

2007-08 ENGINE

Mechanical - Amanti

GENERAL

SPECIFICATIONS

GENERAL SPECIFICATIONS

Description			Specifications	Limit
			3.8L	
General				
Type			V-type, DOHC	-
Number of cylinders			6	-
Bore			96 mm (3.7795 in)	-
Stroke			87.0 mm (3.4252 in)	-
Total displacement			3,778 cc (230.55 cu. in.)	-
Compression ratio			10.4	-
Firing order			1-2-3-4-5-6	-
Idle RPM			700 RPM	-
Valve timing				
Intake	Opens (ATDC)		10°	-
	Closes (ABDC)		62°	-
Exhaust	Opens (BBDC)		42°	-
	Closes (ATDC)		6°	-
Cylinder head				
Flatness of gasket surface			Less than 0.05 mm (0.0019 in.) [Less than 0.02 mm (0.0008 in.)/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	46.8 mm (1.8425 in.)	-
		Exhaust	45.8 mm (1.8031 in.)	-
	RH Camshaft	Intake	46.8 mm (1.8425 in.)	-

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		Exhaust	45.8 mm (1.8031 in.)	-
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 ~ 0.0022 in.) 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 (0.00275 in.)

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	Exhaust	0.030 ~ 0.054 mm (0.00118 ~ 0.00212 in.)	0.09 mm (0.00354 in.)
Valve guide			
Inner diameter	Intake	5.500 ~ 5.512 mm (0.2165 ~ 0.2170 in.)	-
	Exhaust	5.500 ~ 5.512 mm (0.2165 ~ 0.2170 in.)	-
Length	Intake	41.8 ~ 42.2 mm (1.6457 ~ 1.6614 in.)	-
	Exhaust	41.8 ~ 42.2 mm (1.6457 ~ 1.6614 in.)	-
Valve seat			
Width of seat contact	Intake	1.15 ~ 1.45 mm (0.05118 ~ 0.05709 in.)	-
	Exhaust	1.35 ~ 1.65 mm (0.05315 ~ 0.06496 in.)	-
Seat angle	Intake	44.75° ~ 45.20°	-
	Exhaust	44.75° ~ 45.20°	-
Valve spring			
Free length		43.86 mm (1.7267 in.)	-
Load		19.3 ± 0.8 kg/34.0 mm (42.7 ± 1.8 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			

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Intake		0.17 ~ 0.23 mm (0.0067 ~ 0.0090 in.)	0.10 ~ 0.30 mm (0.0039~0.0118 in.)
Exhaust		0.27 ~ 0.33 mm (0.0106 ~ 0.0129 in.)	0.20 ~ 0.40 mm (0.0078 ~ 0.0157 in.)
Cylinder block			
Cylinder bore		96.00 ~ 96.03 mm (3.7795 ~ 3.7807 in.)	-
Flatness of gasket surface		Less than 0.05 mm (0.0019 in.) [Less than 0.02 mm (0.0008 in.)/150 x 150]	-
Piston			
Piston outer diameter		95.96 ~ 95.99 mm (3.7779 ~ 3.7791 in.)	-
Piston to cylinder clearance		0.03 ~ 0.05 mm (0.0012 ~ 0.0020 in.)	-
Ring groove width	No. 1 ring groove	1.22 ~ 1.24 mm (0.0480 ~ 0.0488 in.)	1.26 mm (0.0496 in.)
	No. 2 ring groove	1.22 ~ 1.24 mm (0.0480 ~ 0.0488 in.)	1.26 mm (0.0496 in.)
	Oil ring groove	2.01 ~ 2.03 mm (0.0791 ~ 0.0799 in.)	2.05 mm (0.0807 in.)
Piston ring			
Side clearance	No. 1 ring	0.03 ~ 0.07 mm (0.0012 ~ 0.0027 in.)	0.1 mm ~ 0.004 in.)
	No. 2 ring	0.03 ~ 0.07 mm (0.0012 ~ 0.0027 in.)	0.1 mm (0.004 in.)
	Oil ring	0.06 ~ 0.15 mm (0.0024 ~ 0.0059 in.)	0.2 mm (0.008 in.)
End gap	No. 1 ring	0.17 ~ 0.32 mm (0.0067 ~ 0.0126 in.)	0.6 mm (0.0236 in.)
	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 (0.0004 ~ 0.0008 in.)	-
Connecting rod small end inner diameter		22.974 ~ 22.985 mm	-

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		(0.9045 ~ 0.9049 in.)	
Connecting rod small end hole clearance		-0.032 ~ -0.016 mm (-0.0012 ~ 0.0006 in.)	-
Connecting rod			
Connecting rod big end inner diameter		58.000 ~ 58.018 mm (2.2834 ~ 2.2842 in.)	-
Connecting rod bearing oil clearance		0.038 ~ 0.056 mm (0.0015 ~ 0.0022 in.)	-
Side clearance		0.1 ~ 0.25 mm (0.0039 ~ 0.0098 in.)	-
Crankshaft			
Main journal outer diameter		68.942 ~ 68.960 mm (2.7142 ~ 2.7149 in.)	-
Pin journal outer diameter		54.954 ~ 54.972 mm (2.1635 ~ 2.1642 in.)	-
Main bearing oil clearance		0.022 ~ 0.040 mm (0.0008 ~ 0.0016 in.)	-
End play		0.10 ~ 0.28 mm (0.0039 ~ 0.0110 in.)	-
Oil pump			
Relief valve opening pressure		450 ~ 550 kPa (4.59 ~ 5.61 kgf/cm ² , 65.28 ~ 79.79 psi)	-
Engine oil			
Oil quantity (Total)		6.0L (6.34 U.S. qts, 5.28 imp. qts)	When replacing a short engine or a block assembly.
Oil quantity (Oil pan)		5.5L (5.81 U.S. qts, 4.84 imp. qts)	When replacing an oil pan only.
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		8.7L (9.19 U.S. qts, 7.66 imp. qts)	-
Thermostat	Type	Wax pellet type	-
	Opening temperature	82 ± 2°C (179.6 ± 35.6°F)	-

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	Fully opened temperature	95°C (203°F)	-
	Full lift	10 mm (0.3937 in.) MIN	-
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 SPECIFICATIONS

Item	Quantity	N.m	kgf.m	lb-ft
Crankshaft pulley bolt	1	284.2 ~ 303.8	29.0 ~ 31.0	209.76 ~ 224.22
Timing chain cover bolt B	17	18.62 ~ 21.56	1.9 ~ 2.2	13.74 ~ 15.91
Timing chain cover bolt C	4	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain cover bolt D	1	58.80 ~ 68.80	6.0 ~ 7.0	43.40 ~ 50.63
Timing chain cover bolt E	1	58.80 ~ 68.80	6.0 ~ 7.0	43.40 ~ 50.63
Timing chain cover bolt F	2	24.50 ~ 26.46	2.5 ~ 2.7	18.08 ~ 19.53
Timing chain cover bolt G	4	21.56 ~ 23.52	2.2 ~ 2.4	15.91 ~ 17.36
Timing chain cover bolt H	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain cover bolt I	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain cover bolt J	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Cam to cam guide bolt	4	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain auto tensioner bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain auto tensioner nut	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68

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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	17.64 ~ 21.56	1.8 ~ 2.2	13.02 ~ 15.91
Drive belt idler bolt	1	53.90 ~ 57.82	5.5 ~ 5.9	39.78 ~ 42.67
OCV (oil control valve) bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Cylinder head bolt	16	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 cap	8	71.54 ~ 75.46	7.3 ~ 7.7	52.80 ~ 55.69
Oil filter cap	-	24.50	2.5	18.08
Oil drain bolt cap	1	34.30 ~ 44.10	3.5 ~ 4.5	25.31 ~ 32.55

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Oil pump bolt	3	20.6 ~ 22.6	2,1 ~ 2.3	15.2 ~ 16.6
Oil filter body bolt	10	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Oil filter body cover bolt	11	9.80 ~ 11.76	1.0 ~ 1.2	7,23 ~ 8.68
Water vent hose bolt (Timing chain cover bolt L)	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Water pump bolt (Timing chain cover bolt K)	1	21.56 ~ 26.46	2.2 ~ 2.7	15.91 ~ 19.53
Water pump bolt	4	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Water pump pulley bolt	4	7.84 ~ 9.80	0.8 ~ 1.0	5.78 ~ 7.23
Water temp, control nut	4	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 (M8 x 25)	3	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
Surge tank bolt (M6 x 106)	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Surge tank nut	1	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
Breather pipe bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Surge tank bracket bolt rear (M10 x 18)	2	27.44 ~ 31.36	2.8 ~ 3.2	20.25 ~ 23.14
Surge tank bracket bolt front (M8 x 16)	2	18.62 ~ 23.52	1.9 ~ 2.4	13,74 ~ 17.36
ETC bracket bolt	2	15.68 ~ 25.48	1.6 ~ 2.6	11.57 ~ 18.80
Exhaust manifold nut	16	39.20 ~ 44.10	4.0 ~ 4.5	28.93 ~ 32.55
Heat proctor bolt	8	16.66 ~ 21.56	1.7 ~ 2.2	12.30 ~ 15.91
Front muffler	2	39.20 ~ 58.80	4.0 ~ 6.0	28.93 ~ 43.40

INSPECTION

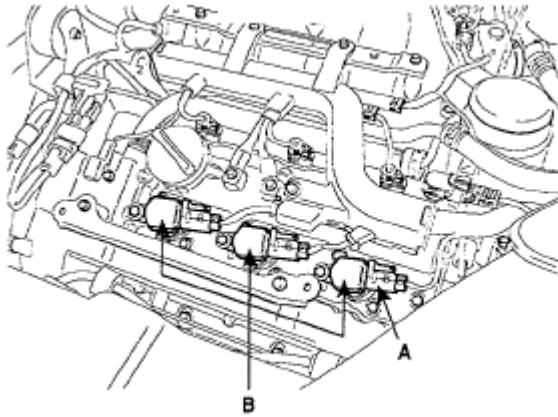
COMPRESSION PRESSURE

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

1. Warm up and stop engine.

Allow the engine to warm up to normal operating temperature.

2. Remove the surge tank.
3. Remove the ignition coil connectors (A) and ignition coils (B).



SGHEM7001N

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

4. Remove the spark plugs.

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

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

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

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

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

Compression pressure :

1,225 kPa (12.5 kgf/cm² , 177 psi)

Minimum pressure :

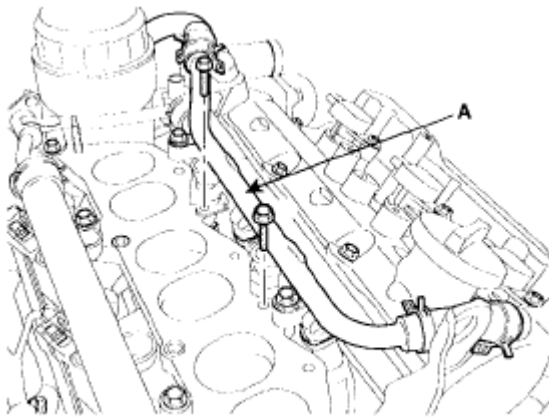
1,078 kPa (11.0 kgf/cm² , 156 psi)

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

VALVE CLEARANCE INSPECTION AND ADJUSTMENT

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

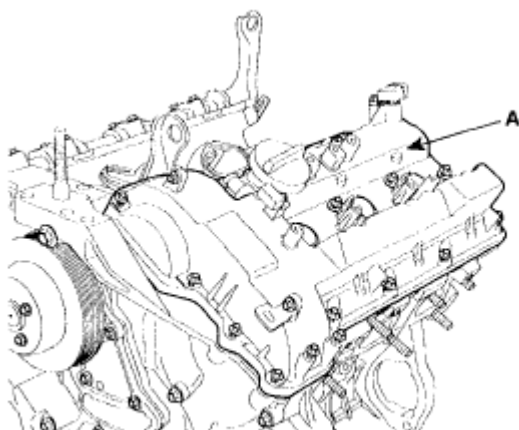
1. Remove the engine cover.
2. Remove air cleaner assembly.
3. Remove the surge tank.
4. Remove the cylinder head cover.
 1. Disconnect the ignition coil connector and remove the ignition coil.
 2. Disconnect the breather pipe assembly (A) from the cylinder head cover.



ECBF031A

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

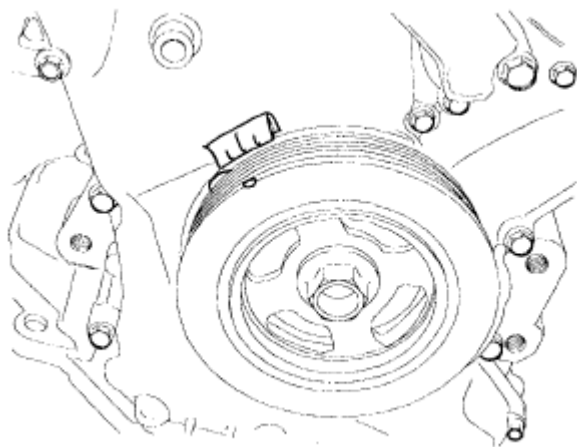
3. Loosen the cylinder head cover bolts and then remove the cover (A) and gasket.



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

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



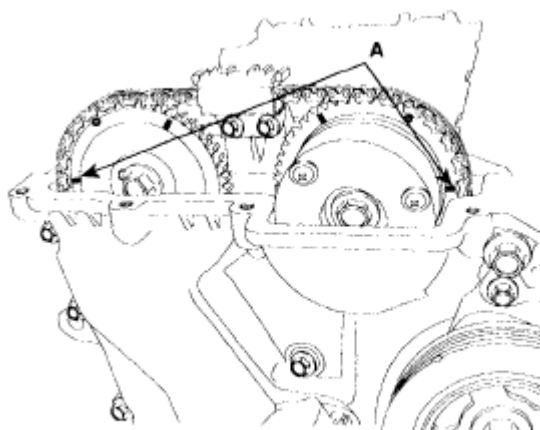
KDRF106A

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

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

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

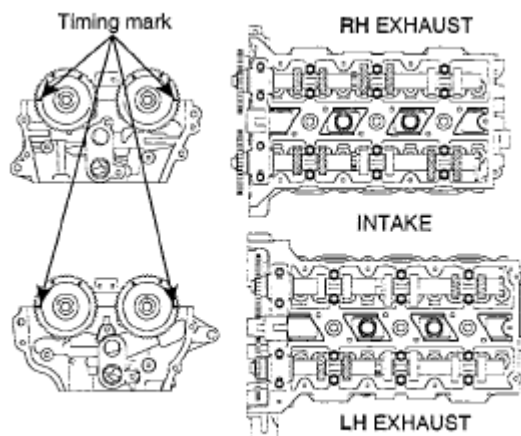
NOTE: Do not rotate engine counterclockwise



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

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



EDRF021A

Fig. 6: Identifying Timing Mark
 Courtesy of KIA MOTORS AMERICA, INC.

Measurement method.

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

Valve clearance

Specification

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

Limit

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

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

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

NOTE: Do not rotate engine counterclockwise

3. Check only valves indicated as shown in illustration. [NO. 4 cylinder: TDC/compression]. Measure the valve clearance. (Refer to procedure step 1).

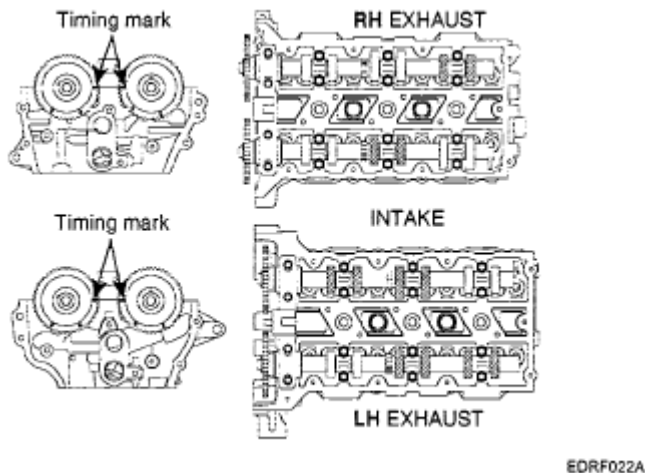
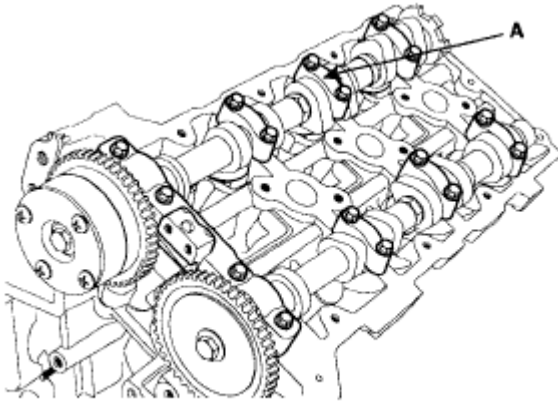


Fig. 7: Identifying Timing Mark
Courtesy of KIA MOTORS AMERICA, INC.

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

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

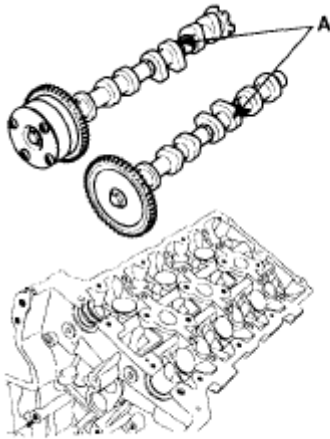
3. Remove the camshaft bearing caps (A).



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

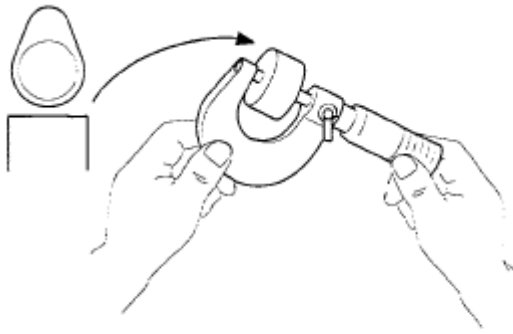
4. Remove the camshaft assembly (A).



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

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



EDKE889D

Fig. 10: Measuring Thickness Of Tappet Using Micrometer
Courtesy of KIA MOTORS AMERICA, INC.

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

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

T: Thickness of removed tappet

A: Measured valve clearance

N: Thickness of new tappet

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

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

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

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

9. Place a new tappet on the cylinder head.

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

10. Install the intake and exhaust camshaft.
11. Install the bearing caps. (Refer to **CYLINDER HEAD ASSEMBLY**)
12. Install the timing chain. (Refer to **TIMING SYSTEM**)
13. Turn the crankshaft two turns in the operating direction (clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks (A).

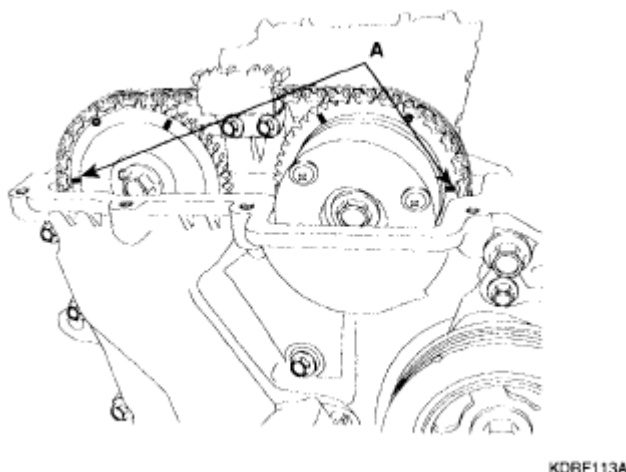


Fig. 11: Locating Mark Of Camshaft Timing Sprockets
 Courtesy of KIA MOTORS AMERICA, INC.

14. Recheck the valve clearance.

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

[Specification]

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

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

TROUBLESHOOTING

TROUBLESHOOTING CHART

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings.	Replace the crankshaft and bearings as required.
	Loose or damaged engine drive plate.	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.
Engine misfire with abnormal valve train noise.	Worn crankshaft thrust bearings	Replace the crankshaft and bearings as required.
	Stuck valves. (Carbon buildup on the valve stem)	Repair or replace as required.
	Excessive worn or misaligned timing chain.	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifters.

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Engine misfire with coolant consumption.	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> Drain the oil. Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	<ul style="list-style-type: none"> Inspect the thrust bearing and crankshaft. Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	<ul style="list-style-type: none"> Inspect the camshaft lobes. Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
	Worn drive belt, idler, tensioner and bearing.	Replace as required.
Lower engine noise, regardless of engine speed.	Low oil pressure.	Repair as required.
	Loose or damaged drive plate.	Repair or replace the drive plate.
	Damaged oil pan, contacting the oil	<ul style="list-style-type: none"> Inspect the oil pan.

	pump screen.	<ul style="list-style-type: none"> Inspect the oil pump screen. Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	<ul style="list-style-type: none"> Inspect the oil pump screen. Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	<ul style="list-style-type: none"> Inspect the piston, piston pin and cylinder bore. Repair as required.
	Excessive piston pin-to-piston clearance.	<ul style="list-style-type: none"> Inspect the piston, piston pin and the connecting rod. Repair or replace as required.
	Excessive connecting rod bearing clearance	<p>Inspect the following components and repair as required.</p> <ul style="list-style-type: none"> The connecting rod bearings. The connecting rods. The crankshaft pin journals.
	Excessive crankshaft bearing clearance.	<p>Inspect the following components, and repair as required.</p> <ul style="list-style-type: none"> The crankshaft bearings. The crankshaft main journals. The cylinder block.
	Incorrect piston, piston pin and connecting rod installation	<ul style="list-style-type: none"> 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 :

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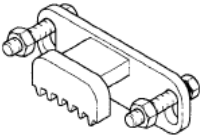

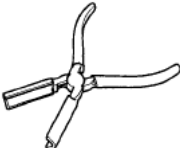
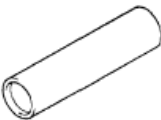
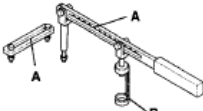
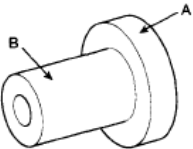

		<ul style="list-style-type: none"> • The connecting rod bearings. • The connecting rods. • The crankshaft.
	Excessive crankshaft bearing clearance.	<p>Inspect the following components, and repair as required.</p> <ul style="list-style-type: none"> • The crankshaft bearings. • The crankshaft main journals. • The cylinder block.
Engine will not crank-crankshaft will not rotate.	Hydraulically locked cylinder. <ul style="list-style-type: none"> • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder. 	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 1. Inspect timing chain and gears. 2. Repair as required.
	Material in cylinder. <ul style="list-style-type: none"> • Broken valve • Piston material • Foreign material 	<ol style="list-style-type: none"> 1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	<ol style="list-style-type: none"> 1. Inspect crankshaft and connecting rod bearing. 2. Repair as required.
	Bent or broken connecting rod.	<ol style="list-style-type: none"> 1. Inspect connecting rods. 2. Repair as required.
	Broken crankshaft.	<ol style="list-style-type: none"> 1. Inspect crankshaft. 2. Repair as required.

SPECIAL SERVICE TOOLS**SPECIAL SERVICE TOOLS**

Tool (Number and name)	Illustration	Use
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Crankshaft front oil seal installer (09231-3C100)	 KDRF233A	Installation of the front oil seal
Flywheel stopper (09231-3C300)	 KDRF030D	Removal and installation of the flywheel and crankshaft pulley.
Torque angle adapter (09221-4A000)	 LCAC030A	Installation of bolts & nuts needing an angular method
Valve stem seal remover (09222-29000)	 KDRF232A	Removal of the valve stem seal
Valve stem seal installer (09222-3C100)	 LCAC030D	Installation of the valve stem seal
Valve spring compressor & holder (09222-3K000) (09222-3C300)	 ECRF003A	Removal and installation of the intake or exhaust valves 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)



B6327000

Removal and installation of the oil filter

ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL

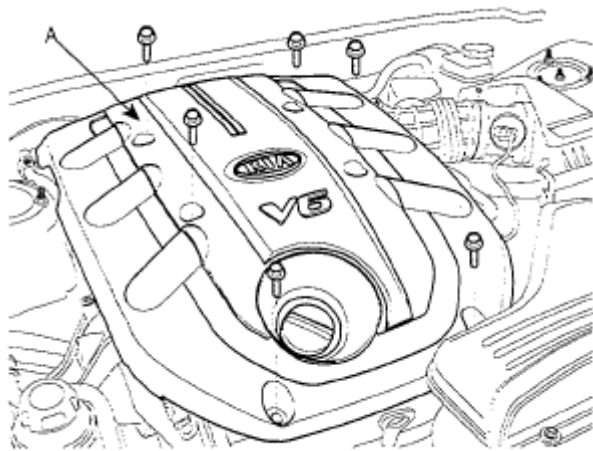
CAUTION:

- 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 misconnection.

1. Remove the engine cover (A).

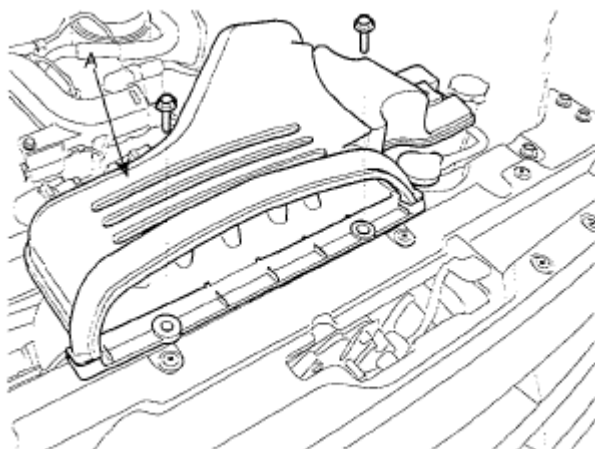


8QHAT7001N

Fig. 12: Locating Engine Cover

Courtesy of KIA MOTORS AMERICA, INC.

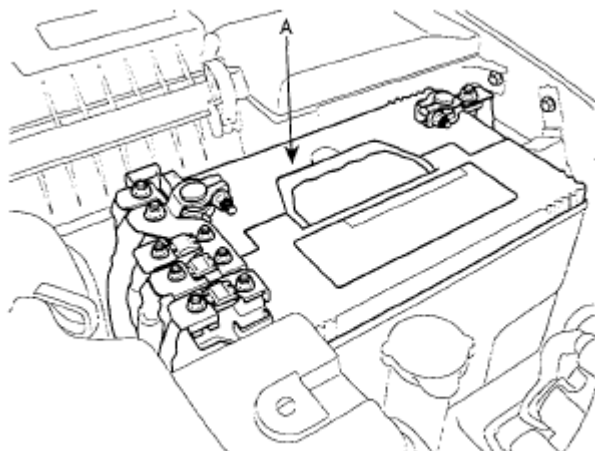
2. Remove the air duct (A).



SGHAT7003N

Fig. 13: Identifying Air Duct**Courtesy of KIA MOTORS AMERICA, INC.**

3. Disconnect the negative terminal from the battery (A).



SGHAT7002N

Fig. 14: Identifying Battery**Courtesy of KIA MOTORS AMERICA, INC.**

4. Recover refrigerant and remove the high and low pressure pipe. (Refer to **AIR CONDITIONING COMPRESSOR**)
5. Remove the intake air hose and air cleaner assembly.
 1. Disconnect the AFS connector (A).
 2. Disconnect the breather hose (B) from air cleaner hose.
 3. Disconnect the ECM connector.
 4. Remove the intake air hose (C) and air cleaner body (D).

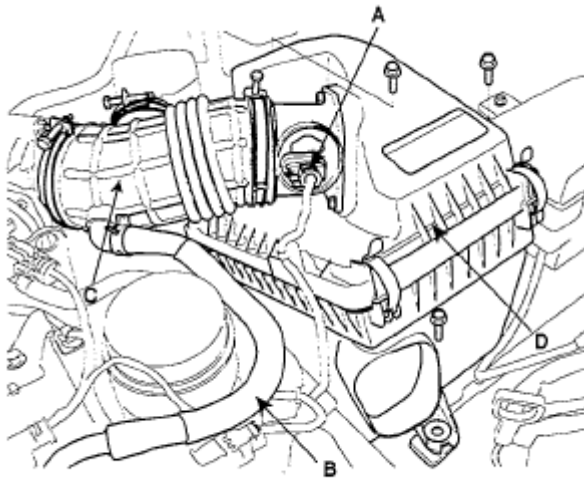


Fig. 15: Identifying Intake Air Hose And Air Cleaner Body
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove the battery tray (A).

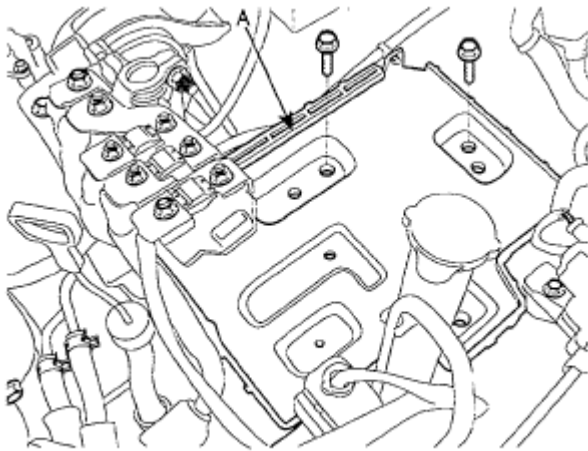
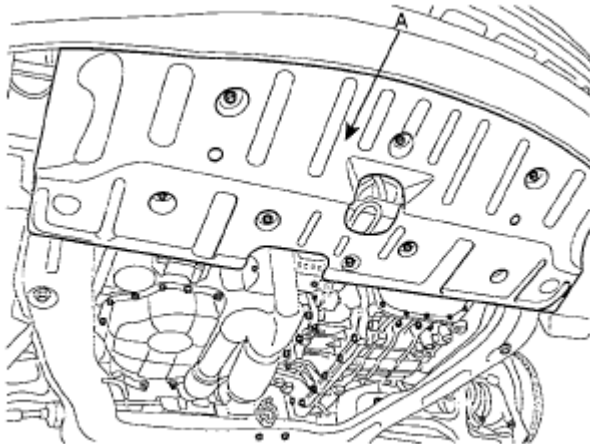


Fig. 16: Identifying Battery Tray And Bolts
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove front wheels.
8. Remove under cover (A).



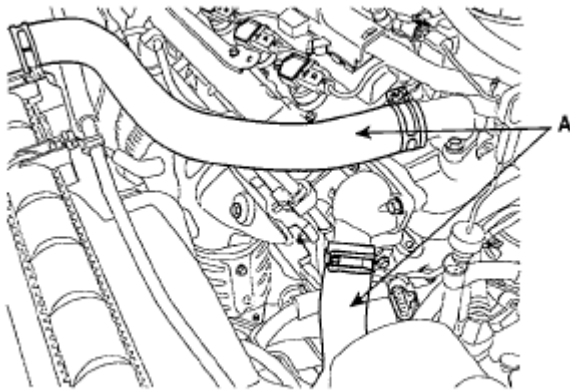
SGHAT6021D

Fig. 17: Identifying Under Cover
Courtesy of KIA MOTORS AMERICA, INC.

9. Drain the engine coolant.

Remove the radiator cap to speed draining.

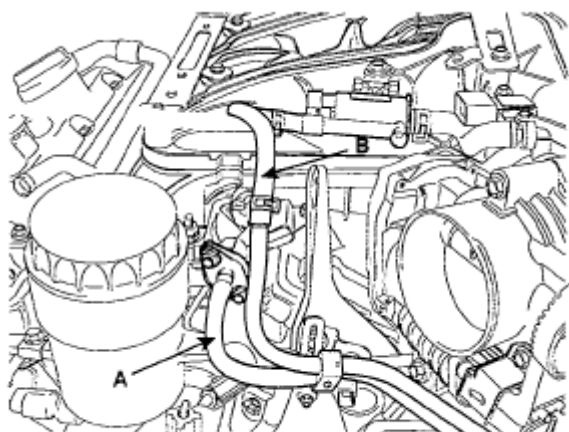
10. Remove the upper radiator hose and lower radiator hose (A).



KDRF148A

Fig. 18: Identifying Upper Radiator Hose And Lower Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

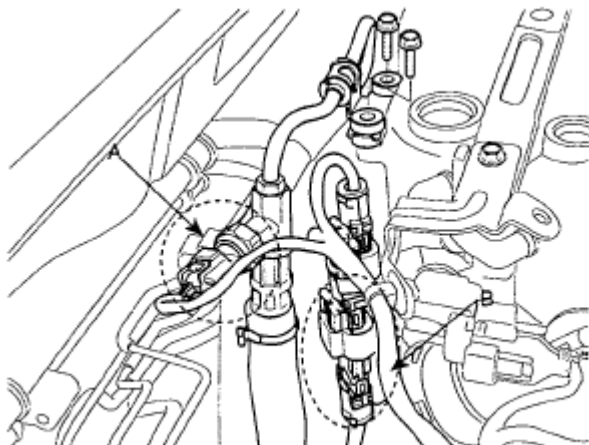
11. Remove transaxle oil cooler hose.
12. Remove fuel hose (A) and PCSV (B) hose.



ACCF008A

Fig. 19: Identifying Fuel Hose And PCSV Hose
Courtesy of KIA MOTORS AMERICA, INC.

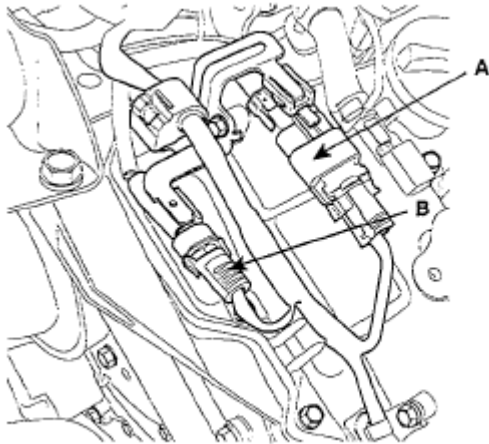
13. Remove engine wiring.
 1. Disconnect RH oxygen sensor connector (B).
 2. Disconnect power steering oil pressure sensor connector (A).



SGHEM7008N

Fig. 20: Identifying RH Oxygen Sensor Connector And Power Steering Oil Pressure Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

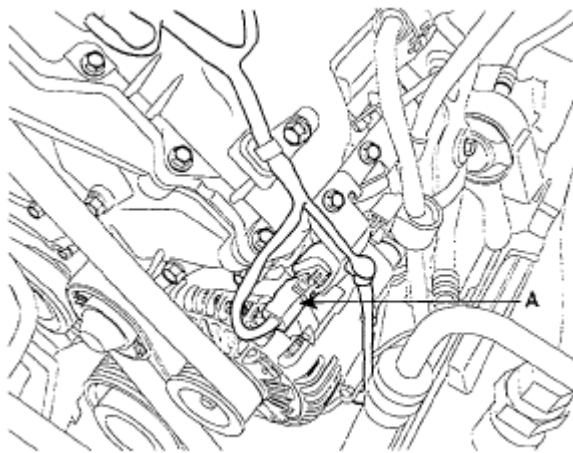
3. Disconnect RH injector connector and ignition coil connector.
 4. Disconnect OCV connector (A) and knock sensor connector (B).



KDRF155A

Fig. 21: Identifying OCV Connector And Knock Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

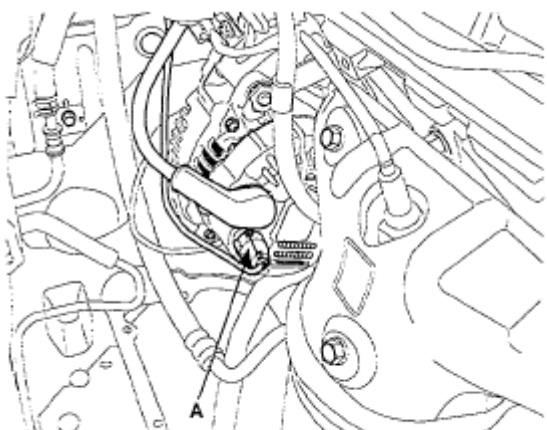
5. Disconnect LH front oxygen sensor connector (A).



KDRF156A

Fig. 22: Identifying LH Front Oxygen Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

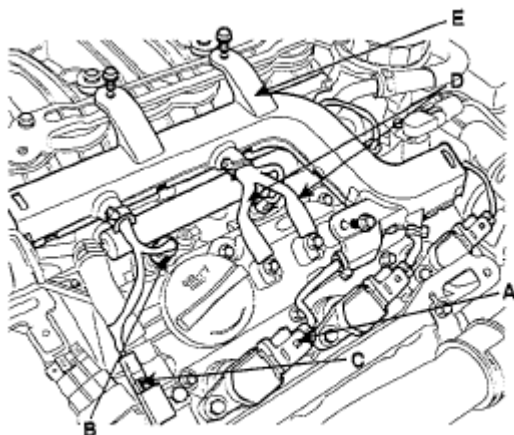
6. Disconnect alternator connector (A).



KDRF157A

Fig. 23: Identifying Alternator Connector
 Courtesy of KIA MOTORS AMERICA, INC.

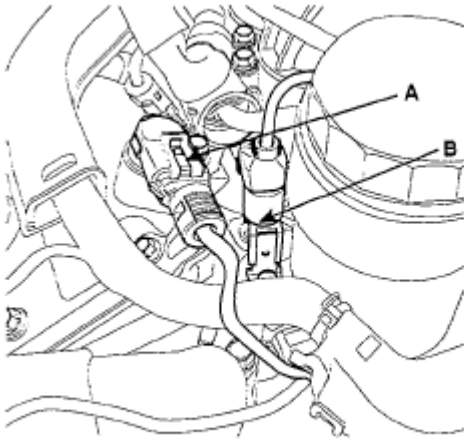
7. Disconnect LH ignition coil connector (A), injector connector (B), condenser connector (C) and ground (D), and remove wiring harness protector (E).



KDRF158A

Fig. 24: Identifying LH Ignition Coil Connector And Condenser Connector
 Courtesy of KIA MOTORS AMERICA, INC.

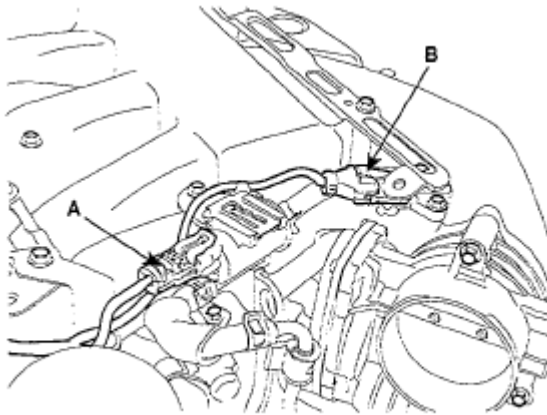
8. Disconnect LH CMPS (A) and oil pressure switch connector (B).



KDRF159A

Fig. 25: Identifying LH CMPS And Oil Pressure Switch Connector
Courtesy of KIA MOTORS AMERICA, INC.

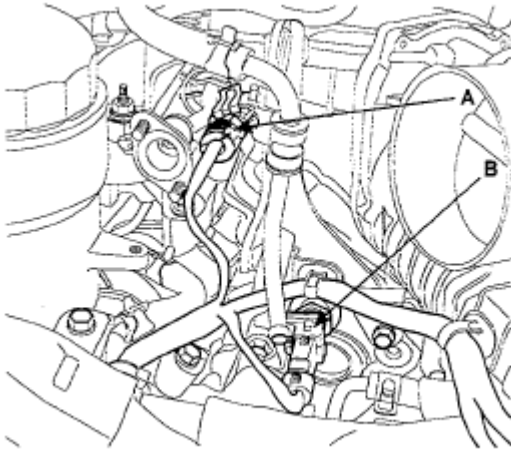
9. Disconnect PCSV connector (A) and MAP sensor connector (B).



UCBF003A

Fig. 26: Identifying PCSV Connector And MAP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

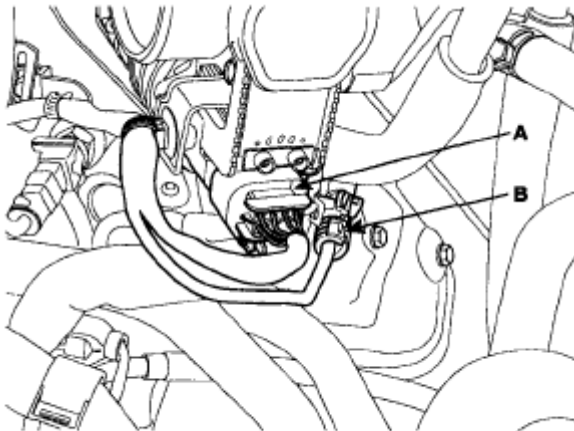
10. Disconnect RH CMPS (A) and OTS connector (B).



KDRF161A

Fig. 27: Identifying RH CMPS And OTS Connector
Courtesy of KIA MOTORS AMERICA, INC.

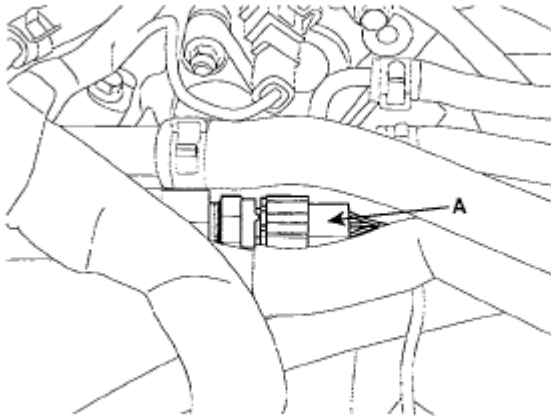
11. Disconnect ETC connector (A) and knock sensor connector (B).



KDRF162A

Fig. 28: Locating ETC Connector And Knock Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

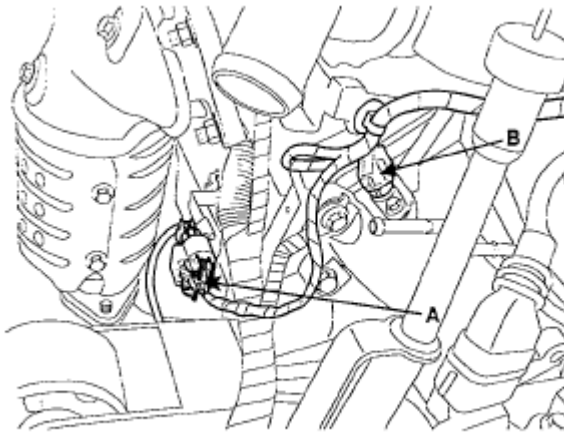
12. Disconnect ECT sensor connector (A).



KDRF163A

Fig. 29: Identifying ECT Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

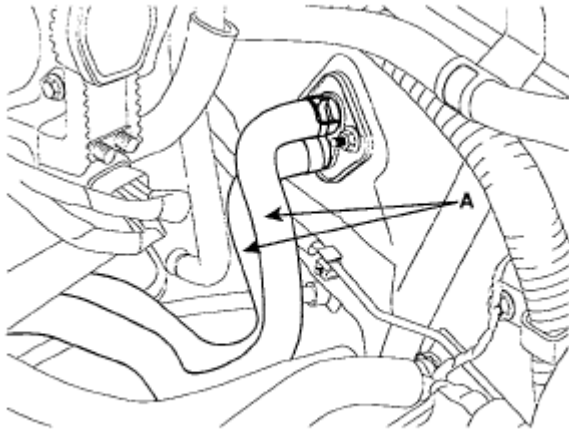
13. Disconnect LH rear oxygen sensor connector (A) and CPS connector (B).



KDRF164A

Fig. 30: Identifying LH Rear Oxygen Sensor Connector And CPS Connector
Courtesy of KIA MOTORS AMERICA, INC.

14. Disconnect the transaxle wire harness connector and remove the transaxle control cable.
15. Remove heater hose (A).

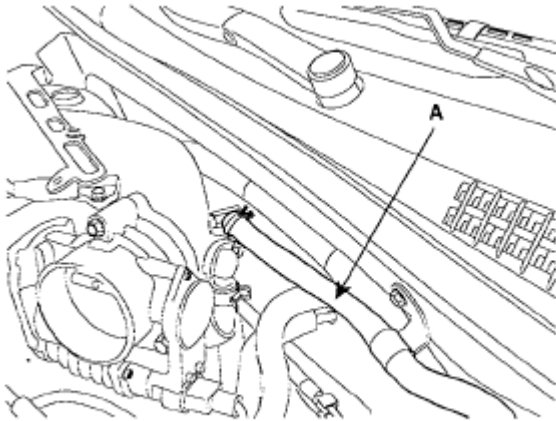


KDRF185A

Fig. 31: Identifying Heater Hose

Courtesy of KIA MOTORS AMERICA, INC.

16. Remove brake vacuum hose (A).

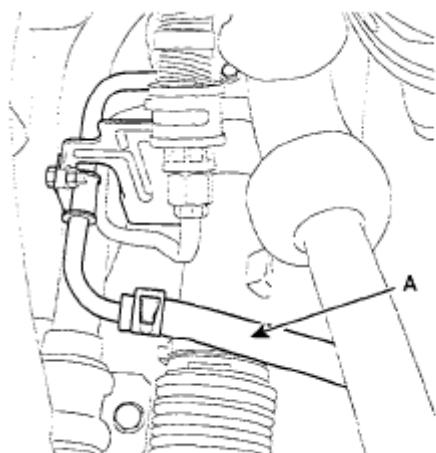


KDBF101A

Fig. 32: Identifying Brake Vacuum Hose

Courtesy of KIA MOTORS AMERICA, INC.

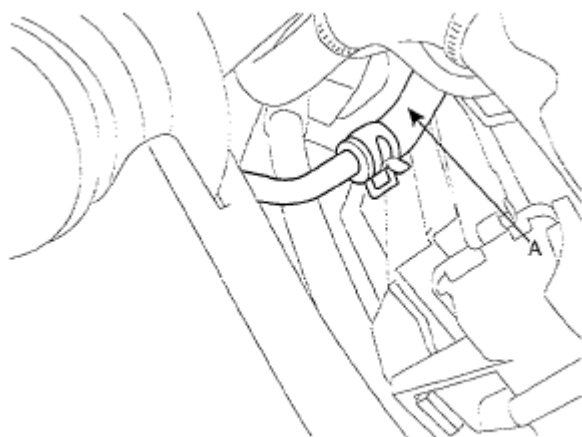
17. Remove power steering pump hose (A).



KDRF175A

Fig. 33: Identifying Power Steering Pump Hose
Courtesy of KIA MOTORS AMERICA, INC.

18. Remove A/C compressor hose.
19. Drain transaxle oil.
20. Remove lower arm ball joint.
21. Remove tie rod end ball joint.
22. Remove stabilizer link.
23. After removing a split pin and nut from the steering bar tie rod, disconnect it.
24. Remove power steering return hose (A) and drain power steering oil.

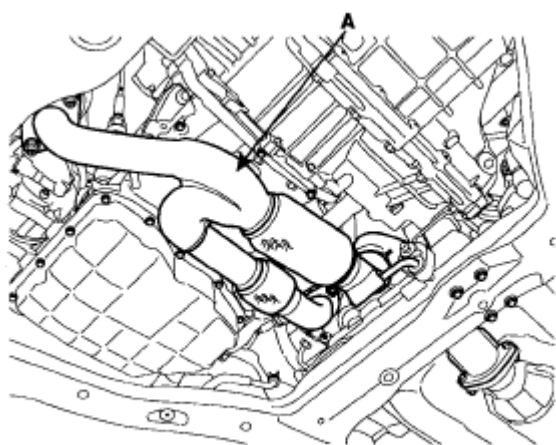


SGHAT6022D

Fig. 34: Identifying Power Steering Return Hose
Courtesy of KIA MOTORS AMERICA, INC.

25. Remove front roll stopper mounting bolt.
26. Remove rear roll stopper mounting bolt.
27. Remove steering u-joint mounting bolt.

28. Remove front exhaust pipe (A).



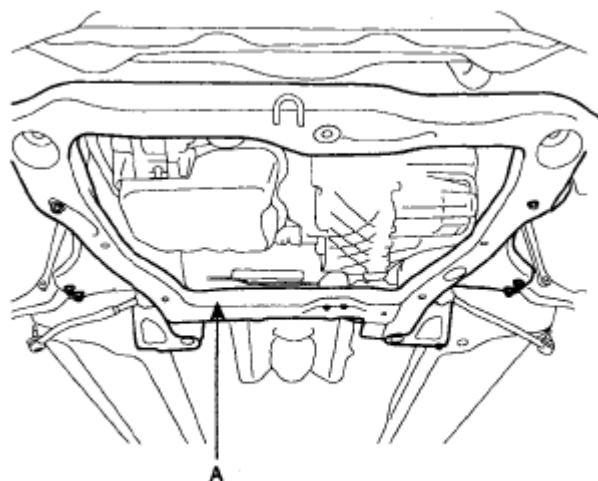
KCBF102A

Fig. 35: Locating Front Exhaust Pipe
Courtesy of KIA MOTORS AMERICA, INC.

29. Supporting the crossmember (A) with a jack, remove the stay with the mounting bolts.

Tightening torque :

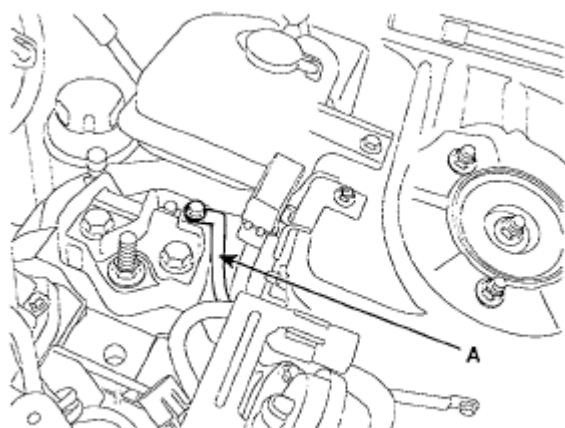
137.3~156.9 N.m (14.0~16.0 kgf.m, 101.3~115.7 lb-ft)



KMRE009R

Fig. 36: Identifying Crossmember
Courtesy of KIA MOTORS AMERICA, INC.

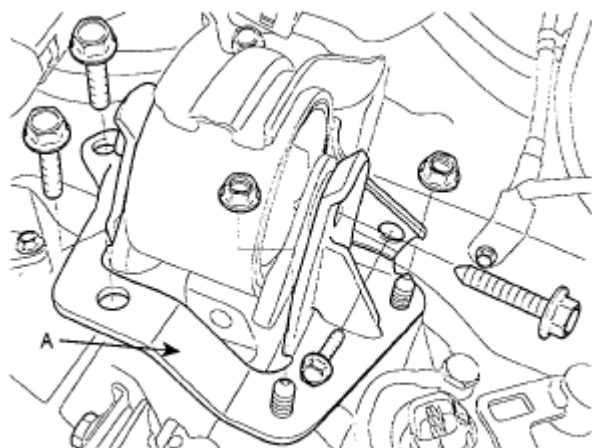
30. Remove drive shaft from transaxle.
31. Install jack for supporting engine and transaxle assembly.
32. Disconnect the ground cable (A) from the engine mounting bracket.



KDBF102A

Fig. 37: Identifying Ground Cable
Courtesy of KIA MOTORS AMERICA, INC.

33. Remove the engine mounting bracket.
34. Remove the transaxle mounting bracket (A).



SGHEM7009N

Fig. 38: Identifying Transaxle Mounting Bracket
Courtesy of KIA MOTORS AMERICA, INC.

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

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

INSTALLATION

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

- Adjust the shift cable.

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

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

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

TIMING SYSTEM

TIMING CHAIN

COMPONENTS

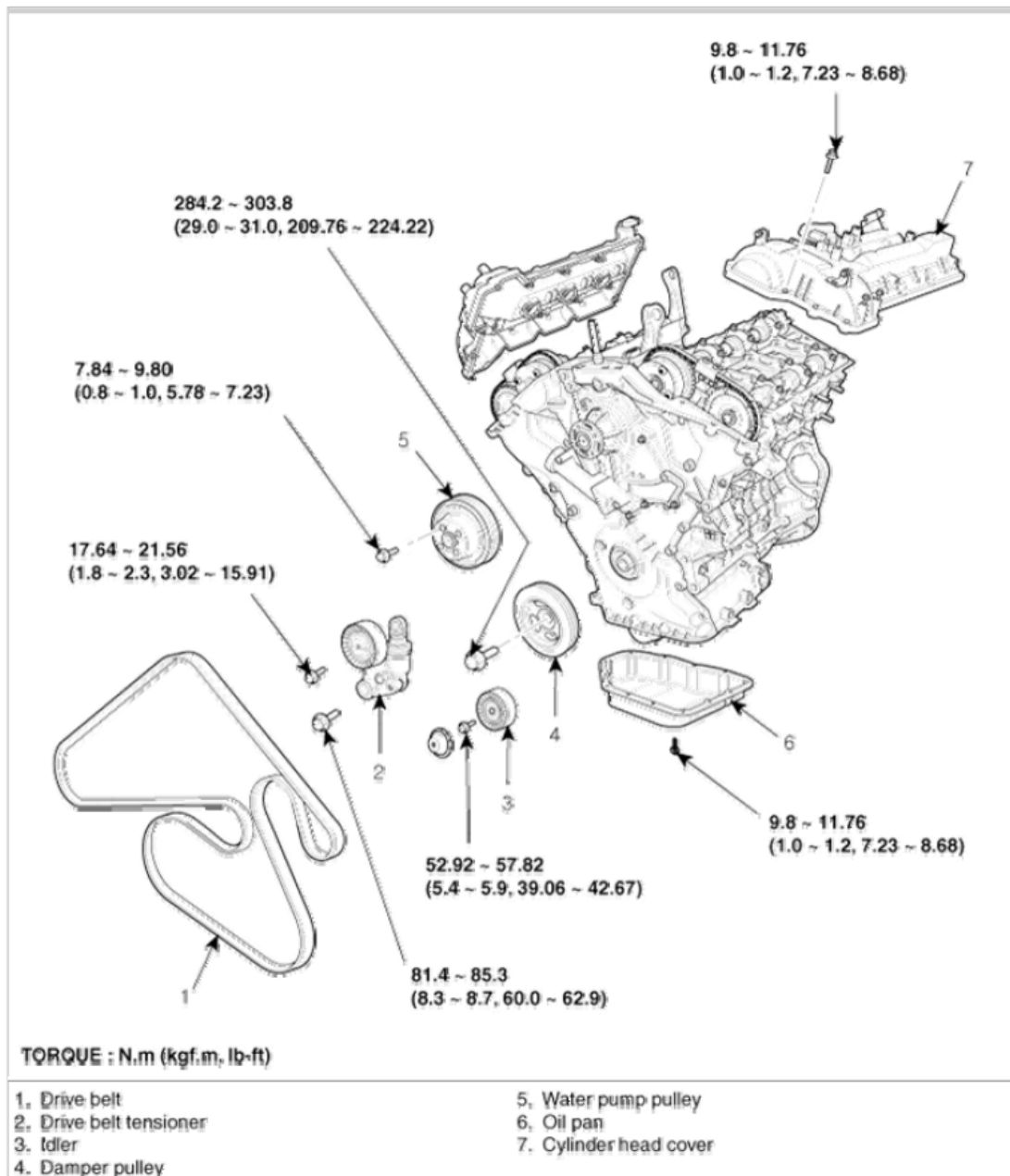


Fig. 39: Identifying Timing Chain Components (1 Of 2)

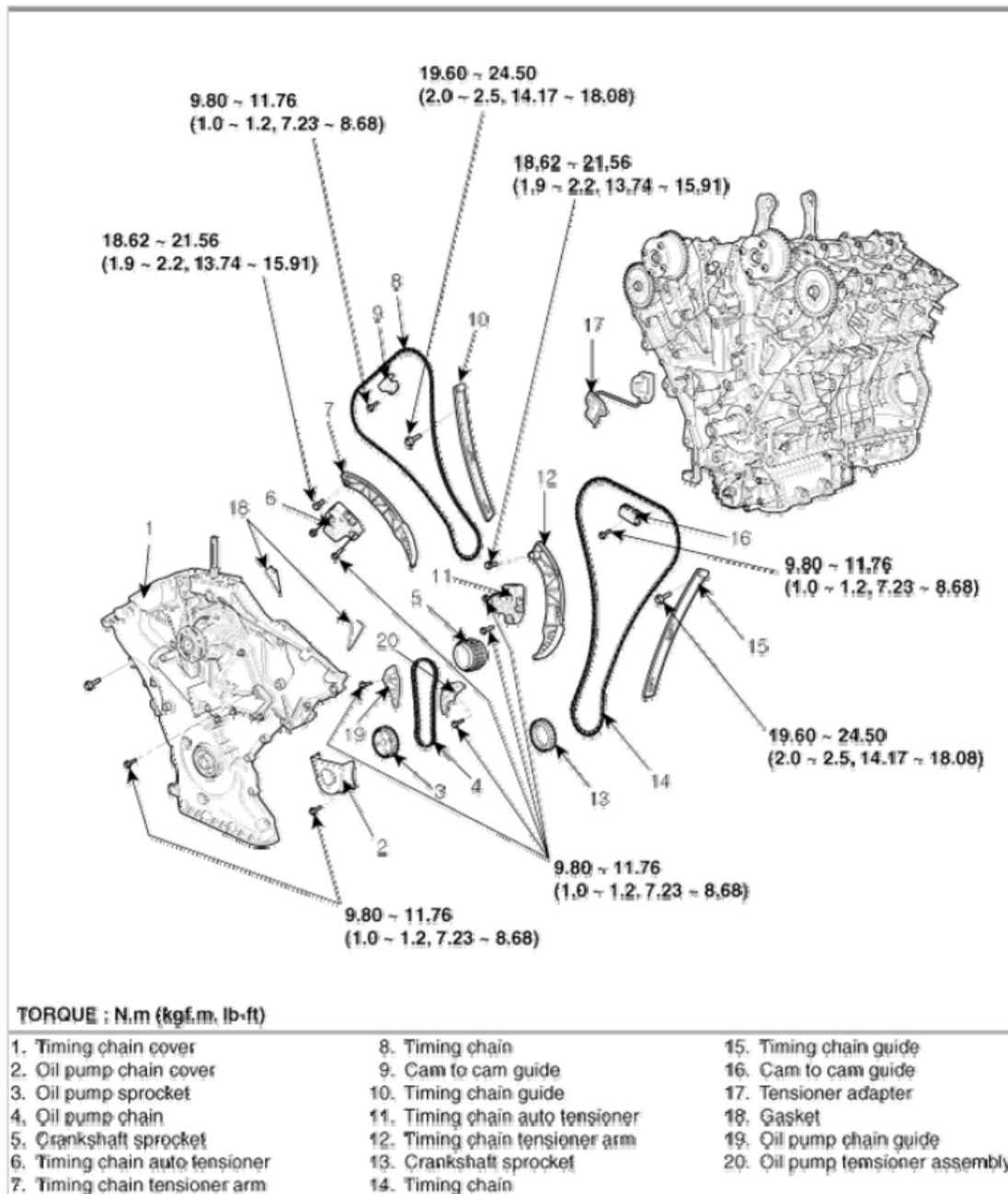


Fig. 40: Identifying Timing Chain Components (2 Of 2)

REMOVAL

CAUTION:

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

NOTE:

- Mark all wiring and hoses to avoid misconnection.

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

1. Disconnect the battery negative cable (A).

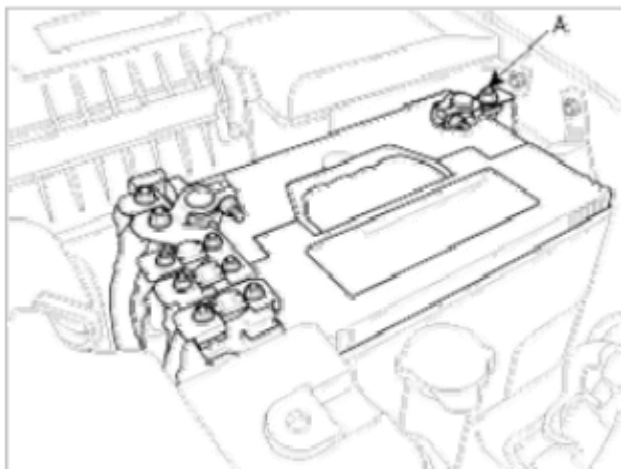


Fig. 41: Locating Battery Negative Cable

2. Remove the engine cover (A).

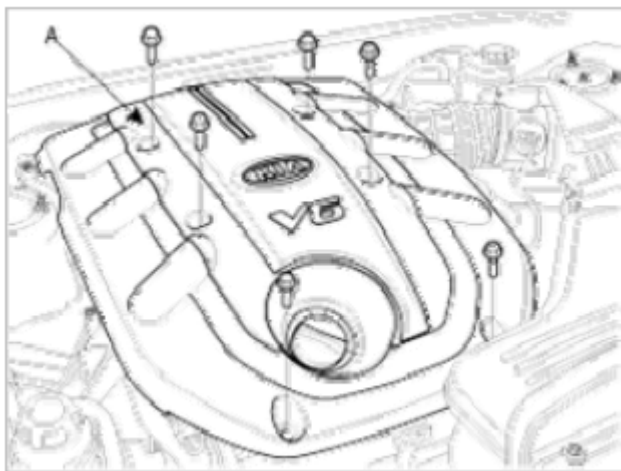


Fig. 42: Locating Engine Cover

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

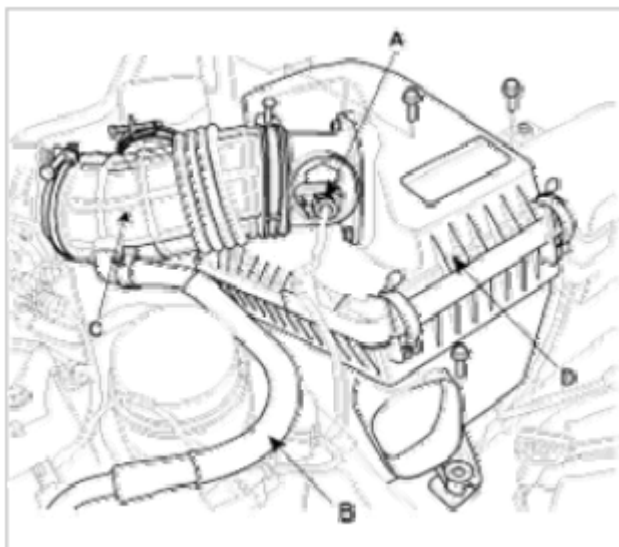


Fig. 43: Identifying AFS Connector, Breather Hose, Intake Air Hose And Air Cleaner Body

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



Fig. 44: Locating Under Cover

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

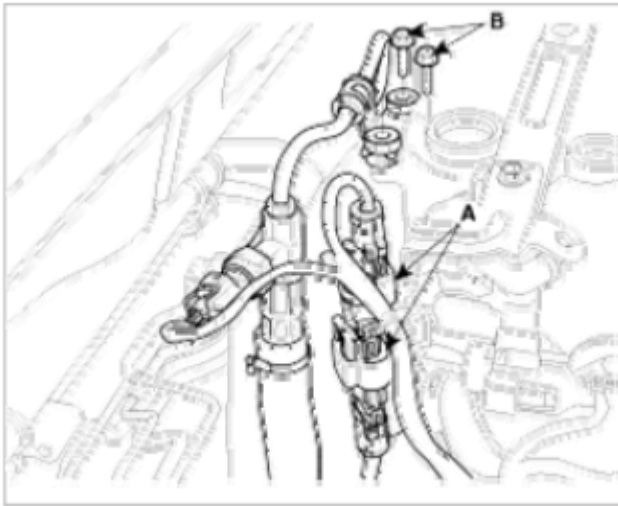


Fig. 45: Locating RH Oxygen Sensor Connector And Power Steering Hose Mounting Bolts

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

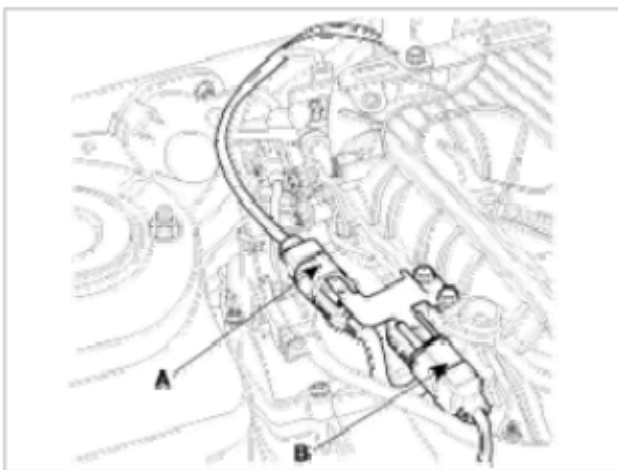


Fig. 46: Locating RH Injector Connector And Ignition Coil Connector

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

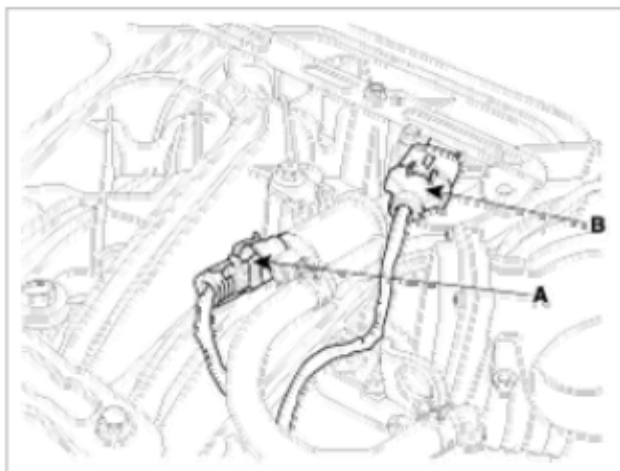


Fig. 47: Locating PCSV Connector, MAP Sensor Connector And PCSV Hose

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

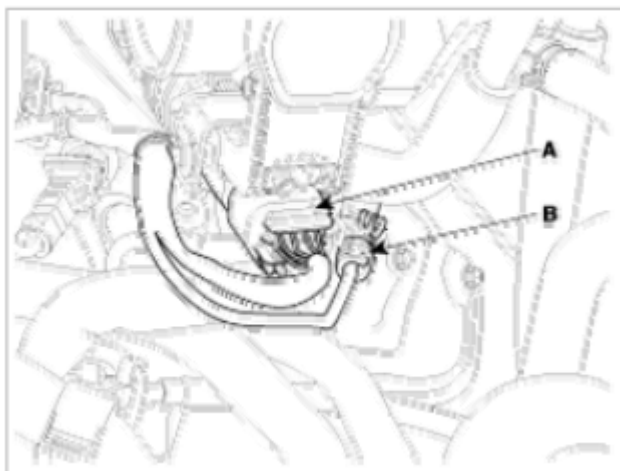


Fig. 48: Locating ETC Connector And Knock Sensor Connector

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

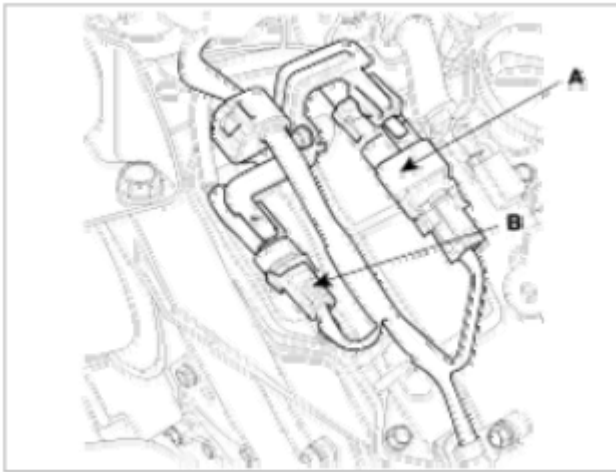


Fig. 49: Locating OCV Connector And Knock Sensor Connector

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

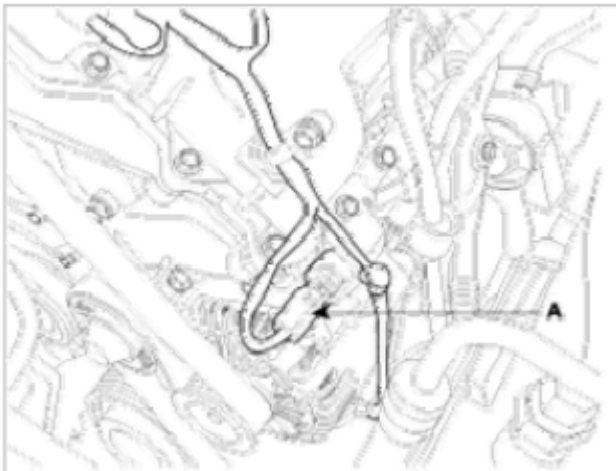


Fig. 50: Locating LH Front Oxygen Sensor Connector

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

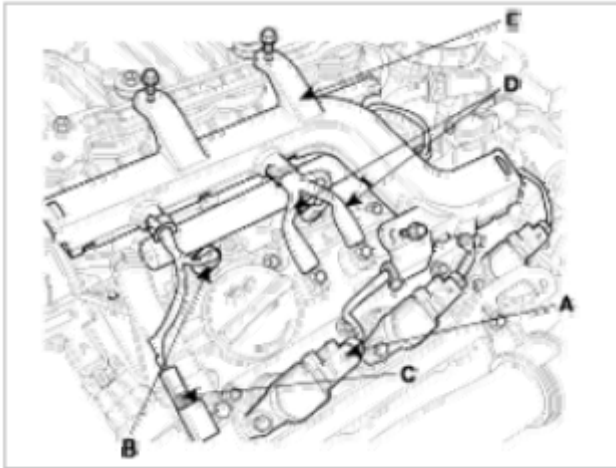


Fig. 51: Locating LH Ignition Coil Connector, Injector Connector, Condenser Connector, Ground And Wiring Harness Protector

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

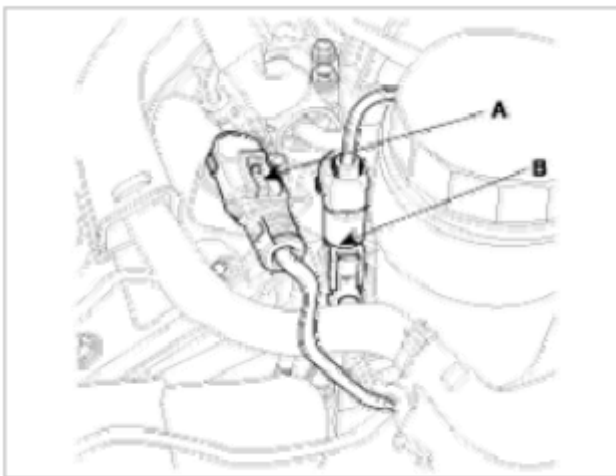


Fig. 52: Locating LH CMPS And Oil Pressure Switch Connector

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

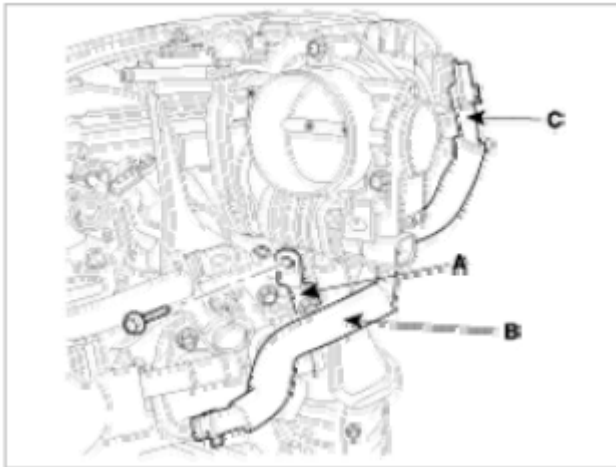


Fig. 53: Locating ETC Bracket, Water Hoses And PCV Hose

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

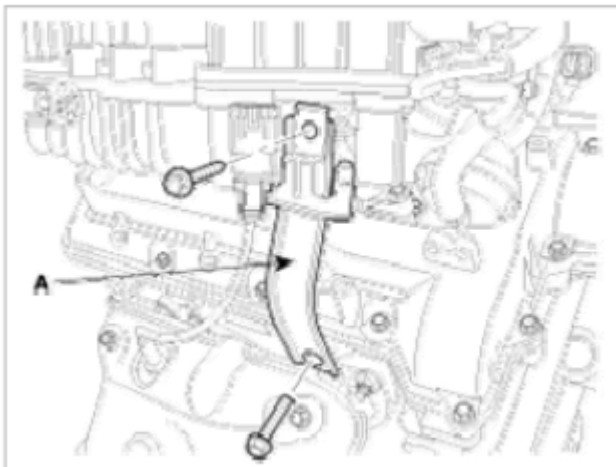


Fig. 54: Locating Surge Tank Stay

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

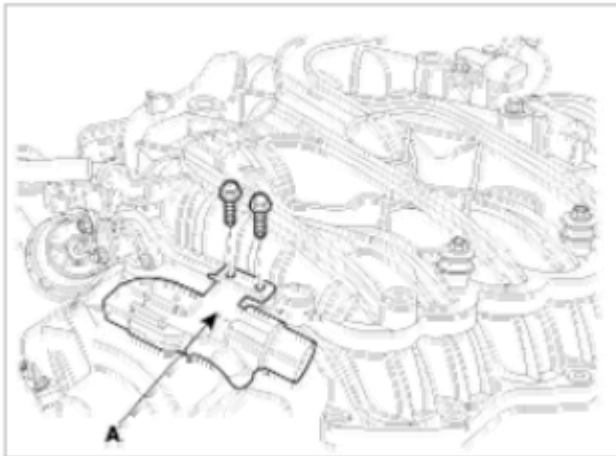


Fig. 55: Locating Surge Tank Connector Bracket

15. Remove the surge tank (A).

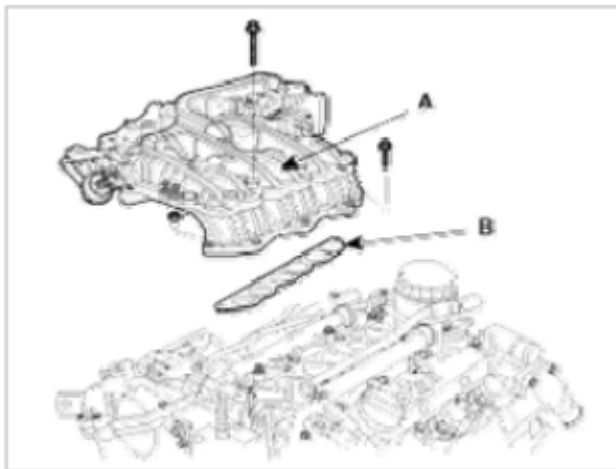


Fig. 56: Locating Surge Tank

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

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

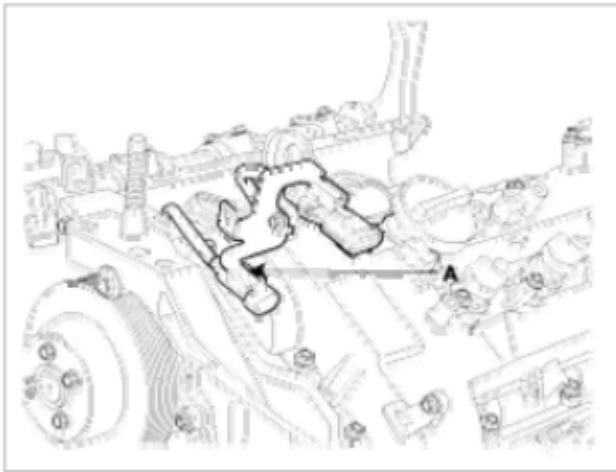


Fig. 57: Locating LH Cylinder Head Cover Connector Bracket

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

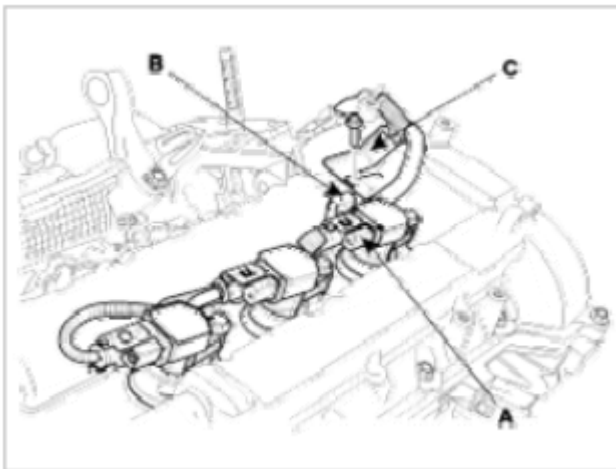


Fig. 58: Locating RH Ignition Coil Connector, Condenser Connector And Wiring Bracket

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

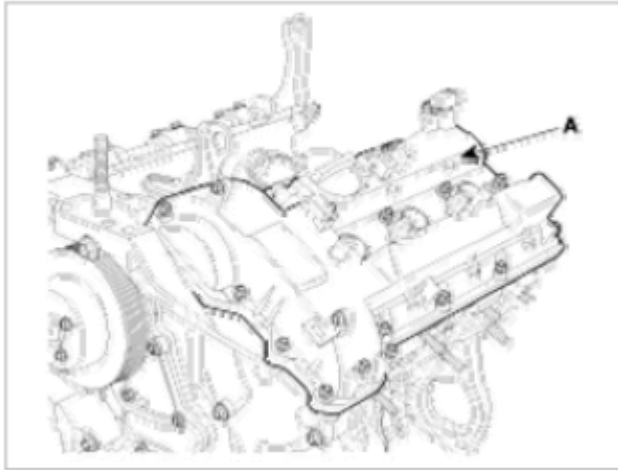


Fig. 59: Locating RH Cylinder Head Cover

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

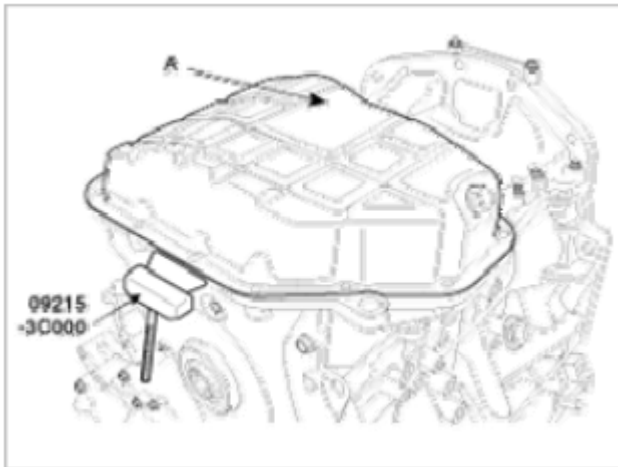


Fig. 60: Removing Lower Oil Pan Using SST (09215-3C000)

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

13. Set a jack to the upper oil pan.

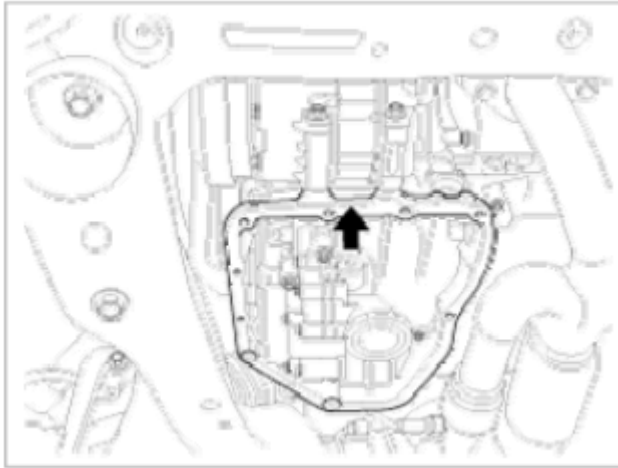


Fig. 61: Locating Upper Oil Pan

14. Just loosen the transaxle mounting bracket bolts and nuts without removing the transaxle mounting bracket.

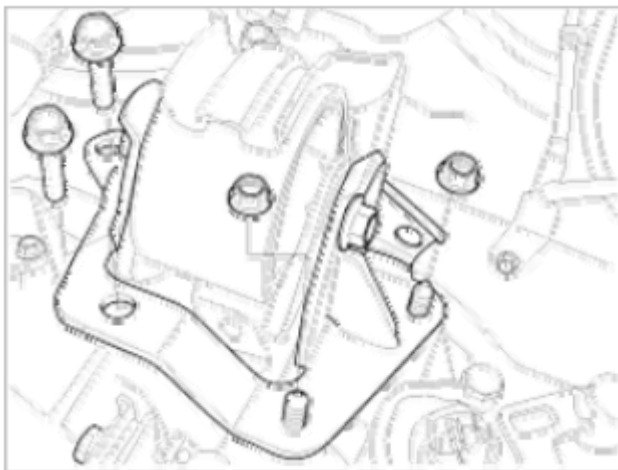


Fig. 62: Identifying Transaxle Mounting Bracket, Bolts And Nuts

15. Remove the engine mounting bracket (A).

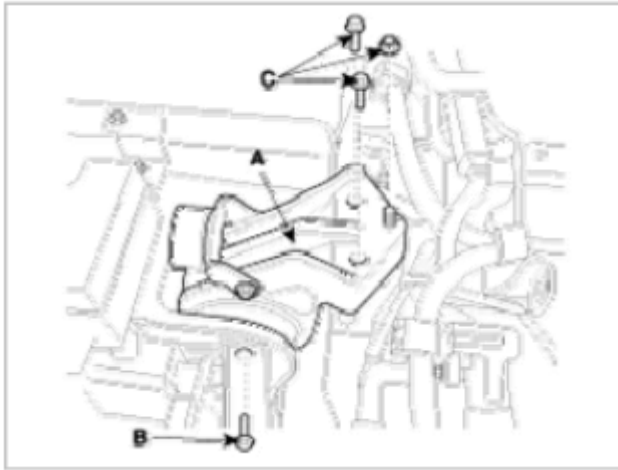


Fig. 63: Locating Engine Mounting Bracket, Bolts And Nuts

16. Set No.1 cylinder to TDC/compression.

1. Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing chain cover.

NOTE: Do not rotate engine counterclockwise.

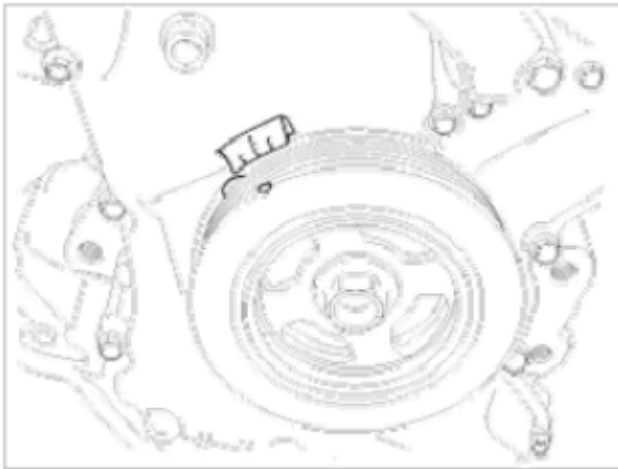


Fig. 64: Aligning Crankshaft Pulley Groove With Timing Mark "T" Of Lower Timing Chain Cover

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

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

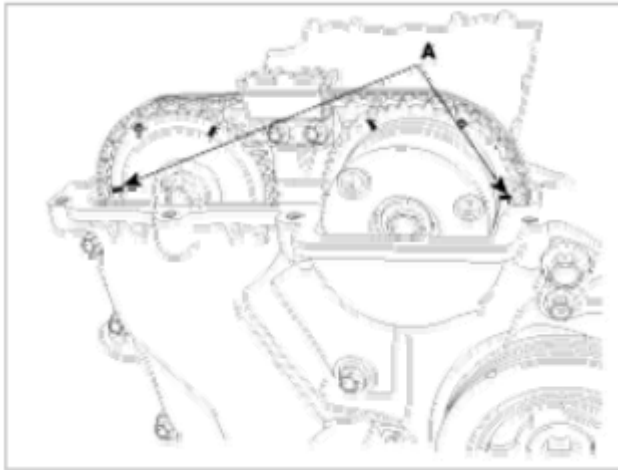


Fig. 65: Checking Mark Of Camshaft Timing Sprockets Are In Straight Line On Cylinder Head Surface

NOTE: Do not rotate engine counterclockwise.

17. Remove the drive belt (A).

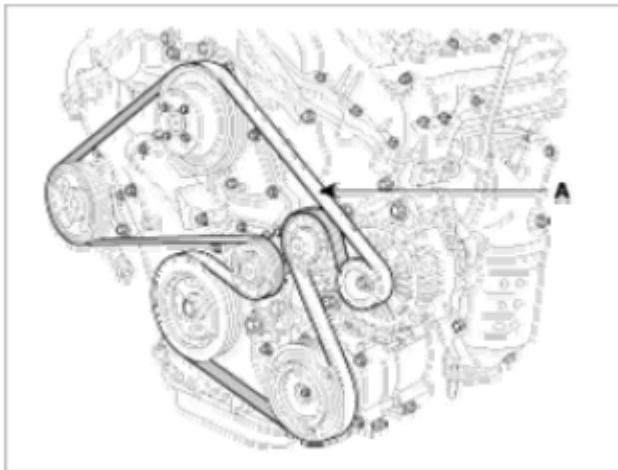


Fig. 66: Locating Drive Belt

18. Remove the crankshaft damper pulley (A).

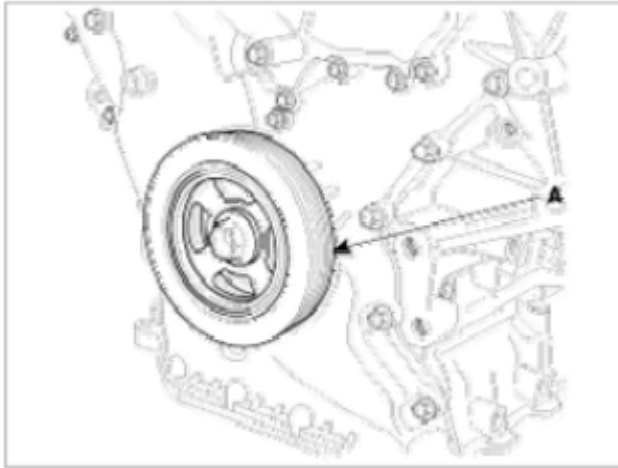


Fig. 67: Locating Crankshaft Damper Pulley

NOTE: There are two methods to hold the ring gear when installing or removing the crankshaft damper pulley.

- Install the SST (09231-3C300) to hold the ring gear after removing the starter.

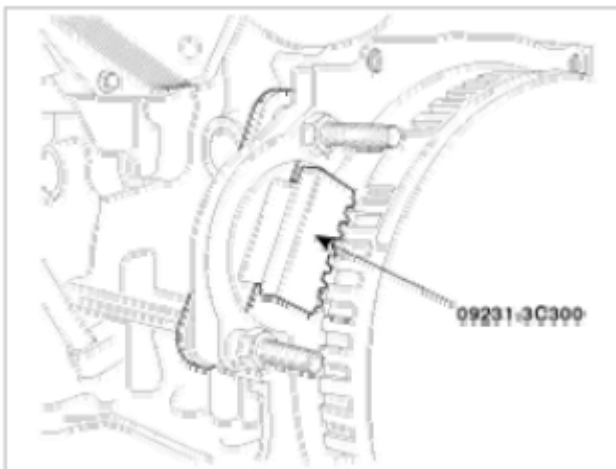


Fig. 68: Installing SST (09231-3C300) To Hold Ring Gear After Removing Starter

- Install the SST (09231-3D100) to hold the ring gear after removing the dust cover.
1. Remove the front muffler. (Refer to Intake And Exhaust system)
 2. Remove the dust cover (A) on the bottom of the upper oil pan and unfasten the two transaxle mounting bolts (B).

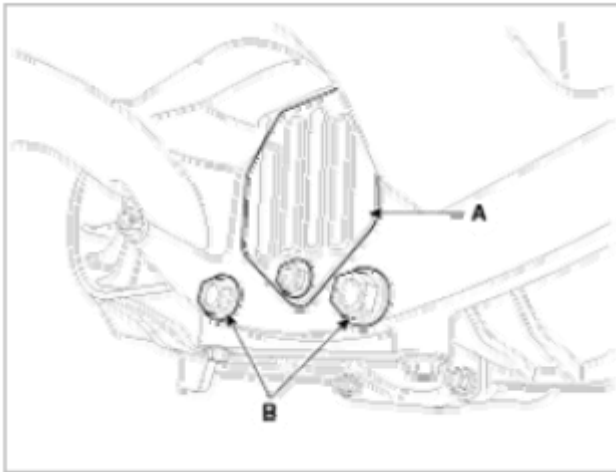


Fig. 69: Locating Dust Cover On Bottom Of Upper Oil Pan And Transaxle Mounting Bolts

3. Adjust the length of the holder nuts (A) so that the front plate of the holder (B) puts in the ring gear (C) teeth.
4. Fasten the two transaxle mounting bolts in the original mounted holes.

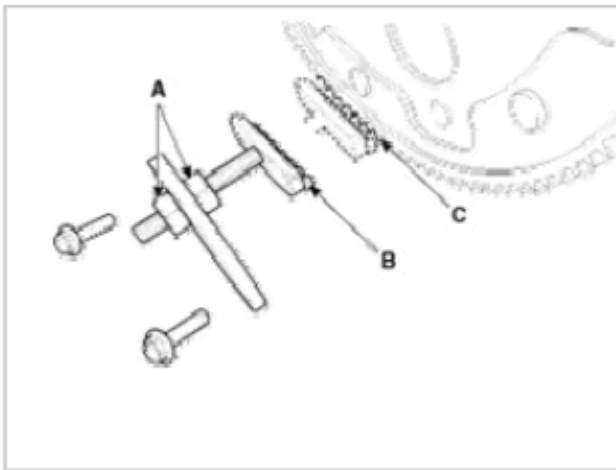


Fig. 70: Locating Holder Nuts, Front Plate Holder And Ring Gear

5. Install the SST (09231-3D100) using the two mounting bolts. Tighten the bolts and nuts of the holder securely.

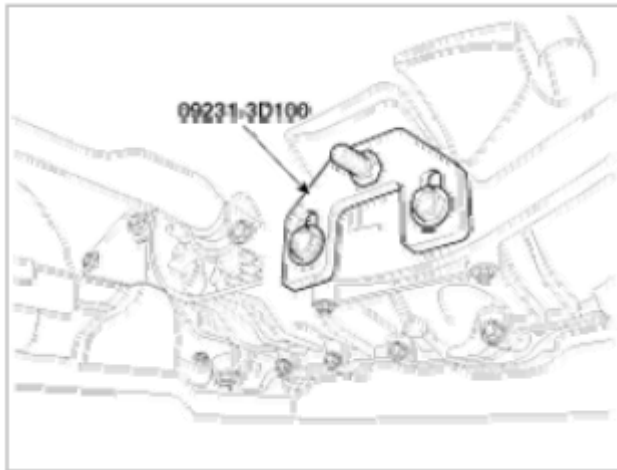


Fig. 71: Identifying SST (09231-3D100) And Mounting Bolts

19. Lift up the engine assembly to using the jack.
20. Remove the power steering pump (A).

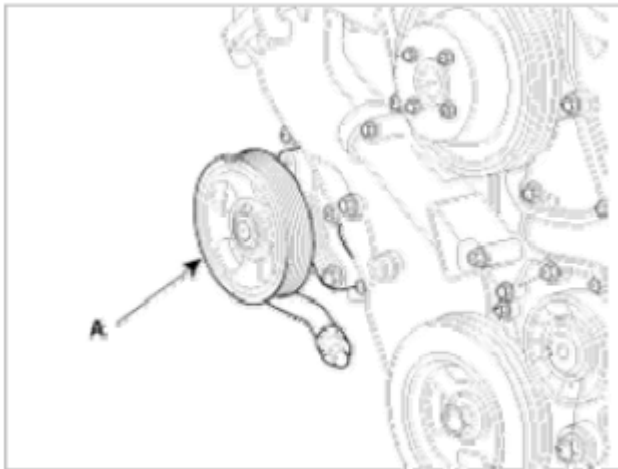


Fig. 72: Locating Power Steering Pump

21. Remove the alternator (A).

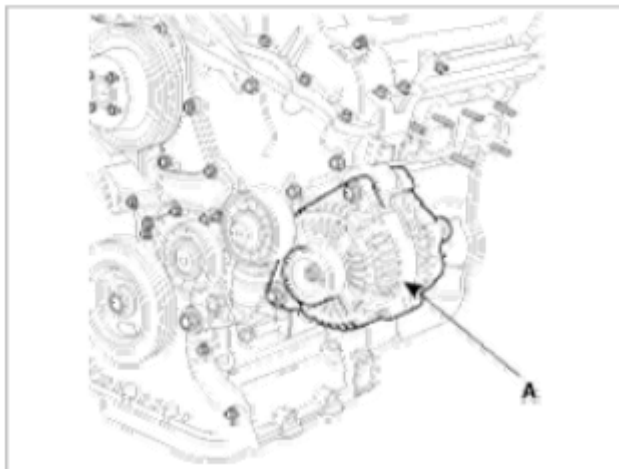


Fig. 73: Locating Alternator

22. Remove the drive belt idler (A).

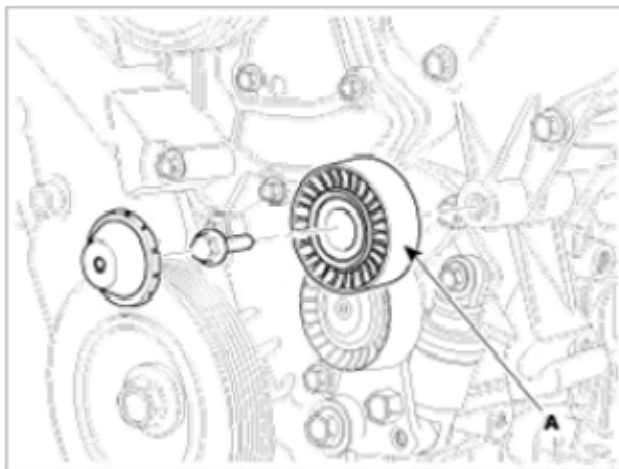


Fig. 74: Locating Drive Belt Idler

23. Remove the drive belt auto tensioner (A).

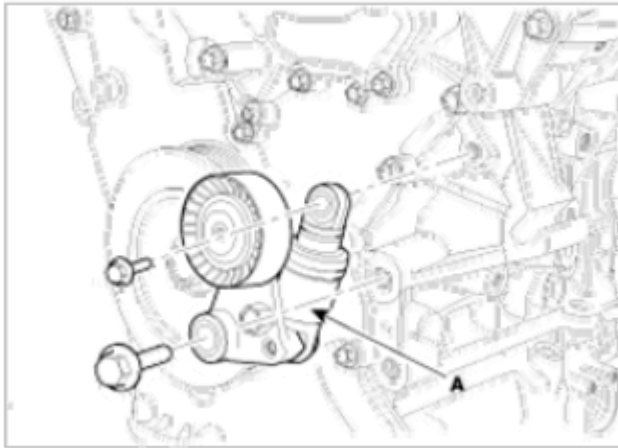


Fig. 75: Locating Drive Belt Auto Tensioner

24. Remove the water pump pulley (A).

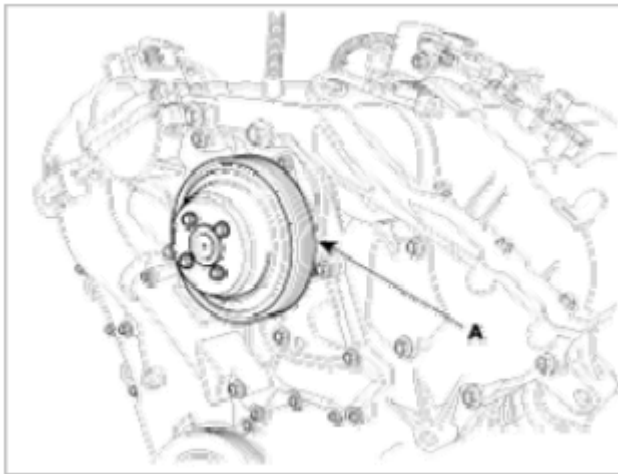


Fig. 76: Locating Water Pump Pulley

25. Remove the timing chain cover (A).

If necessary remove the water pump (B) first.

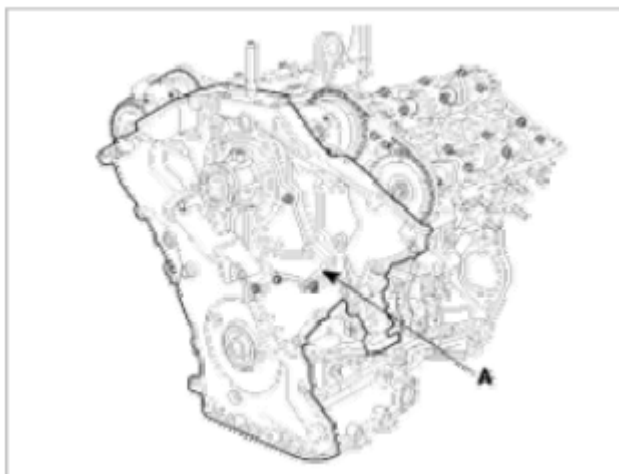


Fig. 77: Locating Timing Chain Cover

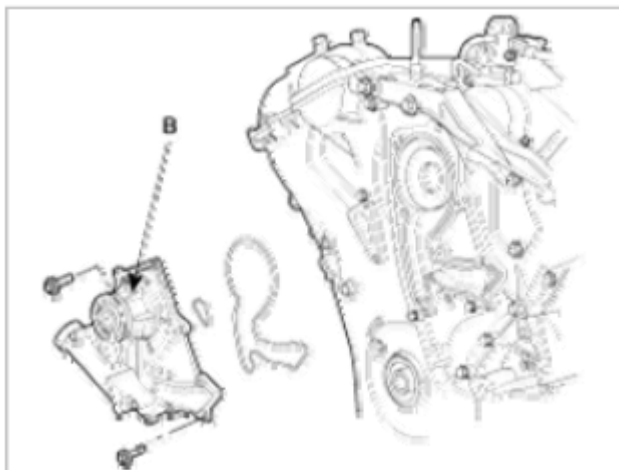


Fig. 78: Locating Water Pump

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

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

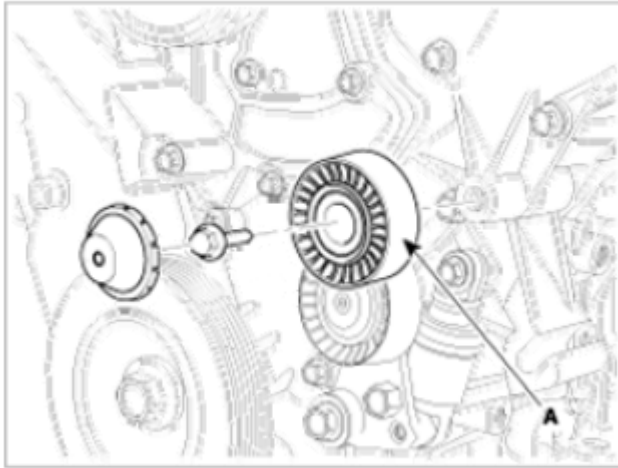


Fig. 79: Installing Set Pin After Compressing Timing Chain Tensioner

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

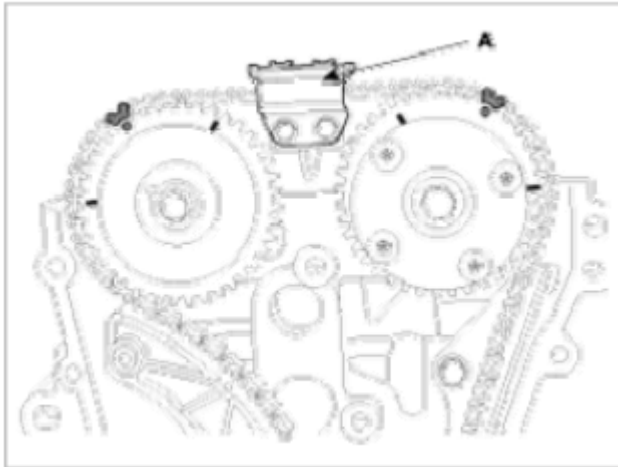


Fig. 80: Locating RH Cam-To-Cam Guide

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

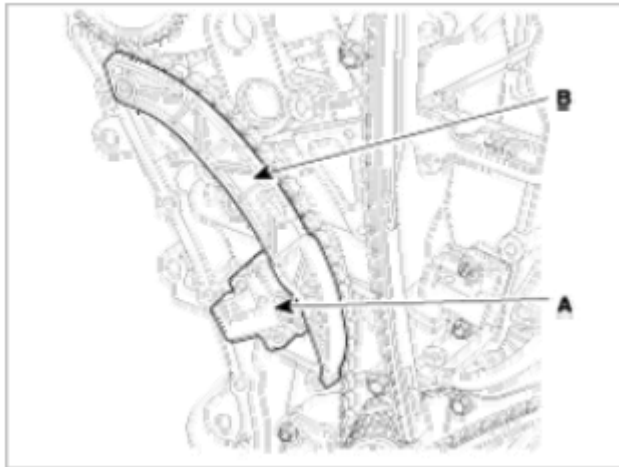


Fig. 81: Locating RH Timing Chain Auto Tensioner And RH Timing Chain Tensioner Arm

29. Remove the RH timing chain.
30. Remove the RH timing chain guide (A).

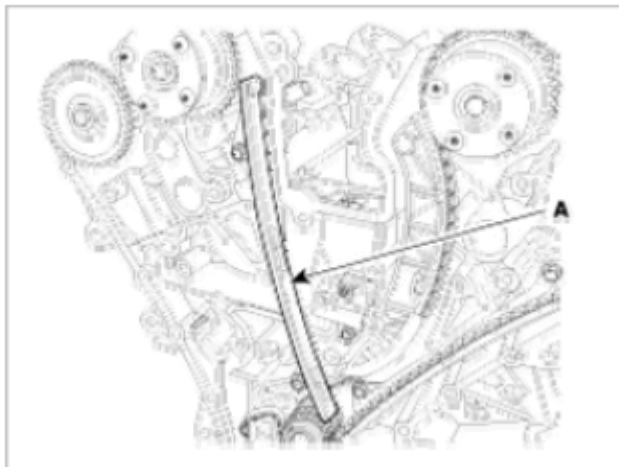


Fig. 82: Locating RH Timing Chain Guide

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

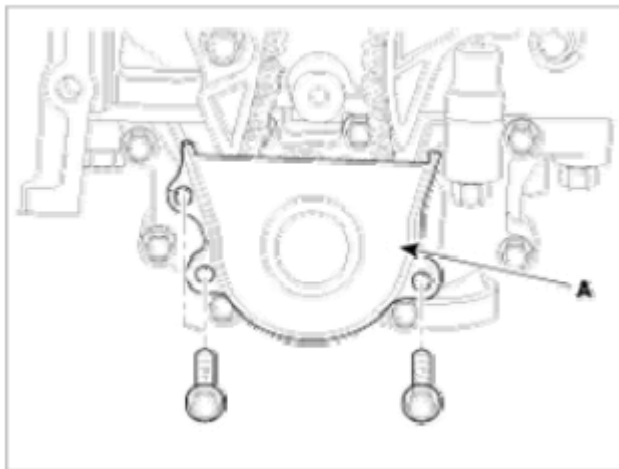


Fig. 83: Locating Oil Pump Chain Cover

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

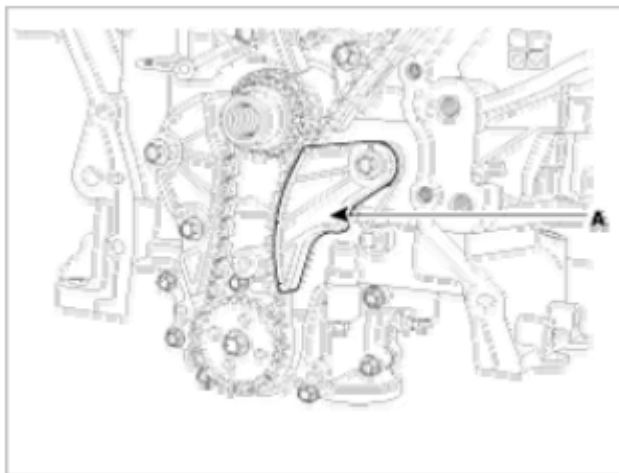


Fig. 84: Locating Oil Pump Chain Tensioner Assembly

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

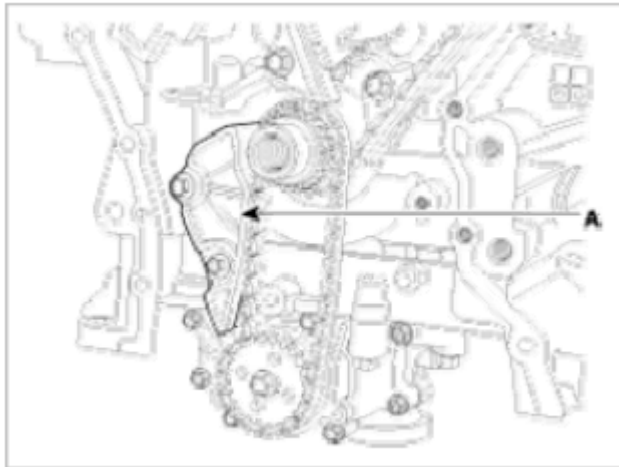


Fig. 85: Locating Oil Pump Chain Guide

34. Remove the oil pump chain sprocket (A) and oil pump chain (B).

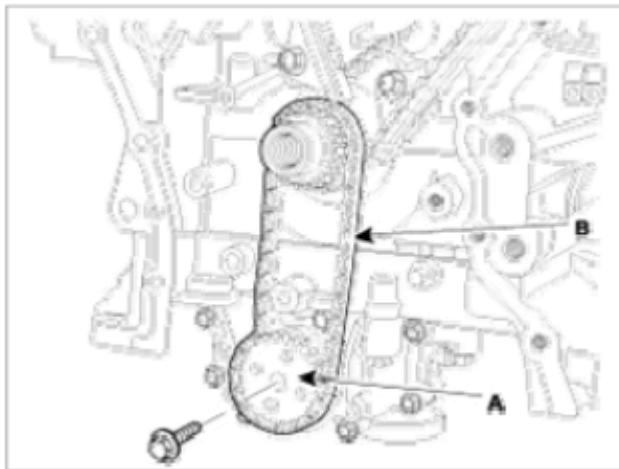


Fig. 86: Locating Oil Pump Chain Sprocket And Oil Pump Chain

35. Remove the crankshaft sprocket (A) (Oil pump&RH camshaft drive).

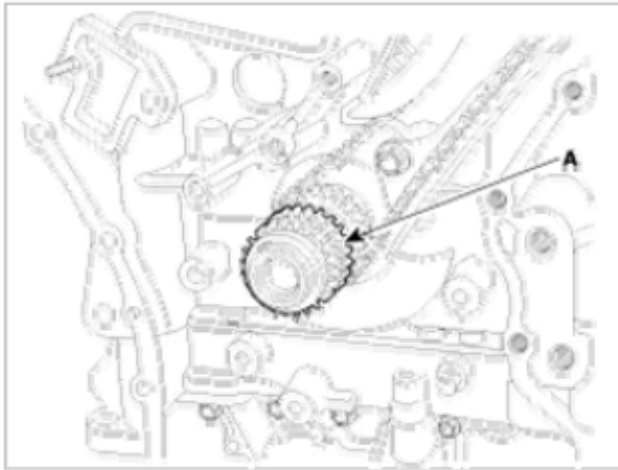


Fig. 87: Locating Crankshaft Sprocket (Oil Pump & RH Camshaft Drive)

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

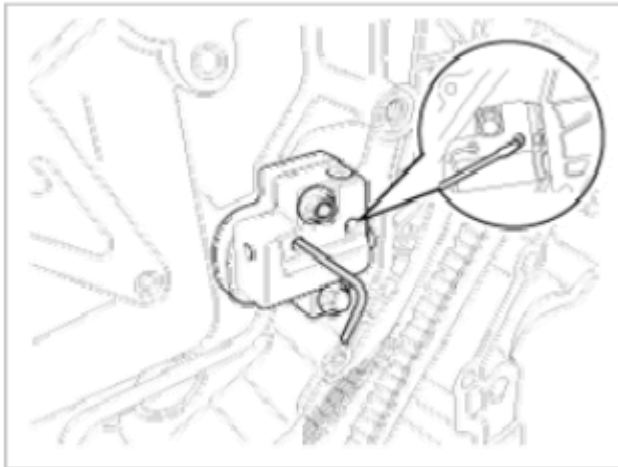


Fig. 88: Installing Set Pin After Compressing LH Timing Chain Tensioner

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

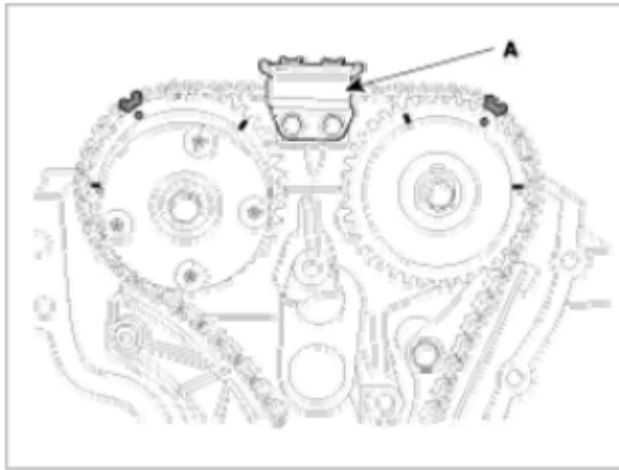


Fig. 89: Locating LH Cam-To-Cam Guide

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

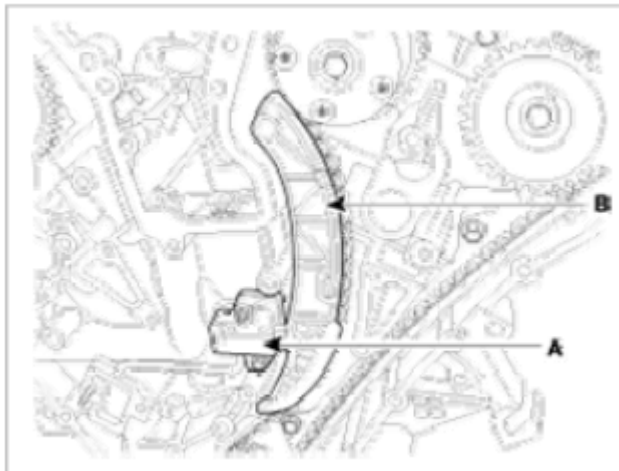


Fig. 90: Locating LH Timing Chain Auto Tensioner And LH Timing Chain Tensioner Arm

39. Remove the LH timing chain.
40. Remove the LH timing chain guide (A).

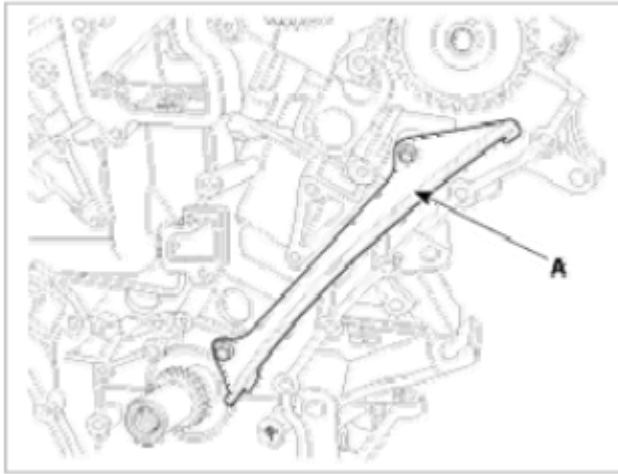


Fig. 91: Locating LH Timing Chain Guide

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

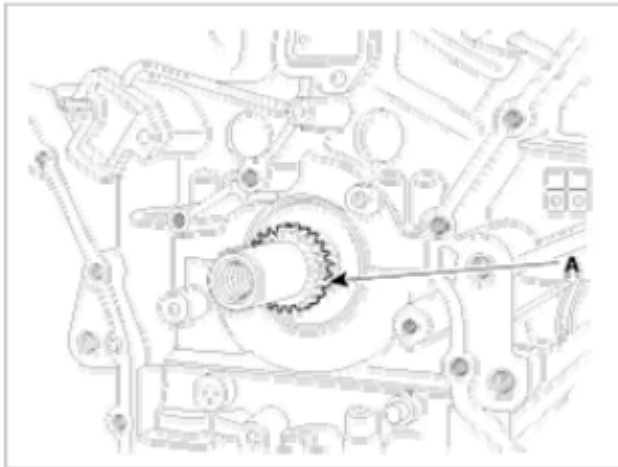


Fig. 92: Locating Crankshaft Sprocket (LH Camshaft Drive)

42. Remove the tensioner adapter assembly (A).

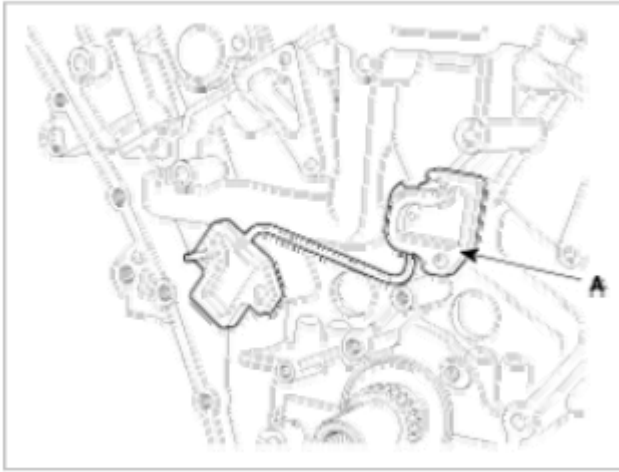


Fig. 93: Locating Tensioner Adapter Assembly

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.

INSTALLATION

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

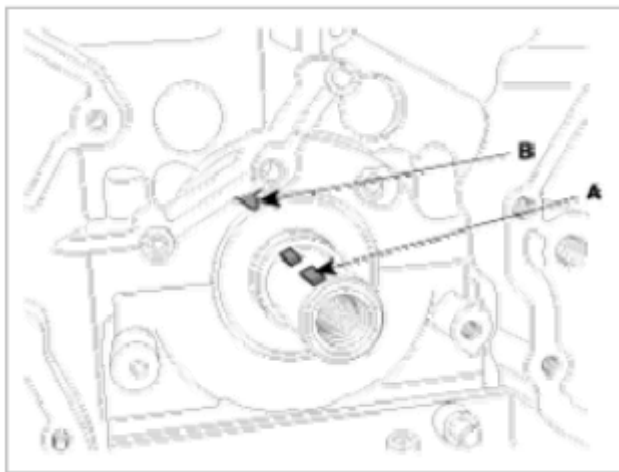


Fig. 94: Aligning Crankshaft Key With Timing Mark Of Timing Chain Cover

3. Install the tensioner adapter assembly (A).

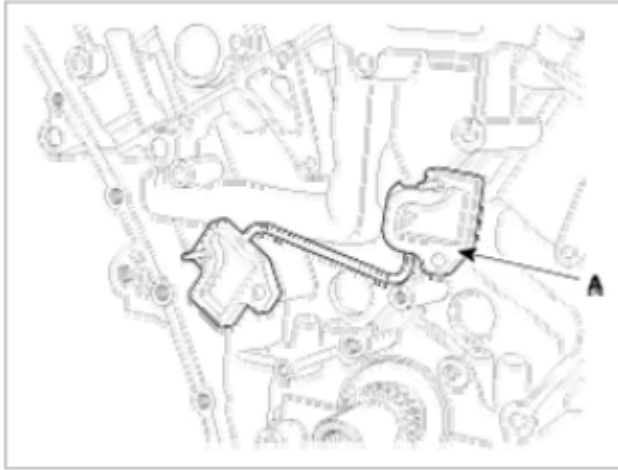


Fig. 95: Locating Tensioner Adapter Assembly

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

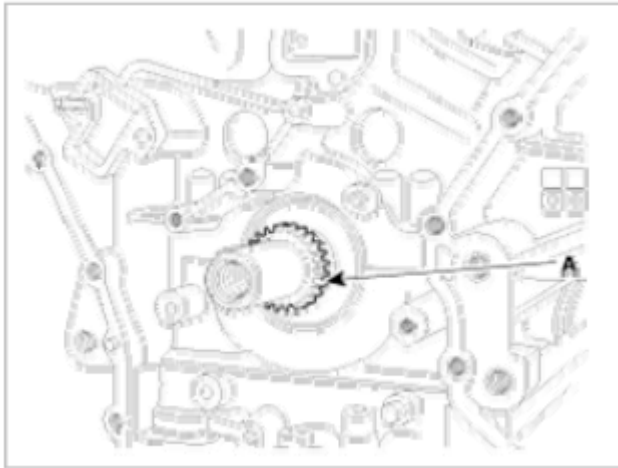


Fig. 96: Locating Crankshaft Sprocket (LH Camshaft Drive)

5. Install the LH timing chain guide (A).

Tightening torque:

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

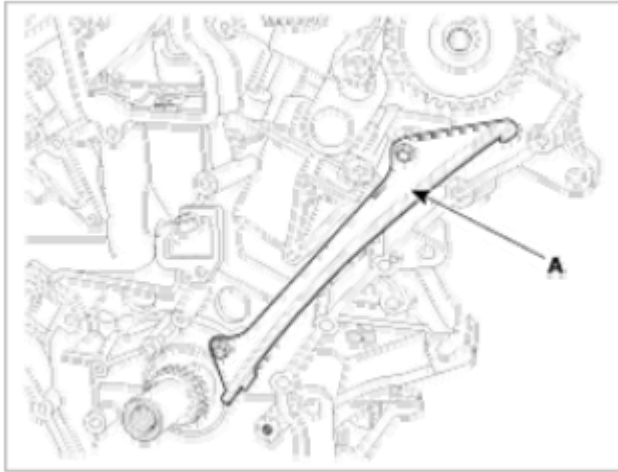


Fig. 97: Locating LH Timing Chain Guide

6. Install LH timing chain.

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

Crankshaft sprocket --> Timing chain guide --> Exhaust camshaft sprocket(C) --> Intake camshaft sprocket(D). The timing mark of each sprocket should be matched with timing mark (color link) of timing chain at installing timing chain.

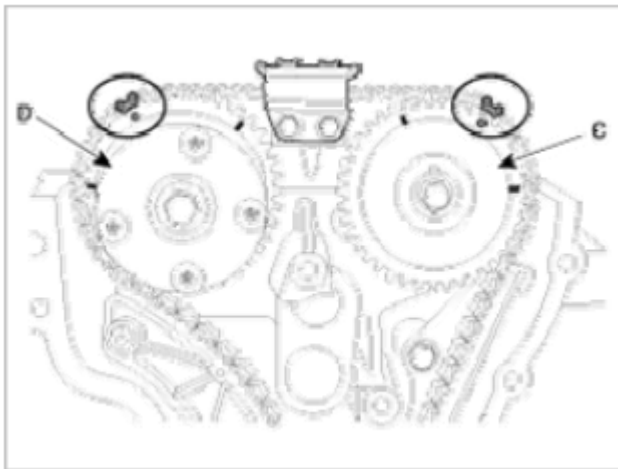


Fig. 98: Identifying Timing Mark Of Camshaft Sprocket Matched With Timing Mark (Color Link) Of Timing Chain

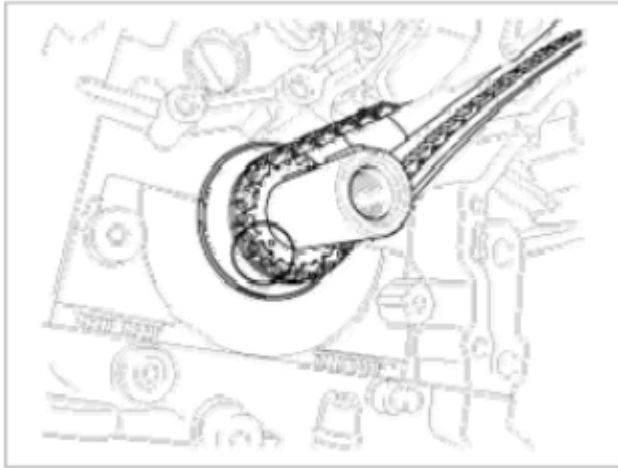


Fig. 99: Identifying Timing Mark Of Crankshaft Sprocket Matched With Timing Mark Of Timing Chain

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

Tightening torque:

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

8. Install the LH chain tensioner (A).

Tightening torque:

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

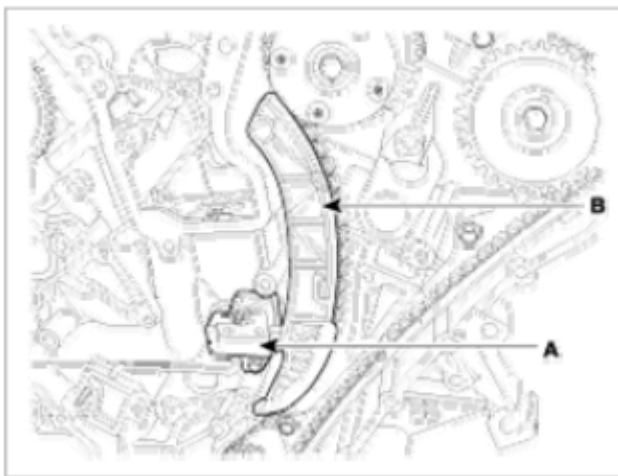


Fig. 100: Locating LH Chain Tensioner And LH Timing Chain Tensioner Arm

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

Tightening torque:

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

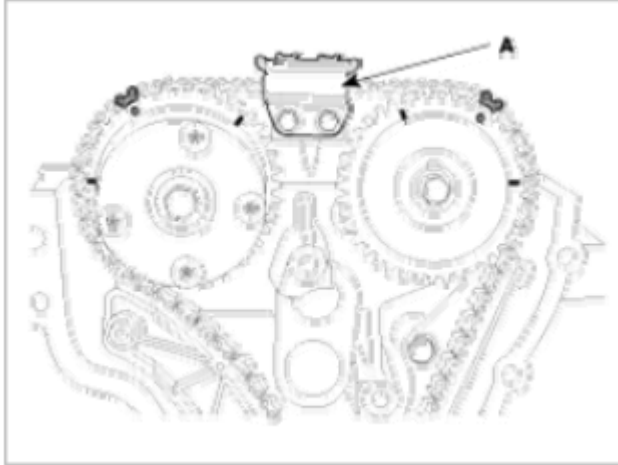


Fig. 101: Locating LH Cam-To-Cam Guide

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

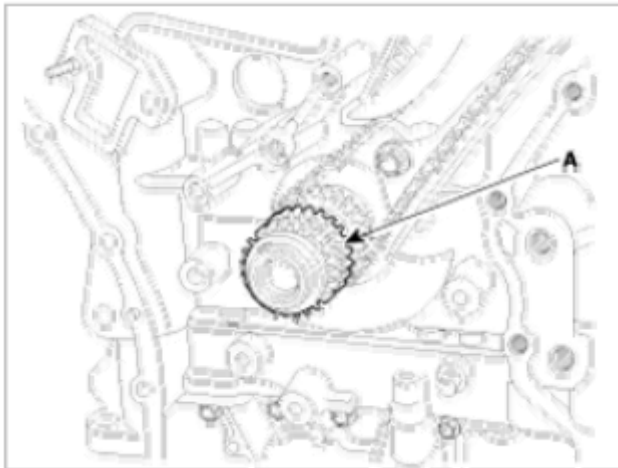


Fig. 102: Locating Crankshaft Sprocket (Oil Pump & RH Camshaft Drive)

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

Tightening torque:

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



Fig. 103: Locating Oil Pump Chain And Oil Pump Sprocket

12. Install the RH timing chain guide (A).

Tightening torque:

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

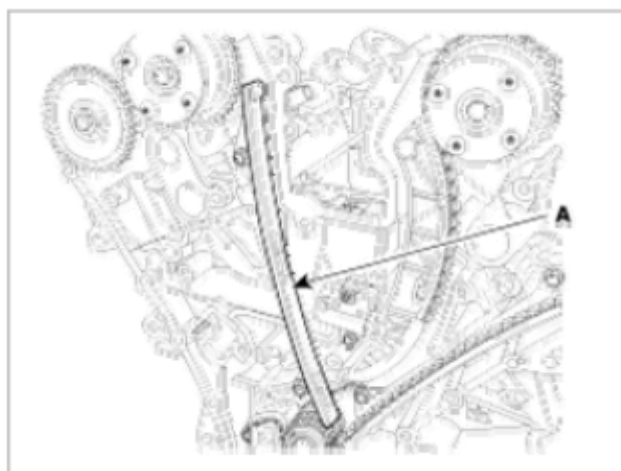


Fig. 104: Locating RH Timing Chain Guide

13. Install the RH timing chain.

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

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

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

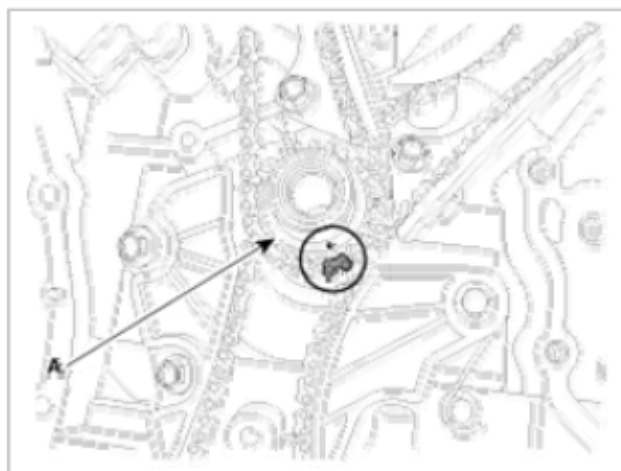


Fig. 105: Identifying Timing Mark Of Crankshaft Sprocket Matched With Timing Mark (Color Link) Of Timing Chain

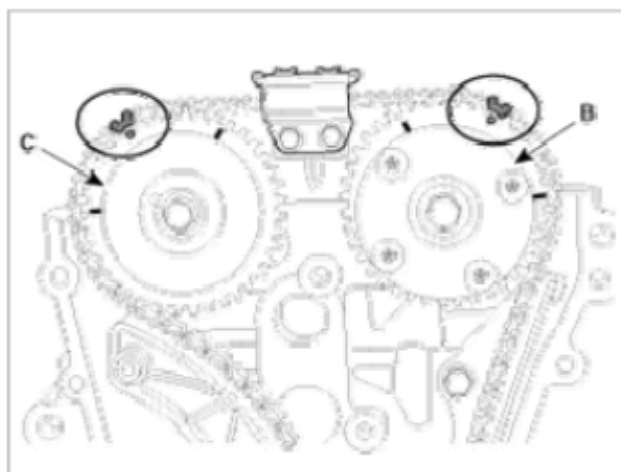


Fig. 106: Identifying Timing Mark Of Camshaft Sprocket Matched With Timing Mark (Color Link) Of Timing Chain

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

Tightening torque:

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

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

Tightening torque:

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

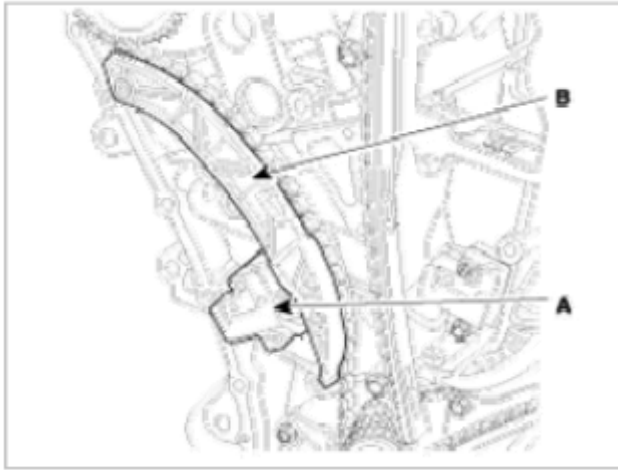


Fig. 107: Locating RH Timing Chain Auto Tensioner And RH Timing Chain Tensioner Arm

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

Tightening torque:

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

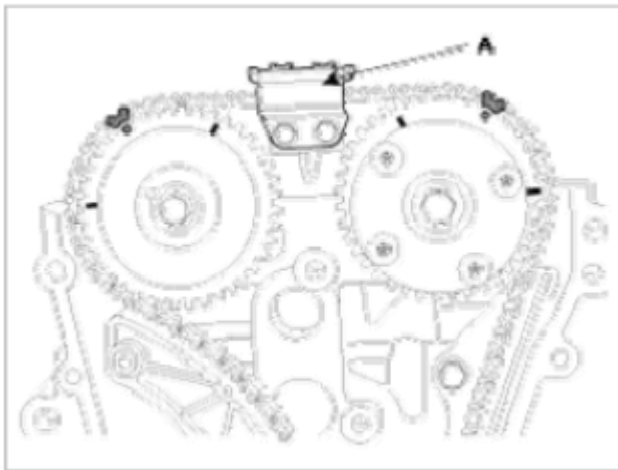


Fig. 108: Locating RH Cam-To-Cam Guide

17. Install the oil pump chain guide (A).

Tightening torque:

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

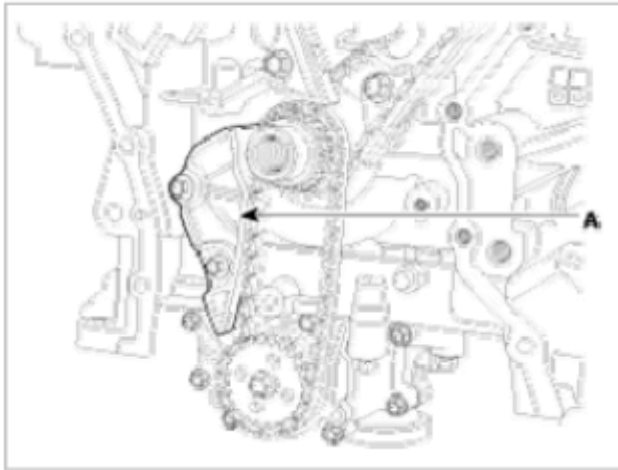


Fig. 109: Locating Oil Pump Chain Guide

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

Tightening torque:

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

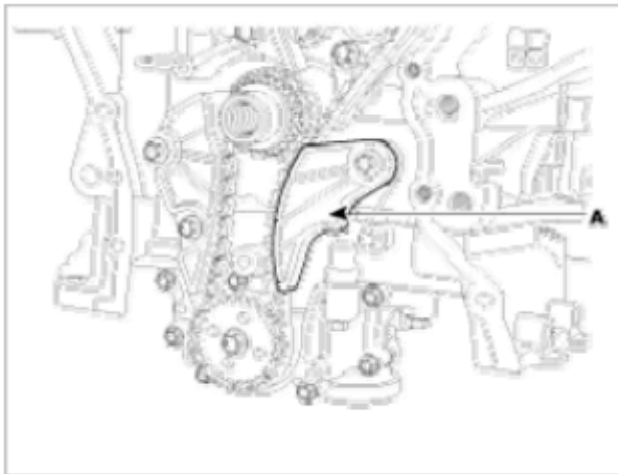


Fig. 110: Locating Oil Pump Chain Tensioner Assembly

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

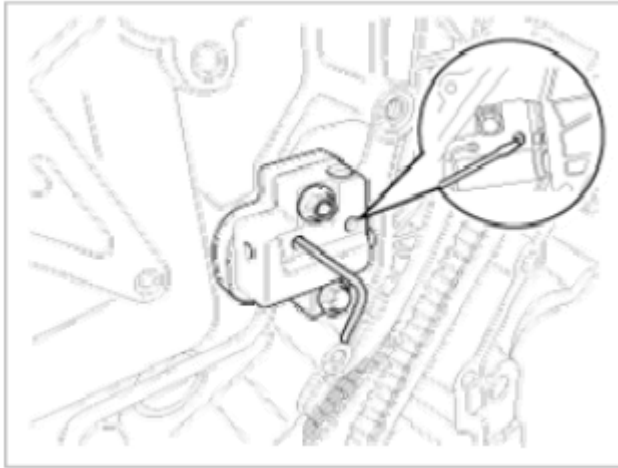


Fig. 111: Pulling Out Pins Of Hydraulic Tensioners (LH)

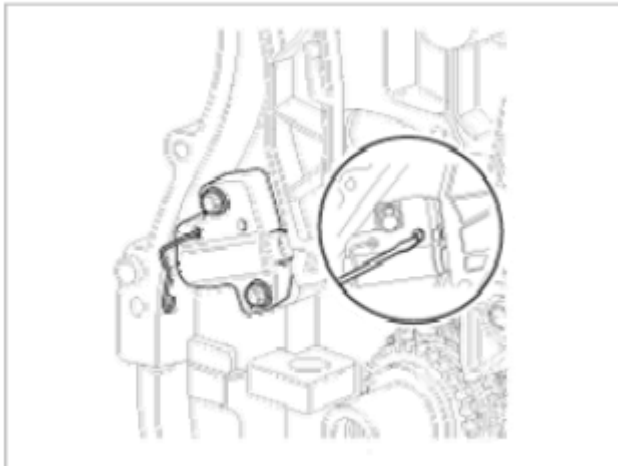


Fig. 112: Pulling Out Pins Of Hydraulic Tensioners (RH)

20. Install the 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)

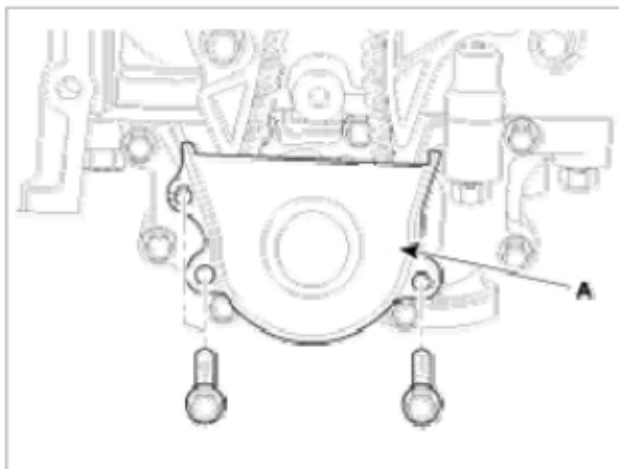


Fig. 113: Locating Oil Pump Chain Cover

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

NOTE: Always turn the crankshaft clockwise.

22. Install the timing chain cover.
1. 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.
 2. Before assembling the timing chain cover, the liquid sealant TB1217H should be applied on the gap between cylinder head and cylinder block.

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

Bead width: 2.5 mm (0.1 in.)

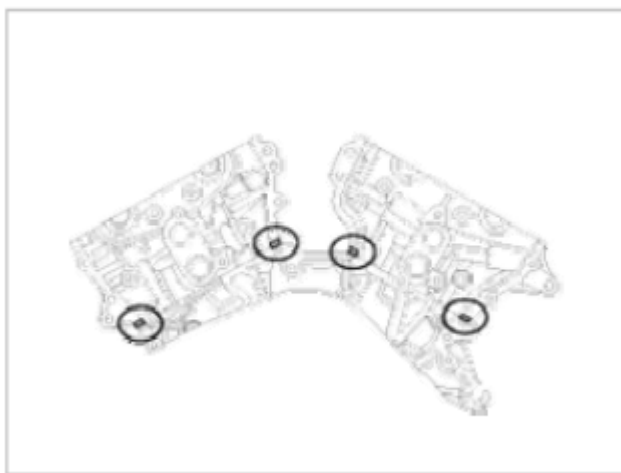


Fig. 114: Identifying Sealant Locations On Chain Cover

3. After applying liquid sealant TB1217H on the timing chain cover.

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

Sealant should be applied without discontinuity.

Bead width: 2.5 mm (0.1 in.)

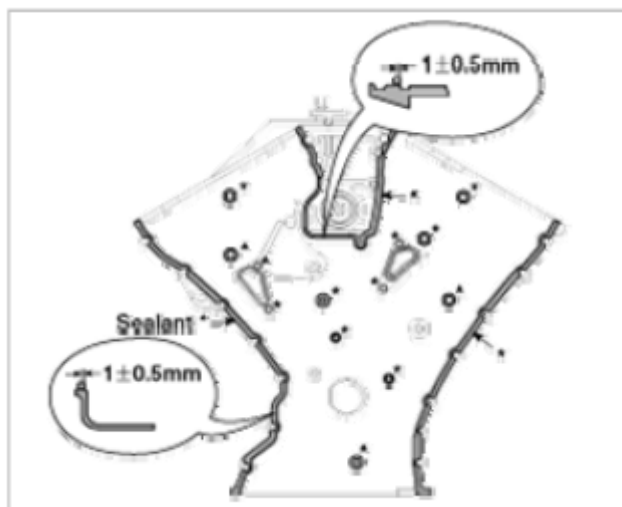


Fig. 115: Identifying Timing Chain Cover Liquid Sealant TB1217H Applying Specifications

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

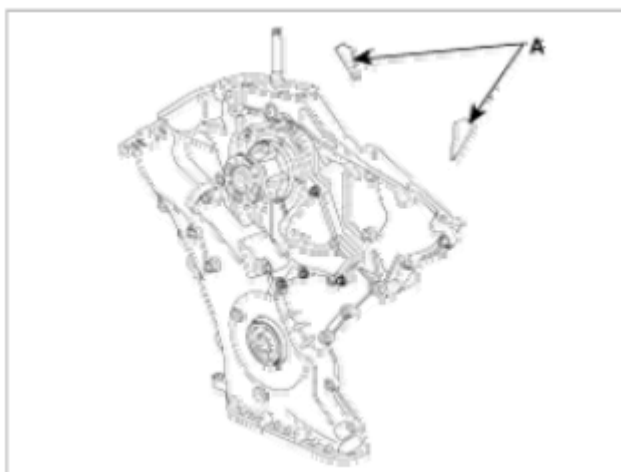


Fig. 116: Locating Timing Chain Cover Gasket

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

5. 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 ~ 21.56 N.m (1.9 ~ 2.2 kgf.m, 13.74 ~ 15.91 lb-ft)

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

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

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

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

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

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

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

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

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

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

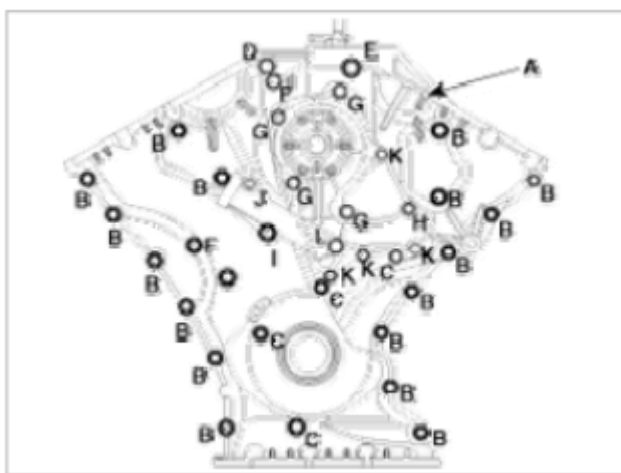


Fig. 117: Identifying Timing Chain Cover Bolts Tightening Torque

6. The firing and/or blow out test should not be performed within 30 minutes after the timing chain cover was assembled.
23. Install the water pump pulley (A).

Tightening torque:

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

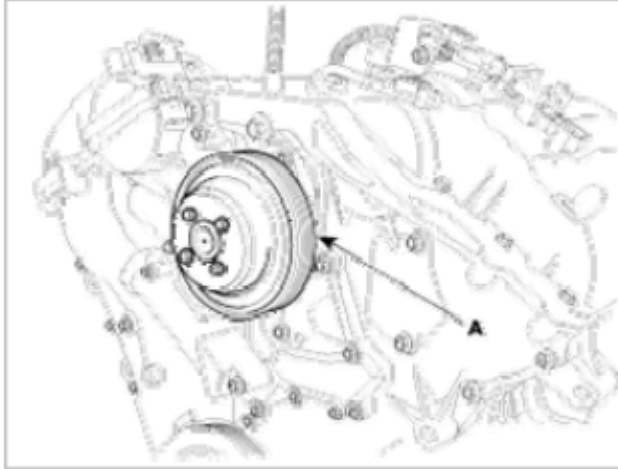


Fig. 118: Locating Water Pump Pulley

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

Tightening torque:

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

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

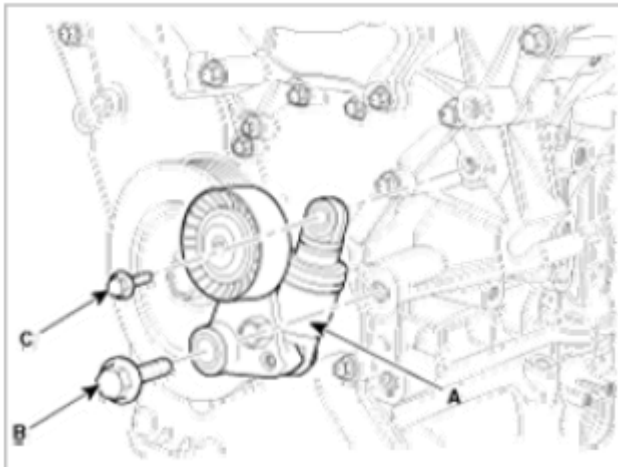


Fig. 119: Locating Drive Belt Auto Tensioner

25. Install the drive belt idler (A).

Tightening torque:

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

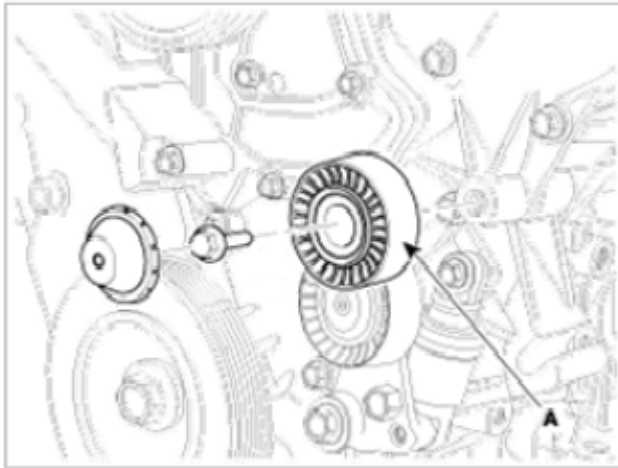


Fig. 120: Locating Drive Belt Idler

26. Install the alternator (A).

Tightening torque:

26.48 ~ 33.34 N.m (2.7 ~ 3.4 kgf.m, 19.53 ~ 24.59 lb-ft)

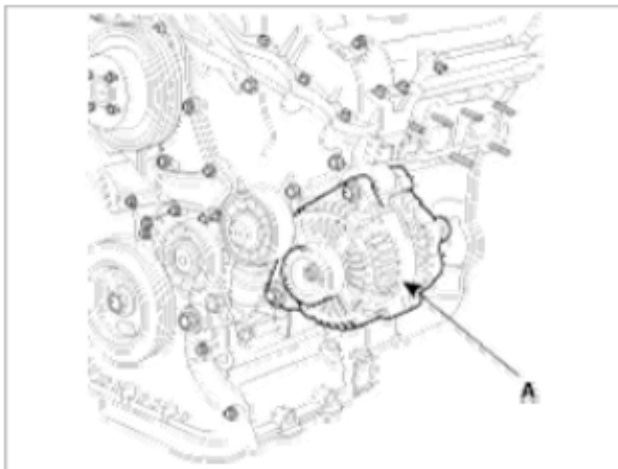


Fig. 121: Locating Alternator

27. Install the power steering pump (A). (Refer to ST group)

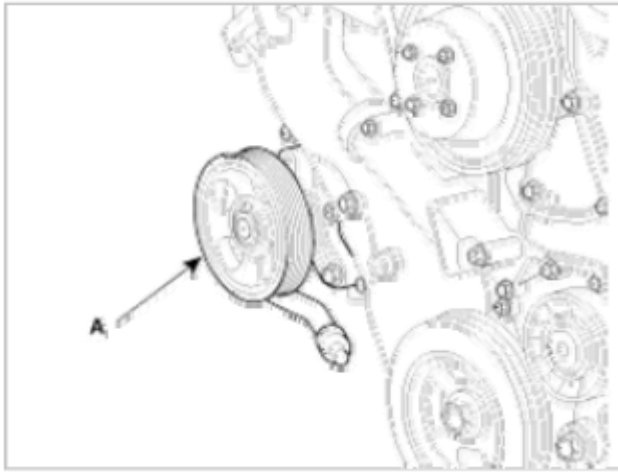


Fig. 122: Locating Power Steering Pump

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

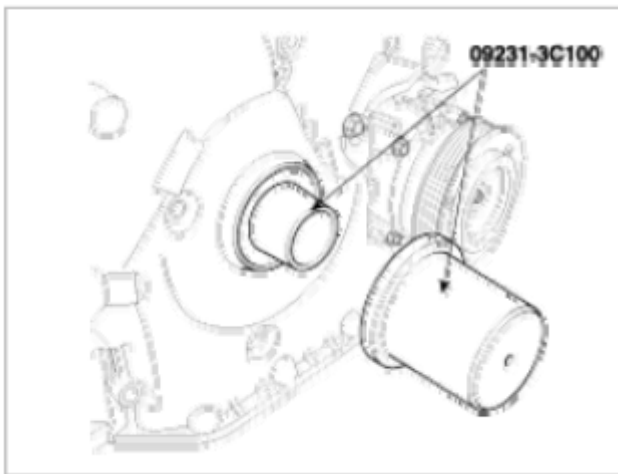


Fig. 123: Installing Timing Chain Cover Oil Seal Using SST (09231-3C100)

30. Install the crankshaft damper pulley (A).

Tightening torque:

284.2~303.8 N.m (29.0~31.0 kgf.m, 209.76~224.22 lbft)

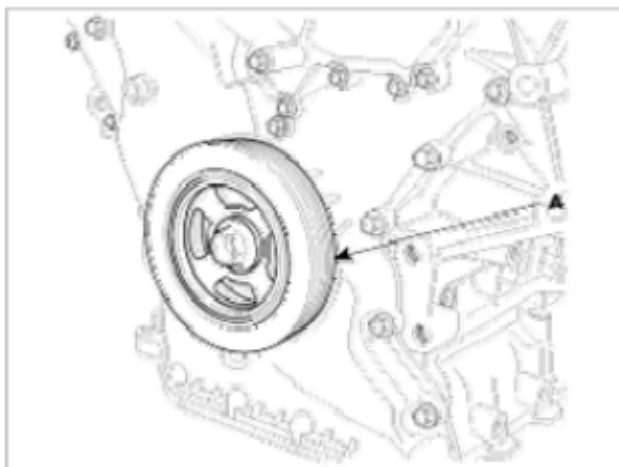


Fig. 124: Locating Crankshaft Damper Pulley

NOTE: There are two methods to hold the ring gear when installing or removing the crankshaft damper pulley.

- Install the SST (09231-3C300) to hold the ring gear after removing the starter.

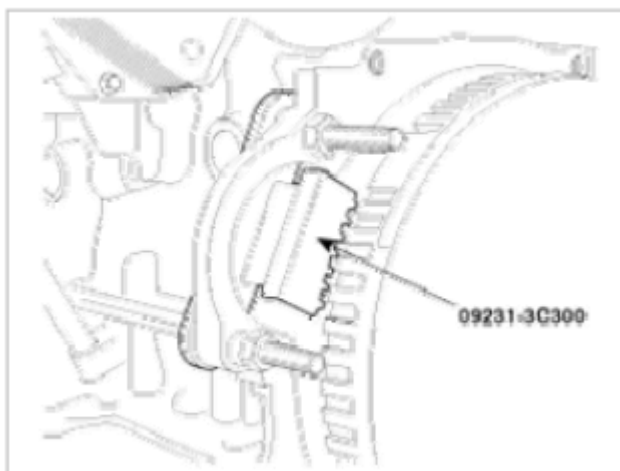


Fig. 125: Installing SST (09231-3C300) To Hold Ring Gear After Removing Starter

- Install the SST (09231-3D100) to hold the ring gear after removing the dust cover.
1. Remove the front muffler. (Refer to Intake And Exhaust system)
 2. Remove the dust cover (A) on the bottom of the upper oil pan and unfasten the two transaxle mounting bolts (B).

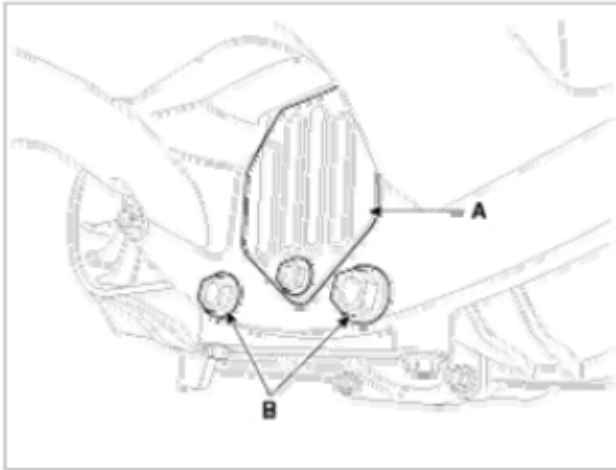


Fig. 126: Locating Dust Cover On Bottom Of Upper Oil Pan And Transaxle Mounting Bolts

3. Adjust the length of the holder nuts (A) so that the front plate of the holder (B) puts in the ring gear (C) teeth.
4. Fasten the two transaxle mounting bolts in the original mounted holes.

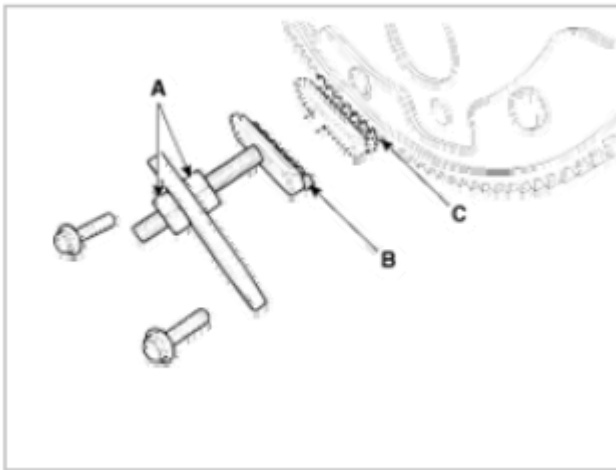


Fig. 127: Locating Holder Nuts, Front Plate Holder And Ring Gear

5. Install the SST (09231-3D100) using the two mounting bolts. Tighten the bolts and nuts of the holder securely.

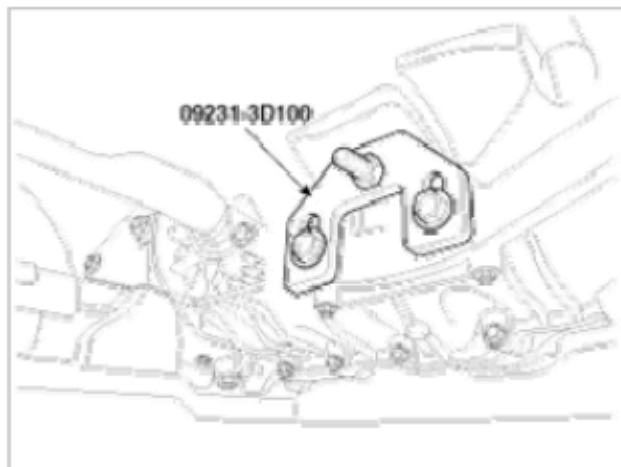


Fig. 128: Identifying SST (09231-3D100) And Mounting Bolts

31. Install the 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 counterclockwise moving auto tensioner pulley bolt with wrench.

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

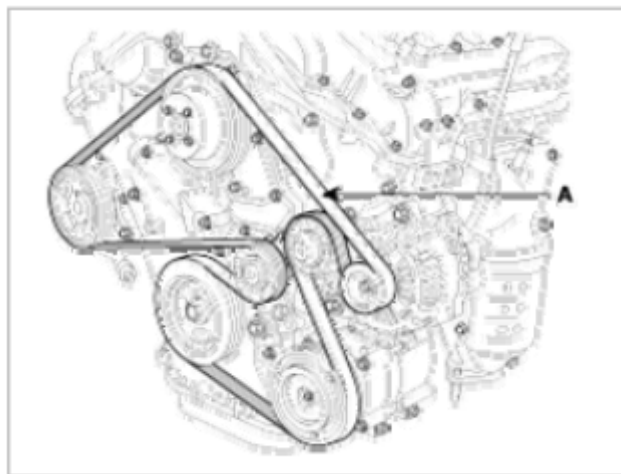


Fig. 129: Locating Drive Belt

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

Bead width: 2.5 mm (0.1 in.)

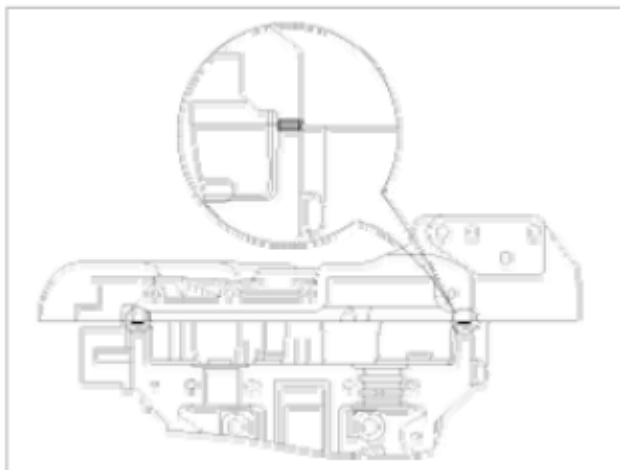


Fig. 130: Identifying Hardening Sealant Located On Upper Area Between Timing Chain Cover And Cylinder Head

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

Tightening torque:

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

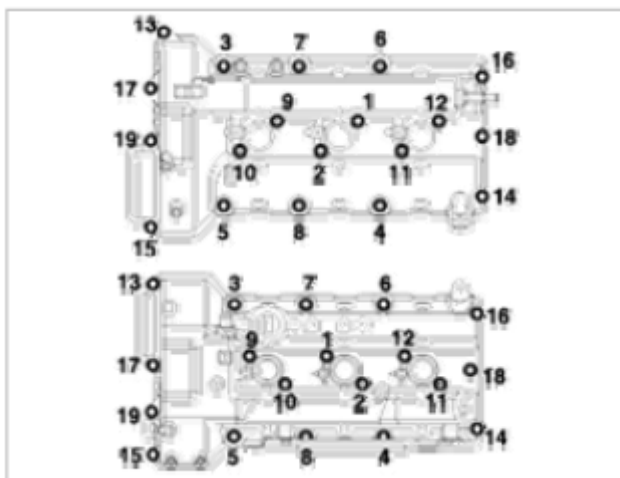


Fig. 131: Identifying Cylinder Head Cover Bolts Tightening Sequence (LH And RH)

CAUTION: Do not reuse cylinder head cover gasket.

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

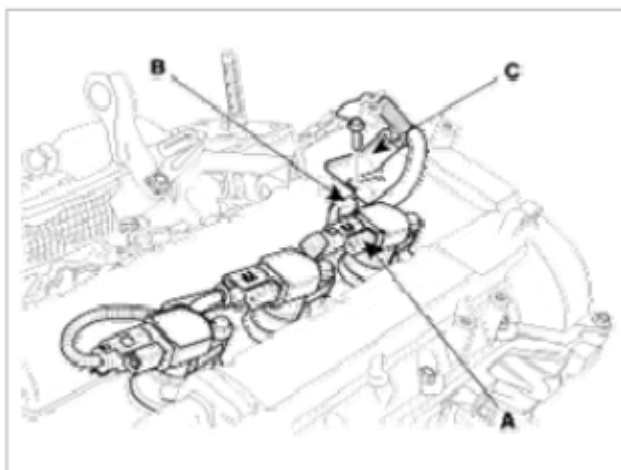


Fig. 132: Locating RH Ignition Coil Connector, Condenser Connector And Wiring Bracket

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

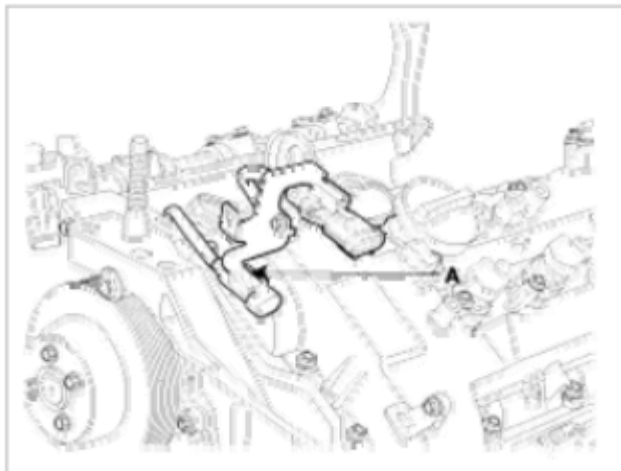


Fig. 133: Locating LH Cylinder Head Cover Connector Bracket

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

Tightening torque:

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

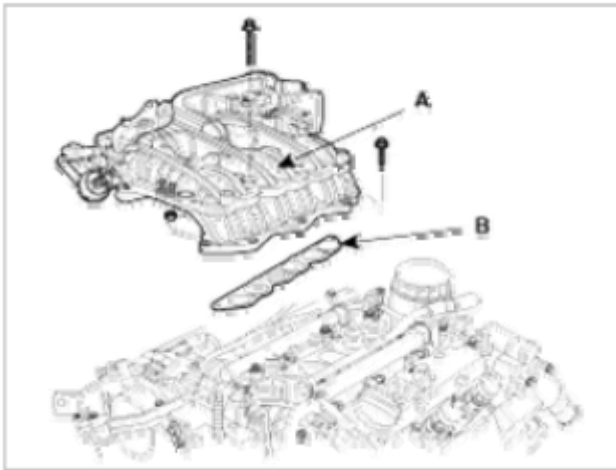


Fig. 134: Locating Surge Tank

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

Tightening torque:

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

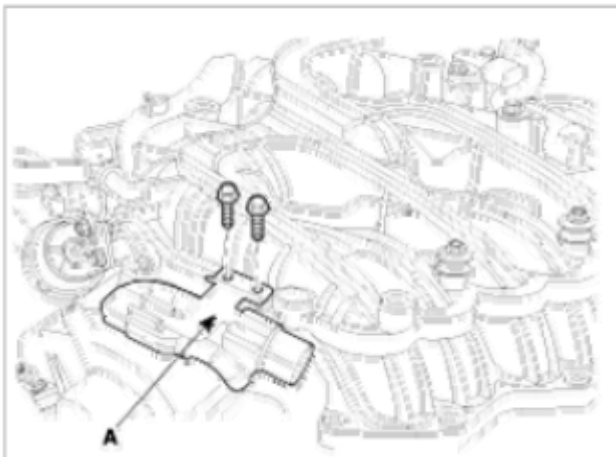


Fig. 135: Locating Surge Tank Connector Bracket

3. Install the surge tank stay.

Tightening torque:

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

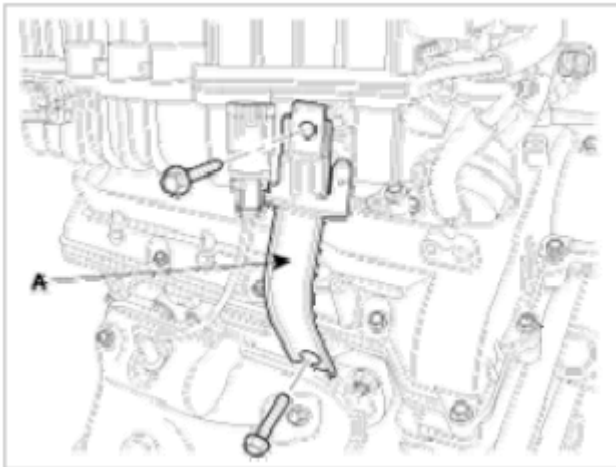


Fig. 136: Locating Surge Tank Stay

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

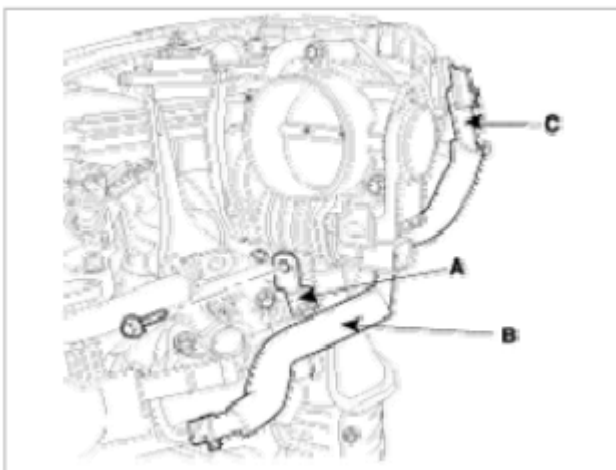


Fig. 137: Locating ETC Bracket, Water Hoses And PCV Hose

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

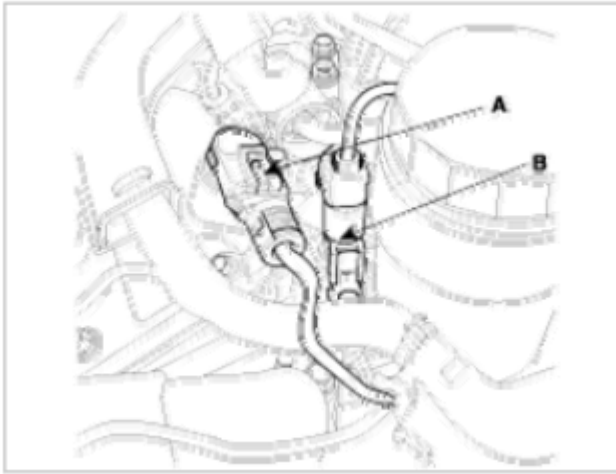


Fig. 138: Locating LH CMPS Connector And Oil Pressure Switch Connector

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

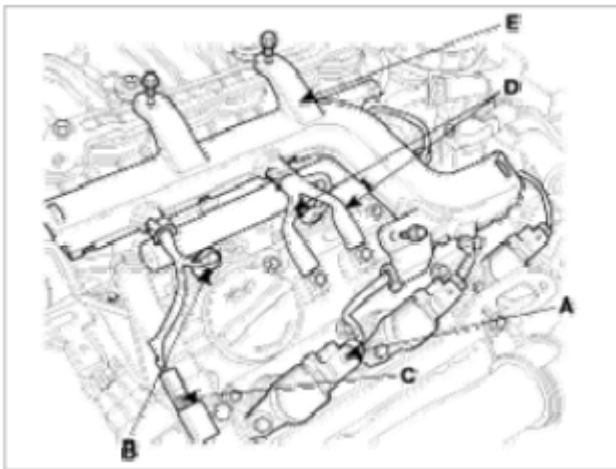


Fig. 139: Locating Wiring Harness Protector, LH Ignition Coil Connector, Injector Connector, Condenser Connector And Ground

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

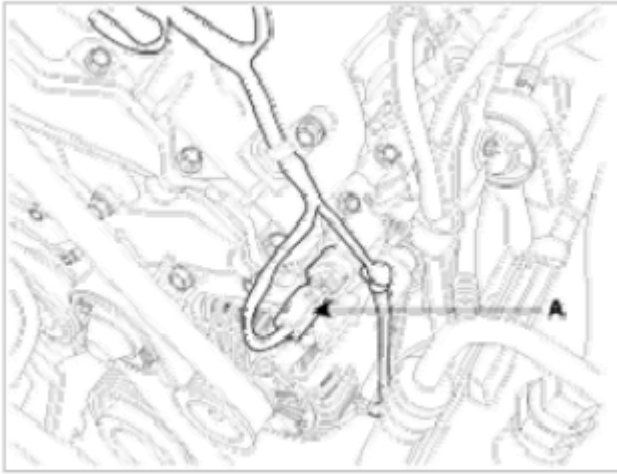


Fig. 140: Locating LH Front Oxygen Sensor Connector

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



Fig. 141: Locating OCV Connector And Knock Sensor Connector

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

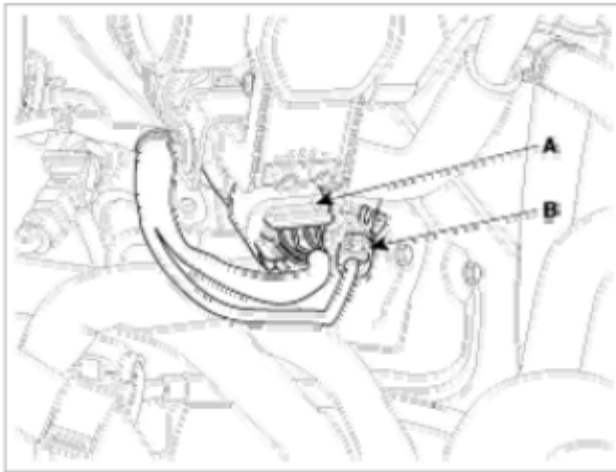


Fig. 142: Locating ETC Connector And Knock Sensor Connector

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

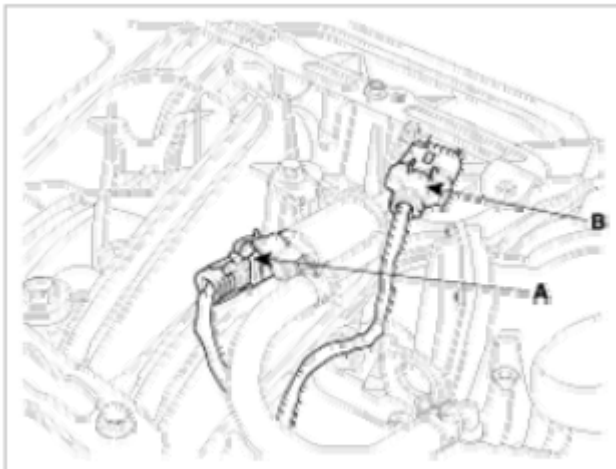


Fig. 143: Locating PCSV Connector And MAP Sensor Connector

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

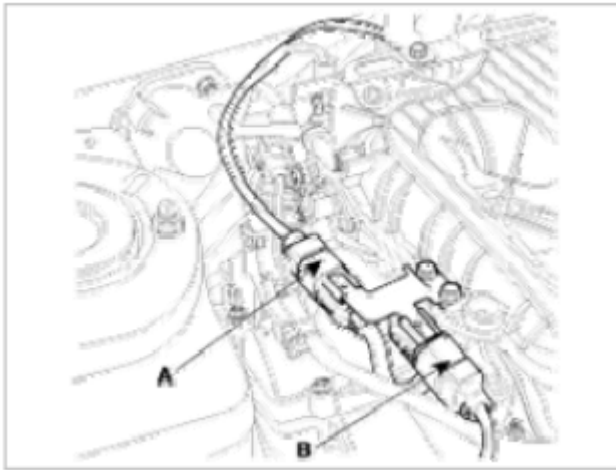


Fig. 144: Locating RH Injector Connector And Ignition Coil Connector

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

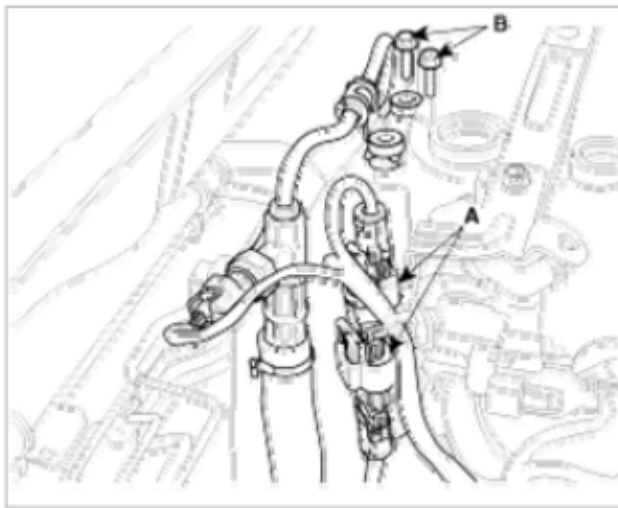


Fig. 145: Locating RH Oxygen Sensor Connector And Power Steering Hose Mounting Bolts

34. Install the engine mounting bracket (A).

Tightening torque:

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

C: 58.8 ~ 78.5 N.m (6.0 ~ 8.0 kgf.m, 43.4 ~ 57.9 lb-ft)

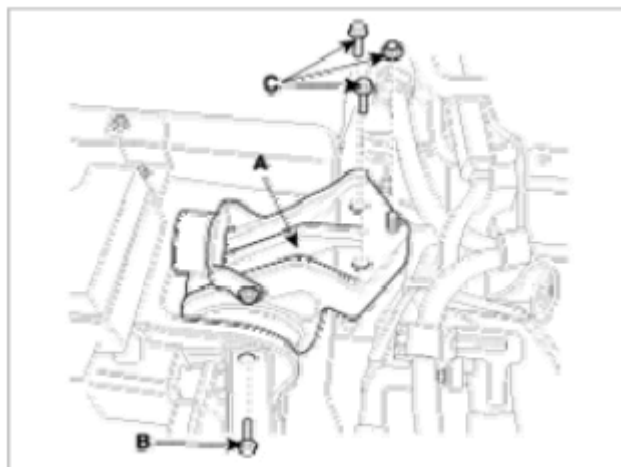


Fig. 146: Locating Engine Mounting Bracket, Bolts And Nuts

35. Install the transaxle mounting bracket bolts and nuts.

Tightening torque:

58.8 ~ 78.5 N.m (6.0 ~ 8.0 kgf.m, 43.4 ~ 57.9 lb-ft)

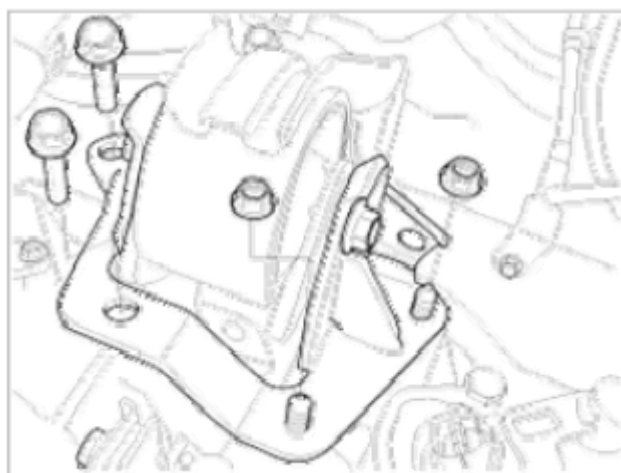


Fig. 147: Identifying Transaxle Mounting Bracket, Bolts And Nuts

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

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

Bead width: 2.5 mm (0.1 in.).

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

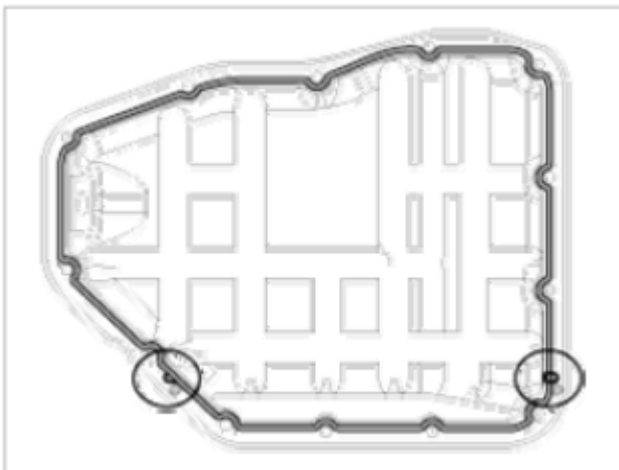


Fig. 148: Identifying Liquid Sealant TB1217H On Oil Pan

CAUTION:

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

3. Install the lower oil pan (A).

Tightening torque:

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

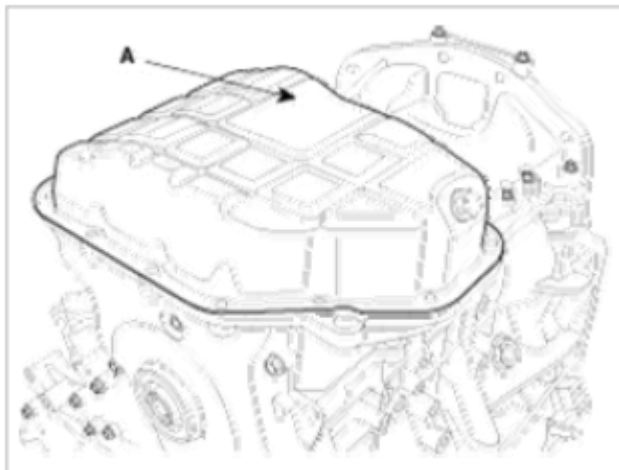


Fig. 149: Locating Lower Oil Pan

38. Tighten the power steering oil cooler return pipe mounting bolt.
39. Install the side cover.

Tightening torque:

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

40. Install the under cover (A).

Tightening torque:

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

**Fig. 150: Locating Under Cover**

41. Install the RH front wheel.

Tightening torque:

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

42. Install the intake air hose and air cleaner assembly.
 1. Install the intake air hose (C) and air cleaner body (D).
 2. Connect the breather hose (B) to the air cleaner hose.
 3. Connect the AFS connector (A).

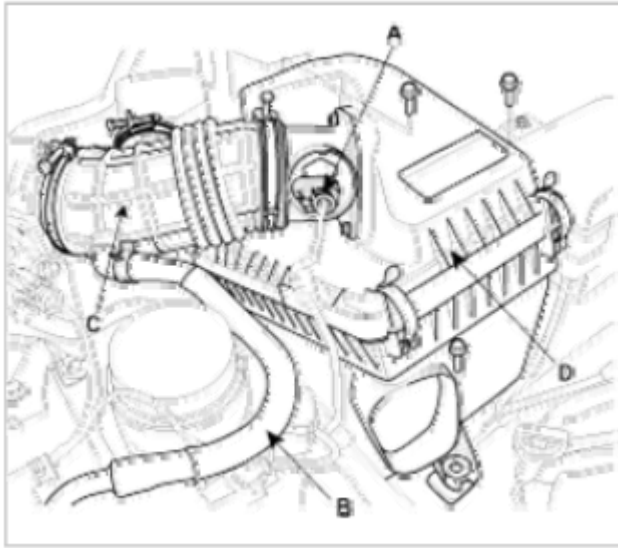


Fig. 151: Locating AFS Connector, Breather Hose, Intake Air Hose And Air Cleaner Body

43. Install the engine cover (A).

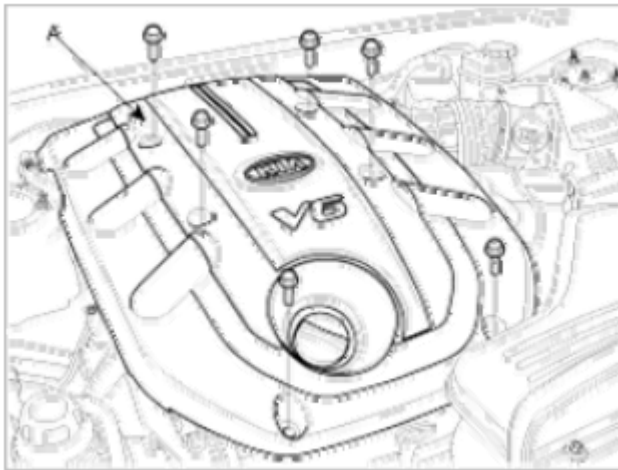


Fig. 152: Locating Engine Cover

44. Connect the battery negative cable (A).

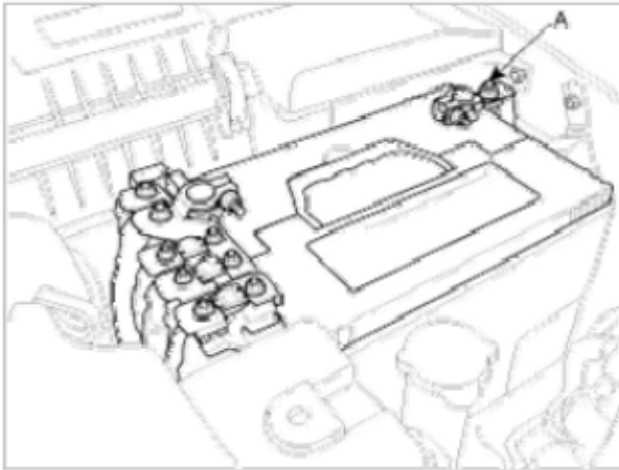


Fig. 153: Locating Battery Negative Cable

NOTE:

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

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)

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

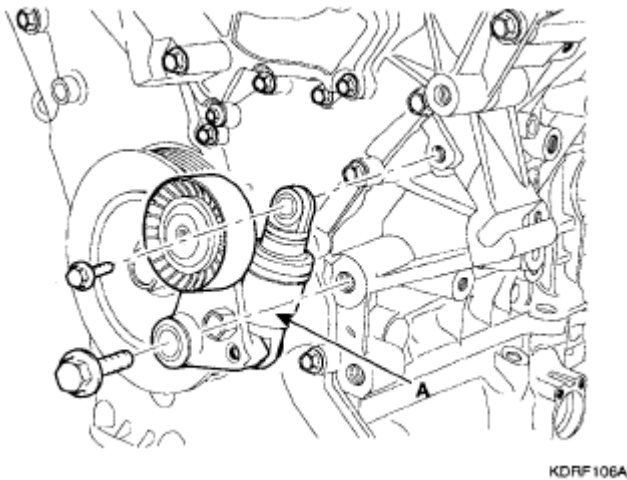
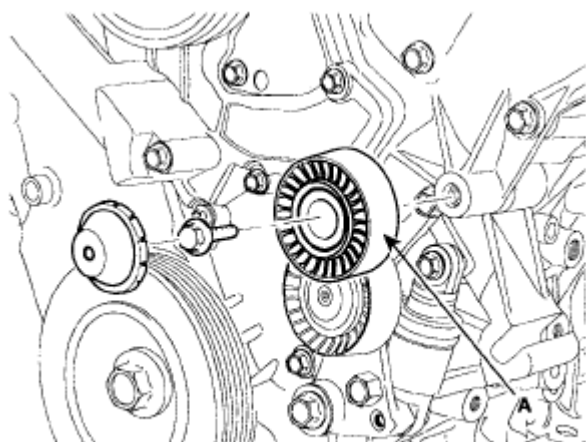


Fig. 154: Locating Drive Belt Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

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)



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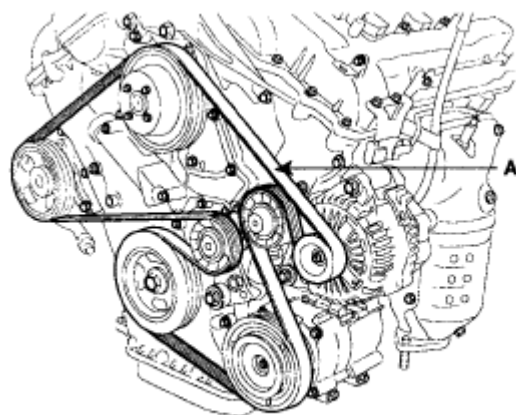
Fig. 155: Locating Drive Belt Idler
Courtesy of KIA MOTORS AMERICA, INC.

3. Install drive belt (A).

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

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

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

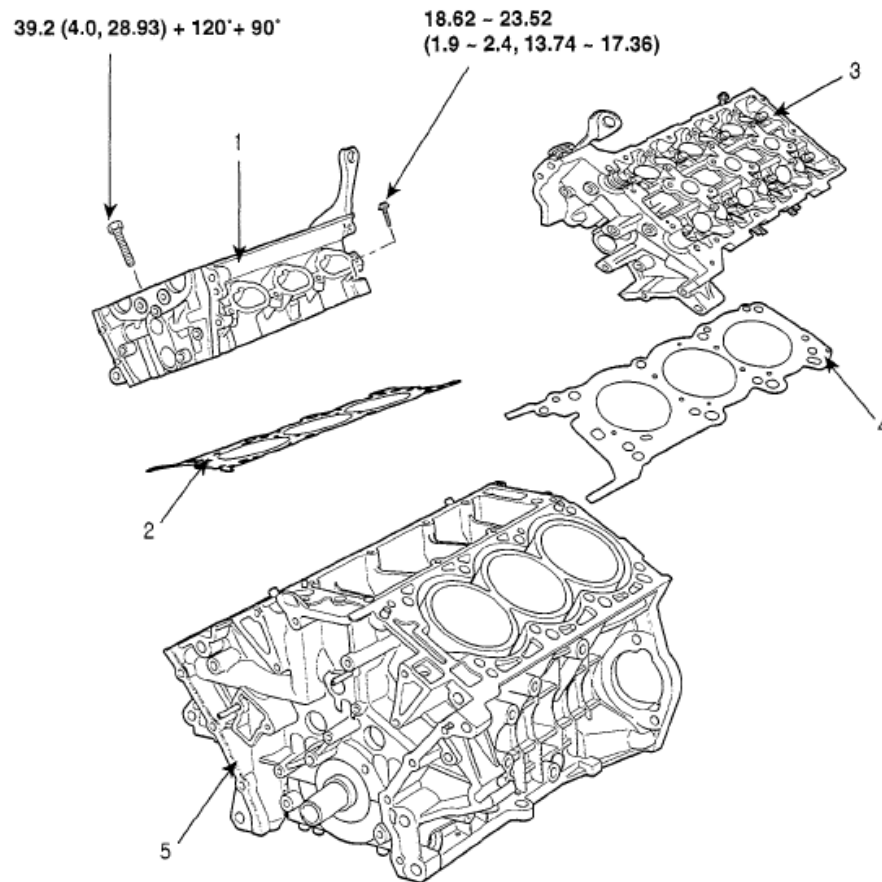


KDRF101A

Fig. 156: Locating Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

CYLINDER HEAD ASSEMBLY

COMPONENTS

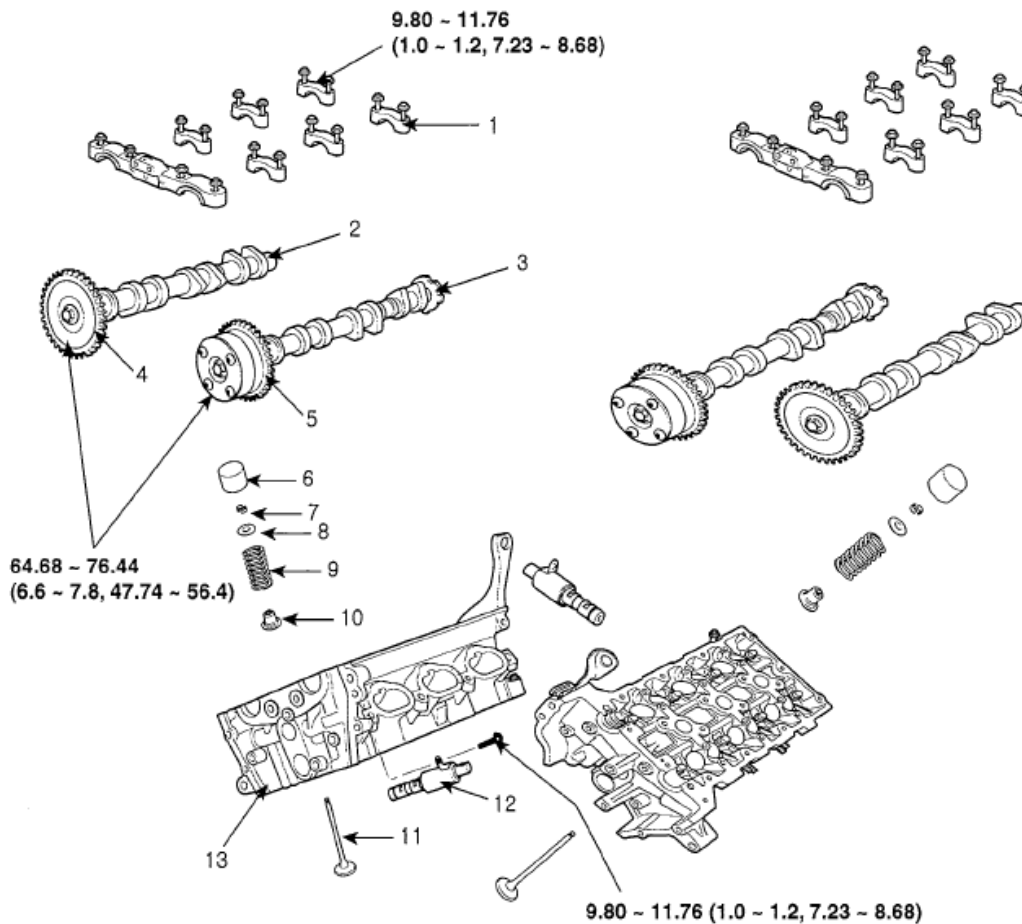


TORQUE : N.m (kgf.m, lb-ft)

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

ECBF010A

Fig. 157: Identifying Cylinder Head Assembly Components With Torque Specifications (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.



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

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

ECBF011A

Fig. 158: Identifying Cylinder Head Assembly Components With Torque Specifications (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

CAUTION:

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

holding the connector portion.

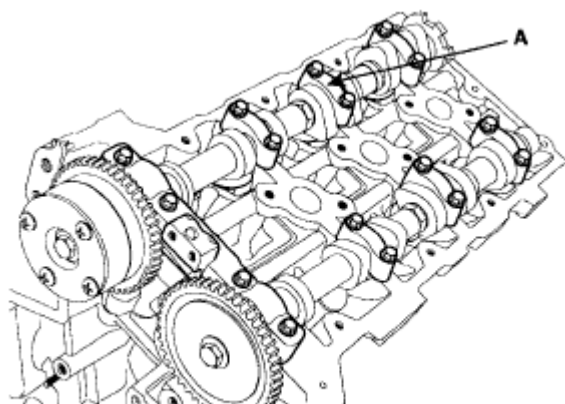
NOTE:

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

NOTE:

Engine removal is required for this procedure.

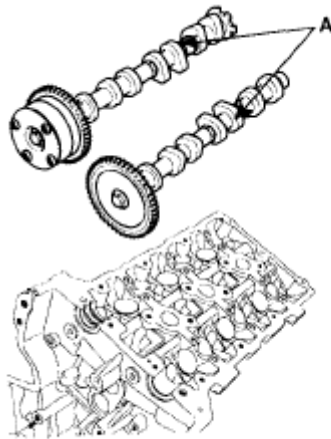
1. Remove exhaust manifold.
2. Remove intake manifold.
3. Remove timing chain.
4. Remove water temperature control assembly.
5. Remove camshaft bearing cap (A).



KDRF196A

Fig. 159: Locating Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

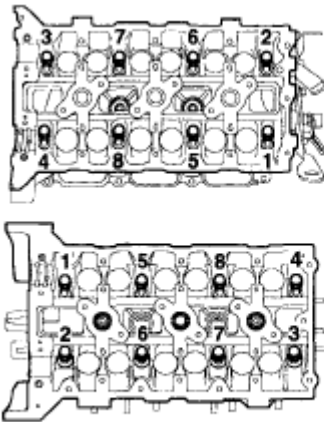
6. Remove camshaft assembly (A).



KDRF197A

Fig. 160: 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 in illustration. Remove the 16 cylinder head bolts and plate washers.



KDRF199A

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

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

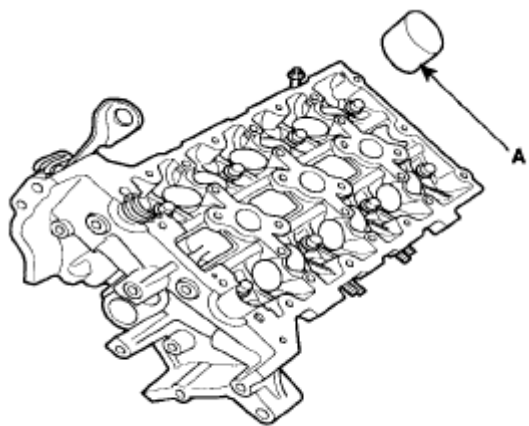
2. Lift the cylinder head from the dowels on the cylinder block and place the cylinder head on wooden blocks on a bench.

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

DISASSEMBLY

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

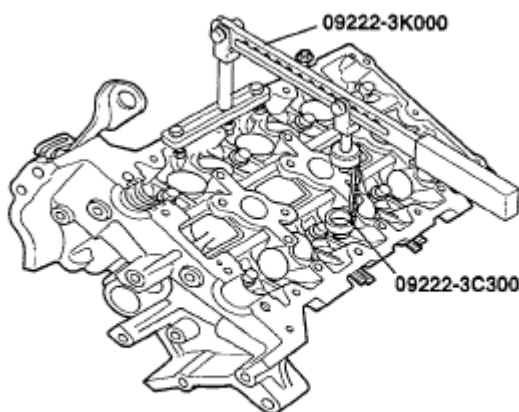
1. Remove MLAs (A).



KDRF200A

Fig. 162: 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. 163: 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.

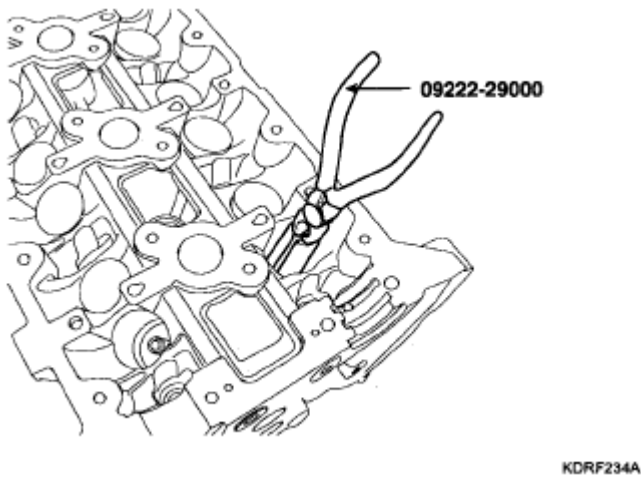


Fig. 164: Identifying SST (09222-29000)
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not reuse old valve stem seals.

3. Remove OCV (A).

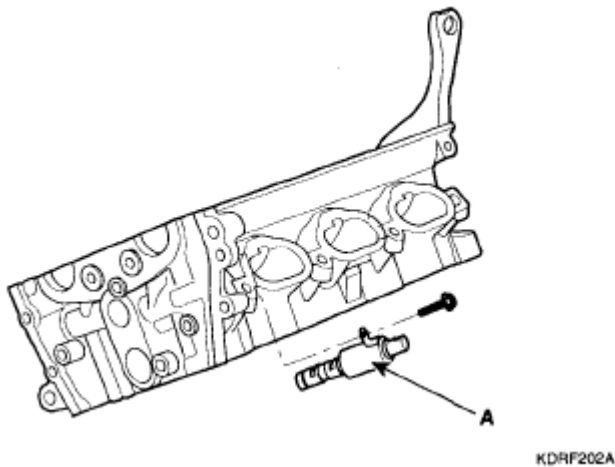


Fig. 165: Identifying OCV
 Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

CYLINDER HEAD

1. Inspect for flatness.

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

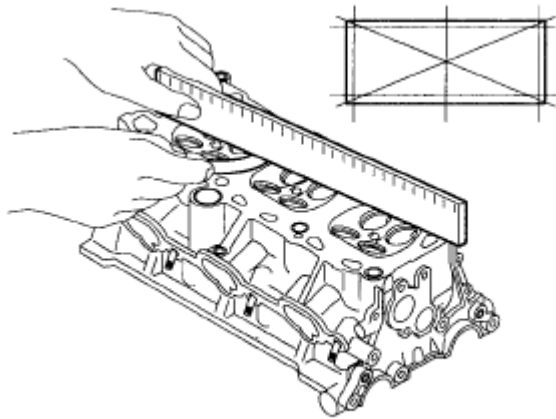
the manifolds for warpage.

Flatness of cylinder head gasket surface

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

Flatness of manifold gasket surface

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



EQQF160A

Fig. 166: Measuring Surface Contacting Cylinder Block And Manifolds For Warpage
Courtesy of KIA MOTORS AMERICA, INC.

2. Inspect for cracks.

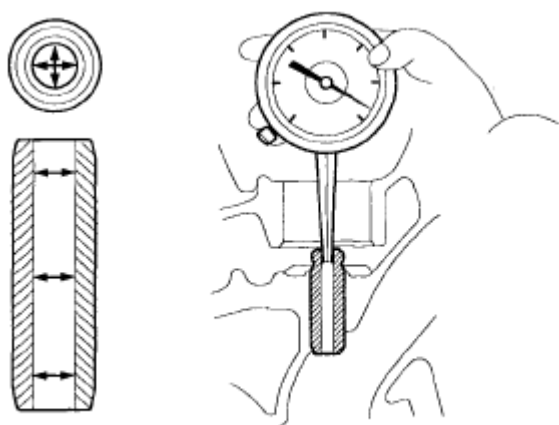
Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

VALVE AND VALVE SPRING

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

Valve guide I.D.

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



ECBF034A

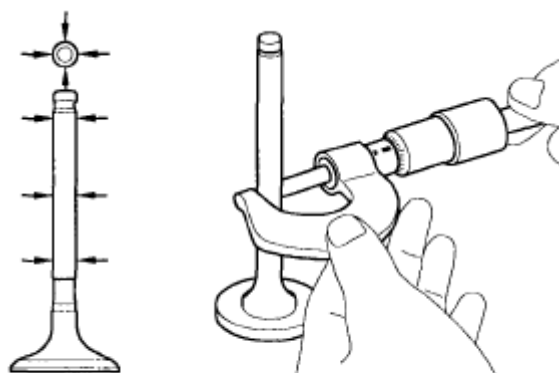
Fig. 167: Measuring Inside Diameter Of Valve Guide
 Courtesy of KIA MOTORS AMERICA, INC.

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. 168: 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.

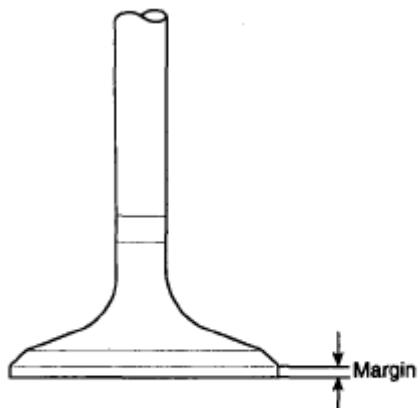
If the margin thickness is less than minimum, replace the valve.

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

4. Check the valve length.

Length

Intake: 105.27 mm (4.1445 in)

Exhaust: 105.50 mm (4.1535 in)

5. Check the surface of the valve stem tip for wear. If the valve stem tip is worn, replace the valve.
3. Inspect valve seats

Check the valve seat for evidence of overheating and improper contact with the valve face. If the valve seat is worn, replace cylinder head. Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace cylinder head. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.

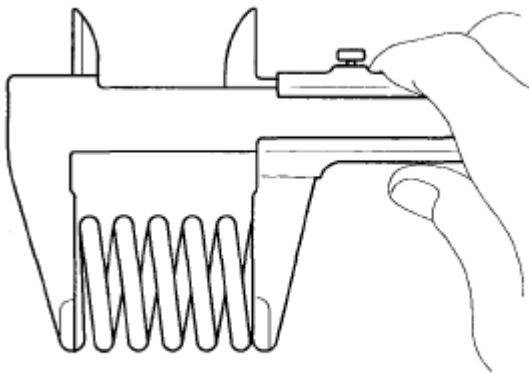
4. Inspect valve springs.
 1. Using a steel square, measure the out-of-square of the valve spring.
 2. Using vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height: 43.86 mm (1.7267 in.)

Out-of-square : 1.5°



KCRF205A

Fig. 170: 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.)

- 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.)

- 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

- Inspect cam lobes.

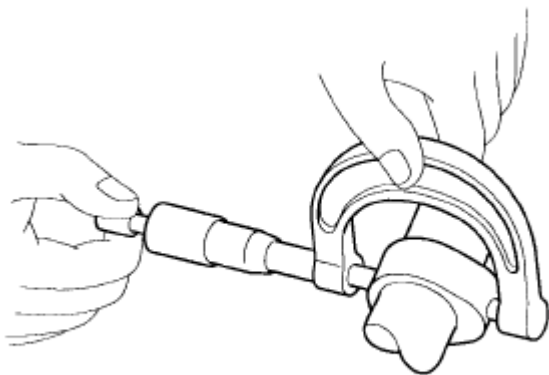
Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

Intake: 46.8 mm (1.8425 in.)

Exhaust: 45.8 mm (1.8031 in.)

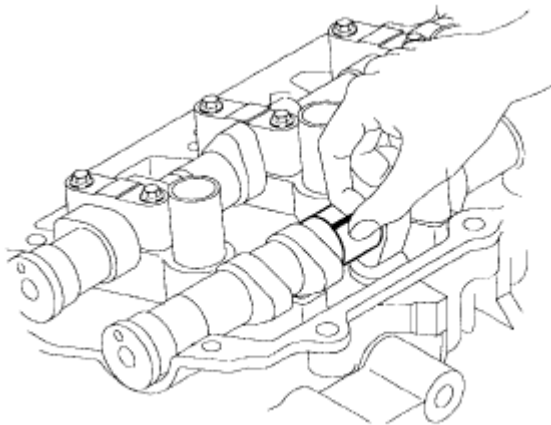


KCRF206A

Fig. 171: 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 journals.



KGRF207A

Fig. 172: Inspecting Camshaft Journal Clearance
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

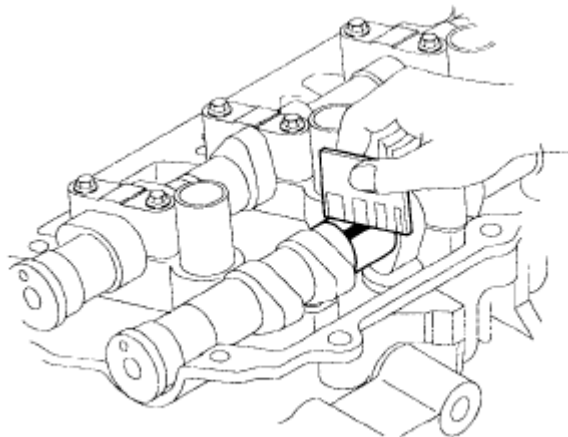
No. 1 journal: 0.020 ~ 0.057 mm (0.0008 ~ 0.0022 in.)

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

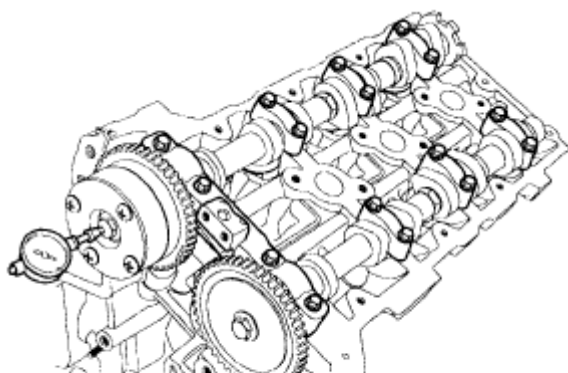
Fig. 173: Measuring Plastigage At Its Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

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

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

Camshaft end play

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



KDRF196B

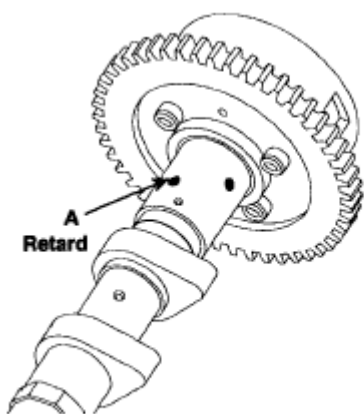
Fig. 174: Measuring End Play While Moving Camshaft Back And Forth
 Courtesy of KIA MOTORS AMERICA, INC.

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

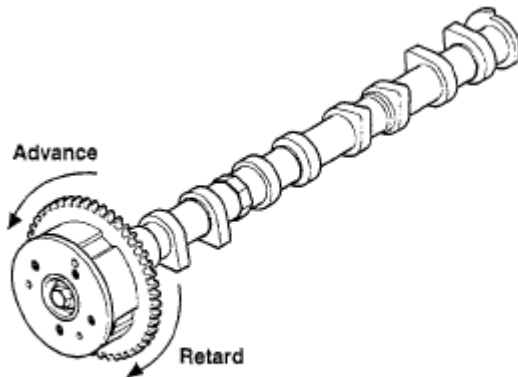
Fig. 175: Locating Retard Hole
 Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

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.



SGHEM7010N

Fig. 176: Identifying Camshaft Advance And Retard Position
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 interference.

Standard: Movable smoothly in the range about 22.5°

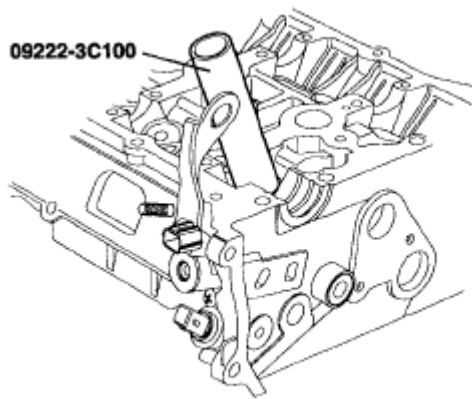
6. Turn the CVVT assembly with your hand and lock it at the maximum delay angle position (clockwise).

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.



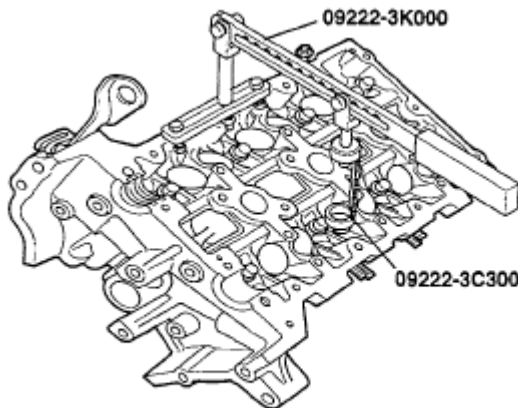
KCRF120B

Fig. 177: Identifying SST (09222-3C100)
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

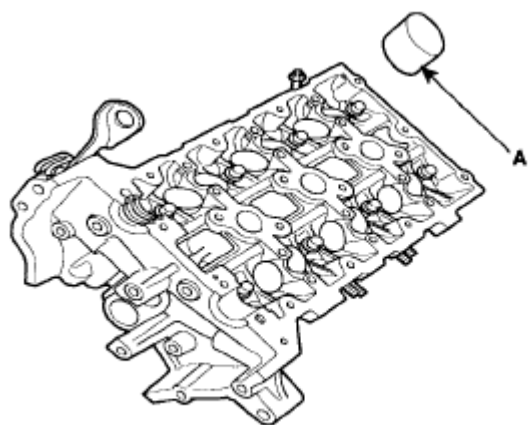


KDRF201A

Fig. 178: 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. 179: Identifying MLAs

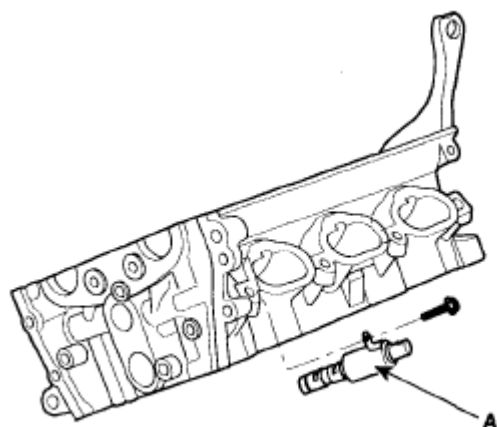
Courtesy of KIA MOTORS AMERICA, INC.

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. 180: Identifying OCV

Courtesy of KIA MOTORS AMERICA, INC.

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

CAUTION: Do not reuse the OCV when dropped.

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

INSTALLATION

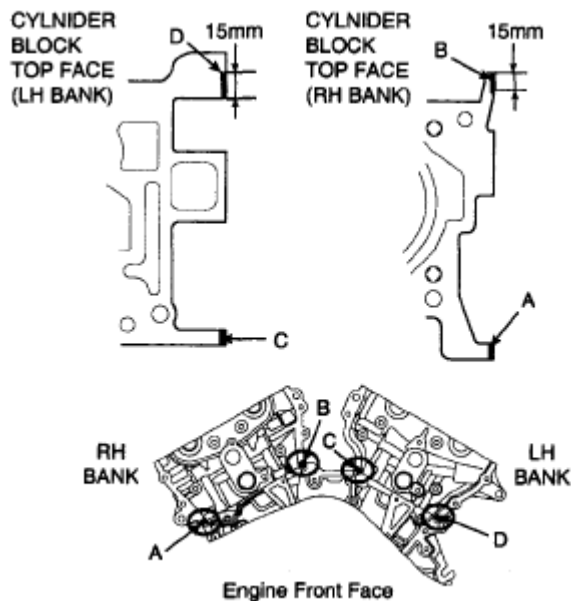
NOTE:

- 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

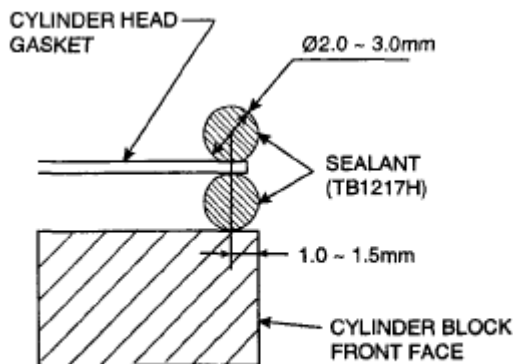
Fig. 181: Identifying Sealant Applying Dimension On Cylinder Block Top Face
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Refer to the illustration below to apply the sealant.

Bead width: 2.0~3.0 mm

Sealant locations: 1.0~1.5 mm from block surface

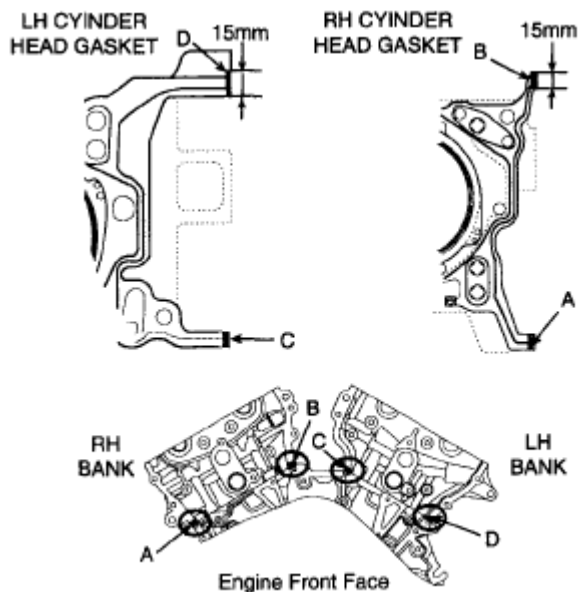
Recommended sealant: Liquid sealant TB1217H



ECBF018A

Fig. 182: Identifying Sealant Bead Width
Courtesy of KIA MOTORS AMERICA, INC.

- c. Apply sealant on cylinder head gaskets after assembling cylinder head gaskets on cylinder block. The part must be assembled within 5 minutes after sealant was applied.



ECBF019A

Fig. 183: Identifying Sealant Applying Dimension On Cylinder Head Gaskets
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Be careful of the installation direction.

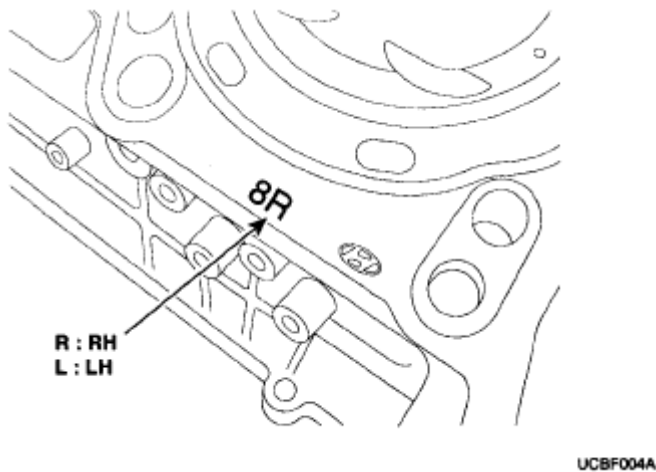


Fig. 184: Identifying Cylinder Head Installation Direction
Courtesy of KIA MOTORS AMERICA, INC.

- d. Install the cylinder head.

NOTE: Remove the extruded sealant after assembling cylinder heads.

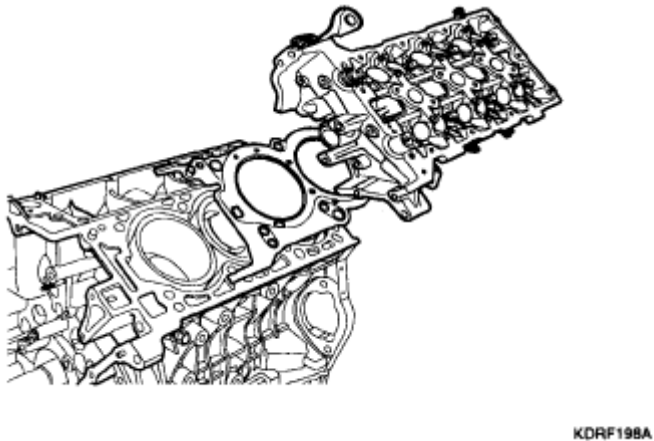


Fig. 185: Identifying Cylinder Head
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

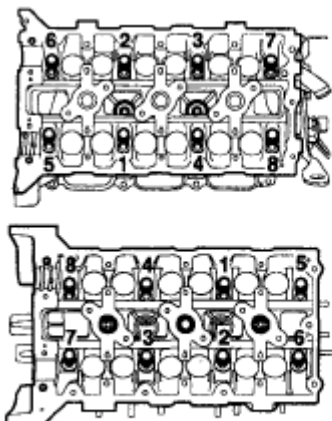
1st step: 37.3~41.2 N.m (3.8~4.2 kgf.m, 27.5~30.4 lb-ft)

2nd step: $120^{\circ} \pm 2^{\circ}$

3rd step: $90^{\circ} \pm 2^{\circ}$

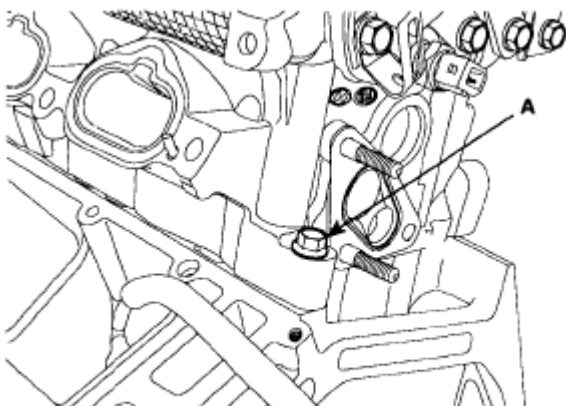
18.62 ~ 23.52 N.m (1.9 ~ 2.4 kgf.m, 13.74 ~ 17.36 lb-ft) (A)

NOTE: Always use new cylinder head bolts.



KDRF199B

Fig. 186: Identifying Cylinder Head Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.



ECBP035A

Fig. 187: Identifying Cylinder Head Bolt "A"
Courtesy of KIA MOTORS AMERICA, INC.

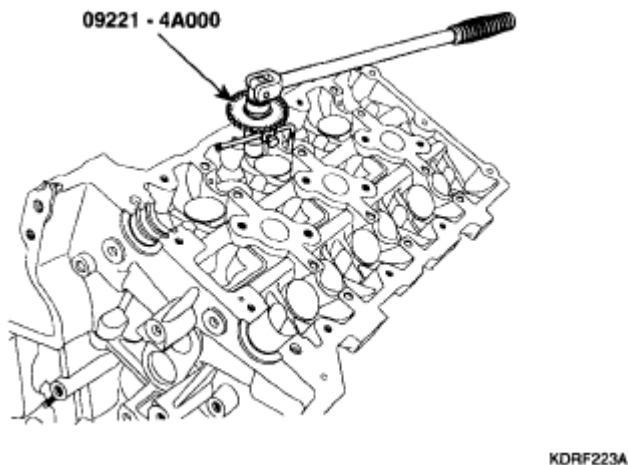


Fig. 188: Identifying SST (09221 -4A000)
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the CVVT and camshaft sprocket.

Tightening torque

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

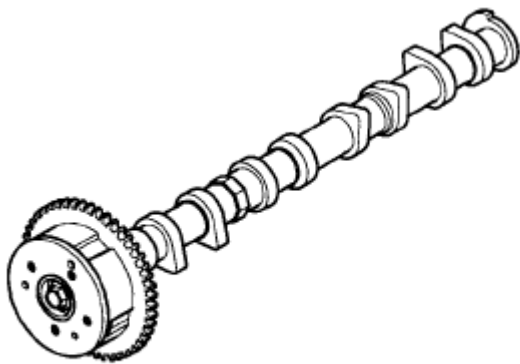


Fig. 189: Identifying CVVT And Camshaft Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

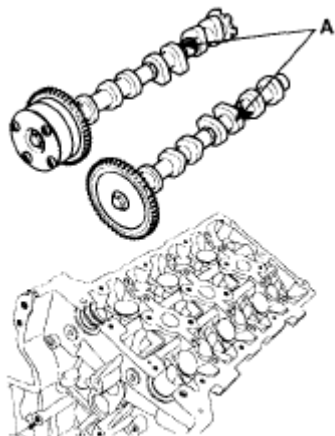
At this time, do not install to oil hole of camshaft-inlet.

- 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).

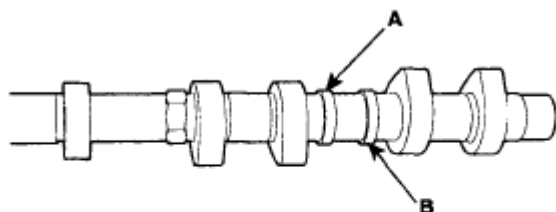
NOTE:

- 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. 190: Identifying Camshaft Assembly
Courtesy of KIA MOTORS AMERICA, INC.

INTAKE CAMSHAFT

KDRF226A

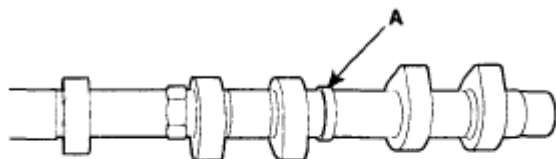
Fig. 191: Identifying Intake Camshaft
Courtesy of KIA MOTORS AMERICA, INC.

INTAKE CAMSHAFT SPECIFICATIONS

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

	B: 27 mm (1.0630 in.)	B: 30 mm (1.1811 in.)
--	-----------------------	-----------------------

EXHAUST CAMSHAFT

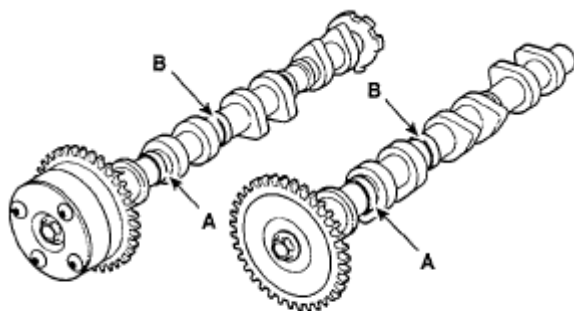


KDRF227A

Fig. 192: Identifying Exhaust Camshaft
Courtesy of KIA MOTORS AMERICA, INC.

EXHAUST CAMSHAFT SPECIFICATIONS

-	LH	RH
3.8L	A: 027 mm (1.0630 in.)	A: 30 mm (1.1811 in.)



SBLM16209L

Fig. 193: Identifying LH And RH Camshaft Position
Courtesy of KIA MOTORS AMERICA, INC.

CAMSHAFT SPECIFICATIONS

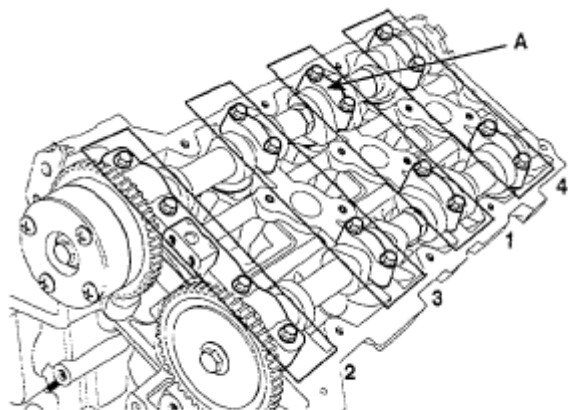
-	LH	RH
3.8L	A : 30 mm (1.1811 in.) B : 27 mm (1.0630 in.)	A : 30 mm (1.1811 in.) B : 27 mm (1.0630 in.)

6. Install camshaft bearing caps as following order.

Tightening torque

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

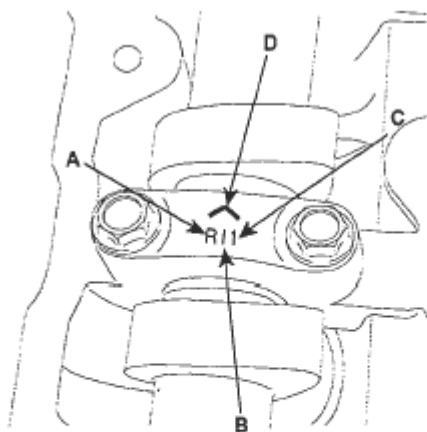
2nd step: 9.80 ~ 11.76 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.68 lb-ft) - 2nd step



UCBF014A

Fig. 194: Identifying Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

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



ECBF036A

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

Fig. 195: Identifying Mark On Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

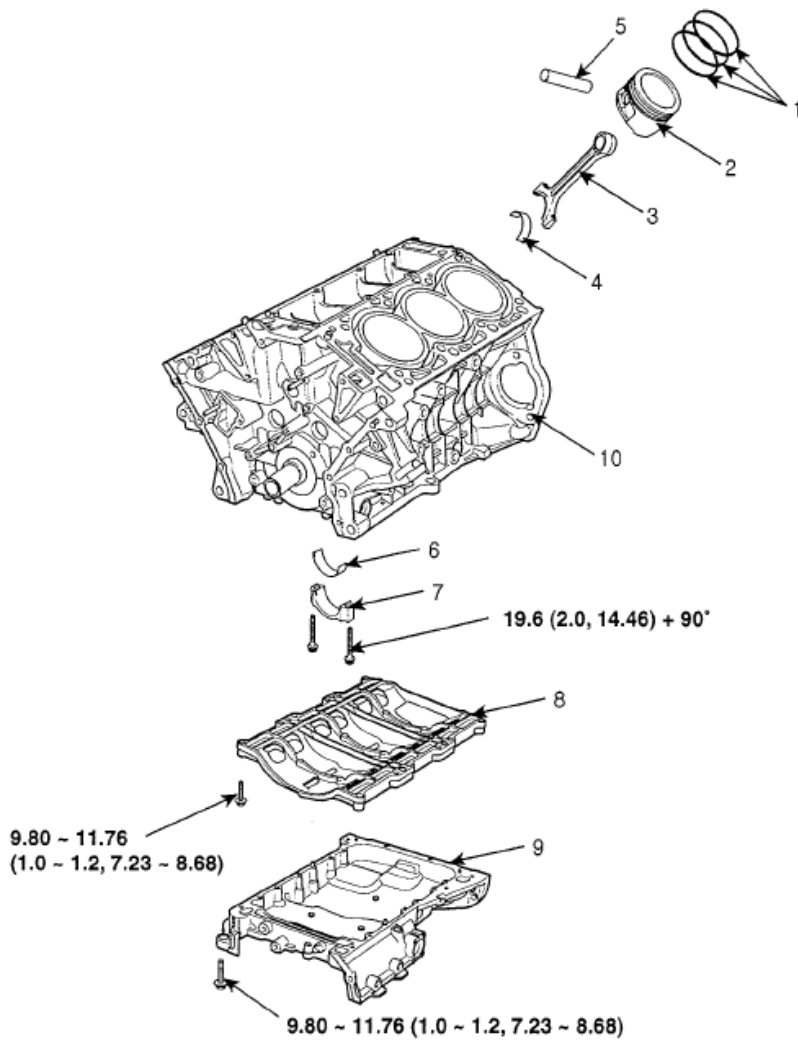
- A. L (LH), R (RH)
- B. I (Intake), None (Exhaust)
- C. Journal number
- D. Front mark

CAUTION: Rotate the crankshaft so as not to contact the valves to the pistons by positioning 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

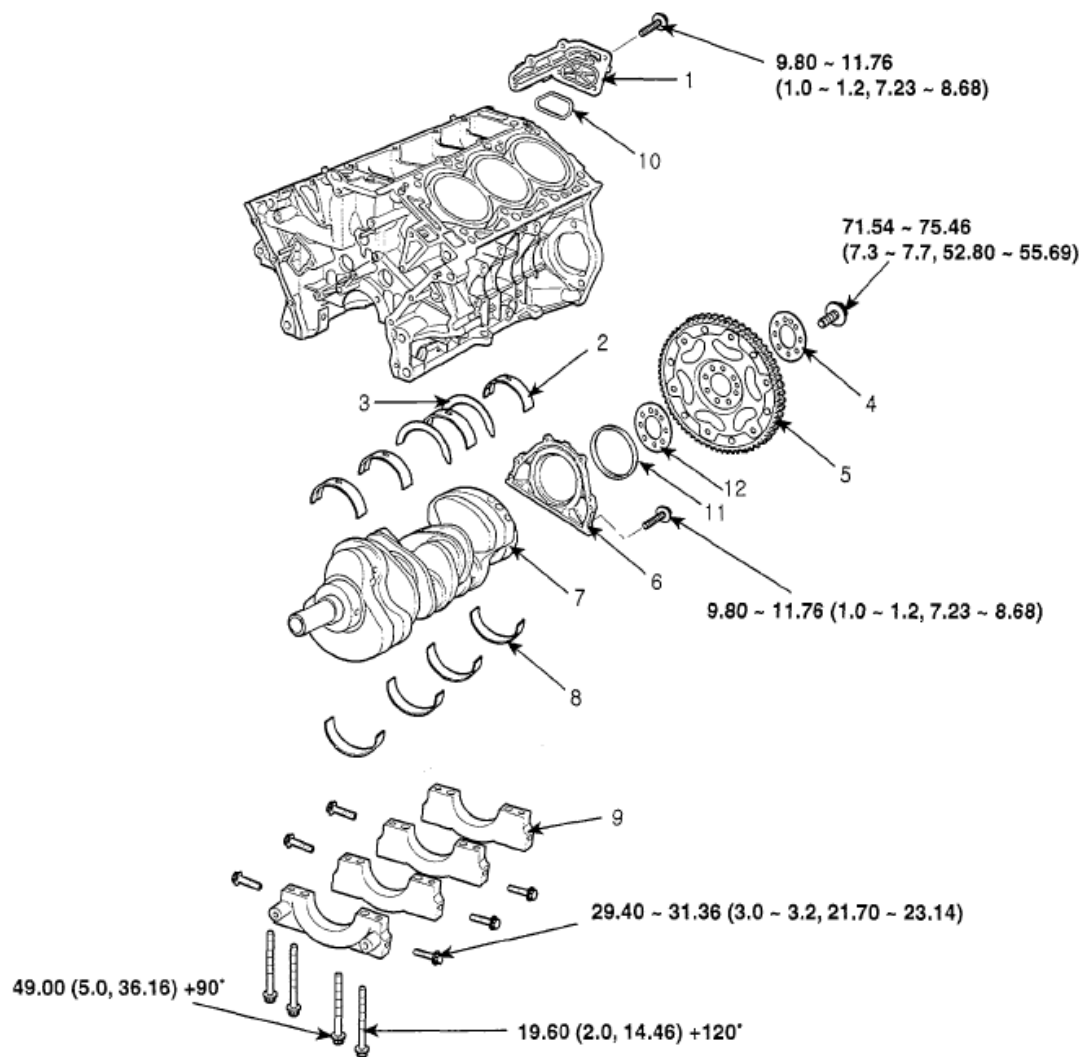


TORQUE : N.m (kgf.m, lb-ft)

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

SGHEM7011N

Fig. 196: Identifying Engine Block Components With Torque Specifications (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 |

SBLM18203L

Fig. 197: Identifying Engine Block Components With Torque Specifications (2 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

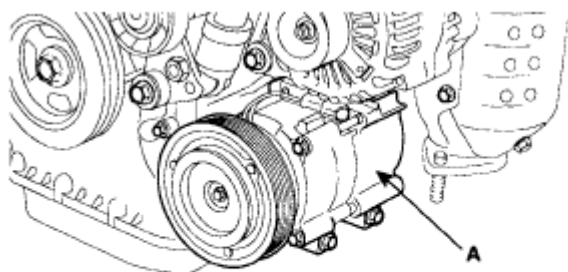
CAUTION:

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

NOTE:

- Mark all wiring and hoses to avoid misconnection.
- Inspect the timing belt before removing the cylinder head.
- 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 cylinder head.
6. Remove oil pump.
7. Remove oil filter assembly.
8. Remove A/C compressor (A) from engine.

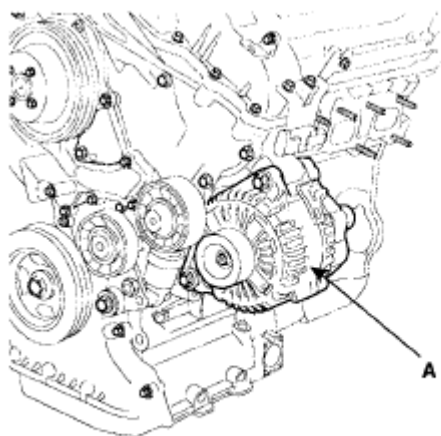


KDRF103A

Fig. 198: Locating Air Compressor

Courtesy of KIA MOTORS AMERICA, INC.

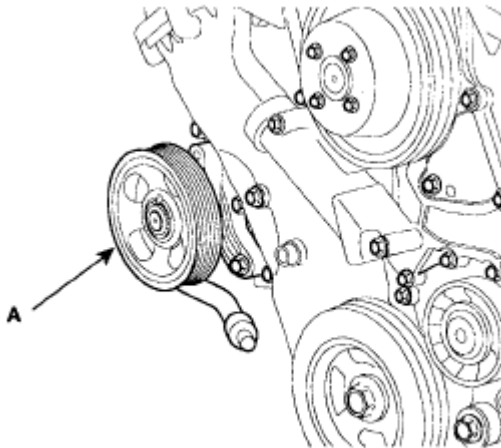
9. Remove alternator (A) from engine.



KDRF104A

Fig. 199: Locating Generator**Courtesy of KIA MOTORS AMERICA, INC.**

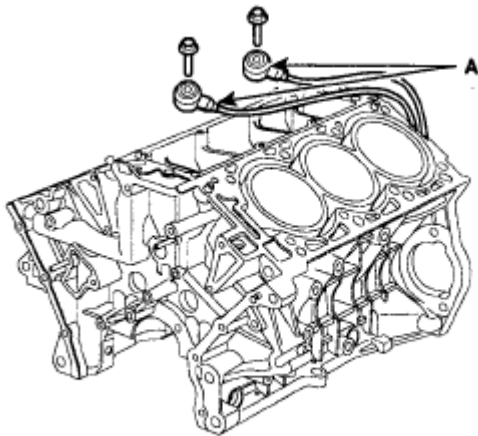
10. Remove power steering pump (A) from engine.



KDRF102A

Fig. 200: Locating Power Steering Pump**Courtesy of KIA MOTORS AMERICA, INC.****DISASSEMBLY**

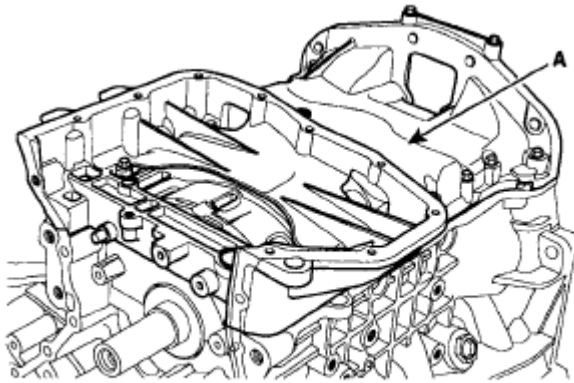
1. Remove drive plate.
2. Remove knock sensor (A).



KDRF205A

Fig. 201: Locating Knock Sensor**Courtesy of KIA MOTORS AMERICA, INC.**

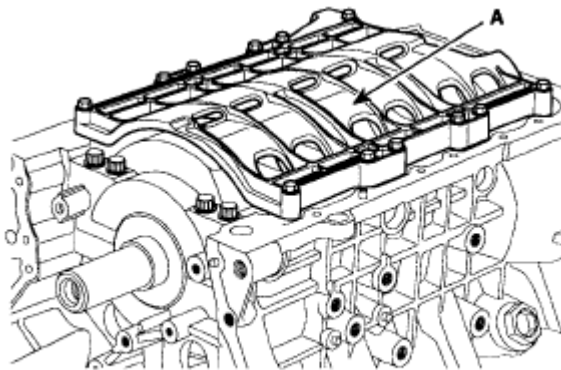
3. Remove upper oil pan (A).



KDRF206A

Fig. 202: Locating Upper Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

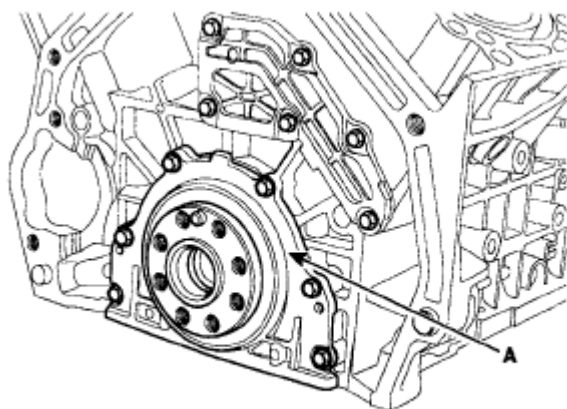
4. Remove baffle plate (A).



KDRF207A

Fig. 203: Locating Baffle Plate
Courtesy of KIA MOTORS AMERICA, INC.

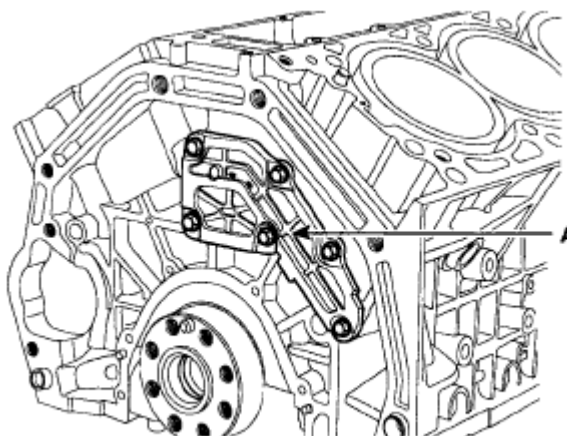
5. Remove rear oil seal case (A).



KDRF208A

Fig. 204: Locating Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove oil drain cover (A).



KDRF209A

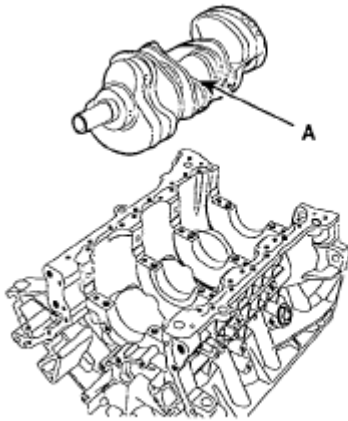
Fig. 205: Locating Oil Drain Cover
Courtesy of KIA MOTORS AMERICA, INC.

7. Check the connecting rod end play.
8. Check the connecting rod cap 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. 206: Identifying Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

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

13. Check fit between piston and piston pin.

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

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

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

15. Disconnect connecting rod from piston.

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

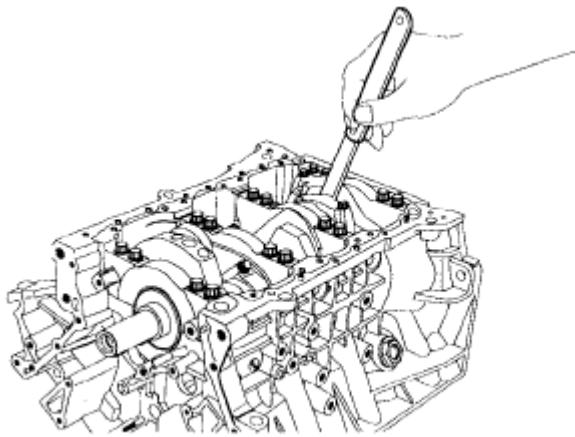
INSPECTION

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. 207: Measuring Connecting Rod End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

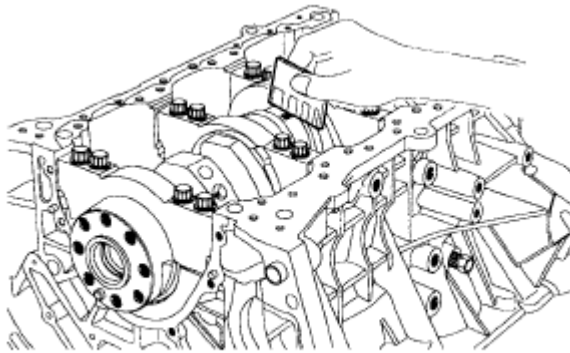
19.6 N.m (2.0 kgf.m, 14.46 lb-ft) + 90°

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

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

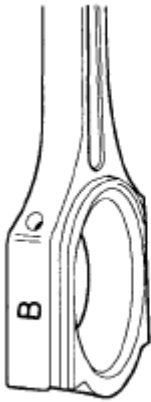
CAUTION: Do not file, shim, or scrape the bearings or the caps to adjust clearance.

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

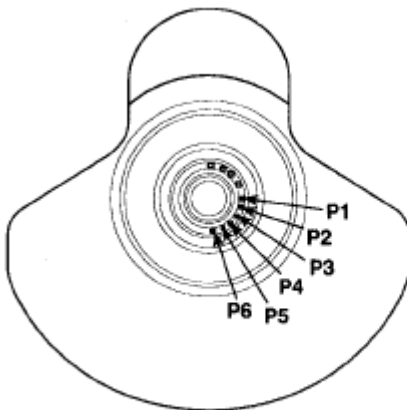
Fig. 209: Identifying Connecting Rod Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

IDENTIFICATION OF CONNECTING ROD

CONNECTING ROD SPECIFICATIONS

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 (IDENTIFICATION OF CRANKSHAFT)



ECBF037A

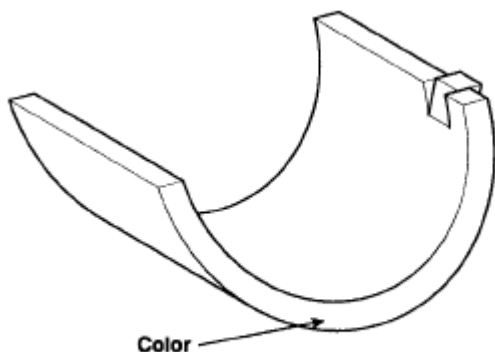
Fig. 210: Identifying Crankshaft Pin Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT

CRANKSHAFT SPECIFICATIONS

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. 211: Identifying Place Of Identification Mark (Connecting Rod Bearing)
 Courtesy of KIA MOTORS AMERICA, INC.

IDENTIFICATION OF CONNECTING ROD BEARING

THICKNESS SPECIFICATIONS OF 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.)

		in.)
C	BROWN	1.508 ~ 1.511 mm (0.0594 ~ 0.0595 in.)
B	GREEN	1.505 ~ 1.508 mm (0.0593 ~ 0.0594 in.)
A	YELLOW	1.502 ~ 1.505 mm (0.0591 ~ 0.0593 in.)

11. Selection

CONNECTING ROD REFERENCE CHART

-		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)

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°

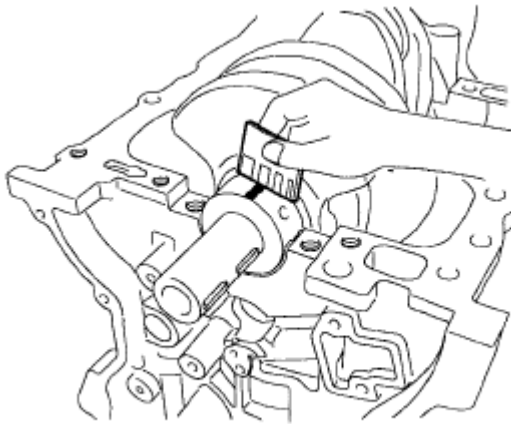
29.40 ~ 31.36 N.m (3.0 ~ 3.2 kgf.m, 21.70 ~ 23.14 lb-ft)

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. 212: 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 **CRANKSHAFT BEARING SPECIFICATIONS** table), 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.

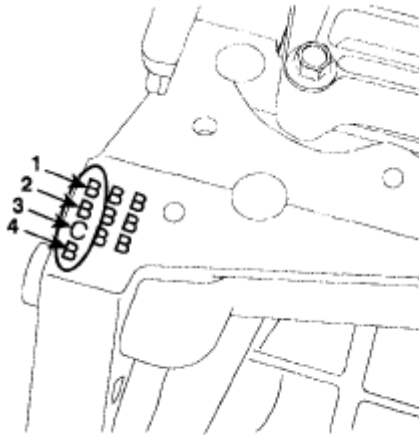
NOTE: If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

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

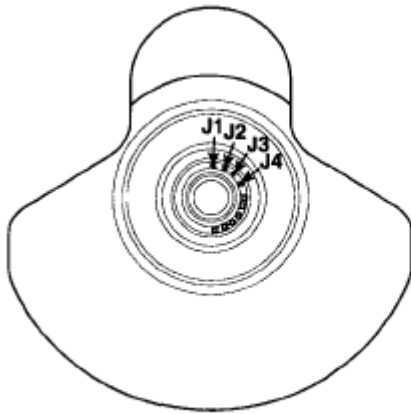
Fig. 213: Identifying Crankshaft Bore Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CYLINDER BLOCK

CYLINDER BLOCK SPECIFICATIONS

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

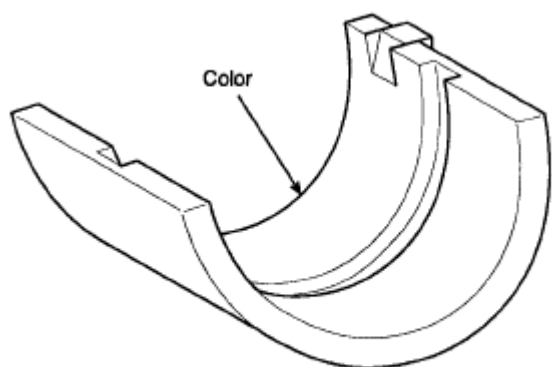
Fig. 214: Identifying Crankshaft Journal Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT

CRANKSHAFT JOURNAL SPECIFICATIONS

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

PLACE OF IDENTIFICATION MARK (CRANKSHAFT BEARING)



ECRF022A

Fig. 215: Identifying Place Of Identification Mark (Crankshaft Bearing)
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT BEARING

CRANKSHAFT BEARING SPECIFICATIONS

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

SELECTION

CRANKSHAFT BORE IDENTIFICATION MARK REFERENCE

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

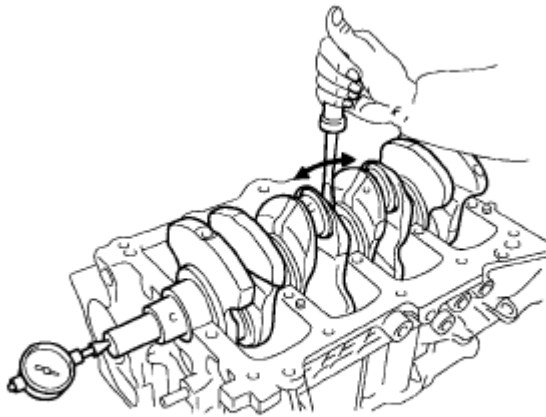
IDENTIFICATION MARK			(BROWN)	(BLACK)
	3 or C	C (BROWN)	D (BLACK)	E (BLUE)

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. 216: 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

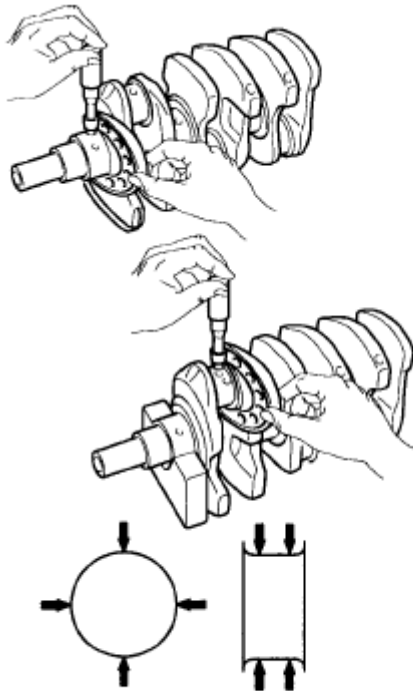
2.41 ~ 2.45 mm (0.0949 ~ 0.0964 in.)

5. Inspect main journals and crank pins

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

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. 217: Measuring Diameter Of Main Journal And Pin Journal
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.

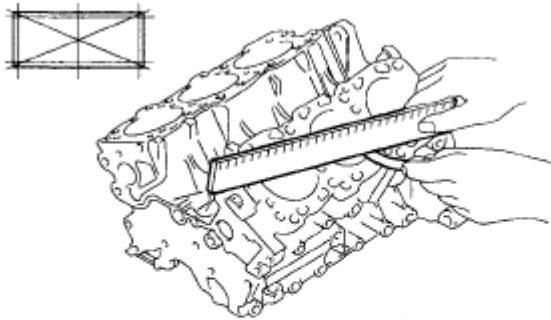
2. Clean cylinder block

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

4. Inspect cylinder bore diameter

Visually check the cylinder for vertical scratches.

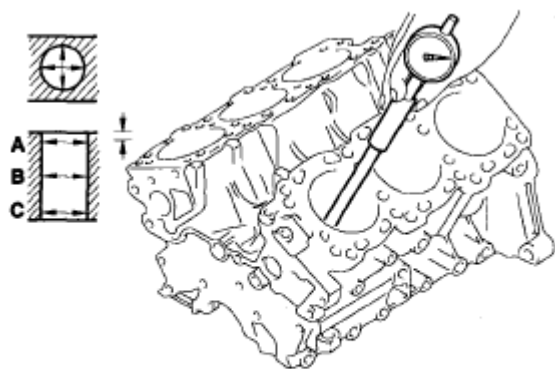
If deep scratches are present, replace the cylinder block.

5. Inspect cylinder bore diameter

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

Standard diameter

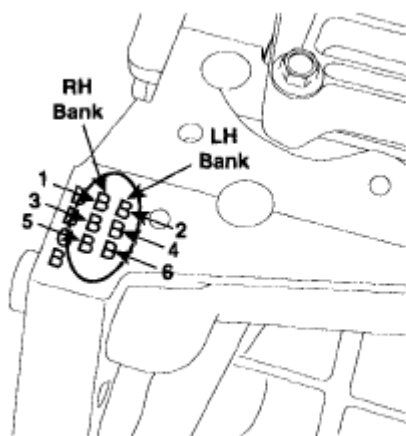
96.00 ~ 96.03 mm (3.7795 ~ 3.7807 in.)



EDQF153A

Fig. 219: 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

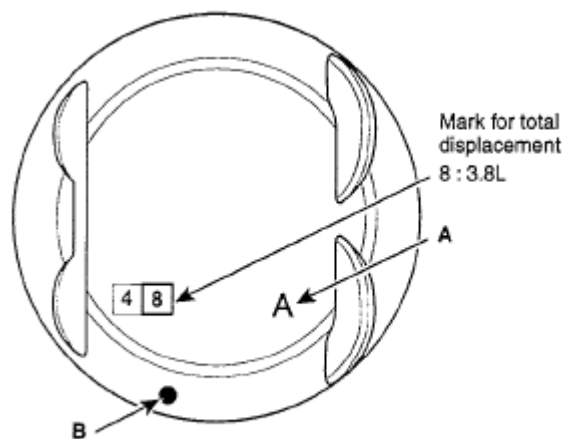
Fig. 220: Identifying Cylinder Bore Size Code On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

CYLINDER BORE SPECIFICATIONS

Class	Size code	Cylinder bore inner diameter
		3.8L
A	A	96.00 ~ 96.01 mm (3.7795 ~ 3.7799 in.)
B	B	96.01 ~ 96.02 mm (3.7799 ~ 3.7803 in.)

C	C	96.02 ~ 96.03 mm (3.7803 ~ 3.7807 in.)
---	---	---

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



SGHEM7002N

Fig. 221: Identifying Piston Size Code And Front Mark On Piston Top Face
Courtesy of KIA MOTORS AMERICA, INC.

PISTON SPECIFICATIONS

Class	Size code	Piston outer diameter
		3.8L
A	A	95.96 ~ 95.97 mm (3.7779 ~ 3.7783 in.)
B	B	95.97 ~ 95.98 mm (3.7783 ~ 3.7787 in.)
C	C	95.98 ~ 95.99 mm (3.7787 ~ 3.7791 in.)

8. Select the piston related to cylinder bore class.

Clearance :

0.03 ~ 0.05 mm (0.0012 ~ 0.0020 in.)

PISTON AND RINGS

1. Clean piston

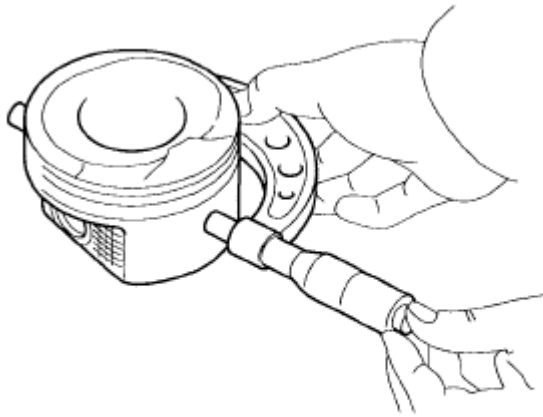
1. Using a gasket scraper, remove the carbon from the piston top.
2. Using a groove cleaning tool, clean the piston ring grooves.
3. Using solvent and a brush, thoroughly clean the piston.

NOTE: **Do not use a wire brush.**

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

Standard diameter

95.96 ~ 95.99 mm (3.7779 ~ 3.7791 in.)



ECKD001D

Fig. 222: Measuring Piston Outside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston-to-cylinder clearance

0.03 ~ 0.05 mm (0.0012 ~ 0.0020 in.)

4. Inspect the piston ring side clearance.

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

Piston ring side clearance

Standard

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

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

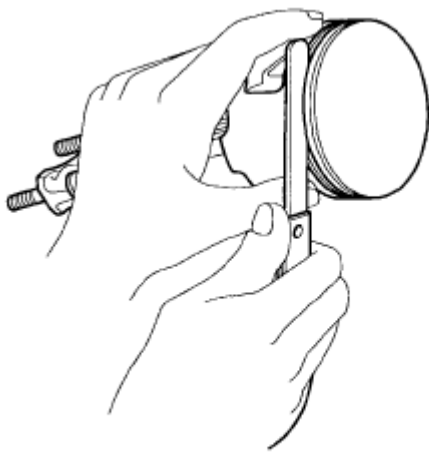
Oil ring: 0.06 ~ 0.15 mm (0.0024 ~ 0.0059 in.)

Limit

No. 1: 0.1 mm (0.004 in.)

No. 2: 0.1 mm (0.004 in.)

Oil ring: 0.2 mm (0.008 in.)



ECKD001G

Fig. 223: 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.)

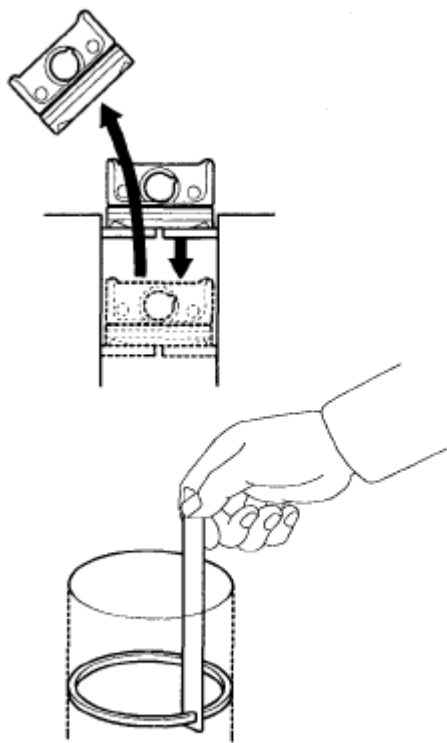
Oil ring: 0.20 ~ 0.70 mm (0.0079 ~ 0.0275 in.)

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

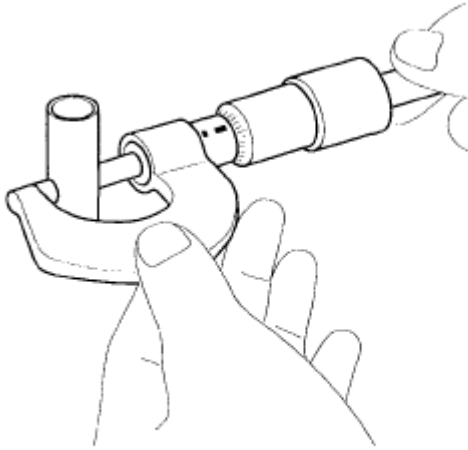
Fig. 224: Inspecting Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter

23.001 ~ 23.006 mm (0.9056 ~ 0.9057 in.)



ECKD001Z

Fig. 225: Measuring Diameter Of Piston Pin
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston pin-to-piston clearance

0.01 ~ 0.02 mm (0.0004 ~ 0.0008 in.)

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

Piston pin-to-connecting rod interference

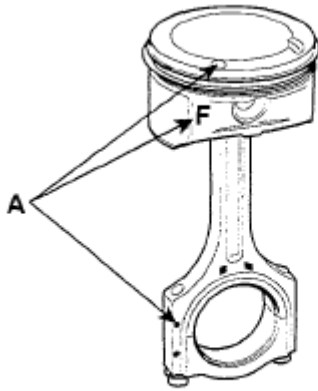
-0.032 ~ -0.016 mm (-0.00126 ~ -0.00063 in.)

REASSEMBLY

NOTE:

- Thoroughly clean all parts to be 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.

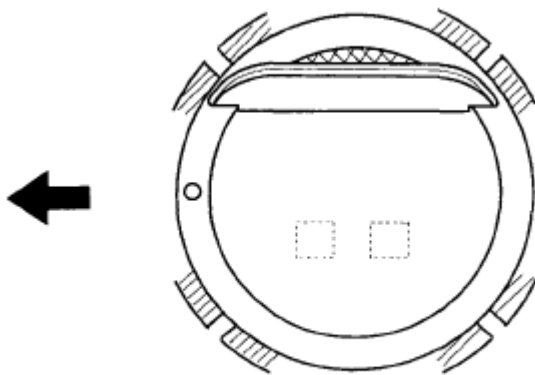
1. Assemble piston and connecting rod.
 1. Use a hydraulic press for installation.
 2. The piston front mark and the connecting rod front mark must face the timing belt side of the engine.



SGHEM7012N

Fig. 226: Identifying Piston Front Mark And Connecting Rod Front Mark
Courtesy of KIA MOTORS AMERICA, INC.

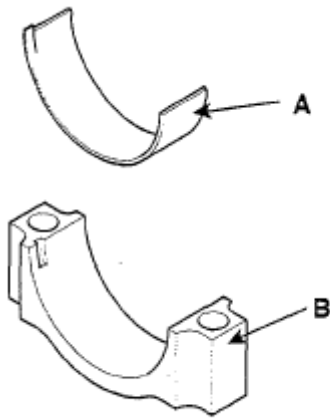
2. Install piston rings.
 1. Install the oil ring spacer and 2 side rails by hand.
 2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
 3. Position the piston rings so that the ring ends are as shown in illustration.



ECKD321A

Fig. 227: 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).



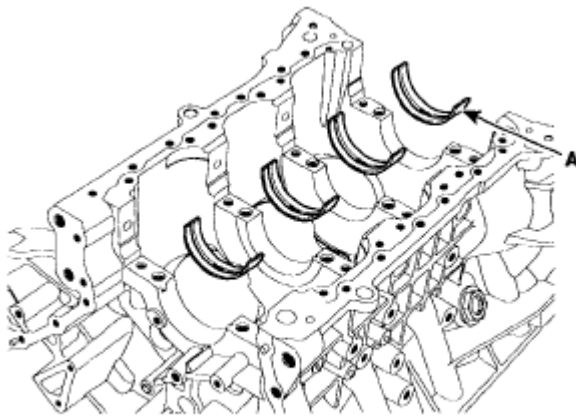
SGHEM7013N

Fig. 228: Identifying Connecting Rod Bearings
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).

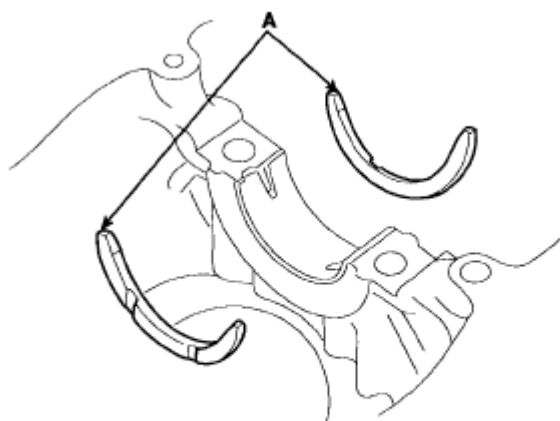


KDRF216A

Fig. 229: Identifying Lower 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.

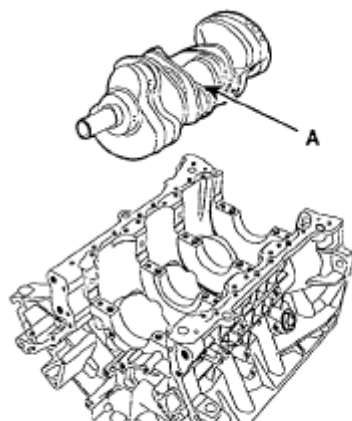
Install the 2 thrust bearings (A) under the No. 3 journal position of the cylinder block with the oil grooves facing outward.



ECKD324A

Fig. 230: Identifying Thrust Bearings
Courtesy of KIA MOTORS AMERICA, INC.

6. Place crankshaft on the cylinder block.



KDRF210A

Fig. 231: Identifying Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

Main bearing cap bolt

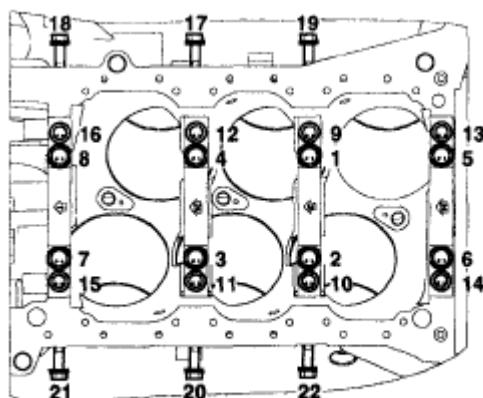
49.00 N.m (5.0 kgf.m, 36.16 lb-ft) + 90° (1 ~ 8)

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

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

NOTE:

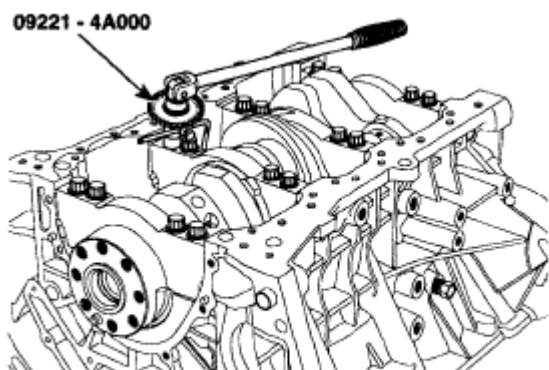
- Always use new main bearing cap bolts.
- If any of the bearing cap bolts are broken or deformed, replace it.



KDRF140A

Fig. 232: Identifying Bearing Cap Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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



KDRF224A

Fig. 233: Identifying SST (09221-4A000)
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.

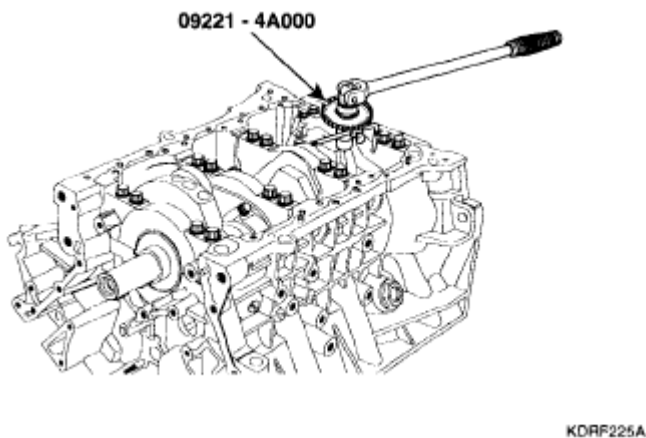
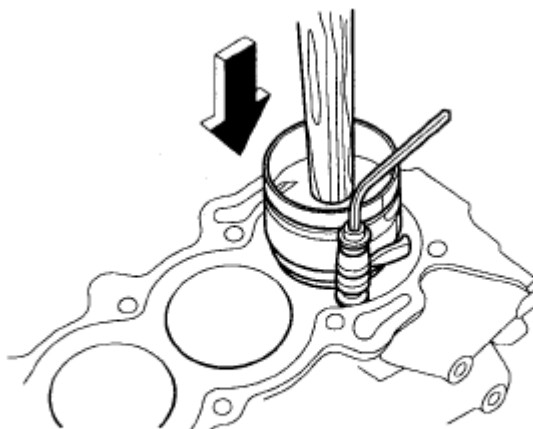


Fig. 234: Identifying SST (09221-4A000)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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



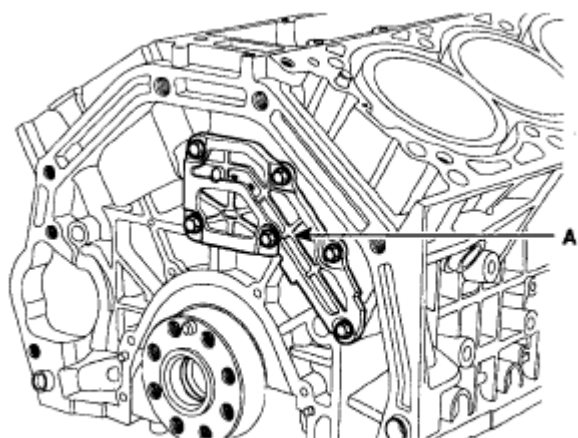
ECKD001F

Fig. 235: Installing Piston And Connecting Rod Assemblies
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

9.80 ~ 1176 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.67 lb-ft)



KDRF209A

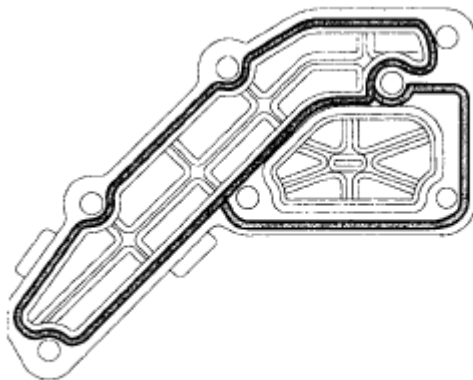
Fig. 236: Locating Oil Drain Cover
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before

applying sealant

- Before assembling oil drain cover, the liquid sealant TB1217H should be applied to the 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.



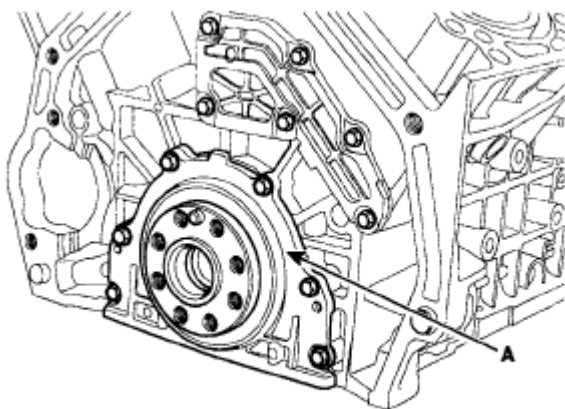
ECBF003A

Fig. 237: Identifying Sealant Area On Oil Drain Cover
Courtesy of KIA MOTORS AMERICA, INC.

13. Install rear oil seal case.

Tightening torque

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

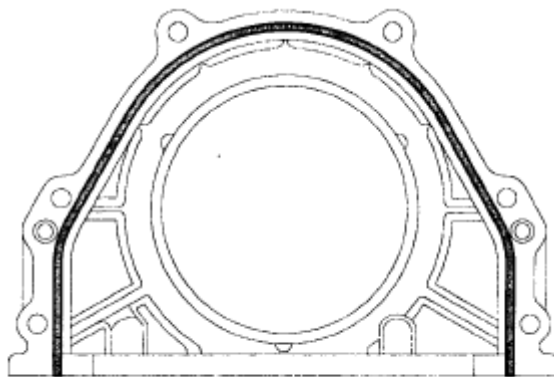


KDRF208A

Fig. 238: Locating Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

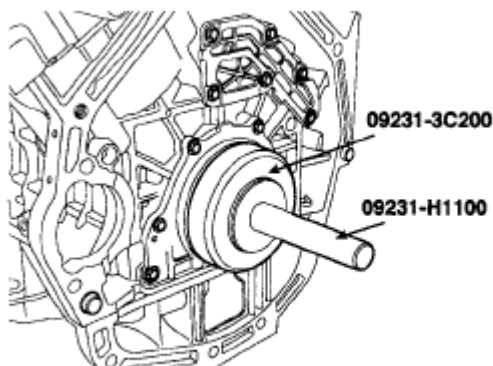
- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant
- Before assembling rear oil seal case, the liquid sealant TB1217H should be applied to the rear oil seal case.
- The part must be assembled within 5 minutes after sealant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



KDRF218A

Fig. 239: Identifying Sealant Area On Rear Oil Seal Case
 Courtesy of KIA MOTORS AMERICA, INC.

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



KDRF237A

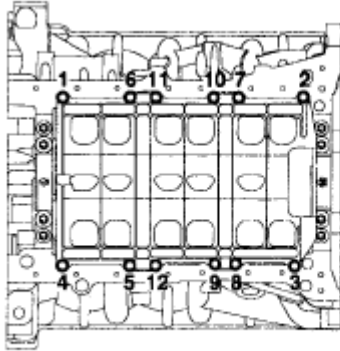
Fig. 240: Identifying SST (09231-3C200, 09231-H1100)
 Courtesy of KIA MOTORS AMERICA, INC.

15. Install baffle plate.

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

Tightening torque

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

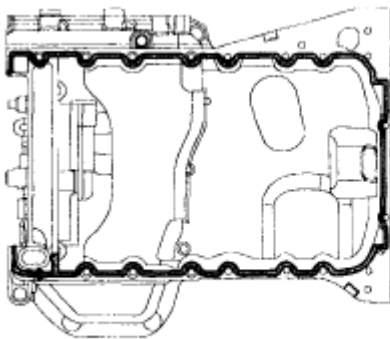


KDRF135A

Fig. 241: Identifying Baffle Plate Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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

Bead width: 2.5 mm (0.1 in.)



KDRF130A

Fig. 242: Identifying Liquid Sealant Applied On Upper Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant
- When applying sealant gasket, sealant must not protrude into the inside of oil pan.

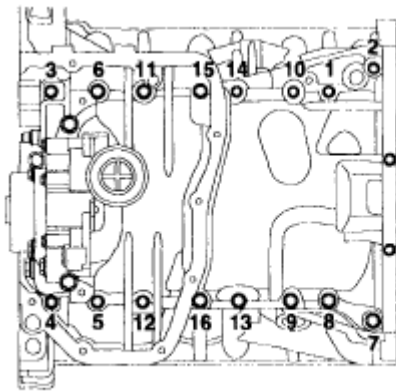
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.

c. Install upper oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

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



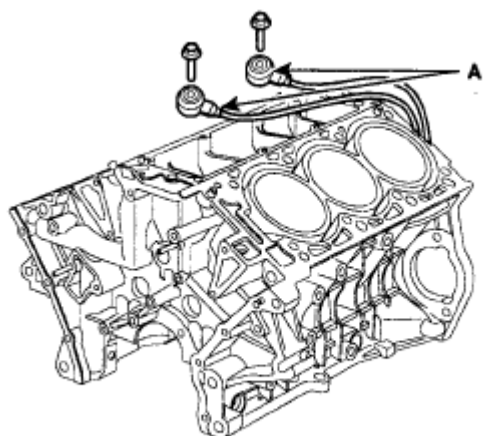
KDRF131A

Fig. 243: Identifying Upper Oil Pan Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

17. Install knock sensor.

Tightening torque

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



KDRF205A

Fig. 244: Locating Knock Sensor
 Courtesy of KIA MOTORS AMERICA, INC.

18. Install drive plate.

Tightening torque

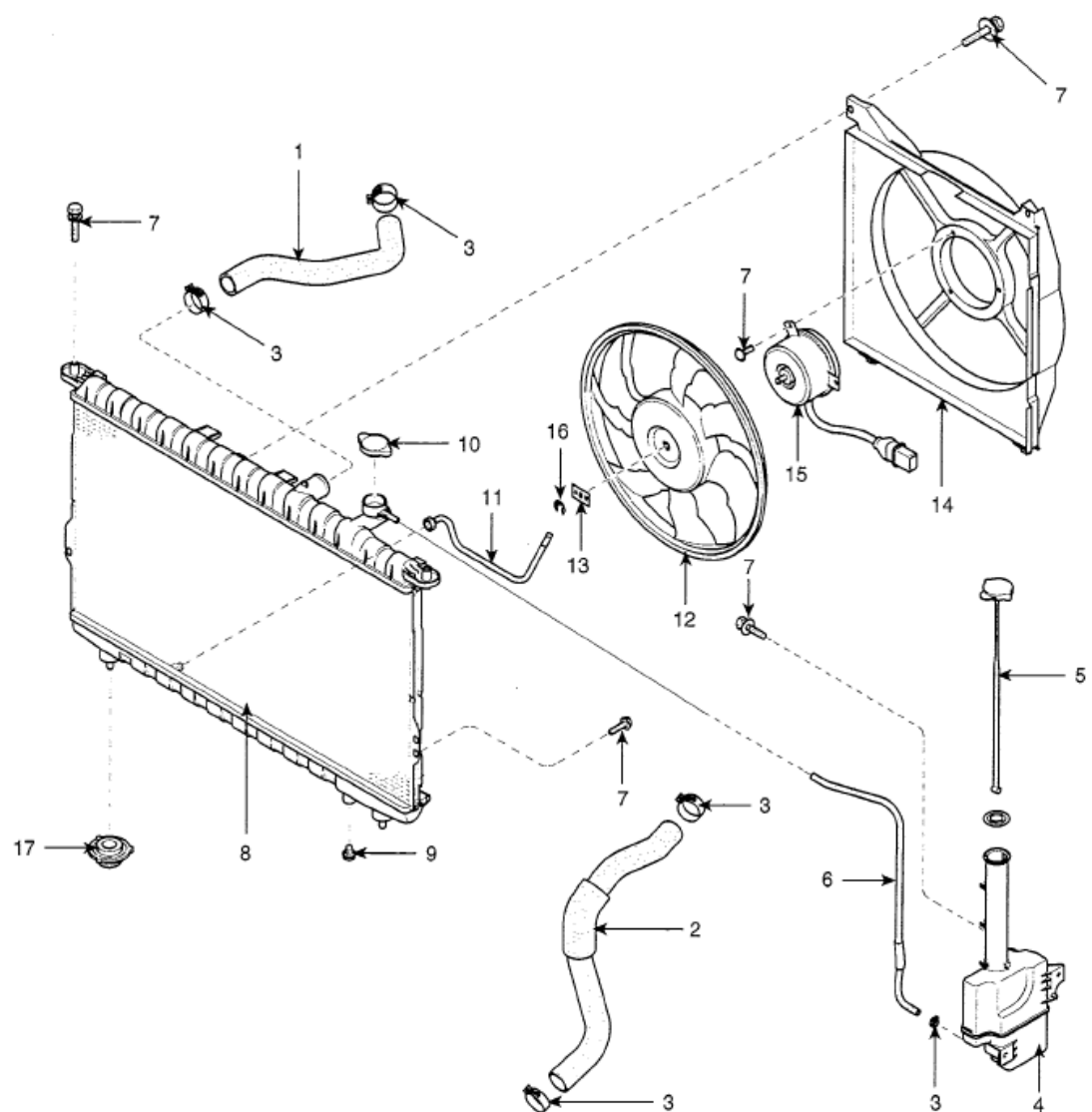
71.54 ~ 75.46 N.m (7.3 ~ 7.7 kgf.m, 52.80 ~ 55.69 lb-ft)

INSTALLATION

1. Install power steering pump.
2. Install alternator.
3. Install air conditioner 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



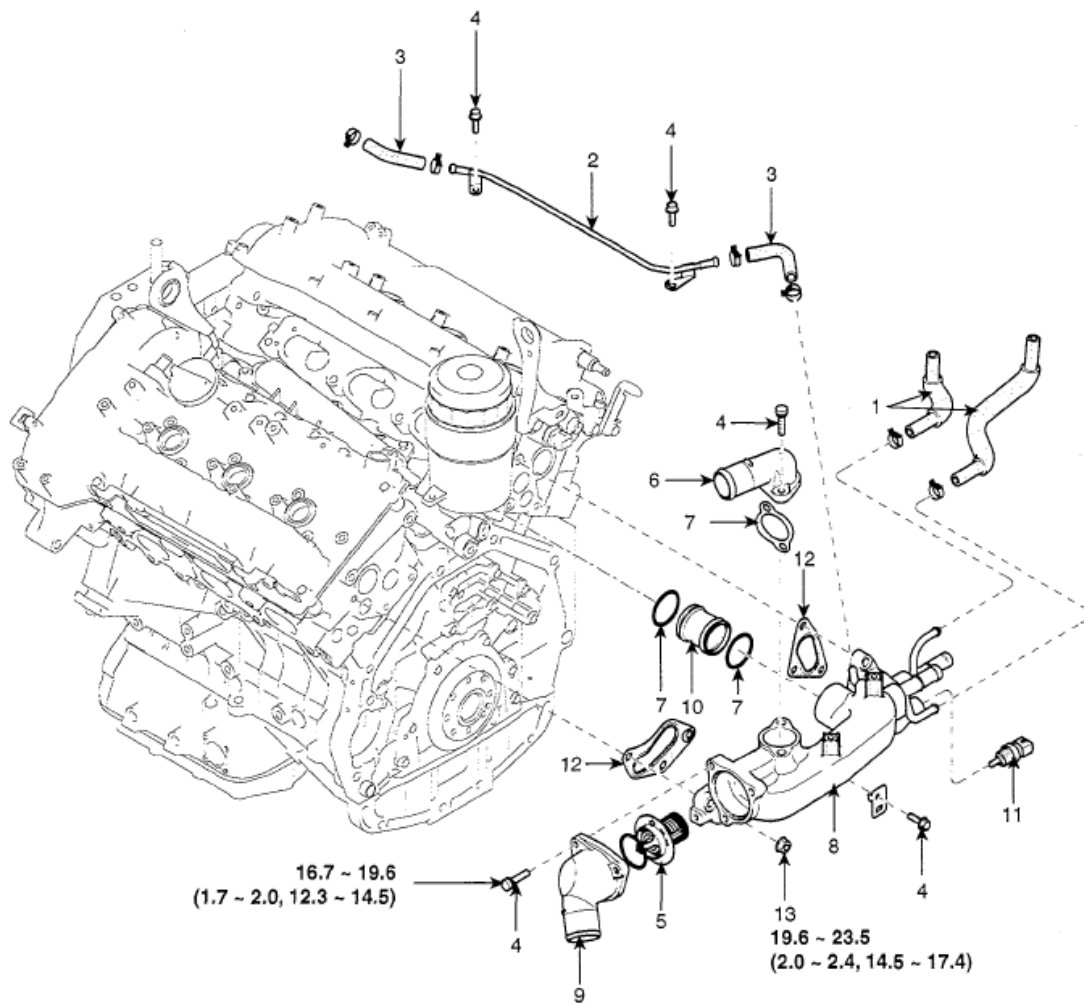
- 1. Radiator upper hose
- 2. Radiator lower hose
- 3. Hose clamp
- 4. Reservoir
- 5. Reservoir cap
- 6. Reservoir hose

- 7. Bolt
- 8. Radiator
- 9. Drain plug
- 10. Radiator cap
- 11. Oil cooler tube
- 12. Cooling fan

- 13. Washer
- 14. Radiator shroud
- 15. Motor assembly
- 16. Retainer
- 17. Radiator mounting lower insulator

SGHEM7003N

Fig. 245: Identifying Cooling System Components With Torque Specifications (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.



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

- | | |
|------------------------|---------------------------------------|
| 1. Water hose | 8. Thermostat housing assembly |
| 2. Vent pipe | 9. Inlet fitting |
| 3. Vent hose | 10. Tube |
| 4. Bolt | 11. Engine coolant temperature sensor |
| 5. Thermostat assembly | 12. Thermostat gasket |
| 6. Outlet fitting | 13. Nut |
| 7. Gasket | 14. Inlet fitting O-ring |

SQHEM7014N

Fig. 246: Identifying Cooling System Components With Torque Specifications (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

ENGINE COOLANT REFILLING AND BLEEDING

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

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

rinse it off immediately.

1. Make sure the engine and radiator are cool to the touch.
2. Remove radiator cap.
3. Loosen the drain plug, and drain the coolant.
4. Tighten the radiator drain plug securely.
5. Remove, drain and reinstall the reservoir. Fill the tank halfway to the 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 to 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.**

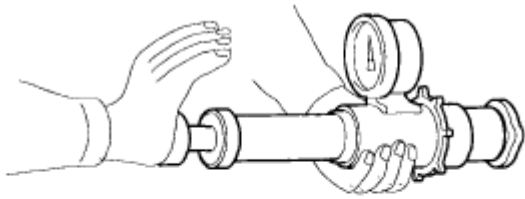
7. Start the engine and run so coolant circulates. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
8. Repeat 7 until the cooling fan cycles 3-5 times and bleed air sufficiently out of the cooling system.
9. Install the radiator cap and fill the reservoir tank to the "MAX" line with coolant.
10. Run the vehicle under idle until the cooling fan operates 2-3 times.
11. Stop the engine and wait until 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:

Bleed air out of the cooling system and refill coolant when coolant completely cools, recheck the coolant level in the reservoir tank for 2-3 days after replacing coolant.

CAP TESTING

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



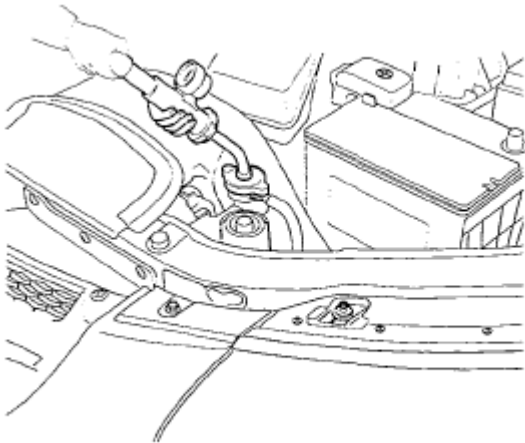
ECKD501X

Fig. 247: Testing Radiator Cap
 Courtesy of KIA MOTORS AMERICA, INC.

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

TESTING

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



SGHEM7015N

Fig. 248: Testing Radiator Pressure
 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.

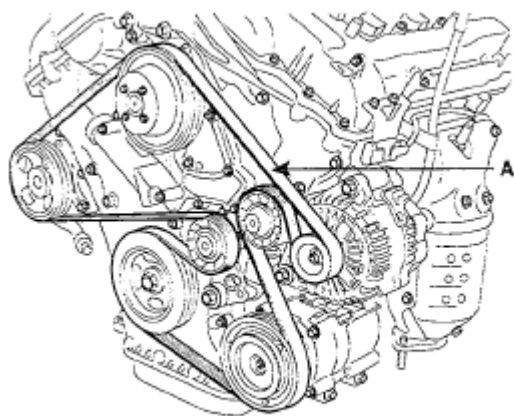
REMOVAL

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.

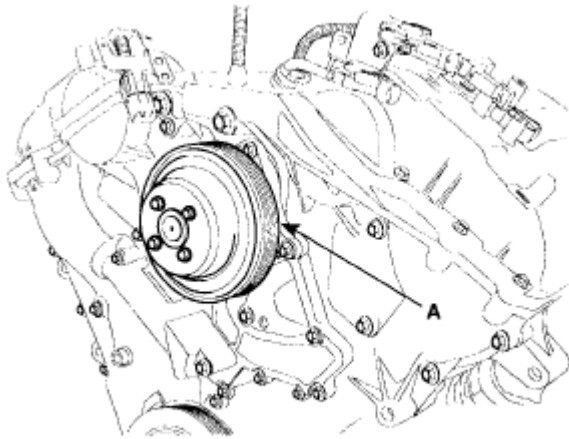
2. Remove drive belt (A).



UCBF009A

Fig. 249: Identifying Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

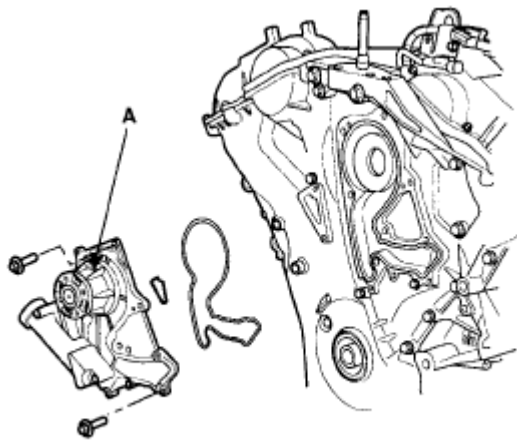
3. Remove the 4 bolts and pump pulley (A).



KDRF107A

Fig. 250: Locating Water Pump Pulley
Courtesy of KIA MOTORS AMERICA, INC.

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

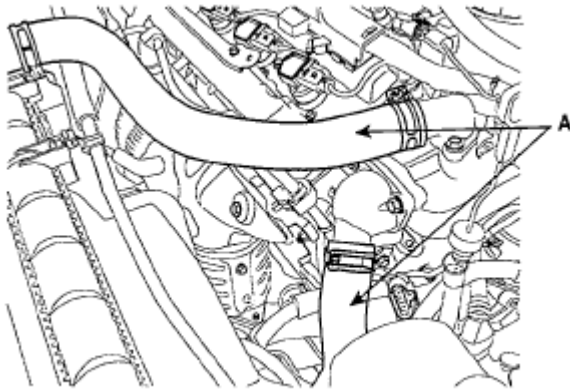


KDRF221A

Fig. 251: Identifying Water Pump And Gasket
Courtesy of KIA MOTORS AMERICA, INC.

WATER TEMPERATURE CONTROL ASSEMBLY

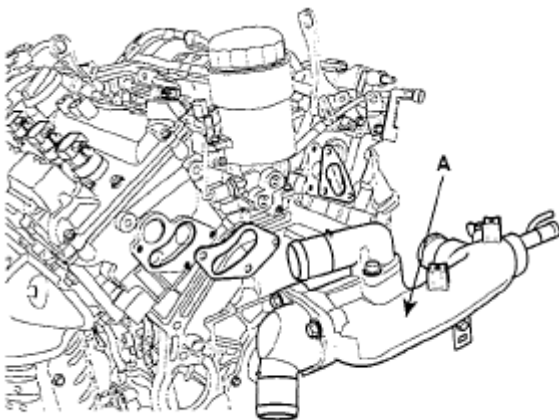
1. Drain the engine coolant.
2. Remove air cleaner assembly.
3. Disconnect radiator upper and lower hose (A).



KDRF148A

Fig. 252: Identifying Upper Radiator Hose And Lower Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

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



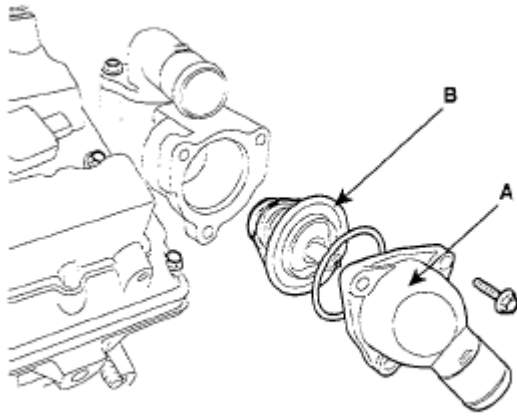
SGHEM7016N

Fig. 253: 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).

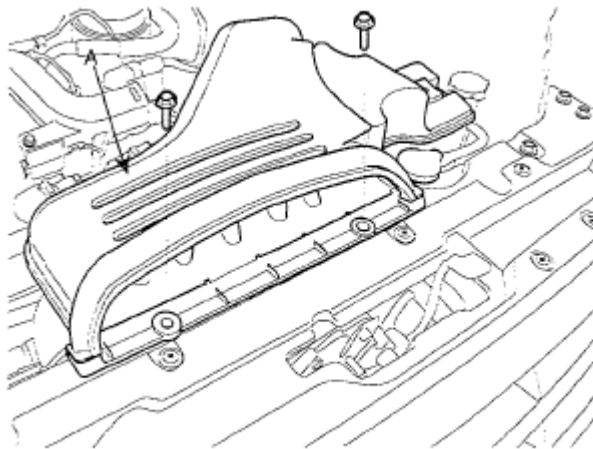


SGHEM7017N

Fig. 254: Identifying Water Inlet And Thermostat
Courtesy of KIA MOTORS AMERICA, INC.

RADIATOR

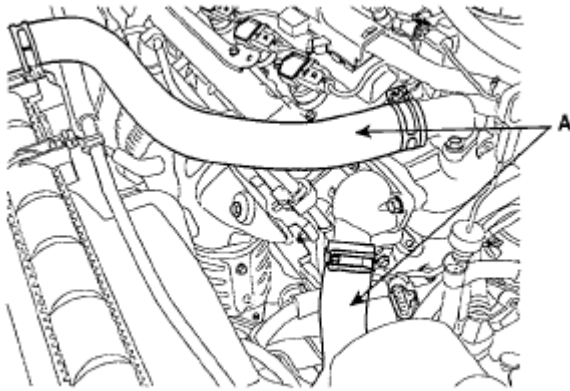
1. Drain the engine coolant.
2. Remove the air duct (A).



SGHAT7003N

Fig. 255: Identifying Air Duct
Courtesy of KIA MOTORS AMERICA, INC.

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



KDRF148A

Fig. 256: Identifying Upper Radiator Hose And Lower Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect transaxle oil cooler hoses.
5. Disconnect the radiator fan connector.
6. Remove the radiator bracket.
7. Remove the radiator.

INSPECTION

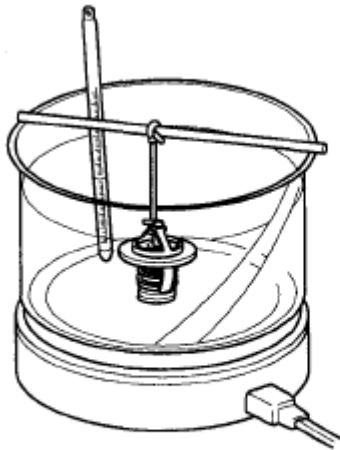
WATER PUMP

1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.
3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. Replace the coolant pump assembly.

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. 257: Checking Valve Opening Temperature
Courtesy of KIA MOTORS AMERICA, INC.

2. Check the valve opening temperature. Valve opening temperature : 82°C (177°F) Full opening temperature : 95°C (205°F)

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

3. Check the valve lift.

Valve lift: Min. 10 mm (0.4 in.) at 95°C (205°F) If the valve lift is not as specified, replace the thermostat.

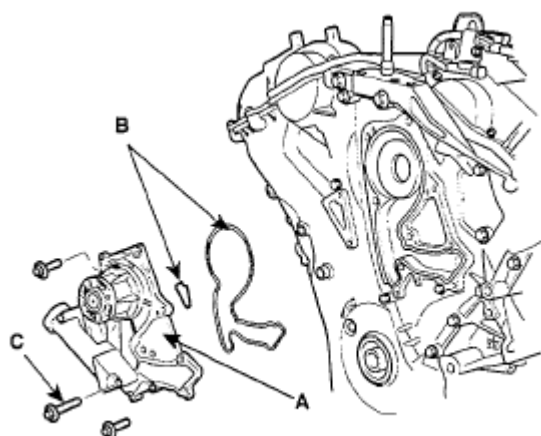
INSTALLATION

WATER PUMP

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



SGHEM7018N

Fig. 258: Identifying Water Pump & Gasket
Courtesy of KIA MOTORS AMERICA, INC.

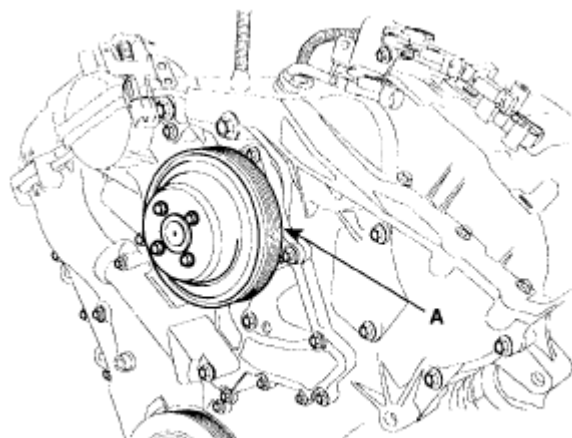
NOTE:

- Clean the contact face before assembly.
- Always use a new bolt (C) and gaskets (B).

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

Tightening torque

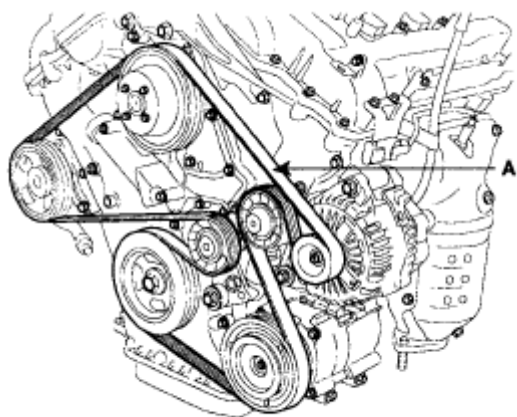
7.84 ~ 9.80 N.m (0.8 ~ 1.0 kgf.m, 5.78 ~ 7.23 lb-ft)



KDRF107A

Fig. 259: Locating Water Pump Pulley
Courtesy of KIA MOTORS AMERICA, INC.

3. Install drive belt (A).



KDRF101A

Fig. 260: Locating Drive Belt

Courtesy of KIA MOTORS AMERICA, INC.

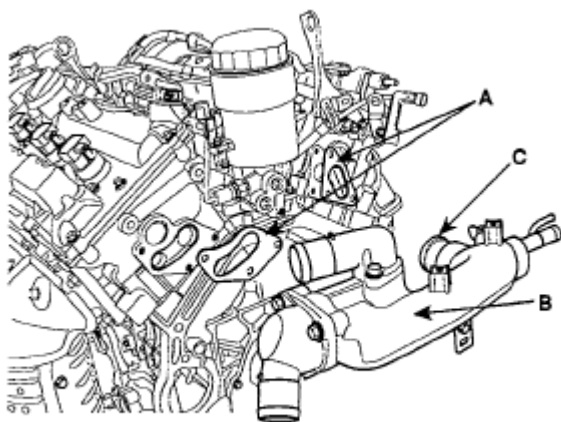
4. Fill with engine coolant.
5. Start engine and check for leaks.
6. Recheck engine coolant level.

WATER TEMPERATURE CONTROL ASSEMBLY**NOTE: Clean the contact face before assembly.**

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

Tightening torque

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



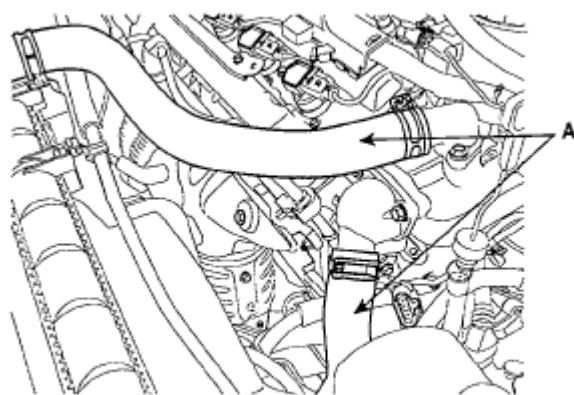
SGHEM7019N

Fig. 261: Identifying Water Temperature Control Assembly And Gasket

Courtesy of KIA MOTORS AMERICA, INC.

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

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



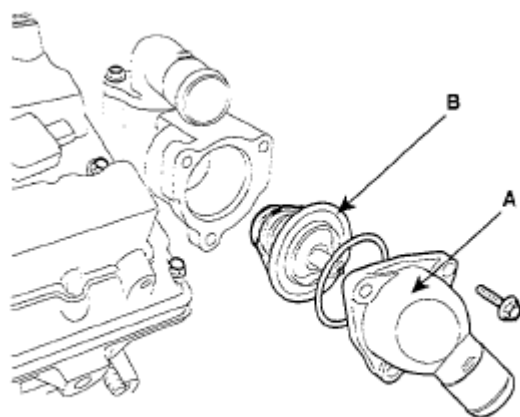
KDRF148A

Fig. 262: Identifying Upper Radiator Hose And Lower Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

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

THERMOSTAT

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



SGHEM7017N

Fig. 263: Identifying Water Inlet And Thermostat
 Courtesy of KIA MOTORS AMERICA, INC.

2. Install water inlet (A).

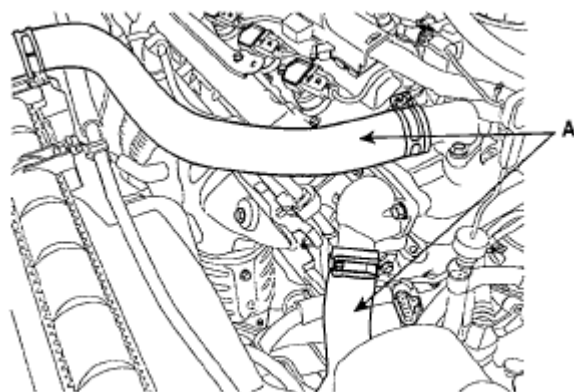
Tightening torque

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

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

RADIATOR

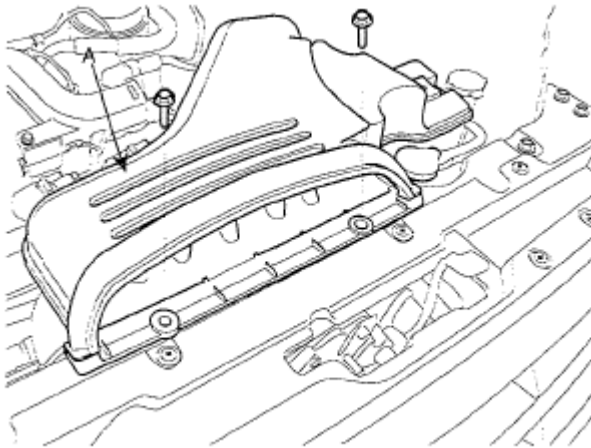
1. Install the radiator.
2. Install the radiator bracket.
3. Reconnect the radiator fan connector.
4. Connect transaxle oil cooler hoses.
5. Connect radiator upper and lower hoses (A).



KDRF148A

Fig. 264: Identifying Upper Radiator Hose And Lower Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

6. Install the air duct (A).



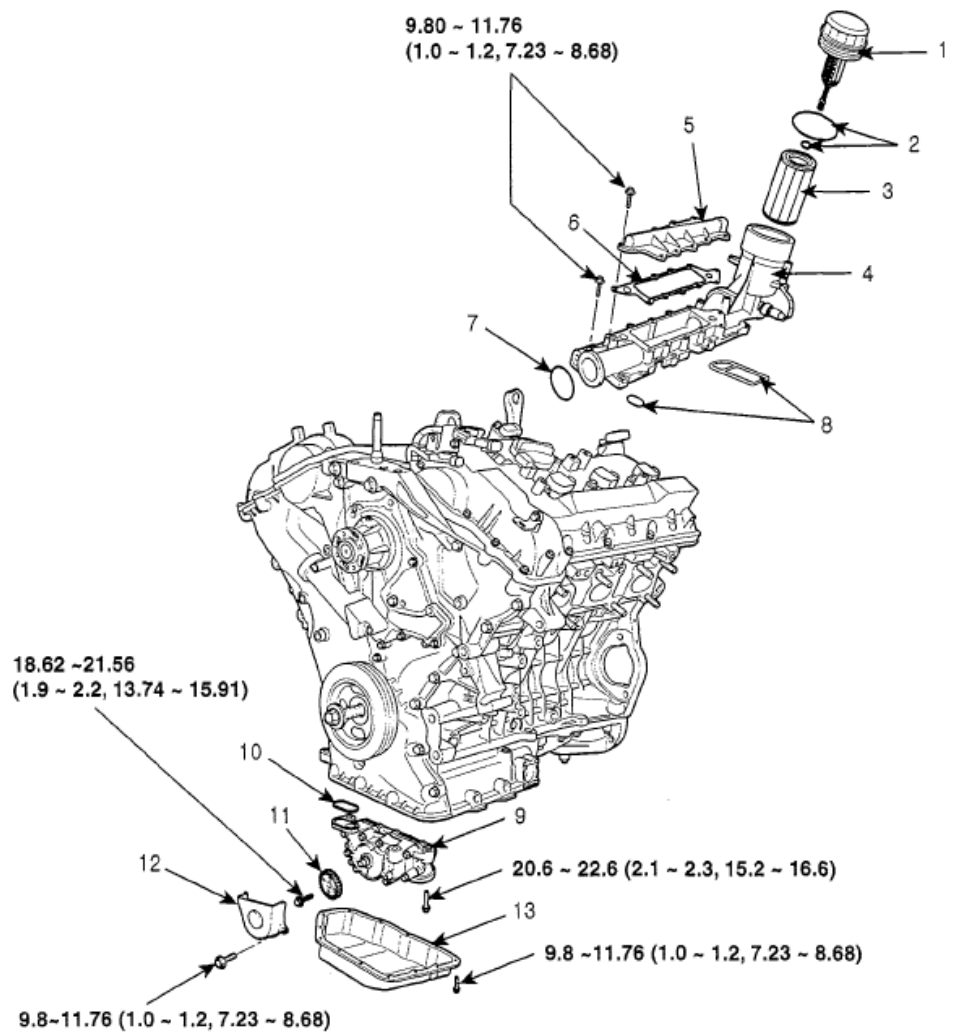
SGHAT7003N

Fig. 265: Identifying Air Duct
Courtesy of KIA MOTORS AMERICA, INC.

7. Fill with engine coolant.
8. Start engine and check for leaks.
9. Recheck engine coolant level.

LUBRICATION SYSTEM

COMPONENTS



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

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

ECBF005A

Fig. 266: Identifying Lubrication System Components With Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

1. Check engine oil quality.

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

If the quality is visibly poor, replace the oil.

2. Check engine oil level.

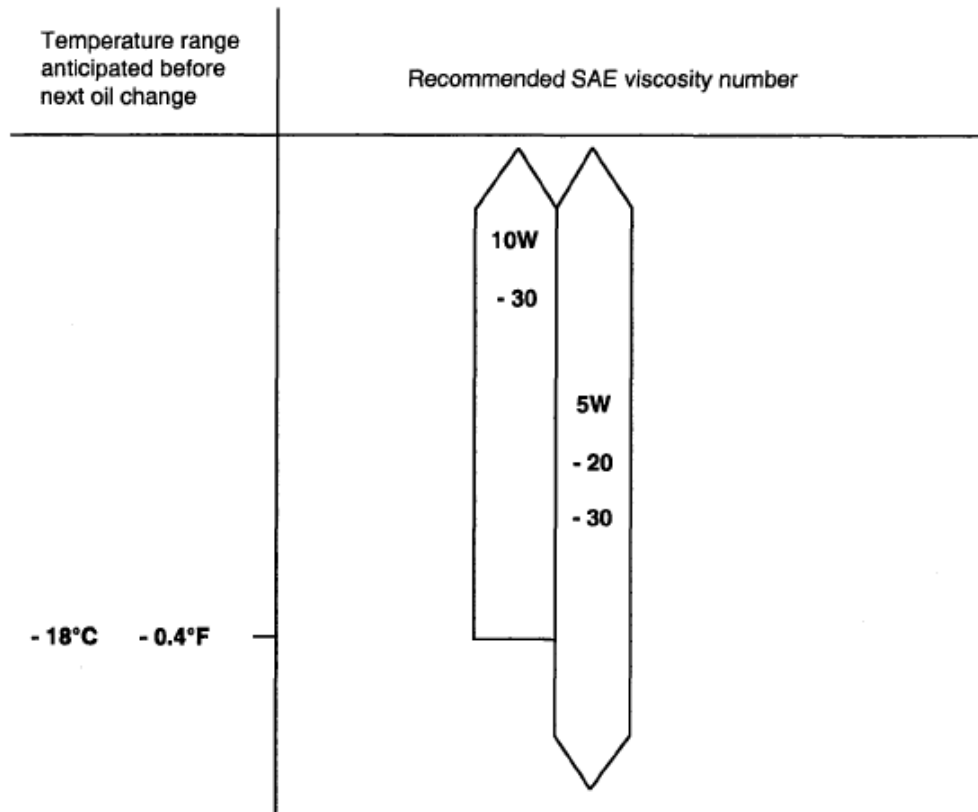
After warming up the engine and then 5 minutes after the engine stops, oil level should be between the "L" and "F" marks on the dipstick.

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

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

SELECTION OF ENGINE OIL

Recommended API classification : Above SJ or SL Recommended SAE viscosity grades : 5W-20 If 5W-20 engine oil is not available, 5W-30 or secondary recommended engine oil for corresponding temperature range can be used.



EORF020A

Fig. 267: Recommended SAE Viscosity Grades Chart
Courtesy of KIA MOTORS AMERICA, INC.

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

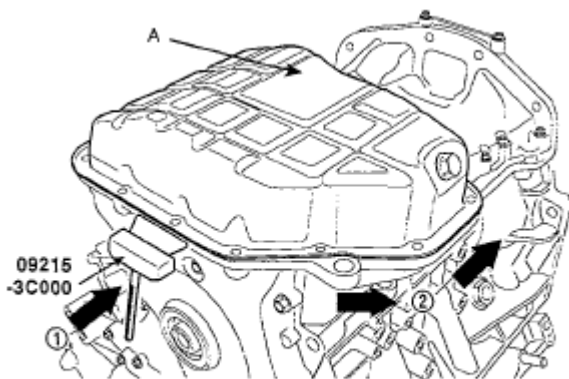
- Satisfy the requirement of the API classification.
- Have proper SAE grade number for expected ambient temperature range.

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

REMOVAL

OIL PUMP

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



STGEM7100N

Fig. 268: Inserting Blade Of SST Between Upper Oil Pan And Lower Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

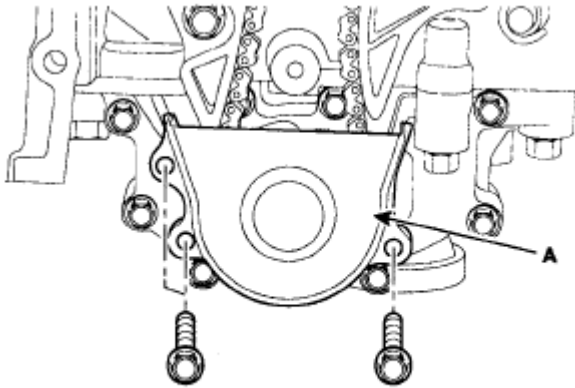
NOTE: Be careful not to damage the contact surfaces of upper oil pan and lower oil pan.

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 shown in illustration.
- After tapping the SST with a plastic hammer along the direction of (2) arrow shown in illustration around more than 213 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.

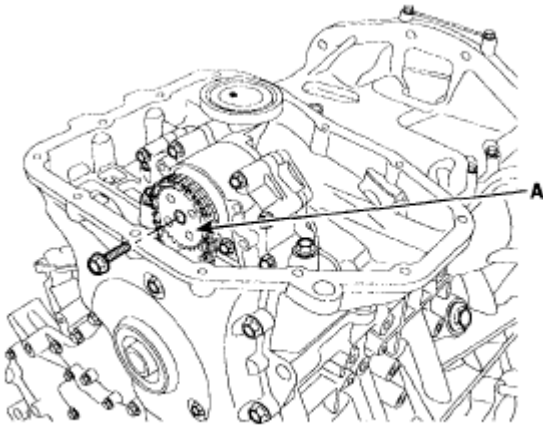
3. Remove oil pump chain cover (A).



KDRF185A

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

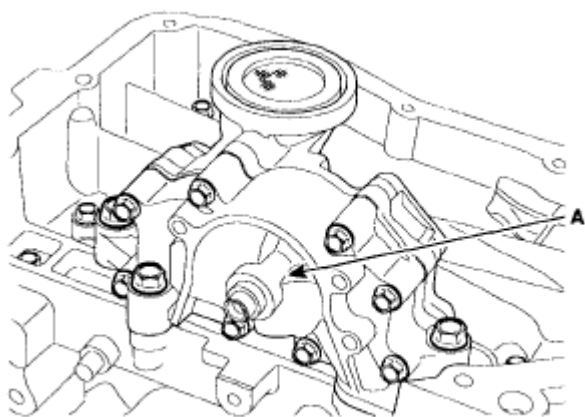
4. Remove oil pump chain sprocket (A).



KDRF189A

Fig. 270: Locating Oil Pump Chain Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove oil pump (A).



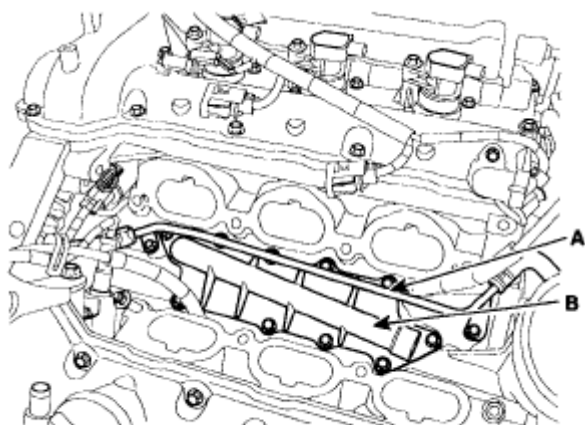
KDRF190A

Fig. 271: Locating Oil Pump

Courtesy of KIA MOTORS AMERICA, INC.

OIL FILTER ASSEMBLY

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

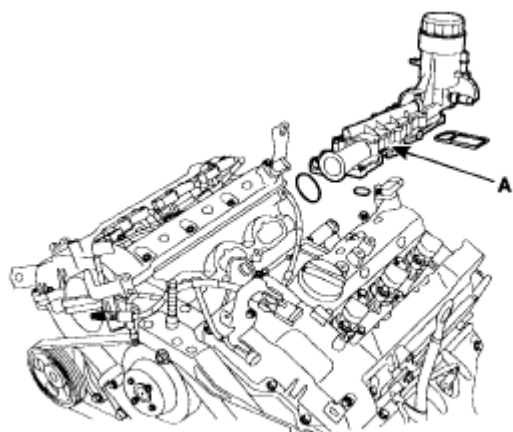


KDRF191A

Fig. 272: Locating Oil Filter Body Cover

Courtesy of KIA MOTORS AMERICA, INC.

9. Remove oil filter body (A).



KDRF192A

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

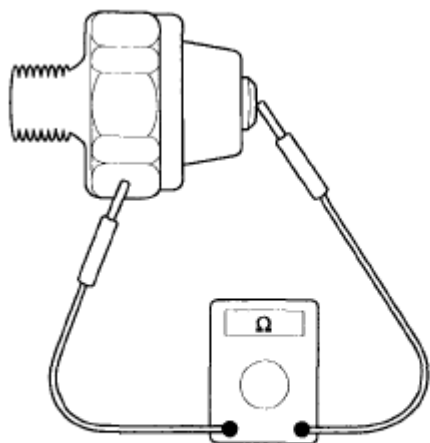
NOTE: Be careful of the knock sensor connector.

INSPECTION

OIL PRESSURE SWITCH

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

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



ECKD001W

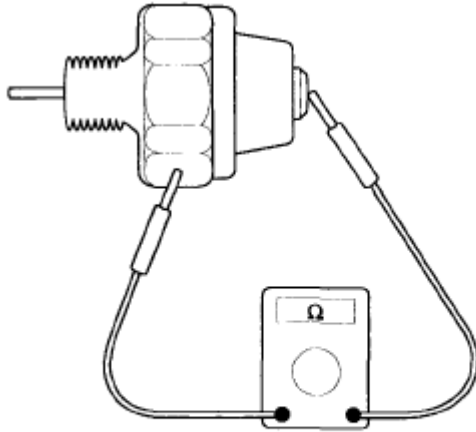
Fig. 274: Checking Continuity Between Terminal And Body With An Ohmmeter
 Courtesy of KIA MOTORS AMERICA, INC.

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

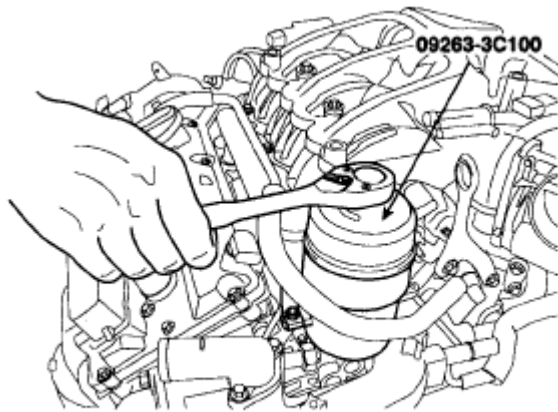
Fig. 275: Checking Continuity Between Terminal And Body When Fine Wire Is Pushed
Courtesy of KIA MOTORS AMERICA, INC.

OIL AND FILTER

CAUTION:

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

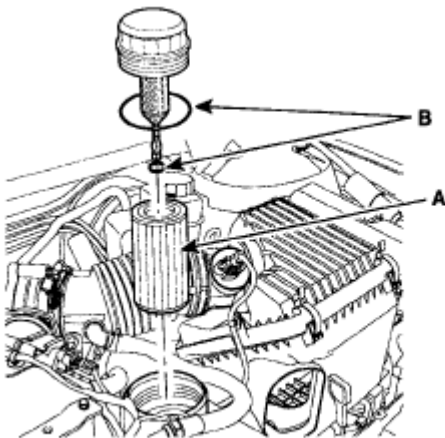
1. Park the car on level ground. Start the engine and let it warm up.
2. Turn the engine off and open the hood. Remove the engine cover.
3. Wait for 5 minutes after loosening the oil filter cap by turning it counterclockwise with SST (09263-3C100) to drain well the oil in the oil filter.



ECRF051A

Fig. 276: 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 same as old one.
 - e. Install new oil filter element (A) and two new O-rings (B).



KDAF185A

Fig. 277: Identifying Oil Filter Element And O-Rings
 Courtesy of KIA MOTORS AMERICA, INC.

- f. Apply clean engine oil to the new O-rings. Lightly screw the oil filter cap into place, and tighten it

until the O-ring contacts the seat.

- g. Finally tighten it again by specified tightening torque.

Tightening torque

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

6. Refill with engine oil.

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

Tightening torque

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

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

Capacity

When replacing a short engine or a block assembly :

6.0L (6.34 U.S. qts, 5.28 Imp. qts)

When replacing an oil pan only :

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

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

- 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.

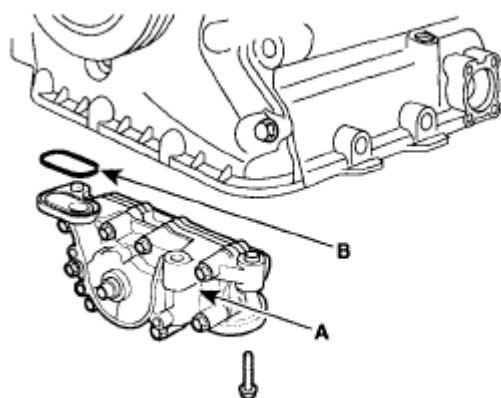
INSTALLATION**OIL PUMP**

1. Install oil pump (A).

Tightening torque

20.6 ~ 22.6 N.m (2.1 ~ 2.3 kgf.m, 15.2 ~ 16.6 lb-ft)

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



KDRF222A

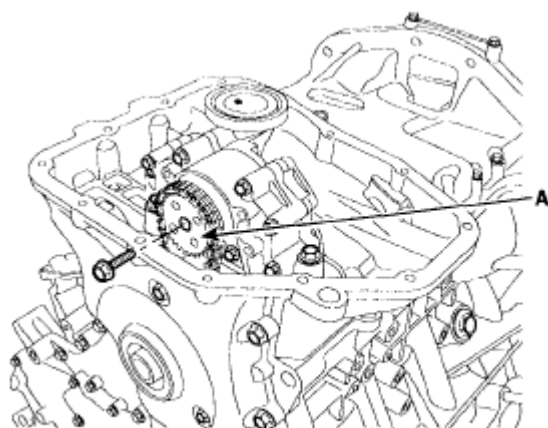
Fig. 278: Identifying Oil Pump

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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



KDRF189A

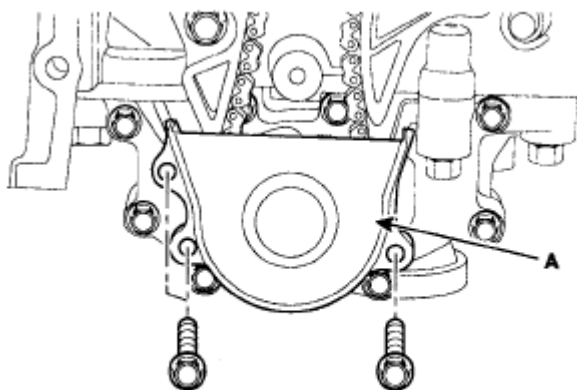
Fig. 279: Locating Oil Pump Chain Sprocket

Courtesy of KIA MOTORS AMERICA, INC.

3. Install oil pump chain cover (A).

Tightening torque

9.80 ~ 11.76 N.m (1.0 ~ 1,2 kgf.m, 7.23 ~ 8.68 lb-ft)



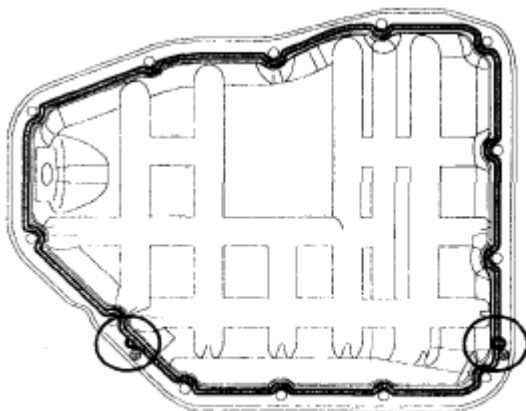
KDRF185A

Fig. 280: Locating Oil Pump Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

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

Bead width: 2.5 mm (0.1 in.)

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



KDRF136A

Fig. 281: Identifying Lower Oil Pan Sealant Bead
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant

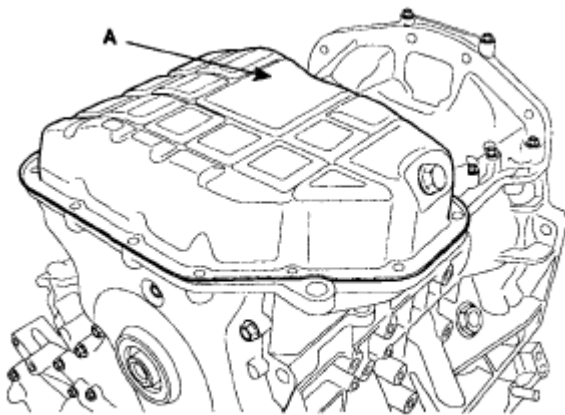
- When applying sealant gasket, sealant must not be protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.

c. Install lower oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

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



KDRF114A

Fig. 282: Locating Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

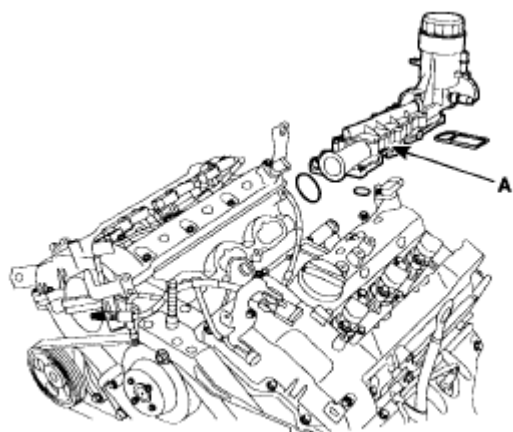
d. After assembly, wait at least 30 minutes before filling the engine with oil.

OIL FILTER ASSEMBLY

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

Tightening torque

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



KDRF192A

Fig. 283: Identifying Oil Filter Body

Courtesy of KIA MOTORS AMERICA, INC.

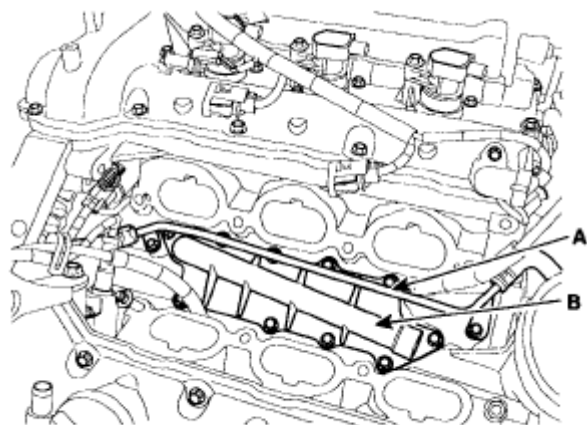
NOTE:

- All rubber gaskets must not be damaged by assembling parts.
- Be careful of the knock sensor connector.
- Always use a new O-ring

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

Tightening torque

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



KDRF191A

Fig. 284: Locating Oil Filter Body Cover

Courtesy of KIA MOTORS AMERICA, INC.

3. Connect water vent hose (A)

Tightening torque

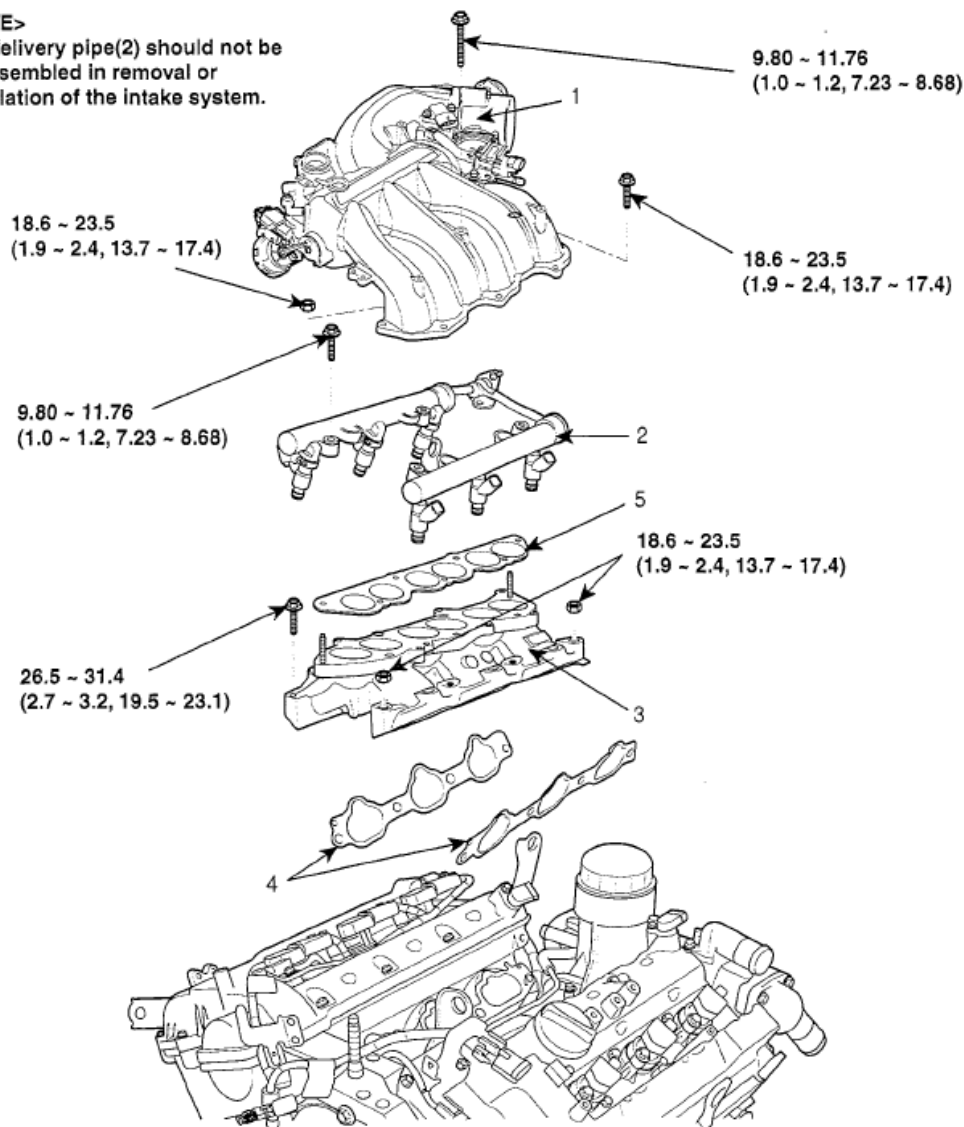
9.80 ~ 11.76 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.68 lb-ft)

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

INTAKE AND EXHAUST SYSTEM**INTAKE MANIFOLD****COMPONENTS**

<NOTE>

The delivery pipe(2) should not be disassembled in removal or installation of the intake system.



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

- 1. Surge tank
- 2. Delivery pipe
- 3. Surge tank gasket

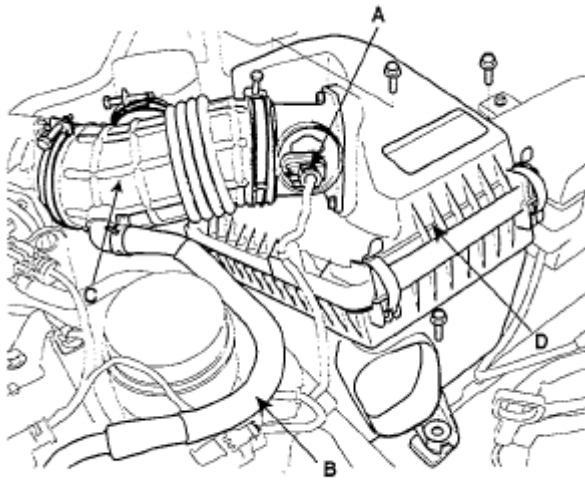
- 4. Intake manifold
- 5. Intake manifold gasket

STGEM7101N

Fig. 285: Identifying Intake Manifold Components With Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

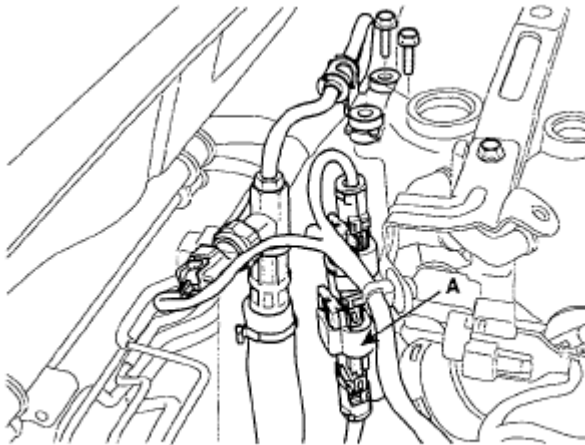
1. Disconnect AFS (A) and breather hose (B).
2. Remove air cleaner body (D) and intake hose (C).



SGHEM7005N

Fig. 286: Identifying Intake Air Hose And Air Cleaner Body
Courtesy of KIA MOTORS AMERICA, INC.

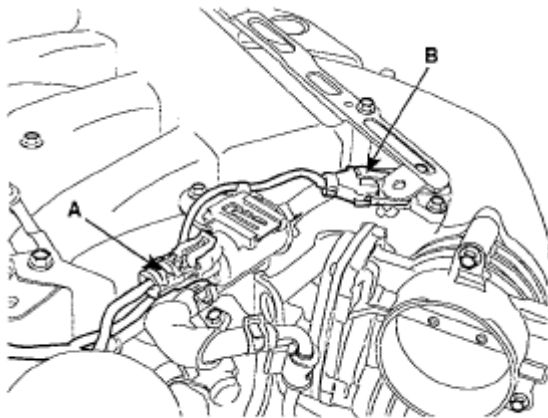
3. Disconnect RH oxygen sensor connector (A).



SGHEM7006N

Fig. 287: Identifying RH Oxygen Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

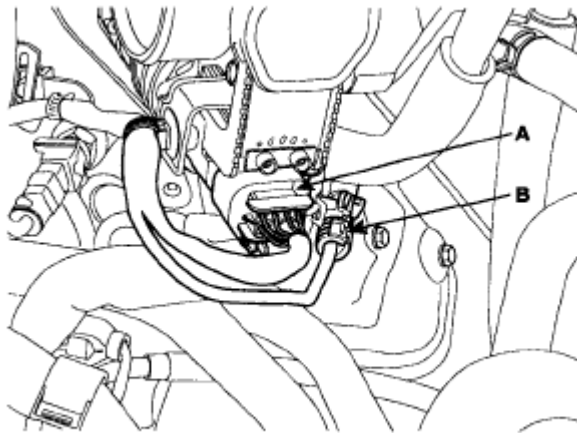
4. Disconnect RH injector connector and ignition coil connector.
5. Disconnect PCSV connector (A), MAP sensor connector (B) and PCSV hose.



UCBF003A

Fig. 288: Identifying PCSV Connector, MAP Sensor Connector And PCSV Hose
 Courtesy of KIA MOTORS AMERICA, INC.

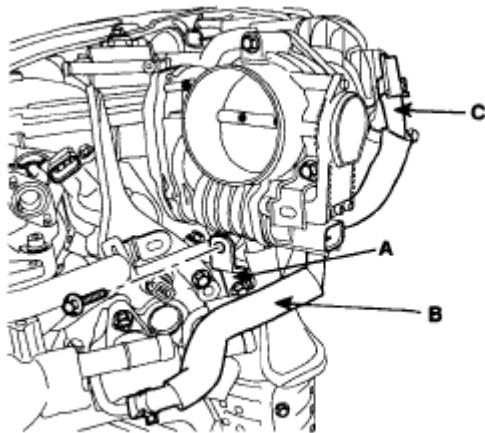
6. Disconnect ETC connector (A) and knock sensor connector (B).



KDRF162A

Fig. 289: Locating ETC Connector And Knock Sensor Connector
 Courtesy of KIA MOTORS AMERICA, INC.

7. Disconnect water hoses (B) from ETC.
8. Disconnect PCV (C) hose.

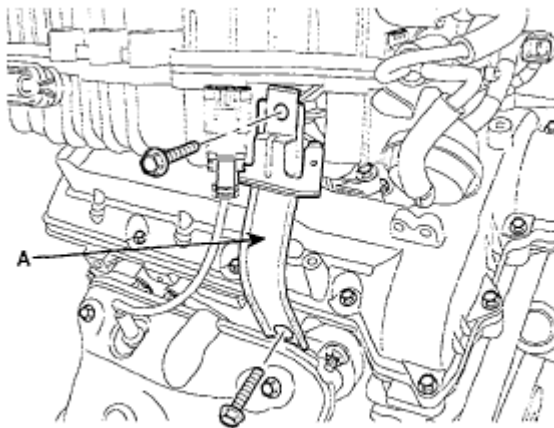


KDRF176A

Fig. 290: Locating PCV Hose

Courtesy of KIA MOTORS AMERICA, INC.

9. Disconnect brake vacuum hose.
10. Remove surge tank stay (A).

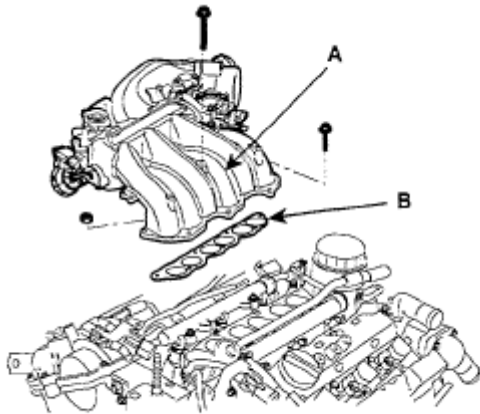


UCBF020A

Fig. 291: Identifying Surge Tank Stay

Courtesy of KIA MOTORS AMERICA, INC.

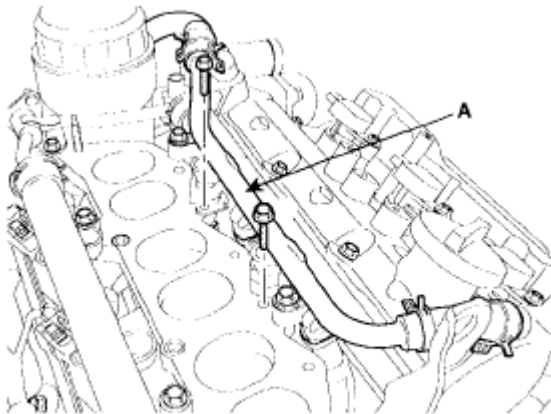
11. Remove connector bracket from surge tank or connectors (2EA).
12. Remove surge tank (A).



UCBF007A

Fig. 292: Identifying Surge Tank
Courtesy of KIA MOTORS AMERICA, INC.

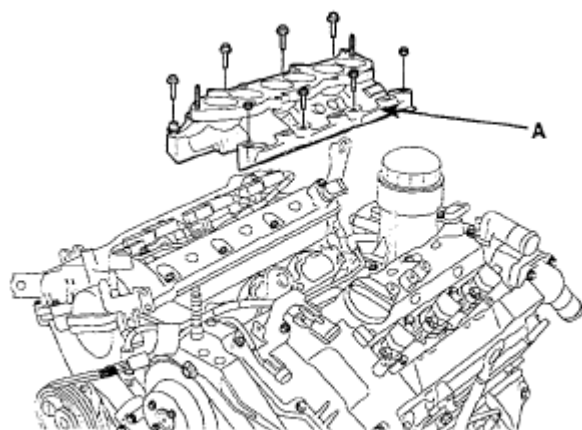
13. Disconnect breather pipe assembly (A).



ECBF031A

Fig. 293: Locating Breather Pipe Assembly
Courtesy of KIA MOTORS AMERICA, INC.

14. Disconnect LH injector connector.
15. Remove intake manifold (A) and gasket.



KDRF182A

Fig. 294: Identifying Intake Manifold And Gasket
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

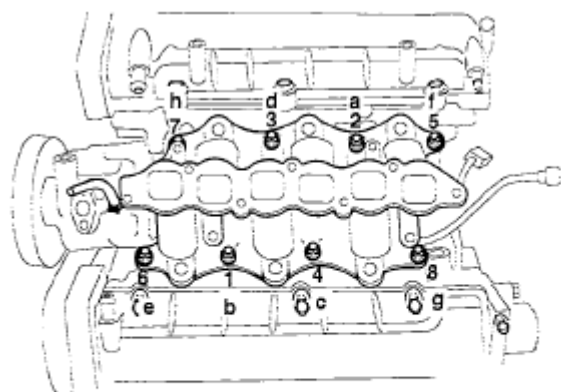
1. Install intake manifold and new gasket on the cylinder head.

Tightening torque

1st: 3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft) 2nd: 18.62 ~ 23.52 N.m (1.9 ~ 2.4 kgf.m, 13.74 ~ 17.36 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. 295: Identifying Cylinder Head Bolts Installing Sequence
Courtesy of KIA MOTORS AMERICA, INC.

2. Install delivery pipe. (Refer to **GENERAL (FUEL SYSTEM)**)
3. Connect LH injector connector.
4. Connect breather Pipe assembly.

Tightening torque

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

5. Install surge tank.

Tightening torque

9.80 ~ 11.76 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.68 lb-ft) - Long bolt 1EA

18.62 ~ 23.52 N.m (1.9 ~ 2.4 kgf.m, 13.74 ~ 17.36 lb-ft) - Short bolts 3EA/Nuts 2EA

6. Install connector bracket on the surge tank.

Tightening torque

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

7. Install surge tank stay.

Tightening torque

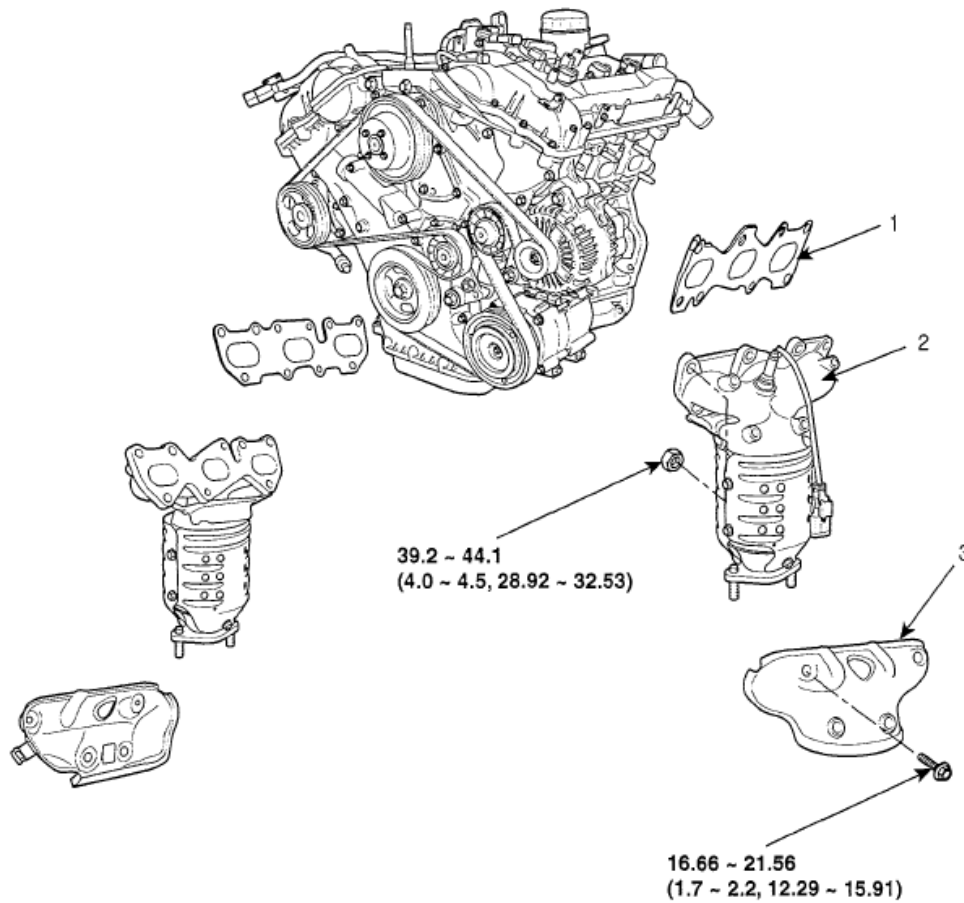
27.44 ~ 31.36 N.m (2.8 ~ 3.2 kgf.m, 20.25 ~ 23.14 lb-ft) - Engine front side

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

8. Connect brake vacuum hose.
9. Connect PCV hose.
10. Connect water hoses to ETC.
11. Connect ETC connector and knock sensor connector.
12. Connect PCSV connector, MAP sensor connector and PCSV hoe.
13. Connect RH injector connector and ignition coil connector.
14. Connect RH oxygen sensor connector.
15. Install air cleaner upper cover and in take hose.
16. Connect AFS (A) and breather hose.

EXHAUST MANIFOLD

COMPONENTS



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

- 1. Gasket
- 2. Exhaust manifold

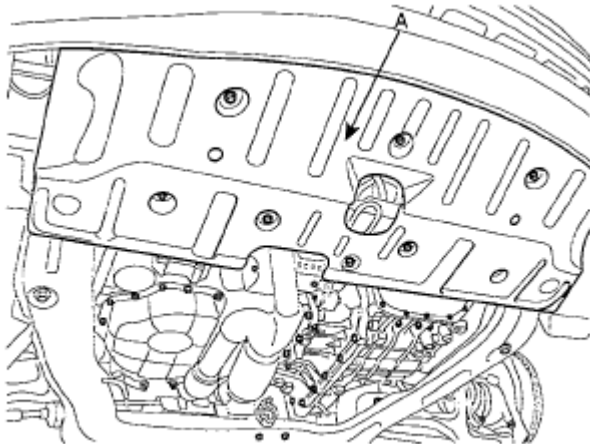
- 3. Heat protector

ECBF014A

Fig. 296: Identifying Exhaust Manifold Components With Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

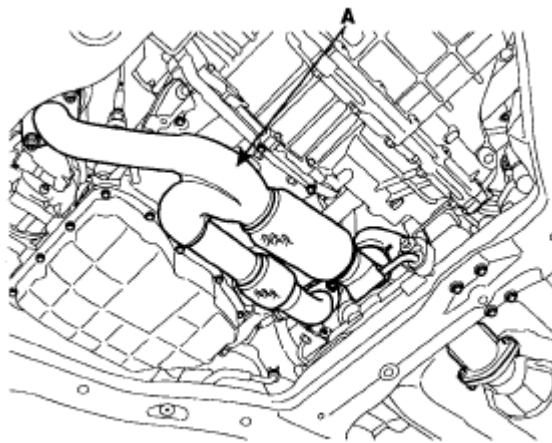
1. Remove under cover (A).



SGHAT6021D

Fig. 297: Identifying Under Cover
 Courtesy of KIA MOTORS AMERICA, INC.

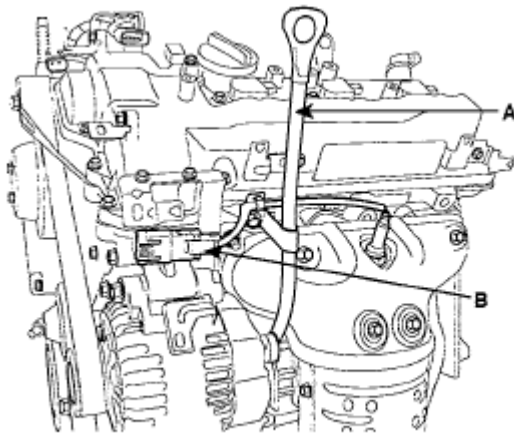
2. Disconnect LH, RH rear oxygen sensor connector from bracket.
3. Remove front muffler (A).



KCBF102A

Fig. 298: Locating Front Muffler
 Courtesy of KIA MOTORS AMERICA, INC.

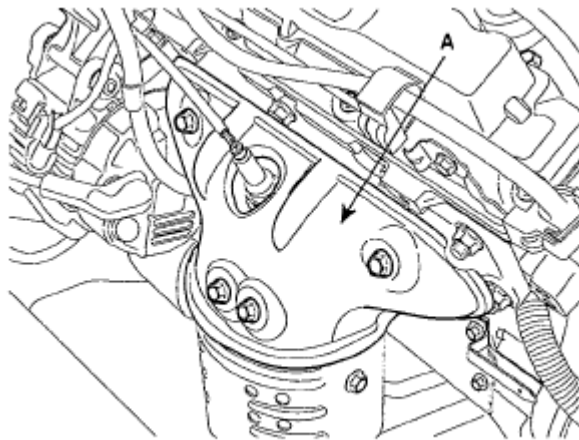
4. Remove oil level gauge (A).
5. Disconnect LH front oxygen sensor connector (B) from bracket.



UCBF010A

Fig. 299: Identifying LH Front Oxygen Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

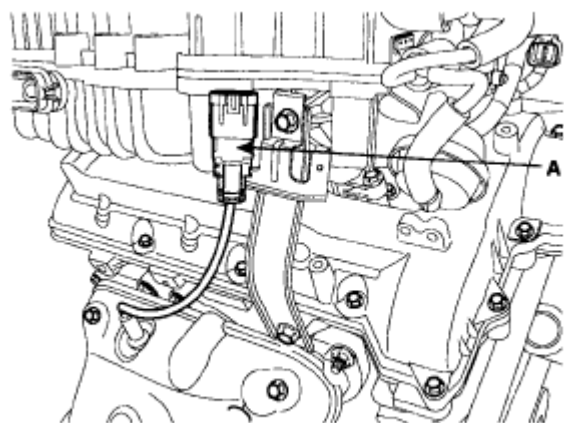
6. Remove LH heat protector.



UCBF011A

Fig. 300: Identifying LH Heat Protector
Courtesy of KIA MOTORS AMERICA, INC.

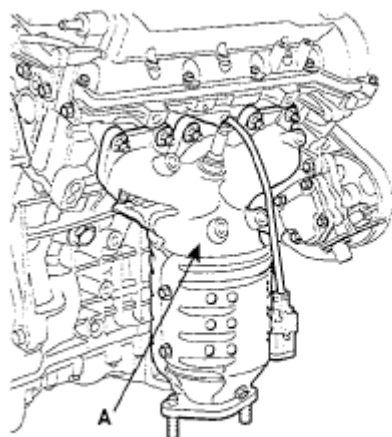
7. Remove LH exhaust manifold.
8. Disconnect RH front oxygen sensor connector from bracket.



KDRF177B

Fig. 301: Locating RH Front Oxygen Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

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



UCBF012A

Fig. 302: Identifying RH Heat Protector And Exhaust Manifold
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

1. Install new gasket and exhaust manifold.

Tightening torque

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

2. Install heat protector.

Tightening torque

16.66 ~ 21.56 N.m (1.7 ~ 2.2 kgf.m, 12.30 ~ 15.91 lb-ft)

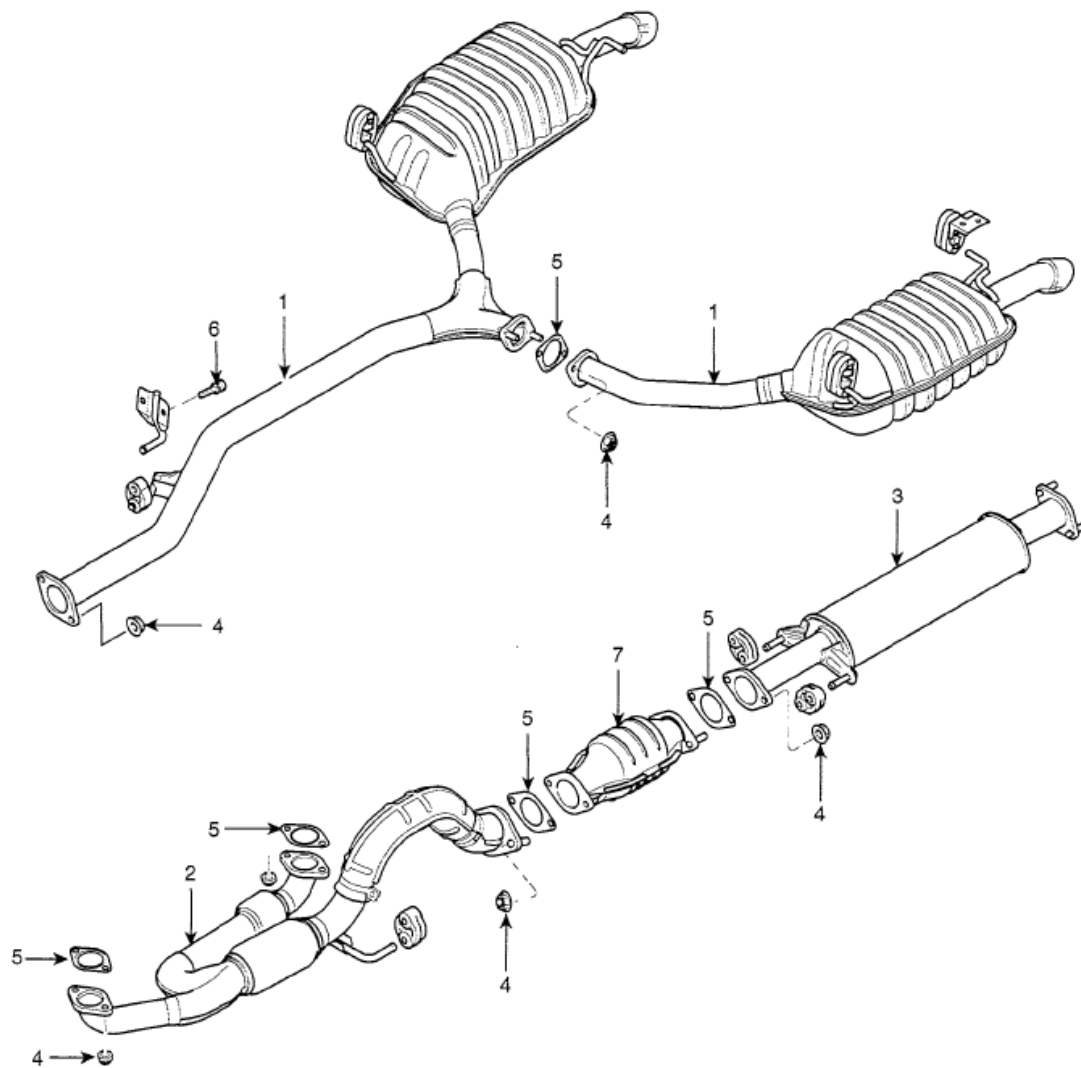
3. Install front muffler.

Tightening torque

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

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

EXHAUST PIPE**COMPONENTS**



- | | |
|----------------------------|------------------------|
| 1. Main muffler assembly | 5. Exhaust pipe gasket |
| 2. Front muffler assembly | 6. Bolt |
| 3. Center muffler assembly | 7. Catalytic converter |
| 4. Nut | |

SGHEM7007N

Fig. 303: Identifying Exhaust Pipe Components
 Courtesy of KIA MOTORS AMERICA, INC.