

2008 Kia Sorento

2007-08 ENGINE Mechanical - Sorento

2007-08 ENGINE**Mechanical - Sorento****GENERAL****SPECIFICATION****SPECIFICATION**

Description			Specifications		Limit
			G6DB-3.3	G6DA-3.8	
General					
Type		V-type, DOHC			
Number of cylinders		6			
Bore		92 mm (3.6220 in)	96 mm (3.7795 in)		
Stroke		83.8 mm (3.2992 in)	87.0 mm (3.4252 in)		
Total displacement		3.342 cc (203.86 cu.in)	3.778 cc (230.55 cu.in)		
Compression ratio		10.4			
Firing order		1-2-3-4-5-6			
Valve timing					
Intake	Opens (ATDC)		14°	10°	
	Closes (ATDC)		66°	66°	
Exhaust	Opens (BTDC)		52°	52°	
	Closes (ATDC)		0°	0°	
Cylinder head					
Flatness of gasket surface		Less than 0.05 mm (0.0019 in) [Less than 0.02 mm (0.0008 in) / 150 x 150]			
Flatness of manifold mounting	Intake		Less than 0.1 mm (0.0039 in) [Less than 0.03 mm (0.001 in)/110 x 110]		
	Exhaust		Less than 0.1 mm (0.0039 in) [Less than 0.03 mm (0.001 in)/110 x 110]		
Camshaft					
Cam height	LH Camshaft	Intake	46.3 mm (1.8228 in)	46.8 mm (1.8425 in)	
		Exhaust	45.8 mm (1.8031 in)		
	RH Camshaft	Intake	46.3 mm (1.8228 in)	46.8 mm (1.8425 in)	
		Exhaust	45.8 mm (1.8031 in)		

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Journal outer diameter	LH, RH Camshaft	Intake	No. 1: 27.964-27.978 mm (1.1009 -1.1015 in) No. 2,3,4: 23.954-23.970 mm (0.9430-0.9437 in)		
		Exhaust	No. 1: 27.964-27.978 mm (1.1009-1.1015 in) No.2,3,4: 23.954-23.970 mm (0.9430-0.9437 in)		
Bearing oil clearance	LH, RH Camshaft	Intake	No. 1: 0.027-0.057 mm (0.0011-0.0022in) No. 2,3,4: 0.030-0.067 mm (0.0012 -0.0026 in)		
		Exhaust	No.1: 0.027-0.057 mm (0.0011-0.0022 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 (0.00275in)
	Exhaust		0.030-0.054 mm (0.00118-0.00212 in)		0.09 mm (0.00354in)
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	Intake		1.15-1.45 mm (0.05118-0.05709		

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contact		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 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		92.00-92.03 mm (3.6220-3.6232 in)	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) / 150 x 150]	
Piston			
Piston outer diameter		91.96-92.00 mm (3.6205-3.6220 in)	95.96-95.99 mm (3.7779-3.7791 in)
Piston to cylinder clearance		-->	0.03-0.05 mm (0.0012-0.0020

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Ring groove width	No. 1 ring groove	-->	in) 1.22-1.24 (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)
	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				
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)		

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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 (Oil pan)	4.5-5.5L (4.76-5.81 U.S. qts, 3.96-4.84 Imp. qts)	
Oil quantity (Oil filter)	0.4L (0.42 U.S. qts, 0.35 Imp. qts)	
Oil quantity (Drain and refill)	5.2L (5.49 U.S. qts, 4.58 Imp. qts)	
Oil quality	Above SJ or SL	
Oil pressure	130 kPa (1.32 kgf/cm ² , 18.77 psi) [at 1000 RPM, 110°C (230°F)]	
Cooling system		
Cooling method	Forced circulation with electrical fan	
Coolant quantity	9.0L (9.40 U.S. qts, 7.83 Imp. qts)	
Thermostat	Type	Wax pellet type
	Opening temperature	82 ± 2°C (179.6 ± 35.6°F)
	Fully opened temperature	95°C (203°F)
	Full lift	more than 10 mm (0.3937 in)
Radiator cap	Main valve opening pressure	93.16-122.58 kPa (0.95-1.25 kg/cm ² , 13.51-17.78 psi)
	Vacuum valve opening pressure	0.98-4.90 kPa (0.01-0.05 kg/cm ² , 0.14-0.71 psi)
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

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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	81.4-85.3	8.3-8.7	60.0-62.9
Drive belt auto tensioner bolt(M8)	1	29.4-33.3	3.0-3.4	21.7-24.6
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	39.2 + 120° +90°	4.0 + 120° +90°	28.93+ 120° + 90°
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	19.60 + 90°	2.0 + 90°	14.46 + 90°
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	1	24.50	2.5	18.08
Oil drain bolt	1	34.30-44.10	3.5-4.5	25.31-32.55
Oil pump bolt	3	19.60-23.52	2.0-2.4	14.47-17.36
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

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Water vent hose bolt	2	9.80-11.76	1.0-1.2	7.23-8.68
Water pump bolt (Timing chain cover bolt L)	1	21.56-26.46	2.2-2.7	15.91-19.53
Water pump bolt (Timing chain cover bolt K)	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	19.6-23.52	2.0-2.4	14.5-17.36
Water temp, control bolt	2	19.6-23.52	2.0-2.4	14.5-17.36
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	26.5-31.4	2.7-3.2	19.5-23.1
Intake manifold nut	2	18.62-23.52	1.9-2.4	13.74-17.36
Surge tank bolt	1	9.80-11.76	1.0-1.2	7.23-8.68
Surge tank nut	2	18.6-23.5	1.9-2.4	13.7-17.4
Exhaust manifold stay bolt	4	52.0-56.9	5.3-5.8	38.3-42.0
Surge tank bolt	3	18.6-23.5	1.9-2.4	13.7-17.4
Breather pipe bolt	2	9.80-11.76	1.0-1.2	7.23-8.68
Surge tank bracket bolt	2	27.44-31.36	2.8-3.2	20.25-23.14
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	6	9.8-11.8	1.0-1.2	7.2-8.7
Front muffler	2	39.20-58.80	4.0-6.0	28.93-43.40

INSPECTION**COMPRESSION PRESSURE**

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 ignition coils. Refer to Ignition in **GENERAL (FUEL SYSTEM)** .
3. Remove spark plugs.

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

4. Check cylinder compression pressure.
 - a. Insert a compression gauge into the spark plug hole.
 - b. Fully open the throttle.
 - c. After 7 times of cranking the engine, measure the compression pressure.

NOTE: Always use a fully charged battery to obtain engine speed of 200 RPM or more.

- d. Repeat steps (a) through (c) 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)

- e. 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 (a) through (c) 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.
5. Reinstall spark plugs.
6. Install ignition coils. See **GENERAL (ENGINE ELECTRICAL SYSTEM)** .

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 (A).

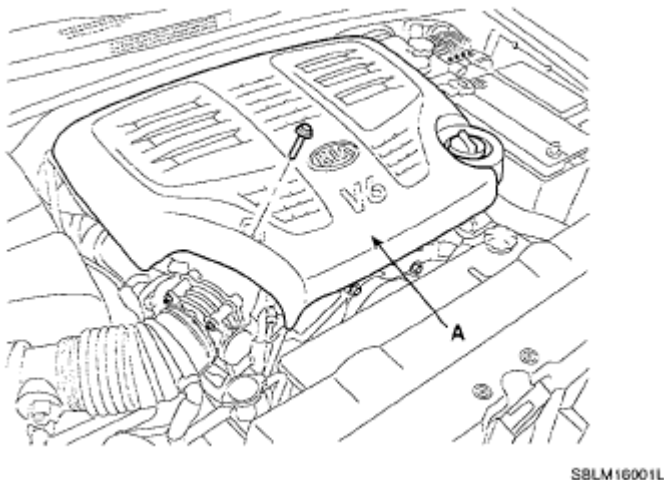


Fig. 1: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the engine room resonator (A).

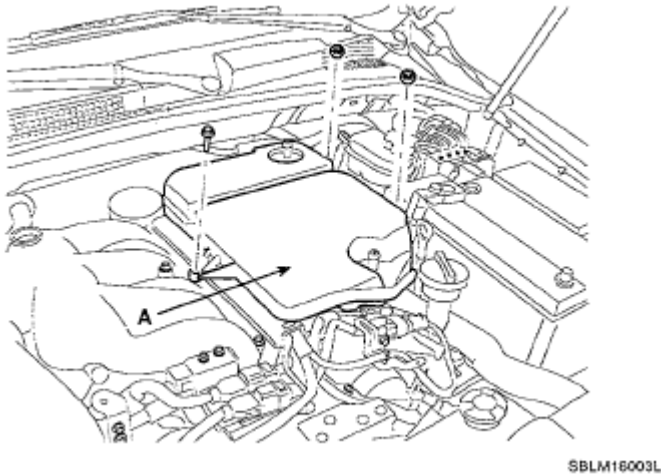


Fig. 2: Identifying Engine Room Resonator
 Courtesy of KIA MOTORS AMERICA, INC.

3. After disconnecting the MAF sensor connector (A) and the breather hose (B), remove the air cleaner assembly (C).

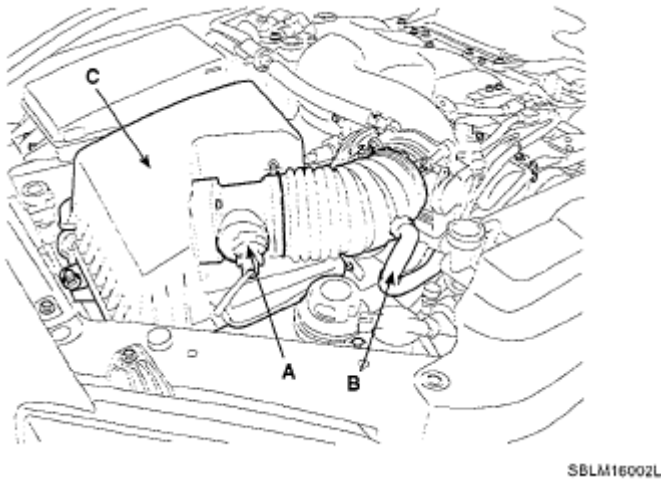
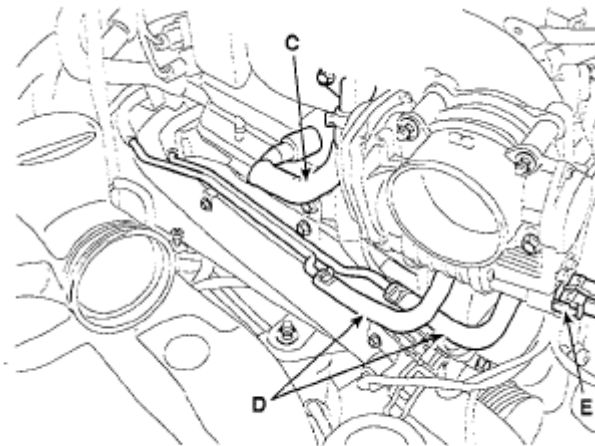


Fig. 3: Disconnecting MAF Sensor Connector And Breather Hose
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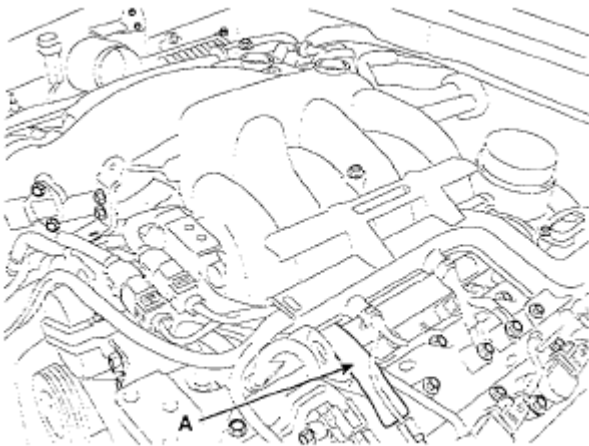
4. Disconnect the other breather hose (A), the Purge Control Solenoid Valve (PCSV) hose, the Positive Crankcase Ventilation (PCV) hose (C) and the Electronic Throttle Control (ETC) cooling hoses (D) and connector (E).



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Fig. 4: Disconnecting Purge Control Solenoid Valve (PCSV) Hose And Positive Crankcase Ventilation (PCV) Hose

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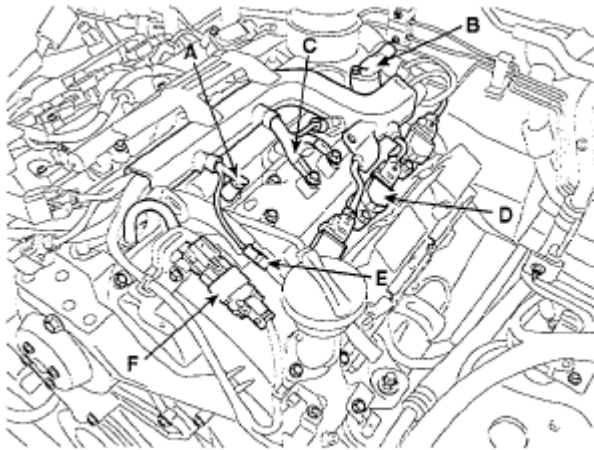


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Fig. 5: Disconnecting Breather Hose

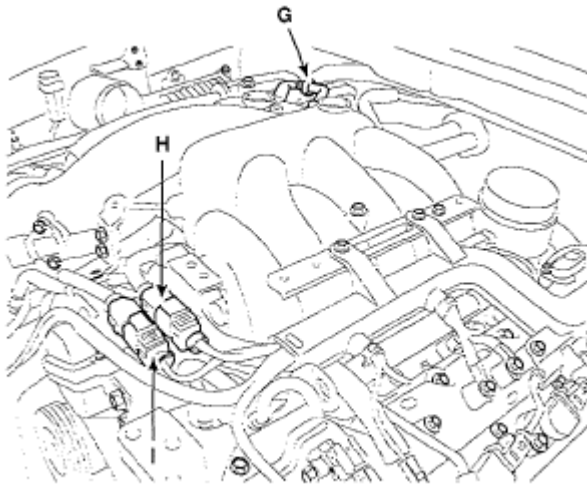
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the wiring over the surge tank.
 1. Disconnect the injection harness connector (A).
 2. Disconnect the camshaft position sensor (CMP) harness connector (B).
 3. Disconnect the ground line (C).
 4. Disconnect the ignition coil harness connector (D).
 5. Disconnect the condenser connector (E).
 6. Disconnect the variable induction system (VIS) solenoid valve connector (G).
 7. Disconnect the oil control valve (OCV) harness connector (F).
 8. Disconnect the injector wiring (H) and ignition coil wiring (I).



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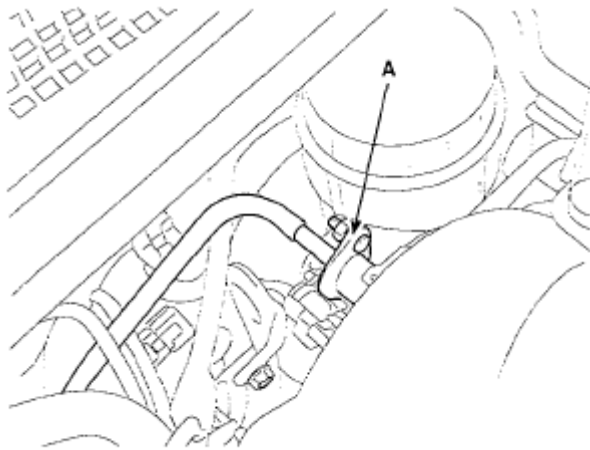
Fig. 6: Disconnecting Injection Harness Connector And Ground Line
Courtesy of KIA MOTORS AMERICA, INC.



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Fig. 7: Disconnecting Injector Wiring And Ignition Coil Wiring
Courtesy of KIA MOTORS AMERICA, INC.

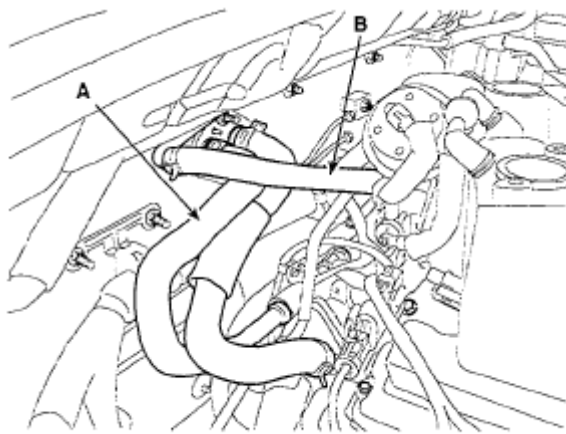
6. Disconnect the fuel hose tube (A).



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Fig. 8: Disconnecting Fuel Hose Tube
Courtesy of KIA MOTORS AMERICA, INC.

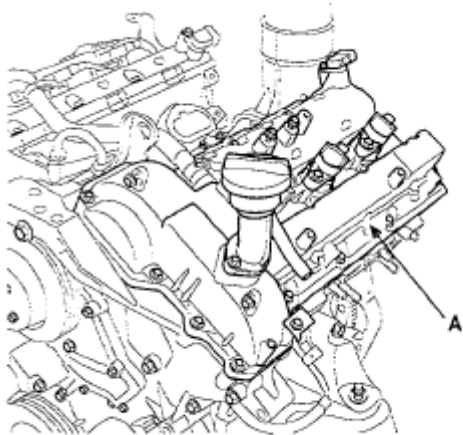
7. Remove heater hose (A) and disconnect the brake vacuum hose (B).



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Fig. 9: Heater & Brake Vacuum Hoses
Courtesy of KIA MOTORS AMERICA, INC.

8. Disconnect the surge tank stay.
9. Remove the surge tank.
10. Loosen the cylinder head cover bolts and then remove the cover (A) and gasket.

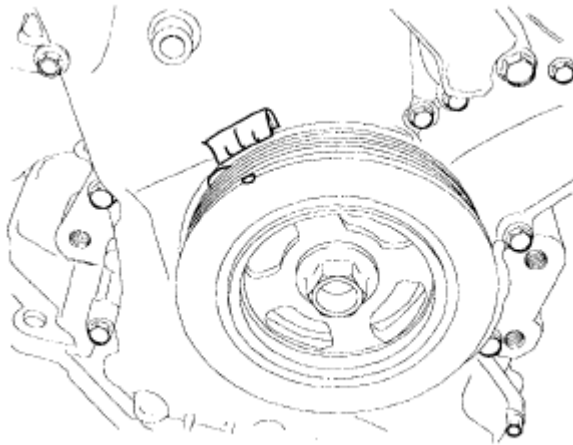


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Fig. 10: Identifying Cover

Courtesy of KIA MOTORS AMERICA, INC.

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



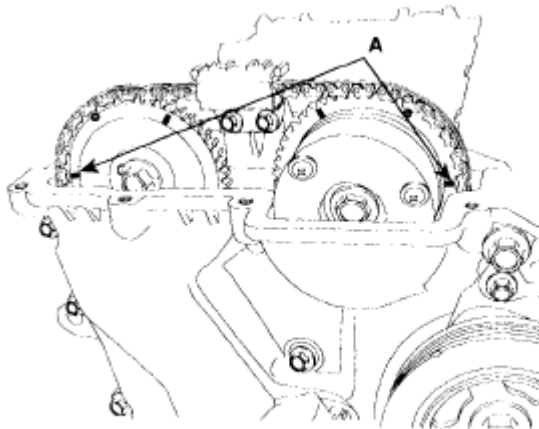
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Fig. 11: Identifying Crankshaft Pulley

Courtesy of KIA MOTORS AMERICA, INC.

- b. 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°)

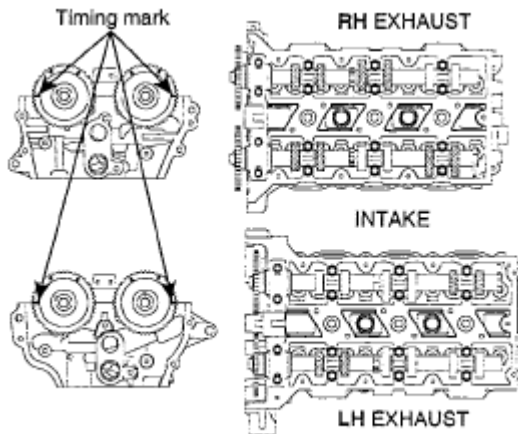
NOTE: **Do not rotate engine counterclockwise**



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Fig. 12: Identifying Mark Of Camshaft Timing Sprockets
 Courtesy of KIA MOTORS AMERICA, INC.

12. Inspect the valve clearance.
 - a. Check only the valve indicated as shown [No. 1 cylinder: TDC/Compression]. Measure the valve clearance.



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Fig. 13: Identifying Timing Marks
 Courtesy of KIA MOTORS AMERICA, INC.

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

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

- b. 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

- c. Check only valves indicated as shown [No. 4 cylinder: TDC/compression]. Measure the valve clearance.

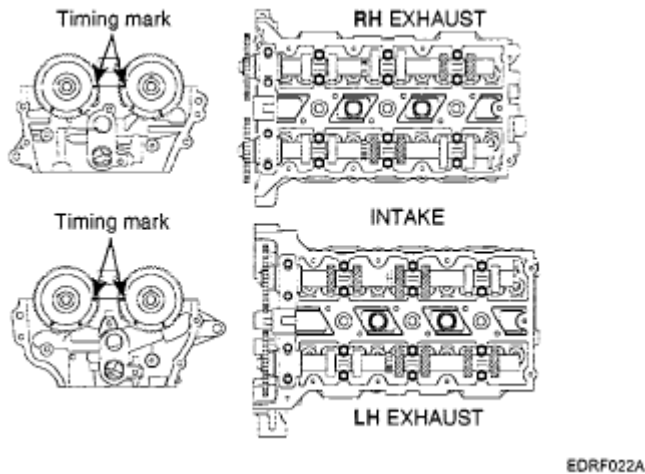
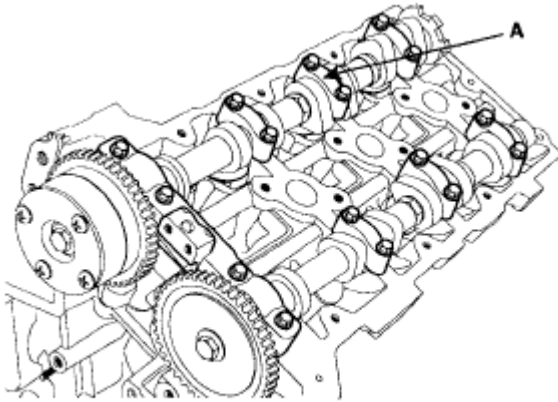


Fig. 14: Identifying Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

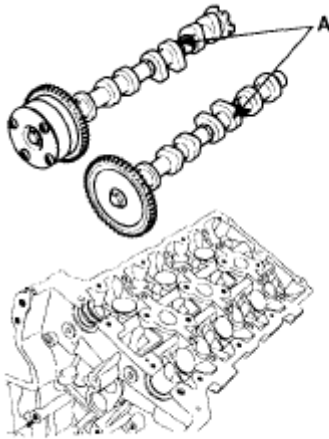
13. Adjust the intake and exhaust valve clearance.
 - a. Set the No.1 cylinder to the TDC/compression.
 - b. Mark on the timing chain on the basis of the marking on sprocket and CVVT.
 - c. Remove the timing chain.
 - d. Remove the camshaft bearing caps (A).



KDRF196A

Fig. 15: Identifying Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

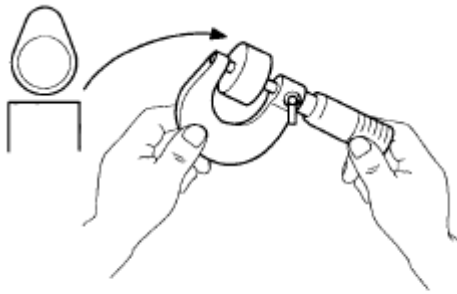
- e. Remove the camshaft assembly (A).



KDRF197A

Fig. 16: Identifying Camshaft Assembly
Courtesy of KIA MOTORS AMERICA, INC.

- f. Remove MLAs.
- g. Measure the thickness of the removed tappet using a micrometer.



EDKEM88D

Fig. 17: Measuring Thickness Of Tappet
 Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

- j. Place a new tappet on the cylinder head.

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

- k. Install the intake and exhaust camshaft.
 l. Install the bearing caps.
 m. Install the timing chain.
 n. Turn the crankshaft two turns in the operating direction (clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks.
 o. 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

TROUBLESHOOTING

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.	- Faulty 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 faulty head gasket. - Repair or replace as required.
Engine misfire with excessive oil consumption.	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	- Inspect the cylinder for a loss of compression. - Repair or replace as required.
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity.	- Drain the oil. - Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	- Inspect the thrust bearing and crankshaft. - Repair or replace as required.

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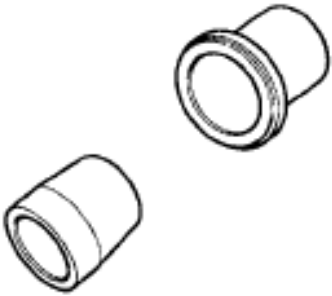
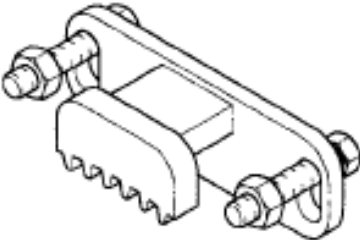
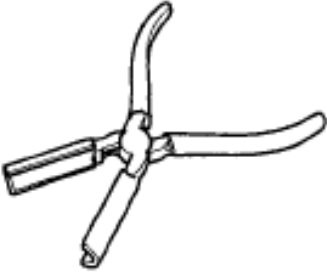
Upper engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	- Inspect the camshaft lobes. - Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves (Carbon on the valve stem or valve seat may cause the valve to stay open).	Inspect the valves and valve guides, then repair as required.
Lower engine noise, regardless of engine speed.	Worn drive belt, idler, tensioner and bearing.	Replace as required.
	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.

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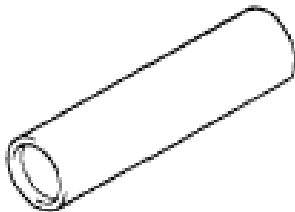
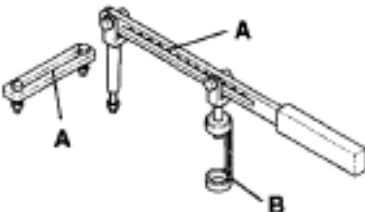
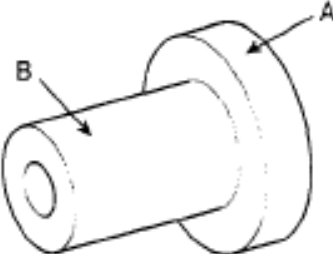
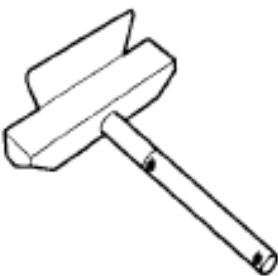
		• The cylinder block.
	Incorrect piston, piston pin and connecting rod installation	• Verify the piston pins and connecting rods are installed correctly. • Repair as required.
Engine noise under load.	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance.	Inspect the following components and repair as required: • The connecting rod bearings. • The connecting rods. • The crankshaft.
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required. • The crankshaft bearings. • The crankshaft main journals. • The cylinder block.
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.

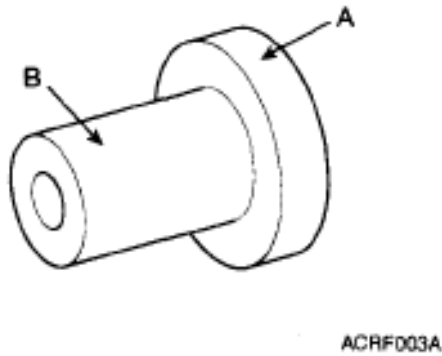
SPECIAL SERVICE TOOLS**SPECIAL SERVICE TOOLS**

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09231-3C100)	 KDRF233A	Installation of the front oil seal
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)	 KDRF232A	Remover of the valve stem seal

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Valve stem seal remover (09222-3C100)	 LCAD0300D	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)	 ACRF003A	Installation of the crankshaft rear oil seal A. 09231-3C200 B. 09231-H1100
Oil pan remover (09215-3C000)	 KDRF219A	Removal of oil pan
Oil filter wrench (09263-3C100)		Removal and installation of the oil filter



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

1. Remove the engine cover (A).

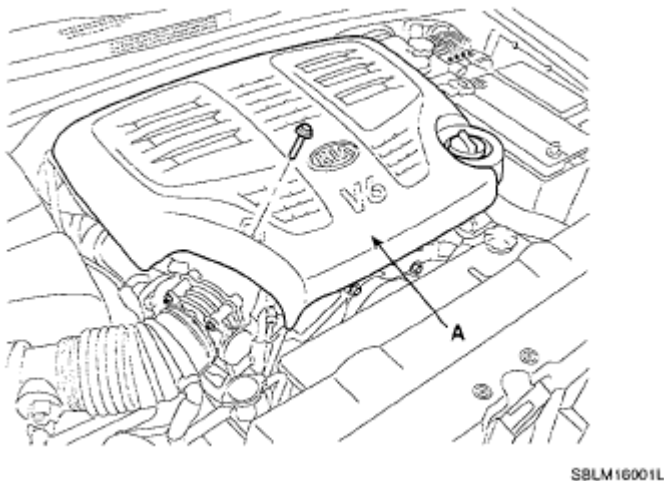
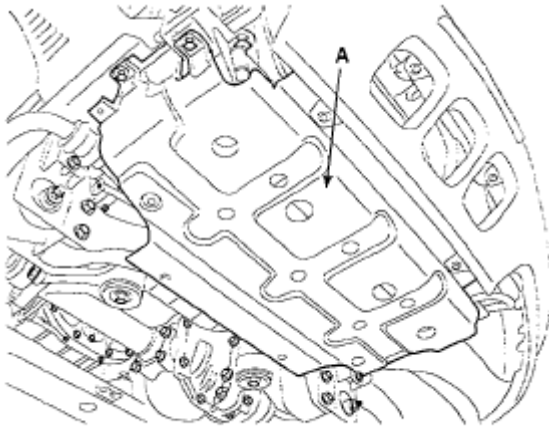


Fig. 18: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

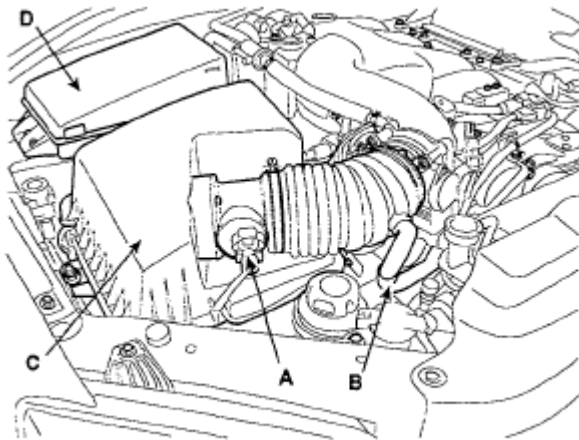
2. Recover refrigerant by opening the high & low pressure pipe caps and connecting the refrigerant station. Refer to **AIR CONDITIONING SYSTEM**.
3. Remove the under cover (A).



SBLM16016L

Fig. 19: Identifying Under Cover
Courtesy of KIA MOTORS AMERICA, INC.

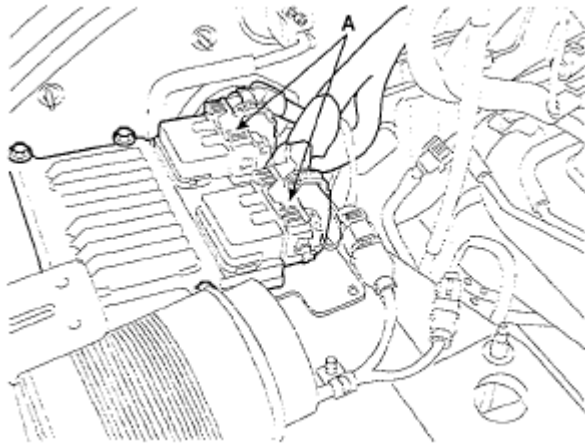
4. Drain engine oil, transaxle fluid and engine coolant.
5. Disconnect the negative terminal from the battery and remove the battery (A).
6. Remove the intake air hose and air cleaner assembly.
 1. Disconnect the MAF connector (A).
 2. Disconnect the breather hose (B) from air cleaner hose.
 3. Remove the intake air hose and air cleaner assembly (C) with the resonator (D).



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Fig. 20: Identifying Air Cleaner Assembly, Resonator And Breather Hose
Courtesy of KIA MOTORS AMERICA, INC.

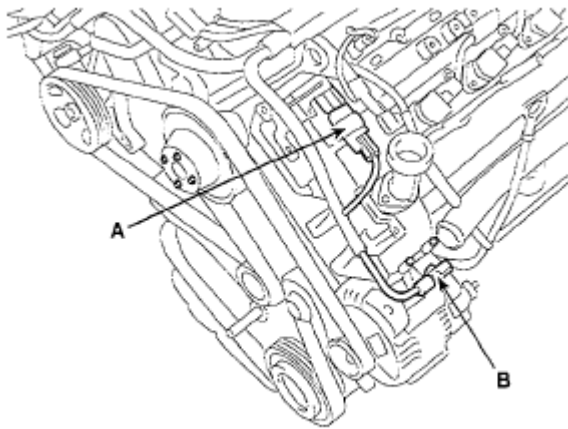
7. Disconnect the PCM connectors (A).



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Fig. 21: Disconnecting PCM Connectors
Courtesy of KIA MOTORS AMERICA, INC.

8. Remove the battery tray while recovering refrigerant.
9. Disconnect the high and low pressure pipes from the radiator or the compressor. Refer to **AIR CONDITIONING SYSTEM**.
10. Remove the radiator. Refer to **RADIATOR**.
11. Disconnect the engine wiring harness connectors.
 1. Disconnect the oil control valve (OCV) harness connector (A) and the knock sensor (LH) harness connector (B)



SBLM16010L

Fig. 22: Disconnecting Oil Control Valve Harness Connector And Knock Sensor Harness Connector
Courtesy of KIA MOTORS AMERICA, INC.

2. Disconnect the MAP (A), ETC (B), ignition coil harness connector (C) and the injection harness connector (D).

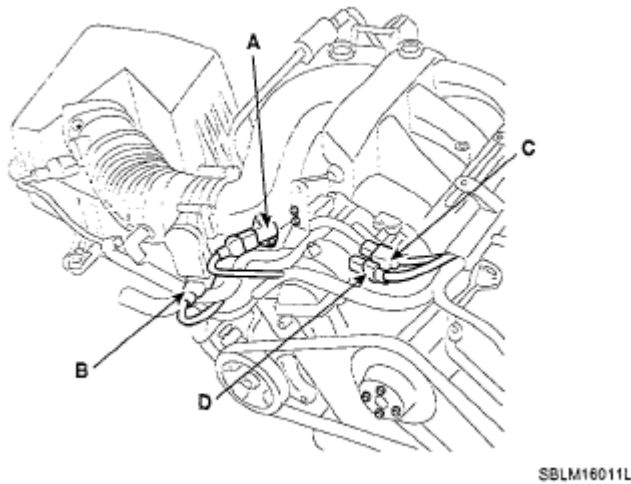


Fig. 23: Disconnecting MAP, ETC And Ignition Coil Harness Connector
 Courtesy of KIA MOTORS AMERICA, INC.

3. Disconnect the battery connector (A), the power steering switch connector (B) and the knock sensor (RH) harness connector (C).

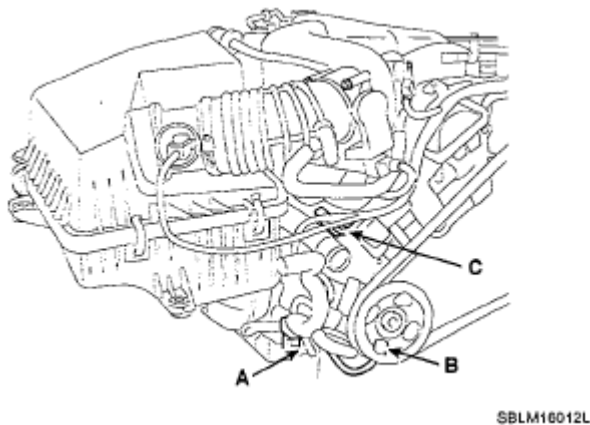
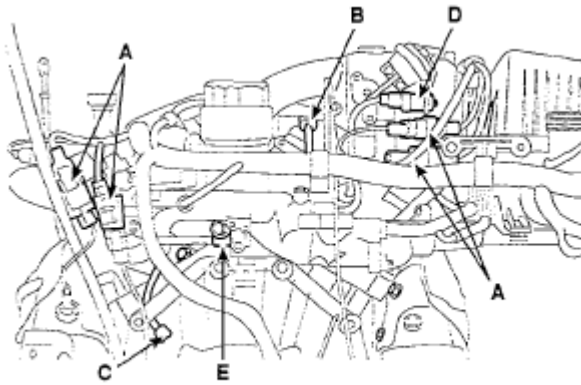


Fig. 24: Disconnecting Battery Connector And Power Steering Switch Connector
 Courtesy of KIA MOTORS AMERICA, INC.

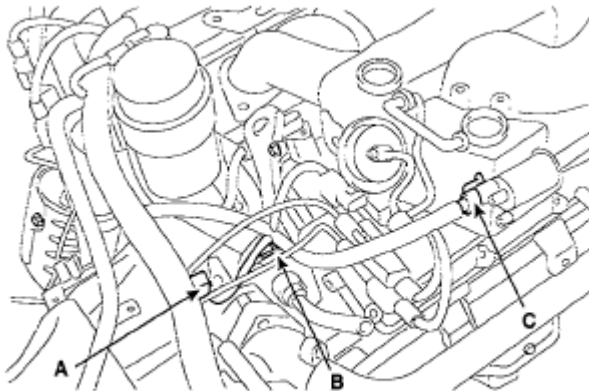
4. Disconnect the oxygen sensors (A), CMP (B), CKP (C), VIV (D) and the condenser harness connector (E).



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Fig. 25: Disconnecting Oxygen Sensors, CMP, CKP, VIV And Condenser Harness Connector
 Courtesy of KIA MOTORS AMERICA, INC.

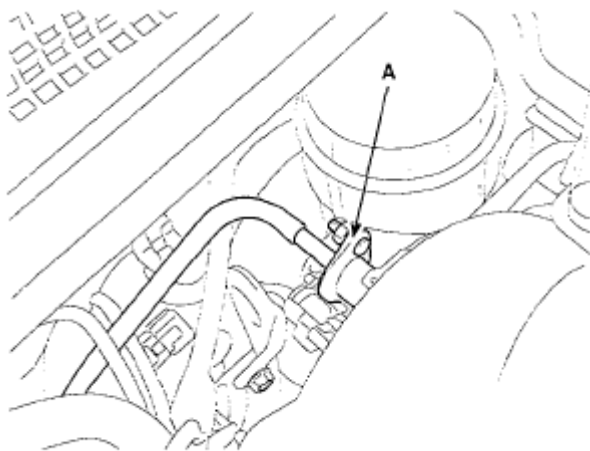
5. Disconnect the water temperature sensor (WTS) harness connector (A), the oil temperature sensor (OTS) harness connector (B) and the purge control solenoid valve (PCSV) harness connector (C).



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Fig. 26: Disconnecting Water Temperature Sensor Harness Connector And Oil Temperature Sensor Harness Connector
 Courtesy of KIA MOTORS AMERICA, INC.

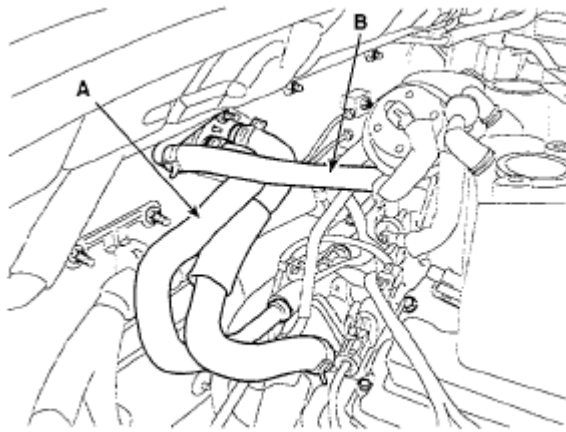
12. Disconnect the transaxle wire harness connector and remove the transaxle assembly. Refer to **AUTOMATIC TRANSAXLE SYSTEM**.
13. Disconnect the fuel hose tube (A).



SBLM16015L

Fig. 27: Disconnecting Fuel Hose Tube
Courtesy of KIA MOTORS AMERICA, INC.

14. Disconnect the front exhaust muffler with the exhaust manifolds.
15. Remove the front wheels and tires. Refer to Suspension system in **SUSPENSION SYSTEM (TPMS)** .
16. Remove heater hose (A) and disconnect the brake vacuum hose (B).



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Fig. 28: Identifying Heater Hose And Brake Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

17. Remove the exhaust and intake manifold covers. Refer to **INTAKE AND EXHAUST SYSTEM**.
18. Remove the power steering pump assembly.
19. Remove the hood assembly. Refer to Hood in **BODY (INTERIOR AND EXTERIOR)** .
20. Install a jack for supporting the engine assembly.
21. Remove the engine mounting brackets (A).

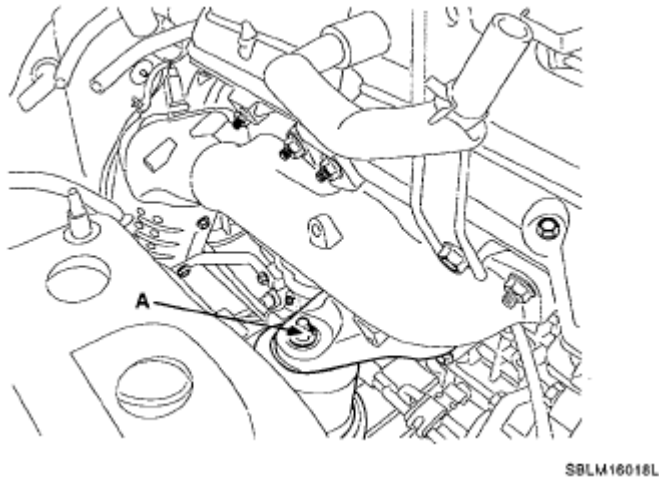


Fig. 29: Identifying Engine Mounting Brackets
Courtesy of KIA MOTORS AMERICA, INC.

22. Jack up the engine assembly in order to remove the engine from the vehicle.

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

COMPONENTS

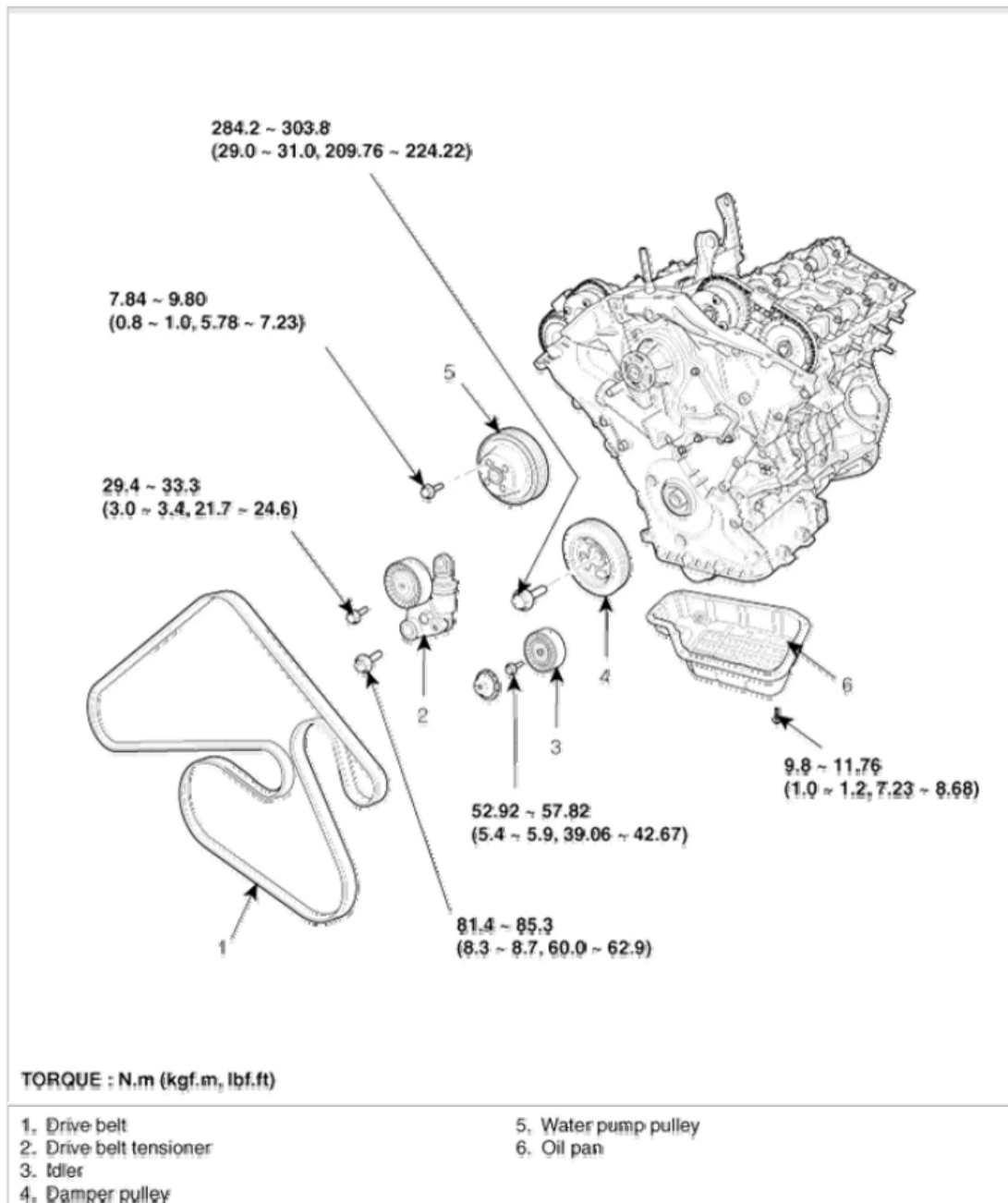


Fig. 30: Exploded View Of Timing Chain System With Torque Specification (1 Of 2)

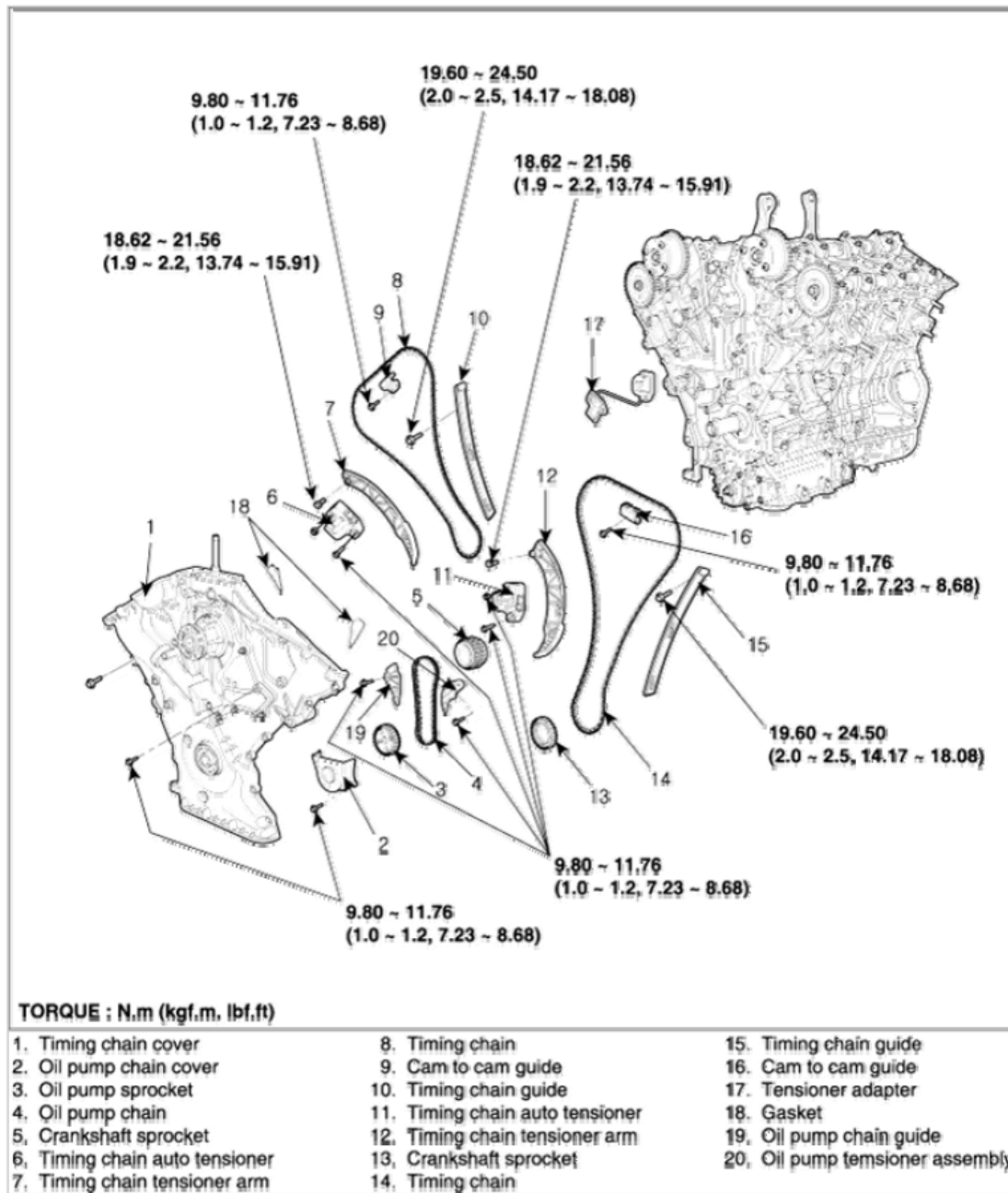


Fig. 31: Exploded View Of Timing Chain System With Torque Specification (2 Of 2)

REMOVAL

Radiator removal is required for this procedure. (Refer to 'Radiator removal')

1. Remove the drive belt(A).

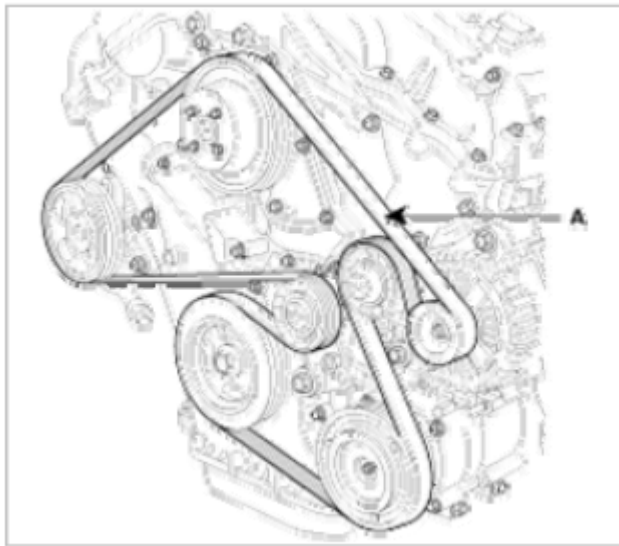


Fig. 32: Identifying Drive Belt

2. Remove the power steering pump(A).

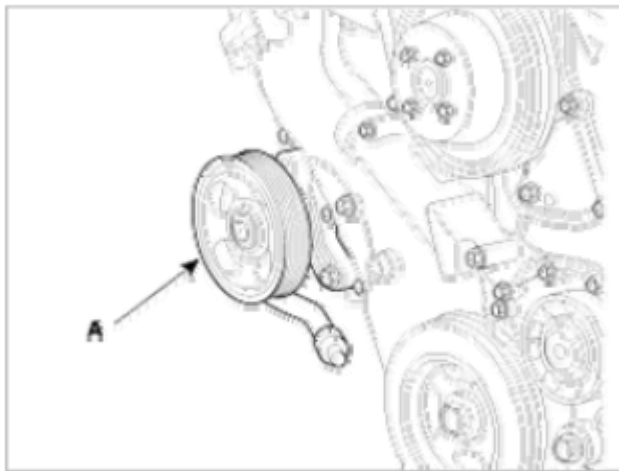


Fig. 33: Identifying Power Steering Pump

3. Remove the air compressor(A).

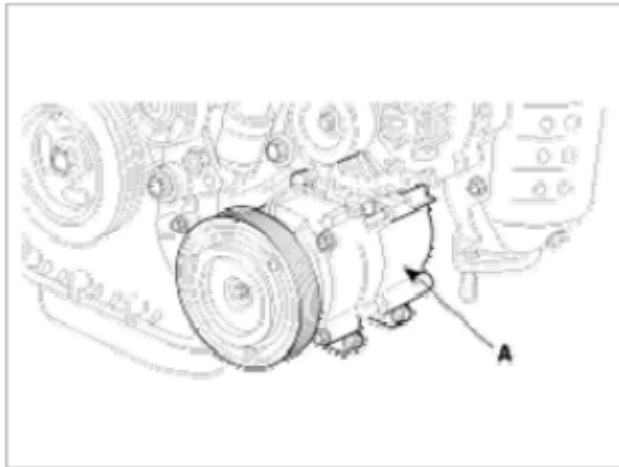


Fig. 34: Identifying Air Compressor

4. Remove the alternator(A).

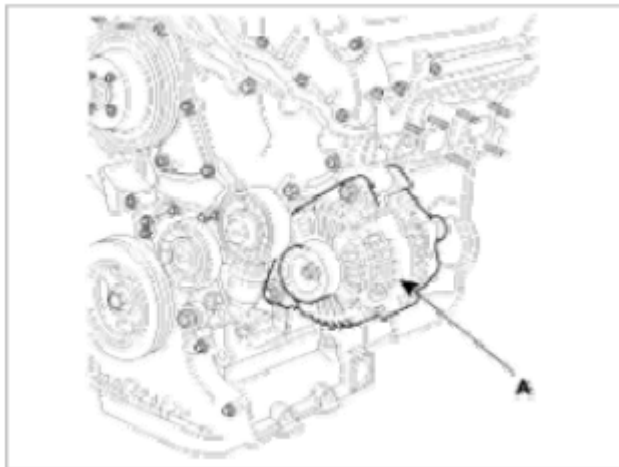


Fig. 35: Identifying Alternator

5. Remove drive belt idler(A).

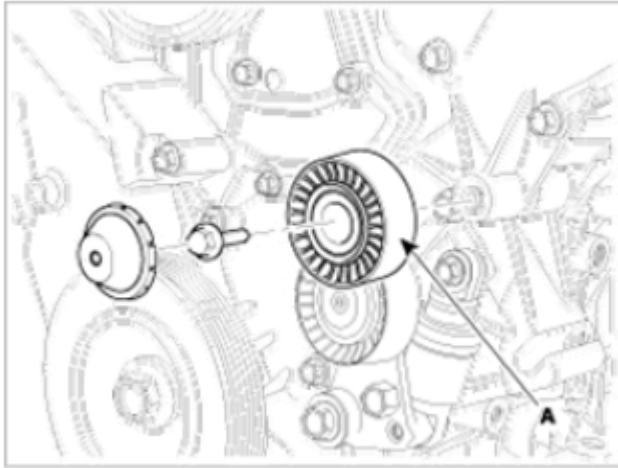


Fig. 36: Identifying Drive Belt Idler With Mounting Bolt

6. Remove drive belt auto tensioner(A).

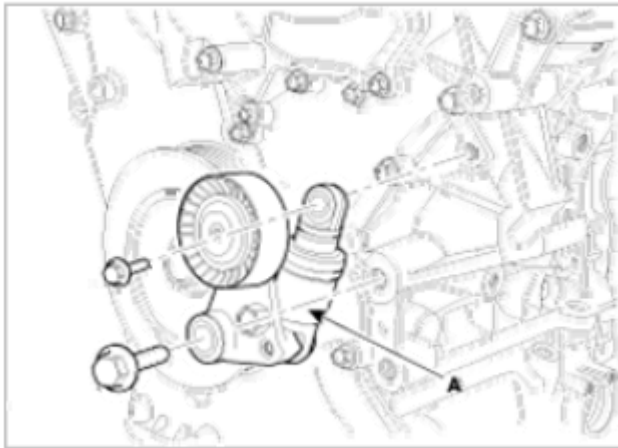


Fig. 37: Identifying Drive Belt Auto Tensioner With Mounting Bolts

7. Remove water pump pulley(A).

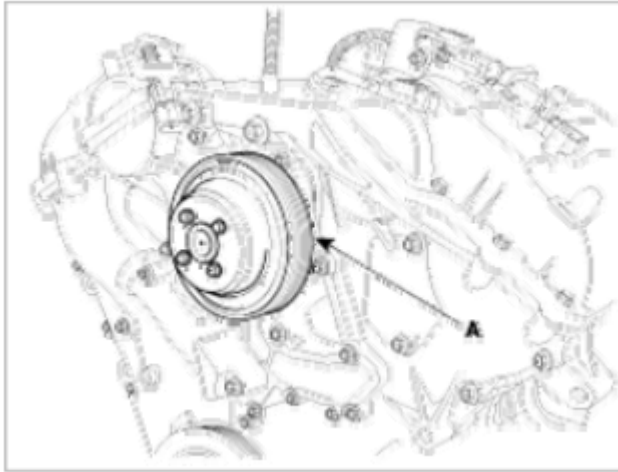


Fig. 38: Identifying Water Pump Pulley

8. Remove intake manifold.

INSTALLATION

1. Install intake manifold.
2. Install water pump pulley(A).

Tightening torque

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

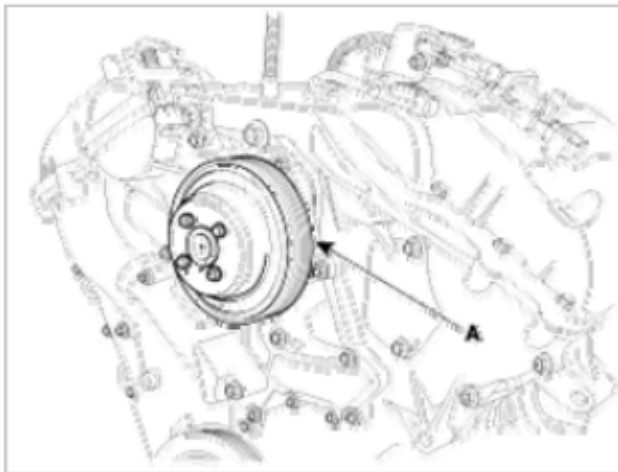


Fig. 39: Identifying Water Pump Pulley

3. Install drive belt auto tensioner(A).

Tightening torque

81.4 ~ 85.3Nm(8.3 ~ 8.7kgf.m, 60.0 ~ 62.9lb-ft)

29.4 ~ 33.3Nm(3.0 ~ 3.4kgf.m, 21.7 ~ 24.6lb-ft)

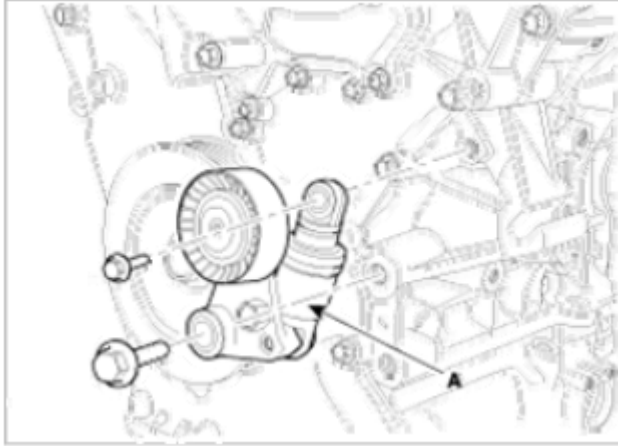


Fig. 40: Identifying Drive Belt Auto Tensioner With Mounting Bolts

4. Install drive belt idler(A).

Tightening torque

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

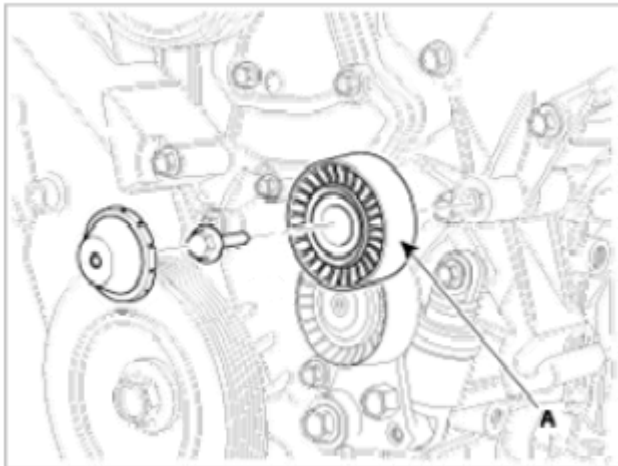


Fig. 41: Identifying Drive Belt Idler With Mounting Bolt

5. Install alternator
6. Install air compressor
7. Install power steering pump.
8. Install drive belt(A).

Crankshaft pulley --> A/C pulley --> idler pulley --> alternator 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.

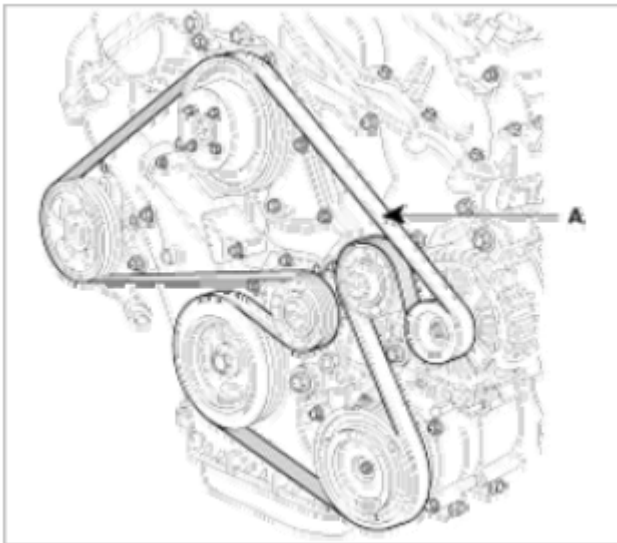


Fig. 42: Identifying Drive Belt

DISASSEMBLY

1. Remove the engine cover.

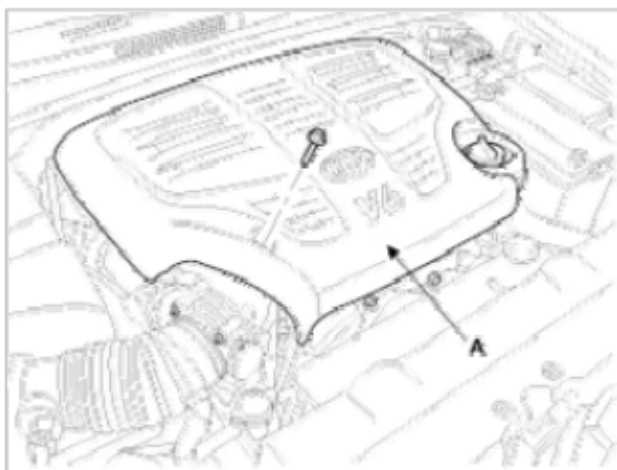


Fig. 43: Identifying Engine Cover With Mounting Screw

2. Remove the engine room resonator(A).

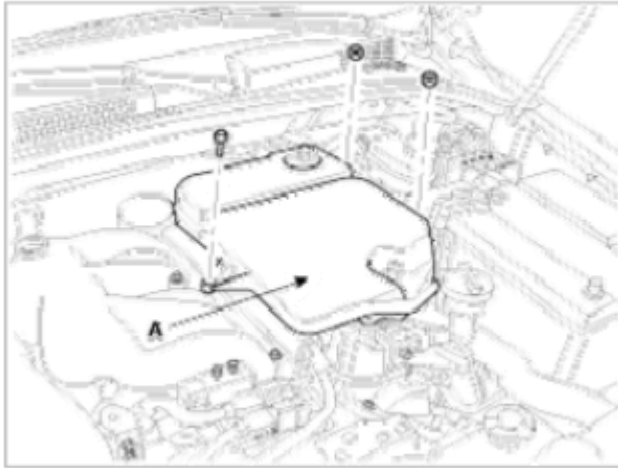


Fig. 44: Identifying Engine Room Resonator With Mounting Screws

3. After disconnecting the MAF sensor connector(A) and the breather hose(B), remove the air cleaner assembly(C).

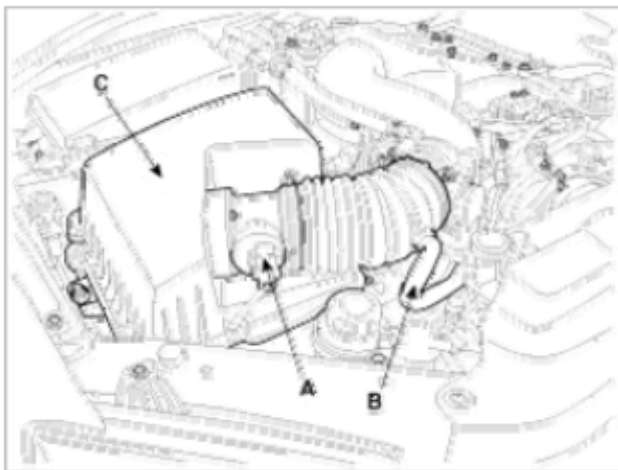


Fig. 45: Identifying MAF Sensor Connector, Breather Hose And Air Cleaner Assembly

4. After disconnecting the other breather hose(A), the Purge Control Solenoid Valve(PCSV) hose(B), the Positive Crankcase Ventilation (PCV) hose(C) and the Electronic Throttle Control(ETC) cooling hoses (D), remove the surge tank assembly(E).

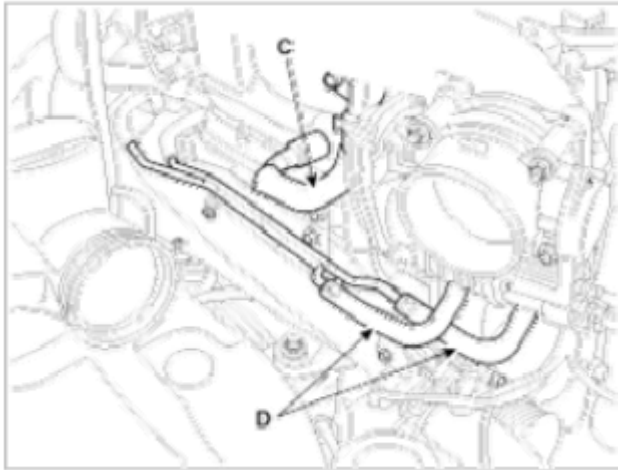


Fig. 46: Identifying Positive Crankcase Ventilation Hose And Electronic Throttle Control Cooling Hoses

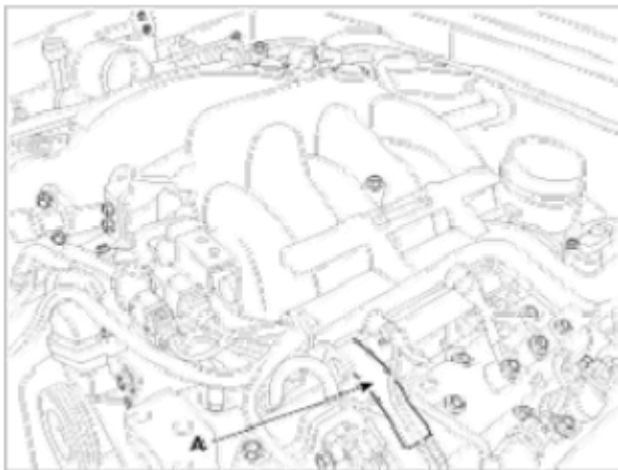


Fig. 47: Identifying Other Breather Hose

5. Remove the wiring over the surge tank.
 1. Disconnect the injection harness connector(A).
 2. Disconnect the camshaft position sensor(CMP) harness connector(B).
 3. Disconnect the ground lines(C).
 4. Disconnect the ignition coil harness connector(D).
 5. Disconnect the condensor connector(E).
 6. Disconnect the oil control valve(OCV) harness connector(F).

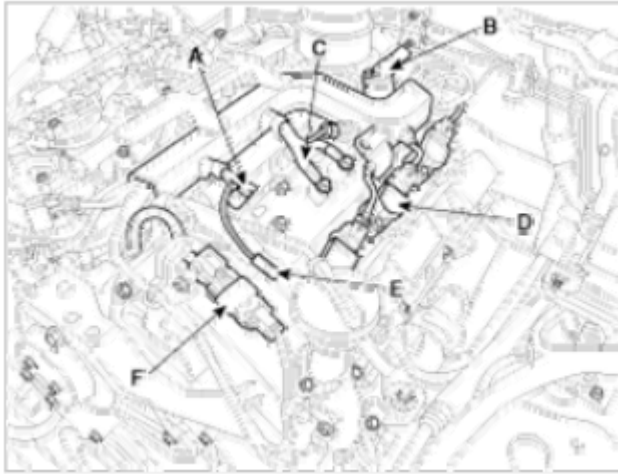


Fig. 48: Identifying Injection Harness Connector, Ground Lines, Ignition Coil Harness Connector, Condensor Connector And Oil Control Valve Harness Connector

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

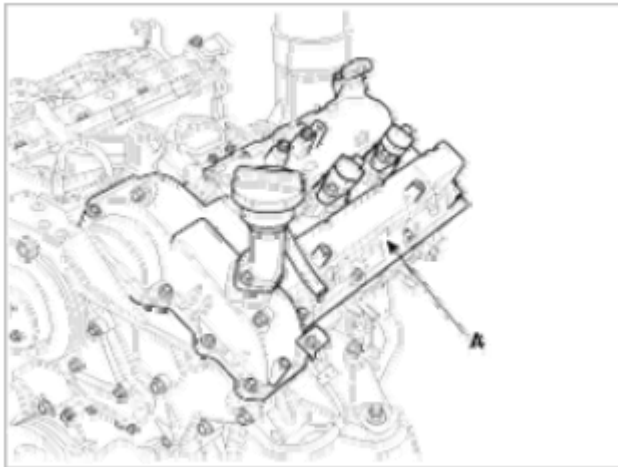


Fig. 49: Identifying Cylinder Head Cover

7. Set No.1 cylinder to TDC/compression.
 - A. 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.

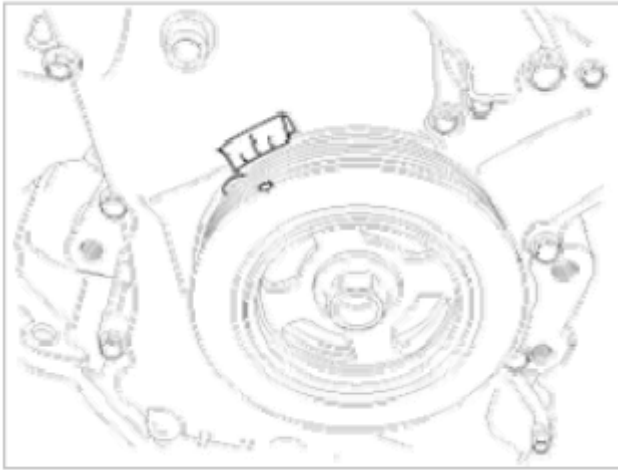


Fig. 50: Identifying Timing Mark On Lower Timing Chain Cover

- B. 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°).

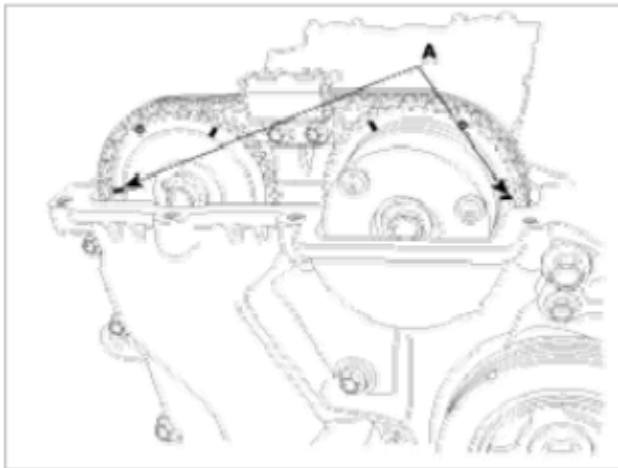


Fig. 51: Identifying Mark On Camshaft Timing Sprockets

NOTE: Do not rotate engine counterclockwise.

8. Remove the lower oil pan(A).

Insert the blade of SST(09215-3C000) between the upper oil pan and lower oil pan, and cut off applied sealer and removed lower oil pan.

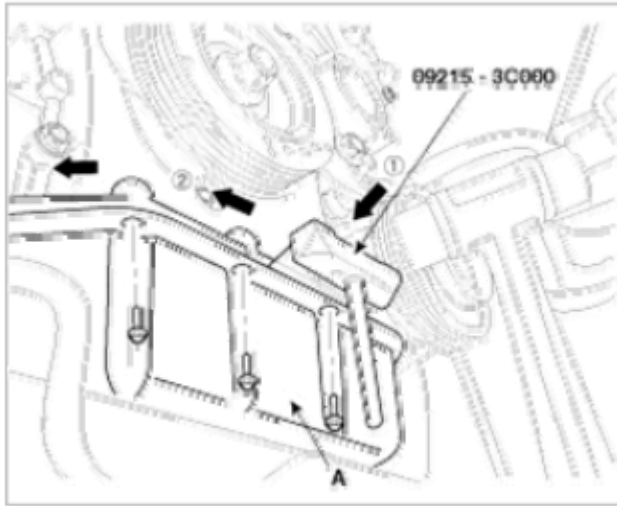


Fig. 52: Inserting Blade Of SST (09215-3C000) Between Upper Oil Pan And Lower Oil Pan

CAUTION:

- Insert the SST between the oil pan and the ladder frame by tapping it with a plastic hammer in the direction of (1) arrow.
- After tapping the SST with a plastic hammer along the direction of (2) arrow around more than 2/3 edge of the oil pan, remove it from the ladder frame.
- Do not turn over the SST abruptly without tapping. It can result in damage of the SST.

9. Remove the crankshaft damper pulley(A).

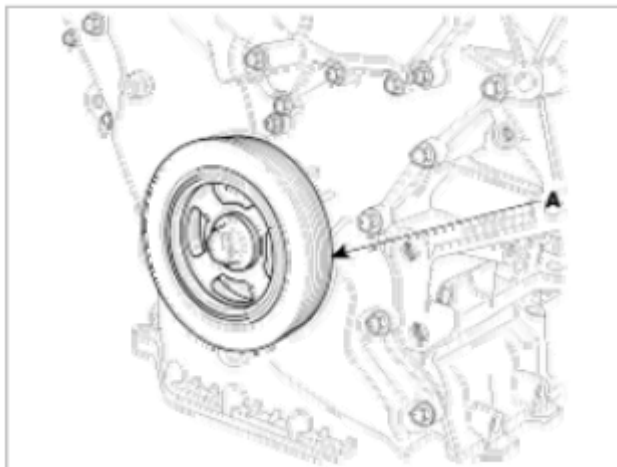


Fig. 53: Identifying Crankshaft Damper Pulley

10. Remove the timing chain cover(A).

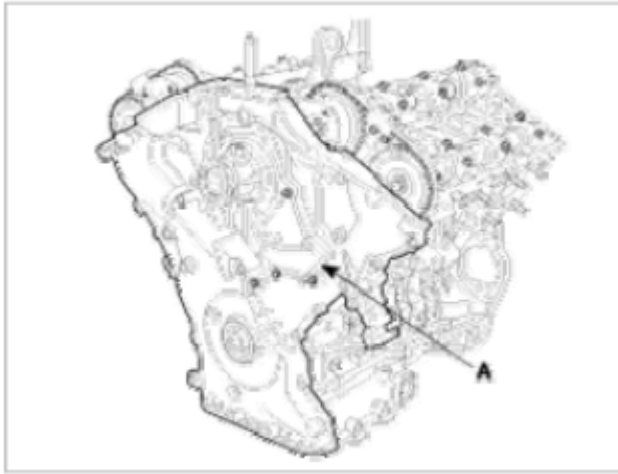


Fig. 54: Identifying Timing Chain Cover

NOTE:

- Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.
- Mark on the timing chain on the basis of the marking on sprocket and CVVT.

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



Fig. 55: Installing Set Pin

12. Remove RH cam-to-cam guide(A).

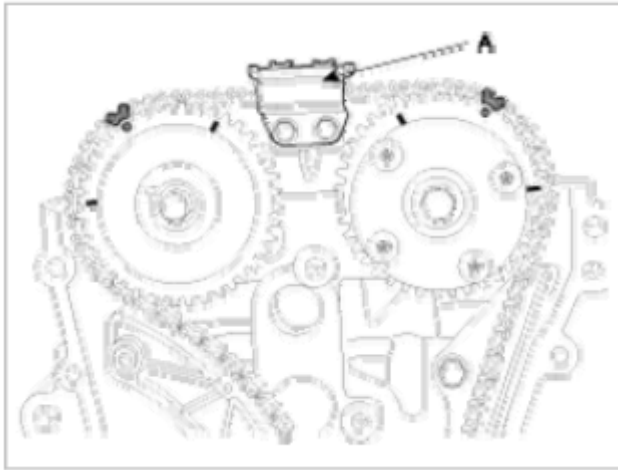


Fig. 56: Identifying RH Cam-To-Cam Guide

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

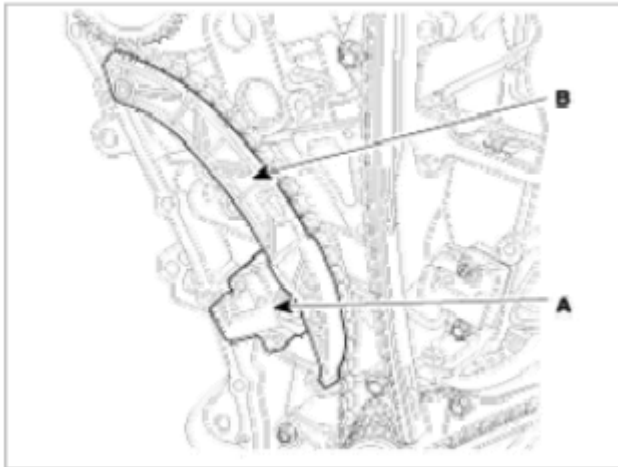


Fig. 57: Identifying RH Timing Chain Auto Tensioner And RH Timing Chain Tensioner Arm

14. Remove oil pump chain cover(A).

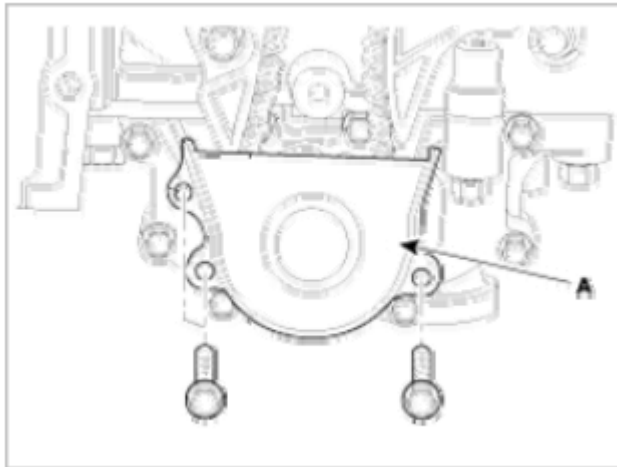


Fig. 58: Identifying Oil Pump Chain Cover With Mounting Bolts

15. Remove oil pump chain tensioner assembly(A).



Fig. 59: Identifying Oil Pump Chain Tensioner Assembly

16. Remove oil pump chain guide(A).

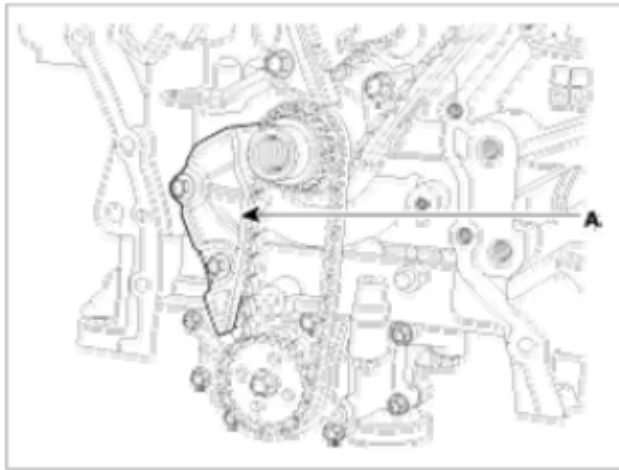


Fig. 60: Identifying Oil Pump Chain Guide

17. Remove RH timing chain.
18. Remove RH timing chain guide(A).

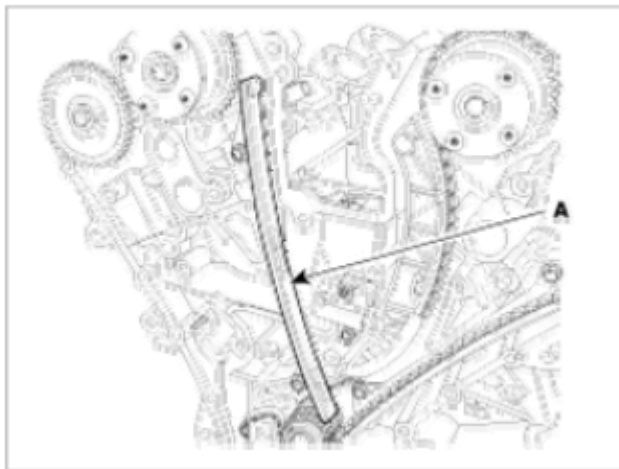


Fig. 61: Identifying RH Timing Chain Guide

19. Remove oil pump chain sprocket(A) and oil pump chain(B).

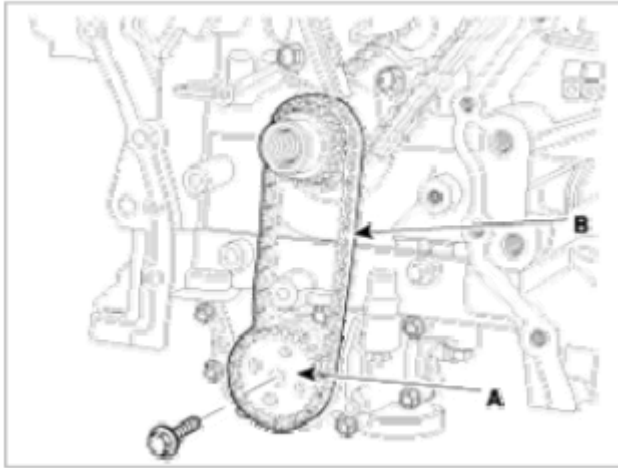


Fig. 62: Identifying Oil Pump Chain Sprocket And Oil Pump Chain With Mounting Bolts

20. Remove crankshaft sprocket(A)(O/P&RH camshaft drive).

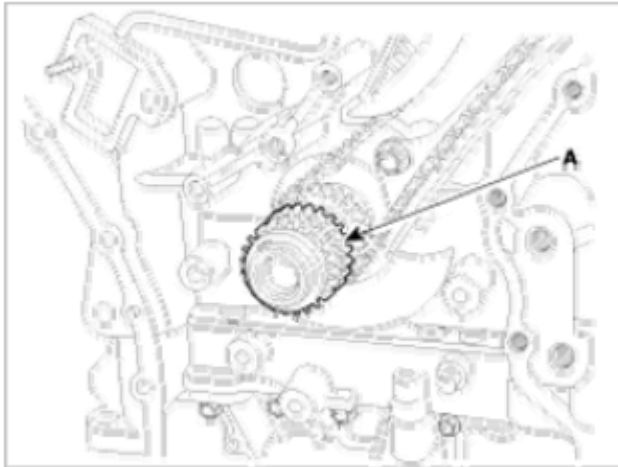


Fig. 63: Identifying Crankshaft Sprocket (O/P And RH Camshaft Drive)

21. Remove LH cam-to-cam guide(A).

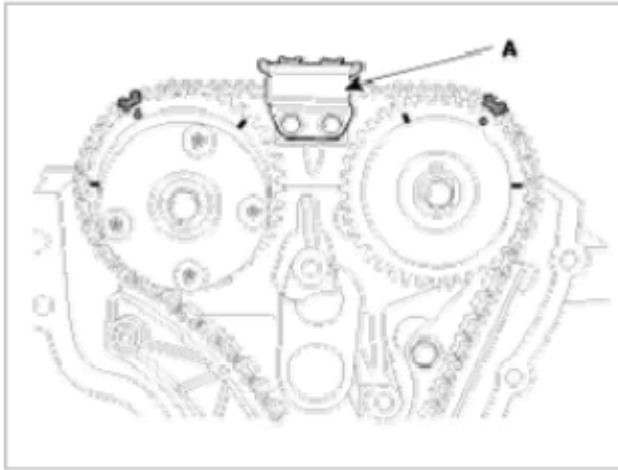


Fig. 64: Identifying LH Cam-To-Cam Guide

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

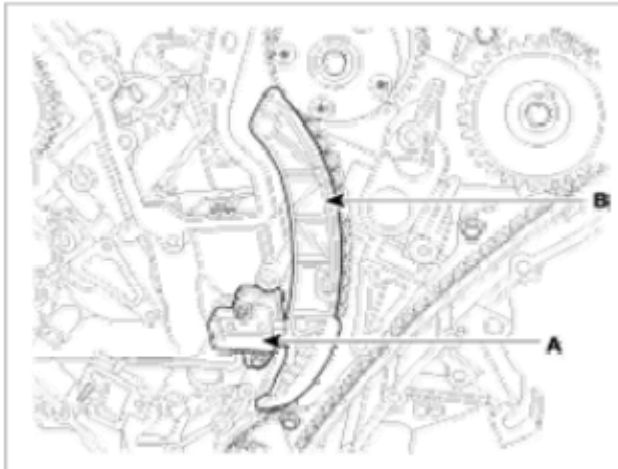


Fig. 65: Identifying LH Timing Chain Auto Tensioner And LH Timing Chain Tensioner Arm

23. Remove LH timing chain.
24. Remove LH timing chain guide(A).

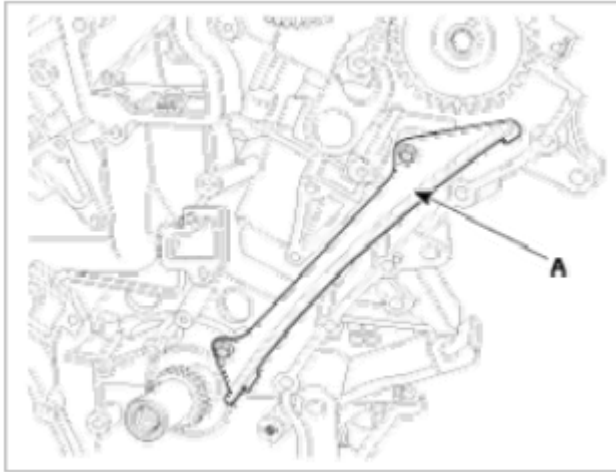


Fig. 66: Identifying LH Timing Chain Guide

25. Remove crankshaft sprocket(A)(LH camshaft drive).

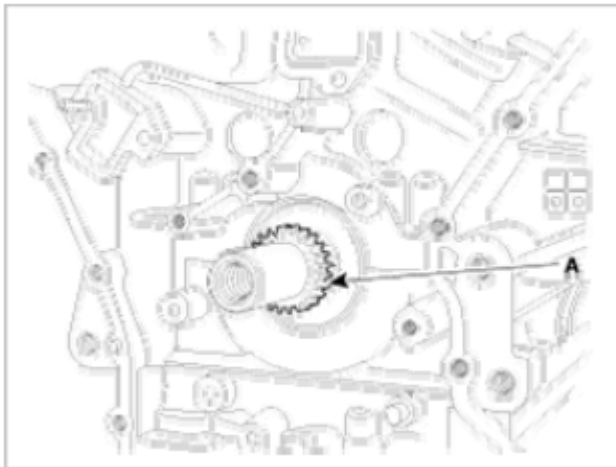


Fig. 67: Identifying Crankshaft Sprocket (LH Camshaft Drive)

26. Remove tensioner adapter assembly(A).

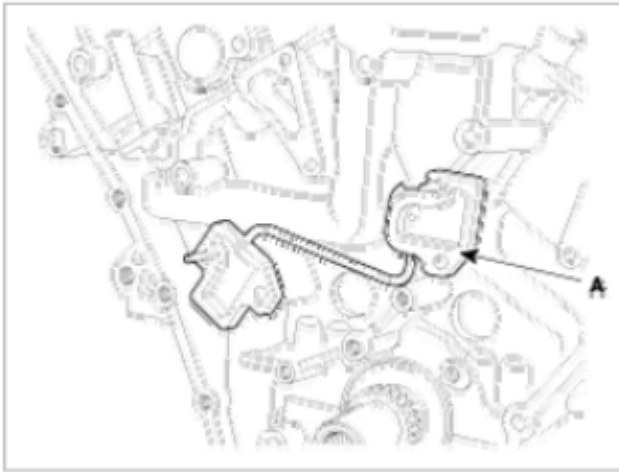


Fig. 68: Identifying Tensioner Adapter Assembly

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.

BELT, IDLER, BELT TENSIONER, PULLEY

1. Check the belt for oil or dust deposits.

Replace, if necessary.

Small deposits should be wiped away with a dry cloth or paper. Do not clean with solvent.

2. When the engine is overhauled or belt tension adjusted, check the belt carefully. If any of the following flaws are evident, replace the belt.

NOTE:

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

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

REASSEMBLY

1. 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.

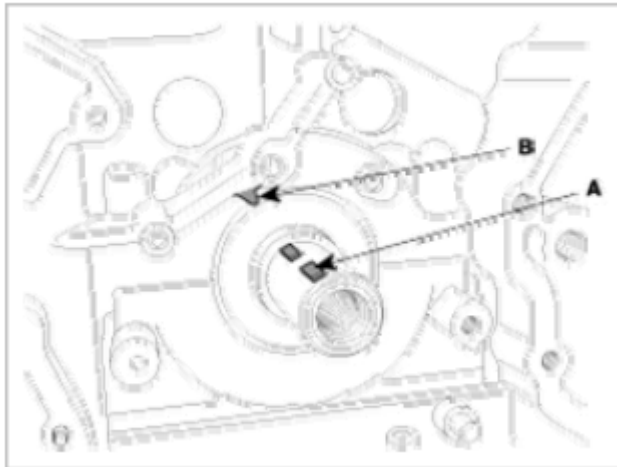


Fig. 69: Identifying Key And Timing Mark On Timing Chain Cover

2. Install tensioner adapter assembly(A).

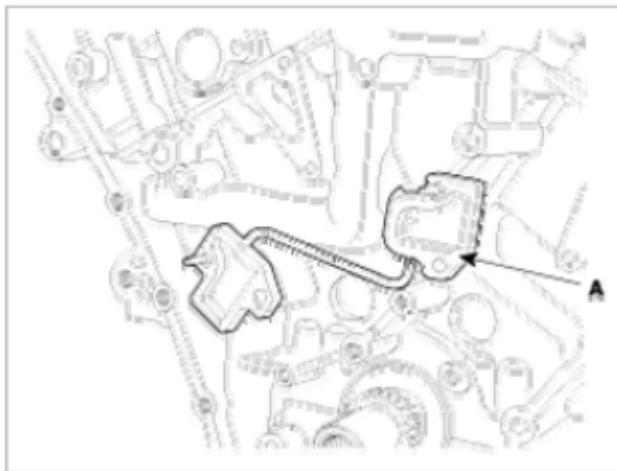


Fig. 70: Identifying Tensioner Adapter Assembly

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

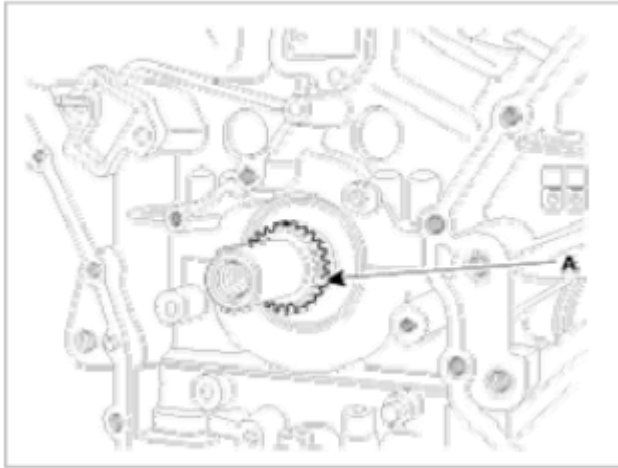


Fig. 71: Identifying Crankshaft Sprocket (LH Camshaft Drive)

4. Install LH timing chain guide(A).

Tightening torque

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

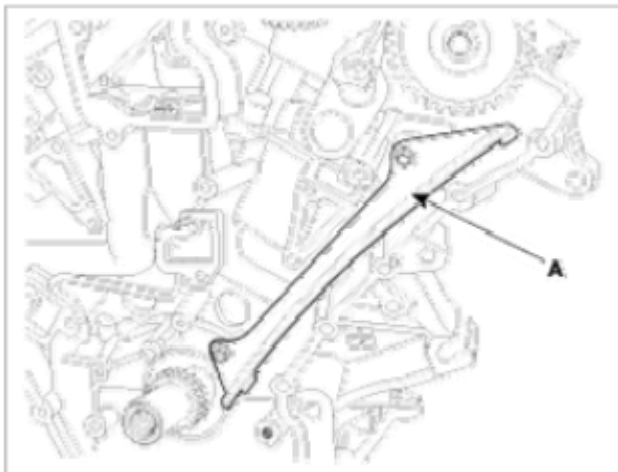


Fig. 72: Identifying LH Timing Chain Guide

5. Install LH timing chain.

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

Crankshaft sprocket(A) --> Timing chain guide(B) --> 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.

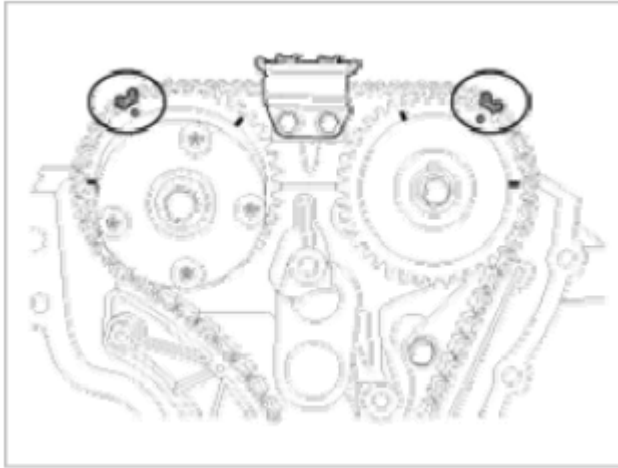


Fig. 73: Identifying Timing Mark On Exhaust Camshaft Sprocket And Intake Camshaft Sprocket

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

Tightening torque

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

7. Install chain tensioner(A).

Tightening torque

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

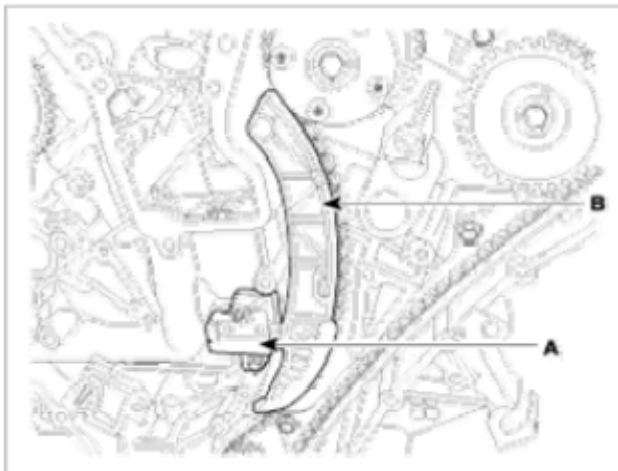


Fig. 74: Identifying LH Timing Chain Tensioner Arm And Chain Tensioner

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

Tightening torque

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

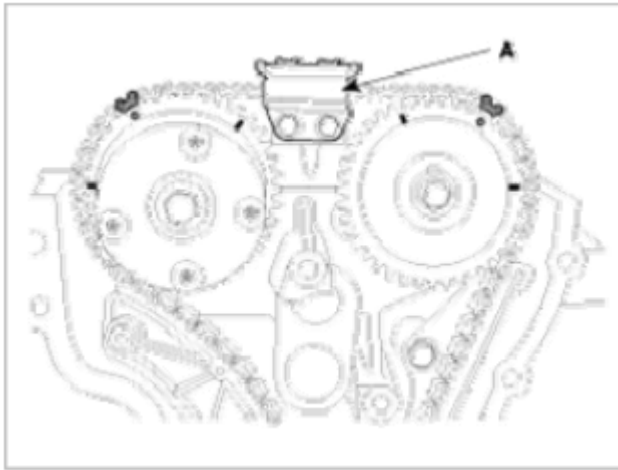


Fig. 75: Identifying LH Cam-To-Cam Guide

9. Install crankshaft sprocket(A)(O/P&RH camshaft drive).

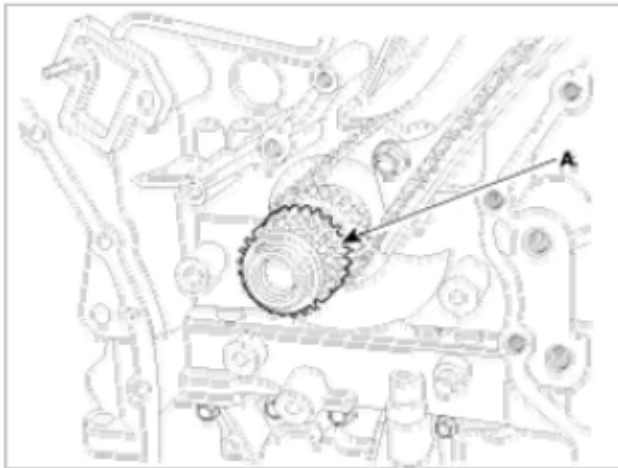


Fig. 76: Identifying Crankshaft Sprocket (O/P And RH Camshaft Drive)

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

Tightening torque

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

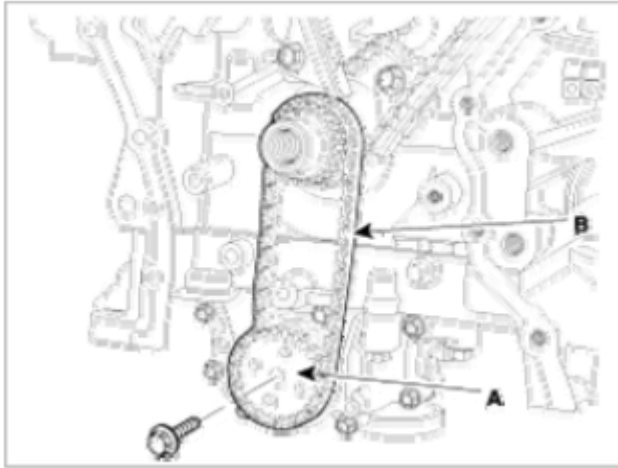


Fig. 77: Identifying Oil Pump Chain And Oil Pump Sprocket With Mounting Bolt

11. Install RH timing chain guide(A).

Tightening torque

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

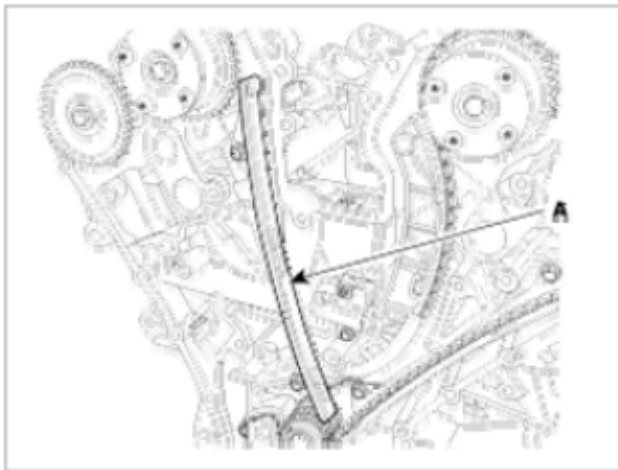


Fig. 78: Identifying RH Timing Chain Guide

12. Install RH timing chain.

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

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.



Fig. 79: Identifying Timing Mark On Crankshaft Sprocket

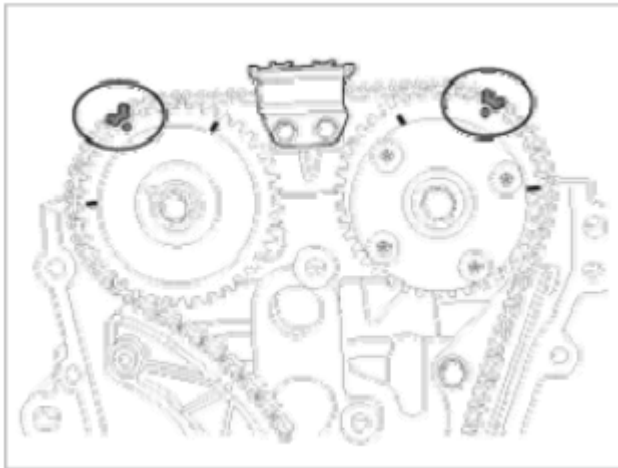


Fig. 80: Identifying Timing Mark On Intake Camshaft Sprocket And Exhaust Camshaft Sprocket

13. Install RH timing chain tensioner arm(B).
14. Install RH timing chain auto tensioner(A).

Tightening torque

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

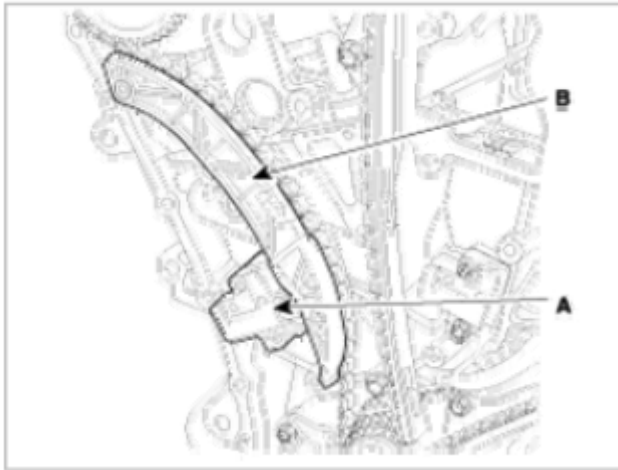


Fig. 81: Identifying RH Timing Chain Auto Tensioner And RH Timing Chain Tensioner Arm

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

Tightening torque

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

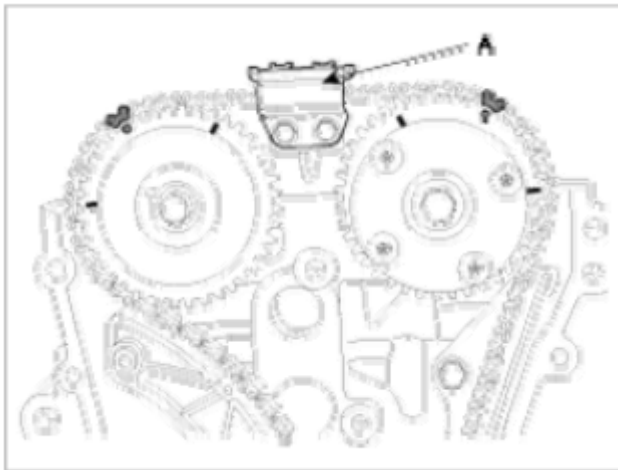


Fig. 82: Identifying RH Cam-To-Cam Guide

16. Install oil pump chain guide(A).

Tightening torque

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

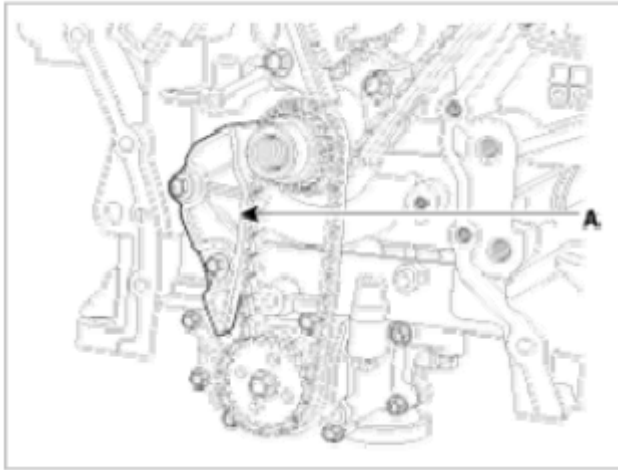


Fig. 83: Identifying Oil Pump Chain Guide

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

Tightening torque

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

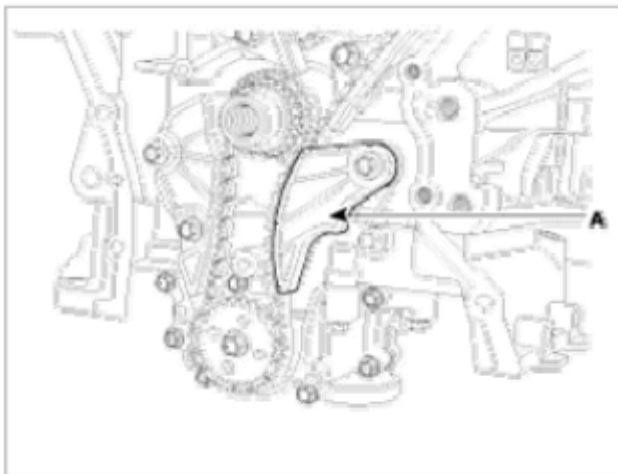


Fig. 84: Identifying Oil Pump Chain Tensioner Assembly

18. Pull out the pins of hydraulic tensioner (LH&RH).
19. Install oil pump chain cover(A).

Tightening torque

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

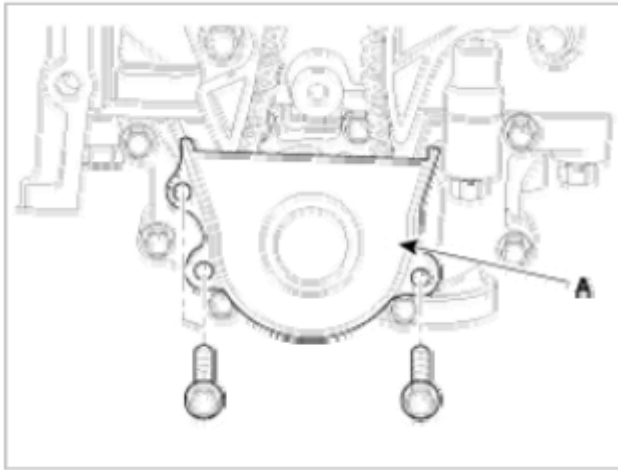


Fig. 85: Identifying Oil Pump Chain Cover With Mounting Bolts

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

NOTE: Always turn the crankshaft clockwise.

21. 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: 2.5mm(0.1in.)

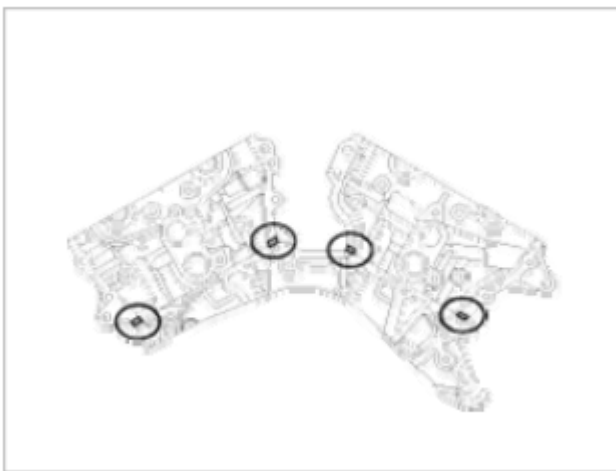


Fig. 86: Identifying Timing Chain Cover

- 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.

Sealant should also be applied all around the two holes of the dowel pins.

Bead width: 2.5mm(0.1in.)

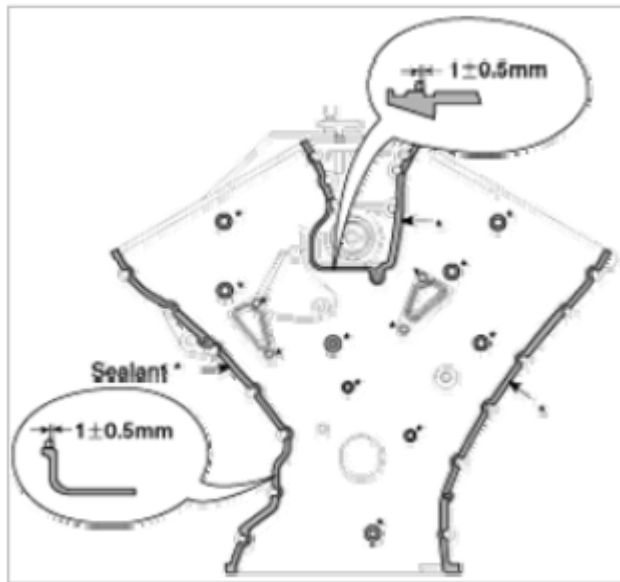


Fig. 87: Identifying Timing Chain Cover Liquid Sealant TB1217H Applying Dimensions

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

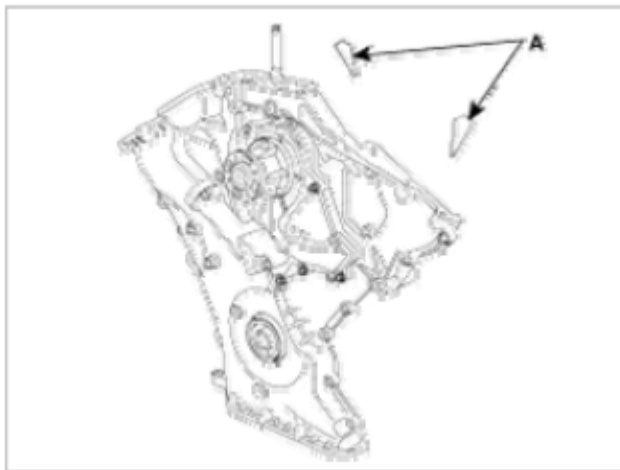


Fig. 88: Identifying Timing Chain Cover Gasket

- 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

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

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

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

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

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

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

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

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

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

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

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

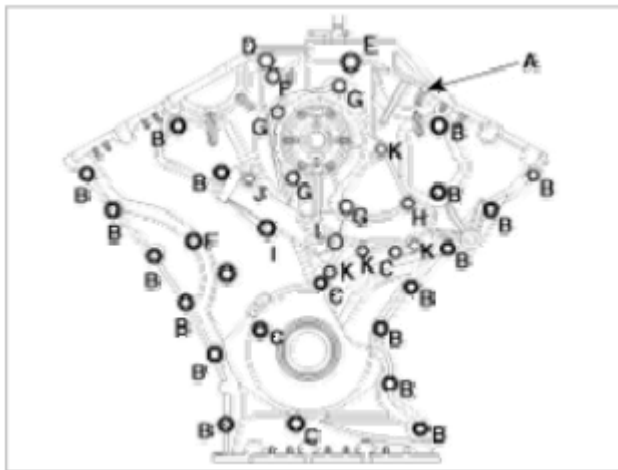


Fig. 89: Identifying Cylinder Block Mounting Dowel Pins Tightening Sequence

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

22. Using SST(09231-3C100), install timing chain cover oil seal.

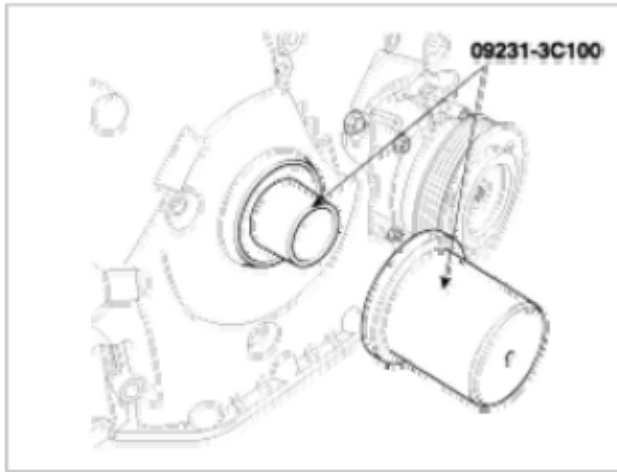


Fig. 90: Installing Timing Chain Cover Oil Seal Using SST (09231-3C100)

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

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

Bead width: 2.5mm(0.1in.).

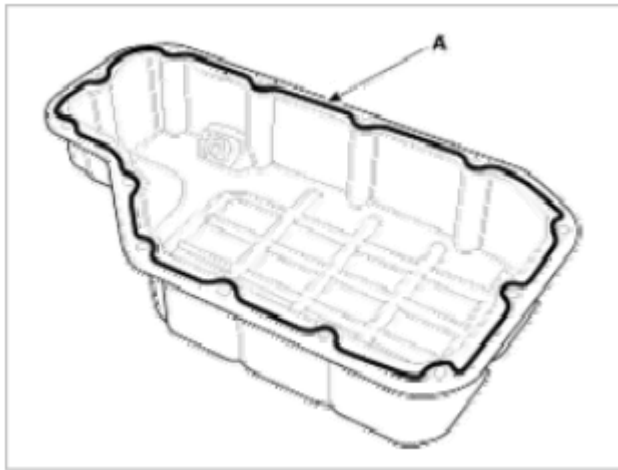


Fig. 91: Identifying Lower Oil Pan Sealant Applying Area

CAUTION:

- Make clean the sealing face 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 to the inner threads of the bolt holes.

C. Install oil pan(A).

Uniformly tighten the bolts in several passes.

Tightening torque

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

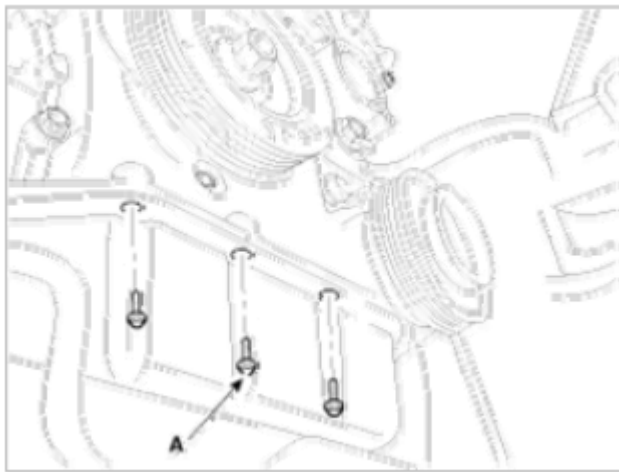


Fig. 92: Identifying Oil Pan Mounting Bolts

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

Tightening torque

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

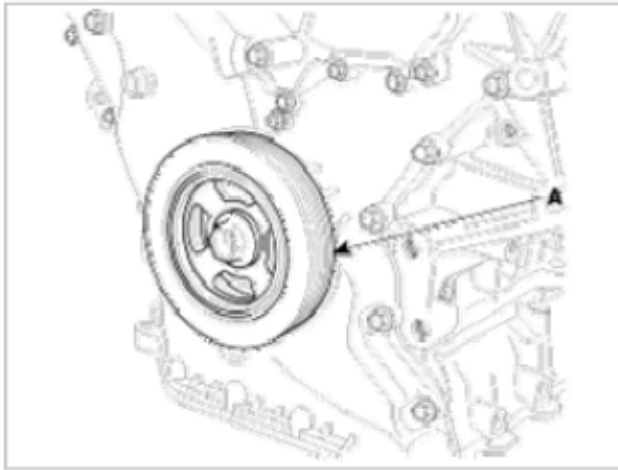


Fig. 93: Identifying Crankshaft Damper Pulley

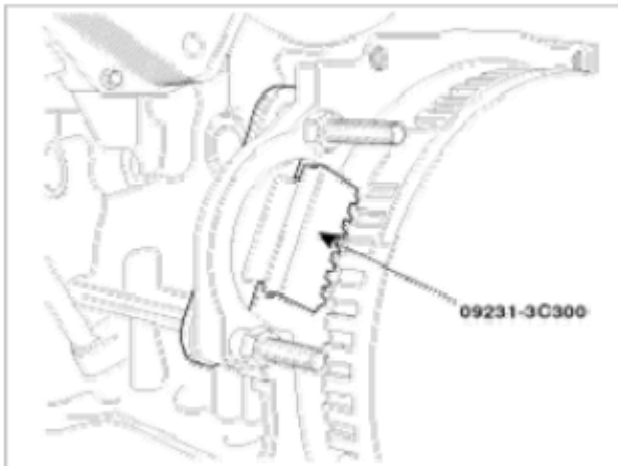


Fig. 94: Installing Crankshaft Damper Pulley Using SST (09231-3C300)

25. Install cylinder head cover.
 - A. The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
 - B. After applying sealant(TB1217H), it should be assembled within 5 minutes. Bead width: 2.5mm(0.1in.)

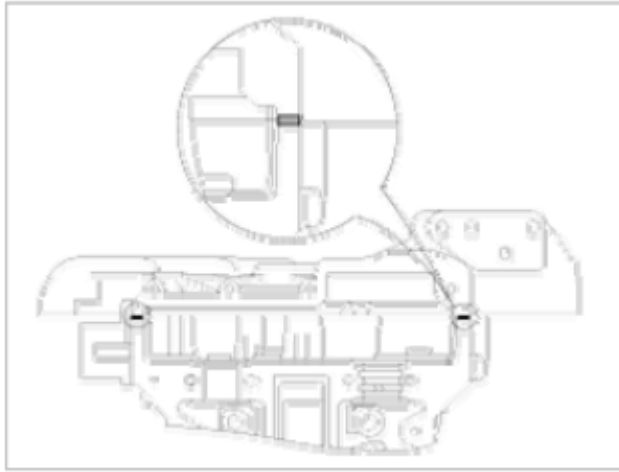


Fig. 95: Identifying Cylinder Head Cover Sealant Applying Area

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

Tightening torque

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

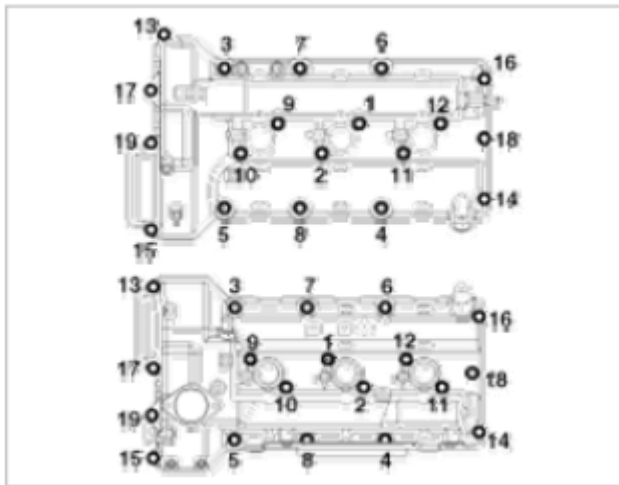


Fig. 96: Identifying Cylinder Head Cover Bolts Tightening Sequence

CAUTION: Do not reuse cylinder head cover gasket.

- E. Install ignition coil
- F. Connect RH ignition coil connector(A), condenser connector(B) and install wiring bracket(C).

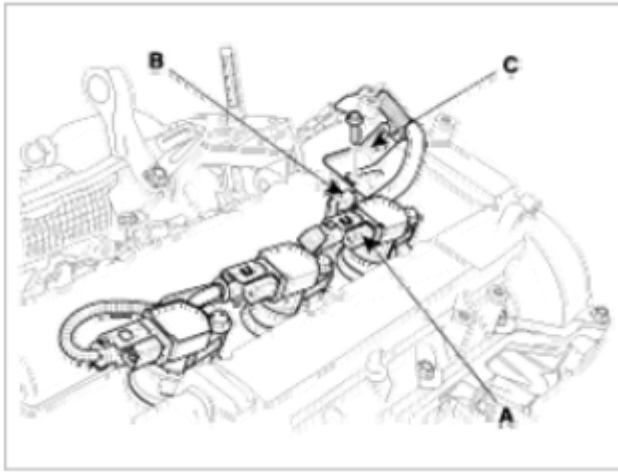


Fig. 97: Identifying RH Ignition Coil Connector, Condenser Connector And Wiring Bracket

G. Install connector bracket from LH cylinder head cover.

ACCESSORY DRIVE BELT

INSPECTION

BELT, IDLER, BELT TENSIONER, PULLEY

1. Check the belt for oil or dust deposits.

Replace, if necessary.

Small deposits should be wiped away with a dry cloth or paper. Do not clean with solvent.

2. When the engine is overhauled or belt tension adjusted, check the belt carefully. If any of the following flaws are evident, replace the belt.

NOTE:

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

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

INSTALLATION

1. Install drive belt auto tensioner (A).

Tightening torque

81.4-85.3 N.m (8.3-8.7 kgf.m, 60.0-62.9 lb-ft)

29.4-33.3 N.m (3.0-3.4 kgf.m, 21.7-24.6 lb-ft)

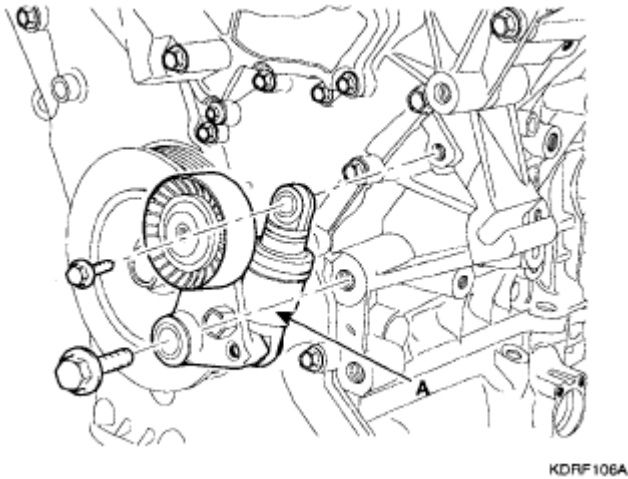


Fig. 98: Identifying Drive Belt Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

2. 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)

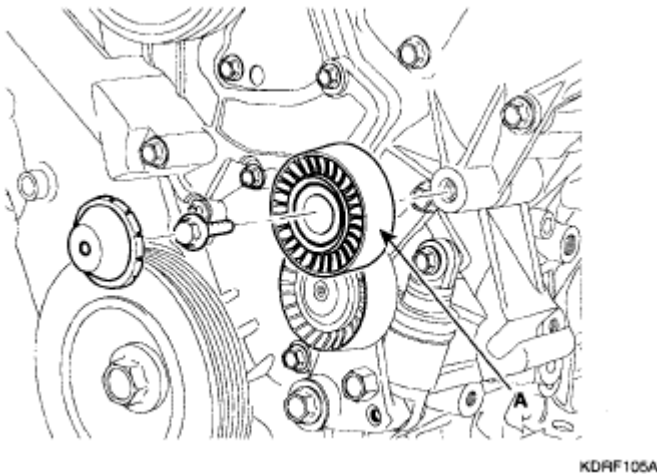
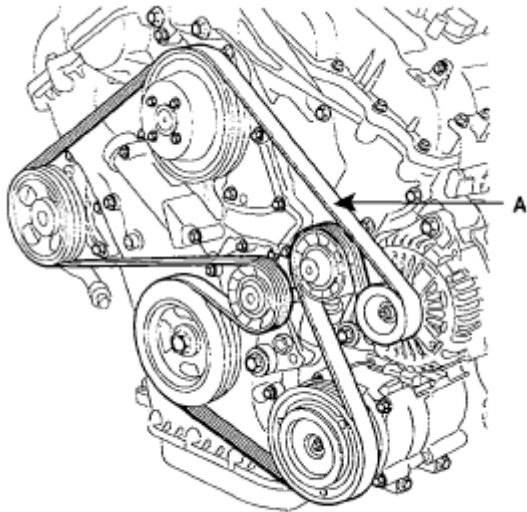


Fig. 99: Identifying Drive Belt Idler
Courtesy of KIA MOTORS AMERICA, INC.

3. Install drive belt (A).

Crankshaft pulley --> A/C pulley --> idler pulley --> alternator 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.

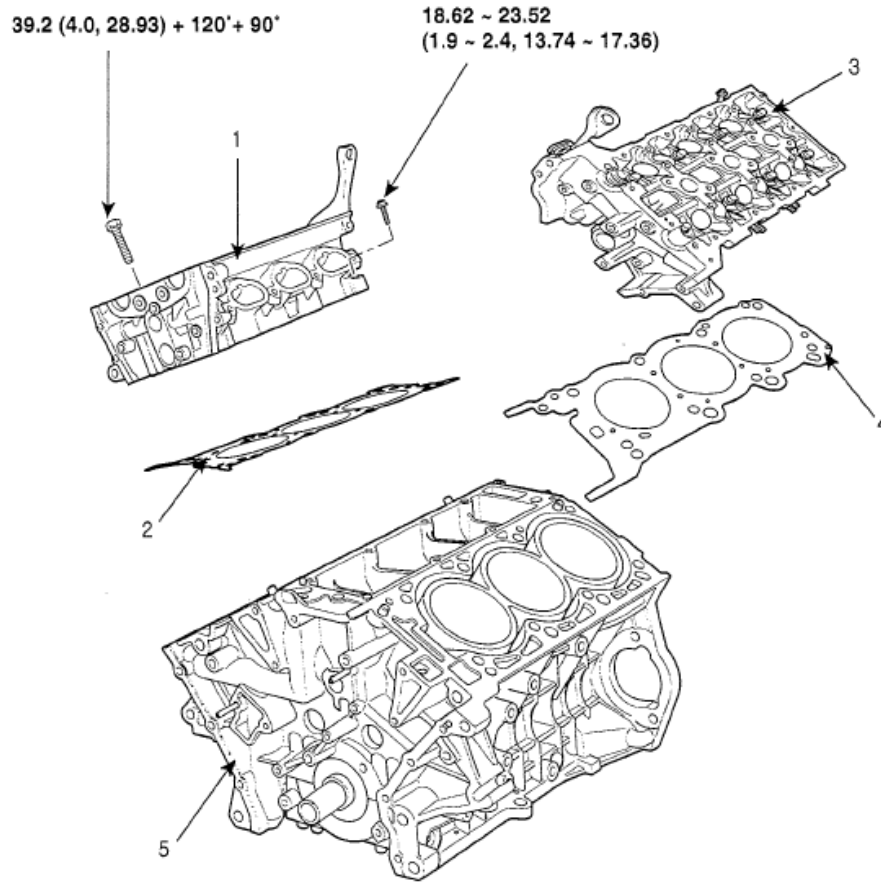


SBLM16101L

Fig. 100: Identifying Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

CYLINDER HEAD ASSEMBLY

COMPONENTS

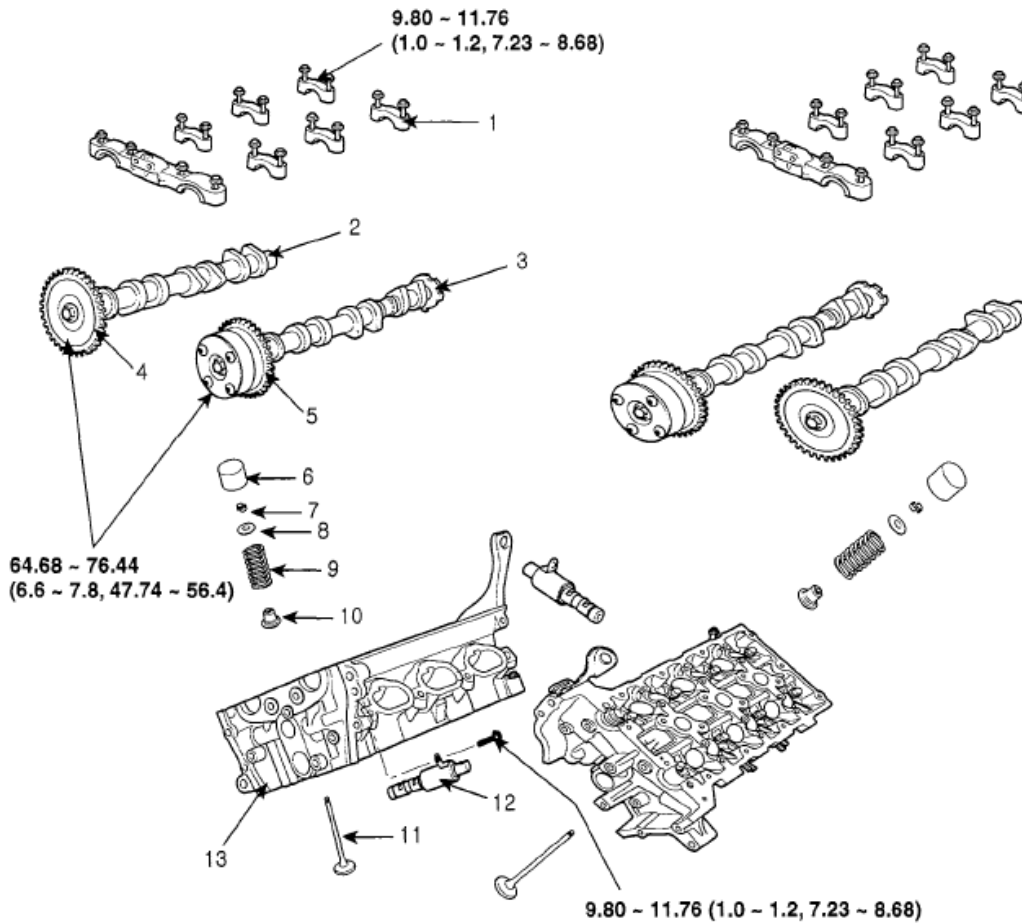


TORQUE : N.m (kgf.m, lbf.ft)

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

EDRF003A

Fig. 101: Identifying Cylinder Head Assembly Components With Torque Specification (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.



TORQUE : N.m (kgf.m, lbf.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 | |

EDRF004A

Fig. 102: Identifying Cylinder Head Assembly Components With Torque Specification (2 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

CAUTION:

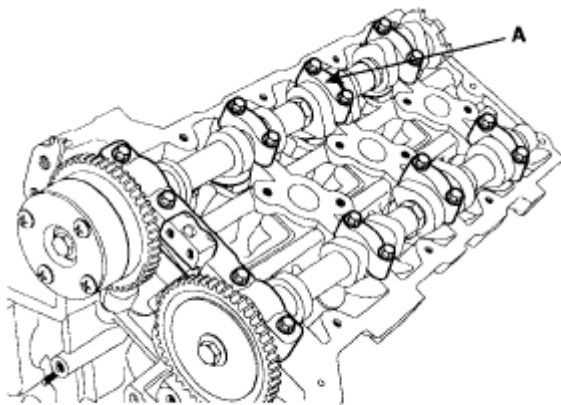
- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To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

NOTE:

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

Engine removal is required for this procedure.

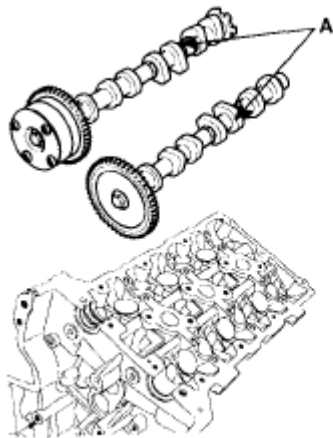
1. Remove exhaust manifold.
2. Remove intake manifold.
3. Remove timing chain.
4. Remove water temperature control assembly.
5. Remove camshaft bearing cap (A).



KDRF196A

Fig. 103: Identifying Camshaft Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove camshaft assembly (A).

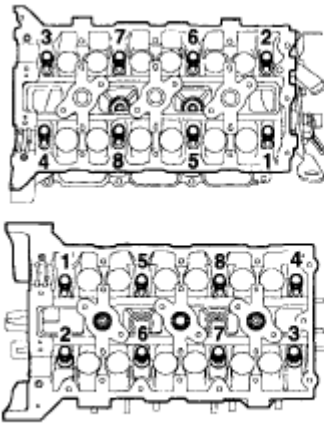


KDRF197A

Fig. 104: Identifying Camshaft Assembly
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. Remove the 16 cylinder head bolts and plate washers.



KDRF199A

Fig. 105: Identifying Cylinder Head Bolt Loosening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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

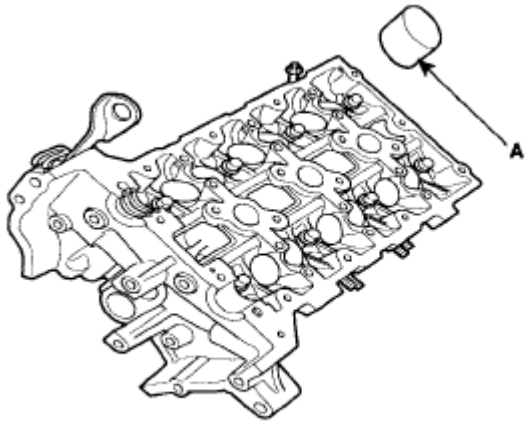
2. Lift the cylinder head from the dowels on the cylinder block and place the cylinder head on wooden blocks on a bench.

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.

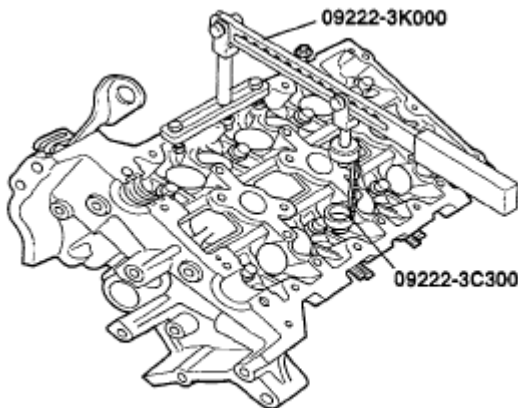
1. Remove MLAs (A).



KDRF200A

Fig. 106: Identifying MLAs
Courtesy of KIA MOTORS AMERICA, INC.

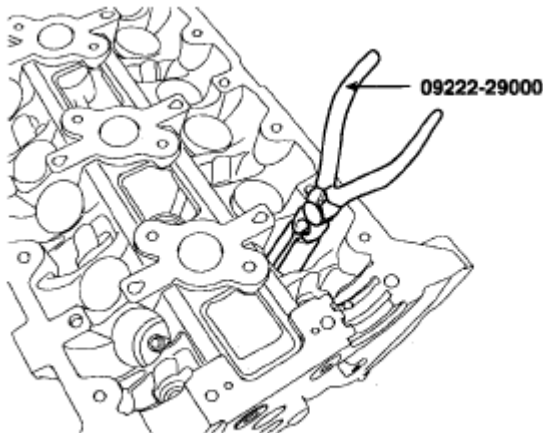
2. Remove valves.
 1. Using SST (09222-3K000, 09222-3C300), compress the valve spring and remove retainer lock.



KDRF201A

Fig. 107: Compressing Valve Spring Using SST
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.

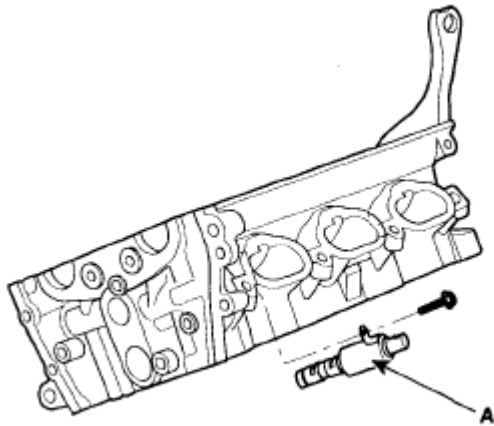


KDRF234A

Fig. 108: Removing Valve Stem Seal
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not reuse old valve stem seals.

3. Remove OCV (A).



KDRF202A

Fig. 109: 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

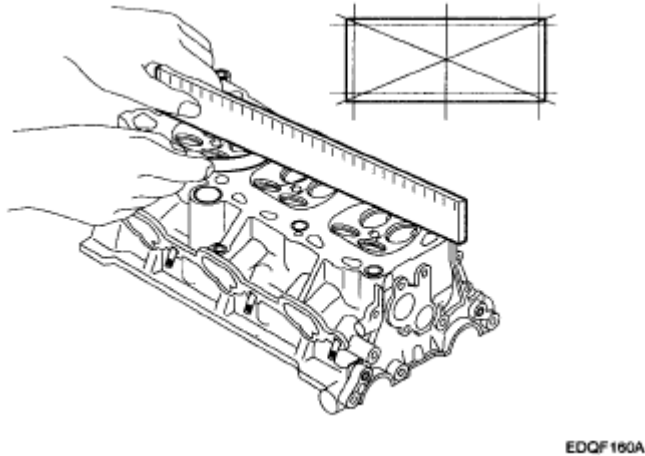


Fig. 110: Measuring Surface Contacting Cylinder Block And Manifolds
Courtesy of KIA MOTORS AMERICA, INC.

2. Inspect for cracks.

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

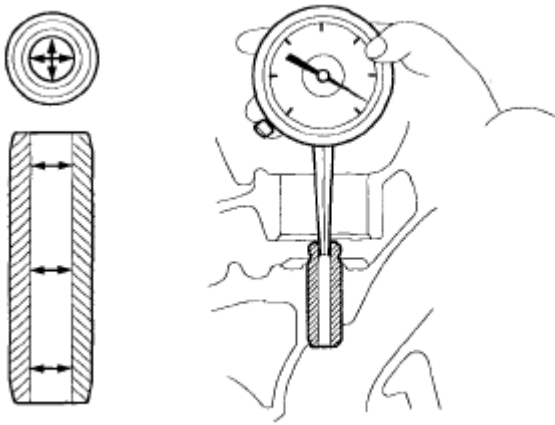
VALVE AND VALVE SPRING

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

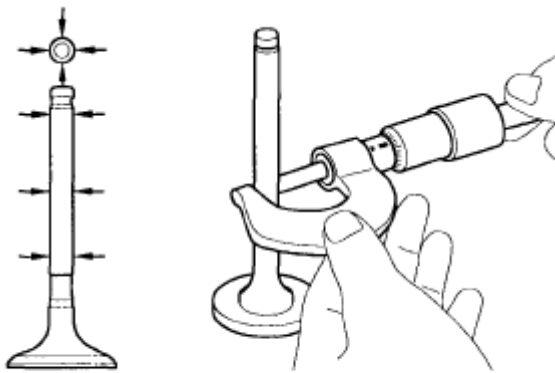
Fig. 111: Measuring Inside Diameter Of Valve Guide
 Courtesy of KIA MOTORS AMERICA, INC.

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. 112: Measuring 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.

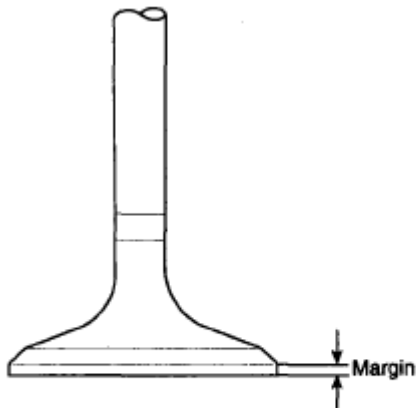
If the margin thickness is less than minimum, replace the valve.

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. 113: Checking Valve Head Margin Thickness
Courtesy of KIA MOTORS AMERICA, INC.

4. Check the valve length.

Length

Intake: 105.27 mm (4.1445in)

Exhaust: 105.50 mm (4.1535in)

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.

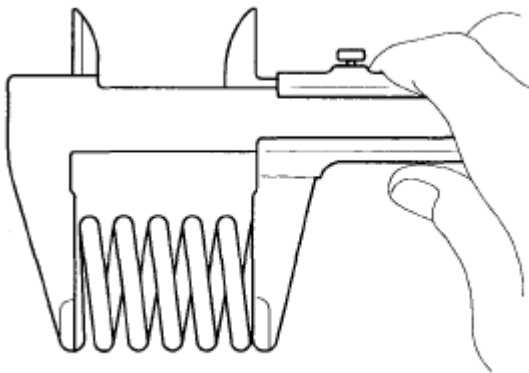
4. Inspect valve springs.
 1. Using a steel square, measure the out-of-square of the valve spring.
 2. Using a vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height: 43.86 mm (1.7267 in.)

Out-of-square: 1.5°



KCRF205A

Fig. 114: 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

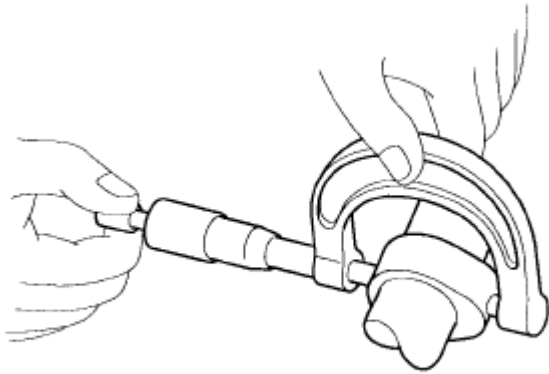
[Standard value]

Intake:

46.3 mm (1.8228 in.) (3.3L engine)

46.8 mm (1.8425 in.) (3.8L engine)

Exhaust: 45.8 mm (1.8031 in.)

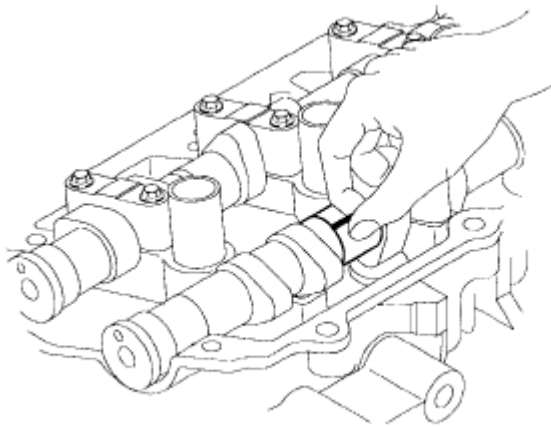


KCRF206A

Fig. 115: 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. 116: Identifying Plastigage
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the bearing caps.

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

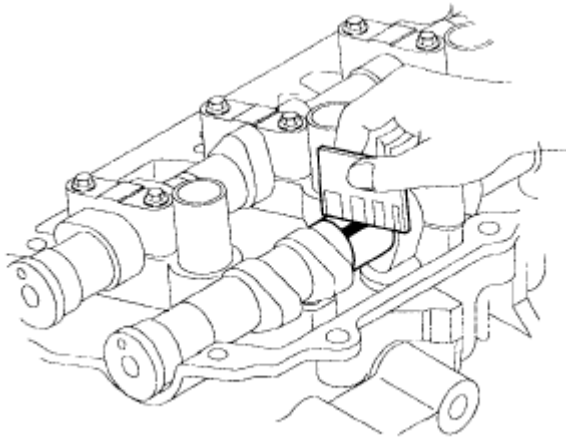
No.1 journal: 0.020-0.057 mm (0.0008-0.0022 in.)

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. 117: Measuring Plastigage At Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

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

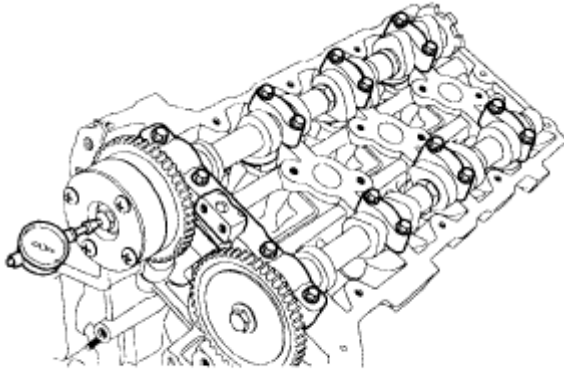
7. Completely remove the plastigage.
8. Remove the camshafts.
3. Inspect camshaft end play.
 1. Install the camshafts.
 2. Using a dial indicator, measure the end play while moving the camshaft back and forth.

Camshaft end play

[Standard value]

0.056-0.064 mm (0.0022-0.0025in) - 3.3L engine

0.02-0.18 mm (0.0008-0.0071in) - 3.8L engine



KDRF196B

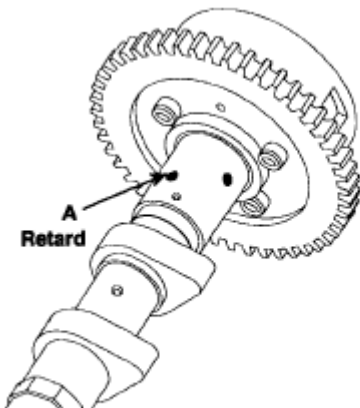
Fig. 118: Measuring End Play While Moving Camshaft Back And Forth
Courtesy of KIA MOTORS AMERICA, INC.

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 in the illustration.



ECRF015A

Fig. 119: Identifying Retard Hole

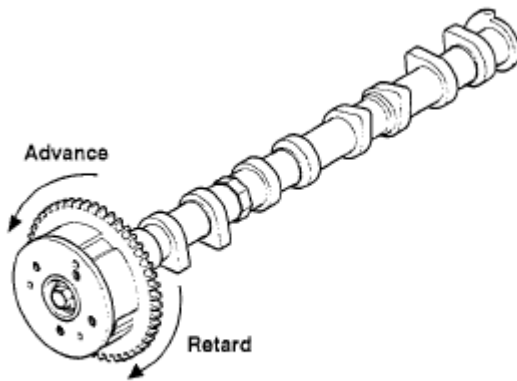
Courtesy of KIA MOTORS AMERICA, INC.

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, under the condition that the pressure can be hardly applied because of the air leakage from the port, there may be the case that the lock pin could be hardly released.



SBLM16202L

Fig. 120: Turning CVVT Assembly To Advance Angle Side
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 disturbance.

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 (clockwise).

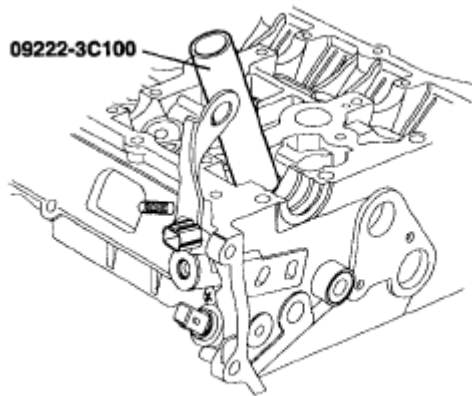
REASSEMBLY

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

1. Install valves.

1. Using SST (09222-3C100), 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.



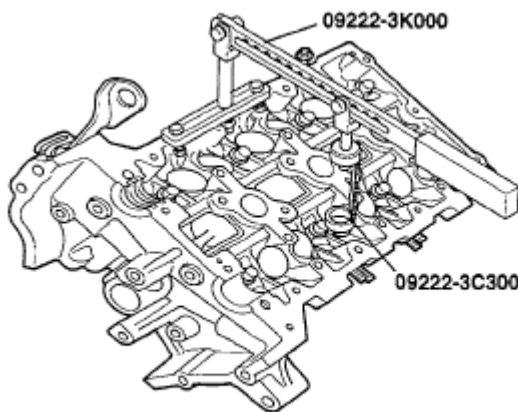
KCRF120B

Fig. 121: Pushing Oil Seal
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 installs 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.

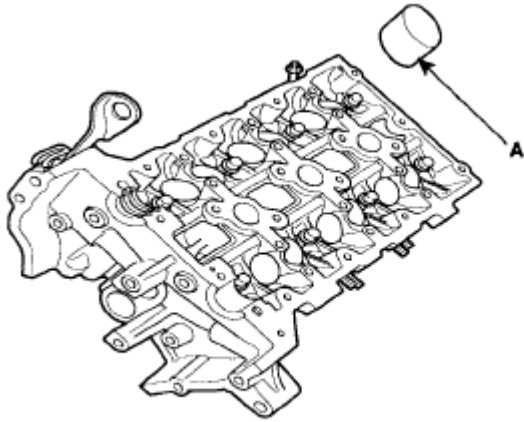


KDRF201A

Fig. 122: Compressing Valve Spring Using SST
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. 123: Identifying MLAs

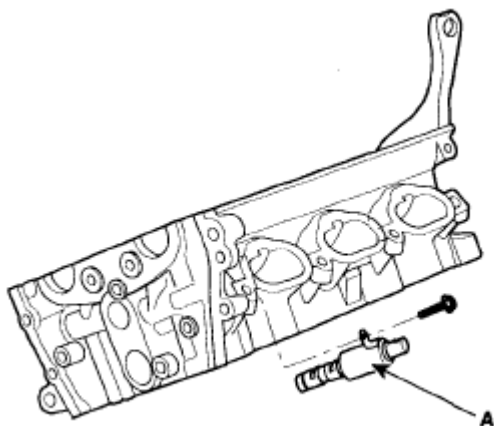
Courtesy of KIA MOTORS AMERICA, INC.

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

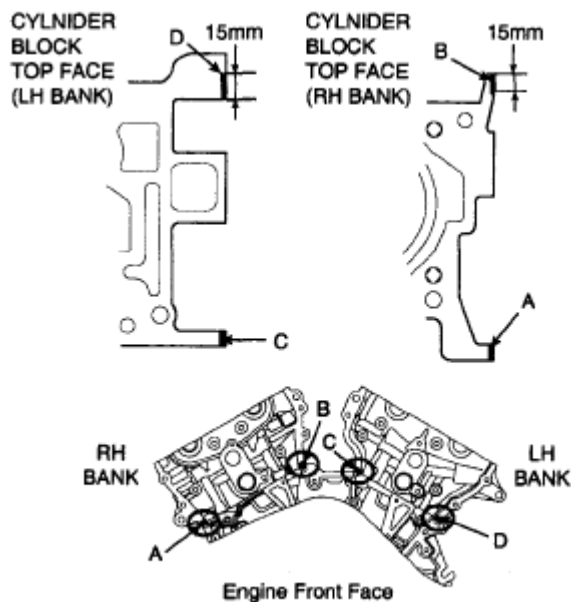
INSTALLATION**NOTE:**

- 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.

1. Install the cylinder head.

- The sealant locations on cylinder head and cylinder block must be free of engine oil and ETC.
- 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

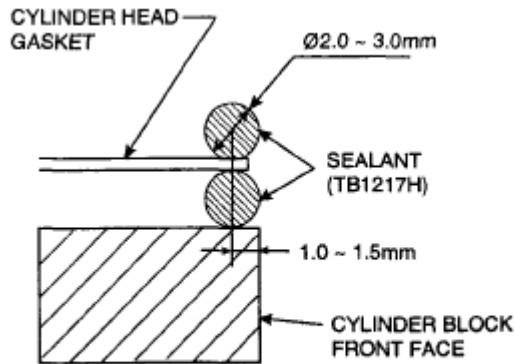
Fig. 125: Identifying Cylinder Block Top Face
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Refer to illustration to apply the sealant.

Bead width: 2.0-3.0 mm

Sealant locations: 1.0-1.5 mm from block surface

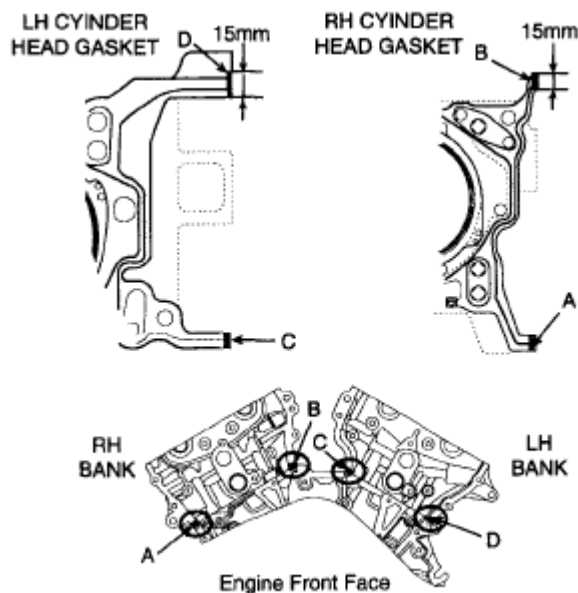
Recommended sealant: Liquid sealant TB1217H



ECBF018A

Fig. 126: Identifying Gap Between Cylinder Block Front Face And Cylinder Head Gasket
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. 127: Assembling Cylinder Head Gaskets On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Be careful of the installation direction.

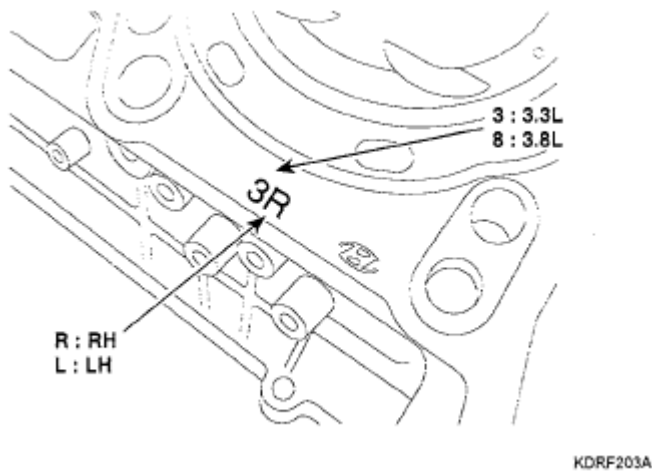


Fig. 128: Identifying Mark On Cylinder Head
Courtesy of KIA MOTORS AMERICA, INC.

- d. Install the cylinder head.

NOTE: Remove the extruded sealant after assembling cylinder heads.

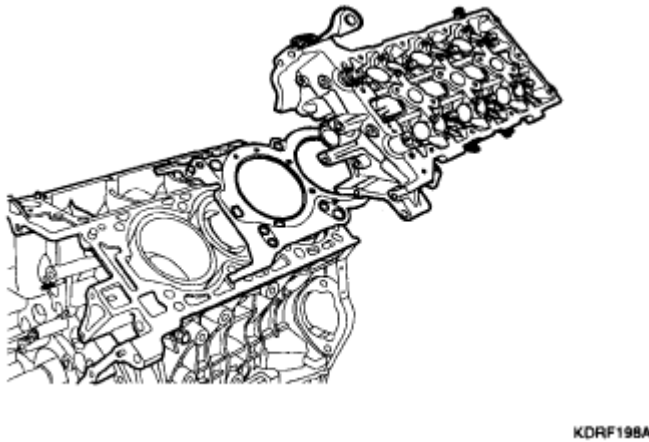


Fig. 129: Identifying Cylinder Head
Courtesy of KIA MOTORS AMERICA, INC.

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.

Tightening torque

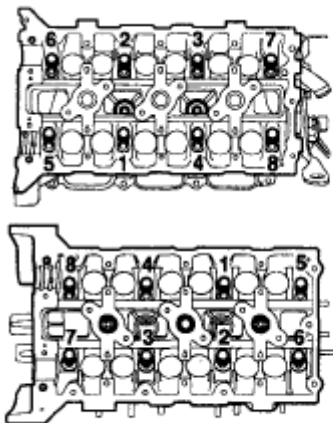
1st step: 39.2 N.m (4.0 kgf.m, 28.9 lb-ft)

2nd step: 120°

3rd step: 90°

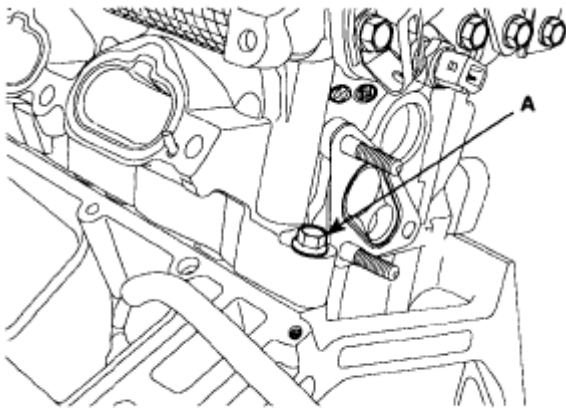
18.62-23.52 N.m (1.9-2.4 kgf.m, 13.74-17.36 lb-ft) (A)

NOTE: Always use new cylinder head bolt.



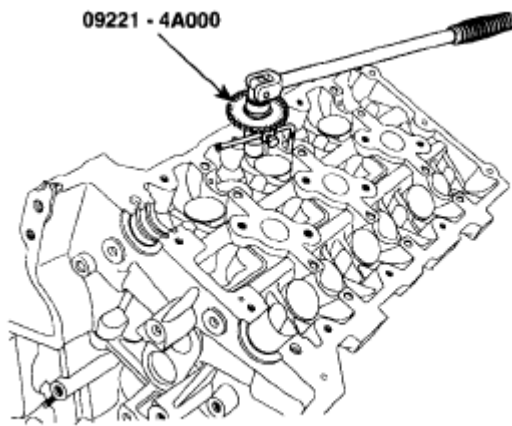
KDRF199B

Fig. 130: Identifying Cylinder Head Bolt Sequence
Courtesy of KIA MOTORS AMERICA, INC.



ECBF035A

Fig. 131: Identifying Cylinder Head Bolt
Courtesy of KIA MOTORS AMERICA, INC.



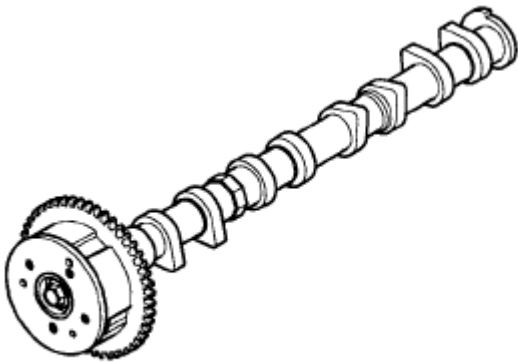
KDRF223A

Fig. 132: Checking Cylinder Head Bolt Tightening Torque
 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. 133: Identifying CVVT And Camshaft Sprocket
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

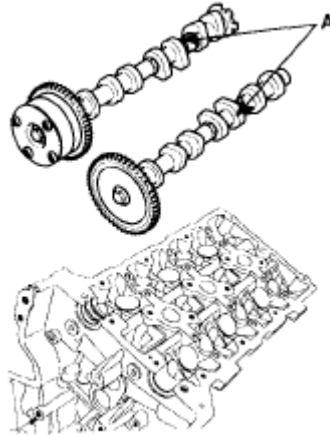
At this time, attend not to be installed to oil hole of camshaft-inlet.

- 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:

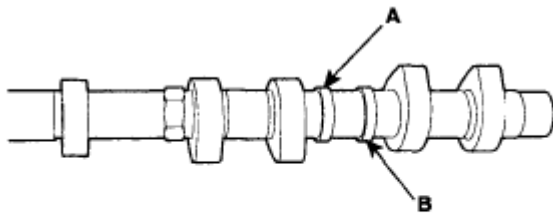
- Apply a light coat of engine oil on camshaft journals.
- Assemble the key groove of camshaft rear side to the same level of head top surface.
- Be careful the right, left bank, intake, exhaust side before assembling.



KDRF197A

Fig. 134: Identifying Camshafts
Courtesy of KIA MOTORS AMERICA, INC.

INTAKE CAMSHAFT



KDRF226A

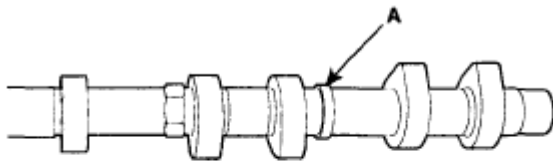
Fig. 135: Identifying Intake Camshaft
Courtesy of KIA MOTORS AMERICA, INC.

INTAKE CAMSHAFT SPECIFICATION

	LH	RH
3.3L	A: 27 mm (1.0630 in.)	A: 30 mm (1.1811 in.)

	B: 27 mm (1.0630 in.)	B: 30 mm (1.1811 in.)
3.8L	A: 30 mm (1.1811 in.) B: 27 mm (1.0630 in.)	A: 27 mm (1.0630 in.) B: 30 mm (1.1811 in.)

EXHAUST CAMSHAFT

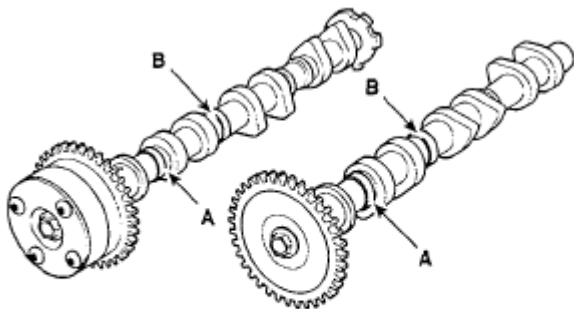


KDRF227A

Fig. 136: Identifying Exhaust Camshaft
Courtesy of KIA MOTORS AMERICA, INC.

EXHAUST CAMSHAFT SPECIFICATION

	LH	RH
3.3L/3.8L	A: 27 mm (1.0630 in.)	A: 30 mm (1.1811 in.)



SBLM16209L

Fig. 137: Identifying Intake And Exhaust Camshaft
Courtesy of KIA MOTORS AMERICA, INC.

INTAKE AND EXHAUST CAMSHAFT SPECIFICATION

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

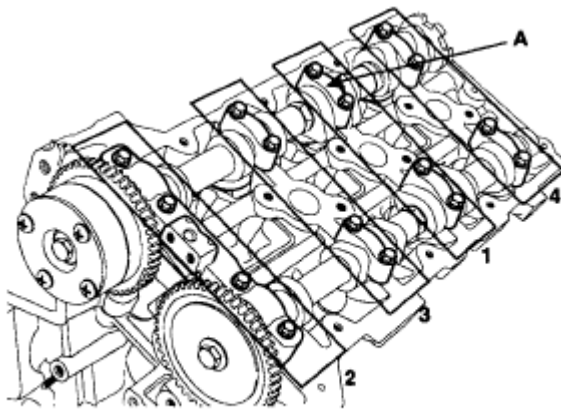
3.3L	in.) B: 27 mm (1.0630 in.)	in.) B: 27 mm (1.0630 in.)
3.8L	A: 30 mm (1.1811 in.) B: 27 mm (1.0630 in.)	A: 30 mm (1.1811 in.) B: 27 mm (1.0630 in.)

6. Install camshaft bearing caps with the order below.

Tightening torque

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

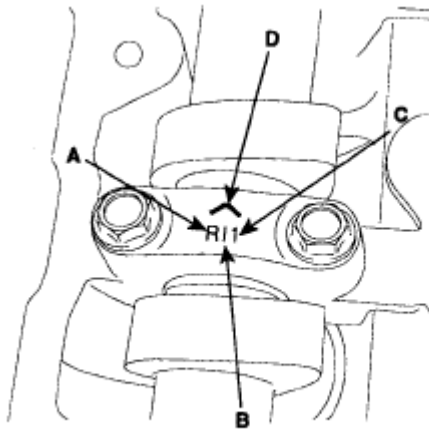
2nd step: 9.80-11.76 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



UCBF008A

Fig. 138: Identifying Camshaft Bearing Caps Order
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Be careful the right, left bank, intake, exhaust side before assembling.



ECBF036A

Fig. 139: Identifying Marks On Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

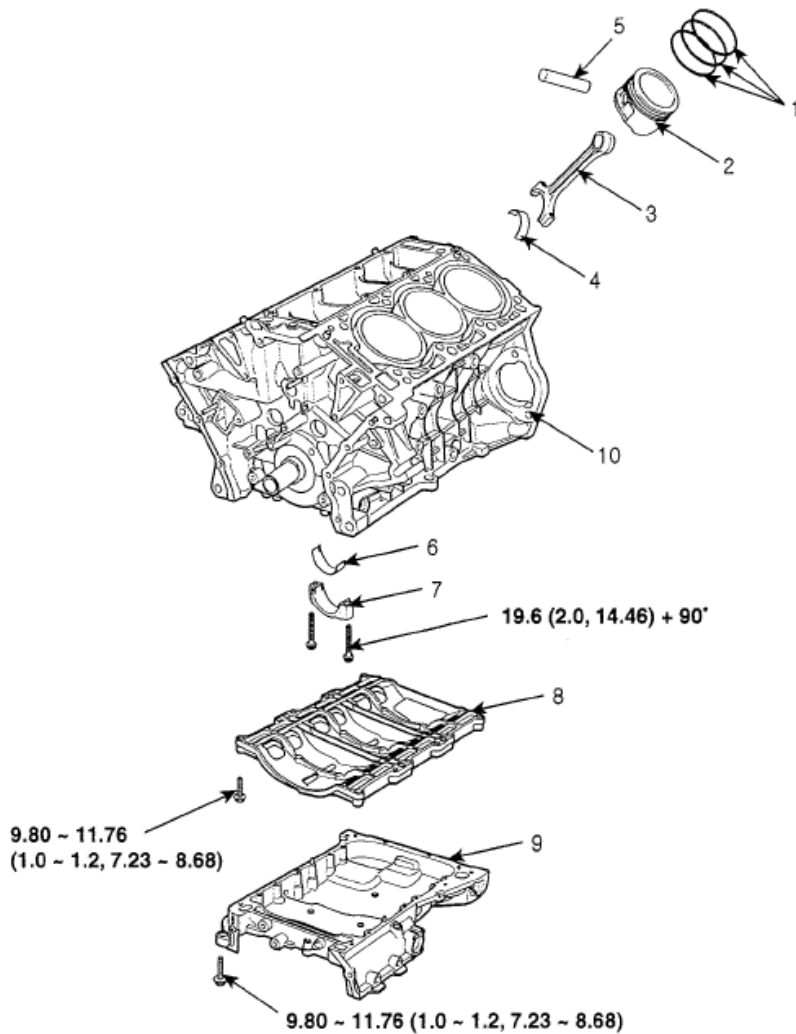
- A. L(LH), R(RH)
- B. I (Intake), None (Exhaust)
- C. Journal number
- D. Front mark

CAUTION: Rotate the crankshaft not to contact the valves to the pistons by making the pistons below 10 mm (0.3937 in.) from the top of cylinder block.

- 7. Install water temperature control assembly.
- 8. Install timing chain.
- 9. Check and adjust valve clearance.
- 10. Install the exhaust manifold.
- 11. Install the intake manifold.

ENGINE BLOCK

COMPONENTS

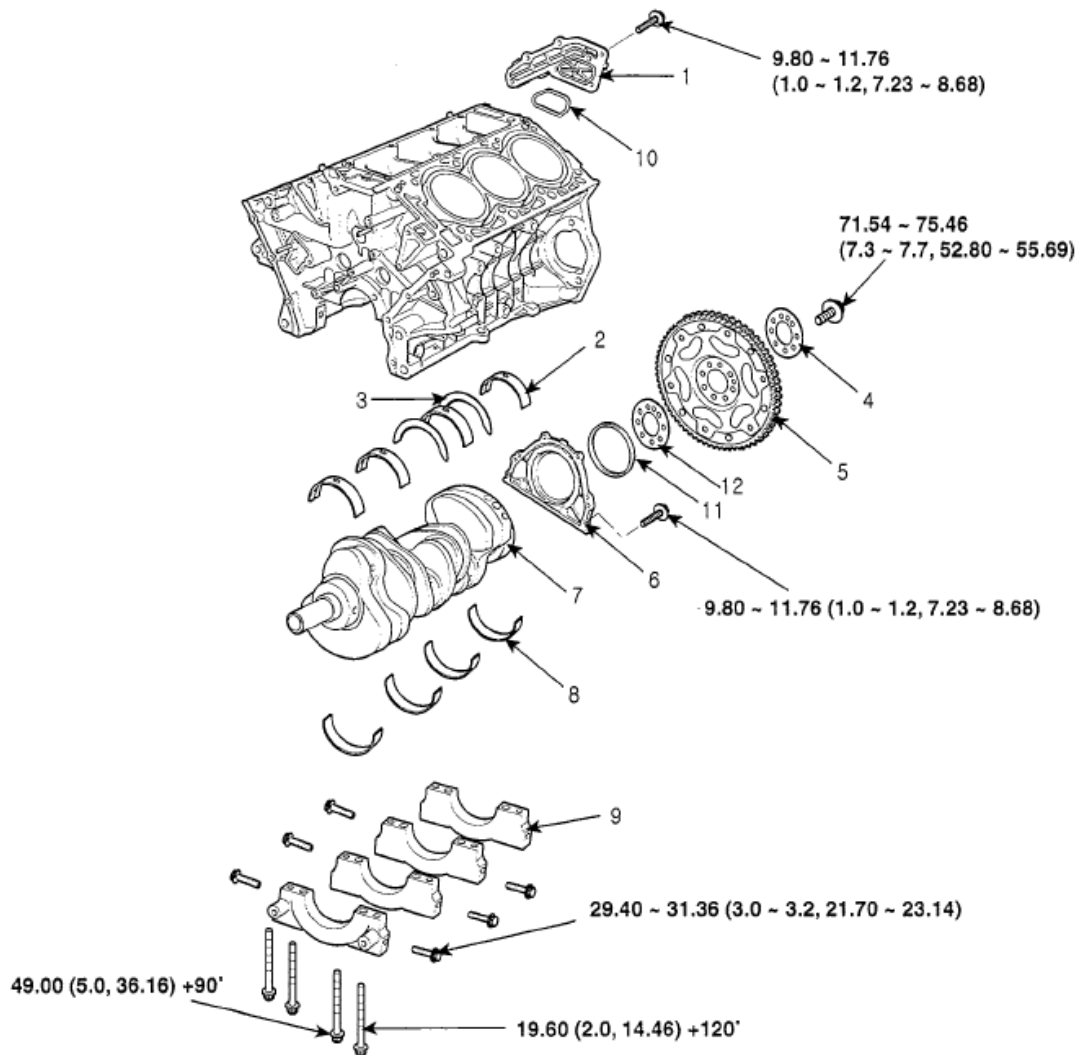


TORQUE : N.m (kgf.m, lbf.ft)

- | | |
|---------------------------------|---------------------------------|
| 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 |

EDRF005A

Fig. 140: Identifying Engine Block Components With Torque Specification (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.



TORQUE : N.m (kgf.m, lbf.ft)

- | | |
|-----------------------------|-----------------------------|
| 1. Oil drain cover | 7. Crankshaft |
| 2. Crankshaft upper bearing | 8. Crankshaft lower bearing |
| 3. Thrust bearing | 9. Main bearing cap |
| 4. Plate adapter | 10. Oil drain cover gasket |
| 5. Drive plate | 11. Rear oil seal |
| 6. Rear oil seal case | 12. Crank adapter |

SBLM16203L

Fig. 141: Identifying Engine Block Components With Torque Specification (2 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

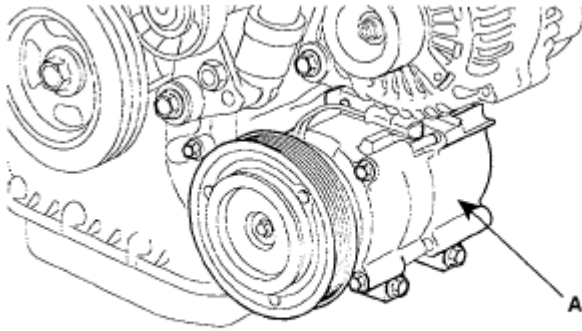
CAUTION:

- 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 mis-connection.
- Inspection the timing belt before removing the cylinder head.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

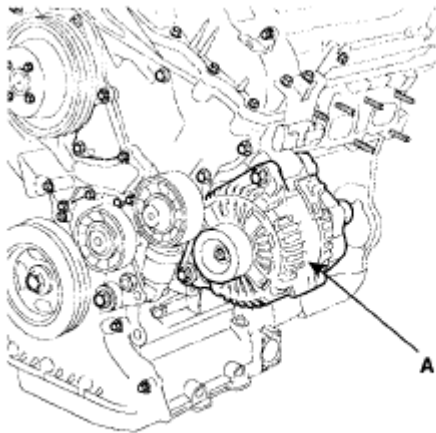
1. Remove exhaust manifold.
2. Remove intake manifold.
3. Remove timing chain.
4. Remove water temperature control assembly.
5. Remove cylinder head.
6. Remove oil pump.
7. Remove oil filter assembly.
8. Remove A/C compressor (A) from engine.



SBLM16103L

Fig. 142: Locating A/C Compressor On Engine
Courtesy of KIA MOTORS AMERICA, INC.

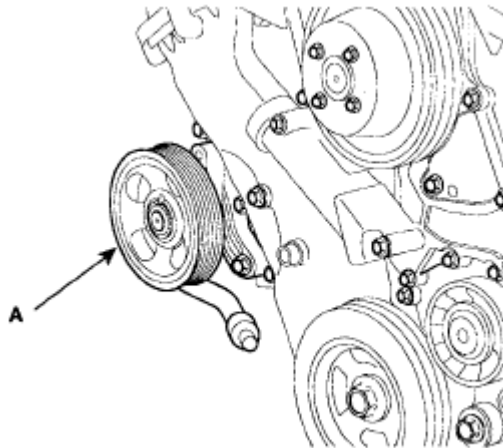
9. Remove alternator (A) from engine.



KDRF104A

Fig. 143: Locating Alternator On Engine
Courtesy of KIA MOTORS AMERICA, INC.

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

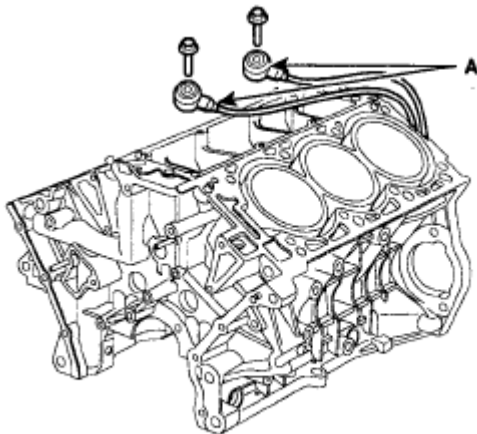


KDRF102A

Fig. 144: Locating Power Steering Pump On Engine
Courtesy of KIA MOTORS AMERICA, INC.

DISASSEMBLY

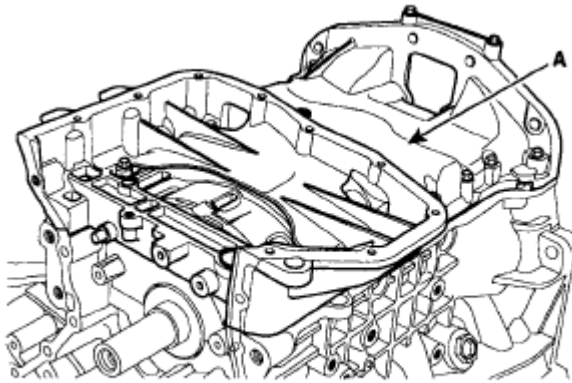
1. Remove drive plate.
2. Remove knock sensor (A).



KDRF205A

Fig. 145: Identifying Knock Sensor
Courtesy of KIA MOTORS AMERICA, INC.

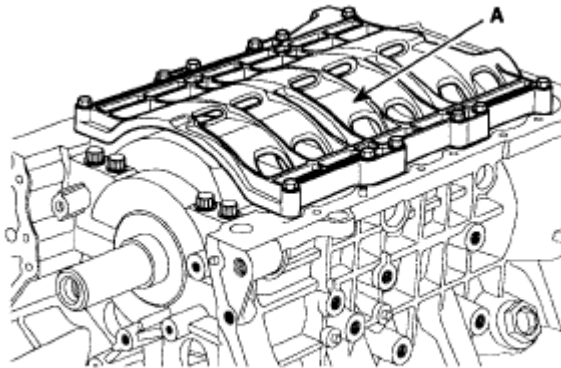
3. Remove upper oil pan (A).



KDRF206A

Fig. 146: Identifying Upper Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

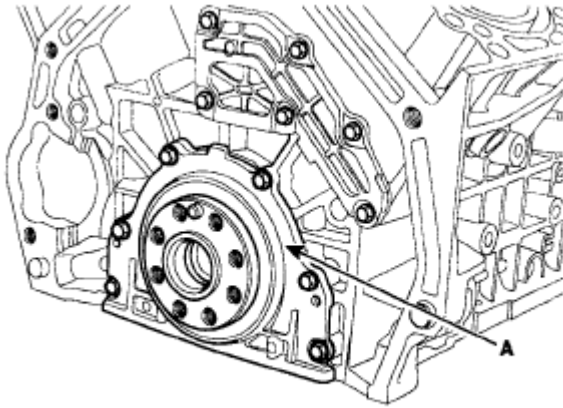
4. Remove baffle plate (A).



KDRF207A

Fig. 147: Identifying Baffle Plate
Courtesy of KIA MOTORS AMERICA, INC.

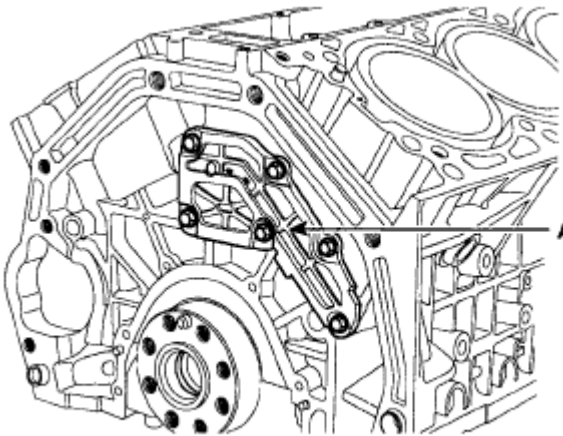
5. Remove rear oil seal case (A).



KDRF208A

Fig. 148: Identifying Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove oil drain cover (A).



KDRF209A

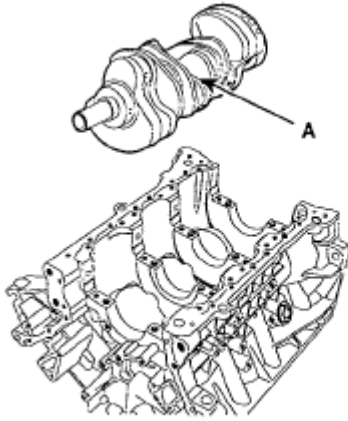
Fig. 149: Identifying Oil Drain Cover
Courtesy of KIA MOTORS AMERICA, INC.

7. Check the connecting rod end play.
8. Check the connecting rod oil clearance.
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.
11. Check the crankshaft end play.
12. Lift the crankshaft (A) out of engine, being careful not to damage journals.



KDRF210A

Fig. 150: 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.

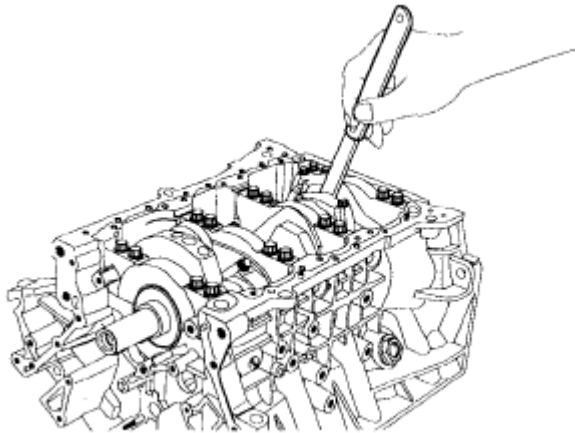
INSPECTION

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. 151: Checking 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

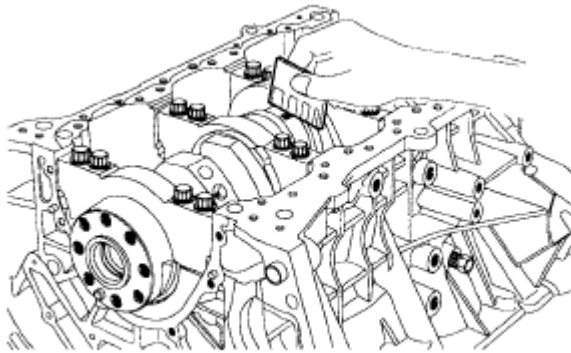
19.6 N.m (2.0 kgf.m, 14.46lbf.ft) + 90°

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. 152: Measuring Plastigage At 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.

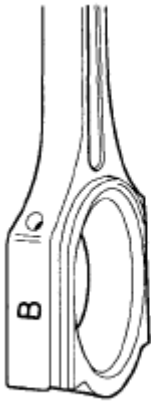
CAUTION: Do not file, shim, or scrape the bearings or the caps to adjust clearance.

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

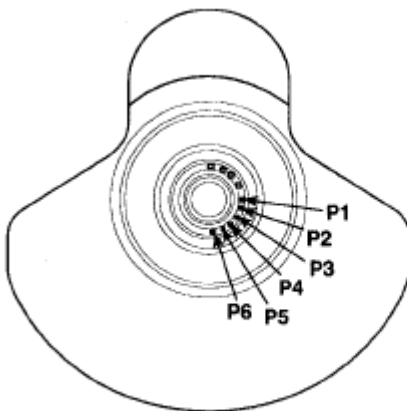
Fig. 153: Identifying Connecting Rod Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CONNECTING ROD

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

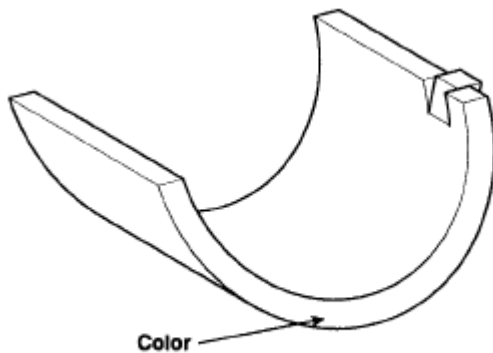


ECBF037A

Fig. 154: Identifying Crankshaft Pin Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT**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. 155: Placing Identification Mark On Connecting Rod Bearing
 Courtesy of KIA MOTORS AMERICA, INC.

PLACE OF IDENTIFICATION MARK (CONNECTING ROD BEARING)**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.)

DISCRIMINATION OF CONNECTING ROD BEARING**SELECTION SPECIFICATION**

		CONNECTING ROD IDENTIFICATION MARK		
		0(a)	1(b)	2(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)

11. Selection

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°

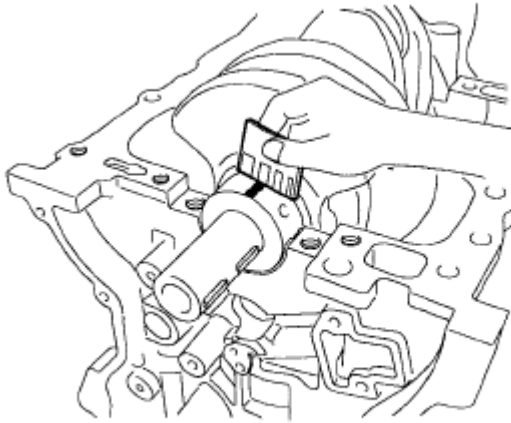
29.40-31.36 N.m (3.0-3.2 kgf.m, 21.70-23.14 lb-ft)

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. 156: 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.

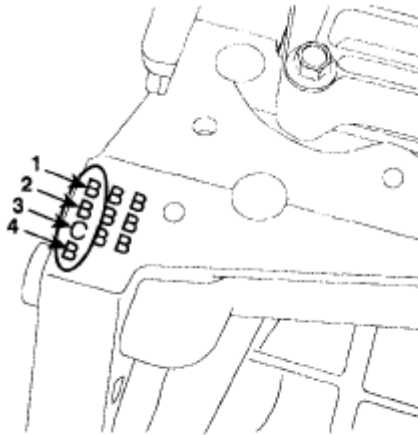
NOTE: If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

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. 157: Identifying Stamped Marks For Main Journal Size
 Courtesy of KIA MOTORS AMERICA, INC.

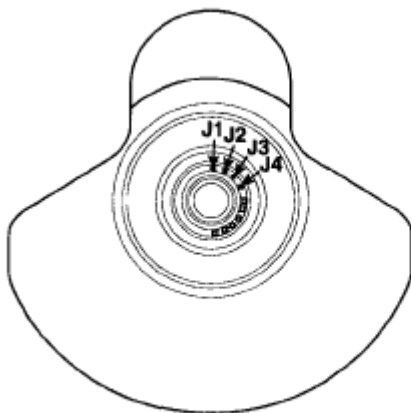
DISCRIMINATION OF CYLINDER BLOCK

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



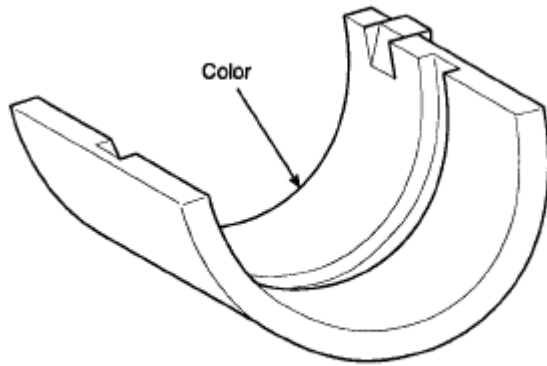
ECBF039A

Fig. 158: Identifying Crankshaft Journal Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT

DISCRIMINATION OF CRANKSHAFT

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

PLACE OF IDENTIFICATION MARK (CRANKSHAFT BEARING)

ECRF022A

Fig. 159: Placing Identification Mark On Crankshaft Bearing
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT BEARING**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**SELECTION SPECIFICATION**

		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)

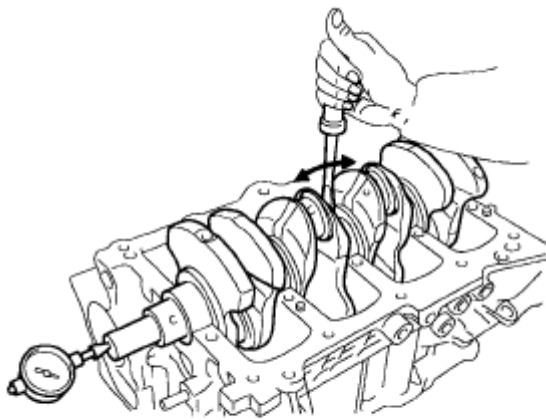
E (BLUE)

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. 160: 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.

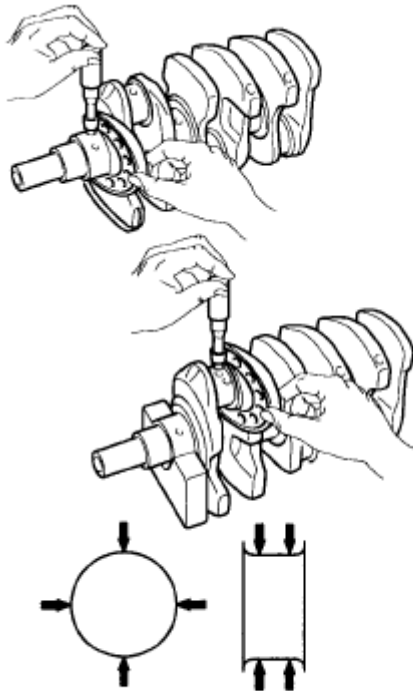
Thrust bearing thickness

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.)



ECKD001E

Fig. 161: Inspecting Main Journals And Crank Pins
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

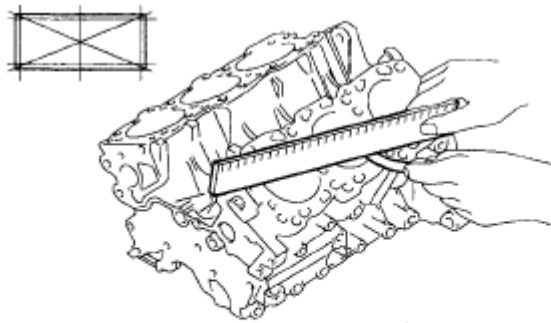
Using a soft brush and solvent, thoroughly clean the cylinder block.

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. 162: Measuring Surface Contacting Cylinder Head Gasket
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.

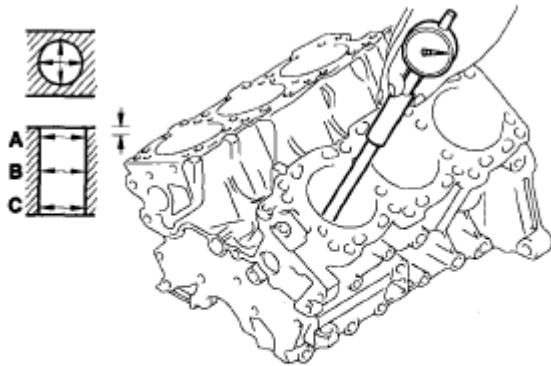
5. Inspect cylinder bore diameter

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

Standard diameter

92.00-92.03 mm (3.6220-3.6232 in) - 3.3L engine

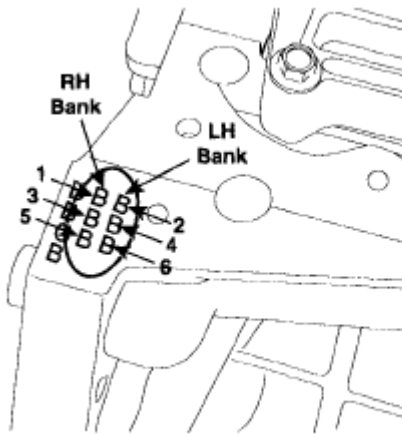
96.00-96.03 mm (3.7795-3.7807 in) - 3.8L engine



EDQF153A

Fig. 163: Measuring Cylinder Bore Diameter At Position In Thrust And Axial Directions
Courtesy of KIA MOTORS AMERICA, INC.

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



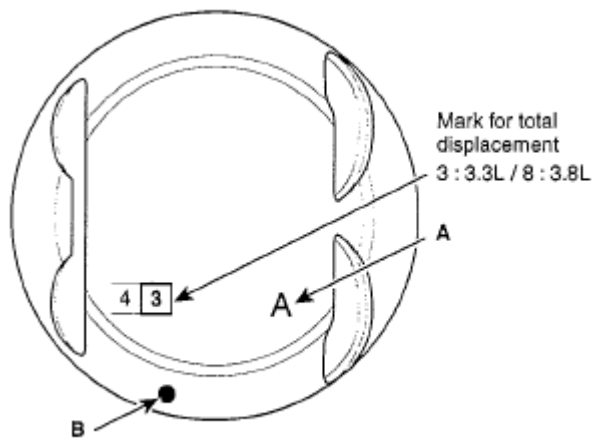
ECBF002A

Fig. 164: Checking Cylinder Bore Size Code On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

CYLINDER BORE INNER DIAMETER SPECIFICATION

Class	Size code	Cylinder bore inner diameter	
		3.3L	3.8L
A	A	92.00-92.01 mm (3.6220-3.6224 in)	96.00-96.01 mm (3.7795-3.7799 in)
B	B	92.01-92.02 mm (3.6224-3.6228 in)	96.01-96.02 mm (3.7799-3.7803 in)
C	C	92.02-92.03 mm (3.6228-3.6232 in)	96.02-96.03 mm (3.7803-3.7807 in)

7. Check the piston size code (A) and the front mark (B) on the piston top face.



SBLM16114L

Fig. 165: Checking Piston Size Code And Front Mark On Piston Top Face
 Courtesy of KIA MOTORS AMERICA, INC.

PISTON OUTER DIAMETER SPECIFICATION

Class	Size code	Piston outer diameter	
		3.3L	3.8L
A	A	91.96-91.97 mm (3.6205- 3.6209 in.)	95.96-95.97 mm (3.7779- 3.7783 in.)
B	B	91.97-91.98 mm (3.6209- 3.6213 in.)	95.97-95.98 mm (3.7783- 3.7787 in.)
C	C	91.98-91.99 mm (3.6213- 3.6219 in.)	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.

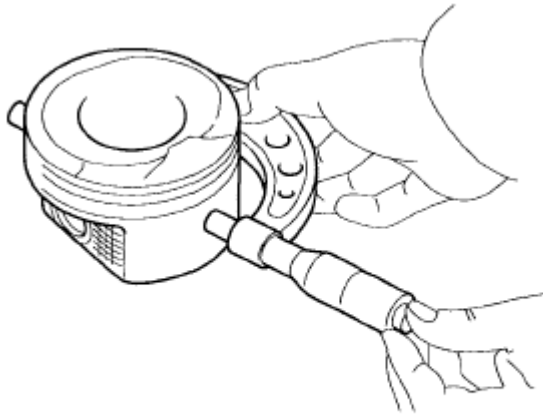
NOTE: Do not use a wire brush.

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

Standard diameter

91.96-91.99 mm (3.6205-3.6216 in) - 3.3L engine

95.96-95.99 mm (3.7779-3.7791 in) - 3.8L engine



ECKD001D

Fig. 166: Removing Carbon From Piston Top
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)

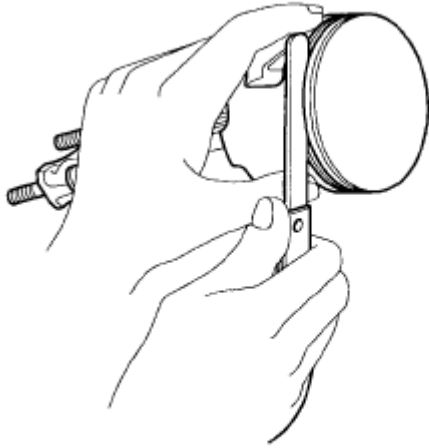
Oil ring: 0.06-0.15 mm (0.0024-0.0059 in)

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. 167: 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. 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: 0.32-0.47 mm (0.0126-0.0185 in)

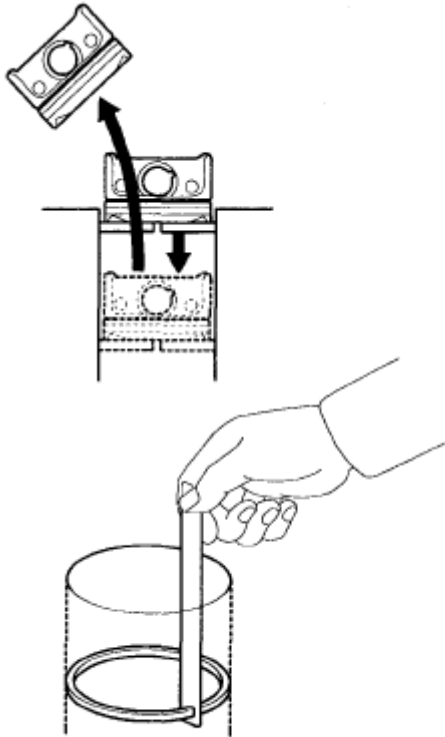
Oil ring: 0.20-0.70 mm (0.0079-0.0275 in)

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

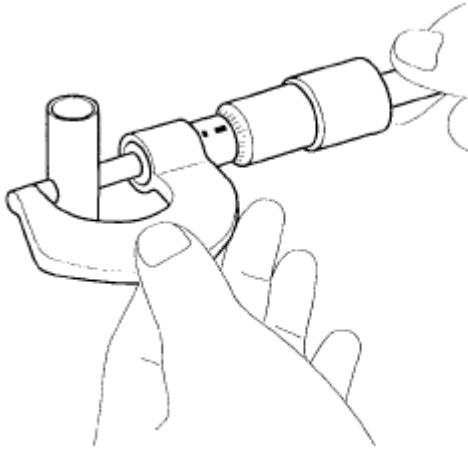
Fig. 168: Measuring Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter

23.001-23.006 mm (0.9055-0.9057 in)



ECKD001Z

Fig. 169: Measuring Diameter Of Piston Pin
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston pin-to-piston clearance

0.010-0.020 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

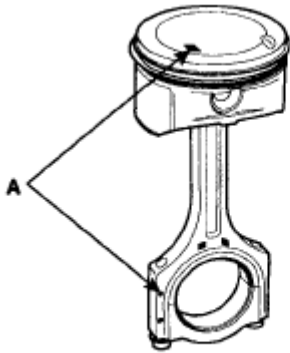
-0.032 to 0.016 mm (-0.0012 to 0.00063 in)

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.

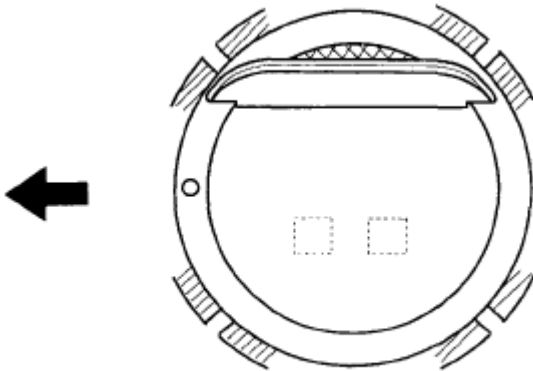
1. Assemble piston and connecting rod.
 1. Use a hydraulic press for installation.
 2. The piston front mark and the connecting rod front mark must face the timing belt side of the engine.



KCRF168A

Fig. 170: Identifying Piston Front Mark And Connecting Rod Front Mark
Courtesy of KIA MOTORS AMERICA, INC.

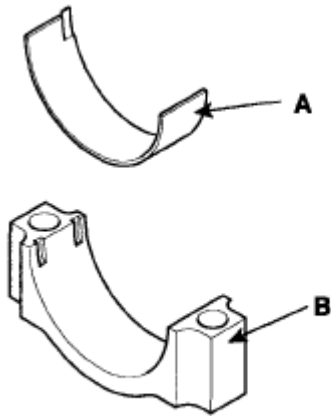
2. Install piston rings.
 1. Install the oil ring spacer and 2 side rails by hand.
 2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
 3. Position the piston rings so that the ring ends are as shown.



ECKD321A

Fig. 171: 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).



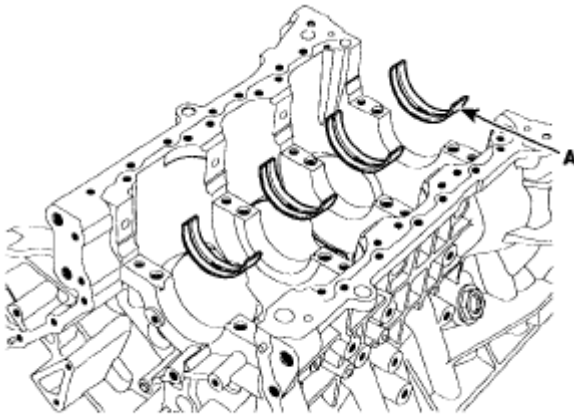
KCRF118B

Fig. 172: Identifying Bearings And Connecting Rod Cap
Courtesy of KIA MOTORS AMERICA, INC.

4. Install main bearings.

NOTE: Upper bearings have an oil groove of 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 (A).

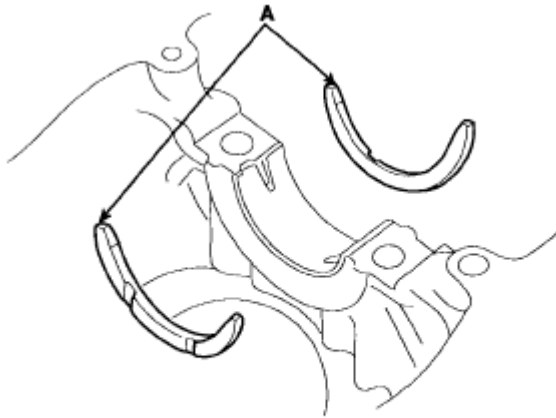


KDRF216A

Fig. 173: Identifying Upper Bearings
Courtesy of KIA MOTORS AMERICA, INC.

2. Align the bearing claw with the claw groove of the main bearing cap, and push in the 4 lower bearings.
5. Install thrust bearings.

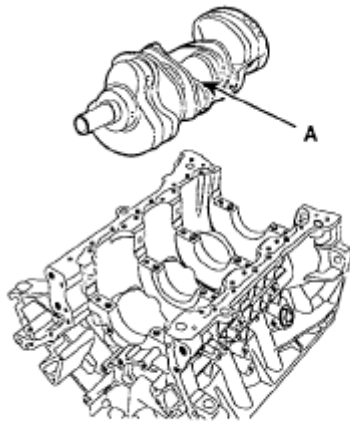
Install the 2 thrust bearings (A) under the No. 3 journal position of the cylinder block with the oil grooves facing outward.



ECKD324A

Fig. 174: Identifying Thrust Bearings
Courtesy of KIA MOTORS AMERICA, INC.

6. Place crankshaft on the cylinder block.



KDRF210A

Fig. 175: Identifying Crankshaft On Cylinder Block
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.

Tightening torque

Main bearing cap bolt

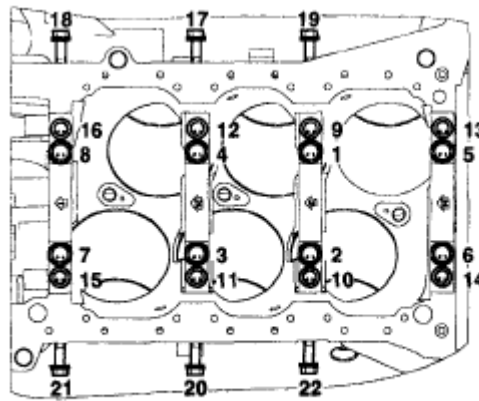
49.00 N.m (5.0 kgf.m, 36.16 lb-ft) + 90° (1-8)

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:

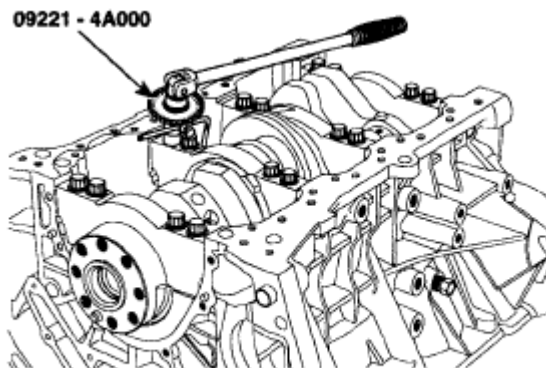
- Always use new main bearing cap bolt.
- If any of the bearing cap bolts in broken or deformed, replace it.



KDRF140A

Fig. 176: Main Bearing Cap Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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



KDRF224A

Fig. 177: Installing Main Bearing Cap Bolts
Courtesy of KIA MOTORS AMERICA, INC.

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

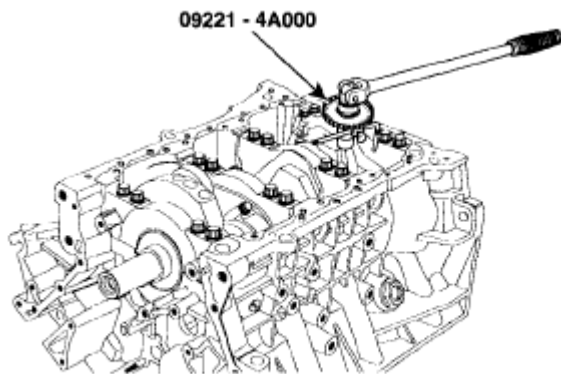
NOTE: Before installing the pistons, apply a coat of engine oil to the ring grooves and cylinder bores.

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

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

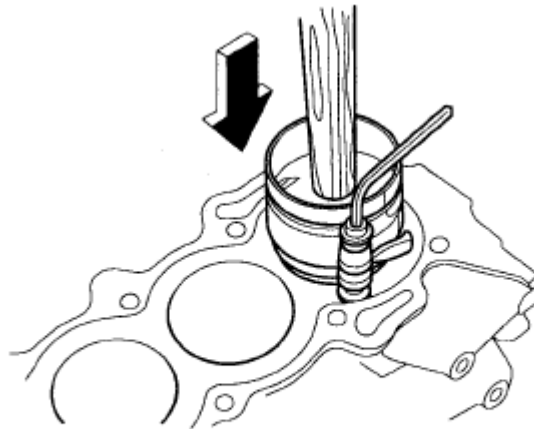
Use SST (09221-4A000), install connecting rod bearing cap bolts.



KDRF225A

Fig. 178: Installing Connecting Rod Bearing Cap Bolts
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.



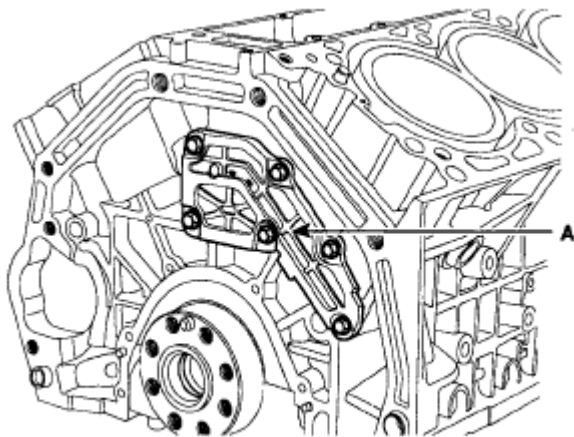
ECKD001F

Fig. 179: Installing Piston Into Bore
Courtesy of KIA MOTORS AMERICA, INC.

11. Check the connecting rod end play.
12. Install oil drain cover.

Tightening torque

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



KDRF209A

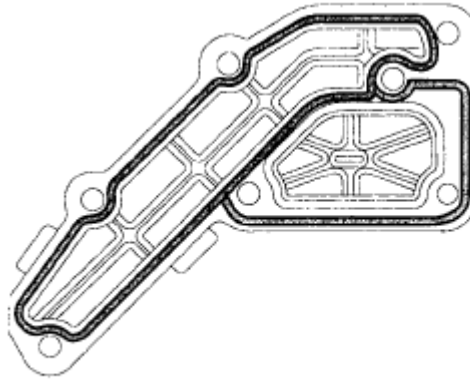
Fig. 180: Identifying Oil Drain Cover
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

sealant

- Be 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.



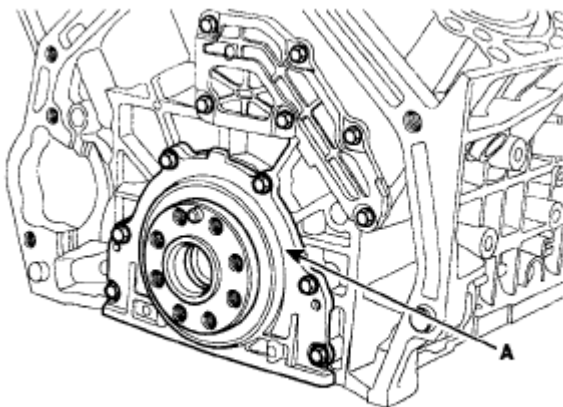
ECBF003A

Fig. 181: Applying Sealant To Inner Bolt Holes On 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)

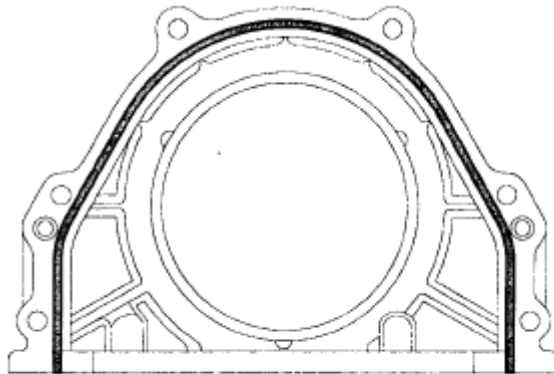


KDRF208A

Fig. 182: Identifying Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

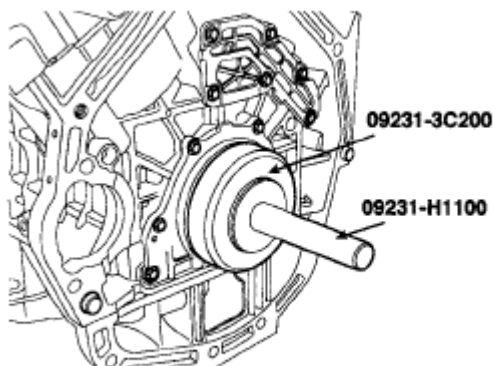
- Make clean the sealing face before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant
- Be assembling rear oil seal case, the liquid sealant TB1217H should be applied rear oil seal case.
- The part must be assembled within 5 minutes after sealant was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



KDRF218A

Fig. 183: Applying Sealant To Inner Threads Of Bolt Holes
Courtesy of KIA MOTORS AMERICA, INC.

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



KDRF237A

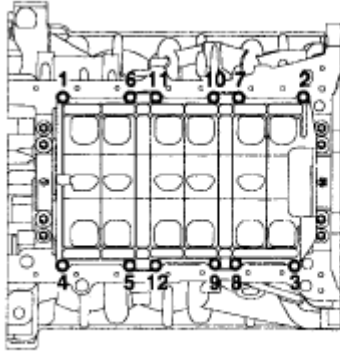
Fig. 184: Installing Rear Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

15. Install baffle plate.

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

Tightening torque

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

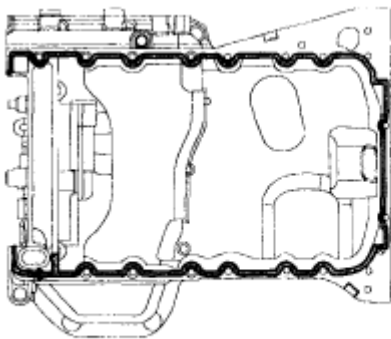


KDRF135A

Fig. 185: Identifying Baffle Plate Bolts
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. 186: Removing Packing Material From Gasket Surfaces
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- Make clean the sealing face 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.

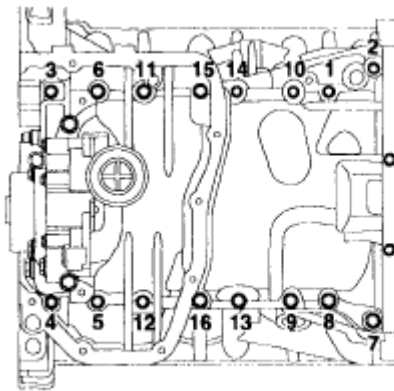
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.

c. Install oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

9.80-1176 N.m (1.0-1.2 kgf.m, 7.23-8.68 lb-ft)



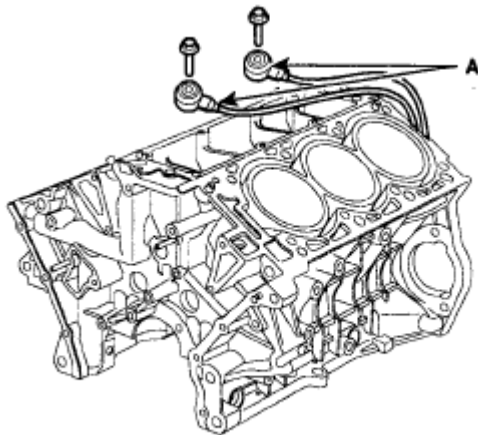
KDRF131A

Fig. 187: Identifying Oil Pan Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

- d. After assembly, wait at least 30 minutes before filling the engine with oil.
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. 188: Identifying Knock Sensor
Courtesy of KIA MOTORS AMERICA, INC.

18. Install drive plate.

Tightening torque

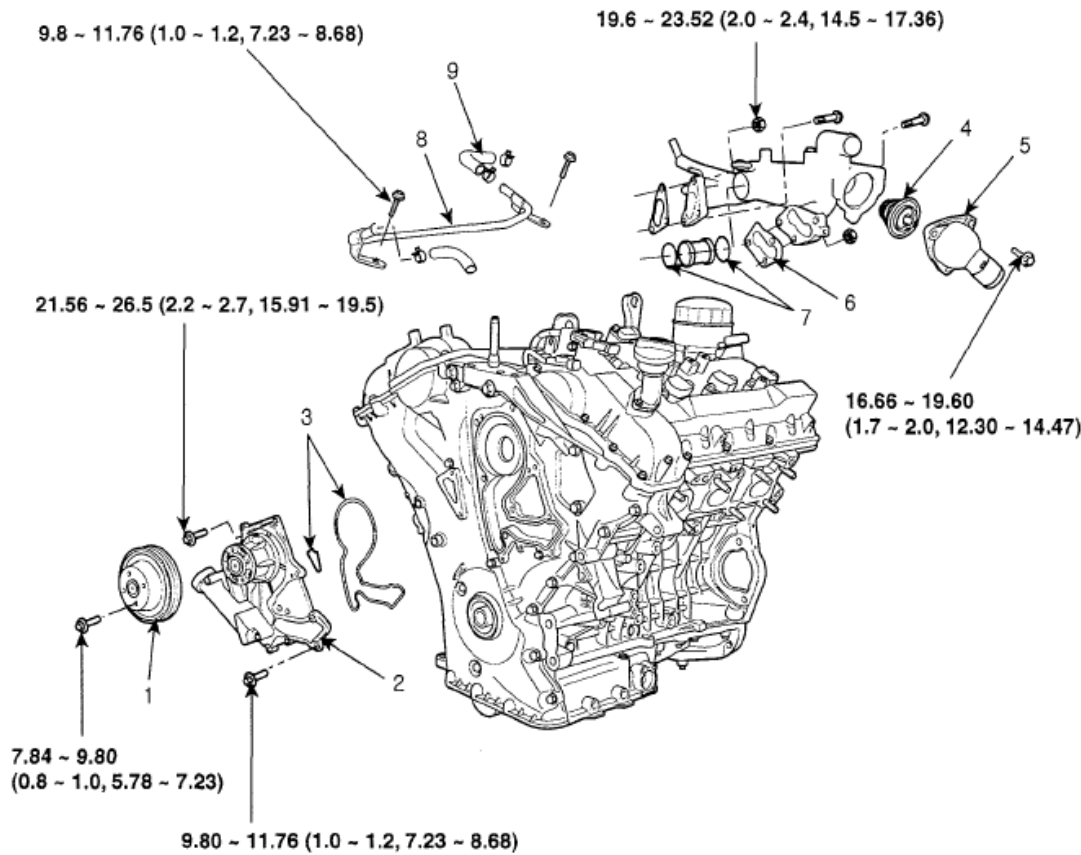
71.54-75.46 N.m (7.3-7.7 kgf.m, 52.80-55.69 lb-ft)

INSTALLATION

1. Install power steering pump.
2. Install alternator.
3. Install air compressor
4. Install oil filter assembly.
5. Install oil pump.
6. Install cylinder head.
7. Install water temperature control assembly.
8. Install timing chain.
9. Install intake manifold.
10. Install exhaust manifold.

COOLING SYSTEM

COMPONENTS



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 |

SBLM16104L

Fig. 189: Identifying Cooling System Components With Torque Specification
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

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 MAX mark with water, then up to the MAX 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 so as bleed air easily.

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 and run coolant circulates.

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

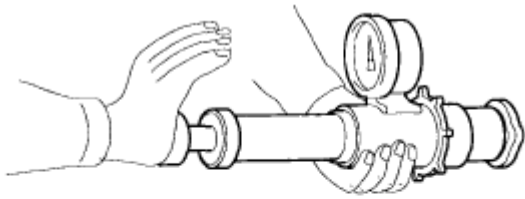
8. Repeat 7 until the cooling fan 3-5 times and bleed air sufficiently out of the cooling system.
9. Install the radiator cap and fill the reservoir tank to the "MAX" line with coolant.
10. Run the vehicle under idle until the cooling fan operates 2-3 times.
11. Stop the engine and wait coolant gets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

NOTE:

As it is to bleed air out to the cooling system and refill coolant when coolant gets cool completely recheck the coolant level in the reservoir tank for 2-3 days after replacing coolant.

CAP TESTING

1. Remove the radiator cap, wet it's seal with engine coolant, then install it to pressure tester.



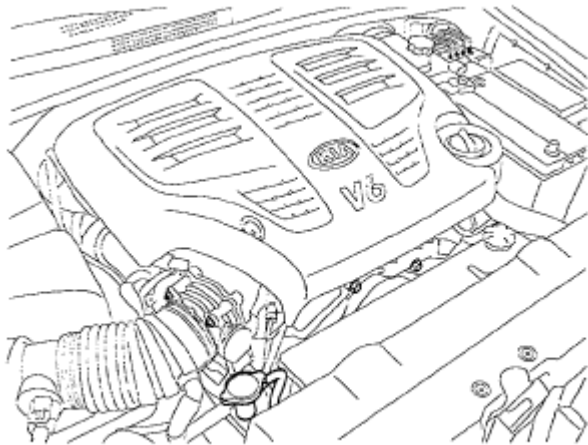
ECKD501X

Fig. 190: Testing Radiator Cap Pressure
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.



SBLM16105L

Fig. 191: Locating Radiator Cap
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.

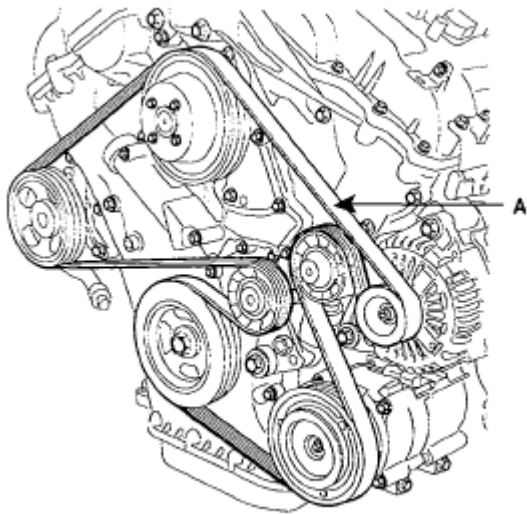
REMOVAL

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.

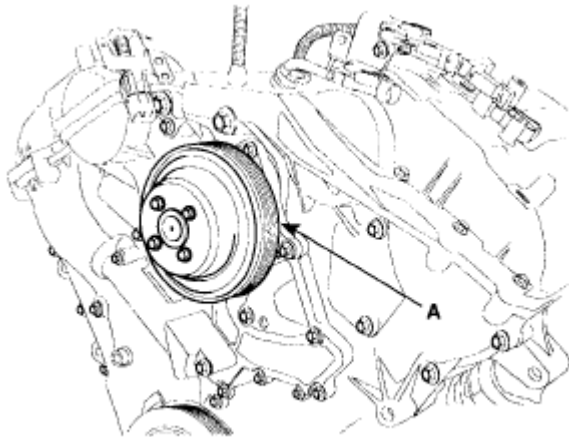
2. Remove drive belt (A).



SBLM16101L

Fig. 192: Identifying Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

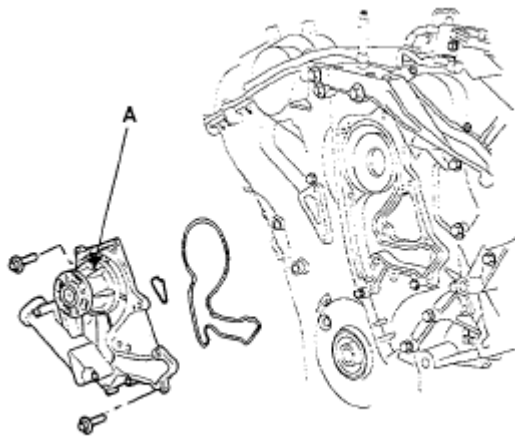
3. Remove the 4 bolts and pump pulley (A).



KDRF107A

Fig. 193: Identifying Water Pump Pulley Bolts
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the cooling fan shroud.
5. Remove the water pump (A) and gasket.

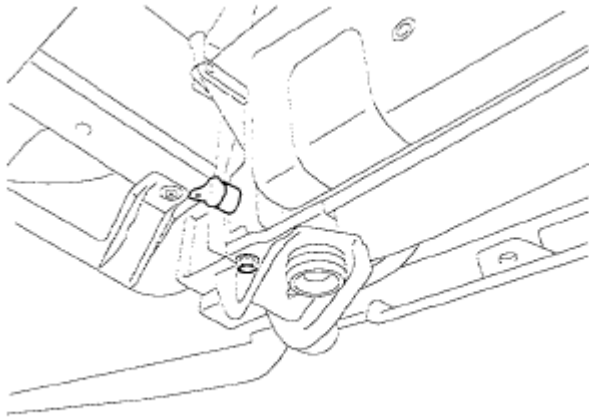


SBLM16106L

Fig. 194: Identifying Water Pump And Gasket
Courtesy of KIA MOTORS AMERICA, INC.

RADIATOR

1. Drain engine coolant.

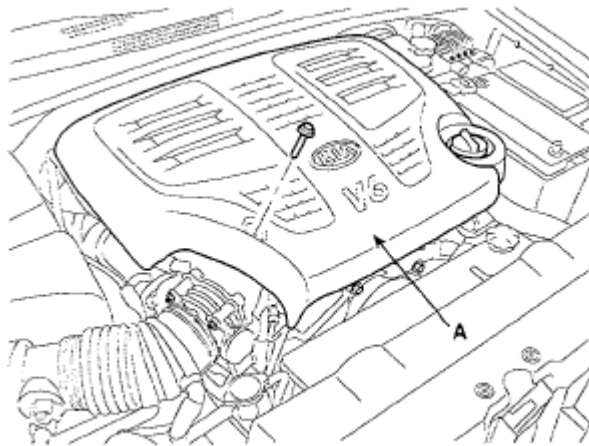


SBLM16021L

Fig. 195: Identifying Engine Coolant Drain Plug On Radiator
Courtesy of KIA MOTORS AMERICA, INC.

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

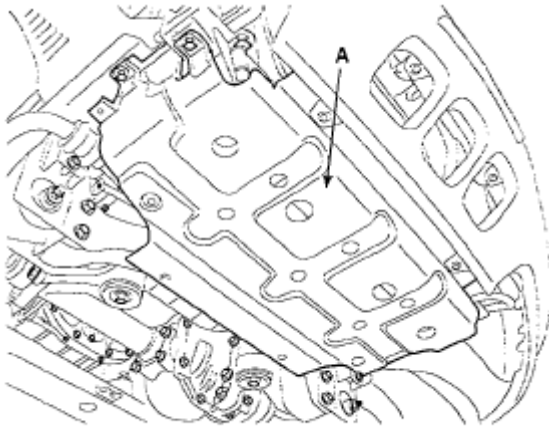
2. Remove the engine cover (A).



SBLM16001L

Fig. 196: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

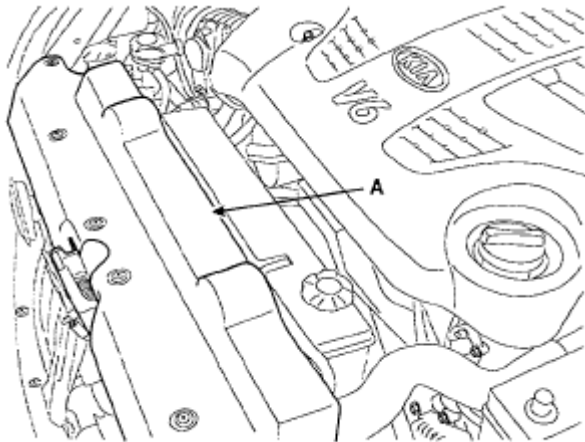
3. Remove the under cover (A).



SBLM16016L

Fig. 197: Identifying Under Cover
Courtesy of KIA MOTORS AMERICA, INC.

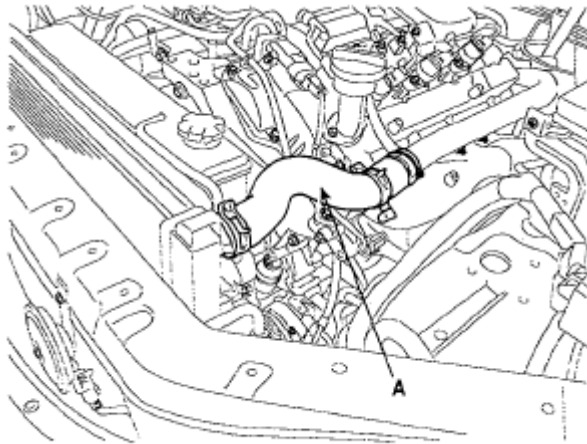
4. Remove the radiator grille upper cover (A).



SBLM16022L

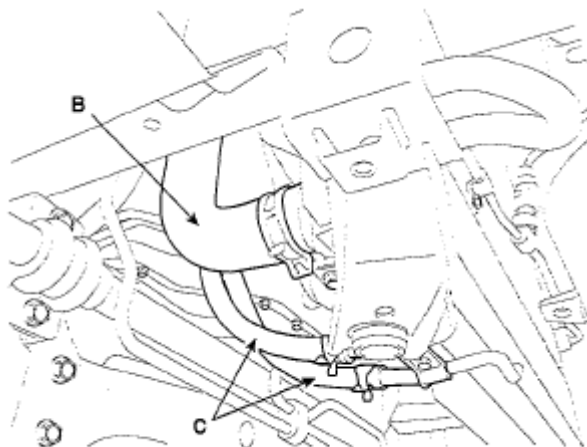
Fig. 198: Identifying Radiator Grille Upper Cover
Courtesy of KIA MOTORS AMERICA, INC.

5. Disconnect the radiator upper hose (A) and lower hose (B) and the automatic transaxle fluid cooler hoses (C).



SBLM16023L

Fig. 199: Identifying Radiator Upper Hose And Lower Hose
 Courtesy of KIA MOTORS AMERICA, INC.



SBLM16024L

Fig. 200: Identifying Radiator Upper Hose And Lower Hose
 Courtesy of KIA MOTORS AMERICA, INC.

6. Remove the radiator from the condenser by removing bolts. Refer to Condenser in **HEATING, VENTILATION AND AIR CONDITIONING**.
7. Remove the cooling fan shroud (A) after disconnecting cooling fan harness connector (B) and loosening the mounting bolts (C).

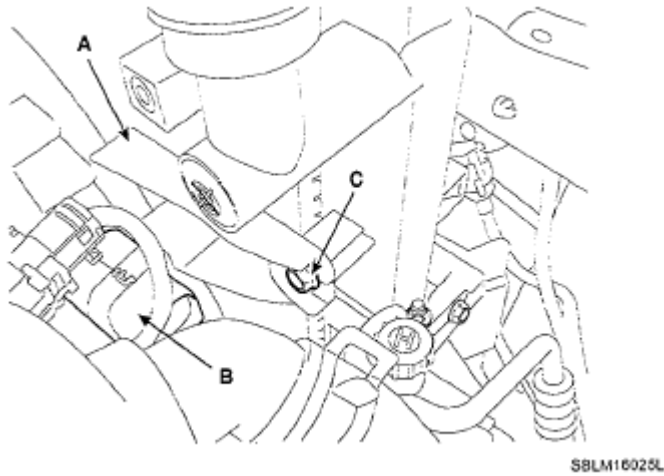


Fig. 201: Identifying Cooling Fan Shroud
 Courtesy of KIA MOTORS AMERICA, INC.

8. Remove the radiator assembly.

WATER TEMPERATURE CONTROL ASSEMBLY

1. Drain the engine coolant.
2. Remove air cleaner assembly.
3. Remove the automatic transaxle oil gauge.
4. Remove the battery assembly (A).

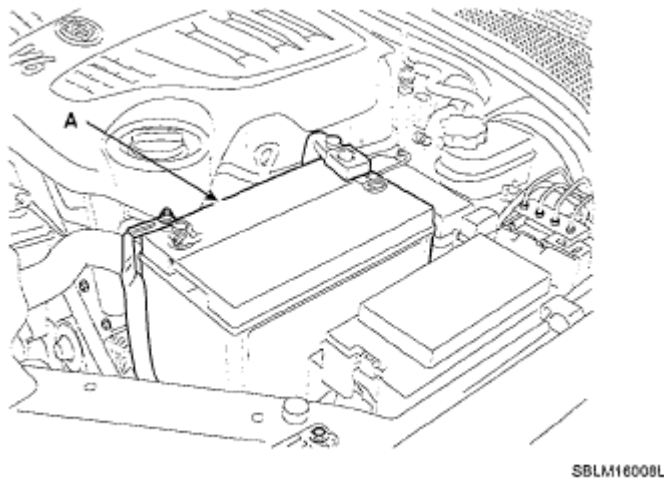
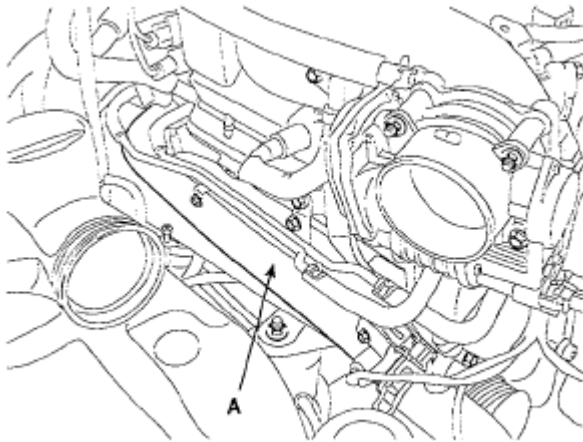


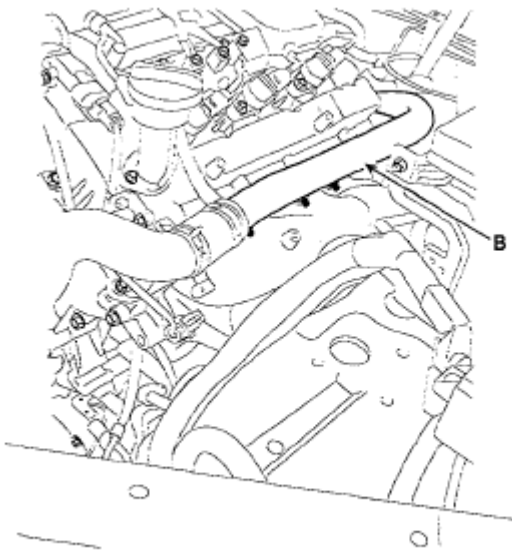
Fig. 202: Identifying Battery Assembly
 Courtesy of KIA MOTORS AMERICA, INC.

5. Disconnect the RH/LH cooling pipes (A, B).



SBLM16115L

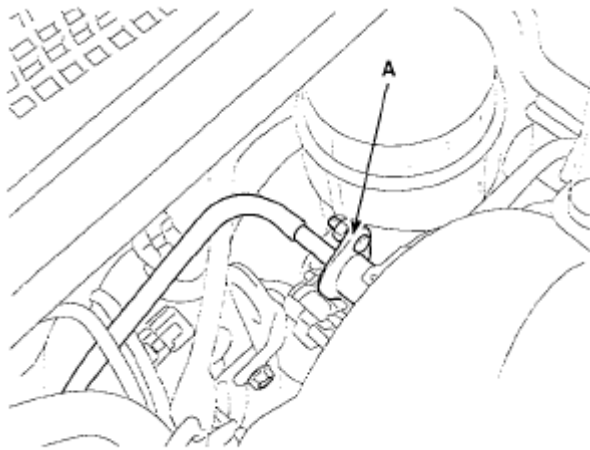
Fig. 203: Identifying RH/LH Cooling Pipes
Courtesy of KIA MOTORS AMERICA, INC.



SBLM16116L

Fig. 204: Identifying Radiator Upper Hose And Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

6. Disconnect WTS connector.
7. Disconnect heater hose, water vent hose and water hose from water temperature control assembly.
8. Remove the fuel pipe (A).

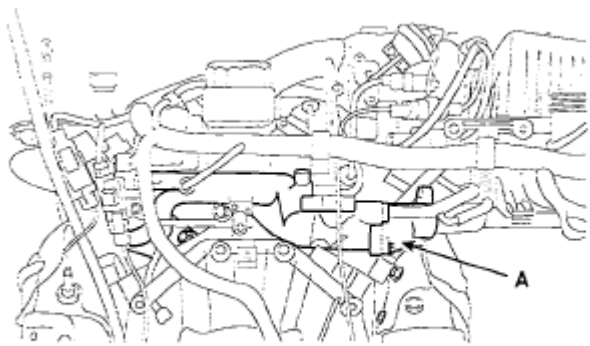


SBLM16015L

Fig. 205: Identifying Fuel Pipe

Courtesy of KIA MOTORS AMERICA, INC.

9. Remove water temperature control assembly (A).



SBLM16204L

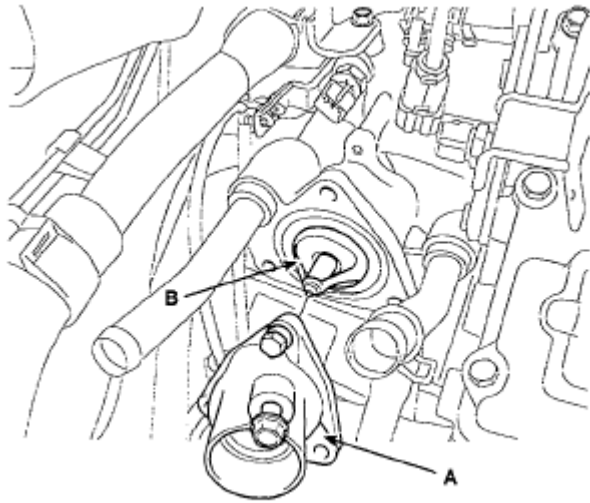
Fig. 206: Identifying Water Temperature Control Assembly

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).



SBLM16026L

Fig. 207: Identifying Water Inlet And Thermostat
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

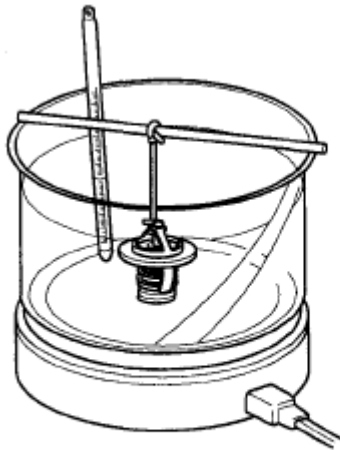
WATER PUMP

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 defective. Replace the coolant pump assembly.

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

THERMOSTAT

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



ECKD503B

Fig. 208: 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

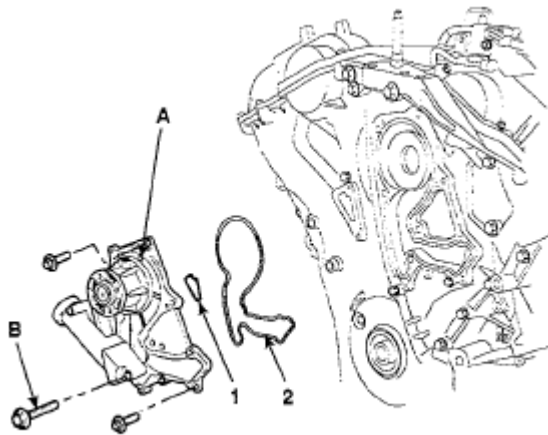
WATER PUMP

1. Install the water pump (A) and a new gasket(1, 2) 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)



SBLM16205L

Fig. 209: Identifying Water Pump Bolts

Courtesy of KIA MOTORS AMERICA, INC.

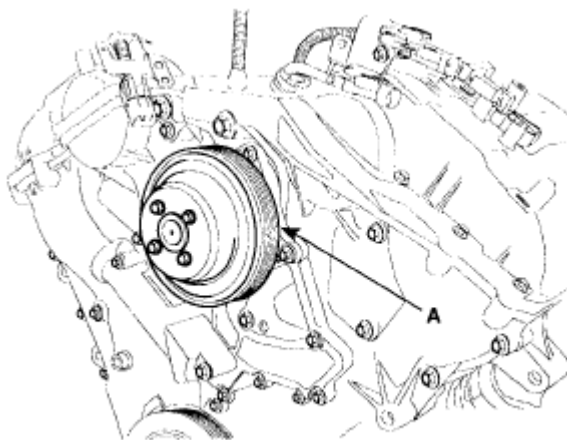
NOTE:

- Make clean the contact face before assembly.
- When replacing a water pump, always use new gasket (1, 2).
- When reassembling a water pump, replace the bolt (B) with a new one.

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)

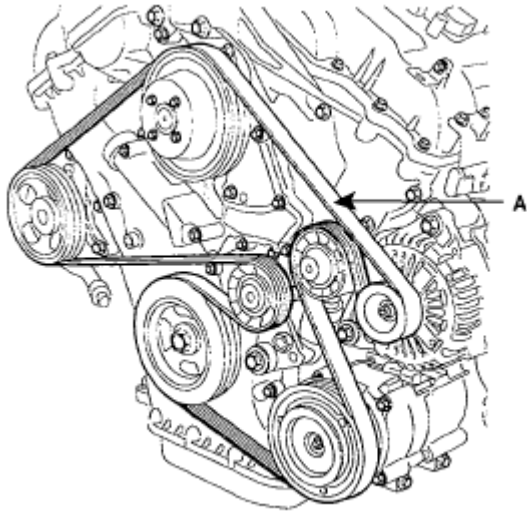


KDRF107A

Fig. 210: Identifying Water Pump Pulley Bolts

Courtesy of KIA MOTORS AMERICA, INC.

3. Install drive belt (A).



SBLM16101L

Fig. 211: Identifying Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

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

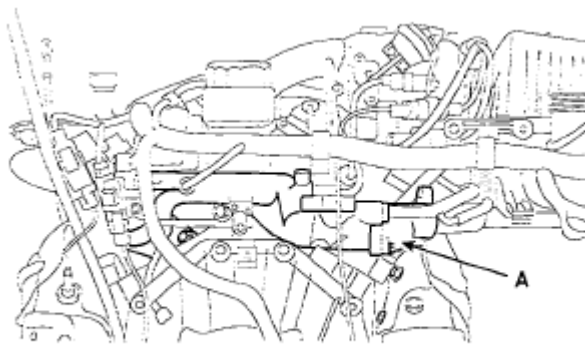
WATER TEMPERATURE CONTROL ASSEMBLY

NOTE: Make clean the contact face before assembly.

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

Tightening torque

19.6-23.52 N.m (2.0-2.4 kgf.m, 14.5-17.36 lb-ft)



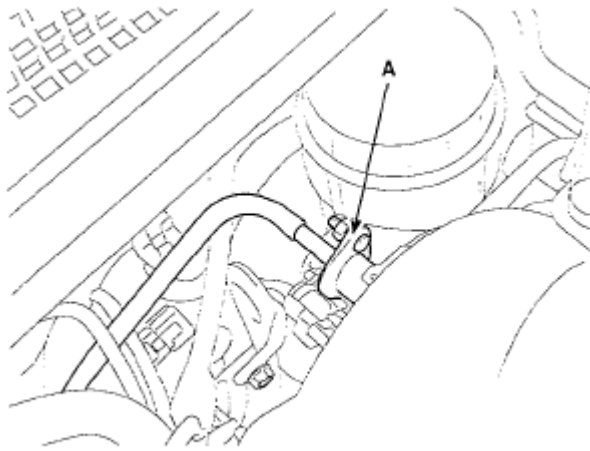
SBLM16204L

Fig. 212: Identifying Water Temperature Control Assembly

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 the fuel pipe (A).

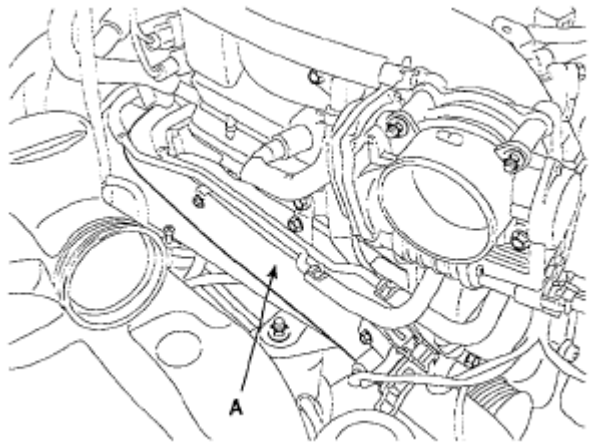


SBLM16015L

Fig. 213: Identifying Fuel Pipe

Courtesy of KIA MOTORS AMERICA, INC.

4. Connect WTS connector.
5. Connect the RH/LH cooling pipes (A, B).



SBLM16115L

Fig. 214: Identifying WTS Connector And RH/LH Cooling Pipes

Courtesy of KIA MOTORS AMERICA, INC.

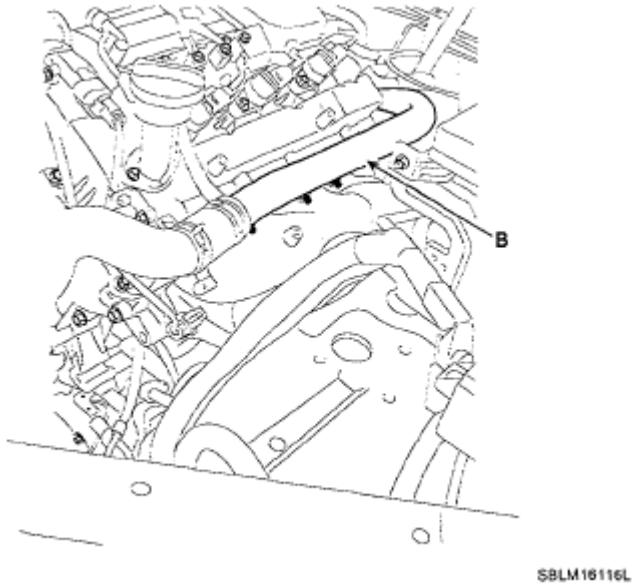


Fig. 215: Identifying RH/LH Cooling Pipes
Courtesy of KIA MOTORS AMERICA, INC.

6. Install the battery assembly (A).

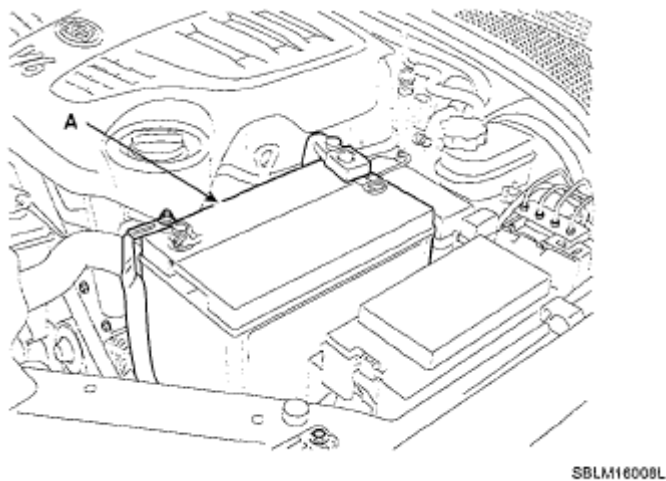
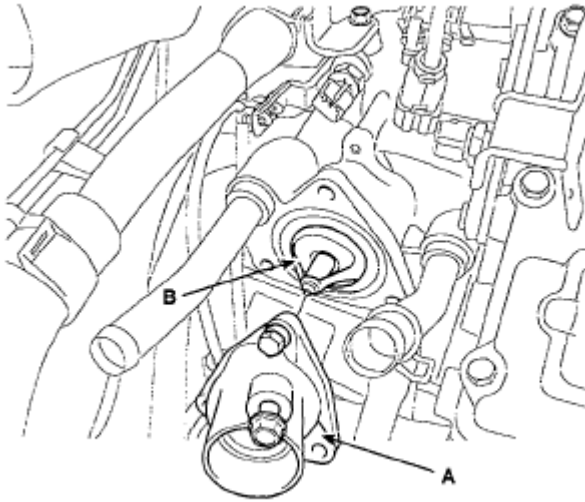


Fig. 216: Identifying Battery
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the automatic transaxle oil gauge.
8. Install air cleaner assembly.
9. Fill with engine coolant.
10. Start engine and check for leaks.
11. 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).



SBLA16026L

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

2. Install water inlet (A).

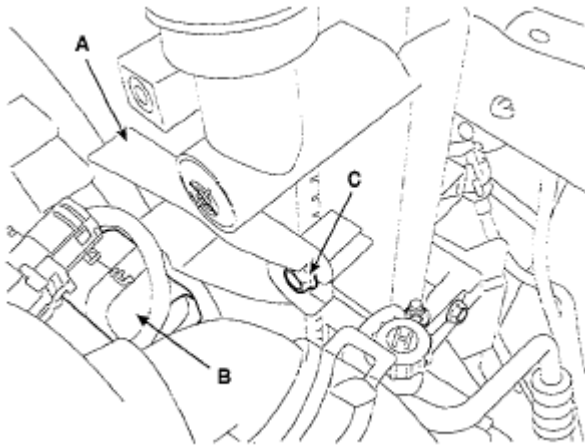
Tightening torque

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

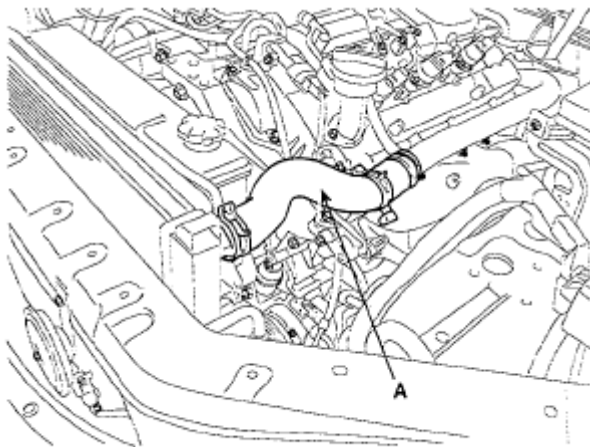
1. Install the radiator assembly.
2. Install the cooling fan shroud (A) by connecting cooling fan harness connector (B) and tightening the mounting bolts (C).



SBLM16025L

Fig. 218: Identifying Radiator Cooling Fan Shroud And Mounting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the radiator with the condenser by tightening bolts. Refer to Condenser in **HEATING, VENTILATION AND AIR CONDITIONING**.
4. Connect the radiator upper hose (A) and lower hose (B) and the automatic transaxle fluid cooler hoses (C).



SBLM16023L

Fig. 219: Identifying Radiator Upper Hose And Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

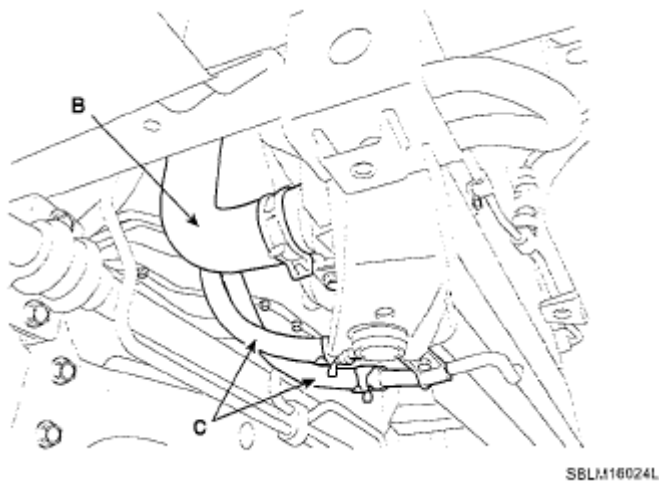


Fig. 220: Identifying Radiator Upper Hose And Lower Hose
 Courtesy of KIA MOTORS AMERICA, INC.

5. Install the radiator grille upper cover (A).

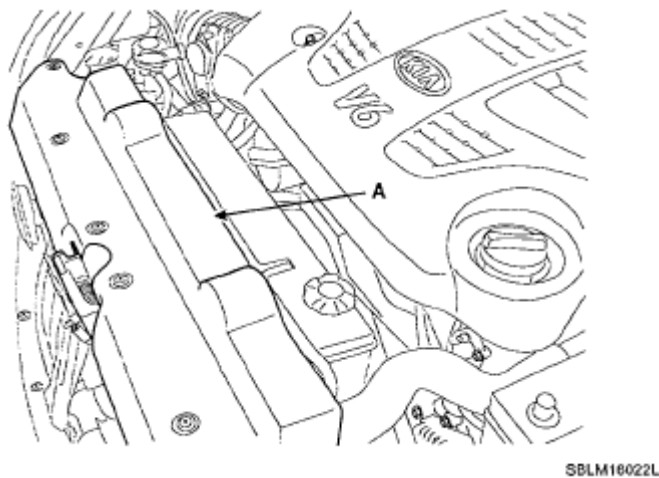
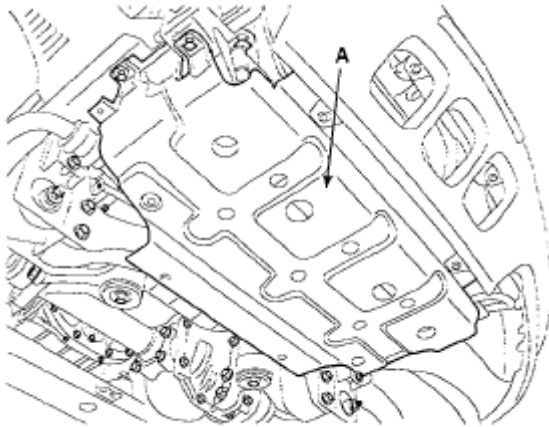


Fig. 221: Identifying Radiator Grille Upper Cover
 Courtesy of KIA MOTORS AMERICA, INC.

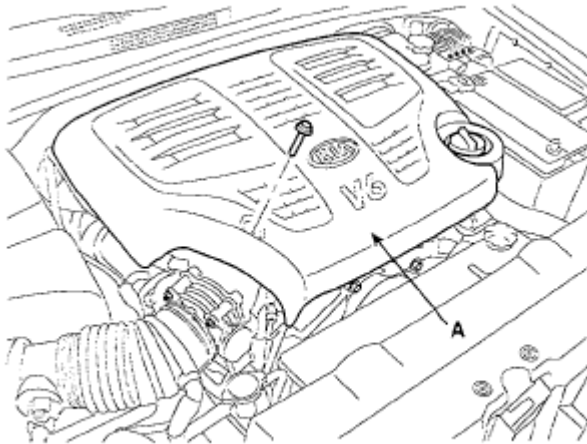
6. Install the under cover (A).



SBLM16016L

Fig. 222: Identifying Under Cover
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the engine cover (A).



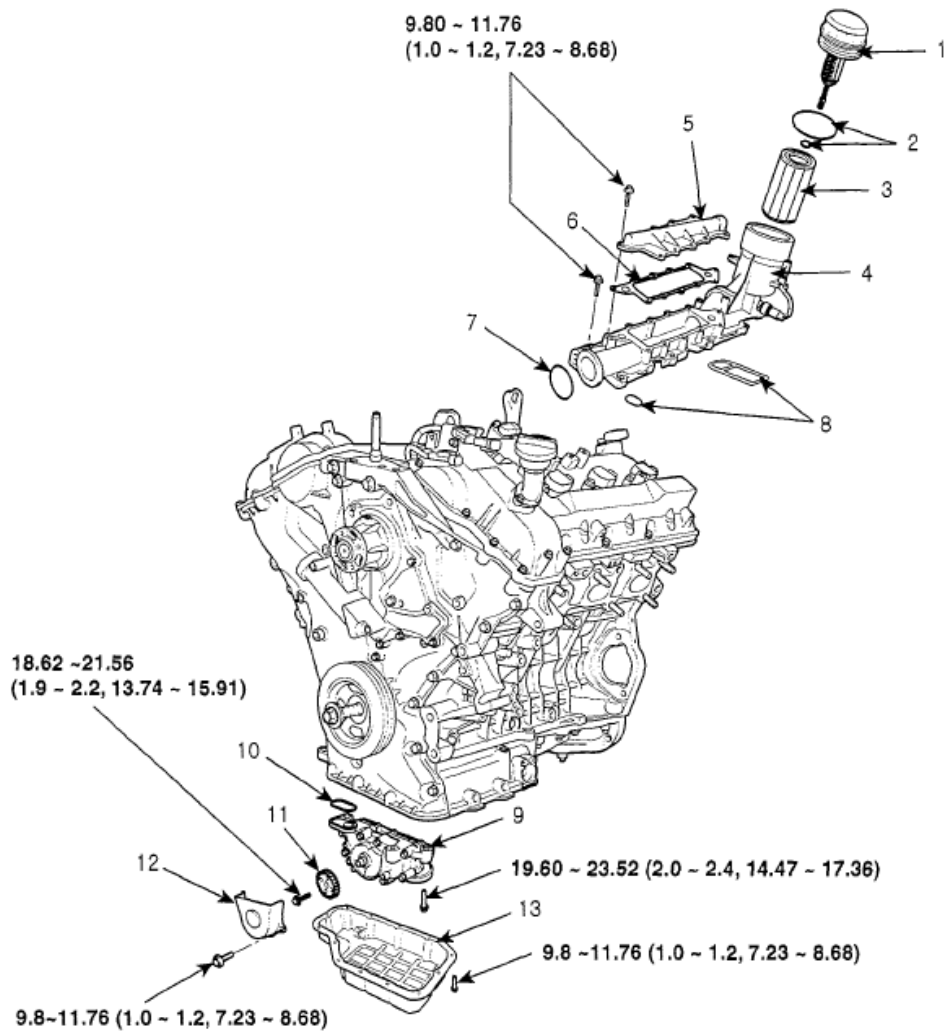
SBLM16001L

Fig. 223: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

8. Refill engine coolant.

LUBRICATION SYSTEM

COMPONENTS



TORQUE : N.m (kgf.m, lbf.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 | |

SBLM16107L

Fig. 224: Identifying Lubrication System Components With Torque Specification
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 waterless 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.**

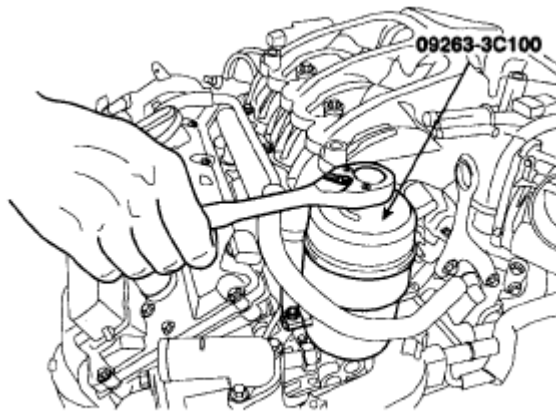
1. Park the car on level ground.

Start the engine and let it warm up.

2. Turn the engine off and open the hood.

Remove the engine cover.

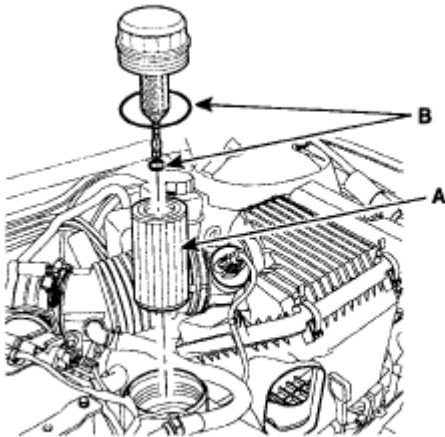
3. Wait for 5 minutes after loosening the oil filter cap by turning it counterclockwise with SST(09263-3C100) to drain well the oil in the oil filter.



ECRF051A

Fig. 225: 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. 226: 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)

CAUTION: When replacing a oil filter, the water temperature control (WTC) assembly should not be stained with oil.

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 remove the engine oil level gauge.

Capacity

Oil filter: 0.4L (0.42 U.S. qts, 0.35 Imp. qts)

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

- 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.

REMOVAL

OIL PUMP

1. Drain engine oil.
2. Remove the front member. Refer to Front suspension system in SUSPENSION SYSTEM (TPMS) .
3. Using SST (09215-3C000) remove lower oil pan (A).

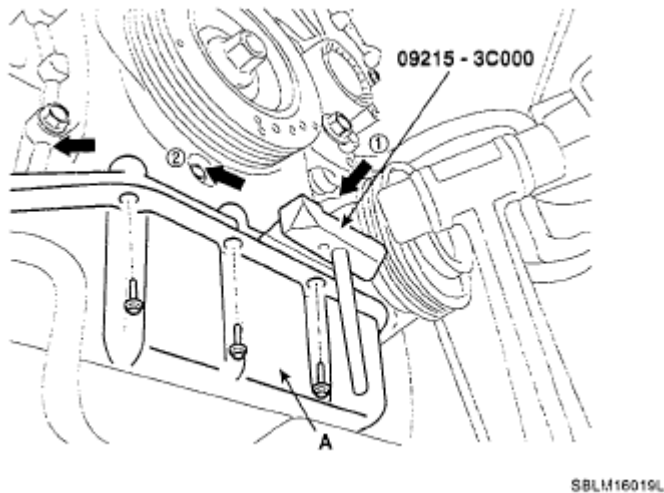
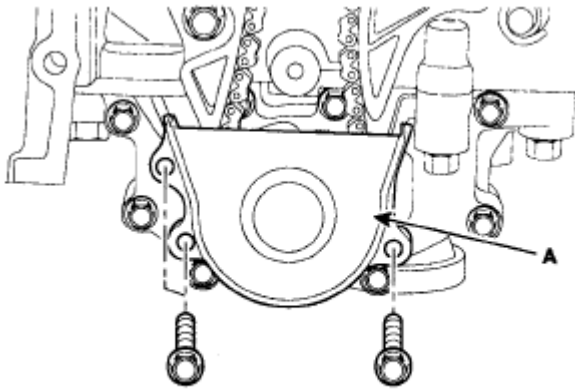


Fig. 227: Removing Lower Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- Insert the SST between the oil pan and the ladder frame by tapping it with a plastic hammer in the direction of (1) arrow.
- After tapping the SST with a plastic hammer along the direction of (2) arrow around more than 2/3 edge of the oil pan, remove it from the ladder frame.
- Do not turn over the SST abruptly without tapping. It can result in damage of the SST.

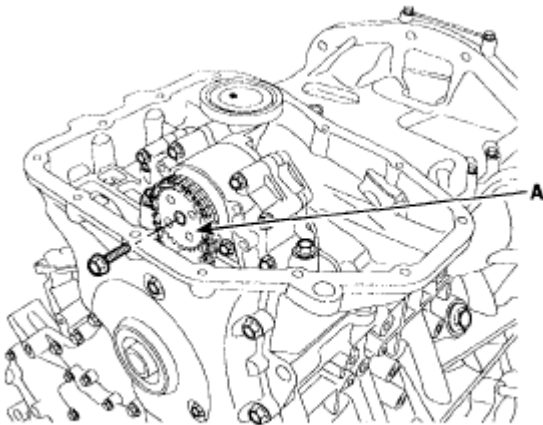
4. Remove oil pump chain cover (A).



KDRF185A

Fig. 228: Identifying Oil Pump Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

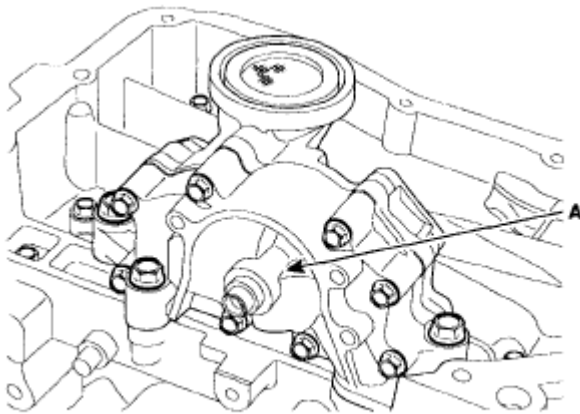
5. Remove oil pump chain sprocket (A).



KDRF189A

Fig. 229: Identifying Oil Pump Chain Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove oil pump (A).



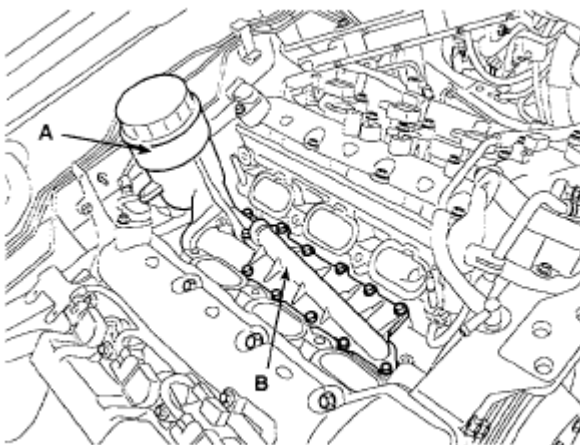
KDRF190A

Fig. 230: Identifying Oil Pump

Courtesy of KIA MOTORS AMERICA, INC.

OIL FILTER ASSEMBLY

1. Remove the engine assembly. Refer to **ENGINE AND TRANSAXLE ASSEMBLY**.
2. Loosen the oil filter cap by turning it counterclockwise to drain well the oil in the oil filter.
3. Remove surge tank and intake manifold.
4. Disconnect oil pressure switch connector.
5. Drain engine coolant.
6. Disconnect water hoses from water temperature control assembly.
7. Remove water temperature control assembly.
8. Remove oil filter body cover (B).
9. Remove oil filter body (A).



SBLM16027L

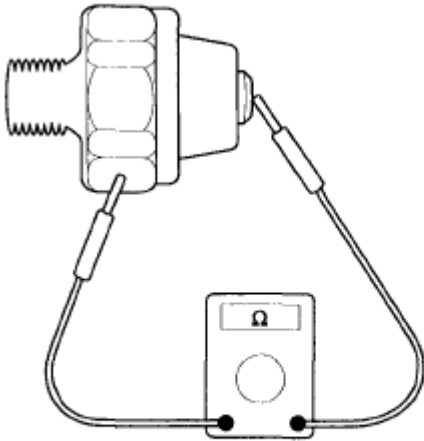
Fig. 231: Identifying Oil Filter Body And Cover

Courtesy of KIA MOTORS AMERICA, INC.

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.

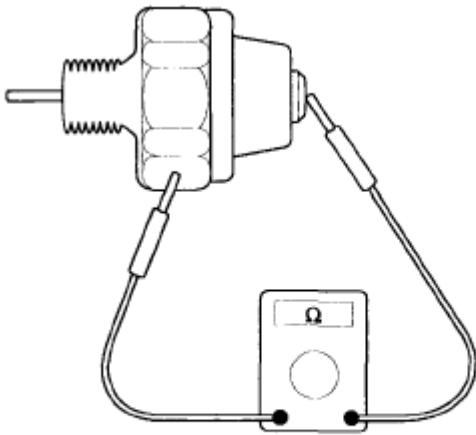


ECKD001W

Fig. 232: Checking Continuity Between Oil Pressure Switch 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. 233: Checking Continuity Between Oil Pressure Switch Terminal And Body
Courtesy of KIA MOTORS AMERICA, INC.

ENGINE OIL

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.

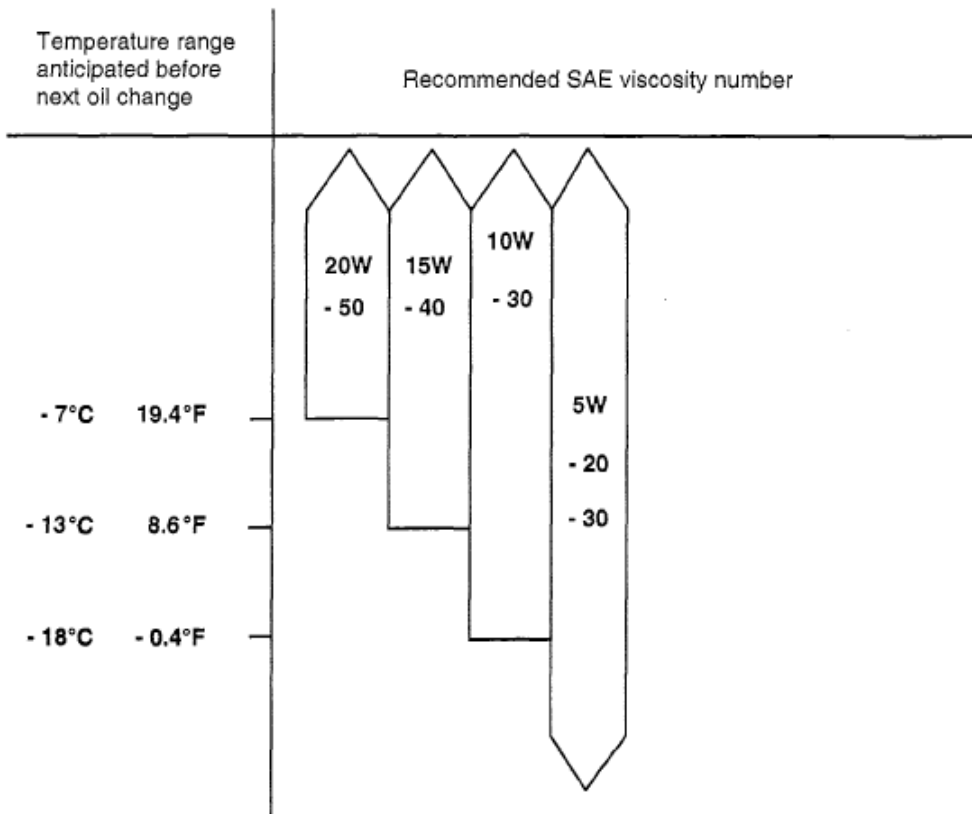
If low, check for leakage and add oil up to the "F" mark.

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.



SBLM16108L

Fig. 234: 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.

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

INSTALLATION

OIL PUMP

1. Install oil pump (A).

Tightening torque

19.60-23.52 N.m (2.0-2.4 kgf.m, 14.47-17.36 lb-ft)

NOTE: Always use a new O-ring.

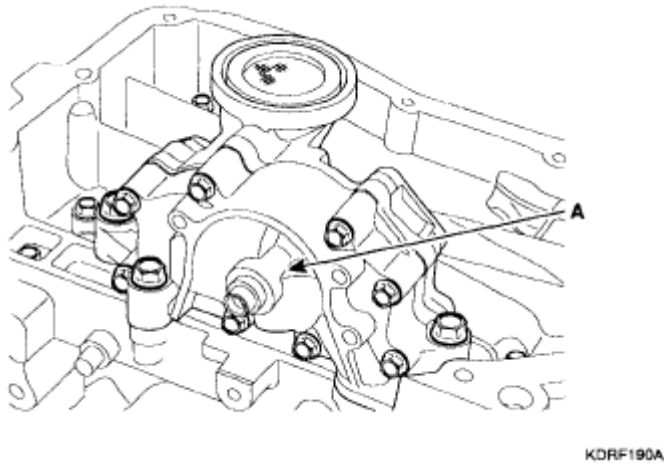


Fig. 235: Identifying Oil Pump And O-Ring
Courtesy of KIA MOTORS AMERICA, INC.

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)

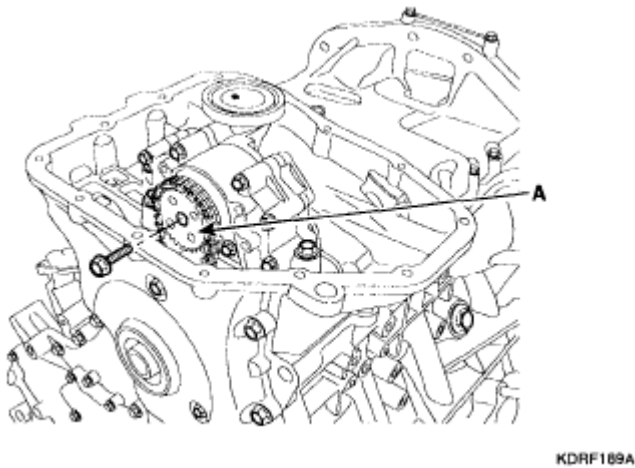
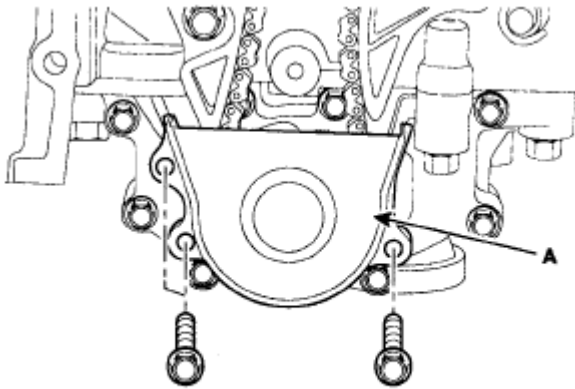


Fig. 236: Identifying Oil Pump Sprocket And Oil Pump Chain
Courtesy of KIA MOTORS AMERICA, INC.

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)

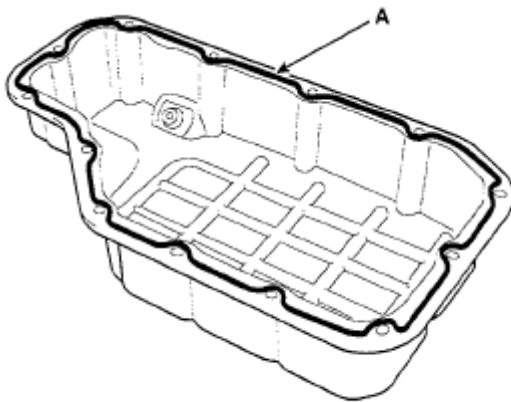


KORF185A

Fig. 237: Identifying Oil Pump Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

4. 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.)



SBLM16020L

Fig. 238: Removing Packing Material From Gasket Surfaces
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- Make clean the sealing face 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.

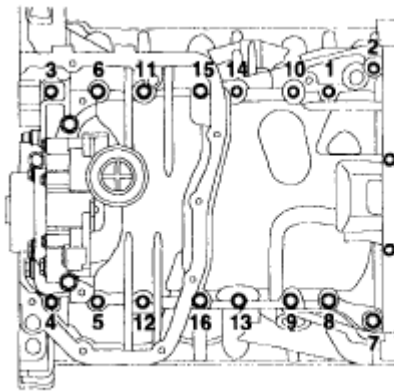
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.

e. 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. 239: Upper Oil Pan Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

f. Install the front suspension member.

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

OIL FILTER ASSEMBLY

1. Install oil filter body and new O-rings.

Tightening torque

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

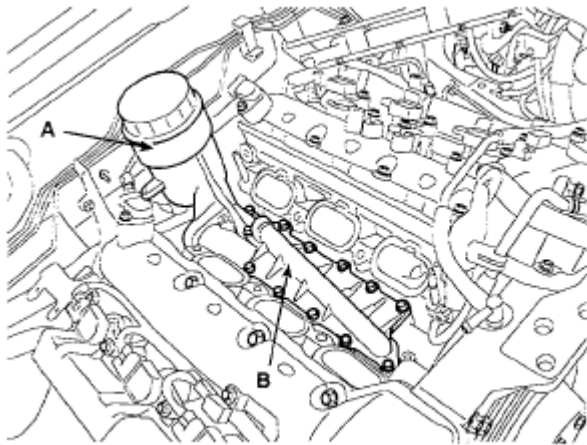
NOTE:

- 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 (A).

Tightening torque

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



SBLM16027L

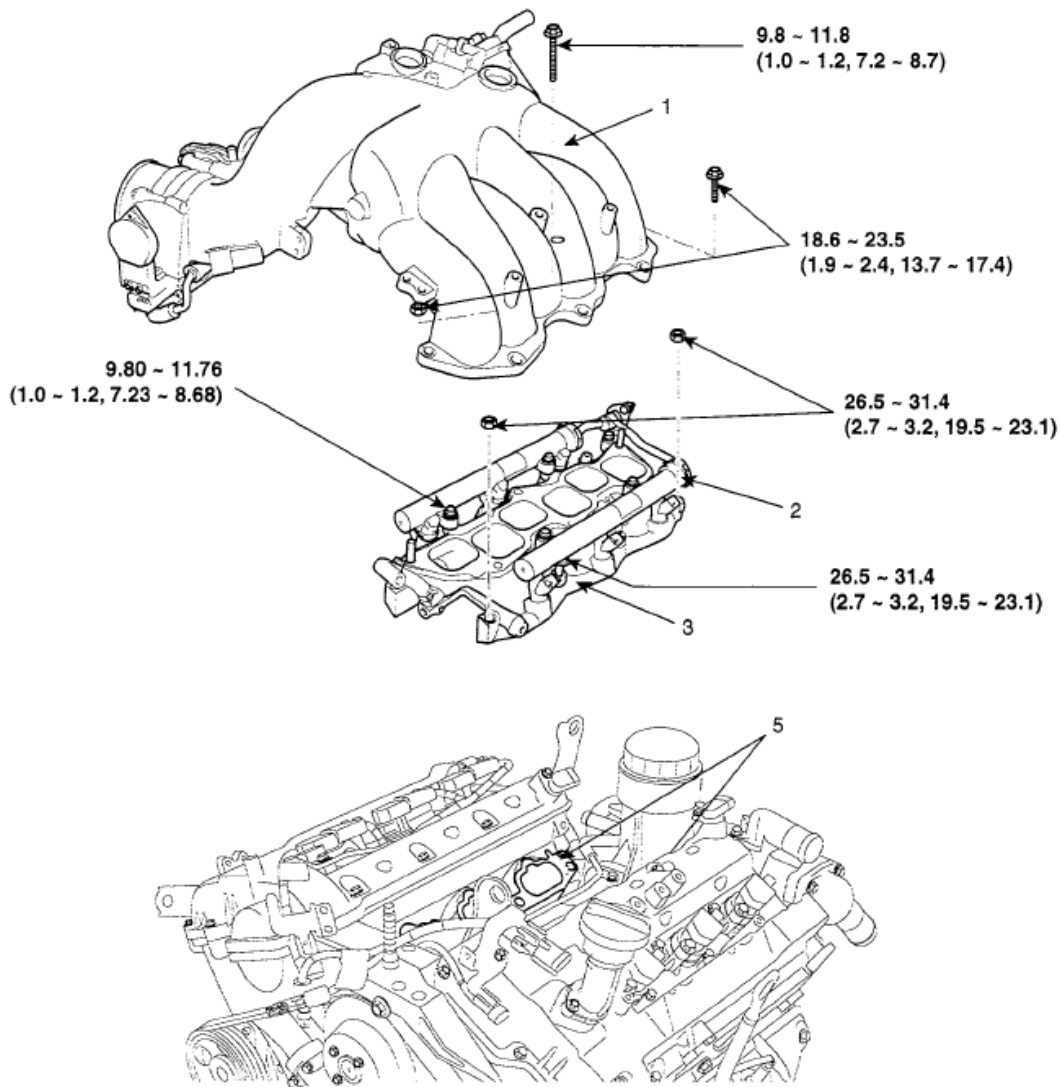
Fig. 240: Identifying Oil Filter Body Cover And Oil Filter Body
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the water temperature control assembly.
4. Connect the water hoses on the water temperature control assembly.
5. Connect the oil pressure switch connector.
6. Install the intake manifold and surge tank.
7. Fill with engine coolant.
8. Start engine and check for leaks.
9. Recheck engine coolant level.

INTAKE AND EXHAUST SYSTEM

INTAKE MANIFOLD

COMPONENTS



TORQUE : N.m (kgf.m, lbf.ft)

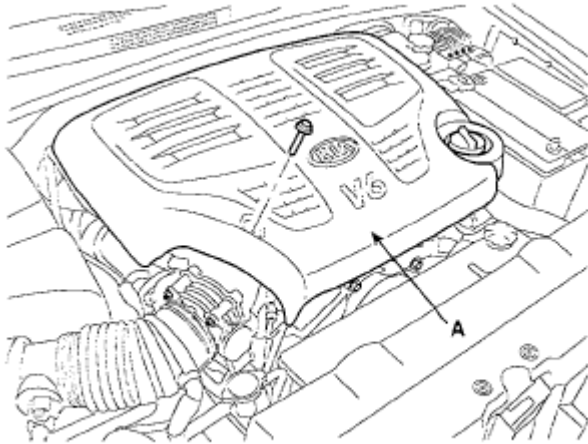
- | | |
|--------------------|---------------------------|
| 1. Surge tank | 4. Surge tank gasket |
| 2. Delivery pipe | 5. Intake manifold gasket |
| 3. Intake manifold | |

SBLM16109L

Fig. 241: Identifying Intake Manifold Components
 Courtesy of KIA MOTORS AMERICA, INC.

REPLACEMENT

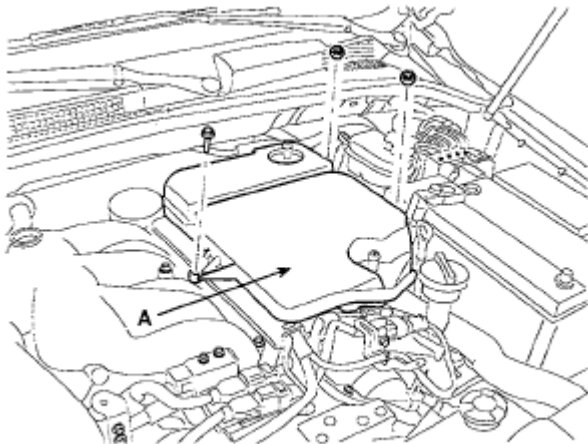
1. Remove the engine cover.



SBLM16001L

Fig. 242: Removing Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

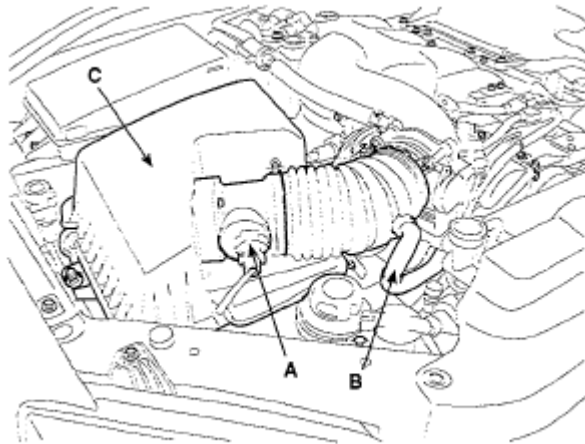
2. Remove the engine room resonator (A).



SBLM16003L

Fig. 243: Removing Engine Room Resonator
Courtesy of KIA MOTORS AMERICA, INC.

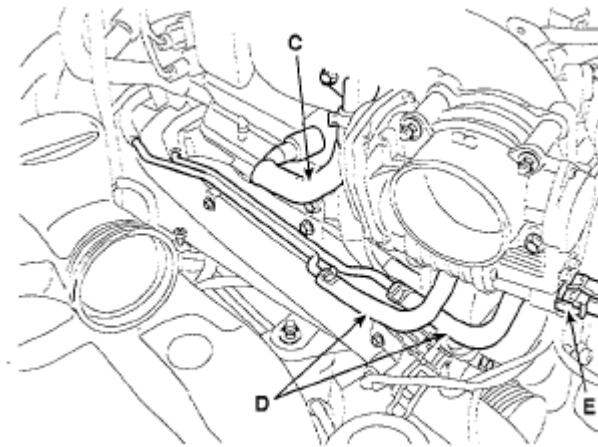
3. After disconnecting the MAF sensor connector (A) and the breather hose (B), remove the air cleaner assembly (C).



SBLM16002L

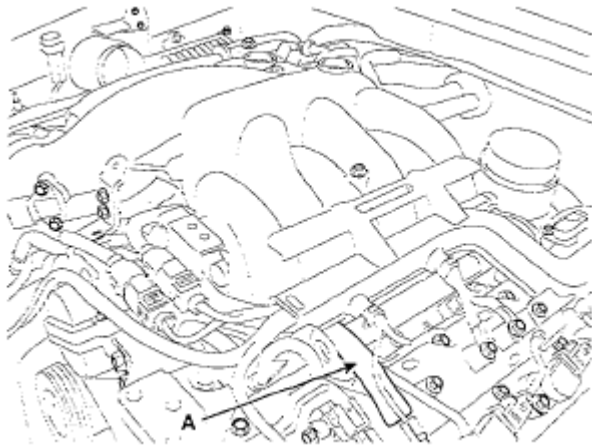
Fig. 244: Removing Air Cleaner Assembly
Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect the other breather hose (A), the Purge Control Solenoid Valve (PCSV) hose, the Positive Crankcase Ventilation (PCV) hose (C) and the Electronic Throttle Control (ETC) cooling hoses (D) and connector (E).



SBLM16208L

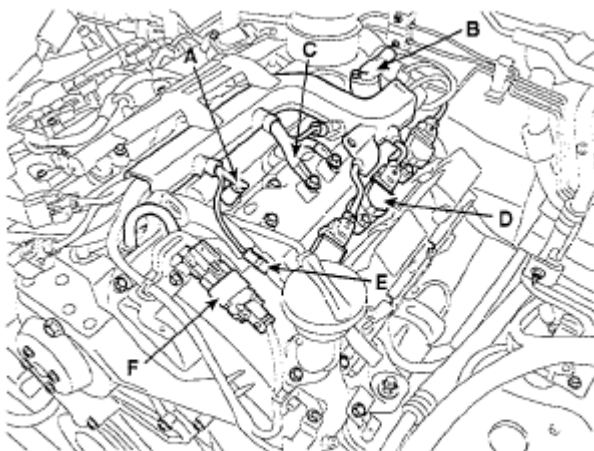
Fig. 245: Identifying Positive Crankcase Ventilation Hose And Electronic Throttle Control Cooling Hoses And Connector
Courtesy of KIA MOTORS AMERICA, INC.



SBLM16005L

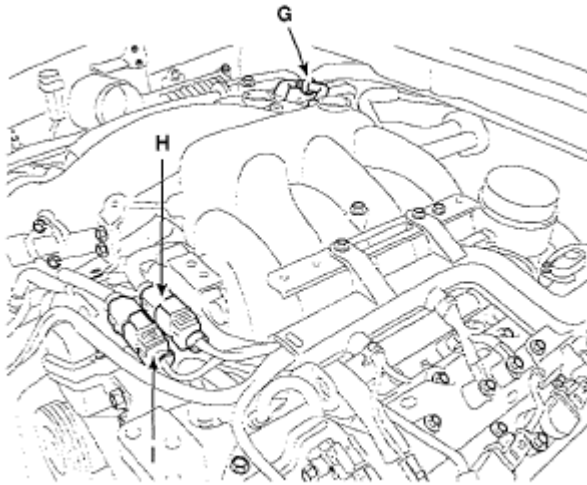
Fig. 246: Identifying Breather Hose
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the wiring over the surge tank.
 1. Disconnect the injection harness connector (A).
 2. Disconnect the camshaft position sensor (CMP) harness connector (B).
 3. Disconnect the ground line (C).
 4. Disconnect the ignition coil harness connector (D).
 5. Disconnect the condenser connector (E).
 6. Disconnect the variable induction system (VIS) solenoid valve connector (G).
 7. Disconnect the oil control valve (OCV) harness connector (F).
 8. Disconnect the injector wiring (H) and ignition coil wiring (I).



SBLM16006L

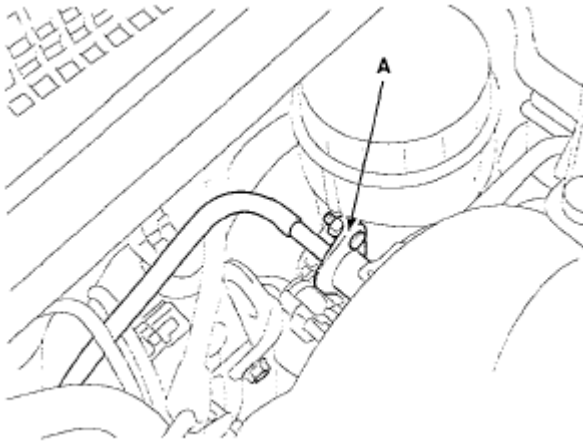
Fig. 247: Identifying Injection Harness Connector
Courtesy of KIA MOTORS AMERICA, INC.



SBLM16206L

Fig. 248: Identifying Injector Wiring (H) And Ignition Coil Wiring
Courtesy of KIA MOTORS AMERICA, INC.

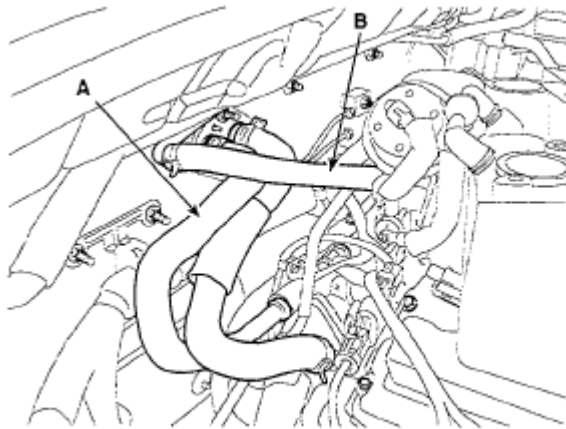
6. Disconnect the fuel hose tube (A).



SBLM16015L

Fig. 249: Identifying Fuel Hose Tube
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove heater hose (A) and disconnect the brake vacuum hose (B).



SBLM16017L

Fig. 250: Identifying Heater Hose And Brake Vacuum Hose
 Courtesy of KIA MOTORS AMERICA, INC.

8. Disconnect the surge tank stay.
9. Remove the surge tank.
10. Disconnect the injector connectors.
11. Disconnect the water hose on intake manifold from the nipple on the chain cover.
12. Remove the delivery pipe and intake manifold as an assembly.

NOTE: Except such cases as defects of injectors or pipe, do not disassemble a delivery pipe from an intake manifold because it is one of the fuel system parts, or you may have some problem in fuel system.

13. 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)

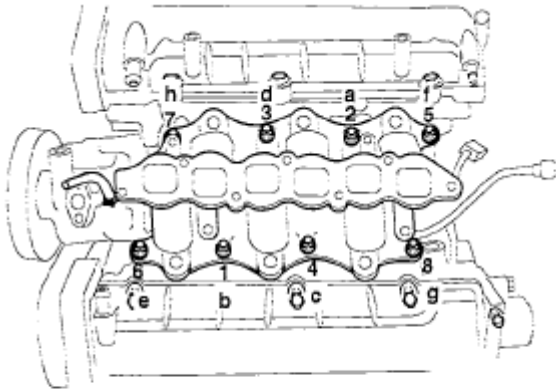
2nd

Bolt: 26.5-31.4 N.m (2.7-3.2 kgf.m, 19.5-23.1 lb-ft)

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

3rd: Repeat 2nd step twice or move.

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



SBLM16207L

Fig. 251: Intake Manifold Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

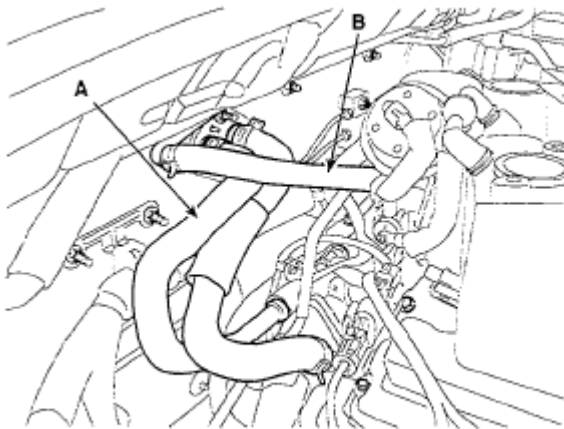
14. Connect the water hose on intake manifold to the nipple on the chain cover.
15. Install delivery pipe. Refer to Delivery pipe in **GENERAL (FUEL SYSTEM)** .
16. Install the surge tank and new gasket on the intake manifold.

Tightening torque

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

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

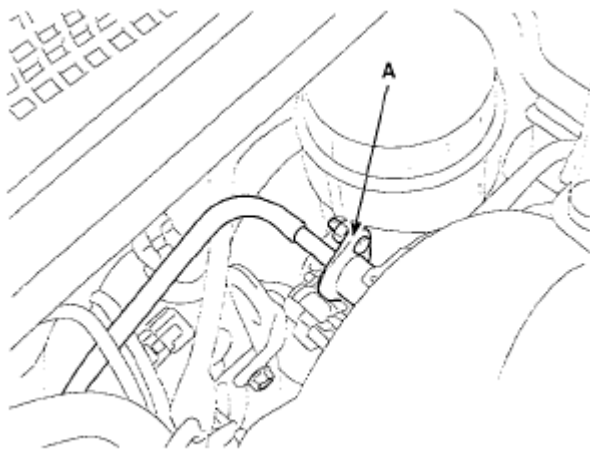
17. Connect heater hose (A) and the brake vacuum hose (B).



SBLM16017L

Fig. 252: Identifying Heater Hose And Brake Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

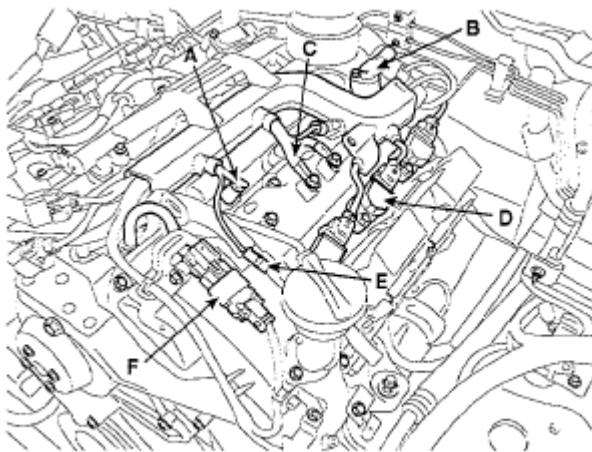
18. Connect the fuel hose tube (A).



SBLM16015L

Fig. 253: Identifying Fuel Hose Tube
Courtesy of KIA MOTORS AMERICA, INC.

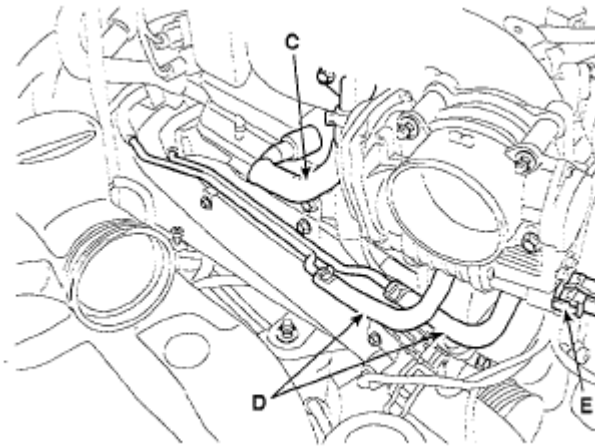
19. Connect the wiring over the surge tank.
1. Connect the injection harness connector (A)
 2. Connect the camshaft position sensor (CMP) harness connector (B).
 3. Connect the ground lines (C).
 4. Connect the ignition coil harness connector (D).
 5. Connect the condenser connector (E).
 6. Connect the variable induction system (VIS) solenoid valve connector (G).
 7. Connect the oil control valve (OCV) harness connector (F).



SBLM16006L

Fig. 254: Identifying Oil Control Valve Harness Connector
Courtesy of KIA MOTORS AMERICA, INC.

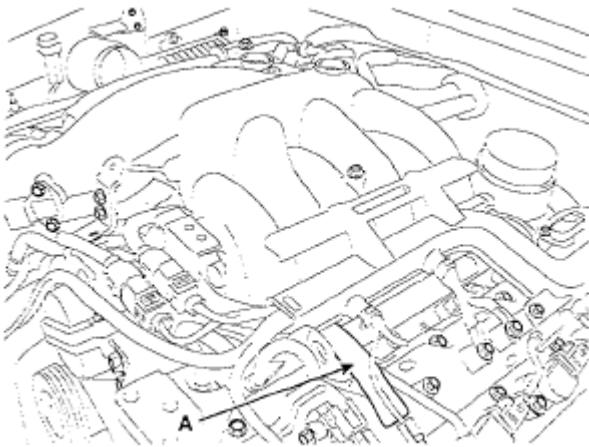
20. Connect the other breather hose (A), the Positive Crankcase Ventilation (PCV) hose (C) and the Electronic Throttle Control (ETC) cooling hoses (D), ETC connector (E).



SBLM16208L

Fig. 255: Identifying Positive Crankcase Ventilation Hose And Electronic Throttle Control Cooling Hoses, ETC Connector

Courtesy of KIA MOTORS AMERICA, INC.

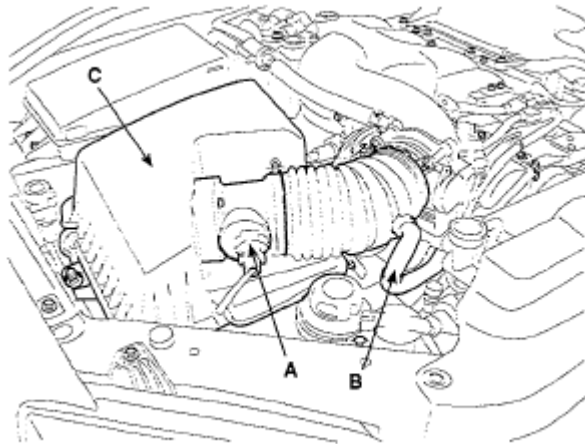


SBLM16005L

Fig. 256: Identifying Breather Hose

Courtesy of KIA MOTORS AMERICA, INC.

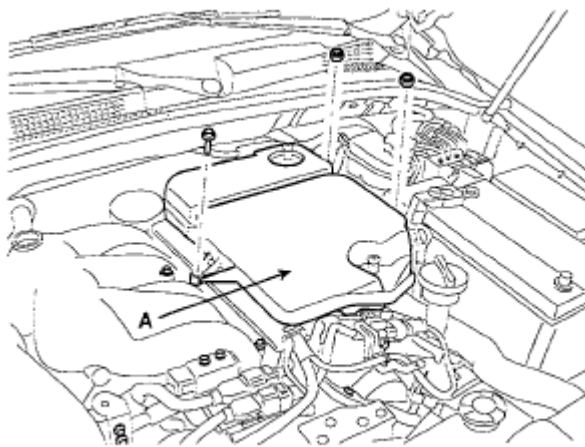
21. After connecting the MAF sensor connector (A) and the breather hose (B), install the air cleaner assembly (C).



SBLM16002L

Fig. 257: Identifying MAF Sensor Connector, Breather Hose And Air Cleaner Assembly
 Courtesy of KIA MOTORS AMERICA, INC.

22. Install the engine room resonator (A).



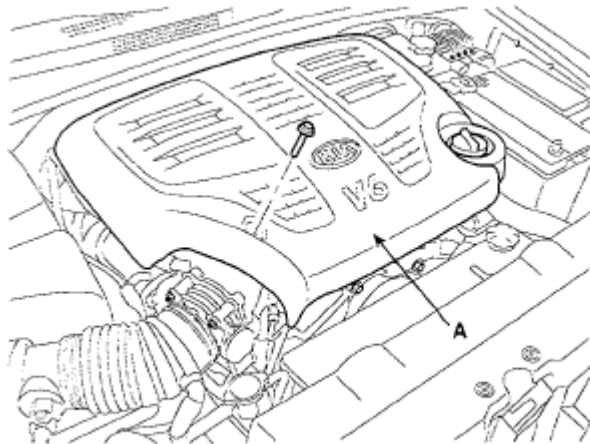
SBLM16003L

Fig. 258: Identifying Engine Room Resonator
 Courtesy of KIA MOTORS AMERICA, INC.

Tightening torque

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

23. Remove the engine cover (A).



SBLM16001L

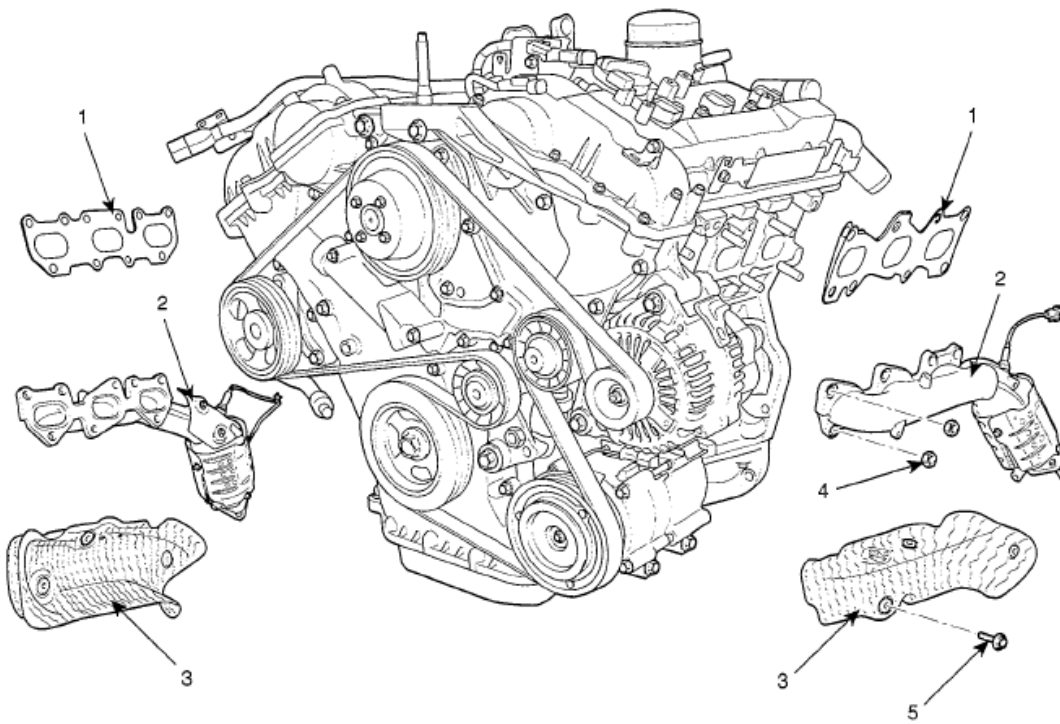
Fig. 259: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

Tightening torque

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

EXHAUST MANIFOLD

COMPONENTS



- 1. Gasket
- 2. Exhaust manifold
- 3. Heat protector

- 4. Self - locking flange nut
- 5. Flange bolt

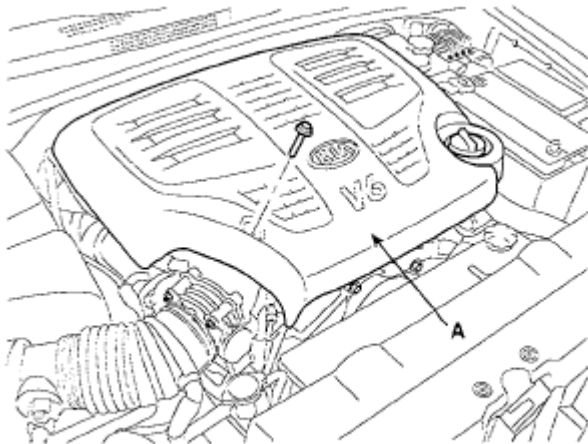
SBLM16110L

Fig. 260: Identifying Exhaust Manifold Components
 Courtesy of KIA MOTORS AMERICA, INC.

REPLACEMENT

[RH SIDE OR BANK 1]

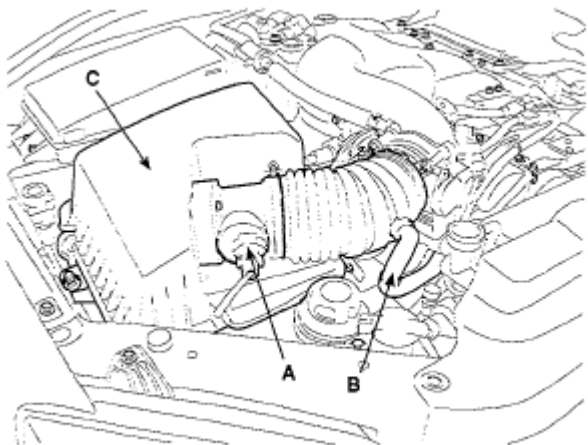
1. Remove the engine cover (A).



SBLM16001L

Fig. 261: Identifying Engine Cover
 Courtesy of KIA MOTORS AMERICA, INC.

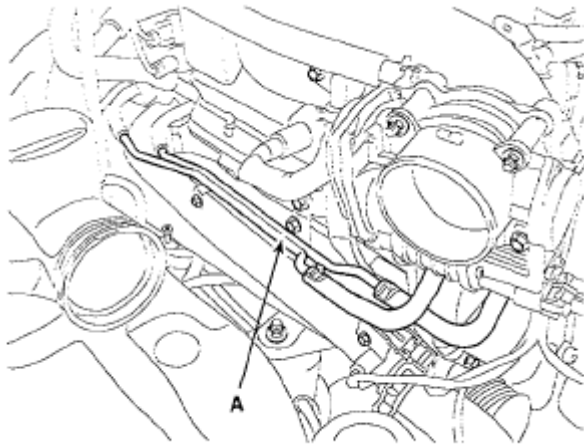
2. After disconnecting the MAF sensor connector (A) and the breather hose (B), remove the air cleaner assembly (C).



SBLM16002L

Fig. 262: Identifying MAF Sensor Connector, Breather Hose And Air Cleaner Assembly
 Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the RH cooling pipe (A).



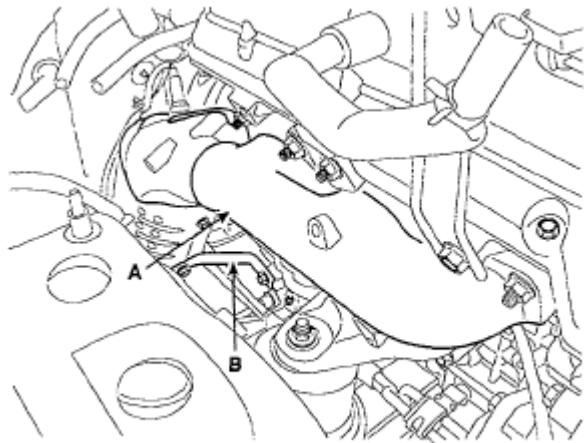
SBLM16111L

Fig. 263: Identifying RH Cooling Pipe
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the RH exhaust manifold heat protector.

CAUTION: Handle the heat protector with caution not to be deformed.

5. After removing the under cover, disconnect the exhaust manifolds from the front muffer.
6. Remove the RH exhaust manifold (A) and the stay (B).



SBLM16117L

Fig. 264: Identifying RH Exhaust Manifold And Stay
Courtesy of KIA MOTORS AMERICA, INC.

[LH SIDE OR BANK 2]

1. Remove the engine oil level gauge.
2. Remove the battery assembly (A).

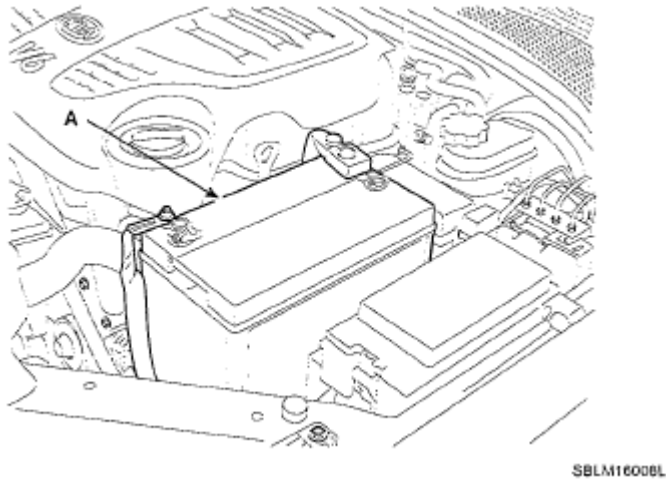


Fig. 265: Identifying Battery Assembly
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the LH exhaust manifold heat protector.

CAUTION: Handle the heat protector with caution not to be deformed.

4. Remove the LH cooling pipe (A).

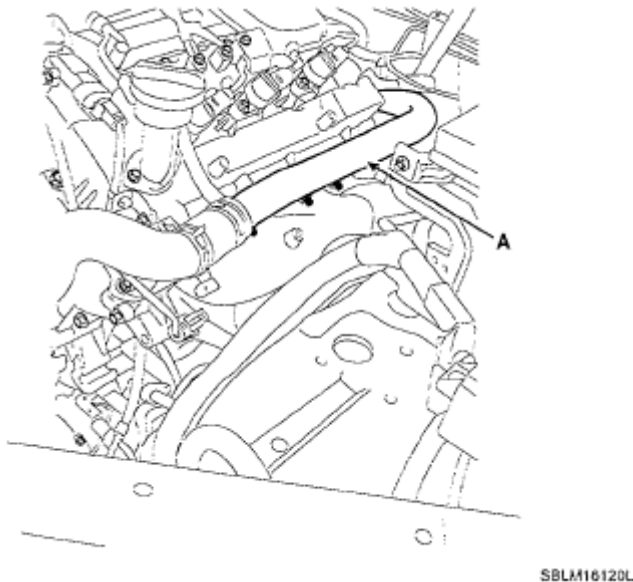


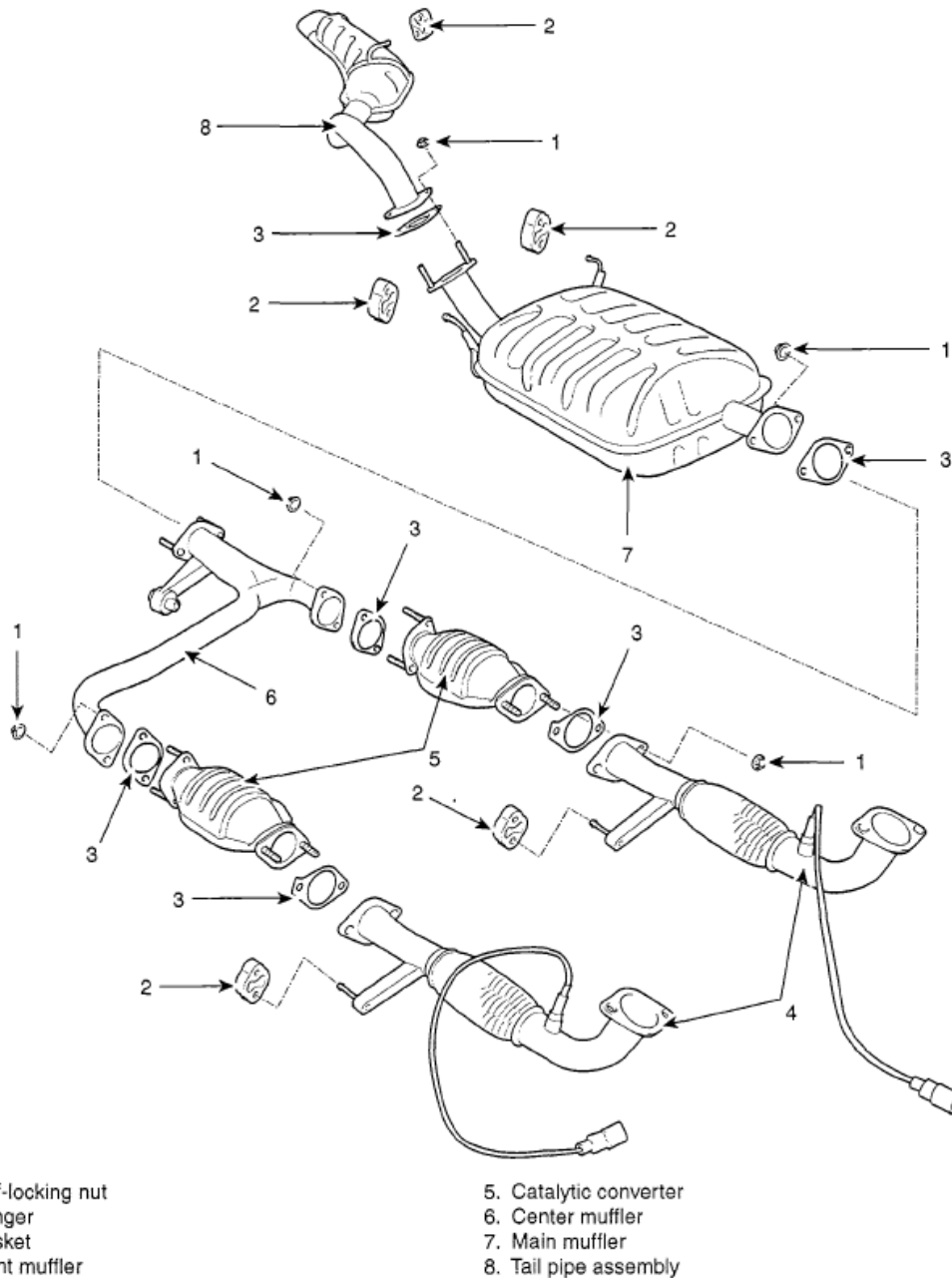
Fig. 266: Identifying LH Cooling Pipe
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the automatic transaxle fluid oil level gauge.
6. Disconnect the oil pressure switch harness connector and the battery ground line.

7. After removing the under cover, disconnect the exhaust manifolds from the front muffler.
8. Remove the LH exhaust manifold.
9. To install, reverse the removal procedure.

EXHAUST PIPE

COMPONENTS



SBLM16031L

Fig. 267: Identifying Exhaust Pipe Components

Courtesy of KIA MOTORS AMERICA, INC.