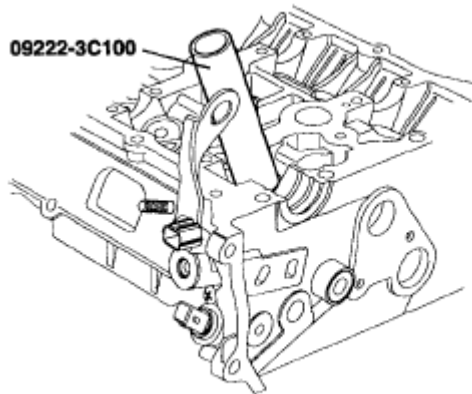
Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.

Replace oil seals with new ones.

1. Install valves.
 1. Using SST (09222-3C100), push in a new oil seal.

NOTE: Do not reuse old valve stem seals.

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



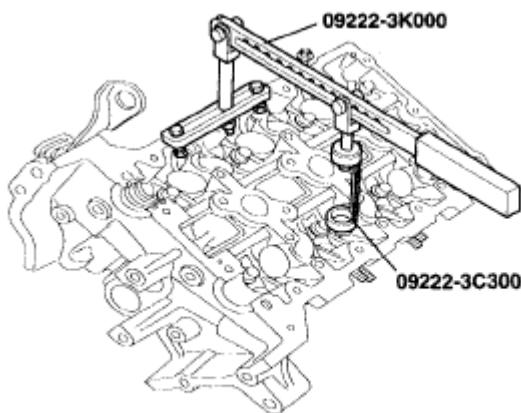
KCRF120B

Fig. 152: Identifying SST (09222-3C100)
Courtesy of KIA MOTORS AMERICA, INC.

2. Install the valve, valve spring and spring retainer.

NOTE: Place valve springs so that the side coated with enamel faces toward the valve spring retainer and then install the retainer.

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



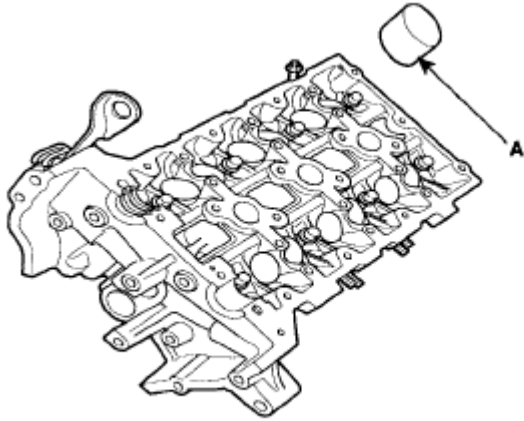
LDKG002A

Fig. 153: 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.

Check that the MLA rotates smoothly by hand.



KDRF200A

Fig. 154: Identifying MLA

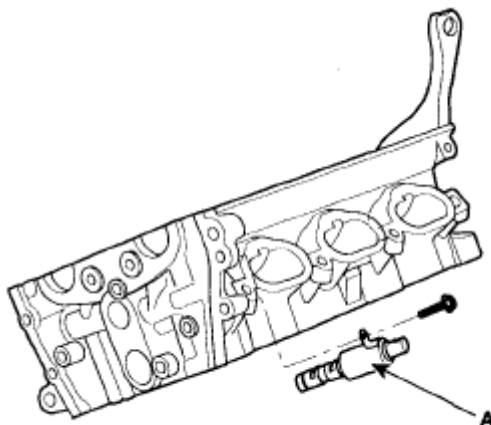
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: MLA can be reinstalled in its original position.

3. Install OCV (A).

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



KDRF202A

Fig. 155: Identifying OCV

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 the OCV assembly clean.
- Do not hold the OCV sleeve during servicing.
- When the OCV is installed on the engine, do not move the engine by holding the OCV yoke.

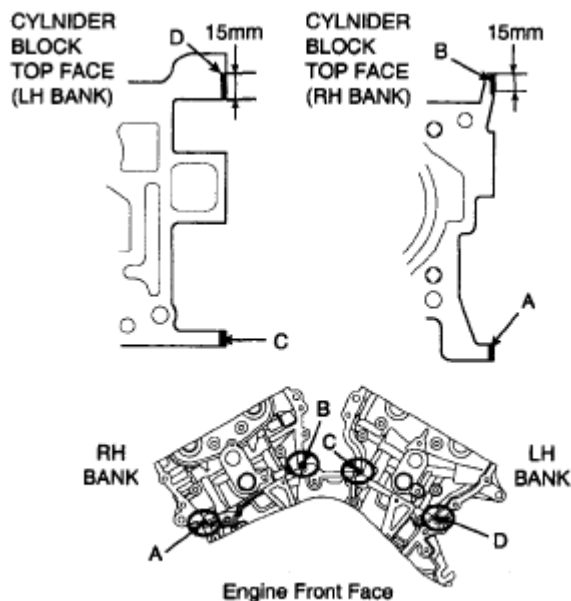
INSTALLATION**NOTE:**

- 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, set the No. 1 piston at TDC. Refer to VALVE CLEARANCE INSPECTION AND ADJUSTMENT.

1. Install the cylinder head.

- The sealant locations on cylinder head and cylinder block must be free from contamination.
- Apply sealant on cylinder block top face before assembling cylinder head gaskets.

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



ECBF017A

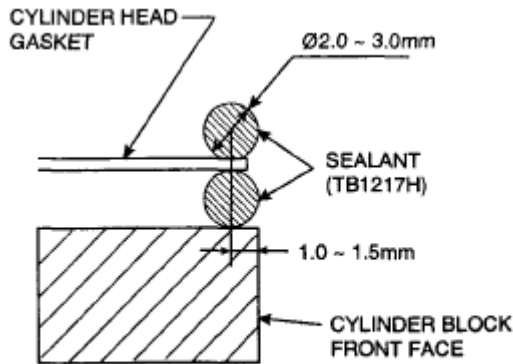
Fig. 156: Identifying Sealant Application Locations
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Refer to below illustration to apply the sealant.

Bead width: 2.0-3.0 mm

Sealant locations: 1.0-1.5 mm from block surface

Recommended sealant: Liquid sealant TB1217H

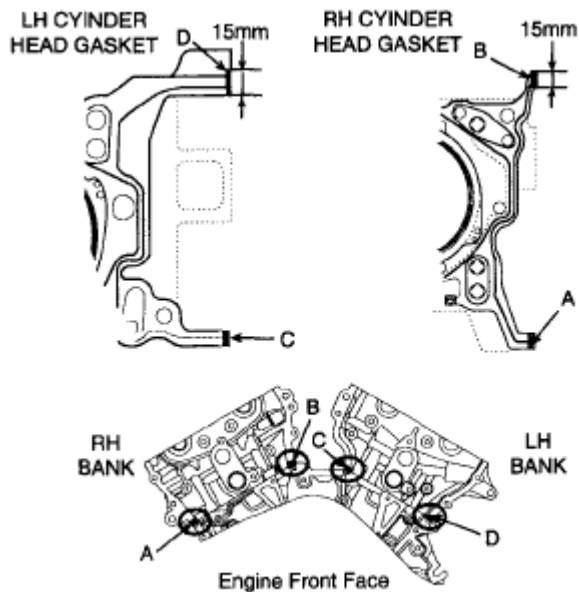


ECBF018A

Fig. 157: Identifying Sealant Bead Width
Courtesy of KIA MOTORS AMERICA, INC.

- c. Apply sealant on cylinder head gaskets after assembling cylinder head gaskets on cylinder block.

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



ECBF019A

Fig. 158: Identifying Sealant Application Locations

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Be careful of the installation direction.

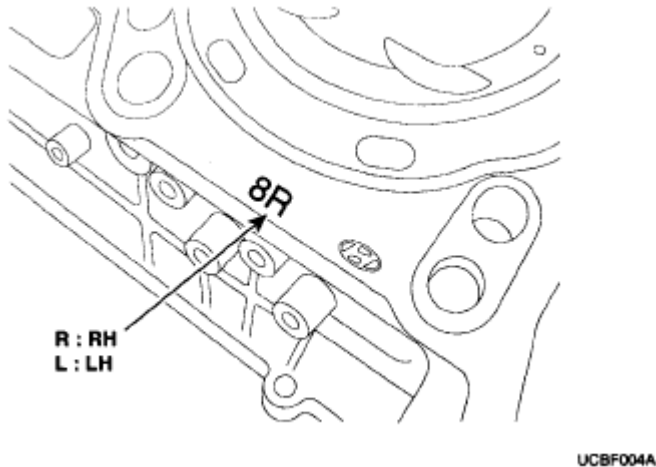


Fig. 159: Identifying Cylinder Head Installation Direction
Courtesy of KIA MOTORS AMERICA, INC.

- d. Install the cylinder head.

NOTE: Remove the extruded sealant after assembling cylinder heads.

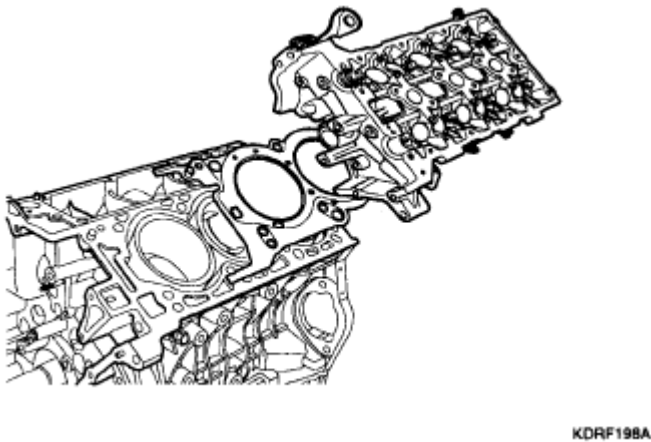


Fig. 160: Identifying Cylinder Head
Courtesy of KIA MOTORS AMERICA, INC.

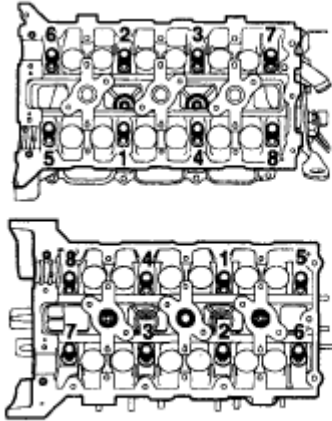
2. Place the cylinder head carefully in order not to damage the gasket with the bottom part of the end.
3. Install cylinder head bolts.
 1. Do not apply engine oil on the threads and under the heads of the cylinder head bolts.
 2. Using SST (09221 -4A000), install and tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown in illustration.

Tightening torque

Head bolt : 37.3~41.2 Nm (3.8~4.2 kgf.m, 27.5~30.4 lb-ft) + 118~122° + 88~92°

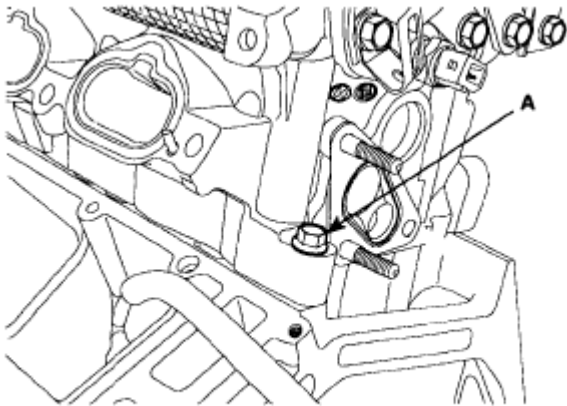
Bolt (A) : 18.62~23.52 Nm (1.9~2.4 kgf.m, 13.74~17.36 lb-ft)

NOTE: Always use new cylinder head bolts.



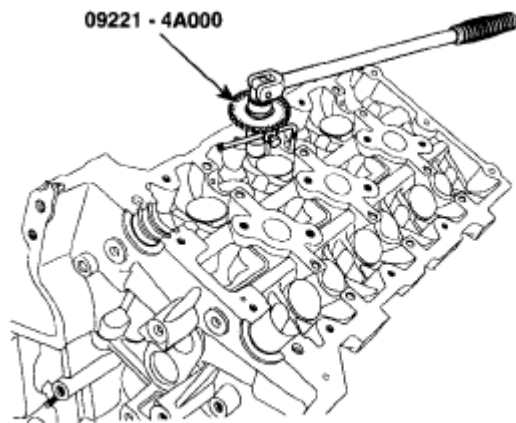
KDRF199B

Fig. 161: Identifying Cylinder Head Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.



ECBP035A

Fig. 162: Identifying Cylinder Head Bolts
Courtesy of KIA MOTORS AMERICA, INC.



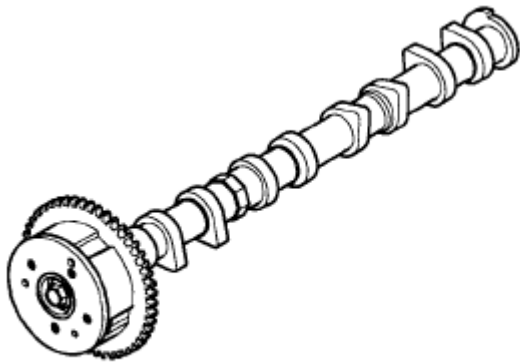
KDRF223A

Fig. 163: Identifying SST (09221-4A000)
 Courtesy of KIA MOTORS AMERICA, INC.

4. Install the CVVT and camshaft sprocket.

Tightening torque

64.68-76.44 N.m (6.6-7.8 kgf.m, 47.74-56.4 lb-ft)



KCRF122A

Fig. 164: Identifying CVVT And Camshaft Sprocket
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Install camshaft-inlet to dowel pin of CVVT assembly.

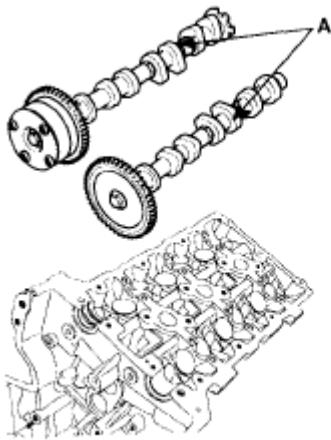
Ensure that the camshaft oil inlet is not obstructed.

- Hold the hexagonal head wrench portion of the camshaft with a vise, and install the bolt and CVVT assembly.
- Do not rotate CVVT assembly when camshaft is installed to dowel pin of CVVT assembly.

5. Install camshafts (A).

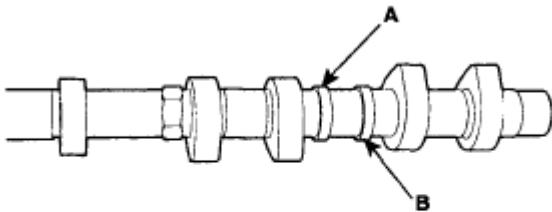
NOTE:

- Apply a light coat of engine oil on camshaft journals.
- Assemble the key groove of camshaft rear side to the same level of head top surface.
- Ensure that the camshaft components are installed in the correct locations.



KDRF197A

Fig. 165: Identifying Camshaft Assemblies
Courtesy of KIA MOTORS AMERICA, INC.

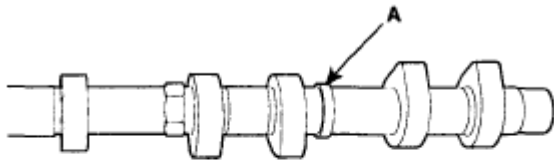
INTAKE CAMSHAFT

KDRF226A

Fig. 166: Identifying Intake Camshaft
Courtesy of KIA MOTORS AMERICA, INC.

INTAKE CAMSHAFT SPECIFICATIONS

LH	RH
A: 30 mm (1.1811 in.)	A: 27 mm (1.0630 in.)
B: 27 mm (1.0630 in.)	B: 30 mm (1.1811 in.)

EXHAUST CAMSHAFT

KDRF227A

Fig. 167: Identifying Exhaust Camshaft
 Courtesy of KIA MOTORS AMERICA, INC.

EXHAUST CAMSHAFT SPECIFICATIONS

LH	RH
A: 27 mm (1.0630 in.)	A: 30 mm (1.1811 in.)

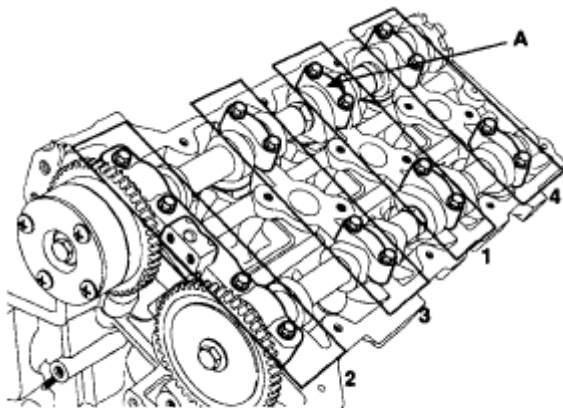
6. Install camshaft bearing caps (A).

Assemble camshaft bearing caps as the order below.

Tightening torque

5.9 N.m (0.6 kgf.m, 4.3 lb-ft) - 1st step

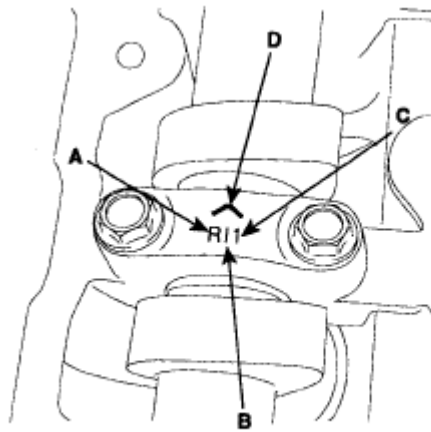
9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft) - 2nd step



UCBF008A

Fig. 168: Locating Camshaft Bearing Caps
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Ensure that the cam bearing caps are installed in the correct location and direction. Refer to the table below.



ECBF036A

Fig. 169: Identifying Cam Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

A: L (LH), R (RH)

B: 1 (Intake), None (Exhaust)

C: Journal number

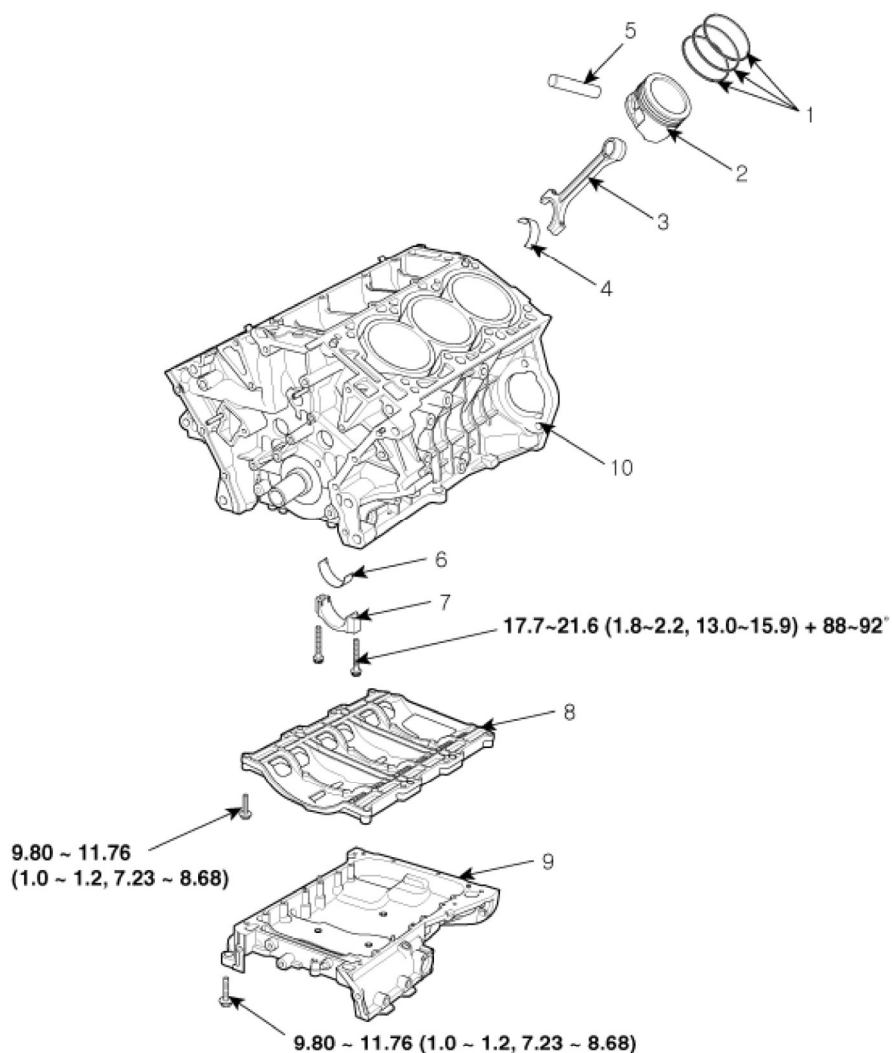
D: Front mark

CAUTION: Rotate the crankshaft to position the pistons 10 mm (0.3937 in.) from the top of the cylinder block.

7. Install water temperature control assembly. Refer to WATER TEMPERATURE CONTROL ASSEMBLY.
8. Install timing chain. Refer to INSTALLATION.
9. Check and adjust valve clearance. Refer to VALVE CLEARANCE INSPECTION AND ADJUSTMENT.
10. Install the exhaust manifold. Refer to EXHAUST MANIFOLD.
11. Install the intake manifold. Refer to INTAKE MANIFOLD.

ENGINE BLOCK

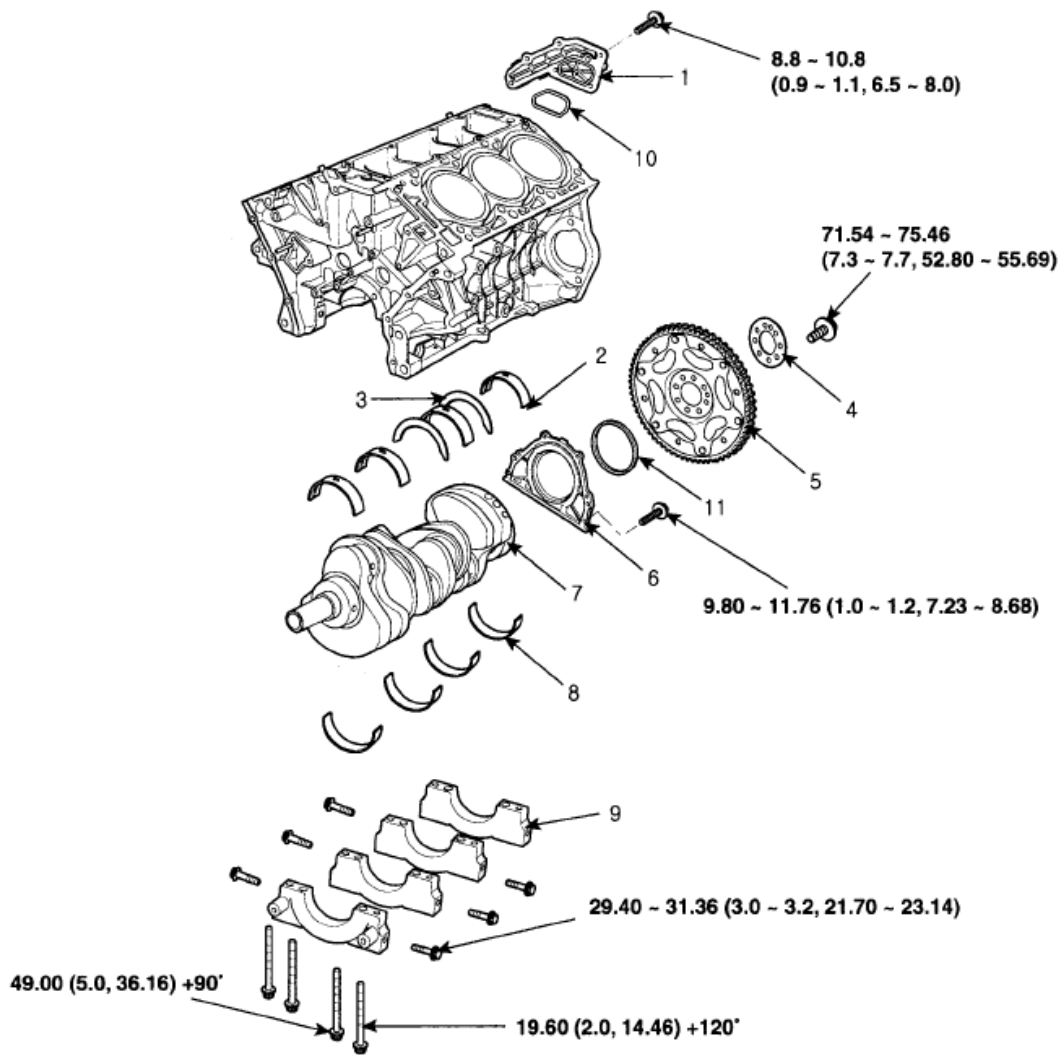
COMPONENTS



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

- | | |
|---------------------------------|---------------------------------|
| 1. Piston ring | 6. Connecting rod lower bearing |
| 2. Piston | 7. Connecting rod bearing cap |
| 3. Connecting rod | 8. Baffle plate |
| 4. Connecting rod upper bearing | 9. Upper oil pan |
| 5. Piston pin | 10. Cylinder block |

Fig. 170: Identifying Engine Block Components And Torque Specifications (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.



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

- | | |
|-----------------------------|-----------------------------|
| 1. Oil drain cover | 6. Rear oil seal case |
| 2. Crankshaft upper bearing | 7. Crankshaft |
| 3. Thrust bearing | 8. Crankshaft lower bearing |
| 4. Plate adapter | 9. Main bearing cap |
| 5. Drive plate | 10. Oil drain cover gasket |
| | 11. Rear oil seal |

BCKG026A

Fig. 171: Identifying Engine Block Components And Torque Specifications (2 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

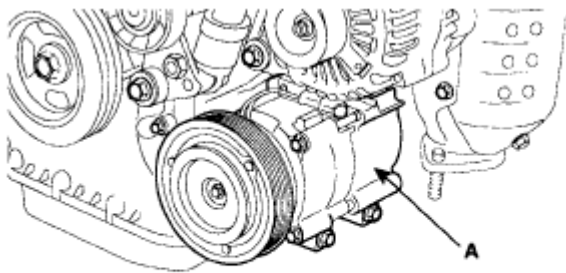
CAUTION:

- 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.
- Inspect the timing belt before removing the cylinder head.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center. Refer to VALVE CLEARANCE INSPECTION AND ADJUSTMENT.
- Engine removal is required for this procedure.

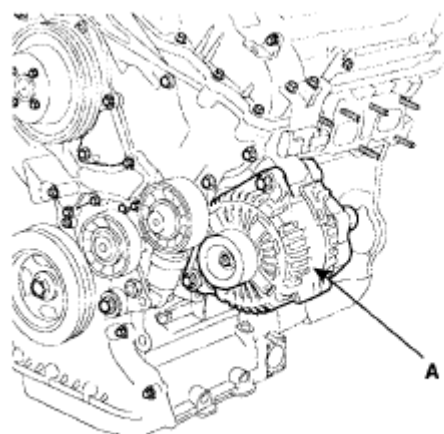
1. Remove exhaust manifold. Refer to EXHAUST MANIFOLD.
2. Remove intake manifold. Refer to INTAKE MANIFOLD.
3. Remove timing chain. Refer to REMOVAL.
4. Remove water temperature control assembly. Refer to WATER TEMPERATURE CONTROL ASSEMBLY.
5. Remove cylinder head. Refer to CYLINDER HEAD.
6. Remove oil pump. Refer to OIL PUMP.
7. Remove oil filter assembly. Refer to OIL FILTER ASSEMBLY.
8. Remove A/C compressor (A) from engine.



KDRF103A

Fig. 172: Locating Air Compressor
Courtesy of KIA MOTORS AMERICA, INC.

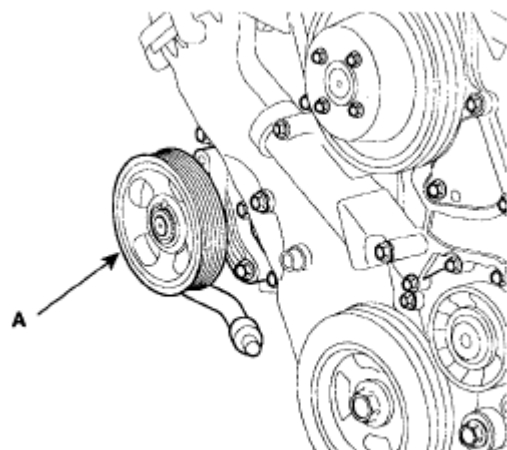
9. Remove generator (A) from engine.



KDRF104A

Fig. 173: Locating Generator
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove power steering pump (A) from engine.

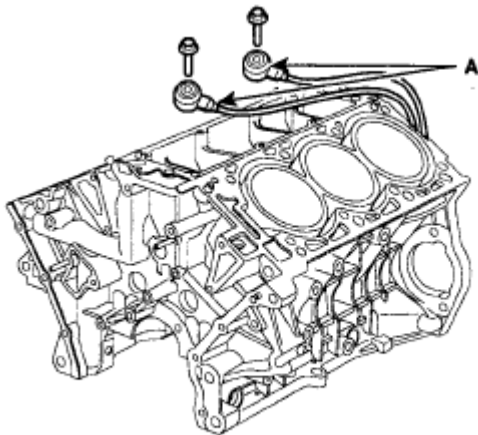


KDRF102A

Fig. 174: Locating Power Steering Pump
Courtesy of KIA MOTORS AMERICA, INC.

DISASSEMBLY

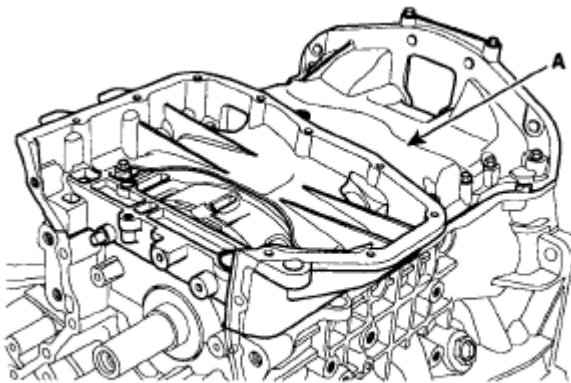
1. Remove drive plate.
2. Remove knock sensor (A).



KDRF205A

Fig. 175: Locating Knock Sensor
Courtesy of KIA MOTORS AMERICA, INC.

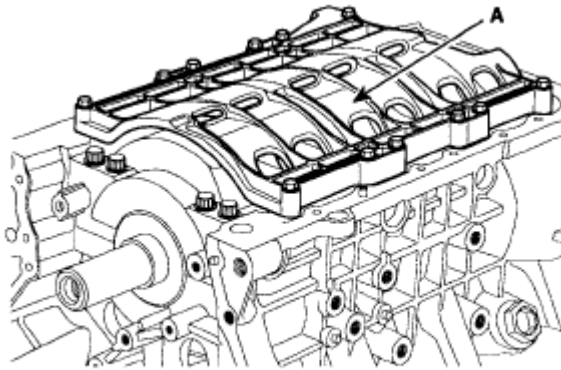
3. Remove upper oil pan (A).



KDRF206A

Fig. 176: Locating Upper Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

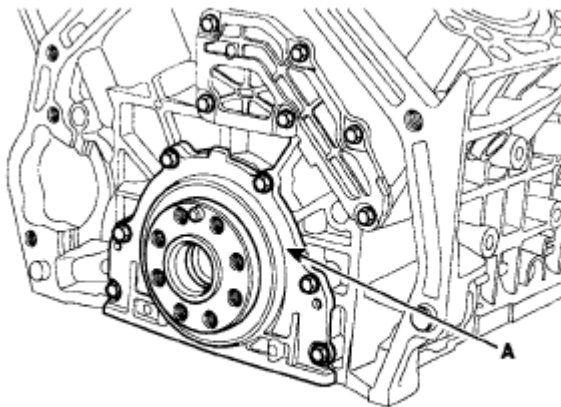
4. Remove baffle plate (A).



KDRF207A

Fig. 177: Locating Baffle Plate
Courtesy of KIA MOTORS AMERICA, INC.

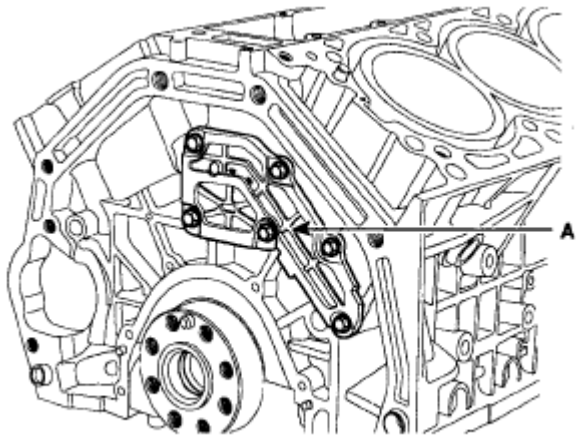
5. Remove rear oil seal case (A).



KDRF208A

Fig. 178: Locating Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove oil drain cover (A).



KDRF209A

Fig. 179: Locating Oil Drain Cover

Courtesy of KIA MOTORS AMERICA, INC.

7. Check the connecting rod end play. Refer to CONNECTING ROD AND CRANKSHAFT.
8. Check the connecting rod cap oil clearance. Refer to CONNECTING ROD AND CRANKSHAFT.
9. Remove piston and connecting rod assemblies.
 1. Using a ridge reamer, remove all the carbon from the top of the cylinder.
 2. Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

NOTE:

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

10. Remove crankshaft main bearing cap and check oil clearance. Refer to CONNECTING ROD AND CRANKSHAFT.
11. Check the crankshaft end play. Refer to PISTON AND RINGS.
12. Lift the crankshaft (A) out of engine, being careful not to damage journals.

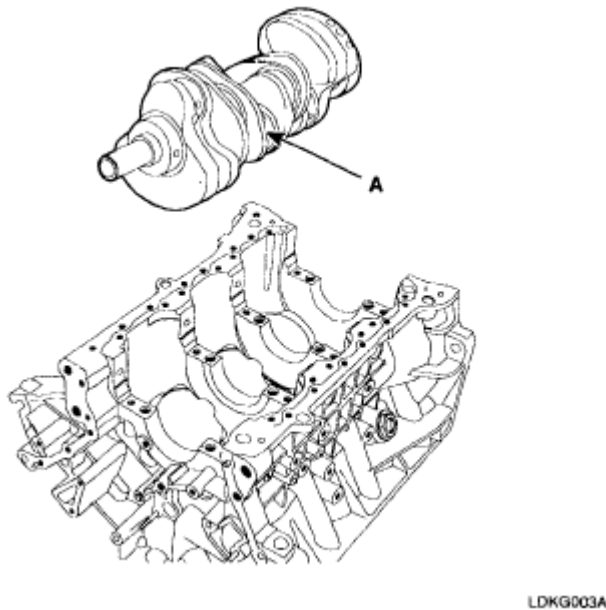


Fig. 180: Identifying Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Arrange the main bearings and thrust bearings in the correct order.

13. Check fit between piston and piston pin.

Try to move the piston back and forth on the piston pin. If any movement is felt, replace piston and piston pin as a set.

14. Remove piston rings.
1. Using a piston ring expander, remove the 2 compression rings.
 2. Remove 2 side rails and the spacer by hand.

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

15. Disconnect connecting rod from piston.

Using a press, remove the piston pin from piston. (Press-in load: 800-1400 kg (1764-3086 lbs.)

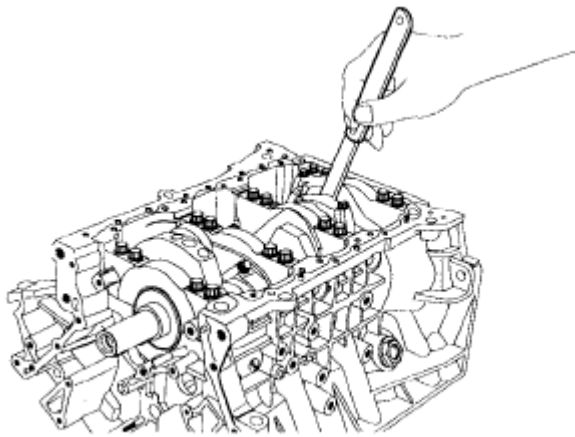
INSPECTION

CONNECTING ROD AND CRANKSHAFT

1. Check the connecting rod end play.

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

Standard end play: 0.1-0.25 mm (0.004-0.010 in.)



KORF211A

Fig. 181: Measuring Connecting Rod End Play
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 2 connecting rod cap bolts.
 3. Remove the connecting rod cap and bearing half.
 4. Clean the crank pin and bearing.
 5. Place plastigage across the crank pin.
 6. Reinstall the bearing half and cap, and torque the bolts.

Tightening torque

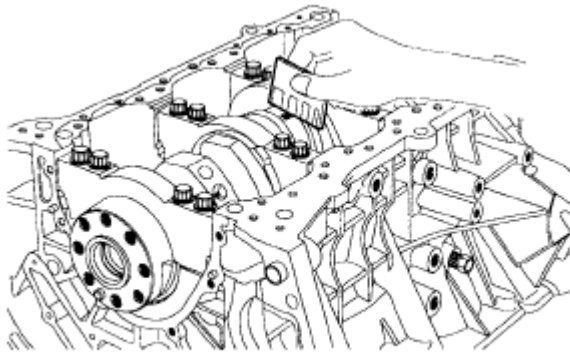
17.7 N.m (1.8-2.2 kgf.m, 13.0-15.9 lb-ft) + 88-92°

NOTE: Do not turn the crankshaft.

7. Remove 2 bolts, connecting rod cap and bearing-half.
8. Measure the plastigage at its widest point.

Standard oil clearance

0.038-0.056 mm (0.0015-0.0022 in.)



KDRF212A

Fig. 182: Measuring Plastigage At Its Widest Point
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.

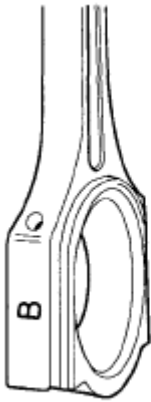
CAUTION: Do not file, shim, or scrape the bearings or the caps to adjust clearance.

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

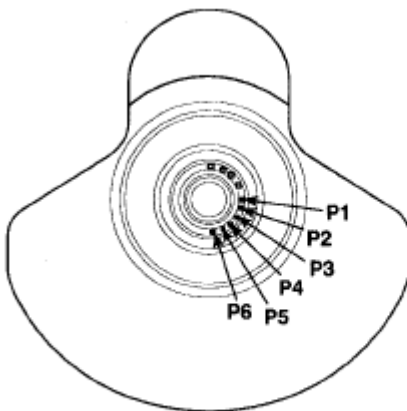
Fig. 183: Identifying Connecting Rod Mark
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CONNECTING ROD

CLASS	MARK	INSIDE DIAMETER
0	a	58.000-58.006 mm (2.2834-2.2837 in.)
1	b	58.006-58.012 mm (2.2837-2.2839 in.)
2	c	58.012-58.018 mm (2.2839-2.2842 in.)

CRANKSHAFT PIN MARK LOCATION

DISCRIMINATION OF CRANKSHAFT



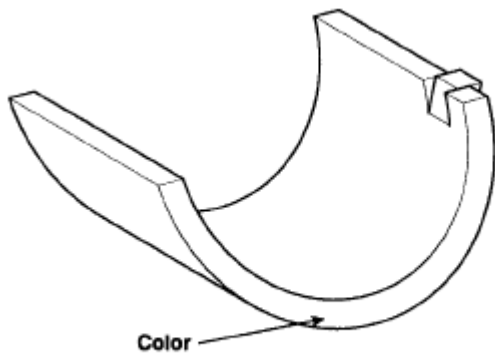
ECBF037A

Fig. 184: Identifying Crankshaft Pin Mark Locations
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT

CLASS	MARK	OUTSIDE DIAMETER OF PIN
I	1 or A	54.966-54.972 mm (2.1640-2.1642 in.)
II	2 or B	54.960-54.966 mm (2.1638-2.1640 in.)
III	3 or C	54.954-54.960 mm (2.1635-2.1638 in.)

PLACE OF IDENTIFICATION MARK (CONNECTING ROD BEARING)



ECRF021A

Fig. 185: Identifying Mark (Color) On Connecting Rod Bearing
Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CONNECTING ROD BEARING

CLASS	MARK	THICKNESS OF BEARING
E	BLUE	1.514-1.517 mm (0.0596-0.0597 in.)
D	BLACK	1.511-1.514 mm (0.0595-0.0596 in.)
C	BROWN	1.508-1.511 mm (0.0594-0.0595 in.)
B	GREEN	1.505-1.508 mm (0.0593-0.0594 in.)
A	YELLOW	1.502-1.505 mm (0.0591-0.0593 in.)

11. Selection

		CONNECTING ROD IDENTIFICATION MARK		
		0 (a)	1 (b)	2 (c)
	1 or A	A (YELLOW)	B (GREEN)	C (BROWN)

CRANKSHAFT IDENTIFICATION MARK	2 or B	B (GREEN)	C (BROWN)	D (BLACK)
	3 or C	C (BROWN)	D (BLACK)	E (BLUE)

3. 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

49.00 N.m (5.0 kgf.m, 36.16 lb-ft) + 90°

19.60 N.m (2.0 kgf.m, 14.46 lb-ft) + 120°

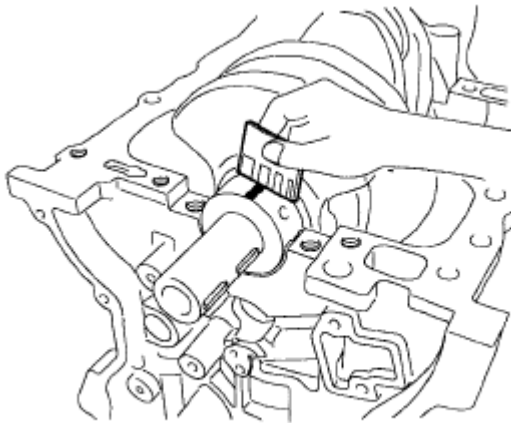
29.40-31.36 N.m (3.0-3.2 kgf.m, 21.70-23.14 lb-ft)

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.022-0.040 mm (0.0009-0.0016 in.)



KCRF170A

Fig. 186: Measuring Widest Part Of 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.

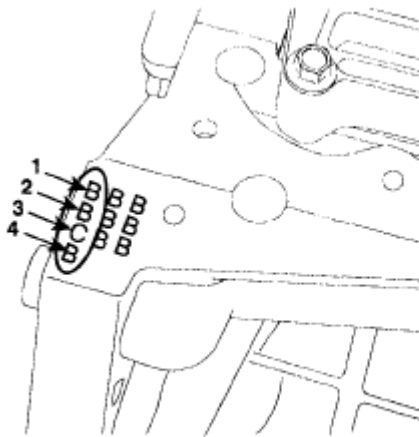
NOTE: If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

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 size of each of the 5 main journal bores.

Use them, and the numbers or bar stamped on the crank (marks for main journal size), to choose the correct bearings.

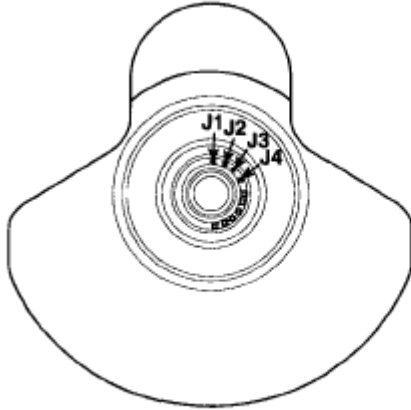


ECBF038A

Fig. 187: Identifying Crankshaft Bore Mark Location
Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CYLINDER BLOCK

CLASS	MARK	INSIDE DIAMETER
a	A	73.500-73.506 mm (2.8937-2.8939 in.)
b	B	73.506-73.512 mm (2.8939-2.8942 in.)
c	C	73.512-73.518 mm (2.8942-2.8944 in.)

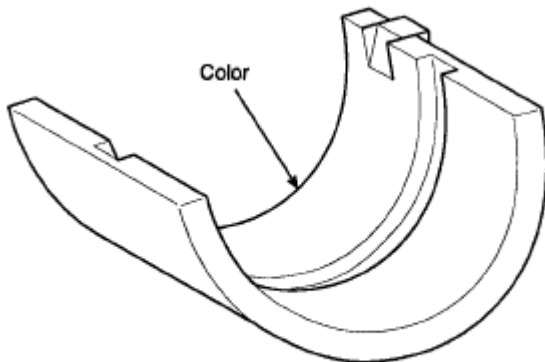
CRANKSHAFT JOURNAL MARK LOCATION**DISCRIMINATION OF CRANKSHAFT**

ECBF039A

Fig. 188: Identifying Crankshaft Journal Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT

CLASS	MARK	OUTSIDE DIAMETER OF JOURNAL
I	1 or A	68.954-68.960 mm (2.7147-2.7150 in.)
II	2 or B	68.948-68.954 mm (2.7145-2.7147 in.)
III	3 or C	68.942-68.948 mm (2.7142-2.7145 in.)

PLACE OF IDENTIFICATION MARK (CRANKSHAFT BEARING)

ECRF022A

Fig. 189: Identifying Mark (Color) On Crankshaft Bearing

Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT BEARING

CLASS	MARK	THICKNESS OF BEARING
E	BLUE	2.277-2.280 mm (0.0896-0.0897 in.)
D	BLACK	2.274-2.277 mm (0.0895-0.0896 in.)
C	BROWN	2.271-2.274 mm (0.0894-0.0895 in.)
B	GREEN	2.268-2.271 mm (0.0893-0.0894 in.)
A	YELLOW	2.265-2.268 mm (0.0892-0.0893 in.)

SELECTION

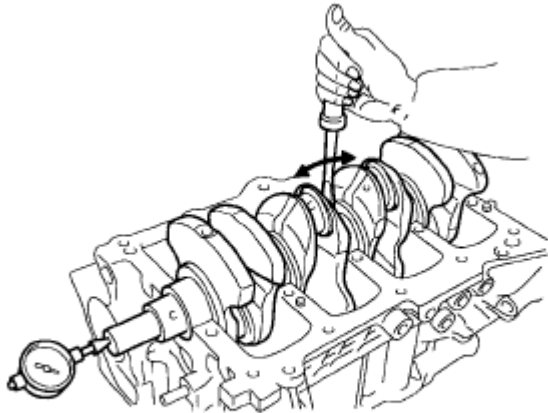
		CRANKSHAFT BORE IDENTIFICATION MARK		
		a (A)	b (B)	c (C)
CRANKSHAFT IDENTIFICATION MARK	1 or A	A (YELLOW)	B (GREEN)	C (BROWN)
	2 or B	B (GREEN)	C (BROWN)	D (BLACK)
	3 or C	C (BROWN)	D (BLACK)	E (BLUE)

4. 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

0.10-0.28 mm (0.0039-0.0110 in.)



ECKD001B

Fig. 190: Checking Crankshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

Thrust bearing thickness

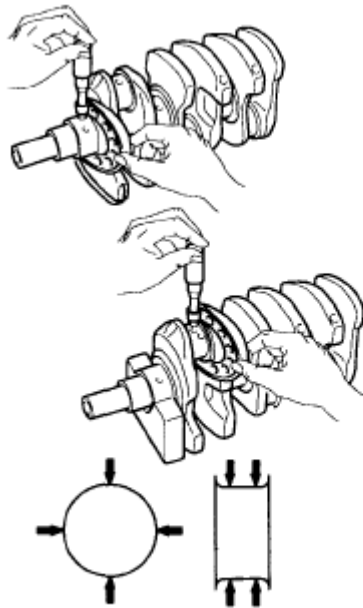
2.41-2.45 mm (0.0949-0.0964 in.)

5. Inspect main journals and crank pins

Using a micrometer, measure the diameter of each main journal and crank p in.

Main journal diameter: 68.942-68.960 mm (2.7142-2.7149 in.)

Crank pin diameter: 54.954-54.972 mm (2.1635-2.1642 in.)



LDK6004A

Fig. 191: Measuring Diameter Of Main Journal And Crank Pin
Courtesy of KIA MOTORS AMERICA, INC.

CONNECTING RODS

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

Allowable bend of connecting rod :

0.05 mm/100 mm (0.0020 in./3.94 in.) or less

Allowable twist of connecting rod :

0.1 mm/100 mm (0.0039 in./3.94 in.) or less

CYLINDER BLOCK

1. Remove gasket material.

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

2. Clean cylinder block

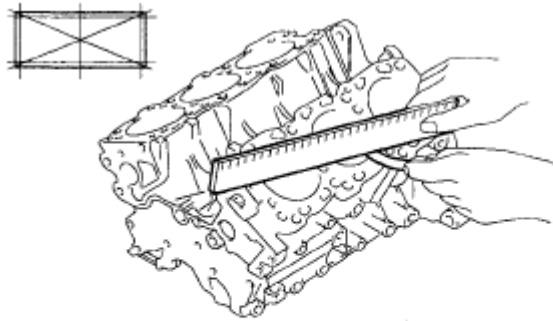
Using a soft brush and solvent, thoroughly clean the cylinder block.

3. Inspect top surface of cylinder block for flatness.

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

Flatness of cylinder block gasket surface

Standard: Less than 0.05 mm (0.0020 in.), Less than 0.02 mm (0.0008 in.) /150 x 150



EDQF154A

Fig. 192: 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.

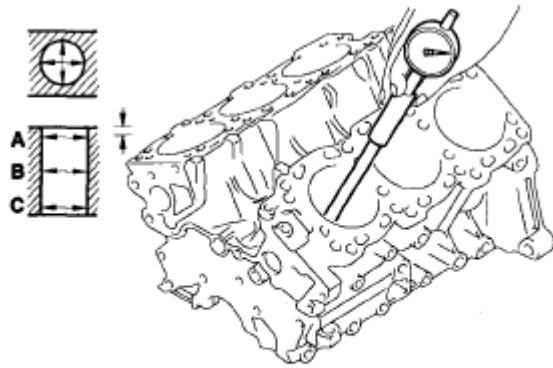
If deep scratches are present, replace the cylinder block.

5. Inspect cylinder bore diameter

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

Standard diameter

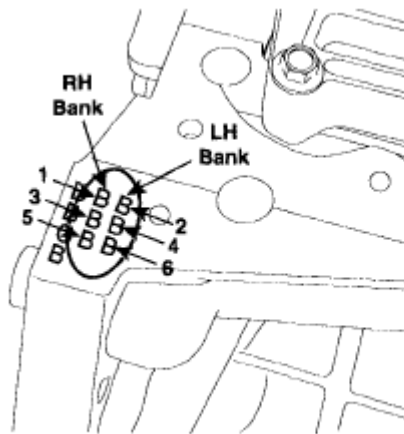
96.00-96.03 mm (3.7795-3.7807 in.)



EDQF153A

Fig. 193: Measuring Cylinder Bore Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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



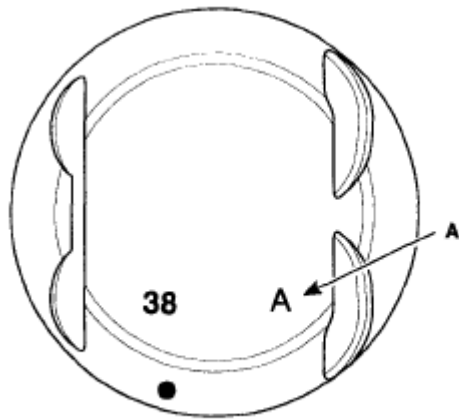
ECBF002A

Fig. 194: Identifying Cylinder Bore Size Code On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

CYLINDER BORE INNER DIAMETER REFERENCE

Class	Size code	Cylinder bore inner diameter
A	A	96.00-96.01 mm (3.7795-3.7799 in.)
B	B	96.01-96.02 mm (3.7799-3.7803 in.)
C	C	96.02-96.03 mm (3.7803-3.7807 in.)

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



BCKG027A

Fig. 195: Identifying Piston Size Code On Piston Top Face
 Courtesy of KIA MOTORS AMERICA, INC.

PISTON OUTER DIAMETER REFERENCE

Class	Size code	Piston outer diameter
A	A	95.96-95.97 mm (3.7779-3.7783 in.)
B	B	95.97-95.98 mm (3.7783-3.7787 in.)
C	C	95.98-95.99 mm (3.7787-3.7791 in.)

8. Select the piston related to cylinder bore class.

Clearance :

0.03-0.05 mm (0.0012-0.0020 in.)

PISTON AND RINGS

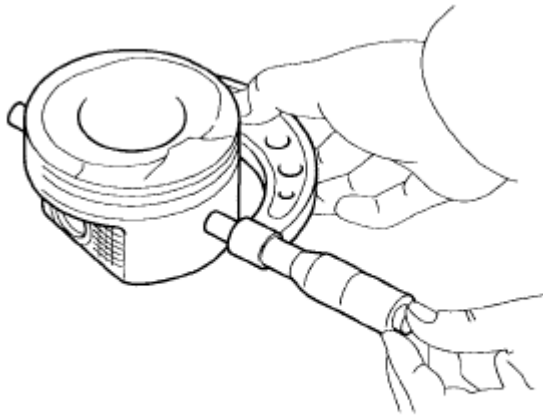
1. Clean piston
 1. Using a gasket scraper, remove the carbon from the piston top.
 2. Using a groove cleaning tool or broken ring, clean the piston ring grooves.
 3. Using solvent and a brush, thoroughly clean the piston.

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

95.96-95.99 mm (3.7779- 3.7791 in.)



ECKD001D

Fig. 196: Measuring Piston Outside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston-to-cylinder clearance

0.03-0.05 mm (0.0012-0.0020 in.)

4. Inspect the piston ring side clearance.

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

Piston ring side clearance

Standard

No. 1: 0.03-0.07 mm (0.0012-0.0027 in.)

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

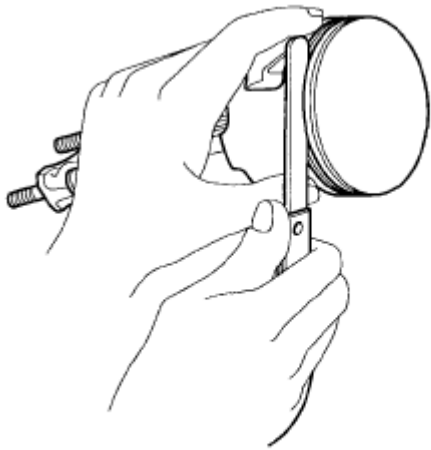
Oil ring: 0.06-0.15 mm (0.0024-0.0059 in.)

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.)



ECKD001G

Fig. 197: Measuring Clearance Between Piston Ring And Wall Of Ring Groove
Courtesy of KIA MOTORS AMERICA, INC.

If the clearance is greater than 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 against the wear limits. Refer to **CYLINDER BORE INNER DIAMETER REFERENCE**. If the bore is over the service limit, the cylinder block must be replaced.

Piston ring end gap

Standard

No. 1: 0.17-0.32 mm (0.0067-0.0126 in.)

No. 2: 0.32-0.47m (0.0126-0.0185 in.)

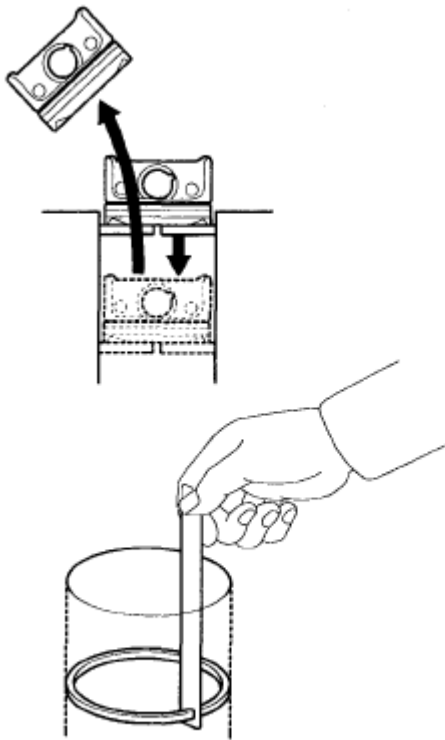
Oil ring: 0.20-0.70 mm (0.0079-0.0275 in.)

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

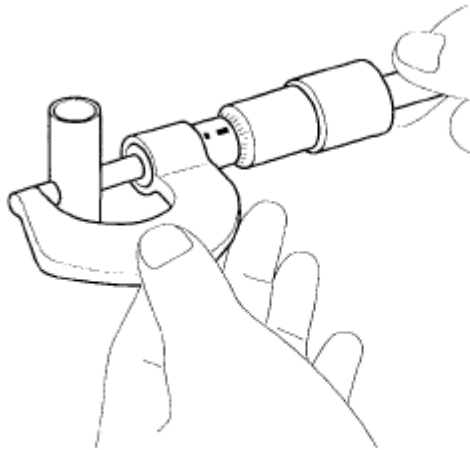
Fig. 198: Inspecting Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter

23.002-23.006 mm (0.9056-0.9057 in.)



ECKD001Z

Fig. 199: Measuring Diameter Of Piston Pin
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston pin-to-piston clearance

0.01-0.02 mm (0.0004-0.0008 in.)

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

Piston pin-to-connecting rod interference

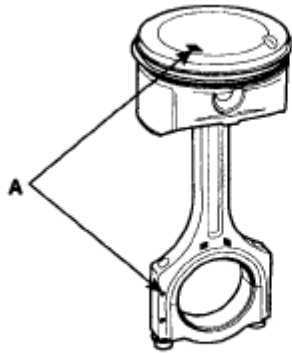
-0.032 to 0.016 mm (-0.00126 to 0.00063 in.)

REASSEMBLY

NOTE:

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

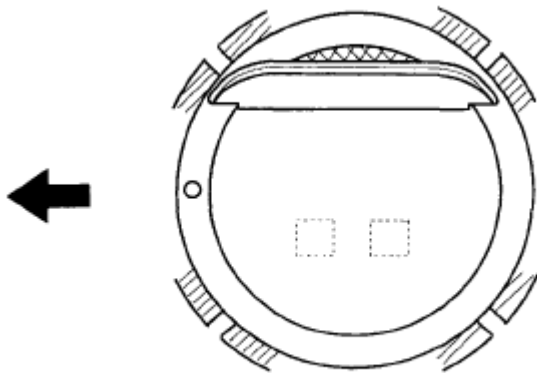
1. Assemble piston and connecting rod.
 1. Use a hydraulic press for installation.
 2. The piston front mark and the connecting rod front mark must face the timing chain end of the engine.



KCRF168A

Fig. 200: Identifying Piston Front Mark And Connecting Rod Front Mark
Courtesy of KIA MOTORS AMERICA, INC.

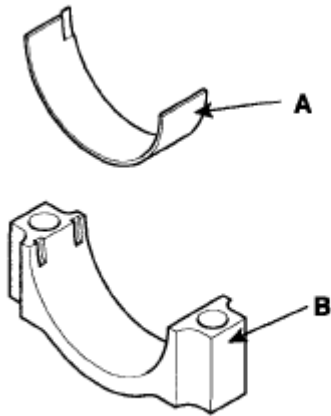
2. Install piston rings.
 1. Install the oil ring spacer and 2 side rails by hand.
 2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
 3. Position the piston rings so that the ring ends are as shown in **Fig. 201**.



ECKD321A

Fig. 201: Positioning Piston Rings
Courtesy of KIA MOTORS AMERICA, INC.

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



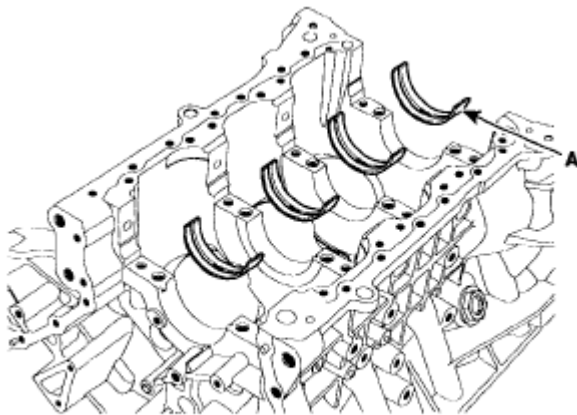
KCRF118B

Fig. 202: Identifying Bearing And Connecting Rod Cap
 Courtesy of KIA MOTORS AMERICA, INC.

4. Install main bearings.

NOTE: Upper bearings have an oil groove and oil holes; Lower bearings do not.

1. Align the bearing claw with the claw groove of the cylinder block, push in the 4 upper bearings.
2. Align the bearing claw with the claw groove of the main bearing cap, and push in the 4 lower bearings (A).

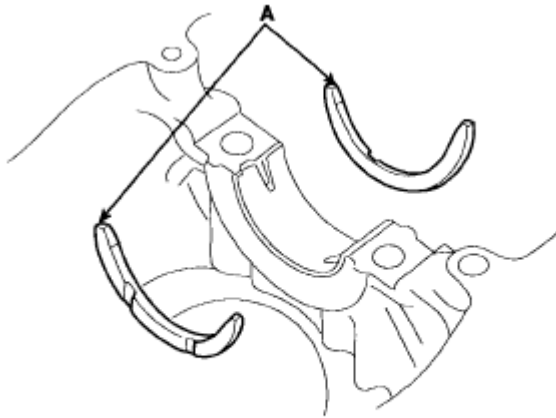


KDRF216A

Fig. 203: Identifying Lower Bearings
 Courtesy of KIA MOTORS AMERICA, INC.

5. Install thrust bearings.

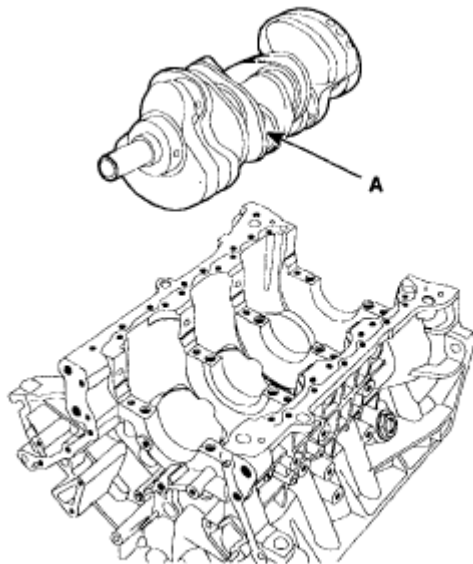
Install the 2 thrust bearings (A) under the No. 3 journal position of the cylinder block with the oil grooves facing outward.



ECKD324A

Fig. 204: Identifying Thrust Bearings
Courtesy of KIA MOTORS AMERICA, INC.

6. Place crankshaft on the cylinder block.



LDKG003A

Fig. 205: Identifying Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

7. Place main bearing caps on cylinder block.
8. Install main bearing cap bolts.
 1. Install and uniformly tighten the bearing cap bolts, in several passes, in the sequence shown in illustration.

Tightening torque

Main bearing cap bolt

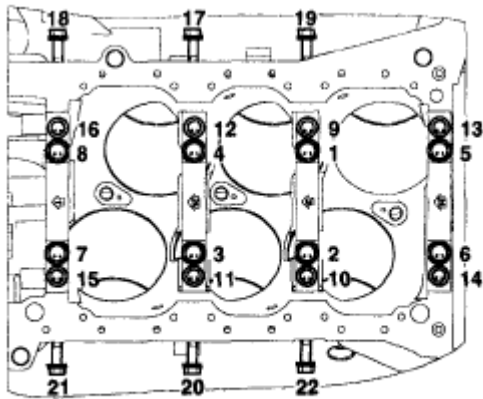
49.00 N.m (5.0 kgf.m, 36.16 lb-ft) + 90° (1-8)

19.60 N.m (2.0 kgf.m, 14.46 lb-ft) + 120° (9-16)

29.40-31.36 N.m (3.0-3.2 kgf.m, 21.70-23.14 lb-ft) (17-22)

NOTE:

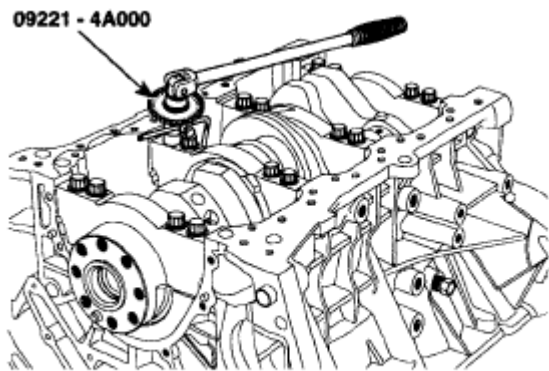
- Always use new main bearing cap bolt.
- If any of the bearing cap bolts is broken or deformed, replace it.



KDRF140A

Fig. 206: Identifying Bearing Cap Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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



KDRF224A

Fig. 207: Identifying SST (09221-4A000)
Courtesy of KIA MOTORS AMERICA, INC.

2. Check that the crankshaft turns smoothly.
9. Check crankshaft end play. Refer to **CONNECTING ROD AND CRANKSHAFT**.
10. Install piston and connecting rod assemblies.

NOTE: Before installing the pistons, apply a coat of engine oil to the ring grooves and cylinder bores.

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 after the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.
3. Apply engine oil to the bolt threads. Install the rod caps with bearings, and torque the bolts.

Tightening torque

17.7-21.6 N.m (1.8-2.2 kgf.m, 13.0-15.9 lb-ft) + 88-92°

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

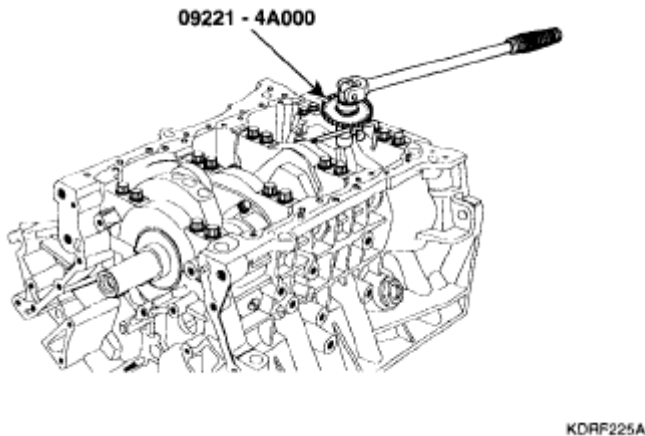
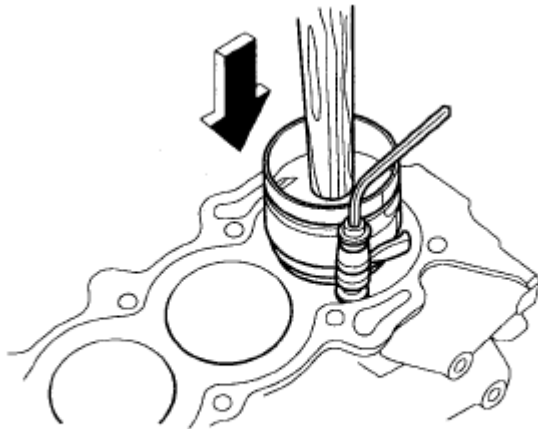


Fig. 208: Identifying SST (09221-4A000)
Courtesy of KIA MOTORS AMERICA, INC.

- NOTE:**
- Always use new connecting rod bearing cap bolt.
 - Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.



ECKD001F

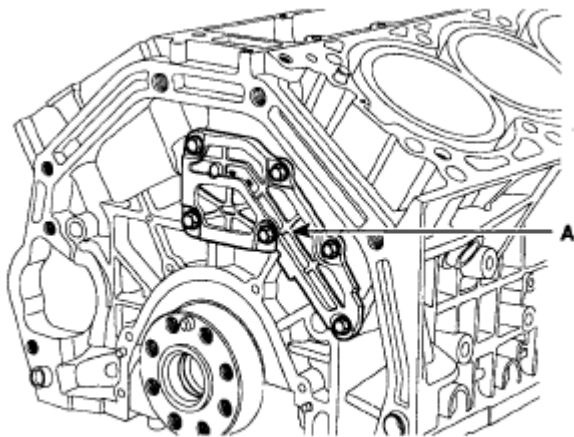
Fig. 209: Installing Pistons

Courtesy of KIA MOTORS AMERICA, INC.

11. Check the connecting rod end play. Refer to CONNECTING ROD AND CRANKSHAFT.
12. Install oil drain cover.

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



KDRF209A

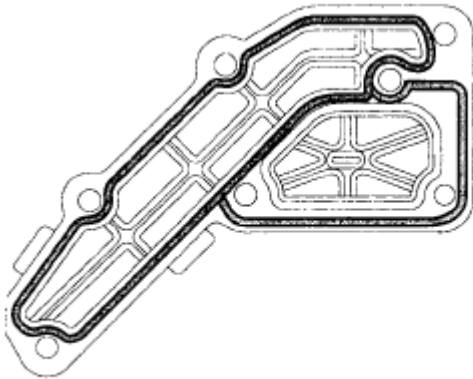
Fig. 210: Locating Oil Drain Cover

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Ensure the sealing face is clean before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant

- Before assembling oil drain cover, the liquid sealant TB1217H should be applied oil drain cover.
- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.



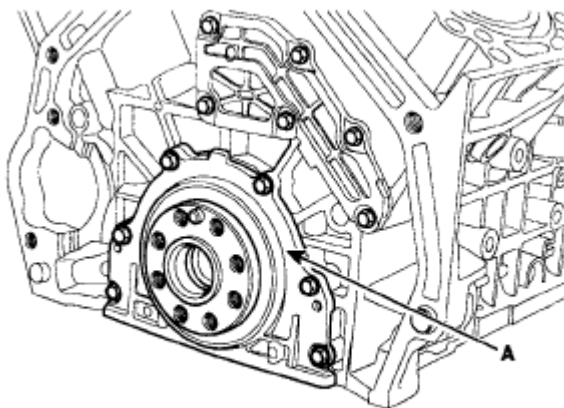
ECBF003A

Fig. 211: Identifying Sealant Area On Oil Drain Cover
Courtesy of KIA MOTORS AMERICA, INC.

13. Install rear oil seal case.

Tightening torque

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



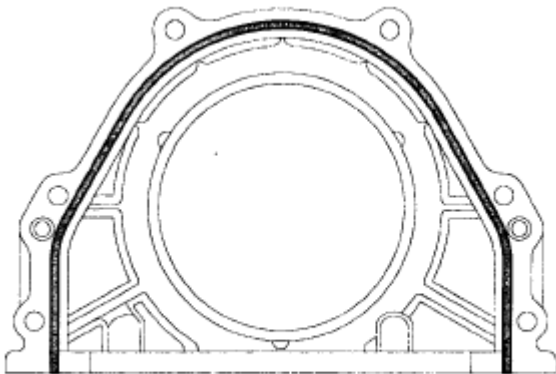
KDRF208A

Fig. 212: Locating Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Make clean the sealing face before assembling two parts.

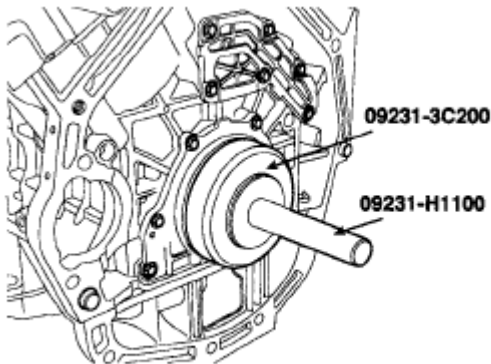
- Remove harmful foreign matters on the sealing face before applying sealant
- Before assembling rear oil seal case, the liquid sealant TB1217H should be applied rear oil seal case.
- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.



KDRF218A

Fig. 213: Identifying Sealant Area On Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

14. Using SST (09231-3C200, 09231-H1100), install rear oil seal.



KDRF237A

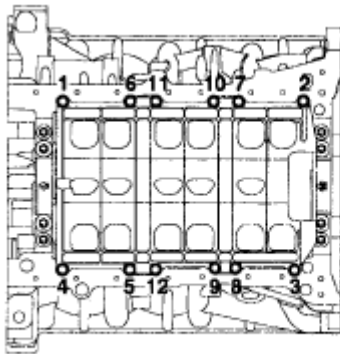
Fig. 214: Identifying SST (09231-3C200, 09231-H1100)
Courtesy of KIA MOTORS AMERICA, INC.

15. Install baffle plate.

Install and uniformly tighten the baffle plate bolts, in several passes, in the sequence shown in illustration.

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)

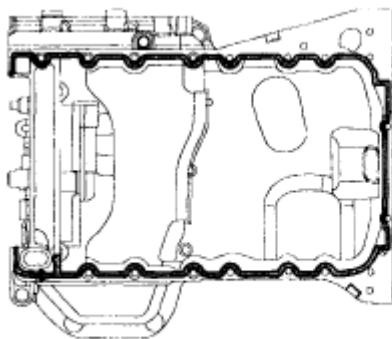


KDRF135A

Fig. 215: Identifying Baffle Plate Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

16. Install upper oil pan.
 - a. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
 - b. 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.

Bead width: 2.5 mm (0.1 in.)



KDRF130A

Fig. 216: Identifying Sealant Area On Upper Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

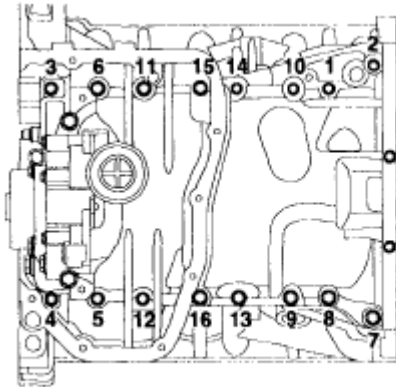
- Ensure the sealing face is clean before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant
- When applying sealant gasket, sealant must not be protruded into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket of the inner threads of the bolt holes.

- c. Install upper oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



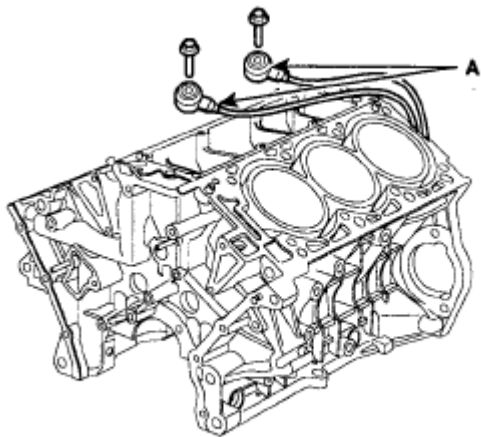
KDRF131A

Fig. 217: Identifying Upper Oil Pan Bolts Tightening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.

17. Install knock sensor.

Tightening torque

15.68-23.52 N.m (1.6-2.4 kgf.m, 11.57-17.36 lb-ft)



KDRF205A

Fig. 218: Locating Knock Sensor
 Courtesy of KIA MOTORS AMERICA, INC.

18. Install drive plate.

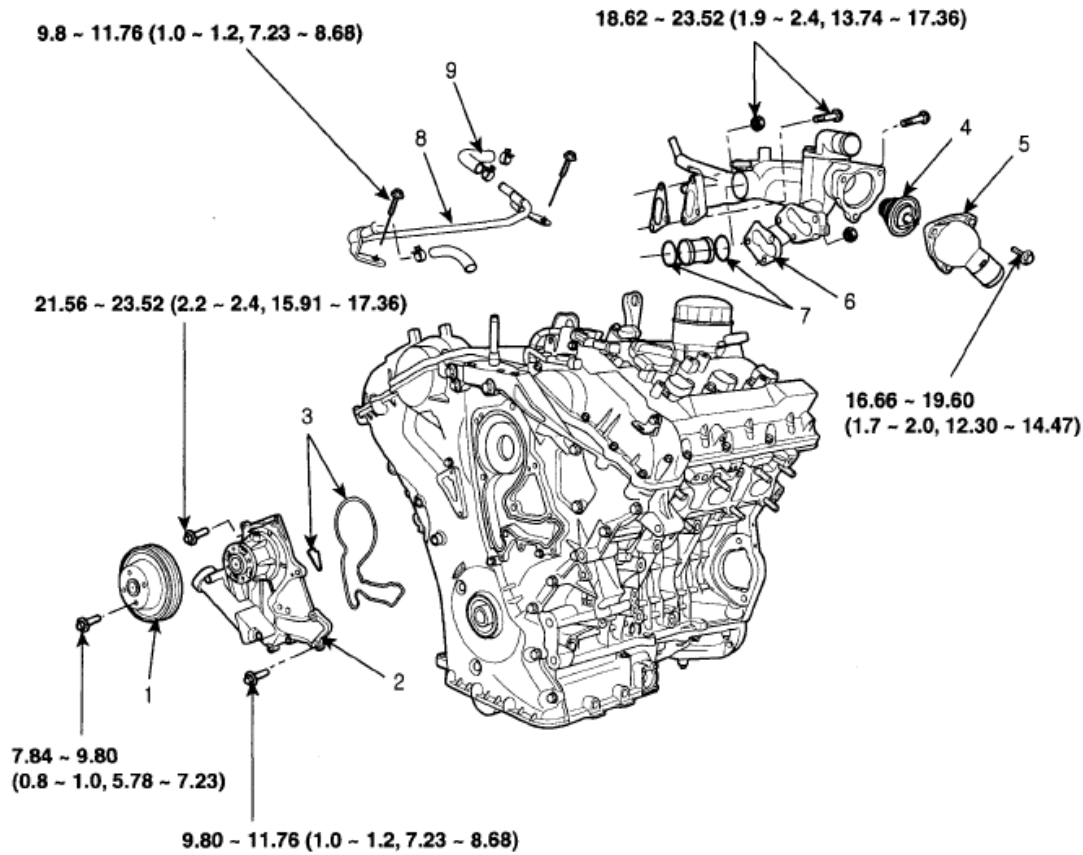
Tightening torque

71.54-75.46 N.m (7.3-7.7 kgf.m, 52.80-55.69 lb-ft)

INSTALLATION

1. Install power steering pump.
2. Install generator.
3. Install air conditioner compressor
4. Install oil filter assembly. Refer to **OIL FILTER ASSEMBLY**.
5. Install oil pump. Refer to **OIL PUMP**.
6. Install cylinder head. Refer to **INSTALLATION**.
7. Install water temperature control assembly. Refer to **WATER TEMPERATURE CONTROL ASSEMBLY**.
8. Install timing chain. Refer to **INSTALLATION**.
9. Install intake manifold. Refer to **INTAKE MANIFOLD**.
10. Install exhaust manifold. Refer to **EXHAUST MANIFOLD**.

COOLING SYSTEM**COMPONENT**

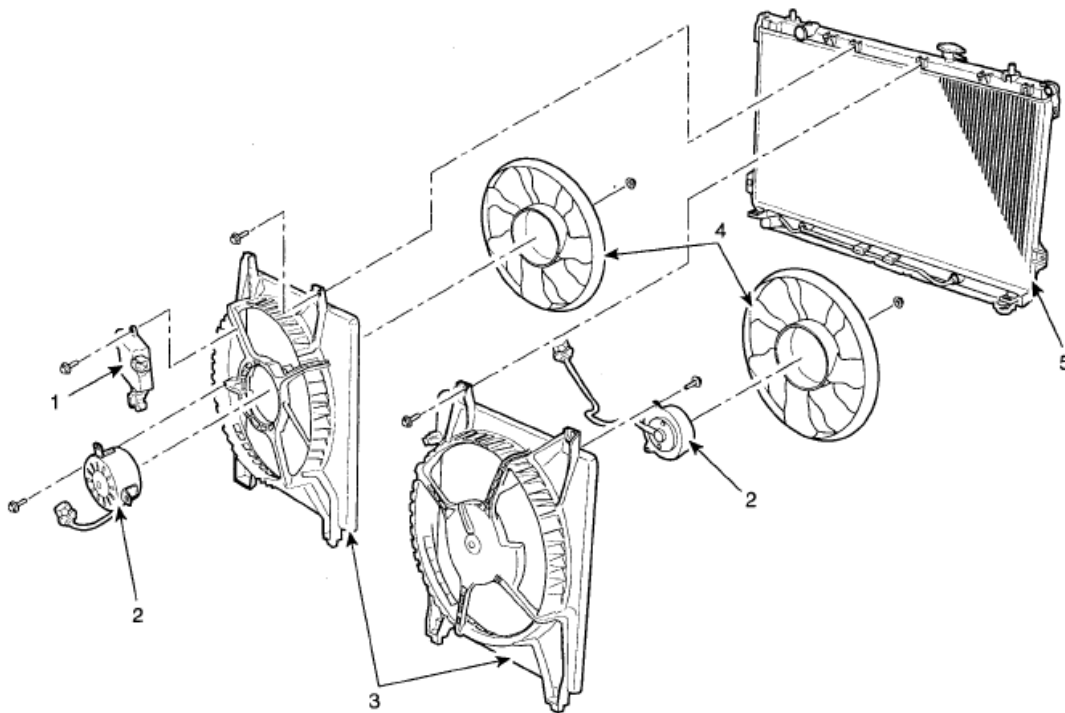


TORQUE : N.m (kgf.m, lb-ft)

- | | |
|----------------------|---------------------|
| 1. Water pump pulley | 5. Water inlet pipe |
| 2. Water pump | 6. Gasket |
| 3. Water pump gasket | 7. O - ring |
| 4. Thermostat | 8. Air vent pipe |
| | 9. Hose |

BCKG028A

Fig. 219: Identifying Cooling System Components And Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.



1. Cooling fan controller
2. Cooling fan motor
3. Cooling fan cover
4. Cooling fan
5. Radiator assembly

BCKG011A

Fig. 220: Identifying Radiator And Fan Components
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. Remove radiator cap.
3. Loosen the drain plug, and drain the coolant.
4. Tighten the radiator drain plug securely.

5. Remove, drain and reinstall the reservoir. Fill the tank halfway to the "F" mark with water, then up to the "F" mark with antifreeze.
6. Fill fluid mixture with coolant and water (4:6) slowly through the radiator cap. Push the upper/lower hoses of the radiator to ensure proper air bleeding.

NOTE:

- **Use only genuine antifreeze/coolant.**
- **For best corrosion protection, the coolant concentration must be maintained year-round at 50% minimum.**

Coolant concentrations less than 50% may not provide sufficient protection against corrosion or freezing.

- **Coolant concentrations greater than 60% will impair cooling efficiency and are not recommended.**

CAUTION:

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

7. Start the engine.

When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.

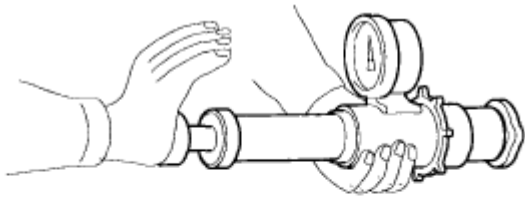
8. Repeat 7 until the cooling fan cycles 3-5 times and bleed air sufficiently out of the cooling system.
9. Install the radiator cap and fill the reservoir tank to the "MAX" line with coolant.
10. Run the vehicle under idle until the cooling fan operates 2-3 times.
11. Stop the engine and wait until the cooling system is cool to the touch.
12. Repeat 6 to 11 until the coolant level doesn't fall any more, bleed air out of the cooling system.

NOTE:

Proper cooling system operation depends on the absence of trapped air within the system. It is essential that the cooling system be properly filled and bled before returning the vehicle to service.

CAP TESTING

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



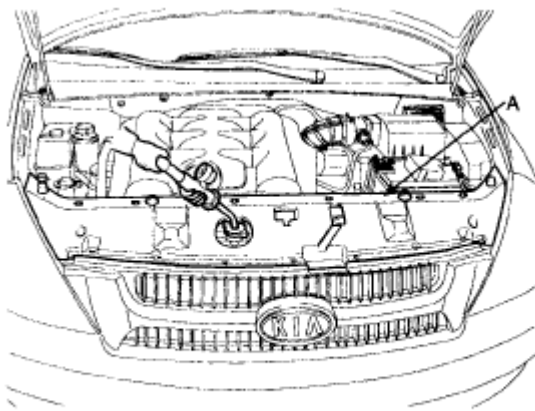
ECKD501X

Fig. 221: 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 and fill the radiator with engine coolant, then install it on the pressure tester.



LDKG005A

Fig. 222: Testing Radiator
Courtesy of KIA MOTORS AMERICA, INC.

2. Apply a pressure tester to the radiator and 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 the coolant and/or coolant in the engine oil.

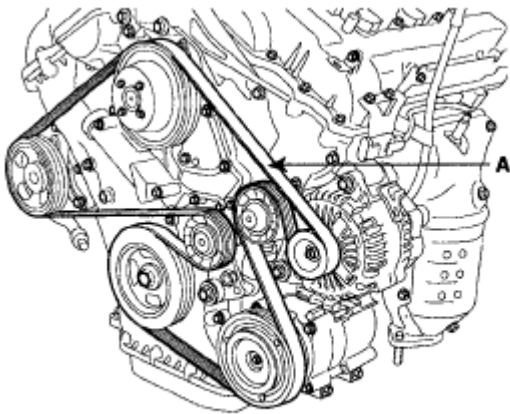
REMOVAL

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.

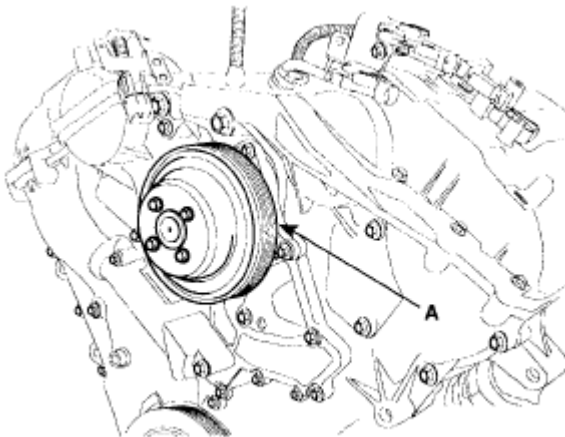
2. Remove drive belt (A).



KDRF101A

Fig. 223: Identifying Drive Belt Routing
Courtesy of KIA MOTORS AMERICA, INC.

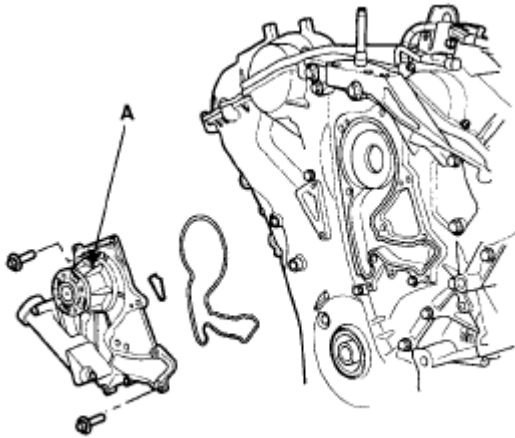
3. Remove the 4 bolts and pump pulley (A).



KDRF107A

Fig. 224: Locating Water Pump Pulley
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the water pump (A) and gasket.

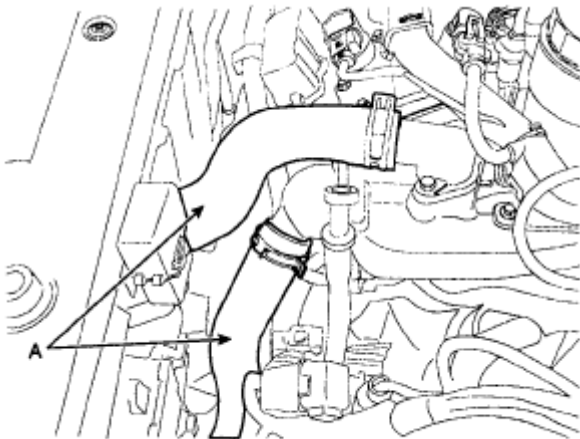


KDRF221A

Fig. 225: Identifying Water Pump And Gasket
Courtesy of KIA MOTORS AMERICA, INC.

WATER TEMPERATURE CONTROL ASSEMBLY

1. Drain the engine coolant.
2. Remove air cleaner assembly. Refer to **ENGINE AND TRANSAXLE ASSEMBLY**.
3. Disconnect radiator upper and lower hose (A).

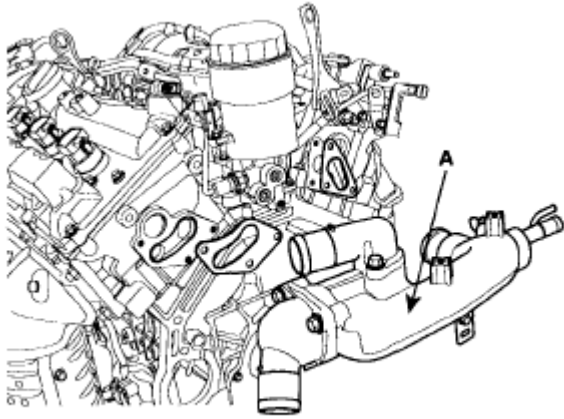


BCKG005A

Fig. 226: Locating Radiator Upper And Lower Hoses
Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect ECT connector.

5. Disconnect heater hose, water vent hose and water hose from water temperature control assembly.
6. Remove wiring protector.
7. Remove water temperature control assembly (A).



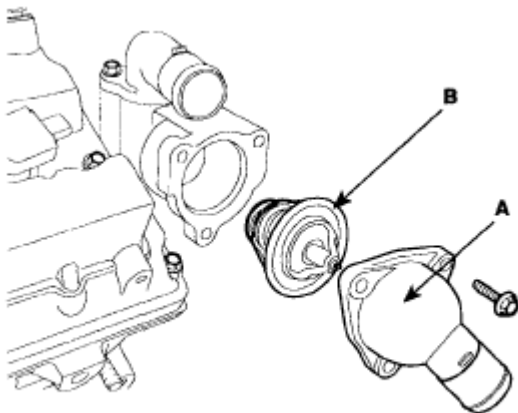
KDRF194A

Fig. 227: Identifying Water Temperature Control Assembly
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 water inlet (A) and thermostat (B).

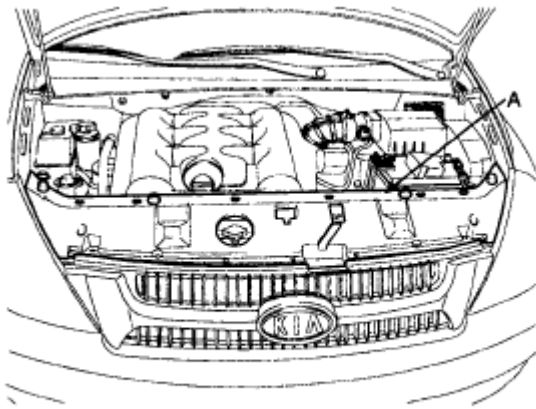


KDRF195A

Fig. 228: Identifying Water Inlet And Thermostat
Courtesy of KIA MOTORS AMERICA, INC.

RADIATOR

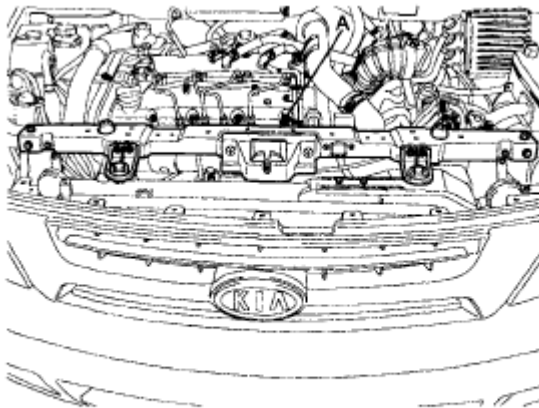
1. Drain the engine coolant.
2. Remove the radiator grille upper cover (A).



ACKF043A

Fig. 229: Locating Radiator Grille Upper Cover
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove under cover.
4. Remove the radiator support upper member assembly (A) for convenience sake.



ACKF047A

Fig. 230: Locating Radiator Support Upper Member Assembly
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: The bottom side bolt (A) which can be seen after removing the under cover should be loosened for removal of the radiator support upper member assembly.

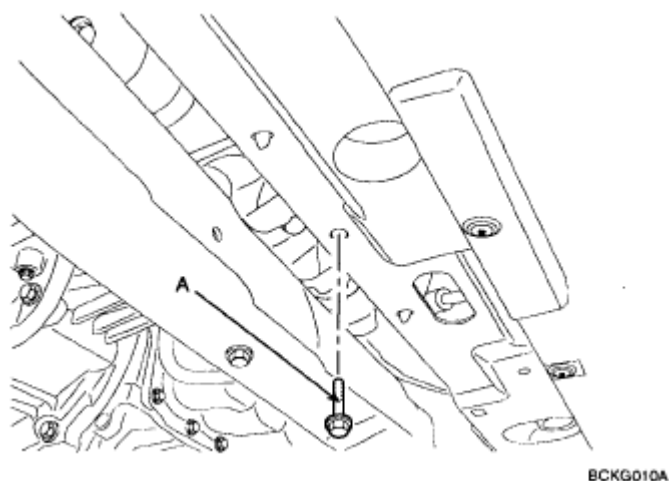


Fig. 231: Identifying Bottom Side Bolt
 Courtesy of KIA MOTORS AMERICA, INC.

5. Disconnect radiator upper and lower hoses (A).

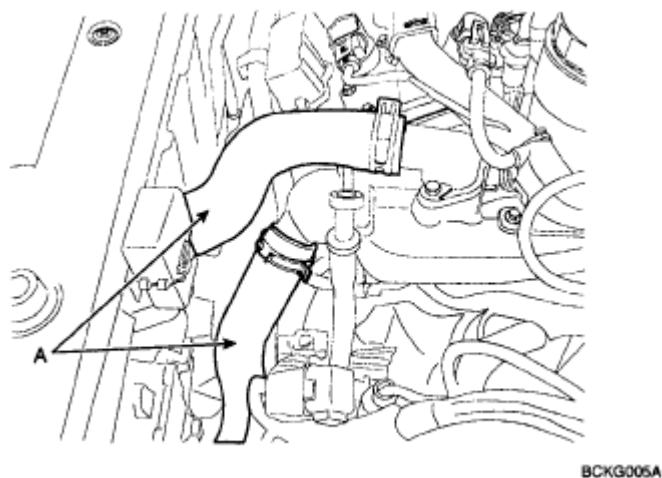
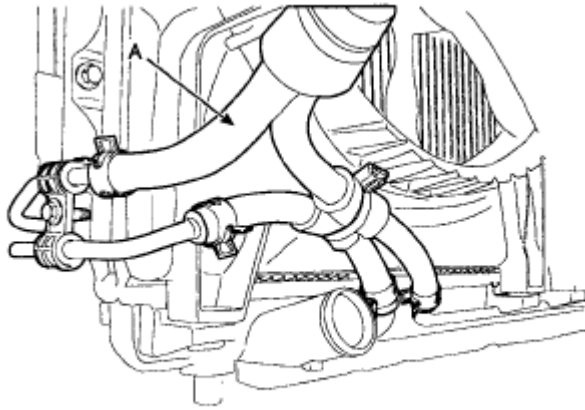


Fig. 232: Locating Radiator Upper And Lower Hoses
 Courtesy of KIA MOTORS AMERICA, INC.

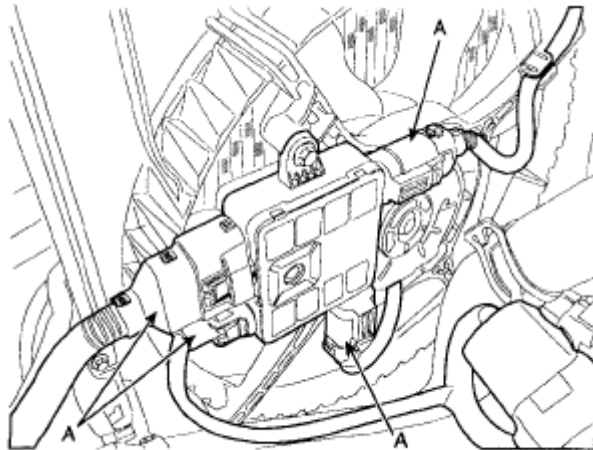
6. Disconnect transaxle oil cooler hoses (A). Refer to **AUTOMATIC TRANSAXLE SYSTEM** .



BCKG015A

Fig. 233: Locating Transaxle Oil Cooler Hoses
Courtesy of KIA MOTORS AMERICA, INC.

7. Disconnect the radiator fan connectors (A).



BCKG012A

Fig. 234: Locating Radiator Fan Connectors
Courtesy of KIA MOTORS AMERICA, INC.

8. Disconnect the pressure lines (A) from the radiator assembly (B).

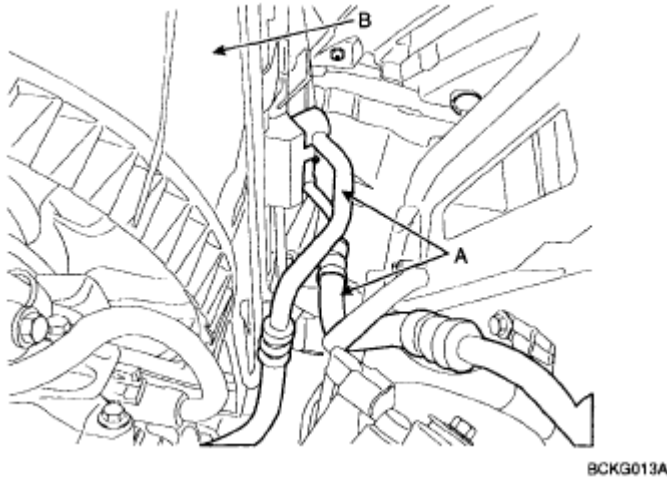


Fig. 235: Locating Pressure Lines And Radiator Assembly
 Courtesy of KIA MOTORS AMERICA, INC.

9. Separate the condenser (A) from the radiator assembly (B) by removing the bolts (C).

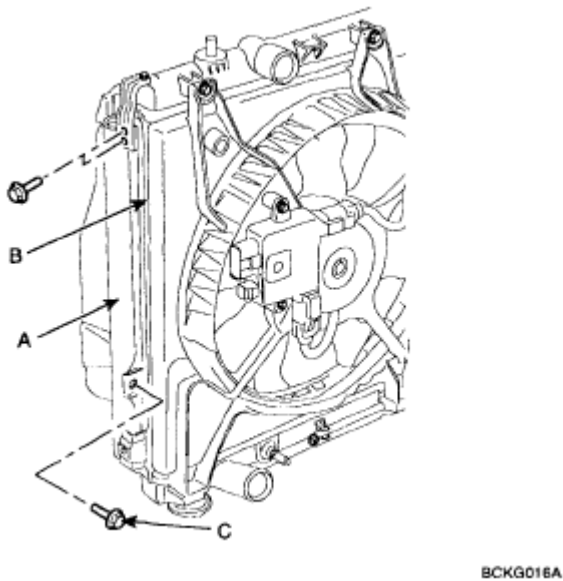
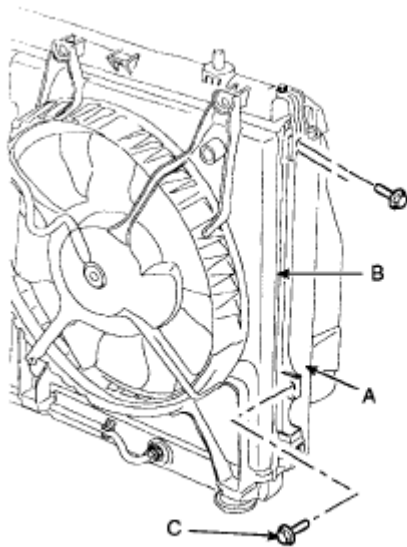


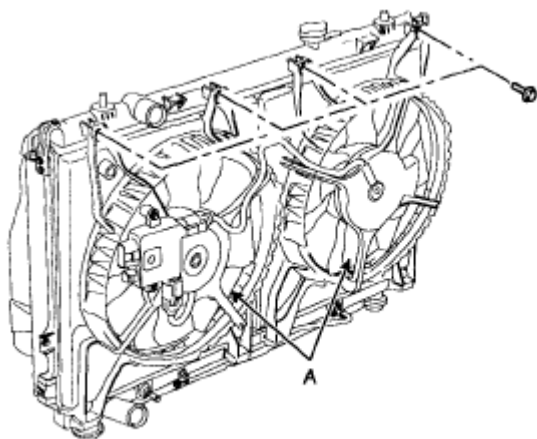
Fig. 236: Locating Condenser, Radiator Assembly And Bolts (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.



BCKG017A

Fig. 237: Locating Condenser, Radiator Assembly And Bolts (2 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

10. Remove the radiator bracket.
11. Remove the radiator assembly.
12. Remove the radiator cooling fan (A).



BCKG018A

Fig. 238: Locating Radiator Cooling Fan
 Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

WATER PUMP

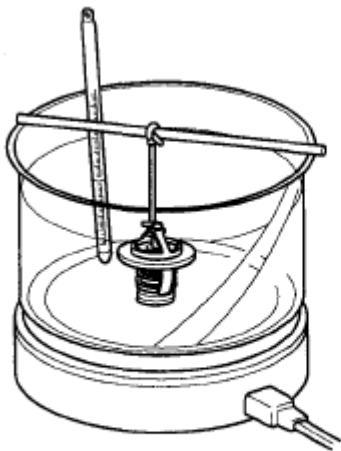
1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.

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 malfunctioning. 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 the water.



ECKD503B

Fig. 239: 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: M in. 10 mm (0.4 in.) at 95°C (205°F)

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

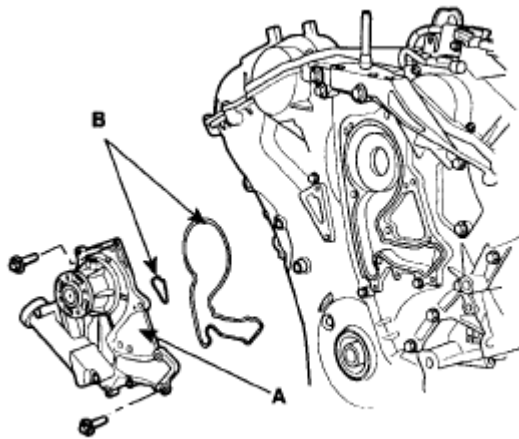
INSTALLATION

WATER PUMP

1. Install the water pump (A) and a new gasket (B) with 12 bolts.

Tightening torque

21.56-23.52 N.m (2.2-2.4 kgf.m, 15.91-17.36 lb-ft) 9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



KDRF221B

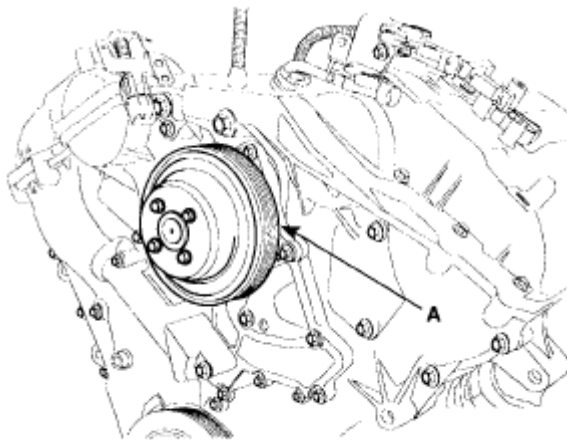
Fig. 240: Identifying Water Pump And Gasket
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Make clean the contact face before assembly.

2. Install the 4 bolts and pump pulley (A).

Tightening torque

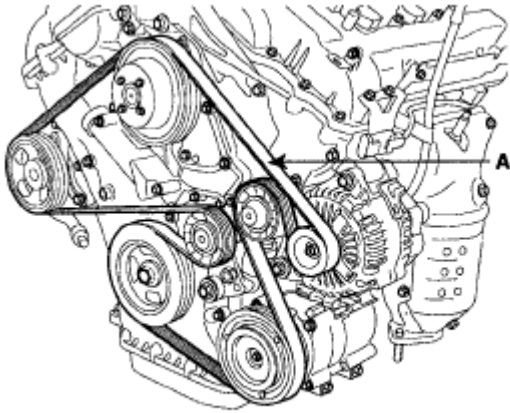
7.84-9.80 N.m (0.8-1.0 kgf.m, 5.78-7.23 lb-ft)



KDRF107A

Fig. 241: Locating Water Pump Pulley
Courtesy of KIA MOTORS AMERICA, INC.

3. Install drive belt (A).



KDRF101A

Fig. 242: Identifying Drive Belt Routing
Courtesy of KIA MOTORS AMERICA, INC.

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

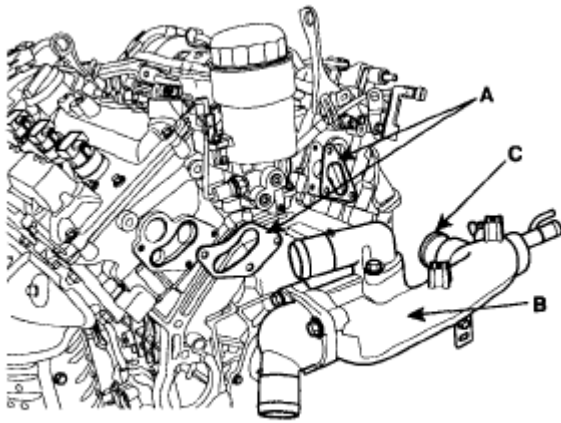
WATER TEMPERATURE CONTROL ASSEMBLY

NOTE: Make clean the contact face before assembly.

1. Install water temperature control assembly (B) and new gasket (A).

Tightening torque

18.62-23.52 N.m (1.9-2.4 kgf.m, 13.74-17.36 lb-ft)

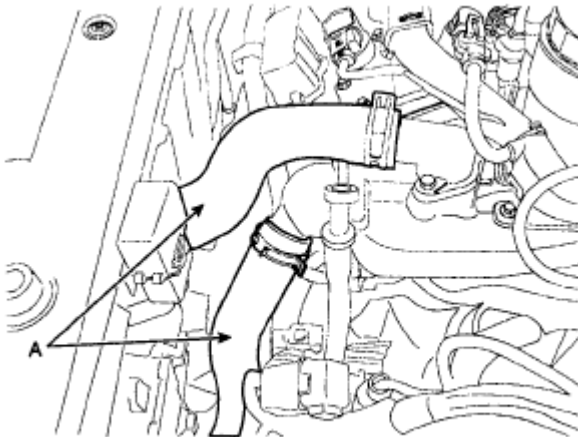


KDRF194B

Fig. 243: Identifying Water Temperature Control Assembly, Gasket And O-Ring
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Use new O-rings (C) when reassembling.

2. Connect water hoses to the water temperature control assembly.
3. Install wiring protector.
4. Connect ECT connector.
5. Connect radiator upper and lower hose (A).



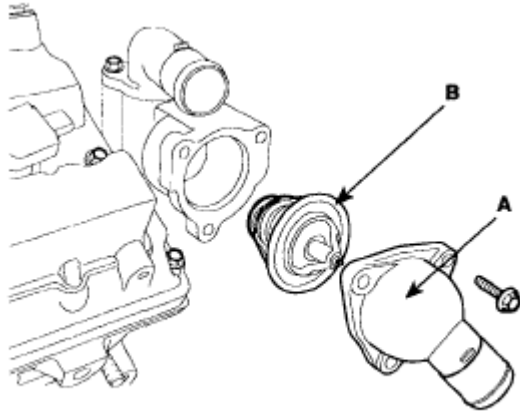
BCKG005A

Fig. 244: Locating Radiator Upper And Lower Hoses)
 Courtesy of KIA MOTORS AMERICA, INC.

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

THERMOSTAT

1. Place thermostat in thermostat housing.
 1. Install the thermostat with the jiggle valve upward.
 2. Install a new thermostat (B).



KORF195A

Fig. 245: Identifying Water Inlet And Thermostat
Courtesy of KIA MOTORS AMERICA, INC.

2. Install water inlet (A).

Tightening torque

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

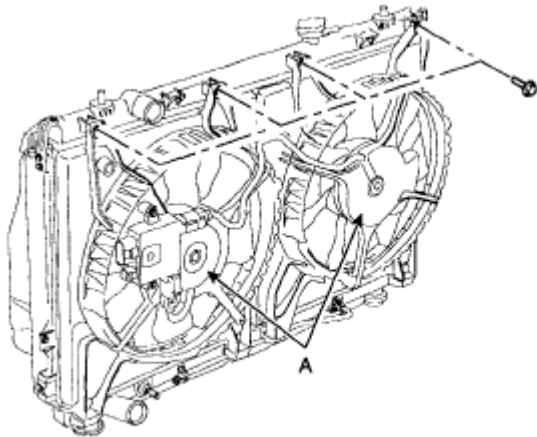
3. Fill with engine coolant.
4. Start engine and check for leaks.

RADIATOR

1. Install the radiator fan (A) to the radiator.

Tightening torque

4.9-7.8 N.m (0.5-0.8 kgf.m, 3.6-5.8 lb-ft)



BCKG033A

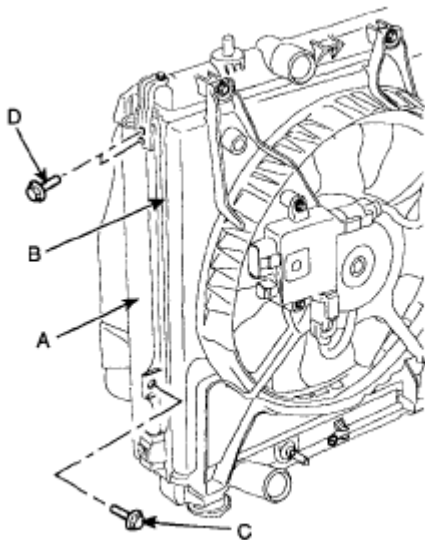
Fig. 246: Locating Radiator Fan
 Courtesy of KIA MOTORS AMERICA, INC.

2. Install the radiator assembly to the vehicle.
3. Install the radiator bracket.
4. Fix the condenser with the radiator assembly.

Tightening torque

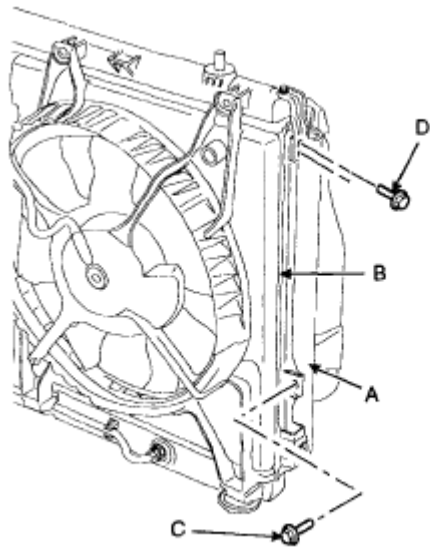
4.9-7.8 N.m (0.5-0.8 kgf.m, 3.6-5.8 lb-ft) - D

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



BCKG032A

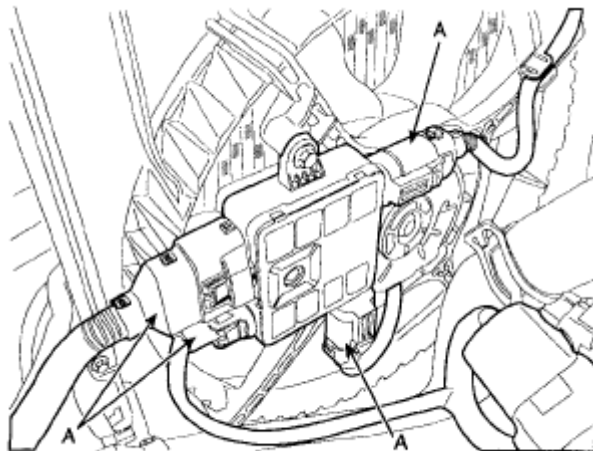
Fig. 247: Locating Condenser, Radiator Assembly And Bolts (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.



BCKG034A

Fig. 248: Locating Condenser, Radiator Assembly And Bolts (2 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

5. Connect the radiator fan connectors (A).



BCKG012A

Fig. 249: Locating Radiator Fan Connectors
 Courtesy of KIA MOTORS AMERICA, INC.

6. Connect the pressure lines (A) to the radiator assembly (B).

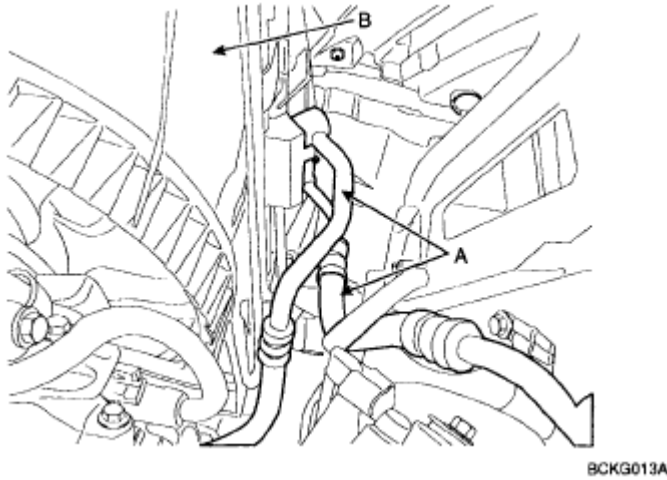


Fig. 250: Locating Pressure Lines And Radiator Assembly
Courtesy of KIA MOTORS AMERICA, INC.

7. Connect transaxle oil cooler hoses (A). Refer to **AUTOMATIC TRANSAXLE SYSTEM** .

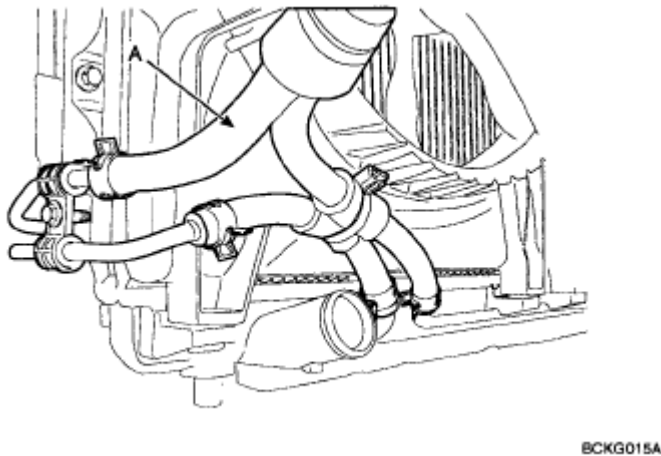
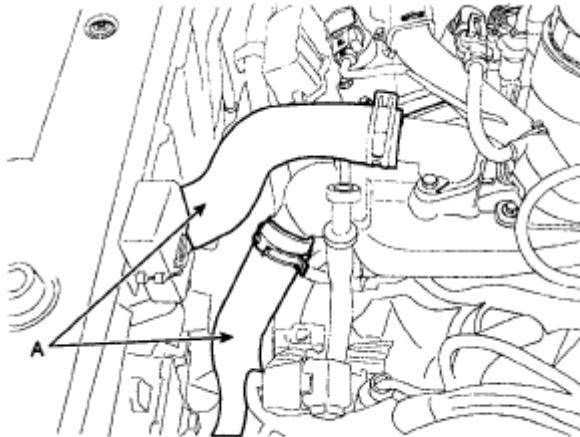


Fig. 251: Locating Transaxle Oil Cooler Hoses
Courtesy of KIA MOTORS AMERICA, INC.

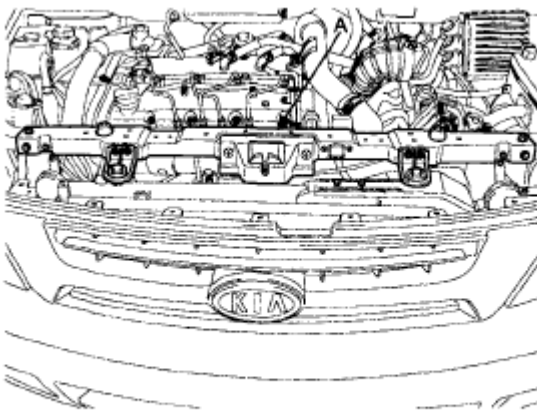
8. Connect radiator upper and lower hoses (A).



BCKG005A

Fig. 252: Locating Radiator Upper And Lower Hoses
Courtesy of KIA MOTORS AMERICA, INC.

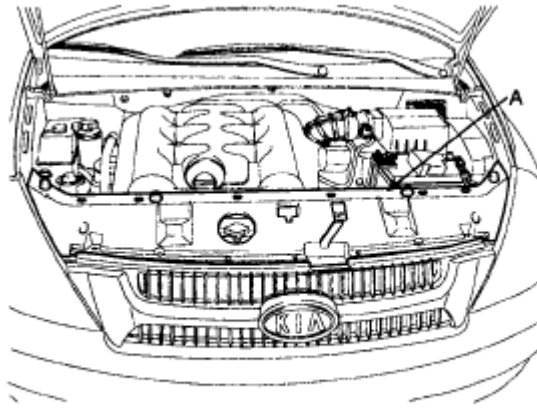
9. Install the radiator support upper member assembly (A).



ACKF047A

Fig. 253: Locating Radiator Support Upper Member Assembly
Courtesy of KIA MOTORS AMERICA, INC.

10. Install under cover.
11. Install the radiator grille upper cover (A).



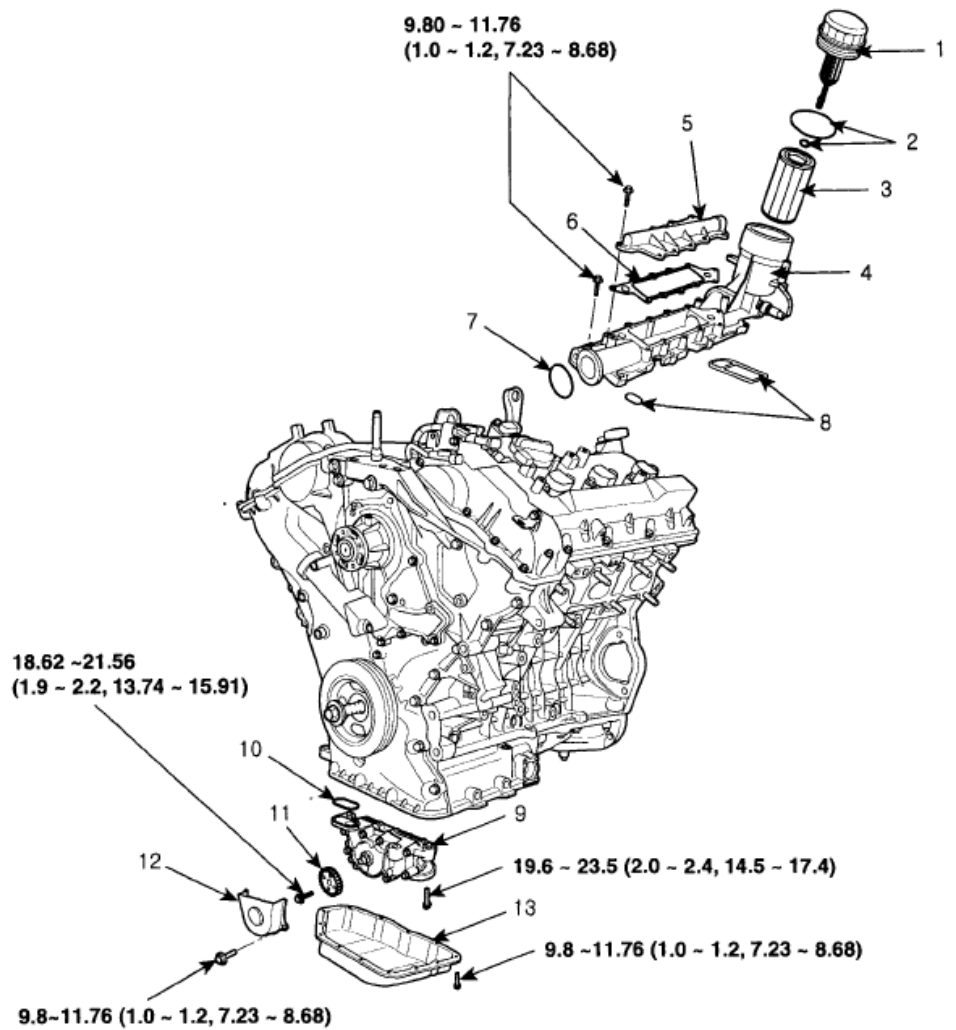
ACKF043A

Fig. 254: Locating Radiator Grille Upper Cover
Courtesy of KIA MOTORS AMERICA, INC.

12. Fill with engine coolant.
13. Start engine and check for leaks.
14. Recheck engine coolant level.

LUBRICATION SYSTEM

COMPONENT



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

- | | | |
|--------------------------|-------------|--------------------------|
| 1. Oil filter cap | 6. Gasket | 11. Oil pump sprocket |
| 2. O - ring | 7. O - ring | 12. Oil pump chain cover |
| 3. Oil filter element | 8. Gasket | 13. Lower oil pan |
| 4. Oil filter body | 9. Oil pump | |
| 5. Oil filter body cover | 10. Gasket | |

BCKG029A

Fig. 255: Identifying Lubrication System Components And Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

OIL AND FILTER

CAUTION:

- Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
- Exercise caution in order to minimize the length and frequency of contact of your skin to used oil. Wear protective clothing and gloves.

Wash your skin thoroughly with soap and water, or use water-less hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.

- **In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.**

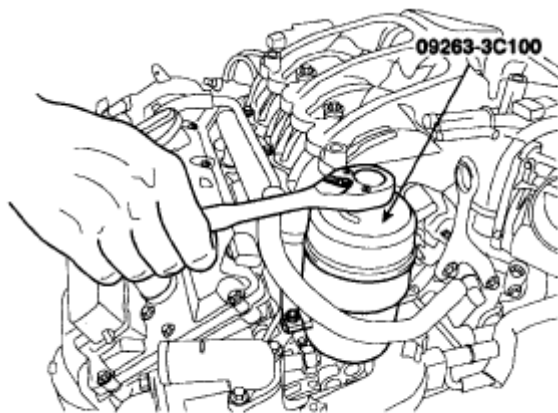
1. Park the car on level ground.

Start the engine and let it warm up.

2. Turn the engine off and open the hood.

Remove the engine cover.

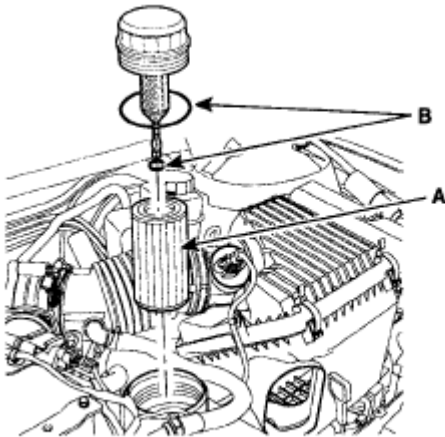
3. Loosen the oil filter cap by turning it clockwise with SST (09263-3C100). Allow 5 minutes for the oil in the filter assembly to drain.



ECRF051A

Fig. 256: Loosening Oil Filter Cap
Courtesy of KIA MOTORS AMERICA, INC.

4. Drain the engine oil.
 - a. Remove the oil filler cap.
 - b. After lifting the car, remove the oil drain plug and drain the oil into a container.
5. Replace oil filter.
 - a. Disconnect the oil filter cap from oil filter body.
 - b. Remove the oil filter element.
 - c. Check and clean the oil filter installation surface.
 - d. Check the part number of the new oil filter is as same as old one.
 - e. Install new oil filter element (A) and two new O-rings (B).



KDAF188A

Fig. 257: Identifying Oil Filter Element And O-Rings
Courtesy of KIA MOTORS AMERICA, INC.

- f. Apply clean engine oil to the new O-rings. Lightly screw the oil filter cap into place, and tighten it until the O-ring contacts the seat.
- g. Finally tighten it again by specified tightening torque.

Tightening torque

24.50 N.m (2.5 kgf.m, 18.08 lb-ft)

6. Refill with engine oil.
 - a. 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)

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

Capacity

Total: 6.4L (6.76 U.S. qts, 5.63 Imp. qts)

Oil pan: 5.5L (5.81 U.S. qts, 4.84 Imp. qts)

Drain and refill: 5.2L (5.49 U.S. qts, 4.58 Imp. qts)

Oil quality : ABOVE API SJ / SL or SAE 5W-20

- c. Install the oil filler cap and oil level gauge.
7. Start the engine and check to be sure no oil is leaking from the drain plug or oil filter.

8. Recheck engine oil level.

INSPECTION

1. Check engine oil quality.

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

If the quality is visibly poor, replace the oil.

2. Check engine oil level.

After warming up the engine and then 5 minutes after the engine stop, oil level should be between the "L" and "F" marks on the dipstick.

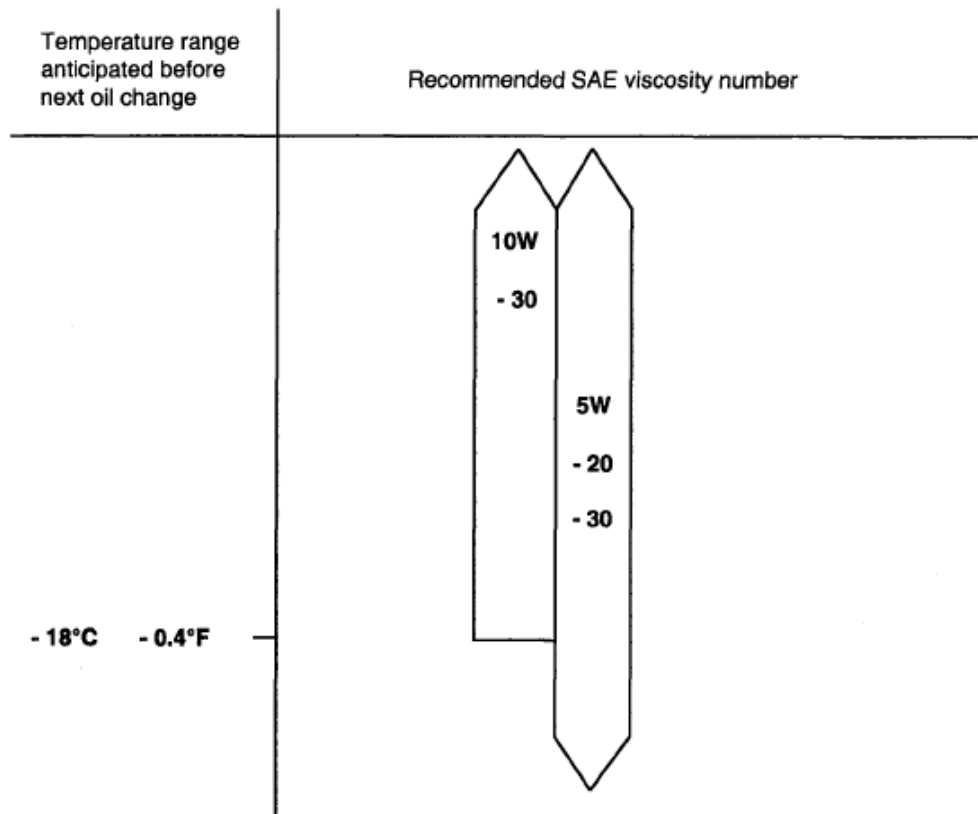
If low, check for leakage and add oil up to the "F" mark.

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

If 5W-20 engine oil is not available, 5W-30 or secondary recommended engine oil for corresponding temperature range can be used.



EORF020A

Fig. 258: 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:

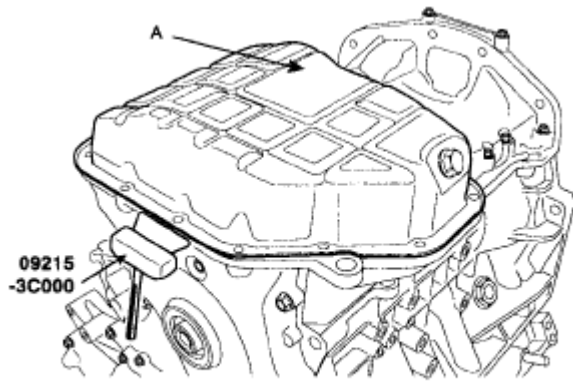
- Satisfy the requirement of the API classification.
- Have proper SAE grade number for expected ambient temperature range.

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

REMOVAL

OIL PUMP

1. Drain engine oil.
2. Using SST (09215-3C000) remove lower oil pan (A).

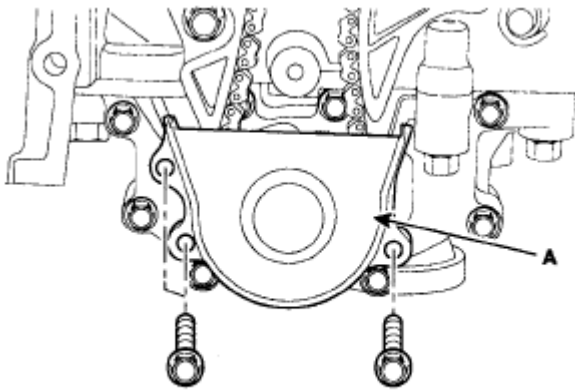


ECRF060A

Fig. 259: Locating 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.

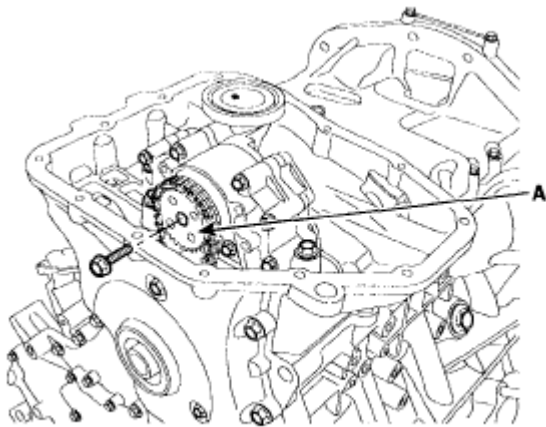
3. Remove oil pump chain cover (A).



KORF185A

Fig. 260: Locating Oil Pump Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

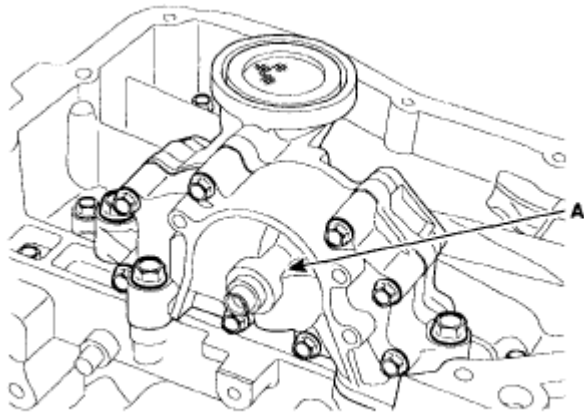
4. Remove oil pump chain sprocket (A).



KDRF189A

Fig. 261: Locating Oil Pump Chain Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove oil pump (A).



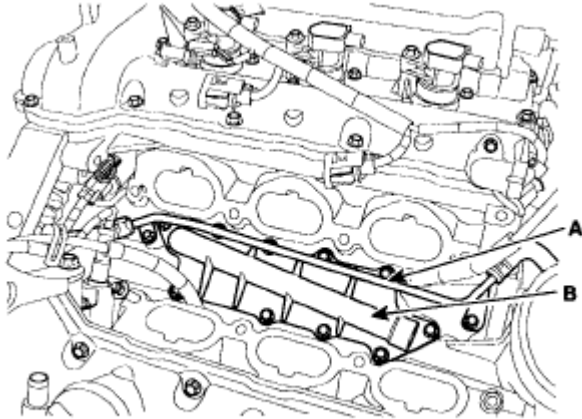
KDRF190A

Fig. 262: Locating Oil Pump
Courtesy of KIA MOTORS AMERICA, INC.

OIL FILTER ASSEMBLY

1. Loosen the oil filter cap by turning it clockwise with SST (09263-3C100). Allow 5 minutes for the oil in the filter assembly to drain.
2. Remove surge tank and intake manifold. Refer to **INTAKE MANIFOLD**.
3. Disconnect oil pressure switch connector.
4. Drain the engine coolant.
5. Disconnect water hoses from ETC.
6. Remove water temperature control assembly. Refer to **WATER TEMPERATURE CONTROL ASSEMBLY**.

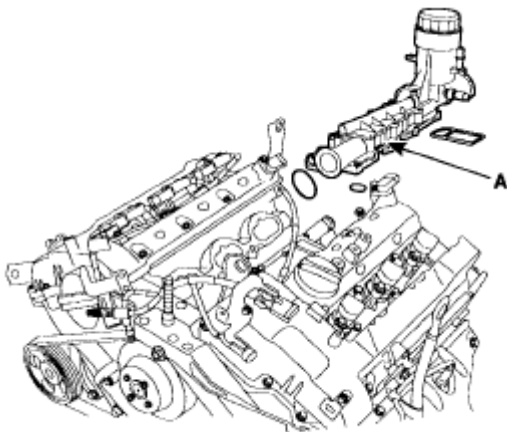
7. Disconnect water vent hose (A).
8. Remove oil filter body cover (B).



KDRF191A

Fig. 263: Locating Water Vent Hose And Oil Filter Body Cover
 Courtesy of KIA MOTORS AMERICA, INC.

9. Remove oil filter body. (A).



KDRF192A

Fig. 264: Identifying Oil Filter Body
 Courtesy of KIA MOTORS AMERICA, INC.

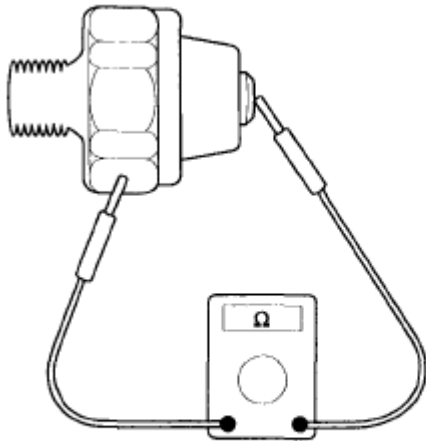
NOTE: Be careful of the knock sensor connector.

INSPECTION

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.

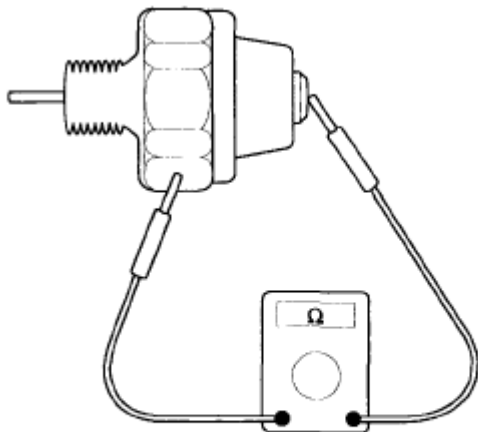


ECKD001W

Fig. 265: Checking Continuity Between Terminal And Body
Courtesy of KIA MOTORS AMERICA, INC.

2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.
3. If there is no continuity when a 50 kPa (7 psi) vacuum is applied through the oil hole, the switch is operating properly.

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



ECKD001Y

Fig. 266: Checking Continuity Between Terminal And Body
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

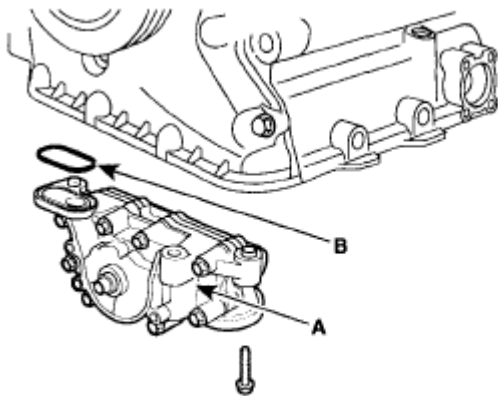
OIL PUMP

1. Install oil pump (A).

Tightening torque

19.6-23.5 N.m (2.0-2.4 kgf.m, 14.5-17.4 lb-ft)

NOTE: Always use a new O-ring (B).



KDRF222A

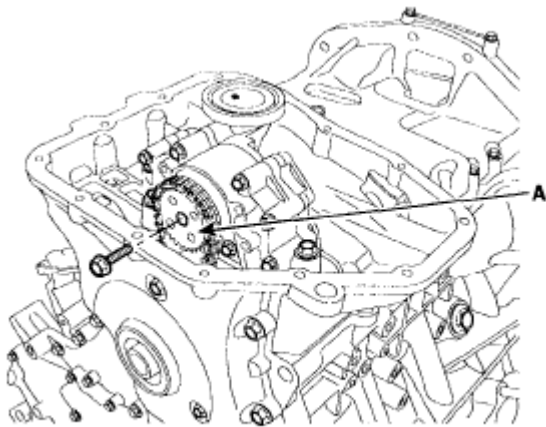
Fig. 267: Identifying Oil Pump

Courtesy of KIA MOTORS AMERICA, INC.

2. Install oil pump sprocket (A) and oil pump chain on the oil pump.

Tightening torque

18.62-21.56 N.m (1.9-2.2 kgf.m, 13.74-15.91 lb-ft)



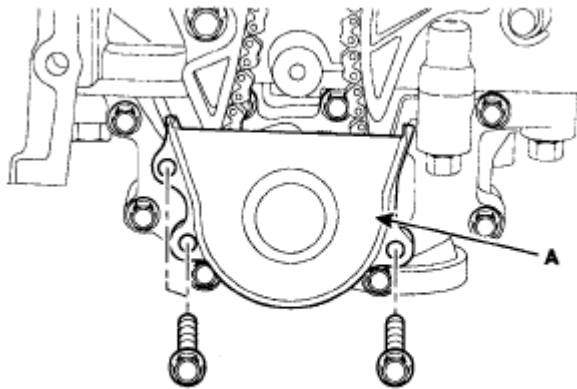
KDRF189A

Fig. 268: Locating Oil Pump Chain Sprocket
 Courtesy of KIA MOTORS AMERICA, INC.

3. Install oil pump chain cover (A).

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



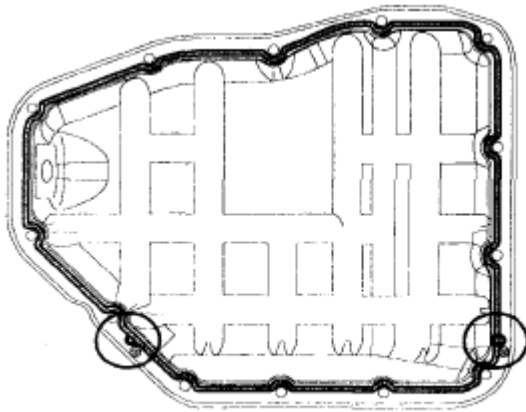
KDRF185A

Fig. 269: Locating Oil Pump Chain Cover
 Courtesy of KIA MOTORS AMERICA, INC.

4. Install lower oil pan.
 - a. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
 - b. 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.

Bead width: 2.5 mm (0.1 in.)

But marked area (*) to be 5.0 mm (0.2 in.)



KDRF136A

Fig. 270: Identifying Lower Oil Pan Bead Width
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

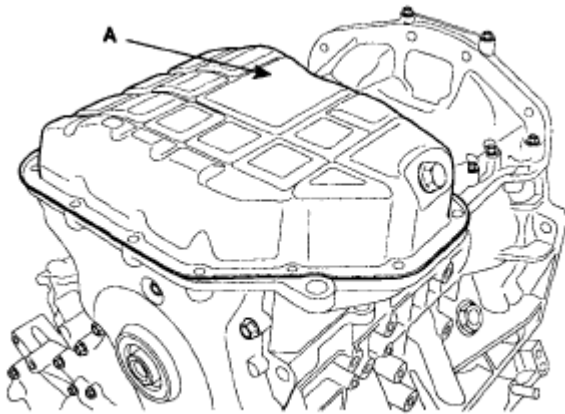
- Ensure the sealing face is clean before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant
- When applying sealant gasket, sealant must not be protruded into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket of the inner threads of the bolt holes.

Install lower oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



KDRF114A

Fig. 271: Locating Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

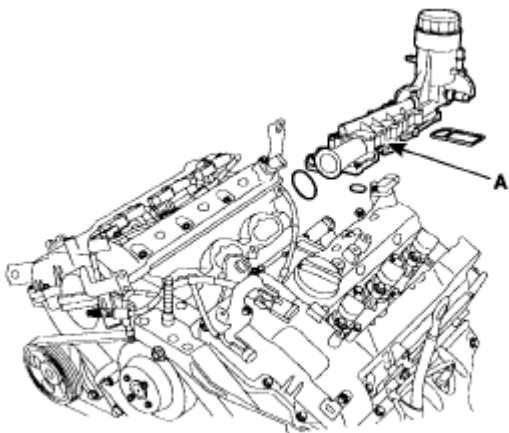
After assembly, wait at least 30 minutes before filling the engine with oil.

OIL FILTER ASSEMBLY

1. Install oil filter body (A) and new O-rings.

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



KDRF192A

Fig. 272: Identifying Oil Filter Body
Courtesy of KIA MOTORS AMERICA, INC.

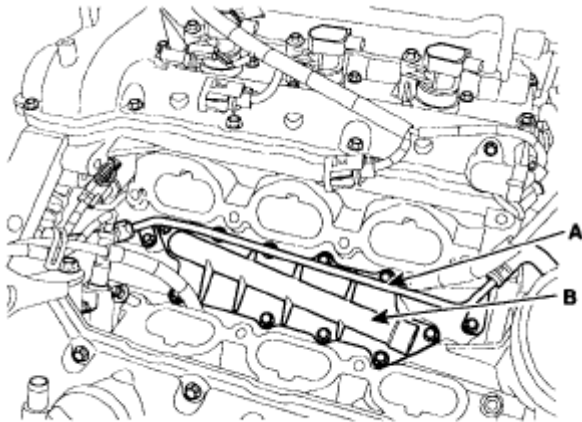
NOTE:

- All rubber gasket must be no damaged by assembling parts.
- Be careful of the knock sensor connector.
- Always use a new O-ring

2. Install oil filter body cover (B) and new gasket on the oil filter body.

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



KDRF191A

Fig. 273: Locating Oil Filter Body Cover
Courtesy of KIA MOTORS AMERICA, INC.

3. Connect water vent hose (A)

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)

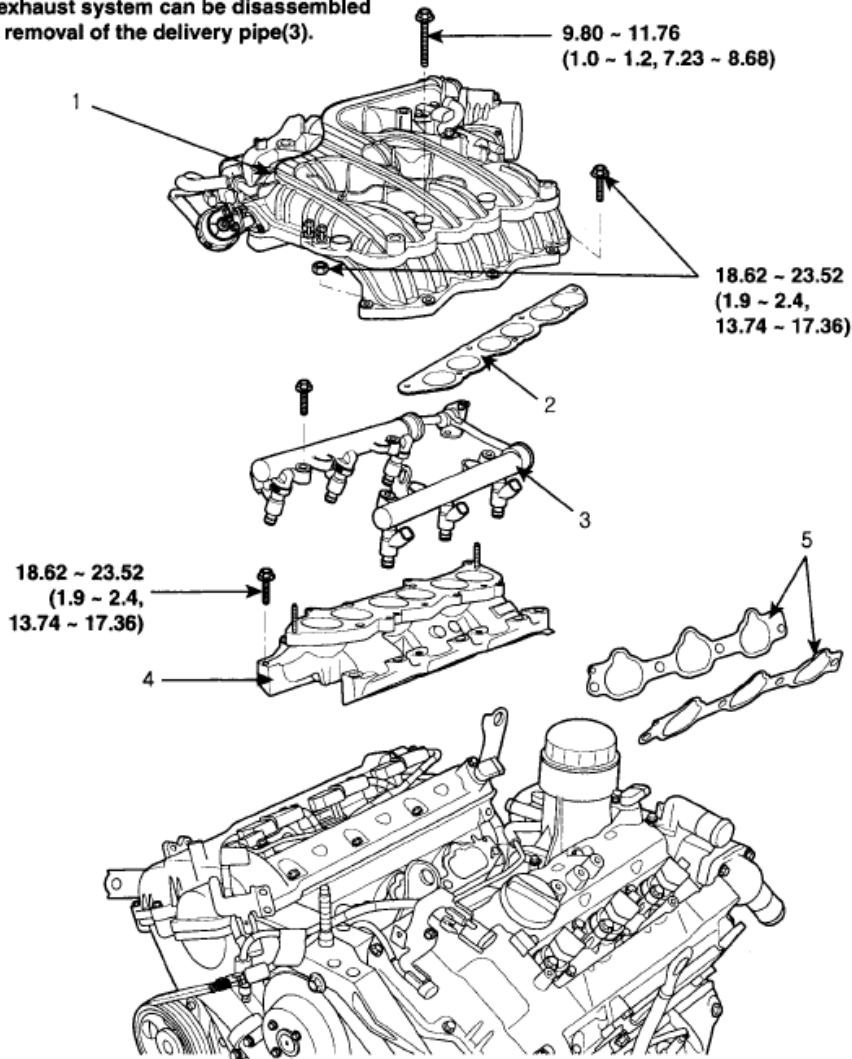
4. Install water temperature control assembly. Refer to **WATER TEMPERATURE CONTROL ASSEMBLY**.
5. Connect water hoses on the ETC.
6. Connect oil pressure switch connector.
7. Install intake manifold and surge tank. Refer to **INTAKE MANIFOLD**.
8. Fill with engine coolant.
9. Start engine and check for leaks.
10. Recheck engine coolant level.

INTAKE AND EXHAUST SYSTEM

COMPONENT

<NOTE>

Intake and exhaust system can be disassembled without the removal of the delivery pipe(3).

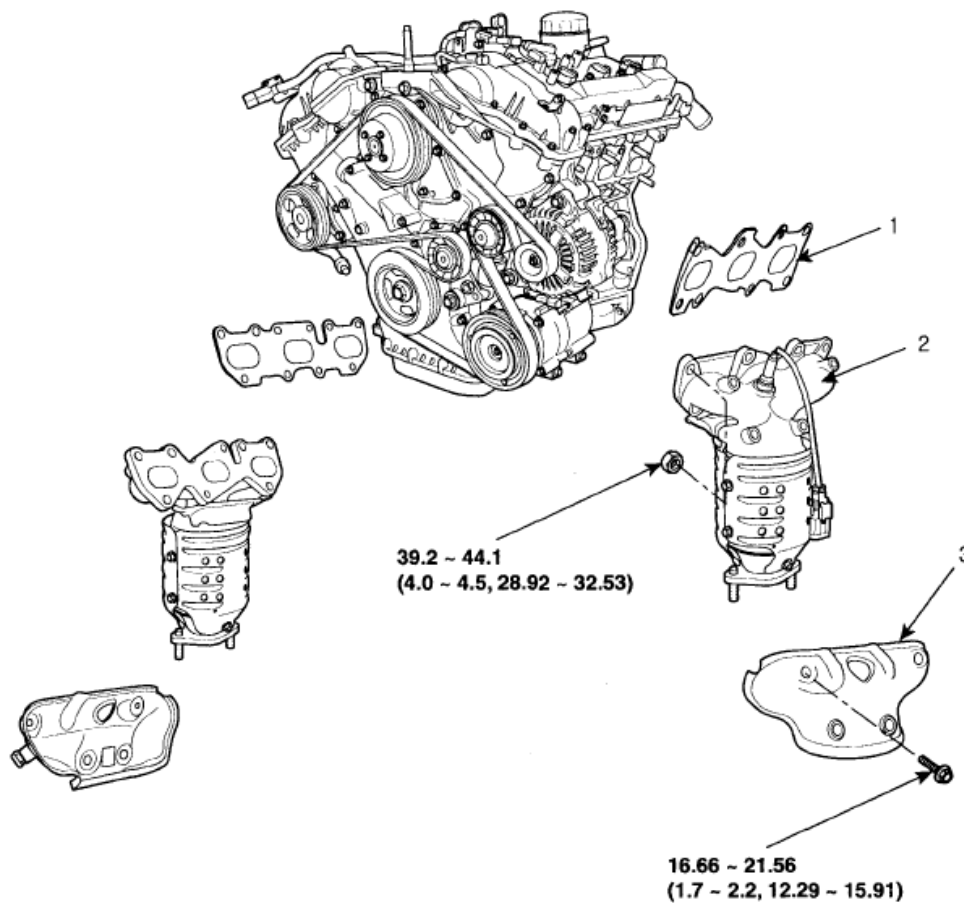


TORQUE : N.m (kgf.m, lb-ft)

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

BCKG030A

Fig. 274: Identifying Intake And Exhaust System Components And Torque Specifications (1 Of 3)
Courtesy of KIA MOTORS AMERICA, INC.



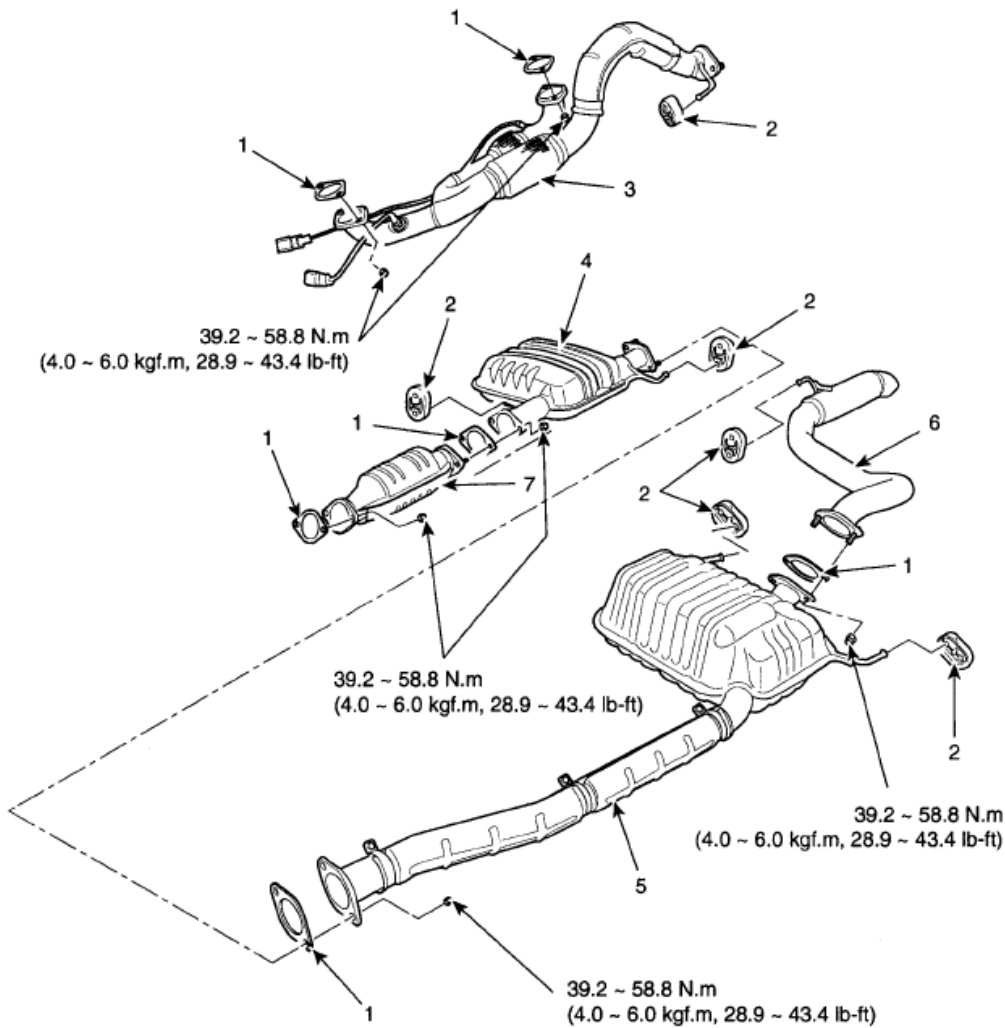
TORQUE : N.m (kgf.m, lb-ft)

- 1. Gasket
- 2. Exhaust manifold

- 3. Heat protector

ECBF014A

Fig. 275: Identifying Intake And Exhaust System Components And Torque Specifications (2 Of 3)
 Courtesy of KIA MOTORS AMERICA, INC.



- 1. Gasket
- 2. Hanger
- 3. Front muffler assembly
- 4. Center muffler assembly

- 5. Main muffler assembly
- 6. Tail pipe muffler assembly
- 7. Catalytic converter assembly

BCKG019A

Fig. 276: Identifying Intake And Exhaust System Components And Torque Specifications (3 Of 3)
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

INTAKE MANIFOLD

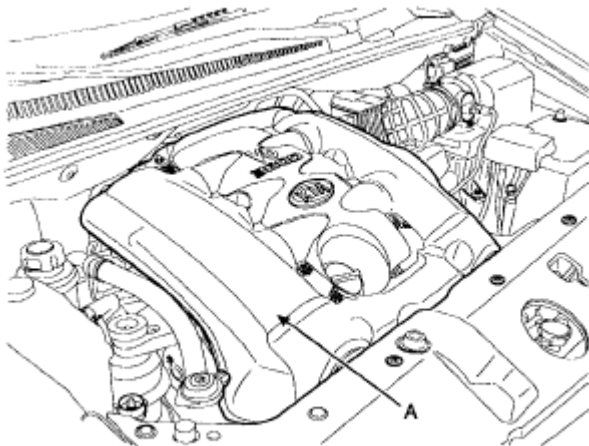
CAUTION:

- 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.

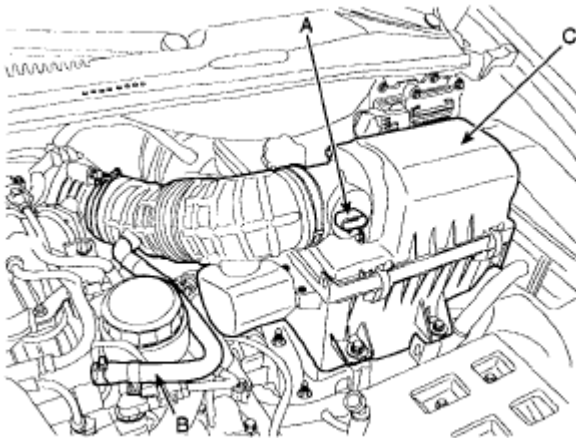
1. Remove the engine cover (A).



BCKG001A

Fig. 277: Locating 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).



BCKG002A

Fig. 278: Locating MAF Connector, Breather Hose And Air Cleaner Assembly**Courtesy of KIA MOTORS AMERICA, INC.**

3. Disconnect RH oxygen sensor connector (A).

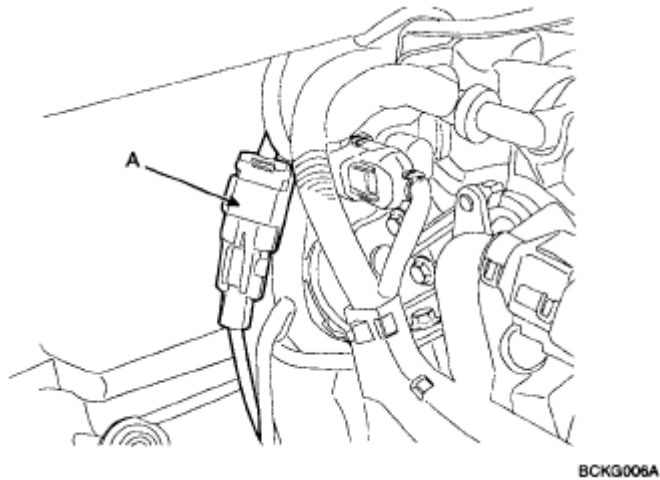


Fig. 279: Locating RH Oxygen Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect RH injector connector (A) and ignition coil connector (B).

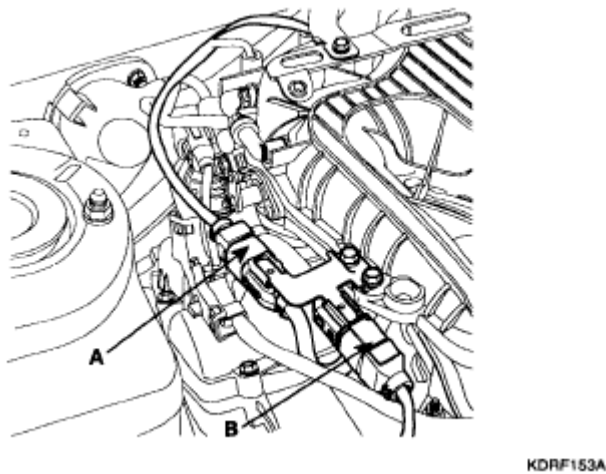


Fig. 280: Locating RH Injector Connector And Ignition Coil Connector
Courtesy of KIA MOTORS AMERICA, INC.

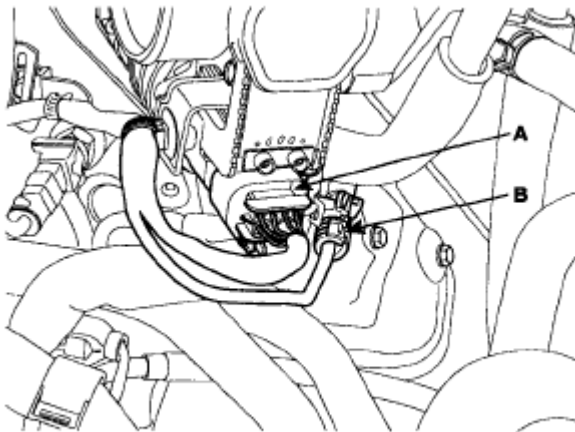
5. Disconnect PCSV connector (A), MAP sensor connector (B) and PCSV hose.



KDRF160A

Fig. 281: Locating PCSV Connector, MAP Sensor Connector And PCSV Hose
 Courtesy of KIA MOTORS AMERICA, INC.

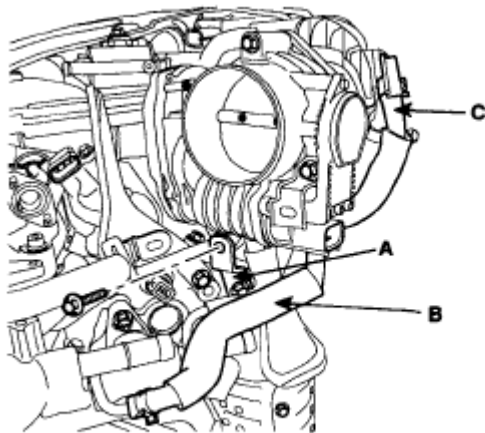
6. Disconnect ECT connector (A) and knock sensor connector (B).



KDRF162A

Fig. 282: Locating ECT Connector And Knock Sensor Connector
 Courtesy of KIA MOTORS AMERICA, INC.

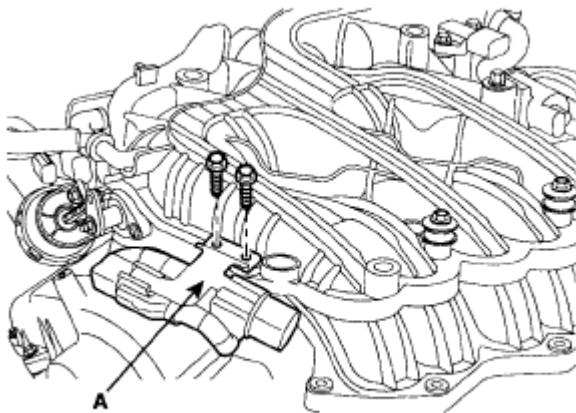
7. Remove ECT bracket (A).
8. Disconnect water hoses (B) from ETC.
9. Disconnect PCV (C) hose.



KDRF176A

Fig. 283: Locating ECT Bracket, Water Hose And PCV Hose
Courtesy of KIA MOTORS AMERICA, INC.

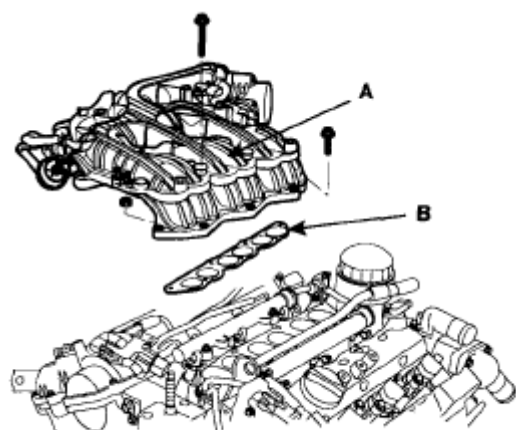
10. Disconnect brake vacuum hose.
11. Remove surge tank stay.
12. Remove connector bracket (A) from surge tank.



KDRF178A

Fig. 284: Locating Connector Bracket
Courtesy of KIA MOTORS AMERICA, INC.

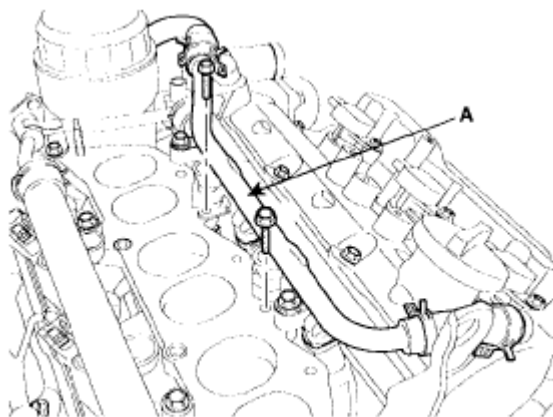
13. Remove surge tank (A).



BCKG031A

Fig. 285: Locating Surge Tank
 Courtesy of KIA MOTORS AMERICA, INC.

14. Disconnect breather Pipe assembly (A).



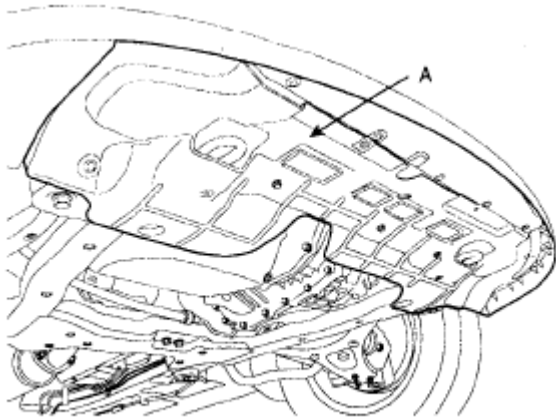
ECBF031A

Fig. 286: Locating Breather Pipe Assembly
 Courtesy of KIA MOTORS AMERICA, INC.

15. Disconnect LH injector connector.
16. Remove the delivery pipe and intake manifold together.

EXHAUST MANIFOLD

1. Remove under cover (A).

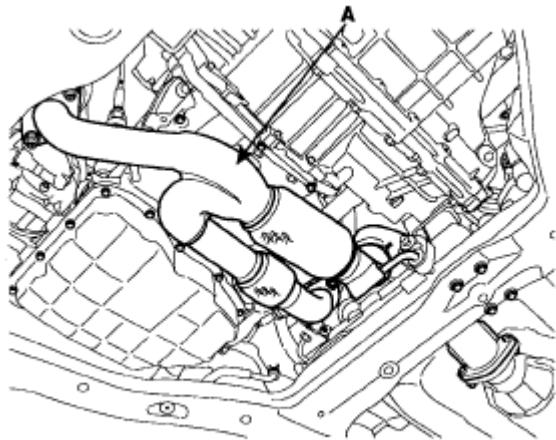


ACKF064A

Fig. 287: Locating Under Cover

Courtesy of KIA MOTORS AMERICA, INC.

2. Disconnect LH, RH rear oxygen sensor connector from bracket.
3. Remove front muffler (A).

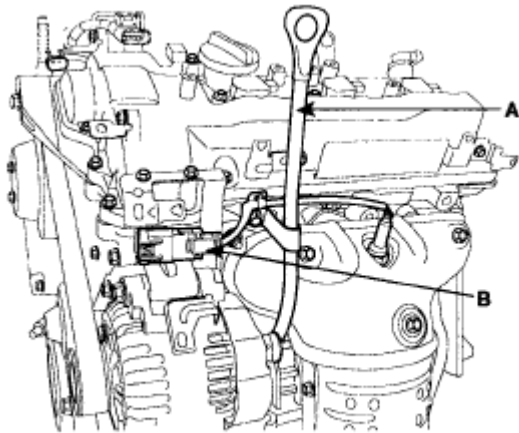


KCBF102A

Fig. 288: Locating Front Exhaust Pipe

Courtesy of KIA MOTORS AMERICA, INC.

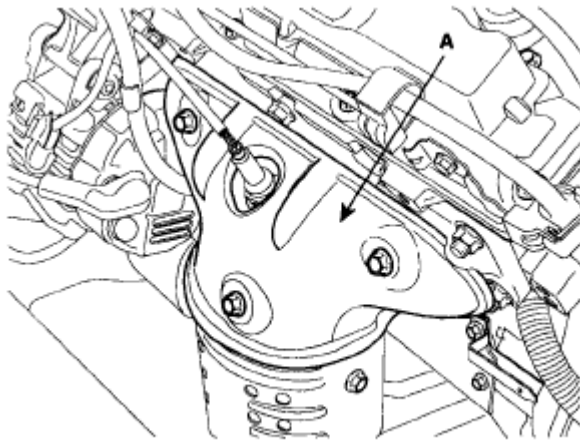
4. Remove oil level gauge (A).
5. Disconnect LH front oxygen sensor connector (B) from bracket.



KDRF183A

Fig. 289: Locating LH Front Oxygen Sensor Connector And Bracket
Courtesy of KIA MOTORS AMERICA, INC.

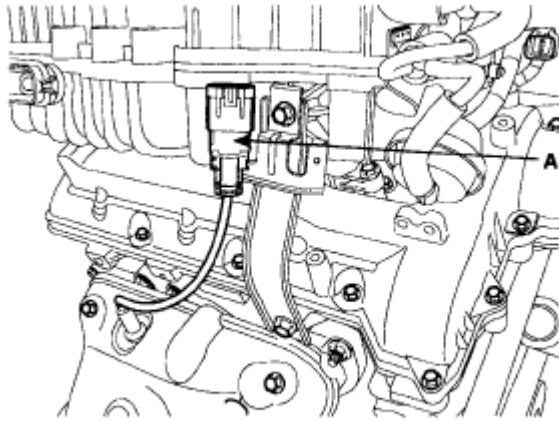
6. Remove LH heat protector (A).



KDRF184A

Fig. 290: Locating LH Heat Protector
Courtesy of KIA MOTORS AMERICA, INC.

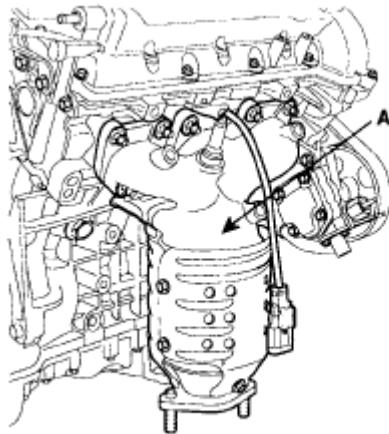
7. Remove LH exhaust manifold.
8. Disconnect RH front oxygen sensor connector (A) from bracket.



KDRF177B

Fig. 291: Locating RH Front Oxygen Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

9. Remove RH heat protector.
10. Remove RH exhaust manifold.



KDRF187A

Fig. 292: Locating RH Exhaust Manifold
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

INTAKE MANIFOLD

1. Install intake manifold and new gasket on the cylinder head.

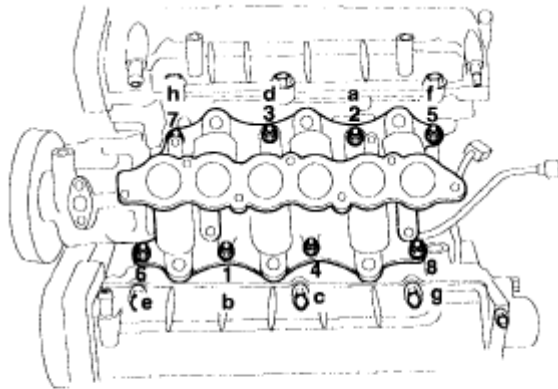
Tightening torque

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

2st: 18.62-23.52 N.m (1.9-2.4 kgf.m, 13.74-17.36 lb-ft)

3st: Repeat 2nd step twice or move.

NOTE: Be careful of the installation direction.
a - h: 1st step order
1-8: 2nd step order



UCBF019A

Fig. 293: Identifying Intake Manifold Bolts Tightening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.

2. Install delivery pipe. Refer to **FUEL DELIVERY SYSTEM** .
3. Connect LH injector connector.
4. Connect breather pipe assembly.

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)

5. Install surge tank.

Tightening torque

9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)

6. Install connector bracket on the surge tank.

Tightening torque

6.86-10.78 N.m (0.7-1.1 kgf.m, 5.06-7.96 lb-ft)

7. Install surge tank stay.

Tightening torque

27.44-31.36 N.m (2.8-3.2 kgf.m, 20.25-23.14 lb-ft)

8. Connect brake vacuum hose.
9. Connect PCV hose.
10. Connect water hoses to ETC.
11. Install ETC bracket.

Tightening torque

15.68-25.48 N.m (1.6-2.6 kgf.m, 11.57-18.80 lb-ft)

12. Connect ETC connector and knock sensor connector.
13. Connect PCSV connector, MAP sensor connector and PCSV hose.
14. Connect RH injector connector and ignition coil connector.
15. Connect RH oxygen sensor connector.
16. Install air cleaner upper cover and intake hose.
17. Connect MAF (A) and breather hose.

EXHAUST MANIFOLD

1. Install new gasket and exhaust manifold.

Tightening torque

39.2-44.1 N.m (4.0-4.5 kgf.m, 28.92-32.53 lb-ft)

2. Install heat protector.

Tightening torque

3.9-5.9 N.m (0.4-0.6 kgf.m, 2.89-4.34 lb-ft)

3. Install front muffler.

Tightening torque

39.2-58.8 N.m (4.0-6.0 kgf.m, 28.92-43.37 lb-ft)

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